

*Believed originally to have occupied the dry forests that once fringed Puerto Rico, this nightbird is restricted to three separate areas of such habitat in the south-west of the island, where the total population is in the order of 670-800 pairs distributed over 10,000 ha of habitat. Despite protected area status for much of the relevant forests, habitat destruction remains a serious threat.*

**DISTRIBUTION** The Puerto Rican Nightjar is endemic to Puerto Rico, where it is now restricted to three separate areas in the south-western portion of the island, namely Guánica Forest (1 km east of Guánica), Susúa Forest (5 km east of Sabana Grande, 18°05'N 66°58'W; coordinates here and below in OG 1958), and the Guayanilla Hills (c.3.5 km east of Guayanilla, 18°01'N 66°47'W, and 2 km from the coast) (Kepler and Kepler 1973, Noble *et al.* 1986, Vilella and Zwank 1987). In addition, since 1986 a number of new nightjar records have been obtained in several areas of south-western Puerto Rico, namely Guánica Forest (section west of Guánica Bay, 17°58'N 66°55'W), the adjacent private lands in Ensenada (Ensenada at 17°58'N 66°56'W), private lands adjacent to Susúa and Maricao Forests (18°09'N 67°00'W) and more recently the Parguera Hills (Parguera at 17°59'N 67°03'W) in 1990 and Sierra Bermeja (c.10 km west of Parguera) in 1992 (Vilella 1989, Vilella and Zwank in press a; see Population, Remarks 1). Former localities (west to east) where the species is known to have occurred include: near Mayagüez, around 1958 (see Reynard 1962); La Cueva Catedral, near Morovís (18°20'N 66°24'W), itself near Bayamón, where bones of this species were examined (Wetmore 1919); near Bayamón, where the type-specimen was taken in October 1888 (Wetmore 1919; also A. Wetmore in Reynard 1962); and Río Piedras (18°24'N 66°03'W), where a possible bird was observed in December 1911 (Wetmore 1919, Bond 1956b). Given the species's present range, former localities and the vegetation-type associated with them, Kepler and Kepler (1973) believed that its original range was coextensive with the moist limestone and coastal forests, the dry limestone forests, the drier sections of the lower cordillera forests and perhaps the dry coastal forest, i.e. it possibly encircled the island, covering most of the coastal plain on both sides of the Cordillera Central and Sierra de Luquillo (see the maps in Kepler and Kepler 1973). Kepler and Kepler (1973) estimated the species's current range to be approximately 3% of its former distribution, although Vilella and Zwank (1988) believed it to be 9-10% (i.e. more than 10,000 ha), and this figure has recently been increased with the post-1986 range extensions (see above); however, it is difficult at present to estimate the total area which should be added to the known range (F. J. Vilella *in litt.* 1992).

**POPULATION** Prior to 1961, only one specimen of the Puerto Rican Nightjar had been collected, near Bayamón in 1888 (Cory 1889, Wetmore 1919, A. Wetmore in Reynard 1962). Wetmore (1919) saw what he thought was this species in 1911 and it was assumed to be extinct or nearly so (Wetmore 1919, Peters 1940, Bond 1956b) until rediscovered in 1961 in Guánica Forest, where its voice was familiar to local people (Reynard 1962). Soon afterwards the number of birds in Guánica Forest was put at 100 (see Kepler and Kepler 1973). Between 1969 and 1971 Kepler and Kepler (1973) conducted censuses in Guánica and Susúa forests (see Remarks 2), resulting in the estimation of 330 to 470 pairs in the former and 30 in the latter. Further censuses conducted within Guánica Forest and adjacent available habitat and Susúa Forest and suitable adjoining private land in June and July 1984 and January 1985 resulted in the estimation of 324 pairs in the former (one singing bird per 8 ha above 75 m and one per 18.8 ha between 25 and 75 m) and 68 pairs in the latter (one bird per 24.5 ha north of Carretera del Bosque and one per 8.1 ha south of Carretera del Bosque) (Noble *et al.* 1986; which see for survey routes and partial results). The estimation of 324 pairs in Guánica Forest was similar to Kepler and Kepler's (1973) lower estimate of 330 pairs, but substantially less than their higher one of 470 pairs, a discrepancy Noble *et al.* (1986) believed was due to the survey method rather than real population size differences, although Kepler and Kepler's (1973) total estimate of 30 pairs in Susúa Forest was too low as they did not census the northern portion of the forest (see Noble *et al.* 1986). In summary, the total population size estimated by Kepler and Kepler (1973) was of 450 to 500 pairs in approximately 3,200 ha, 80% of the nightjars being in Guánica Forest, while Noble *et al.* (1986) and Vilella and Zwank (1987) estimated a total population of 665 "singing males" (see Remarks 3) in about 7,883 ha, with almost 50% of the total population in the Guánica and adjacent areas. Later estimates given by Vilella and Zwank (1988) are of about 670-800 pairs distributed over approximately 10,000 ha (see Remarks 4). Both in Guánica and Susúa Forests, highest nightjar density was one singing bird per 5 ha (Vilella 1989). Díaz Díaz (1984) suggested that before the Puerto Rican Nightjar could be considered to have "recovered", its population should rise to 600 pairs in Guánica

Forest, 400 pairs in the Guayanilla Hills, and 200 pairs in Susúa Forest; however, these figures appear to be above the carrying capacity of the available habitat according to Kepler and Kepler (1973) and Noble *et al.* (1986), who believed that populations in Guánica and Susúa Forests were at equilibrium and possibly at carrying capacity in all suitable public and private habitat. In the Guayanilla Hills rough estimations given by Kepler and Kepler (1973) were of 50-100 pairs on what they believed to be c.500 ha of suitable habitat, although Noble *et al.* (1986) estimated a population of 200 to 260 pairs (but see Remarks 3) on a total of c.1,300 ha. Later censuses conducted in this same area in 1985 and 1986 resulted in densities ranging from 0.04 to 0.12 nightjars per hectare with a total estimated number of 263 singing males (Vilella and Zwank 1987; see Remarks 5). The similar estimate of birds obtained by Kepler and Kepler (1973) and Noble *et al.* (1986) in the Guánica Forest suggests that the species has maintained its numbers for at least 15 years. The later searches which resulted in the discovery of further (previously unreported) areas (see Distribution; Remarks 6) included one individual in the Parguera Hills and five to seven in Sierra Bermeja (all individuals heard); the distribution in this section appeared to be scattered, with a few individuals limited to small fragments of suitable habitat (Vilella 1989).

**ECOLOGY** The Puerto Rican Nightjar currently inhabits the wooded tropical dry limestone forests of south-western Puerto Rico (Kepler and Kepler 1973; see Remarks 7). However, the species formerly inhabited the moist limestone and moist coastal forests of the northern lowlands of the island (for original forest-types see the maps in Kepler and Kepler 1973). Semi-deciduous vegetation consists of hardwood trees on top of limestone hills; important species include *Bourreria* sp., *Bursera simaruba*, *Bucida buceras*, *Acacia farnesiana*, *Swietenia mahagoni*, *Pisonia albida*, *Coccoloba microstachya*, *Colubrina arborescens*, *Exostema caribaeum*, *Thouinia portoricensis*, with the common shrubs *Croton humilis*, *Eugenia foetida* and *Lantana involucrata* (Kepler and Kepler 1973, Díaz Díaz 1984, Vilella and Zwank 1987). Furthermore, the Puerto Rican Nightjar is also found throughout the highly disturbed forest lands of the Guayanilla-Peñuelas region, wherever the canopy has been retained (F. J. Vilella *in litt.* 1992). No birds were detected below elevations of 25 m in the Guánica Forest during summer, but nightjars occur at low elevations in winter (see Noble *et al.* 1986). Kepler and Kepler (1973) believed that nightjars would not occur at altitudes below 75 m, but Noble *et al.* (1986) considered the limit to be about 25 m, below which they thought that nesting would not take place, probably because (a) steady winds have produced a stunted vegetation providing little cover for the species, (b) insect activity may be reduced under such circumstances, and (c) predation may be important below 25 m (feral cats and mongooses were frequently observed). However, further research in both sections of Guánica Forest (east and west of Guánica Bay) has shown that nightjars also occur at elevations near sea level throughout the year; reproduction can also occur below 100 m but small patches of taller forest with accumulated leaf-litter are required: two nests (out of 23) occurred below 100 m; one of these was located at 55 m elevation (Vilella 1989). No surface water or riparian habitat exists in Guánica Forest, and nightjars did not occur in the riparian habitat in Susúa (Kepler and Kepler 1973, Noble *et al.* 1986).

The Puerto Rican Nightjar captures flying insect prey by flying from perches well above the ground (see Kepler and Kepler 1973). Nesting occurs from late February to early July (Vilella 1989). Calling activity reaches peak levels in February (Kepler and Kepler 1973), eggs having been found from 28 February to 1 July (Kepler and Kepler 1973, Noble and Vilella 1986, Vilella 1989). One or two eggs are laid on the bare ground covered only by fallen leaves, and incubation is mostly performed by the male, in contrast to most members of the genus; in addition, an elaborate nest-relief ceremony was discovered, the only member of the genus for which it is known (Vilella 1989, Vilella and Zwank in prep.; also Kepler and Kepler 1973, Noble and Vilella 1986).

**THREATS** The mongoose *Herpestes auropunctatus*, introduced in 1877, has long been presumed to have extirpated the Puerto Rican Nightjar from those areas of its former range with sufficient rainfall and standing water to support mongooses (Noble *et al.* 1986), although this has not been proved and it appears to be the nightjar that is limited by the amount of suitable habitat (Vilella 1989, Vilella and Zwank in press b). Deforestation is the single most important factor affecting the species (Vilella and Zwank 1988). The coastal zone is under intense pressure for residential, industrial and recreational development, with the expected onslaught of people, cats, rats, mongooses and the danger of fire (AOU 1976, Vilella and Zwank 1988). Despite its protected area status, Guánica Forest is threatened by road construction, resort development and tremendous industrial expansion to the east and possibly to the west, and nightjars on

private land are less secure because much of it is being converted to other uses including goat and cattle raising (Kepler and Kepler 1973, Vilella and Zwank 1987, 1988, Noble *et al.* 1988). The species's present restricted range makes it very vulnerable to an expanding human population and natural or man-induced habitat changes (e.g. fires, clearings, parasites and diseases: Díaz Díaz 1984).

**MEASURES TAKEN** The Puerto Rican Nightjar has been declared endangered and is protected (Díaz Díaz 1984). Guánica, Susúa and Maricao Forests are public lands belonging to the Commonwealth of Puerto Rico, Guánica having also been designated a biosphere reserve; Guánica Forest includes two separate areas (2,759 ha east of Guánica Bay and 700 ha west of Guánica Bay) and the Susúa Forest includes 1,287 ha (Noble *et al.* 1986; see Remarks 8). It is estimated that 53% of the species's current range is protected in the Guánica and Susúa Commonwealth Forests (Vilella and Zwank 1988); but see Threats. Suitable habitat for the species throughout Puerto Rico and offshore adjacent islands was unsuccessfully searched between 1969 and 1971 (for localities and dates of these searches see Kepler and Kepler 1973). The present geographic range of the species has been delineated precisely, and field data have been transferred to maps using an electronic digitizer and planimeter (F. J. Vilella *in litt.* 1992).

**MEASURES PROPOSED** Further distributional studies are required in order to seek ways of protecting as many possible areas where the species is found. Private land on which the species occurs (i.e. Guayanilla and Parguera Hills, Sierra Bermeja, and the land adjacent to Guánica, Susúa and Maricao Forests and Ensenada) should be protected and managed for optimum benefit to the nightjars. Habitat destruction or modification other than for the management of the species should be prevented. Buffer zones around critical nesting or feeding areas must be delineated and new lands around present habitat protected immediately. Private owners of nightjar habitat should be contacted and encouraged to manage habitat which they control voluntarily. Regular population monitoring is needed for the immediate future to assess general population trends and the effects of management actions. Vilella and Zwank (1988) also recommended that public education and cooperation between government agencies and private landowners will help to ensure the continued existence of the Puerto Rican Nightjar.

**REMARKS** (1) The three known areas for the species (i.e. Guánica Forest, Susúa Forest and Guayanilla Hills), following the range extension given in Distribution, are better regarded as Guánica-Bermeja, Susúa-Maricao and Guayanilla-Peñuelas (F. J. Vilella *in litt.* 1992). (2) For a map of the census routes in the Guánica and Susúa Forests and a summary of the results in each route, see Kepler and Kepler (1973). (3) Although Kepler and Kepler (1973) and Noble *et al.* (1986) assumed each singing nightjar represented a breeding pair, Vilella and Zwank (1987) found that unmated males may also sing and thus referred to "singing males" rather than treating each singing nightjar as a breeding pair. (4) This estimation is based on total population counts from which an index of abundance was obtained (F. J. Vilella *in litt.* 1992). (5) A map showing the census routes and partial results can be found in Vilella and Zwank (1987). (6) Searches for the species in the areas from where the species has been recently reported (i.e. Sierra Bermeja and at Parguera Hills) between 1969 and 1970 were unsuccessful (see Kepler and Kepler 1973), but F. J. Vilella (*in litt.* 1992) has indicated that the discovery of the species in these areas was achieved with the additional help of playback recordings, an important aid not available to Kepler and Kepler (1973). (7) The vegetation in Susúa Forest would in the past have belonged to the "lower cordillera forest", but current vegetation there ("secondary scrub vegetation") is similar to the "dry limestone forest" in flora and structure (Kepler and Kepler 1973). (8) According to Noble *et al.* (1986) 240 ha of the Susúa Forest are not occupied by the nightjars, this comprising riparian and man-transformed habitat.