(Comstock, The spider book, Cornell Univ. Press, Ithaca, 1948), and abandoned ones might serve as effective insect traps for birds detecting them.—JOHN F. DOUGLASS, *Archbold Biological Station of The American Museum of Natural History, Route 2, Box 180, Lake Placid, FL 33852* (Present address: *Dept. of Ecology and Evolutionary Biology, Univ. of Michigan, Ann Arbor 48109*). *Accepted 27 Sept. 1976.*

Notes on the hummingbirds of Monteverde, Cordillera de Tilarán, Costa Rica.—Monteverde, a lower montane site on the Pacific slope of northwest Costa Rica's Cordillera de Tilarán, supports a strikingly rich avifauna. During the periods October 1971–May 1973 and June–July 1975, I recorded 20 species of hummingbirds—over a third of Costa Rica's total—at Monteverde. Many species were well outside ranges previously described by Slud (Bull. Am. Mus. Nat. Hist. 128, 1964) and others. I present here information on avifaunal affinities of this diverse assemblage as well as data on local distribution, breeding, plumages, and behavior of species seldom studied in the field.

Monteverde lies upon a bench, elevation 1320–1540 m, just below the continental divide, which reaches 1600–1700 m. The approximately 3 km wide belt bounded by the lower edge of the bench and the divide contains a steep gradient of biotic communities, corresponding to the steep moisture gradient produced by trade winds which carry mist over the divide during the November–May "dry season." These communities range from a constantly wet, wind-sculptured elfin forest on the divide proper to a partly deciduous moist forest, subjected to severe dry-season moisture stress, on the lower edge of the bench. One may subjectively divide this gradient into "life zones," though no obvious boundaries exist and elevations are only approximate. Life zones were determined with the aid of Tosi (Mapa ecológico de Costa Rica, Centro Científico Tropical, San José, 1969) and Holdridge (Life zone ecology, Tropical Science Center, San José, 1967; pers. comm. to G. V. N. Powell). They are abbreviated below as follows: MF-WF = Lower Montane Moist Forest-Wet Forest Transition, elevation 1200–1400 m; WF = Lower Montane Wet Forest, elevation 1400–1480 m or higher; WF-RF = Lower Montane Wet Forest-Rain Forest Transition, elevation 1480–1540 m or higher; RF = Lower Montane Rain Forest, elevation over 1540 m; EF = Elfin Forest, crest of divide.

Many of Monteverde's bird species, especially those inhabiting the lower habitats, are characteristic of the dry Pacific northwest or the subtropical belt (*sensu* Slud 1964). Many species of the Caribbean slope stray over the divide, however, and the wetter forests of the higher elevations contain many characteristic highland birds. At these elevations hummingbirds typical of the forests also exploit flowers in the limited second-growth areas. The extensive pasture and scrub habitats of the lower life zones contain a distinct group of species, however, though forest populations contribute scattered individuals (Feinsinger, Organization of a tropical guild of nectivorous birds, Ph.D. thesis, Cornell Univ., 1974).

Though I made observations in all life zones, most studies, mist-netting, and color-marking of hummingbirds—following the method of Stiles and Wolf (Condor 75:244–245, 1973)—took place in MF-WF successional habitats. Within these habitats, hummingbirds fed at flowers of 15 plant species, particularly the herb *Lobelia laxiflora* (Campanulaceae) and the tree *Inga brenesii* (Leguminosae). Aggression was most pronounced during flowering peaks of these species. Territorial species directed most aggression toward flying or feeding birds; only *Philodice bryantae* consistently displaced perched conspe-

cifics. Feeding birds often spread their rectrices as a display, a stabilizing maneuver, or both. Most species vocalized while fighting, feeding, perching, or flying. Additional information on foraging and aggressive behavior is given by Feinsinger (1974) and by Feinsinger and Chaplin (Am. Nat. 109:217–224, 1975).

Phaethornis guy, Green Hermit (resident).—A bird of the humid sub-tropical and lower montane belts of both slopes (Slud 1964), at Monteverde this species resided in mature forest understory from MF-WF through EF. At least one lek site existed in RF. G. V. N. Powell (pers. comm.) discovered a nest with eggs in January 1971.

Phaethornis longuemareus, Little Hermit (vagrant).—The Little Hermit is local in the dry Pacific northwest of Costa Rica and on the lower slopes of the northwestern cordilleras (F. G. Stiles, pers. comm.; see Slud 1964). In April 1970, W. H. Buskirk (pers. comm.) sighted an individual in WF-RF understory. I observed a bird at the lower edge of the Monteverde bench (MF-WF) on 5 May 1972, and netted an adult in the same spot on 21 January 1973.

Doryfera ludovicae, Green-fronted Lancebill (vagrant).—On 16 October 1972, I netted an immature near a flowering *Inga brenesii* tree in a MF-WF pasture. (Immatures were identified by their striated culmens—see Ortiz-Crespo (Auk 89:851–857, 1972).) Previous published records for Costa Rica are restricted to the Caribbean slope of the central highlands (Slud 1964).

Campylopterus hemileucurus, Violet Sabrewing (resident).—A locally common highland species (F. G. Stiles, pers. comm.; Slud 1964), this large hummingbird commonly foraged among banana flowers at Monteverde. Forest-edge and forest understory at all elevations also supported a moderate density of sabrewings. F. G. Stiles (pers. comm.) recorded a lek at Monteverde; however, I noted only single singing males, usually near rich food sources. Males, which weighed more and had shorter bills than females (Feinsinger 1974), exhibited a range of plumages from solid green through mixed green and violet to solid violet. This sequence was correlated with disappearance of culmen striations, indicating a distinct immature male plumage unlike that of the gray-bellied females (*contra* Wetmore, Smithson. Misc. Collect. 150(2), 1968).

Colibri delphinae, Brown Violet-ear (vagrant).—I netted an immature of this species near an *Inga brenesii* tree on 15 October 1972. On 17 October, at least one other Brown Violet-ear fed at a nearby *I. brenesii*. Slud (1964) cites several isolated records from the central and southern mountains and one from the Cordillera de Guanacaste (the next mountain range to the northwest) but none from the Cordillera de Tilarán.

Colibri thalassinus, Green Violet-ear (seasonal).—From October through June, nonforested habitats from MF-WF through RF supported large numbers of this widespread highland species. Singing, presumably by males, took place on exposed perches well away from food sources. Even at particularly rich food sources, Violet-ears made few efforts at defense and were often displaced by smaller birds (Feinsinger 1974). Feeding birds often voiced a repetitious dry chatter.

Chlorostilbon canivetii, Fork-tailed Emerald (seasonal).—From late January through late November, a number of Emeralds resided in the MF-WF study areas. Immature males resembled females but possessed dark-green patches of varying extent on breast and throat. Many individuals of both sexes possessed entirely black mandibles and thus resembled the race—or species (Wetmore 1968)—*assimilis* of southwestern Costa Rica and Panama. Others resembled the race *salvini*, a member of the dry northwest avifauna that is abundant on the lower slopes of the northwestern mountains (Slud 1964). All individuals observed behaved similarly, however, exploiting scattered flowers while giving a soft, wren-like chatter.

Panterpe insignis, Fiery-throated Hummingbird (resident).—This highland species is most typical of the Cordillera Central and Cordillera de Talamanca (Slud 1964). The EF and upper RF at Monteverde also support a conspicuous resident population, discussed by Stiles and Hespenheide (Condor 74:99–101, 1972). Individuals I observed foraged in clearings and at epiphytes in the forest canopy but rarely entered forest understory.

Hylocharis eliciae, Blue-throated Goldentail (seasonal).—Common lower on the Pacific slope (Slud 1964), Goldentails entered Monteverde's MF-WF non-forested habitats only. A few adults and many immatures converged on *Lobelia laxiflora* fields February–April 1972 and 1973. During October and November 1972, some individuals fed at *Inga brenesii* trees. Immatures were dull buff on the underside, with pale pink at the base of the bill and flecks of blue on the throat or upper breast. Adults and immatures alike defended territories, often fighting with each other or with Blue-vented Hummingbirds.

Amazilia saucerottei, Blue-vented Hummingbird (resident).—Typical of the drier Pacific slope and central highlands of Costa Rica (Slud 1964), this species remained abundant year-around in the MF-WF study areas but was seldom seen above 1400 m or in wooded regions. Nearly every rich flower in the study areas supported a Blue-vented Hummingbird territory. Any other hummingbird that attempted to forage among defended flowers and attracted the attention of the territory holder was chased. These high-speed chases often entered other territories and became 3- or 4-bird affairs. Occasionally chase attempts were unsuccessful. Green Violet-ears entering Blue-vented territories in *Lobelia laxiflora* fields often ignored the residents and continued to feed. The numerous heliconiine, ithomiine, and pierid butterflies attracted to large *Hamelia patens* shrubs also ignored resident Blue-vented Hummingbirds despite the birds' continued efforts to eject them. On such occasions, defenders often abandoned their attempts in favor of irregular feeding, presumably a displacement activity.

Two marked Blue-vented Hummingbirds in particular remained in the study areas throughout much of the 1971–73 research period. These moved their territories from one flower concentration to another over the months. Their "shifting territories" (*sensu* Wolf, Condor 72:1–14, 1970) remained within a limited area which might be considered the home range.

Singing and fighting that took place well away from rich flower clumps peaked from early August through October 1972, indicating a possible spurt of mating activity in late wet season. Immatures (as judged by culmen striations) appeared throughout the year, however, and there was a great influx of them in May 1972. I encountered 2 nests, 1 on 2 December 1971 (containing a well-grown juvenile) and 1 on 9 January 1972 (containing eggs). The latter nest was on a dead *Cecropia obtusifolia* branch at secondary forest edge, elevation 1200 m. The nest with the juvenile was on a *Ficus* vine along a pasture edge at 1370 m. On 2 December an adult fed the juvenile at the nest, but on 4 December the latter had fledged and was in the grass beneath the nest. The bird feeding it chased away another adult that landed on the rim of the empty nest and made side-to-side head movements suggestive of feeding. This juvenile possessed duller plumage than most adults or immatures. Primaries and secondaries were medium gray instead of black; coverts and contour feathers on head, neck, and back appeared quite buffy (probably due to buffy edgings); and the rectrices were a light iridescent bluish-green resembling the color of a Green Violet-ear tail. I estimated exposed culmen length at 8 mm, less than half that of an adult. During the May 1972 influx of immatures, several netted had especially deep bill striations as well as duskier plumage and tails lighter in color than adults. These may have recently fledged.

Amazilia tzacatl, Rufous-tailed Hummingbird (resident or seasonal).—Widespread at lower elevations and occurring in clearings to at least 1500 m (F. G. Stiles, pers. comm.; Slud 1964), at Monteverde I observed this species only sporadically. Rufous-tailed Hummingbirds were especially conspicuous in the MF-WF study areas during June 1972, when they wrested control of many large *Hamelia patens* bushes from Blue-vented Hummingbirds. This species breeds at Monteverde: F. G. Stiles (pers. comm.) has discovered nests, and on 13 and 15 November 1971 I observed an adult feeding a juvenile perched on a WF roadside tree. Though its tail was the same striking rufous-brown as the adult's, the juvenile's green plumage appeared much duller (perhaps due to gray or buffy edgings) and its culmen appeared somewhat shorter.

Eupherusa eximia, Stripe-tailed Hummingbird (resident).—A typical mid-elevation species (Slud 1964), the Stripe-tailed Hummingbird was abundant throughout forest-edge and deep forest from MF-WF through EF. Stripe-tails often entered MF-WF clearings as well. They visited a wide variety of flowers, piercing those corollas adapted for longer-billed species. Foraging or fighting individuals often voiced loud buzzes and spread their striking tails for the duration of each buzz.

Elvira cupreiceps, Coppery-headed Emerald (resident).—This normally Caribbean-slope species (Slud 1964) was most abundant in forest-edge and forest habitats in the MF-RF and lower RF. Emeralds also entered MF-WF openings at times, usually to feed at *Inga brenesii* flowers. G. V. N. Powell (pers. comm.) found 2 nests in WF-RF in November 1971 and October 1972.

Lampornis hemileucus, White-bellied Mountain-gem (vagrant).—On 14 February 1973, I netted an immature at 1320 m elevation in the MF-WF study areas. I also observed an immature or female in the same area on 29 May 1972. W. H. Buskirk (pers. comm.) observed this species on the Caribbean slope northeast of Monteverde during dry season. Previously, this species was not recorded further north than the Caribbean slope of the central highlands (Slud 1964).

Lampornis calolaema, Purple-throated Mountain-gem (resident).—I often encountered this common highland hummingbird in all habitats from WF through EF. Some Mountain-gems strayed into the MF-WF study areas to feed at *Inga brenesii*. Although dominant over even Blue-vented Hummingbirds, Mountain-gems gave few displays. Nests with eggs or young were encountered during all seasons in understory trees or shrubs (January, March 1972—WF), on low forest-edge vines (October 1972, WF; December 1972, WF-RF), even in crevices in a clay roadbank (May 1972, August 1972, July 1975—WF-RF and RF).

Heliodoxa jacula, Green-crowned Brilliant (resident).—W. H. Buskirk and G. V. N. Powell (pers. comm.) netted these birds year-around in mature forests of the WF-RF zone. Slud (1964) cites no records from the northwestern cordilleras for this species, more typical of the subtropical-lower montane Caribbean slope.

Heliomaster constantii, Plain-capped Starthroat (seasonal).—A member of the dry-forest avifauna (Slud 1974), this species appeared in the MF-WF study areas. Females or immatures frequently foraged at the vine *Mandevilla veraguasensis* (Apocynaceae) May–August 1972 and July–August 1975.

Philodice bryantae, Magenta-throated Wood-star (seasonal).—Wood-stars were considered "very uncommon" by Slud (1964), who listed several records from the central highlands but only 1 from the Cordillera de Guanacaste and none from the Cordillera de Tilarán. At Monteverde, however, these unique little birds appeared predictably and abundantly from September through April of each year. Though most common at *Inga brenesii* and *Lobelia laxiflora* flower concentrations in the MF-WF study areas, Wood-stars also foraged in openings and forest edges through at least WF-RF.

Intense intraspecific belligerence characterized both sexes of Wood-stars. Rich food sources were vigorously defended. Territory holders perched on dead branches high in trees near the defended flowers. Territorial males sang a complex weak, scratchy melody that often included loud snaps. Songs were often interspersed with preening bouts or with displays that consisted of rotating the head back and forth, presumably exposing the males' brilliant gorgets. Conspecific intruders of either sex, whether feeding or perching, were immediately attacked. If its rapid approach failed to displace the intruder, the attacker hovered back and forth over the trespassing bird, uttering a variety of squeaks and a buzzy *churrrr* and occasionally darting at the other. The slender rectrices were kept spread throughout this action, producing a palmate appearance in contrast to the fanlike spread tails of other species with broader rectrices. These displays seldom failed to elicit either flight or a battle. Both "churrrring" loudly, fighting Wood-stars circled each other 5–30 cm apart and darted back and forth. Still circling and darting, the fighting pair sometimes rose high in the air. More often, however, opponents stayed near ground level; failing to eject one another, both would resort to displacement-feeding, still churrrring. Males performed an aerial display reminiscent of certain North American species. These displays were usually aimed at a male or female trespasser that the defender had been unable to displace, but were occasionally aimed at perched females and thus may have served a mating function as well. A displaying bird swept back and forth pendulum fashion in a shallow, 20–30 m wide arc that centered just above the target individual. At each endpoint, the displayer paused or flew at a tangent for 2–3 sec before sweeping down again. The visual display was accompanied by a loud, snipe-like whistle, undoubtedly produced by the wings, and at the bottom of the arc by 3 to 7 loud manakin-like snaps, perhaps produced by the rectrices. From 1 to 8 such displays were performed in a sequence, the plane of the arc changing all the while. The performer invariably concluded by flying to a nearby perch. I never observed females to sing or to engage in the pendulum display. Nevertheless, females often defended feeding territories, displaced both sexes from flowers or perches, and darted around intruders if necessary.

Perched Wood-stars never uttered the *churrrr*. Foraging birds often did so, however, especially if agitated. A feeding bird never opened its rectrices unless under attack but rather kept the tail closed and pointed up at about a 60° angle from the body plane. Moving methodically from flower to flower, never chirping, wings beating so rapidly and smoothly that a steady loud hum was produced, these stocky, dull-colored birds resembled large hymenopterans. In fact, they may derive some benefit from that resemblance (Feinsinger 1974).

Archilochus colubris, Ruby-throated Hummingbird (seasonal).—A number of females and an occasional male of this species, which is most often observed at lower elevations on the Pacific slope (see Slud 1964, Wolf 1970), appeared in the MF-WF study areas from October–March. Culmen striations showed that all 6 birds netted were birds of the year. Nevertheless, all 4 males, even 1 caught on 14 October 1972, possessed full gorgets.

Selasphorus scintilla, Scintillant Hummingbird (vagrant).—On 7 July 1975 I observed an individual of this tiny species feeding in a field of *Rubus rosaeafolia* (Rosaceae) in the WF-RF zone, and 2 individuals were netted on 10 July. Slud (1964) mentions no records of this mid-elevation species from the northwestern cordilleras.

I especially wish to thank the people of Monteverde for allowing and indeed encouraging these studies on their land. I am also grateful to F. G. Stiles for copious comments on the manuscript, and to W. H. Buskirk and G. V. N. Powell for use of their field notes. Field work was supported by an Andrew D. White (Cornell University) Fellowship, a Cornell Graduate Fellowship, an NSF grant to the Section of Ecology and Systematics at

Cornell, and a grant from J. S. Dunning.—PETER FEINSINGER, *Dept. of Zoology, Univ. of Florida, Gainesville, 32611. Accepted 1 Oct. 1975.*

Nest-site differences between Red-headed and Red-bellied woodpeckers in South Carolina.—Red-headed (*Melanerpes erythrocephalus*) and Red-bellied (*M. carolinus*) woodpeckers are potential competitors for nest-sites over much of their range. Parameters serving to lessen competition between them have been discussed by Reller (Am. Midl. Nat. 88:270–290, 1972) for Illinois and by Jackson (Condor 78:67–76, 1976) for Kansas. Reller states that "All Red-heads observed nested in trunks of dead trees. Red-bellies, on the other hand, favored dead limbs in live trees for nest sites," her observations having been made in oak-maple-hickory woodlands. Jackson (op. cit.), studying the 2 species under differing ecological conditions, noted that while both species preferred to nest in dead trees, 50% of which were elms, the Red-headeds preferred nest trees with open spaces around them and Red-bellieds, ones located in woodlands. Other differences were that Red-headeds, in contrast to Red-bellieds, preferred dead limbs with no bark and ones with a crack in which to make entrance holes. The aim of this report is to describe nest-site differences under still other conditions, namely those of the coastal plain in South Carolina.

Observations were made at a quail shooting plantation in Luray in April and May 1973 to 1975. Pairs of Red-bellieds and of Red-headeds were more or less intermixed in terrain where strips of loblolly pines (*Pinus taeda*), along with scattered oaks and other deciduous trees alternated with open fields. As shown in Table 1 the Red-bellied occupied holes carved originally by Red-cockaded Woodpeckers (*Picoides borealis*) in living pines or excavated ones of their own in pines that had recently died. The outstanding feature of these latter was that they still retained bark and branches. Pairs of Red-headeds, in contrast, excavated or occupied pines dead for some years. These were well-weathered, had almost no bark, and had only broken limbs remaining. Many, having lost their tops, were no more than stubs. One exceptional dead pine fell between the categories. It had, oddly enough, a pair of Red-bellieds trying to nest in an old hole made by Red-bellieds

TABLE 1

NEST TREES OCCUPIED BY RED-HEADED AND RED-BELLIED WOODPECKERS EARLY IN THE BREEDING SEASON ON A PLANTATION IN SOUTH CAROLINA

Location of Nest Hole (completed or being excavated)	No. of Pairs	
	Red-headed	Red-bellied
Hole of Red-cockaded, living	1	6*
Recently dead pines	0	8
Old dead pines	10	0
Old pine stubs	13	0
Deciduous tree; dead trunk or limb	0	2
TOTALS	24	16

* One of the pines had died within the previous year.