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BIRDS OF THE TAMBO AREA, AN ARID VALLEY IN THE BOLIVIAN ANDES

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ABSTRACT.—We surveyed birds in an arid valley at 1,500 m elevation in the Andes of western depto. Santa Cruz, Bolivia, in January and February, and in June and July. This is one of the only localities with xeric vegetation to be surveyed in an arid intermontane valley of the Eastern Andes. The 50 species breeding or presumed to be breeding in the arid scrub provides a striking example of high species richness at tropical latitudes. Differences between the surveys in January–February ("summer" wet season) and the one in June ("winter" dry season) show strong seasonality in the presence/absence or abundance in 32 of the 92 regularly occurring species. Whereas at least 51 species were breeding or probably breeding during the January–February surveys, only five were breeding or probably breeding during the June–July survey. Subcutaneous fat levels were scored as "no fat" or "low" in 95% of all individuals collected. Most species occurring at this Andean locality have primarily lowland, rather than Andean, geographic distributions.

RESUMEN.—Investigamos las aves en un valle árido a 1,500 m de altura en los Andes al oeste del Departamento de Santa Cruz, Bolivia, en Enero y Febrero, y en Junio y Julio. Esta es una de las únicas localidades con vegetación xerofitica a ser investigadas en un valle árido intermontano en los Andes Orientales. Las 50 especies que se reproducen o que se presume que se reproducen en arbustos áridos nos dá un notable ejemplo de una gran riqueza de especies en latitudes tropicales. Las differencias entre las investigaciones en Enero–Febrero ("verano" estación húmeda) y la de Junio ("invierno" estación seca) muestran una fuerte estacionalidad en la presencia/ausencia o abundancia en 32 de las 92 especies que regularmente están presentes. Considerando que por lo menos 51 especies se estaban reproduciendo o probablemente reproduciendo durante la investigación de Enero-Febrero, solamente seis se estaban reproduciendo o probablemente reproduciendo durante la investigación de Junio–Julio. Los niveles de grasa subcutánea fueron calificados como "sin grasa" o "bajo" en 95% de todos los individuos colectados. La mayoria de las especies que ocurren en esta localidad andina tienen primordialmente distribución geográfica de tierres bajas, en vez de andina.

The eastern slope of the Eastern Andes of South America is best known for its humid cloud-forest. Rain-shadows in some intermontane valleys, however, produce arid conditions that create isolated areas of xerophytic vegetation. Perhaps the best-studied of these areas are the Marañón Valley of northern Peru (Dorst 1957) and the Urubamba Valley of central Peru (Chapman 1921), both of which possess many endemic bird taxa and form important biogeographic barriers to humid forest biota (e.g., Vuilleumier 1984; O'Neill 1992). Other intermontane Andean valleys that do not transect the Eastern Andes have been studied by Miller (1947, 1952).

Although also rich in endemic bird taxa and important as a biogeographic barrier, the Río Grande Valley of central Bolivia has received less attention. This dry, intermontane valley system forms a major barrier to dispersal for humid forest birds of the Andes, few of which occur south of the Río Grande Valley (Remsen et al. 1986, 1987). Within the valley, a mosaic of vegetation types ranges from semi-humid forest to barren scrub. The Río Grande Valley has been disturbed heavily by humans, and so the character of the original vegetation is unknown. Two bird species are endemic to the valley system: *Ara rubrogenys* (Red-fronted Macaw) and *Poospiza garleppi* (Cochabamba Mountain-Finch); five other species whose main distribution is the Río Grande Valley system but which also occur in the nearby Río La Paz or Río Pilcomayo valleys are: *Oreotrochilus adela* (Wedge-tailed Hillstar), *Upucerthia harterti* (Bolivian Earthcreeper), *Sicalis*

luteocephala (Citron-headed Yellowfinch), *Poospiza boliviana* (Bolivian Warbling-Finch), and *Oreopsar bolivianus* (Bolivian Blackbird) (Remsen and Traylor 1989, Fjeldså and Krabbe 1990).

METHODS

We conducted intensive avifaunal surveys at site near the Tambo school and the village of San Isidro, a small community of about 30 dwellings at 1,500 m on the Río San Isidro (known locally as the Río Pulquina), roughly 150 km west of the city of Santa Cruz de la Sierra, depto. Santa Cruz. Our study site (hereafter "Tambo"; ca. 18°02′S, 64°25′W; Paynter 1992) was 2.5 km north of the Tambo school, roughly 0.5 km northeast of the El Rancho church.

The area surveyed covered roughly 2 km^2. Approximately 75% of this area consisted of xeromorphic scrub vegetation (Fig. 1), 25% of cultivated fields bordered by hedgerows, and less than 1% of riparian woodland. The river, estimated to be 15–30 m wide, had created a flat floodplain valley in an otherwise hilly area. The floodplain has been converted completely to cultivated fields (mainly tomatoes, corn, and beans) except for (a) a very narrow (usually just a few meters wide) riparian strip of trees 10–20 m tall and (b) bushes and small trees along hedgerows and irrigation ditches, often with bordering patches of grasses and weeds. The hillsides were covered with a variety of xeromorphic shrubs, small trees, and many columnar cacti; vegetation height was roughly 2–5 m, slightly higher in the arroyos. The vegetation only locally formed dense thickets. Virtually every tree and shrub was thorny. Epiphytes and hemiparasites were present but not conspicuous. Terrestrial bromeliads were abundant on the steepest slopes. Numerous cattle and goats made trails everywhere through the hillsides. Although no rainfall data are available from the region, the similarity of the vegetation physiognomy (Fig. 1) to that found in the Sonoran Desert of North America suggests that annual rainfall is roughly equivalent.

We did not collect plant specimens for identification. However, Michael Nee, who is familiar with the vicinity of the site and with the flora of depto. Santa Cruz, provided us (pers. comm.) with the following predictions on the identifications of the most common arborescent species: (1) riparian trees and shrubs: *Prosopis alba, P. kuntzei,* and *Acacia aroma* (Mimosaceae); *Tipuana tipu* (Fabaceae); *Schinopsis haenkeana* and *Schinus fasciculatus* (Anacardiaceae); and *Vassobia breviflora* (Solanaceae); (2) xeromorphic hillside and dry-wash scrub: the columnar cacti *Harrisia tephracantha* and *Neoraimondia herzogiana*; *Jodina rhombifolia* (Santalaceae); *Condalia* sp. (Rhamnaceae); *Celtis chichape* and *C. spinosa* (Ulmaceae); *Aloysia gratissima* (Verbenaceae); *Capparis retusa, C. speciosa, C. atamisquea,* and *Koeberlinia spinosa* (Capparidaceae); *Gymnosporia spinosa* (Celastraceae); *Achatocarpus praecox* (Achatocarpaceae); and *Porlieria microphylla* (Zygophyllaceae). The terrestrial bromeliad is almost certainly *Deuterocohnia longipetala.*

We surveyed birds during the wet season from 8 to 20 February 1979 and from 15 January to 3 February 1984, and during the dry season from 23 June to 2 July 1984. The general aspect of the vegetation differed strongly between the two study periods, with many trees and shrubs losing their leaves in the dry season. We observed and collected birds daily from dawn to noon, and often again late in the afternoon until dusk. In 1979, we operated 3–6 mist nets in xeromorphic habitats and 1–2 nets in riparian habitats for a total of ca. 530 daytime net-h. In January and February 1984, we operated 3–5 nets in xeromorphic habitats and 1–2 in riparian habitats for a total of ca. 850 daytime net-h. In June–July 1984, we operated 3–5 mist nets in xeromorphic habitats and one in riparian habitats for a total of 441 daytime net-h. All nets were 12-m long.

We placed each species into one of six categories of relative abundance based on the average number of individuals detected (sight, voice, and mist-net capture) per day: "Abundant" (> 50/day), "Common (15–49/day), "Fairly Common" (3–14/day), "Uncommon" (1–2/day), "Rare" (not seen daily, but regularly enough to be assumed to be part of the "core" avifauna, as defined by Remsen [1994]), and "Visitor" (1–2 records, probably not part of core avifauna). No substantial differences in abundance were noted between the January and February (wet season) samples, and so these were combined. Within our limited temporal framework, we doubt that our data would allow us to detect differences in relative abundance of only one of the above categories between samples (January-February vs. June-July); therefore, we only consider between-season differences in abundance of at least two categories to represent real differences. Because our visits were relatively brief and sampled only portions of four of the twelve months of the year, and because we were not intimately familiar with the region's avifauna, we predict that some of our assignments to categories are incorrect.

Specimens were inspected during preparation for evidence of breeding. We considered as "strong" evidence for breeding the presence of an egg with shell in the oviduct, a brood patch,

FIG. 1. Arid scrub on hillsides at study site near Tambo, 1,500 m, depto. Santa Cruz, Bolivia.

a cloacal protuberance, or enlarged ova. We considered enlarged testes as "weak" evidence for breeding. See Appendix 1 for details. Body mass (Appendix 2) was measured using Pesola balances. Specimens are deposited at the Delaware Museum of Natural History, the Museum of Natural Science, Louisiana State University, and the Museo Nacional de Historia Natural, La Paz. Miscellaneous natural history observations of little-known species are summarized in Appendix 3.

RESULTS AND DISCUSSION

We recorded 103 bird species during our three surveys (Table 1), 11 of which, were detected only 1–2 times. One of these 11 species, *Elaenia strepera*, is a long-distance migrant that had presumably just begun migrating from its breeding towards its winter range (Marantz and Remsen 1991). Seven other species may have been wanderers from adjacent regions. The status of three nocturnal species was uncertain. The remaining 92 species were considered the core avifauna for analysis (Table 2).

Of the 92 core species, 50 (54%) were breeding-season or permanent residents in xeromorphic vegetation (scrub and washes; Table 1). Therefore, this structurally simple habitat contains more breeding species than the richest forests at temperate latitudes in North America or elsewhere. For example, the number of species recorded on 43 Breeding Bird Census plots in "broadleaf forests" in 1994 in North America ranged from 11 to 47 with a mean of 27 species (*J. Field Ornith.* 66:S5–S6, 1995); although the plot size of these censuses is smaller than the area that we sampled, we found 47 of the 50 species on our most intensively sampled area, roughly 20 ha. Thus, the species diversity of the Tambo avifauna provides another example of the extraordinary richness of bird communities at tropical latitudes.

Of the core avifauna, 69 species (75%) were detected during both the wet and dry season surveys (Table 1) and were presumably permanent residents. However, 14 (20%) of these showed substantial change in relative abundance between seasons: 13 were classified only as Visitors during the dry season, and one species (*Thraupis bonariensis*) decreased in relative abundance from wet to dry season by two ranks on our scale. Of these 14 species, four changed in status from Rare to Visitor, and so whether these truly changed in abundance is open to question. Four of the 14 species are known to be migratory elsewhere in South America (*Crotophaga ani, Myiophobus fasciatus, Vireo olivaceus, Thraupis bonariensis*). That leaves four species for which we can find no previous documentation of seasonal movements: *Coragyps atratus, Turdus rufiventris, Poospiza nigrorufa*, and *Molothrus badius*.

Of the 23 core species detected during only one season, 15 (16%) were wet-season residents that were breeding or presumed breeding. Of these 15, 13 are known to be migratory elsewhere in South America (*Phalacrocorax brasilianus, Tapera naevia, Hydropsalis brasiliana, Elaenia parvirostris, Myiodynastes maculatus, Tyrannus melancholicus, Empidonomus aurantioatrocristatus, Pachyramphus polychopterus, P. validus, Phytotoma rutila, Catamenia analis, Tiaris obscura, Sporophila caerulescens*; Remsen and Hunn 1979; Fjeldså and Krabbe 1990; Chesser 1994, 1995, 1997; Bates 1997). The two for which we can find no previous report of seasonal movements are *Phaethornis pretrei* and *Euphonia musica*. Concerning the latter, T. A. Parker (in Isler and Isler 1987) had suspected that it moved seasonally in the Andes. Two species, *Empidonax alnorum* and *Catharus ustulatus*, are Nearctic breeding species present at our Bolivian site only during the boreal winter. Six species (*Accipiter striatus, Pyrrhura molinae, Sublegatus modestus, Knipolegus aterrimus, Pygochelidon cyanoleuca*, and *Myioborus brunniceps*) were present only during the dry season; all are known to be make seasonal movements elsewhere in South America (Fjeldså and Krabbe 1990; Chesser 1994, 1995, 1997).

From specimen data, we found strong evidence (see Methods) for wet-season breeding for 37 species and weak evidence for another 14 species (Appendix 1). Because we did not search actively for nests, and because relatively small numbers of specimens (none for many species) were obtained, we regard this as a conservative estimate of the proportion (51 of 83 core species, 62%) of the wet-season avifauna that was breeding. Other than the two Nearctic wintering species, we suspect that virtually all species were breeding during the wet season. In the dry season, the proportion of species that was breeding was significantly lower (Chi-square = 348, $P = 0.0001$): we found strong evidence for breeding for only two (3%) of the 62 core species (*Picoides lignarius, Columbina picui*) and weak evidence for three other species (*Nothoprocta pentlandii, Chlorostilbon aureoventris, Amazilia chionogaster*). Breeding during the dry season is well-known for pigeons and hummingbirds (Skutch 1950). In contrast to the wet season, only a few species (*Amazilia chionogaster, Cranioleuca pyrrhophia, Stigmatura budytoides, Polioptila*

TABLE 1

BIRDS OF THE TAMBO AREA, 1,500 M, DEPTO. SANTA CRUZ, BOLIVIA. STATUS REFERS TO THE TYPICAL NUMBER FOUND IN APPROPRIATE HABITAT WITHIN THE STUDY AREA IN A MORNING OF FIELDWORK, AS FOLLOWS: "A" = ABUNDANT (> 50), "C" = COMMON (15–49), "FC" = FAIRLY COMMON (3–14), "U" = UNCOMMON (1–2), AND "R" = RARE (NOT SEEN DAILY, BUT REGULARLY ENOUGH TO BE ASSUMED TO BE PART OF THE CORE AVIFAUNA), AND "V" = VISITOR (1–2 RECORDS, PRESUMABLY NOT PART OF CORE AVIFAUNA). HABITAT CODES ARE: "SCRUB" = ARID HILLSIDE SCRUB; "WASHES" = MAINLY WASHES IN DESERT SCRUB (USED FOR SPECIES RESTRICTED TO, OR IN MUCH HIGHER DENSITIES IN, WASHES THAN ON SURROUNDING HILLSIDES); "RIPARIAN" = RIPARIAN WOODS, THICKETS; "FIELDS" = AGRICULTURAL FIELDS OR THEIR WEEDY EDGES; "AERIAL" = FORAGING OVERHEAD; "RIVER" = AQUATIC HABITAT; "OVERHEAD" = SEEN FLYING OVER ONLY, NOT FORAGING IN THE STUDY AREA; AND "?" = HABITAT NOT RECORDED. HABITAT WITH HIGHEST DENSITY FOR THAT BIRD SPECIES IS LISTED FIRST. DISTRIBUTION PATTERNS ARE AS FOLLOWS: "WIDESPREAD" = INCLUDES LOWLANDS AND HIGHLANDS; "LOWLANDS" = WIDESPREAD IN NEOTROPICAL LOWLANDS; "DRY ANDES" = PRIMARILY IN DRY MONTANE REGIONS; "S. DRY ANDES" = DRY ANDES, MAINLY SOUTHERN PERU TO NORTHERN ARGENTINA; "S. LOWLANDS" = LOWLANDS OF SOUTH AMERICA GENERALLY SOUTH OF AMAZONIA; "HUMID ANDES" = PRIMARILY HUMID OR SEMI-HUMID ANDES; "HA-SL" = HUMID ANDES AND SOUTHERN LOWLANDS; "DA-SL" = DRY ANDES AND SOUTHERN LOWLANDS; "SDA-SL" = SOUTHERN DRY ANDES AND SOUTHERN LOWLANDS; "N.A. MIGRANT" = MIGRANT FROM NORTH AMERICA; "ENDEMIC" = ENDEMIC TO RÍO GRANDE VALLEY SYSTEM

Family/Species	Status		Habitat	Distribution
	Jan.–Feb.	June–July		
TINAMIDAE				
Nothoprocta pentlandii	R	U	Washes	Dry Andes
PHALACROCORACIDAE				
Phalacrocorax brasilianus	R	—	River	Lowlands
CATHARTIDAE				
Cathartes aura	FC	U	Aerial	Widespread
Coragyps atratus	U	V	Aerial	Lowlands
Vultur gryphus	R	R	Aerial	Dry Andes
ACCIPITRIDAE				
Accipiter striatus	—	R	Washes	HA-SL
Buteo magnirostris	R	U	Fields, scrub	Lowlands
COLUMBIDAE				
Zenaida auriculata	FC	U	Fields	Lowlands
Columbina picui	C	A	Fields	S. lowlands
Leptotila verreauxi	FC	FC	Washes, riparian	Lowlands
PSITTACIDAE				
Ara rubrogenys	R	V	Overhead	Endemic
Aratinga acuticauda	C	A	Riparian, washes	Lowlands
Aratinga mitrata	U	C	Overhead	Dry Andes
Bolborhynchus aymara	R	R	Scrub	S. dry Andes
Brotogeris chiriri	FC	FC	Overhead	Lowlands
Pyrrhura molinae	—	R	Scrub	S. lowlands
Amazona aestiva	FC	U	Scrub	S. lowlands
CUCULIDAE				
Crotophaga ani	U	V	Fields	Lowlands
Guira guira	U	FC	Fields	S. lowlands
Tapera naevia	R	—	Riparian	Lowlands
STRIGIDAE				
Glaucidium brasilianum	—	V?	?	Lowlands
CAPRIMULGIDAE				
Caprimulgus parvulus	—	R?	Scrub	Lowlands
Hydropsalis brasiliana	U	—	Riparian, scrub	S. lowlands

TABLE 1
CONTINUED

Family/Species	Status		Habitat	Distribution
	Jan.–Feb.	June–July		
APODIDAE				
Aeronautes montivagus	—	V?	Aerial	Humid Andes
Streptoprocne zonaris	—	V?	Aerial	Widespread
TROCHILIDAE				
Phaethornis pretrei	U	—	Riparian	S. lowlands
Chlorostilbon aureoventris	R	U	Scrub	S. lowlands
Amazilia chionogaster	FC	C	Scrub	SDA-SL
Lesbia nuna	—	V	Washes	Dry Andes
BUCCONIDAE				
Nystalus chacuru	U	U	Riparian, washes	S. lowlands
PICIDAE				
Picumnus dorbignianus	U	U	Riparian, washes	Dry Andes
Melanerpes cactorum	C	C	Scrub	S. lowlands
Picoides lignarius	U	R	Washes	S. dry Andes
Piculus rubiginosus	V	—	Riparian, washes	Humid Andes
Colaptes melanochloros	R	U	Scrub	S. lowlands
Campephilus leucopogon	R	U	Washes	S. lowlands
DENDROCOLAPTIDAE				
Lepidocolaptes angustirostris	C	FC	Washes	S. lowlands
FURNARIIDAE				
Upucerthia harterti	FC?	FC	Scrub	Endemic
Furnarius rufus	C	FC	Fields, washes	S. lowlands
Synallaxis frontalis	U	U	Riparian	S. lowlands
Cranioleuca pyrrhophia	FC	C	Scrub	S. lowlands
Phacellodomus striaticeps	U?	U	Washes	S. dry Andes
FORMICARIIDAE				
Thamnophilus caerulescens	U	FC	Riparian, washes	Widespread
Thamnophilus ruficapillus	U	R	Riparian, washes	HA-SL
TYRANNIDAE				
Phaeomyias murina	U	V?	Washes	Lowlands
Camptostoma obsoletum	—	V?	Washes	Lowlands
Sublegatus modestus	—	R	Washes	Lowlands
Suiriri suiriri	FC	C	Washes	S. lowlands
Elaenia flavogaster	V	—	Washes	Lowlands
Elaenia parvirostris	C	—	Riparian, scrub	S. lowlands
Elaenia strepera	V	—	Riparian	Humid Andes
Serpophaga munda	U	FC	Riparian, washes	S. lowlands
Stigmatura budytoides	C	C	Scrub	S. lowlands
Hemitriccus margaritaceiventer	U	FC	Scrub, riparian	Lowlands
Tolmomyias sulphurescens	R	—	Washes	Lowlands
Myiophobus fasciatus	FC	V	Fields	Lowlands
Empidonax alnorum	R	—	Riparian	N.A. migrant
Knipolegus aterrimus	—	U	Washes	SDA-SL
Sayornis nigricans	—	V?	Riparian	Humid Andes
Satrapa icterophrys	U	V	Riparian	S. lowlands
Hirundinea ferruginea	U	U	Washes (steep banks)	DA-SL
Pitangus sulphuratus	U	U	Fields	Lowlands
Myiodynastes maculatus	U	—	Washes	Lowlands
Tyrannus melancholicus	U	—	Riparian	Lowlands
Empidonomus aurantioatrocristatus	U	—	Scrub	S. lowlands
Pachyramphus polychopterus	U	—	Riparian	Lowlands
Pachyramphus validus	U	—	Riparian	HA-SL
COTINGIDAE				
Phytotoma rutila	U	—	Washes	SDA-SL

TABLE 1
CONTINUED

Family/Species	Status		Habitat	Distribution
	Jan.–Feb.	June–July		
HIRUNDINIDAE				
Pygochelidon cyanoleuca	—	FC	Aerial	Widespread
TROGLODYTIDAE				
Troglodytes aedon	FC	FC	Fields, scrub	Widespread
POLIOPTILIDAE				
Polioptila dumicola	C	FC	Scrub	S. lowlands
TURDIDAE				
Catharus ustulatus	R	—	Riparian	N.A. migrant
Turdus chiguanco	R	R	Riparian, scrub	S. dry Andes
Turdus rufiventris	U	V	?	S. lowlands
Turdus amaurochalinus	C	U	Washes	S. lowlands
VIREONIDAE				
Cyclarhis gujanensis	U	U	Riparian, washes	Lowlands
Vireo olivaceus	FC	V	Riparian	Lowlands
EMBERIZIDAE				
Zonotrichia capensis	A	A	Fields, scrub	Widespread
Lophospingus griseocristatus	A	A	Scrub, fields	S. dry Andes
Poospiza nigrorufa	FC	V	Riparian	S. lowlands
Poospiza torquata	U	FC	Fields, scrub	SDA-SL
Poospiza melanoleuca	FC	FC	Riparian, scrub	S. lowlands
Sicalis flaveola	C	A	Fields, scrub	Lowlands
Sporophila caerulescens	FC	—	Riparian	S. lowlands
Tiaris obscura	C	—	Riparian	Dry Andes
Catamenia analis	U	—	Riparian	Dry Andes
Arremon flavirostris	U	U	Riparian, washes	S. lowlands
Coryphospingus cucullatus	FC	U	Fields, riparian, scrub	S. lowlands
Pheucticus aureoventris	C	FC	Riparian	HA-SL
Saltator aurantiirostris	C	C	Riparian, scrub	SDA-SL
Cyanocompsa brissonii	U	U	Riparian, washes	Lowlands
THRAUPIDAE				
Piranga flava	U	U	Riparian, washes	Widespread
Thraupis sayaca	FC	FC	Riparian	Lowlands
Thraupis bonariensis	A	FC	Washes	DA-SL
Euphonia chlorotica	FC	FC	Riparian	Lowlands
Euphonia musica	R	—	Riparian	Lowlands
PARULIDAE				
Parula pitiayumi	U	FC	Riparian, washes	Widespread
Geothlypis aequinoctialis	R	V	Fields	Lowlands
Myioborus brunniceps	—	U	Riparian	Humid Andes
ICTERIDAE				
Icterus cayanensis	R	V	Washes	Lowlands
Molothrus badius	C	V	Fields	SDA-SL
Molothrus bonariensis	R	V	Fields	Lowlands
FRINGILLIDAE				
Carduelis magellanica	U	U	Riparian	Widespread

dumicola, Saltator aurantiirostris, Parula pitiayumi) sang regularly during the dry season, when dawn was strikingly devoid of bird song.

Of the 88 species for which body mass data were obtained, individuals with subcutaneous fat levels scored as "moderate" (following McCabe 1943) were found in 25 (28 %) species, and as "heavy" in eight (9 %) species (Appendix 2). Of the 708 adult individuals collected, sub-

TABLE 2

SUMMARY OF SPECIES RICHNESS, AND SEASONAL CHANGES OF THE AVIFAUNA AT TAMBO, DEPTO. SANTA CRUZ, BOLIVIA

	Seasons combined	Wet season	Dry season
Total species	103	90	82
Core avifauna	92	83	62

cutaneous fat levels were generally low: only 34 (5%) had moderate fat and only eight (1%) had heavy fat (Appendix 2). No substantial seasonal differences were evident in the proportion of individuals with moderate or heavy fat. Unfortunately, we are not aware of any community-wide samples of tropical birds for comparison. The eight individuals having heavy subcutaneous fat deposits were: *Hirundinea ferruginea pallidior* (1 July), *Catharus ustulatus* (17 February), *Turdus amaurochalinus* (27 June), *Vireo olivaceus chivi* (19 January), *Sporophila caerulescens* (26 January), *Catamenia analis* (26 January), *Euphonia chlorotica* (1 July), and *Carduelis magellanica* (27 January). Five of these species were strongly seasonal at our site, and so the elevated fat levels were presumably associated with migration, but three species (*H. ferruginea, E. chlorotica, C. magellanica*) did not differ in status between our samples.

Of the 88 species with body mass data (Appendix 2), no previous data were listed for 13 species by Dunning (1993), although body mass data had already been published for one (*Upucerthia harterti*) by Remsen et al. (1988). For the vast majority of the other 75 species, however, our data are the first that include differences due to sex and to subcutaneous fat levels. The wide ranges in masses reported by many species by Dunning (1993) are almost certainly due to differences in fat levels, not true individual variation.

Of the 83 species in the breeding avifauna, the majority of species are primarily lowland forms; of these, 27 (33%) are widespread in South American lowlands, and 26 (31%) are found primarily south of Amazonia (Table 1). Although our study site, at 1,500 m, is definitely in the Andes, only 11 core species (13%) are found largely in the Andes, all in dry regions. (The remaining species cannot be assigned easily to exclusively montane or lowland distribution patterns.) Thus, the Tambo avifauna of central Bolivia is primarily derived from the lowlands rather than the adjacent montane regions at higher elevations.

Only two species (*Ara rubrogenys* and *Upucerthia harterti*; see Remsen et al. [1988] for summary of our natural history observations of the latter at Tambo) of the seven endemic to the Río Grande Valley or adjacent dry valleys are found at Tambo; the other five are restricted to higher elevations (see Remsen and Traylor 1989; Fjeldså and Krabbe 1990), as are many other species of birds of the dry Andes whose elevational ranges do not extend as low as 1,500 m. At the subspecies level, however, 11 (14%) of the 81 nonendemic, core breeding species are represented at Tambo by subspecies evidently endemic to the Río Grande Valley system or adjacent dry valleys: *Lepidocolaptes angustirostris hellmayri, Cranioleuca pyrrhophia striaticeps, Thamnophilus caerulescens connectens, Stigmatura b. budytoides, Pitangus sulphuratus bolivianus, Phytotoma rutila angustirostris, Polioptila dumicola saturata, Cyclarhis gujanensis dorsalis, Poospiza h. hypochondriaca, Thraupis bonariensis composita*, and *Molothrus badius bolivianus*.

The results from the few other locality surveys from comparable elevations in Andean dry valleys suggest that derivation of these intermontane avifaunas from lowland avifaunas is a general pattern. Chapman (1917), whose pioneering work on Andean biogeography included the first analyses of avifaunas of arid montane valleys, and Miller (1947, 1952) showed that the avifauna of the upper Magdalena Valley was derived from lowland avifaunas, but the localities that they studied were much lower than Tambo. Chapman's (1921) analysis of the Urubamba Valley avifauna of Peru, which included several localities, and only one as high as 1,500 m, showed that the avifauna of dry habitats there consisted of 58% widespread lowland forms and 29% of species found in lowlands primarily south of Amazonia, i.e. roughly comparable to the affinities of the Tambo avifauna.

Similarly, absence of locality surveys from higher elevations within the Río Grande Valley prevents us from determining whether the avifauna in this valley system becomes more montane in nature gradually with increasing elevation, or whether some threshold elevation is crossed from primarily lowland to primarily montane avifaunas.

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APPENDIX 1

BREEDING CONDITION OF BIRDS AT TAMBO, DEPTO. SANTA CRUZ, BOLIVIA. BREEDING CONDITION: "+" = ENLARGED GONADS (TESTES ≥2 × 2 MM FOR BIRDS <8 G; >7 × 4 MM FOR BIRDS <50 G, OR >10 × 5 MM FOR BIRDS >50 G; LARGEST OVA >1 MM FOR BIRDS <50 G OR >2 MM FOR BIRDS >50 G; "−" = NONREPRODUCTIVE GONADS (TESTES <2 × 2 MM FOR BIRDS <8 G, <4 × 3 MM FOR BIRDS <50 G OR <7 × 4 MM FOR BIRDS >50 G; LARGEST OVA <1 MM; "±" = INTERMEDIATE TESTES SIZE OR FOR LARGEST OVUM = 1 MM FOR FEMALES <50 G, OR = 2 MM FOR FEMALES >50 G. NUMBERS IN PARENTHESES REFER TO NUMBER OF SPECIMENS FROM EACH SEX IN THE GIVEN CONDITION; ★ = PRESENCE OF A CLOACAL PROTUBERANCE; ● = PRESENCE OF A BROOD PATCH; E = EGG WITH SHELL IN OVIDUCT

Species	Breeding condition	
	January–February	June–July
Nothoprocta pentlandii		+(1♂), ±(1♀), −(1♂)
Phalacrocorax brasilianus	−(1♂, 1♀)	
Columbina picui	+(5♂♂)	+(2♂♂, 1♀), ±(1♂, 1♀), −(2♂♂, 1♀)
Aratinga acuticauda	+(1♂), −(1♂)	−(1♂)
Aratinga mitrata	±(1♂)	
Bolborhynchus aymara		−(2♂♂, 1♀)
Brotogeris versicolurus	−(1♀)	
Amazona aestiva	±(1♀), −(1♀)	
Crotophaga ani	+(1♂), ±1(♀●)	
Guira guira	+(2♀♀), −(1♀)	
Tapera naevia	−(2♂♂)	
Caprimulgus parvulus		±(1♀)
Hydropalis brasiliana	−(1♀)	
Phaethornis pretrei	+(2♂♂), −(1♀)	
Chlorostilbon aureoventris	±(1♀), −(1♂, 1♀)	+(1♂), −(2♂♂)
Amazilia chionogaster	+(2♂♂), ±(1♂), −(2♀♀)	+(8♂♂), ±(2♀♀), −(2♂♂, 4♀♀)
Nystalus maculatus	+(2♀♀; 1●), ±(1♂, 1♀)	−(3♂♂, 1♀)
Picumnus cirratus	−(5♂♂, 2♀♀)	−(4♂♂, 1♀)
Melanerpes cactorum	+(1♀), ±(6♀♀), −(3♀♀)	±(2♀♀), −(9♂♂)
Picoides lignarius	±(2♀♀), −(2♂♂, 1♀)	+(1♀), −(1♂)
Piculus rubiginosus		−(1♀)
Colaptes melanochloros	−(1♂)	
Campephilus leucopogon		±(1♀), −(1♀)
Lepidocolaptes angustirostris	+(1♂), ±(2♀♀), −(4♂♂, 2♀♀)	±(2♀♀), −(4♂♂)
Upucerthia harterti		±1(♀), −(2♂♂, 5♀♀)

APPENDIX 1
CONTINUED

Species	Breeding condition	
	January–February	June–July
Furnarius rufus	+(1♂), ±(1♀), −(1♂, 2♀♀)	−(3♂♂)
Synallaxis frontalis	+(3♂♂, 1♀), ±(2♀♀), −(2♀♀)	−(1♂, 1♀)
Cranioleuca pyrrhophia	+(1♂, 2♀♀; 1●), −(2♂♂, 2♀♀)	−(6♂♂, 3♀♀)
Phacellodomus striaticeps		−(1♀)
Thamnophilus caerulescens	+(1♂, 2♀♀●), −(1♀)	−(1♂, 1♀)
Thamnophilus ruficapillus	+(2♀♀; 1●), ±(2♂♂), −(4♂♂)	±(1♀), −(1♂)
Camptostoma obsoletum		−(1♂)
Phaeomyias murina	+(1♂), ±(4♂♂), −(1♂, 3♀♀)	
Sublegatus modestus		−(1♂)
Suiriri suiriri	+(1♂), −(1♀)	−(3♂♂, 2♀♀)
Elaenia flavogaster	−(1♀)	
Elaenia parvirostris	+(19♂♂; 2★, 12♀♀, 6●), ±(6♀♀; 1●), −(2♀♀)	
Elaenia strepera	+(1♂)	
Serpophaga munda	−(1♀)	
Stigmatura budytoides	+(1♂, 2♀♀; 1●), ±(2♂♂, 2♀♀; 1●), −(1♂, 5♀♀)	−(4♂♂, 8♀♀)
Hemitriccus margaritaceiventer	−(1♂)	−(1♂, 1♀)
Tolmomyias sulphurescens	−(1♀)	
Myiophobus fasciatus	+(3♂♂, 2♀♀●), ±(5♂♂, 1♀), −(4♂♂, 6♀♀)	
Empidonax alnorum	−(2♀♀)	
Knipolegus aterrimus		−(1♀)
Satrapa icterophrys	+(2♂♂), ±(1♀), −(2♂♂, 1♀)	
Hirundinea ferruginea		−(3♂♂, 1♀)
Pitangus sulphuratus		−(1♂)
Myiodynastes maculatus	+(1♂)	
Empidonomus aurantioatrocristatus	+(1♂)	
Tyrannus melancholicus	+(1♂, 2♀♀●), ±(1♀●), −(1♂)	
Pachyramphus polychopterus	+(1♂★)	
Pachyramphus validus	+(1♂★)	
Phytotoma rutila	+(2♂♂)	
Troglodytes aedon	+(1♂)	−(1♂, 1♀)
Polioptila dumicola	+(1♂), −(1♀)	−(3♂♂, 1♀)
Catharus ustulatus	−(3♂♂, 2♀♀)	
Turdus chiguanco		−(1♀)

APPENDIX 1
CONTINUED

Species	Breeding condition	
	January–February	June–July
Turdus rufiventris	+(4♂♂; 3★, 1♀●)	−(1♀)
Turdus amaurochalinus	+(13♂♂, 4★, 4♀♀; 3●), ±(1♂, 4♀♀), −(4♀♀)	
Cyclarhis gujanensis	±(1♂★)	±(1♀)
Vireo olivaceus	+(17♂♂; 6★, 2♀♀●), ±(1♂, 2♀♀), −(1♂, 2♀♀)	−(1♀)
Zonotrichia capensis	+(13♂♂; 7★, 6♀♀●: 1E), ±(2♀♀●)	−(9♂♂, 7♀♀)
Lophospingus griseocristatus	+(5♂♂, 5♀♀; 3●), ±(2♂♂, 1♀), −(2♂♂, 2♀♀)	−(3♂♂, 6♀♀)
Poospiza nigrorufa	+(6♂♂; 2★, 1♀●)	
Poospiza torquata	+(4♂♂; 1★)	−(4♂♂)
Poospiza melanoleuca	+(4♂♂; 1★), ±(1♂, 1♀), −(1♂)	
Sicalis flaveola	+(10♂♂; 5★, 4♀♀; 1●), ±(5♀♀; 3●), −(5♀♀)	−(4♂♂, 3♀♀)
Sporophila caerulescens	+(11♂♂; 4★, 5♀♀; 2●), ±(1♂, 7♀♀), −(4♀♀)	
Catamenia analis	−(3♂♂, 1♀)	
Tiaris obscura	+(5♂♂, 6♀♀), ±(5♂♂), −(1♂)	
Arremon flavirostris	+(2♂♂; 1★, 4♀♀; 2●)	−(1♂, 1♀)
Coryphospingus cucullatus	+(3♂♂, 2♀♀; 1●)	−(1♂, 1♀)
Pheucticus aureoventris	+(11♂♂; 3★, 5♀♀●), ±(2♀♀)	−(1♂, 1♀)
Saltator aurantiirostris	+(7♂♂, 6♀♀; 5●), ±(2♀♀)	−(3♀♀)
Cyanocompsa brissonii	+(4♂♂; 2★, 2♀♀; 1●)	−(2♂♂)
Piranga flava	−(1♀)	
Thraupis sayaca	+(3♂♂; 1★)	−(1♂)
Thraupis bonariensis	+(17♂♂; 8★, 3♀♀; 3●: 1E), −(1♂, 1♀)	−(1♂, 2♀♀)
Euphonia chlorotica	±(2♀; 1●), −(1♂, 2♀♀)	−(3♂♂, 2♀♀)
Euphonia musica	−(1♂)	
Parula pitiayumi		−(1♂)
Geothlypis aequinoctialis	+(2♂♂; 1★, 1♀●), −(2♂♂)	−(1♂)
Myioborus brunniceps		−(2♂♂, 2♀♀)
Icterus cayanensis	±(1♂)	−(1♀)
Molothrus badius	+(11♂♂; 1★, 1♀●), ±(7♀♀)	−(2♀♀)
Molothrus bonariensis		−(1♂)
Carduelis magellanica	+(1♂), ±(1♀), −(2♀♀)	−(1♂)

APPENDIX 2

BODY MASS (G) OF BIRDS AT TAMBO, DEPTO. SANTA CRUZ, BOLIVIA. BODY FAT CLASSIFIED AS: "+" = HEAVY OR VERY HEAVY FAT (DEEP FAT IN FEATHER TRACTS, FURCULA AREA, AND THROUGHOUT INTESTINAL TRACT); "±" = MODERATE FAT (FURCULA AREA ALMOST FILLED WITH FAT; FAT PRESENT IN FEATHER TRACTS); "−" = NO FAT TO ONLY TRACE OR LIGHT FAT. INDIVIDUALS IN JUVENAL PLUMAGE NOT INCLUDED

Species	Mean mass (g) ♂♂ (N; range)			♀♀ (N; range)		
	−	±	+	−	±	+
Nothoprocta pentlandii	186 (2; 164–208)	—	—	192 (1)	—	—
Phalacrocorax brasilianus	1400 (1)	—	—	1520 (1)	—	—
Zenaida auriculata	—	—	—	78.2 (1)	—	—
Columbina picui	44 (9; 40.3–51)	—	—	42 (1)	45 (1)	—
Aratinga acuticauda	168 (3; 167.7–172	—	—	—	—	—
Aratinga mitrata	273.5 (1)	—	—	—	—	—
Bolborhynchus aymara	30.0 (2; 29–31)	—	—	30.5 (1)	—	—
Brotogeris versicolurus	—	—	—	60.0 (1)	—	—
Amazona aestiva	—	—	—	405.0 (2; 402–408)	—	—
Crotophaga ani	108.9 (1)	—	—	84.0 (1)	—	—
Guira guira	—	—	—	122.6 (3; 108.7–139.5)	—	—
Tapera naevia	43.8 (2; 40.0–47.7)	—	—	—	—	—
Caprimulgus parvulus	—	—	—	—	31.5 (1)	—
Hydropsalis brasiliana	—	—	—	45.5 (1)	—	—
Phaethornis pretrei	4.9 (2; 4.8–5.1)	—	—	4.3 (1)	—	—
Chlorostilbon aureoventris	3.4 (3; 3.4–3.5)	3.4 (1)	—	3.2 (2; 2.8–3.6)	—	—
Amazilia chionogaster	5.3 (9; 4.9–6.7)	5.8 (3; 5.6–6.0)	—	4.8 (7; 4.6–5.2)	4.9 (1)	—
Nystalus maculatus	35.3 (4; 32.6–38.3)	—	—	38.7 (4; 38.7–41.7)	—	—
Picumnus cirratus	10.1 (9; 8.5–11.5)	—	—	10.3 (3; 10.1–10.5)	—	—
Melanerpes cactorum	37.8 (10; 31.0–42.0)	—	—	32.3 (14; 26.4–35.2)	—	—
Picoides lignarius	28.2 (2; 28.1–28.4)	—	—	31.2 (4; 28.6–33.2)	—	—
Piculus rubiginosus	—	—	—	66.5 (1)	—	—
Colaptes melanochloros	106.4 (1)	—	—	117.3 (2; 116.8–117.9)	—	—
Campephilus leucopogon	—	—	—	191 (2; 185–198	—	—
Lepidocolaptes angustirostris	26.7 (9; 23.6–30.0)	—	—	30.3 (4; 24.7–45.1)	—	—
Upucerthia harterti	24.9 (3; 23.6–26.2)	—	—	23 (6; 21.6–23.8)	—	—
Furnarius rufus	39 (5; 31.4–44)	—	—	41.3 (3; 38.0–43.2)	—	—
Synallaxis frontalis	15.1 (4; 13.1–16.8)	—	—	13.3 (6; 12.1–15.3)	—	—

APPENDIX 2
CONTINUED

Species	Mean mass (g) ♂♂ (N; range)			♀♀ (N; range)		
	−	±	+	−	±	+
Carnioleuca pyrrhophia	13 (9; 12.6–14.5)	—	—	13.4 (8; 12.2–14.5)	—	—
Phacellodomus striaticeps	23.3 (1)	—	—	24 (1)	—	—
Thamnophilus caerulescens	19 (2; 17.2–20)	—	—	19 (4; 15.2–20.9)	—	—
Thamnophilus ruficapillus	20.8 (7; 19.9–21.5)	—	—	19.5 (3; 16.3–21.3)	—	—
Phaeomyias murina	10.4 (6; 7.8–11.7)	—	—	8.3 (2; 7.5–9.2)	8.0 (1)	—
Sublegatus modestus	—	14.4 (1)	—	—	—	—
Suiriri suiriri	15.1 (3; 15.0–15.3)	—	—	13.5 (2; 13.0–14.0)	—	—
Elaenia flavogaster	23.4 (1)	—	—	—	—	—
Elaenia parvirostris	14.0 (19; 11.4–16.8)	—	—	13.5 (18; 10.9–16.6)	15.3 (2; 14.3–16.3)	—
Elaenia strepera	20.5 (1)	—	—	—	—	—
Serpophaga munda	6.8 (1)	—	—	5.5 (1)	—	—
Stigmatura budytoides	11.7 (9; 10.9–12.3)	—	—	10.5 (14; 9.4–12.6)	11.7 (1)	—
Hemitriccus margaritaceiventer	8.1 (2; 7.1–9.2)	—	—	—	—	—
Tolmomyias sulphurescens	—	—	—	13.1 (1)	—	—
Myiophobus fasciatus	10.5 (12; 9.0–17.0)	—	—	9.1 (8; 7.1–10.6)	—	—
Empidonas alnorum	11.0 (2; 10.9–11.2)	—	—	—	—	—
Knipolegus aterrimus	—	—	—	21 (1)	—	—
Satrapa icterophrys	16.8 (4; 15.5–17.8)	—	—	17.0 (1)	21.0 (1)	—
Hirundinea ferruginea	21.2 (1)	24.6 (1)	21.5 (1)	—	23.1 (1)	—
Pitangus sulphuratus	64.5 (1)	—	—	—	—	—
Myiodynastes maculatus	—	55.4 (1)	—	—	—	—
Empidonomus aurantioatrocristatus	22.9 (1)	—	—	—	—	—
Tyrannus melancholicus	38.8 (2; 38.1–39.5)	—	—	42.2 (3; 39.0–44.6)	—	—
Pachyramphus polychopterus	20.9 (1)	—	—	—	—	—
Pachyramphus validus	39.1 (1)	—	—	—	—	—
Phytotoma rutila	40.5 (2; 36.0–45.1)	—	—	—	—	—
Troglodytes aedon	10.0 (2; 9.0–11)	—	—	10.3 (1)	—	—
Polioptila dumicola	6.6 (4; 5.8–7.7)	—	—	6.6 (2; 6.1–7.1)	—	—
Catharus ustulatus	27.5 (2; 26.8–28.3)	28.6 (1)	—	24.1 (1)	—	32.4 (1)
Turdus chiguanco	—	—	—	80 (1)	—	—
Turdus rufiventris	63.9 (3; 63.1–64.6)	—	—	77 (2; 68.2–86)	—	—

APPENDIX 2
CONTINUED

Species	Mean mass (g) ♂♂ (N; range)			♀♀ (N; range)		
	−	±	+	−	±	+
Turdus amaurochalinus	57.5 (11; 46.5–64.6)	61.2 (1)	—	60.8 (9; 54.3–70)	64.2 (1)	58 (1)
Cyclarhis gujanensis	36.1 (1)	—	—	32 (1)	—	—
Vireo olivaceus	13.1 (19; 10.1–15.0)	14.6 (1)	—	12.8 (6; 11.4–14.7)	—	15.5 (1)
Zonotrichia capensis	20.8 (22; 16.8–24.0)	—	—	20 (14; 17.1–31)	24.1 (1)	—
Lophospingus griseocristatus	17.8 (11; 15.6–20.0)	—	—	18 (14; 13.1–20.2)	—	—
Poospiza nigrorufa	16.0 (6; 13.0–17.4)	—	—	18.3 (1)	—	—
Poospiza torquata	10.6 (6; 10.0–11.0)	—	—	—	—	—
Poospiza melanoleuca	12.9 (6; 11.7–13.7)	—	—	13.3 (1)	—	—
Sicalis flaveola	15.7 (14; 13.1–17.8)	—	—	15 (14; 13.8–17.2)	18.6 (1)	—
Sporophila caerulescens	10.2 (11; 9.1–11.6)	—	11.1 (1)	9.3 (16; 7.4–11.5)	—	—
Catamenia analis	11.6 (2; 11.3–11.9)	—	13.1 (1)	—	12.4 (1)	—
Tiaris obscura	10.4 (5; 9.5–11.9)	—	—	10.9 (10; 8.5–18.3)	11.2 (2; 11.0–11.3)	—
Arremon flavirostris	23.1 (3; 20.3–26.0)	—	—	25 (4; 23–28.0)	—	—
Coryphospingus cucullatus	12 (3; 11.7–13)	—	—	14.2 (3; 12.9–14.9)	—	—
Pheucticus aureoventris	49 (11; 44.8–53)	—	—	50 (8; 43.8–57.2)	61.4 (1)	—
Saltator aurantiirostris	39 (9; 33.1–44.8)	—	—	45 (11; 38–54.3)	—	—
Cyanocompsa brissonii	23.8 (6; 20.0–26.1)	—	—	24.6 (1)	29.8 (1)	—
Piranga flava	34.5 (1)	—	—	27.7 (1)	—	—
Thraupis savaca	32.2 (4; 29.7–36.0)	—	—	—	—	—
Thraupis bonariensis	30.8 (18; 24.9–36.3)	—	—	38 (5; 33–45.1)	30.0 (1)	—
Euphonia chlorotica	12.5 (1)	12.1 (2; 12.0–12.3)	—	11.4 (4; 8.4–13.6)	12.9 (1)	14.3 (1)
Euphonia musica	17.1 (1)	—	—	—	—	—
Parula pitiayumi	7.9 (1)	—	—	—	—	—
Geothlypis aequinoctialis	10.2 (3; 9.6–11.0)	10.9 (1)	—	13.5 (1)	—	—
Myioborus brunniceps	8.8 (2; 8.1–9.6)	—	—	8.5 (2; 8.2–8.9)	—	—
Icterus cayanensis	31.5 (1)	—	—	29.5 (1)	—	—
Molothrus badius	47.4 (11; 39.3–61.5)	—	—	43.2 (10; 39.9–45.6)	—	—
Molothrus bonariensis	59 (1)	—	—	-	—	—
Carduelis magellanica	10.2 (1)	13.3 (1)	—	—	12.2 (1)	12.6 (1)

APPENDIX 3

NATURAL HISTORY OBSERVATIONS ON SOME LITTLE-KNOWN SPECIES OF THE TAMBO AREA, DEPTO. SANTA CRUZ, BOLIVIA. ALTHOUGH WE THINK THAT SONAGRAMS ARE THE ONLY VALID MEANS FOR COMPARING VOCALIZATIONS, WE DID NOT OBTAIN RECORDINGS OF BIRDS FROM THE STUDY SITE BECAUSE OF MECHANICAL PROBLEMS WITH OUR TAPE-RECORDER. IN THE ABSENCE OF SONAGRAMS, WE OFFER SOME TRANSLITERATIONS OF VOICES AND COMPARISONS TO OTHER DESCRIPTIONS, BUT WE CAUTION AGAINST OVER-INTERPRETATION OF PERCEIVED DIFFERENCES

Amazilia chionogaster. This hummingbird was one of the most common bird species in xeromorphic scrub. Chases and fights were noted frequently among individuals competing for their primary nectar source, the red flowers of an epiphytic or hemiparasitic plant that grew in dense clusters in the scrub. (The plant was most likely a mistletoe, *Ligaria cuneifolia,* or possibly *Tristerix penduliflorus* [M. Nee, pers. comm.].) The vocalizations of this hummingbird were variable and complex. We rarely heard what we though was the "song": a series of about five syllables of hoarse, grating, complex buzzy, "churring" notes sometimes introduced by a few high-pitched, clear, finchlike notes "tseep, tseep, tseep, tseep." This species sometimes also gave low, harsh, buzzy notes at regular intervals, ca. 1/sec, that also might have been a "song." Similar notes were also given more irregularly, as well as a thin "tsip." The differences between our descriptions of the voice and those given by Fjeldså and Krabbe (1990) seem to be more than merely differences in interpretation and transliteration.

Picumnus dorbygnianus. Winkler et al. (1995) found no published descriptions of the voice of this taxon. The "song" is a series of sharp notes, with bouncing-ball rhythm, that is remarkably similar to a faint version of the "song" of *Picoides pubescens* (Downy Woodpecker).

Melanerpes cactorum. The population density of this species seemed to be extraordinarily high for a woodpecker, with 20 to 35 individuals regularly tallied in a morning on the hillsides with columnar cacti near camp. The density was the highest for any woodpecker species in our collective experience. The tops of columnar cacti were favored perches. The typical call was a "throaty," hoarse *whu-hu, whi-hu, whi-huh, whi,* although often only one syllable was given. Also frequently heard was a hoarse *ji-ji* that was similar in quality to calls of many melanerpine woodpeckers. These descriptions are similar to those given by Short (1982).

Picoides lignarius. The descending rattled "song" is remarkably similar to that of North American *P. scalaris.*

Lepidocolaptes angustirostris. The most frequently heard vocalization was a descending, bouncing-ball-rhythm trill: *zee, zew-zew-zew-zew-zew-zew.* It also gave a "liquid" call reminiscent of that of *Myiozetetes similis,* but lower-pitched, and a mournful, tyrannidlike, whistled *wheeeeaa.*

Stigmatura budytoides. Ridgely and Tudor (1994) described the vocalizations and displays performed by duetting pairs. We add that up to 20 phrases are delivered, in total lasting roughly 5 s. The phrases in the songs of birds at Tambo consisted of only four notes, with the second one accented: *ja-JE-je-je.* Duetting birds pointed their tails downwards in contrast to the characteristic horizontal posture during foraging. Individuals occasionally gave a loud *wheep-wheep-wheep-WHEEP*?

Hemitriccus margaritaceiventer: Birds at Tambo gave vocalizations that evidently differ somewhat from those described by Ridgely and Tudor (1994). The vocalization that we heard most frequently was a hoarse, three-noted *chew-chew-chew*? (the last note inflected upwards). We also heard it give a soft, descending, low-pitched, trilled *tsu, TSEE-tse-tse-tsu-tsu.*

Lophospingus griseocristatus. Little has been published on the natural history or voice of this species (Ridgely and Tudor 1989). At Tambo, this was the most abundant bird species, both in arid scrub, where they frequently perched on the tops of columnar cacti, and in weedy fields; more than 100 were tallied most mornings. Flocks typically numbered 10–20 individuals; these were often joined by *Sicalis flaveola, Zonotrichia capensis,* and *Poospiza torquata.* The most frequent call note, difficult to describe, was *tsew,* reminiscent of a *Thraupis* tanager; less frequently given was a more sparrowlike *pick*?

Myioborus brunniceps. The call note of this species is evidently undescribed (Ridgely and Tudor 1989, Curson et al. 1994). Birds at Tambo gave a high-pitched *tsew.*