



UCLA Institute of the Environment and Sustainability

Center for Tropical Research

NEWSLETTER

NOVEMBER 2013



Letter from the Director

Dear Friends,

This past year marked two troubling milestones that portend tremendous challenges ahead for the future of our planet: the world's human population surpassed 7 billion and the concentration of carbon dioxide in the atmosphere rose above 400ppm. To help meet these challenges in Central Africa, CTR is expanding the International Research and Training Center that has served as a logistical research hub for more than 800 international scientists from 15 countries since 2010, to create the Center for Integrative Development. Located on the campus of our partner, the International Institute for Tropical Agriculture, the CID will focus on finding solutions to three overarching challenges facing the region: climate change and biodiversity, food and water security, and human health. The architectural firm Gensler recently completed the designs of the Phase I construction for the Center in Yaoundé. To view the Phase I plans, see CTR's home page.

We hope you enjoy our two featured articles. The first, by Richard N. Rosomoff and Judith Carney, examines the complex challenges of mangrove conservation and preserving food-gathering traditions in the Senegambia region of West Africa. The second article, by Trevon Fuller, explores how spatial modeling can predict outbreaks of novel influenza strains in China and help prevent human-to-human transmission of the H7N9 virus.

Very best wishes,

Tom Smith
Director CTR

CTR Research News

FEATURED ARTICLES

Life on the Edge:
The Dilemma of
People and Protection in a
West African Mangrove System



By Richard N. Rosomoff and Judith Carney

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By Kevin Njabo

Inaugural Professional
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By Ryan Harrigan



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Life on the Edge: The Dilemma of People and Protection in a West African Mangrove System

By Richard N. Rosomoff and Judith Carney*

Mangroves define the edge of continents throughout much of the tropical and subtropical world. From Asia to Africa to the Americas, in coastal estuaries where marine saltwater meets riverine freshwater, mangrove trees thrive in the insalubrious conditions and weave blankets of impenetrable green. Dominating a habitat not quite of the sea and not quite of the land, mangroves are specially adapted to inundated soils and mud flats with salt levels that would be lethal to most other botanical species. Nevertheless, for the huge diversity of life they harbor, they are aptly called “rainforests of the sea.”

Mangroves are among the world’s most vulnerable ecosystems. They are aggressively cleared for shrimp ponds, tourist infrastructure, roads, and firewood, and are disappearing at a rate comparable to the loss of terrestrial rainforests. The United Nations’ Food and Agriculture Organization (FAO) estimates that since 1980 an alarming 20% of the world’s mangroves, or 3.6 million hectares, has been lost globally. Some estimates put the reduction as high as 35%. It is now the case that approximately 75% of the world’s mangrove forests are found in just 15 countries, with less than 7% under protection.

The mangrove forest situated along Atlantic estuaries from Senegal to Guinea is a priority conservation area. It fronts one of the world’s most biologically diverse and economically important marine habitats and fishing zones, known by the IUCN as the West African Marine Eco-Region (WAMER). WAMER spans 3,500 kilometers of the Atlantic coast from Mauritania to Senegal, The Gambia, Guinea-Bissau, Guinea, and includes the offshore Cape Verde archipelago. The upwelling of cold water from the Atlantic Canary Current delivers nutrients to the sea-beds and rocky reefs that support WAMER’s vast and productive fishing grounds.

Three-quarters of WAMER’s estimated 1,000 fish species spawn in the stilt-root mangrove waters of West Africa. Several mammalian and amphibian species—including the endangered West African manatee, dolphins, and five species of turtle—depend on the mangrove ecosystem for food and breeding sites. The habitat is home to some five hundred resident and migrating bird species, making it a globally significant avian flyway. The area’s human populations also rely on WAMER mangroves for protein from fish and oysters, firewood, building materials, tannin, dyes, honey, and medicines.

Mangroves also protect coastal areas from erosion and storm surges. Their function as a natural bio-shield will almost certainly assume greater importance with anticipated sea level rise this century. Climate scientists increasingly note the importance of mangrove forests as sinks for carbon storage. They absorb huge quantities of carbon dioxide from the atmosphere, and so act to naturally trap greenhouse gases in underlying sediments. Destruction of this crucial habitat affects not only the process of carbon sequestration, but also releases the stored “blue carbon” back into the atmosphere. Beyond the impact on climate change, mangrove loss places many species at risk, including human communities that have for millennia inhabited these coastal ecosystems.

Historical records reveal that people were already living and securing food and livelihood in the mangrove forests of West Africa when Portuguese caravels arrived in the mid-fifteenth century. A testament to the importance of WAMER mangroves is the actual word *mangrove* itself. Mangroves are found in tropical and sub-tropical areas the world over, but the word is originally from the Senegambian Wolof language. Confronted with an ecosystem unknown in Europe, Portuguese mariners adopted the Wolof word *mangi*, from which the Portuguese *mangue* and English *mangrove* is derived.

The WAMER mangroves present us with the dilemma of protection and people: how to reconcile habitat conservation with the needs of traditional user groups. This is why we call the WAMER mangroves a coupled human-environmental ecosystem. Indeed, there is evidence to suggest that the effectiveness of conservation policies in the region may be ham-





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pered by insufficient understanding of the underlying dynamics of the ecological system and its interactions with local human communities. Thus, new research to develop a holistic appreciation of mangrove-people relationships is critical to forest conservation and ecosystem sustainability. Our project examines the problem of mangrove deforestation by looking at a crucial region of WAMER mangroves that straddles the two West African countries of Senegal and The Gambia. The region hosts the most intact as well as some of the most degraded mangrove forests in WAMER. It is the focus of several ambitious REDD reforestation projects as well as conservation initiatives funded by WWF, the Peace Corps, and other NGOs. Some of these initiatives attempt to integrate the livelihoods of local communities with overall conservation objectives.

Among traditional user groups of Senegambian mangroves, female oyster collectors are important stewards of the environment. Oysters grow on the finger-like stilt roots of *Rhizophora* mangroves and have long provided villagers with protein and women a marketable commodity. Female collectors pilot wooden dugout canoes through the mangroves and follow the tangle of tributaries and waterways that lead to harvest sites. The collectors traditionally remove their catch without damaging the stilt roots, since they well understand that sustainable, healthy mangroves with intact roots are required to host the next generation of oysters. Once taken, the oysters are sometimes eaten fresh but more commonly boiled, since boiling is the best way to protect the meat from spoiling under the tropical sun. If preserved in this manner, the surplus catch can be transported and sold in local markets. A common sight in The Gambia is groups of women camped along the main roads in and around the capital, Banjul, with buckets of boiled oysters for sale.

The WWF currently funds a project in The Gambia that exploits this particular symbiosis of humans and mangroves to advance ecosystem conservation. The project allows traditional oystering groups access to the 6300 hectare Tanbi Wetlands, which became a national park in 2008 and is now protected. By promoting formal oyster culture, a seasonal ban on collecting, and marshaling female oysters into monitoring groups, WWF hopes to create local incentives to protect Tanbi, WAMER's largest remaining intact mangrove forest.



WAMER mangroves along a tributary of the Gambia River



Wild oysters on *Rhizophora* stilt roots



Women paddling to wild oyster sites



Women oyster vendors

Despite the ongoing project in Tanbi, many unprotected mangrove forests in Senegambia are seriously degraded. Behind this loss we find a complex web of social, ecological, and political-economic forces. Our preliminary research suggests that mangrove deforestation in Senegambia is largely driven by the wood fuel demands of rapidly urbanizing coastal populations, which have increased since the 1980s due to accelerating rural-to-urban migration. More than 95% of Gambian households depend on firewood or charcoal for cooking. Along the Atlantic corridor, mangrove forests are a major source for wood. As it turns out, two species of mangrove tree dominate the forest: *Rhizophora* and *Avicennia*. *Rhizophora* is the colonizing waterfront species—it is also the spawning habitat for most of WAMER's fish species and the host for the West African oyster,



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String method of oyster culture

Crassostrea gasar—whereas *Avicennia* occupies inland salt flats. Unfortunately, it's the wood from the oyster-bearing *Rhizophora* that is particularly prized for cooking and construction, so the selective harvesting of *Rhizophora* to supply urban areas has an enormous impact on ecosystem functioning, services, and sustainability.

There is also evidence that political instability abets the unregulated harvest of mangrove forests. Senegal's southern province of Casamance has experienced continuing rural unrest since the 1980s and a secessionist struggle that is West Africa's longest. The Gambia effectively divides Senegal from its fertile southern province, and so shares a largely unenforced border with Casamance. Political instability has allowed uncontrolled felling of mangroves and the illicit movement of firewood and charcoal to The Gambia, mostly along back roads to avoid frontier check-

points. As a result, mangrove firewood from Casamance is widely available in the marketplaces of western Gambia. The rebellion, illicit cross-border wood sales, a porous transnational border that facilitates smuggling, and Gambian firewood demand are primary anthropogenic drivers of mangrove loss in the Casamance region.

One of the tools we are using to assess overall changes in Senegambian mangroves is analysis of Landsat satellite images. In collaboration with CTR affiliate and Geography Professor Tom Gillespie, we have used remote sensing to identify sub-regions of notable mangrove increase or decrease since the 1980s. Surprisingly, the analysis shows that in some areas mangrove coverage has increased, while in others it has decreased. Finding these patterns within the larger mosaic of Senegambian mangrove forests is the first step toward understanding the causes—biophysical, socio-economic, policy interventions—behind the changes in mangrove coverage. One objective is to pinpoint areas of significant deforestation and to examine the drivers of mangrove degradation. Another important objective is to assess the effectiveness of conservation initiatives on ecosystem sustainability and community wellbeing. Of particular concern is the possibility that areas of increasing mangrove coverage may be due to expansion of *Avicennia* species instead of the more important *Rhizophora*. Additional fieldwork is needed to answer this very important question. Finally, we hope to be able to identify those projects that are having positive effects so that they might be replicated elsewhere in West Africa.



Mangrove firewood for sale in The Gambia

**Richard N. Rosomoff is a Senior Research Fellow in the CTR. Dr. Judith Carney is Professor of Geography, an Affiliated Faculty member of CTR, and a Professor in the Institute of the Environment and Sustainability.*



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Integrating surveillance and spatial modeling to predict virus outbreaks

By Trevon Fuller*

Three-quarters of recent emerging viruses in humans, such as Ebola, HIV/AIDS, and swine flu, originated in wildlife and domestic animals. Among the characteristics that an animal-origin virus would likely require to trigger a pandemic are high virulence and transmissibility among people after spilling over from an animal reservoir. It is estimated that five new zoonotic pathogens have jumped to humans from animals every year since 1940. To date, those viruses that have spilled over to people and have been highly virulent have had limited or stuttering person-to-person transmissibility. A salient example is the H7N9 avian influenza virus, which crossed the species barrier from poultry and wild birds to infect humans for the first time in Shanghai in February 2013. Thus far, the virus has had a 32% mortality rate in 140 human cases but person-to-person spread appears to have been limited to family members. H7N9 viruses isolated in China have a number of characteristics that might potentially lead to a pandemic, such as the ability to transmit among lab animals via respiratory droplets and replicate in the upper and lower respiratory tract of primates. However, at present, it is impossible to predict whether H7N9 will evolve sustained human-to-human transmission, triggering worldwide outbreaks.

Decision-makers require predictions about which geographic areas are most likely to be the site of new outbreaks in order to control H7N9 and other emerging zoonotic pathogens. However, logistical constraints often restrict surveillance efforts to a small number of sites. Spatial modeling approaches can allow decision-makers to generalize from a limited number of surveillance locations to assess outbreak risk at the national scale. Such models can identify geographic hotspots where it is most important to implement control measures such as vaccination of health care workers. Spatial models can also prioritize regions where surveillance should be intensified.

To provide a context for our spatial models of avian influenza, we will first summarize relevant aspects of influenza virology and ecology. The influenza A virus has a segmented genome consisting of eight genes. Subtypes of the virus are designated by “H” and “N” numbers, which refer to two surface proteins: hemagglutinin and neuraminidase. In total, 17 different H types and 10 N types have been identified in mammals and wild birds, which are the ecological reservoir of the virus. The past century has seen four pandemics of the influenza A virus: H1N1 in 1918, which killed 40 million, H2N2 in 1957, which killed 1.25 million, H3N2 in 1968, which resulted in 750,000 deaths, and most recently, the H1N1 “swine flu” pandemic of 2009, which killed 285,000. In poultry, the influenza A virus can have low pathogenicity, causing some clinical signs but little mortality, or be highly pathogenic, causing rapid death of domestic birds. For example, the Asian lineage of subtype H5N1, first isolated in southern China in 1996, is highly pathogenic and has had a 60% mortality rate in humans in 630 cases in the Eastern Hemisphere. The virus is thought to have spread to Africa and Europe from Asia in 2005 by migratory birds. Currently, H5N1 is endemic in poultry in Bangladesh, China, Egypt, India, Indonesia and Vietnam. As mentioned above, H7N9 was detected in humans for the first time this spring with substantial mortality. Although epidemiological investigations are still ongoing, many H7N9 cases appear to be associated with exposure to poultry in live bird markets.

The influenza pandemics of 1957 and 1968 arose through a process called reassortment, in which human and avian subtypes of the virus exchanged genes to generate novel strains that successfully invaded the human immune system. Laboratory studies suggest that genes from H5N1 viruses, which have high mortality rates in humans, and human seasonal influenza viruses of subtype H3N2, which have high person-to-person transmissibility, can combine to create new strains that have high mortality rates in mice. This raises the possibility that, among humans, reassortment between H3N2 and H5N1 could result in a virus that spreads rapidly resulting in many deaths. Recently, the CTR has developed spatial models to predict where such reassortment is most likely to occur in Asia. The rationale for this work is to help decision-makers prioritize areas where biosecurity should be enhanced at farms and markets to stop the intermingling of human and avian viruses, potentially preventing reassortment.

Our modeling approach consists of first sampling humans and domestic and wild animals in the field to identify geographic areas in which the virus of interest is present (Fig. 1). After the positive sites have been determined via laboratory screening, we analyze the environmental properties of the site where the sample was collected using satellite images and GIS. We include environmental variables that represent mechanisms hypothesized to affect the persistence of the virus. After fitting a risk model to data on influenza occurrences and environmental variables measured at sampling locations, we then apply the model



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to an entire country or continent. This is possible because predictor variables measured by satellite are available for most of the Earth's surface, including both the sampling locations and remote inaccessible areas that cannot be sampled on the ground easily.

The outputs of our mapping analysis include: (1) the risk that the pathogen such as the avian influenza virus will occur in a geographic area. For example, spatial modeling suggests that the risk of avian influenza in wild birds in the US is greatest in the Central US and Pacific Northwest (upper right map in Figure 1); (2) the confidence interval of prediction, which is a measure of uncertainty. Areas with high uncertainty about avian influenza, such as the Central US (lower right map in Figure 1), can be prioritized for increased surveillance to reduce this uncertainty; (3) hypothesis tests of which environmental variables are statistically significant as drivers of the virus, and finally (4) predictions about where the pathogen may shift in the future in response to global climate change.

We recently applied our spatial modeling approach to prioritize geographic hotspots where human H3N2 and avian H5N1 viruses are most likely to reassort in East Asia (for details, see *Emerging Infectious Diseases* 13: 581-88). The rationale for this study was that if we can pinpoint where a reassortant virus is circulating in animals before it crosses the species barrier to infect humans, it is likely to be much easier to limit the virus' spread. For example, detecting and stamping out the 2009 H1N1 virus in pigs before human spillover would have had major public health and economic benefits. Although our study of influenza hotspots in Asia was published before H7N9 was identified in humans, the areas that the model prioritized as having

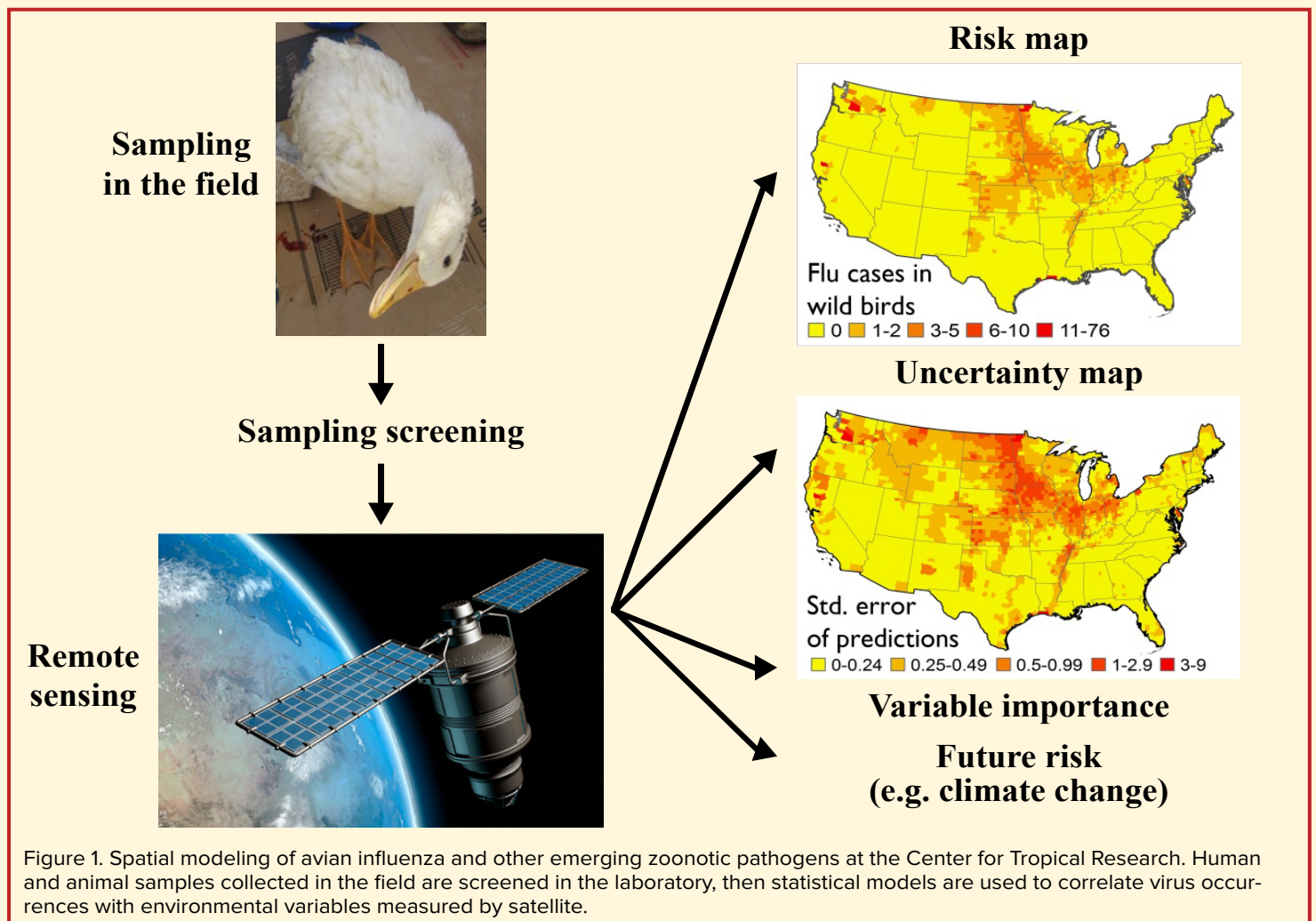
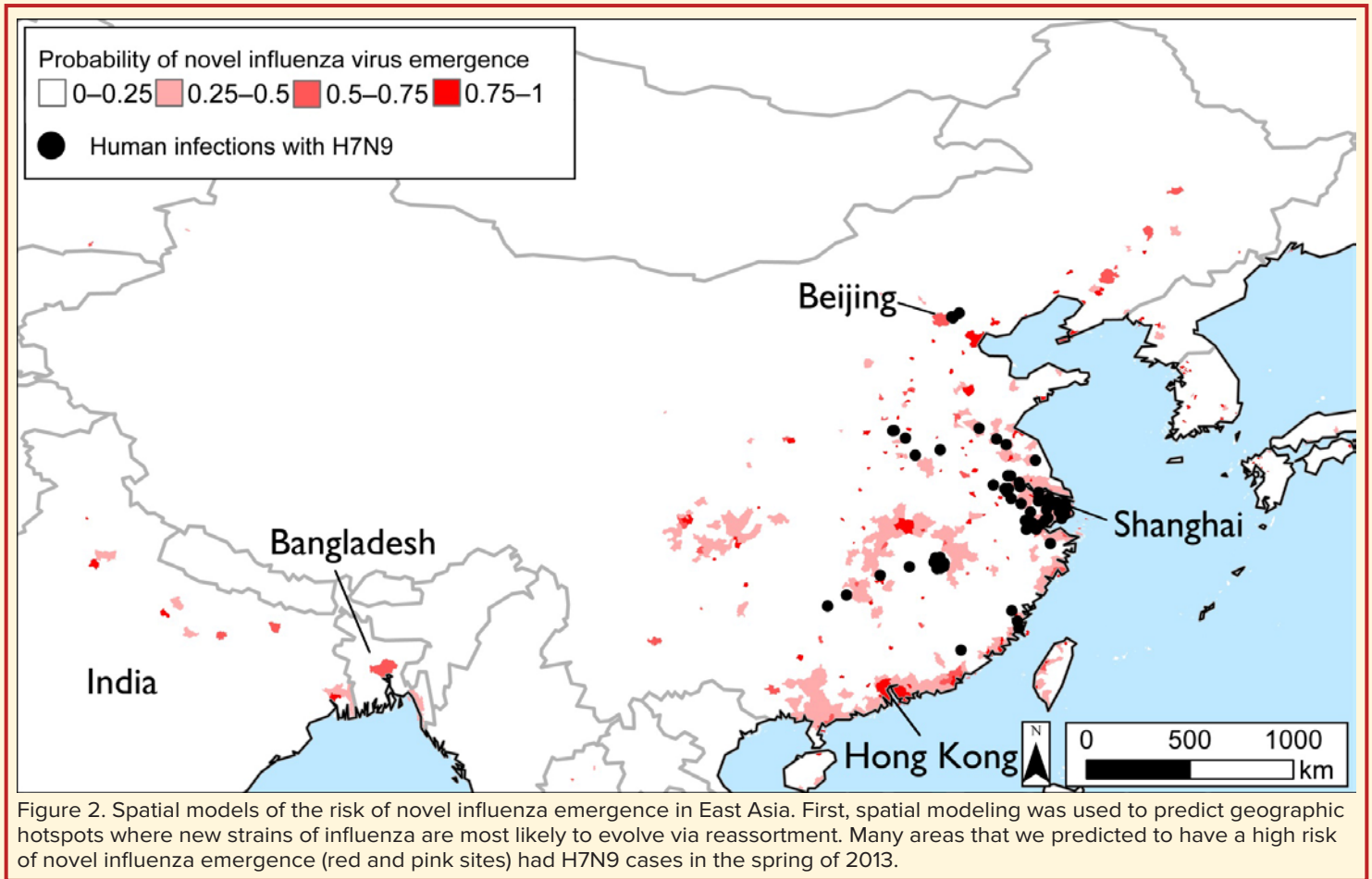


Figure 1. Spatial modeling of avian influenza and other emerging zoonotic pathogens at the Center for Tropical Research. Human and animal samples collected in the field are screened in the laboratory, then statistical models are used to correlate virus occurrences with environmental variables measured by satellite.



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a high risk of novel influenza virus emergence overlap substantially with H7N9 cases (Figure 2). Our risk model was constructed from environmental variables including human and poultry population density and measures of agricultural production. These variables may be effective predictors of H7N9 emergence because populous cities in southeastern China had high densities of poultry in live bird markets.



In conclusion, we believe that integrating spatial modeling with field-based surveillance can enhance decision-makers' ability to evaluate the threat posed by zoonotic viruses. Although we have focused on influenza virus in birds, spatial modeling may have utility for a variety of pathogens. Satellite images of ecological variables that control disease distributions are freely available at the global scale. Thus, the approach presented here can be applied to any country.

* *Dr. Trevon Fuller is a senior postdoctoral fellow in the CTR.*



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CTR UPDATES

Field Research Trips

Tim Bonebrake led a team of CTR researchers (Tom Smith, Kevin Njabo and Francis Forzi), to collect *Bicyclus dorothea* butterfly samples throughout Cameroon as part of the recently awarded NSF-PIRE grant. During the month of July, individuals were collected from several sites including Lobeke, Nkolbisson, the Dja Faunal Reserve, and Campo Ma'an. The team is hopeful the samples will provide information on the distributional limits of *B. dorothea*. Preliminary studies have also begun in preparation for the *B. dorothea* common garden experiment. Female *B. dorothea* individuals have been brought to husbandry facilities at the International Institute of Tropical Agriculture (IITA) in Yaoundé, Cameroon, and are currently being offered a variety of host plants. CTR is now working out ideal conditions (host plants, temperature, humidity, cage structure) for colony growth so that common garden experiments can begin early next year.

Anthony Chasar traveled to Cameroon and Gabon from October 2012-January 2013 to continue collaborations with the government and private institutions in order to expand CTR's influenza surveillance efforts in Central Africa. He and his team visited sampling sites across the countries of Gabon and Cameroon, collecting samples from over 1000 domestic poultry. In October-November 2013, he and his team returned to Cameroon to continue influenza sampling in live bird markets.

Brenda Larison and Tom Smith visited Zambia and the Caprivi Strip in Namibia in October 2012 to collect tissue samples from plains zebra for a project examining the genetic and adaptive bases of stripe variation in plains zebra.

Kevin Njabo, Tom Smith, and CTR researcher Francis Forzi carried out a large-scale sampling and specimen collection this past summer as part of the NSF-PIRE grant. Sampling was collected at four sites in Cameroon (Ebo Forest, Edea - Palm d'Or, Kribi, and Mbam-Djerem National Park). Work included sampling wild birds via mist nets at Ebo Forest and Mbam-Djerem National Park. In addition, they collected specimens of the rainforest skink *Trachylepis affinis* as part of the NSF-PIRE grant.

Camille Yabut travelled to Kenya from July to August 2013 to collect samples from endangered Grevy's zebra. These samples will be used to investigate population genetic structure in Grevy's zebra, with the goal of understanding how anthropogenic activities impact spatial patterns of genetic variation. She sampled animals from four conservancies in the Laikipia district of the Great Rift Valley. Her fieldwork was funded by the NSF and the UCLA Department of Ecology and Evolutionary Biology.

Other News

Julia Barske received the 2012 Outstanding Student Paper Award from the Organization for Tropical Studies for her paper: Barske J, Schlinger B, Wikelski M, Fusani L. Female choice for male motor skills. *Proceedings of the Royal Society B: Biological Sciences* 2011; 278:3523–3528. This paper focused on the courtship displays of wild male Golden-collared manakins (*Manacus vitellinus*) in the forests around Gamboa, Panama.

Elena Berg is wrapping up a three-year post-doc at Uppsala University, Sweden, where she has been investigating the evolution of aging in seed beetles. She recently accepted a position as Assistant Professor of Biology at the American University of Paris and will be relocating to France this December. At AUP, Elena will continue her research on the behavior and life history of beetles and will be helping to develop an undergraduate and master's program in Environmental Science.

Emily Curd completed her field research and has been analyzing data. Her results have been presented as posters and a presentation at scientific meetings. First, a poster entitled "A metagenomic study of soil microbial communities on carbon cycling under various vegetation types" was presented to the annual meeting of the Federation of European Microbiological Societies Congress. Her second poster was presented to the 5th Annual Argonne Soil Metagenomics Meeting and entitled "Digging the decomposer community out of soil metagenomic data." She also gave a talk at the Ecological Society of America meeting entitled "A metagenomic study of soil microbial communities under various vegetation types and soil depths." She also received a UCLA Office of Instructional Development Teaching Assistant Mini-Grant.

Jean Bernard Dongmo was approved this year by the Cameroon government as an official Cameroon National Birding



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Guide (Reg. N° 06/CF/MINTOUL/SG/DET/SDAC). With 12 years experience based at the University of Yaoundé, he can be hired to accompany you anywhere in the country to help you find your required bird species for field research.

Trevon Fuller was one of 23 postdoctoral fellows to be nominated for the Chancellor's Award for Postdoctoral Research that honors outstanding research accomplishments by a UCLA postdoctoral scholar. Trevon gave a presentation at the American Association for the Advancement of Science, Pacific Division Meeting in Las Vegas, Nevada on June 17, 2013 entitled "Identifying areas with a high risk of human infection with the avian influenza A (H7N9) virus in East Asia." Trevon also presented two posters at the 7th Annual Centers for Excellence in Influenza Research and Surveillance (CEIRS) Network Meeting in Memphis, Tennessee on July 8, 2013. The first poster was entitled "Identifying areas with a high risk of human infection with the avian influenza A (H7N9) virus in East Asia" and included CTR co-author Tom Smith. His second poster, entitled "Seasonal dynamics of avian influenza outbreaks in Central Africa" included CTR co-authors Kevin Njabo, Erin Toffelmier, Anthony Chasar, and Tom Smith.

Leonida Fusani was invited to deliver a plenary lecture at the IX Meeting of the European Ornithologist's Union in August about his work on courtship behavior of golden-collared manakins in Panama.

Ryan Harrigan, along with a group of CTR scientists, traveled to Gabon, Africa, to help lead an intensive six-day workshop centered on professional development for over 60 international students. This workshop covered a wide range of topics, including the writing of grants, developing leadership and career opportunities, and conducting effective field studies. See workshop report for more details.

Rachel Johnston received a Research Award from the UCLA Department of Ecology and Evolutionary Biology in June 2013. She is using this award to identify genes associated with bird migration by comparing transcriptome-wide gene expression in migratory and non-migratory Swainson's thrushes.

Kristine Kaiser was appointed to Visiting Assistant Professor at Pomona College this past January. She is teaching courses on Comparative Vertebrate Endocrinology, Conservation Biology, and Urban Ecology.

Jordan Karubian, along with co-authors Tom Smith, Renata Duraes, and Jenny Storey, were selected by the Editors of *Biotropica* as the recipient of the 2013 Annual Award for Excellence in Tropical Biology and Conservation for their publication "Mating behavior drives seed dispersal by the long-wattled umbrellabird *Cephalopterus penduliger*." Criteria for this award included clarity of presentation, strong basis in natural history, well-planned design, and novel insights gained into critical processes that influence the structure and functioning of tropical biological systems.

Brenda Larison received a grant in 2011-2012 from the National Geographic Society to cover field research on her project "How the zebra changed its stripes: the evolution of stripe variation in the plains zebra." In August 2013, as a NGS grantee, she was invited to give a lecture and update on her project to the NGS Committee for Research and Exploration during the Committee's site visit to Kruger National Park in South Africa.

Alison Lipman will be leading a new 8-week field study program in the Bolivian Amazon during summer 2014. Students will live, conduct research, and work side by side with indigenous people on local projects that build healthier, more sustainable communities. Students can choose to focus in one theme area: conservation, education, or health/nutrition. AmazonX is open to all interested students and faculty. There is a soft application deadline of Dec 9, 2013. For more information please visit <http://selvainternational.org/amazonexchange.htm>

Kevin Njabo was appointed Assistant Adjunct Professor with the UCLA Institute of the Environment and Sustainability this past spring.

Hilton Oyamaguchi presented his Ph.D. work entitled "Importance of the Amazon-Cerrado gradient in preserving adaptive variation in a changing world" at the International Congress for Conservation Biology in Maryland in July 2013. He received a travel award from the Society for Conservation Biology and from the Dept. of Ecology and Evolutionary Biology, UCLA to attend this meeting. In this conference, he received 1st place in the student poster prize sponsored by the Animal Conservation



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journal ([http://onlinelibrary.wiley.com/journal/10.1111/\(ISSN\)1469-1795](http://onlinelibrary.wiley.com/journal/10.1111/(ISSN)1469-1795)).

Kristen Ruegg was appointed Assistant Adjunct Professor with the UCLA Institute of the Environment and Sustainability this past summer. She was also the invited keynote speaker at the National Audubon Society's Lafont Teach-in that took place in Atherton, California on November 12, 2012. Kristen's well-received lecture was entitled "Identifying migratory connections using genetic and isotopic methods."

Raul Sedano completed his dissertation research on evaluating avian phylogeography in latitudinal and altitudinal gradients in the Tropical Andes. He received his Ph.D. from the Department of Ecology and Evolutionary Biology at UCLA in June 2013. Raul has returned to his home country of Columbia and has accepted a faculty position at the Universidad Industrial de Santander, Columbia.

Tom Smith and Kevin Njabo travelled to Geneva, Switzerland from October 2-4, 2013 to attend the 9th edition of the EMA Invest Forum. Organized under the main theme, "Geneva and Africa: the new win-win," the EMA Invest Forum brought together stakeholders in Africa's economy, business people, and Swiss investors. The government of Cameroon sent a team led by Emmanuel Nganou Djoumessi, Minister of Economy, Planning and Regional Planning. Two of CTR's projects were presented at the forum: the proposed building of a high-tech campus and research center named "Center for Integrative Development," and the Dja-REDD+ project. The trip was made possible by a generous grant from CTR Friend Lee Cooper.

Antonio Guillén-Servent and colleagues served as faculty in August as part of the first "Latin American Course on Bat Acoustics." This was an introductory hands-on course held at the Tirimbina Rainforest Center, Costa Rica prior to the International Bat Research Conference (IBRC) in Costa Rica. The main objectives of the course were to promote the use of ultrasound techniques to study bats in the Neotropics, and to provide the students with the basic knowledge to initiate their own studies using ultrasound detection techniques. There are plans to offer a similar course prior to the 1st Latin American Bat Congress (Congreso Latinoamericano de Murciélagos), to be held in Quito, Ecuador in August 2014.

Madeline Tiee received a GAANN (Graduate Assistance in the Areas of National Need) graduate support fellowship for 2013-2014 from the U.S. Department of Education. The GAANN grant program aims to promote careers in areas of national need that combine research with teaching. This fellowship will support her research on understanding how environmental and ecological correlates such as bat population structure, population connectivity, and migration affect viral diversity and evolution. In addition to her bat research, Madeline is currently working on a project that aims to understand the historical range and diversity of monkeypox virus within one of its natural hosts in Central Africa.

Paula White and the Zambia Lion Project's (ZLP) work to develop and promote age-based trophy selection of Africa's wild lion populations, earned the African Professional Hunters Association's "Conservation Award" for 2013. This effort constitutes a primary focus of ZLP's work and includes field-based research, interfacing with African governments, USFWS, and professional hunter associations, as well as conducting hunter outreach and education.

Camille Yabut was awarded a three-year Graduate Research Fellowship by the National Science Foundation in April 2013, and a Research Award from the UCLA Department of Ecology and Evolutionary Biology in June 2013. These awards will be used to study the genetic and ecological effects of anthropogenic activities in endangered Grevy's zebra.

Publications and Press

Trevon Fuller and colleagues published a paper in March 2013 in the journal *Emerging Infectious Diseases* entitled "Predicting hotspots for influenza virus reassortment" that garnered significant press. As the name suggests, they aim to predict where the next flu outbreaks are likely to occur in hopes of avoiding future pandemics. Quotes from Trevon and Tom were featured in a variety of news outlets including the L.A. Times, UCLA Newsroom, Avian Flu Diary, Infectious Disease News, Science Daily, and UC Health. Please see: <http://newsroom.ucla.edu/portal/ucla/predicting-hotspots-for-future-244172.aspx>; <http://www.latimes.com/news/science/sciencenow/la-sci-sn-bird-flu-h7n9-shanghai-20130404,0,894324.story>; <http://articles.latimes.com/2013/mar/19/news/la-heb-influenza-hotspots-h5n1-h3n2-20130319>; <http://www.sciencedaily.com/releases/2013/03/130314141333.htm>; <http://health.universityofcalifornia.edu/2013/03/14/predicting-hotspots-for-future-flu-outbreaks>



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Trevon Fuller and colleagues published a paper entitled “Intraspecific morphological and genetic variation of common species predicts ranges of threatened ones” in the journal *Proceedings of the Royal Society Biology*. This finding has the potential to revolutionize the design of biological surveys because it suggests that habitat for threatened species can be predicted by collecting genetic and phenotypic samples from common ones. See <http://news.mongabay.com/2013/0605-isaacs-rarity-biodiversity.html>

Colin Rundel and colleagues published an article in the August 2013 edition of *Molecular Ecology* entitled “Novel statistical methods for integrating genetic and stable isotope data to infer individual-level migratory connectivity.” This paper discovers why a subspecies of the Wilson’s Warbler has been vanishing. A summary was featured on <https://birdsnews.com/2013/1276/#.UqoLuKUbp4P>

Kristen Ruegg and colleagues published a paper entitled “Long-term population size of the North Atlantic humpback whale within the context of the worldwide population structure” in *Conservation Genetics*.

Sassan Saatchi and his team at NASA’s Jet Propulsion Laboratory have previously mapped out carbon across the world’s tropics. In partnership with the WWF Germany, they are starting a new project that garnered press in *Nature*. In this latest endeavor, the team will be mapping forest biomass to accurately measure the carbon stored in the rainforests of the Democratic Republic of the Congo (DRC). The ultimate goal is to help DRC sell carbon credits and establish a system to monitor deforestation. See <http://www.nature.com/news/congo-carbon-plan-kicks-off-1.13910>

Tom Smith and colleagues published a paper entitled “Predicting bird song from space” that appears in the September 2013 issue of *Evolutionary Applications*. This paper looked at how satellites and the data they collect can be used to predict complex animal behavior, in this case bird song, at large spatial scales. See <http://www.united-academics.org/magazine/earth-environment/birds-evolution-from-satellites>; http://science.leidenuniv.nl/index.php/ibl/newsitem/may_2013_predicting_birdsong_from_space; <http://www.themunicheye.com/news/To-Predict-a-Bird%27s-Song%2C-Head-Out-to-Space-2686>

Kelly Swing is featured in a special 40-page *National Geographic* article that was published as part of their 125th anniversary. The story is centered on the growing struggle between conservation and oil exploitation in Ecuador’s Yasuni rainforest. The article can be viewed here: <http://ngm.nationalgeographic.com/2013/01/yasuni-national-park/wallace-text>. In addition, Kelly was asked to contribute to a blog published on the NGS website. His post, “Science in Yasuni Sheds Light on Impacts of Oil Development in the Amazon” can be found here: <http://newswatch.nationalgeographic.com/2012/12/26/-science-in-yasuni-sheds-light-on-impacts-of-oil-development-in-amazon>

As background, since 2007, when Ecuador’s President, Rafael Correa, proposed to save a portion of the world’s most diverse region, the Yasuni Biosphere Reserve, through an innovative plan to leave oil deposits untouched, the search for offsetting funds has been disappointingly unfruitful. Stating that “the world has failed us” on the 15th of August of 2013, he announced that in the near future, heavy machinery would move into the easternmost concession area to begin development, pointing out that it is poverty that applies the greatest of all pressures on nature. In order to protect the 100,000 species that inhabit each hectare of intact forest as well as the uncontacted Tarmenane people, he has pledged that cutting-edge technologies and strategies will be employed.

Mr. Correa has asked the people of Ecuador and of the world to understand that the sacrifice to the sector in question, called the ITT Block, will be “less than 0.1%” of its surface area while the payoff will amount to US \$18.2 billion. Knowing the devastating history of oil extraction in other parts of Ecuador, many are saying that this scenario sounds too good to be true. If off-shore methods are faithfully incorporated, including no new access roads, it might indeed be possible to avoid the historical outcomes seen in neighboring expanses. Noting that over half of the national park is already impacted by industrial operations, concerned scientists and conservationists encourage the drawing of “a line in the sand” so as to set aside a substantial portion of what remains of this unique piece of western Amazonia.

Paula White published numerous scientific articles in *Conservation Genetics*, *Small Carnivore Conservation*, *Quaternary International* and a number of popular articles. Seminal research aimed at refining methodologies to age wild lions will continue in 2014, while completion of finer-scale genetic analyses of Zambia’s lion populations is anticipated this coming year.



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Grants

California Landscape Conservation Cooperative provided funding to the CTR in partnership with Drs. Seth Riley and Katy Semple Delaney of the Santa Monica Mountains National Recreational Area (SMNRA) to examine four species of vertebrates that differ in range size and habitat requirements. Species included: the side-blotched lizard (*Uta stansburiana*), the western fence lizard (*Sceloporus occidentalis*), the western skink (*Plestiodon skiltonianus*), and the wrentit (*Chamaea fasciata*). Although none of these species are of conservation concern in particular, researchers determined that those regions in Southern California that harbor high genetic diversity for common species are likely to contain similarly high genetic diversities in rare or endangered species. The final results of this work are being incorporated into a manuscript that will then help inform and prioritize conservation efforts in the Santa Monica Mountains.

Jordan Karubian recently received funding from the U.S. Fish and Wildlife Service for work on migratory birds in Ecuador, and from the Louisiana Board of Regents and Disney Worldwide Conservation Fund for work on fairy-wrens in Papua New Guinea.

The **NIH Centers for Excellence in Influenza Research and Surveillance (CEIRS)** continues to provide funding to CTR for flu research and surveillance. Avian influenza virus is a major threat to human health and the poultry industry. Since expanding from Asia to Europe and Africa in 2006, the virus, which is transmitted to humans by domestic and wild birds, has infected more than 600 people in the eastern hemisphere with 60% mortality. Although Central Africa has been highly impacted by avian influenza with eight countries reporting outbreaks, important aspects of the virus remain unknown in this region, such as its prevalence in wild birds, the frequency of transmission to poultry, and the seasonal timing of outbreaks. CEIRS funding has allowed CTR to test wild and domestic birds for avian influenza in Cameroon, Central African Republic, Gabon, and the Republic of Congo. Since 2010, more than 3000 birds from 190 species at 23 field sites in the Congo Basin have been tested. This research has discovered that avian influenza spikes twice a year in wild birds: once during the little rainy season in the spring and again during the big rainy season in the fall, which coincides with the arrival of Palearctic migrants in Central Africa. Results also found substantial prevalence of avian influenza in resident songbirds, which likely maintain the virus throughout the year. In January 2014, CTR will expand sampling for the first time to the Democratic Republic of Congo.

CTR continues to receive funding from the **NIH Fogarty International Center (FIC)** to support examination of comparative spillover dynamics of avian influenza in Cameroon and Egypt. CTR recently completed a one-year effort in collaboration with partners the EcoHealth Alliance and University of Oklahoma. The work investigates the role of wild bird interactions and transmission potential between wild birds and domestic poultry from contact rate data collected, and analyzed the differences in these contact rates. CTR also integrated social and cultural data collected previously under NIH FIC funded studies from human subjects in Egypt and Cameroon into social networking models to compare how socioeconomic structure and farming practices influence H5N1 highly pathogenic influenza endemicity. CTR also conducted spatial modeling and integration of environmental data in collaboration with other project team members, with a specific focus on understanding the environmental correlates of H5N1 as well as identifying regions of potential reassortment.

CTR is completing Year 1 of a \$5 million five year **Partnerships in International Research and Education (PIRE)** grant from the National Science Foundation. The project unites senior investigators, junior researchers, and students from the U.S., Africa, and Europe focused on a common research and education plan centered in Gabon and Cameroon, Africa. A major emphasis of the PIRE project is to collectively build an undergraduate and graduate educational program that will partner U.S. and African students in a common learning environment and provide them with cutting edge skills in the biological, environmental and social sciences. CTR will also organize annual professional development workshops for U.S. and African early career scientists and advanced graduate students in order to prepare them for a future career in environmental sustainability sciences. The overall research goal of the grant is to develop an integrated framework for protecting and managing Central African biodiversity under climate change that is both evolutionary-informed and grounded in the socioeconomic constraints of the region. Towards this goal, the PIRE partners have formed the **Central African Biodiversity Alliance (CAB)**. CAB is an extensive international collaboration/partnership and involves researchers, policy makers, and students from the US, Cameroon, Gabon, Equatorial Guinea, and Europe. Please visit www.caballiance.org for more details.

The PIRE grant is developing spatially explicit modeling approaches to map evolutionary process in taxa with a diverse set of



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life history traits and sensitivities to climate change, including a butterfly, a frog, a *Marantaceae* family plant species, two birds (CTR focal taxa the Little Greenbul and Olive Sunbird), a rodent, a skink, the chimpanzee and the blue duiker. CTR's research will identify Regions of Evolutionary Adaptive Potential ("REAPs"), and then develop an integrative prioritization scheme that ranks candidate REAPs for protection based not only on their evolutionary potential and connectivity but also on their socioeconomic opportunity costs, degree of threat, and cultural value.

Announcements

Establishment of the Center for Integrated Development/Cameroon (CID/C)

Plans for establishing the Center for Integrated Development/Cameroon (CID/C) and transitioning the IRTC are quickly progressing. The International Research and Training Center (IRTC), located in Yaoundé, Cameroon has served as a logistical research hub and lodging facility for international scientists since 2010. Over that time, it has been used by more than 800 researchers from 15 countries.

Building on the IRTC's success, the CID/C is being created as a permanent, multidisciplinary enterprise focused on innovative evidence-based solutions to the critical development challenges facing the region. Initial CID/C scientific and training programs will focus on three overarching issues facing Central Africa: climate change and biodiversity, food and water security, and human health. The CID/C is being developed with consortium partners, including: the International Institute of Tropical Agriculture (IITA), the World Agroforestry Centre (ICRAF), Centre Pasteur du Cameroun, and all seven major universities of Cameroon. More than 35 UCLA faculty members from 17 Divisions and Schools are participating in the project.



Gensler, a leading global architecture firm, has developed the building plans for the first phase of the campus (see above image). With a green designed Research and Education Park as its foundation, the CID/C is leveraging the resources of universities, industry, and development organizations to expand and amplify the capacity to create a larger and more integrated research and training facility, training hub, and test bed for innovative technologies focused on sustainability. Utilizing the existing IITA campus, the new CID/C will include: 1) a distance learning center for U.S. and African students, 2) digital data repositories, 3) technical training and equipment repair facility, 4) remote sensing research and GIS research and training lab, 5) molecular genetics and analytical laboratories, 6) platform/technology test bed innovation facility, 7) an incubator for start-ups and entrepreneurs, 8) lodging and conference center, and 9) logistics and administrative office to assist international participants and help partner them with local researchers. The CID/C will serve as a regional hub for activities in Gabon, the Republic of Congo, Nigeria, Chad, the CAR, Equatorial Guinea, and the DRC.

For more information, see <http://www.environment.ucla.edu/ctr/initiatives/index.html>

CTR Establishes the Betty and E. P. Franklin Grant in Tropical Biology and Conservation thanks to an endowment provided by the Franklin family. This annual grant will provide travel awards to UCLA graduate students conducting field research in the tropics. Many exciting proposals were received in its debut year and CTR was able to grant a total of three awards. Recipients included Rita Rachmawati and Adrea Gonzalez-Karlsson from the Ecology and Evolutionary Biology department, and Corey Rovzar from Geography. Rita is studying the response of Indonesian corals to bleaching events associated with global warming. Adrea is studying communication space and modality integration in *Ithomiini* butterflies in Costa Rica. Corey is studying species distribution modeling of *Hibiscus brackenridgei* on Oahu, Hawaii. CTR would like to congratulate all the applicants on a job well done and looks forward to what's in store next year.



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Partnership for International Research and Education Program (NSF-PIRE) - Science and Policy Workshop, Yaoundé, Cameroon, July 3, 2013

By Kevin Njabo

Dr. Thomas B. Smith, Dr. Mary Katherine Gonder, Professor, Drexel University and CTR Fellow, Dr. Kevin Njabo and Dr. Mark Gold (UCLA) in partnership with the Ministry of Higher Education, Republic of Cameroon organized a one-day National Science Foundation - Partnerships for International Research and Education Program (NSF-PIRE) workshop in Yaoundé, on Wednesday July 3, 2013.

The main objective of the workshop was to introduce the project to government officials and NGO leaders in Cameroon. The workshop brought together the major institutions involved in the development and implementation of biodiversity policy, education, and training in Cameroon, and involved a detailed discussion about the NSF-PIRE project, talks and round-table discussions related to the project with the aim of uniting the partners in a common vision of how this project will proceed. The workshop was chaired by Professor Tjade Eone, representing the Minister of Higher Education's Professor Jacques Fame Ndongo, who assured the unflinching support of the government of Cameroon to see the project to fruition.



Opening ceremony at the Science and Policy Workshop

The workshop was attended by 28 scientists, representing 17 different institutions including the Ministry of Higher Education (MINESUP), Ministry of Scientific Research and Innovation (MINRESI), Ministry of Wildlife and Forestry (MINFOF), Ministry of the Environment, Nature Protection and Sustainable Development (MINEPDED), World Agroforestry Center (ICRAF), IITA, IUCN, WWF, WCS, the Universities of Yaoundé I, Dschang and Buea. The workshop is part of a 5-year project whose goal is to develop an integrated framework for conserving Central African biodiversity under climate change that is informed by the ecology and socioeconomic constraints of the region. The project unites researchers and students from the United States, Cameroon, Gabon, United Kingdom, Germany, France and the Netherlands around an innovative research program that seeks to identify meaningful conservation measures to mitigate the effects of habitat loss and climate change. Joint international research and educational efforts will enhance existing collaborations and establish new partnerships that will build a foundation for lasting conservation and sustainability in Central Africa.

The National Cameroon TV station (CRTV), provided news coverage of the event. See: <http://www.youtube.com/watch?v=E5CD08v67Ww&list=UU6FgrtJW9xChZVXyMbFrNbA>

** Dr. Kevin Njabo is the Africa Director for CTR and is Assistant Adjunct Professor with the UCLA Institute of the Environment and Sustainability.*



Mark Gold presenting at plenary session



Tom Smith presenting a gift to Professor Ndongo by way of Professor Eone



Participants during a breakout session



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Inaugural Professional Development Workshop for the National Science Foundation's Partnership in Research and Education

By Ryan Harrigan*

This summer, a group of scientists, led by Professor Dr. Nicola Anthony, Professor at the University of New Orleans and CTR Senior Research Fellow, traveled to Gabon, Africa, to help lead an intensive six-day workshop centered on professional development of international students. The NSF-PIRE workshop covered a wide range of topics, including the writing of grants, developing leadership and career opportunities, and conducting effective field studies. In developing countries, it is imperative that young researchers have access to the latest in laboratory and field techniques so as to understand the development of the field, and how their own research is part of a global effort to understand the dynamics of biological systems. With widely available internet service and the emergence of free software packages, it has never been easier to provide students with the tools necessary to create cutting-edge research endeavors. Professional development also includes acquiring social and writing skills necessary to communicate findings and inspire fellow students and researchers in their own work.



From left to right: Ephrem Nzengue, Instructor Ryan Harrigan, and Roland Mitola

The Central and West African tropics are home to an amazing diversity of plants and animals, but these organisms are impacted by numerous threats, including climate change, anthropogenic destruction (logging and hunting are still major sources of income and subsistence in these areas, respectively), and land development. In order to prevent destruction of the most biologically valuable parts of the tropics, researchers must first understand where the most diversity exists. By identifying these areas, conservationists can then reach out to governments to protect the wildlife living in them. While international researchers have been successful at persuading officials to protect parts of the African tropics, local students and researchers are the group most likely to impart change in this region. By arming these scientists with the ability to identify biodiversity, and understand how to best conserve it, the health of this unique and biologically rich region can be assured.



Bridge the participants used to visit a pygmy village

Students and instructors from around the world gathered in the town of Franceville in eastern Gabon, Africa, for the first (of three) professional development workshops to be held to bring the latest research and technology to Central Africa. Partners included researchers and faculty from the University of New Orleans, the University of Oregon, Cardiff University (U.K.), Harvard University, and the American Museum of Natural History. Faculty from the Université des Sciences et Techniques de Masuku, the campus which hosted the workshop, contributed unique and extensive knowledge of the local biota and ecological processes to the international faculty and students alike. More importantly, several international collaborations and lines of communication were established at this meeting, ensuring international experience can be shared across continents in future research efforts.

The workshop concluded with a 3-day hands-on computer laboratory session, where participants then learned the ins and outs of computer programming,

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Student giving presentation during workshop



Ministry of Forestry Building, Gabon

geographic information systems (GIS), and analysis of genetic data. Over 60 students from around the world attended the workshop, and the enthusiasm and thirst for knowledge did not end with the conclusion of the week. Many of the students are continuing research started at the workshop and building upon international collaborations with researchers that attended.

CTR looks forward to the 2014 workshop, which will be held in Cameroon, Africa, and will build upon the research topics and lessons learned in Gabon.

* *Dr. Ryan Harrigan is a senior postdoctoral fellow in the CTR.*