

Formerly widespread in various habitats on Puerto Rico and still so on adjacent Mona and Monito islands, this icterid has declined steeply and retreated into two areas on Puerto Rico, in the south-west and the east, having almost vanished in the latter; the total population is under 1,250, having been twice that in 1975. A range of threats, most notably cowbird brood parasitism, and measures to counter them, are identified.

DISTRIBUTION The Yellow-shouldered Blackbird is endemic to Puerto Rico (n nominate race) and Mona and Monito islands (race *monensis*) (Barnés 1945, Furniss 1983). The species's population is now concentrated in three centres, namely Mona and Monito islands, coastal south-western Puerto Rico and coastal eastern Puerto Rico (see the map in Post and Wiley 1976). On the mainland it once occurred throughout Puerto Rico, mainly in the lowlands (Post and Wiley 1976). On Mona and Monito island the species can still be found throughout (Furniss 1983, Pérez-Rivera 1983, Hernández-Prieto and Cruz 1987, 1989, Hernández-Prieto *et al.* in prep.). The localities on mainland Puerto Rico (coordinates from OG 1958) to which the species is currently confined are: (south-west population; see Remarks 1), in a narrow coastal zone about 35 km from Ensenada (17°58'N 66°56'W) to Boca Prieta (18°03'N 67°12'W); and (eastern population) Roosevelt Roads Naval Station (3,260 ha) south-east to Ceiba (18°16'N 65°39'W) (Post and Wiley 1976, 1977, Heisterberg and Núñez-García 1988, Wiley *et al.* 1991). However, during the mid- and late 1970s it was still reported from a few isolated localities (west to east; data from Pérez-Rivera 1980): San Germán (18°05'N 67°03'W), where 10-12 pairs nested in 1975 (not present in 1982: Post and Wiley 1977, Wiley *et al.* 1991); Estación Experimental Agrícola de Isabela (18°30'N 67°01'W); Barranquitas (18°11'N 66°18'W), where five birds were observed in July 1979; university campus at Humacao (18°09'N 65°50'W); Toita de Cayey (Cayey at 18°07'N 66°10'W), where a bird was feeding a juvenile in November 1979; mangroves near Bacardí, Cataño (18°27'N 66°07'W), where a blackbird was feeding a juvenile Shiny Cowbird *Molothrus bonariensis* in July 1979; Caño de Martín Peña (18°26'N 66°05'W), where a pair was nesting in July 1979 and several nests were found in October 1979; near río Gurabo (18°17'N 66°01'W). Further marginal nesting localities as indicated by Post and Wiley (1976) included: Boquerón (18°02'N 67°10'W), Boca Prieta, and Carolina (18°23'N 65°57'W).

POPULATION The Yellow-shouldered Blackbird was an abundant and widespread species until the 1940s (Taylor 1864, Post and Wiley 1976), since when its numbers have declined precipitously, probably coincidentally with the arrival of the Shiny Cowbird in Puerto Rico (Post and Wiley 1976, 1977, Wiley *et al.* 1991). The south-western population of Yellow-shouldered Blackbirds was estimated at only about 300 individuals in 1982; censuses of the species's roosts conducted in winter (December to February) in 1974-1975 and 1981-1982 in the south-west population (mainly in Boquerón Forest: Wiley *et al.* 1991) showed that it declined by about 80% in the intervening period (1,663 birds for the former census and 266 for the latter); census results were as follows (numbers in brackets refer to the 1974-1975 and 1981-1982 counts respectively): Pita Haya (1,050, 165); La Parguera (156, 30); Bahía Montalva (284, 14); Bahía Sucia (147, 52); Boca Prieta (9, 0); Boquerón (17, 5) (Wiley *et al.* 1991; see Remarks 1). Subsequent censuses in communal roosts resulted in 343 birds in 1985, 146 in 1986 and 240 in 1987 (McKenzie and Noble 1989). However, in October 1987 approximately 300 blackbirds were counted in two separate mixed-species flocks of icterids c.500 m north-east of Punta Pita Haya in south-west Puerto Rico (McKenzie and Noble 1989; see Remarks 2). About 200 Yellow-shouldered Blackbirds were estimated at Roosevelt Roads in 1975-1976 (Post and Wiley 1976); by 1982, the population at this site had declined to six pairs ("97% decline"; in fact 94%) and in 1985 and 1986 only two nesting pairs were known there (Wiley *et al.* 1991); in this same area Heisterberg and Núñez-García (1988) estimated a total population of at least 31 birds in 1986 (16 adults, eight fledglings and seven of unknown age) and thus believed that this population is perilously close to extirpation. The blackbird population on Mona Island appears to be stable and has not suffered cowbird parasitism (Pérez-Rivera 1983, Hernández-Prieto and Cruz 1987, 1989). Kuns *et al.* (1965) estimated around 15 individuals per c.50 ha on the plateau in the early 1950s. Pérez-Rivera (1983) estimated at least 500 to 600 individuals on Mona in the late 1970s and between 220 and 300 in the early 1980s. A year-round (1987-1988) and several breeding season studies have estimated the minimal population to fluctuate between 400 and 908 individuals (Hernández-Prieto and Cruz 1987, 1989). Thus, the total population of the Yellow-shouldered Blackbird in the period 1982-1986 stood between 771 and 1,212 birds, these figures contrasting with an estimated population of 2,400 birds for

1975 (Post and Wiley 1976, Wiley *et al.* 1991).

ECOLOGY Given its former distribution throughout Puerto Rico, the Yellow-shouldered Blackbird must have inhabited many different habitats types (for original habitats in the island see, e.g., Kepler and Kepler 1973). According to Post and Wiley (1976) and Furniss (1983), the species is known to nest in eight habitat types: (1) mangrove pannes and salinas in the coastal mangrove zone, the trees in question being primarily black mangrove *Avicennia germinans*, red mangrove *Rhizophora mangle*, white mangrove *Laguncularia racemosa* and button mangrove *Conocarpus erectus*; (2) red mangrove cays (100-1,000 km²) 200-500 m offshore, where aggregates of 2-6 pairs may nest; (3) black mangrove forest in the east, where birds nest near the fringe of the forest by small pools or clearings; (4) lowland pastures in the south-west, where birds nest usually 6-9 m up and often close together in large deciduous trees (mostly 11-14 m high oxborn bucida *Bucida buceras*) in pastures at the edge of the mangroves; (5) suburban San Germán, where blackbirds nested on the campus of the university 12-15 m up among the fronds of 16-18 m royal palms *Roystonea borinquena* planted around the buildings (Furniss 1983 reported other such sites); (6) coconut *Cocos nucifera* and royal palm plantations, where blackbirds build nests in the axis of the trees, particularly at Boquerón, La Paraguera and Boca Prieta; (7) the dry thorny cactus scrub (dominated by *Philosocereus royenii*) on the central plateau of Mona Island; and (8) coastal cliffs surrounding Mona Island, where nests are placed on ledges or in crevices and in water-surrounded rocks (for this see also Pérez-Rivera 1983).

In Puerto Rico the Yellow-shouldered Blackbird mainly forages in the upper strata of trees, obtaining arthropods by probing and gleaning epiphytes, leaf-clusters and the surfaces of branches and trunks, but also feeds on the ground, where it mostly gathers vegetable material rather than arthropods; the bulk of the diet consists of arthropods (Lepidoptera, Araneae, Orthoptera, Homoptera, Coleoptera, Hymenoptera, Arachnida) (Post 1981, which see for a more detailed inventory of prey items and foraging behaviour). In Mona Island the species forages in monospecific flocks, mainly in the lower strata of the vegetation (Barnés 1946, Hernández-Prieto and Cruz 1987, 1989); birds there have been observed foraging on nectar of a variety of plants such as *Inga laurina*, *Aloe vera*, *Harrisia portoricensis*, *Tabebuia heterophylla*, *Stenocereus histrix*, on fruits and seeds, e.g. *Cissus trifoliata*, *H. portoricensis*, *Reynosia uncinata*, *Paspalum rupestre*, *Bursera simaruba*, *Panicum maximum*, *Lantana involucrata*, *Melocactus intortus*, *Ficus citrifolia*, *Pilosocereus royenii*, *Metopium toxiferum* (Danforth 1926, Furniss 1983, Hernández-Prieto and Cruz 1987, 1989); molluscs *Cepholis gallopavonis*, *Cerion monensis* and *Drymaeus elongatus*, the spider *Argiope argentata*, the homopteran *Icera purchasi*, coleopterans, lepidopterans, orthopterans and even “iguanids” (presumably carcasses or hatchlings) have also been recorded (Kuns *et al.* 1965, Hernández-Prieto and Cruz 1987, 1989). Large foraging flocks mixed with other icterids (e.g. Greater Antillean Grackle *Quiscalus niger*, Shiny Cowbird) have been reported feeding in mesquite *Prosopis pallida* woodland and on caterpillars *Mocis latipes* taken from the blades and culms of *Cenchrus ciliaris* and *Bothriochloa pertusa* (McKenzie and Noble 1989).

The breeding season runs from April (in eastern Puerto Rico) and May (in the south-west) to September, but appears to be somehow regulated by the first spring rains (Post and Wiley 1977, Post 1981); however, Pérez-Rivera (1980) reported that breeding activity may begin as early as February on Mona Island and could last through to November depending on the rainfall pattern during the year. The average clutch-size varies between one and four (Barnés 1945, Post 1981, Pérez-Rivera 1983, Hernández-Prieto and Cruz 1989, Hernández-Prieto *et al.* in prep.). Of 202 nests inspected at Boquerón Forest from 1973 to 1982, 39% were open nests and 61% were in natural or provided cavities and boxes; an overall breeding success (“successful” nests from the standpoint of nest predation or desertion were those fledging at least one host or cowbird chick) of 51% (102/202) was recorded (Post and Wiley 1977, Wiley *et al.* 1991).

THREATS Many factors have contributed to the Yellow-shouldered Blackbird's decline, including disease (see Remarks 3), loss of feeding and nesting habitats, nest predation by the Pearly-eyed Thrasher *Margarops fuscatus* and introduced mammals (e.g. rats, cats, mongooses), but the major cause of decline is the extensive parasitism of nests by the Shiny Cowbird, a recent invader of West Indian islands, recorded for the first time in Puerto Rico in 1955 (Post and Wiley 1976, 1977, Post 1981, Pérez-Rivera 1983, Cruz *et al.* 1985, Wiley *et al.* 1991). Shiny Cowbirds, although detected on Mona since the early 1970s, have not yet been found parasitizing this population (Furniss 1983, Hernández-Prieto and Cruz 1989,

Hernández-Prieto *et al.* in prep.). The decrease of the Yellow-shouldered Blackbird in Boquerón Forest and surrounding areas (see Population) was accompanied by an increase of Shiny Cowbirds during the same interval by about 20% (Wiley *et al.* 1991); furthermore, 95% of blackbirds were parasitized from 1973 to 1982 at this site, and the same percentage was determined at Roosevelt Roads between 1975 and 1982 (Wiley *et al.* 1991). The occurrence of nest-mites *Ornithonyssus bursa* and *Androlaelaps casalis* in both natural and artificial cavities and nest-boxes (no differences were found) might lead to premature fledging and to adult desertion (see Wiley *et al.* 1991). Mangroves are particularly vulnerable to exploitation, and large areas have already been destroyed in Puerto Rico (Post and Wiley 1976). The population on Mona Island appears to have avoided predation by introduced mammals (rats and cats) through the use of inaccessible nest-sites (see Ecology); however, natural events such as “storm waves”, hurricanes and severe periodic droughts may be responsible for fluctuations in numbers there but these cannot be considered threats in themselves (Pérez-Rivera 1983).

MEASURES TAKEN The species has been recognized as having endangered status by both Federal and Commonwealth of Puerto Rico conservation agencies and thus it receives official protection (King 1978-1979, Wiley *et al.* 1991). The Boquerón Commonwealth Forest, where the blackbirds are now concentrated, is protected by the Department of Natural Resources, and since 1977 the area has been patrolled and the destruction of mangroves and the invasion of cays by squatters has been stopped (Wiley *et al.* 1991). This accomplishment is particularly important in the case of the offshore cays, because they provide the only blackbird habitat that is still relatively cowbird-free (Wiley *et al.* 1991). In 1980 the U.S. Navy, in cooperation with the Fish and Wildlife Service, established a zoning plan for the Roosevelt Roads Naval Station to minimize the impact of their activities on the Yellow-shouldered Blackbird (Furniss 1983; see also Remarks 6 under West Indian Whistling-duck *Dendrocygna arborea*). The species and its habitat receive protection under various Federal and Commonwealth laws which prohibit the disturbance, molesting and capturing of the species, and the disturbance or destruction of mangroves; the Mona Island population receives complete protection from habitat destruction from the Department of Natural Resources personnel on Mona (Furniss 1983); the personnel regularly provide fresh water to blackbirds in that area (E. Hernández-Prieto *in litt.* 1992).

In 1975 conservation techniques to reduce cowbird parasitism and to improve Yellow-shouldered Blackbird breeding success and productivity were developed; this included the instalment of nest-boxes and “modified natural cavities” adjacent to suitable nesting habitat in both Boquerón Commonwealth Forest and Roosevelt Roads Naval Station (Wiley *et al.* 1991; see Remarks 4). Nest success, productivity and parasitism rates were also studied before cowbird removal (Wiley *et al.* 1991). Only 1% of all nests found were in artificial cavities, but nest-boxes proved more successful, with 51% of nests at Boquerón Forest placed in them (Wiley *et al.* 1991). However, cowbirds also parasitized all types of box that were used by the blackbirds, and it is unlikely that a nest-box can be devised that blackbirds will accept but which cowbirds will not enter, partly because the two species are approximately the same size (see Wiley *et al.* 1991). Parasitized artificial cavity nests have, however, the potential advantage of producing more host young than do parasitized open nests, because the incidence of predation is lower than at open sites (Post and Wiley 1977, Wiley *et al.* 1991); furthermore, pairs using open nests fledged fewer blackbird chicks than did pairs using boxes and natural cavities, and fewer cowbirds fledged from parasitized boxes than from open nests in Boquerón Forest (see Wiley *et al.* 1991). An additional advantage of artificial nest-sites is that they can be placed in sites away from trees and fitted with predator-guards; roof rats *Rattus norvegicus* are the main predators of hole-nesting passerine birds in Puerto Rico (Wiley *et al.* 1991). Rats also benefited from the nest-boxes (30% of which were occupied by them in 1977), but this figure dropped to an average of 6% between 1978-1981 after boxes were protected with rat-guards (Wiley *et al.* 1991). Artificial nest cavities can also create new breeding localities in areas adjacent to traditional nesting habitat, such as salt-flats that have no trees (Wiley *et al.* 1991). Larger nest-boxes were also erected for use by other bird species, with the result that competition for nest-sites was reduced (see Wiley *et al.* 1991). The removal experiments of Shiny Cowbirds showed that this measure can improve the breeding success of the blackbirds: nest success in 1975-1982 at Roosevelt Roads was 35%, but increased to 71% during 1983-1986 after removal measures were taken (see Wiley *et al.* 1991). Further removal of cowbirds was conducted in Roosevelt Roads during two consecutive breeding seasons in 1985 and 1986 (Heisterberg and Núñez-García 1988).

MEASURES PROPOSED Mangrove has proved to be of great importance for the species as it constitutes the main breeding habitat of the remaining population, and coastal south-western Puerto Rico contains one of the last extensive, undisturbed tracts of this habitat (Post and Wiley 1976). The habitat being used by the blackbirds in south-western Puerto Rico is believed to belong principally to the Department of Natural Resources, but boundary lines are poorly defined; ownership needs to be determined in order to ensure that all important areas are protected (Furniss 1983).

No nest-boxes should be erected for the species without rat-guards, and some natural cavities (e.g. in trees far enough from other trees that no corridors exist for rats) can and should also be fitted with rat-guards (see Wiley *et al.* 1991). Larger nest-boxes should also be provided in order to reduce interspecific competition for nest-sites. It is necessary to maintain rat-guards and nest-boxes (by removing old nest material) in good condition (see Remarks 5); nest cavities should be treated against mite infestation (see Cruz and Nakamura 1984, Wiley *et al.* 1991). Other arthropods, such as scorpions, wasps and bees, should be destroyed, as they reduce the attractiveness of the nest-boxes to blackbirds (see Wiley *et al.* 1991). Wiley *et al.*'s (1991) recommendation of providing food in the vicinities of the nesting colonies in order to keep blackbirds in the mangrove zone should be carefully considered, as it might also attract more cowbirds to the area. Wiley *et al.* (1991) suggested that any feeding stations would have to be protected from rats. A campaign to eliminate or at least reduce rats near nesting colonies is urgently needed; bird-proof (covered) bait-boxes and rodent traps should be placed in the nesting areas in order to achieve this goal (Cruz and Nakamura 1984), but further experiments in rat control are required.

Control of the Shiny Cowbird population by removal of birds should be conducted around blackbird nesting colonies and adjacent areas (Heisterberg and Núñez-García 1988, Wiley *et al.* 1991). Heisterberg and Núñez-García (1988) found that cowbird removal in Roosevelt Roads in 1985 was not followed by ready replacement by outside cowbirds, as 1986 captures rates were greatly reduced. Similar results were previously obtained in the south-west population, so Wiley *et al.* (1991) believed that cowbird removal has excellent potential for improving Yellow-shouldered Blackbird reproductive success, and should be continued for several years to determine its efficacy. Removal of cowbirds should be started in April and continued throughout the breeding season (Cruz and Nakamura 1984). Although trapping might not be the most effective means of controlling cowbird parasitism on the native avifauna, it is adequate at least as a stop-gap measure until less labour-intensive means can be devised (Wiley *et al.* 1991). More investigation is needed to determine the impact of disease on blackbirds (Furniss 1983).

Periodic censuses should be conducted in order to monitor the trends of the species in the remaining three populations. Communal roosts have proved to be good for censusing the total population in south-western Puerto Rico, but locating and estimating numbers of Yellow-shouldered Blackbirds in foraging concentrations can provide supplementary data to censuses, as shown by McKenzie and Noble (1989). An ongoing long-term study on Mona Island should be maintained to determine possible threats and more data on the breeding biology of the species. Hernández-Prieto and Cruz (1987, 1989) proposed that at least two (hopefully four) censuses that cover all of Mona, and well spaced throughout the year, should be carried out by the Department of Natural Resources, USFWS and other interested researchers; they also proposed that during the breeding season the Department of Natural Resources should open a second station in or at the lighthouse to ensure that (1) hunters (for wild pigs and goats) do not disturb the breeding of the blackbirds, and that (2) a close monitoring of areas identified as active nesting sites in the eastern part of the island is carried out, perhaps with limited access to visitors; furthermore they agree that efforts to eliminate rats and cats from Mona should be made. A study of the phylogenetic relationship of the two subspecies should be undertaken (E. Hernández-Prieto *in litt.* 1992; see Remarks 6).

REMARKS (1) Maps showing the species's current distribution, including nesting areas and roost sites, are in Post and Wiley (1976) and Post (1981), Pérez-Rivera (1983) and Hernández-Prieto and Cruz (1989). (2) McKenzie and Noble (1989) suggested that locating and estimating numbers of Yellow-shouldered Blackbirds in such foraging concentrations could provide supplementary data to censuses taken at communal icterid roosts. (3) Whittaker *et al.* (1970) reported the nematode *Acuaria* in the blackbird at Rio Piedras, and Post and Wiley (1976) noted the incidence of fowl pox in the species: in a total of 305 birds, they found 57 (18.7%) to have tumours, although the magnitude and consequences for the species are not known. Kuns *et al.* (1965) reported no parasites or virus for the blackbirds at Mona. (4) Between 1975 and 1977, 51 nest-boxes and 12 "modified natural cavities" were set up at Roosevelt Roads, and from 1977 to 1982 189 and five at Boquerón Forest (for more details see Wiley *et al.* 1991). (5) Cruz and

Nakamura (1984) found that boxes that were not maintained or cleaned were not used by blackbirds, and indicated that rat-guards must be cleaned or replaced on a regular basis in order to maximize their effectiveness against predators. (6) Presumably this would be in order to judge whether introduction of the Mona form to the mainland might be acceptable.