The Auk 118(2):472–483, 2001

AVIFAUNA OF A LOWLAND FOREST SITE ON ISABEL, SOLOMON ISLANDS

ANDREW W. KRATTER,[1,4] DAVID W. STEADMAN,[1] CATHERINE E. SMITH,[2] CHRISTOPHER E. FILARDI,[2] AND HORACE P. WEBB[3]

[1]*Florida Museum of Natural History, P.O. Box 117800, University of Florida, Gainesville, Florida 32611, USA;* [2]*Burke Museum, University of Washington, P.O. Box 353010, Seattle, Washington 98195, USA; and* [3]*2048 White Oak Circle, Kennesaw, Georgia 30144, USA*

ABSTRACT.—We provide the first comprehensive description of a bird community from a lowland rainforest site on a major island in the Solomon Islands. During two dry season visits (July 1997, June 1998) to the lower Garanga River valley on the island of Isabel, we recorded 65 resident and 6 migrant species of birds. We document relative abundances, habitat preferences, and foraging guilds for the members of the bird community. The Garanga River site sustains all but 11 of the 76 species of landbirds known from Isabel. Of those 11 species, four are small-island or beach specialists, three are montane, and four are of unknown status. Habitat heterogeneity, maintained largely by river dynamics, is a major contributor to avian diversity at the site. The avifauna is dominated by nonpasserines, especially parrots, pigeons, kingfishers, and hawks. The flightless rail *Nesoclopeus woodfordi*, previously regarded as rare and threatened with extinction, was common. We recorded *Ixobrychus flavicollis*, *Falco severus*, and *Eudynamys scolopacea* for the first time on Isabel. We also documented occurrence in the lowlands of *Micropsitta finschii*, *Collocalia spodiopygia*, *Coracina caledonica*, and *Pachycephala pectoralis*, four species previously thought to be confined to upper elevations on Isabel. The depauperate understory avifauna of the Garanga River site may be anthropogenic and could belie what otherwise seems to be an intact avifauna. *Received 27 December 1999, accepted 13 December 2000.*

THE SOLOMON ISLANDS have one of the world's most distinctive avifaunas, with more "restricted range species" (species with ranges <50,000 km²) than any other Endemic Bird Area in the world (Stattersfield et al. 1998). Although analyses of intriguing patterns of distribution and endemism among Solomon Island landbirds have figured prominently in island biogeography and community ecology (Greenslade 1968, Diamond et al. 1976, Diamond and Mayr 1976, Diamond 1982), we lack even one thorough description of a bird community from a single site within the Solomon Islands. In fact, descriptions of avifaunas from single sites are rare anywhere in Oceania outside of New Guinea. In contrast, single-site descriptions of avifaunas are commonplace for Neotropical birds (e.g. Karr 1990, Terborgh et al. 1990, and various papers in Remsen 1997). These papers have been instrumental in understanding the ecological processes that promote and maintain avian diversity; they also provide a foundation for identifying areas of high conservation priority.

In 1997 and 1998, we surveyed birds at a lowland forest site on Isabel, the fourth largest island in the Solomons. Although Isabel is known to sustain a rich avifauna (73 resident species are listed in Mayr 1945 and Webb 1992; current island total is 76 species), its birds have yet to receive an in-depth investigation. Four subspecies are restricted to the island (*Nesoclopeus woodfordi immaculatus*, *Ninox j. jacquinoti*, *Pitta a. anerythra*, and *Coracina caledonica welchmani*). Isabel shares more species and subspecies of birds with Choiseul than any other island. Those two islands (as well as Buka, Bougainville, and the Florida Islands) were connected during late Pleistocene low sea-level stands (Wickler and Spriggs 1988). For example, all but two of the 45 species of birds recorded in lowland Bougainville by Kaestner (1987) also occur on Isabel.

In this paper, we describe the avifauna of Isabel's lower Garanga River valley, including data on endemism, species diversity, foraging guilds, and habitat associations. We also discuss importance of the area for conservation. Our specimen-based data (mass, molt, age, and

[4] E-mail: kratter@flmnh.ufl.edu

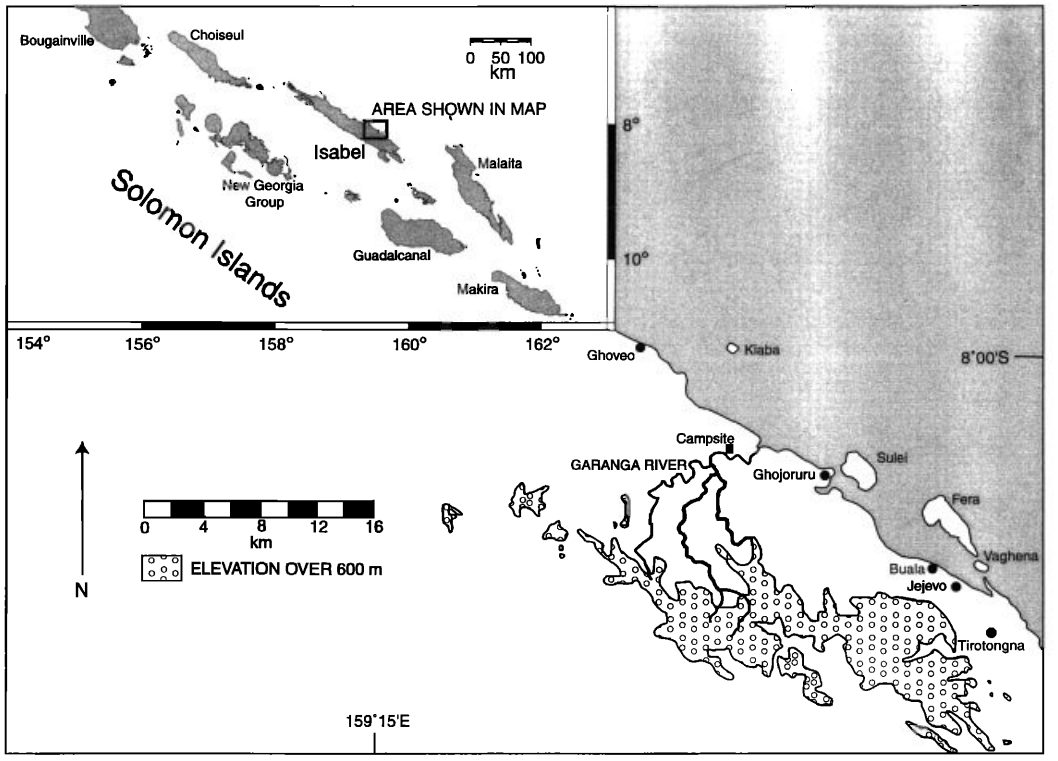

FIG. 1. The northern coast of Isabel, showing localities mentioned in the text.

reproductive activity) are reported elsewhere (Kratter et al. in press).

STUDY AREA AND METHODS

Isabel (3,995 km²) is a long (199 km) narrow island, in most places 20–25 km in width, centered on 8°S and 159°E (Fig. 1). The island is geologically complex, rises to 1,250 m elevation, and is incised by many river systems that empty onto a coastal plain of variable width. The Garanga River (Fig. 1) begins at ~1,100 m near the island's center and flows 13 km north into the Pacific. The coastal plain along the lower reaches of the Garanga, ~5 km wide, is a mosaic of river terraces, gentle rolling hills, and isolated limestone outcrops. The river is about 30 m wide here, alternating between pools (to ~4 m deep) and rocky-bottomed shallow rills. At low water, the banks are ~2 m tall. During our dry season visits, sandy and gravelly beaches lined most of the river, although water levels rose above the beaches during heavy rains. Behind the sandy beach at the river's mouth is a small lagoon (~200 × 50 m).

The natural vegetation on most of Isabel is tall lowland forest, with shorter montane forests at higher elevations. Successional vegetation occurs where floodplain forests are disturbed by flooding. Some of the coastal plain has been cleared for gardens, villages, and coconut (*Cocos nucifera*) plantations. From near the mouth of the Garanga River, a coconut plantation extends southeast for 3 km along the coast and for ~1 km inland. Much of this plantation is untended and thus many native trees are becoming established beneath the coconut palms. Overgrown old gardens are scattered along the lower Garanga River, upstream to near our camp. Several limestone outcrops below our camp, however, are covered with mature forest. A ~4 ha clearing was felled during our visit in 1997 about 1.5 km downstream from our camp. In 1998, several small houses and gardens had been started, although no one was living at the site yet. At and above our camp, the forests are more continuous and mature. Trails, made by hunters to track wild pigs (*Sus scrofa*), extend to at least a few kilometers above our camp.

River edge vegetation was dominated by early successional species, including *Hibiscus tiliaceus*, *Camprosperma brevipetiola*, *Macaranga* sp., *Pipturus argenteus*, and *Ficus* sp. (small, nonstrangling), as well as nonwoody *Musa* sp., *Zingiber* sp., *Dioscorea* sp., and ferns. The more mature forest reached a canopy height of 25–30 m, with emergent trees to 40 m. We were unable to assess the relative abundance of tree species in the species-rich mature forest, although

these genera were conspicuous: *Aglaia, Calophyllum, Ficus, Myristica,* and *Pometia.* Large fruiting banyans (*Ficus* spp.) were common and attracted multiple species of frugivorous birds. The Solomon Islands sustain 63 species of *Ficus*—more than any Pacific island group excluding New Guinea (Corner 1967). The beachfront forest at the mouth of the Garanga River featured *Barringtonia asiatica, Calophyllum inophyllum, Heritiera littoralis,* and *Terminalia catappa,* with occasional thickets of *Hibiscus tiliaceus* along the river's banks. Absent in the area was Australian pine (*Casuarina equisetifolia*), which forms swampy thickets in northern Isabel and the nearby island of San Jorge (A.W.K., C.E.F., and C.E.S. pers. obs.).

Our visits (9–23 July 1997 and 22–29 June 1998) were during the dry season. The weather was mild to hot and humid, with partly cloudy to cloudy skies. We recorded rain on seven days in 1997 and five days in 1998, including a series of storms from 15–18 July 1997. During most early mornings (from 0630–0730, GMT + 12 h), at least one of us (C.E.F.) conducted dawn surveys of birds flying over the river near camp. All observations and specimens are from within 1 km of the river, usually within 2 km but occasionally as much as 4 km upstream or downstream from camp. Most birds were collected with shotguns by local hunters, especially Mark Hafe, an Isabel islander, who was thoroughly familiar with the plumages, vocalizations, and behavior of all species on Isabel. Limited mist-netting in interior forest (four 12 m, 36-mm mesh nets on the west side of the river in 1997, and five on the east side in 1998) supplemented the collection via hunting. A single 12 m, 60-mm mesh net also was placed across the Garanga River ~250 m upstream from our camp in 1997. Specimens are housed at the Florida Museum of Natural History (UF), University of Washington Burke Museum (UW), and Solomon Islands National Museum. Tissues preserved in lysis buffer are stored at UW. Specimen tag data include sex, reproductive condition, molt scoring, soft part colors, subdermal fat levels, stomach contents, skull ossification, presence of bursa, and habitat.

RESULTS

Overview.—We recorded 71 species of birds along the lower Garanga River (Table 1). All but six of these were found in both years. Of the 71 species, 65 are residents, two (*Halcyon sancta, Chrysococcyx l. lucidus*) are migrant landbirds from the south, and four (*Pluvialis fulva, Numenius phaeopus, Tringa nebularia,* and *Actitis hypoleucos*) are northern migrant shorebirds. Among the resident species, 18 (27%) are endemic to the Solomon Islands, with an additional 24 (37%) represented by subspecies endemic to the archipelago. All four subspecies endemic to Isabel were recorded at our site. No introduced species were recorded.

As on other islands in the Solomons (Galbraith and Galbraith 1962, Hadden 1981) the Garanga River avifauna on Isabel is dominated by nonpasserines, whether in species richness, generic-level diversity, or abundance (Table 1). Hawks, columbids, psittacids, and kingfishers each have five or six resident species. Of the 42 species of nonpasserines, 19 were common and three—all parrots—were abundant. Morning flight surveys were dominated by psittacids (especially *Cacatua ducorpsii* and *Chalcopsitta cardinalis*) and columbids (especially *Ducula rubricera* and *Ptilinopus viridis*). *Chalcopsitta cardinalis* also was abundant in the coconut plantation close to the river mouth, and many of the birds flying over our forest site may have been commuting from an inland roost to feed on the prolific nectar produced by coconut palms. The tiny parrot *Micropsitta finschii* was abundant in the forest interior. Passerines accounted for only 23 (35%) of the resident species and 14 (28%) of the resident genera. The richest passerine families were cuckoo-shrikes (five species) and starlings (four species). Eleven passerine species were considered common and two were abundant.

Habitat affinities.—Most resident species were found in a variety of habitats (Table 1). Forest interior habitats were preferred by slightly more species (26) than river-edge habitats (24 species). Beaches and river edges were preferred by 11 species. The remaining five species were noted only in the air (swiftlets, *Falco severus*) or were infrequently encountered (*Podargus ocellatus*).

Many of the most common species in successional river-edge and interior forest habitats were canopy species. Among migrant species, shorebirds were found along the river, primarily on sand and gravel beaches, and both migrant landbirds used river-edge vegetation, although *Chrysococcyx lucidus* was found as well in the interior forest.

Mixed species flocks.—Mixed-species flocks were encountered more frequently in forest interior than in other habitats. *Pachycephala pectoralis, Rhipidura rufifrons, R. cockerelli,* and *Coracina caledonica* were found only as part of the forest-interior flocks. Most flocks also contained *Coracina lineata, C. tenuirostris, C. holo-*

polia, Myiagra ferrocyanea, Monarcha castaneiventris, M. barbata, and *Zosterops metcalfii,* although these species were not restricted to flocks. The dominant members of most flocks, whether in river-edge vegetation or the forest interior, were *M. castaneiventris, M. barbata, Z. metcalfii, C. tenuirostris,* and *C. holopolia.* Other species (e.g. *Mic. finschii, Nectarinia jugularis*) occasionally joined flocks. Within tall forests, the flocks usually kept well above the ground (>10 m) in the leafy subcanopy. *Monarcha barbata* and *M. castaneiventris* occasionally descended to within a few meters of the ground. The mixed-species flocks on Isabel resemble those reported from Bougainville (Diamond 1975).

Foraging guilds.—We categorized foraging guilds (Table 2) by the predominant substrate or microhabitat where we observed the species foraging (for species that sally, we noted the perch, not the substrate) and by its predominant food. Stomach contents from specimens (housed at UF) and literature sources (e.g. Schodde 1977) were used to identify common prey. The five canopy guilds made up 57.8% of the avifauna and included the three richest guilds (14 frugivores, 12 insectivores, 9 omnivores). The only comparably species-rich guild was that feeding on fish and aquatic invertebrates (9 species, 12.7% of total); four of these were migrant shorebirds. The three terrestrial guilds (totaling 9.9% of the avifauna) and the two understory guilds (4.2%) were depauperate, especially in the interior of mature forests (see above). The four insectivore guilds (terrestrial, undergrowth, canopy, aerial) totaled 29.6% of the avifauna, followed closely by frugivores (24.0%).

Selected species accounts.—We present accounts for three species not previously known from Isabel and several others with poorly documented natural histories.

Ixobrychus flavicollis. The first Isabel records of *I. flavicollis* were collected on 11 July 1997 (UF 39523, adult female) and 27 June 1998 (UW 60298, immature male). This widespread species is known from other major islands in the Solomons.

Accipiter imitator. On 24 June 1998, we mist-netted a dark-morph *Accipiter* in the forest interior (UF 40173, reproductively active male; full details in LeCroy et al. in press). Melanistic specimens had not been confirmed before in this species, which is difficult to identify (Schodde 1977, Thiollay 1994, Debus 1995). Previous records of *A. imitator* from Isabel were based on observations or vocalizations (Webb 1992, 1995). Although other melanistic specimens of *Accipiter* from Isabel have been assigned to *A. albogularis* (Mayr 1945), all pied or black specimens of *Accipiter* from Isabel in the American Museum of Natural History are *A. imitator* (LeCroy et al. in press).

Haliaeetus sanfordi. Endemic to the Solomon Islands, this eagle is usually regarded as rare or uncommon. We recorded *H. sanfordi* nearly daily at our inland site; it was more common along the coast, as reported for New Georgia (Blaber 1990). Most of our inland records were of solitary birds flying just above the canopy. M. Hafe collected a male harassing fruit-doves (*Ptilinopus viridis, P. superbus*) in a fruiting *Ficus* tree. This specimen (UF 40196) yielded the world's first skeleton of *H. sanfordi,* along with a spread wing and study skin (minus bill). As in other species of *Haliaeetus* (Olson 1982), the first two phalanges in the fourth toe are fused. A. Kratter observed an individual flying ~50 m above the water at low tide along a reef edge; it abruptly stooped down and plucked a ~0.8 m long eel with its talons.

Falco severus. On 11 July 1997, A. Kratter and D. Steadman saw a rather small but stocky falcon flying ~100 m over the river, just upstream from camp. The underparts were mostly rufous, with streaking on the breast. This bird almost certainly was *F. severus,* which agrees with the observed field marks and is the only small falcon known in the Solomons. This is the first record for Isabel for *F. severus,* which appears to be rare in the archipelago, although it has been recorded from Buka, Bougainville, Choiseul, Gizo, Kulambangara, Guadalcanal, and Makira (Mayr 1945, Sibley 1946, Cain and Galbraith 1956, Schodde 1977, Gibbs 1996, J. M. Diamond pers. comm.).

Amaurornis [*olivacea*] *moluccanus.* In 1997, M. Hafe saw an individual of this rail, but was unable to collect it. We failed again to obtain this species in 1998, although M. Hafe collected a male in hill forest, ~3 km south of the village of Tirotongna (UF 40216; complete skeleton, skin, and spread wing; first specimen of *A. moluccanus* from Isabel). The long wing (chord 141 mm) and pale plumage of UF 40216 clearly ally it with *A. m. nigrifrons* of Choiseul, Bougainville, New Georgia, and the Bismarck Archi-

TABLE 1. Relative abundance, habitat selection, foraging guild, and specimens of birds from the Garanga River valley. Relative abundance: m = nonresident migrant; a = abundant (recorded daily in large numbers); c = common (encountered regularly by all observers each time in habitat); u = uncommon (encountered daily or almost daily in small numbers); r = rare (encountered less than five times). Habitats, given in decreasing order of importance for each species: r = river, beaches; rev = river-edge vegetation; f = forest interior; a = aerial. Foraging Guild (microhabitat/prey): microhabitats: AQ = water and water edge; AE = aerial; B = branches; C = canopy; T = terrestrial; U = understory; prey: FR = fruit and other vegetative material; FI = fish and aquatic invertebrates; N = nectarivore; O = omnivore; I = insects (includes all nonaquatic arthropods and other invertebrates; V = terrestrial vertebrates. * Taxon endemic to the Solomon Islands (* before species = species endemic; * before subspecies = subspecies endemic; ** before subspecies = subspecies endemic to Isabel).

FAMILY species	Relative abundance (97/98)	Habitat	Foraging guild	Specimens 97	Specimens 98
ARDEIDAE					
Egretta sacra sacra Pacific Reef-Egret	c/u	r	AQ/FI	2	—
Butorides striatus solomonensis Striated Heron	u	r	AQ/FI	—	1
Nycticorax caledonicus mandibularis Rufous Night-Heron	c	r	AQ/FI	1	—
*Ixobrychus flavicollis *woodfordi* Black Bittern	u	r, rev	AQ/FI	1	1
ANATIDAE					
Anas superciliosa pelewensis Pacific Black Duck	c	r	AQ/FR	6	—
PANDIONIDAE					
Pandion haliaetus cristatus Osprey	u	r, a	AE/FI	—	—
ACCIPITRIDAE					
*Aviceda subcristata *gurneyi* Pacific Baza	c	rev, c	C/I-V	7	—
*Haliastur indus *flavirostris* Brahminy Kite	u	r, a	AE/V	1	—
*Haliaeetus *sanfordi* Sanford's Fish-Eagle	u	r, f, a	AE/V-Fi	—	1
*Accipiter *imitator* Imitator Sparrowhawk	u	f, a	C/V	—	1
*Accipiter novaehollandiae * rufoschistaceus* Gray Goshawk	c	f, rev, a	C/V-I	4	1
FALCONIDAE					
Falco severus Oriental Hobby	r	a	AE/V	—	—
MEGAPODIIDAE					
Megapodius [freycinet] eremita Dusky Scrubfowl	u	rev, f	T/O	—	2
RALLIDAE					
*Nesoclopeus *woodfordi **immaculatus* Woodford's Rail	c	rev, f	T/O	14	—
*Amaurornis moluccanus *nigrifrons* Rufous-tailed Bush-hen	r/—	f	T/O	—	—
Porphyrio porphyrio samoensis Purple Swamphen	c	rev	T-AQ/O	2	—
CHARADRIIDAE					
Pluvialis [dominica] fulva Pacific Golden Plover	mu	r	AQ/FI	—	—
SCOLOPACIDAE					
Numenius phaeopus Whimbrel	mu	r	AQ/FI	—	—
Tringa nebularia Common Greenshank	mr	r	AQ/FI	—	—
Actitis hypoleucos Common Sandpiper	mc/r	r	AQ/FI	1	—
COLUMBIDAE					
*Macropygia mackinlayi *arossi* Mackinlay's Cuckoo-Dove	u	rev	C/FR	5	—
*Chalcophaps stephani *mortoni* Stephan's Dove	u	f, rev	T/FR	1	—
Ptilinopus s. superbus Superb Fruit-Dove	u	f, rev	C/FR	1	—
Ptilinopus viridis lewisii Claret-breasted Fruit-Dove	c	f, rev	C/FR	2	6
*Ducula rubricera *rufigula* Red-knobbed Imperial-Pigeon	c	f, rev	C/FR	5	1
PSITTACIDAE					
*Chalcopsitta *cardinalis* Cardinal Lory	a	rev, f, a	C/FR	9	—
Trichoglossus haematodus massena Rainbow Lorikeet	c	rev, a	C/FR	3	—
*Cacatua *ducorpsii* Ducorps's Cockatoo	a	rev, f, a	C/FR	5	1
*Micropsitta finschii *nanina* Finsch's Pygmy-Parrot	a	f, rev	B/FR	14	3
Geoffroyus heteroclitus heteroclitus Singing Parrot	u	f, a, c	C/FR	—	—
Eclectus roratus solomonensis Eclectus Parrot	c	f, rev, a	C/FR	2	1
CUCULIDAE					
Chrysococcyx l. lucidus Golden Bronze Cuckoo	mu	f, rev	C-U/I	3	1
*Cacomantis variolosus *addendus* Brush Cuckoo	r	rev	C/I	1	—
*Eudynamys scolopacea *alberti* Asian Koel	u	rev, f	C/O	1	—
STRIGIDAE					
*Ninox *jacquinoti **jacquinoti* Solomon Islands Hawk-Owl	c	rev, f	C/V-I	3	—

TABLE 1. Continued.

FAMILY species	Relative abundance (97/98)	Habitat	Foraging guild	Specimens 97	Specimens 98
PODARGIDAE					
*Podargus ocellatus *inexpectatus* Marbled Frogmouth	—/r	rev?	C/I-V	—	—
APODIDAE					
Collocalia vanikorensis vanikorensis Uniform Swiftlet	c	a	AE/I	1	—
*Collocalia esculenta *?becki* Glossy Swiftlet	c	a	AE/I	—	—
Collocalia spodiopygia reichenowi White-rumped Swiftlet	r	a	AE/I	—	—
HEMIPROCNIDAE					
Hemiprocne mystacea woodfordiana Moustached Treeswift	c	rev, a	AE/I	2	—
ALCEDINIDAE					
*Alcedo atthis *salomonensis* Common Kingfisher	c	r	AQ/FI	9	—
*Ceyx lepidus *meeki* Variable Kingfisher	u	f, rev	U/I-V	2	3
*Ceyx pusillus *bougainvillei* Little Kingfisher	—/r	rev	U/FI	—	—
*Halcyon *leucopygia* Ultramarine Kingfisher	c	rev	U/I-V	7	2
*Halcyon chloris *alberti* Collared Kingfisher	c	rev, f	C/I-V	—	1
Halcyon sancta Sacred Kingfisher	mu	rev	C/I-V	4	—
CORACIIDAE					
*Eurystomus orientalis *solomonensis* Dollarbird	u	rev, f	C/I	1	1
BUCEROTIDAE					
*Aceros plicatus *harterti* Blyth's Hornbill	c	f, rev, a	C/FR	4	—
PITTIDAE					
*Pitta *anerythra **anerythra* Black-faced Pitta	r/—	f	T/I	—	—
HIRUNDIDIDAE					
Hirundo tahitica subfusca Pacific Swallow	c	r	AE/I	2	—
CAMPEPHAGIDAE					
*Coracina caledonica **welchmani* Melanesian Cuckoo-shrike	—/r	f	C/O	—	2
*Coracina lineata *nigrifrons* Yellow-eyed Cuckoo-shrike	u	f	C/O	6	2
*Coracina papuensis *perpillada* White-bellied Cuckoo-shrike	c	rev	C/O	4	3
*Coracina tenuirostris *saturatior* Slender-billed Cicadabird	c	f, rev	C/O	5	1
*Coracina *holopolia holopolia* Solomon Islands Cuckoo-shrike	u	f, rev	C/O	3	3
RHIPIDURIDAE					
Rhipidura leucophrys melaleuca Willie Wagtail	c	r	T/I	7	2
*Rhipidura rufifrons *commoda* Rufous Fantail	r	f	C/I	2	1
*Rhipidura *cockerelli interposita* White-winged Fantail	r/u	f	C/I	—	3
MONARCHIDAE					
*Monarcha *castaneiventris castaneiventris* Chestnut-bellied Monarch	c	f, rev	C/I	10	6
*Monarcha *barbata barbata* Black-and-white Monarch	u/c	f	C-U/I	4	7
*Myiagra *ferrocyanea ferrocyanea* Steel-blue Flycatcher	u	f, rev	C/I	2	2
PACHYCEPHALIDAE					
*Pachycephala pectoralis *orioloides* Golden Whistler	u	f	C/O	4	3
STURNIDAE					
Aplonis cantoroides Singing Starling	r/—	rev	C/FR	—	—
*Aplonis *grandis grandis* Brown-winged Starling	c	rev, f	C/FR	6	—
Aplonis metallica nitidus Metallic Starling	c	rev, f	C/FR	10	—
Mino dumontii kreffti Yellow-faced Myna	c	rev, f	C/FR	8	3
CORVIDAE					
*Corvus *woodfordi vegetus* White-billed Crow	c	f, rev	C/O	4	1
NECTARINIIDAE					
Nectarinia jugularis flavigaster Olive-backed Sunbird	a	rev, f	C-U/N	12	—
DICAEIDAE					
*Dicaeum *aeneum aeneum* Midget Flowerpecker	c	rev, f	C-U/N	13	3
ZOSTEROPIDAE					
*Zosterops *metcalfii **metcalfii* Yellow-throated White-eye	a	f, rev	C/O	11	2
MELIPHAGIDAE					
*Myzomela *lafargei* Scarlet-naped Myzomela	r/c	f	C/N	—	1

TABLE 2. Foraging guilds of resident species. For definition of guilds, see text and Table 1. For species with multiple categories of microhabitat or prey (Table 1), the predominant (first) category is used.

Guild (microhabitat/prey)	Number	Percentage
Aerial/insects	5	7.0
Aerial/vertebrates	3	4.2
Aerial/fish	1	1.4
Aquatic/fish	9	12.7
Aquatic/fruit	1	1.4
Terrestrial/fruit	1	1.4
Terrestrial/insects	2	2.8
Terrestrial/omnivore	4	5.6
Understory/insects	2	2.8
Understory/fish	1	1.4
Branches/fruit	1	1.4
Canopy/fruit	14	19.7
Canopy/insects	12	16.9
Canopy/nectar	3	4.2
Canopy/omnivore	9	12.7
Canopy/vertebrates	3	4.2

pelago, rather than *A. m. ultimus* of islands east of Isabel (Taylor 1998).

On the basis of vocalizations, Webb (1992) regarded *A. moluccanus* to occur on Isabel. However, the calls he described ("wild duets consisting of alternating shrieks overlapping in a harmonic beat") sound similar to us to the calls of *Nesoclopeus woodfordi* (see below). We did not hear the calls that Webb (1992) described for *N. woodfordi* ("unmusical series of metallic shrieks unvarying in pitch"), but these are reminiscent of the distinctive growling shrieks described for *A. moluccanus* and *A. olivaceus* (Lambert 1998).

NESOCLOPEUS WOODFORDI. This rail has been described as "extinct or in low numbers and endangered" (Diamond 1987), "obviously scarce" (Blaber 1990), or "close to extinction" (Taylor 1998), even though the last source cited Webb (1992), who regarded it as uncommon on Isabel in old gardens and river edge habitats. In fact, this large flightless rail was common in early successional habitats within 100 m of the river, although we also found it in mature forests. Elusive and difficult to see when not calling, *N. woodfordi* vocalized infrequently (a pair near camp would duet only once or twice per day), yet the loudness and distinctiveness of its vocalizations made detection easy. In most late afternoons or on cloudy days, this rail engaged in bouts of duets: one pair would begin, and then other pairs would follow when the first duet died off, and so on up and down the river.

The three forms of *N. woodfordi* are *N. w. immaculatus* on Isabel, *N. w. woodfordi* on Guadalcanal, and *N. w. tertius* on Bougainville. An undescribed form of *Nesoclopeus* may occur as well on New Georgia (Blaber 1990). Our specimens represent two downy chicks; one immature female and four immature males (bursa present); and five adult females and one adult male (bursa absent); the age of one male could not be assessed. The immature and adult specimens showed a great deal of plumage variation, even within age/sex classes. Nine of the 12 nondowny specimens had some white spotting in the remiges, underwing coverts, and undertail coverts. The characters used to distinguish *N. w. immaculatus* (larger, blacker, lacking white mottling on the underparts and white barring in the remiges, axillaries, and wing coverts; Mayr 1949) are negated by the variation in our specimens. Intrapopulation variation went unnoticed by Mayr (1949) because so few specimens were available then.

Previous authors described *N. woodfordi* as "probably flightless." Men from Isabel stated that it never flies; this was confirmed in our specimens. The distal part of each remix or rectrix is lax, with a weak rachis and noninterlocking barbs. Lacking aerodynamic function, the flight feathers cannot support the body weight. The wing is small relative to the leg. Also, the sternal keel and the relative mass of the breast muscles (pectoralis major and supracoracoideus) are much reduced.

MICROPSITTA FINSCHII. In contrast to Webb's (1992) report that *M. finschii* was confined to montane areas on Isabel, we found this tiny parrot to be one of the most abundant interior forest species along the Garanga River. We found three other species (*Collocalia spodiopygia, Coracina caledonica, Pachycephala pectoralis*) at our lowland site that previously had been considered as largely or wholly montane species on Isabel (Mayr 1945, Webb 1992).

Aided by stiffened rectrices, *Micropsitta finschii* usually hitched along trunks and larger branches, from 4–20 m up in monospecific flocks of two to eight birds. We observed birds entering arboreal termitaria at dusk, presumably to roost (see Juniper and Parr 1998). The displays in species of *Micropsitta* are not well known because they are rarely kept in captivity

and are inconspicuous in the wild. On 27 June 1998, AWK observed a pair of *M. finschii* perched sideways on a 2 cm vertical vine, ~6 m above the ground. The female was ~20 cm above the male, and their bills were oriented in the same direction. The male hitched up the stem and touched bills with the female. This process was repeated several times over the next minute as the male chased the female up the vine. At one point, the male flew 30 cm out away from the vine and hovered for a few seconds. Both birds gave a high-pitched chattering continuously during the display.

Eudynamys scolopacea. Except for an unconfirmed report of a bird seen by J. Diamond (cited in Webb 1992), *E. scolopacea* had not been reported for Isabel. We recorded *E. scolopacea* daily in small numbers, especially in river-edge vegetation. Although difficult to see, its distinctive song was given frequently and often at night (as reported by Blaber 1990). An immature (UW 58734), collected on 10 July 1997, is the first specimen from Isabel.

Discussion

Diversity.—In contrast to islands further east in Polynesia (e.g. Steadman et al. 1990, Steadman and Freifeld 1998, Freifeld 1999), in Vanuatu (Bowen 1997), or on peripheral islands in the Solomons (Diamond et al. 1976, Diamond 1984, Filardi et al. 1999), the bird communities of islands in the main chain of the Solomons have more direct Papuan influences and are more diverse (Diamond and Mayr 1976). Major islands of the Solomons, such as Isabel, are larger and more geologically and topographically heterogeneous than most islands further east in Oceania. Increased diversity of birds on larger or higher islands in Oceania is thought to result from non-overlapping distributions among ecologically similar species across elevational gradients, which may arise from competitive interactions (Mayr and Diamond 1976, Diamond and Mayr 1976, Schodde 1977). Although montane areas of Isabel are not particularly high or extensive, two strictly montane species are known, *Charmosyna meeki* and *Phylloscopus poliocephalus* (Mayr 1945). Several other species are primarily montane on Isabel (*Nesasio solomonensis, Collocalia spodiopygia, Pitta anerythra, Coracina caledonica, Pachycephala pectoralis*; Webb 1992, A.W.K., C.E.F., and C.E.S. pers. obs.), although we found four of those species near sea level along the Garanga River. Thus, the relatively high overall diversity of birds on Isabel may result more from species packing within habitats and species replacements across habitats within the floristically rich lowlands, rather than from elevational specialization of species.

We found at least 86% of Isabel's resident species at the Garanga River site, indicating that a single lowland site dominated by forest may contain almost all species on an island, even an island with elevations >1,000 m. The lower Garanga River has created a mosaic of older forests, successional vegetation, rocky and sandy beaches, and forest edges. The bird community reflects that habitat heterogeneity. The erosional and depositional processes associated with meandering rivers are key contributors to habitat heterogeneity at the landscape scale elsewhere in tropical lowlands (e.g. Robinson and Terborgh 1997).

Understory avifauna.—We were struck by how few birds we observed in the understory of mature forests. Our mist-net efforts, though minimal, supported these observations. A single mist net across the Garanga River captured *Egretta sacra,* two *Anas superciliosa, Actitis hypoleucos,* and three *Alcedo atthis* in ~30 net-hours in 1997. In the interior forest, 170 net-hours in 1997 yielded a single bird (*Monarcha barbata*); in 1998, 182 net-hours yielded eight birds, all nonpasserines (4 *Ceyx lepidus,* 3 *Micropsitta finschii,* and 1 *Accipiter imitator*). Thus, 352 net-hours from nine nets at two mature forest sites captured only one passerine and eight nonpasserines (2.6 birds/100 net-hours). In contrast, most continental tropical forest sites have diverse communities of terrestrial and understory species, especially passerines, which are usually the easiest avifaunal component to sample with nets (Remsen and Good 1996).

Our observations and capture rates indicate that the terrestrial and understory avifauna at the Garanga River site is depauperate in both diversity and abundance. Terrestrial and understory guilds totaled only 16% of the resident landbirds (Fig. 2), compared to 31% across seven lowland forest sites in New Guinea (Bell 1982, Beehler and Mack in press). The only regularly occurring understory or terrestrial species that we did not net were large non-passerines (*Nesoclopeus woodfordi, Megapodius eremita, Chalcophaps stephani)* and one

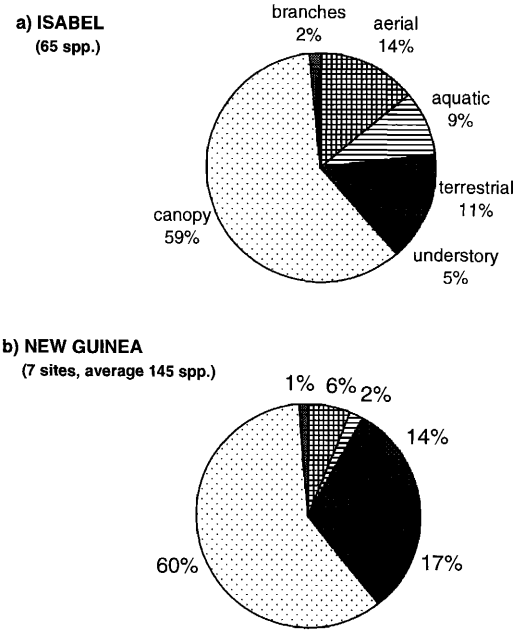

FIG. 2. Distribution of resident landbird species among preferred microhabitats at lowland forest sites in (a) the Solomon Islands, along the Garanga River on Isabel (this study, Table 1); and (b) Papua New Guinea (one site on the Brown River floodplain [Bell 1982] and six sites in the Lakekamu Basin [Beehler and Mack in press]). For b the proportion of the avifauna using each microhabitat was averaged across the seven sites; microhabitat use for these sites is from the above citations, as well as Beehler et al. (1986).

passerine (*Pitta anerythra*), the latter two being rare (Table 1). Missing from the site were those terrestrial and understory taxa that either still occur or once occurred on nearby large islands in the Solomons or Bismarcks (Mayr 1945, Diamond 1991, Steadman et al. 1999): a large species of *Megapodius*, other flightless rails (*Gallirallus, Porphyrio, Gallinula*), columbids (*Gallicolumba* spp., *Microgoura meeki*), and passerines (*Turdus poliocephalus, Petroica multicolor*).

An impoverished understory bird community is a widespread phenomenon in Oceania, much of this resulting from prehistoric, anthropogenic extinctions (Steadman 1995). The depauperate nature of the understory avifauna in the Garanga River valley may also be anthropogenic, which would include predation by non-native mammals. Even on New Ireland, which is larger, higher, and closer to New Guinea, and with a much richer modern avifauna (106 species) than Isabel, 12 of the 50 species of birds recorded in prehistoric cultural deposits no longer live on the island (Steadman et al. 1999). Other possible causes for a low capture-rate of understory birds seem less likely, such as seasonal shifts in foraging height or habitat preference.

Species not recorded.—With our new records for *Ixobrychus flavicollis, Falco severus,* and *Eudynamus scolopacea,* Isabel and its offshore islets are known to have 76 species of resident land and freshwater birds (previous summations from Mayr 1945, Webb 1992). One other species, *Accipiter albogularis,* has been listed as occurring on Isabel (Mayr 1945, Webb 1992, 1997), although all Isabel specimens in the American Museum of Natural History appear to be *A. imitator* (see its account) and the few sight records are controversial (Debus 1995).

We found 65 of the 76 species known from Isabel (86%) in the Garanga River valley. Of the 11 species not recorded, we found five at other sites on Isabel in 1997 and 1998. Four of these (Island Imperial-Pigeon *Ducula pistrinaria,* Beach Kingfisher *Halcyon s. saurophaga,* Islet Monarch *Monarcha cinerascens impediens,* and Nicobar Pigeon *Caloenas n. nicobarica*) are small-island or beach specialists that occur on islets just off the north coast of Isabel (see Fig. 1). Another, the Fearful Owl (*Nesasio solomonensis*), we found in the mountains southeast of Buala (Fig. 1).

Of the remaining six species, two (Island Leaf-Warbler, *Phylloscopus poliocephalus,* and Meek's Lorikeet, *Charmosyna meeki*) may be confined to montane forests (Mayr 1945, Webb 1992), one is nocturnal (White-throated Eared-Nightjar, *Eurostopodus mystacalis*) and may not have been calling during our visits, and one (White-throated Pigeon, *Columba vitiensis*) is known on Isabel from a Whitney South Sea Expedition specimen, but has not been seen since (Webb 1992). *Reinwardtoena crassirostris* (Crested Cuckoo-Dove) has never been collected on Isabel—the only record is a sight record by Webb (1992), who reported that locals said it was common (but his given local name—*fela*—is the same as that given to us for *Macropygia mackinlayi*). The other species not definitely recorded by us (Duchess Lorikeet, *Charmosyna margarethae*) may have been observed in the Garanga River valley in 1998, but could not be confirmed. On two occasions, A. Kratter noted

flocks (2–6 birds) of very small psittacids flying within the canopy giving two-note calls that were less shrill than those of *Trichoglossus haematodus*.

Conservation.—The Garanga River valley is a prime candidate for conservation. A protected area from the river mouth and adjacent offshore islets and extending along the lowland portions of the River would include populations of at least 91% of the Isabel's species of birds. Incorporating highlands at the sources of the Garanga watershed, a linear distance of only 8 km from the coast, would protect populations of all resident landbird species, except perhaps the several species of uncertain status.

Protecting the lower parts of the watershed is of foremost importance because lowland forests are the first to be destroyed in the Solomon Islands (Stattersfield et al. 1998) and across Oceania (Steadman 1995). Although mature forests are preferred by many species along the Garanga River, successional riverine habitats are essential for others, including the flightless rail *Nesoclopeus woodfordi*, a species of great evolutionary importance that is likely to remain common as long as riverine habitats are intact.

Although we doubt that the Garanga River avifauna is pristine, we found populations of many species in the same families (megapodes, rails, columbids, and psittacids) that dominate the anthropogenic extinction record in Oceania (Steadman 1995). Introduced species of birds are absent. The Garanga River site sustains one species listed as "near-threatened" (*Corvus woodfordi*), two listed as "vulnerable" (*Haliaeetus sanfordi, Pitta anerythra*), and two others (*Accipiter imitator, Nesoclopeus woodfordi*) listed as "endangered" (Collar et al. 1994). At population levels suggested by our fieldwork, those classifications may be exaggerated for all five species. The conservation status of birds in Oceania can be evaluated accurately only through rigorous fieldwork.

The Garanga River valley is particularly inviting for protection because the provincial government of Isabel owns its lower stretches, thereby simplifying ownership issues. The provincial government also owns much of Fera Island (12 km ESE of the Garanga River mouth), where we found four of the species missing along the Garanga. Thus, a tract of land with at least 91% of Isabel's resident species of landbirds is already in government hands. Although the Melanesian tradition of custom land can complicate issues of land protection, that system of land management has resulted in a fairly intact avifauna surviving on Isabel in spite of many millennia of human occupation. Other than an expansion of commercial logging or other intensive land uses (e.g. oil palm plantations), the future of birdlife on Isabel is not bleak.

Acknowledgments

Field research was supported by the University of Florida College of Liberal Arts and Sciences (grant RDA-1-23 95-86) to D.W.S. and the Ornithology Endowment of the University of Washington Burke Museum to C.E.F. and C.E.S. Museum-based research was supported by the National Science Foundation (grant EAR-9714819 to D.W.S.). Mary LeCroy and Jared Diamond provided information that was instrumental to our analyses. Terry Taylor helped to prepare specimens. Moses Biliki, Joe Horako, Lawrence Foanaota, and Audrey Rusa kindly provided logistical support and research permits from the national government of the Solomon Islands. On Isabel, Amos Gigini, Mark Hafe, Austel Ruumana, and William, Veronica, and Roger Manehage supplied companionship, access to the site, and immeasurable help in the field. For constructive comments that improved the manuscript, we thank B. M. Beehler, S. Debus, J. M. Diamond, H. Ford, and T. K. Pratt.

Noting that Diamond (1975) dedicated a paper on Bougainville birds (written in 1974) to Ernst Mayr on his 70th birthday, we take this wonderful opportunity to dedicate our paper to Professor Mayr on the occasion of his 97th birthday. All that we have done in the Solomon Islands rests on the foundation laid by these two gifted men.

Literature Cited

Beehler, B. M., and A. L. Mack. 1999. Constraints to characterising spatial heterogeneity in a lowland forest avifauna in New Guinea. *In* Proceedings XXII International Ornithological Congress. (N. Adams and R. Slotow, Eds.) University of Natal, Durban, South Africa.

Beehler, B. M., T. K. Pratt, and D. A. Zimmerman. 1986. Birds of New Guinea. Princeton University Press, Princeton, New Jersey.

Bell, H. L. 1982. A bird community of lowland rainforest in New Guinea. I. Composition and density of the avifauna. Emu 82:24–41.

Blaber, S. J. M. 1990. A checklist and notes on the current status of the birds of New Georgia, Western province, Solomon Islands. Emu 90:205–214.

BOWEN, J. 1997. The status of the avifauna of Loru Protected Area, Santo, Vanuatu. Bird Conservation International 7:331–344.

CAIN, A. J., AND I. C. J. GALBRAITH. 1956. Field notes on birds of the eastern Solomon Islands. Ibis 98: 100–134.

COLLAR, N. J., M. J. CROSBY, AND A. J. STATTERSFIELD. 1994. Birds to Watch 2. BirdLife Conservation Series no. 4

CORNER, E. J. H. 1967. *Ficus* in the Solomon Islands and its bearing on the post-Jurassic history of Melanesia. Philosophical Transactions of the Royal Society of London, Series B 253:23–159.

DEBUS, S. J. S. 1995. The morphs of Solomon Islands *Accipiter* spp.—A comment on Webb (1992). Emu 95:71–72.

DIAMOND, J. M. 1975. Distributional ecology and habits of some Bougainville birds (Solomon Islands). Condor 77:14–23.

DIAMOND, J. M. 1982. Effect of species pool size on species occurrence frequencies: Musical chairs on islands. Proceedings of the National Academy of Sciences USA 79:2420–2424.

DIAMOND, J. M. 1984. The avifauna of Rennell and Bellona islands. Natural History of Rennell Island, British Solomon Islands 8:127–168.

DIAMOND, J. M. 1987. Extant unless proven extinct? Or, extinct unless proven extant? Conservation Biology 1:77–79.

DIAMOND, J. M. 1991. A new species of rail from the Solomon Islands and convergent evolution of insular flightlessness. Auk 108:461–470.

DIAMOND, J. M., M. E. GILPIN, AND E. MAYR. 1976. Species-distance relation for birds of the Solomon Archipelago, and the paradox of the great speciators. Proceedings of the National Academy of Sciences USA 73:2160–2164.

DIAMOND, J. M., AND E. MAYR. 1976. Species-area relation for birds of the Solomon Archipelago. Proceedings of the National Academy of Sciences USA 73:262–266

FILARDI, C. E., C. E. SMITH, A. W. KRATTER, D. W. STEADMAN, AND H. P. WEBB. 1999. New behavioral, ecological, and biogeographic data on the avifauna of Rennell, Solomon Islands. Pacific Science 52:319–340.

FREIFELD, H. B. 1999. Habitat relationships of forest birds on Tutuila Island, American Samoa. Journal of Biogeography 26:1191–1213.

GALBRAITH, I. C. J., AND E. H. GALBRAITH. 1962. Land birds of Guadalcanal and the San Cristoval group, eastern Solomon Islands. Bulletin of the British Museum (Natural History), Zoology 9:1–86.

GIBBS, D. 1996. Notes on Solomon Island birds. Bulletin of the British Ornithologists' Club 116:18–25.

GREENSLADE, P. J. M. 1968. Island patterns in the Solomon Islands bird fauna. Evolution 22:751–761.

HADDEN, D. 1981. Birds of the North Solomons. Wau Ecology Institute Handbook 8. Wau, Papua New Guinea.

JUNIPER, T., AND M. PARR. 1998. Parrots, a Guide to the Parrots of the World. Yale University Press, New Haven, Connecticut.

KAESTNER, P. 1987. Some observations from lowland swamp forest in south Bougainville. Muruk 2: 34–38.

KARR, J. R. 1990. The avifauna of Barro Colorado Island and the Pipeline Road, Panama. Pages 183–198 *in* Four Neotropical Rainforests (A. H. Gentry, Ed.). Yale University Press, New Haven, Connecticut.

KRATTER, A. W., D. W. STEADMAN, C. E. SMITH, AND C. E. FILARDI. 2001. Reproductive condition, moult, and body mass of birds from Isabel, Solomon Islands. Bulletin of the British Ornithologists' Club 121: in press.

LAMBERT, F. R. 1998. A new species of *Amaurornis* from the Talaud Islands, Indonesia, and a review of taxonomy of bush hens occurring from the Philippines to Australasia. Bulletin of the British Ornithologists' Club 118:67–82.

LECROY, M., A. W. KRATTER, D. W. STEADMAN, AND H. P. WEBB. 2001. *Accipiter imitator* on Isabel Island, Solomon Islands. Emu 101: in press.

MAYR, E. 1945. Birds of the Southwest Pacific. Macmillan, New York.

MAYR, E. 1949. Notes on the birds of northern Melanesia, 2. American Museum Novitates 1417.

MAYR, E., AND J. M. DIAMOND. 1976. Birds on islands in the sky: Origin of the montane avifauna in northern Melanesia. Proceedings of the National Academy of Sciences USA 73:1765–1769.

OLSON, S. L. 1982. The distribution of fused phalanges of the inner toe in the Accipitridae. Bulletin of the British Ornithologists' Club 102:8–12.

REMSEN, J. V., JR., ED. 1997. Studies in Neotropical ornithology honoring Ted Parker. Ornithological Monographs, no. 48.

REMSEN, J. V., JR., AND D. A. GOOD. 1996. Misuse of data from mist-net captures to assess relative abundance in bird populations. Auk 113:381–398.

ROBINSON, S. K., AND J. TERBORGH. 1997. Bird community dynamics along primary successional gradients of a Amazonian whitewater river. Ornithological Monographs no. 48:641–672.

SCHODDE, R. 1977. Survey of birds of southern Bougainville Island, Papua New Guinea. Contributions to Papuasian ornithology VI. Commonwealth Scientific and Industrial Research Organization, Melbourne, Australia.

SIBLEY, C. G. 1946. The second specimen of the Oriental Hobby from the Solomon Islands. Condor 48:97.

STATTERSFIELD, A. J., M. J. CROSBY, A. J. LONG, AND D. C. WEGE. 1998. Endemic bird areas of the

world. BirdLife International, Cambridge, United Kingdom.

STEADMAN, D. W. 1995. Prehistoric extinction of Pacific island birds: Biodiversity meets zooarchaeology. Science 267:1123–1131.

STEADMAN, D. W., AND H. B. FREIFELD. 1998. Distribution, relative abundance, and habitat relationships of landbirds in the Vava'u group, Kingdom of Tonga. Condor 100:609–628.

STEADMAN, D. W., D. S. PAHLAVAN, AND P. V. KIRCH. 1990. Extinction, biogeography, and human exploitation of birds in Tikopia and Anuta, Polynesian outliers in the Solomon Islands. Bishop Museum Occasional Papers no. 30:118–153.

STEADMAN, D. W., H. P. WHITE, AND J. ALLEN. 1999. Prehistoric birds from New Ireland, Papua New Guinea: Extinctions on a large Melanesian island. Proceedings of the National Academy of Sciences USA 96:2563–2568.

TAYLOR, P. B. 1998. Rails, a Guide to the Rails, Crakes, Gallinules and Coots of the World. Yale University Press, New Haven, Connecticut.

TERBORGH, J., S. K. ROBINSON, T. A. PARKER III, C. A. MUNN, AND N. PIERPONT. 1990. Organization of an Amazonian bird community. Ecological Monographs 60:213–238.

THIOLLAY, J. M. 1994. Family Accipitridae (hawks and eagles). Pages 52–205 *in* Handbook of the Birds of the World, vol. 2. (J. del Hoyo, A. Elliot, and J. Sargatal, Eds.). Lynx Edicions, Barcelona, Spain.

WEBB, H. P. 1992. Field observations of the birds of Santa Isabel, Solomon Islands. Emu 92:52–57.

WEBB, H. P. 1995. Reply to Debus. Emu 95:73.

WEBB, H. P. 1997. Nesting and other observations of Solomon Island birds. Australian Bird Watcher 17:34–41.

WICKLER, S., AND M. SPRIGGS. 1988. Pleistocene human occupation of the Solomon Islands, Melanesia. Antiquity 62:703–706.

Associate Editor: B. Loiselle