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Into the northern Philippines rainforest

Smugglers and guerrillas were research variables for an international team studying the species-rich Palanan wilderness

Leonardo Co had a problem. Last spring the young Philippine botanist joined an international scientific team that spent five weeks gathering specimens from a tropical rainforest on the northeastern coast of Luzon. This remote area, known as the Palanan wilderness, proved to be such a diverse habitat that botanists collected more than 800 samples, each of them in replicates of ten. It was Co's job to make sure the 8000 specimens reached the National Museum in Manila, where laboratory workers would preserve them for shipment to herbaria in the United States and Europe. But the specimen sacks were too bulky to be shipped out inexpensively by small plane.

How could Co get the specimens out of the forest? The isolation that made Palanan almost untouched scientific ground had become a logistical nightmare. Standing guard on the forest's western flank are the Sierra Madre Mountains, a rugged range not crossed by any road. The scientists had chartered a small plane into Palanan, a coastal town with 10,000 inhabitants on the edge of 500,000 acres of wilderness that bears the same name. The rest of the team left by plane, but Co had to take the only other way out of the secluded town. He booked passage on a smuggling boat, where he and the botanical samples rode alongside valuable hardwoods poached from the wilderness by illegal loggers.

"There was really no other transportation in or out of Palanan except the illegal logging boats," he said during an interview in Manila. "For four or five days we hopped along the

coast, playing cat-and-mouse with the Philippine coast guard and picking up more logs." Co says he began to worry when the boat developed engine trouble and spent three days drifting in the Pacific. "We were so long in picking up logs and drifting at sea that we began to run out of [drinking] water," he says.

Eight days after leaving Palanan, the smuggling boat sneaked into port a hundred miles from Manila, where Co and his samples caught a bus to the museum. "This is a very challenging job," the young botanist says.

Co's experience dramatizes the difficulties faced by scientists drawn to a wilderness so remote it has been visited by only four previous research teams, and so vast as to promise rich finds. Says Lawrence Heaney, a mammalogist with the Field Museum in Chicago, "It is the largest remaining forest on Luzon, an intact ecosystem in the sense of greater Yellowstone."

Roads pose potential disaster

But Palanan, declared a wilderness in 1979 by then-President Ferdinand Marcos, is in danger of losing the isolation that has offered it more protection than any government decree. Logging interests are pressing the Philippine government to build a road across the Sierra Madre and to open the area to commerce with populous central Luzon.

"A road going in would be a real disaster," says Lee Hannah, an ecologist with Conservation International in Washington, DC. Hannah coordinated the work of 21 scientists who visited Palanan between February and April of last year. Their visit was intended to convince the Philippine government that Palanan rated prior-

ity consideration in its plans to create an Integrated Protected Areas System (IPAS) similar to the US national parks.

But the Philippine government's conservation plans are complicated by the existence of three towns inside this supposed wilderness. "We have to create a zone around the three towns to give them a chance to take forest products without going deeper into the wilderness," says Domingo Madulid, botanical advisor to the IPAS committee and curator of the Philippine National Museum. "The government must provide alternative livelihood programs and shift people to marine industries."

Scientists flying into biological hot spots is not a new environmental tactic, but what made the Palanan expedition exceptional was the team's diversity. It included botanists, ornithologists, mammalogists, and marine scientists from the United States, Europe, and the Philippines. They gathered data using standard methods, such as walking transects and trapping mammals, as well as more controversial techniques, such as taking blood samples for genetic analysis in lieu of gathering voucher specimens of birds—not to mention the unorthodox means used to transport scientific findings to the museum laboratory.

"The coming together of this group had a lot to do with the remarkable degree of interest in Palanan itself," Hannah says. "We've really only scratched the surface, but what we did find suggests that this area is one of the most biologically significant places on the planet."

After studying the botanical specimens gathered by Dutch, Filipino, and American field workers, Al Gentry of the Missouri Botanical Garden called Palanan "surprisingly diverse."

by Tom Abate

The early results of the Palanan survey indicate that the wilderness may harbor as many as 60% of the plant species in the Philippines (nearly 5000 species, more than are found in all of Canada).

During the survey, Danish ornithologists sighted the endangered Philippine eagle near Palanan, the first time in five years that the bird had been seen in that part of the country. They also saw 20 other species of threatened birds found nowhere but the Philippines. Mammalogists discovered two possible new species among their specimens, and marine scientists think an abundant and as yet undeveloped offshore fishery could offer Palanan residents an alternative to poaching trees for a living.

By documenting the diversity, the scientists were calling attention to a nation once nicknamed "the emerald isles" for the 30 million acres of forest that covered 40% of its land. Today, that forest cover has been cut in half, and commercial loggers are removing more of it at the rate of 470,000 acres a year. Less than 900,000 acres of virgin forest remain, much of it around Palanan. Members of the Palanan team hope other scientists would become interested in these old-growth forests, rather than focusing exclusively on the Amazon and Madagascar. "The Philippines has a very high number of endemic species," says Heaney. "It is a happenstance of the history of the earth, of the way these islands popped up on the ocean's floor in isolation from the mainland."

In a sense, the Palanan expedition wanted to put the Philippines on the world ecological map. First, however, the scientists had to get in and out of the Palanan wilderness.

Guerrillas in the mist

Benito Tan joined the Palanan expedition by virtue of his work with the Harvard University Herbaria, which has an extensive collection of Philippine flora. Many of its specimens were collected by deceased botanist E. D. Merrill, sometimes called the Ameri-



Rolando Frogoso, an inspector for the Department of the Environment and Natural Resources in Cabagan, Isabela Province, with confiscated logs that had been harvested illegally. Photo: Tom Abate.

can Linnaeus because he named more than 3000 new species. Many of these Merrill discovered in the Philippines, where the flora has often evolved unique offshoots of species that originated on the Asian mainland, Indonesian archipelago, or South Pacific islands.

"The Philippine rainforest does have unique aspects because of its geographic location," Tan says. "There was a time in the 1960s when Harvard went on the Central American bandwagon and paid less attention to Southeast Asia. In the 1980s, that began to change. We realized since we had these historical ties to the region we ought to keep them up."

Tan is an expert on bryophytes, the mossy plants that grow on tree limbs and form green carpets that hold moisture on the forest floor. Noting their use as folk remedies, drug companies have begun to study these obscure mosses. "Bryophytes have many chemical compounds not found elsewhere," Tan says. They tend to contain terpenes and phenols, whereas

other medicinal plants produce alkaloids.

Although hardy varieties can grow in drainpipes, many bryophytes can only be found in the cool air and mists of high-elevation forests. Tan convinced the team of seven botanists to hike over the mountains into Palanan to gather specimens in the unexplored Sierra Madre. Tan knew that communist guerrillas patrolled the mountains, so he hired a guide with guerrilla contacts. Halfway up the slopes, however, the guide and porters demanded a raise. "It was dangerous," Tan says. "They threatened to leave us in the forest if we didn't pay."

The scientists refused to pay. Four of the ten porters deserted them. The scientists, carrying much of their own luggage, and the remaining porters hiked back to town to catch a plane into Palanan. On their aborted hike they had seen the deforestation on the Sierra Madre's inland slopes. "Everywhere that is accessible, the forest is being cut," Tan says.

After reaching the town of Palanan,

the botanists studied the dipterocarp forest in the surrounding lowlands. Madulid says the dipterocarp is a family of trees named for their characteristic two-winged leaf, which spins as it falls, helping seeds dig into the ground. "The dipterocarps are our export hardwoods," Madulid says. "They are commonly known as Philippine mahogany, although they are not, strictly speaking, mahoganies." Forty to 100 tree species are typically found in a hectare of dipterocarp forest, compared with 10 to 25 species in the same area in the northeastern United States. Madulid says the most common tree species around Palanan were red lauán (*Shorea negrosensis*), tangile (*Shorea polysperma*), and apitong (*Dipterocarpus grandiflorus*).

One interesting facet of the Palanan study was the discovery of several forest types in proximity. "We had a lowland rainforest, a beach forest, a forest over limestone, and a forest over ultrabasic rocks," Madulid says. "That made it very diverse as far as the flora was concerned." Beneath the dipterocarp canopy, the botanists found rattans from the genera *Calamus* and *Daemonorops*, used to make furniture, and many species of orchids. "We have a thousand species of orchids in the Philippines," Madulid says. "Ninety percent of them are endemic."

The work of surveying the habitat around Palanan was directed by Colin Ridsdale, a research botanist with the Rijksherbarium in Amsterdam. The Rijksherbarium, a center for the study of Southeast Asian flora, began its collection more than 40 years ago near the end of Dutch rule of Indonesia.

Under Ridsdale's direction, the field team used a method devised by the Missouri Botanical Garden. They staked out 10 transects, each 50 meters by 2 meters, for a total study area of approximately a quarter of an acre. The botanists combed these ten transects, recording each species encountered. They found 181 species inside this study area. To arrive at an overall botanical diversity ranking,



Domingo Madulid, curator of the Philippine National Museum, works with samples brought to the museum via smuggling boat and bus. After the specimens were dried, they were treated with denatured alcohol, mercury chloride, and phenol, the same method used by Linnaeus. Most herbaria have moved away from this toxic method and now freeze-dry specimens. Photo: Tom Abate.

the findings at Palanan were compared with those from 130 Latin American, Asian, and African tropical sites and 20 subtropical and temperate forests in Europe and North America. "I had always assumed the Philippines was too deforested to be interesting, in part because I'm kind of prejudiced by Amazonia," says Gentry. "But Palanan is almost as rich as the richest tropical sites."

In addition to counting species, the botanists collected plants of interest. Co suspects that "no less than 15 of the specimens we collected are either new species or species that were not previously known to exist in the Phil-

ippines." One of the most fascinating finds occurred in the ultrabasic forest, an area rooted in igneous rocks whose high content of heavy metals makes for a hostile soil. In this area, Co discovered what appears to be *Scaevola pauciflora*, a shrub previously found only on New Guinea at an elevation of 3000 meters. How it reached Palanan or adapted to the lowlands is unknown. "The migration of plants from New Guinea and Australia has not been well studied," Co says. "There may be a strange affinity between these areas and the Pacific coast."

Another curious find was a flowering plant that produced an oil like kerosene. Co said it resembled flammable plants of the *Kokoona* genus that are fairly common in Malaysia. But until the Palanan expedition, only one species of *Kokoona* had ever been found in the Philippines, and that on Palawan, an island at the southwest end of the chain. Co is certain the botanists will find other unknown species in the unexplored forests at the crests of the Sierra Madre.

New bird-sampling technique

The international flavor of the Palanan expedition, and the novel techniques that emerged as a result, was exemplified by the ornithological team directed by Arne Jensen. A former director of the Danish Zoological Society, Jensen is working in the Philippines under the auspices of the International Council for Bird Preservation (ICBP). Founded in 1922 in Cambridge, England, ICBP lays claim to being the first international environmental group.

Today, ICBP, with 10 million members in 100 countries, is training field workers in a technique that avoids the standard practice of taking voucher specimens. Museums collect and store voucher specimens to preserve a skeletal record that can be compared against future field discoveries, to prove or disprove the existence of new species. "People in developing countries often see a lot of specimens leav-

ing," says Hannah of Conservation International. "They think it is incongruent to go in and preach conservation while taking out so many birds."

Instead of collecting specimens, Jensen's team netted birds, photographed them and drew blood samples. "It is possible from one drop of blood to analyze the taxonomy of the bird," Jensen says. "The blood sample can be divided 100 times for distribution to other researchers." Other scientists, like the Field Museum's Heaney, have used genetic blood analysis to gain new insights into vertebrate taxonomy.

Although this new technique avoids removing birds from the wild, Jensen says it limits research in other ways. "We cannot do an analysis of stomach contents," he says. "It might be difficult to tell if a bird in a photograph was a new species. With a voucher specimen you can do a skeletal comparison."

Genetic analysis of blood samples is also expensive, and few laboratories are equipped to do the tests. "The ICBP is not against a limited policy of collecting specimens," Jensen said, but it is trying to popularize the blood technique as a way of beginning a database that could one day include a genetic "fingerprint" of every bird species. "It gives an entirely new dimension to our understanding," Jensen says.

Heaney says the new process will not entirely do away with the need to collect voucher specimens. For one thing, he says, blood sampling cannot be used to study mammals, because their red blood cells, unlike those of birds, lack the nuclei needed for genetic analysis.

The seven ICBP researchers also used familiar techniques in their ten-week field survey of birds. These methods included transect counts, mist netting, bioacoustical surveys, ethno-biological identification, and general observations. "With these five methods, we identified 216 out of the 224 bird species known to exist in this part of Luzon," Jensen says. "If we can preserve the Palanan wilderness in

Agta could suffer from development

The wilderness around Palanan is home to the Agta, a tribe of hunters thought to be descendents of the first human settlers in the Philippines. Bion Griffin, an anthropologist at the University of Hawaii, and Thomas Headland, a linguist from the University of Texas, have each spent more than 20 years living among the Agta. Griffin described them as Negritos, members of an ethnic group whose short stature, dark skin, and kinky hair set them physically apart from the majority of Filipinos. Griffin says Negrito tribes like the Agta migrated to the Philippines thousands of years ago and were pushed into wilderness areas like Palanan by later waves of Malay immigrants.

Headland estimates that the entire wilderness region contains some 7000 Agta, a decline of 40% since the last reliable count in 1936. "They are going extinct," he says. "It is one of the few human populations that we have documented in decline." In the forests closest to the town of Palanan, the number of Agta fell from 800 to 600 in the 20 years he has been keeping records, whereas the number of townspeople more than doubled to 10,000.

According to Griffin, the Agta are forced to serve as scouts by communist guerillas and army patrols. They are hired to guide illegal loggers to hardwood groves or are employed to gather valuable orchids and rattan. For these services, they might be paid with liquor or cigarettes that ruin their health. "There's a long history of the Agta being kept in a subordinate role," Griffin says. As more and more Filipinos move to Palanan and two other towns that have sprung up in the region, illegal logging intensifies and more forest is converted to farmland. "When the Agta get in their way, the colonists kill them," Headland says.

If the government builds a road into the Palanan wilderness, the pressure from settlers would probably intensify. Vic Milan, Conservation International's Philippines representative, explained the market dynamics behind what the locals call carabao logging. Tree poachers use water buffalo to drag logs down to the coast, where smuggling boats buy them for six pesos per board foot. The minimum wage in the Philippines is 110 pesos a day. This wage is the equivalent of 18 board feet of hardwood. "A man can buy a chainsaw on credit and pay for it in a single day," Milan says.

some sustainable way, that means we can protect much of the biodiversity of the region." Jensen says the Philippines has a large number of endemic bird species, not quite so many as top-ranked Brazil, but enough to make the islands a priority. "The Philippines ranks sixth in the world for the number of birds on the endangered species list," Jensen says. "Luzon has the rank of number one among Asian islands as to threatened birds."

The team's most spectacular find was a sighting of two haribon, the

common name of the Philippine eagle (*Pithecophaga jefferyi*), an endangered species that had been thought to exist only on the southern islands of Mindanao and Samar. "It is very hard to find the haribon," Jensen says. "Unlike the bald eagle, it does not soar around the mountain ridges."

The presence of the haribon attested to the health of the wilderness. "Each haribon pair requires 65 square kilometers of old growth," Jensen says. "It's a good indicator of the treatment of the wild, and its presence assures



The jade vine (*Strongylodon macrobotrys*) is a highly endangered member of the legume family found in abundance near Palanan Point. Photo: Vic Milan, Conservation International.

you there is a good tract of forest.” Jensen estimated the Palanan wilderness might contain 30 to 35 haribon pairs.

Other ornithological findings resulted from careful ground work. Jensen selected seven transects from sea level to 1300 meters in elevation. They represented four forest types: high-elevation old growth, low-elevation old growth, forest recovering from logging, and recently logged forests. Surveys of the latter two categories were intended to identify vulnerable or threatened species, and Jensen says his team failed to find four bird species identified in earlier surveys.

The team spent a week walking each of the transects, which varied in length from 2.5 to 3.5 kilometers. At least four persons walked each transect to cross-check field observations. Researchers estimated the number of trees per acre, their average diameter, the height of the overstory, and other habitat features. “By putting the raw

data from the transects into a computer program that contains habitat data for the forest, we can estimate population to within 5–10% accuracy,” Jensen says.

In addition to walking transects to identify diurnal species, Jensen’s team used mist nets to capture nocturnal creatures. They captured 90 birds that flew into the nets, which were made of a thin, flexible material 12 meters long by 3 meters high. The team photographed the birds and drew blood samples for genetic analysis.

Jensen supplemented the mist netting with bioacoustical techniques. Team members tape-recorded birds they had heard but not seen. Because they did the fieldwork during spring mating season, they assumed birds would respond to calls on their home turf. Each morning they played the unidentified calls over a directional microphone. “You can even end up with the bird sitting on the microphone,” Jensen says. “It was very

funny.”

Finally, the team interviewed Agta natives. Descendants of the first human inhabitants of the Philippines, the Agta still maintain a semblance of their former life-style. But unlike hunter-gatherer tribes elsewhere on Luzon, the Agta did not display an intimate knowledge of the region’s bird life, and the ornithological team found them of little help. “They asked us, ‘Why do you have names for all the green pigeons?’” Jensen says. “They all taste the same.”

A rodent-friendly environment

The marine and mammal surveys uncovered fewer finds than did the botanical and ornithological aspects of the Palanan expedition. This result disappointed marine scientists accustomed to speaking of Philippine sea life in superlatives. “The Philippines and Indonesia have the highest diversity and density of coral reef species found anywhere in the world,” says Alan White of the University of Rhode Island, who designed the marine survey. “They have a very high degree of speciation and endemism. Fish can develop around a particular island more or less in isolation.” But that diversity thrives in the sheltered reefs of the archipelago’s inner islands. Entirely different conditions prevail in Palanan, which faces the Pacific. “This was a rugged coast with tall cliffs down to the sea,” White says. “The coral takes a pretty severe pounding from the waves.”

Marine surveyors chose ten sections of coast, each three kilometers long, and swam the surface using snorkels to estimate the extent and condition of coral life. Underwater measurements by scuba divers, the preferred method, was impossible because the team could not fly in enough oxygen tanks. White says the surface method, which has proven reasonably accurate elsewhere, disclosed that half of the coral was alive. In sheltered inlets, the surveyors found sea grass beds and mangrove swamps. Rich in nutrients from decaying plants,

these areas provide fish breeding grounds vital to the humans and animals who harvest coastal fish.

In the long run, Palanan's offshore fishery may be the richest aspect of its marine life. The survey gauged the fishery potential by interviewing boat owners in Palanan and by talking with skippers of Taiwanese fishing trawlers who frequent northern Luzon. From these rough estimates of fish landings, the team guessed that 1000 metric tons of fish were harvested yearly from the waters off Palanan. Reports indicated that tuna and mackerel are abundant, along with snappers, groupers, and grunts.

To these reports, the marine surveyors added some observations of their own. For example, Hannah says that while returning one day from a coral survey, he hooked a marlin on a hand line. "Of course it broke the line," he says. "But I saw it arc out of the water like something out of a Hemingway movie."

If a road does open Palanan to the outside, marine scientists said the fishery might spawn a tourist trade as well as a commercial market. "It would provide an alternative livelihood to the illegal logging," White says. "They could try to zone the area so the people there can control the fishery, as is already being done elsewhere."

Bad luck plagued the mammal survey, to Heaney's chagrin. After a decade of fieldwork elsewhere in the Philippines, Heaney was anxious to explore Palanan's highland forests, where he stood a good chance of discovering new mammals. "In the last ten years, 17 new species of mammals have been found in the Philippines," Heaney says. "There are as many new species of mammals being described in the Philippines as on any continent."

Unfortunately, it rained throughout the two weeks Heaney was supposed to hike through the mountains setting traps to capture voucher specimens of the rats and bats that make up the majority of Philippine mammalia. Heaney showed the ICBP team how to

set his traps. They collected mammal specimens in the course of walking bird transects. Back in Chicago, Heaney is trying to figure out whether they trapped any unknown mammals. "We suspect there are two new species," he says. "There are two rodents nobody has ever seen." But he only has one specimen of each, not enough to make a certain identification.

Even more tantalizing was a specimen turned in by Palanan residents. "It is one of the most spectacular rodents anyone has ever run into," Heaney says, describing an animal the size of a woodchuck, with silver and black coloration. But with only one specimen and no data on where it was found, he is left with a mystery. The mammal survey also disclosed that the Palanan forest is home to the wild deer (*Cervus mariannus*) and wild pig (*Sus barbatus*), species hunted by the Agta.

Despite his bad luck at Palanan, Heaney argues the importance of studying Philippine mammals, who suffer in popularity by being mostly rodents and bats rather than animals of pin-up potential. But Heaney says Philippine mammals show the same tendency to differentiate into new species that Darwin first described among finches on the Galapagos Islands. "Some flock of bats gets boosted off the mainland by a typhoon, hits the Philippines, finds abundant resources and few predators," Heaney says. "Over a long time, one species becomes many."

This process of adaptive radiation occurs not only among Philippine mammals, but also among birds, flora, and marine life, making these islands a laboratory for the study of speciation, Heaney says. Although much of the Philippine forest has been irrevocably lost, the Palanan wilderness offers a glimpse of the emerald isles as they once appeared. "Palanan still has forest from the tops of the mountains down to the ocean and indigenous people living as they once did along the sea," says Hannah. How long that would last if the area is opened by a road is anyone's guess.

But in Manila, Leonardo Co is not wasting time. Undeterred by his harrowing boat ride, Co is preparing to return to Palanan in April, a year after his original adventure, to continue gathering botanical specimens. Riding with the log smugglers convinced him that the forces of destruction were moving a lot faster than science. "At the rate the forest is being cut, there is a very real fear that some of these species will disappear without being documented," Co says. "Sometimes we who are involved in this collecting have a joke that we are rounding up the last of the Mohicans." □

Tom Abate is a freelance science writer based in New York. He was in the Philippines on a Pulitzer Travelling Fellowship.



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