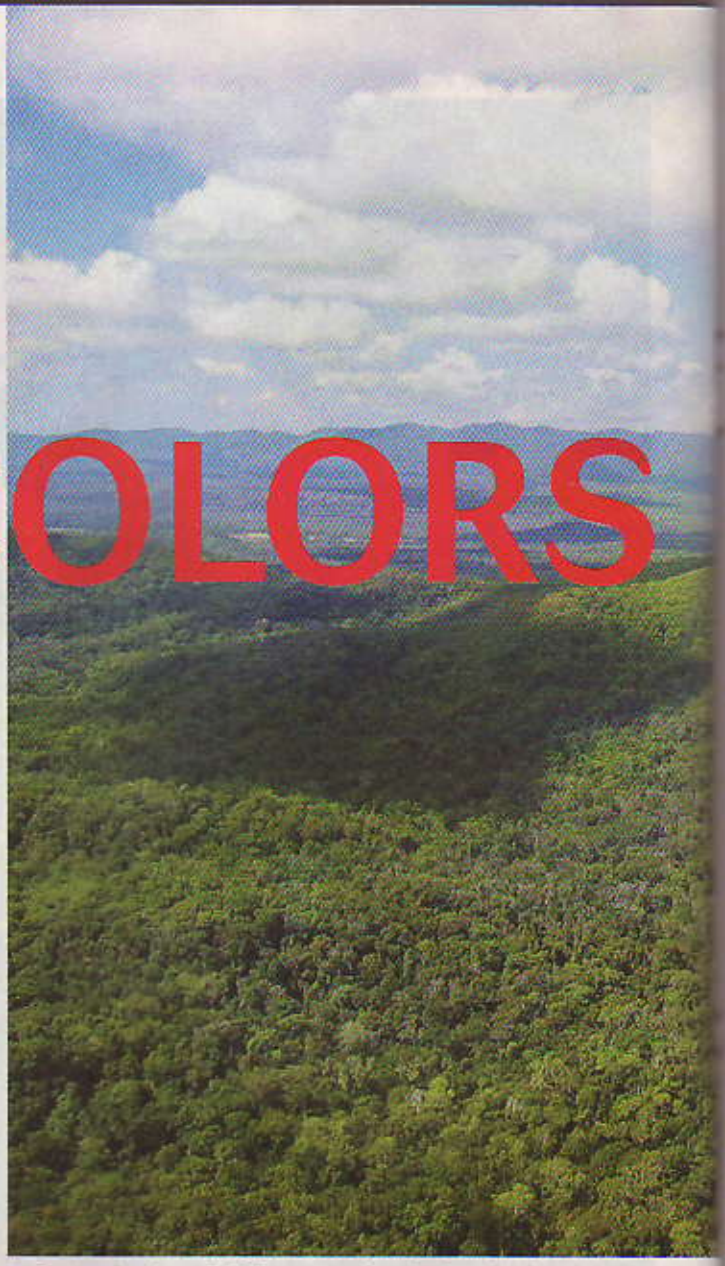
Eclectus' TRUE COLORS Revealed

RESEARCHERS TAKE TO THE TREETOPS & DISCOVER THAT COLOR MEANS EVERYTHING TO ECLECTUS.

By Robert Heinsohn



Robert Heinsohn and fellow researchers had to climb to the top of the forest canopy to reach hollows housing Eclectus chicks. The photo right shows a male Eclectus feeding a female as she perches near the entrance of her nest hollow.

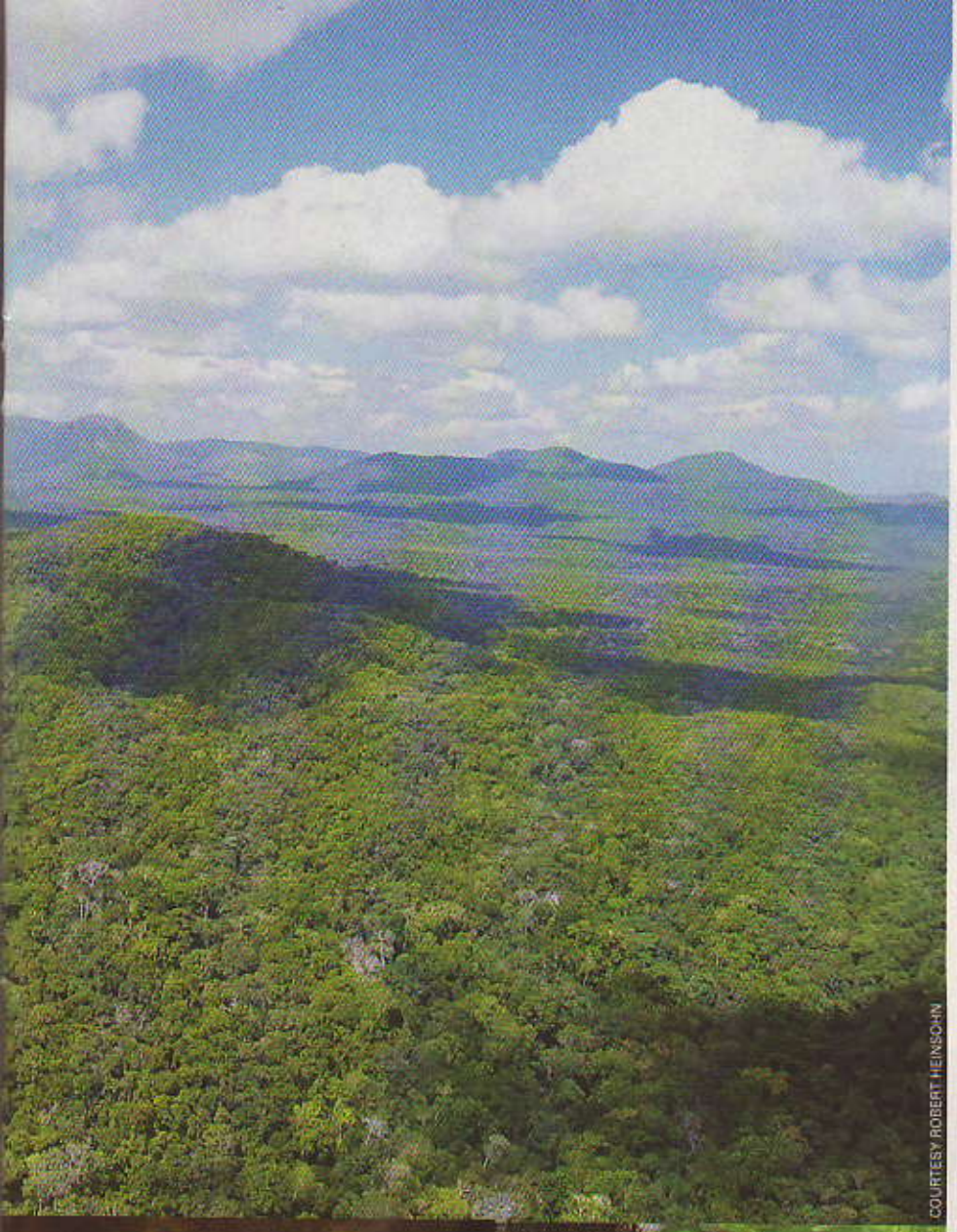
Few birds have puzzled scientists more than the Eclectus parrot (*Eclectus roratus*). One of the 20th Century's great evolutionary biologists, the late Professor Bill Hamilton of Oxford University, used to show a slide in his lecture series of a male and female parrot sitting side by side. The male was a vibrant green, and the female a stunning vermilion. Whereas evolutionary theory had plenty to say about why one sex in birds is often larger or more gorgeously colored, it stumbled somewhat in establishing what had happened in this species. No other bird has sexes so "beautified," but in such different ways. Hamilton ended his talk by saying, "When I understand why one sex is red and the other green, I will be ready to die."

Hamilton was essentially puzzled over why Eclectus parrot boys look like girls and the girls look like boys. Sadly, however, he passed away before the mystery could be solved. Male and female Eclectus parrots are in fact so different, they were long thought to be different species. Male Eclectus from the Moluccan Islands of eastern Indonesia were first discovered in 1776, but the females were not seen until 1837, and even the best naturalists of the 19th century were fooled for a long time. It was not until 1874 that males and females of this species were finally united under the same name.

Solving The Eclectus Puzzle

Despite the long-standing popularity of Eclectus parrots as pet birds, there had been no field studies of this species until my research commenced in 1997. This was understandable, as few birds present the field worker with such logistical difficulties. Eclectus parrots live in the canopy of rainforests in New Guinea, west to the Moluccas, east to the Bismarck Archipelago and Solomon Islands, and also on the tip of Cape York Peninsula in northern Australia.

Apart from living in such remote locations, their nest hollows can be 20 to 30 meters (65 to 100 feet) above the ground, and they are notoriously shy birds that fly away over the tree-tops when disturbed. It was a rash moment when I



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committed myself to solving the Eclectus puzzle.

Australians are fortunate because the rainforest patches of the Iron and McIllwraith Ranges on Cape York Peninsula, in the far north-east of the country, are just large enough to support a population of this remarkable parrot. Eclectus parrots do not fly far enough to cross the 70-mile wide Torres Strait between Cape York and New Guinea. Instead, they probably found their way into northern Australia when land bridges connected the two land masses more than 10,000 years ago.

The first nest tree we encountered at Iron Range was the remarkable "Smugglers Fig," a green fig (*Ficus albipilla*) in far northern Queensland's Iron Range National Park. This majestic old denizen, which still has rusted metal spikes sticking from its trunk as a testament to the bad old days of parrot smuggling, represents a microcosm of Cape York wildlife. In its various hollows, it supports 17 Eclectus parrots distributed among three different breeding groups, two pairs of sulphur-crested cockatoos (*Cacatua galerita*) and roosting cavities for bats inside its trunk. Its crown is decorated with a magnificent colony of metallic starlings (*Aplonis metallica*) with their multitude of nests that hang from the upper branches. Preying on all these creatures is a resident pair of grey Goshawks (*Accipiter novaehollandiae*), and a large slaty-grey snake (*Stegonotus cucullatus*) haunts the ground below, waiting for the starling chicks to fall. When they are all at home, the 12 male and five female Eclectus parrots light up the branches like a Christmas tree.

We have spent a lot of our research time moving between the 40 widely dispersed nest trees in our study area and climbing to the hollows using single-rope techniques. It can be extremely tricky using a slingshot to shoot a line into the right position and also very hair-raising climbing a hollow for the first time. But it is also a joyous experience rising up through the gloom and oppressive humidity, and breaking through the canopy into the breezes and brighter light. It's a different world up there looking down on passing birds, beetles and butterflies. It is also an incredible privilege to be part of the Eclectus' world, especially upon reaching the hollow and looking in to see the fluffy chicks.

Although we approach nest trees cautiously, we are often met by the raucous cry of Eclectus females quickly exiting their hollows. During our visits, they usually sit in nearby trees, but those with eggs or chicks re-enter the hollows immediately upon our departure. Without such permissive behavior, our research would not be possible.

Feather Fast

Another Eclectus parrot mystery is that chicks grow straight into adult plumage, and hence reveal their sex at a very young age. This differs dramatically from most birds, which stay in drab and unisexual juvenile plumage for at least the first year of life. It seems that emerging in full-colored plumage allows Eclectus parrots to compete immediately in the harsh world of the adults. Females start searching for nest hollows immediately, and males disperse to find the best females in which to invest their efforts for long-term reproductive rewards.

Fight For A Good Nest

One of our first discoveries was that, unless threatened, females virtually never leave the vicinity of their nests. They sit in their holes with their resplendent red heads sticking out and watch the world go by at least a month before laying eggs

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(usually in September). The females do all the incubation and brooding of small chicks. Where they differ from most other parrots is that they refuse to leave the hollow when the chicks are older. Even after the chicks have fledged, the females still return to their hollow every day to make sure no intruders have usurped it.

A female with a good hollow has no choice but to sit tight and defend it from others. Scuffles often break out between females, and they will even fight to the death to defend this precious resource. The threat of losing the hollow forces the females to stay at their nest tree for up to 11 months each year. They literally sit at the hollow entrance, calling to let other Eclectus parrots know they are in residence, and only manage to avoid starvation because they are fed by multiple males.

The females need large hollows in tall emergent rainforest trees to breed, but useable hollows are few and far between. Herein lies the first clue to solving Hamilton's puzzle, as much of the reversed coloration in Eclectus parrots ultimately seems to relate to the scarcity of nesting hollows. Nest hollows are typically in very large emergent rainforest trees. In fact, 75 percent of our known tree hollows are in just three major tree types: figs, (*Ficus sp*), milkwoods (*Alstonia sp*) and the black bean tree (*Castenospermum australe*).

The trees used for nesting are clearly visible from the air, as they tower prominently above their neighbors. Using a light aircraft, we conducted comprehensive aerial surveys for potential nest trees in the rainforests in and around Iron Range National

"The female's red when contrasted with the shiny green of the males as she slips out of the nest to receive food is one of nature's truly beautiful sights."

Park and found that there are only a few hundred suitable trees in the whole region; which, incidentally, makes up half of the Australian Eclectus habitat. The average is only one per square kilometer of rainforest.

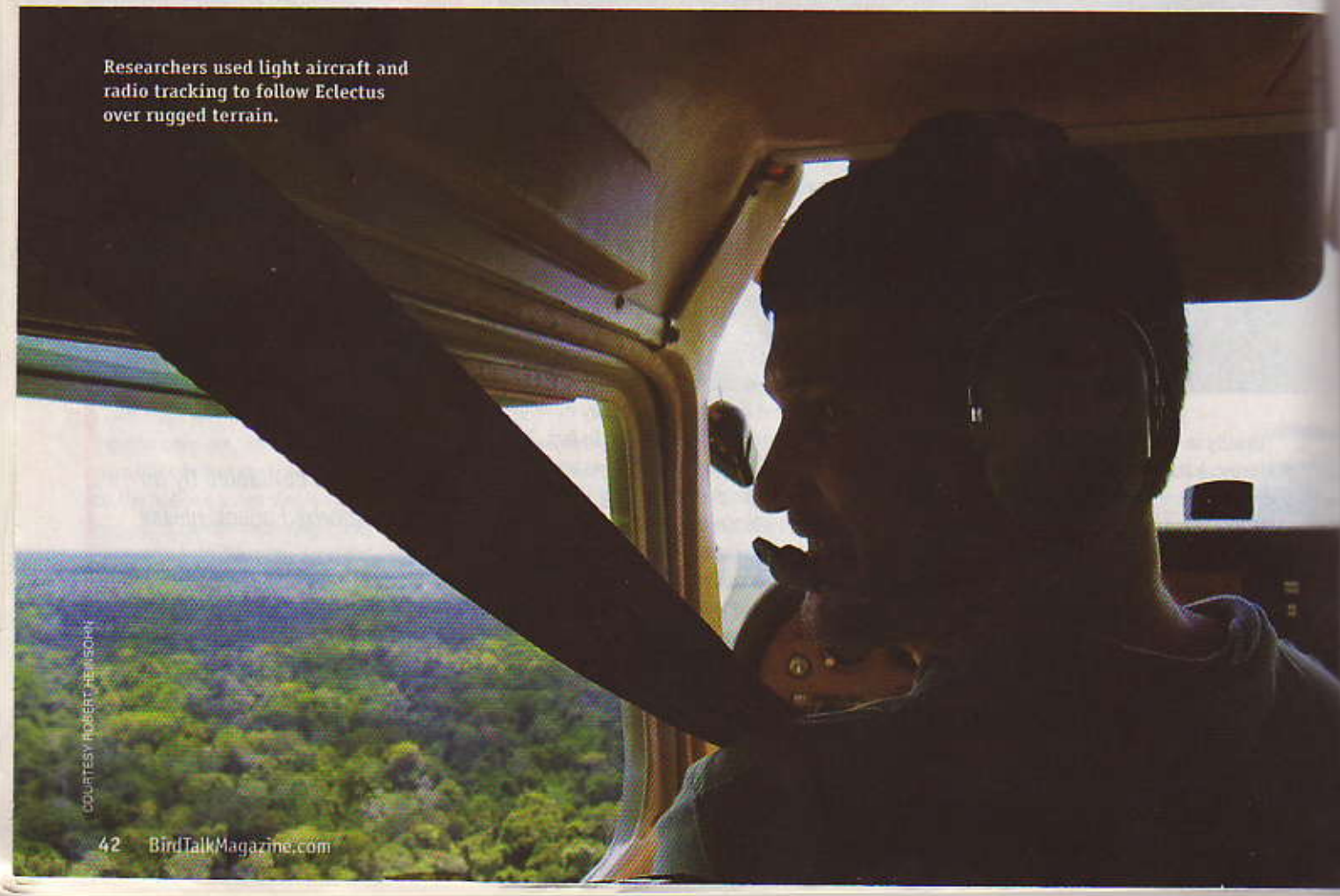
Not only are nest trees rare, but many of the hollows are hopeless for breeding because they flood in heavy rain. When that happens, even large chicks drown, and the previously cozy hollows become unavailable for several weeks. A good hollow is clearly one that stays dry for at least four months during the crucial breeding period; one month for incubation plus three months from hatching the eggs to fledging the chicks. One of the best hollows in the Iron Range study area is in the Smugglers Fig. This hollow never floods, and the same female has been in residence there since at least 1997. During this period, she has fledged more than 20 chicks, compared to many of her neighbors, which have managed, at best, one or two fledglings.

Males Offer Support

Each female is attended by up to five dutiful males that scour the countryside for fruit. Upon returning, they lock beaks with the female and regurgitate the fruit pulp and seeds. With great effort we managed to catch some males in mist nets that were hoisted into the rainforest canopy and attached tiny radio-transmitters to their tail feathers before letting them go. This proved to be a wonderful method from the birds' perspective, because the attachment to the tail guaranteed that the transmitters would eventually fall off when the feather molted.

The only way to follow the birds over the rugged rainforest terrain was by mounting our aerials on a light aircraft and radio-tracking them from the air. We found that males travel up to 20 kilometers on each trip to find food and have very large home ranges of up to 100-square kilometers. They clearly work extremely hard but are rewarded with sexual favors if they feed the females well enough.

Our genetic studies using the birds' DNA showed that males are not related to each other. They jostle, peck and claw one another for access to their shared bride. They can't all be fathers, because she only lays two eggs at a time. However, our genetic studies have shown that many of them do eventually become fathers, at least once, if they stay with her for long enough. This can happen if the female lays a second



Researchers used light aircraft and radio tracking to follow Eclectus over rugged terrain.

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clutch in the same season, or over multiple years. One male we studied fathered two chicks with the same female seven years apart but failed to gain any offspring with her in between!

Flirtatious Males & Partner Swapping

The males outnumber the females by about two to one, and many miss out on fatherhood despite their hard work feeding the chicks. To increase their chances, they often "two-time" their partners and visit more than one female. We saw some of the males flirt with up to five different nesting females!

They would typically alight near the nest hollow and chirp and chatter to the female. Sometimes they were chased away, but on other occasions they succeeded in mating with her. This mating system, in which both sexes seek multiple sexual partners, is unlike that of any other parrot. Males and females in most parrot species live in relatively dull and monogamous (but harmonious) marital bliss. The strange system in Eclectus parrots seems to be due to the all important shortage of nest hollows that forces males to wife-share and to look elsewhere for sex when it is not forthcoming.

The Reason Behind The Dimorphism

Ultimately, the shortage of hollows also drives the remarkable reversed color scheme of male and female Eclectus parrots. We used a technique known as spectrometry to work out the purpose of such different plumage. This entailed catching the birds, scanning their plumage and measuring the surrounding light in the rainforest using a spectrometer connected to a laptop computer. All hollows are in bright light, and females usually sit at the entrance with their heads and chests glowing like beacons. Their bright red color acts as an obvious signal to other females, saying in effect "This hollow is occupied."

Such a strong proclamation seems essential in the females' competitive world, but it comes at a high price. Old females with good hollows can use them

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option of "switching off" their signal, and are twice as likely to be attacked by Peregrine falcons and Rufous owls.

Why then is male Eclectus color so different from that of the females? If we remember that females stay at their hollow and the males go out to forage, it begins to make sense. The males spend virtually all of their time in the tree-tops and, unlike the females, need to blend in with their green surroundings for safety from their aerial predators. However, they also need to be bright and showy when they compete for the female's attention at the nest hollow. To achieve this double-act, their green has an extra quality. It positively glows using a color, ultra-violet, that the parrots can see, but their predators (including humans) cannot.

Males look dull green and camouflaged to hawks and owls (and us) when they are out collecting food, but stunningly gorgeous to the other Eclectus parrots back at the nest hollow. It was only by using a spectrometer that we could detect this hidden color.

The female's red when contrasted with the shiny green of the males as she slips out of the nest to receive food is one of nature's truly beautiful sights. Although it took 10 years of grueling field work to get as far as we have in solving Hamilton's mystery, the rewards of finding each piece of the puzzle have made all the effort incredibly worthwhile. The name Eclectus (with the same Greek origin as "eclectic") is indeed apt as the ecology; the color and sexual behavior of males and females have turned out to be truly remarkable for their oddity and variety. ■

Rob Heinsohn is an Associate Professor/Reader in conservation and evolutionary biology at the Fenner School of Environment and Society, Australian National University. His research interests lie in the conservation biology and evolutionary ecology of vertebrates. His most recent study involves the migratory movements of birds between Australia and its northern neighbors. His long-term studies on Cape York and New Guinea parrots investigate the behavior and social organization of the breeding parrot groups, the availability of nest hollows in large rainforest trees,and the evolution of parrot color and visual systems.