ELSEVIER

Biological Conservation 108 (2002) 259–263

BIOLOGICAL
CONSERVATION

www.elsevier.com/locate/biocon

Short note

Increasing nest success in the yellow-shouldered blackbird *Agelaius xanthomus* in southwest Puerto Rico

Ricardo López-Ortiz[a,*], Eduardo A. Ventosa-Febles[a], Leonard R. Reitsma[b], Derek Hengstenberg[b], William Deluca[b]

[a]*Departamento de Recursos Naturales y Ambientales de Puerto Rico, Negociado de Pesquería y Vida Silvestre, PO Box 491, Boquerón, Puerto Rico 00622*

[b]*New England Institute for Landscape Ecology, RR2 Box 38H, Canaan, NH03741, USA*

Received 2 August 2000; received in revised form 15 January 2002; accepted 12 March 2002

Abstract

The yellow-shouldered blackbird, *Agelaius xanthomus*, is endemic to Puerto Rico and Mona Island, and endangered since 1976 mainly because of brood parasitism by the shiny cowbird, *Molothrus bonariensis*. In 1984 an artificial nest structures program was initiated, combined with the removal of *M. bonariensis*, to improve the reproductive success of *A. xanthomus*. The nesting success was high in artificial nest structures. From 1996 to 1999, 22 out of 804 nests in artificial structures and one of 203 nests in natural substrates were parasitized. The use of natural substrates increased from less than 1% (1996) to 35% (1999). Predation was the main cause of egg and chick loss and was high in natural substrates. The increase in the use of natural substrates for nesting is a trend favorable for the recovery of this species. Continued management is still needed to augment the breeding population and reproductive output.

Keywords: *Agelaius*; Brood parasitism; *Molothrus*; Nests; Puerto Rico

1. Introduction

The yellow-shouldered blackbird, *Agelaius xanthomus*, endemic to Puerto Rico and Mona Island, has been on the US Fish and Wildlife Service endangered species list since 1976 (US Fish and Wildlife Service, 1976). This species is classified as endangered, according to the criteria for listing species on the International Union for Conservation of Nature Red List (IUCN, 2001). Based upon roost counts during the nonbreeding season, the *A. xanthomus* population declined in southwest Puerto Rico from 1663 individuals (1974–1975) to 266 (1981–1982; Wiley et al., 1991). It is endangered due to a combination of factors including habitat loss, shiny cowbird (*Molothrus bonariensis*) brood parasitism, and nest predation by introduced species (Wiley et al., 1991). Nest piracy in open spaces by the more aggressive Caribbean martin, *Progne dominicensis*, also has negatively affected the reproductive success of *A. xanthomus* (Hirsch, 1990). The biology of *A. xanthomus* has been described (Post and Wiley, 1976, 1977; Post, 1981; Mackenzie and Noble, 1989; Wiley et al., 1991). Post and Wiley (1976) described the nesting habitats of *A. xanthomus* as mud flats, salinas, offshore red mangrove cays, black mangrove forests, lowland pastures, dry costal forests, suburban areas, coconut plantations, and coastal cliffs. The distribution of the populations of this species was described by Cruz-Burgos (1999). The largest population is found within the mangrove habitat at the Boquerón State Forest, located in southwestern Puerto Rico.

In 1984 the Puerto Rico Department of Natural and Environmental Resources, through a cooperative agreement with US Fish and Wildlife Service, initiated an artificial nest structures program in the Boquerón State Forest to improve the reproductive success of this species by preventing brood predation and parasitism. This program was complemented by the trapping and elimination of *M. bonariensis* near feeding and nesting areas of blackbirds as recommended by Wiley et al. (1991). From 1989 to 1995, almost every nest of *A. xanthomus* was in artificial structures and few nests were

* Corresponding author. Tel.: +1-787-254-3770; fax: +1-787-851-7440.

E-mail address: ysbldner@caribe.net (R. López-Ortiz).

0006-3207/02/$ - see front matter
PII: S0006-3207(02)00122-2

known to occur in natural substrates in southwest Puerto Rico, although little effort was invested in searching for natural nests. From 1996 to 1999 the Department of Natural and Environmental Resources, the New England Institute for Landscape Ecology, and US Fish and Wildlife Service gathered nesting data in natural and artificial substrates. In this paper we present updates on the progress of the program in increasing the number of *A. xanthomus* nesting in natural substrates.

2. Materials and methods

We searched the Boquerón State Forest (municipality of Cabo Rojo and Lajas) and private lands along the coast of both municipalities for yellow-shouldered blackbird natural nesting (Fig. 1). These localities were selected based on their proximity to the artificial nest structures area, the likely source of pairs constructing nests in natural substrates. Specific areas searched were based upon habitat characteristics and localities reported in the literature. Once a nest was detected, its status was recorded and the nest was monitored every 2–3 days whenever possible, with minimal disturbance to nests (no management). Nests found high in trees were reached with a "sky-master truck," a "tree bicycle" (Swiss tree grippers), an aluminum ladder, or climbing equipment. Nests in black mangroves required no climbing gear for successful monitoring, but in certain cases required the use of a mirror connected to a telescoping pole.

Concurrently, 229–251 artificial nest structures were visited once per week. Each artificial nest structure consisted of a fence post with a 10-cm diameter polyvinyl chloride (PVC) elbow attached at the top. Inside the PVC elbow, and close to the lower end, a wire basket was built to prevent the nest material from falling out. A strip of wire mesh (3 cm wide and 30 cm long) was attached to the entrance of the PVC elbow to provide traction for *A. xanthomus* adults and fledglings. An inverted tin cone (50 cm in diameter) was attached to the post 20 cm below the PVC elbow to prevent rat predation. These structures were placed in mud and salt flats and painted a natural brown color. Manipulation of nests found in artificial nest structures consisted of treatment with acaricide (5% Sevin dust Carbaryl Insecticide), removal of cowbird eggs and banding of every nestling blackbird.

The same method to monitor activity, success, egg and chick loss, and parasitism was used in every completed blackbird nest (in both artificial and natural substrates). Only nests with at least one egg were considered to be active. A successful nest was one with at least one fledgling. Percentage of successful nests was based on the ratio of successful nests to the total number of active nests. For multiple clutches, each clutch was considered a separate nesting event. Predation was unlikely to be observed, but some predators and evidence of predation were recorded. Therefore, predation was assumed to have occurred if eggs were missing or broken or if chicks were missing even when direct documentation of the event of predation was not possible. Possible causes for unsuccessful nests were grouped as egg loss due to predation (broken and missing eggs) or abandonment (unpunctured eggs more than 2 weeks old and without parents in the vicinity), chick loss due to

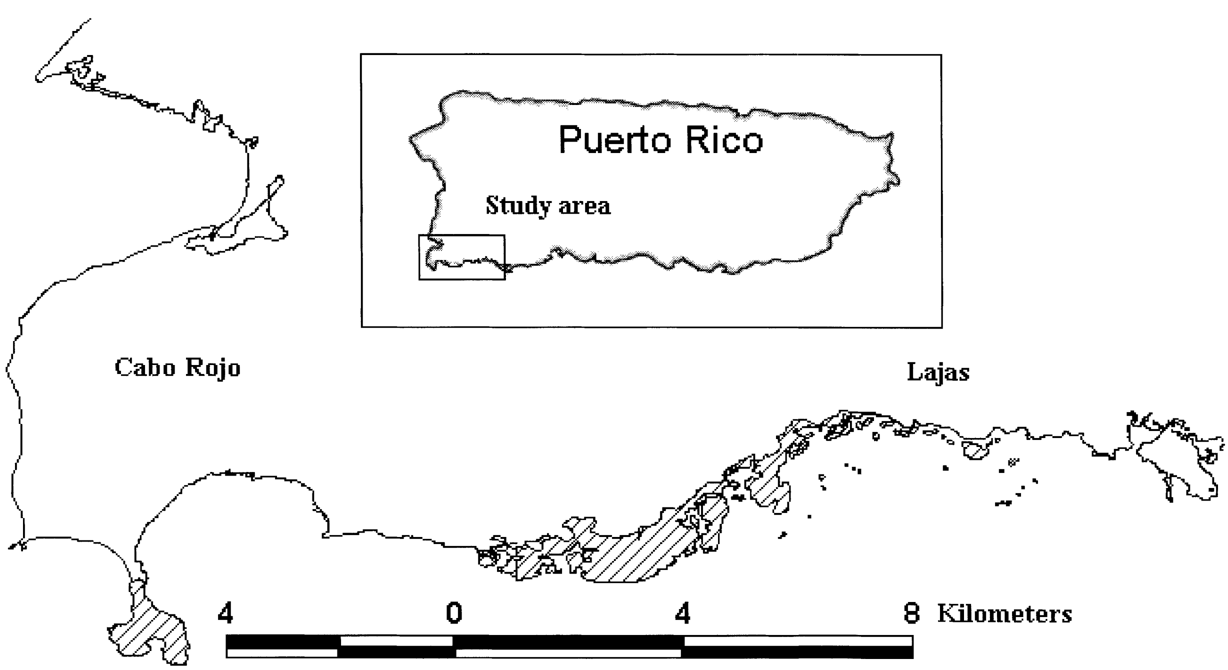

Fig. 1. The Study area. The Boqueron State Forest (municipality of Cabo Rojo and Lajas) is presented with a stripped pattern.

predation (missing chicks), and abandonment or starvation (chicks found dead).

The program SPSS (1999) for Windows was used for statistical analyses and significance was set at the 0.05 level. We used Fisher's Exact Test to compare artificial structures with natural substrates.

3. Results

An increase in the use of natural substrates was found during the last 4 years from less than 1% (1996) to 35% (1999; Fig. 2). Almost every nest found in natural substrates was built as an open-cup nest and only four nests were found in natural cavities. Nest data are presented in Table 1.

Nests in artificial structures were 17% more successful than nests found in natural substrates (Fisher's Exact Test: $X^2=12.342$, df = 1, $P=0.001$). There was 31% more natural substrate nests with egg loss (Fisher's Exact Test: $X^2=25.474$, df = 1, $P=0.001$). The main cause of egg loss was predation in both substrates with no significant difference between their percentages (Fisher's Exact Test: $X^2=2.001$, df = 1, $P=0.198$). There was 30% fewer nests with chick loss in artificial structures compared to natural substrates (Fisher's Exact Test: $X^2=24.076$, df = 1, $P=0.001$). The main cause of chick loss was also predation with no significant difference between nest substrates (Fisher's Exact Test: $X^2=0.826$, df = 1, $P=0.570$). Nests parasitism was similarly low for both nest substrates (Fisher's Exact Test: $X^2=1.771$, df = 1, $P=0.351$).

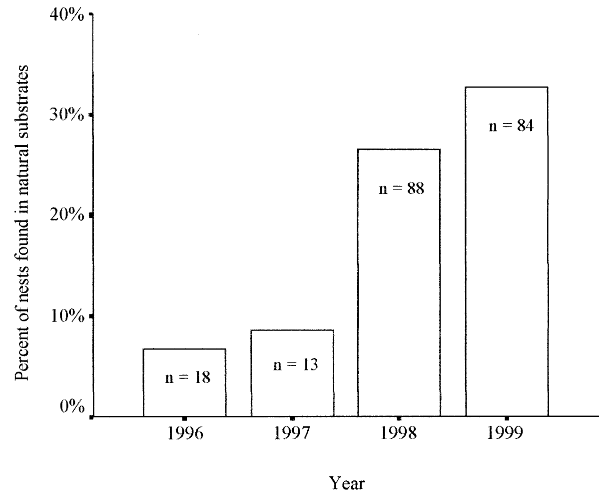

Fig. 2. Percentage of the total nests that were found in natural substrates each year.

4. Discussion

The increased in the use of natural substrates for nesting during the last 4 years, reveal the success of the artificial nest structure program. The nesting success documented in this study in artificial structures was the highest to date for this species (65%). Yellow-shouldered blackbird nests found in cavities have a greater nesting success, fledgling/egg ratio, and egg hatched/egg laid ratio (Post and Wiley, 1977). Wiley (1985) reported an average success of 39% (26/66) for *A. xanthomus* in southwest Puerto Rico. Post and Wiley (1977) reported a maximum success of 58% (11/19) in offshore nests and a nesting success of 63% (10/16) in offshore open nests not parasitized by cowbirds.

The success in artificial structures was significantly greater than in natural substrates mostly due to the management of the artificial structures aimed at reducing predation of eggs and chicks, and eliminating ectoparasites. The greater success in artificial structures indicates that the management is successfully enhancing reproduction. Nevertheless, the nesting success in natural substrates was high (48%) considering the endangered status and history of this species and compared to similar species. As an example, a 31% nesting success was reported in Ohio for the red-winged blackbirds, *Agelaius phoeniceus* (Dolbeer, 1976), a non endangered species.

The cowbird removal program detailed by Wiley et al. (1991) appear to be decreasing the brood parasitism in *A. xanthomus* nests of southwestern Puerto Rico. The increase in the use of natural substrates for nesting also suggests that *A. xanthomus* may not need artificial structures once cowbirds have been removed. Wiley (1985) reported that in mangrove habitats of southwest Puerto Rico between 1975 and 1981, 71% (5/7) of the resident non raptorial land bird species and 89% (59/66) of *A. xanthomus* nests were parasitized by cowbirds. In 1982, 100% ($n=44$) of *A. xanthomus* nests examined in mangrove habitats of the Boquerón State Forest and the Roosevelt Roads Naval Station (in the eastern end of Puerto Rico) were parasitized by the *M. bonariensis* (Cruz et al., 1985). In our study only one parasitized natural nest was found. In 4 years, parasitism was found only during 1998 in 22 of 228 active nests (one egg per parasitized nest) in artificial nest structures. Davis (1942) in a histological study, shows that *M. bonariensis* laid eggs in clutches of as much as five eggs. Therefore, those eggs were probably laid by the same small flock of cowbirds.

As brood parasitism had a negligible effect on nest success (because parasitism either was not found or was eliminated in the egg stages), the difference in success between nest substrates was caused by the difference in egg and chick loss mainly by predation. Wiley (1985) reported that 47% of 977 nests (of 19 resident non raptorial land bird species in mangroves of southwest Puerto Rico) failed and 61% of these failures were attributed to predation and 33% to desertion.

Table 1
Number of active, successful and parasitized nests, and the nests with egg and chick loss for each year in artificial structures (numerator) and natural substrates (denominator)[a]

Nests	1996	1997	1998	1999	Mean
Monitored	238/5	138/12	243/81	172/79	
Active	220/4	134/11	228/49	156/56	
Successful	154/2	88/5	132/22(43)	108/26	
Successful (%)	70/50	66/45	58/51	69/46	65/48
With egg loss	136/2	38/4(6)	100/14(23)	45/35(41)	
With egg loss (%)	62/50	28/67	44/61	29/85	43/74
With egg loss due to abandonment	28/0	11/1	11/4	18/5	
With egg loss due to abandonment (%)	21/0	29/25	12/17	41/12	21/18
With egg loss due to predation	108/2	27/3	89/10	27/30	
With egg loss due to predation (%)	79/100	71/75	88/83	59/88	79/82
With chicks	157/3	103/6	159/20	117/27	
With chick loss	8/1	31/4	48/8	32/16	
With chick loss (%)	5/33	30/67	30/40	27/59	22/52
With chick loss due to abandonment	1/1	7/0	8(47)/0	5/2(15)	
With chick loss due to abandonment (%)	12/100	23/0	17/0	16/13	18/11
With chick loss due to predation	7/0	24/4	39(47)/8	27/13(15)	
With chick loss due to predation (%)	88/0	77/100	83/100	84/87	82/89
Parasitized	0/0	0/0	22/0	0/1(54)	
parasitized (%)	0/0	0/0	10/0	0/2	3/1

[a] In some cases a number in parentheses is given representing the number of nests surveyed in such case.

Some factors that historically have contributed to *A. xanthomus* decline are nest predation by the pearly-eyed thrasher, *Margarops fuscatus*, and introduced mammals (Post and Wiley, 1976). Rats, *Rattus rattus* and *R. norvegicus*, are the main predators of hole-nesting passerine birds in Puerto Rico (Wiley et al., 1991). Predation by rats was usually evident and sometimes rats were found using nests as dens. Rats used modified cavities in trunks of trees as nests and shelter (Wiley et al., 1991). Predation by rats was greatly diminished in artificial structures by metal cones. Therefore, predation in these structures was mainly due to avian predators. During this study, a great egret, *Casmerodius albus*, was observed following a yellow-shouldered blackbird fledgling. Also, other possible predators that were seen near the structures were smooth- billed ani, *Crotophaga ani*; mangrove cuckoo, *Coccyzus minor*; yellow-billed cuckoo, *Coccyzus americanus*; black-crowned night-heron, *Nycticorax nycticorax*; yellow-crowned night-heron, *N. violaceus*; osprey, *Pandion haliaetus*; and red-tail hawk, *Buteo jamaicensis*. The greater predation found in natural substrates could be caused by rats; domestic cats, *Felis catus*; and avian predators not found near the artificial structures but found in La Parguera and Boquerón (i.e. *M. fuscatus*). Wiley (1988) found that more chicks fledge from cavities than open nests, and possibly this difference arises from the lower predation rates (primarily from *M. fuscatus*) at cavity nests.

Although *A. xanthomus* is still on the endangered species list, its current reproductive success is relatively high. The high nesting success in artificial nest structures may be effective in helping this species recover. Parasitism rates have fallen from 100% in 1982 (Cruz et al., 1985) to less than 3% in southwest Puerto Rico (overall average from 1996 to 1999 in both substrates), probably due to a decrease in the local cowbird population due to trapping and egg removal. The increase in the use of natural substrates for nesting is a trend favorable for the recovery of this species, but predation was high in natural substrates. Therefore, the artificial nest structures are the principal source of new individuals to the southwest population and continued management will be needed to further increase the breeding population and reproductive output.

Acknowledgements

We are grateful to Marelisa T. Rivera for her commitment to the endangered species of Puerto Rico. Her support was vital in the achievements alluded to in this paper. Thanks to Susan Silander, James P. Oland, Miguel A. García, and José L. Chabert for sponsoring this project. We are grateful to those who helped us collect field data: Verónica Acevedo, Daniel Brunetti, José Camacho, José A. Cruz-Burgos, Verónica Córdova, Arnaldo Falcón, Maniel Fernández, Roberto López-Ortiz, Gilberto Puentes, Rolando Ortiz, Brian Ramos and Ilia Velásquez-Vega. Additional improvements to the manuscript were suggested by Julio E. Cardona, Carlos A. Delannoy, Annette Díaz-Rodríguez, Allen R. Lewis and three anonymous reviewers. This work was supported by the Department of Natural and Environmental Resources of Puerto Rico and the United States Fish and Wildlife Service, Boquerón Field Office.

References

Cruz, A., Manolis, T. and Wiley, J.W. 1985. The shiny cowbird: a brood parasite expanding its range in the Caribbean region. In Neotropical Ornithology (P.A. Buckley, M.S. Foster, E.S. Morton, R.S. Ridgely and F.G. Buckley, Eds.). Ornithological Monographs No. 36.

Cruz-Burgos, J.A., 1999. Movements, activity patterns and habitat use of the endangered yellow-shouldered blackbird [*Agelaius xanthomus xanthomus* (Sclater)] in southwestern Puerto Rico. Unpublished MS thesis, University of Puerto Rico, Mayagüez, Puerto Rico.

Davis, D.E., 1942. The number of eggs laid by cowbirds. Condor 44, 10–12.

Dolbeer, R.A., 1976. Reproductive rate and temporal spacing of nesting of red-winged blackbirds in upland habitat. Auk 93, 343–355.

Hirsch, R., 1990. Choice of artificial nest structures by the yellow-shouldered blackbird, *Agelaius xanthomus*. MS thesis, Yale School of Forestry and Environmental Studies, New Haven, CT.

IUCN, 2001. Red list categories and criteria: Version 3.1. IUCN Species Survival Commission. IUCN, Gland, Switzerland and Cambridge, UK.

Mackenzie, P.M., Noble, R.E., 1989. Notes on a large foraging concentration of the endangered yellow-shouldered blackbird (*Agelaius xanthomus*) in southwestern Puerto Rico. Caribbean Journal of Science 25, 90–91.

Post, W., 1981. Biology of the yellow-shouldered blackbird—*Agelaius* on a tropical island. Bulletin of the Florida State Museum Biological Sciences 26, 125–202.

Post, W., Wiley, J.W., 1976. The yellow-shouldered blackbird: present and future. American Birds 30, 13–20.

Post, W., Wiley, J.W., 1977. Reproductive interactions of the shiny cowbird and the yellow-shouldered blackbird. Condor 79, 176–184.

SPSS, Inc., 1999. Statistical Package for Social Sciences. Users Guide, Base 9.0 SPSS, Inc, Chicago, Illinois.

U.S. Fish and Wildlife Service, 1976. Determination of the yellow-shouldered blackbird as an endangered species and designation of critical habitat. Federal Register 41, 510119–510122.

Wiley, J.W., 1985. Shiny cowbird parasitism in two avian communities in Puerto Rico. Condor 87, 165–176.

Wiley, J.W., 1988. Host selection by the shiny cowbird. Condor 90, 289–303.

Wiley, J.W., Post, W., Cruz, A., 1991. Conservation of the yellow shouldered blackbird *Agelaius xanthomus*, an endangered West Indian species. Biological Conservation 55, 119–138.