BUTTERFLY FARMING AND CONSERVATION BEHAVIOR IN THE EAST USAMBARA MOUNTAINS OF TANZANIA

By

THERON MORGAN-BROWN

A THESIS PRESENTED TO THE GRADUATE SCHOOL
OF THE UNIVERSITY OF FLORIDA IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE DEGREE OF
MASTER OF SCIENCE

UNIVERSITY OF FLORIDA

2007

To my amazing parents and wonderful wife

ACKNOWLEDGEMENTS

This study would not have been possible without assistance I received from the Tropical Conservation and Development Program, Tanzania Forest Conservation Group, Amani Butterfly Project, Dr. Susan Jacobson, Dr. Kenneth Wald, Dr. Brian Child, Amiri Saidi, Victoria Mwaifunga, Christina Misana, and David Loserian.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Abstract of Thesis Presented to the Graduate School
of the University of Florida in Partial Fulfillment of the
Requirements for the Degree of Master of Science

BUTTERFLY FARMING AND CONSERVATION BEHAVIOR IN THE EAST USAMBARA MOUNTAINS OF TANZANIA

By

Theron Morgan-Brown

December 2007

Chair: Susan Jacobson
Major: Interdisciplinary Ecology

The commercialization of non-timber forest products has been proposed to strengthen the link between biological conservation and economic development in forest adjacent communities, but is also associated with unsustainable harvesting. A compromise solution is to use natural forests as a source of seeds and genetic diversity required for intensive production of non-timber forest products in nearby communities.

I assessed this approach by evaluating a new conservation and development project involving the commercialization of butterflies in the East Usambara Mountains of Tanzania. I compared 150 butterfly farmers and a matched control group of 170 non-butterfly farmers on their strength of support for conservation, knowledge of conservation behavior, perception of ability to aid conservation, and self-reported participation in conservation behavior.

I found that butterfly farmers were significantly more likely to express support for conservation, believe in their ability to help conservation, and participate in conservation behavior. Knowledge of conservation behavior was not significantly different between butterfly farmers and non-butterfly farmers. Multivariate regression analysis demonstrated that the rank of butterfly farming income among household sources was an important predictor of conservation behavior.

While butterfly farming only relies on natural forests for a few inputs, these inputs appear sufficient to link butterfly farming to forest conservation. Butterfly farming, as practiced in this project, is an example of how forest conservation can be promoted by linking limited harvest of non-timber forest products from natural forests with cultivation of the same products in adjacent communities.

CHAPTER 1
INTRODUCTION

Conservation scientists hold diverse views regarding the role of economic development in biodiversity conservation in the developing world. Some scientists believe that development benefits are critical to win the support of local people for conservation efforts (Peter et al. 2002; Wells & McShane 2004). For other scientists, the two goals are fundamentally different and best approached as separate issues (Oates 1995, 1999; Struhsaker 1998; Terborgh 1999). However, in the minds of many conservationists, the disappointing results of many conservation and development projects are due to a failure to implement key principles and understand wider institutional relationships rather than a failure of the concept itself (Adams & Hulme 2001; Peter et al. 2002; Wells & McShane 2004).

A challenge in many conservation and development projects is the tenuous or non-existent link between development benefits and conservation (Newmark & Hough 2000). Consequently, the sustainable harvest of non-timber forest products (NTFPs) has been advocated as a way to create a clear link between forest conservation and development (Peters et al. 1989; Shackleton 2001). However, the actual experience with many NTFPs has been discouraging. The majority of NTFPs don't result in substantially increased income for rural peoples, and when they do the harvesting levels are often unsustainable (Arnold & Perez 2001; Belcher et al. 2005; Blaise Paquit & Edwin J 1997; Kusters et al. 2006). Furthermore, some researchers argue that the long term trend for the most valuable NTFPs is domestication and that domestication will diminish the economic incentive to conserve NTFPs *in situ* (Arnold & Perez 2001; Crook & Clapp 2001). Additionally, they argue that NTFP producers who are dependent on natural forests will be at a competitive disadvantage compared to producers who rely on domesticated sources (Crook & Clapp 1998).

This study evaluates the Amani Butterfly Project, a project of the Tanzania Forest Conservation Group, in the East Usambara Mountains of Tanzania. The project uses the limited harvest of adult butterflies and their host plants from natural forests to support commercial butterfly farming in adjacent communities. Therefore, unlike full domestication, this system maintains a linkage between farming and the forest. Individual farmers capture wild female butterflies and place them in net cages with host plants for egg laying. Since these captive populations are often built with only a few females, farmers periodically add wild male butterflies to maintain genetic diversity. In order to feed their butterfly larvae, which are host plant specific, farmers also grow host plants collected from the forest edge as seeds or seedlings. Gordon and Ayiemba (2003) describe the farming process of a similar project in more detail.

The Amani Butterfly Project[1] provides technical advice and essential marketing services. It buys pupae from member farmers and sells them primarily to live butterfly exhibits in Europe and the US, with lesser sells of dried specimens to internet specimen dealers. The project's finances and marketing are managed by project staff members employed by the Tanzania Forest Conservation Group, while the project's politics and prices are determined by an elected committee of butterfly farmers.

Annual sales from the project have increased each year from $20,000 USD in 2004 to $50,000 USD in 2006. Sixty-five percent of the project's earnings go directly to 300 member farmers and 7% accrue to a village development fund, which is controlled by the elected committee of butterfly farmers and used for projects like school buildings. Baseline income surveys conducted in 2003 and subsequent sales data indicate that participating households have increased their annual income by about 20%. Of the 21 sub-village farming groups that began farming butterflies in 2002, all but two were still active at the time of this study and the project is

[1] For more information see www.amanibutterflyproject.org .

currently adding 5 more groups.

An important characteristic of butterfly farming is that is requires diversity. Butterfly farmers that can produce a wide variety of species can ship their pupae directly to live butterfly exhibits, which is more profitable than shipping to pupae suppliers. Therefore, butterflies are unlike many non-timber forest products, where commercialization typically leads to species specialization (Belcher et al. 2005). Additionally, because butterflies are host plant specific, the farming process links each butterfly species to a different host plant. Members of the Amani Butterfly Project use more than 30 species of native trees, shrubs, herbs, and lianas in their butterfly farming operations.

Butterfly farming as practiced in this project differs somewhat with the "butterfly ranching" practiced in Papua New Guinea (New 1994). Ranching operations are more dependent on wild butterfly populations because they do not keep adult butterflies in enclosures. Butterfly farming is more desirable for the live pupae trade because netted enclosures reduce the risk of disease and parasitism in pupae and allow the producer to better track the age of his or her pupae. However, farmers in the Amani Butterfly Project still depend on the forest as a source of genetic diversity for their captive populations and as a source of younger host plants, which are often more desirable for egg-laying and feeding young larvae.

As invertebrates, butterflies have a rapid reproductive rate, a key criteria for linking NTFP harvesting to conservation (Crook & Clapp 1998). In the case of butterfly farming, this means there is not only a reduced chance of over-harvesting, but also little need for harvesting in the first place since just a few female butterflies can rapidly produce very large captive populations. Furthermore, since butterfly pupae are widely dispersed and cryptic in the wild, it is easier to farm pupae than harvest them from the wild. Similarly, in the case dried specimens, it is much easier to obtain perfect, undamaged specimens through farming than by wild harvest. A study of

butterfly farming in Kenya concluded that there was no indication of a negative effect on wild butterfly populations (Gordon & Ayiemba 2003). It is also unlikely that farming will have a negative impact on host plants since most of the plants are removed from the forest boundaries, which are frequently cleared as fire breaks. Thus, butterfly farming appears ecologically sustainable.

The second critical question, which is the focus of this study, is whether or not the link between butterfly farming and forest conservation is strong enough to change people's behaviors in a way that will benefit conservation. The corollary of its light ecological footprint is that most of the value of butterfly farming is created outside of the forest. As farmers develop their skill to maintain captive butterfly populations and host plant nurseries, the necessity of accessing the forest is diminished. Furthermore, in order for the linkage to be translated into conservation behavior, butterfly farmers must believe that the income they receive from butterfly farming is sufficient to cover the opportunity costs of engaging in conservation behavior. This study is the first to examine the relationship between butterfly farming and conservation behavior.

I tested the following three hypotheses:

1. Butterfly farmers believe that forest conservation is essential for butterfly farming.
2. Butterfly farmers will participate in more conservation behavior than a non-butterfly farming control group
3. Income from butterfly farming will be positively associated with participation in conservation behaviors.

In addition to economic motivation, whether or not butterfly farmers choose to participate in conservation behaviors is also contingent on their belief that the behaviors will be effective (Ajzen 2002; Stern 2000), knowledge of the behaviors (Schultz 2002), and general attitudes about forest conservation (Ajzen 1985). For instance, butterfly farmer's can help prevent illegal forest uses that might compete with butterfly farming by participating in village environmental

committees that help enforce forest laws. However, butterfly farmers might choose not to participate in the committees or engage in other conservation behaviors if they believed that their behaviors will be futile because of the actions of others. Therefore, I also examined widely accepted behavioral components.

Because there is no baseline data regarding conservation behavior in these communities prior to the project's start date, I used non-butterfly farmers from the same communities as a control group. To control for self-selection bias among butterfly farmers, I also asked butterfly farmers about why they joined the project and tracked demographic variables that might reveal preexisting differences between butterfly farmers and non-butterfly farmers.

CHAPTER 2
METHODS

Study Site

The two villages chosen for the study, Msasa and Kwezitu, are highland villages in the East Usambara Mountains at 800 to 1000 m ASL and are two of the most successful villages in the Amani Butterfly Project. The villages are fairly similar, consisting of mostly Sambaa people and are about 50% Muslim and 50% Christian. They are long established villages with 84% of adult residents claiming to having been born in the area or to have lived in the area for more than 20 years.

More than 90% of people in these two villages earn income and subsist from agriculture. The primary crops in the area are corn, cassava, banana, beans, sugar cane, cardamom, cloves, cinnamon, black pepper, and small holder tea (Reyes et al. 2005). Due to the combination of steep slopes, heavy rainfall, and relatively poor soils, many of the current agricultural practices are unsustainable (Reyes et al. 2005). Some households also have livestock including chickens, cows, and goats. About 20% of households in these two villages earn income from farming butterflies.

The East Usambara Mountains are a priority area for conservation within the Eastern Arc Biodiversity Hotspot (Burgess et al. 2007) and have a long history of conservation and development projects of limited success (Stocking & Perkin 1992). Msasa and Kwezitu border several official forest reserves. Kwezitu also has a community forest reserve. Villagers are allowed to access the forest reserves for firewood and medicinal plants twice a week. All other uses of forest reserves are prohibited (except for butterfly farming activities), but there are still numerous threats to the forest including agricultural encroachment, illegal cutting, fire, and charcoal production (Newmark 2002). On household land, cutting trees for timber must be

approved by district forest officials, and in practice timber processing of many species is never approved (Vihemäki 2005). However, this restriction is meaningless because clearing household land for agriculture does not need to be approved. The Division of Forestry and Beekeeping is responsible for enforcing forest regulations, but the presence of forest officers is limited. Therefore, the government relies greatly on village environmental committees to help enforce forest regulations (Vihemäki 2005).

Data Collection

The treatment sample consisted of 150 butterfly-farmers drawn at random from the Amani Butterfly Project's list of registered butterfly farmers. This represented about 85% of all officially registered butterfly farmers in the two villages. The control sample of 170 households was drawn at random from village government household lists not including households with butterfly farming income. This represented 22% of eligible households. Using the AAPOR's reporting guidelines (American Association for Public Opinion Research 2006), Contact Rate 1 for butterfly farmers was 95% and the Cooperation Rate 1 was 99%. The Contact Rate 1 for the control was 90% and the Cooperation Rate 1 was 99%.

The survey for this study was conducted in June and July of 2006. The survey questionnaire was administered in Swahili in face to face interviews by two graduates from the University of Dar es Salaam's Environmental Studies Program with no prior connection to the study area. They asked local residents to help locate individuals on the sample lists and made up to three attempts to locate interviewees. Before each interview, the interviewers read a brief consent statement asking for permission to conduct the interview and informing the respondent that their name would not be recorded on the questionnaire forms.

Survey Instrument Design

The survey questionnaire was written in English by a native English speaker and then

translated into Swahili by a native Swahili speaker. The survey was then back-translated by a second native Swahili speaker to insure the correct translation of concepts.

I revised the 63 item survey instrument after it was reviewed by the institutional review board of the University of Florida and the manager of the Amani Butterfly Project. I also pre-tested the survey with 10 respondents from two neighboring villages not included in the study and revised questions that respondents in the pre-test phase found unclear.

Conservation Behavior and Related Measures

I assessed *conservation behavior* using 12 questions. However, after a Cronbach's scale analysis, I removed 4 items that were not related to other items in the scale. The 8 remaining questions examined participation in village environmental committee meetings, tree planting on household land, preserving forested parts of household farmland, participation in tree planting on village land, reporting illegal behavior, and discouraging illegal behavior. All the questions were framed at the household level and measured reported behavior in the previous 12 months prior to the interview. The specific quantified responses were ranked into 4 categories that were scored from 0 (no participation in behavior) to 3 (above average participation in behavior). The standardized Cronbach's alpha for the scale was 0.74.

I assessed *support for conservation* using eight questions. However, after analyzing the scales Cronbach's alpha I excluded two variables that were not related to other items in the scale. Each question had 3 or 4 discrete answers representing different degrees of support. The six questions included in the scale asked about the size of protected areas, timber cutting, pole cutting, illegal timber cutting in a forest reserve, the creation of a new forest reserve, and whether or not farmers should be obliged to report illegal activities to conservation authorities. The standardized Cronbach's alpha for the final scale was 0.55.

To access *beliefs about ability to aid conservation*, I asked respondents if they believed

there were things they could do to aid conservation. I also asked about the effectiveness of tree planting, environmentally friendly building, local conservation officials, other butterfly farmers, and participation in village environmental committees. Each question had 3 or 4 discrete answers with scores ranging from 0 to 3. Since not sure responses conveyed a lack of confidence in effectiveness, they were treated as negative responses. The standardized Cronbach's alpha for the scale was 0.63.

I examined *knowledge of conservation behaviors* by asking about knowledge of environmentally friendly forms of house construction, knowledge about the importance of house construction materials, and knowledge of conservation friendly wood. These four questions formed an index with each correct answer receiving 1 point.

Other Measures

To test whether butterfly farmers thought there is a direct relationship between butterfly farming and forest conservation, I asked butterfly farmers four questions examining their perceptions of threats to forests and butterfly farming. To better understand any selection bias among people who chose to become butterfly farmers, I asked butterfly farmers to name three reasons for joining the butterfly project in an open ended question.

In addition to recording whether or not the respondent was a butterfly farmer, butterfly farmer status was also evaluated using the rank of butterfly farming as a source of income among household income sources. Butterfly income rank scores ranged from 0 (butterfly income is not a part of household income) to 3 (butterfly income is the first source of household income).

To better understand any differences between butterfly farmers and the matched control group, I asked demographic questions including the respondents' gender, age, education level, ethnicity, length of residency in the area, number of close friends and relatives that farm butterflies, and participation in other conservation and development projects. Wealth was

measured by the number of hectares and cows owned by household.

Data Analysis

I sampled 85% of butterfly farmers, which is a lower sampling error than assumed by most statistical tests. Therefore, my results, which are unadjusted for the low sampling error, are conservative. I used Mann-Whitney *U* tests to detect differences between butterfly farmers and the control sample when the dependent variables were ordinal or nominal. For demographic comparisons involving multiple ordinal variables, I used Kruskal-Wallis H tests. Additionally, I used Spearman's rank correlations (Spearman's *r*) to determine associations between nominal and ordinal variables. I used case-wise deletion for these first analyses. I then ran a simultaneous entry linear regression model of conservation behavior including all demographic and behavior component variables. For this analysis, I treated conservation behavior as a continuous variable. I plotted the residuals and did not find any serious departures from normality or constant variance for the conservation behavior scale.

The conservation behavior scale and the perceptions of ability to aid conservation scale contained significant amounts of missing data. For the conservation behavior scale, interviewer error on two variables resulted in a 38% reduction in data using list-wise deletion. To test whether or not missing data influenced the results of this study, I used the multiple imputation procedure available in SAS 9.1 known as PROC MI to generate appropriate values for missing data using the MCMC method. Since most of the variables for the conservation behavior scale are complete for each case, the imputed values generally only represent one or two missing variables in the eight variable scale. Thus, imputing values allows for the examination of a greater proportion of complete data than list-wise deletion.

I included all variables in the imputation model and bound the imputations to values appropriate for the variable being imputed. Given that most of the missing data was in only two

variables within an eight variable scale and that less than 10% of data was missing from other variables, I felt that it was reasonable to create 10 imputations (Fichman & Cummings 2003). I used PROC MIANALYZE to combine regression analysis results for the 10 imputed datasets. The results are presented in the regression analysis of conservation behavior and compared to the results obtained with list-wise deletion.

CHAPTER 3
RESULTS

Butterfly Farming and Forest Conservation

A majority of butterfly farmers see a strong relationship between their ability to farm butterflies and forest conservation (Figure 3-1). Eighty-seven percent believed cutting timber or poles was very dangerous for wild butterflies and their host plants. Seventy-three percent reported that living near the forest was very helpful for butterfly farming and 81% said that it would be very difficult to continue farming butterflies if the forests in their area were cleared. This 81% of butterfly farmers also scored higher on the conservation behavior scale than other butterfly farmers (Mann-Whitney, $p = 0.043$).

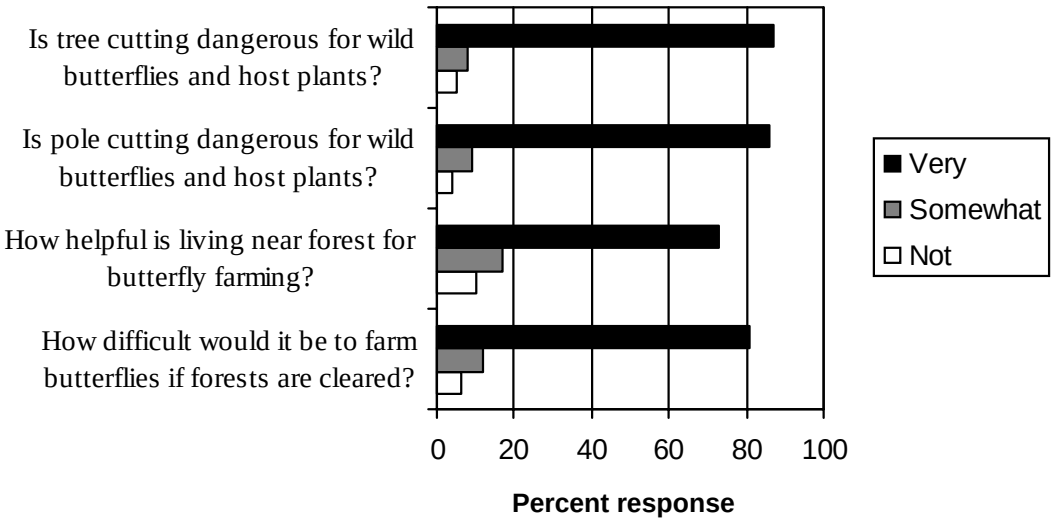

Figure 3-1. Butterfly farmer beliefs about butterfly farming and forest conservation.

Conservation Behavior and Components

Butterfly farmers reported greater participation in conservation behavior, support for conservation, and belief in their ability to influence conservation than the control, even though they did not report greater knowledge of conservation behaviors than the control (Table 3-1).

On specific behaviors within the conservation behavior scale, butterfly farmers were more

likely than the control group to be environmental committee members, attend environmental committee meetings, plant non-timber tree species, participate in village tree planting activities, preserve household land as forest, and discourage illegal cutting (Table 3-2). Butterfly farmers were not significantly more likely than the control group to plant timber species or report illegal cutting to authorities (Table 3-2).

Table 3-1. Mann-Whitney *U* test comparisons of median scores for butterfly farmers and the control group for the conservation behavior scale and related scales.

	Butterfly Farmers		*Control Group*			
Variable	N	Median Score	n	Median Score	M-W *U*	*p*
Conservation behavior participation	87	11	94	6.5	2386	<0.001
Support for conservation	128	16	129	15	6476	0.003
Belief in ability to aid conservation	139	15	144	12	5395	<0.001
Conservation behavior knowledge	128	3	130	3	7558	0.188

Table 3-2. Mann-Whitney *U* test comparisons of the percent of butterfly farmers and the control group participating in specific conservation behaviors.

	Butterfly Farmers		*Control Group*			
Variable	N	%	n	%	M-W *U*	*p*
Environmental committee member	139	71	150	44	7587	<0.001
Environmental committee attendance	107	80	103	60	4398	0.001
Non-timber tree planting on household land	124	90	136	68	6588	<0.001
Timber tree planting on household land	123	57	127	46	6932	0.076
Tree planting on village land	132	56	150	32	7518	<0.001
Preserving household land as forest	135	45	149	31	8618	0.013
Discouraging illegal cutting	135	57	150	31	7455	<0.001
Reporting illegal cutting	134	17	148	14	9621	0.494

Forty percent of butterfly farmers mentioned conservation as a reason for becoming a butterfly farmer. This group scored higher on the conservation behavior scale and the conservation knowledge index than other butterfly farmers (Mann-Whitney, $p = 0.010$, $p = 0.002$ respectively), but did not score higher on the belief in effectiveness and support for conservation scales. However, butterfly farmers that did not report conservation as an original motivation for joining the project still reported more participation in conservation behaviors than non-butterfly

farmers (Mann-Whitney, $p = 0.007$).

Demographics

Butterfly farmers were not significantly different from the control group in age, religion, ethnicity, gender, length of residency, number of adults in household, number of adult contributors to household income, children in household or household cow ownership. However, butterfly farmers owned slightly more land, participated in a greater number of other conservation and development projects, and had more close friends and relatives who farmed butterflies (Table 3-3). Also, a greater percentage of butterfly farmers completed primary school and were aware of the Amani Butterfly Project's community development fund (Table 3-3).

Table 3-3. Socio-demographic differences between butterfly farmers and the control group.

	Butterfly Farmers		*Control Group*			
Variable	n	Median or %	n	Median or %	M-W *U*	*p*
% completed primary school	140	78%	150	61%	8796	0.001
Acres owned	131	5	144	4	8054	0.036
Other conservation & development projects participated	140	2	152	1	8005	<0.001
% aware of project village development fund	140	26%	151	6%	8406	<0.001
Close friends & relatives who farm butterflies	140	5	150	3	6402	<0.001

Butterfly farmers also had more diversified income sources. Ninety-five percent of the control group and 73% of butterfly farmers said that agriculture was their primary source of household income. Twenty-four percent of butterfly farmers reported that butterfly farming was their primary source of income. Fifty-six percent of butterfly farmers reported that butterfly farming was the second most important source of income in their households; where as 59% of the control group did not report a secondary income source.

The 40.1% of butterfly farmers who reported conservation as a motivation for joining the project were significantly more educated than other butterfly farmers (93% vs. 70%, Mann-

Whitney, $p = 0.001$), and were also more likely to have participated in other conservation and development projects (Mann-Whitney, $p = .024$).

However, among butterfly farmers, butterfly income rank was not correlated with conservation motivation for joining, primary school completion, or land ownership. Participation in other conservation and development products was somewhat negatively associated with butterfly income rank (Kruskal-Wallis, chi square = 7.54, $p = 0.057$).

Butterfly Income and Predictors of Conservation Behavior

Butterfly income rank was more strongly correlated with the conservation behavior scale than butterfly farmer status (Spearman's $r = 0.40$, $p < 0.0001$ vs. $r = 0.36$, $p < 0.0001$), but the two variables were highly covariate (Spearman's $r = 0.937$, $p < 0.0001$). A bar chart of butterfly income rank and conservation behavior shows an increase in conservation behavior for each increase in butterfly income rank (Figure 3-2).

To see if the relationship between income and conservation behavior remained significant while controlling for all other variables in the study, I ran a linear regression model of conservation behavior using simultaneous entry of all demographic variables and behavior component variables included in the survey (Table 3-4).

In the regression analysis of conservation behavior using list-wise deletion of cases with missing values (150 cases out of 292), the model was significant (Adjusted $R^2 = 0.35$, $F = 5.80$, $p < 0.0001$). The explanatory variables significant at the 0.05 level were butterfly income rank and belief in ability to aid conservation.

As described in the data analysis section, I reran the linear regression model after using multiple imputations to impute missing values (Table 3-4). Similarly to the first analysis, the model using the full data set was significant (Adjusted $R^2 = 0.34$, $F = 10.14$, $p < 0.0001$). Butterfly income rank and belief in ability to aid conservation remained significant explanatory

variables. Many variables that were nearly significant in the list-wise deletion model were significant in the post imputation model. These included length of respondent residency, the log transformation of acres owned, participation in other conservation and development projects, conservation support, and knowledge of conservation behaviors. Knowledge of the project's development fund was nearly significant.

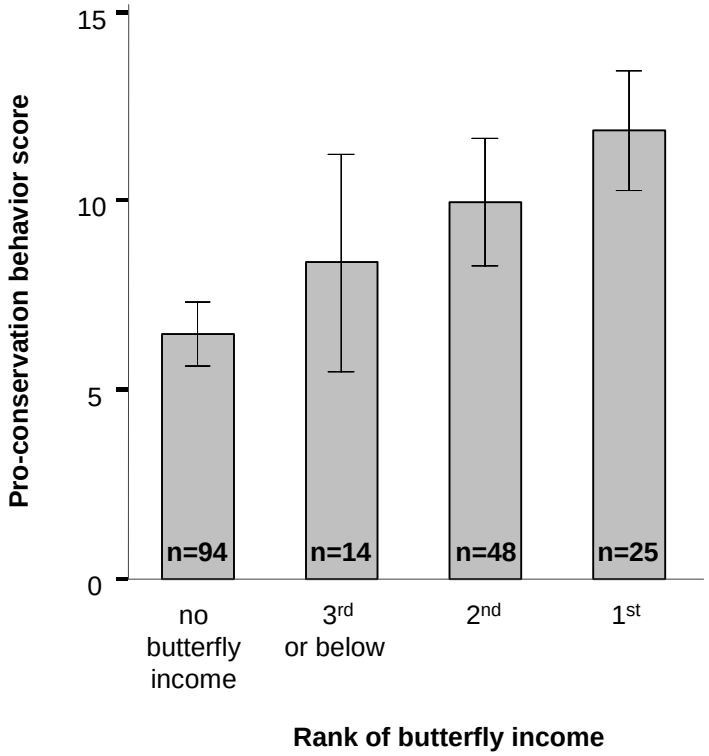

Figure 3-2. Mean conservation behavior scores by the rank of butterfly income among household income sources (error bars show 95% confidence intervals).

Table 3-4. Linear regression models of participation in conservation behavior using simultaneous entry of all variables

	Conservation behavior (list-wise deletion) n = 142		*Conservation behavior* (multiple imputation) n = 292	
Independent Variables	B	*p*	B	*p*
Butterfly income rank	1.43	0.0002	1.18	< 0.0001
Number other conservation and development projects participated	0.55	0.1180	0.75	0.0015
Number of friends and family who farm butterflies	0.01	0.8851	-0.03	0.6527
Aware of project development fund	0.42	0.6212	1.26	0.0517
Support for conservation	0.22	0.0720	0.23	0.0101
Belief in ability to aid conservation	0.42	0.0024	0.19	0.0108
Conservation behavior knowledge	0.33	0.3776	0.46	0.0261
Age	0.01	0.8437	-0.02	0.4045
Male	0.38	0.6027	0.56	0.2544
Sambaa ethnicity	0.61	0.4734	0.26	0.6309
Completed primary school	-0.58	0.5819	-0.46	0.4752
Length of residency	0.74	0.1034	0.61	0.0351
Muslim	-0.21	0.7803	0.25	0.6077
Household size	0.11	0.2785	0.09	0.1448
Own Cow(s)	0.16	0.8426	-0.01	0.9873
Log transformation of acres owned	0.64	0.1829	0.70	0.0161
Model R^2	0.35		0.34	
Model F score	5.80		10.14	
Model *p* value	< 0.0001		< 0.0001	

CHAPTER 4
DISCUSSION

Butterfly Farmers and Conservation Behavior

In support of my first hypothesis, a strong majority of butterfly farmers see a clear link between their ability to farm butterflies and the preservation of natural forests (Figure 3-1). This result shows that partial domestication does not lead butterfly farmers to conclude that *in situ* preservation is unnecessary. I also found that butterfly farmers who recognized the conservation linkage were more likely to participate in conservation behavior than the small minority of butterfly farmers who believed they could continue to farm butterflies in the absence of forests. Similarly, a meta-analysis of conservation and development projects concluded that butterfly farming was likely to have a strong link to conservation (Salafsky & Wollenberg 2000). However, their conclusion was based on expert opinion rather than project participant beliefs and this may partly explain why they did not find an association between conservation linkage and threat reduction in a macro-level study of 39 different conservation and development initiatives including 2 butterfly farming initiatives (Salafsky et al. 2001; Salafsky & Wollenberg 2000).

In support of my second hypothesis, butterfly farmers reported more participation in conservation behavior than non-butterfly farmers (Table 3-1), and this relationship held true for 7 of the 8 conservation behaviors measured on the conservation behavior scale (Table 3-2). Butterfly farmers also expressed greater support for conservation and believed more in their ability to aid conservation than the control (Table 3-1).

I found a paucity of studies with which to compare my findings, both with regard to butterfly farming and to non-timber forest products in general. Butterfly farming in Kenya was associated with an increase in support for conservation among butterfly farmers and some evaluations of non-timber forest product commercialization schemes have found a positive

relationship between participation and attitudinal support for conservation (Gordon & Ayiemba 2003; Mehta & Heinen 2001). However, in both the NTFP literature and more general conservation and development literature, studies examining behavior are rare. In a recent review article that examined attitude and behavioral success in conservation and development projects, the authors reported that they excluded 80% of the 124 conservation and development project articles they reviewed due to lack of data (Brooks et al. 2006). I reviewed the articles they did include and found that many of them lacked quantifiable behavioral measures as well. Several recent studies report a positive relationship between conservation behavior and conservation projects (Abbot et al. 2001; Holmes 2003; Stem et al. 2003). However, almost no studies provide a control or baseline data with which to evaluate behavior findings. The use of baseline data or a control group is unfortunately the exception rather than the rule in current conservation and development research.

The results of the regression analysis (Table 3-4) also indicate a strong relationship between butterfly farming and conservation behavior. While land ownership and participation in other conservation and development projects are predictors of conservation behavior, they do not interfere with butterfly income rank as a unique predictor of conservation behavior. Figure 3-2 shows an increase in conservation behavior for each butterfly income rank increase, which is consistent with my third hypothesis; that butterfly farmers recognize economic incentives for engaging in conservation behavior.

I did not find any published studies that directly examined the relationship between conservation income dependency and participation in conservation behavior. Salafsky et al. (2001) examined the relationship between the percent of average household incomes obtained from conservation-related enterprises and success of conservation and development projects. However, their analysis was conducted at the macro-level using threat reduction assessment and

therefore was not sensitive to conservation income differences within projects. From their macro-oriented view, they concluded that other factors in addition to income were more important determinants of conservation and development project success. Given the high rate of failure among the projects they studied, this conclusion seems reasonable. However, my results suggest that income generation should not be disregarded.

Although many other authors have arrived at a similar conclusion with limited data (Abbot et al. 2001; Marcus 2001; Newmark & Hough 2000), the chart of butterfly income rank and conservation behavior (Figure 3-2) illustrates very clearly that minor livelihood improvements are unlikely to create substantial changes in behavior. Butterfly farmers with the lowest butterfly income rank score did not report significantly more conservation behavior than the control. However, the chart also indicates that conservation linked income sources need not be a household's primary income source in order to promote significant behavior change. Households that rank butterfly farming as their second most important source of income (56% of butterfly farmers) report significantly greater participation in conservation behaviors than non-butterfly farmers, even though butterflies probably make up only 20% of their income.

In the absence of baseline data, I examine competing explanations for my findings. The comparison of demographic variables shows that butterfly farmers ranked higher in education, land ownership, and participation in conservation and development projects (not including butterfly farming). Even though butterfly farming does not require land ownership or education, the economic security that these factors provide may have allowed early butterfly farmers to be more entrepreneurial and take risks. Therefore, it is possible that some butterfly farmers represent what are described as "early adopters" in the theory of *diffusion of innovation* (Rogers 1995). This finding seems to agree with other findings that rural households try to maintain a diversified economic strategy and are unlikely to concentrate too heavily on any one NTFP,

especially if they perceive risk (Belcher et al. 2005). Moreover, given the uneven record of conservation and development projects in the area (Stocking & Perkin 1992), it is not surprising that many residents were initially skeptical of butterfly farming.

Forty percent of butterfly farmers mentioned the project's connection to conservation as a reason for joining the project. However, the 60% of butterfly farmers who did not claim conservation as an initial motivation for joining the project also scored significantly higher on the conservation behavior scale than non-butterfly farmers. Additionally, none of the demographic differences between butterfly farmers and the control are associated with butterfly income rank. This is not surprising, because people that own more land, are more educated, and participate in other conservation and development projects are likely to have more diversified incomes and less time to devote to butterfly farming. Therefore, though it appears there are factors that influenced which community members would become butterfly farmers, these factors are not associated with success as a butterfly farmer and do not explain the correlation between the butterfly income rank and participation in conservation behavior.

The Role of Organizations and Institutions

Probably the most important factor contributing to the success of the Amani Butterfly Project is the organization itself. Prior to the establishment of the project, a few community members captured butterflies and occasionally sold them to collectors. However, without the marketing infrastructure, expertise and organization provided by the project, the full value of butterfly resources in the area would not have been recognized by the community. This fact highlights a short-coming in many NTFP case study reviews. While they do a good job of characterizing current NTFP situations (Belcher et al. 2005; Crook & Clapp 1998; Kusters et al. 2006), their conclusions imply that the current market and institutional realities are fixed. Many of the case studies tend to focus on NTFPs in local markets and miss examples of NTFPs that

have global markets (Shackleton 2001). The Amani Butterfly Project demonstrates that economically competitive scenarios that empower rural producers are possible and even necessary.

The institution of the Amani Butterfly Project also gives butterfly farmers *de facto* ownership over butterflies in their area, by giving them control over the market for butterflies and access to the forest. New members in the project must be approved by existing members. For instance, the original members of the project have recently allowed 100 new farmers from two villages in the area to join the project, but on the condition that they only farm species which are not currently produced in sufficient numbers.

The project also created a democratic organization that brought together roughly 20% of households in these two communities for a common purpose. Participation in group butterfly farming activities might explain why butterfly farmers reported greater confidence in their ability to aid conservation. In effect, butterfly farmers are creating new social norms, a key ingredient in conservation behavior (Dietz et al. 2005; Stern 2000). In addition to the survey results presented in this study, there are several examples of butterfly farmers engaging in conservation behaviors as a group. Independent of the project's professional staff, butterfly farmers have brought attention to and stopped destructive firewood cutting practices by local tea estates. In Msasa/IBC village, butterfly farmers convinced the village to purchase land to create a new community forest reserve using a portion of the village's development funds awarded by the Amani Butterfly Project. Subsequently, butterfly farmers in Msasa/IBC have organized a tree planting campaign in Msasa/IBC village aimed at rehabilitating their new village forest reserve. In Kwezitu village, butterfly farmers worked with the environmental committee chairman (who was not a butterfly farmer) to help secure the last remaining portion of unprotected village forest as a village forest reserve that is specifically under the management of butterfly farmers. This has nearly doubled

the original size of Kwezitu village's forest reserve. Kwezitu village is currently seeking to have the new forest reserve gazetted as an official village forest reserve under Tanzania's Community Forest Act.

The behavior of butterfly farmers as individuals and as a group also illustrates how economic incentives can complement other conservation actions. Lack of conservation behavior knowledge can be a barrier to participation in conservation behavior (Schultz 2002). In Kwezitu village in particular, the Tanzania Forest Conservation Group built local peoples' capacity to manage tree nurseries and manage community forests long before the creation of the butterfly project. Butterfly farming has given these communities increased economic incentive to apply the training and knowledge that TFCG has provided.

Salafsky et al. (2001) describe a similar phenomenon in their review of what they describe as the "community-based enterprise strategy". Many of the enterprises that were failures in financial terms reported positive conservation outcomes. The authors concluded that the process of creating a community enterprise was as important as the outcome of the enterprise and that the process can help communities form institutions that empower local communities to manage their resources and create new social norms regarding conservation. In the case of the Amani Butterfly Project, project meetings provided a venue for discussions about conservation issues in which people were motivated to listen.

Lessons

Butterfly farming, as practiced by members of the Amani Butterfly Project, provides an alternative model for NTFP harvesting that can successfully link forest conservation and development goals. Even though actual harvesting from the forest is limited and most of the value creation occurs outside of the forest, butterfly farmers clearly recognize a connection between their ability to farm butterflies and forest conservation. Partial-domestication in this

case appears to be sufficient to create economic motivation for conservation behavior in rural communities and may be replicable in other areas.

Butterfly farming and similar ventures will not eradicate poverty. However, the project is advancing development in the East Usambara Mountains in addition to increasing the incomes of participating farmers. Predictable monthly butterfly income enabled project members to create their own SACCOS (savings and credit cooperative societies), a self loan system that is popular in Tanzania. Villages in the project area have used community development funds awarded by the project to build new primary school buildings. Also, 55% of the project's registered farmers are women and 20% of respondents in the survey report using butterfly farming income to send children to secondary school.

The linear relationship between conservation behavior and butterfly income rank highlights a potential problem that excessive taxes and fees can create for integrated conservation and development projects. Members of the Amani Butterfly Project are fortunate because at the moment they only pay about 10% of their earnings into the village development fund. This tax rate is comparable to the village tax rate on cash crops produced in the study area. However, governments often place special fees on nature based products, even when produced on private or community land, because they are viewed as public goods (Maraseni et al. 2006; Mayaka et al. 2005). For instance, under the Tanzanian Wildlife Act 1974, all wildlife is the property of the state. The Amani Butterfly Project may shortly be required to pay a $0.10 fee to the Division of Wildlife for every pupa it exports, which would effectively double the tax rate paid by member farmers. Higher tax rates may be justified if the taxes are spent on protecting the resource base, but not when they are simply a means of increasing general government revenue. The Division of Wildlife has no official presence in the East Usambara Mountains and does not share revenue with the Division of Forestry and Beekeeping. Therefore, the fees do not serve a local

conservation purpose. Even tax revenue spent in communities on village wide development projects is unlikely to promote the same level of behavior change as direct individual earnings. The overall effect of such taxes is to put environmentally friendly land uses at a competitive disadvantage and reduce conservation incentive (Child 2000).

Though butterfly farming as practiced by the Amani Butterfly Project and similar projects may be a competitive land use form on small scales, it seems unlikely that butterfly farming can serve as the sole justification for conserving vast forest areas (Muriithi & Kenyon 2002). However, butterfly farming works well alongside protected areas, where butterfly farming does not have to compete with incompatible forest uses. Unlike the experience with many domesticated NTFPs (Crook & Clapp 1998), forest dependent butterfly farmers have some competitive advantages over butterfly farmers who produce butterflies under fully domesticated conditions. The micro-climate is more favorable and the host plants and butterflies are readily available. These conditions greatly reduce the capital requirements of butterfly farming. Additionally, forest dependent producers have a market advantage if they can convince buyers that they are stewards of the natural habitat where the butterflies are found.

Worldwide butterfly trade was estimated to be $100 million USD in the early 1990's and is most likely much more now (Slone et al. 1997). Rural communities bordering protected forests could capture a greater proportion of this market if projects like the Amani Butterfly Project can successfully market their conservation credentials. As is the case with many nature based products, a certification system might help buyers identify conservation friendly suppliers. This may be particularly effective marketing approach for the live butterfly exhibits because many of the exhibits are attached to zoos and museums visited by people who are interested in conservation. One of the Amani Butterfly Project's buyers, a major pupae distributor in the UK, advertises that they spend more than £400,000 on pupae each year from projects that promote

development and conservation in the tropics (Calvert 2006). The Amani Butterfly Project's database of live butterfly exhibits, which is far from complete, currently includes more than 200 live butterfly exhibits. The Xerces society reports that a typical large live butterfly exhibit in the US spends more than $100,000 a year on pupae (Black et al. 2001).

The market for butterflies has other potential benefits for conservation. Butterflies, beetles, mantids, spiders, and scorpions are fascinating creatures, especially for children, and interacting with these creatures may help suburban and urban children develop an appreciation of nature (Basile & White 2000). Conservationists should encourage live butterfly exhibits to include more education for the general public about the source of their butterflies and the threats to biodiversity in these locations. Insect farming can allow people to interact with nature, whether in live exhibits or as dried specimens, in a way that does not threaten nature while at the same time generating increased worldwide interest in conservation and improving the relationship between rural people and conservation.

Butterfly farming is an under-explored topic and, in light of my findings, should be further investigated as a means to promote conservation and development. To the best or my knowledge, butterfly farming is an export business in Papua New Guinea, Indonesia, Thailand, Vietnam, Malaysia, the Philippines, Taiwan, the United States, Costa Rica, Belize, Peru, Ecuador, Kenya, Tanzania, Uganda, Madagascar, and South Africa. However, in the past 20 years, most of the handful of published articles on butterfly farming have described farming in Kenya and Papua New Guinea (Gordon & Ayiemba 2003; New 1994). There is a great diversity in the farming practices and institutional structures associated with butterfly farming in different countries, and it is unclear how these differences affect its relationship with forest conservation.

Perhaps the greatest lesson from this study is that systematic evaluations of conservation and development projects are feasible. My quasi-experimental approach with a matched control

group echoes a recent call by prominent conservation scientists for more experimental evaluations of conservation and development initiatives (Ferraro & Pattanayak 2006). Also, unlike many evaluations which only examine environmental attitudes or knowledge (Brooks et al. 2006), my study provides a quantifiable measure of the initiative's most important outcome – conservation behavior. This is important because attitudes and knowledge are not always directly associated with participation in conservation behavior (Kollmuss & Agyeman 2002) and therefore less representative of behavior changes that may affect biodiversity conservation. Finally, my system of evaluation demonstrates the advantage of separating project participants into levels of benefit or intervention. If the association between conservation outcomes and level of intervention or benefit matches the trend seen between project participants and the non-participant control, then this strengthens the case that the intervention is responsible observed differences in conservation outcomes. In my case, the measure was butterfly income rank, but many other measures in addition to income are possible, such as amount of training received, or length of membership in the project.

APPENDIX A
AMANI BUTTERFLY PROJECT 2006 SURVEY QUESTIONNAIRE (SWAHILI)

Survey Information

Date:_____

Interviewer: _____

Subvillage: _____

Tamko litakalo somwa kwa kila kaya

Habari, jina langu ni (jina la mwanafunzi mtanzania). Ninatoka Chuo Kikuu cha Kilimo cha Sokoine na ningependa kukualika kushiriki katika utafiti ninaoufanyia kazi na mtafiti kutoka Chuo Kikuu cha Florida cha Marekani. Lengo la utafiti huu ni kujifunza zaidi kuhusu jinsi watu kama ninyi mnajisikiaje na uhifadhi wa misitu katika milima ya Usambara Mashariki. Tunatembelea kaya mbalimbali 300 na kuwauliza maswali machache ambayo yatachukua dakika 20 hadi 30 ili kuyajibu.

Kama utakubali kushiriki, ningependa kukuambia kwamba majibu yako itakuwa ni siri kwasababu sitandika jina lako kwenye karatasi hii (Ujisikie uhuru). Kama hukubali kushiriki katika utafiti huu, hiyo ni sawa pia.
Je,unakubali kushiriki?_____

Tamko litakalo somwa kama mhojiwa anakubali
Tunapenda sana kufahamu maoni yako, kwa hiyo tafadhali jitahidi kujibu kwa ufasaha iwezekanavyo. Aidha, uwe huru kujibu maswali haya kwa namna upendavyo, pamoja na kuweza kuniambia kama huna maoni yoyote au hutaki kujibu swali fulani. Pia, unaweza kuamua kutoendelea katika utafiti huu wakati wowote ule.

Hisia juu ya Hifadhi

Soma kwa mhojiwa: Sasa nitakuuliza maswali kuhusiana na unavyojisikia kuhususiana na vitu fulani fulani. Ninachokihitaji hasa ni kufahamu maoni yako na majibu yote ni sahihi kwa maswali haya. Nitasoma swali na majibu matatu au manne halafu nitaomba jibu lako. Kama huna maoni kuhusiana na swali fulani au huelewi swali fulani, tafadhali nieleze.

1. Je, unadhani kwamba kiasi cha misitu iliyotengwa kwa ajili ya hifadhi katika eneo hili inatakiwa:

a. Ibaki kama ilivyo	(2)
b. Iongezwe	(3)
d. Ipunguzwe	(0)
e. Sina uhakika/ Sijui/ Sina maoni	(66)
f. Sielewi swali	(77)
g. Kakataa kujibu	(88)
h. Imerukwa na mhojaji	(99)

2. Je, unadhani ni vizuri kwa serikali kuruhusu wanakijiji wakate miti ya kujengea nyumba zao ndani ya msitu wa hifadhi?

a. Ndio, ni vizuri sana	(0)
b. Ndio, ni vizuri kiasi	(1)
c. Hapana, siyo vizuri	(2)
d. Hapana, siyo vizuri kabisa	(3)
c. Sina uhakika/ Sijui/ Sina maoni	(66)
f. Sielewi swali.	(77)
g.Kakataa kujibu	(88)
h. Imerukwa na mhojaji	(99)

3. Je, unadhani ni vizuri kwa serikali kuruhusu wanakijiji wakate miti ya mbao ndani ya msitu wa hifadhi?

a. Ndio, ni vizuri sana	(0)
b. Ndio, ni vizuri kiasi	(1)
c. Hapana, siyo vizuri	(2)
d. Hapana, siyo vizuri kabisa	(3)
c. Sina uhakika/ Sijui/ Sina maoni	(6)
f. Sielewi swali.	(7)
g.Kakataa kujibu	(8)
h. Imerukwa na mhojaji	(9)

4. Je, unakubaliana au haukubaliani na usemi huu:
Kazi ya ziada inahitajika ili kudhibiti ukataji holela wa miti katika misitu ya hifadhi.

a. Ndio, nakubaliana kabisa	(3)
b. Ndio, nakubaliana kiasi	(2)

c. Hapana, sikubaliani (0)
e. Sina uhakika/ Sijui/ Sina maoni (6)
f. Sielewi swali. (7)
g.Kakataa kujibu (8)
h. Imerukwa na mhojaji (9)

5. Je, unakubaliana au haukubaliani na usemi huu:
Wanavijiji wote wanapaswa kupanda miti katika ardhi yao.

a. Ndio, nakubaliana kabisa (3)
b. Ndio, nakubaliana kiasi (2)
c. Hapana, sikubaliani (0)
e. Sina uhakika/ Sijui/ Sina maoni (6)
f. Sielewi swali. (7)
g.Kakataa kujibu (8)
h. Imerukwa na mhojaji (9)

6. Je, unakubaliana au haukubaliani na usemi huu:
Uchanaji mbao sio tatizo katika msitu wa hifadhi wa Derema?

a. Sio tatizo kabisa (0)
b. Ni tatizo kiasi (1)
c. Ni tatizo kubwa (2)
e. Sina uhakika/ Sijui/ Sina maoni (6)
f. Sielewi swali. (7)
g.Kakataa kujibu (8)
h. Imerukwa na mhojaji (9)

7. Kwa ujumla unajisikiaje kuhusu eneo jipya la hifadhi ya msitu wa Derema?

a. Umefurahishwa sana (3)
b. Umefurahishwa kiasi (2)
c. Hujafurahishwa wala Hujakasirishwa (1)
d. Umekasirishwa (0)
e. Sina uhakika/ Sijui/ Sina maoni (6)
f. Sielewi swali. (7)
g. Kakataa kujibu (8)
h. Imerukwa na mhojaji (9)

8. Kama jirani yako akimkuta mtu anakata miti kwa ajili ya mbao, je unadhani anapaswa kutoa taarifa kwa afisa wa msitu au kamati ya mazingira?

a. Ndio, ni muhimu sana (3)
b. Ndio, ni muhimu kiasi (2)
c. Hapana, siyo muhimu (0)
c. Sina uhakika/ Sijui/ Sina maoni (6)
d. Sielewi swali. (7)

e.Kakataa kujibu (8)
f. Imerukwa na mhojaji (9)

Tabia ya kujali mazingira

Soma kwa mhojiwa: Ahsante sana kwa majibu yako hadi hapa. Sasa nitakuuliza maswali kuhusu shughuli ambazo wewe unashiriki au watu katika kaya yako wanashiriki. Kumbuka kuwa majibu yote ni sahihi. Nitasoma swali halafu nitaomba jibu lako.

9. Je, wewe ama watu wengine wa kaya yako ni wana chama wa Kamati ya Mazingira?_____

a. Ndio (3)
b. Hapana (0)
e. Sina uhakika/ Sijui/ Sina maoni (6)
f. Sielewi swali. (7)
g. Kakataa kujibu (8)
h. Imerukwa na mhojaji (9)

10.Katika mwaka uliopita, je ni mara ngapi unadhani, wewe ama watu wengine wa kaya yako, walishiriki katika mikutano ya kamati ya mazingira?_____

a. Sina uhakika/ Sijui/ Sina maoni (6)
b. Sielewi swali (7)
c. Kakataa kujibu (8)
d. Imerukwa na mhojaji (9)

11. Katika mwaka uliopita, je wewe au watu wengine wa kaya yako, mlishawahi kupanda miti au mimea ya vipepeo katika ardhi yenu (Siyo kwenye viriba)?_____ na ni miti mingapi?_____

a. Sina uhakika/ Sijui/ Sina maoni (6)
b. Sielewi swali (7)
c. Kakataa kujibu (8)
d. Imerukwa na mhojaji (9)

12. Je,kati ya miti iliyopandwa, mingapi haikuwa mdalasini au karafuu au mimea ya vipepeo?_____

a. Sina uhakika/ Sijui/ Sina maoni (6)
b. Sielewi swali (7)
c. Kakataa kujibu (8)
d. Imerukwa na mhojaji (9)

13. Je, kaya yako ina mpango au imeanza kulima chai badala ya iliki?_____

a. Sina uhakika/ Sijui/ Sina maoni (6)
b. Sielewi swali (7)
c. Kakataa kujibu (8)
d. Imerukwa na mhojaji (9)

14. Je, kaya yako ina eneo la shamba ambalo mmepanga liendelee kuwa msitu?_____ni eka ngapi?_____

a. Sina uhakika/ Sijui/ Sina maoni (6)
b. Sielewi swali (7)
c. Kakataa kujibu (8)
d. Imerukwa na mhojaji (9)

15. Je wewe au mtu yeyote katika kaya yako mlishawahi kushiriki katika upandaji wa miti kwenye ardhi ya kijiji?_____ na ni mara ngapi katika mwaka uliopita_____?

a. Sina uhakika/ Sijui/ Sina maoni (6)
b. Sielewi swali (7)
c. Kakataa kujibu (8)
d. Imerukwa na mhojaji (9)

16. Je, wewe au mtu yeyote wa kaya yako, mlishawahi kutoa taarifa za uhalifu kwa kamati ya mazingira au afisa wa msitu ndani ya mwaka uliopita_____? Na ni mara ngapi_____?

a. Sina uhakika/ Sijui/ Sina maoni (6)
b. Sielewi swali (7)
c. Kakataa kujibu (8)
d. Imerukwa na mhojaji (9)

17. Katika mwaka uliopita, umeshawahi kumwambia jirani yako yeyote asikate miti au mijengo ndani ya msitu wa hifadhi? _____ Mara ngapi_____?

a. Sina uhakika/ Sijui/ Sina maoni (6)
b. Sielewi swali (7)
c. Kakataa kujibu (8)
d. Imerukwa na mhojaji (9)

18. Chakula kinapikwaje katika kaya yako?

a. Jiko la umeme (3)
b. Jiko sanifu la kuni linalotunzwa (2)
c. Jiko sanifu la kuni lisilotunzwa (1)
d. Jiko la mafiga matatu la kuni (0)
e. Au jiko la mkaa (0)
f. Sina uhakika/ Sijui/ Sina maoni (6)
g. Sielewi swali (7)
h. Kakataa kujibu (8)
i. Imerukwa na mhojaji (9)

19. Je, kaya yako imejenga jengo jipya lolote ndani ya kipindi cha mwaka uliopita? _____ Unaweza kunionesha? _____

a. Sina uhakika/ Sijui/ Sina maoni (6)
b. Sielewi swali (7)
c. Kakataa kujibu (8)
d. Imerukwa na mhojaji (9)

20. (Kama utajenga jengo) Umetumia (Utatumia) nini kwa ajili ya ukuta _____?

a. Mawe (3)
b. Matofari ya block (3)
c. Matofari ya kukausha kwa jua (3)
d. Matofari ya kuchomwa (1)
e. Miti ya kujengea na udongo (0)
f. Sina uhakika/ Sijui/ Sina maoni (6)
g. Sielewi swali (7)
h. Kakataa kujibu (8)
i. Imerukwa na mhojaji (9)

21. (Kama utajenga jengo) Ni aina gani ya mti (mtatumia) mlitumia kwa ajili ya kupaulia_____?

a. Sina uhakika/ Sijui/ Sina maoni (6)
b. Sielewi swali (7)
c. Kakataa kujibu (8)
d. Imerukwa na mhojaji (9)

22. Je, kuna mtu yeyote wa kaya yako alichonga meza, kabati, kitanda katika mwaka uliopita?_____ Pisi Ngapi _____? Ulitumia aina gani ya miti_____?

a. Sina uhakika/ Sijui/ Sina maoni (6)
b. Sielewi swali (7)
c. Kakataa kujibu au haionekani (8)
d. Imerukwa na mhojaji (9)

Kwa wakulima wa kipepeo tu…

Maoni juu ya mradi wa kipepeo

23. Ni vitu gani vilikuvutia katika mradi wa kipepeo hapo mwanzoni ulivyoanza? (orodha ya kutaja)

a. _____
b. _____
c. _____
d. Sina uhakika/ Sijui/ Sina maoni (6)
e. Sielewi swali (7)
f. Kakataa kujibu (8)

g. Imerukwa na mhojaji (9)

24. Ulitumia kununua vitu gani pesa za kipepeo? (Circle all that Apply)

a. Karo za shule ya sekondari
b. Chakula
c. Mifugo
d. Ujenzi
e. Kumiliki mali
f. Sherehe
g. Kuweka akiba
h. Vingine _____
i. Sina uhakika/ Sijui/ Sina maoni (6)
j. Sielewi swali (7)
k. Kakataa kujibu (8)
l. Imerukwa na mhojaji (9)

25. Unadhani kuwa maafisa wa mradi wa vipepeo wanafanya kazi nzuri kusaidia wafugaji?

a. Ndio, wanasaidia sana (3)
b. Ndio, wanasaidia kiasi (2)
c. Hapana, hawasaidii (1)
d. Sina uhakika/ Sijui/ Sina maoni (6)
e. Sielewi swali. (7)
f. Kakataa kujibu (8)
g. Imerukwa na mhojaji (9)

26. Unadhani maafisa wa mradi wanafanya maamuzi ya haki hasa katika zoezi la kukusanya mabuu ya vipepeo wakati wa siku za soko?

a. Ndio, wanafanya kwa haki sana (3)
b. Ndio, wanafanya kwa haki kiasi (2)
c. Hapana, hawafanyi kwa haki (0)
e. Sina uhakika/ Sijui/ Sina maoni (6)
f. Sielewi swali. (7)
g.Kakataa kujibu (8)
h. Imerukwa na mhojaji (9)

27. Naomba niambie vitu viwili vizuri na viwili vibaya kuhusiana na mradi wa Kipepeo? (Orodha ya kutaja)

a. Vizuri:_____
b. Vizuri:_____
c. Vibaya:_____
d. Vibaya:_____
e. Sina uhakika/ Sijui/ Sina maoni (6)
f. Sielewi swali (7)

g. Kakataa kujibu (8)
h. Imerukwa na mhojaji (9)

Utegemezi wa Kilimo cha Kipepeo na Msitu

Soma kwa mhojiwa: Ahsante sana kwa majibu yako mpaka hapa. Tumekaribia kumaliza. Katika sehemu hii, nitasoma maswali na majibu halafu utaniambia jibu lako.

28. Je, unadhani ni kwa kiasi gani kaya yako inategemea mradi wa kipepeo?

a. Inategemea sana (3)
b. Inategemea kiasi (2)
c. Inategemea kidogo sana (1)
d. Haitegemei kabisa (0)
e. Sina uhakika/ Sijui/ Sina maoni (6)
f. Sielewi swali (7)
g. Kakataa kujibu (8)
h. Imerukwa na mhojaji (9)

29. Je, kama utaacha kufuga vipepeo, unadhani itakuwa rahisi kupata kipato sawa na kile kitokanacho na ufugaji wa vipepeo kwa kufanya shughuli nyingine?

a. Itakuwa rahisi sana (0)
b. Itakuwa rahisi kiasi (1)
c. Ni vigumu kidogo (2)
d. Ni vigumu sana. (3)
e. Sina uhakika/ Sijui/ Sina maoni (6)
f. Sielewi swali (7)
g. Kakataa kujibu (8)
h. Imerukwa na mhojaji (9)

30.Unadhani kwa muda gani mradi wa vipepeo utaendelea?

a. Hauna mwisho (3)
b. Kwa angalau miaka 10 ijayo (2)
c. Miaka 2 mpaka 5 ijayo (1)
d. Unakaribia kufa (0)
e. Sina uhakika/ Sijui/ Sina maoni (6)
f. Sielewi swali (7)
g. Kakataa kujibu (8)
h. Imerukwa na mhojaji (9)

31. Unadhani utafuga vipepeo kwa muda gani?

i. Sitaacha kufuga (3)
j. Kwa angalau miaka 10 ijayo (2)
k. Miaka 2 mpaka 5 ijayo (1)
l. Huu ni mwaka wangu wa mwisho (0)
m. Sina uhakika/ Sijui/ Sina maoni (6)
n. Sielewi swali (7)

o. Kakataa kujibu (8)
p. Imerukwa na mhojaji (9)

32. Je, unadhani watoto wako wataweza kuwa wafugaji wa kipepeo?

a. Ndio, nina uhakika sana (3)
b. Ndio, nina uhakika kiasi (2)
c. Sina uhakika (1)
d. Hapana, haitawezekana (0)
e. Sielewi swali (7)
f. Kakataa kujibu (8)
g. Imerukwa na mhojaji (9)

Imani juu ya Hifadhi ya Msitu na Kilimo cha Kipepeo

33. Je, unaamini kuwa ukataji miti ya mbao ni hatari kwa idadi ya vipepeo wa pori pamoja na mimea inayowahifadhi?

a. Ndio, ni hatari sana (3)
b. Ndio, ni hatari kiasi (2)
c. Hapana, siyo hatari (1)
d. Sina uhakika/ Sijui/ Sina maoni (6)
e. Sielewi swali. (7)
f. Kakataa kujibu (8)
g. Imerukwa na mhojaji (9)

34. Je, unaamini kuwa ukataji wa miti ya kujengea ni hatari kwa idadi ya vipepeo wa pori pamoja na mimea inayowahifadhi?

a. Ndio, ni hatari sana (3)
b. Ndio, ni hatari kiasi (2)
c. Hapana, siyo hatari (0)
d. Sina uhakika/ Sijui/ Sina maoni (6)
e. Sielewi swali. (7)
f. Kakataa kujibu (8)
g. Imerukwa na mhojaji (9)

35. Je, unaamini kuwa kuishi karibu na msitu kunarahisisha kufanya kilimo cha kipepeo? Ni kwa kiasi gani unajisikia hivyo?

a. Ndio, inasaidia sana (3)
b. Ndio, inasaidi kiasi (2)
c. Hapana, haisaidii (0)
d. Sina uhakika/ Sijui/ Sina maoni (6)
e. Sielewi swali. (7)
f. Kakataa kujibu (8)
g. Imerukwa na mhojaji (9)

36. Kama miti ndani ya misitu ya hifadhi ikikatwa, unaamini bado utaweza kufanya kilimo cha kipepeo?

a. Ndio, naamini itakuwa rahisi kuendelea (0)
b. Ndio, lakini itakuwa ngumu (1)
c. Hapana, sitaweza kuendelea kabisa (3)
d. Sina uhakika/ Sijui/ Sina maoni (6)
e. Sielewi swali. (7)
f. Kakataa kujibu (8)
g. Imerukwa na mhojaji (9)

Imani juu ya ufanisi wa ndani na nje ya misitu kuhusiana na Hifadhi ya Msitu

37. Je unadhani kwamba vipo vitu ambavyo unaweza kufanya ili kusaidia uhifadhi wa misitu?

a. Ndio, naweza kusaidia sana (3)
b. Ndio, naweza kusaidia kiasi (2)
c. Hapana, siwezi kusaidia kabisa (0)
d. Sina uhakika/ Sijui/ Sina maoni (6)
e. Sielewi swali. (7)
f. Kakataa kujibu (8)
g. Imerukwa na mhojaji (9)

38. Je unadhani kama wanakijiji wakipanda miti kwenye mashamba yao itasaidia uhifadhi wa misitu?

a. Ndio, itasaidia sana (3)
b. Ndio, itasaidia kiasi (2)
c. Hapana, haitasaidia kabisa (0)
d. Sina uhakika/ Sijui/ Sina maoni (6)
e. Sielewi swali. (7)
f. Kakataa kujibu (8)
g. Imerukwa na mhojaji (9)

39. Je, unadhani kuwa wafugaji wa vipepeo wengi wanafanya vitu ambavyo vinasaidia kuhifadhi misitu? Ni kwa kiasi gani unajisikia hivyo?

a. Ndio, wapo wengi (3)
b. Ndio, wapo wachache (2)
c. Hapana, hawapo kabisa (0)
d. Sina uhakika/ Sijui/ Sina maoni (6)
e. Sielewi swali. (7)
f. Kakataa kujibu (8)
g. Imerukwa na mhojaji (9)

40. Je, unadhani kuwa maafisa misitu wanafanya kazi nzuri ya kulinda msitu? Ni kwa kiasi gani unajisikia hivyo?

a. Ndio, wanafanya kazi nzuri sana (3)
b. Ndio, wanafanya kazi nzuri kiasi (2)
c. Hapana, hawafanyi kazi nzuri (1)
d. Hapana, hawafanyi kazi kabisa (0)
e. Sina uhakika/ Sijui/ Sina maoni (6)
f. Sielewi swali. (7)
g. Kakataa kujibu (8)
h. Imerukwa na mhojaji (9)

41. Je, unadhani kuwa maafisa misitu wanasikiliza mapendekezo kutoka kwa wanakijiji kuhusiana na ulinzi wa misitu?

h. Ndio, wanasikiliza sana (3)
i. Ndio, wanasikiliza kiasi (2)
j. Hapana, hawasikilizi (1)
k. Hapana, hawasikilizi kabisa (0)
l. Sina uhakika/ Sijui/ Sina maoni (6)
m. Sielewi swali. (7)
n. Kakataa kujibu (8)
o. Imerukwa na mhojaji (9)

Imani juu ya tabia zinazojali mazingira

42. Ni njia gani ya kujenga kuta za nyumba unadhani ni nzuri kwa ajili ya uhifadhi wa misitu? (USISOME MAJIBU)

a. Mawe ya kuchonga (3)
b. Matofari ya block (3)
c. Matofari ya udongo ambayo hayajachomwa (3)
d. Matofari ya kuchomwa (1)
e. Miti na udongo (0)
f. Nyingine_____ ( )
g. Sina uhakika/ Sijui/ Sina maoni (6)
h. Sielewi swali. (7)
i. Kakataa kujibu (8)
j. Imerukwa na mhojaji (9)

43. Kuhusiana na uhifadhi wa misitu, je unadhani kuna umuhimu wowote wa kuangalia jinsi ambavyo watu wanajenga nyumba zao?

a. Ndio, kuna umuhimu sana (3)
b. Ndio, kuna umuhimu kiasi (2)
c. Hapana, hakuna umuhimu (1)
d. Hapana, hakuna umuhimu kabisa (0)
e. Sina uhakika/ Sijui/ Sina maoni (6)
f. Sielewi swali. (7)
g. Kakataa kujibu (8)

h. Imerukwa na mhojaji (9)

44. Ili kulinda misitu unadhani ni aina gani ya miti ni bora itumike kwa kujengea (USISOME MAJIBU)?_____

a. Sina uhakika/ Sijui/ Sina maoni (6)
b. Sielewi swali (7)
c. Kakataa kujibu au haionekani (8)
d. Imerukwa na mhojaji (9)

45. Ili kulinda misitu unadhani ni aina gani ya miti ni bora itumike kwa kupaulia?_____

e. Sina uhakika/ Sijui/ Sina maoni (6)
f. Sielewi swali (7)
g. Kakataa kujibu au haionekani (8)
h. Imerukwa na mhojaji (9)

46. Je unadhani ukishiriki katika kamati ya mazingira ya kijiji itasaidia kuhifadhi msitu?

a. Ndio, itasaidia sana (3)
b. Ndio, itasaidia kiasi (2)
c. Hapana, haitasaidia (1)
d. Hapana, haitasaidia kabisa (0)
e. Sina uhakika/ Sijui/ Sina maoni (6)
f. Sielewi swali. (7)
g. Kakataa kujibu (8)
h. Imerukwa na mhojaji (9)

Demographic Information

Sasa kwa sehemu ya mwisho ya utafiti, Nitakuuliza kuhusu maswali machache yanayo kuhusu wewe na kaya yako. Ahsante sana kwa msaada wako, na tumekaribia kumaliza.
Mhojiwa

47. Je, una umri wa miaka mingapi?_____

48. Una kiwango gani cha elimu?

a. Sina elimu (0)
b. Elimu ya msingi (1)
c. Darasa la 7 (2)
d. Kidato cha 1 mpaka 3 (3)
e. Kidato cha 4 (4)
f. Kidato cha 6 (5)
g. Chuo (6)
h. Chuo kikuu (7)
i. Kakataa kujibu (8)
j. Imerukwa na mhojaji (9)

49. Wewe ni muumini wa dini ipi?

a. Mwislamu (1)
b. Mkristu (2)
c. Nyingine (3)
d. Sina (4)
e. Kakataa kujibu (8)
f. Imerukwa na mhojaji (9)

50. Je wewe ni wa kabila lipi? _____

51. Onesha me au ke (USIULIZE) _____

52. Ni kwa muda gani umeishi katika milima ya Usambara Mashariki? _____

Idadi ya wana kaya
53. Ni watu wangapi wenye umri zaidi ya miaka 18 wanaishi katika kaya hii au wanaotegemea chakula au kipato cha kaya hii? _____

54. Ni watu wangapi wenye umri zaidi ya miaka 18 wanachangia kuleta kipato au wanasaidia kufanya kazi shambani katika kaya hii? _____

55. Kuna watoto wangapi wa chini wa umri wa miaka 18 katika familia hii pamoja na wale wasioishi katika kaya hii? _____

Shughuli za kiuchumi za Kaya
56. Je, ni ipi ndiyo njia muhimu sana kuliko zote ya kujipatia kipato kwa kaya yako?_____

57. Je, ni ipi ndiyo njia ya pili ya kujipatia kipato kwa kaya yako?_____

58. 51. Je, ni ipi ndiyo njia ya tatu ya kujipatia kipato kwa kaya yako?_____

59. Je, eneo la ardhi ambalo kaya yako inamiliki lina ukubwa wa eka ngapi?_____

60. Je unamiliki ng'ombe, na ni wangapi?_____

Ushirikishwaji/Uelimishwaji wa Miradi ya Hifadhi na Maendeleo
61. Je, wewe, au mtu yeyote wa kaya yako, alishawahi kushiriki katika miradi ya (Circle all that apply):
a. mabwawa ya samaki
b. misambu
c. majiko sanifu
d. miradi ya misitu yetu (TFCG)
e. au miradi mingine yeyote inayolenga kusaidia uhifadhi katika eneo hili _____?

62. Je, kati ya ndugu zako, jamaa, na marafiki, ni wangapi kati yao ni wakulima wa kipepeo?_____

63. Je, unafahamu shughuli yeyote ya maendeleo ya jamii inayofadhiliwa na mfuko ya jamii ya mradi wa kipepeo?_____Itaje_____

Mwisho wa Utafiti
Ahsante sana kushiriki katika utafiti huu na kujibu maswali yangu. Umekuwa msaada mkubwa sana.

LIST OF REFERENCES

Abbot, J. I. O., D. H. L. Thomas, A. A. Gardner, S. E. Neba, and M. W. Khen. 2001. Understanding the Links Between Conservation and Development in the Bamenda Highlands, Cameroon. World Development **29**:1115-1136.

Adams, W. M., and D. Hulme. 2001. If community conservation is the answer in Africa, what is the question? Oryx **35**:193-200.

Ajzen, I. 1985. From intentions to actions: A theory of planned behavior. Pages 11-39 in J. Kuhl, and J. Beckman, editors. Action-control: From cognition to behavior. Springer, Heidelberg, Germany.

Ajzen, I. 2002. Perceived Behavioral Control, Self-Efficacy, Locus of Control, and the Theory of Planned Behavior1. Journal of Applied Social Psychology **32**:665-683.

American Association for Public Opinion Research 2006. Standard Definitions: Final Dispositions of Case Codes and Outcome Rates for Surveys. 4th edition. AAPOR, Lenexa, Kansas.

Arnold, J. E. M., and M. R. Perez. 2001. Can non-timber forest products match tropical forest conservation and development objectives? Ecological Economics **39**:437-447.

Basile, C., and C. White. 2000. Respecting Living Things: Environmental Literacy for Young Children. Early Childhood Education Journal **28**:57-61.

Belcher, B., M. Ruiz-Perez, and R. Achdiawan. 2005. Global patterns and trends in the use and management of commercial NTFPs: Implications for livelihoods and conservation. World Development **33**:1435-1452.

Black, S. H., M. Shepard, and M. M. Allen. 2001. Endangered Invertebrates: The Case for Greater Attention to Invertebrate Conservation. Endangered Species Update **18**:41.

Blaise Paquit, N., and K. A. Y. Edwin J. 1997. The regulatory framework for the exploitation of medicinal plants in Cameroon: the case of Prunus africana on Mount Cameroon. Biodiversity and Conservation **6**:1409-1412.

Brooks, J. S., M. A. Franzen, C. M. Holmes, M. N. Grote, and M. B. Mulder. 2006. Testing Hypotheses for the Success of Different Conservation Strategies. Conservation Biology **20**:1528-1538.

Burgess, N. D., T. M. Butynski, N. J. Cordeiro, N. H. Doggart, J. Fjeldsa, K. M. Howell, F. B. Kilahama, S. P. Loader, J. C. Lovett, B. Mbilinyi, M. Menegon, D. C. Moyer, E. Nashanda, A. Perkin, F. Rovero, W. T. Stanley, and S. N. Stuart. 2007. The biological importance of the Eastern Arc Mountains of Tanzania and Kenya. Biological Conservation **134**:209-231.

Calvert, J. 2006. The Butterfly Farm makes a difference to hundreds of lives in developing countries. Butterfly Farm News. The Startford Butterfly Farm.

Child, B. 2000. Making wildlife pay: converting wildife's comparative advantage into real incentives for having wildlife in African savannas, case studies from Zimbabwe and Zambia. Pages 335-387 in H. H. T. Prins, J. G. Grootenhuis, and T. T. Dolan, editors. Wildlife conservation by sustainable use. Kluwer Academic Publishers, Norwell, MA.

Crook, C., and R. A. Clapp. 1998. Is market-oriented forest conservation a contradiction in terms? Environmental Conservation **25**:131-145.

Crook, C., and R. A. Clapp. 2001. Ecosystem structure, economic cycles and market-oriented conservation. Environmental Conservation **28**:194-198.

Dietz, T., A. Fitzgerald, and R. Shwom. 2005. ENVIRONMENTAL VALUES. Annual Review of Environment & Resources **30**:335-372.

Ferraro, P. J., and S. K. Pattanayak. 2006. Money for Nothing? A Call for Empirical Evaluation of Biodiversity Conservation Investments. PLoS Biology **4**:e105.

Fichman, M., and J. N. Cummings. 2003. Multiple Imputation for Missing Data: Making the most of What you Know. Organizational Research Methods **6**:282-308.

Gordon, I., and W. Ayiemba. 2003. Harnessing Butterfly Biodiversity for Improving Livelihoods and Forest Conservation: The Kipepeo Project. The Journal of Environment Development **12**:82-98.

Holmes, C. M. 2003. The influence of protected area outreach on conservation attitudes and resource use patterns: a case study from western Tanzania. Oryx **37**:305-315.

Kollmuss, A., and J. Agyeman. 2002. Mind the Gap: why do people act environmentally and what are the barriers to pro-environmental behavior. Environmental Education Research **8**:239-260.

Kusters, K., R. Achdiawan, B. Belcher, and M. R. Perez. 2006. Balancing development and conservation? An assessment of livelihood and environmental outcomoes of nontimber forest product trade in Asia, Africa, and Latin America. Ecology and Society **11**:Article 20.

Maraseni, T., G. Shivakoti, G. Cockfield, and A. Apan. 2006. Nepalese non-timber forest products: An analysis of the equitability of profit distribution across a supply chain to India. Small-Scale Forestry **5**:191-206.

Marcus, R. 2001. Seeing the Forest for the Trees: Integrated Conservation and Development Projects and Local Perceptions of Conservation in Madagascar. Human Ecology **29**:381-397.

Mayaka, T. B., T. Hendricks, J. Wesseler, and H. H. T. Prins. 2005. Improving the benefits of wildlife harvesting in Northern Cameroon: a co-management perspective. Ecological Economics **54**:67-80.

Mehta, J. N., and J. T. Heinen. 2001. Does Community-Based Conservation Shape Favorable Attitudes Among Locals? An Empirical Study from Nepal. Environmental Management **28**:165-177.

Muriithi, S., and W. Kenyon. 2002. Conservation of biodiversity in the Arabuko Sokoke Forest, Kenya. Biodiversity and Conservation **11**:1437-1450.

New, T. R. 1994. Butterfly ranching: Sustainable use of insects and sustainable benefit to habitats. Oryx **28**:169-172.

Newmark, W. D. 2002. Conserving Biodiversity in East African Forests: A Study of the Eastern Arc Mountains. Springer, Berlin, Germany.

Newmark, W. D., and J. L. Hough. 2000. Conserving Wildlife in Africa: Integrated Conservation and Development Projects and Beyond. BioScience **50**:585-592.

Oates, J. F. 1995. The dangers of conservation by rural development - a case-study from the forests of Nigeria. Oryx **29**:115-122.

Oates, J. F. 1999. Myth and Reality in the Rainforest: How Conservation Strategies Are Failing in West Africa. University of California Press, Berkeley, California.

Peter, R. W., R. B. Steven, L. F. Crystal, and C. W. Patrick. 2002. Reinventing a Square Wheel: Critique of a Resurgent "Protection Paradigm" in International Biodiversity Conservation. Society & Natural Resources **15**:17-40.

Peters, C. M., A. H. Gentry, and R. O. Mendelsohn. 1989. Valuation of an Amazonian rainforest. Nature **339**:655-656.

Reyes, T., R. Quiroz, and S. Msikula. 2005. Socio-economic comparison between traditional and improved cultivation methods in agroforestry systems, East Usambara Mountains, Tanzania. Environmental Management **36**:682-690.

Rogers, E. M. 1995. Diffussion of Innovations. Free Press, New York.

Salafsky, N., H. Cauley, G. Balachander, B. Cordes, J. Parks, C. Margoluis, S. Bhatt, C. Encarnacion, D. Russell, and R. Margoluis. 2001. A Systematic Test of an Enterprise Strategy for Community-Based Biodiversity Conservation. Conservation Biology **15**:1585-1595.

Salafsky, N., and E. Wollenberg. 2000. Linking Livelihoods and Conservation: A Conceptual Framework and Scale for Assessing the Integration of Human Needs and Biodiversity. World Development **28**:1421-1438.

Schultz, P. W. 2002. Knowledge, information, and household recycling: examining the knowledge-deficit model of behavior change in T. Dietz, and P. C. Stern, editors. New Tools for Environmental Protection: Education, Information and Voluntary Measures. National Research Council, Washington D.C.

Shackleton, C. M. 2001. Re-examining local and market-orientated use of wild species for the conservation of biodiversity. Environmental Conservation **28**:270-278.

Slone, T. H., L. J. Orsak, and O. Malver. 1997. A comparison of price, rarity and cost of butterfly specimens: Implications for the insect trade and for habitat conservation. Ecological Economics **21**:77-85.

Stem, C. J., J. P. Lassoie, D. R. Lee, D. D. Deshler, and J. W. Schelhas. 2003. Community Participation in Ecotourism Benefits: The Link to Conservation Practices and Perspectives. Society & Natural Resources **16**:387.

Stern, P. C. 2000. Toward a Coherent Theory of Environmentally Significant Behavior: Toward a Coherent Theory of Environmentally Significant Behavior. Journal of Social Issues **56**:407-424.

Stocking, M., and S. Perkin. 1992. Conservation-with-Development: An Application of the Concept in the Usambara Mountains, Tanzania. Transactions of the Institute of British Geographers **17**:337-349.

Struhsaker, T. T. 1998. A Biologist's Perspective on the Role of Sustainable Harvest in Conservation. Conservation Biology **12**:930-932.

Terborgh, J. 1999. Requim for Nature. Island Press, Washington, D.C.

Vihemäki, H. 2005. Politics of Participatory Forest Conservation: Cases from the East Usambara Mountains, Tanzania. The Journal of Transdisciplinary Environmental Studies **4**:1-16.

Wells, M. P., and T. O. McShane. 2004. Integrating Protected Area Management with Local Needs and Aspirations. AMBIO: A Journal of the Human Environment **33**:513-519.

BIOGRAPHICAL SKETCH

Theron Morgan-Brown was born in 1977 in a cabin near Oregon City. He spent the majority of his childhood in Bandon, Oregon and graduated valedictorian from Bandon High School in 1996. Theron went on to earn a B.A. in biology from Lewis and Clark College in Portland, Oregon in 2000. He first traveled to East Africa as a student in 1998 and then returned in 2001, when he was awarded a Fulbright Fellowship to conduct research in Tanzania.

In Tanzania, Theron investigated the feasibility of using butterfly farming as economic incentive to promote forest conservation in the East Usambara Mountains. Based on the results of this research, Theron went on to found The Amani Butterfly Project in 2003, Tanzania's first butterfly farming enterprise that helps hundreds of rural households farm and export butterfly pupae to live butterfly exhibits in Europe and the US.

After completing his M.S. program in interdisciplinary ecology, Theron plans to pursue a Ph.D. in the same program. In the long run, Theron plans to return to Tanzania with his wife, Jacqueline Kweka, to continue to explore the synergies between rural economic development and biological conservation in Africa.