



2015 ANNUAL REPORT



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CENTRE VALBIO'S 2015 YEAR IN REVIEW

Centre ValBio had another excellent year with several new foci in research, an increase in scientific tourism and the launching of three new initiatives; The Lichtenstein Foundation Project for vehicle purchase, station renovation and Malagasy student fellowships, The Three Graces Foundation project “My Rainforest, My World” to teach participatory science to fourth graders in ten remote village schools, Catholic Relief Service subcontract (USAID) for reforestation with endemic trees.

2015 highlights include:

- Pascal Rabeson was named National Director of Centre ValBio in July, 2015.
- Pascal Rabeson, CVB National Director and Dr. Jean Claude Razafimahaimodison, Chair of CVB Department of Research attended the Conservation Biology meetings in Montpellier, as did CVB researchers CVB Board Member Dr. Thomas Gillespie and Dr. Onja Razafindratsima.
- Three CVB researchers obtained their doctorates: Onja Razafindratsima from Rice University, Tuomas Aivelo, University of Helsinki, and Rachel Jacobs, Stony Brook University; and five CVB researchers obtained their master's degrees: Kristin Deraus from Emory University, Emily Headrick from Emory University, S. Richter from University of Copenhagen, Cassidy Rist from Emory University, and Katie Smith from Emory University.
- In June, the second Mouse Lemur Research Conference was held at the Museum of Natural History in Paris with Dr. Benjamin Andriamihaja, National Representative of Stony Brook, Dr. Patricia Wright, International Director for CVB, Herman Rafalinirina, CVB researcher and graduate student at University of Antananarivo, Dr. Caitlin Karanewsky, post doctoral fellow at Stanford University and CVB researcher, Dr. Mark Krasnow, Chair of Biochemistry, Stanford and CVB Board member and researcher.
- In December in NYC, the PIVOT board meeting was attended by CVB Board member and CVB researcher Tom Gillespie, CVB Board Chair, Jim Herrnstein, CVB Board Member Robin Herrnstein and Dr. Benjamin Andriamihaja, ICTE/ CVB national representative. The collaboration between CVB and PIVOT was discussed.

- Drs. Thomas Gillespie and Matt Bonds, CEO of PIVOT, continued to expand the infectious disease research effort through the Gates Foundation Grand Challenges One Health Program. Drs. Gillespie and Bonds presented this work as keynote speakers at the 13th Annual Conference on Ecology and Evolution of Infectious Diseases. Athens, Georgia. Dr. Gillespie also presented on this work this year as a featured speaker at the World Health Summit in Berlin, Germany, and the One Health Africa Summit in Kampala, Uganda.
- Dr. Jim Bliska contributed to infectious disease efforts spearheading a study that found antibodies of plague in the *Rattus rattus* population.
- The “Mouse Lemur Genome Project” continued with an annual molecular biology training course in November 2015. The Stanford team, including Drs. Mark Krasnow and his post-doctoral fellow Caitlin Karanewsky, trapped mouse lemurs and produced mouse lemur fibroblasts in our CVB laboratory. Over 650 mouse lemurs have been trapped and provided with microchip transponders for identification and long-term monitoring.
- Our biodiversity research projects included field studies on a diversity of taxa. Mar Cabeza led a team on disease transmission in bats, Brett Scheffers and his team climbed into the canopy to monitor the climate change effect on frogs and other canopy biodiversity, Steig Johnson (CVB Board member) began to monitor lemur transects inside the park and Patrice Ravonjjarisoa studied macrofungi.
- Centre ValBio continued working towards the purchase of 20 hectares of unprotected forest in the peripheral zone of Ranomafana National Park (Ambatolahy dimy).
- In 2015 Centre ValBio hosted 3 study abroad programs: two from Stony Brook University, and one from the University of Helsinki, Finland. We also supported many Malagasy students from the Universities of Fianarantsoa, Tulear, and Antananarivo through student research scholarships from the Indianapolis Prize fund and the Lichtenstein Foundation Fellowship Fund.
- CVB’s outreach programs continued in 54 villages around the park. Education programs continued in 34 schools and 20 conservation clubs throughout the periphery of the park, promoting biodiversity, reforestation and health. Our mobile health team continued to provide critical mobile health delivery to remote villages - delivering diagnostics, treatment and preventative education to rural communities.

New Initiatives

Lichtenstein Foundation

In July we were pleased to receive a Lichtenstein Foundation Grant of \$500,000 to upgrade our vehicles, renovations at LovaBe Hall, and support Malagasy students. We immediately purchased a well needed Toyota Landcruiser so that we could continue our field expeditions. Plans for the kitchen renovation were drawn up by Mr. Lucien Robert, our contractor who built both LovaBe and NamanaBe halls. The LovaBe renovation will include a kitchen up to international standards with stainless steel appliances, an extension of the dining room, a staff conference room, an infirmary for sick researchers, an open office room, and extra storage space. We set up a Lichtenstein Fellowship to cover Centre ValBio station fees for Malagasy students. Funds have also been applied for the development of a children's cartoon show on the environment for television. The first episode will be completed by the end of 2016.

My Rainforest My World Science Education Project

In September we received a grant from the Three Graces Foundation to implement an innovative new education program, *"The My Rainforest, My World Project"* (\$100,000 for the first year with possibilities to renew for the next two years). Our pilot project to teach participatory science, critical thinking and inquiry based learning to fourth graders in remote villages was initiated with a workshop in October. The Oakland Park Zoo, Chapman School of Los Angeles, and The South Fork Nature History Museum on Long Island, all contributed experts and materials, to train 10 school teachers from 10 remote villages and 10 student teachers from the University of Fianarantsoa on the lessons designed for the program. We hired a project manager (Lova Razafindravony) to work with our CVB education leader and began School Term I with biodiversity recognition and training.

Business for Conservation

Board Member Susan Cummings-Findel visited Ranomafana in October to follow-up on the women's groups who have been granted microloans from Sunshine Comes First, and the promotion of the artisanal trail she is helping to develop. This year was important for launching a new eco-shop at Ambatovaky to feature the work of local blacksmiths and handicraft groups. A brochure was developed for the Tourist Trail by volunteer consultant Diane Powers and CVB's Artist in Residence Alain Rasolo.



Environmental Arts

Our Environmental Arts program continued with Alain Rasolo joining CVB as the Artist in Residence. Our local musicians performed lively music and dance throughout the tourist season. During the last week of October, Centre ValBio collaborated with MNP for World Lemur Week celebration in Ranomafana National Park.

Scientific Tourism to CVB

Throughout the year, we also expanded our outreach through scientific tourism talks and diversified programs from a day to a week in duration, including groups such as the Sierra Club.

CNN Anthony Bourdain

In May, 2015 Centre ValBio was featured in CNN's "*Parts Unknown*" hosted by Anthony Bourdain. The TV film includes a traditional ceremony asking the ancestors if they approve of the transfer of land to conservation of the Ambatolahy dimy region, as well as close-ups of lemurs.

Special Guests

In July US Ambassador Robert Yamate, USAID Country Director, Susan Riley, USAID Food and Security Officer, Chris LaFargue, and USAID Health Officer John Yunulis visited CVB to see the station and inaugurate the recording studio.

Jane Alexander, Oscar nominated film and television star and her twin 12 year old grandsons Finn and Mac Alexander visited Centre ValBio in November.

Wonderful staff!!

All of this success would not have been possible without our outstanding staff in Madagascar, at CVB, ICTE/CVB Antananarivo, and ICTE/CVB Stony Brook. 2015 has been a good year and I look forward to a productive and successful 2016.



Centre ValBio Station Use

In 2015 Centre ValBio station hosted 280 individuals from 20 countries. We are pleased to note that CVB experienced an increase in the number station days of individuals hosted by the center. The total number of station-days in 2015 increased to 6,477 compared to 4,692 station-days in 2013 and 4,561 station-days in 2014.



Centre ValBio continues to attract researchers, training programs, project partners and tourists due to increasing interest in biodiversity and the people of Madagascar. Centre ValBio hosts researchers and course participants (86%), as well as volunteers and interns, scientific tourists and partners, film or artist teams, and workshop participants. While we remain at capacity during the 2015 high season from September to November, we need to continue to be proactive in promoting station usage throughout the year, especially in the low season. Expanding training courses and the duration of participants' stay at the center as opposed to other locations, increased advertising for hosting workshops and conferences even at a national scale, and encouraging further research during the low season to increase station usage is important. Additional study abroad programs, including the SBU Winter Session Experiential Learning Program, are also in development for 2016.

Centre ValBio hosted 280 individuals for a total of 6,477 station usage days. As in previous years, both Research Projects and Training Programs dominated Centre ValBio’s station usage in 2015. However, the number of Scientific Tourists and Project Partners visits increased, in particular workshops held by Catholic Relief Service and My Rainforest My World education workshop.

Table 1: Station usage by category in 2015

	Researchers	Training Programs	Project Partners	Scientific Tourism	Workshops
No. Station Days	3,321	1,742	836	486	92
No. Individuals	102	86	67	30	95
No. Nationalities	14	9	6	3	3

While scientific tourist visits ranged from 1 day to one week, Centre ValBio is drawing a diversity of people through lectures, tours, meals, and participation in research and education programs.

Residents of 12 countries were hosted at CVB in 2015 from the U.S.A (35%), Madagascar (30%) Britain, France, Ireland, Canada, Germany, Finland, Japan, the Netherlands, Portugal, and South Africa. Most of our scientific tourism for 2015 was developed in partnership with Malagasy and international tour agencies working predominantly with British and American tourists. Field trip visitors are predominantly composed of school group members (teachers and students) from Madagascar and consist of 96% Malagasy nationals. Additional school and university level training courses targeting Malagasy are in development for 2016.

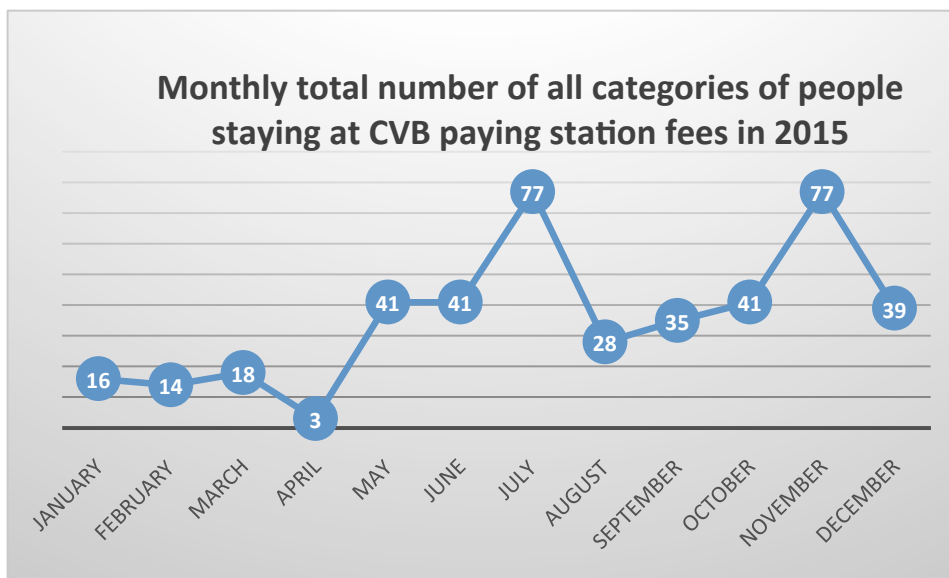


Figure 1: Monthly number of people staying overnight at CVB in 2015. Note that January, February, March and especially April have the fewest filled beds.

Projects and Activities

RESEARCH AT CENTRE VALBIO

Centre ValBio and its laboratories continue to provide exceptional resources for visiting researchers. In 2015, 102 researchers spent a total of 3,321 researcher-days at Centre ValBio. CVB facilitated several Malagasy researchers independently developing and implementing post-graduate, Ph.D., and Master's projects. In addition, ICTE and Centre ValBio supported several Malagasy student scholarships in 2015 through the Indianapolis Prize Fund and the Lichtenstein Foundation Fellowship continuing our mission of promoting opportunities for in country researchers. During 2015, 22 research projects, four national universities (Toamasina, Fianarantsoa, Toliara, and Antananarivo) and 20 international Universities (15 countries).

The primary topics of research projects in 2015 concerned lemur biology, seed dispersal plant ecology, disease and parasite ecology, lemur population densities in fragmented forests, reptile and amphibian abundance in the canopy. We were pleased to host several teams of returning researchers working on long-term projects at CVB.



Photo by Franck Rabenahy

Dr. Mark Krasnow and his team from Stanford University continued their study of mouse lemur genomics from August through November. For the fifth consecutive year, Dr. Krasnow also taught his course in mouse lemur biology. This year the class included local high school students from the Ranomafana region where they learned basic genetic methods via lectures and lab exercises.

CVB Board member Dr. Thomas Gillespie and his team from Emory University continued their studies of the ecology and epidemiology of infectious diseases in the people, domesticated animals and wildlife in and around Ranomafana National Park in collaboration with Dr. Matt Bonds (CEO of Pivot) and Dr. Patricia Wright.

CVB Board member Steig Johnson on his NSERC grant and his graduate students continued to survey the Packard Foundation transects, detecting changes in lemur populations from 2002-2015.

Mar Cabeza led two research teams in (1) socio-ethnographic work around RNP's periphery to assist in gaining a better perspective of villager's perception of the park, and (2) a bat research team that selected public buildings (schools) in the periphery of the park to explore systematics, distributions, and potential disease transmission through guano.

Brett Scheffers, University of Florida, sent his team to Valohoaka for investigation of the canopy. They climbed over 60 trees and found over 1,000 individuals of biodiversity including a frog living 30 meters high.

Dr. Onja Razafindratsima, Rice University, continued her research on seed dispersal, extending experiments in seedling propagation both in the forest and CVB's on-site tree nursery.

Dr. Patricia Wright (Stony Brook University) and Katie Guzzetta (Hamilton College) began the Microbiome Project on *Propithecus edwardsi*. The Microbiome project targeting individuals from the north side of the Namarona/road vs. the south side of the Namarona river/road for a comparative study of their gut microbiome as determined by feces.

Centre ValBio's Long-term Research

LONG TERM RESEARCH PROJECTS

Climate data (28 years of continuous monitoring)

Since 1987 Centre ValBio staff collects both temperature and precipitation daily via manual rain gauges and thermometers every morning at 6 am. Total annual rainfall was 3,720 mm, which is higher than average (3,000mm).

Tree Phenology (28 years of continuous monitoring)

Tree phenology monitoring consists of monthly observation and measurement of the states of selected trees in Ranomafana National Park. Each month, the CVB team conduct a 5 day monitoring, focusing specially on their vegetative and reproductive parts (leaves, flowers, and fruits). 342 endemic trees within 71 species, 46 genera, and 24 families are monitored. This year Manuel Rakotoarisoa, Lyon University, compared the rainfall data, tree fruit productivity with sifaka reproduction to find that more infants were born in years with high fruit productivity. However high rainfall did not correlate with high fruit productivity.

LONG TERM RESEARCH PROJECTS continued

Primates

Propithecus edwardsi (Milne Edwards sifaka) (29 year continuous follows)

Eight groups of *Propithecus* from three different sites (Valohoaka, Talatakely, and Sahamalaotra) have been continuously followed this year. Beginning in 1986 research on diet, reproduction, female dominance, dispersal, hostile takeovers, predation by fossa, parasites, aging, and lethal aggression have resulted in over 50 publications.

Microcebus rufus (brown mouse lemur)

The Mouse Lemur Genome project began in 2002, trapping and marking with microchips over 660 *Microcebus* in Talatakely within RNP and CVB upper campus (outside the RNP). Various studies on aging, diet, reproduction, parasites, morphometrics and disease ecology have been conducted. Mark Krasnow and Caitlin Karanewsky (Stanford University) are currently working on the genomics.



Photo by Patricia Paladines

Hapalemur aureus and ***Prolemur simus*** (golden bamboo lemur and greater bamboo lemur)

Four groups of *Hapalemur aureus* have been followed by CVB technicians in the Talatakely Trail system within Ranomafana National Park since 2000. During those 15 years the group size of each group has increased and the population density has more than doubled. The *Prolemur simus* group has decreased since 2000 and the father and daughter pair still remain in Talatakely alone. With the Ranomafana National Park director, we are planning on translocating more individuals from Vohirivatra in 2016

Varecia variegata editoreum (black and white ruffed lemurs) *Varecia* is a good indicator of forest health as they are frugivores that are typically restricted to undisturbed forests. Since 2009 *Varecia* has been observed within the Talatakely trail system – indicating successful forest regeneration since protection of the park was established. Sightings in Talatakely, Sakaroa, Vatoharonina and Valohoaka continue to be frequent, confirming that the selectively logged (in 1986-1989) forest is recovering and now provides food unavailable after the logging. Andrea Baden first described “day-care” behavior in this species. The groups studied by Andrea Baden in Mangevo are still censused annually and populations are slightly increasing.

Eulemur rubriventer (red-bellied lemurs)

Red bellied lemurs have been studied since 1987 and censuses conducted every year. The population densities of this species has nearly doubled over the 20 years since Deborah Overdorff and Beth Erhart studied them. Rachel Jacobs finished her dissertation on this species in 2015 “Vision in *Eulemur rubriventer*” and published a paper comparing photos of faces of 80 individuals and computer generated models.

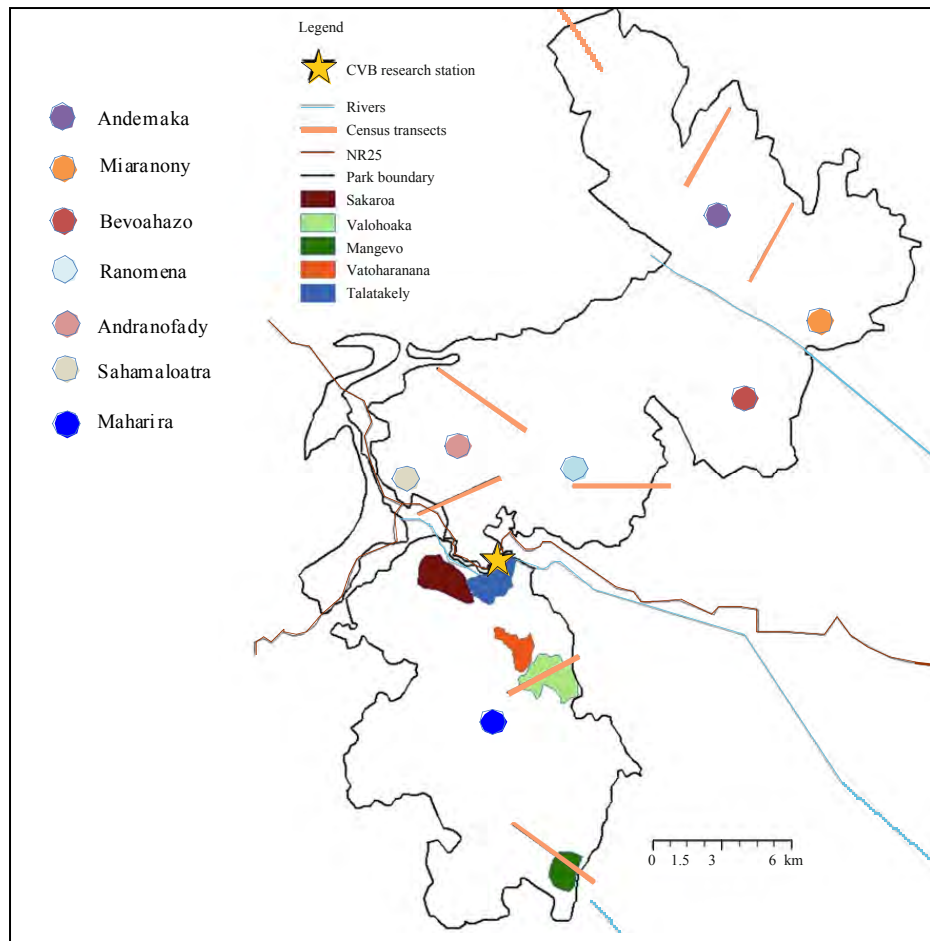


Figure 2: Long-term research sites at Ranomafana National Park (RNP)

The fact that Centre ValBio’s research teams are covering such a large area throughout the year is crucial to assist the authorities of Madagascar National Parks (MNP) in management of the park. Gold mining continues to be a problem, especially in the central portion of the park, just north of the road. We work closely with MNP to georeference, photograph, and take any additional details on observed disturbance. Mixed patrols are also supported by CVB in collaboration with MNP and the gendarme. Centre ValBio promotes educational campaigns and alternative and more sustainable economic opportunities for communities surrounding the park. The attack of the village Torotosy by 100 bandits, stealing 200 cattle and many possessions, was devastating to the village. CVB immediately responded with providing rice and beans to this population. The gendarmes tracked the bandits and arrested 30 people and the banditry has momentarily halted.

Tropical Ecology Assessment and Monitoring (TEAM) Network

The TEAM Project (a collaboration with Conservation International) continued through its fifth year and has been renewed for a sixth year of monitoring vegetation, terrestrial vertebrates and climate within the [TEAM network](#). The same standardized methodologies were conducted as in previous years and as implemented across all TEAM sites globally. Six vegetation 1ha plots (green squares), sixty camera trap points (black triangles or red circles), and climatic parameters were recorded through the automated climatic station (on CVB's upper campus) at established monitoring points (Figure). Claude Jaquot Ralazampirenena (Laza) did an excellent job as the TEAM site Manager.

Terrestrial Vertebrates: Camera traps were deployed (for 30 consecutive days) utilizing our established sixty camera trap sampling points, with sampling points at a density of 1 camera every 2 km². For the past year's terrestrial vertebrate monitoring, almost 30,000 images were captured (with an average of 8,682.66 images per array and 434.13 images per camera trap point) and documented a total of 24 vertebrate species

The continuous evidence of human presence across all terrestrial vertebrate sampling arrays is cause for alarm. Due to the large area of the park covered systematically and annually, our technicians are also extremely valuable informants for park management. Unfortunately, our teams are still frequently encountering either ongoing signs of disturbance from small-scale gold mining as well as encountering large numbers of people in the park for this purpose. Gold miners are continuing to cut trees and digging up substantial portions of the park in an effort to find gold. New trails and indication of more extensive and frequent use of existing trails was evident when teams went out this year, especially around the middle portion of the park (Andranofady and Ranomena). If and how this disturbance affects our variables being monitored is under investigation. The goal of TEAM monitoring is to be able to detect changes to the biodiversity, so it can be used for guiding conservation action and setting up an early alarm system on its status for better management actions.



Centre ValBio continues to inform Madagascar National Park's Ranomafana office upon any indication of anthropogenic disturbance and work closely with both MNP and the gendarme in patrolling, monitoring and educational components. However, the simultaneous and continuous annual monitoring of vegetation and terrestrial vertebrates to detect any influence new, increasing or prolonged anthropogenic disturbance will be invaluable.

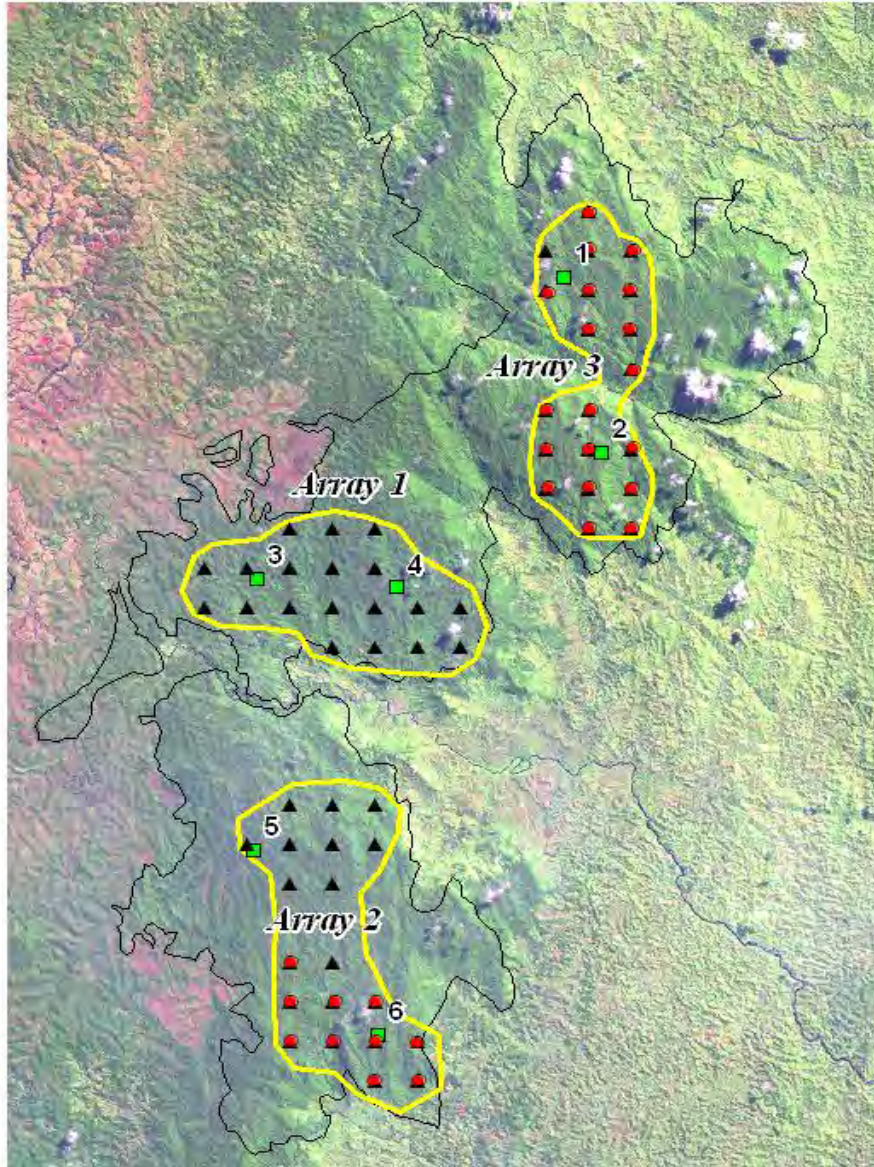


Figure 3: TEAM sampling points for vegetation and terrestrial vertebrate monitoring.

Participatory Ecological Monitoring

For 2015, Centre ValBio planned to target 10 villages located near sizable forest fragments in the periphery of Ranomafana National Park to be part of a Participatory Ecological Monitoring (PEM) program. In PEM, villagers are trained in doing observations of plants and animals in their forests and patrolling for pressures in the forest. The targeted villages were chosen based on the presence of forest fragments belonging to the communities traditionally and they are interested in assistance with protecting these areas to be managed as a community based association (COBA). The goal is to invest and empower local communities to manage their forests and be active in monitoring the biodiversity and pressures in these fragments.

Centre ValBio supported the reconnaissance expeditions to have baseline data as part of the GIS training component and project development. Research funding is necessary to continue these important baseline assessments and long-term monitoring within fragments and with village communities surrounding the park.

Finnish Association for Nature Conservation (FANC)

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The Manondroala project has been collaborating with Centre ValBio, Madagascar National Parks and local guides from the community to work on vegetation classification of Ranomafana National Park and its surrounding area. Basically, local partners are responsible for visiting pre-determined locations to map and classify habitat types. Data collected are sent to GIS specialist working with FANC to produce more accurate maps throughout Madagascar. Since most of the field mapping and classifications was done in previous year, In 2015 FANC brought the final version of vegetation classification map for Ranomafana. The mapping project collaborating with FANC is expected to continue for the next few years.



Ranomafana North



- Andranomafana
 - RAN026062009_170_793RFCLASS05
 - MLclosed/shadows
 - MLclosed/lowland
 - MLsparse/lowland
 - MLriparian
 - SLmixedwith ML
 - SLeven/structure
 - SLsparse/light
 - Treeless/Savoka
 - Treeless/mixed
 - Plantation/Eucalpure
 - Plantation/Eucmixed
 - Plantation/mixed(and ravenala treeless)
 - Plantation/Fruits/Ravenala
 - Non-forests/Tavi
 - Non-forests/Ramarasana
 - Non-forests/Rano
 - Non-forests/Rice
 - Non-forests/Fields
 - Non-forests/Infra
 - Non-forests/Bare soils
 - Non-forests/Rurungas
 - Cloud/Shadow
- 0 1 km



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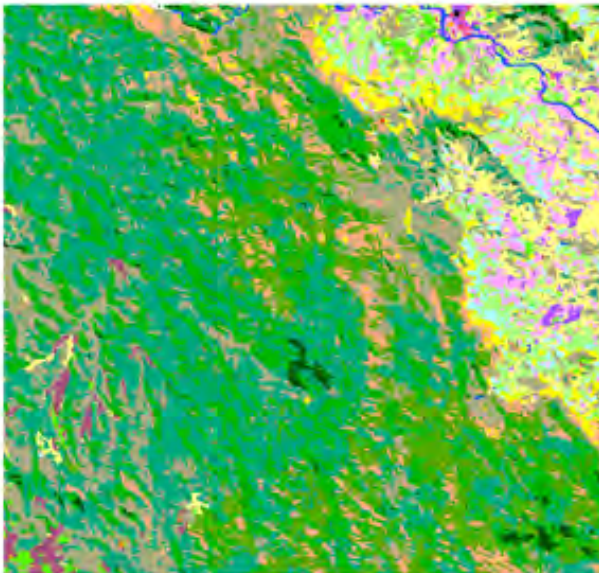
Figure 4: Vegetation classification in the north of RNP



Ranomafana South



- Andranomafana
 - RAN026062009_170_393RFCLASS05
 - MLclosed/shadows
 - MLclosed/lowland
 - MLsparse/lowland
 - MLriparian
 - SLmixedwith ML
 - SLeven/structure
 - SLsparse/light
 - Treeless/Savoka
 - Treeless/mixed
 - Plantation/Eucalpure
 - Plantation/Eucmixed
 - Plantation/mixed(and ravenala treeless)
 - Plantation/Fruits/Ravenala
 - Non-forests/Tavi
 - Non-forests/Ramarasana
 - Non-forests/Rano
 - Non-forests/Rice
 - Non-forests/Fields
 - Non-forests/Infra
 - Non-forests/Bare soils
 - Non-forests/Rurungas
 - Cloud/Shadow
- 0 1 km



15

Figure 5: Vegetation classification in the South of RNP

Ambatolahy dimy Land Acquisition

For 2015, we continued to formalize the purchase a portion of unprotected forest in Ambatolahydimy, located between Centre ValBio’s upper campus, the periphery of RNP’s northern parcel of the park, and the village of Ambatolahy. In a continued collaboration with the local communities owning the land, we mapped the independent parcels of individual land (18 parcels, from 15 individual land owners) that includes a total area of 17.2832 hectares.



Figure 6: Map of Amatolahydimy land acquisition

In 2014 we had meetings with the person responsible for deeds and topography in Mananjary, and we formalized the size and initial paperwork submission towards moving through with the purchase. Unfortunately, in 2015 we had to delay the 6 additional steps in the paperwork due to changes in the laws. In the meantime, the local landowners have been involved in the process and provided the individual parcel measurements.

LABORATORIES

COMPUTER and GIS LABORATORY

Biodiversity database structure

Centre ValBio is in the process of constructing a long-term set of databases to enhance facility and personnel management, administrative needs, visitor resources, and provide comprehensive access to more than two decades of biodiversity, climate, and human socioecological/economic data. This is a major undertaking that will require considerable investment in the next couple of years. The loss of John Cadle this year impeded our progress.

GIS software and training Centre ValBio played a central role in GIS Day in Manakara, led by National Director, Pascal Rabeson.

Centre ValBio applied for and was awarded an ArcGIS license to be used for mapping and was provided a laptop suitable for GIS analysis for launch CVB's laboratory. This training played an important role in the improvement of CVB's GIS component. With the laptop, license and the books sent from Esri to CVB, CVB has produced maps for researchers and students for their work, as well as to give training for our staff and other people in the region of Vatovavy Fitovinany.

CLEAN LABORATORY

Centre ValBio's laboratories saw extensive use in 2015 by three Study Abroad classes (two from Stony Brook University, and one from the University of Helsinki); an infectious disease team led by Thomas Gillespie of Emory University; and a mouse lemur genomics group led by Mark Krasnow of Stanford University. In addition, many individual researchers used the laboratories for biodiversity research on parasites, insects, crustaceans, snakes, and plants. Some of the major lab-related activities included the following:

Laboratory manager. In September 2015, we hired Raivo Rakotonoely as our lab manager. Raivo has a bachelor's degree in biology from the University of Antananarivo and has been working hard supporting our visiting research teams, inventorying the labs, and preparing guidelines for lab use. She visited Mitsinjo Reserve to observe the chytrid fungus lab along with Benjamin Andriamihaja and our contract, Mr. Lucien Robert to prepare for us being a focal point for chytrid in the southeast.

NSF FSML (Field Stations and Marine Labs). We submitted the final annual report for the NSF-FSML facility grant (2012-2015). We have had significant successes carried out by research teams using the Centre ValBio molecular labs. These included the successful culturing of mouse lemur fibroblast cells, successful DNA amplification, the detection of chytrid fungi in frogs from Ranomafana, and expanded use of the GIS facilities, for which one of our senior staff, Mr. Pascal Rabeson, attended month-long training sessions in the U.S. to further increase our capacity in this area.

Chytrid-alert activities. With the confirmation that chytrid fungi (an amphibian pathogen) are present in Madagascar, and in part stemming from discussions during the ACSAM2 meeting, we received a grant from IUCN AARK to build a quarantine facility at Centre ValBio. In January 2015, CVB including our laboratory manager, Rence and our Senior Scientist, John Cadle, an exploratory visit to Mitsinjo, an amphibian conservation center near Perinet National Park, with the goal of learning about their amphibian rearing facility and learning from their programs. The report is in the appendix. In September 2015 a second visit was made by our new lab manager, Raivo with the contractors, Lucien Robert and Mahefa Rakotomalala to take measurements and develop a plan for the construction (in appendix).

BIODIVERSITY LABORATORY & COLLECTIONS

Students from three study abroad classes (one from University of Helsinki, and two from Stony Brook University) used the laboratories heavily during their independent study projects, which included studies of insects, frogs and tadpoles, rodent and frog parasites, plant ecology, bats, and tenrecs. In addition, we continued our plant herbarium reference collection as part of the TEAM project.

TRAINING PROGRAMS

STUDY ABROAD PROGRAMS

Stony Brook University, Summer 2015 (began 2008)

A 6 week study abroad program took place between May 26 and July 6. The Stony Brook study abroad group was comprised of 12 students (9 from the USA and 2 from Madagascar), plus personnel: Prof. Patricia Wright (Program Director SBU Anthropology), Dr. Heidi Hutner (Resident Coordinator, SBU Sustainability) and Mr. Franck Rabenahy (Teaching Assistant). During this session, students were exposed to a large range of knowledge and experiences including Malagasy language, health, environmental education, ecosystem diversity, and research. The program included lectures, field exercises, a cross country trip, and independent projects. The focus was on endemism and invasive species of plants and animals and the unique Malagasy culture and ecosystem diversity. Students designed unique and independent research projects that covered a large spectrum of issues in Madagascar. The results of these projects were presented at the Centre ValBio in Ranomafana and American Embassy in Antananarivo. Students also wrote blogs about their weekly experiences which can be found at <http://madagascarstudyabroad.wordpress.com/>

Stony Brook University, Fall 2015 (began 1993)

A 10 week study abroad program took place between September 12 and November 22, 2015. The Stony Brook study abroad student group comprised of 16 students (14 from the USA and 2 from Madagascar). The staff included Dr. Patricia Wright (Program Director, SBU Anthropology), Jan Gogarten (Resident Coordinator, U of Berlin) and Mr. Franck Rabenahy (Teaching Assistant). Several visiting lecturers also shared their expertise ranging from geology, ornithology, entomology, herpetology, botany, environmental education, health and hygiene and

primatology. The program focused mostly on biodiversity in general, endemism, endangered and invasive species of plants and animals and the Malagasy unique culture, language and ecosystem diversity. The results of these projects were presented at CVB and at the University of Antananarivo. Students authored a blog of their weekly activities which can be found at <http://madagascarstudyabroad.wordpress.com/>

University of Helsinki, RESPECT, Fall, 2015 (began 2005)

The University of Helsinki RESPECT Program ran from November to early December. This program included 14 students (six Finnish and six Malagasy), plus two professors and 3 teaching assistants and focused training and group research projects on comparing amphibians, birds, and vegetation in pristine forests within the park compared to forest fragments in the periphery of Ranomafana National Park.

Plans for Increasing Study Abroad Enrollment and Funding

Recruitment

- On Campus

During the start of each semester, posters advertising both the summer and fall study abroad programs are displayed around campus. These posters are primarily hung in departments that we generally recruit the most students from (anthropology, biology, sustainability), as well as in common spaces such as the library, the Student Activities Center, and the Union.

ICTE staff participates in IAP-run study abroad fairs throughout the semester. During these events, at least one staff member and one former study abroad student are present to attract students to the program and answer questions. In addition, we run our own information sessions during the semester (3-4 sessions per semester). All Stony Brook students are invited to these events via email. During these info sessions, an ICTE staff member gives a presentation on the program, followed by a question and answer session. Former study abroad students also attend these sessions to share their experiences with prospective students.

During the first week of classes, an ICTE staff member visits some classes to give a short presentation on the study abroad program and hand out fliers. Targeted classes include anthropology (ANP 120, ANP 200, ANP 201, ANP 325, and ANT 102), biology (BIO 201, BIO 202, BIO 203), and other environmentally focused classes (e.g. ECO 373, ENS 301). These sessions expose a large number of students in relevant majors to the program and allow them to ask questions and gain more information.

Leading up to the application deadline, email blasts are sent to students in anthropology, biology, and sustainability to alert students to the approaching deadline and encourage them to complete their applications. These emails include a description of the program, the courses, and the campus (Centre ValBio), as well as pictures on an attached flier.

ICTE offices are open 9-5 Monday through Friday, and a staff member is on hand during these times to meet with interested students. We are also available via email and answer many inquiries at all hours of the day.

- Off Campus

ICTE maintains a list of emails for study abroad offices at schools from which we have had students in the past. At the start of each semester, we contact these offices with a description of the program and attached fliers. We ask for assistance in promoting the Madagascar study abroad program at these schools. If the school is willing to display our materials at a study abroad fair, we request former study abroad participants that may still be students to attend the fair and promote the program.

Future Goals

- New Programs

In addition to the current fall and summer semesters, we plan to increase the number of available study abroad programs to include a winter session and a spring semester. The winter session program will be for three weeks during the Stony Brook winter session, and is an internship called Experiential Learning, which we hope to begin in winter 2016. This program will attract students who cannot dedicate the time to a full semester program, as well as students with interests outside of anthropology.

The new spring semester program will focus on sustainability studies in Madagascar. This program will offer courses relevant for students with majors the growing Sustainability department at Stony Brook, as well as other departments across the country. We will be working with Dr. Heidi Hutner of Stony Brook to develop this program for Spring 2017.



Sustainable Development Projects

The Conservation Education & Outreach (CE&O) Department works within the context of poverty, population growth, low education, unsustainable agricultural practices (tavy or slash & burn agriculture) and natural resource exploitation (subsistence hunting & harvesting) within villages surrounding Ranomafana National Park (RNP). Through the years, conservation priorities for the surrounding community have been identified as sustainable activities for poverty alleviation, medical diagnostics, treatment and prevention of common diseases, forest protection and reforestation and promoting the value of the forest and biodiversity. Our program includes both an education component (biodiversity & conservation, reforestation, health and hygiene) as well as a practical component (conservation clubs, reforestation techniques, improved agricultural techniques, sanitation and nutritional techniques and medical diagnostics, prevention and basic treatment).

CONSERVATION EDUCATION

New Education Grant: The Three Graces Foundation, My Rainforest, My World

In September 2015 a new grant was awarded from the Three Graces Foundation for \$100,000 a year for three years. This project targets ten remote schools to teach fourth graders critical thinking and participatory science. For sustainability we collaborated from the Fianarantsoa Teaching College and selected 10 student teachers to work with the 10 state-funded teachers to enact this program. The first workshop was held in October with 10 local school teachers, 10 Fianarantsoa student teachers, the CVB education team, the manager of the project Lova Razafindravony, the local school district officials and four fourth grade science teaching experts from the USA. These experts were from Oakland Park Zoo (Melinda Shutler, Dan Flynn), Chadwick Elementary School, LA, (Ann Bleidenburg), Rochester Elementary School (Rebecca Vigdor) and South Fork Natural History Museum (Nicole Cummings). These science experts had their airfares paid for by their home institutions and their home institutions donated many supplies and materials for the children taking these courses. A curriculum was developed for Term I on biodiversity science. Alain Rasolo produced art work for the project including a Lemurs of Ranomafana Poster. (see appendix My Rainforest, My World Term I Report). CVB education department assisted with this new endeavor.

CVB CONSERVATION EDUCATION TEAM 2015

CVB Conservation Education Department targets 46 communities at various levels including school children and educators, youth (post-school teenagers) and adults. This is accomplished through school programs (34), conservation clubs (20) and households. For 2015, we reached over 10,000 local members of the community surrounding Ranomafana National Park in our conservation education and outreach efforts through our various programs. This year we initiated critical thinking and participative science for fourth graders (My Rainforest, My World Project

Centre ValBio's Target Schools and School Population

During the school year 2014/2015, Centre ValBio worked with **34** schools (22 accessible by road and 12 offroad, remote schools) with **3232** schoolchildren (1577 boys, 1655 girls), **225** teachers, and **3,523** parents. In a more concerted effort to reach unprivileged schools in 2014, we continued with our 22 'road' schools. The My Rainforest, My World project began to reach out to **10** remote villages and **195** fourth graders in October to December.



CVB Education Team coordinator Florent Ravoavy, CVB Education team leader Lovasoa Razafindravony, CVB Administrative Coordinator Prisca Andriambintsoa, CVB National Director Pascal Rabeson, and Dr. Patricia Wright.

School Rainforest and Reforestation Classes

Rainforest and reforestation classes for the 22 off-road schools was scheduled at least once a month during the 2014-2015 academic year.

- Visits of the botanical gardens and school arboreta as learning sites were conducted. Schoolchildren participated on maintaining school arboreta and botanical gardens New environmental posters on lemurs, reptiles and amphibians, and a map of Madagascar forest habitats were developed with the My Rainforest, My World project and will be distributed in 2016

School Health & Hygiene Education

Members of Centre ValBio's health team paired up with our classroom education program to promote nutritional and sanitation education targeting school aged children. Our education team had found students with poor nutritional conditions less interactive in the school programs. Our H&H team followed-up on promoting the vegetable garden program that had been established in several schools as an opportunity for enhanced nutrition for the students. Themes incorporated into the classroom sessions were techniques and understanding sanitary practices, construction of hygienic infrastructure (latrine, shower and garbage pits), the use of sanitation infrastructure and practices in daily routines both at school and at home, improving the cleanliness of the

environment surrounding the schools and villages, livestock management, food and water sanitation, suggestions for nutritional improvements and malaria awareness and prevention.

Youth-Based Conservation Clubs

- Due to the overall low educational level of members of Ranomafana's rural communities, many youth are not targeted in Centre ValBio's school programs. CVB's CE&O also targets previously neglected groups (illiterate and poorly-educated adolescents and young adults) in our effort to reduce negative impacts on the national park and its peripheral zone by converting these young members of society from being environmental destroyers to environmental advocates. CVB currently has **20** Conservation Clubs (CCs) with **481** members in the villages surrounding Ranomafana National Park. CC members are encouraged to become friends of nature and advocates for the environment and sustainable development.
- *Art & Culture* (A&C) - Creating new bands for cultural performances is also part of the Conservation Club program to help them maintain their own cultural development leading them to be initiated on cultural tourism combined with agricultural tourism, since CVB started to bring students in the villages through its Study Abroad program.
- Centre ValBio's Agricultural Development Agents (ADD) are busy throughout the year providing training and follow-up on sustainable agricultural techniques, reforestation with endemic trees, seed bank management, vegetable gardens and compost-based fertilizers.

Support for Community Development Programs

CVB Board member Susan Cummings-Findel visited in November, 2015 at which time she. And the CVB EE staff went to Vohiparara to check on the death of all the pigs and piglets purchased last year. Susan was pleased with the progress of the Ambatovaky Blacksmith project. The ecoshop has been inaugurated, a fresco has been painted on the outside of the building, large painted sign are up to attract tourists. The store is well stocked and the village women are taking money and writing receipts. The store has regular hours when it is opened and the products inside are selling well.

Waste Management & Compost

Centre ValBio has promoted cleaning sanitation throughout its target villages and schools. Villagers are encouraged to clean up their own household and surrounding environment in an effort to reduce the likelihood of attracting rodents and fleas that increase the prevalence of disease. The biodegradable items are turned into compost and available to the local community and also used for Centre ValBio's endemic saplings, vegetable and flower garden demonstration sites as well as school, conservation club and village plots. Kianja Maitso's waste management center had receives over 2,000 wheelbarrows full of material that need to be sorted. The commune has identified a large-scale garbage management site and produced a preliminary budget has been made, including necessary transport since the location is in Morafeno village.

For 2015, in collaboration with Madagascar National Parks and the Seneca Park Zoo, once again we were able to support the Ambatolahy primary schoolchildren and teachers to visit Ranomafana National Park. In addition to the forest visit, in which they learn about the interrelationship of biodiversity and the environment, members of each of the groups were given an educational tour of Centre ValBio's campus and provided lunch. These students have also been part of a Saturday Program working in the tree nursery and transplantation of endemic saplings in and around Ambatolahy village and come to Centre ValBio about once a month as part of our environmental audio-visual program. We hope to continue to enable more of the schools, clubs and villagers to visit Ranomafana National Park, especially targeting those programs that both excel academically or in promoting our outreach efforts as well as those who have yet to visit the park to fully understand its beauty and value.

REFORESTATION & RESTORATION

Seed Collection, Planting and Germination

Through our knowledge of local fruiting cycles of endemic tree species, we target seed collection from multiple parent trees for multiple species throughout the year. During 2015, we collected over 5,000 individual seeds from 10 families, 12 genera and 14 different species shown below. Collected seeds are then prepared and sown at Centre ValBio's upper campus tree nurse

Communal Reforestation

We have been promoting reforestation and restoration through endemic saplings (for biodiversity), fast-growing endemics (for communities to use as an alternative to invasive species for construction purposes and beehives) and fruit trees (as a nutritional and economic resource) in an effort to continue to green the periphery of Ranomafana National Park. Our future plans are to continue restoration ecology along rivers and to plant cash crops such as vanilla, pepper, chocolate and coffee underneath the canopy of this growing forest. If the forests are producing a good income this will be strong incentive not to burn the forest. For example coffee sells for 4,000 Ar a kilo, and vanilla 50,000 a kilo and bananas 800 Ar a kilo.

In 2015 Catholic Relief Service (funded under the USAID Food and Security program) subcontracted Centre ValBio to reforest areas near Ifanadiana. A proposal was funded for \$120,000 to begin in January, 2016.

MOBILE HEALTH CLINIC

In general, the remote populations surrounding Ranomafana National Park still have a lack of access to healthcare, money, hygiene, education, and diversification of livelihoods. Most depend on cultivation for mere subsistence, which is hard physical work done with little to no tools or equipment. While the addition of PIVOT to the communities of Ranomafana and Ifanadiana have improved the basic clinics and the district hospital and added ambulances to the community, the remote off-road villages continue to have Paleolithic health care.

Goals:

The goals of the mobile health team are to:

1. Improve the health of rural villages within the periphery of Ranomafana National Park
2. Promote a way of life that is compatible with improving health within the social context of rural villagers with little education
3. Gather important demographic and diagnostic data that can lead to improvements and advances in infectious disease research.

Activities

CVB's core activities involve visits to the villages in the periphery of the park to:

1. Conduct free consultations and provide primary and urgent care
2. Gather demographic, diagnostic, and hygiene related data
3. Educate the villagers within their social context to promote better hygiene and more favorable habits to reinforce disease prevention and improved health
4. Family planning

Location of Mobile Health Outreach

Criteria for choosing villages:

- Villages within the periphery of Ranomafana National Park (RNP)
- Villages (remote locations) with difficult access to community health centers (at least 3 hours by foot to the nearest CSB (community health center))
- Villages that are critical in sustaining the preservation of RNP's biodiversity

For 2015, we targeted a total of 4 zones, conducting expeditions 17 days per month, to provide consultations and education programs to 5 villages in each zone (for a total of 20 villages) for 3 consecutive days in each village twice a year. The closest villages are 3 hours by foot and the furthest 12 hours by foot.

The **20** target villages in 2015 included **8,251** individuals from 3 communes.

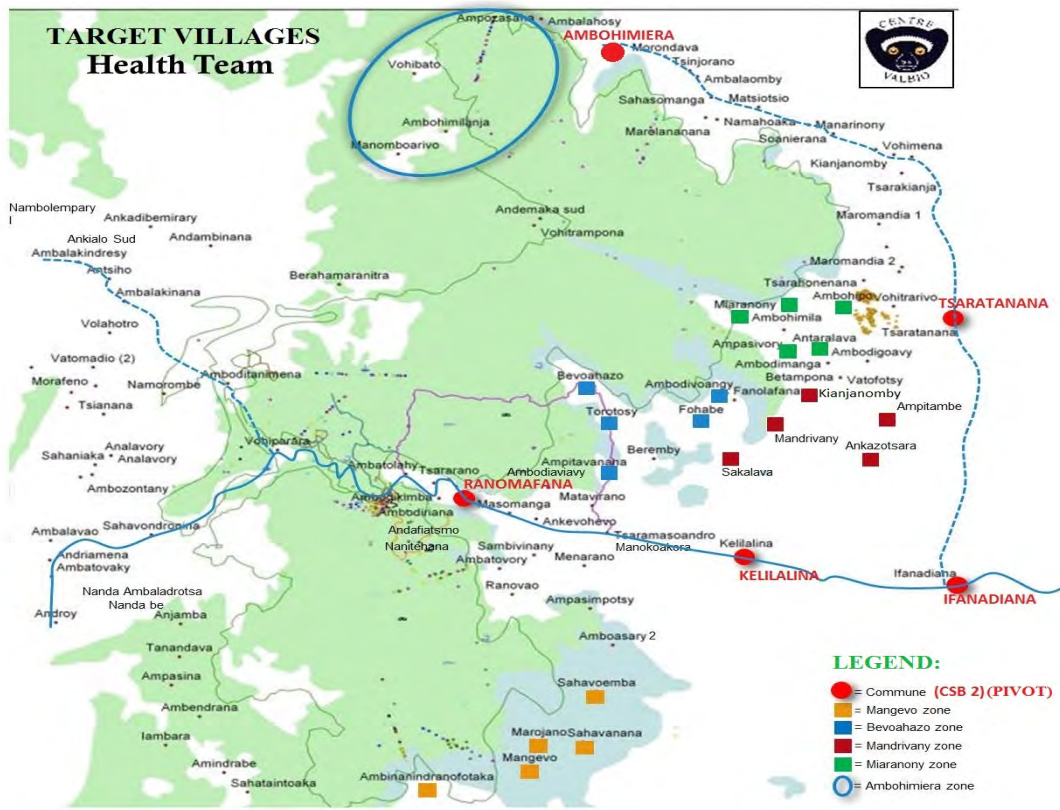


Figure 7: Target villages for the CVB mobile health team

Over the course of 2014-2015, Centre ValBio’s health team conducted nearly 4,000 consultations for rural villagers surrounding Ranomafana National Park. During these consultations, 13 illnesses were the most commonly diagnosed and comprised of over 70% of the illnesses. Osteo-articular related illness respiratory illness, malaria and flu/cold. Consultations are conducted twice a year, in an effort to sample different seasons that could influence our representation of illnesses. Continued presence and offering healthcare bi-annually and forming long-term relationships with these community members has improved villagers trust in us and we know that we will continue to gain a greater understanding of disease prevalence in these rural areas.

Our midwife, in particular, was proactive in helping during remote childrearing. In fact, she delivered several infants in these remote villages, especially when their mothers were experiencing difficult deliveries. During these visits, advice is provided for troubleshooting during birth complications with traditional birth assistants. In addition, these traditional relay groups are encouraged to advise pregnant mothers to seek pre-natal care and post-natal vaccinations available through the community health centers.



CVB Health Team providing critical care and education on hygiene, disease prevention, and improved health for communities bordering Ranomafana National Park.

Voluntary Health Agents (AVS)

Our health team has 50 villages to visit throughout the year and therefore rely heavily on local voluntary health agents (AVS or AC – agent communautaire) located permanently within each of our target villages that are trained in basic healthcare and dispensing of common medicines. The AVS are an important relay group for our health team between and during site visits. The 50 AVS (1 per village) follow-up on health education and outreach activities within their respective villages.

Health & Hygiene Education & Outreach

One of our main objectives is to educate people on practices that will improve the well being of the population so they can participate in the conservation of the environment, for which their livelihoods depend. We hope they will incorporate good practices of health and hygiene in their daily lives. Our efforts focus on the prevention of diseases while simultaneously adapting these themes to social contexts via our consultations and data collection. We aim to reduce unnecessary and easily preventable deaths by reducing exposure to pathogens. The themes we use depend on the social context according to the data collected, the consultations made and common diseases diagnosed; however the general topics addressed are:

- *Hygiene:* Poor hygiene is the cause of most infectious diseases found; thus, improvement in hygienic behavior (personal hygiene, clean clothing, clean and nutritiously balanced foods, hygiene of the village environment) and promotion of hygienic infrastructure and practices (latrines, showers, garbage pits) are proven steps towards disease prevention. While collecting demographic data during village visits, we found that very few households had hygiene infrastructure

(latrines, etc.) thus this will continue to be an important component in our health outreach.

- *Prevention of common diseases:* The most common diseases are related to lifestyle and bad habits; thus, education towards behavioral change and promoting items such as mosquito nets, etc. can greatly reduce the incidence of disease.
- *Annual themes, especially Family Planning:* On average, a woman of 25 years typically gives birth to 5 children and many rural villagers have misconceptions about the benefits of waiting to conceive, spacing births (for both maternal and infant nutritional improvement) and readily and freely available options to space births to improve maternal and children's health.

As part of CVB's mission, we have sought to improve the health of remote villagers surrounding Ranomafana National Park. CVB's mobile health team is an important component in achieving this goal and ultimately maintaining healthy people and a healthy environment. Our mobile health team brings critical care and outreach to remote populations of villagers that would otherwise have no access to healthcare, while also collecting data that contributes to a greater understanding of tropical diseases and avenues of prevention. Our mobile health team is critical for gaining important health related data, delivering basic and emergency healthcare that would otherwise be unavailable, and promoting rural communities to utilize community health centers when possible. For 2016, we will continue to work closely with our new health NGO partner, PIVOT, Marie Stopes Inc., and the Ministry of Health in a communal goal to improve the livelihoods of villagers in the periphery of the park.

PARTNERSHIPS

COMMUNE OF RANOMAFANA

Centre ValBio continued to work closely with the Commune of Ranomafana in collaboration on a diversity of projects, events, and community support. In particular, the mayor's support for moving forward with negotiations for acquiring electricity for Ambatolahy was crucial and the commune given partial funding towards this endeavor. World Lemur week and festivities held in Ranomafana village was also an important opportunity to highlight the importance of Ranomafana's special biodiversity to the local community and livelihoods. With the facilitation of the mayor of Ranomafana, Centre ValBio provided emergency assistance to the village of Torotosy, after they experienced a bandit raid when 200 head of cattle, food and possessions were stolen.

MADAGASCAR NATIONAL PARKS

As scientific and technical partner of Madagascar National Parks, Centre ValBio (CVB) and MNP have regular monthly meeting the first Tuesday of every month. Many different subjects are discussed during the meeting such as writing information in the brochure for tourists by MNP, the use of the old research cabin in Talatakely, the news from the monitoring of biodiversity in the Park (*Prolemur simus* for example), program of researchers, security issues especially related to disturbances in the park such as intruders

to the Park for gold mining. Beside the regular meetings, MNP and Centre ValBio call for a meeting when there are urgent issues to be solved immediately.

MNP and CVB collaborate in many domains. The Director of the Park gave lectures on conservation and management of the Park for the three Study Abroad programs. MNP have been attending actively conferences or workshops held at CVB such as the workshop led by Finnish Association for Nature Conservancy (FANC) presenting the map of vegetation classification of Ranomafana area at CVB and discussing use of drones in Conservation.

Joint activities

Joint activities were conducted by MNP and CVB when needed whether working in the field or participating in other events organized by partners outside Ranomafana. MNP and CVB and Region of Vatovavy Fitovinany worked together to combat fires around Ranomafana National Park. For data collecting in the field with the Tropical Ecosystem Assessment and Monitoring (TEAM), MNP agents join CVB team for the fieldwork on vegetation and camera trap with vertebrates.

Interpretation Center Launch 2015

Consultants asked CVB to take a leading role in our partnership and continue promoting research, conservation education and health outreach surrounding the park.. In 2015 MNP inaugurated a new interpretation center funded by World Bank. CVB assisted in planning and creation of several of the biodiversity, cultural and conservation displays. CVB also contributed to the furniture of the assembly hall with chairs, benches and a table. Noel Rowe, CVB Board member, donated his photos of lemurs for the walls of the assembly room.

FIMARA AND AMPANJAKA

Traditional leaders and healers have been partners of Centre ValBio since 2004 during the project of drug discovery and economic development working with the National Institute of Health: International Cooperative Biodiversity Group (NIH-ICBG, U.S.) in Ranomafana. After the project was completed, Centre ValBio, the traditional leader and healers continued collaborating on other projects such cultivating medicinal plants, plants for essential oil (Ravintsara and Geranium), maintaining the plantation of medicinal plants at Mahatsarabe, and selling medicinal plant product including Homeopharma products at the store “Pharmacie Verte” or green pharmacy.

MAHATSARABE AND THE ESSENTIAL OILS PROJECT

The 3 ha medicinal plant site in Mahatsarabe belonging to the associations of Ampanjaka (traditional kings) and traditional healers include the plantation of medicinal plants, essential oil plants (Ravintsara and Geranium), in a form of botanical garden where visitors come to know more about medicinal plants and traditional healing in

Ranomafana. Visitors are composed by groups of national or international students, local and international tourists. The cultivated Ravintsara in 5 villages in 1 to 2 ha were grown and ready to be harvested to be extracted as essential oil. Now is the sixth year for the cultivation.

This year the Mahatsarabe association asked the community and Centre ValBio to buy a steam distillation machine to produce essential oils to sell. Dana Cutolo, an SBU study abroad alumnae, who has a small botanical lotions NGO based in NYC called Nyala, was an advisor to this project. Trey Murphy, a study abroad student also, invested in buying the steam distillation machine with the advice from Dana that the essential oils produced are very high quality. A liter of Ravensara or Geranium is sold by the Farmer Cooperative to the Buyer for \$250. One liter can be produced each day. Both Centre ValBio and Trey Murphy are first investors in this project. Plans are for Dana Cutolo to buy the essential oils to use in her products sold in NY.

PIVOT COLLABORATION

2015 marked a year of expansion for PIVOT. While Centre ValBio's mobile health team continues to bring mobile health diagnostics, treatment and prevention to the remote rural communities surrounding Ranomafana National Park, PIVOT reinforced and refurbished the public Ministry run health centers. PIVOT's staff is now almost 100 with a fleet of cars and ambulances and construction of office space. After the PIVOT board meeting in New York City in December, 2015, it was decided that the relationship between health and the environment should be strengthened and the two organizations should collaborate on this goal, in both getting funds and accomplishing this project. Pivot board members, Drs. Thomas Gillespie and Benjamin Andriamihaja, initiated an internal review of opportunities for Pivot at the environmental interface in February 2016.

U.S. EMBASSY COLLABORATION

Centre ValBio continues to receive support and encouragement from the U.S. Embassy. The US Ambassador, Robert Yamate, the Country Director of USAID, Susan Riley, and, USAID head of Mikolo (health), John Yanulis visited Centre ValBio in July. We finalized our recording studio in Namanabe Hall, and the US Ambassador inaugurated the recording studio in July, 2015. The U.S. Embassy also supported several billboards promoting Centre ValBio and Madagascar National Parks that have been placed along the national road. In addition, as part of our continued 'Artist & Environment' project,

ART & ENVIRONMENT PROGRAM

Centre ValBio continues to promote environmental conservation and sustainable development through the arts. For 2015, we continued to work with our local handicraft and musician groups as well as hosted national and international artists.

Handicrafts
FAMIOVA



FAMIOVA, our local women's textile weaving cooperative, continued to remain relatively independent, proactive as a successful small business, and productive for 2015.

MAEVA

Centre ValBio continued to provide MAEVA with assistance and technical support, also marketing their unique and well made basketry products.

Centre ValBio's board member, Mrs. Susan Findel (Sunshine Comes First, Ltd.) visited with MAEVA along with Centre ValBio's team for a meeting in Sahavondronina for meeting with the MAEVA association. In general, MAEVA felt that everything has been going well for the association, although they need a more accessible and obvious sales location to market their products.

Association Soa Fianarana (ASF)



We also continued supporting ASF during 2015. The group leader, Florine, continues to be an inspiration and they have been most successful in their production of unique

embroidered biodiversity products and still continue to work with the local recycling art initiative turning plastic bags into purses, belts and jewelry.

Ambatovaky Ironworkers

As part of an artistical trail under development, Centre ValBio started to promote visits and some support to an association of ironworkers in Ambatovaky (along the national road between Fianarantsoa and Ranomafana). The association primarily produces high-quality agricultural tools (e.g., shovels) and the process for which they do this is worth a visit. The association constructed a new demonstration site and sales point along the road to promote Ambatovaky and its handicrafts as a tourist destination. Our CVB artist, Alain Rasolo, painted the entrance to the shop, as well as large, colorful signs to attract tourists. Diane Powers and Alain developed a tourist trail brochure to attract tourists. MNP collaborated in the inauguration of this Eco-shop in November.

Centre ValBio's Eco-shop

Centre ValBio's eco-shop promotes and sells products (both purchased and on consignment) from artist groups from Antananarivo, including Alexandrine (woven vetiver products), Nannie (metal sculptures), and Onja (embroidery and stuffed animals). Showcasing the local artists products, in particular, has been an important training for them to understand interest, design as well as functionality of products, for foreign markets. In 2015 our ecoshop increased the number of items sold, and added tourist guides to Madagascar and For the Love of Lemurs book by Patricia Wright.

MUSICIANS

Local Musician Monthly Workshops & Performances (2015)

With some continued support from the U.S. Embassy as part of our Artists and Environment collaboration, Centre ValBio continues to support workshops, exchanges, and performances with collaborating local artists from the periphery of Ranomafana National Park. The five groups have seen great personal and professional growth. Centre ValBio continued local artist performances geared towards the tourist community. This was one way to give tourists additional entertainment while visiting Ranomafana as well as the opportunity to experience more of the local culture through music and dance. This is also an important venue to convey cultural preservation and environmental protection to the local and national community.

PROJECT AND COLLABORATION DEVELOPMENT

Ambatolahy dimy Land Acquisition

During the past year Pascal Rabeson and Patricia Wright have continued to work with 17 landholders from Ambatolahy who own land at Ambatolahy dimy. These 17 plots of land

are adjacent to our Centre ValBio property on the north side of the road. Pascal has been working with the Office of Land Deeds to assure that everything is legal about the purchase. We are optimistic that the ownership of the 17 hectares will be officially transferred to Centre ValBio/MICET in 2016.

Ambatolahy Village (Ranomafana Commune) Electricity Project

Ambatolahy fokontony has been one of the first villages to work with the Dr. Wright, however, are still among the nearby villages without electricity, despite power lines running over their heads. Dr. Stacey Tecot (University of Arizona) and Patricia Wright (SBU) raised the funds to pay for the electricity, but JIRAMA (the electric company) has delayed installation until 2016.

Northern Forest Monitoring and Assessment

One of CVB's new priority areas is a 10,000 hectare unprotected forest just north of RNP. This area is still under intense pressure from mineral mining (rubies), gold mining, and slash-and-burn agriculture. In late 2014, two fragments within this forest parcel were officially transferred as COFAV's (community run areas) with the assistance of the District water and forest office and Conservation International. The District water and forest office has asked Centre ValBio to continue our work in this area but because of security issues (bandits), our work in this region was curtailed for 2015.

Torotosy Relief Efforts

One of Centre ValBio's conservation education outreach villages, Torotosy that is located in the northeast periphery of the park was attacked by bandits in mid-November. One hundred armed bandits entered the village and stole over 200 head of cattle, rice, clothing and cooking pots. The village residents fled. Our "My Rainforest, My World" student teacher locked the door of the school and hid under a table. When the bandits broke into the school, she popped up from under the table and said, "Don't kill me, I am a schoolteacher." Luckily the bandits moved out of the school without harming her. No one was injured or killed in this raid, but 200 households were destitute. Centre ValBio immediately provided rice and clothing for these village residents. The student teacher returned to the school to teach two weeks after evacuation.

We assessed the major needs for relief efforts with the local leader, commune of Ranomafana and PIVOT. In addition, Centre ValBio will continue to work with the villagers with our mobile health clinic and conservation education outreach and brainstorm about alternatives sources of revenue to small scale gold mining to ensure future security and livelihoods.

SCIENTIFIC TOURISM

Centre ValBio's Scientific Tourism Program continued in 2015. CVB promoted 'Scientific Tourism' by offering more diverse activities in collaboration with both

national and international tour agencies as well as by word of mouth. Centre ValBio formed collaborations with both National Tour Agencies (Dodo Travel, Madagascar Chameleon, Madagascar Grace Tours, Remote River Expeditions, Tamana Tours, Trans Continent, Wilderness Travel, and Za Tours) as well as International Tour Agencies (Sierra Club and Wildlife Worldwide). Through our various activities, Centre ValBio generated almost 5,000 in revenue through visit fees, lectures, meals, and program and lodging fees.

Scientific Tourist programs varied from one activity for one hour (e.g., tour or lecture) to several activities over the course of a week. In addition to biodiversity and conservation lectures and tours of Namanabe Hall, Centre ValBio also offered diversified options for half, full and multi-day programs. Additional programs included reforestation sessions, which included learning about native tree reforestation efforts, sowing seeds in our campus tree nursery, and planting saplings to promote tourist involvement in contributing to greening Madagascar. Centre ValBio staff also guided tours to visit our local handicraft groups, the medicinal plant plantation in town (Mahatsarabe), and the arboretum. Longer programs also included participation in biodiversity research on lemurs, in particular, as well as visits to our conservation projects in villages around the park. Julie Watts was an example of a scientific tourist who worked with us for over a month.

Opening our doors to tourism is an avenue for income generation and publicity for Centre ValBio. 2015 proved that continuing to expand this type of service holds great potential for interest and income generation. From our experience, these visits can also stem into continued interest and support for our programs.

FILM AND TELEVISION

CNN Part's Unknown

On May 8, 2015, the Parts Unknown television show filmed in 2014 with Anthony Bourdain, Darren Aronofsky and Patricia Wright was aired.

National Geographic Program

Ben Mirin, the beatboxer from Brooklyn, who features lemurs in his recordings was featured in National Geographic on line.

Film Star Visit

Jane Alexander, Oscar nominated actress, and conservationist visited CVB with her two grandchildren.



SPECIAL EVENTS

World Lemur Week

A major event of this year was participating in World Lemur Week in Ranomafana on October 31, 2015. Different activities were organized jointly between CVB and other partners in Ranomafana including the Commune of Ranomafana and Madagascar National Parks to celebrate this day with festivals, debates, sports, performances by local artists, biodiversity films, and closing with a dance the last evening in the town hall.

International GIS Day Celebration

Following the GIS training in the U.S., Centre ValBio applied for membership as an institutional partner in the national Society for Conservation in GIS (SCGIS). As part of the SCGIS national Malagasy chapter and the fellowship responsibilities, Centre ValBio led in organizing the second national GIS day celebration held on November 28, 2015 in Manakara. The workshop brought together several organizations utilizing GIS techniques and presented the utility of this work via oral presentations and posters.

CONFERENCES, TRAININGS & WORKSHOPS

Workshops Held At Centre Valbio During 2015

My Rainforest, My World conservation science education workshop held October 1-6 with Oakland Zoo, Chadwick School, Los Angeles, Rochester Middle School, and South Fork Nature Center Experts as well as fourth grade teachers and assistant teachers from 10 villages surrounding the park.

Reinforcement of security in Ranomafana, Centre ValBio, Madagascar, November 2015: PIVOT, MNP, Commune, Gendarme, Deputy about gold mining and banditry.

Signing of the Accord of Collaboration with the University of Fianarantsoa, Centre ValBio, Madagascar, November, 2015: University of Fianarantsoa Professors from the Department of Sciences, Drs. Patricia Wright, and Jean Claude Razafimahamadison.

Construction & Information Technology

Construction

In July Centre ValBio received a Lichtenstein Foundation grant which included renovation of the kitchen and office space in LovaBe Hall. The Contractor Lucien Robert was hired and the floor plans are below. The dining hall will extend out at the west wing, and the kitchen is being renovated and equipped with modern appliances. Below the dining room extension will be offices including a conference room, a health station (quarantine bed for sick people) and more desks for staff. The storage shed in the driveway will be extended as part of this construction plan.

Information Technology

Linking CVB to the rest of the world is important to its growth as a research campus. CVB's microwave based network connection has proven invaluable for research and administrative purposes. It has also been a major attractant for secondary programs that help fund CVB such as conferences, events, media crews, and visitors / scientific tourists.

High Speed Internet Overview of IT and Technology

Over the course of 2015 CVB IT has completed a number of key milestones in its cyber infrastructure plan. We have moved all CVB network users to a more secure login system. This year we created and are rolling out access to new network resources to streamline operations such as an internal Wiki based information repository, an internal webserver, and a new file server system. We have replaced and upgraded over 20 computers across the campus. Additionally we have introduced new technology to CVB including it's first (and soon much larger second) 3d printer enabling CVB to not only better serve the needs of existing researchers, but create entirely new research synergies.

However, 2015 was not without its deficiencies. CVB's erratic power continues to cause major issues with technology both with IT infrastructure and elsewhere such as in the CVB labs. This has caused over \$7000 in damages to CVB IT infrastructure over 2015. In addition we still faces major issues with our current internet connection which operates at about 0.5-10% its guaranteed "minimum" speed and suffers from fairly regular outages. The internet is expensive, costing \$2000 a month. It is fortunate that we received the Lichtenstein Foundation grant which provided for maintenance and repair for our internet for at least one year.

We expect 2016 to be a very excellent year for CVB's technology department. The main theme for our 2016 agenda is "Structural Reinforcement" addressing some of the long term infrastructure issues such as the power and internet connection. We will also be working on structurally reinforcing our finances and trying to secure long term funding to keep CVB's technology infrastructure second to none in Africa. Additionally to our thematic goals, our conference facilities which traditionally generate a fair amount of income for CVB, will be augmented by two additional conference rooms funded by the Lichtenstein Foundation funds. In 2016 CVB IT will also continue to roll out new network and intranet advances including a central booking system, online portal allowing guests to schedule their stay and coordinate research activities at CVB.

Although the majority of installation funding was provided through the Krasnow Howard Hughes Foundation and the Wright FSML NSF grant. Our monthly fees, which must be paid for the remainder of the contract term of three years, are about \$6000 a month. Of that, \$4000 a month is an endowment from the TELMA foundation. This leaves \$2000 for CVB to pay each month. We currently are looking for other options for internet.

Internal Network

CVB started construction on its internal network in late 2013 and major sections have been completed in 2015. It currently consists of five HP 2920/24 network switches connected to a Untangled UTM box which manages internet connectivity coming from a microwave dish. All switching fabric is running at 1Gbs. This is pictured in Figure 1. Two D-link unmanaged switches serve as access level switches providing wired connectivity to the wall outlets in NamanaBe. A Ubiquity Networks "Unify" WIFI system provides wireless coverage throughout CVB. CVB currently has one converted desktop acting as it's file and application server. This hosts all shared network resources, database, WIFI management console, RADIUS server, security camera system, and a file backup system. A new server purchased in 2014 will soon take over as the application server as well as act as a database and internal web server. As of now CVB has wired network connections in 93% of all offices and WIFI covers about 85% of the campus.

I.T. Personnel

Jesse McKinney continues to function as head of Technology and I.T. at half-time for one year. Jesse has 15 years of professional I.T. experience in a wide range of technology

fields such as software and database programming, hardware design and fabrication, industrial design, computer and server administration, user experience design, and industrial robotics. Prior to his appointment Jesse served as a Peace Corps I.T. volunteer and helped CVB on a volunteer basis from 2012-2014. We hope to increase his position to full time.

High Speed Internet

Linking CVB to the rest of the world is important to its growth as a research campus. At the end of 2013 and beginning of 2014 we saw a major steps forward in accomplishing this with the completion of CVB's microwave based network connection funded mainly though an NSF grant awarded to Dr. Mark Krasnow (Stanford) on CVB's behalf. This system has proven invaluable for research and administrative purposes. It has also been a major attractant for secondary programs that help fund CVB such as conferences, events, media crews, and visitors / scientific tourists.

Although at first this system work well, both service quality and speed has significantly dropped off over the last year. On average the connection functions at between 0.5-10% its guaranteed “minimum” speed during much of any given month. Repeated trips out by TELMA, our internet service provider, have not yielded any long term resolution to the problem. CVB has traced the problem back to the TELMA home office in Antananarivo, but as we have no jurisdiction to troubleshoot the national phone company, and TELMA having a reluctance to investigate, we can take no further action to solve this issue. However, CVB It believes it to be a Quality of Service (QOS) issue at the TELMA Office. Because we pay more than a home user, we should have higher priority over the connections off the island - higher QOS - vs every phone and home user in Madagascar. This higher QOS should guarantee much faster speeds and more reliability over standard home users. This does not appear to be the case right now and CVB It’s own internal testing has reviled we have no better service than someone paying \$45 USD in Tana for internet despite us paying nearly 4000% as much. Additionally CVB currently does not have a funding mechanism to cover the \$2000 monthly shortfall as the Internet grant did not cover the whole cost of the connection after the first year of funding was up.

This system is expensive @ 4x the cost of the next highest competitor’s rates, and does not function to the level of service CVB needs. In 2016 CVB will be attempting to attract a competitor to the RNF market area to eliminate TEMPLA’s monopoly. This should hopefully leverage TELMA into providing us with the service they contractually are obligated to provide, or allow us to switch to the competitors service.

I.T. IN 2016

Internal Network

Over the last year CVB has suffered significant damage to its core IT infrastructure. Erratic power delivery from Jirama (Madagascar Power Company) which regularly sways from ideal 220v 50hz power by +- 30% depending on the time of day and season,

has subjected CVB's equipment to voltages outside tolerance range. In addition improper building grounding - finally corrected in Q2 of 2015 - and a lightning strike directly to the link between LovaBe and NamanaBe further damaged IT assets and has severely crippled CVB's core network. Figure 1.2.a shows what the core network should look like if functioning normally. Figure 1.2.b shows CVB's current network layout with damage and temporary rerouting / hacks put in place to bring as much of the network back online as possible until replacement equipment can be purchased.

For 2016 it is of the utmost importance that we take immediate action to repair the network to a fully functioning state and finally purchase safeguards to protect CVB against further damage caused by Madagascar's erratic power. Since 2013 funding for this has been requested in every report to the board, we now have accumulated over \$12,000 in damage from equipment as a direct result of failure to act on this immediate issue. CVB cannot afford to continue down this route, loss of any more equipment will render the entire network inoperable shutting down admin functions and research. Quotes have been gotten for a power stabilizer that will protect all equipment in LovaBe and NamanaBe. They range from \$9,000->\$45,000USD installed. Although this is a significant amount of money this issue does not just effect our IT assets but also all lab equipment and therefore research. Erratic power is suspected to have also blown the compressor and damaged a control board on the -80 freezer in late 2015 causing sample loss. The freezer has yet to be fully repaired.

I.T. Personnel

In 2014 ICTE (CVB) through SBU hired its first dedicated Technology staff member Jesse McKinney to function as Head of Technology and I.T. in a co-hire with Pivot Madagascar. Jesse has 16 years of professional Technology Design and IT experience in a wide range of technology fields such as software and database programming, hardware design and fabrication, industrial design, computer and server administration, user experience design, and industrial robotics. At CVB in 2015 Jesse was responsible for all IT operations, co-creating / writing the awarded \$100,000 MRMW grant, advising on a number of reforestation and conservation grants, serving as liaison to researcher and as a technology advisor for countless research projects at CVB.

Jesse's current contract is up at the end of June 2016 and Stony Brook University continuing to fund this position after that time is not guaranteed. Additionally the current 50/50 time split Jesse currently does between CVB and Pivot is no longer sustainable as both organizations now have large IT and technology footprints that demand someone's full time attention. Because of this, we are strongly urging to board to take immediate action to find a way to fund Jesse's position full time at CVB starting when his contract is up with both Pivot and CVB on June 30th 2016.

In Q1 of 2016 CVB will be hiring a local IT technician to handle more day to day repairs of computers at CVB and basic troubleshooting tasks. In the event that Jesse does leave when his contract is up, or Stony Brook declines to fund his position further, CVB at very

minimum needs someone full time that understands IT systems and repair just to maintain basic CVB operations.

Power Systems Overhaul

As mentioned in section 1.2 finding a solution to the power issue is a very high priority goal for CVB in 2016. All electronic equipment from freezers and microscopes, to the water filtration components, to computers and network equipment are susceptible to the damage caused by this improperly regulated power.

CVB I.T. feels the quickest, most reliable solution to this problem is to purchase a large enough voltage stabilizer to cover both LovaBe and NamanaBe. Run umbilical power feeds from NamanaBe to LovaBe with proper gauge cable to provide generator and power stabilization to both buildings. The voltage regulator will ensure that any line voltage within a certain tolerance (about 180v to 260v) will be converted to exactly 220v AC before it enters the building. The low voltage transfer switch automatically switches a building to a backup generator if the line voltage gets too low for the stabilizer to work. The generator would then take over power production until power levels are once again above the minimum power threshold needed for the regulator to function. Quotes on this system range greatly depending on where it is purchased - USA vs Madagascar - as well as the brand and "Quality" of equipment purchased. The ballpark is between \$9,000USD and \$45,000USD

CVB Computer Replacement

CVB IT is happy to report in 2015 we have replaced 20 computers with state of the art desktops and laptop systems. This allowed us to retire many systems at CVB, some over 12 years old. We still are in need of an additional 12 systems in 2016 to meet our current needs. We also are in need a maintenance budget to support these systems in the event they need repaired. Each system costs \$800 so \$9,600 to finish our computer replacements, and an additional \$900 in maintenance budget for computer support and repair costs.

Software Needs

CVB subscription to our main UTM (Network Brain) will expire this year. We absolutely have to renew this for another three years. Not only does it keep attacks and hackers out of our network, but it controls all network operations. Without it CVB will not have a network. The nonprofit rate for this device is \$8,640.00 for a new three year subscription.

CVB currently uses subscription based Microsoft Office (Word, Excel, PowerPoint) for all computers on the network. Each 5 pack license costs \$99 and we have 41 computers at CVB. We request funding to make this yearly subscription purchase which will cost \$800.

I.T. Supply Budget

CVB I.T. requests \$3,000 be allocated as a yearly budget to procure supplies and emergency equipment replacements. This budget item covers things like failure of small equipment, cables, tools, adapters, and other I.T. supplies that do not fit under one of the other budget items discussed above. This budget is very tight but is enough to replace any one item in the network / I.T systems at CVB failing in a given year as well as money for consumable I.T. supplies and small ticket items like cables and connectors.

Keeping CVB Organized

Starting in 2015 CVB IT began developing software tools to better meet our guest's needs at CVB, reduce confusion, and keep CVB organized. CVB is happy to report the first two of those tools, the CVB webserver, and the CVB Wiki are now operational.

The CVB Wiki, is a vast knowledge repository of anything related to CVB - policies, forms, rules, staff and researcher bios, maps, data, ext.. It also has a large repository of information about the national park and surrounding lands, research, and many related subject. Although now in place, it will take a while to really start to populate this vast resource with appropriate content. Currently CVB IT and CVB Labs are in the process of entering everything related to our areas with other departments soon to follow. This WIKI is now hosted on the CVB Intranet webserver, another 2015 addition that was a pre-requisite requirement for many resource development roadmap steps.

In 2016 we will continue to develop these virtual resources. We hope to introduce a central scheduling system to automate all CVB reservations such as room booking, logistics needs, meals and dietary requirements, bills, kitchen orders, tech requests, permits, ext... Giving the researcher completely transparent and real-time control over their stay.

FUTURE PROJECTS

Establishing an Environmental Mercury and Toxics Laboratory and Program at CvB that would have the capacity to measure Hg in biological tissue, soil, water, and air, and can be used to establish baselines for mercury in the environment and local human populations in order to monitor any changes in hg levels as a result of the rapidly increasing ASGM (artisanal and small scale gold mining) in the region.

Establishing a drone-based Forest Threat Assessment program at CvB to rapidly identify deforestation/forest degradation in Ranomafana National Park, and identify the drivers for identified forest loss (logging, mining etc), and create time series to better understand forest change, ecology and plant/animal interactions in the park.

Green Climate Fund. We hope to work together with the Malagasy government to acquire funds for reforestation that will enable a significant impact on the restoration of Madagascar.

We will be applying for USAID Biodiversity and Environment funds to better protect the region of Fianarantsoa to Manakara.

These programs would be the first of its kind in Madagascar, and would represent a significant advance in using cutting edge tools for conservation in the country, as well as a possible model that would be replicated in other regions.



Appendix 1: Summary of 2015 Research Projects Conducted at CVB

Organized by PI's Last Name

** Note: all projects are not abstracted*

Socioeconomic inequities in early pregnancy, age at marriage and contraception use in Madagascar

Meghana ANUGU (Stony Brook University School of Medicine, M.D. Candidate, *CVB Student Internship)

According to data from the 2008-2009 Demographic and Health Surveys from Madagascar, nearly half of women surveyed were married by age 18.9 years, 32% of women between ages 15-19 have begun childbearing, and only 29% of currently married women ages 15-49 are using a modern method of contraception. Given the limited literature of recent data surrounding early pregnancy age, early marriage and contraceptive use for the general population in Madagascar, particularly in a health equity lens, I aim to study the determinants of these parameters. Data for the study will come from Standard Demographic and Health Surveys (DHS), which is funded by the U.S. Agency for International Development (USAID) and implemented by ICF International. The DHS are large, nationally representative cross-sectional surveys that collect a wide-range of data in the areas of health, population and nutrition in over 90 countries. I will analyze data from the women's questionnaire, which is administered to women ages 15 to 49, and includes information on background characteristics, reproductive behavior and intentions, and contraception. The main outcomes of interest are contraceptive use, early marriage, and early pregnancy. If time permits, I plan to conduct key informant interviews to contextualize the findings of my quantitative analysis. There have been many changes since the last DHS was conducted in 2008, particularly given the coup and the resulting withdrawal of much international aid. Key informants will help identify areas of need for future programming and provide information regarding whether my estimates will be upper bounds due to decreased funding and services since the coup. It will be imperative to replicate these analyses when a new DHS is conducted. Key informants will include health workers (formal and lay), community leaders (including leaders of women's groups), and NGO staff.

Mitigating the potential extinction crisis of Malagasy frog communities from chytridiomycosis: Selection of probiotics that inhibit *Batrachochytrium dendrobatidis*

Molly BLETZ (Ph.D. candidate, James Madison University/ Technische Universität Braunschweig), Falitiana Rabemananjara (Chytridiomycosis Working Group), Che Weldon (North-West University, South Africa), Serge Ndriantsoa (University of Antananarivo)

Recent work has shown that some species of amphibians' skin bacteria inhibit the lethal amphibian pathogen *Batrachochytrium dendrobatidis* (Bd) (Harris et al. 2006; 2009a,b;

Muletz et al. 2012). Bd causes the disease chytridiomycosis, which has caused widespread amphibian declines and extinctions around the world. Anti-Bd skin bacteria isolated from amphibians can be used as a probiotic to inhibit Bd. Indeed, defensive skin microbes are the only line of amphibian defense that is not directly host produced and has been successfully manipulated to mitigate disease. Sampling of amphibians will take place in various locations in Madagascar in order to obtain a sample of protective skin microbes from our target endangered and threatened species and from members of the three major families (Mantellidae, Microhylidae, Hyperoliidae). We will sample, collect and identify effective antifungal probiotics from Malagasy amphibians to target critically endangered species and at-risk amphibian communities. A proactive plan is necessary to protect currently endangered species and to prevent widespread species declines and extinctions. We have developed two treatment strategies that involve augmenting amphibian-derived, locally-occurring anti-Bd skin bacteria onto susceptible amphibian hosts. The first strategy is a species-specific strategy that focuses on treating individuals of endangered species with probiotic baths. The second strategy is a community-based strategy that targets amphibian assemblages by treating ponds or local areas with a locally-occurring community-based probiotic that is effective for multiple amphibian hosts. Anti-Bd bacteria can be transmitted from soil and water to amphibians. Our species-specific and community-based strategies to develop effective amphibian probiotics are divided into five and six phases, respectively. At the end of phase two, we will have the following product: a collection of Bd-inhibitory isolates that are probiotic candidates for protecting critically-endangered species with species-specific probiotics and for protecting phylogenetically diverse amphibian assemblages with community-based probiotics. We plan to complete the remaining phases with additional funding. With our established collaborations in Madagascar, environmental persistence (phase 3) and host colonization and persistence trials (phase 4) can be accomplished using in-country ex-situ conservation facilities, such as those at Association Mitsinjo. This collaboration will involve local university students in the development of effective probiotics. Clinical trials (phase 5) will be completed outside of Madagascar, using biosecure international zoo breeding colonies. The final product will be effective probiotics that can stem Bd spread when it arrives in Madagascar and therefore potentially prevent the massive Bd-associated amphibian extinctions that were seen in Central America.

Bat's in Madagascar: Health Hazards or food security assets

Mar CABEZA, Kati Suominen (University of Helsinki), Christoph Meyer (University of Lisbon), Daniel Rakotondravony, and Maria Hariniaina (University of Antananarivo)

Bats are among the most economically important non-domesticated mammals in the world. They are well-known pollinators and seed dispersers, they make an important protein contribution to the diets of many, their waste - “guano” has been shown to be a highly effective fertilizer, and they appear to play an important role in crop pest suppression. Despite these numerous benefits that bats provide to both humans and ecosystems, bats have in recent years drawn increasing attention due to their association with a number of emerging infectious diseases. Bats thus potentially also pose a high

health risk to humans. Disease exposure through bats is, however, often a result of anthropogenic activities, increasing with environmental degradation. Extensive forest loss in Madagascar has led many species – including bats – to become increasingly “human-tolerant”, with bats now inhabiting a growing proportion of public buildings, with a preference for schools, thus sharing closed spaces with children. In addition, ongoing food insecurity in rural Madagascar has resulted in an increased consumption of bats. This combination of environmental erosion with high population densities increases human exposure to disease, with similar cases documented elsewhere. For instance, the 2007 outbreak of Ebola in the DRC was linked to bat use as food, and bats are believed to have recently carried the virus to West Africa. Our goals twofold: a) research to understand the complexity of dynamics between humans and bats, particularly from the perspective of human health risks and food security, and an overall understanding of how these dynamics are influenced by local perceptions and the broader environment, and b) a broad dissemination of research findings with the aim of increasing awareness of both the costs (risks) and benefits (services) that bats provide. We will conduct a pilot study primarily sampling rural villages surrounding RNP, but also conduct primarily passive sampling (echolocators) within the park, to compare bat communities. For sampling in villages, we will preferably sample bats at school buildings, other public buildings and some households. Bats in public buildings will be trapped with mistnets at night. We will also use endoscope cameras when possible, to count densities of bats roosting between ceiling and roof of public buildings. Trapped bats will be identified, and measured. A small biopsy sample will be taken from the wings (this has been proven to not affect flight, and heal within days), for genetic and bacteriological studies. We will also take samples of ectoparasites, and small blood samples, that will be placed on filter paper and dried, for viral analyses. Blood samples and biopsy samples will be sent to Finland for initial screening and to develop detailed future plans in collaboration with Institute Pasteur of Madagascar.

Educational outreach (biodiversity of reptiles and amphibians): Live from Ranomafana National Park

Erik CALLENDER (Erik’s Reptile Edventures)

This research/ educational outreach program will allow me the opportunity to share knowledge with children about the biodiversity of reptiles, and amphibians that live within Ranomafana National Park, Madagascar. Erik’s Reptile Edventures recently launched a distance-learning program that utilizes internet technology (SKYPE, U stream, U tube) to produce live animal shows from different countries and share them with children. We have been up and running since Feb 2006. This Research/ Educational outreach program will help children develop an appreciation and understanding of the biodiversity of Reptiles and Amphibians of Madagascar. Malagasy and US students will share in the learning process together through live interaction, and internet communication. The students will develop an understanding of animals in the environment, wildlife conservation, animal adaptations, geography, and respect and stewardship of our natural world. New York State and the US require that students meet specific learning standards for Life Science, Math, Social Studies and Language Arts.

Erik's Reptile Edventures educational outreach program is aligned with these standards. This coupled with interaction with animals during the program will result increased enthusiasm for nature and benefit academic growth of the student participating in the program. In addition Erik's reptile Edventures is committed to the development of fundraising projects within school systems that will donate money to help provide supplies for Malagasy schools. The ultimate goal of the program is to use technology as a tool to educate children of all ages about Malagasy species of reptiles and amphibians, and encourage them to enjoy life science and respect Nature. During the process, students will learn to identify species of Malagasy reptiles and amphibians; learn adaptations of the animals observed during the SKYPE sessions; gain familiarity with maps using Google earth, physical maps and globes; learn how to create and use dichotomous keys to identify animal species; and develop communication and writing skills.

The Influence of global climate change on plant-pollinator interactions

Christopher COLLINS (Stony Brook University, undergraduate), Sahondra Rahanitriniaina (University of Antananarivo)

Pollinators are important because their interactions benefit biodiversity, and in turn benefit people. Pollination interactions provide important ecological services. A growing amount of evidence that shows that many ecosystems are being affected by regional and global climate changes, particularly the temperature increases associated with global warming. Because of this, and because of the ecological benefits of pollinators, there has been a dramatic increase in the scientific interest associated with the ecological effects of climate warming. These changes are most apparent, for pollinators, in their changes in flowering phenology and the changes in the appearance of migrating butterflies. Through field observations of bees in particular, this study will aim to better understand the influence of ambient temperature on plant-pollinator interactions using the following guiding research questions, including: (1) Is there a relationship between time of day and number of plant-pollinator interactions? (2) What is the relationship between size of active pollinators and ambient temperature? (3) What is the relationship between size of active pollinators and number of flowers visited per patch? (4) What is the relationship between visitor category and ambient temperature? (5) What is the relationship between visitor category and number of flowers visited per patch? It is expected that the rate of pollination will vary with temperature differences. The data acquired will hopefully help in the future of conservation, as well as set the precedent for conservation.

Patterns of antimicrobial resistance in enteric bacteria of humans in rural Madagascar

Robert C. GIORDANO (Rollins School of Public Health, Emory University, Advisee of Thomas Gillespie, MPH candidate)

In recent years, Madagascar's human population has increased exponentially, leading to serious sanitation infrastructure issues. Thus, control of orally- transmitted fecal

pathogens is often inadequate, which has led to diarrheal disease becoming the leading cause of mortality in children under five, and the second leading factor for increased morbidity across all age groups, second to malaria. Only 34% of the rural population has access to clean water and 27% has access to adequate sanitation effectively leading to high rates of enteric disease. Although morbidity/mortality rates are projected to show great improvements in developing regions by 2020, most models neglect to address the growing concern of increasing antimicrobial resistance. We propose to screen fecal samples for positive isolates of *Vibrio cholerae*, *Salmonella spp.*, Enterotoxigenic *Escherichia coli*, and *Shigella spp.* while systematically testing for susceptibility to antibiotics through Antimicrobial Resistance Tests (AMR). In addition, we plan to screen all fecal samples for the presence of resistance genes that may exist within the full enteric bacterium population. The information from this survey will provide a key resource for practitioners and policy makers alike, which can then be used to further guide clinical management on appropriate treatments of diarrheal disease in the region. These results may also aid updating treatment guidelines, educating prescribers and guiding infection control policies. There are few proven mechanisms that effectively address resistance control and, importantly, almost none of those that are effective have been validated for developing regions. Widespread misuse and mishandling of antimicrobial agents in the tropics has led to serious issues of antimicrobial resistance. Our data will be useful in establishing a baseline for AMR in the Ranomafana Region by providing useful information on the social contexts that are key in bacterial resistance development. The main study tools will consist of Antibiotic Susceptibility Tests conducted on cultured pathogenic isolates from human fecal samples and surveys administered by trained enumerators from INSTAT. The survey will be translated into Malagasy, piloted and back-translated to confirm accuracy in assessing the varying human behaviors that could lead to favorable conditions for AMR development. Our survey will be included in a larger survey containing questions on basic demographics, size of household, distance to nearest water source, etc., as part of a larger Gates Grand Challenges study aimed at defining an economic burden of disease. It is my hope to better understand the epidemiology factors that influence the development of AMR in infectious enteric disease in the region surrounding RNP. I am particularly interested in understanding the correlation between disease ecology, land-use change, and socioeconomic standing. Not only will the information from this study play an integral role in the development of my master's thesis, but also, it will ultimately help to develop a comprehensive Malagasy health care system.

Enteric pathogen transmission among humans and mouse lemurs in Ranomafana National Park, Madagascar

Robert GIORDANO (Emory University Department of Environmental Sciences, Advisee of Thomas Gillespie, B.S. received)

** Lemur work was conducted in collaboration with the Mark Krasnow/Stanford 2014 project*

The nature and frequency of human interactions with wild lemurs is changing rapidly as a result of land use modification. These activities bring humans and lemurs into close proximity or direct contact, allowing for the potential alteration of disease dynamics in ways that may allow for disease emergence and transmission from people to threatened

lemur populations. With only 10% of its original forest cover remaining and rampant deforestation pressuring residual forest refuges, the island nation of Madagascar is at elevated risk for human-wildlife overlap and associated disease transmission. Further, it has been projected that lemurs could face extinction within the next 20 years, short of drastic action to tackle the poverty driven habitat disturbance. As it stands 93 of the 105 known lemur species are on the endangered list. Our goal is to investigate the ecological impact that habitat overlap has on infection rates and patterns of transmission of environmentally persistent gastrointestinal bacteria between humans and wild lemurs. We will focus on *Microcebus rufus*, the eastern brown mouse lemur, as our model system, as this species has relatively high population densities, allowing for a maximum sample size. We hypothesize that the data will demonstrate higher levels of human-wildlife habitat overlap leads to increased risk of zoonotic transfer of disease. It is our hope that the results of this study will help to pinpoint regions of Madagascar with elevated risk of zoonotic transfer, offering the opportunity for interventions benefiting both human and wildlife populations.

The Use of Stable Isotope Analysis to Infer the Trophic Levels of *Prolemur simus*, *Hapalemur griseus*, and *Hapalemur aureus*

Kevin GUILFOYLE (Long Island University), Tojohery Tiana RASAMIMANANA (University of Antananarivo)

Stable isotope analysis has been used to analyze the nutritional ecology of numerous species. As forest cover is reduced, as in the case of degraded forest, the ratio of carbon isotopes present in the animal's diet and as a result, in their feces, will be different. It is thus hoped that we could use the stable isotope composition of feces from three bamboo lemur species as a proxy for the level of habitat degradation and to assess the impact of reforestation efforts over time. The primary goal of this study is to better understand how each of the following species, *Prolemur simus*, *Hapalemur griseus*, and *H. aureus*, utilize nutritional resources across time and in response to numerous variables. Fecal samples from *Prolemur simus*, *Hapalemur griseus*, and *H. aureus* will be collected in RNP (pristine) and in degraded habitat on the park's boundary. A fecal sample will be collected from each individual and then exported to the US, cleaned, and then analyzed in a stable isotope mass spectrometer. Ratios of carbon isotopes present in samples from animals in "pristine" forest will be compared to those living in degraded forest. Because these three lemur species feed almost exclusively on bamboo, and live within the same ecological niche, we expect to see carbon isotope ratios in these three species to be nearly identical to one another in "pristine" habitat. As an animal is forced to feed in degraded, more open forest, carbon isotope ratios in the feces will be different. Thus, we expect to see significant differences in carbon isotope ratios present in the populations of Ranomafana than in those in surrounding degraded forest.

Integrative Taxonomy of the Herpetofauna of Madagascar

Carl HUTTER (Ph.D. candidate, University of Kansas), April Hillman, Zo Faniry Andriampenanana, Shea Lambert (assistant), Asa Conover (assistant), Richard Glor (University of Kansas)

Our primary goal is to understand and adequately report the extent of undescribed reptile and amphibian biodiversity occurring in Madagascar, with a current focus on the undescribed species of Ranomafana National Park. The presence of up to 40 divergent lineages of frog in Ranomafana National Park (based on morphological, acoustic and molecular evidence) is suggested in recent studies, as well as fieldwork conducted by this research team in the past two years. Visiting nearby sites is necessary to collect related species for comparison. In the field, we will use morphological (body size, shape, color) and acoustic (call length, frequency, call repetition rate) evidence to hypothesize whether the specimen represents a divergent lineage. If our careful observations in the field lead us to believe that the specimens represent an undescribed taxa, we will then test this hypothesis through careful examination and laboratory work, where we will study the sequence divergence (through DNA barcoding) of these specimens and compare their morphology and vocalization to closely related species in order to validate if they represent evolutionary distinct species. Therefore we will also need to collect species closely related to the undescribed taxa in order to more accurately describe and compare the relationships of any new taxa. We also aim to collect additional data on species richness, abundances and habitat preferences of all taxa we encounter. Finally, several technical manuscripts will be prepared describing each of the new taxa through their morphological, acoustic, and molecular differences. This study will aid in further understanding the extent of herpetofauna biodiversity in RNP, and Madagascar. As many of these species are increasingly threatened by habitat loss, it is important to catalogue and understand the biodiversity in Madagascar in order to help guide conservation efforts by targeting and protecting areas with large numbers of threatened and endemic species.

The Effect of Social Support on Childhood Malnutrition in Rural Madagascar

Samuel POTTER (Stony Brook University School of Medicine, M.D. candidate,
**CVB Student Internship*)

The World Health Organization has stated that malnutrition, especially among children, is one of the biggest threats to the world's public health. In Madagascar, the rate of malnutrition among children is the 9th highest in the world. 53% of children under the age of 5 are stunted, 42% are underweight and 13% are wasted. The population of Madagascar has become increasingly at risk to suffer from malnutrition given the increasing frequency of droughts, cyclones and recent political turmoil. Understanding the effects of different social, political and environmental factors on this topic is critical to informing policy and programming on the issue. This is especially important in light of new evidence that child malnutrition may not be entirely due to food scarcity or a lack of family economic resources. I will assess the role that various forms of social support have on the occurrence of childhood malnutrition. I suspect that my study will confirm that

lack of social support will have a greater impact on children who are at greater risk for malnutrition due to a shortage of food stores in the previous year. From 2004 to 2005, two ethnographic surveys were conducted in 12 Tanala villages in eastern and southeastern clusters of Ranomafana National Park through a grant from the Packard Foundation. A total of 2,511 individuals in all 12 villages participated in the first survey, followed by 1,785 individuals in the second. Demographic data and information on farming practices were collected from heads of household. This population has previously been shown to suffer from high rates of childhood malnutrition. Given limited measures available in the secondary data source, this project will measure only indicators of support availability and received support. Support availability will be measured by the presence of a partner living with the mother as well as the presence of relatives living in the same village. Received support will be measured by the type of support received (housekeeping, childcare, cooking, firewood collection, financial or labor). Degree of social support will be assessed on a graded scale of 0-9 depending on the type and quantity of support received. Child malnutrition will be measured comparing height, growth and weight to the international growth standards. This will be done for all children aged 0-9.

Seed dispersal of plant species consumed by *Eulemur rubriventer*, *E. rufifrons*, and *Varecia variegata variegata* in the Ranomafana National Park

Andrilalao M. RAKOTONAVALONA (Ph.D. candidate, University of Antananarivo)

Species have evolved complex interdependencies. Arguments on the co-evolution in plant-frugivore interactions are highly controversial. One estimate suggests that approximately 90% of tropical tree species require some sort of interaction with animals to reproduce. In tropical forests, endozoochory is the most important mode of seed dispersal and potential primary dispersers are birds and bats. As bats have a low density and are mainly insectivores in Madagascar, primates play a particularly important role in seed dispersal instead. Ranomafana National Park preserves one of the richest primate fauna in the world. Six of the 13 species of lemurs are sympatric and they are mainly frugivorous. Some tree species depend on lemurs for both seed dispersal and germination. The main seed dispersers are *Eulemur rubriventer*, *E. rufifrons* and *Varecia variegata variegata*. Lemurs swallow fruit pulp with seeds, which they are unable to separate. Seeds pass through their digestive system and they are dispersed through the defecation far from the parent plant. Once on the ground, they germinate and take root. The removal of the pulp and intestinal treatment are even considered fostering or a prerequisite for successful seed germination for some species of plants. In general, animals travelling a lot in one day deposit seeds on a larger area than those that move over shorter distances. Indeed, the seeds that spend more time in the digestive tract are generally deposited at greater distances from the parent tree and animals with a short retention period gut often deposited seeds closer to the parent tree. Then exclusive or semi-exclusive lemur feeding on certain species of fruit, in theory, can be quite significant to the ecological change of plant communities and it is reasonable to expect that the loss or the immigration of lemurs seed dispersers change the spatial distribution of seedlings of certain plant species over time. The overall objective of this study is to continue research on seed dispersal in

RNP, especially the post-dispersal phase. *Objective 1:* estimate the distance of seed dispersal; identify the genotypes of the target plant species; distribution mapping. *Objective 2:* determine the ecological requirements of the target plant species; compare species richness and ecological parameters between study sites; modeling of the dynamics of forest stands. The study will help to determine the influence of sympatric lemurs on the dynamics of forest stands, it will be a step in the study conducted post-dispersal and the ecological requirements of the species of plants are known for future reforestation.

Improving Forest Conservation in the Tropical Forest of Ranomafana, Madagascar.

Stephane Olivier RANDRIAMANANTSOA (Kyoto University, M.S. candidate,
*CVB Student Internship)

Malagasy endemic tree species have been threatened by various indigenous people's activities such as slash and burn agriculture, monoculture, logging, charcoal production and many others. These activities are major factors of forest fragmentation and the downfall of endemic tree species, and the increase of invasive species such as the Eucalyptus, Psidium, Pine, non-native bamboo, etc. in unprotected areas in the periphery of RNP. Because of the extension of forest degradation, preserving endemic trees has become tremendously important. Besides, the loss of endemic trees is a major factor of reduction of various endemic animals that feed on those trees' leaves, fruits, seeds, etc. Consequently, CVB launched projects to conserve and propagate endemic trees, and restore degraded landscapes around Ranomafana. The objectives of this internship study were to forge knowledge on the importance of preserving the tropical forest by various methods. Anthropogenic impact on the forest in Ranomafana is an important factor of deforestation in this region because most indigenous people depend considerably on the community forest to meet their livelihoods. Understanding the different challenges of safeguarding tropical forests is an important objective in order to develop more efficient conservation methods. Additionally, the conservation of endemic plants depends heavily on the management of nursery plants and reforestation of degraded areas. Nevertheless, the success of reforestation depends greatly on multiple variables. Many plants requires specific conditions to grow, however, reforestation often take place in impoverished soil such as fallow land. Therefore, it is crucial to evaluate the reforestation activities especially by monitoring the growth of young plants in the nursery and the transplanted saplings. Data collection on the area and plants such as height, diameter, leaves, elevation etc. in order to work out on the best area to grow specific plants was also an important component of the internship. Sapling mortality in the nursery was caused mainly by rat predation, and less frequently birds; although the success rate in the plant nursery yard is very high because it can reach up to 90 and 95 percent. Higher mortality rates of transplanted plants need further attention and oversight. Conservation is strongest when grassroots community efforts are seeded at country and local levels. Currently, many projects are conducted in the Ranomafana region to empower villagers, but teaching them that they can make a better life through ecotourism and by protecting the forest and wildlife existing there is a challenging task.

Madagascar Dog Initiative: Controlling feral dogs to conserve Madagascar's wildlife

Zoavina RANDRIANA (D.V.M. SOS Madagascar), Kim Valenta (PhD Candidate, University of Toronto), Zach J. Farris (PhD. Candidate; Virginia Tech), Mamiarilala Jean Céléstin Tojonirina (Veterinary student, University of Antananarivo)

We propose a targeted research project that will include capturing, spaying, neutering and vaccinating feral dogs, transporting feral dogs to a local shelter for training and placement in permanent homes, and monitoring dog and wildlife populations. We will collaborate with Malagasy (University of Antananarivo, SOS Madagascar, Centre ValBio), US (Virginia Tech), and Canadian (University of Toronto) institutions to control feral and domestic dog populations and monitor wildlife populations at RNP. In addition, we will provide a critical service to villages surrounding RNP while also working to understand the ultimate causes of why domestic animals are allowed to go feral within Madagascar's forests. As these exotic predators and endemic wildlife species are increasingly forced into isolated fragments of forest, predation by exotic predators are impacting endemic wildlife populations that are simultaneously being limited by declining habitat quality and human encroachment. Our project represents the first attempt at combining a targeted feral and domestic dog spay/neuter, vaccination, and relocation program with simultaneous surveys of how wildlife respond to these efforts. This project will serve to improve the livelihoods of the people living in villages near RNP while also improving the efforts of CVB and MNP to protect Madagascar's threatened wildlife.

Seed dispersal interactions and plant community structure

Onja H. RAZAFINDRATSIMA (Ph.D. received, Rice University), Parfait Rafalinirina, Daniella Takiya, Fenosoa Francine Rajoarivelo (ENS, University of Antananarivo), Amy Dunham, Jake Kraws, Jordan Sinclair (Rice University), Zo Faniry Andriampenanana (University of Antananarivo)

The purpose of this project is to understand how seed dispersal and recruitment of plant species in a community are dependent on other species with similar vectors and producing fruit in the same season. We conduct an experiment to assess how the dissemination of seeds per lemurs affects seed germination and seedling recruitment trees producing fruit in the same season, examining the effects of soil pathogens associated with different species trees on the germination and recruitment of seeds. In Phase 1 (wet season), we use 4 species of seeds that are dispersed by frugivorous lemur species: Tavolomanitra, Ramandriona, Natovoraka and Solaitra fotsy. *Seedling recruitment monitoring*. We selected 6 species (2 lemur dispersed, 2 bird dispersed, and 2 abiotically dispersed) from the 128 species represented in our botanical transects and recorded all seedlings within 1 meter of either side of the transect. Seedlings were designated as either first year or >1 year and their location on the transect was recorded as well as all adult species within a 15m radius. *Seed traps and germination rates*. We sampled seed rain using seed traps placed under the same 6 species. Seed traps were placed under 5

individuals from 5 of the target species and under 2 individuals from one species due to rarity of that species, hung on trees to a height of 1-1.5 m to reduce seed removal by granivores. We recorded the identity and number of seeds in each trap every two weeks and will continue this monitoring throughout the year. A subset of seeds from the trap was then placed in a defined area under the same adult tree and germination are being monitored and recorded on a bi-weekly basis. *Phylogenetic trends in germination rate.* Using the same 27 individuals from 6 species described above, we set-up an area under each tree, place seeds from all 6 species in a defined area, and monitor germination rates. Seeds for this experiment were obtained from the seed traps. Accurate phylogenies are an important tool for studying community assembly and functional trait evolution. Using leaf samples, DNA barcode sequences can be produced and used to create a phylogeny with > 98% accuracy. We collected a leaf sample from individuals from as many of the 128 species found along the series of transects mentioned above. Fresh leaves were cut from the tree to ensure accurate species identification. Samples were placed in a paper bag, stored in a sealed container with silica gel to dry, and exported to Rice University for genetic analysis to create the phylogeny. *Summary of field results.* We mapped all trees within our 20 phenological transects in Valohoaka and Vatoharanana, and surveyed all mature trees within 10 new quadrats in Vohiparara. We continued monitoring the phenology of the plant species within our transects, and checked whether all tagged individuals were still present. It appears that besides natural disaster, which knocked down a large number of trees, some individuals were intentionally cut by humans. Few seeds of *Solaitra fotsy*, *Ramandriona* and *Natovoraka* germinated in the nursery experiment, which is still running until January 2015. Including last field season, we collected fruit samples from 26 species for nutritional analyses. Besides *Eulemur spp.*, *Alectroenas madagascariensis* (Madagascar blue pigeon) was observed to consume the fruits of *Cryptocarya*; however, they seem to be unable to disperse *Cryptocarya* seeds away from parent tree because of their behavior – defecating seeds few minutes after ingestion, or dropping seeds after consuming only part of the fruit pulp. None of the seeds in the germination trails had germinated yet. As for the secondary dispersal, we haven't analyzed data yet; only the native rodent species *Nesomys rufus* was seen removing seeds from their initial location in both Valo and Vohiparara field sites (pictures from camera traps). We collected leaves from 115 tree species. These samples have been exported to Rice University where they will be processed for genetic analysis. Data from the seedling transects have not been analyzed yet. Seeds planted under the six target species have not germinated yet but continue to be monitored.

Epiphytes, mini-ecosystems with big biodiversity: Assessing the threat of human disturbance on the rainforest canopies of Madagascar

Brett SCHEFFERS (University of Florida, Gainesville), Andriamahohatra Rakotoniaina (ENS, University of Antananarivo)

Epiphytes (i.e., free living plants in forest canopies such as basket ferns) represent a common above-ground structure in rainforests and provide shelter for biodiversity in rainforest canopies. We will identify the importance of *Asplenium* bird's nest ferns (an epiphyte) to canopy dwelling frogs and determine whether these ferns might serve as

refuges that counter the negative effects of warmer and drier climates caused by human disturbances such as selective logging and climate change. These surveys will also document an unknown community of frog as few canopy surveys have been conducted in Madagascar. This will be a highly comprehensive assessment of plant usage by frogs in Madagascar and of habitat disturbance on canopy frogs in Madagascar. Furthermore, our study on habitats within rainforest canopies will help us understand their roles in climate change adaptation and mitigation. This study will reveal important considerations for conserving species in Madagascar both from direct habitat loss and long-term impacts from novel climates. Our proposed research will identify plausible mitigation and adaptation options for canopy animals under changing climates, with the following goals: (1) Determine if ferns amplify non-invertebrate biodiversity such as frogs; (2) Identify fern and surrounding habitat characteristics that best determine fern density and frog usage of ferns across elevation and within undisturbed and selectively logged habitats; (3) Measure the microclimate within ferns to determine if they function as a climate refuge; and (4) Create a comprehensive library of frog calls in Ranomafana National Park.

Cross-Species analysis of helminth prevalence and health effects in Ranomafana National Park, Madagascar

Katie SMITH (Rollins School of Public Health, Emory University, Advisee of Thomas Gillespie, MPH recieved)

Soil transmitted helminths (STH) are intestinal parasites that infect roughly 2 billion people worldwide. Those infected usually live in extreme poverty with poor access to sanitation and poor hygiene. STHs live in the intestinal tract where they lay thousands of eggs every day, which are excreted into the feces. The eggs enter the soil through contaminated feces, causing infection when the eggs contaminate vegetables and water sources, when people walk barefoot through contaminated soil, or place fingers with contaminated soil into their mouths. STHs cause severe health effects in their hosts, with higher intensity of parasite burden leading to increased morbidity. Health effects are general malaise, diarrhea, abdominal pain, as well as physical and developmental retardation in children. STHs also cause anemia, a reduction in the number of red blood cells. Hookworms are the main cause of anemia, as they feed on blood in the intestines and cause intestinal hemorrhaging. Anemia causes the patient to feel fatigued, short of breath, causes headaches and dizziness, and complications can even lead to death. This leads to educational and economic losses as children feel too weak to attend school and adults are unable to work. Little research has been done on helminth prevalence in Madagascar. In 1995, Kightlinger showed high prevalence of roundworms (*Ascaris lumbricoides*), whipworms *Trichuris trichiura*), and hookworms in children living around Ranomafana. And while STHs can be seen in macroscopic evaluation of livestock feces, no data on STH prevalence in livestock could be found for Madagascar. Seven villages around RNP have been chosen for inclusion in the study (Ambatolahy, Ambodiaviavy, Ankialo, Vohiparara, Menarano, Bevohazo, and Manokoakora). The villagers have a high level of contact with their own livestock and the wildlife in the forest, combined with a lack of sanitation and safe water, increasing their chances of STH infection. Fecal samples will be collected from the people randomly selected to participate in the

questionnaire, covering subjects such as number and type of livestock owned, interaction with livestock and wildlife, hygiene habits, and health status.. Allowing for a 90% compliance rate, an expected 440 fecal samples will be collected. Fecal samples will also be taken from livestock and rodents in each village. Traps will be set in the households overnight. Fecal samples will be obtained from all livestock owned by the 10 selected households, which will include pigs and zebu. 80% of fecal samples will be stored in formalin and prepared using a formalin-ethyl acetate sedimentation concentration procedure. The other 20% of fecal samples will be evaluated fresh in the field, since storage in formalin may effect what is seen in the sediments later. Prevalence will be determined by using light microscopy to identify ova morphologically down to genus level. Eggs per gram of feces will be calculated as an indirect measure of worm intensity. I will use a portion of this blood (collected by the nurse & veterinarian) to perform a packed cell volume (PCV), which will give a basic measure of anemia in the patients. Two sample t-tests will be done to determine if there is an association between anemia (low PCV) and STH infection.

Infant care behavior in the red-bellied lemur (*Eulemur rubriventer*)

Stacey R. TECOT (University of Arizona), Andrea Baden (Hunter College), Rachel Jacobs (Stony Brook University), Avery Lane, Laura Diakiw (University of Arizona), Soafaniry Razanajatovo (University of Antananarivo), Alicia Sanchez (Spain)

The research is a continuation of the pilot study initiated in August 2013 to document variability in infant care behavior by fathers and siblings. *Eulemur rubriventer* are one of the few lemur species in which individuals other than the mother commonly care for infants (allomaternal care). While it is known that siblings and fathers help transport infants, little is known about 1) how often and when during the infant's development mothers receive help, 2) who provides help, or 3) the proximate mechanisms (e.g., hormones) promoting infant care. Answering these questions is critical to understanding the evolution of primate allomaternal care. While few studies have investigated the energetic burden and benefits of caring for lemur infants, no studies of allomaternal care have been conducted with wild *E. rubriventer*. Furthermore, no studies have investigated the relationship between allomaternal care and the hormonal mechanisms mediating this behavior in any free-ranging lemur species. This study is designed to determine who cares, how much, and whether kinship (i.e., genetic relatedness) or steroid hormone (e.g., cortisol and testosterone) changes during gestation and infant development vary with the amount of infant care provided. This 2014 study will allow us to refine behavioral data collection methods, and add infant care behavior to our pilot dataset to increase our sample size to an acceptable level. The goal of this pilot project is to collect infant care behavior data to establish the extent to which such behavior varies across individuals, and to collect fecal samples to 1) estimate genetic relatedness and 2) measure steroid levels, and document changes in these steroid levels across gestation and infant development. The results of this study will aid in the development of methods for a long-term study on allomaternal care, infant development, and the hormonal mechanisms involved in infant care. Specifically, this pilot study will ask the following questions: What are the best behavioral data collection methods to document infant care behavior? Who provides

infant care? What proportion of an individual's time budget is devoted to infant care? Do individuals providing infant care vary in the type or frequency of care that they provide? Is the amount of infant care related to kinship (i.e., genetic relatedness)? Are cortisol level changes during gestation associated with the type or amount of care individuals provide? Are testosterone level changes from pre- to post-partum associated with the type or amount of care individuals provide?

Parasite prevalence in lemurs: The effect of human-induced habitat changes and climate factors from a multi-scale perspective

Iris de WINTER (Ph.D. candidate, Wageningen University, The Netherlands), Niels Kil, Hilde de Laat, Freek Ijdema, Elke van Gils, Jeroen Baron Bentick, Anna Luijten, Wessel Nieuwland, Nathalie Houtman, Jeroen Schutt (M.S. candidates, Wageningen University, The Netherlands)

The mission of this PhD project is gaining a better understanding of the current and future distribution and transmissibility of gastrointestinal parasite infections in wild prosimian primates. We aim to assess the most important mechanisms determining ectoparasite (e.g., ticks, lice and mites) and gastrointestinal (GI) parasite (e.g., bacteria and nematodes) prevalence in non-human, prosimian primates throughout the seasonal cycle, while focusing on the effects of anthropogenic habitat disturbance and human proximity. By improving our understanding of disease ecology in non-human primates, we will gain more insight into the relations between anthropogenic and natural stress factors and the occurrence of parasites in a wild primate species. The association between parasite prevalence and the potential spread of infectious diseases within and between wildlife and human populations underlines the importance of this project from an anthropological, conservation and medical perspective. The questions and hypotheses of this study focus on habitat disturbance and seasonal variation at the population level (1), on group behavior, home range and dominance at the group level (2), and on characteristics including age, sex, body condition, immune system and social rank at the individual level (3). Six field sites, three sites with a relatively high level of disturbance and three with a relatively low level of disturbance), within RNP form an ideal location to test these hypotheses. To what extent do anthropogenic and natural stress factors influence lemur parasite prevalence and diversity, from a population, group and individual perspective? The main hypothesis is that parasite prevalence in lemurs is determined by a range of anthropogenic and natural factors which operate on different demographic/organizational levels (i.e., population, group and individual).

In addition, several masters students are assisting with components of the data collection including Anna Luijten, Parasite infections in sympatric *Eulemurs*; Jurian van Duursen, Microbial composition in sympatric *Eulemurs*, Wessel Nieuwland, Fluctuations in parasite infections in *E. rubriventer/Eulemurs* - seasonal and yearly variation + behavioural study; Nathalie Houtman, Fluctuations in parasite infections/microbial composition in *E. rubriventer* over time + behavioural study, and Jeroen Schutt, Lemur densities in Ranomafana (Vatohoronina, Valoahoaka, Talatakely, Sakaroa, Vohiparara, and Miaranony).

Impacts of the environment and ecosystem health on biodiversity

Patricia WRIGHT (ICTE, CVB, Stony Brook University), James Herrera (Ph. D. candidate, Stony Brook University), John Cadle (CVB), Lydia Tongaso (Ph.D. candidate, University of Antananarivo), Centre ValBio technicians

The loss of seed-dispersing lemurs due to anthropogenic disturbance can have cascading effects in the ecosystem. Understanding the feedback between the biodiversity and ecosystem health and function is critical to predicting changes to forest communities in the future. Genetic diversity is a strong indicator of the health and viability for a population, and diversity is usually highest where resources are most abundant. Thus, understanding the links between the environment, biodiversity and ecosystem health are crucial for conservation. Our goal is to understand the intimate relationships between the natural environment, biodiversity and humans in a rainforest community. We can then use the relationship to estimate the total population size of the species at our study sites, which is one of the only protected sites for several endangered species.

Preliminary analysis has resulted in biodiversity data for six main groups of organisms that are commonly surveyed and for which standardized methods are available to accurately estimate presence and abundance. These data will allow us to compare the effects of habitat disturbance on many different kinds of organisms and so far we have shown that disturbance has an effect on some lemur species (e.g., *Eulemur rufifrons*, *Varecia variegata*, *Cheirogaleus* sp.), some species have not been heavily affected by disturbance (e.g., *Propithecus edwardsi* seem to be relatively abundant in both sites), while other species are just very rare in general and difficult to find (*Lepilemur microdon*, *Hapalemur griseus*, *H. aureus*, *P. simus*, *Daubentonia madagascariensis*). We suggest these species may be at high risk of extinction due to their low abundance, limited geographic range and the amount of disturbance we detected in their habitat. Some species are already considered Endangered or Critically Endangered (*Hapalemur aureus*, *P. simus*), but others (*Hapalemur griseus*, *Lepilemur microdon*) are considered of low conservation threat. We suggest the conservation status of these last two species be updated to reflect their extremely low abundance and limited geographic range size. Preliminary analysis of the data on birds in RNP suggests that, similarly to lemurs, some species exist at higher abundance in disturbed habitats, others are higher in undisturbed habitats, and many species are widespread. We must further investigate the traits of species that allow some to be so widespread, and this will help us to understand how so many birds seem to be of low conservation concern. Early comparisons of frog data from Miaranony and Valohoaka suggest that habitat disturbance decreases frog diversity and abundance due to factors such as increased light, heat and wind and much lower moisture levels. The distribution and abundance of micromammals suggest that elevation and habitat disturbance are affecting species. Some, such as *Nesomys audebertii*, are only found at low elevations and are replaced by close relatives at higher elevation (*N. rufus*). Some, however, are only found at higher elevation (e.g., *Gymnoromys*, *Brachytarsomys*, *Eliurus tanala*). Further, during trapping we took data on the ectoparasite prevalence on captured animals and it appears that parasite load varies among species. The combination of disturbance and parasites has been shown to affect lemurs in RNP, and we should

follow up to collect similar data on rodents. Analysis of botanical data suggests differences in species composition between the two sites, between disturbed and undisturbed transects and in the size of trees in relation to disturbance. The Miaranony site is pristine with abundant large trees and little to no evidence of logging in the park. In contrast, at Valohoaka there are many areas that show evidence of past selective logging for *Dalbergia*, as well as recent cutting for honey or other wild resource extraction as well as for building materials.

Health survey of *Propithecus edwardsi* in Ranomafana National Park

Patricia WRIGHT (ICTE, CVB, Stony Brook University), Elizabeth Abram (Oakland Zoo), Margaret Rousser (Oakland Zoo), Hajanirina Rakotondrainibe (D.V.M, Ambatovy), Lydia Tongaso (University of Antananarivo), Centre ValBio technicians.

The survey and analysis of wildlife health of a population of lemurs within Ranomafana National Park is extremely important for their conservation. The only way to determine long-term status of a population is to observe an animal known in time. Unfortunately, we know too little about the lemurs. Our study is very important to monitor the population of lemurs in Ranomafana. Collars should be checked annually to enable our research teams to continue important long-term studies. We have established a database to begin a long-term program to monitor the health of the population of lemurs in the Ranomafana National Park, primarily from *Varecia* from Mangevo. We want to expand this project to include *Propithecus* (and *Avahi*). For this, the capture and collection of biological samples are needed. The data will help us to track changes over time, allow us to revise strategies for captive breeding and the long-term health monitoring of these species. Health Examinations will provide us with important baseline information for which we can use to compare the results of future studies to determine whether the population is declining, improves or remains the same. This information has significant value for conservation.

Demography of *Propithecus edwardsi* in Ampatsona-Ambohidaza, an unprotected Malagasy forest corridor, during the 2014 birth season

Andrew J. ZAMORA (Stony Brook University, M.A. candidate), Charles Rasolondraoavy (University of Antananarivo)

Milne Edward's sifaka (*P. edwardsi*) is an endangered lemur native to the southeastern rainforests of Madagascar that exhibits a high degree of variation in social groups. While *P. edwardsi* has been extensively studied inside of Ranomafana National Park (RNP), little research on *P. edwardsi* populations outside of RNP has been published. Moreover, much of the data used to assess the status of *P. edwardsi* has relied on research conducted within the few protected areas, such as RNP, within its known range. Additionally, research in RNP has demonstrated that disturbance has adverse effects on the demography and home ranges of *P. edwardsi* populations. As the amount of protected habitat encompasses just over 10% of *P. edwardsi*'s it is imperative that populations at other sites be studied. Ampatsona-Ambohidaza is a montane forest located at S21.009,

E47.398 which encompasses 100 km² of unprotected forest north of RNP and ranges in elevation from 1200-1400m. Much of the site consists of secondary and disturbed forest that has been recovering from agricultural, non-commercial, and logging use during the mid-20th century. My goals are: (1) Gather demographic data on *P. edwardsi* found in Ampatsona-Ambohidaza; (2) Collect preliminary data on the home ranges of groups; (3) Collect fecal samples for use in future pedigree analyses; (4) Survey how many *P. edwardsi* infants are born during the 2014 birth season; (5) Actively participate in ongoing conservation efforts with local Malagasy in Ampatsona-Ambohidaza.

Mosquito-borne parasite ecology (malaria and filariasis) and vector transmission dynamics in humans and lemurs* around Ranomafana National Park

Sarah ZOHDY (Rollins School of Public Health, Emory University, Advisee of Thomas Gillespie, Postdoctoral fellow), Wesley Mason (USA), Centre ValBio technicians

** Lemur work was conducted in collaboration with the Mark Krasnow/Stanford 2014 project.*

Two mosquito-borne parasites of particular public health concern in Madagascar are malaria and lymphatic filariasis. An understanding of how the environment influences mosquito ecology is necessary in order to better understand the role of transmission dynamics of these diseases, and to better implement prevention and intervention strategies to intercept and control these parasites and their vectors before they can cause deadly and debilitating disease in human populations. The goal of our research is to better understand the role that habitat destruction plays in vector transmission dynamics in humans and lemurs that live in and around RNP. The main objectives of this study are to collect mosquitoes to 1) survey mosquito populations in different land-use sites and screen them for human and lemur malarial and filarial parasites to identify potential ‘hotspots’ of disease, 2) to identify mosquito species that act as vectors of human and lemur malaria and filariasis in RNP, and 3) to evaluate insecticide resistance in the region. Then in collaboration with the Stanford Krasnow Mouse Lemur Genomics Research Group 4) characterize lemur malaria and filarial nematodes in wild brown mouse lemurs and identify their mosquito vectors, and 5) examine prevalence of these parasites in a wild population of brown mouse lemurs and identify host-specific characteristics that make certain lemur individuals susceptible to these parasites. We aim to combine these efforts to better elucidate the role that deforestation and land-use change play in human and lemur vector transmission dynamics in the hopes of creating and implementing effective research-based conservation and public health strategies to simultaneously improve human and lemur health. The ultimate goal of this research is to investigate how habitat destruction influences vector borne diseases in human and lemur populations simultaneously to better inform conservation and human health implementation strategies.

Appendix 2: Publications & Degrees Completed

2015 (24 publications)

- Aivelo T, Medlar A, Löytynoja J, Laakkonen J, Jernvall J. 2015. Tracking year-to-year changes in intestinal nematode communities of rufous mouse lemurs (*Microcebus rufus*). *Parasitology* 142 (8) 1095 -1107.
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- Crouse D, Richardson Z, Jain A, Tecot S, Baden A, Jacobs R. 2015. Lemur face recognition: tracking a threatened species and individuals with minimal impact MSU Technical Report MSU-CSE-15-8:1-14.
- Karanewsky, C.J., Bauert, M., and Wright, P.C. (2015). Effects of sex and age on heterothermy on Goodman's mouse lemur (*Microcebus lehilahytsara*). *International Journal of Primatology* (36): 970-981.
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