LINDBERGH GRANT
FINAL REPORT FORM

Project:
Investigating wild silkworm production to conserve rural communities and forests in Madagascar

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Project Dates: March 8 2010 to March 7 2011
Approved Funding: $ 10,580
Money Spent: $ 10,583

Money Due to the Fdtn: $ 0

Report Due Date: August 15th 2011

A PDF copy of this report was sent that has my approval
to be posted to the Lindbergh Web site as appropriate _X_yes ___no

Signature of P.I.: _____

Date Submitted: August 15th 2011

2. Summary

Knowing the genetic diversity and life history of the endemic wild silkworm of Madagascar, *Antherina suraka*, contributes to development of silk farming, which will provide cash to the local people. Determining its distribution is also important for habitat loss evaluation of endangered forests. We collected *A. suraka* and investigated the local food plants in eight sites in Madagascar (March-July 2010 and February- March 2011).

Results of fieldwork and museum records show that *A. suraka* consumes about 31 species of host plants from 28 families. Ten host plants were newly recorded with half of them endemic. The species showed regional preferences for one or two host plant species. Two out of the eight sites visited have ongoing wild silk farming, and three are potential farming sites in that presence of optimal food plants and local associations will facilitate implementation of silk rearing. The farmers can be instructed to plant only the local host plants in their regions, thus contributing to forest conservation as well as reducing risks associated with introduction of non-indigenous plants that are costly and potentially invasive.

The DNA barcoding analyses on a limited number of samples yielded no difference between regions, except for one group in Analalava where the DNA sequence divergence is significantly higher (3.45%) than the average between two species of Saturniidae (0.46%), thus indicating a distinct geographical form of *A. suraka*. However, because this difference was not shown in other specimens with similar ecosystems, expanding the analysis to include other taxonomically informative regions, such as the internal transcribed spacers (ITS), is necessary to confirm the results. Establishing whether genetically distinct forms exist is critical in that the different geographical forms eat completely different plant species and have ecologically different habitat requirements, so, using one standard rearing protocol for all forms would not work in the long run for species conservation. Amino-acid analyses of the silk of the cocoons showed no real variation attributable to the identity of the food plants consumed. The silk from *A. suraka* is, however, chemically different from silks produced by other species in the same family Saturniidae. It is mainly enriched in alanine; glycine and serine are also present. The peculiarity of the suraka silk might be useful in developing new biomaterials.

The Lindbergh Foundation offered me a chance to explore the basic life history of an insect, which is really important in Madagascar because so many life histories of living organisms are still unknown. This project is the beginning of a long-term effort to investigate the life histories of all wild silkworms so that they can be used not only to study fundamental biological processes but also to preserve the endangered remaining tropical forests in Madagascar as well as to help the local people to improve their life at the same time.

3. Discussion

A. Problem

Some efforts have been undertaken to use different groups of animals in determining forest conservation priorities in Madagascar; not only vertebrates but insects such as ants and butterflies have been used (Kremen *et al.* 2008). *Antherina suraka* and its host plants are located in riparian zones of forests, which are a specific habitat greatly threatened by human activities as most forest exploitation activities start in the borders of forests and then move further when human populations increase (Styger *et al.* 2007).

B. Solution

I expanded knowledge of the current distribution of *A. suraka*, which is important for forest conservation. I also initiated studies to determine the genetic diversity, the life history and the silk biochemical properties of *A. suraka*; this knowledge can contribute to development of the silk industry by improving rearing methods through use of the food plants in the border of the forests, which will provide cash to the local people in the long run and will prevent habitat loss at the same time.

C. Results

I first hypothesized that *A. suraka* shows strict regional dietary preferences, which have led to genetic diversity and cryptic speciation. To test this hypothesis:

a. I documented the diversity of *A. suraka* and its associated host plants in Madagascar. We collected different developmental stages of *A. suraka* in different parts of Madagascar from March to May 2010, as well as in February and March 2011. Eight main sites characterized by specific ecosystems were chosen (Table 1). As the larval stage appears at the same time in different regions, I worked with teams of two or three entomologists from the University of Antananarivo, the host institution in Madagascar. A local guide was hired in each site to facilitate investigation of potential habitats and host plants.

We investigated larvae by inspecting leaves and branches of previously recorded host plants. We collected twigs of the plants on which larvae were found for later identification to species and biochemical analyses. We collected cocoons by removing grasses and dead leaves that cover the soil directly under the host plants. We captured adult saturniids by light traps set up during the night from 9 p.m. to 3 a.m. We killed individuals and stored them in glassine envelopes.

To document the exact identity of the host plants, I gathered information from the literature, from wild silk farmers and NGO working on the silkworm, and from my own fieldwork in different sites. I reared caterpillars to confirm that they could complete their development cycle on the food plants on which they were found so that the plant would be definitively identified as host plants of *A. suraka*.

Table 1: Sites visited during investigation of *Antherina suraka* in 2010-2011.

Region	Sites	Subsites
Humid dense forests		
North -East	Maroantsetra	Ambalamahogo (Makira Reserve) Anantoraka (Littoral) Vodiriana (Littoral)
Central East	Vohimana Forest	Around the Researcher Village
South-East	Ranomafana National Park	Along the National Road
Degraded vegetation		
Central	Antananarivo City	Ambatomaro Ambohitsaina Ambohimiandra
Rupicolous vegetation (on rocky areas)		
South-Central	Anja Forest	
South-Central	Isalo National Park	Piscine Naturelle
Fire-resistant forests		
West-Central	Arivonimamo	Ankahalalana
South-Central	Isalo National Park	Oasis Piscine Naturelle
South-Central	Analalava Forest	
Deciduous dry forests		
South-Central	Isalo National Park	Oasis Piscine Naturelle
South-Central	Analalava Forest	
South-West	Kirindy reserve	Research Center

In brief, rearing this particular wild silkworm in Madagascar is very promising. Records from literature, museum collections and my own fieldwork showed that *A. suraka* is widely distributed in Madagascar (Figure 1). *Antherina suraka* consumes about 31 species of host plants belonging to 28 families. Ten species were newly recorded during fieldwork, with half of them endemic to Madagascar. Although the species is very polyphagous, it shows specific preference for one or two host plant species per region. *Ischnolepis tuberosa* (Asclepiadaceae), a species with toxic latex, as well as *Weinmannia* sp. (Cunoniaceae) and *Bakerella grisea* (Loranthaceae), which is a plant parasite, were surprisingly eaten by the wild silkworm.

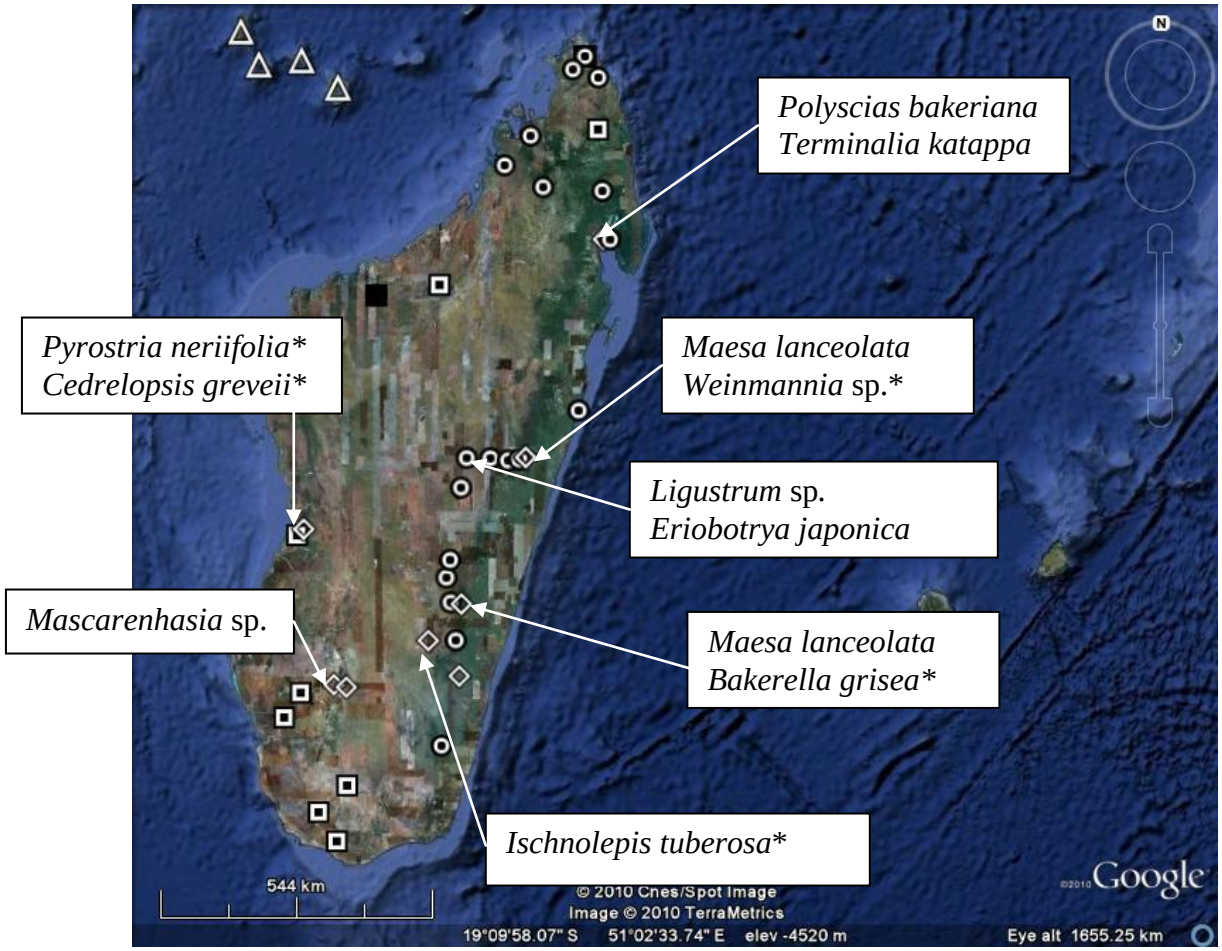

Figure 1. Distribution of *Antherina suraka* and its main host plants in Madagascar and Comoros Islands (top left). Location obtained from specimens in the French National Museum (MNHN) and Parc Botanique et Zoologique de Madagascar (PBZT) insect collection. Coordinates obtained from the museum specimens indicate the location name but not the exact site: dotted circle is *A. suraka* in humid areas, dotted square is *A. suraka* in dry areas, black square shows presence of two geographical forms of *A. suraka*, triangle is *A. suraka* in Comoros island, diamond is my own data collection 2008-2011. (*) indicates newly recorded host plants. More than two host plants were found in one area.

Anja, Vohimana and Ranomafana are good locations for implementing silkworm rearing as alternative activities because local associations and NGOs focusing on local-community-based conservation of the forest and women associations for handicrafts are already present (Table 2). These local associations are probably willing to add sericulture in their activities. We found out that larvae reared on *I. tuberosa* and *Maesa lanceolata* (Maesaceae) could produce cocoons without problems. The host plants are abundant in these regions and could be grown for farming purpose. In Vohimana, the local people are already involved in growing aromatic plants and producing essential oils. Therefore, future sericulture will not be a problem and could be a solution to maintain the current habitats that are partly destroyed because of current pipeline construction for mineral extraction. In Antananarivo, farmers mainly use privet leaves (*Ligustrum* sp., Oleaceae) as food plants. In Maroantsetra, CPALI (Conservation and Poverty

Alleviation, International) is implementing local farming by setting up groups of farmers who are willing to intercrop *Polyscias bakeriana* trees (Araliaceae) with other crops.

Table 2. Suggested host plants to use for silkworm rearing in each site.

Locality	Optimal host plant	Local community association/Organization	Farming possibilities
Kirindy	Optimal one to be tested among seven host plants	No organization recorded	Villagers near forests present but possibilities of rearing still need futher studies
Isalo, Analalava	Just one host plant recorded (*Mascarenhasia* sp.)	No organization recorded	Villagers near forests present but possibilities of rearing still need futher studies
Anja	*Ischnolepis tuberosa*	- Anja Miray Association - Women association for landibe handicrafts	Promising
Ranomafana	*Maesa lanceolata*	Local Villagers might be interested, and already active for other conservation projects	Promising
Vohimana	*Maesa lanceolata*	MATE, already active in other conservation projects	Promising
Antananarivo	*Ligustrum* sp.	Private farming	Farming already in action
Maroantsetra	*Polyscias bakeriana*	CPALI	Farming already in action

b. I also tried to determine if there is regional genetic variation within the species of *A. suraka*. Regional groups of *A. suraka* were evaluated through DNA barcoding analyses to ascertain whether the species constitutes a complex of cryptic species (greater than 0.46 % sequence divergence, the typical threshold of saturniid sequence divergence between two species, Hajibabaei *et al* 2006) or locally specialized individuals of the same species with feeding preferences determined by the availability of host plant species in a particular region (less than 0.46 %).

The DNA barcoding results (Figure 2) averaged 0.93% of sequence divergence within *A. suraka*. One distinct clade (group) possesses about 3.45 % sequence divergence which is greater than 0.46%. This is suspected to be a distinct geographical form of *A. suraka* , possibly the dry form *australis* as it is found in Analalava, a dry deciduous forest. The host plant species in Analalava Forest are unknown although a second expedition undertaken last March allowed us to record *Mascarenhasia* sp. as the host plant mentioned by villagers. We could not find live caterpillars on any plants, though. The remaining samples of *A. suraka*, which have 0.43 % sequence divergence, constitute the major clade, which is the *suraka* form composed of

specimens collected mainly from evergreen vegetation but surprisingly including dry deciduous areas. That might be possible as records from the National insect collection (Parc Botanique et Zoologique de Tsimbazaza) showed that two sites could be home to the two forms. Unfortunately too little information was gathered to reach a definitive conclusion.

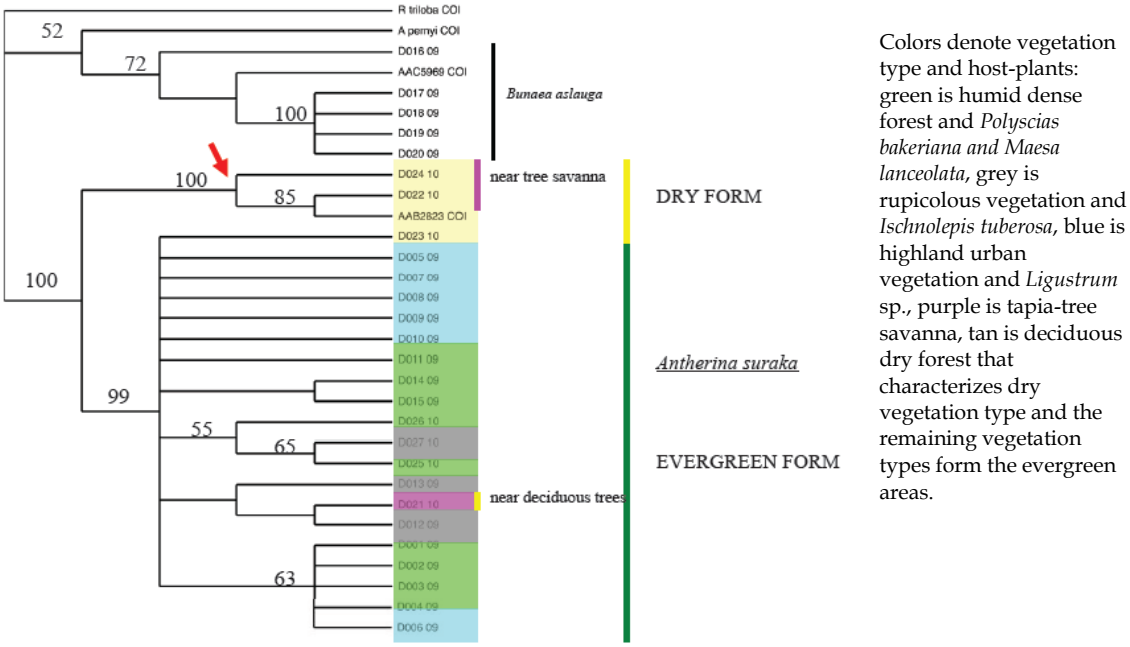

Figure 2: Parsimony consensus tree showing that the Analalava group (see the red arrow) is different from the remaining specimens of *Antherina suraka*.

From these data, I could confirm that two geographical forms *australis* (found in Analalava) and *suraka* (found in all sites) exist as the literature mentioned. The form *australis* does not really differ from the typical form *suraka*, except for smaller size and slight differences in wing coloration (Figure 4).

Figure 3: Dorsal view of two geographical forms of *Antherina suraka*: typical form *suraka* (left), *australis* (right, photo by P. Basquin).

In spite of these physical and host plant differences, I still could not define them as separate species as the samples are too few for a proper study of an entire population of each group to see whether the two forms can hybridize and survive multiple generations and whether they can survive when eating the host plants the other form eats. Fortunately, more adult samples were recently collected (February and March 2011) in the dry areas of Isalo and Kirindy so that I will be able to confirm the results of DNA barcoding by using another gene, the internal

transcribed spacer genes (ITS), which will compensate the lack of ecological data and provide more insight into what extent the forms found in dry versus humid areas of *A. suraka* differ.

I also hypothesized that preference for and utilization of particular food plants affect the biochemical characteristics of *A. suraka* cocoons. Little information is available on the content and composition of silk secreted by the last larval stage of the silkworm, particularly with respect to diet. To test this hypothesis:

a. I tried to determine the major amino-acids forming the silk in the cocoon of *A. suraka* feeding on different host plants. I found that the major amino-acids of the silk of this species are alanine, glycine and serine. Comparison of the concentrations of the major amino-acids in *A. suraka* cocoons revealed no differences in composition of silk produced by larvae reared on different host plant species. Small sample sizes (3-10) with a significant inequality of variances may, however, limited the robustness of this finding.

b. I also tried to determine if the biochemical properties of the cocoons affect the property of the silk produced: I compared the results with silk protein composition of *Amyelois transitella*, the navel orangeworm, which belongs to the Pyralidae, another family of Lepidoptera (Figure 4). The amino-acid composition of the silk proteins of the cocoons of these two polyphagous species is significantly different, with *A. suraka* silk enriched in alanine relative to the silk of *A. transitella*. More samples will be needed to understand the effect of host plant identity on the silk production of the wild silkworm *A. suraka*.

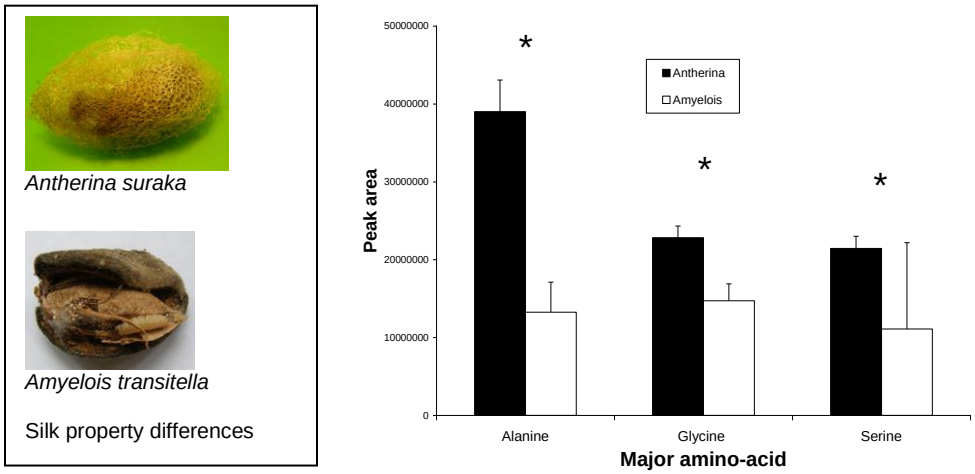

Figure 4. The three major amino-acids of cocoon proteins of *Antherina suraka* and *Amyelois transitella* showing significantly different concentrations (*). Pictures on the left show hard and thick texture for *A. suraka* cocoon and the soft and thin texture for *A. transitella* (the white weblike structure on the left side of the almond nut).

D. Application

Out of eight sites, two sites, Antananarivo and Maroantsetra, have already ongoing wild silk farming managed by NGO and private farmers, and three other sites, Anja, Ranomafana, and Vohimana, show some potential on silk farming as I can suggest optimal plants for them. In addition, presence of different local associations and NGOs would facilitate implementation of the new activities. Four host plants were newly recorded in these promising areas, and seven more from dry areas in Morondava. That information will be useful for setting some host plant preference tests for future farming. These findings are important as the farmers can use or/and

plant the host plants already present in their region, thus conserving forests and preventing habitat loss. Using the local plants will also prevent introduction of non-indigenous plants that costly for farmers to acquire and that could potentially exact ecological costs if they become invasive.

By using molecular analyses which are still ongoing, I documented some differences between regional groups, especially in Analalava Forest. This is an important start as sustainability of the silkworm industry depends on how well the silkworm can be reared. In the event that the different geographical forms eat completely different food plants and live in different conditions (e.g., temperature and humidity), using one standard rearing protocol for all forms would not work over the long term for optimal sustainability..

The Lindbergh Foundation offered me a chance to explore the basic life history of an insect by using advanced technology such as DNA barcoding and simple methods such as investigating its host plants. This is really important in Madagascar as so many life histories of living organisms are still unknown despite the fact that details of the life history are among the basic data needed to make correct decisions when solving problems of forest conservation and economic development.

E. Future

Biochemical analyses of the cocoon silk showed that silk from *A. suraka* is different from the other kinds of silk produced by other species. Further studies on the physical properties of the silk such as tensile strength and resistance to temperature will be interesting as the suraka silk might be used as biomaterials in biomedical fields.

As I gained new collaborators (3) in the local university of Madagascar and other institutions, we will work together to find funding for future projects in different biological aspects of wild silkworms as many species, mostly found nowhere else in the world, are still open to exploration and need further studies. When I finish my PhD, I will conduct research and teach in universities to train students so that more people can work on preserving the remaining tropical forests. I have already started to train two field assistants who are still students and who have already gained some fieldwork skills. They will surely use that experience for their future work in entomology. I have also trained villagers living near each site by recruiting local guides (11 in total). Those guides will be useful in our future research as they will be able to see the life cycles of the insects and to report other interesting information about them in all seasons of the year.

In brief, this project is the beginning of a long-term effort to investigate the life history of all wild silkworms and other moths, inspired from research undertaken for decades in Costa Rica under the direction of Dan Janzen, so that they can be used for fundamental studies of different fields of biology at the same time they provide a focus for preserving the endangered remaining tropical forests in Madagascar and help the local people to improve their life.

Reports and other presentations have been already submitted after fieldwork to the local authorities such as ministries, conservation organizations and the host institution (University of Antananarivo) that deliver research and collecting permits. In addition, the results will be presented at scientific meetings such as the Entomological Society of America annual meeting, and will be published in scientific journals and also as part of my own PhD dissertation.

F. Other

Results of this study will certainly help NGOs such as CPALI expand its activities to other areas of Madagascar. CPALI is currently providing training programs to help farmers in Maroantsetra develop their own sustainable silk enterprises.

References

Kremen C., A. Cameron, A. Moilanen, S. J. Phillips, C. D. Thomas, H. Beentje, J. Dransfield, B. L. Fisher, F. Glaw, T. C. Good, G. J. Harper, R. J. Hijmans, D. C. Lees, E. Louis Jr., R. A. Nussbaum, C. J. Raxworthy, A. Razafimpahanana, G. E. Schatz, M. Vences, D. R. Vieites, P. C. Wright, and M. L. Zjhra. 2008. Aligning Conservation Priorities Across Taxa in Madagascar with High-Resolution Planning Tools. Science 320: 222-226.

Styger H., M. Rakotondramasy, M. J. Pfeffer, E. C. M. Fernandes, D. M. Bates. 2007. Influence of slash-and-burn farming practices on fallow succession and land degradation in the rainforest region of Madagascar. Agriculture, Ecosystems and Environment 119: 257–269.

CPALI: www.cpali.org

4. **Personnel** (about 18 individuals in total):

A. We usually work 6-8 hours during the day and 4 hours during the night:

Name	**Work accomplished**	**Number of hours**
Herisolo Razafindraleva	Colleague helping investigate the species in Ankalalahana and Kirindy and Vohimana (2010) and Team leader in 2011.	187 + 200 = 387
Saholy Ramiliarijaona	Colleague helping investigate in Isalo and Ranomafana (2010-2011)	110 + 100 =210
Herisoa Rakotondrandriambeloson	Field assistant in Isalo and Vohimana (2010)	132
Mamy Ratsimbazafy	Colleague helping investigate the species in Maroantsetra (2010)	55
Rakotoarisoa	Technician helping investigate in Vohimana (2010) and in Krindy (2011)	55 + 100 = 155
Andrianjaka brothers (2)	Local guide helping collect in Ankalalahana (2010)	20
Kirindy guide	Local guide showing sites (2010 and 2011)	4 +4 = 8
Razafindranaivo Xavier	Local employee of Malagasy National Park who helped investigate the species in Isalo and Analalava Forest (2010 and 2011).	55 + 50 = 105
Research village caretaker	Local guide helping investigate the species in Vohimana (2010)	24
Rabotoson	Local guide helping investigate the species in Anja (2010)	40
Randriamanjaka Dolo	Local guide helping investigate the species in Anja (2010)	40
Samuel Joelison	-Local guide helping investigate species in Ambalamahogo (Maroantsetra) in 2010 -Porter of equipment	18
Bertrand and his friend	Local guide helping investigate the species in Anantoraka and Maroantsetra Town (2010)	28
Marie-Jeanne Laina	Local guide showing possible host plants and helping investigate the species in Anantoraka and Vodiriana (2010)	49
Denis Ramasy	Local guide helping investigate in Vodiriana (2010)	22
Porters	Carried equipment and food in Isalo and Vohimana (2010)	3

B. Current work and/or future plans of all personnel:

Name	**Current work**	**Future plans**
Herisolo Razafindraleva	PhD, 2010. Lecturing at the University of Antananarivo	doing research on wild silkworms, collaborating with other researchers
Saholy Ramiliarijaona	Chief of pest management of crops of South-west Madagascar	Enrolling in a PhD program
Herisoa Rakotondrandriambeloson	Medical entomologist at PNLP (a national program to fight against malaria)	Getting a permanent job in Entomology
Aina M. R. Raobelina	First year M.S. student in Entomology	Seeking a topic for her thesis
Mamy Ratsimbazafy	Representative of CPALI in Madagascar	Developing rearing techniques of wild silkworms
Rakotoarisoa	Retired technician in the department of Entomology	Still working on wild silkworms of Madagascar, his passion.
Local guides and porters	Usually farmers then occasionally guides or porters	Silkworm farmers, interested in a project that gives extra-cash.

5. **Equipment**

All the equipments were lower than $100 or donated by Ideawild organization.

6. **Funding** awarded following notification of my selection as a Lindbergh Grant Recipient until the present time.

- UIUC Graduate College Conference Travel Grant, December 2010 ($275) to present a poster at the annual meeting of the Entomological Society of America held in San Diego, CA.

- Herbert Holdsworth Ross Memorial Fund 2011. ($1200) offered by Illinois Natural History Survey (INHS) for molecular analyses by using ITS genes in addition to the COI.

7. **Accounting**:

A. Complete the Financial Report Form attached.
See attached
B. Add to it copies of all approved requests for changes in the budget.
Ok
C. Submit copies of all receipts/vouchers for any single items whose cost is over $250.
Ok
D. Please feel free to include a narrative to accompany the Financial Report Form if an explanation is necessary.
Ok
E. The final $1,000 of the grant amount awarded, less any unspent funds due the Foundation, will be remitted to the organization or person stated in the original Letter of Agreement. Any unspent funds in excess of the $1,000 must be returned to the Foundation.

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To be included with Final Report Form submitted to The Charles A. and Anne Morrow Lindbergh Foundation.

As no host plant was found in dry areas in 2010, I decided to gather the remaining money mainly from the US-Madagascar ticket budget and other trip costs that were less expensive than expected (about $2508) in order to pay a second trip to the same areas of Isalo and Kirindy in 2011. This money mainly defrays the cost of extra-car renting and extra-field assistant per diem (about $1452). I could do that as I already trained some people during my first year of fieldwork and collaborated to the host institution to provide me a team leader so that I could afford this second trip without major problems. I also had to pay mailing and money wiring to send money and documents to the field crew. I had to buy a new camera for the second crew as I only had one and illustrating their findings onsite could be important sometimes.

Some of the receipts of car renting were hand-written as we had to rent cars from local people in the nearest city as rental cars from larger companies are really expensive as I have to pay gasoline from the larger cities to the final destination and other fees instead of just taking bush-taxies to the major cities near the sites which costs about ten times cheaper.

Trip to Ankarafantsika (in dry West) was cancelled as it is hard to undertake three simultaneous teams in terms of logistics and I wanted to focus more on the dry areas I have already visited in 2010 (kirindy and Isalo) to get maximum information about them before exploring another site.

Please see details on the next pages.

*NOTE: Itemize and include vouchers/receipts for purchases over $250.00.

Signed _____ Date _____

Budget (1/3)

Budget Category	Original budget	Approved Budget Changes (attached)	Amount spent 2010 1$ for 2030Ar.	Amount spent 2011 1$ for 1916 Ar.	Total amount spent*	Excess/ Deficiency	Details
TRIP (RT: roundtrip)							
Champaign-Tana RT	4000	4000	2468	0	2468	1532	air ticket,taxi, bus
Tana-Kirindy RT	309	599	303	110	413	186	gas, bus tickets
Tana-Isalo RT	442	547	350	99	449	98	gas, bus tickets
Fianarantsoa-Anja RT	31	31	56	0	56	-25	gas
Tana-Tsiroanomandidy RT	53	53	92	0	92	-39	gas
Tana-Vohimana RT	67	67	58	0	58	9	gas
Fianarantsoa-Ranomafana-Tana	117	117	71	0	71	46	gas
Tana-Maroantsetra RT	357	393	393	0	393	0	
Tana-Ankarafantsika RT	186	0	0	0	0	0	cancelled
LODGING							
Tana-Kirindy	150	150	88	97	185	-35	hotel, center
Tana-Isalo	290	290	43	63	106	184	dormitories, hotel
Fianarantsoa-Anja	20	20	27	0	27	-7	dormitory, local hospitality, tents
Tana-Tsiroanomandidy	100	100	13	0	13	87	local dormitory
Tana-Vohimana	25	25	33	0	33	-8	research village
Fianarantsoa-Ranomafana	140	140	82	0	82	58	hotel
Tana-Maroantsetra	140	140	0	0	0	140	CPALI hospitality
Tana-Ankarafantsika	140	0	0	0	0	0	cancelled

Budget (2/3)

Budget Category	Original budget	Approved Budget Changes (attached)	Amount spent 2010 1$ for 2030Ar.	Amount spent 2011 1$ for 1916 Ar.	Total amount spent*	Excess/ Deficiency	Details
MEALS							
Tana-Kirindy	88	88	55	113	168	-80	
Tana-Isalo	168	168	40	217	258	-90	
Fianarantsoa-Anja	56	56	39	0	39	17	
Tana-Tsiroanomandidy	80	80	40	0	40	40	
Tana-Vohimana	56	56	39		39	17	
Fianarantsoa-Ranomafana	80	80	44	0	44	36	
Tana-Maroantsetra	80	80	74		74	6	
Tana-Ankarafantsika	88	0	0	0	0	0	cancelled
OTHER EXPENSES							
US Visa return	135	135	140	0	140	-5	
Research and export permits	30	30	0	0	0	30	
Host institution fees	300	148	172	5	178	-30	
Host supervisor per diem	155	155	99	0	99	56	
Entry pass to sites	50	50	33	36	70	-20	Kirindy, Isalo
Equipment carrier wages	90	90	13	21	34	56	Isalo, Vohimana, Maroantsetra
Ranomafana Valbio Center fees	30	30	0	0	0	30	
Local guide wages	621	140	140	60	200	-60	Kirindy, Isalo, Anja,Ankahalalana, Vohimana, Maroantsetra
Field assistant per diem	1131	789	766		766	23	Kirindy, Isalo, Anja, Ankahalalana, Vohimana, Ranomafana, Maroantsetra
Extra-field assistant per diem	340	226	0	1169	1169	-943	Kirindy, Isalo
Car renting	400	814	814	522	1336	-522	Kirindy, Isalo, Anja,Ankahalalana, Vohimana, Ranomafana
Insect rearing	0	271	295		295	-24	box, insect rearing
Ethanol	0	0	0	85	85	-85	conserving insects

Budget (3/3)

Budget Category	Original budget	Approved Budget Changes (attached)	Amount spent 2010 1$ for 2030Ar.	Amount spent 2011 1$ for 1916 Ar.	Total amount spent*	Excess/ Deficiency	Details
Fedex mailing	0	0	0	104	104	-104	mailing the insects collected and other documents
Western Union Money wiring	0	0	0	199	199	-199	money transfer in 2011
Battery for light trap and accessories	0	195	89	106	195	0	needed 2 batteries for light traps for 2 teams
Camera	0	0	0	190	190	-190	needed one more camera for the team
Portable hard disk	0	0	0	90	90	-90	storing data
Protein analyses	0	0	100	0	100	-100	Quantitation of silk protein
Miscellaneous materials	35	227	115	118	233	-6	phone, internet, CD, materials of capture, medicines
Total **10586**	10580	10580	7183	3403	**10586**	-6	

*NOTE: Please, find attached vouchers/receipts for purchases over $250.00.

Signed Date

8. **Publications/Publicity/Photos, Etc.:**

A. Enclose copy(ies) of all publications/publicity generated regarding your grant/project. Please include the date and publication where it appeared, and the circulation of the publication, if available.

M. Randrianandrasana, M. Ratsimbazafy, N. S. Ramiliarijaona, H. Rakotondrandriambeloson, Rakotoarisoa, L. H. Ravaomanarivo and M. R. Berenbaum. The Malagasy wild silkworm *Antherina suraka* (Saturniidae) and its foodplants. Poster presented at the Entomological Society of America meeting 2010 in San Diego. (http://esa.confex.com/esa/2010/webprogram/Paper51482.html).

B. Please find attached groups of photoes for permanent Foundation use in publicizing this work.

C. Credits

Many thanks to the: Lindbergh Foundation, Departments of Entomology at University of Antananarivo and University of Illinois (UIUC), IdeaWild, the Malagasy Direction of Protected Areas, L'Homme et l'Environnement, Anjà Miray Association and Wildlife Conservation Society; the local people of Vohimana, Anjà, Ambalamahogo, Anantoraka and Ankahalalana, CPALI and Dr. Catherine Craig, Dr. Lala Ravaomanarivo, Dr. Rodolphe Rougerie and Canadian Centre of barcoding, Francis M. and Harlie M. Clark Summer Fellowship (Integrative Biology, UIUC), Phillip W. Smith Memorial Fund at Illinois Natural History Survey (INHS), UIUC Graduate College, Rita and Arnold Goodman Fund (WGGP), Sindhu Krishnankutty, Ratsimbazafy family, and my family in Madagascar.

9. **Copies**: Please submit a complete original (items 1-9) of this report and a second copy of items 1-6.

Ok.

Submit your Final Report to:

President
The Charles A. and Anne Morrow Lindbergh Foundation
2150 Third Avenue North, Suite 310
Anoka, MN 55303-2200

Direct any questions to:

Grants Administrator

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