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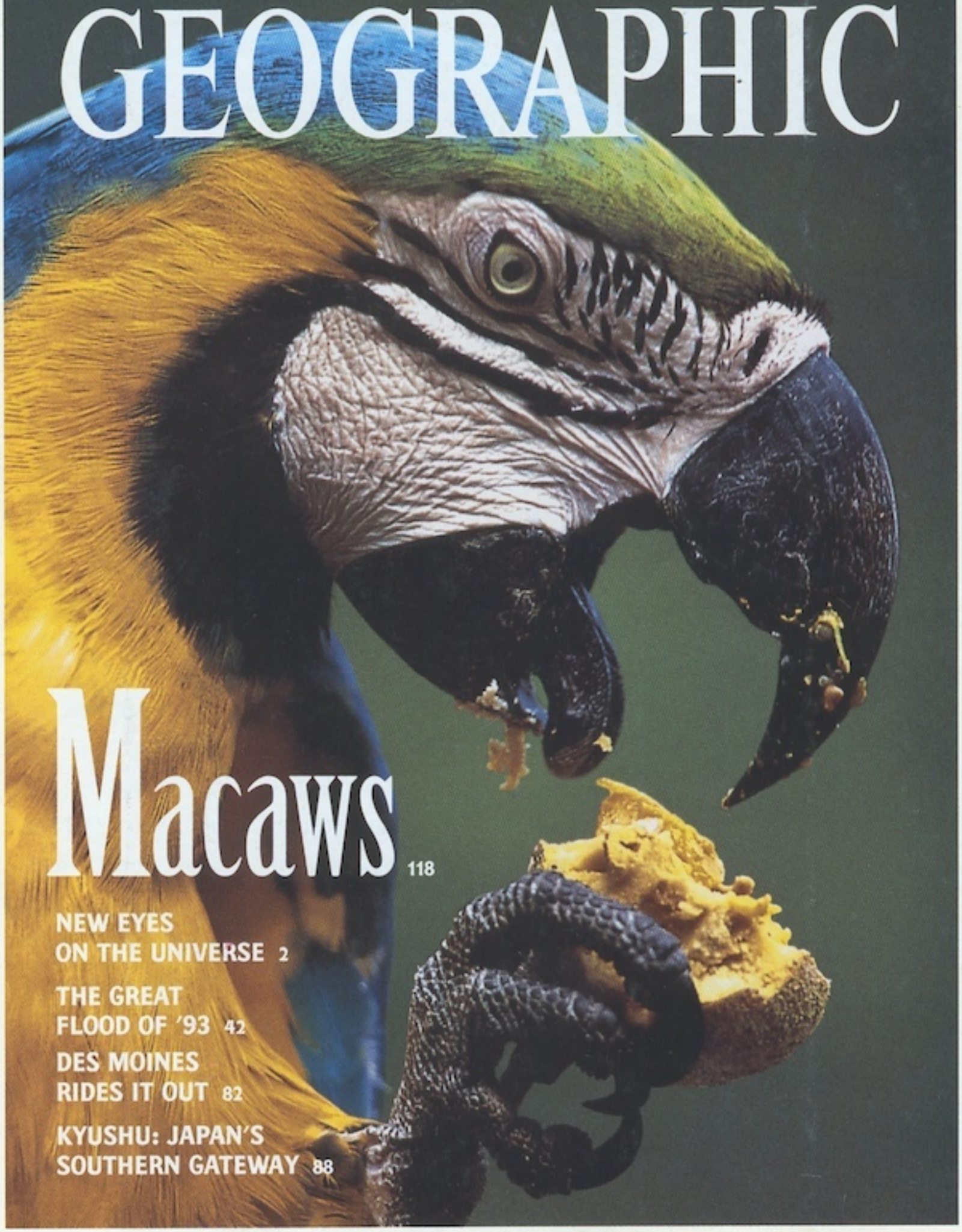

Macaws 118

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A rowdy crowd of macaws spatters their brilliance on a clay riverbank in a Peruvian rain forest. Why they congregate daily to eat clay by the footful is still a question. Study of these smart, long-lived birds brings the promise of knowledge that may help protect them for—and from—their admirers.

Winged Rainbows

Macaws

By CHARLES A. MUNN

Photographs by FRANS LANTING

In one flash a four-month-old fledgling scarlet macaw learns to fly on wings that span almost three feet. Native to the Americas, macaws have been coveted by collectors since Spanish and Portuguese explorers took specimens back to Europe in the early 1500s.

WHEN the morning sun clears the Amazon tree line in southeastern Peru and strikes a gray-pink clay bank on the upper Tambopata River, one of the world's most dazzling wildlife gatherings is nearing its riotous peak.

The steep bank has become a pulsing, 130-foot-high palette of red, blue, yellow, and green as more than a thousand parrots squabble over choice perches to grab a beakful of clay, a vital but mysterious part of their diet. More than a dozen parrot species will visit the clay lick throughout the day, but this midmorning crush belongs to the giants of the parrot world, the macaws.

Hidden in a blind a hundred feet away, I watch the congregation. Flying in on wings of royal blue with a hint of green, the husky red-and-green macaw is the largest, weighing three pounds and measuring more than three feet from head to tail. The slightly slimmer scarlet macaw unfurls darker blue wings with brilliant yellow shoulders. The blue-and-yellow macaw flashes feathers more turquoise and gold. All three shake tails as long as their bodies and boast probably the most powerful bites in the bird world.

Macaws seem to mate for life, so most arrive at the lick in pairs. Some are shepherding offspring. The juveniles are perfectly capable of biting off their own clay, but they're spoiled. Bleating relentlessly at their parents, they usually get their way, and the adults regurgitate clay into their mouths, pampering them as they have since the day they hatched.

Only a third of the macaws can get on the lick at a time. About every half minute the rotation changes, and those shrieking for their turn from surrounding trees and vines surge forward. The air reels with color.

Now one macaw sees an eagle soaring above and screams an alarm that catapults the birds into flight. Ten adults peel off from the flock and circle just above the predator, which can attack only by diving. They

CHARLES A. MUNN is a senior research zoologist with the Wildlife Conservation Society. The work of wildlife photographer FRANS LANTING has appeared frequently in NATIONAL GEOGRAPHIC as well as in the Society's recent book *Forgotten Edens*.

TWINING CHANNELS of the Tambopata River bring water from the Peruvian Andes to rain forest at the edge of the Amazon basin. Mostly untouched by the development that has scarred neighboring areas, 50,000 square miles here shelter an especially diverse group of plants and animals, including eight species of macaws.

assault it with their loudest cries, and the eagle quickly flies away. I came to appreciate the close-range power of that ultimate macaw shriek early on in my ten years of studying these extraordinary birds. A trumpet blown straight into your ear would not feel worse.

THE FIRST MACAW clay lick I ever saw was 150 miles northwest of the Tambopata lick, in Manu National Park, where I was researching small forest birds. Other biologists and I assumed that it was the only macaw lick in the world. That's how little was known in 1984 when I began the first study of macaws in the wild for the New York Zoological Society, now called NYZS/The Wildlife Conservation Society.

Today we have counted 18 major licks in southeastern Peru and heard reliable reports from the region's native people of 15 others. There are likely dozens more on riverbanks in the inaccessible reaches of this forest—arguably the most biologically diverse and intact rain forest in the Amazon, and in the world.

Sixteen species of macaws inhabit tropical forests from central Mexico to northern Argentina, distinguished among the world's 340 parrot species by their long tails and huge beaks. Eight are considered large; the others weigh a pound or less. Nine are endangered or threatened, and Spix's macaw of Brazil may soon be extinct in the wild. Macaws' intelligence ranks them among birds as chimpanzees rank among apes.

Eight species of macaws remain abundant in southeastern Peru. But when I began to study the region's three largest—the red-and-green, the scarlet, and the blue-and-yellow—the birds and their forest were facing some of the pressures that have imperiled macaw species elsewhere.

Fortunately, export of rain forest birds (outlawed by Peru in 1973) had not been a problem in this wilderness east of the Andes—it was simply too remote. But the 400 Machiguenga Indians in Manu National Park would occasionally shoot macaws for their tough, stringy meat if a day's hunt for spider monkeys and tapir had failed. Also gold miners were pushing into tributaries of the Tambopata River. And that region's virgin stands of timber were luring commercial harvesters.

ARA CHLOROPTERA

As I began to fill in the blanks of macaw biology—what is their diet? why do they eat clay? how often do they reproduce? what is their family structure?—the sheer joy of watching these birds gave me an idea.

If the Machiguenga and others could make money showing wild macaws to tourists, macaw conservation—and the conservation of their Amazon habitat—would be profitable.

Now a fledgling ecotourism industry is under way, and appreciation of the value of macaws contributed to Peru's recent proposal to create a 1.8-million-acre national park in the Tambopata-Candamo Reserved Zone. Macaws—elegant, rambunctious, always personable—are becoming Peru's rain forest ambassadors.

ON THE MAP Manu National Park lies less than a hundred miles north of the ancient Inca capital of Cuzco. With 3.7 million acres, the Connecticut-size park probably holds more species of plants and animals than any other protected region on earth: an Amazon realm of jaguars, giant otters, ocelots, red howler monkeys, emperor tamarin monkeys, black caimans, brilliantly colored tree frogs, hundred-pound catfish, and a thousand known kinds of birds.

The human population averages around 500: two villages and scattered clans of Machiguenga Indians and about 40 Peruvians, Americans, and Europeans working with me or the Cocha Cashu Biological Station, operated by biologist John Terborgh of North Carolina's Duke University. There are also several tiny clans of Mashco-Piro and Yaminahua Indians, who are rarely seen; they leave everyone else in peace and wish the same for themselves.

The macaw lick where my work began is 12 winding miles from the Cocha Cashu station up the 200-yard-wide Manu River. Near the lick we cleared ground for the Machiguenga Ccollpa Biological Station.

A thousand-square-foot raised wooden platform with a palm-thatch roof serves as kitchen, dining room, and work area. There are seldom more than a dozen scientists and assistants in camp at any one time. We sleep on the ground in tents with window mesh fine enough to keep out the tiniest insects. We stock the station each May, at the end of the rainy season, by loading food and gear onto a lumber truck in Cuzco and crossing the two eastern ranges of the Andes on a single-lane dirt road.

More than five hours out, the road peaks at the top of the second range, and the green sea of the Amazon basin swells to the horizon below. A seven-hour descent from cloud forest to lowland forest brings us to the eight-family village of Atalaya on the Alto Madre de Dios River. The next morning we move our supplies into 55-foot cargo canoes and push into trackless rain forest. After five hours we meet the Manu River and veer northwest for three hours. The next day six hours of slow motoring brings us to camp. We sleep well that night and awake at dawn to the cries of macaws.

GAUDY, RAUCOUS BIRDS would seem to be easy subjects to track. But when macaws fly into the dense forest canopy to search for food, they become invisible and almost silent.

To learn what they were eating, my assistants and I spent the first two seasons of the study

A GALLERY of portraits enables author Charles Munn and his wife, Mariana, to identify individual red-and-greens that visit a nearby clay lick on the Manu River (above). "Lines of face feathers are as unique as fingerprints," Charles explains. With this knowledge of the local macaw community, the Munns can build a picture of each bird's habits and interactions throughout the four decades of its life.

walking the forest and listening for the subtle sounds of debris falling onto the thin layer of leaf litter, a sure sign that parrots or monkeys were feeding in the canopy 120 to 180 feet above.

If the falling seeds or fruit had scoop-shaped beak marks, we knew we had found parrots, and we hoped they would be large macaws. If we waited in silence, the birds would often reveal themselves by squawking quietly—communicating, we now know, with family members. Then we could locate them with high-powered telescopes and observe their feeding behavior.

We discovered that macaws break through the pulp of fruits to get directly to the seeds, which they crack and eat. They also eat the pulp of some fruits and occasionally flowers and leaves. But their main goal is seeds, making macaws unlike most birds in the tropical forest.

In feeding, a macaw displays mammal-like dexterity. Each muscular leg powers a foot of four clawed toes, two facing forward, two backward. The bird can hang upside down or reach sideways effortlessly, anchored by one foot to pick fruit with the other. Its hooked beak can act as a third foot for climbing.

Once the bird has lifted a fruit to its beak, it cannot see it, but its thick tongue judges the shape and works with the skills of a thumb to rotate the fruit and position its seed for cracking.

No seed appears to be a match for that beak. We find

IN A FIREWORKS BURST, macaws lift off from a clay lick on the Tambopata River. Such spectacles are a major attraction for a growing ecotourism industry, which generates jobs without harming the birds or destroying their habitat.

macaws eating in mahoganies, kapoks, coral bean trees, and rubber trees—among a list of 60 or so favorites. But I think they experiment with everything. It's part of their curious nature to bite and test. How hard is it? Does it taste good? If I eat one or two, will it hurt me? And in a forest of maybe 2,000 species of flowering or fruiting trees, plants, and vines, they may come upon something they haven't seen before, that blooms only every few years.

But if macaws seem to have no lack of food, why are they also eating riverbank clay?

We found that the clay is high in salts and minerals the birds may not get from their primarily vegetarian diet. Even more intriguing, as we analyzed the commonly eaten seeds, we discovered that many held toxic chemical compounds—tannins and alkaloids. I tried chewing the seeds myself. Some were sweet at first taste, then my mouth began to tingle, burn, and swell.

It is likely that macaws take almost daily doses of clay to detoxify themselves. Clay binds to the toxins and speeds them through the body. Indians in the high Andes eat clay to counter the effects of bitter wild potatoes.

Another clue is the seasonal fluctuation of visits to clay licks. Most years macaws eat less clay during May and June, at the start of the dry season, when many plants are flowering. By late July the licks are active again, and the macaw crowds peak in August and September, the driest time of the year. We suspect that as food sources dwindle, macaws may have to fall back on more toxic seeds.

To pinpoint the biochemical function of clay eating, James Gilardi of the University of California at Davis is now analyzing dried foods from Manu for toxic compounds. In lab experiments he is also feeding these foods to Amazon parrots—more manageable macaw relatives that also eat clay in the wild.

ARA ARARAUNA

WITH A WICKED BITE and a tongue as agile as a thumb, a blue-and-yellow will open a nutritious seed with ease after tearing away the fruit. Of the myriad fruits and flowers available to macaws (opposite), many contain toxic seeds that fend off predators. The birds show no ill effects; they may gain protection—along with basic minerals—from the clay they eat.

MACAWS NEST in cozy tree cavities a hundred feet or more off the ground. Two questions loomed as I set out to investigate macaw reproduction. How would I get up there, and how would the birds react once I did?

Climbing straight up most rain forest trees is not a good option. Their trunks are highways for stinging insects and are tangled with vines and bromeliads. I took my lead from the technique of cavers, who need to get up and down fragile cave walls without touching them—then improvised.

I start with a giant slingshot, launching a weight on a long thin line over a branch near the nest. Then I tie a climbing rope to the unweighted end and pull the weighted end by hand until the rope is hanging over the branch. With one end anchored to the base of a thick tree, I attach a harness to the other, sit in it, and hoist myself using special clamps.

As I approached my first nest, where a red-and-green macaw chick was about to fledge, I had a feeling that the adults would not attack me outright. But I honestly had to wonder: If they objected to my presence, would they use their considerable intelligence to size up the situation and bite through the rope?

In fact they did neither; instead they sat on a close branch and screamed. The fledgling screamed. I wanted to scream as I stuffed toilet paper into my

populations could not quickly replace those taken. What my colleagues and I learned among the macaws contributed to the U. S. import ban that became effective last year.

Our data suggest that in a sample of a hundred mated pairs, only 10 to 20 pairs try to reproduce in a given year and that only 6 to 14 fledglings will come of these efforts.

Since males and females look alike, we can distinguish between the sexes only during breeding and nesting. They usually mate in December, and the female lays two eggs. While she incubates them for four weeks, her partner brings her food he has swallowed and stored in a throat pouch. He regurgitates it into her mouth, just as both parents will do later for their young.

If the eggs are not chilled by rainwater or eaten by long-beaked toucans or by weasels called tayras, they hatch in January, one to five days apart. The oldest nestling enjoys the major competitive advantage of being fed first at every meal. Its sibling seldom survives. Usually the parents push a dead chick out of the nest. But my colleague Daniel Blanco Zamalloa of the University of Cuzco found one red-and-green buried in the nest floor.

When a macaw is ready to fledge at three to four months, it is as large as its parents—but it still has a lot to learn. Maneuvering its body out of the nest hole is the first challenge if the hole is quite narrow. Sometimes the parents cut back the nestling's rations to force it to make the effort.

That was the case at the red-and-green macaw nest I first climbed to. When the nestling finally squeezed out, it flew awkwardly to a nearby tree, its doting parents flying just behind, squawking what probably

SPROUTING its first gaudy feathers at five weeks, a red-and-green rides out a nestling study weigh-in. Although this chick, like most, hatched in a hollow tree trunk, some now thrive in nests of textured PVC pipe. A researcher guides one such nest to the top of a tree, where he will strap it in place. Augmenting nest sites in this way has increased successful breeding.

ears and made a mental note that industrial earplugs would be part of my next climb.

My colleagues and I have now made thousands of ascents to chart life in 140 macaw nests. The screaming occurs only on the initial visit. On follow-up trips the birds simply watch as we dangle before the nest hole to count eggs, weigh hatchlings, and follow their progress. They remember us.

IT WAS STILL LEGAL in the late 1980s to import wild tropical birds into most of the U. S. Opponents of this policy were gathering scientific evidence to back their conviction that wild bird

was advice and encouragement. Then the youngster flew a wobbly course through the forest mid-story and crash-landed in soft leafy branches. Several days passed before it was flying confidently with its parents at a stately 20 miles an hour.

MACAWS PLAY and interact with each other in ways that most other birds don't. A pair of mated adults will preen each other and their offspring for hours, removing lice and ticks and naturally dispersing body oil on one another's feathers. They don't usually socialize with macaws outside their nuclear family, but they talk to each other constantly.

In a trio or quartet of macaws we can identify the young by their eye color. Their irises are dark, becoming yellowish-white with age. But their behavior is a giveaway too; even when they can care for themselves, they often pretend to be babies.

Macaws usually leave their parents and start looking for a mate at age two or three. Finding a place to lay eggs is a far more difficult matter. I learned, to my surprise, that a contributing factor in the macaws' low reproduction rate is an acute housing shortage.

A square mile of virgin rain forest in Amazonian Peru contains as few as one or two nest sites that are deep, clean, and dry enough for large macaws.

A HUNDRED DIZZYING FEET high, Eduardo Nycander von Massenbach examines a blue-and-yellow for parasites. Twice a week he checks on the progress of dozens of chicks, weighing and measuring them before returning them to their nests.

The blue-and-yellows look for dead palms in the river floodplains. Red-and-greens seek hardwoods on higher ground. Versatile scarlets use both. The competition is intense.

Once red-and-greens lay claim to a nest hole, they guard it year-round. We came upon an attempted takeover one day and watched fighting birds tumbling in a blur of red feathers. Beak-to-beak and talon-to-talon, they separated just above the ground.

A couple of blue-and-yellows saw their chance to grab a nest occupied by a single parent and two young nestlings and began a harassment campaign. The solo adult, perhaps widowed by an eagle attack, finally had to leave its young unprotected in order to get food. The marauding pair grabbed the larger nestling and dropped it 50 feet to the ground, killing it. The parent returned to defend the survivor, which then fledged prematurely a few days later. Now the victors moved in, but the parent stayed near to feed its fledgling, which took shelter in bushes. After several days the interlopers left to nest in a palm right next door, and parent and fledgling flew off to another nest site.

AN ARCHITECT from Lima, Eduardo Nycander von Massenbach never imagined he would turn his talents to designing homes for macaws—and climb 150 feet up trees to install and monitor them. But working as my assistant in 1987, he says, "brought me to a crossroads in my life."

Nycander is now also a field biologist and the director of the Wildlife Conservation Society's macaw project at the Tambopata Research Center. Much of the work is financed by a Lima brewery, Cervecería San Juan, and Rainforest Expeditions, a company Nycander created with macaw biologist Kurt Holle Fernández to introduce tourists to wild macaws. The center, 600 yards from the spectacular Tambopata River clay lick, is much like our camp in Manu.

Expanding macaw nesting opportunities is one aim of the center. Nycander and his field director, José Moscoso Garcés, experimented with several materials for birdhouses (wood was devoured by termites within two years; metal risked overheating) before settling on PVC pipe. They burn the outside, then scrub it with a steel brush to give it the same color and texture as the tree trunks.

In 1992 they hoisted six PVC nests, 14 inches in diameter, eight feet tall, and strapped them to the trees. All but one, for reasons we're unsure of, attracted macaws, all scarlets.

Last year the center launched another mission: to balance the chances of survival for that second macaw nestling. Nycander and his team took 18 weaker siblings from nests (natural and artificial). They fed them formula by hand, slept with them in the nursery at night, and lived with colorful chaos. "The birds are very loving," Nycander reports. "They control their bills to just nibble softly on our ears."

Wild macaws took a social interest in the foster birds as they began to fly. Now 18 macaws that probably would have died in infancy have joined the clay-lick throngs. They return to camp for daily visits.

The overriding good news from our housing and day-care experiments in Peru is that we

RED-FACED FROM ANXIETY, blue-and-yellows (left) guard a nest site from another pair scouting for a place to breed. Once the rains sweep in the season of abundance, a female usually lays two eggs, which she incubates for a month. Macaws are thought to mate for life; both sexes feed their offspring. In close quarters (above) one regurgitates food into the mouth of a hungry chick.

have two proven ways to try to boost the most endangered macaw populations. Wildlife Conservation Society biologists are already setting up the nests in Bolivia and Brazil.

THE IDEA that macaws could be raised by humans and still successfully interact with wild flocks came from the practices of the Machiguenga Indians, who would cut down trees to take nestlings as pets. They were also using bows and arrows to shoot adult macaws for food when I arrived in Manu. I at first thought that the birds would be too skittish to study. With time the Machiguenga and I began to learn from each other, and now they have become allies in macaw conservation.

They agreed to stop hunting and capturing macaws, to help us locate nests and licks, and to teach us what the birds eat in different seasons. The Wildlife Conservation Society in turn provides shortwave radios, money for boats, medicine, and education, and advice on running the Machiguenga's tourist bungalows, which sit on Cocha Salvador, the finest lake in the Manu region.

Fifty miles southeast, the macaw clay lick at Blanquillo, on the Madre de Dios River, is not officially in a national park. But it is treated as such by four Quechua-speaking Peruvians who, as wilderness homesteaders, legally claimed 5,000 acres around the lick in 1989. They had come to Manu a few years earlier to work with me. To try their hand at conservation tourism, they filed a land claim and built the rustic 20-bed Manu Parrot Inn.

The partners survived the slump in Peruvian tourism—now beginning to rise as peace returns to the country—by serving meals to boats of Quechua-speaking gold miners from Cuzco, who pass by daily to pan rivers downstream. They taught the miners about the lick and showed videos, provided by the Wildlife Conservation Society, of macaws and other wildlife in the Manu area. Soon the miners' commute was sounding like a nature tour, with the boat drivers and passengers calling out names of passing flora and fauna. "No throwing trash or bothering animals here," the drivers announce as they dock the boats at Blanquillo. "This is a park!"

As I had hoped, ecotourism is helping macaw conservation pay for itself and at the same time raising awareness of the birds. The national park in Tambopata has been planned with a farsighted balance of Peru's conservation and economic needs. Beyond the northern edge of the park, commercial zones for small-scale streambed gold mining and Brazil-nut harvesting will provide income without destroying the forest cover. The country will also profit from tourists drawn to the rich wildlife in a 1.8-million-acre park that will protect the world's largest known macaw clay lick.

NEW BREAKTHROUGHS in macaw research should be happening this year. Accurate tracking of macaws in a rain forest is impossible from the ground. Radio collars won't work; macaws nonchalantly destroy them as they preen one another. We have been able to follow their paths to and from the clay licks only from observation posts in the tallest trees on the highest ridges, swaying in harnesses with our eyes pressed to telescopes. Now we will actually be able to fly with the birds, in an ultralight aircraft equipped with pontoons.

AS CURIOUS AS TODDLERS, young red-and-greens chew apart headphones at the Tambopata Research Center. Since macaws often fatally underfeed the younger of their two chicks, researchers rescued 18 weaker siblings to raise by hand. Besieged at feeding time, Alvaro del Campo flinches from a nip. "They have different personalities, and some are very difficult," he says. The birds now fly free in the forest, reinforcing the local population.

AS IF FOR PROTECTION, a juvenile scarlet takes a friend under its wing. If human efforts to protect them and their rain forest home are successful, they may yet live out their years free and safe.

We have speculated that the birds using any one lick are coming from no more than five miles away. In the ultralight we can follow them to the forest where they forage and nest. This will also let us calculate an area's population density.

When clay-lick attendance falls in May and June, we will be able to learn if the macaws are still feeding in their home forest or if they are traveling to a rich source of nontoxic food in another area. Many blue-and-yellow macaws leave the Tambopata lick area between April and July, returning in August. Where are they going? And are they protected there? Now we can follow them.

Another long-term project may be the analysis of photographs of the faces of red-and-green macaws taken at the Manu lick. The red-and-green, I discovered, has a unique pattern of feather lines on each side of its face. (So does the blue-and-yellow, but not the scarlet.) This facial fingerprint makes it possible to watch the behavior of individual birds over many years. Macaws seem to mate for life, but perhaps they also divorce and remarry. We could also learn more about their life span.

Macaws in captivity live for 50, 60, occasionally 70 years. In the wild, large macaws that survive their first year have few natural predators and probably die between the ages of 30 and 45 from a combination of eagle attacks, parasites, disease, and old age.

Few birds live so long or learn so much throughout their lives. It pleases me to know that years after I have retired from its rain forest, that first red-and-green nestling I met face-to-face will probably still be flying—protected and free. □