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## OBSERVATIONS OF RAPTORS IN THE REPUBLIC OF VANUATU

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**ABSTRACT.**—Road and trailside surveys were conducted in the Republic of Vanuatu, formerly known as the New Hebrides in the Southwest Pacific, to determine relative abundance of raptors. Three diurnal and one nocturnal species were observed during 74 hr of observation over 594 km surveyed. Swamp Harriers (*Circus approximans approximans*) were most frequent and found on all islands surveyed including Efate ( $N = 6$ ), Espiritu Santo ( $N = 31$ ), Gaua ( $N = 11$ ) and Tanna ( $N = 19$ ). Peregrine Falcons (*Falco peregrinus nesiotus*) were observed on Gaua ( $N = 2$ ) and Tanna ( $N = 1$ ), while Brown Goshawks (*Accipiter fasciatus viligax*,  $N = 2$ ) and Barn Owls (*Tyto alba interposita*,  $N = 2$ ) were observed on Tanna and Espiritu Santo, respectively. Observations of Swamp Harriers on Gaua and Brown Goshawks on Tanna are the first reported for these species on these islands. Indices of relative abundance were calculated for each species based on the number of individuals observed per km traveled.

**KEY WORDS:** *Brown Goshawk; Accipiter fasciatus viligax; raptor roadside survey; relative abundance; Swamp Harrier; Circus approximans approximans; Vanuatu.*

### Observaciones de rapace en la República de Vanuatu

**RESUMEN.**—Estudios de caminos y calles fueron conducidos en la Republica de Vanuatu antes conocido como Nuevo Hebrides en el Pacifico del Sud-oeste, para determinar la abundancia relativamente de rapace. Tres especie del día y uno de la noche fueron observados durante 74 hr en una region de 594 km. *Circus approximans approximans* fueron mas frecuente, y localizados en todas las islas inspeccionadas incluyendo Efate ( $N = 6$ ), Espiritu Santo ( $N = 31$ ), Gaua ( $N = 11$ ), y Tanna ( $N = 19$ ). *Falco peregrinus nesiotus* fueron observados en Gaua ( $N = 2$ ) y Tanna ( $N = 1$ ), fueron observados en Tanna y Espiritu Santo, respectivamente. Observaciones de aguiluchos en Gaua y *Accipiter fasciatus viligax* en Tanna son las primeras especie reportadas en estas islas. Indice de abundancia relativa fueron calculadas para cada especie basado en numero de individuales observados por km caminados.

[Traducción de Raúl De La Garza, Jr.]

Tropical rainforests are perhaps the most biologically rich terrestrial habitats in the world. Thiollay (1994) estimated that over 46% of the world's presently recognized falconiforms are tropical forest species. Tropical forest raptors, including strigiforms, are also much less known than Nearctic and Palearctic species, and in need of further study to better understand their basic biological and ecological requirements, including density in certain

habitats, population numbers and trends, and environmental factors limiting their numbers. Burnham and Cade (1995) recently suggested that more attention should be focused on species that are little known and needing study and in geographical "hotspots," because those species and locations are most likely to be, or are soon to become, jeopardized through continued human encroachment and development.

Though not recognized as a geographical "hotspot" for its high biodiversity like the nearby islands of New Guinea and New Caledonia, the Republic of Vanuatu is an important faunal cross-

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roads where the main streams of colonization of Southwest Pacific birds meet (Bregulla 1992). This nation of large and small islands has received little attention from biologists due in part to its remote location. Most of the resident birds are thought to have been derived from Australia, New Guinea or Fiji. Resident raptors include the Brown or Australian Goshawk (*Accipiter fasciatus vigilax*), Swamp Harrier (*Circus approximans approximans*), Peregrine Falcon (*Falco peregrinus nesiotus*) and Barn Owl (*Tyto alba interposita* and *T. a. lulu*). The Brahminy Kite (*Haliastur indus flavirostris*) occurs as an occasional vagrant from the neighboring Solomon Islands (Wattel 1973, Weick 1980, Bregulla 1992).

During a related study of Vanuatu's largest and most accessible islands to determine if Sanford's Sea Eagle (*Haliaeetus sanfordi*), thought to be endemic in the Solomon Islands, occurs in the archipelago as a resident or vagrant species, I also sought to determine the distribution of the islands' birds of prey, and estimate their observed relative abundance. Here, I used numbers of individuals observed per km traveled, and numbers seen per hr of observation, to estimate relative abundance during a roadside and trailside survey. This may not have been done previously for the islands.

#### STUDY AREA AND METHODS

Located between the equator and the Tropic of Capricorn (13–23°S, 166–173°E), the Republic of Vanuatu is a chain of about 100 ash and coral uplifted islands and islets. They were formerly known as the New Hebrides until 1980 when independence was gained from the condominium governments of France and the United Kingdom. The Y-shaped archipelago of mainly small volcanic islands occurs in one of the most geologically active areas in the world, and is part of a continuous island arc system stretching from Papua New Guinea and the Solomon Islands to Fiji and Tonga. The largest island is Espiritu Santo with a surface area of 3900 km<sup>2</sup>. Other major islands include Efate (915 km<sup>2</sup>), Gaua or Santa Maria in the Banks Islands group (310 km<sup>2</sup>) and Tanna (572 km<sup>2</sup>) which are mountainous and extremely rugged. The highest peak in Vanuatu is Mt. Tabwemasana on Espiritu Santo at 1879 m (Fig. 1; Bregulla 1992).

Vanuatu has a wet, tropical climate in the north gradually changing to subtropical in the south, and largely exposed to prevailing southwesterly winds. Evergreen rainforest covers about 75% of the country. Three major plant communities are readily recognized on the larger mountainous islands, including evergreen tropical rainforest on the lowland, warm, wet, windward slopes; semi-deciduous forest and fire-induced savannahs and grasslands on lowland, warm, drier, leeward slopes; and evergreen forest on upland and summit areas with cooler, wetter and more humid climatic conditions (Bregulla 1992, Harcombe and O'Byrne 1995).

Standardized road and trailside counts were conducted on the islands of Efate, Espiritu Santo, Gaua and Tanna using a car and on foot from 19 October–7 November 1996 (Fig. 1). Three to four observers walking and traveling together located and identified raptors on both sides of roads or trails during these counts, and recorded data on species and number observed, habitat type and activity (Thiollay 1989). Driving speeds were variable, but roadway conditions always limited speeds to <40 km/hr. When raptors were observed, the vehicle was stopped momentarily to identify the birds. Periodic stops were also made to scan for distant raptors in open habitats or over the forest canopy whenever conditions allowed. The location of each observation was plotted on 1:50 000 or 1:100 000 scale maps of the islands, and the date and time of each sighting noted. Survey times ranged from 0500–1900 H. Weather conditions were variable during the survey period, but mostly without any precipitation.

Some studies have indicated that roadside and trailside counts can give biased estimates of raptor densities and habitat associations. However, road counts can be useful and appropriate when large areas need to be sampled and monitored (Fuller and Mosher 1987). Use of roadways and trails on Vanuatu was the only feasible means of satisfying the study objectives.

I used the method developed by Woffinden and Murphy (1977) to calculate an index of observed relative abundance for each raptor species sighted:

$$\text{Index} = \left[ \frac{\text{(Total number of a species observed)}}{\text{(Total km traveled)}} \right] \times 1000$$

#### RESULTS AND DISCUSSION

Nearly 600 km were traveled and 74 hr of observation time logged (Table 1), giving an average of 1.0 raptors sighted per hr of observation time, or 0.12 individuals sighted per km (8.0 km traveled per bird sighted).

Swamp Harriers were most common and accounted for 90% of the raptors sighted (Table 2). Bregulla (1992) suggested the Swamp Harrier was the largest raptor in Vanuatu, and found on most islands, except Gaua, Mota Lava, Mere Lava and Tongariki. Also known as the Pacific Marsh Harrier, Amadon et al. (1988), Olsen (1995) and Clarke (1995, 1996) suggested, and others (Grossman and Hamlet 1964, Brown and Amadon 1968, Watson 1977, Weick 1980, Cupper and Cupper 1981) earlier treated, the Swamp Harrier and three other *Circus* species as a complex, conspecific with the widely distributed Western Marsh Harrier (*C. aeruginosus*) of Europe, North Africa and the Middle East. My observations of Swamp Harriers ( $N = 11$ ) on Gaua suggest the species may be extending its range in the archipelago to previously unoccupied islands. Alternatively, Swamp Harriers may have been present, but simply unobserved during pre-

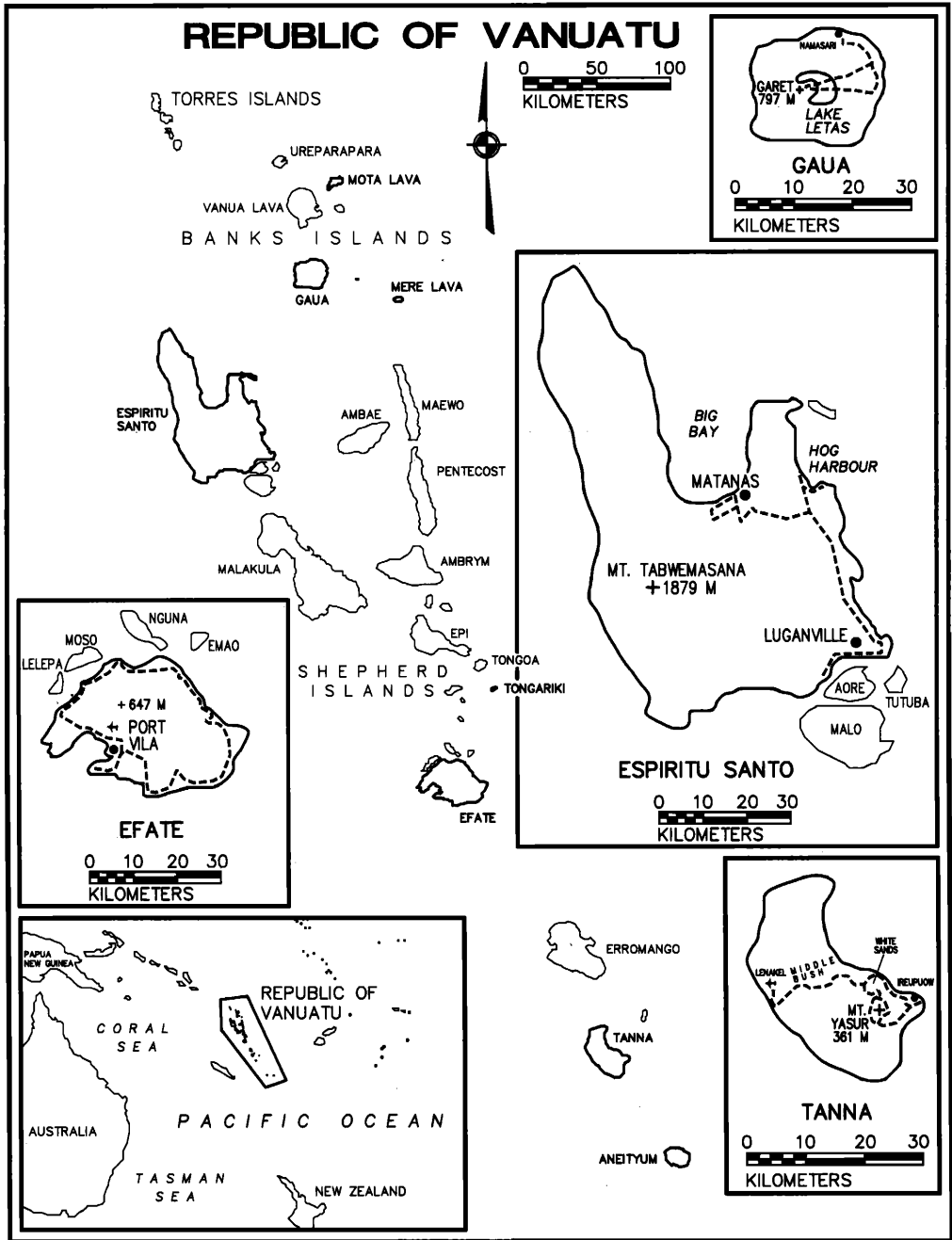


Figure 1. Raptor survey routes in the Republic of Vanuatu, 19 October–7 November 1996.

Table 1. Islands surveyed, distances traveled, and duration of raptor surveys conducted in Vanuatu, October–November 1996.

ISLAND	NUMBER AND TYPE OF SURVEY (CAR/FOOT)	OBSERVATION TIME (hr)	DISTANCE TRAVELED (km)
Efate	1	7.0	146
	2	4.5	10
Espiritu Santo	5	14.5	302
	5	11.5	26
Gaua (Santa Maria)	—	—	—
	4	16.0	35
Tanna	1	2.5	37
	4	18.0	38
Total	22	74.0	594

vious surveys of the island. However, I find this explanation less likely given Swamp Harriers tend to spend most of the day on the wing, usually over open habitats but also frequently over forest, and should have been readily observed if present (Bregulla 1992). Elsewhere in the South Pacific, *C. a. approximans* occurs on Wallis Island, the Loyalty Islands, New Caledonia, Fiji, Tonga, the Society Islands, Samoa, Chatham and Kermadec Islands (Brown and Amadon 1968, Hollands 1984).

Peregrine Falcons were observed on the islands of Gaua ( $N = 2$ ) and Tanna ( $N = 1$ ), while Barn Owls were observed on Espiritu Santo ( $N = 2$ ; Table 2). Bregulla (1992) suggested both species were found on most islands of Vanuatu. Several authors including Brown and Amadon (1968), Weick (1980), White and Boyce (1988) and Ratcliffe (1993) described *F. p. nesiototes* on the islands of Vanuatu, the Loyalty Islands, New Caledonia and Fiji. In addition to the island of Tanna, Peregrine Falcons have been observed breeding on the islands of Emae, Nguna, Erromango, Vete Manung, Efate and Tongoa during aerial surveys conducted from 1993–95 (C.M. White, pers. comm.).

Bunn et al. (1982), Bregulla (1992) and Taylor (1994) identified two subspecies of Barn Owl in Vanuatu, *T. a. interposita* on the northern islands (and the Santa Cruz Islands [Solomon Islands]) and *T. a. lulu* on the southern islands of Vanuatu (Erromango, Tanna and Aneityum), the Loyalty Islands, New Caledonia, Fiji, Tonga, Samoa and the Society Islands. My observations of two Barn Owls

Table 2. Frequency of raptor sightings and observed relative abundance indices of raptors sighted during surveys in Vanuatu, October–November 1996.

SPECIES	km TRAVELED INDEX OF RELATIVE ABUNDANCE <sup>a</sup>		
	NUMBER OBSERVED	PER INDIVIDUAL	RELATIVE ABUNDANCE <sup>a</sup>
Swamp Harrier ( <i>Circus approximans approximans</i> )	67	8.9	112.8
Peregrine Falcon ( <i>Falco peregrinus nesiototes</i> )	3	198.0	5.1
Brown Goshawk ( <i>Accipiter fasciatus viligax</i> )	2	297.0	3.4
Barn Owl ( <i>Tyto alba interposita</i> )	2	297.0	3.4

<sup>a</sup> Analysis of relative abundance after Woffinden and Murphy (1977).

on northeastern Espiritu Santo near Hog Harbour would probably be assigned to the former based on the location of these sightings.

Brown or Australian Goshawks were sighted on the island of Tanna ( $N = 2$ ; Table 2), and are observations equally significant to the Swamp Harriers seen on Gaua. Wattel (1973), Weick (1980) and Bregulla (1992) described *A. f. viligax* as similar in plumage to the nominate subspecies *A. f. fasciatus* of Australia, but smaller in size and found on New Caledonia and the Loyalty Islands. The only previous definite records for the Brown Goshawk in Vanuatu are from the island of Aneityum, south of Tanna, where it was not numerous (Bregulla 1992). My observations of two Brown Goshawks in lowland wooded habitat near the village of White Sands, north of Mt. Yasur (361 m), suggest the species may also be extending its range in the archipelago. However, since the Brown Goshawk frequents a variety of wooded habitats in lowlands and mountains, including forest edges, wooded grasslands and secondary growth, it could have been present yet easily overlooked during previous surveys on Tanna.

Wattel (1973) suggested Vanuatu was colonized in the distant past by Brown Goshawks from New Caledonia, with the success of *A. fasciatus* as an island colonist further emphasized by its occurrence on many small islands to the north and northeast

of Australia. Geographical variation in the size of the Brown Goshawk provides a good example of "Bergmann's rule," such that all tropical subspecies are smaller than the temperate Australian and nominate subspecies, *A. f. fasciatus* (Pianka 1978).

Sanford's Sea-Eagles were not observed on the islands surveyed. However, future investigations in the Torres Islands, the northwestern most island group in the archipelago, could prove fruitful. These islands are less than 452 km southeast of San Cristobal in the Solomon Islands where Sanford's Sea-Eagle has been observed in the past (Brown and Amadon 1968).

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