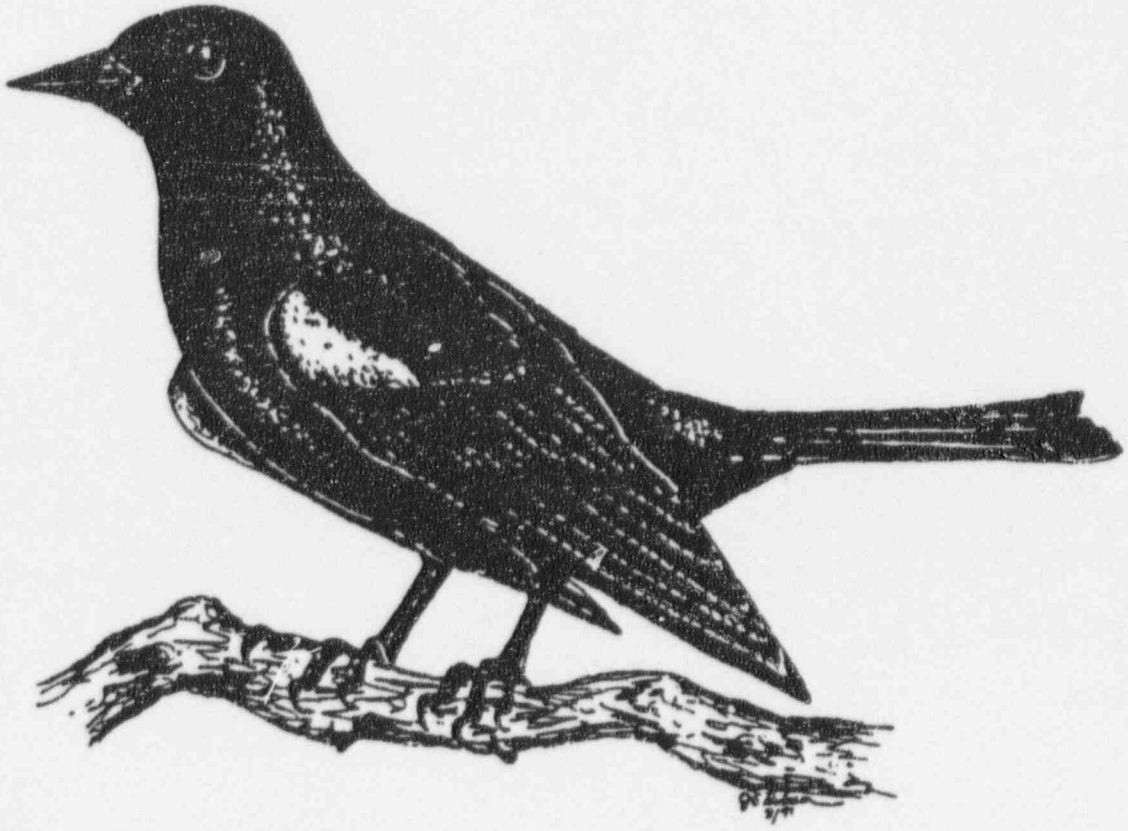
Recovery Plan For The Yellow-shouldered Blackbird (*Agelaius xanthomus*)



U.S. Fish and Wildlife Service
Southeast Region
Atlanta, Georgia

YELLOW-SOULDERED BLACKBIRD REVISED RECOVERY PLAN

(*Agelaius xanthomus*)

(Original Approved: May 25, 1983)

Prepared by

Marelisa Rivera
U.S. Fish and Wildlife Service
Boquerón Field Office
Boquerón, Puerto Rico

for

U.S. Department of the Interior
Fish and Wildldife Service
Southeast Region
Atlanta, Georgia

Approved by: Noreen K. Clough

Noreen K. Clough, Regional Director, Southeast Region
U.S. Fish and Wildlife Service

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Literature citation should read as follows:

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EXECUTIVE SUMMARY OF THE YELLOW-SHOULDERED BLACKBIRD REVISED RECOVERY PLAN

Current Status: The yellow-shouldered blackbird (*Agelaius xanthomus*) is listed as endangered. This species is endemic to Puerto Rico and Mona Island. At present, it is restricted to a few localities in southwestern, southern, and eastern Puerto Rico, and to Mona and Monito Islands.

Habitat Requirements and Limiting Factors: Present distribution of the species includes the Boquerón Commonwealth Forest in southwestern Puerto Rico, Roosevelt Roads Naval Station in eastern Puerto Rico, Salinas in southern Puerto Rico, and Mona and Monito Islands. In southwestern Puerto Rico, a mean of 258 and 352 yellow-shouldered blackbirds have been counted during pre- and post-reproduction seasons, respectively. Approximately 400 individuals are known from Mona Island, 20 individuals have been sighted in Salinas, and approximately 14 individual were observed at Roosevelt Roads Naval Station. Although nesting yellow-shouldered blackbirds have been reported from a variety of habitats (mudflats and salinas, mangrove forests and cays, coastal upland dry forest, palm trees, suburban areas, caves, and coastal cliffs), at present, almost all the nests monitored have been located in artificial structures (PVC pipes and elbows). The species is currently threatened by loss of habitat, nest invasion by Caribbean martins, and parasitism by shiny cowbirds.

Recovery Objective: Downlisting to threatened status.

Interim Recovery Criteria: In order to ensure a self-sustaining population in the Boquerón Commonwealth Forest (BCF), the reproductive success should be enhanced to ≥0.96 daily survival for eggs and chicks, and parasitism rates should be reduced to ≤20 percent. These criteria should be maintained for at least 5 years in the artificial structures. The criteria for delisting should be developed after modeling data obtained from natural nests in the BCF and at least two additional areas in Puerto Rico, including Mona Island.

Actions Needed:

1. Protect and manage yellow-shouldered blackbird habitat.
2. Protect and manage yellow-shouldered blackbird populations.
3. Monitor reproductive success in existing artificial nest structures.
4. Develop an education program.

Date of Recovery: Downlisting should be initiated in 2020, if interim recovery criteria are met.

Recovery Costs: Recovery costs for the yellow-shouldered blackbird have been estimated at $302,000 for the first 3 years of this plan. Subsequent expenditures will depend on the results of these preliminary studies and activities, and, therefore, cannot be estimated at this time.

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The yellow-shouldered blackbird (*Agelaius xanthomus*), commonly known as "la Mariquita de Puerto Rico" or "Capitán," is endemic to Puerto Rico and Mona Island. In the past, this species was considered abundant and widespread in Puerto Rico. In the mid-1970s, the southwestern and eastern populations declined drastically. The destruction of the species' nesting and foraging habitat and brood parasitism by the shiny cowbird (*Molothrus bonariensis*) were identified as the two most important factors responsible for the species' decline. At present, the yellow-shouldered blackbird is restricted to a few localities in southwestern, southern, and eastern Puerto Rico, and to Mona and Monito Islands.

The yellow-shouldered blackbird was determined to be an endangered species and critical habitat was designated in 1976, pursuant to the Endangered Species Act of 1973, as amended (U.S. Fish and Wildlife Service (Service) 1976). Critical habitat designation included all of Mona island; a portion of southwestern Puerto Rico in the municipalities of Cabo Rojo, Lajas, and Guánica (Figure 1); a circular area with a 1-mile radius in the town of San Germán; and Roosevelt Roads Naval Station (RRNS), southeast of Ceiba (50 CFR 17.95 (b)).

Description

This species is one of the nine species of the blackbird genus *Agelaius*. There are two recognized subspecies: *Agelaius x. xanthomus*, known only from Puerto Rico and formerly from Vieques Island, and *Agelaius x. monensis*, which occurs only on Mona and Monito Islands (Post 1981a).

The yellow-shouldered blackbird is a medium-sized (20 to 23 centimeters) bird which is glossy black with yellow epaulets (humeral patches). The plumage of males and females is similar. Immature birds are a duller black than adults and possess a brown abdomen (Raffaele 1989). The humeral patch is usually edged with a narrow white margin, and under the wing the humeral feathers are occasionally tinged with orange (Post 1981a).

Historical Range and Status (1864 - 1974)

The yellow-shouldered blackbird was widespread and abundant in Puerto Rico and Mona Island until the 1940s (Post and Wiley 1976). In the mid-19th century it was described as "excessively abundant" in the San Juan region (Taylor 1864). The species was collected even in the mountainous interior at Lares and was also considered common throughout lowland Puerto Rico (Wetmore 1927 and Danforth 1936). Kuns *et al.* (1962) estimated a density of 0.15 yellow-shouldered blackbirds per hectare in the upland forest and the cacti forest in Mona Island. Leopold (1963) reported the species as common along the

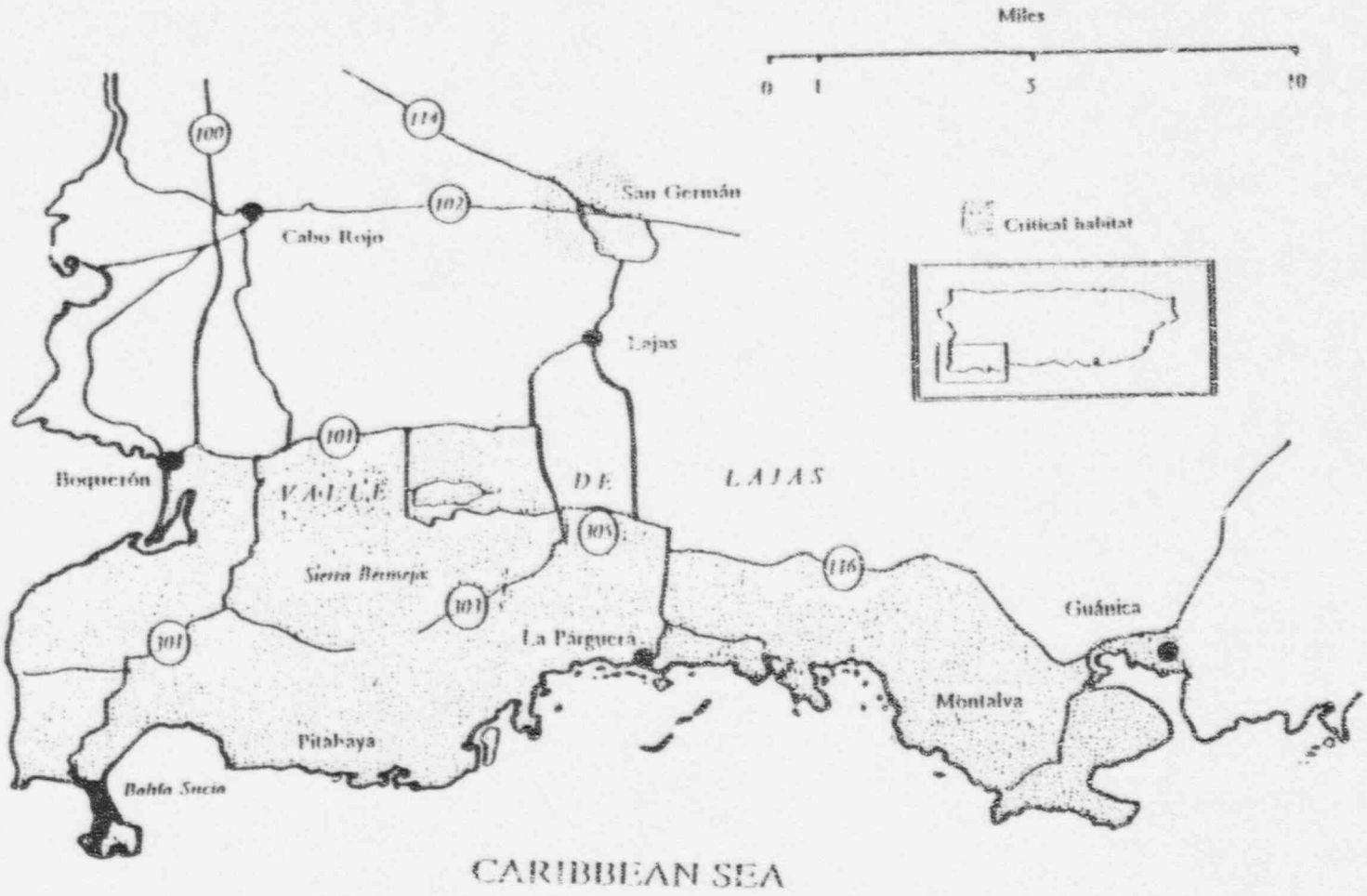


Figure 1. Designated critical habitat for the yellow-shouldered blackbird in southwestern Puerto Rico.

coastline of Puerto Rico. Kepler and Kepler (1970) estimated a density of 0.0098 yellow-shouldered blackbirds per hectare at Guánica. Post and Wiley (1976) estimated the total population of the yellow-shouldered blackbird to be about 2,400 and considered that the population was concentrated in three areas: coastal southwestern Puerto Rico with 2,000 individuals; coastal eastern Puerto Rico with 200; and Mona Island with approximately 200 birds. They also considered that coastal southwestern Puerto Rico, from Ensenada to Punta Guaniquilla, was the most important population center for the species.

The yellow-shouldered blackbird was reported from Vieques in April 1974 and in March 1978 (Service 1978).

Present Distribution and Abundance (1974 - 1995)

Southwestern Puerto Rico:

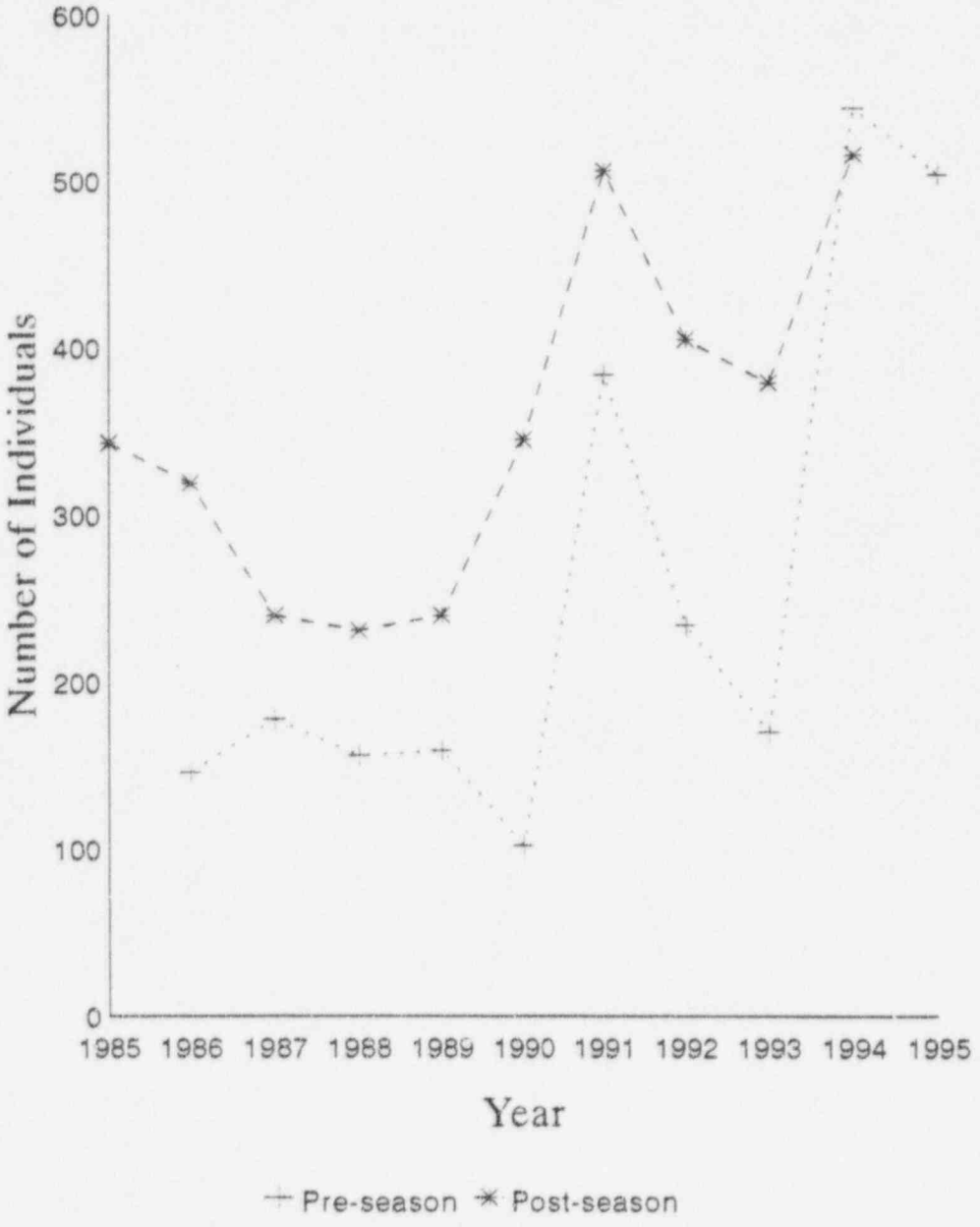
From 1975 to 1981, the yellow-shouldered blackbird population in coastal southwestern Puerto Rico declined by about 80 percent (Wiley *et al.* 1991). In contrast to 2,000 individuals estimated in 1976, the population was estimated at about 300 individuals in 1982.

Roost counts conducted between 1985 and 1995 in southwestern Puerto Rico by the Commonwealth Department of Natural and Environmental Resources (Department) showed mean counts of 258.9 $\pm$ 39.0 yellow-shouldered blackbirds during pre-reproductive season and a mean of 352.8 $\pm$ 25.8 yellow-shouldered blackbirds during post-reproductive season (Figure 2). These data show that this population, as measured by seasonal counts, is increasing. Based on pre-reproductive season counts, Collazo *et al.* (1995) estimated that the southwestern population is increasing at a rate of 0.13 $\pm$ 0.04 per year (finite rate or $\lambda = 1.14$). This means that the population increased at a rate of 14 percent annually or 39 birds per year, on average.

Collazo *et al.* (1995) found a positive relationship between the number of yellow-shouldered blackbirds during pre- and post-season counts. On the average, 71 $\pm$ 9.94 percent of the birds counted during the post-season counts were being counted during pre-season censuses. However, high post-season counts did not always result on higher pre-season counts. They found that the ability to predict pre-reproductive season numbers on the bases of post-season counts was not strong. They stated that this lack of ability was probably a function of the openness of the population and that the counts were comprised of members of other populations besides the southwestern population.

According to the Department (1992), the decrease observed in the surveys conducted before the nesting season may be the result of winter dispersion of the species. Variations in roost counts conducted after the nesting season may be due to human errors, the timing

Figure 2. Roost counts in southwestern Puerto Rico, 1985 - 1995.



of the breeding seasons, timing of counts, number of areas included on the counts, frequency and number of counts, and dispersion of the species.

Roosevelt Roads Naval Station:

At the RRNS in Ceiba (mentioned previously as coastal eastern Puerto Rico), the yellow-shouldered blackbird population declined to six pairs (97 percent decline) in 1982 (Wiley *et al.* 1991). These same authors mentioned that only two nesting pairs were found in 1985 and 1986 in this area. After Hurricane Hugo in September of 1989, this population was believed to have been extirpated (Service 1991). One individual was observed in May 1993 (J. Saliva, pers. comm.). Wunderle (pers. comm.) reported two yellow-shouldered blackbirds in December 1994. The Department (1995) reported that one yellow-shouldered blackbird was found dead at an electrical substation, and 15 yellow-shouldered blackbirds were reported near the principal gate of the base. Intensive surveys are needed to determine how many yellow-shouldered blackbirds remain in the area.

Mona and Monito Islands:

The only known localities for the subspecies *Agelaius x. monensis* are Mona and Monito islands. In 1971 and 1972, several hundred yellow-shouldered blackbirds were reported from Mona island (Raffaele 1973). Post and Wiley (1976) estimated the Mona population to be 200 individuals. Pérez-Rivera (1983) reported that in 1981 and 1982 the population was from 220 to 310 individuals, respectively. Lewis (1982) estimated the Mona population to be 250 pairs. In two roost counts conducted by the Department on Mona in 1986, approximately 338 yellow-shouldered blackbirds were recorded (Department 1986). Hernández-Prieto and Cruz (1987) reported a mean of 290 yellow-shouldered blackbirds from roost count estimates conducted in the summer of 1986 (counts ranged from 276 to 305 individuals). Hernández-Prieto and Cruz (1989) suggested that the total yellow-shouldered blackbird population on Mona exceeds 400 individuals (an average of 652, ranging between 467 and 908). Roost counts were carried out by the Department in five different locations on Mona island in 1992. A total of 310 yellow-shouldered blackbirds was counted (Department 1992). In 1994, the Department reported 267 yellow-shouldered blackbirds in three areas (Department 1994). In 1995, the Department reported a total of 153 yellow-shouldered blackbirds (Department 1995).

On Monito Island, Hernández-Prieto and Cruz (1987) reported "no less than 25" individuals, of which 13 had juvenile plumage. The Department reported 25 yellow-shouldered blackbirds in 1994 and 23 in 1995 (Department 1994 and Department 1995). Bonilla (pers. comm.) reported that blackbirds fly to Monito from the Cabo Barrio Nuevo area of Mona, suggesting that the source of the blackbirds on Monito may be western Mona. Hernández-Prieto and Cruz (1987) and Hernández-Prieto and González-Román (1990) reported breeding in Monito in 1986.

Yellow-shouldered blackbirds have been found on coastal cliffs and adjacent plateau areas of eastern and southern Mona (Hernández-Prieto and Cruz 1989). Danforth (1936) collected specimens from Playa Pájaros, in the southeastern part of Mona. They have also been reported from cliffs on the northern coast (Lewis 1982 and Pérez-Rivera 1983), and have been observed in the interior of the plateau (Camino del Diablo and Bajura de los Cerezos) and coastal areas (Sardinera and Pájaros) (Hernández-Prieto and Cruz 1989).

Barnés (1946) collected yellow-shouldered blackbirds from caves such as Cueva el Gato (northwest) and Cueva El Capitán (northwest), Las Caobas area (west) and plateau areas of northwestern and northeastern Mona island. Hernández-Prieto and Cruz (1987) indicated that the caves in eastern Mona (Cueva de Frío to Playa Pájaros) were commonly used by yellow-shouldered blackbirds for roosting. Other roosting areas were identified on the southern coast, from Uvero Beach to the vicinity of Caigo o Nc Caigo, and on the cliffside areas. Small numbers of blackbirds were found in the Cueva del Esqueleto, Punta Capitán, Cabo Barrio Nuevo, and Cabo Noroeste areas. No blackbird roosts were found in the plateau or beach areas, but birds were observed feeding at these locations (Hernández-Prieto and Cruz 1987 and Hernández-Prieto 1993).

San Germán:

Although the species was known from San Germán when it was listed in 1976, no counts or population estimates were conducted in that particular area. In 1992, thirteen blackbirds were counted in a roost in San Germán (Department 1992).

Salinas:

A new population of yellow-shouldered blackbirds was found between Guayama and Salinas (Department 1991). Censuses were carried out by the Department in Salinas, and 20 individuals were detected in 1991 and 41 in 1995 (Department 1991 and Department 1995).

Other Areas:

The yellow-shouldered blackbird has been reported from other areas. In December 1982, yellow-shouldered blackbirds were reported from the Caño Martín Peña, when the inventory of fauna and flora was conducted for the construction of the "Agua-guagua" project. Núñez-García (pers. comm.) reported yellow-blackbirds nesting near Yabucoa in 1986. He reported 11 individuals including fledglings. He also reported an unparasitized blackbird nest which fledged three chicks at the Union Caribe Grafito Company. In 1990, reports of yellow-shouldered blackbirds were received from Ponce, Mayagüez, Añasco, Yauco, Guánica, Guayanilla, and Guayama (Department 1990). In 1991, reports of blackbirds were received from Utuado, Ponce, Guánica, Guayama, and Salinas (Department 1991). In 1992, yellow-shouldered blackbirds were reported from the town

plaza of Cabo Rojo. Personnel from the Department confirmed the presence of a nest with a chick at this site (Department 1992). In 1994, six yellow-shouldered blackbirds were reported from Cataño (G. Bonilla, pers. comm.) and four were observed in Naguabo (personal observation). The species has been reported from Las Vegas Ward in Barranquitas (J. Colón, pers. comm.).

Breeding Biology

The breeding season for this species extends from April through August. Post and Wiley (1977b) and Post (1981a) suggested that the breeding season or initiation of pairing coincides with spring rains. The latter explained that the spring growth of vegetation provided food for foliage-feeding insects (on which the species feeds). Pérez-Rivera (1980) reported that breeding activity may begin as early as February on Mona Island and could last through November in San Juan and Cayey, depending upon the rainfall pattern during the year.

According to Post (1981a), the yellow-shouldered blackbird is a monogamous species. Pairing generally begins 6 or 10 weeks prior to breeding. Pairs establish themselves in the nesting areas of previous years. The males establish limited territories around nesting areas. Site defense by the females begins only after the nest is built, and decreases when females stop brooding the young. Intraspecific defense is primarily the male's role, with the area regularly defended within a 3-meter radius (Post 1981a).

Yellow-shouldered blackbirds in La Parguera nested in scattered mangroves, as well as in cavities in the dead trees and stumps (Post 1981a). The species used two types of cavities, holes in the sides of dead trees and holes in the tops of stumps. In large deciduous trees, the nests were placed on main branches or crotches at an average height of 5.6 meters. On offshore cays, yellow-shouldered blackbirds usually placed their nests on main branches or crotches. On the mainland, birds nested in the open nests or platforms made of leaves, grass, cotton, and occasionally paper, string, plastic bags, and twine. Nest cups were made of grass leaves, stems, and cotton, and were usually lined with fine grass leaves and stems. Nests on cays were bulkier than those found on the mainland because they contained large quantities of sargassum (Post 1981a).

In southwestern Puerto Rico, as well as on Mona Island, clutches contained an average of 3 eggs (Post 1981a and Pérez-Rivera 1982). There was no difference in the average clutch size of birds nesting on islands and on the mainland, nor between birds using cavity or open nests. Incubation began after the second egg was laid, and hatching was asynchronous. Only the female incubates and broods, while both sexes bring food and clean the nest. The incubation period lasts 12 to 13 days and the nestling period ranged from 13 to 16 days. Yellow-shouldered blackbirds usually nest in colonies and the distance between nests ranges from 5 to 35 meters (Post 1981a). This author believed that nesting aggregations resulted from active attraction among birds.

The yellow-shouldered blackbird is relatively long-lived. The annual survival rate for the adult population in southwestern Puerto Rico has been estimated at 82.4 percent (Post and Wiley 1977b). Post and Wiley (1977b) calculated the annual recruitment rate to be 18.1 percent, which in this case is about equal to the adult mortality rate. They estimated that about two blackbirds must be fledged per breeding pair each year for the population to be maintained.

Nesting Habitats

Nesting yellow-shouldered blackbirds have used a variety of habitats. The yellow-shouldered blackbird has been found nesting in the Boquerón Commonwealth Forest (BCF) and coastal upland dry forest in southwestern Puerto Rico, RRNS in eastern Puerto Rico, and on Mona Island. Other nesting localities such as Guánica, San Germán, Cabo Rojo, Salinas, and Carolina have also been reported (Department 1991, Department 1992, and Post and Wiley 1976). Wetmore (1927) found nests at Laguna Cartagena in Lajas.

In studies conducted by Post and Wiley (1976), yellow-shouldered blackbirds were described as using eight types of nesting habitats: mud flats and salinas, offshore red mangrove cays, black mangrove forest, lowland pastures (dry coastal forest), suburban areas, coconut plantations, and coastal cliffs. However, at the present time, most of these areas are not being used by the yellow-shouldered blackbird for nesting.

Southwestern Puerto Rico:

Post and Wiley (1976) described the abandoned salinas or salt flats and mud flats in the coastal mangrove zone as the most important nesting habitat for the species in southwestern Puerto Rico. The principal vegetation in these areas was black mangrove (*Avicennia germinans*), red mangrove (*Rhizophora mangle*), and white mangrove (*Laguncularia racemosa*). The trees were usually small and were either recolonizing an area that was once cleared of trees for extraction of salt and subsequently abandoned, or recolonizing a mud flat, where trees had died from extremely high concentrations of salt due to poor water circulation. In these areas, two types of nest sites were described: (1) open, cup-shaped nests, placed near the mud or water in small mangrove trees; and, (2) cup nests placed in a cavity or hollow of a dead mangrove.

Wood boxes and PVC pipes have been installed in these open mud flats in Pitahaya and Parguera (BCF) as artificial nesting structures for the yellow-shouldered blackbird. According to available data, since 1989 only a few natural nests (nests not located in artificial structures) have been found in this type of habitat.

The offshore red mangrove cays of La Parguera Reserve in the BCF were also identified by Post and Wiley (1976) as nesting sites for the species. The small islands are located approximately 250 to 550 meters from shore. Nests were usually built on the main

branches of the red mangrove, 0.2 to 4.0 meters above water (Post and Wiley 1976). Yellow-shouldered blackbirds nesting on offshore islands flew to the mainland to forage. At present, nesting has not been documented on these cays. The presence of houseboats and rats, and human disturbance on the cays, among other impacts, may have contributed to the loss of this nesting habitat.

The dry coastal upland forest in southwestern Puerto Rico (from La Parguera to Pitahaya) has been reported as nesting habitat for the yellow-shouldered blackbird (Post and Wiley 1976, Department 1986, Department 1989, and Department 1990). Nests have been observed in large deciduous trees, primarily úcar (*Bucida buceras)* and algarroba (*Hymenaea courbaril*) found in pastures at the edge of the mangrove forest (BCF). Nests are usually located from 6 to 9 meters from the ground. As in the black mangrove forest, pairs nested close together in the same tree.

Post and Wiley (1976) reported nesting activity at the Interamerican University Campus in suburban San Germán. The nests were found on the fronds of royal palms (*Roystonea borinquena*) which reach 16 to 18 meters in height. Nests were located 12 to 15 meters above the ground in these palms, which had been planted around the buildings. Nesting in San Germán has not been reported since 1976. At present, breeding in urban sites has been reported in Cabo Rojo and La Parguera (Department 1992).

Post and Wiley (1976) reported yellow-shouldered blackbird nests in the axils of coconut (*Cocos nucifera*) and royal palms, particularly at Boquerón, La Parguera, Boca Prieta, and on Mona Island.

Roosevelt Roads Naval Station:

At the RRNS, in the municipality of Ceiba (eastern Puerto Rico), Post and Wiley (1976) reported yellow-shouldered blackbirds nesting in dense stands of black mangrove. Nests were sometimes aggregated and usually located near the fringe of the mangrove forest along small pools or clearings. The area was heavily affected by Hurricane Hugo in 1989. Only one nest has been reported from RRNS since the hurricane (Department 1995).

Mona Island:

On Mona Island, Barnés (1946) reported blackbirds nesting in cacti in scrub habitat. The sheer cliffs and caves surrounding the island have been reported as nesting habitat for the yellow-shouldered blackbird. Post and Wiley (1976) reported that the blackbirds placed their nests on ledges or in crevices. Pérez-Rivera (1982) observed blackbird nesting on water-surrounded rocks on Mona Island.

Artificial Structures:

In the late 1970s in the BCF, wooden nest boxes were installed in open salt flats in known yellow-shouldered blackbird nesting habitat in order to increase fledgling success. The boxes were accepted and successfully utilized by the blackbirds. This allowed the creation of nesting habitat in areas, such as open salt flats, where management activities could be undertaken. Although the number of shiny cowbird eggs in nest boxes was larger than the number in open natural nests, reproductive success of blackbirds was higher in the box nests in 1983 (Cruz and Nakamura 1984). The authors indicated that the advantage of box nesting was that rat (*Rattus rattus*) predation was reduced. Thereafter, the boxes deteriorated and were heavily used by the Caribbean martins (*Progne dominicensis*).

In the mid-1980s, PVC elbows and pipes were utilized to build nest structures which were placed in breeding areas of the BCF (often replacing deteriorated wooden nest boxes). These structures were located in mud flats surrounded by mangrove forest. The PVC pipe nest structures were also accepted and utilized by the blackbirds for nesting. The number of PVC pipe structures was increased from 30 in 1986, to 190 in 1988, and to 286 in 1990. The number of structures remained the same between 1990 and 1994. During this period, the percent of nests located in PVC structures as opposed to those in vegetation also increased from 20 percent in 1986, to 98.7 percent in 1988, and 100 percent in 1990. From 1990 to 1994, one hundred percent of the nests monitored have been located in PVC structures. In 1995, two nests were located on mangroves.

Feeding Habits

Little is known about the feeding ecology of the yellow-shouldered blackbird. Wetmore (1916) reported yellow-shouldered blackbirds probing bucaré (*Erythrina sp.*) blossoms for nectar but, in examining 55 stomachs, he found that 90 percent of the food consisted of animal matter. Danforth (1926) observed blackbirds on Mona Island taking nectar from the guamá (*Inga fagifolia*) as well as feeding on the fruits of several species of cacti (*e.g.*, *Cephalocereus royenii*). Pérez-Rivera (1980) reported birds feeding on the fruits of the cactus *Opuntia sp.* and the threatened higo chumbo (*Harrisia portoricensis*). Post (1981a) recorded observations of probing for nectar in the aloe (*Aloe vera*) and yuca (*Manihot esculenta*). Lewis (1982) reported seeing blackbirds on Mona Island probing blossoms of the shrub *Croton discolor*. Ventosa (pers. comm.) reported 8 yellow-shouldered blackbirds probing for nectar in maguey flowers (*Furcraea tuberosa*).

Post and Wiley (1977a) indicated that yellow-shouldered blackbirds and shiny cowbirds fed in mixed-species flocks around cattle feeding lots, monkey feeders, and in pastures. Post (1981a) identified the bulk of the food from young birds as arthropods with a trace of vegetable matter. The arthropods were gathered from the canopy and branches of the trees, whereas the vegetable matter was obtained at domestic animal feeding sites.

McKenzie and Noble (1990) indicated that yellow-shouldered blackbirds foraged in mixed-species flocks with shiny cowbirds and grackles (*Quiscalus niger*), particularly when caterpillars were the major food item. Head-down display associated with allopreening (interspecific preening invitation display) between cowbirds and blackbirds was described (McKenzie and Noble 1990). They mentioned that these species foraged primarily on the larvae of *Mocis latipes*, *Melipotis ochrodes*, *Spodoptera spp.*, *Molipotis sp.*, *Heliothis sp.*, and *Anticarsia gemmatalis*.

On Mona Island, the blackbird's diet consists of both animal and plant matter. According to Hernández-Prieto and Cruz (1987), the animal food consisted mainly of arthropods; and plant material consisted mainly of fruits, pulps, seeds, and nectar of 16 identified families and 23 genera. These authors reported that, on both Mona and Monito islands, the federally-listed *Harrisia portoricensis* was the most important plant in the yellow-shouldered blackbird's diet. Other plants important in the diet were *Cissus trifoliata*, *Ficus citrifolia*, and *Lantana involucrata*.

Reasons for Listing

Post and Wiley (1976) determined that the decline of the yellow-shouldered blackbird populations was caused by a number of factors, including extensive brood parasitism by the shiny cowbird, nesting and feeding habitat destruction, predation by exotic mammals, and diseases.

Shiny Cowbird Parasitism:

The shiny cowbird, an avian brood parasite, was originally confined to South America, Trinidad, and Tobago, but during the last 100 years, the species has spread throughout the West Indies and to the eastern United States (Cruz *et al.* 1989, Post and Cruz 1993). In Puerto Rico, the shiny cowbird was first reported in 1955 (Grayce 1957). However, Post and Wiley (1977a) believed that it may have arrived before then. This species is distributed throughout Puerto Rico, but it is most common in disturbed lowland habitats, often in association with agriculture and livestock (Cruz *et al.* 1985).

From 1972 to 1975, Post and Wiley (1976) found that 73.7 percent of the yellow-shouldered blackbird nests in Puerto Rico were parasitized. Post and Wiley (1977b) reported the yellow-shouldered blackbird to be the main host of the shiny cowbird. All of the 53 mainland yellow-shouldered blackbird nests examined in 1975 (35 at the BCF and 18 at the RRNS) were parasitized by shiny cowbirds. In contrast, they found that only three of 19 nests on offshore La Parguera (BCF) were parasitized from 1972 to 1975.

From 1975 to 1981, ninety-three percent (152 of 164) of the yellow-shouldered blackbird nests examined in mangrove habitats of the BCF and the RRNS were parasitized by the shiny cowbird (Wiley 1987). In 1982, all of the 44 blackbird nests examined by Cruz *et al.* (1985) in both areas were parasitized. In 1983, a total of 94.8 percent of the blackbird nests studied in BCF were parasitized by cowbirds (Cruz and Nakamura 1984).

As reported by Post and Wiley (1976), the extensive nest parasitism of the yellow-shouldered blackbird by shiny cowbirds was the most crucial factor in the decline of the blackbird in Puerto Rico. Brood parasitism by the shiny cowbird reduced the reproductive output of the yellow-shouldered blackbird (Post and Wiley 1977b). The reduced productivity at parasitized nests resulted mainly from puncturing and breaking of host eggs by female cowbirds.

According to Post and Wiley (1977b), the effects of brood parasitism in RRNS were more severe than in BCF. In BCF, they found that 35 nests produced 27 blackbirds and 24 cowbirds; however, in RRNS, 18 nests produced only three yellow-shouldered blackbirds, but 17 cowbirds. The low level of yellow-shouldered blackbird production at RRNS was directly related to brood parasitism by cowbirds. Post and Wiley (1977b) concluded that the production of blackbirds at BCF and RRNS was below that needed (two blackbird fledglings per breeding pair each year) for population maintenance.

A summary of breeding success of yellow-shouldered blackbirds and degree of parasitism by the shiny cowbird at BCF and the RRNS between 1975 and 1981 is presented in Table 1 (Wiley 1987). The percent of successful nests (a successful nest was described as a nest from which at least one chick fledged) in both areas was very similar, but under 50 percent. In RRNS, a lower percent of hatched eggs and a lower rate of fledging success (number of fledglings per number of eggs) were found during this period. These lower values may be related to the higher number of parasitized nests found in that area.

In contrast to the data from Post and Wiley (1977), which showed that non-parasitized blackbird nests had higher nest success than parasitized nests, Wiley (1987) found no better nest success in non-parasitized nests than at parasitized nests in both study areas (Table 2). Wiley (1987) compared the clutch size (mean number of eggs per nest), hatching success (mean number of eggs hatched per nest), and fledging success (mean number of chicks fledged per nest) at parasitized and non-parasitized nests at both study areas, and he found that in BCF, the clutch size of blackbirds was larger in parasitized nests. In both areas, parasitized nests hatched more chicks. The yellow-shouldered blackbird in BCF had higher fledging success in parasitized nests than in non-parasitized nests.

A summary of breeding success of yellow-shouldered blackbirds and degree of parasitism by the shiny cowbird at BCF in 1983 is presented in Table 3. Unlike the previous study, where the study areas were mangrove forests only, Cruz and Nakamura (1984) included data on nests in wood boxes (52 nests in mangroves, six in trees or cacti, one in a natural cavity, and 11 in wood boxes). Negative effects of parasitism on the fledging success of the yellow-shouldered blackbird were found in the breeding season of 1983. Cruz and Nakamura (1984) found a lower percent of fledging success than was found by Wiley (1987) in the parasitized nests in the same region. This low fledging success was

Table 1. Breeding success of yellow-shouldered Blackbirds in RRNS and BCF from 1975 to 1981 (Wiley 1987).

Yellow-shouldered blackbirds	RR NS	BCF
Total # active nests (TAN)	98	66
Total # successful nests (TSN)	37	26
% successful nests (SN)	38	39
Total # eggs (TE)	248	163
Total # eggs hatched	48	60
% hatching success (HS)	19	37
Total # fledglings (TF)	12	30
% fledging success (FS)	5	18
Fledglings/succ. nest	0.3	1.2
Nests parasitized	93	59
% parasitized nests	95	89
Fledglings/successful nest	1.5	1.6

TAN = at least one egg was laid
TSN = at least one chick fledged
SN = (TSN/TAN) x 100
FS = (TF/TE) x 100

Table 2. Comparison of clutch size, nest success, hatching success and fledging success in parasitized and non-parasitized nests in RRNS and BCF (Wiley 1987).

	Parasitized Nests		Non-parasitized Nests	
	RRNS	BCF	RRNS	BCF
Clutch size	2.63	2.62	3.0	2.5
Nest success	0.5	0.4	0.2	0.1
Hatching success	.49	.98	.40	.29
Fledging Success	.11	.47	.40	.29

Table 3. Breeding success of yellow-shouldered blackbirds in the BCF in 1983 (Cruz and Nakamura 1984).

Yellow-shouldered blackbird	BCF
Active nests	58
Nest success (NS)	0.41 (24/58)
Fledglings/active nest	0.74 (43/58)
Fledglings/successful nest	1.79 (43/24)
Fledglings/eggs	0.29 (43/150)
Eggs hatched/eggs laid	0.32 (48/150)
Eggs/active nest (EAN)	2.69 (148/55)
Cowbird eggs/active nest (CEAN)	2.78 (153/55)
% Parasitized nests	95 (55/58)

NS = fledged at least one blackbird young
EAN= 55 active nests containing at least one blackbird egg
CEAN= 55 active nests containing at least one cowbird egg

primarily related to the high prevalence of shiny cowbird parasitism. Cruz and Nakamura (1984) stated that host egg puncturing and breakage of host eggs by shiny cowbirds were the main factors in the decline in numbers of blackbird eggs hatched.

Although 61 percent of the resident passerine species in mangrove areas in Puerto Rico have been found to be parasitized by the cowbirds, the yellow-shouldered blackbird is considered to be its primary host (Cruz *et al.* 1985). Some factors have been identified to explain the cowbird's preference for the yellow-shouldered blackbird. The shiny cowbird apparently is not recognized by the yellow-shouldered blackbird as a potential threat, and therefore, the blackbird does not attack it with the same intensity that it attacks other species that it may recognize as competitors or nest predators (Cruz *et al.* 1985). Post and Wiley (1977b) mentioned that the concentration of cowbirds on the southwestern coast in the summer coincides with the breeding season of the yellow-shouldered blackbird. A combination of factors has been identified by Post and Wiley (1977b) to explain the parasitism of blackbirds by cowbirds. These include the behavior of the cowbird as an expanding population, the close taxonomic relationship of host and parasite, similarity of size and color of eggs, lack of cryptic nests, colonial nesting patterns of the yellow-shouldered blackbird, low nest attendance, and other ecological similarities.

Although cowbirds have been reported from Mona Island, cowbird parasitism of blackbirds on Mona Island has not been observed (Hernández-Prieto and Cruz 1987 and Hernández-Prieto and Cruz 1989).

Habitat destruction:

The feeding and nesting habitat of the yellow-shouldered blackbird has been extensively reduced since 1900. The utilization of extensive acreage of coastal forest for the monoculture of sugar cane, and its subsequent development for housing due the decline of the sugar cane industry, reduced the feeding habitat available to the species. In addition, the extensive utilization of the lowlands for industrial, residential, and tourist development has reduced significantly the yellow-shouldered blackbird's nesting and feeding habitat. Cruz *et al.* (1989) mentioned that forest fragmentation creates small patches of forest surrounded by open habitat, thus increasing the forest edge habitat available for cowbirds. Cowbirds tend to utilize edge habitat for feeding and nest searching. Habitat fragmentation, by increasing the ratio of patch perimeter to area, greatly exacerbates the problem of cowbird parasitism (Wiley 1982 and Cruz *et al.* 1989).

Nest Predation:

The introduced rat (*Rattus rattus*) and the mongoose (*Herpestes auropunctatus*) are widespread in lowland Puerto Rico. Rats are an important predator of yellow-shouldered blackbirds. Post and Wiley (1977a) documented loss of yellow-shouldered blackbird nests due to rat predation. Cruz and Nakamura (1984) reported that nest predation accounted for 48 percent of the nests that failed in 1983. They found that rat predation of yellow-shouldered blackbird nests increased sharply during July and August, the months when the

water level receded and exposed peripheral mangroves to dry land. The Department (1985) documented the presence of rats, mongooses, and feral cats in the BCF and found some of these animals in cowbird traps and nest boxes. They stated that rats were the most important predator responsible for the loss of eggs and hatchlings. Since 1989, no natural nests have been found in the mangroves at the BCF, where predation by rats was the major cause of the loss of eggs and chicks. In PVC structures, the predation of rats is controlled by rat excluding devices (metal guards on supporting poles).

Parasitism and Diseases:

Post (1981a, 1981b) documented mite infestation in open, cavity, and artificial (boxed) yellow-shouldered blackbird nests. Blood sucking mites of two species (*Ornithonyssus bursa* and *Androlaelaps casalis*) were found. He mentioned that infestation by mites may lead to premature desertion of the nest by young birds. The author also found four cases of adult blackbirds deserting young that were in cavities infested with mites. At present, the mite infestation is controlled by applying the insecticide Sevin to the PVC pipes.

Studies of the factors leading to the decrease of island species have implicated fowl pox as a potential problem (Amadon 1950). Post (1981b) reported that 19 percent of the blackbirds examined from 1974 to 1975 were infected with avian pox and that infected birds had a significantly lower survival rate than uninfected birds. A record for the nematode *Acuaria* sp. was reported by Whittaker *et al.* (1970). At Mona island, avian pox was observed on two yellow-shouldered blackbirds in March 1994 (F. López, pers. comm.).

Present Management of Yellow-shouldered Blackbird Reproduction

The Department, through a Cooperative Agreement with the Service, has been conducting a program for the control of shiny cowbirds and the monitoring of yellow-shouldered blackbird reproduction in southwestern Puerto Rico, specifically in the BCF, for the last 13 years (from 1982 to 1995). The yellow-shouldered blackbird program has been conducted under the Section 6 Endangered Species Program since its establishment in 1984. In 1984, the Department established an office in the Cabo Rojo National Wildlife Refuge to monitor yellow-shouldered blackbird reproduction and conduct a cowbird control program.

Objectives of the Program:

The principal objectives of the program are the following: (1) to monitor reproductive success of the yellow-shouldered blackbird and associated shiny cowbird populations in artificial structures; (2) to trap and remove shiny cowbirds; (3) to install and monitor artificial nest structures for the yellow-shouldered blackbird to increase its population; (4) to control rats and mites that affect the reproductive success of the yellow-shouldered blackbird; and, (5) to monitor yellow-shouldered blackbird populations.

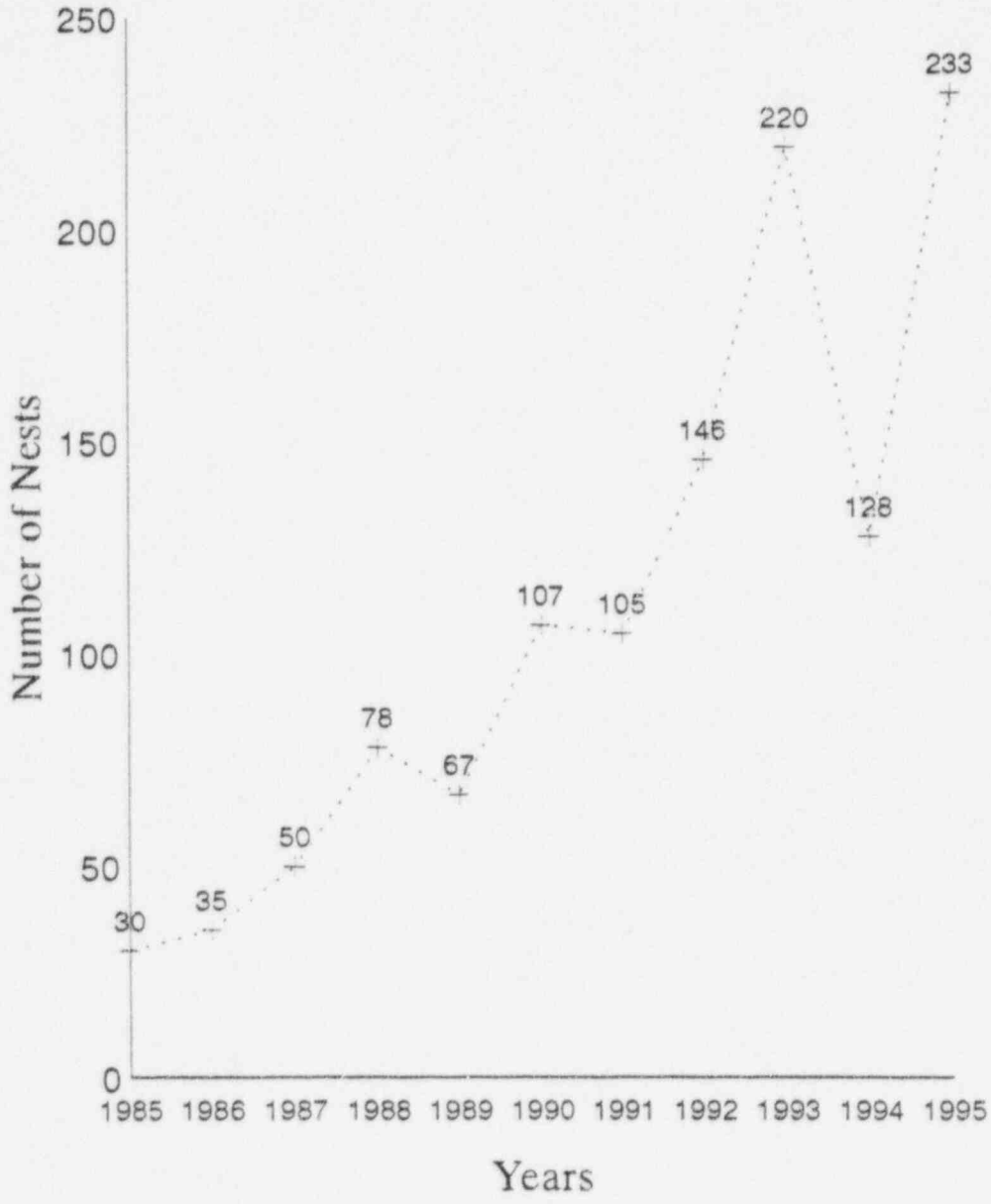
Areas of reproduction are located primarily in mud flats surrounded by black mangrove forests at the BCF (from La Parguera to Pitahaya). In 1990, a design of 286 artificial nest structures (PVC straight and elbow pipes) in nine reproduction areas in southwestern Puerto Rico was implemented. The distribution of artificial structures was altered in 1995. The Department removed all the PVC pipes used two or more times by the Caribbean martins in the previous 5 years and replaced them with PVC elbows. The elbows had not been heavily used by martins throughout the history of the project. In addition, some groups of artificial nesting structures, located in open areas, that were taken over by Caribbean martins, were relocated inside mangrove forest. The purpose of the new design was to minimize the interference of Caribbean martins with yellow-shouldered blackbirds. No Caribbean martins had been reported in mangrove forests by Department personnel (Department 1995). A total of 58 PVC elbows was installed and nine groups of structures were relocated. Another 14 structures (seven PVC elbows and seven PVC straight pipes) were placed randomly inside a new mangrove area (fastened to mangrove trees) without rat exclusion devices. The main objective of this new design was to promote nesting in natural habitat, as well as to measure the incidence of predation of yellow-shouldered blackbird nests in mangroves.

Since 1988, reproduction has been heavily manipulated, including removal of shiny cowbird eggs and chicks from artificial structures, placement of rat guards, and dusting of mite infested nests with insecticide. To evaluate the breeding success of the yellow-shouldered blackbird in the artificial nest structures, these are visited at least once a week. The Department has gathered data on the number of nests parasitized by the shiny cowbird, number of shiny cowbird eggs per nest, number of yellow-shouldered blackbird eggs per nest, number of shiny cowbird fledglings, and number of yellow-shouldered fledglings. Predation and harassment by rats, Caribbean martins, and other species, and infestation with mites were monitored and evaluated.

Number of Nests (1985 - 1995):

The number of yellow-shouldered blackbird nests located in the BCF increased between 1985 to 1995 (Figure 3). Figure 3 includes both natural and artificial nest structures. Since 1990, the number of nests located increased dramatically when compared with previous years. One possible reason for this increase is the large number of PVC

Figure 3. Number of nests, Boqueron Commonwealth Forest, 1985 - 1995.



structures placed since 1988 in the nesting areas (Table 4). The number of artificial structures doubled from 1986 to 1990, resulting in an increase in number of structures used for nesting. The percent of use increased from 7.4 percent in 1986, to 24.1 in 1990. Although the number of artificial structures has remained almost the same from 1990 to 1995, the percent of use increased to 68.4 percent in 1995, the hi[illegible]t percent use in the 11 years of the project.

The types of structures used by yellow-shouldered blackbirds for nest construction have changed during this time (Figure 4). Artificial structures were not heavily used by the yellow-shouldered blackbird through the early 1980s. More than 75 percent of the nests studied in 1985 were found in vegetation, with natural stumps being the most important nesting sites for the species. Nest boxes were not heavily used by the yellow-shouldered blackbird due to the deterioration of the boxes and the disturbance by the Caribbean martin in these structures. In 1986, the mangrove forest of the BCF was the most important nesting habitat for the blackbirds. This trend changed in 1987, when almost 50 percent of the nests were located in PVC structures and wood boxes were not used by the species. Although some nests were found in vegetation in 1989 and 1990, more than 75 percent of the nests located were in PVC structures. This change in use of sites for nest construction may have been a response to the increased number of PVC structures placed in 1988 and the establishment of a new design for the location and distribution of artificial PVC nest structures in the nesting areas. In 1988, one nest was located in a post, and the remaining 77 nests were located in PVC. After 1991, almost all the nests were located in PVC structures. In 1995, two nests were found in the mangroves.

The number of active nests found in the project area increased from eight active nests in 1985, to 229 active nests in 1995 (Table 5). An active nest is defined by the Department as a nest where at least one blackbird egg was laid. The percentage of active nests has been maintained at over 60 percent for the 11 years of the study. In 1995, ninety-eight percent of the nests located were used by yellow-shouldered blackbirds for nesting. Lower percentages of active nests were reported in 1985 and 1991. The lower percentage of active nests meant that yellow-shouldered blackbirds invested energy in the construction of a nest that was abandoned before laying eggs. Disturbance of reproduction areas by people or by other bird species, or predation of eggs before the nest was monitored, may have been the principal factors affecting these percentages. Heavy and aggressive use of nest boxes by Caribbean martins was reported during 1985. Therefore, only two nest boxes were used by yellow-shouldered blackbirds. This interference with Caribbean martins in the boxes may have caused the yellow-shouldered blackbirds to use the natural vegetation for nesting. Five of the eight active nests produced at least one fledging, resulting in a relatively high percentage (62 percent) of successful nests.

In 1991, thirty-seven of 105 nests were reported as "nests in construction abandoned." The Department (1991) related this event to interference by Caribbean martins. They also reported that 44 percent (30 out of 68) of the active nests were taken over by Caribbean

Table 4. Comparison between the number of artificial structures available for the yellow-shouldered blackbird and the number of structures used for nest construction, 1985 - 1995.

Year	Structures Available	Structures Used	Percent of Use
1985	-	2	-
1986	136	10	7.4
1987	130	27	20.8
1988	240	77	32.1
1989	245	56	22.9
1990	286	69	24.1
1991	286	105	36.7
1992	286	146	51.0
1993	286	171	59.8
1994	286	128	44.8
1995	272	186	68.4

- = data was not available

Figure 4. Nesting structures used, Boqueron Commonwealth Forest, 1985 - 1995.

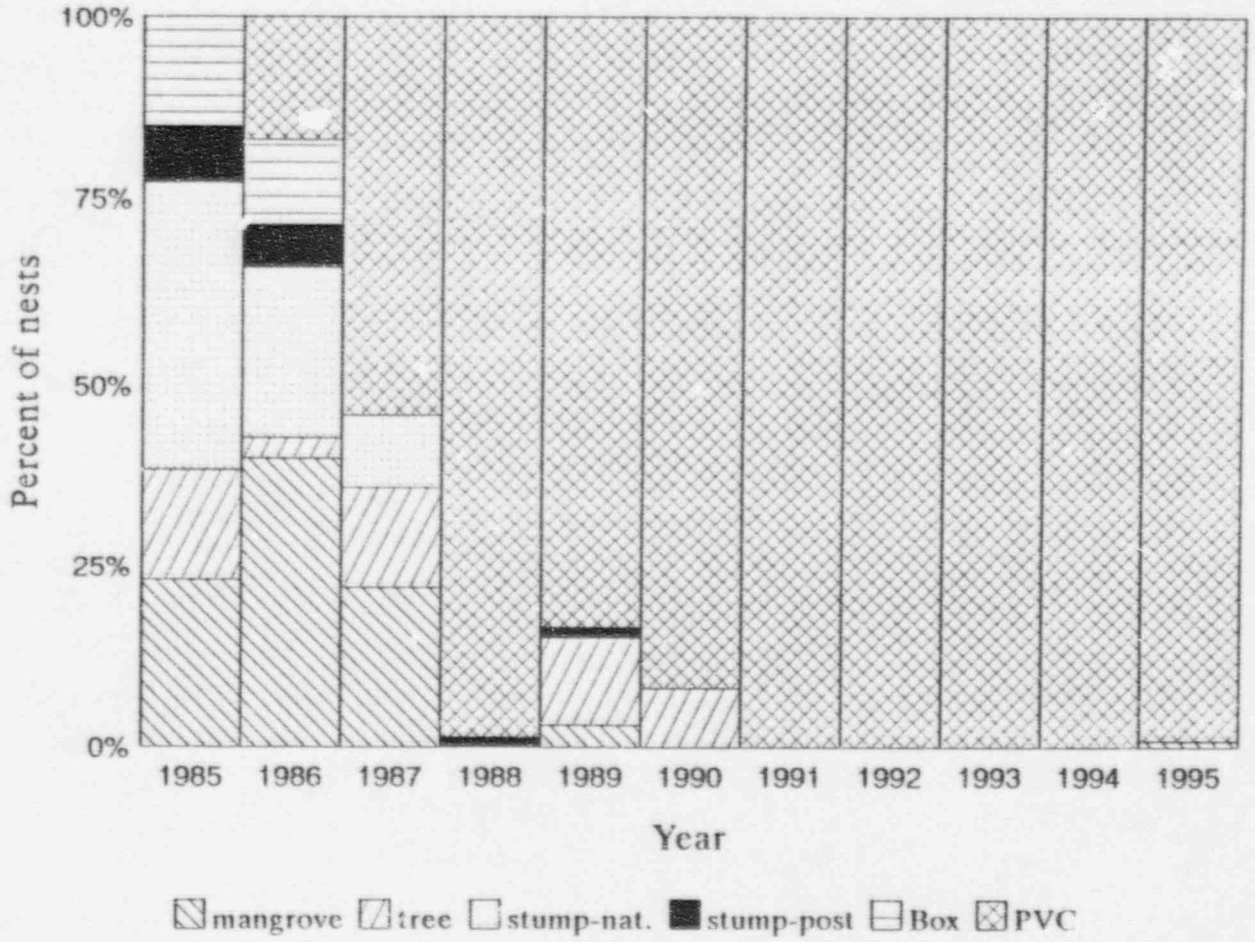


Table 5. Number of active and successful nests of yellow-shouldered blackbirds, 1985 to 1995.

Year	Nests Located	Active Nests	% Active Nests	Successful Nests	% Successful Nests
1985	13	8	61	5	62
1986	35	32	91	20	62
1987	50	41	82	26	63
1988	78	61	78	21	34
1989	57	42	74	20	47
1990	101	79	78	69	87
1991	105	68	65	51	76
1992	146	125	86	105	84
1993	220	187	85	130	70
1994	128	97	76	68	70
1995	233	229	98	158	69

martins. However, in the same year, 76 percent of the active nests produced at least one fledging. This percentage is higher than previous years, except for 1990 (Table 5). This higher percentage of successful nests may be related to the timing of the interference because most of the active nests were taken by Caribbean martins after yellow-shouldered blackbirds fledged their chicks.

The lowest percentages of successful nests were reported in 1988 and 1989, with 34 and 47 percent, respectively. Figure 5 shows that in these 2 years, the highest percentages of eggs and chicks lost were reported. More than 60 percent of the total number of eggs and close to 20 percent of the chicks were lost. This figure indicates that the loss of eggs may be the principal factor affecting the reproductive output (production of fledglings).

Figure 5 also shows that after 1987, in general, higher percentages of eggs and chicks lost were reported. What happened in the project after 1987, that resulted in these higher percentages? After 1987, the amount of artificial structures installed almost doubled and continued increasing in the following 2 years (Table 4). The percentage of use of these artificial structures also increased dramatically in 1987 and thereafter. In addition, the type of structures used by the species changed dramatically after 1987. Before 1987, inclusive, the yellow-shouldered blackbird used vegetation for nesting. After 1987, the species nested mostly in PVC structures. Although the reproduction in artificial structures is intensively managed for the removal of shiny cowbird eggs and chicks, rat exclusion, and prevention of mite infestation, PVC structures seems to be very attractive to Caribbean martins.

Clutch Size and Fledging Success:

During the 11 years of study, the clutch size (number eggs per nest) of the yellow-shouldered blackbird was near three eggs, the same as the clutch size reported for the species by Post (1981a) (Table 6). The small clutch size reported in 1987 may be related to predation by rats, mongoose, and shiny cowbirds. According to Department (1987), six nests were lost due to rats and mongoose and three were lost due to egg puncturing, possibly by shiny cowbirds. During the study years, at least two yellow-shouldered blackbird chicks fledged from successful nests each year, except for 1994.

A fledging success greater than 50 percent was estimated for the majority of the years. Fledging success rate is the number of chicks that fledged from the total number of eggs laid. Fledging success under 50 percent was reported during breeding seasons of 1986, 1988, 1989, and 1994. As we discussed before, the high percentage of eggs and chicks lost during these years contributed to the low fledging success.

Figure 5. Eggs and chicks lost, Boqueron Commonwealth Forest, 1985 - 1995.

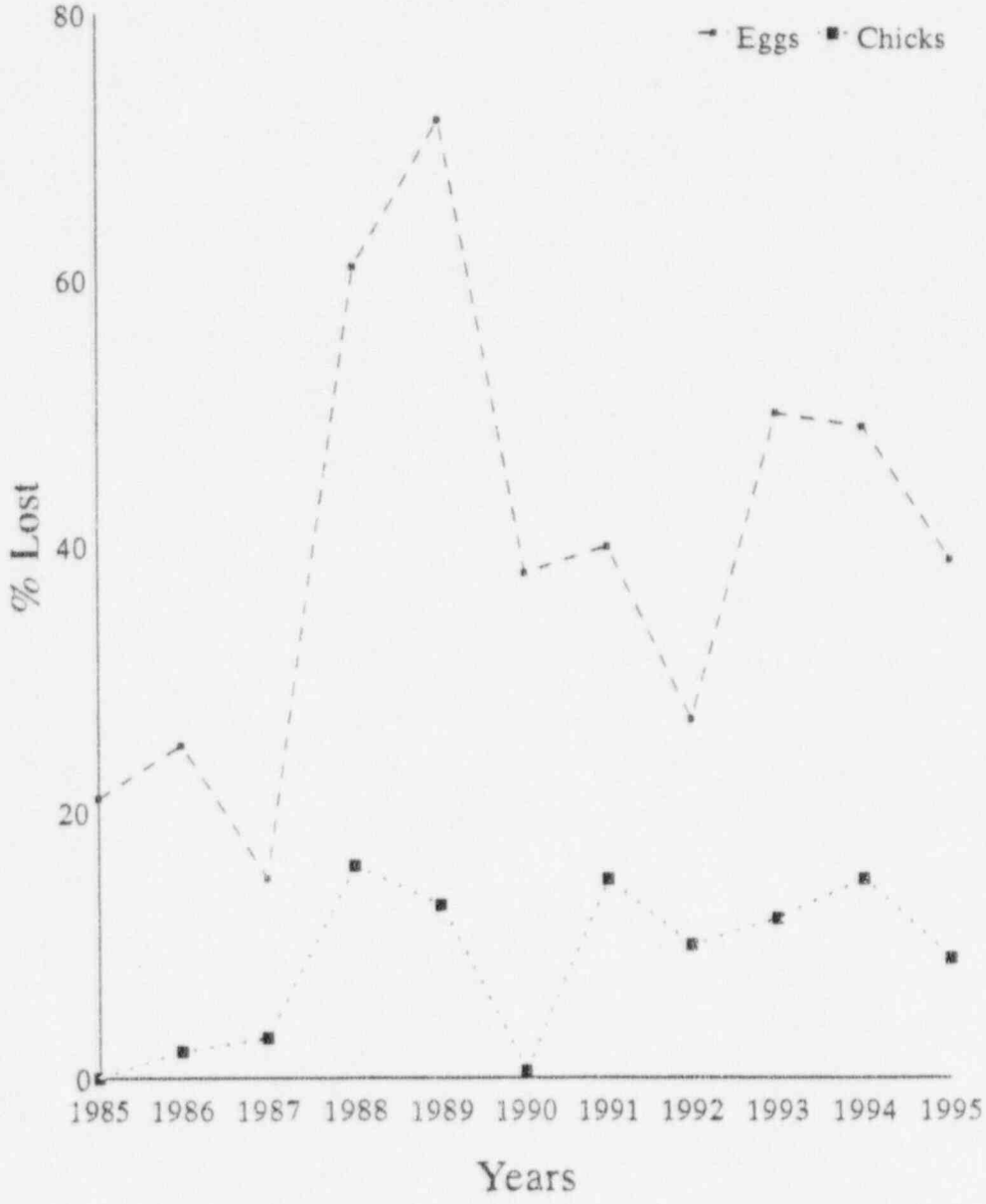


Table 6. Clutch size and fledging success of the yellow-shouldered blackbird in the BCF from 1985 to 1995.

Year	Total # eggs (TE)	Eggs/ nest	Total # successful nests (TSN)	Total # fledglings (TF)	Fledglings/ successful nest	% fledging success (FS)
1985	24	3.0	5	15	3.0	62
1986	96	3.0	20	43	2.1	45
1987	98	2.4	26	78	3.0	64
1988	169	2.8	21	51	2.4	30
1989	120	2.9	20	46	2.3	38
1990	257	3.2	69	180	2.6	70
1991	205	3.0	51	116	2.2	57
1992	382	3.1	105	252	2.4	66
1993	584	3.1	130	335	2.6	57
1994	281	2.9	68	117	1.7	42
1995	663	2.9	158	355	2.5	53

TSN = at least one chick fledged
FS = (TF/TE) x 100

Collazo *et al.* (1995) analyzed data from 1989, 1992, 1993, and 1994, and estimated reproductive success using the Mayfield method. They excluded 145 of 464 nests from the data sets because nests records were incomplete, and in many instances, data was not collected in a systematic fashion. Using this method and a reduced sample size, they estimated that the mean probability of a nest surviving the entire nesting period and producing at least one young was 0.76 ± 0.03 (Appendix 1). They also found that nestlings had a significantly greater daily survival probability than did eggs (0.917 ± 0.018 and 0.834 ± 0.022, respectively, Z=3.57, P=0.0002).

Model outputs under several scenarios were generated by Collazo *et al.* (1995) (Appendix 2). They used productivity per successful nest of 2.3 (without cowbird parasitism) (Department 1995) and 1.8 (with cowbird parasitism) (Post and Wiley 1977b). Under the first scenario, they examined productivity rates under the highest of reported values for selected parameters (survival estimates of 0.82 for adults and 0.18 for fledgings [Post 1981], parasitism rates of 5 percent [Department 1995], and a renesting attempt rate of 60 percent). Under this scenario, the population of the BCF increased in size. The model showed that the population could tolerate parasitism rates of up to 45 percent and still be able to reach the sink-source cutoff point even if pairs attempted to raise only one brood per season. When they dropped egg daily survival rates to 0.96 percent, a population that attempted to breed only once a season would not produce enough to maintain itself at parasitism rates of 30 percent. They stated that to overcome that deficit, a portion of the population had to raise a second brood.

Under the subsequent scenarios they incorporated different levels of parasitism and proportion of nesting population to model when the cutoff point was not reached by a population capable of raising a second brood. These scenarios are included in Appendix 2.

Present Threats to the Species

Although parasitism of yellow-shouldered blackbird nests continues, loss of habitat and the invasion of nesting areas by Caribbean martins are the two most important threats to the species.

Loss of Habitat:

At the present time, the center of the yellow-shouldered blackbird mainland population is in the southwest, roosting and reproducing principally in the BCF. Within the BCF, the two principal areas that this population utilizes are Pitahaya and La Parguera. At this moment, Pitahaya is the center of the reproduction of the species, and La Parguera is the most important roosting area for this population. Historically, at least 11 cays of La Parguera Natural Reserve were utilized (until the 1970s) for nesting and roosting, with as many as 1,663 individuals roosting together in La Parguera (Post 1981a).

From 1989 to 1995, more than 50 percent of the yellow-shouldered blackbirds counted during pre-season and post-season censuses have been recorded in La Parguera (Ventosa pers. comm.). Until January 1995, when a new roosting area was found in Bahía Sucia, more than 70 percent of the individuals were observed in the roosting areas of La Parguera and Pitahaya. There is only one roosting area in Parguera that is consistently used by the species; however, it shifts among at least four mangrove cays and the number of birds roosting varies throughout the year.

Mainland mangroves in La Parguera, as well as those of off-shore cays, have been eliminated and adversely affected by legal and illegal construction of stilt homes, docks, and the mooring of floating houses. The potential impacts to the yellow-shouldered blackbird in La Parguera have been an issue since prior to 1978, as a result of the disorderly construction of piers and stilt houses in the coastal mangrove area. In 1979, the Department and the Corps of Engineers signed a Memorandum of Understanding (MOU) specifying guidelines that were to ensure the preservation and best use of the environment of La Parguera area. The MOU provided the opportunity to improve habitat conditions in the following manner: (1) no permits were to be granted for cay houses or docks; (2) abandoned structures on the mainland were to be removed; (3) houses or docks abandoned or damaged were to be removed; and, (4) phase out of private ownership of shoreline structures was to occur.

After-the-fact permits on private structures along the shoreline were granted but the off-shore cays were excluded; at that time no permits were granted for existing cay structures. Structures on the cays were to be removed by the Department by June 13, 1980. All abandoned or unsafe structures along the shoreline would become property of the Department within 12 years, and thereafter, restructured according to a Master Plan to be developed. The MOU was later amended and after-the-fact permits were granted for private structures on the off-shore cays for the remainder of the 12-year period. At that time, there were 14 structures on the cays. No new structures or additions were to be permitted, and cay structures were to be removed after the 12-year period.

In 1989, the Corps of Engineers issued a Public Notice for after-the-fact permits involving 69 unauthorized structures and floating houses, 36 of which were located on off-shore cays. Thirty-three unauthorized structures were located along the shoreline, in addition to the 144 structures that were issued temporary permits in 1979. The Service issued a Biological Opinion that stated that the issuance of the after-the-fact permits would adversely modify designated critical habitat of the yellow-shouldered blackbird and would be likely to jeopardize the continued existence of the species.

The MOU was never successfully implemented. Inventories of structures that were conducted showed that structures continued to expand. Although cease and desist orders were issued, restoration has not been completed for most of the violations; only a few structures have been removed, and additional violations continue to occur. In 1994, the Service issued a Biological Opinion stating that the reconstruction of an unusable,

abandoned stilt house on Cayo La Gloria was likely to jeopardize the continued existence of the yellow-shouldered blackbird and would adversely modify designated critical habitat of the species. The utility lines for water and electrical power still run underwater from the shoreline and the remaining stilt homes on Cayo La Gloria are using these utilities.

The mooring of floating houses, construction of docks and stilt houses, development of utility lines, and accumulation of waste on cays may have direct and indirect impacts on yellow-shouldered blackbird nesting success. These impacts include: (1) clearing of mangroves that results in a decrease of essential nesting habitat and in an increase of habitat edge, attractive to shiny cowbirds; (2) an increase in rats; (3) an increase in feral cats and other predators, such as as the mongoose, being transported to cays; and, (4) the accumulation of above-ground waste that supports rat populations and allows foraging cowbirds greater access to nesting blackbirds. The construction of roads, boat ramps, catwalks, and stilt houses on the shoreline also results in many indirect impacts on yellow-shouldered blackbirds, foremost being the proliferation of future unauthorized human use and construction activity on the cays.

The disturbances caused by the extensive and intensive use of the 144 authorized structures, 30 to 40 unauthorized floating houses, additional unauthorized structures in the cays and the shoreline, boats, sailboats, and personal water craft and their impacts (direct, indirect, and cumulative) on the roosting areas in La Parguera have not been evaluated. Observations conducted by Department personnel (Ventosa, pers. comm.) suggest that yellow-shouldered blackbirds do not use cays with any kind of structures for roosting. Furthermore, they have observed that yellow-shouldered blackbirds periodically shifted mangrove cays for roosting, perhaps moving away from cays invaded by people.

If the population in Pitahaya continues growing, additional roosting and nesting areas will be needed in La Parguera. Restoration and preservation of these areas are vital for the recovery of the species. The Service believes that the present use of La Parguera waters, cays, and shoreline is incompatible with the needs of the species for roosting and nesting in the area.

The destruction of the blackbird's foraging and nesting habitat on the mainland for residential and tourist development, as well as for agricultural activities, continues in southwestern Puerto Rico. On September 17, 1992, an interagency meeting was conducted with the Department to discuss management problems and current threats to the species. The destruction of the species feeding, roosting, and breeding habitats was identified as the major threat to the species. More than 18 development projects were identified in three municipalities within the designated critical habitat for the species. Most of the projects were proposed as residential and tourist developments. All of them were proposed on privately-owned lands and could adversely affect the survival and recovery of the species. For some of the projects, earth movement has been initiated. Although these projects are located within the designated critical habitat area for the species, Federal funds, permits, or subsidies are not involved. Therefore, consultation under Section 7 of the Endangered Species Act is not required.

Nest Invasion by Caribbean Martins:

Although the shiny cowbird invaded a large number of yellow-shouldered blackbird nests between 1985 and 1988, that is not the case at the present time (Figure 6). After 1988, more yellow-shouldered blackbird nests have been invaded by Caribbean martins than by shiny cowbirds. In the early 1980s, Caribbean martins utilized the wood boxes that remained in the reproduction areas, although these boxes were very deteriorated. Upon installation of PVC structures in 1986, the yellow-shouldered blackbird moved completely to this type of structure. Since 1989, invasion of PVC structures by Caribbean martins has increased considerably. In 1993, all the yellow-shouldered blackbird nest invasions were by Caribbean martins. Although the wood boxes used by Caribbean martins for reproduction were relocated in 1990 at a distance from the PVC structures, the martins continue to use the blackbirds' nests. Caribbean martins were observed entering blackbird nests, displacing blackbirds, and stepping on the eggs until they were broken or buried in the nests (Department 1989).

Parasitism by Shiny Cowbirds:

In the 1970s and 80s, parasitism by shiny cowbirds was considered to be the principal factor contributing to the reduction of reproductive success of the yellow-shouldered blackbird and the most important threat to the survival of the species. At the present time, the prevalence (percentage of parasitized nests) of parasitism by shiny cowbirds has been reduced dramatically in the artificial structures (Figure 7). The Department completely controls parasitism in the PVC structures, removing all shiny cowbird eggs at the end of the incubation period and prior to hatching. The use of artificial nest structures, specifically PVC, has apparently caused a reduction in parasitism by shiny cowbirds. In 1995, only 5 percent of the nests were parasitized by shiny cowbirds.

Mortality Factors

If the data from the 11 years of study are combined, the disappearance of eggs and chicks, abandonment of nests with eggs and chicks, and nests taken by Caribbean martins are the three principal factors responsible for mortality in the artificial structures (Figure 8). If these mortality factors are separated by year, the following changes can be observed.

Figure 6. Parasitism by shiny cowbirds, Boqueron Commonwealth Forest, 1972 - 1995.

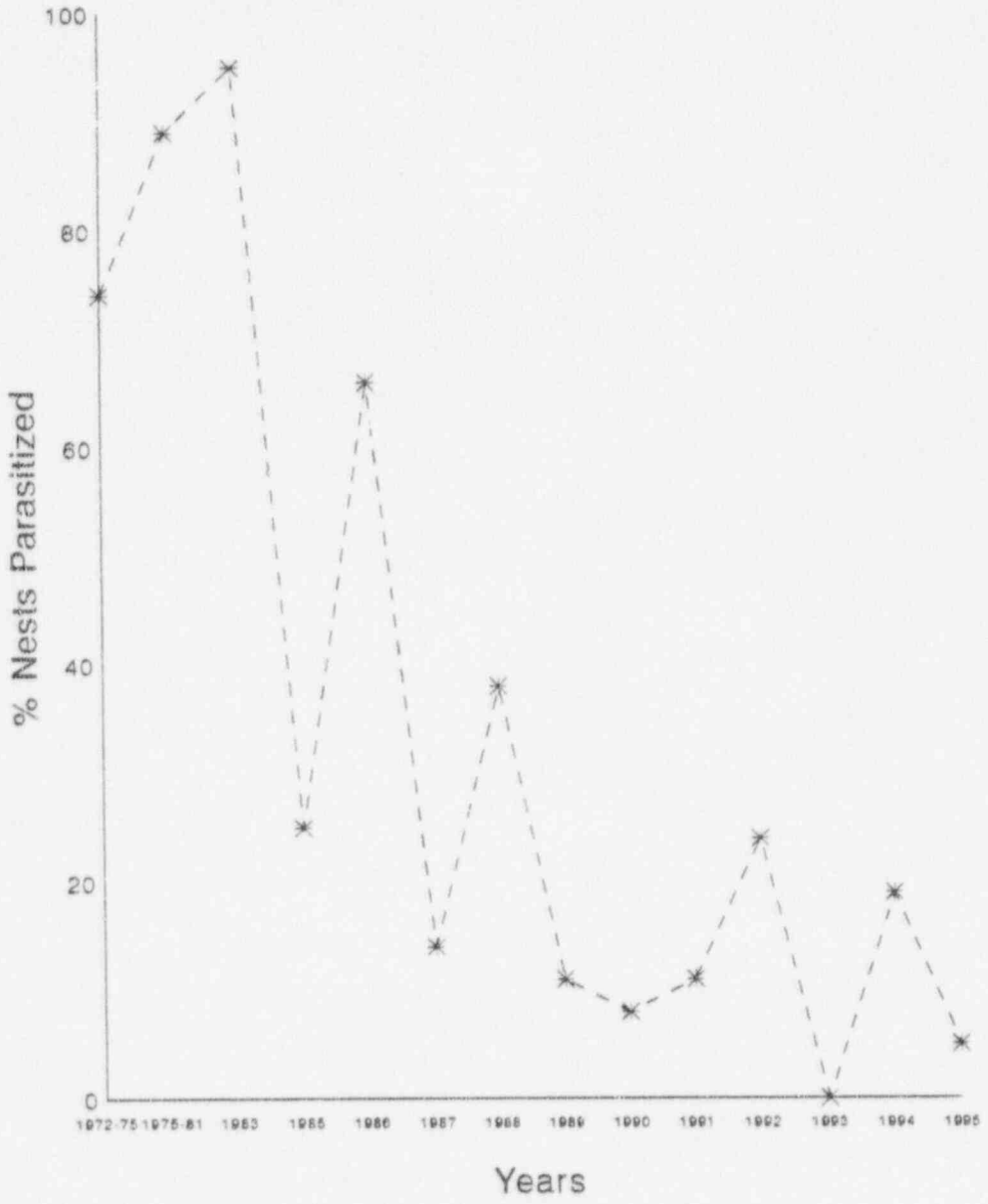


Figure 7. Nests invaded by shiny cowbirds and Caribbean Martins, Boqueron Commonwealth Forest, 1985-1995.

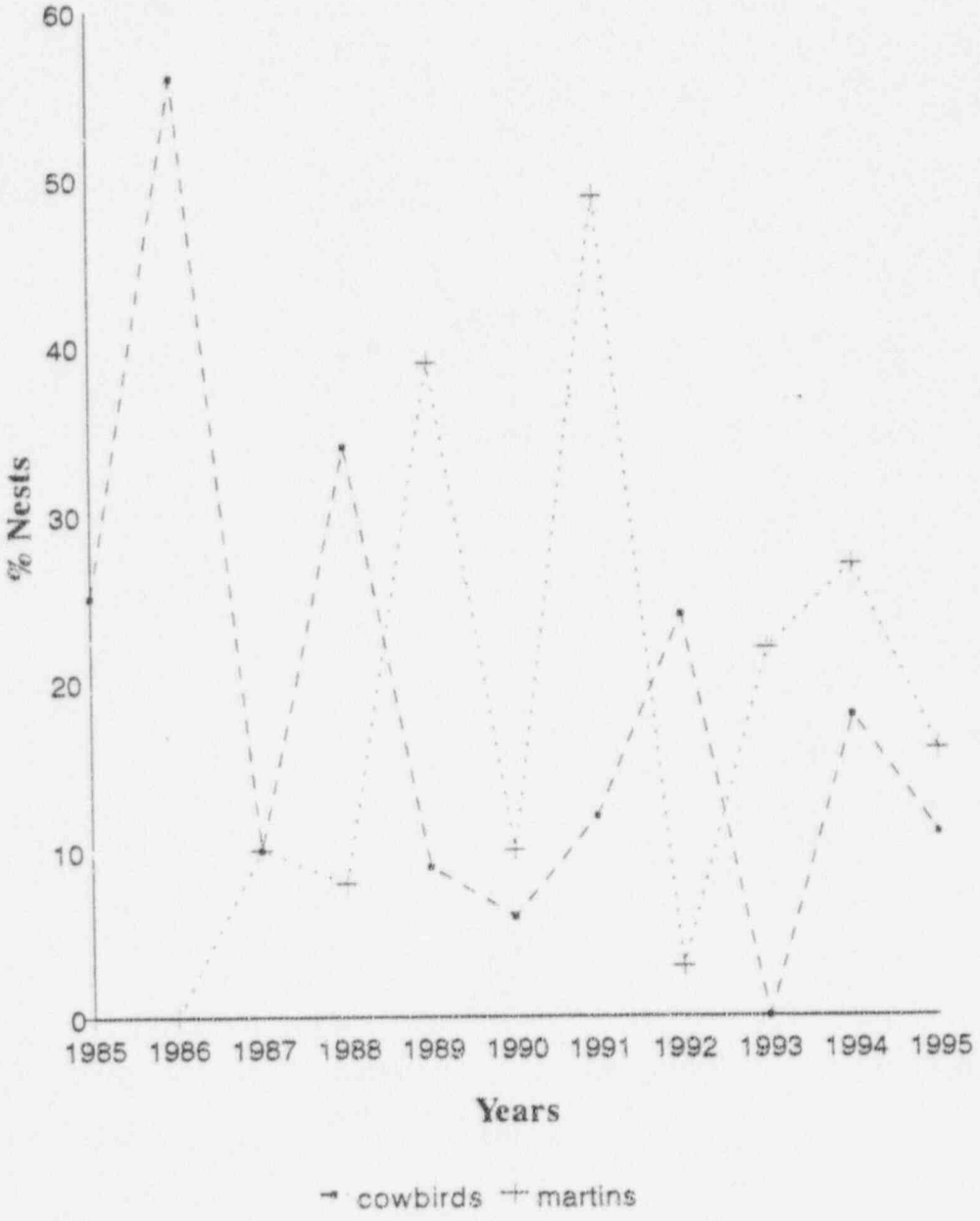
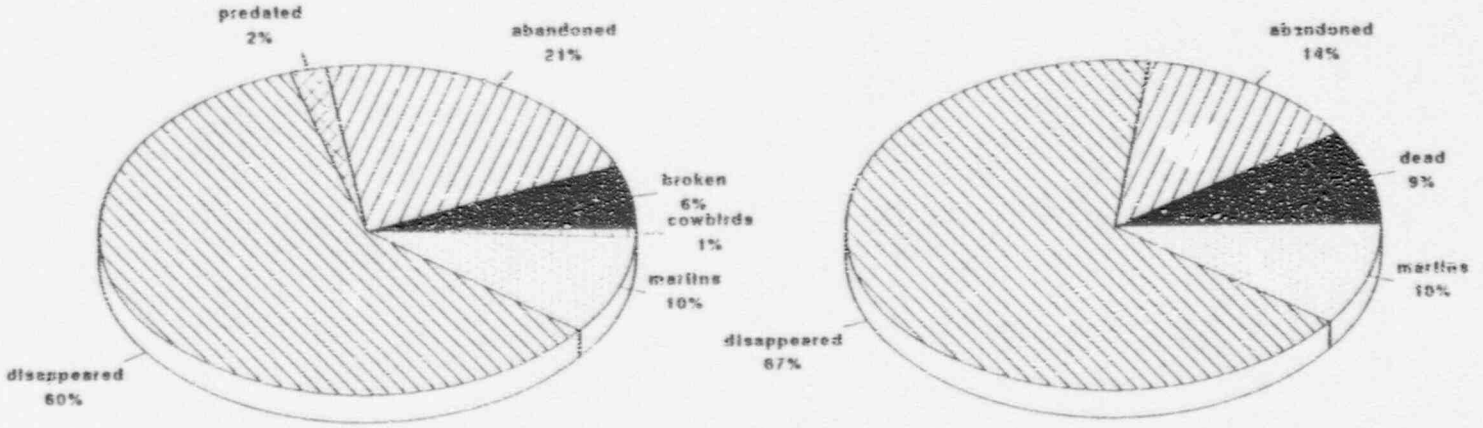


Figure 8. Mortality factors, Boqueron Commonwealth Forest, Combined Data.



Eggs

Chicks

Eggs:

During the first years of the project, when nesting occurred mostly in natural areas (mangroves and stumps), predation by rats was the principal cause of egg loss (Figure 9). When PVC structures became the principal type of nest structure utilized by the species, interference by Caribbean martins began and the number of punctured (broken) eggs increased, along with the disappearance and abandonment of eggs. Based on the project's final reports, broken eggs were mostly related to parasitism by shiny cowbirds; however, abandonment of eggs was mostly related to interference and disturbance by Caribbean martins. In 1993, forty-three eggs were abandoned in yellow-shouldered blackbird nests that were subsequently occupied by Caribbean martins. Disappearance of eggs was the principal factor that contributed to the loss of eggs since 1988. The disappearance of eggs may be related to invasion of the nest by Caribbean martins, nonhatched eggs removed by the blackbirds from the nests, and broken eggs hidden in the bottom of the nest.

Chicks:

Factors contributing to chick mortality varied with time (Figure 10). Death of chicks in the nests was primarily attributed to mite infestation. Treatment of nests with Sevin has eliminated this cause of death. Interference by Caribbean martins and abandonment of the nests and chicks by the parents have also contributed to the loss of chicks. Between 1991 and 1995, the majority of the losses were attributed to the disappearance of chicks. Because artificial structures are visited only one or two times per week, the possibility that some of these chicks may have fledged from the nest should not be discounted. Some of these chicks may have died in the nests and been removed by their parents. Because of the presence of excluding devices on the PVC structures, predation by rats is not a factor; however, predation by other birds may explain some of these disappearances. Intensive monitoring of these structures should be considered by project personnel to determine the reasons for these disappearances.

Conservation Efforts

Southwestern Puerto Rico:

Between 1973 and 1979, ninety-six nest boxes were placed in the BCF by the Service. In 1980, the Youth Conservation Corp of the Cabo Rojo National Wildlife Refuge built 80 new nest boxes and 12 cowbird traps to be placed and operated in the BCF. A cowbird trapping experiment was initiated in the BCF in 1980 (Wiley 1980). The

Figure 9. Percent of eggs lost, Boqueron Commonwealth Forest, 1985 - 1995.

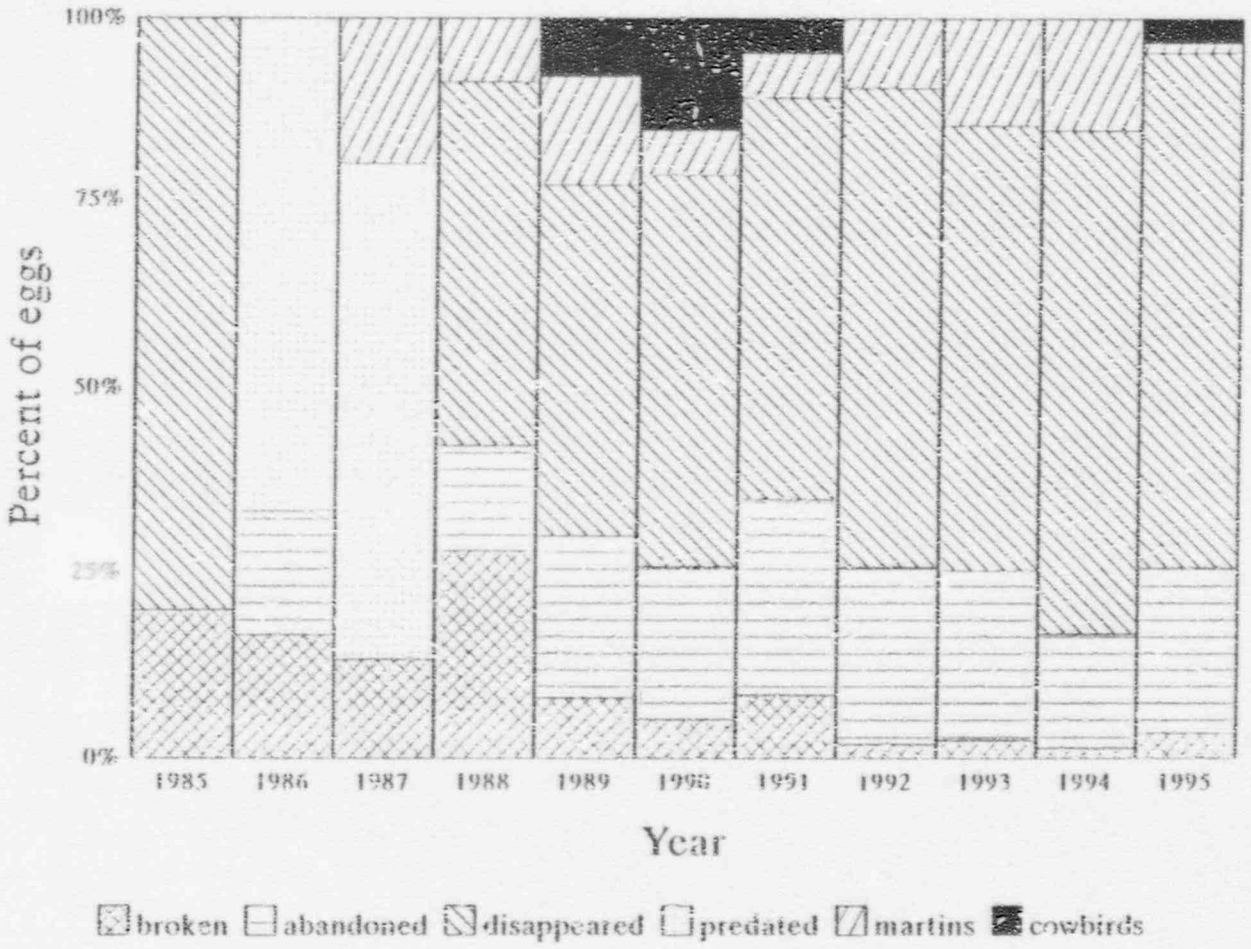
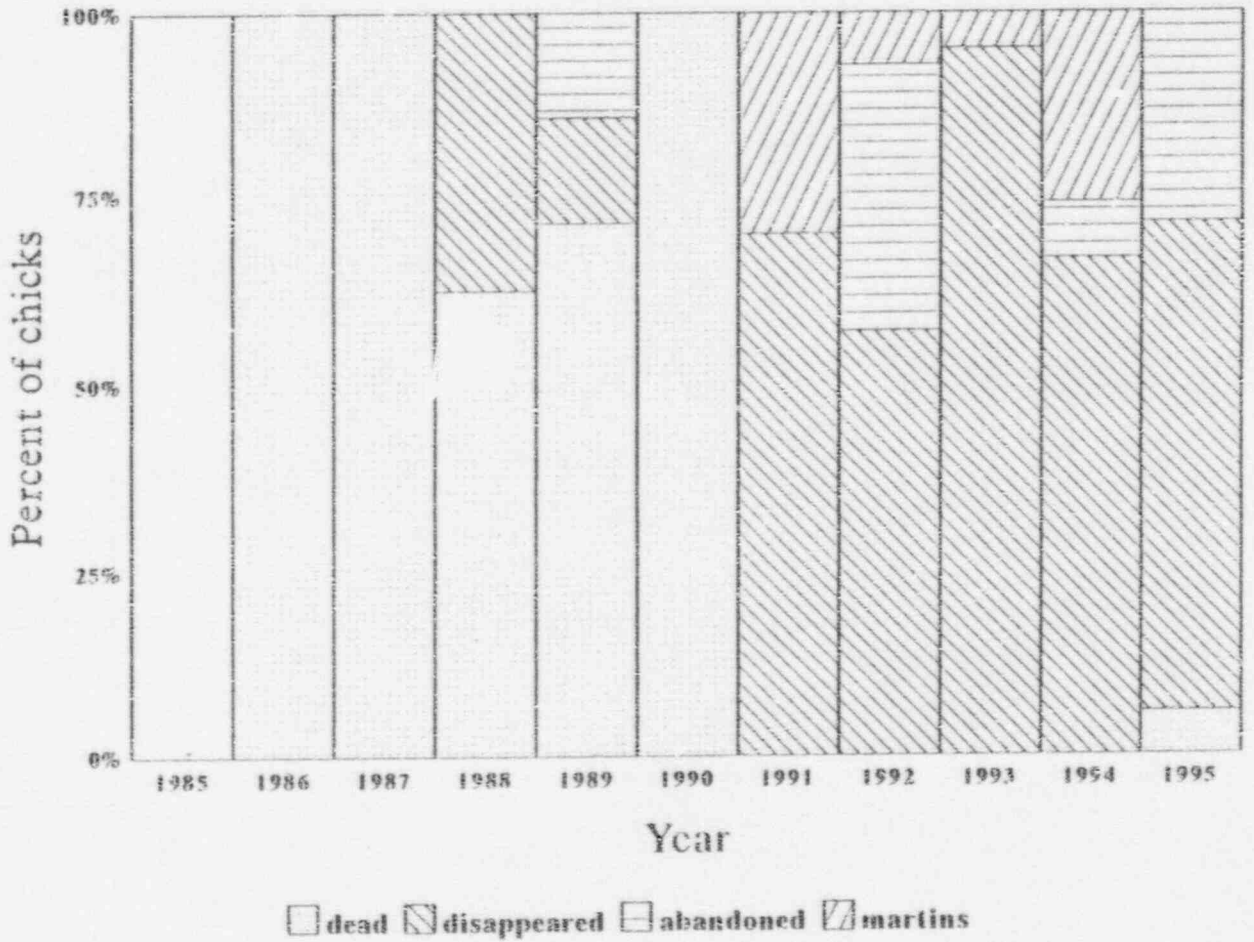


Figure 10. Percent of chicks lost, Boqueron Commonwealth Forest, 1985 - 1995.



The experiment resulted in higher blackbird nest success and productivity. The removal of all female cowbirds and the removal of all the cowbirds in the trap were most effective in improving blackbird reproductive success.

In 1982, the Service built 70 more nest boxes and supported a cowbird trapping program adjacent to known nesting areas in the BCF. In 1983, the yellow-shouldered blackbird program was transferred to the Department, and it has been conducted under their Section 6 Endangered Species program. To reduce parasitism, the Department has been capturing shiny cowbirds in 10 to 11 wire traps located in feeding and nesting areas since 1983. In the 11 years of the program, over 19,000 shiny cowbirds have been captured.

Although parasitism in the artificial structures has been reduced, the number of shiny cowbirds captured in the traps has remained relatively high, except for 1995, in which the number of cowbird trapped was reduced to 1,070 individuals (Figure 11).

RRNS:

In Ceiba, the U.S. Navy, in cooperation with the Service, established, an agreement in 1980 to minimize the impact of their activities on the yellow-shouldered blackbird. An experimental cowbird trapping project was first conducted at RRNS in 1978. Cowbird control projects were conducted on several occasions in RRNS between 1983 and 1987 (Wiley *et al.* 1983, Heisterberg *et al.* 1985, and Service 1987).

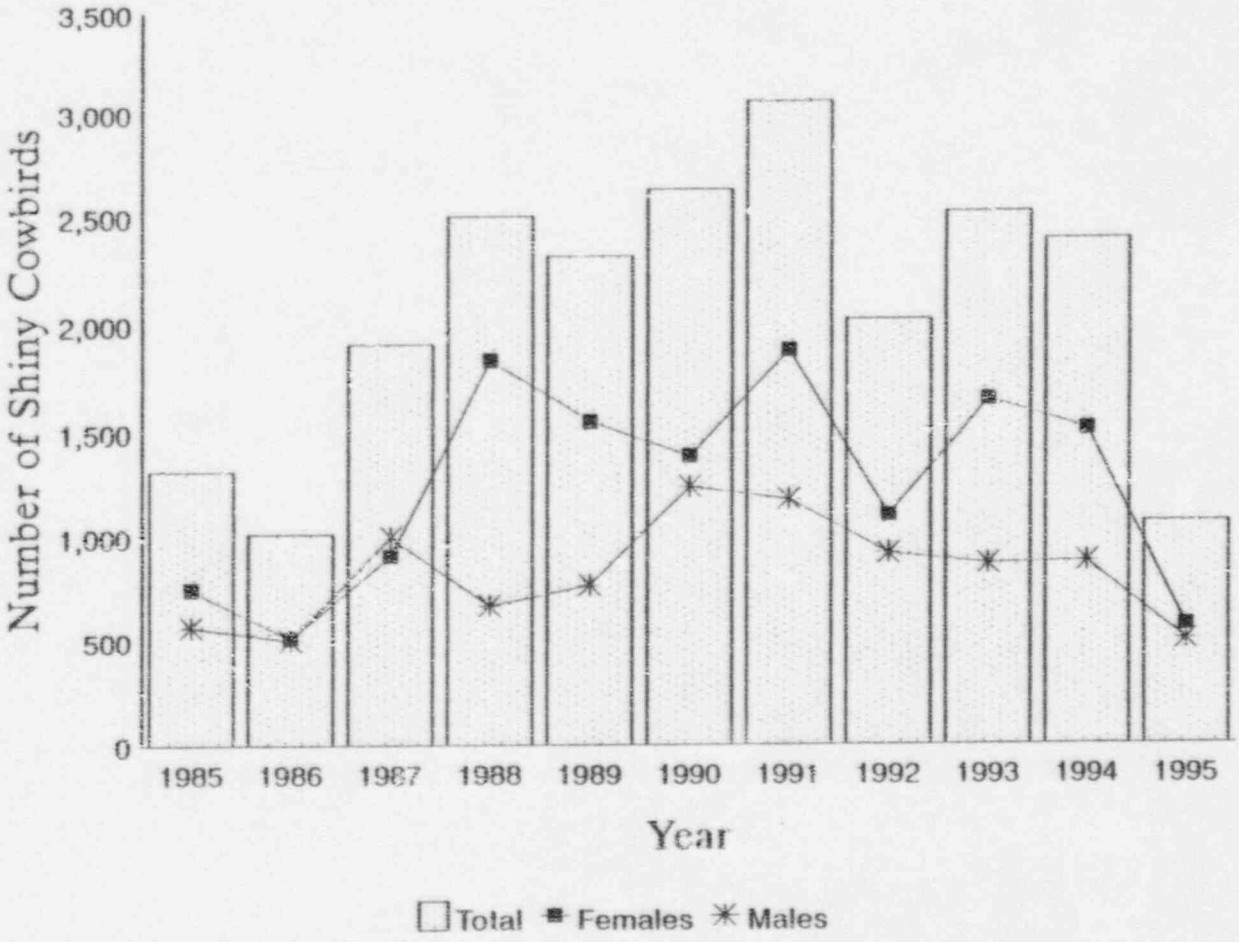
Summary of Comments Received

Copies of the Technical/Agency Draft Revision of the Yellow-shouldered Blackbird Recovery Plan were sent to 51 reviewers, including four peer reviewers, for review and comments. A notice of availability of the Technical/Agency Draft was published in the *Federal Register*. Twelve comment letters were received. Comments providing supplemental data have been incorporated into the appropriate sections of this plan.

The Atlantic Division of Naval Facilities Engineering Command in Virginia provided comments on the plan, and stated that prior to committing to a course of action, they would like additional information regarding the number of yellow-shouldered blackbirds needed to maintain a viable population at RRNS. They mentioned that the Navy was conducting a habitat study for the species, and according to preliminary findings, habitat in the base has increased over the last 15 years.

Dr. Joseph Wunderle, International Institute of Tropical Forestry, recommended that, given the risk of hurricanes and their limited range of damage, an effort should be made to spread yellow-shouldered blackbirds throughout the island. He proposed the use of models to evaluate this. He suggested the use of nesting boxes and translocation of birds into RRNS.

Figure 11. Shiny cowbirds trapped, Boqueron Commonwealth Forest, 1985 - 1995.



Dr. James Wiley recommended translocation of wild-caught blackbirds birds from BCF to other parts of the island, including RRNS. He also recommended management of translocated birds, including monitoring, nest site provisioning, and cowbird control.

The National Wildlife Health Center of the National Biological Service suggested a monitoring project for the yellow-shouldered blackbirds observed with pox lesions, including virus isolation or histopathology, because they mentioned that not all "lumps and bumps" are pox. In order to obtain an overall picture of the yellow-shouldered blackbird health, they recommended a systemic collection and evaluation of egg fertility, contaminant residue analysis, pox monitoring and necropsy of suitable carcasses. The Office of Prevention, Pesticides, and Toxic Substances of the Environmental Protection Agency recommended the evaluation of possible impacts of the application of pesticides on foraging blackbirds in agricultural fields.

II. RECOVERY

A. Recovery Objective

Objective: To downlist the species to threatened status.

Delisting recovery criteria cannot be set at this time because critical demographic information for a reliable population viability model is lacking. However, interim criteria, using a preliminary model were developed by Collazo *et al.* (1995), utilizing the following assumptions: (1) a recruitment rate of 0.18; (2) an adult survival rate of 0.82; (3) all adults attempt to breed at least once per year; (4) 2.3 fledglings per successful nests produced in non-parasitized nests; and (5) 1.8 fledglings per successful nests produced in parasitized nests.

In order to ensure a self-sustaining population in the BCF, the reproductive success should be enhanced to ≥0.96 daily survival for eggs and chicks, and parasitism rates should be reduced to ≤20 percent. These criteria should be maintained for at least 5 years in the artificial structures. There should also be additional documentation of population trends and adequate support habitat.

The criteria for delisting will be developed after modeling data are obtained from natural nests in the BCF and at least two additional areas in Puerto Rico, including Mona Island.

B. Narrative Outline

1. Protect and manage yellow-shouldered blackbird habitat. Preventing further habitat loss and degradation is essential to the recovery of the yellow-shouldered blackbird in Puerto Rico. Present habitat degradation has resulted in reduced availability of predator free nesting areas that are needed for successful nesting and of additional roosting areas that can support an increasing population.

   Based on our current knowledge, the priority for habitat protection should be given to nesting and roosting areas. Existing populations and their habitat should be appropriately protected and managed by public agencies, and the habitat enhanced for maximum breeding success. The protection of the species by private landowners is encouraged. Additional habitat protection must also be provided to areas required for species expansion and recovery. The protection of currently known breeding, roosting and feeding areas, as well as historic sites, must be given the highest priority. Protecting feeding and other support habitat for juveniles and non-nesting adults is also important.

   11. Develop and implement management plans for government-owned habitat. Management plans for the protection of existing breeding and roosting habitat at the BCF, Mona and Monito Islands, and RRNS should be developed and implemented. Although La Parguera is included in the BCF, it is designated and managed by the Department as a Natural Reserve. The plan should include the protection and management of the existing and historic roosting sites on the offshore cays of La Parguera, as well as the historic nesting sites. Regular patrolling of these areas, limiting recreational use, the removal of tourist houses on the cays, and predator control on the cays are examples of programs necessary to achieve protection of these areas. These cays were used by the species as breeding sites in the past and efforts need to be directed toward restoration of this use.

   12. Avoid vandalism and disturbance. The access road to the BCF, adjacent to the reproduction areas, should be closed and patrolled during the breeding season.

   13. Identify existing habitat on privately-owned lands and obtain protective status for it. An inventory of privately-owned lands currently used by the species should be conducted. Privately-owned sites should be protected through land acquisition, the establishment

of conservation easements, the development of habitat conservation plans, and the implementation of private land programs and landowner agreements.

2. Protect and manage yellow-shouldered blackbird populations. Yellow-shouldered blackbird populations must be monitored on a long-term basis in order to produce demographic data needed to determine the delisting recovery criteria for the species.

21. Enforce existing Federal and Commonwealth endangered species regulations. The Endangered Species Act of 1973, as amended, and the Commonwealth Department of Natural Resources Regulation to Govern the Management of Threatened and Endangered Species of 1985 provide for criminal penalties for illegal take of the species. Permits may be issued to carry out otherwise prohibited activities involving endangered wildlife species under certain circumstances.

Development projects which occur on privately or publicly-owned land may be funded through local or Federal agencies or require Federal or local permits. Section 10 of the regulation provides for consultation on endangered species which may be affected by a particular project, similar to Section 7 of the Federal Endangered Species Act. A Section 7 consultation would be necessary for any Federal action that might affect the species.

Permitting and funding agencies (both Commonwealth and Federal) should be made aware of the endangered status of the yellow-shouldered blackbird, the laws pertinent to the protection of the species, and their responsibilities pursuant to these laws.

22. Continue to gather information on distribution and abundance. Additional information concerning the distribution and abundance of the species can affect future management decisions and the development and implementation of recovery tasks. Censuses should be conducted on a regular basis in roosting and breeding areas to determine relative abundance of the species. Emphasis should be given to Pitahaya, La Parguera, RRNS, Salinas, and Mona and Monito islands. Counts should be conducted before, during, and after the nesting season.

23. Search for new populations. Islandwide searches for new populations should be conducted.

24. Search for natural nests. Natural nests should be located and monitored. Reproductive success and parasitism level on natural

nests should be determined and compared with artificial structures. Emphasis should be given to known breeding areas such as BCF (from Bahía Sucia, Cabo Rojo, to Bahía Montalva, Lajas, including offshore cays); coastal upland forests adjacent to the BCF and the Parguera Natural Reserve; RRNS; and Salinas.

25. Gather ecological information. Basic field observations on population biology, reproductive biology, feeding biology, movement patterns, food availability, and other aspects of life history should be conducted in currently known populations. Emphasis should be given to coastal forest areas in southwestern (Cabo Rojo and Lajas) and southern (Salinas) Puerto Rico.

26. Determine number of individuals and populations necessary to ensure species' stability, security, and self-perpetuation. As additional information is gathered, the number of individuals and population necessary to ensure species' stability, security and self-perpetuation should be determined. This will allow to establish more precise and realistic recovery criteria.

27. Characterize existing habitat. Characterization of the habitat preferred by the species for breeding, feeding, and roosting should be conducted.

28. Identify potential breeding, roosting, and feeding sites. Potential habitat for yellow-shouldered blackbirds should be identified. The results from characterization studies of known breeding, roosting, and feeding habitat, aerial-photo interpretation studies, as well as historical and anecdotal records should be utilized.

29. Conduct surveys in identified potential sites and ensure protection. Surveys should be conducted in identified sites. If yellow-shouldered blackbirds are discovered in a new site, surveys should be conducted to determine number of individuals and describe habitat use. Information on reproductive biology, feeding behavior, and other aspects of life history should be collected. Habitat assessments should be conducted on new sites.

If new sites are not already on protected land, steps must be taken to alter the status of such land in order to provide protection for new populations. Management plans for these new sites should be developed or modified, if existing, to include considerations for this species.

3. Monitor reproductive success in existing artificial nest structures. Continue the existing project on enhancement of reproductive success of the yellow-shouldered blackbird through the use of artificial structures in the BCF.

31. Develop and implement alternative management measures to increase nesting in natural habitat. Short-term and long-term measures should be developed, evaluated, and implemented in order to increase nesting in natural habitats and reduce the use of artificial structures.

32. Monitor reproductive success on artificial structures. Monitoring of reproductive success of yellow-shouldered blackbirds in existing artificial nest structures at Pitahaya, Cabo Rojo, should continue. Artificial structures with nests should be visited at least three times a week. Effects of parasitism by shiny cowbirds and martins should be evaluated.

33. Trap and destroy shiny cowbirds. Trapping and destroying of shiny cowbirds in blackbird nesting areas should be conducted during nesting season. Cowbird traps in shiny cowbird feeding areas should be operated only outside the nesting season.

34. Evaluate effects of trapping and destroying shiny cowbirds on reproductive success. Efforts should be directed to evaluating the effects of trapping and destroying cowbirds on the yellow-shouldered blackbird's reproductive success in both natural and artificial nests. Scientific data to support trapping and destroying efforts should be collected. Studies should be designed and conducted to determine whether trapping is indeed beneficial.

35. Evaluate effects of Caribbean martins on the reproductive success of the yellow-shouldered blackbird. Efforts should be directed to evaluating the effects of invasion by Caribbean martins on yellow-shouldered blackbird reproductive success in the artificial structures. Studies should be designed and conducted in order to address this mortality factor.

36. Control mites and rats. Dusting of active nests with Sevin should continue to provide control of mites in yellow-shouldered blackbird nests in artificial structures. To avoid predation by rats, excluder devices should be installed, repaired, or replaced, when needed, on artificial structures.

4. Incorporate the yellow-shouldered blackbird into existing education program. Both Federal (Service) and Commonwealth (Department) agencies are involved in informing the public on general conservation values, as well as on the importance of protecting endangered species and of adhering to Federal and local regulations. The yellow-shouldered blackbird should be included in brochures and slide presentations presented to local schools and organizations.

   Prudent use of the media (newspapers, magazines, radio, and television) is an effective means of educating the public. Brochures and posters stressing the importance of protecting the yellow-shouldered blackbird and its habitat should be prepared and distributed throughout schools, local communities, and at conservation activities.

III. LITERATURE CITED

Amadon, D. 1950. The Hawaiian honeycreepers (Aves, Drepanididae). Bull. Am. Mus. Nat. Hist. 95:151-262.

Barnes, V., Jr. 1946. The birds of Mona Island, Puerto Rico. Auk. 63:318-327.

Collazo, J.A., S.G. Williams, and G.L. Famsworth. 1995. Analysis of baseline data of yellow-shouldered blackbirds (*Agelaius xanthomus*) in southwestern Puerto Rico: implications for future research and recovery activities. Final Report to the Caribbean Field Office, U.S. Fish and Wildlife Service. 21 pp.

Cruz, A. and T.K. Nakamura. 1984. The 1983 nesting season of the yellow-shouldered blackbird (*Agelaius xanthomus*) in southwestern Puerto Rico. Report submitted to the Department of Natural Resources, Puerto Rico, and the United States Fish and Wildlife Service. 32 pp.

Cruz, A., T. Manolis, and J.W. Wiley. 1985. The shiny cowbird: a brood parasite expanding its range in the Caribbean region. Pp. 607-620 in Neotropical Ornithology. P.A. Buckley, M.S. Foster, E.S. Morton, R.S. Ridgely, and F.G. Buckley (eds.). Ornithological Monographs 36. American Ornithologists Union.

Cruz, A., J.W. Wiley, T.K. Nakamura, and W. Post. 1989. The shiny cowbird *Molothrus bonariensis* in the West Indian region - Biogeographical and ecological implications. Pp. 519-540 in Biogeography of the West Indies. C.A. Woods, Editor. Sandhill Crane Press. Gainesville, Florida.

Danforth, S.T. 1936. Los pájaros de Puerto Rico. Rand McNally and Co., New York.

Department of Natural Resources. 1985. Commonwealth of Puerto Rico Department of Natural Resources annual performance report for the project ES-1-7. Puerto Rico Endangered Species Program.

_____. 1986. Commonwealth of Puerto Rico Department of Natural Resources annual performance report for the project ES-1-7. Puerto Rico Endangered Species Program.

_____. 1987. Commonwealth of Puerto Rico Department of Natural Resources annual performance report for the project ES-1-7. Puerto Rico Endangered Species Program.

_____ _____. 1988. Commonwealth of Puerto Rico Department of Natural Resources annual performance report for the project ES-1-7. Puerto Rico Endangered Species Program.

_____. 1989. Commonwealth of Puerto Rico Department of Natural Resources annual performance report for the project ES-1-7. Puerto Rico Endangered Species Program.

_____. 1990. Commonwealth of Puerto Rico Department of Natural Resources annual performance report for the project ES-1-7. Puerto Rico Endangered Species Program.

_____. 1991. Commonwealth of Puerto Rico Department of Natural Resources annual performance report for the project ES-1-7. Puerto Rico Endangered Species Program.

_____. 1992. Commonwealth of Puerto Rico Department of Natural Resources annual performance report for the project ES-1-7. Puerto Rico Endangered Species Program.

_____ _____. 1993. Commonwealth of Puerto Rico Department of Natural Resources annual performance report for the project ES-1-7. Puerto Rico Endangered Species Program.

_____. 1994. Commonwealth of Puerto Rico Department of Natural Resources annual performance report for the project ES-1-7. Puerto Rico Endangered Species Program.

_____. 1995. Commonwealth of Puerto Rico Department of Natural Resources annual performance report for the project ES-1-7. Puerto Rico Endangered Species Program.

Grayce, R.L. 1957. Range extensions in Puerto Rico. Auk 74:106.

Heisterberg, J.F., F. Núñez-García, and A. Díaz-Pérez. 1985. Evaluating shiny cowbird control techniques in eastern Puerto Rico: A progress report on work conducted June-September 1985. Denver Wildlife Research Center. Bird Damage Research Report No. 354.

Hernández-Prieto, E. 1993. Ecological comparison of the landbird fauna of two subtropical dry forests in the West Indies. Ph.D Dissertation. University of Colorado. 406 pp.

Hernández-Prieto, E. and A. Cruz. 1987. The yellow-shouldered blackbird on Mona Island - summer of 1986 field season. Report submitted to the Department of Natural Resources, Puerto Rico, and the United States Fish and Wildlife Service. 36 pp.

_____. 1989. The Mona Island yellow-shouldered blabkbird project: 1987-1988 season report. Report submitted to the Department of Natural Resources, Puerto Rico, and the U.S. Fish and Wildlife Service. 28 pp.

Hernández-Prieto E. and M. González-Román. 1990. The yellow-shouldered blackbird (*Agelaius xanthomus monensis* Barnés) on Monito Island, Puerto Rico. Ornitol. Carib. 3:54-55.

Kepler, C.B. and A.K. Kepler. 1970. Preliminary comparison of bird diversity and density in Luquillo and Guánica forests. Chapter E-14 in "A Tropical Rain Forest: A study of irradiation and ecology at El Verde", H.T. Odum and R.F. Pigeon (eds.). U.S. Atomic Energy Commission, Oak Ridge, TN.

Kuns, M.L., T.P. Griffin, T. Brenner and W.E. Pippin. 1965. Ecological and epidemiological studies of Mona Island, Puerto Rico. U.S.A.F. Air Providing Grownd Command, Air Eglin Air Force Base, Florida.

Leopold, N.F. 1963. Checklist of birds of Puerto Rico and the Virgin Islands. University of Puerto Rico Agricultural Experiment Station - Bulletin 168, Río Riedras, Puerto Rico.

Lewis, A. 1982. Letter to Refuge Manager, Caribbean Islands National Wildlife Refuges, Boquerón, Puerto Rico. Dated August 10, 1982.

McKenzie, P.M. and R.E. Noble. 1990. Habitat use, movements, and behavior of shiny cowbirds in Southwestern Puerto Rico. Report submitted to the U.S. Fish and Wildlife Service, Caribbean National Wildlife Refuges, as part of a final report under Contract Number 14-16-009-1561.

Pérez-Rivera, R.A. 1980. Algunas notas sobre la biología y "status" de la Mariquita (*Agelaius xanthomus*), con especial énfasis en la subespecie de Mona. Memorias del segundo coloquio sobre la fauna de Puerto Rico. Univ. Puerto Rico, Humacao. Pp. 54-63.

_____. 1982. Letter to Regional Director, Fish and Wildlife Service, Atlanta, Georgia. Dated July 20, 1982.

_____. 1983. Sobre el status de la Mariquita de Mona (*Agelaius xanthomus*). Memorias del cuarto simposio sobre la fauna de Puerto Rico y el Caribe. Univ. Puerto Rico, Humacao. Pp. 54-63.

Post, W. 1981a. Biology of the yellow-shouldered blackbird - *Agelaius* on a tropical island. Bull. Florida State Mus., Biol. Sci. 26(3):125-202.

_____. 1981b. The prevalence of some ectoparasites, diseases and abnormalities in the yellow-shouldered blackbird. J. Field Ornithology 52:16-22.

Post. W. And A. Cruz. 1993. The north american invasion pattern of the shiny cowbird. J. Field Ornithology 64:32-41.

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

_____. 1977a. The shiny cowbird in the West Indies. Condor 79:119-121.

_____. 1977b. Reproductive interactions of the shiny cowbird and the yellow-shouldered blackbird. Condor 79:176-184.

Raffaele, H.A. 1973. Assessment of Mona Island avifauna. Pp. 1-32 in Mona and Monito Islands - an assessment of their natural and historical resources. Junta de Calidad Ambiental, Puerto Rico

Raffaele, H.A. 1989. A guide of the birds of Puerto Rico and the Virgin Islands. Princeton University Press, New Jersey.

Taylor, E.C. 1864. Five months in the West Indies. Part II, Martinique, Dominica, and Porto Rico. Ibis 6:157-173.

U.S. Fish and Wildlife Service. 1976. Determination of the yellow-shouldered blackbird as an endangered species and designation of critical habitat. *Federal Register* 41:51019-510122.

_____. 1978. Annual progress report: Status and distribution of the yellow-shouldered blackbird in Puerto Rico. Study plan 1 of work unit 2 of Project P-H-V- Endangered and Threatened Species of the Caribbean. U.S. Fish and Wildlife Service, Patuxent Wildlife Reseach Center, Laurel, Maryland.

_____. 1987. Report of the cowbirds control project in Roosevelt Roads, Ceiba, Puerto Rico. U.S. Fish and Wildlife Service, Caribbean Field Office.

_____. 1989. Annual progress report: Development of control methods for the shiny cowbird. Study plan 3 of work unit 2 of Project P-H-V-Endangered and Threatened Species of the Caribbean. U.S. Fish and Wildlife Service, Patuxent Wildlife Reseach Center, Laurel, Maryland.

_____. 1991. An ecological evaluation of some marine and terrestrial systems at Ceiba and Vieques Island after Hurricane Hugo: Fiscal Year 1990-1991. Prepared for the Environmental Engineering Division, U.S. Naval Station, Ceiba, Puerto Rico.

Wetmore, A. 1916. Birds of Porto Rico. U.S. Dept. Agric. Bul. 326:1-140.

_____. 1927. The birds of Porto Rico and the Virgin Islands. New York Acad. Sci. Scienific Survey of Puerto Rico and the Virgin Islands 9:409-571.

Whittaker, F.H., G.D. Schmidt, and J. García-Díaz. 1970. Helminth parasites of some birds in Puerto Rico. Proc. Helminth. Soc. Wash. 37(1):123-124.

Wiley, J.W. 1980. Development of control methods for the glossy cowbird. Ann. Rept. Patuxent Wild. Research Center. 15 pp.

Wiley, J.W. 1987. Shiny cowbird parasitism in two avian communities in Puerto Rico. Condor 87:165-176.

Wiley, J.W., E. Litovich, and F. Núñez-García. 1983. Progress on the shiny cowbird control program in eastern Puerto Rico. Unpublished U.S. Fish and Wildlife Service Report.

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

IV. IMPLEMENTATION

The following Implementation Schedule outlines actions and estimated costs for the recovery of the yellow-shouldered blackbird over the next 3 years, begining in 1997.

Key to Implementation Schedule column 1:

Priority 1: Those actions that must be taken to prevent extinction or to prevent the species from declining irreversibly in the foreseeble future.

Priority 2: Those actions that must be taken to prevent a significant decline in species population/habitat quality or some other significant negative impact short of extinction.

Priority 3: All other actions necessary to provide for full recovery of the species

Key to Agency Designations in columns 5 and 6:

FWS - U.S. Fish and Wildlife Service
R4 - FWS Region 4
ES - FWS Division of Ecological Services
LE - FWS Division of Law Enforcement
DNER - Puerto Rico Department of Natural and Environmental Resources
RRNS - Roosevelt Roads Naval Station
UNIV - Universities
Org. - Conservation Organizations

IMPLEMENTATION SCHEDULE FOR THE YELLOW-SHOULDERED BLACKBIRD REVISED RECOVERY PLAN

Task Priority	Task Number	Task Description	Task Duration	Responsible Organization FWS	Other	Cost Estimates FY 1	FY 2	FY 3	Comments
1	11.	Develop and implement management plans for government-owned habitat.	Annual	R4, ES	DNER, RRNS				No costs anticipated.
1	12.	Avoid vandalism and disturbance.	Annual	R4, ES	DNER				No costs anticipated.
1	13.	Identify existing habitat on privately-owned lands and obtain protective status for it.	Annual	R4, ES	DNER, UNIV, Org.				Costs cannot be determined at this time.
1	21.	Enforce existing Federal and Commonwealth endangered species regulations.	Ongoing	R4, ES, LE	DNER, RRNS				No costs anticipated.
1	22.	Continue to gather information on distribution and abundance.	Ongoing	R4, ES	DNER, RRNS, UNIV, Org.	10	15	20	Costs include Task 23.
1	23.	Search for new populations.	Annual	R4, ES	DNER, RRNS, UNIV, Org.				
1	24.	Search for natural nests.	Annual	R4, ES	DNER, RRNS, UNIV, Org.	10	10	10	
1	25.	Gather ecological information.	Annual	R4, ES	DNER, RRNS, UNIV, Org.	25	25	25	
1	26.	Determine the number of individuals and populations necessary to ensure species' stability, security, and self-perpetuation.	Annual	R4, ES	DNER, UNIV	20			

Task Priority	Task Number	Task Description	Task Duration	Responsible Organization FWS	Other	Cost Estimates FY 1	FY 2	FY 3	Comments
1	27.	Characterize existing habitat.	Annual	R4, ES	DNER, RRNS, UNIV, Org.	10	10		
1	31.	Develop and implement alternative management measures to increase nesting in natural habitat.	Ongoing	R4, ES	DNER, UNIV	10	10	10	
1	32.	Monitor reproductive success on artificial structures.	Ongoing	R4, ES	DNER	15	15	15	
1	33.	Trap and destroy shiny cowbirds.	Ongoing	R4, ES	DNER	14	14	14	
1	34.	Evaluate effects of trapping and destroying shiny cowbirds on reproductive success.	Ongoing	R4, ES	DNER	10	10	10	Costs include Task 35.
1	35.	Evaluate effects of Caribbean martins on reproductive success of the yellow-shouldered blackbird.	Ongoing	R4, ES	DNER, UNIV				
1	36.	Control mites and rats.	Ongoing	R4, ES	DNER				
2	28.	Identify potential breeding, roosting, and feeding sites.	Annual	R4, ES	DNER, UNIV	10	10		
2	29.	Conduct surveys in identified potential sites and ensure protection.	Annual	R4, ES	DNER	10	10	10	
2	4.	Incorporate the yellow-shouldered blackbird into existing education program.	Ongoing	R4, ES	DNER, RRNS				

V. LIST OF REVIEWERS

Dr. Pedro Gelabert
Secretary
Department of Natural and Environmental Resources
P.O. Box 5887
San Juan, PR 00906

Mr. José Chabert
Terrestrial Ecology Section
Department of Natural and Environmental Resources
P.O. Box 5887
San Juan, PR 00906

Mr. Vicente Quevedo
Natural Heritage Program
Department of Natural and Environmental Resources
P.O. Box 5887
San Juan, PR 00906

Mr. Edgardo González
Forest Service Area
Department of Natural Resources
P.O. Box 5887
San Juan, PR 00906

Mr. Eduardo Ventosa
Proyecto Recuperación de la Mariquita
Departamento Recursos Naturales y Ambientales
P.O. Box 5887
San Juan, PR 00906

Mr. Robert Matos
Division of Refuges and Reserves
Department of Natural and Environmental Resources
P.O. Box 5887
San Juan, PR 00906

Ms. Iris Alameda
Refugio de Aves de Boquerón
Division of Refuges and Reserves
Department of Natural and Environmental Resources
P.O. Box 5887
San Juan, PR 00906

Ms. Carmen D. Guzmán
Parguera Natural Reserve
Division of Refuges and Reserves
Department of Natural and Environmental Resources
P.O. Box 5887
San Juan, PR 00906

Mr. Geraldo Hernández
Boqueron Commonwealth Forest
Forest Service Area
Department of Natural and Environmental Resources
P.O. Box 5887
San Juan, PR 00906

Mr. Miguel Canals
Guánica Commonwealth Forest
Forest Service Area
Department of Natural and Environmental Resources
P.O. Box 5887
San Juan, PR 00906

Ms. Carmen González
JOBANER Natural Reserve
Department of Natural and Environmental Resources
P.O. Box 5887
San Juan, PR 00906

Mr. Carlos Pagán
Mayaguez Regional Office
Box 1600
Mayaguez, PR 00680

Comandante Edwin Pérez
Department of Natural and Environmental Resources
P.O. Box 5887
San Juan, PR 00906

Ms. Doris Betancourt
Acting Director
Department of Biology
Mayagüez Campus - UPR
P.O. Box 5000
Mayagüez, PR 00681

Ms. Ana María Vera
Fundación Puertorriqueña de Conservación
Calle O' Neill number 11
Hato Rey, PR 00918

Mr. Francisco Javier Blanco
Fideicomiso de Conservacion de Puerto Rico
P.O. Box 4747
San Juan, PR 00902-4747

Mr. Francisco Ferrer
Sociedad de Historia Natural de Puerto Rico
Apartado 361036
San Juan, PR 00936

Ms. Agnes Mojica, Chancelor
Interamerican University
San Germán Campus
San Germán, PR 00683

Dr. Ariel Lugo
Institute of Tropical Forestry
U.S. Forest Service
Call Box 25000
Río Piedras, PR 00928

Ms. Suzette Delgado
Servicios Científicos y Técnicos
Cond. El Centro, Oficina 1401
San Juan, PR 00936

Mr. Agustín P. Valido
U.S. Fish and Wildlife Service
P.O. Box 1600
Río Grande, PR 00745

Environmental Protection Agency
Hazard Evaluation Division - EEB (TS769C)
401 M Street, SW.
Washington, DC 20460

Mr. Carl A. Soderberg, Director
U.S. Environmental Protection Agency
Caribbean Field Office
1413 Fernández Juncos Avenue, Office 2A
Santurce, PR 00909

Lt. Col. Chester D. Fowler
Deputy District Engineer
U.S. Army Corps of Engineers
400 Fernandez Juncos Avenue
San Juan, PR 00906

Mr. Héctor Russé Martínez
President
Environmental Quality Board
P.O. Box 11488
Santurce, PR 00907-08

Ms. Norma E. Burgos
President
Puerto Rico Planning Board
P.O. Box 41119
San Juan, PR 00940

U.S.D.A. Soil Conservation Service
Caribbean Area Service
P.O. Box 364868
San Juan, PR 00936-4868

Mr. Nelson Castellanos
Federal Highway Administration
Federal Building - Room 329
159 Carlos Chardón Avenue
Hato Rey, PR 00918

Ms. Ileana Echegoyen
State Director
Farmer's Home Administration
GPO Box 6106-G
San Juan PR 00936

Housing and Urban Development
Caribbean Office
159 Carlos Chardon Avenue
Hato Rey, PR 00918-1804

Hon. Santos Ortíz, Mayor
Municipality of Cabo Rojo
P.O. Box 1308
Cabo Rojo, PR 00623

Hon. José Rivera Nazario, Mayor
Municipality of Lajas
P.O. Box 910
Lajas, PR 00667

Hon. Manuela Santiago, Mayor
Municipality of Vieques
P.O. Box 154
Vieques, PR 00765

Hon. Edwin Galarza, Mayor
Municipality of Guánica
P.O. Box 785
Guanica, PR 00653

Hon. Jorge A. Ramos Comas
Mayor
Municipality of San German
Box 85
San Germán, PR 00683

Hon. Basilio Baerga, Mayor
Municipality of Salinas
Box 1149
Salinas, PR 00751

Dr. Enrique Hernández-Prieto (*)
Biology Department
University of Puerto Rico
Humacao Campus
Humacao, PR 00971

Dr. Carlos A. Delannoy
Biology Department
University of Puerto Rico - RUM
P.O. Box 5000
Mayagüez, PR 00681

Mr. Raúl Pérez Rivera
Biology Department
University of Puerto Rico
Humacao Campus
Humacao, PR 00971

Dr. Alex Cruz (*)
Department of EPO Biology
B-334
University of Colorado
Boulder, CO 80309-0334

Dr. James Wiley (*)
2201 Ashland Street
Ruston, LA 71270

Herbert A. Raffaele
5232 Cherokee Avenue
Alexandria, VA 22312

Mr. Carlos A. Díaz
Federal Aid Program
U.S. Fish and Wildlife Service
1875 Century Boulevard
Atlanta, GA 30345

Fernando Núñez-García
U.S. Fish and Wildlife Service
P.O. Box 1600
Río Grande, PR 00745

Dr. Allen Lewis
Biology Department
University of Puerto Rico - RUM
P.O. Box 5000
Mayagüez, PR 00681

Dr. William Post (*)
The Charleston Museum
360 Meeting Street
Charleston, SC 29403

Mr. Shaw Davis
Refuge Manager
Caribbean Islands National Widlife Refuges
P.O. Box 510
Boquerón, PR 00622

Dr. Joseph Wunderle, President
Caribbean Ornithological Society
U.S. Forest Service
Call Box 25000
Río Piedras, PR 00928

Dr. Jaime A. Collazo
NC Coop Fish and Wildlife Unit
Box 7617, NCSU
Raleigh, NC 27695-7617

Dr. Francisco Vilella
Mississippi State University
School of Forest Resources
Forest and Wildlife Research Center
Mississippi State, MS 39762

(*) - PEER REVIEWERS

APPENDIX I

Table 5. Mayfield estimates of reproductive success of Yellow-shouldered Blackbirds in southwestern Puerto Rico, 1989,1992,1993,1994.

Incubation Period	Number of nests lost	Number of nest exposure days	Number of successful nests	Number of nests	Daily survival rate	S.E. of daily survival rate	Survival rate	S.E. of survival rate
1989	4	154	13	17	0.974	0.013	0.712	0.104
1992	8	1104	93	101	0.993	0.003	0.910	0.029
1993	17	1264.5	119	136	0.987	0.003	0.840	0.034
1994	16	696	57	73	0.977	0.006	0.741	0.052
total	45	3218.5	282	327	0.986	0.002	0.834	0.022

Nestling Period	Number of nests lost	Number of nest exposure days	Number of successful nests	Number of nests	Daily survival rate	S.E. of daily survival rate	Survival rate	S.E. of survival rate
1989	0	164	12	12	1.000	0.000	1.000	0.000
1992	8	1009	53	61	0.992	0.003	0.890	0.035
1993	8	1262	66	74	0.994	0.002	0.911	0.029
1994	2	629	39	41	0.997	0.002	0.954	0.031
total	18	3064	170	188	0.994	0.001	0.917	0.018

Entire Nest Period	Number of nests lost	Number of successful nests	Number of nests	Survival rate	S.E. of survival rate
1989	4	12	19	0.712	0.147
1992	16	53	101	0.810	0.062
1993	25	66	136	0.765	0.060
1994	18	39	74	0.707	0.085
total	63	170	330	0.765	0.038

[1]Length of incubation period, 12.9 days; length of nestling period, 14.7 days (Wiley, pers. comm.).

APPENDIX II

Chart 5. Point estimates of a deterministic demographic model for the southwestern population of the Yellow-shouldered Blackbirds, Puerto Rico.

Yellow-shouldered Blackbird

Input parameters:

	eggs	chicks
Daily Surv	0.98	0.98
dens. factor	0	
fledglings per succ. nest		
w/o c. birds		2.3
w/cowbirds		1.8
% of nests parasitized		0.05
Prop. of adults not nesting.		0
Adult surv.		0.82
Juvenile survival		0.18
Prop. of succ. nesters to attempt a re-nest		0.6

Output:

Model	Prop of all adults to fledge	Total Productivity	Day to break even
Single Brood	0.56	2.19	102
Double Brood	0.41	3.12	86
Probability to fledge 1 nest for a nester			0.96
2 nests			0.41
Break even productivity		2	

Unchangeable parameters:

	Days
laying period	2
incubation	13
nestling stage	15
length of breeding season	150
delay after failed nest	10
delay aftersuccessful nest	25

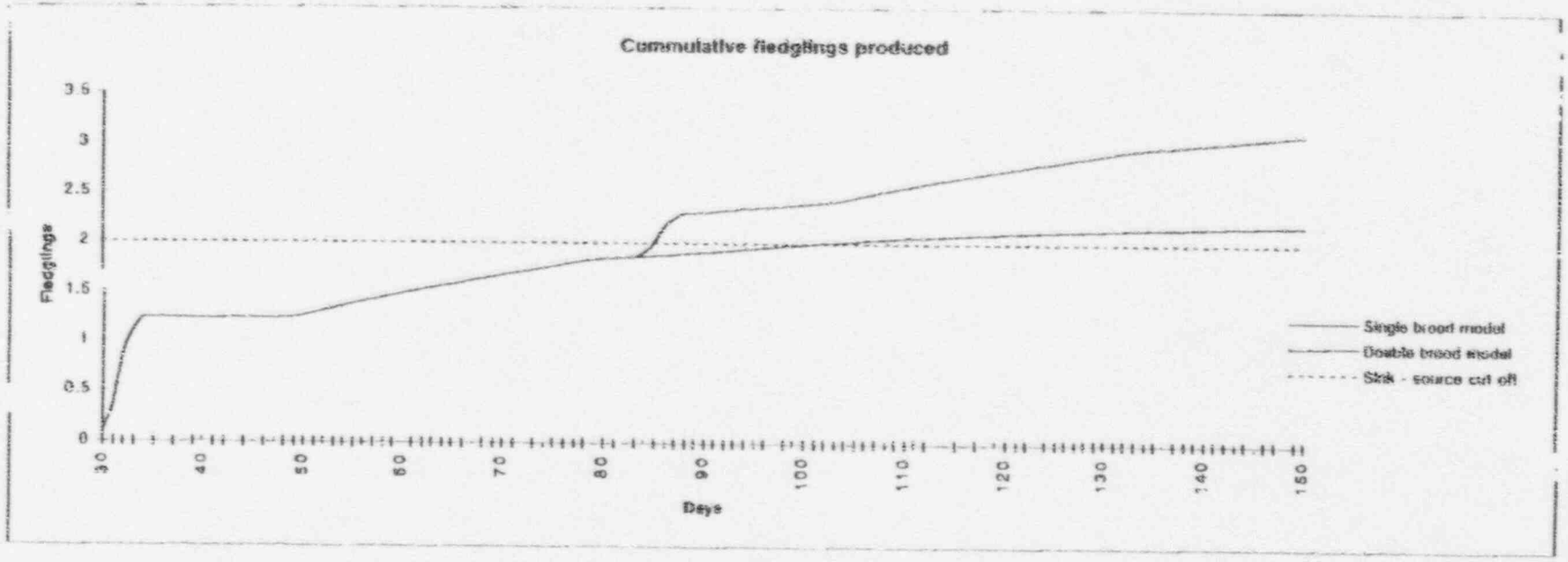


Chart 6. Point estimates of a deterministic demographic model for the southwestern population of the Yellow-shouldered Blackbirds, Puerto Rico.

Yellow-shouldered Blackbird

Input parameters:

	eggs	chicks
Daily Surv	0.98	0.98
dens. factor	0	
fledglings per succ. nest		
w/o c. birds		2.3
w/cowbirds		1.8
% of nests parasitized		0.45
Prop. of adults not nesting		0
Adult surv.		0.82
Juvenile survival		0.18
Prop. of succ. nesters to attempt a re-nest		0.6

Output:

Model	Prop of all adults to fledge	Total Productivity	Day to break even
Single Brood	0.96	2.09	150
Double Brood	0.41	2.84	87
Probability to fledge 1 nest for a nester			0.96
2 nests			0.41
Break even prodctivity		2	

Unchangeable parameters:

	Days
laying period	2
incubation	13
nestling stage	15
length of breeding season	150
delay after failed nest	18
delay aftersuccessful nest	25

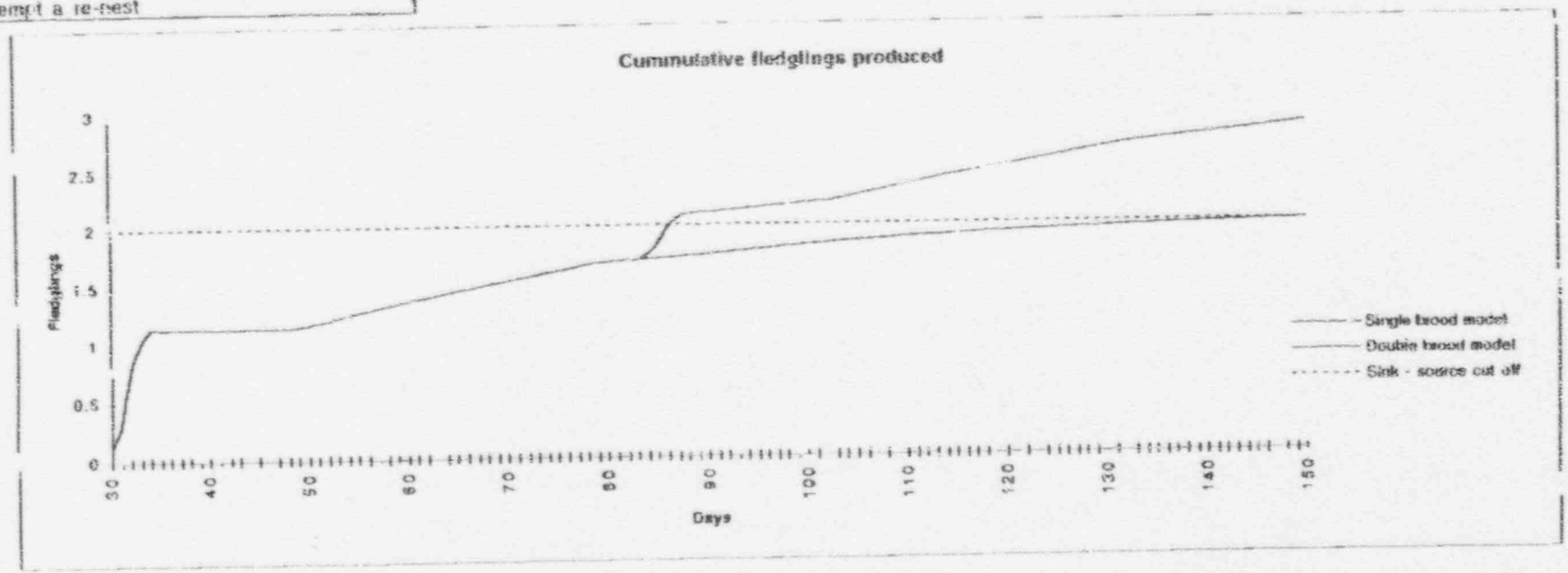


Chart 7. Point estimates of a deterministic demographic model for the southwestern population of the Yellow-shouldered Blackbirds, Puerto Rico.

Yellow-shouldered Blackbird

Input parameters:

	eggs	chicks
Daily Surv	0.96	0.98
dens. factor	0	
fledglings per succ. nest		
w/o c. birds		2.3
w/cowbirds		1.6
% of nests parasitized		0.3
Prop. of adults not nesting.		0
Adult surv.		0.82
Juvenile survival		0.18
Prop. of succ. nesters to attempt a re-nest		0.6

Output:

Model	Prop of all adults to fledge	Total Productivity	Day to break even
Single Brood	0.91	1.95	Never
Double Brood	0.30	2.59	108
Probability to fledge 1 nest for a nester			0.91
2 nests			0.30
Break even prodctivity		2	

Unchangeable parameters:

	Days
laying period	2
incubation	13
nestling stage	15
length of breeding season	150
delay after failed nest	18
delay aftersuccessful nest	25

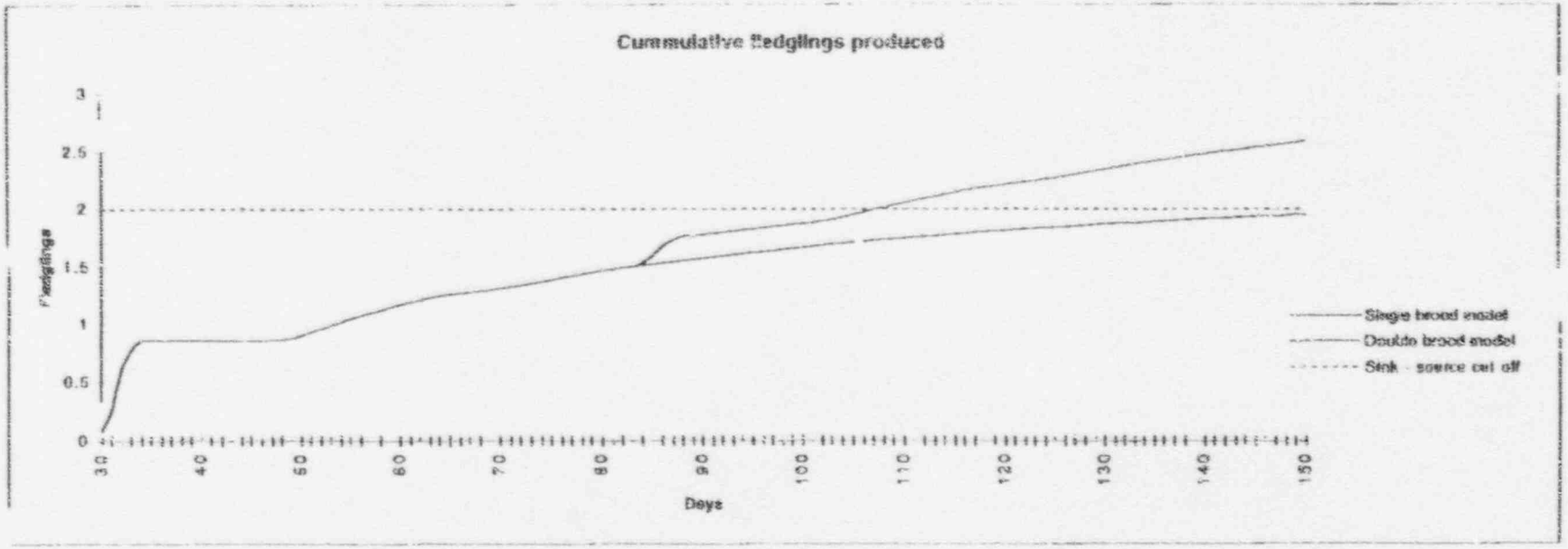


Chart 8. Point estimates of a deterministic demographic model for the southwestern population of the Yellow-shouldered Blackbirds, Puerto Rico.

Yellow-shouldered Blackbird

Input parameters:

	eggs	chicks
Daily Surv	0.98	0.98
dens. factor	0	
fledglings per succ. nest		
w/o c. birds		2.3
w/cowbirds		1.8
% of nests parasitized		0.05
Prop. of adults not nesting.		0.05
Adult surv.		0.82
Juvenile survival		0.18
Prop. of succ. nesters to attempt a re-nest		0.6

Output:

Model	Prop of all adults to fledge	Total Productivity	Day to break even
Single Brood	0.92	2.08	121
Double Brood	0.39	2.96	85
Probability to fledge 1 nest for a nester			0.96
2 nests			0.41
Break even prodctivity		2	

Unchangeable parameters:

	Days
laying period	2
incubation	13
nestling stage	15
length of breeding season	159
delay after failed nest	18
delay aftersuccessful nest	25

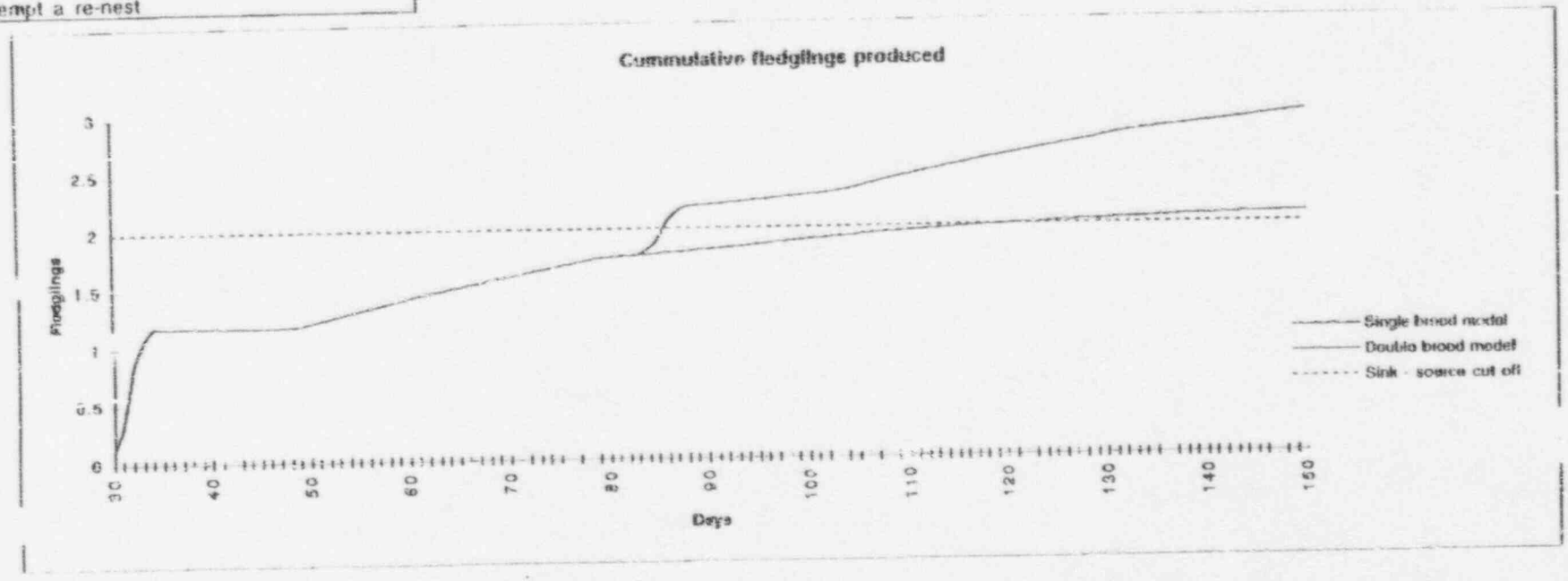


Chart 9. Point estimates of a deterministic demographic model for the southwestern population of the Yellow-shouldered Blackbirds, Puerto Rico.

Yellow-shouldered Blackbird

Input parameters:

	eggs	chicks
Daily Surv	0.98	0.98
dens. factor	0	
fledglings per succ. nest		
w/o c. birds		2.3
w/cowbirds		1.9
% of nests parasitized		0.05
Prop. of adults not nesting.		0.1
Adult surv.		0.82
Juvenile survival		0.18
Prop. of succ. nesters to attempt a re-nest		0.6

Output:

Model	Prop of all adults to fledge	Total Productivity	Day to break even
Single Brood	0.87	1.97	Never
Double Brood	0.37	2.81	87
Probability to fledge 1 nest for a nester			0.96
2 nests			0.41
Break even productivity		2	

Unchangeable parameters:

	Days
laying period	2
incubation	13
nestling stage	15
length of breeding season	150
delay after failed nest	18
delay aftersuccessful nest	25

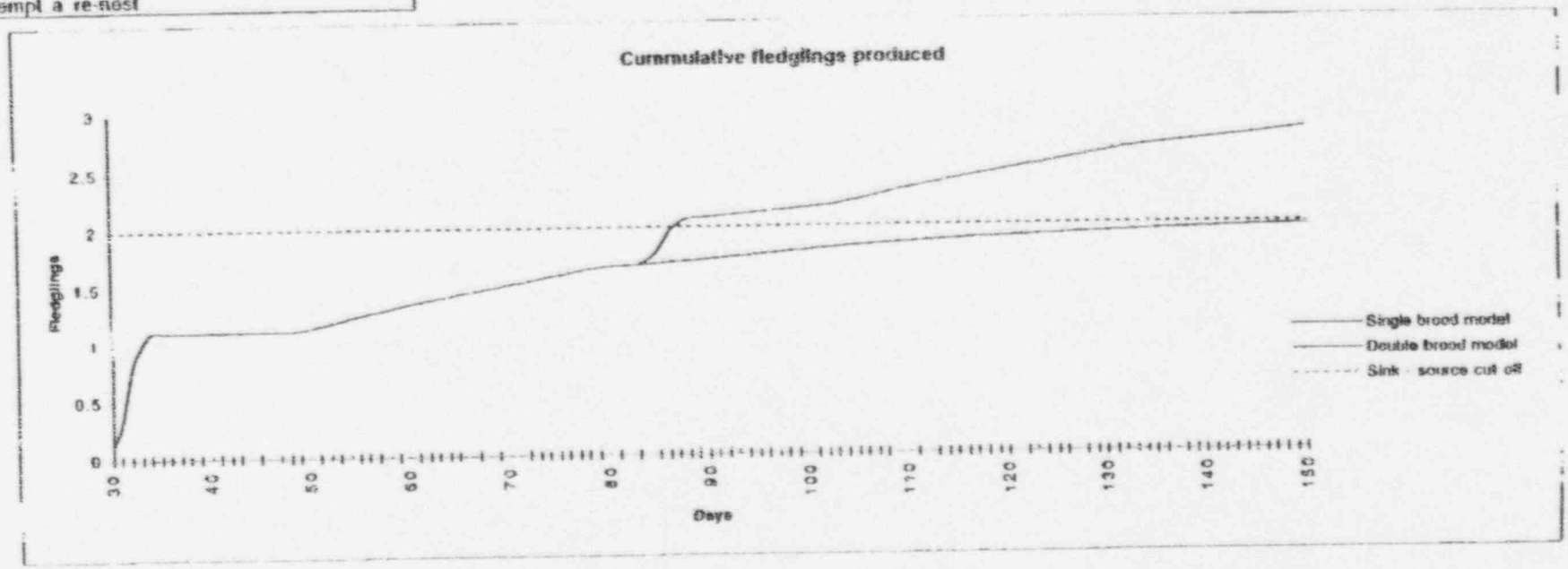


Chart 10. Point estimates of a deterministic demographic model for the southwestern population of the Yellow-shouldered Blackbirds, Puerto Rico.

Yellow-shouldered Blackbird

Input parameters:

	eggs	chicks
Daily Surv	0.96	0.98
dens. factor	0	
fledglings per succ. nest		
w/o c. birds		2.3
w/cowbirds		1.8
% of nests parasitized		0.1
Prop. of adults not nesting.		0.1
Adult surv.		0.82
Juvenile survival		0.18
Prop. of succ. nesters to attempt a re-nest		0.6

Output:

Model	Prop of all adults to fledge	Total Productivity	Day to break even
Single Brood	0.82	1.84	Never
Double Brood	0.27	2.44	114
Probability to fledge 1 nest for a nester			0.91
2 nests			0.30
Break even productivity		2	

Unchangeable parameters:

	Days
laying period	2
incubation	13
nestling stage	15
length of breeding season	150
delay after failed nest	18
delay aftersuccessful nest	25

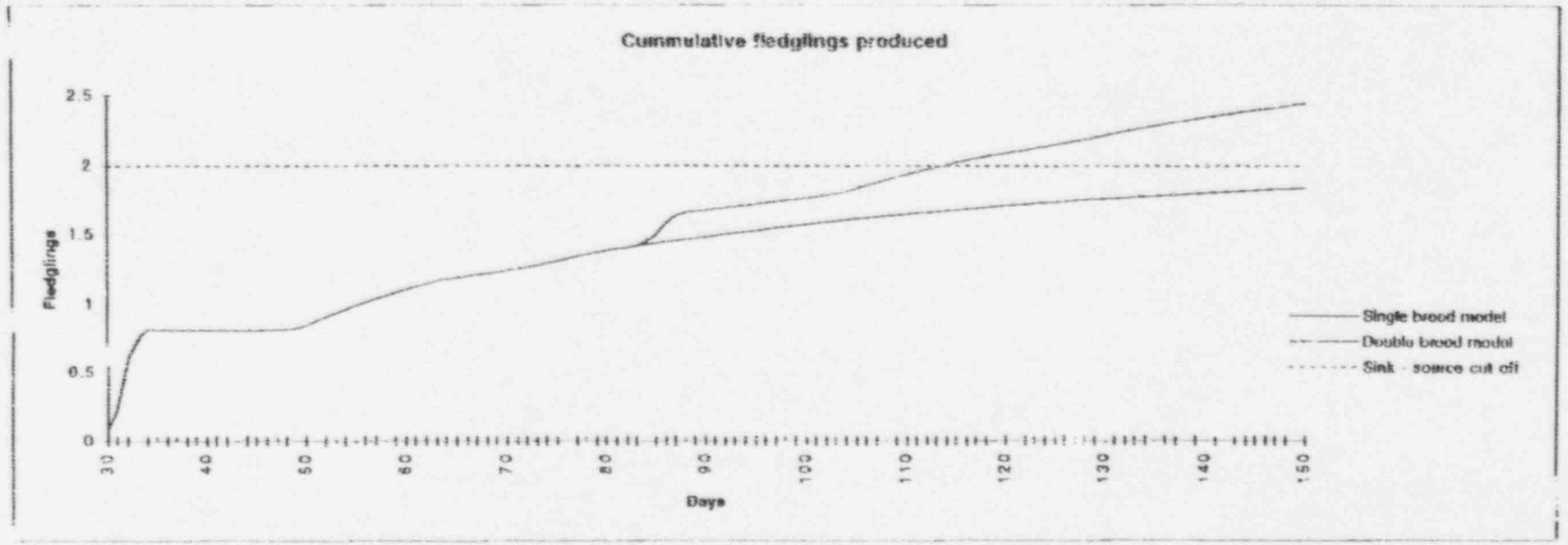


Chart 11. Point estimates of a deterministic demographic model for the southwestern population of the Yellow-shouldered Blackbirds, Puerto Rico.

Yellow-shouldered Blackbird

Input parameters:

	eggs	chicks
Daily Surv	0.96	0.98
dens. factor	0	
fledgiings per succ. nest		
w/o c. birds		2.3
w/cowbirds		1.8
% of nests parasitized		0.1
Prop. of adults not nesting.		0.27
Adult surv.		0.82
Juvenile survival		0.18
Prop. of succ. nesters to attempt a re-nest		0.6

Output:

Model	Prop of all adults to fledge	Total Productivity	Day to break even
Single Brood	0.66	1.49	Never
Double Brood	0.22	1.98	Never
Probability to fledge 1 nest for a nester			0.91
2 nests			0.30
Break even productivity		2	

Unchangeable parameters:

	Days
laying period	2
incubation	13
nestling stage	15
length of breeding season	150
delay after failed nest	18
delay aftersuccessful nest	25

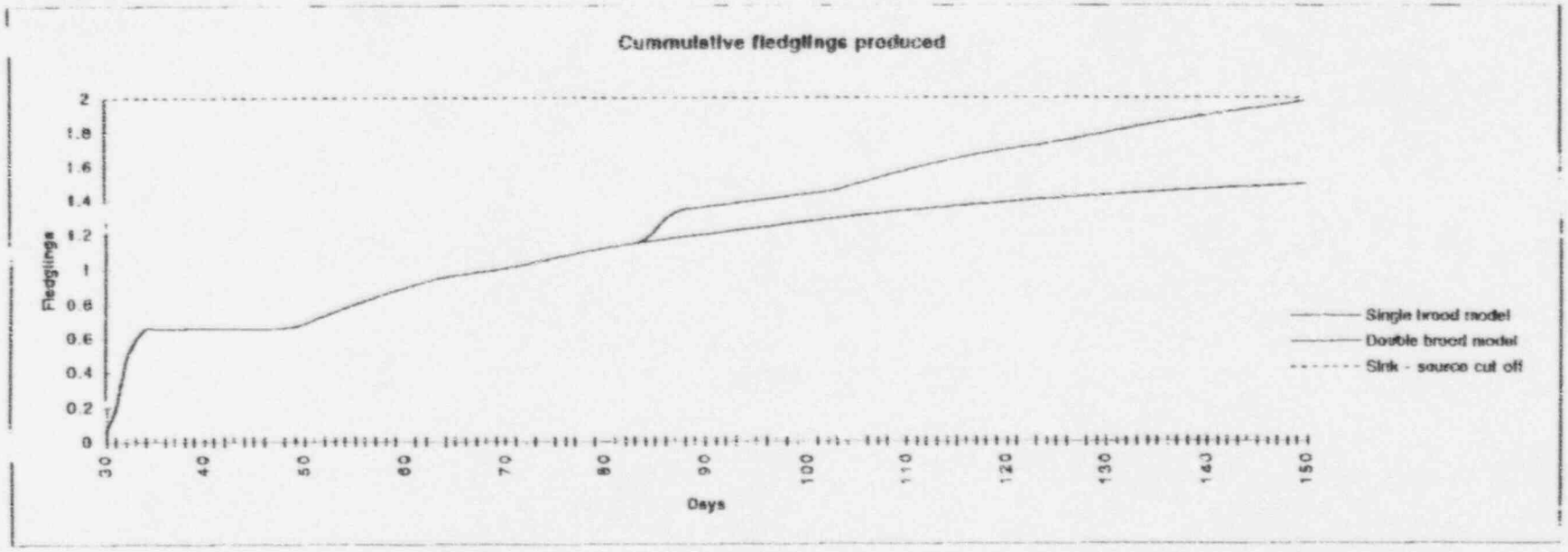


Chart 12. Point estimates of a deterministic demographic model for the southwestern population of the Yellow-shouldered Blackbirds, Puerto Rico.

Yellow-shouldered Blackbird

Input parameters:

	eggs	chicks
Daily Surv	0.96	0.98
dens. factor	0	
fledglings per succ. nest		
w/o c. birds		2.3
w/cowbirds		1.8
% of nests parasitized		0.45
Prop. of adults not nesting		0.2
Adult surv.		0.82
Juvenile survival		0.18
Prop. of succ. nesters to attempt a re-nest		0.6

Output:

Model	Prop of all adults to fledge	Total Productivity	Day to break even
Single Brood	0.73	1.51	Never
Double Brood	0.24	2.00	150
Probability to fledge 1 nest for a nester			0.91
2 nests			0.36
Break even productivity		2	

Unchangeable parameters:

	Days
laying period	2
incubation	13
nestling stage	15
length of breeding season	150
delay after failed nest	18
delay aftersuccessful nest	25

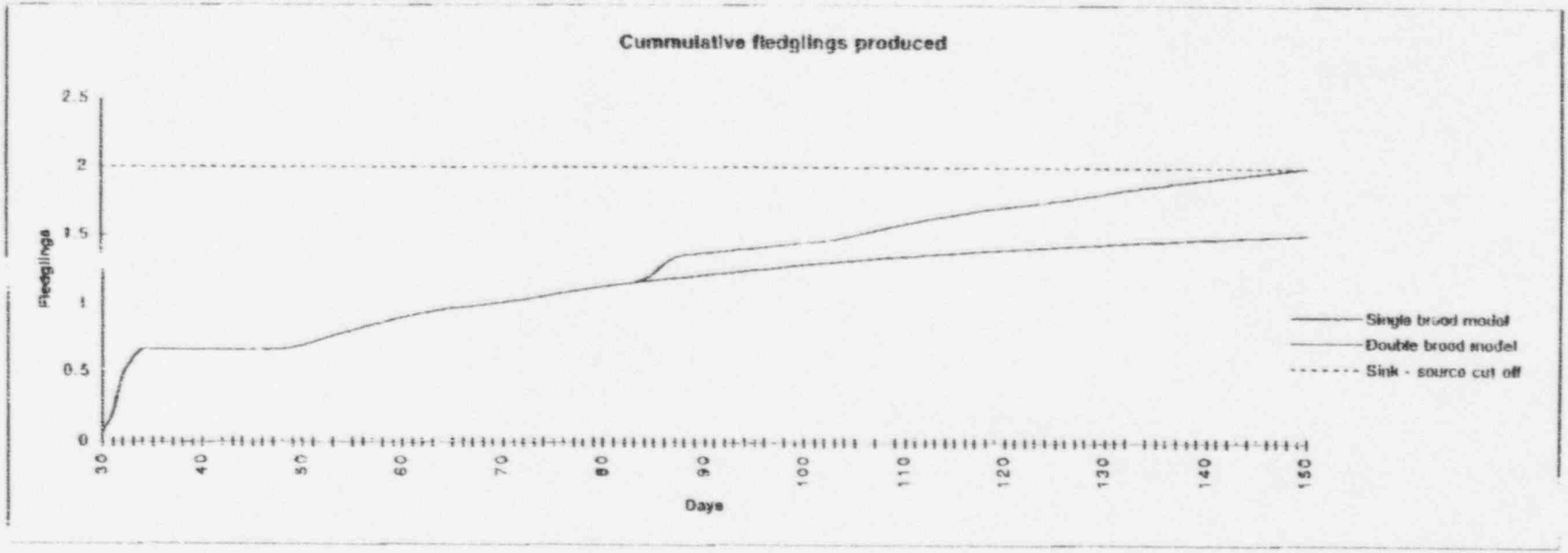


Chart 13. Point estimates of a deterministic demographic model for the southwestern population of the Yellow-shouldered Blackbirds, Puerto Rico.

Yellow-shouldered Blackbird

Input parameters:

	eggs	chicks
Daily Surv	0.98	0.98
dens. factor	0	
fledglings per succ. nest		
w/o c. birds		2.3
w/cowbirds		1.8
% of nests parasitized		0.05
Prop. of adults not nesting.		0.1
Adult surv.		0.81
Juvenile survival		0.17
Prop. of succ. nesters to attempt a re-nest		0.6

Output:

Model	Prop of all adults to fledge	Total Productivity	Day to break even
Single Brood	0.67	1.97	Never
Double Brood	0.37	2.81	106
Probability to fledge 1 nest for a nester			0.96
2 nests			0.41
Break even productivity		2.235294118	

Unchangesble parameters:

	Days
laying period	2
incubation	13
nestling stage	15
length of breeding season	150
delay after failed nest	18
delay aftersuccessful nest	25

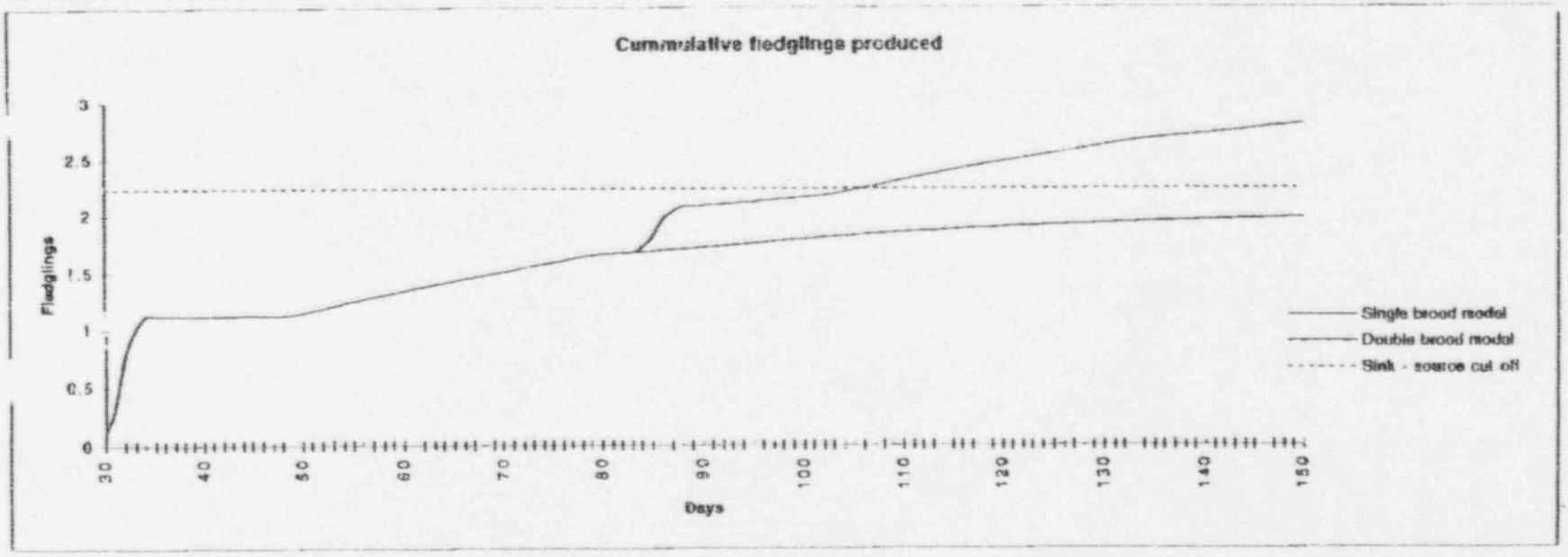


Chart 14. Point estimates of a deterministic demographic model for the southwestern population of the Yellow-shouldered Blackbirds, Puerto Rico.

Yellow-shouldered Blackbird

Input parameters:

	eggs	chicks
Daily Surv	0.98	0.98
dens. factor	0	.
fledglings per succ. nest		
w/o c. birds		2.3
w/cowbirds		1.8
% of nests parasitized		0.25
Prop. of adults not nesting.		0.25
Adult surv.		0.81
Juvenile survival		0.17
Prop. of succ. nesters to attempt a re-nest		0.6

Output:

Model	Prop of all adults to fledge	Total Productivity	Day to break even
Single Brood	0.72	1.57	Never
Double Brood	0.31	2.24	150
Probability to fledge 1 nest for a nester			0.96
2 nests			0.41
Break even productivity		2.235294118	

Unchangeable parameters:

	Days
laying period	2
incubation	13
nestling stage	15
length of breeding season	150
delay after failed nest	18
delay aftersuccessful nest	25

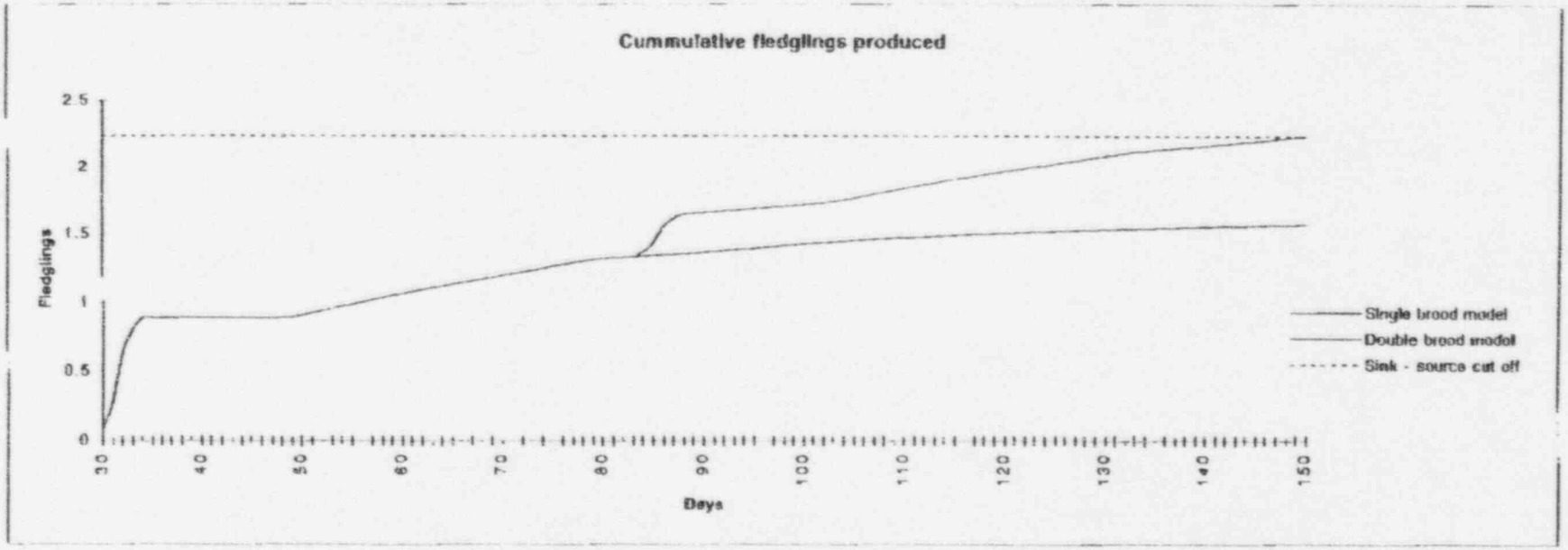


Chart 15. Point estimates of a deterministic demographic model for the southwestern population of the Yellow-shouldered Blackbirds, Puerto Rico.

Yellow-shouldered Blackbird

Input parameters:

	eggs	chicks
Daily Surv	0.96	0.98
dens. factor	0	
fledglings per succ. nest		
w/o c. birds		2.3
w/cowbirds		1.8
% of nests parasitized		0.12
Prop. of adults not nesting.		0.10
Adult surv.		0.81
Juvenile survival		0.17
Prop. of succ. nesters to attempt a re-nest		0.6

Output:

Model	Prop of all adults to fledge	Total Productivity	Day to break even
Single Brood	0.75	1.67	Never
Double Brood	0.24	2.22	Never
Probability to fledge 1 nest for a nester			0.91
2 nests			0.30
Break even productivity		2.235294118	

Unchangeable parameters:

	Days
laying period	2
incubation	13
nestling stage	15
length of breeding season	150
delay after failed nest	18
delay aftersuccessful nest	25

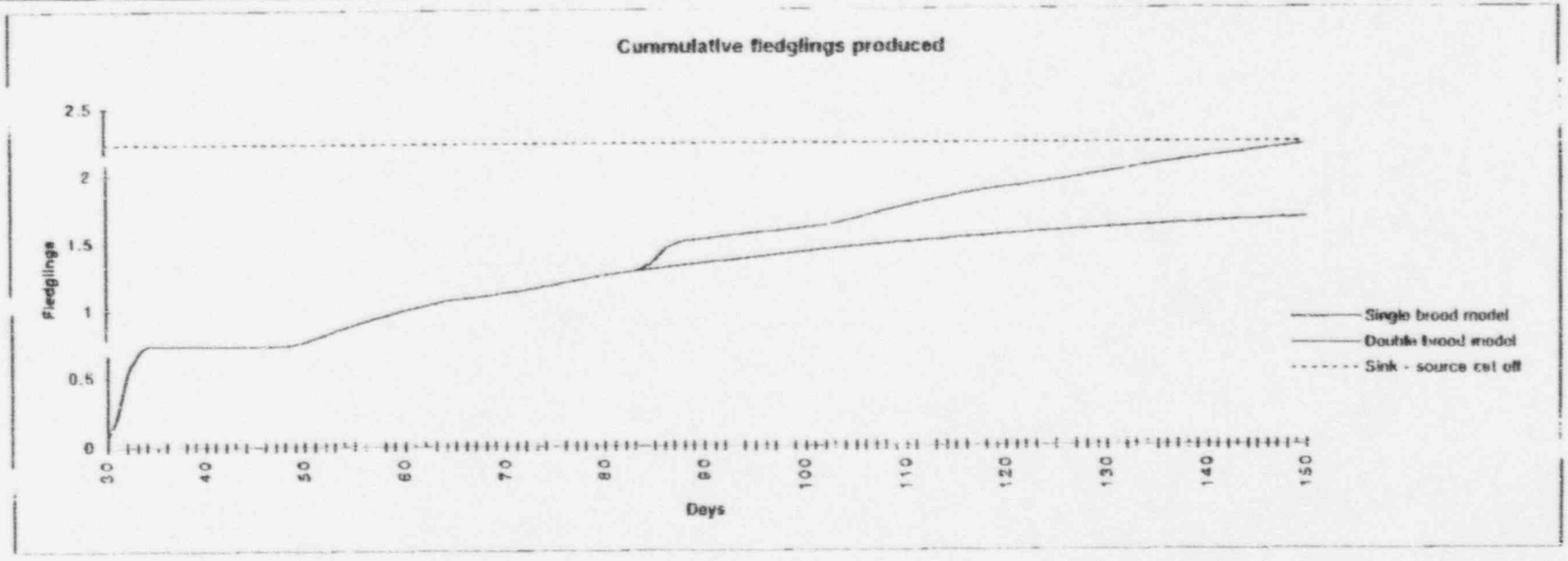


Chart 16. Point estimates of a deterministic demographic model for the southwestern population of the Yellow-shouldered Blackbirds, Puerto Rico.

Yellow-shouldered Blackbird

Input parameters:

	eggs	chicks
Daily Surv	0.98	0.98
dens. factor	0	
fledglings per succ. nest		
w/o c. birds		2.3
w/cowbirds		1.8
% of nests parasitized		0.05
Prop. of adults not nesting		0.1
Adult surv.		0.8
Juvenile survival		0.16
Prop. of succ. nesters to attempt a re-nest		0.6

Output:

Model	Prop of all adults to fledge	Total Productivity	Day to break even
Single Brood	0.87	1.97	Never
Double Brood	0.37	2.81	122
Probability to fledge 1 nest for a nester			0.96
2 nests			0.41
Break even productivity		2.5	

Unchangeable parameters:

	Days
laying period	2
incubation	13
nestling stage	15
length of breeding season	150
delay after failed nest	18
delay aftersuccessful nest	25

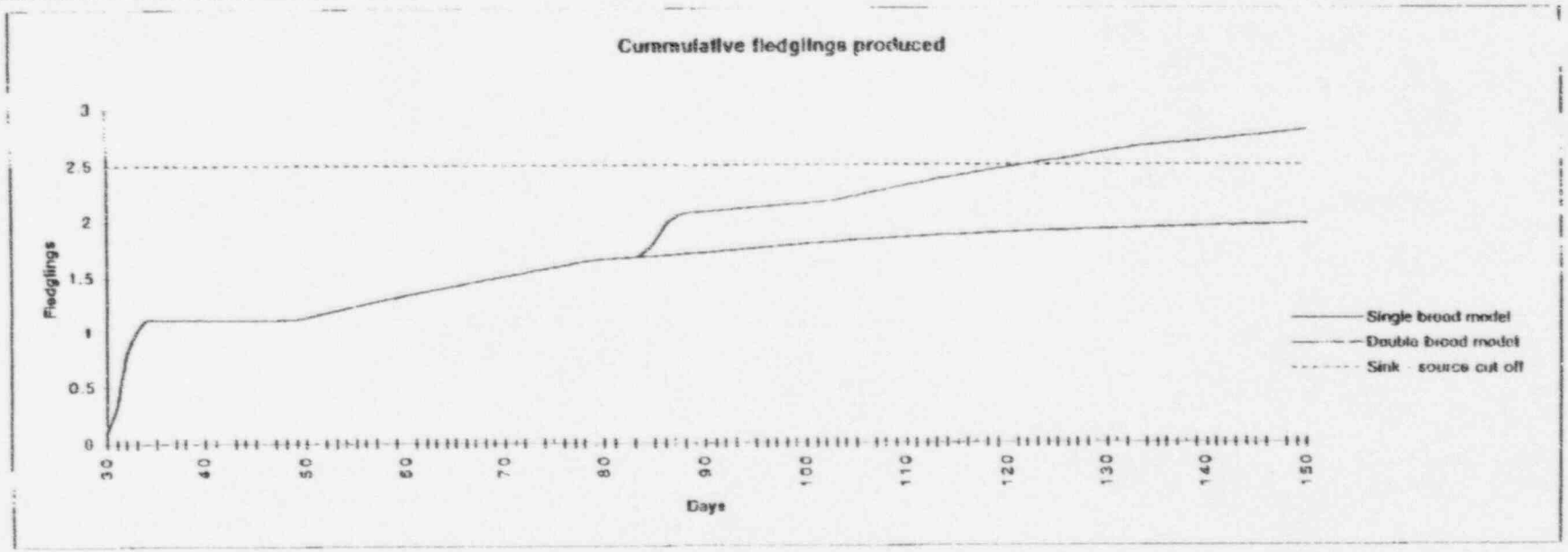


Chart 17. Point estimates of a deterministic demographic model for the southwestern population of the Yellow-shouldered Blackbirds, Puerto Rico.

Yellow-shouldered Blackbird

Input parameters:

	eggs	chicks
Daily Surv	0.98	0.98
dens. factor	0	
fledglings per succ. nest		
w/o c. birds		2.3
w/cowbirds		1.8
% of nests parasitized		0.15
Prop. of adults not nesting.		0.18
Adult surv.		0.6
Juvenile survival		0.16
Prop. of succ. nesters to attempt a re-nest		0.6

Output:

Model	Prop of all adults to fledge	Total Productivity	Day to break even
Single Brood	0.79	1.76	Never
Double Brood	0.33	2.50	150
Probability to fledge 1 nest for a nester			0.56
2 nests			0.41
Break even productivity		2.5	

Unchangeable parameters:

	Days
laying period	2
incubation	13
nestling stage	15
length of breeding season	150
delay after failed nest	18
delay aftersuccessful nest	25

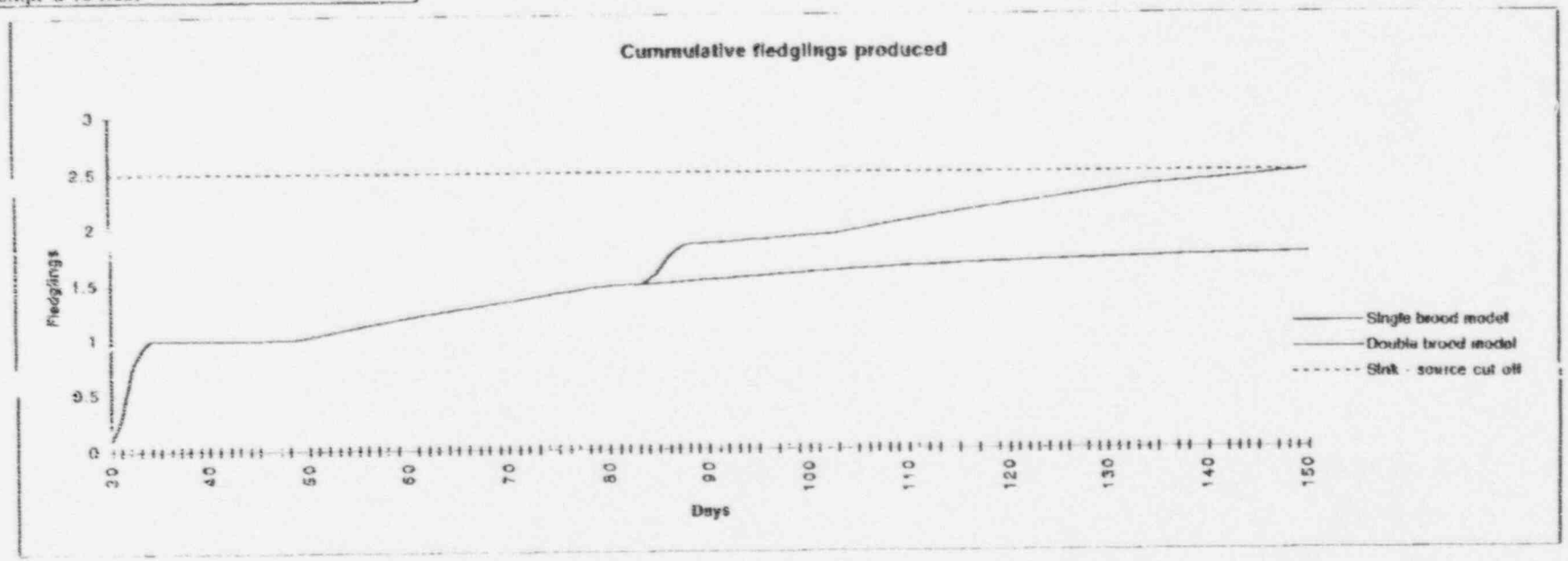


Chart 19. Point estimates of a deterministic demographic model for the southwestern population of the Yellow-shouldered Blackbirds, Puerto Rico.

Yellow-shouldered Blackbird

Input parameters:

	eggs	chicks
Daily Surv	0.96	0.98
dens. factor	0	
fledglings per succ. nest		
w/o c. birds		2.3
w/cowbirds		1.8
% of nests parasitized		0.06
Prop. of adults not nesting.		0.08
Adult surv.		0.8
Juvenile survival		0.16
Prop. of succ. nesters to attempt a re-nest		0.6

Output:

Model	Prop of all adults to fledge	Total Productivity	Day to break even
Single Brood	0.84	1.89	Never
Double Brood	0.27	2.51	150
Probability to fledge 1 nest for a nester			0.91
2 nests			0.30
Break even productivity		2.5	

Unchangeable parameters:

	Days
laying period	2
incubation	13
nestling stage	15
length of breeding season	150
delay after failed nest	10
delay aftersuccessful nest	25