Science & Bat Conservation at Wind-Energy Sites
fifty-two years ago, Rachel Carson alerted us to the danger to bird survival of indiscriminate application of DDT to our environment. Her book, Silent Spring, had a major impact, in no small part because birds are loved and defended by millions of people. No one wanted to contemplate a spring made silent of birdsong by poisonous pesticides. Today a disaster of similar proportions is occurring, but we as a society are not responding because the victims are unpopular animals: bats.

Many animals, such as sharks, snakes, toads, spiders, scorpions and bats suffer from bad reputations. Filthy, diseased, dangerous, and treacherous are some of the anthropocentric and subjective adjectives used to describe them. Bats are arguably the most unfairly judged. Even today, relatively few people know about the invaluable ecosystem functions and services they provide to nature and to humans. Bats are very effective insect pest controllers. Their value has been variously estimated between hundreds of thousands and millions of dollars a year for the cotton and corn industries of Texas alone. Bats are also responsible for pollination of many ecologically or economically important plants. For example, bats pollinate agaves that are used for tequila and mezcal. Tequila alone represents about a billion dollars in sales each year for Mexico. Finally, seed dispersal by tropical bats promotes forest regeneration and provides economically important fruits such as zapotes, guavas, and figs.

People have killed bats in the past simply because of their bad reputation, and now there are two new major sources of mortality, which have killed millions of bats in recent years. The white-nose syndrome (WNS) a disease caused by a cold-loving fungus, has killed over 6 million bats since 2006 in the northeastern U.S. alone. This year, the range of this fungus has expanded to the usually mild-wintered states of Missouri, Arkansas, and South Carolina. WNS will very likely cause the extinction of some bat species. Once a very common bat, the northern long-eared bat has declined by 99% in the northeast, triggering the U.S. Fish and Wildlife Service to list it as an endangered species. Other species of hibernating bats have declined anywhere between 45 and 95%. No one knows how long it will take bat populations to recover or which other species will disappear.

Humans are causing the additional death of hundreds of thousands of migratory bats. Estimates of wind turbine-related mortality installed along corridors of tree-roosting bat migration range between 600,000 and 900,000 bats every year, although some recent reassessment adds uncertainty to these numbers, suggesting that more research is needed to make more robust estimates. At any rate, mortality is likely to be in the hundreds of thousands, one-fourth to one-third of which are hoary bats, a long-distance migrant that has the potential to move between Canada and Mexico, Missouri, Arkansas, and South Carolina. WNS will very likely cause the extinction of some bat species. Once a very common bat, the northern long-eared bat has declined by 99% in the northeast, triggering the U.S. Fish and Wildlife Service to list it as an endangered species. Other species of hibernating bats have declined anywhere between 45 and 95%. No one knows how long it will take bat populations to recover or which other species will disappear.

We owe it to the bats. Their silent partnership with us and our own wellbeing is at stake. Silent spring nights – minus the clicking sounds and the aerial acrobatics of the many bat species that frequent nocturnal skies – are in our future if we do not act now. We can make a difference. It’s time to start.

1) Continued research on WNS to find a cure or preventive measures.
2) Implement and enforce bat-protective turbine management at wind farms. People should contact their power providers, local elected officials and other authorities.
3) Communicate with friends, colleagues, and family about how important bats are so that their unfairly applied negative image is dispelled for good.
4) Avoid consuming or otherwise promoting transgenic products.

Don J. Melnick is Professor of Biology at Columbia University, and Dr. Mary C. Pearl is Provost, Macaulay Honors College and Professor of Biology, Brooklyn College, City University of New York.
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Features

Silent Spring Nights

2 Applying Research to Conservation
Science-based strategies can save bats at wind farms
by Erin Baerwald and Robert Barclay

Bats & Wind: A long search for solutions
by Cris Hein

6 Bats & Cattle Pastures in Mexico’s Rainforest
River corridors help preserve bat diversity
by Erika de la Peña-Cuellar

12 Geophysics & Bat Guano
Probing the depths of Bracken Cave
by George Veni

15 Bats & Coffee in Sumatra’s Rainforest
Expanding coffee plantations threaten diversity on Indonesia’s island
by Joe Chun-Chia Huang

News & Notes

18 New bat species is bad news for an old one
Oklahoma is no longer suspect for WNS
The Passing of Friends
A bat champion retires
BCI Member Snapshot
The Wish List

Cover: TransAlta, Canada’s largest wind-energy producer, is supporting research and action to minimize bat fatalities at its Summerview I Wind Farm in southern Alberta. See page 2.

Photo courtesy of Monty Nicol

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The conservation calculus for wind energy changed dramatically in Fall 2003. Bird fatalities had been the primary environmental concern at the giant, spinning turbines, especially eagles, hawks and other raptors. Then a study commissioned by FPL Energy discovered many more bat carcasses than birds at FPL’s Mountaineer Wind Energy Center in West Virginia. The concerns about environmental impacts of wind power began to change across North America.

The Mountaineer finding caught everyone off guard. A planning session hosted by Bat Conservation International in December 2003 brought together U.S. government agencies and wind-industry representatives. That led in early 2004 to the first major bats-and-wind-energy workshop, which generated far more questions than answers. FPL Energy was host for the workshop. One outcome was the creation of the Bats and Wind Energy Cooperative (BWEC) of key agencies, wind-energy groups and international experts that is led by BCI.

In the years since those bat carcasses were found at Mountaineer, we have learned a great deal about this serious threat to bats. And none of that could have been accomplished without the direct involvement and serious financial support of the wind-energy industry. But now, as wind power continues to grow dramatically around the world, wind companies need to implement strategies that have been proven to reduce bat fatalities.

This is the story of one firm that stepped up.

Indeed, our own bats-and-wind research was initiated and championed by Canada’s largest wind-energy producer, TransAlta. In 2005, as wind energy was beginning to boom in Canada, we wondered if we would see bat fatalities at new wind facilities. We got the answer that fall, when hundreds of dead hoary bats (Lasiurus cinereus) and silver-haired bats (Lasionycteris noctivagans) were found at the new Summerview I Wind Farm in southern Alberta.

TransAlta was surprised and contacted us. We were also surprised. Few bat fatalities had been found at other wind facilities in the area, and Summerview is located in the prairies, smack in the middle of pastures and crops – hardly the place we expected to find so many migratory tree-roosting bats. The company asked us to help them investigate, and we gladly accepted.

So began a close working relationship that produced an undergraduate honors thesis (by Jesika Reimer), a Master’s thesis and a Ph.D. degree (by Erin Baerwald) and almost a dozen peer-reviewed publications. Of course, all this research does not...

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Researchers Erin Baerwald and Cori Lausen examine the body of a bat killed at the Summerview I Wind Farm in Alberta, Canada.
happen in a bubble. Given the potential for fatalities at other wind facilities in southern Alberta, TransAlta formed a research consortium with fellow Canadian wind-energy firms Suncor, Enmax and Alberta Wind Energy Corporation.

This consortium, along with additional funding from BCI, the Alberta Conservation Association, the University of Calgary’s Institute for Sustainable Energy, Environment and Economy, the Natural Sciences and Engineering Research Council of Canada and Shell Canada, provided unprecedented access to wind sites and data, which led ultimately to a much better understanding of bat fatalities at wind-energy facilities.

By having access to multiple facilities, we were able to address questions that could not have been answered at single sites. For instance, we quickly learned that fatality rates vary tremendously from facility to facility. By analyzing data from across North America, we showed that one reason for this is that newer, taller turbines kill more bats than older, shorter ones.

As elsewhere in North America, the majority of bat fatalities at our study sites were of migratory species during the fall migration. We found that more bats were killed at sites on nights when echolocation activity, as measured with bat detectors, was greater, and that activity decreased among migrating bats the farther we moved from the eastern slopes of the Rocky Mountains into the mostly treeless prairies. This leads us to hypothesize that tree bats may be choosing migration routes based largely on the availability of tree roosts.

We also documented that weather influences the behavior of migrating bats much as it does migrating birds. More bats are killed when wind speeds are low (and bats are more likely to be flying), when barometric pressure is falling (which usually occurs before a storm), and when the moon is especially bright (which makes sense if, as hypothesized, bats are attracted to turbines and can see them more easily in moonlight).

BCI and BWEC, meanwhile, also explored the influence of wind speed on bat fatalities and, as early as 2005, proposed that fatality rates might be reduced by adjusting the turbines so their blades do not spin during low-wind periods, when little or no electricity is being generated.

TransAlta suggested that we conduct the first large-scale test of this mitigation strategy. In the summer of 2007, we altered half the turbines at TransAlta’s Summerview site so their blades remained stationary at low wind speeds. We compared those to turbines that operated in the standard way.

The results were dramatic: bat fatalities fell by 60 percent at the experimental turbines. Since our study, other wind-energy facilities have tested this strategy and also report large reductions in bat fatalities with only modest reductions in energy production. BCI and BWEC have been leading this critical research, and we hope to see this effective strategy implemented by wind-energy operators throughout the world. Millions of bat fatalities could be prevented.

TransAlta, meanwhile, has demonstrated its continuing commitment to better understanding and reducing bat fatalities.

“Following the successful implementation of the bat mitigation program at Summerview I, TransAlta has continued to explore ways of reducing its environmental impacts across its

BATS & WIND:
A LONG SEARCH FOR SOLUTIONS

by Cris Hein
Director, BCI Wind Energy Program

One of the first studies by Bat Conservation International and the Bats and Wind Energy Cooperative (BWEC) provided strong circumstantial evidence of a potentially powerful and low-cost strategy for reducing bat fatalities at wind-energy facilities.

The 2004 research at the Mountaineer, West Virginia, and Meyersdale, Pennsylvania, wind facilities (operated by key partner Florida Power and Light Energy) found that, of the 64 wind turbines studied, only one produced no bat fatalities. It was out of service, with its blades “feathered,” or left to rotate slowly. This led scientists urged experiments to test the impact and costs of simply not attempting to power up blade rotation until wind speeds reach profitable levels (see BATS Fall 2005).

Those tests had to wait until 2008, when BCI, under the auspices of BWEC, a BCI-led alliance of key federal agencies, wind-industry groups, academia and international experts, initiated the first U.S.-based operational minimization study at Iberdrola Renewables’ Casselman Wind Power Project in Pennsylvania.

We investigated the effects of raising the cut-in speed (the wind speed at which the spinning turbine blades begin to generate electricity) by 1.5 to 3.0 meters per second (4.9 to 9.8 feet per second) above the manufacturer’s preset speed. The result was an impressive 44 to 93 percent reduction in bat fatalities, with only an estimated annual loss of energy production of just 0.3 to 1 percent.

BCI and other researchers have since worked with additional industry partners, including BP Wind Energy, EDP Renewables, Exelon Energy, First Wind and Invenergy, researchers Ed Arnett, then with BCI (left), Manuela Huso and John Hayes study bats and wind turbines at the Casselman Wind Project in Pennsylvania.
Ultimately, the wind-energy industry has an obligation to pursue scientifically proven minimization strategies to reduce adverse wildlife impacts before they can be considered environmentally “green.”

We support the immediate implementation of feathering blades below the preset cut-in speed and strongly encourage wind-energy facilities to reduce turbine cut-in speeds. Meanwhile, we will continue to work closely with our partners to fine-tune current operational minimization recommendations and to develop new strategies to reduce bat fatalities.

By incorporating new data on bat behavior around wind turbines and on activity patterns associated with other weather variables, we can better determine exactly when to alter turbine operations – resulting in a more ecologically sound and economically viable strategy.

BCI also is working with partners to develop a new generation of ultrasonic acoustic deterrents that are designed to steer bats away from turbines. Initial results were promising, and we have redesigned the existing deterrent and improved sound generation and weatherization. Further testing is needed, however, and a commercially available acoustic deterrent is still years away.

Wind-energy development will no doubt continue to expand across North America and around the world, and we will need multiple tools to protect bats – while reducing our dependence on carbon-based fuels. We are grateful to our industry partners who have shown real environmental leadership and supported the pursuit of solutions to this complex issue. We now look to the industry to showcase its environmental stewardship and begin implementing the strategies that have been collaboratively developed.

ERIN BAERWALD is completing her Ph.D. at the University of Calgary, where ROBERT BARCLAY is Professor and Head of the Department of Biological Sciences.
Hibernation, pups born and nursed, foraging, migration – every SEASON, every MONTH, bats continue through their life cycle, contributing to healthy ecosystems and strong economies.

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Thank you!
Winning permanent protection for intact forests is a powerful tool for conserving bats and biodiversity, but it is rarely sufficient, especially in tropical rainforests that are shrinking at an alarming pace, to make room for agriculture. We must learn through scientific research exactly how these changes impact various species and then determine how agricultural landscapes can be designed and managed for the long-term conservation of biodiversity.

In heavily disturbed Mesoamerican rainforests, riparian corridors (forested areas bordering rivers, streams or other bodies of water) represent a vital refuge for many animals, as well as a protected pathway for moving among surviving forest fragments. Their role as reservoirs of bat species, however, is not clear. Knowledge of bats’ use of riparian habitats and the impact on bat-species diversity is crucial to conservation efforts.

With the support of a Student Research Scholarship from Bat Conservation International, I focused on the Lacandon Forest, a biodiversity hotspot that covers some 5,000 square miles (13,000 square kilometers) of mostly lowland forest in the southern Mexico state of Chiapas. The rainforests of Lacandon are heavily fragmented. It is estimated that 31 percent of the forested area was lost to agriculture, mostly cattle pastures, during the 1990s. And yet, as pastures and farm fields are cleared, riparian vegetation is typically left in place along streams.

My research attempted to determine the influence of riparian areas in a heavily agricultural region on the species composition and density of phyllostomid bats. Phyllostomidae (New World leaf-nosed bats) is an amazingly diverse family of at least 160 species that share little beyond a leaflike structure atop their noses. Seven subfamilies include species that feed on fruit, nectar and/or insects, plus carnivores that eat small frogs, birds, rodents and even other bats. All three...
species of blood-feeding vampire bats are also phyllostomids.

My team and I selected 12 sampling sites, three in each of four categories: riparian vegetation areas within the continuous mature forest, riparian vegetation within pastures, continuous mature forest away from riparian vegetation, and pastures without riparian vegetation. Streams in the riparian areas varied from 6.5 to 26 feet (2 to 8 meters) across. The pasture sites were located in the fragmented landscape of the Marques de Comillas municipality on the south side of the Lacantun River. Continuous forest sites were within the Montes Azules Biosphere Reserve on the north side of the river.

Over two years, we set five mist nets to sample bat diversity twice during the dry season and twice during the wet season at each site for a total of 70 nights. We captured 1,752 bats overall. Each bat was identified by species and classified by one of six “feeding guilds” – groups of species with similar feeding behaviors. These guilds are aerial insectivores, carnivores, gleaning insectivores, frugivores, nectivores and sanguivores (vampire bats).

The captured bats represented 28 species of Phyllostomidae. Ninety-one percent of all captures (1,598 individuals) were from 16 species of the subfamily Stenodermatinae, fruit-eating bats that sometimes also consume insects.

We used several analytical and statistical tools to confirm the adequacy of our results and to analyze the findings.

Our samples were dominated by five species: little yellow-shouldered bats (*Sturnira lilium* – 30%), great fruit-eating bats (*Artibeus lituratus* – 23%), Jamaican fruit bats (*Artibeus jamaicensis* – 11%), tent-making bats (*Uroderma bilobatum* – 10%) and Pallas’ long-tongued nectar bats (*Glossophaga soricina* – 6%). These five species represented more than 80 percent of the bat captures.

We captured 434 bats of 23 species in the riparian forested areas, 885 bats of 21 species in riparian pastures, 134 of 20 in non-riparian forest and 299 of 14 species in open pastures. We found three species exclusively in mature forests, two only in riparian pastures, and one species in riparian forests, while open pastures had no exclusive species.

Frugivores accounted for most of the species (59 percent) and more than 90 percent of individual captures, followed by gleaning insectivores with 18.5% of species, nectivores with 11.1 percent, and sanguivores with just 11 common vampire bats (*Desmodus rotundus*) and two hairy-legged vampires (*Diphylla ecaudata*). The only carnivorous bats in the sample were three fringe-lipped bats (*Trachops cirrhosus*).

The riparian mature and non-riparian mature forests contained all five feeding guilds. Riparian pastures had four guilds (carnivores were absent), while the open pasture had only three guilds (no carnivores or gleaning insectivores).

In summary, bat assemblages in open pasture were both less diverse and less abundant, while they were more diverse and numerous in riparian mature forests and riparian pasture habitats. This result is not unexpected, since many bats are found to prefer rivers with forested banks as commuting corridors that provide both foraging habitat and shelter from winds and predators.

Riparian pasture lands, meanwhile, share more species with mature forests than with open grasslands. Fruit-eating species were found in all habi-
tat types, while gleaning insectivores and carnivores were missing from open pastures, perhaps due to a scarcity of food, shelter and roost resources.

As expected, our study suggests that different bat assemblages utilize riparian and non-riparian habitats. But we also found that riparian areas along pastures can be important habitat for some sensitive species, especially the gleaning insectivores of the subfamily Phyllostominae, which are usually absent from disturbed areas.

Our results demonstrate that retained riparian habitats within an agricultural matrix can serve as reservoirs for bat species, especially those that are mostly strongly associated with undisturbed landscapes. We plan to develop recommendations based on this research to help farmers retain and manage riparian zones to enhance bat conservation.

ERIKA DE LA PEÑA-CUELLAR is completing her Ph.D. in biological sciences at Centro de Investigaciones en Ecosistemas, National Autonomous University of Mexico.
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MA K I N G  A  D I F F E R E N C E
“How deep is it?”

That’s the question I asked myself during my first trip to Bracken Cave in 1976. And I asked it twice. I later discovered that most people who visit the bat-filled cave have the same dual query.

First-time visitors arrive excited and anxious for the bats to emerge. While waiting, they focus on the dark maw of the cave’s entrance and wonder how deep it extends into the earth. The question fades when the cyclone of bats begins to whirl up from the cave and into the sky. As the initial awe subsides, the trip leader will discuss how many tons of insects those millions of bats will eat each night and how the cave’s immense mounds of guano were once mined for fertilizer and (during the Civil War) for saltpeter to make gunpowder.

It is usually then, as a pungent odor drifts up from the cave, that people ask, “How deep is it?”

The answer: No one knows. But stories from long-ago guano miners suggest the back end of the cave was dug down 30 to 60 feet (9 to 18 meters) without reaching the bottom of the guano.

Mylea Bayless, BCI’s Conservation Programs Director, contacted me to ask about “coring” the guano – using a hollow drill to extract a slender, intact column of material from top to bottom. The scientific benefits of analyzing such a column would be many and important. She wondered, for instance, if we could use radiocarbon dating to establish the age of the oldest layers, which could reach back centuries or even millennia. Could DNA analysis identify any bat species that might have preceded today’s Mexican free-tailed bats? And what insects were earlier bats eating?

Mylea contacted me because I am a longtime BCI member and a geologist who has studied the cave, and especially because I’m the Executive Director of the National Cave and Karst Research Institute (NCKRI) in Carlsbad, New Mexico. Mylea and I had worked together to make NCKRI headquarters the world’s first building designed to include a bat roost. Now we would work together on the world’s first geophysical survey of bat guano.
The entrance to Bracken Cave was formed by an ancient, enormous collapse along a cave passage. Guano-covered breakdown (rocky debris) is obvious in much of the cave. Before coring the guano, we had to find where it was deepest and without buried rocks that would block the coring equipment. NCKRI often uses electrical resistivity (ER) equipment to detect subsurface cavities such as cave passages, so we took it to Bracken.

ER works by placing stainless steel electrodes into the ground, applying voltage through a couple of electrodes, measuring it at a couple of others, and then calculating the electrical resistivity between them. Electrode pairs that are close together measure resistivity at shallow depths, while those that are further apart measure greater depths. Resistivity reflects how easily electrical current can pass through different materials in the ground: bedrock, clay, soil, guano, etc.

By taking measurements between dozens of combinations of electrodes, computer analysis produces a profile of resistivity – like a slice through the ground – beneath the line of electrodes.

BCI Bracken Cave Preserve Manager Fran Hutchins and I scheduled the ER study for January 2014, when most of the bats would be at their winter homes in Mexico.

We established four arrays: two of them 184 feet (56 meters) long, one along the cave’s west wall and the other down the middle. A third array stretched 262 feet (80 meters) along the east wall. The fourth formed a 46- by 39-foot (14- by 12-meter) grid at the back of the cave. The lateral surveys would produce two-dimensional profiles, while the grid was designed for a three-dimensional resistivity image.

Fran arranged for a team of volunteers from the Bexar Grotto – the National Speleological Society's San Antonio, Texas, chapter – to help us. A video crew from ResearchWild.com recorded the action and also helped haul, place, and collect the heavy cables and other equipment.

This was far from a typical ER survey. We were all dressed in coveralls and respirators, and the electronic gear was bagged for greater protection. Unlike at many bat caves, the guano in Bracken is dusty and floats through the air, invading noses, lungs, clothes and electrical connections.

Since I was concerned that the fluffy guano would not give us good electrical connections into the ground, we poured salt water on the electrodes to assure reliable results.

When NCKRI does ER surveys on the surface, we use high-precision GPS equipment to get accurate coordinates for each electrode. At Bracken, we had to use a modified cave-surveying technique to get the precision we wanted.

And finally, we spent a lot of time decontaminating our equipment. BCI tests within the cave have found no evidence of the fungus that causes White-nose Syndrome, but to ensure safety, we cleaned all 2,185 feet (666 meters) of cable, 112 electrodes, the resistivity meter and other equipment that entered the cave.

The ER set-up, surveys and cleanup took four days. Data processing – and getting the smell of guano out of my nose – took several days more – but it was worth it.

I had suspected the middle of the passageway wouldn’t be good for coring, and the ER results confirmed it. There is too much breakdown mixed with the guano. The three areas with the least buried breakdown were found under the ER lines along the cave walls and below the 3D array.

So how deep is it? At least 59 feet (18 meters).

ER surveying requires a trade-off between depth and detail. We focused on detail – spotting small rocks that could block the coring equipment – so we spaced our electrodes only about three
feet (1 meter) apart and never saw the bottom of the guano.

How much deeper is the guano likely to go? Well, Bracken Cave is located near Natural Bridge Caverns, and the two share a similar origin. Both formed as large passageways dissolved from the limestone, followed by the collapse of part of the passage. In Natural Bridge, you can follow the tour trail down to the original passage, roughly 150 to 211 feet (45 to 64 meters) below the elevation of the entrance.

Bracken Cave starts out 20 feet (6 meters) higher than Natural Bridge and extends to a depth of 118 feet (36 meters) before access to any deeper passages is filled with guano. Assuming the two caves formed in the same strata and at similar elevations, Bracken’s guano may extend about another 33 feet (10 meters) deeper, but this may be difficult to see with resistivity surveys.

The guano compacts and becomes more moist and clay-like with increasing depth. The lowest elevations in our surveys show very low resistivities, which could signal moist and compacted guano – or perhaps moist clay that predates the bats’ arrival. The answer to that puzzle cannot be found in our initial data. But we may soon find out.

This coming winter offers an opportunity for additional guano studies, and we are already planning more ER surveys. Our goal this time will be reaching to greater depths to locate the bottom of the guano heaps and the buried bedrock of the cave floor.

Coring is planned to follow the new ER surveys, with a multidisciplinary partnership from the Mammoth Cave International Center for Science and Learning in Kentucky, the Southwest Research Institute in San Antonio, Texas, and the University of South Florida in Tampa.

While it’s easy to think of the guano in Bracken Cave as just a big pile of – well, you know – I expect that the next phase of resistivity and coring research will prove it to be an incredibly valuable pile of paleoclimatological and paleobiological information. Stay tuned.

DR. GEORGE VENI is a karst hydrogeologist and Executive Director of the National Cave and Karst Research Institute (NCKRI), headquartered in Carlsbad, New Mexico. NCKRI is a non-profit organization congressionally mandated to conduct, support, and facilitate cave and karst research, education, management, collaborations and archiving of data.

Acknowledgements

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You can watch us at the cave on BCI’s Bracken Webcam: www.batcon.org/brackenbarcam

The yellow electrical resistivity cable is arrayed on the floor near the cave’s west wall, and the electrode positions where electrodes will be place are marked with flags down the middle of the passage. Voltage applied to some electrodes will help determine the depth of the guano.
Bats & Coffee in Sumatra’s Rainforest

Expanding coffee plantations threaten diversity on Indonesia’s island

by Joe Chun-Chia Huang

Mounds of elephant droppings, giant liana vines twisting up through the trees, the morning chorus of siamang primates that amplify their songs by inflating sacs on their throats and towering dipterocarp trees that soar 170 feet (50 meters) above the earth: these are the stuff of a biologist’s dreams. And there I stood in awe and wonder, much as the fabled naturalist Alfred Russel Wallace must have felt when he studied the incredibly diverse rainforests of Sumatra more than a century ago.

It was the summer of 2009, and I was about to leave my native Taiwan to begin my doctoral studies at Texas Tech University. I had journeyed across much of Southeast Asia in search of a site for my dissertation research. I found it in the Bukit Barisan Selatan National Park (BBSNP) on this Indonesian island. The park sprawls across 1,250 square miles (3,240 square kilometers), and it is designated, along with the Gunung Leuser and Kerinci Seblat national parks, as a World Heritage Site to highlight the forests and remarkable wildlife diversity of western Sumatra. Bukit Barisan Selatan is one of the last refuges for Sumatra’s remaining lowland rainforest. More than 90 terrestrial mammal species have been documented there, including critically endangered species of rhinoceros, tiger and elephant.

My first visit to the forest was enchanting, but what convinced me that it is where I should pursue my research was a distressing sight: vast robusta coffee plantations where rainforests and wildlife once thrived. An estimated 28 percent of the primary forest within the BBSNP has been replaced by illegal agriculture, primarily coffee plantations.

Coffee is one of the most important economic crops worldwide and has been cultivated commonly throughout tropical regions. Its export value is second only to petroleum among developing nations, with a total global trade value for 2003 of approximately US$100 billion. Vietnam and Indonesia are Southeast Asia’s leading coffee exporters and cultivated acreage has more than quadrupled in the past decade.

Coffee plantations are generally limited to tropical mountainous regions at elevations up to about 6,500 feet (2,000 meters) – where bat diversity is especially rich. Although this expanding coffee agriculture must impact bats in Southeast Asia, virtually no information is available about this potential threat. Studies on the impact of coffee agriculture on bat diversity have focused so far on Neotropical bats and arabica coffee plantations. Aribaca coffee, however, tolerates more shade and colder temperatures than robusta and the impacts on bats – good or bad – are likely to differ between the two. It is critical to the conservation of tropical bats to determine those potential differences.

My continuing research focuses on estimating bat-species richness across the Sumatran landscape and understanding how different bat species respond to coffee agriculture, with the goal of providing science-based recommendations to local agencies for conserving bat diversity across Bukit Barisan Selatan. But I also...
I hope to demonstrate the economic and ecological values of bats to local farmers, particularly the economic potential of bat-discard ed coffee beans and pest suppression by insect-eating bats.

I collaborated with Elly Lestari Rustiati at Indonesia’s University of Lampung and Meyner Nusalawo at the Wildlife Conservation Society-Indonesia Program. With financial support from Bat Conservation International’s Student Research Scholarships, I led a team of six University of Lampung undergraduate students and two Conservation Society field assistants to the national park from July 2010 to June 2012.

To explore the diversity of the park’s bats, we set harp traps and ground-level mist nets in both pristine and managed forests and in coffee plantations of two types: high-shaded and low-shaded. We also set mist nets across rivers and in the forest canopy, and used a stationary bat detector to monitor bats in such microhabitats as high, open-space above the canopy.

To date, we have confirmed 47 bat species in the Bukit Barisan Selatan National Park and adjacent coffee plantations. Furthermore, working with Mr. Maharadatunkamsi, Ibu Maryanto and Sigit Wiantoro from the Museum Zoologicum Bogoriense, Indonesian Institute of Sciences, we identified another six species collected in the park by previous researchers. These results expanded the total number of documented bat species on Sumatra from 81 to 88.

Even more exciting, we found five groups of bats that we could not assign to any known species. These may quite possibly be undescribed species that are new to science, but more analysis is required to confirm that. Altogether, including another eight species from literature reviews, we reported a total of 61 species for the park and plantations – nearly two-thirds of Sumatra’s bat fauna. A preliminary analysis of the echolocation recordings suggests the possible presence of a few more species we may have missed during the surveys. That work continues.

The probable discovery of new species and evidence that this parkland is a bat diversity hotspot for Southeast Asia are certainly dramatic. But the more important results are the impacts that coffee agriculture is having on the diversity of bats in the national park.

After comparing capture data of 9 of our 12 study locations, I found that the impacts differ according to bat species’ different ecological traits. I classified species according to two ecological traits: diet (insectivorous and phytophagous, i.e., nectar/fruit-eating bats) and roosting ecology (plant-roosting forest bats, cave-roosting bats and generalists) because these traits are presumably correlated with habitat use.

My data told a sad story.

Among insectivorous bats, most plant-roosting species and some roost generalists were disappearing from the coffee plantations. These species are usually considered forest specialists in Southeast Asia and mainly include woolly bats (of the subfamily Kerivoulinae) and tube-nosed bats (Murininae).

In contrast, we found no difference among cave-roosting bat species, mainly Hipposideros and Rhinolophus species, among the varied habitats. Cave bats were dominant in most study sites regardless of habitat type, which highlights the importance of cave roosts in maintaining local bat diversity.

We did not detect any negative response of fruit and nectar bats to coffee agriculture. Instead, roost-generalist phytophagous bats, of the genus Cynopterus, were more abundant in high-shade coffee plantations than in forest.

A frequent goal of conservation biologists is to determine whether any tight correlations exist between certain species and various habitat types. Species that are highly correlated with natural habitats, such as rainforest, or disturbed habitats, such as...
coffee plantations, can sometimes be used as indicators of the level and type of human disturbance.

My data suggest that three species, all of them common throughout much of Southeast Asia, might be regarded as indicators in the park’s landscape. Lesser short-nosed fruit bats (*Cynopterus brachyotis*) were captured mostly within coffee plantations, while insect-eating Hardwicke’s woolly bats (*Kerivoula hardwickii*) and Trefoil horseshoe bats (*Rhinolophus trifoliatus*) were primarily limited to forests.

For example, confirming a Hardwicke’s woolly bat within a landscape where no bat surveys had been done might suggest the presence of undisturbed forest. Lesser short-nosed fruit bats, on the other hand, might indicate highly disturbed habitats. I hope to determine what is behind these species-habitat correlations – the availability of food or roost sites, perhaps, or direct disturbance by humans – and to use these species as indicators for all coffee/forest landscapes in this region.

These results indicate that robusta coffee plantations pose a significant threat to insectivorous bats that roost in trees and other plants. Protecting native forests is essential for their conservation, and preserving forested corridors that connect surviving woodlands would likely be very valuable. The protection of cave roosts in disturbed landscapes is absolutely critical.

My efforts to better understand just how coffee plantations affect bat diversity continues. We are also working to confirm the ecological and economic benefits that bats provide in these coffee-dominated landscapes in hopes of convincing local farmers of the wisdom of bat conservation. More studies of bats among coffee plantations and other agroecosystems are definitely needed to clarify whether our findings from the Bukit Barisan Selatan National Park represent a general pattern throughout Southeast Asia, and how we can help these invaluable mammals share these tropical forests with human farmers.

**Joe Chun-Chia Huang** is a Ph.D. Candidate in the Department of Biological Sciences at Texas Tech University in Lubbock, Texas. His dissertation focuses on the diversity, ecological services and conservation of bats in Bukit Barisan Selatan Landscape on Sumatra, Indonesia.

**Acknowledgement**
The author thanks Dr. Tigga Kingston and Kendra Phelps for their help and advice with this research and its reporting.
New bat species is bad news for an old one

Biologists for decades assumed that the nectar-eating bats across two regions of southeastern Brazil – the biodiversity hotspots of Atlantic Forest and the Cerrado of Minas Gerais savannah – were all members of the same species: Bokerman’s nectar bats (Lonchophylla bokermanni). But now a recent study, published in the journal Zootaxa, reveals the Atlantic Forest population to be a new and distinct species.

The scientists propose naming the new species Peracchi’s nectar bat (Lonchophylla peracchii) to honor the Brazilian bat researcher Adriano Lúcio Peracchi.

Co-author Ricardo Moratelli of the Oswaldo Cruz Foundation in Brazil said this new species is known to occur along some 300 miles (500 kilometers) of Atlantic Forest in habitats ranging from continental islands to evergreen forests, and probably two or three times that distance.

The bad news, says Moratelli, is that after recognizing the Atlantic Forest populations as a distinct species, L. bokermanni is now restricted to just three known localities in the Cerrado of southeastern Brazil – an ecosystem with a rich biodiversity but rapid change. The species now faces a very uncertain future due to the loss of habitat to cattle ranching, charcoal production and other human activities.

Little is known about Bokerman’s bats, except that they forage in natural and disturbed open habitats, feed on pollen, nectar and insects, and pollinate at least two plant species, including a flowering bromeliad that’s found only on this rocky savannah.

Oklahoma is no longer ‘suspect’ for WNS

Scientists were dismayed four years ago when the fungus that causes White-nose Syndrome was identified on the carcass of a bat from a western Oklahoma cave. It was a large and unexpected geographical leap for this devastating bat disease and seemed to open a gateway for the disease to spread into western states.

But improved testing procedures now conclude that finding was in error, and neither the bat nor the cave was infected, the Oklahoma Department of Wildlife Conservation said on May 6. Oklahoma and the cave myotis (Myotis velifer) have been removed from the lists of states and bat species confirmed for the fungus (Pseudogymnoascus destructans).

The U.S. Geological Survey’s National Wildlife Health Center (NWHC) reports that although the 2010 test results were positive for the fungus, subsequent testing of the original specimen with more sensitive and specific markers found no evidence of it. Five additional bats were tested in 2011, along with more than 80 swabs from the original cave and others in the area, and all produced only negative results. The state agency said that monitoring for WNS will continue at Oklahoma caves.

Bat scientists and conservationists welcomed this good news, especially since it comes on the heels of confirmation that White-nose Syndrome spread into three more states this past winter: Arkansas, Michigan and Wisconsin.

And there is a note of caution. “This is likely to be only a temporary reprieve for the state of Oklahoma,” says Imperiled Species Coordinator Katie Gillies of Bat Conservation International. “The fungus has been confirmed across the state line in Arkansas since the winter of 2011-12. So it is probably only a matter of time before it moves into Oklahoma through the Ozarks.”

WNS has killed more than 5.7 million bats since its discovery in North America in 2006. The disease is now confirmed in 25 states and 5 Canadian provinces and is killing bats of nine species. The fungus, but not the disease, has been confirmed in two other states – Iowa and Minnesota.

As many as 25 of the 47 U.S. and Canadian bat species may face the perils of WNS. You can help in the fight to conserve North America’s bats by supporting Bat Conservation International’s WNS Response Fund and other critical bat-conservation efforts. Please visit www.supportbats.org/donate.
The Passing of Friends

Dixie Pierson • 1943 – 2014

Elizabeth “Dixie” Pierson, a passionate and pioneering bat biologist and a key supporter during BCI’s early years, “felt personally hurt by injustices to bats,” says Lyle Lewis, first chairman of the Western Bat Working Group. She was a founding member of the influential organization, he said, “and her tireless leadership and efforts promoted more effective bat conservation globally.”

Dixie, born in New Jersey in 1943, died in April following a long illness. “Dixie will be sorely missed by all who knew her,” said BCI Founder Merlin D. Tuttle. “She devoted her entire career to the conservation of bats and in this she was a national leader.”

Lyle noted that Dixie was renowned for her bat-conservation work in the United States, but she “also played the lead role in writing the proposal for the Convention on International Trade in Endangered Species that gave international protection to many species of Pacific Island flying foxes” and later developed a species-identification guide for enforcement staff.

Bat scientist Bill Rainey, her husband of 31 years, said Dixie graduated from Mount Holyoke College in Massachusetts, spent an adventurous year in Alaska, received a Master of Teaching at Yale University and taught English in Boston-area schools for several years. Along the way, she developed a deep interest in wildlife, and was introduced to the fascinating world of bats by noted Boston University biologist Tom Kunz. Dixie earned her Ph.D. from the University of California at Berkeley.

Rainey said an early-career biochemical study of taxonomic relationships among bats worldwide generated a particular interest in the enigmatic New Zealand short-tailed bat (*Mystacina tuberculata*). Found only in New Zealand, this is the most terrestrial of bats with a diet that includes insects, pollen, nectar and even bird carrion. Her report linking this remarkable species most closely to a South American bat family was published in the journal *Nature*.

She conducted important research around much of the world and led the development of the Conservation Assessment and Strategy for the Townsend’s big-eared bat. BCI described Dixie and Bill as “instrumental in gaining passage of a bill through the U.S. Congress” that ultimately created a U.S. National Park in American Samoa to protect flying foxes and their habitat.

She also served on the Board of Directors of the North American Society of Bat Research. “Dixie was a cherished colleague and a mentor to many,” said Board Chair Allen Kurta. “She will be dearly missed by the bat-research community.”

Helen Johnson • 1923 – 2014

Bat Conservation International mourns the passing of longtime conservationist and supportive member Helen Inez Johnson. A resident of Pacific Grove, California, she died on April 29 at the age of 90. A graduate of the University of California at Berkeley, she had a long career as a nuclear medicine technologist and also worked throughout her life to protect animals.

Her special passion was the western monarch butterfly and she sponsored a variety of educational programs, workshops, conferences and projects about the lovely butterfly. But she also found room in her heart for bats. She joined BCI in 1995 and remained a member until 2009.

Helen attended an early BCI Bat Conservation and Management Workshop and for years after provided scholarships annually to help five naturalists and educators attend the field-training sessions in Arizona.

Her generosity also extended to a multitude of activities that she supported among the Native American Navajo Nation in Arizona and New Mexico.

The dedication of members and supporters like Helen Johnson are what make BCI and bat conservation possible. She was a true friend of nature.
The **Wish List**

Your help with any of these special needs will directly improve BCI’s ability to protect bats and bat habitats. To contribute or for more information, contact BCI’s Department of Philanthropy at (512) 327-9721 or development@batcon.org.

**Saving a Threatened Bat Cave**

The only confirmed roost of the endangered Fijian freetailed bat is a single cave on Fiji’s second largest island. And Nakanacagi Cave runs directly under a road used by heavily loaded logging trucks — traffic that is cracking the cave walls and causing collapses in places. Complete destruction of this critical roost is a possibility. But scientific data on the cave and its bats are limited, and public awareness is almost nil. Bat Conservation International hopes to sponsor a major 12-month effort to map the cave, learn more about the species, search for other roosting sites and begin the desperately needed process of educating the people of Fiji about the value of this little insect-eating bat and the dire threats that it faces. Knowledge is the key to bat conservation. This urgent effort needs $10,000 for equipment, on-site personnel, public-education materials and other needs.

**Eavesdropping on Underground Bats**

BCI’s Subterranean Program surveys hundreds of caves and abandoned mines to identify those that are used by bats and recommend the most appropriate protection to federal agencies and other partners. That means a lot of time dangling from ropes, squeezing through rocky passages and generally exploring dark underground recesses. For monitoring those roosts (both inside and out), our Subterranean scientists need two small but versatile Echometer3 bat detectors from Wildlife Acoustics. Each unit costs $999 and will enhance our ability to determine the presence of bats and the family or species.

**A Better Way for Farmers**

More than 5,000 acres (2,030 hectares) of eastern Madagascar are in the process of winning federal protection for two fruit bats, the Madagascan fruit bat and Madagascar rousette. The land includes native rainforest, as well as heavily degraded habitat following a long — and continuing — tradition of slash-and-burn agriculture. The conservation group Madagasikara Voakajy hopes to slow this destructive practice by introducing and promoting farming practices that can increase yields without the ravages of slash and burn. Julie Hanta Razafimanahaka, the group’s Executive Director, said the project will help community organizations demonstrate enhanced production of bean crops in two villages. Madagasikara Voakajy requests a Global Grassroots Conservation Fund grant of $3,600 for the pilot project, with payoffs for both the people and the fruit bats.

**A bat champion retires**

Wildlife Biologist Calvin Butchkoski, a vigorous champion of bats and a longtime member and partner of BCI — recently retired after 32 years with the Pennsylvania Game Commission. Asked what he is proudest of, Cal said: “I want to say our management of hibernacula, work with artificial roosts and bat education, but that’s not really true. I’m most proud of the people I’ve worked with and showing them what I’ve found successes with. It gives me a warm feeling knowing there is an awesome community of dedicated individuals to persist in our efforts.”

Cal is a real boots-on-the-ground conservationist and has collaborated with BCI scientists on a host of projects and workshops over the years. He was an instructor at BCI field-training workshops in Pennsylvania for at least 14 years.

But these days, he is perhaps best known for his role, until a few months ago, in maintaining the map that tracks the spread of WNS across the continent. When WNS hits a new county, he would add a new blotch of color on his map and email it around the country.

“Maybe that map is kind of a comfort blanket — visual confirmation we’re not in this alone,” he once said.

The map is in different hands now. But Cal’s advice is worth listening to: “The efforts must continue. As we humans continue to take up more space on the landscape and increase our demands on natural resources, there’s a continuing need for education and for strategies to minimize the impacts.

“I’ve found one of the most useful tools in accomplishing tasks is persistence, and I’ve learned to not get too depressed when things don’t go as planned. Be persistent with your goals and over time, many of those that initially fell through will bloom.”

**BCI Member Snapshot**

Debora Westcott, a BCI Member for more than 20 years, is especially proud of her granddaughter, Katherine Marriott (also a Member). A third-grader at Stillwater Elementary School in Stillwater, New York, Katherine presented this bat-conservation project at her school’s Learning Fair. It was, Debora said, “a very informative project covering Cool Facts about Bats, True or False, White-nose Syndrome, Wind Energy and five different types of bats. She truly enjoyed learning about bats and will be a lifelong bat advocate!”

Share a snapshot of your bat activities: email it to pub@batcon.org or mail to Snapshot, Bat Conservation International, PO Box 162603, Austin, TX 78716.
MAKING A DIFFERENCE

Let This Be Your Legacy

By including Bat Conservation International in your estate plans, you’ll help keep bats in the skies, fulfilling essential roles to maintain healthy natural environments and human economies for generations to come.

A bequest is a simple way to support BCI in the future while retaining control of your assets during your lifetime. We can be named as a beneficiary of your will, trust, retirement plan, life insurance policy or financial accounts.

And thanks to you and others like you, bats will continue to enrich the world as pollinators, seed dispersers and hunters of insect pests.

Now that’s a legacy to be proud of.

Thank you!

For more information about making a bequest to BCI:
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Coming Soon – BATS Redesigned
The Fall 2014 issue of BATS will debut a new graphic design featuring great stories and photographs about bat people, places and knowledge.