Successful Reintroduction of Captive-Raised Yellow-Shouldered Amazon Parrots on Margarita Island, Venezuela

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Abstract: *The Yellow-shouldered Amazon (*Amazona barbadensis*) is one of the most endangered species of parrots in Venezuela. An integrated conservation program has focused on reversing the causes of parrot population decline on the Macanao Peninsula in Margarita Island. As a result, the parrot population on the island has increased to about 1900 individuals in 1996 from an estimated population of 750 in 1989, when the project started. Cooperation from national and local authorities and the project's community outreach have resulted in several confiscated chicks. Whereas most confiscated chicks were successfully reintroduced in a cross-fostering nest program, some had to be kept in captivity for later release. We hand-reared 14* A. barbadensis *and housed them for a year in a large outdoor aviary. Before release the birds were screened to determine their general health. Four parrots were fitted with radio transmitters and monitored for a minimum of 11 months. All 4 birds with radio transmitters survived and adapted successfully to their natural environment, 10 of the 12 released parrots survived at least 1 year, and 1 was seen alive 34 months after release. Integration into wild groups varied from 5 days to 9 months, with the two youngest parrots showing a slower integration process. None of the parrots reproduced the first year after release. Later three were seen scouting nesting holes with their partners, and one of the parrots was confirmed attending a nest with three eggs 28 months after release. Two chicks fledged from this nest. A substantial portion of the success of this program rests on 5 years of previous work on environmental education, public awareness, and studies on the parrot's biology. To provide some guidance on the costs of reintroduction projects, we estimated an overall expenditure of about U.S. $2800 per parrot. Previous attempts to reintroduce captive-raised parrots have had limited success, and our study indicates that reintroduction is feasible when captive-raised parrots are introduced to an area with a resident population. Although reintroduction can significantly reduce the chances of extinction, it also involves some risks. The long-term solution against extinction of* A. barbadensis *will be a combination of scientific understanding of their biology and habitat, awareness by local human communities, reduction in the wild bird trade, and continued commitment by conservation enforcement agencies.*

Reintroducción Exitosa del Loro Espalda Amarilla del Amazonas Criados en Cautiverio en la Isla Margarita, Venezuela

Resumen: *La cotorra cabeziamarilla (*Amazona barbadensis*) es uno de los loros más amenazados de Venezuela. Un programa integrado de conservación se enfocó a revertir las causas de la declinación poblacional de cotorras en la Península de Macanao, en la Isla de Margarita. Como resultado, la población total de cotorras en la isla se incrementó hasta los 1900 individuos en 1996, a partir de una población estimada de 750 individuos cuando comenzó el proyecto en 1989. La cooperación de las autoridades nacionales y locales y las actividades educativas, han conducido a varios decomisos de polluelos. Aun cuando la mayoría de los polluelos fueron reintroducidos en un exitoso programa de nidos nodriza, algunos se tuvieron que mantener en cautiverio para soltarlos después. Para este estudio, un total de 14* A. barbadensis *fueron criadas a mano y albergadas en un gran aviario durante un año. Antes de soltarlas, las aves fueron sometidas a análisis de salud*

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general. Se le pusieron radio transmisores a cuatro cotorras, y se monitorearon por 11 meses. Todas las cuatro cotorras con radio transmisores sobrevivieron y se adaptaron exitosamente a su ambiente natural, 10 de las 12 cotorras sobrevivieron al menos durante un año, y una cotorra estaba viva al menos 34 meses después de soltarlas. La integración a grupos silvestres varió entre 5 días y 9 meses, y las dos cotorras mas jóvenes mostraron un proceso de integración más lento. Ninguna de las cotorras se reprodujo el primer año después de soltarlas. Tres de las cotorras fueron vistas explorando oquedades con sus parejas durante el segundo año, y una cuarta fue vista atendiendo un nido con tres huevos, a los 28 meses después de soltarla. Dos polluelos volaron de este nido. Una parte significativa del éxito de este estudio se basa en 5 años de trabajo previo en educación ambiental, conocimiento del publico, y estudios de biología de las cotorras. Para guiar los costos de proyectos de reintroducción, estimamos que el costo total estuvo alrededor de U.S.$2800 por cotorra. Pruebas anteriores para reintroducir loros criados en cautiverio han tenido éxito limitado. Los resultados de nuestro estudio indican que la reintroducción es posible cuando los loros criados en cautiverio son introducidos en un área donde existe una población silvestre residente. Aún cuando la reintroducción puede contribuir a reducir las oportunidades de extinción de esta y otras especies de cotorras, también acarrea riesgos. La solución a largo plazo contra la extinción será una combinación de entendimiento científico de la biología y habitat, conocimiento por parte de las comunidades humanas locales, reducción de la demanda de aves silvestres para el tráfico de mascotas, y la dedicación y continuidad de agencias conservacionistas y de guardería.

Introduction

The Yellow-shouldered Amazon (*Amazona barbadensis*) is one of the most endangered species of parrots in Venezuela (Desenne & Strahl 1991). Its total population size is estimated at 5000 individuals, patchily distributed along the northern coast of Venezuela and the outer islands of Margarita, Blanquilla, and Bonaire (Netherlands Antilles) (Forshaw 1989; Desenne & Strahl 1994). The population of Margarita Island has suffered serious pressure from trapping for the illegal pet trade and from habitat destruction (Silvius 1989; Albornoz et al. 1994).

Since 1989, an integrated conservation program has focused on reversing the causes of population decline for the Margarita Island population. The program includes biological research, population management, environmental education, participation and awareness of local human communities, and strengthening of protected-area management and design. This collaborative effort was possible through a joint partnership of international and national conservation organizations, government agencies, and individuals. As a result, the total island population had grown to an estimated minimum of 1900 individuals in 1996 (A. Rodriguez, personal communication) from an estimated population of 750 in 1989, when the project started (Silvius 1989). Given the success of this program, a similar if less intensive program was started on Blanquilla Island, where the population was estimated at about 100 individuals in 1993.

The main reasons for the sustained population growth of this endangered parrot hinge upon an integrated conservation program. The main factors involved in the population's recovery are (in order of importance): (1) strengthening of enforcement measures by the project personnel at one of the main breeding areas, thus increasing yearly recruitment from 0 individuals in 1989 to about 53 individuals in subsequent years (M. F. Albornoz, J. P. Rodriguez, F. Rojas-Suárez, & V. Sanz, unpublished data); (2) a successful program of intraspecific cross-foster nests that moved 53 nestlings and eventually fledged 44 individuals between 1990 and 1994 (Sanz & Rojas-Suárez, in press); and (3) an environmental education project that focused on local people and on active community participation in the conservation project.

Thanks to these factors and the cooperation of enforcement authorities, several *A. barbadensis* chicks have been confiscated since the early stages of the project. Most of these chicks were returned to protected nests in the successful foster nest program (Sanz & Rojas-Suárez, in press). In some instances, however, foster nests were not a viable solution because the chicks were rejected by the foster parents or because chicks were confiscated after their wing feathers were clipped by poachers, which meant captive rearing was the only option.

Given the small size of the *A. barbadensis* population, reintroduction of captive-raised individuals could help reduce the chances of extinction. Moreover, the study of processes that foster successful reintroduction programs is also relevant to increase the conservation value of captive breeding initiatives. Reintroductions of captive-raised vertebrates are difficult, however, and the success rate has been relatively low (Beck et al. 1994). Previous efforts to reintroduce parrots have met with little success, although numerous feral parrot populations have been established through accidental introductions by humans, mainly in urban and agricultural landscapes (Bull 1973; Hardy 1973; Owre 1973; Ulloa & Fernandez-Badillo 1987; Wiley et al. 1992; Snyder et al. 1994). This seems to indicate that some parrot species have enough behavioral and ecological versatility to adapt to new conditions, particularly if they are wild-caught and if they are given enough food sources and reduced pressure from competition and predation, as is usually the case in human-modified environments.

The main objective of our study was to explore the technical and economic viability of reintroducing captive-raised *A. barbadensis* as a population management tool to reinforce critically endangered populations. We describe captive management techniques, adaptation processes, and the relevance of reintroduction of captive-raised individuals as a conservation technique for Neotropical parrots.

Study Area and Methods

The study took place in the 300-km^2 Macanao Peninsula, which is the western portion of Margarita Island (10°51′ - 11°10′N and 63°46′ - 64°24′W) off the northeast coast of Venezuela (Fig. 1). The topography of Macanao changes from sea level to a central mountain range that reaches a maximum of 760 m above sea level. Average yearly temperature is 27° C, ranging from 24° to 31° C, and mean rainfall is 500 mm, with a distinct dry season from November to May. This dry semiarid tropical climate results in an open cactus-chaparral plant community with columnar cacti and legumes (*Prosopis juliflora, Caesalpinia coriaria*) as the predominant vegetation feature, although seasonal riverbeds can support permanent deciduous forests (Hoyos 1985). These gallery forests are rapidly disappearing because of open-

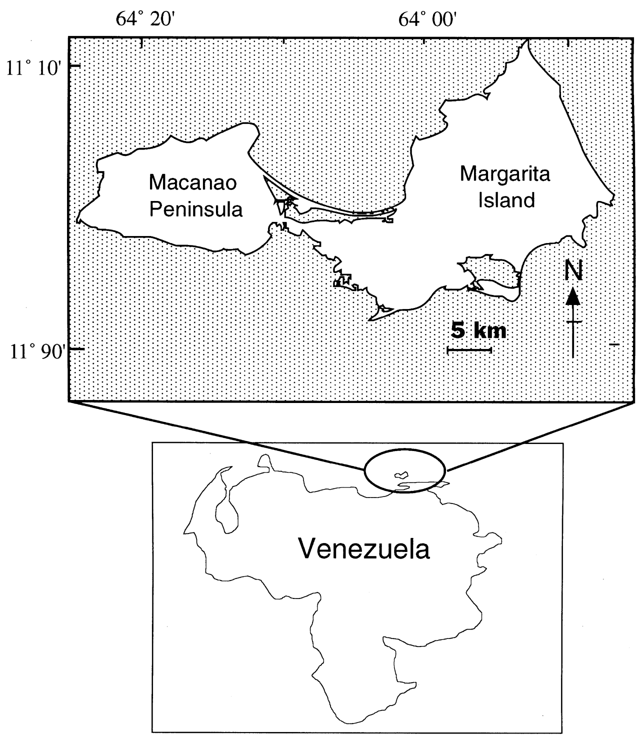

Figure 1. Macanao Peninsula, Margarita Island, and Venezuela.

pit mining for construction sand, resulting in the disappearance of this rare but important nesting and roosting habitat. Other native Psittacine species on Margarita Island include the common Brown-throated Parakeet (*Aratinga pertinax margaritae*) and the now extremely endangered Margarita subspecies of the Blue-crowned Parakeet (*Aratinga acuticaudata neoxena*) (total population size ≤80; Rodriguez & Rojas-Suárez 1994). Individuals of other parrot species escaped from captivity can be seen occasionally on the island, but none has become established (personal observation). Blanquilla is a nearly flat island of 64 km^2 off the northeast coast of Venezuela (11°48′ - 11°54′N and 64°33′ - 64°38′W) with an arid tropical climate. The vegetation is mostly scruby desert with only few trees.

We reared 14 *A. barbadensis*; 7 were confiscated in Margarita and 7 in Blanquilla but reared in Margarita. The Margarita parrots were of different ages and origins: four were hatched in 1990, of which one was from a nest attacked by predators; another one was donated by a local person; and the other two birds were siblings that were confiscated from poachers. The remaining 3 parrots hatched in 1991, all from the same nest, and were confiscated from poachers. The Blanquilla chicks were hatched in 1991 from unknown origins and moved to Margarita for captive rearing. The chicks were from 20 to 50 days of age when we received them. Their eyes were open, and they were partially or completely feathered, according to their age. Birds were not sexed because that would have required a surgical procedure and was deemed unnecessary for this study.

For the first 3 weeks, the captive maintenance protocol, designed by K. Silvius and F. Rojas, consisted of hand-feeding the chicks three times a day with a syringe. Their diet was a commercial, concentrated parrot food (Pikitos™, Purina Co.) and natural fruits such as guava, mango, papaya, and fruit compotes in a concentration of the right fluid consistency. At about 55 days of age (near the beginning of the fledging period) the chicks were offered chunks of naturally occurring fruits; larger chunks were introduced gradually until the parrots were feeding on whole fruits. Simultaneously, hand-feeding was phased out and the birds were transferred to a small wire cage of 1 × 1 × 1 m. Three weeks later, when the birds had a full plumage and could feed by themselves, they were transferred to two large outdoor aviaries of 5 × 5 × 5 m, away from casual human presence, partially shaded, and surrounded by natural habitat. The Margarita and Blanquilla parrots were housed in separate aviaries placed about 50 m from each other. The aviary allowed enough room to fly and for the birds to see and hear wild parrots and other creatures, as well as to experience the climate, insects, and other components of their natural environment. The aviaries were fitted with branches and twigs from natural vegetation, and the perches were changed frequently. The parrots were not in direct contact with other captive birds or domestic animals during the captive period. As part of the community outreach program, two assistants with good knowledge of the parrots' natural history and habitat were recruited from the local community and further trained in captive-rearing methods and field telemetry protocols. Both assistants were in charge of the direct captive-rearing of the parrots and later assisted in the telemetry portion of the study. Food and supplies were bought from local providers whenever possible.

The birds were offered wild foods, based on previous studies of the natural diet of *A. barbadensis* in the area (Silvius 1992). Their diet was complemented with some cultivated fruits and seeds, such as banana, plantain, mango, and sunflower seed, to complete the parrot's nutritional requirements. Foods were presented as they occurred in the wild, without any manipulation or preparation by the caretakers. For example, spines were not removed from cactus fruits and flowers, fruits, or leaf buds were offered on the branch. The diet changed as

Table 1. List of food items offered to Yellow-shouldered Amazon (*A. barbadensis*) during the captive period.

Family and species	*Common name*	*Part eaten*
Anarcardiaceae		
Mangifera indica[a]	mango	fruit
Asclepidaceae		
Matelea maritima	curichagua	fruit
Bignonaceae		
Tabebuia serratifolia	puy	seeds
Bromeliacea		
Bromelia chrysantha	chigüi-chigüi	fruit
Cactaceae		
Stenocereus griseus	cardón	stems,[b] flowers,[b] fruit[b]
Subpilocereus repandus	yaurero	stems,[b] flowers,[b] fruit[b]
Acanthocereus tetragonus	pitajaia	fruit
Pereskia guamacho	guamache	fruit
Capparaceae		
Capparis odoratissima	olivo	leaves, flowers, seeds[b]
Capparis hastata	paniagua	flowers, fruit[b]
Capparis flexuosa	ajito	flowers, fruit[b]
Compositae		
Helianthus annus	sunflower	seeds
Cucurbitaceaae		
Cucumis sp[a]	melon	seeds
Cucumis sp[a]	water melon	seeds
Flacurtaceae		
Casearia sp	manzanita	fruit[b]
Leguminoae		
Cercidium praecox	cuica	seeds
Prosopis juliflora	yaque	flowers, fruit[b]
Pithecelobium unguis-cacti	guichere	leaves, seeds[b]
Caesalpinia coriaria	guatapanare	seeds[b]
Caesalpinia granadillo	quebrahacho	seeds[b]
Caesalpinia mollis	durote	seeds
Calliandra sp	clavellina	seeds
Platymiscium sp	roble	flowers, seeds
Lonchocarpus violaceus	aco	seeds
Musaceae		
Musa sp[a]	plantain	fruit[b]
Musa sp[a]	banana	fruit
Rhamnacceae		
Ziziphus mauritania[a]	ponsingué	fruit
Sapindaceae		
Talisia oliviformis	coperí	fruit
Theophrastaceae		
Jacquinia revoluta	barbasco	fruit
Zygophyllaceae		
Bulnesia arborea	palosano	leaves, flowers, seeds[b]
Guaiacum officinale	guayacán	flowers, fruit[b]

[a] *Cultivated plants.*
[b] *Most selected items.*

food availability changed through the seasons, but at least three different types of foods were offered every day. Through the captive period, a variety of wild food items were offered according to their phenology. Cultivated food items were offered ad libitum (Table 1).

Three weeks before release, the birds were examined by veterinarians to determine their general health, including blood chemistry and blood parasites (hematocrit, plasma total solids, complete white blood cell count, white blood cell differential, and chemistry and enzyme panel including uric acid). Serological studies were conducted to detect infectious laryngotracheitis virus (Herpes), avian influenza, psittacosis, salmonellosis, avian polyoma virus, and paramyxovirus-1 (New Castle disease). Feces were analyzed to detect gastrointestinal parasites.

These veterinary analyses ensured that the birds were not carriers of some of the most common parrot diseases and reduced the risk of disease transmission to wild parrots. To enhance their health by release time, the birds were deparasited with Panacur™ (fendendazol). The potential exposure to other parrots and disease was considered minimal because none of the birds had entered the international pet trade and, even under the poor hygienic conditions of rural trappers, the birds had had little chance of exposure to exotic diseases.

Four parrots were provided with radio transmitters (Wildlife Materials Co.) attached to a brass neck collar. The transmitters were fitted to the birds 2 days before the scheduled release; the radios' function and the parrots' behavior were monitored inside the aviary. The radio and battery combination were covered with a hard epoxy resin, and only the 20-cm antenna protruded out from the system. The whole transmitter—collar, antenna, and batteries—weighed about 14.5 g, in all cases below 5% of body mass.

Two of the radio-collared parrots were 30 months old (hereafter identified as C2 and C6), whereas the other two were 18 months old (identified as C4 and C8). Before the release, all parrots were weighed, measured, and fitted with numbered stainless steel rings around the tarsus.

On the morning of 31 October 1992, one of the upper front panels (2×2 m) of the Margarita parrot aviary was removed to let parrots leave spontaneously. Most of the parrots were reluctant to fly out of the aviary, so branches of their favorite foods were placed just outside the hole in the aviary. For 15 days after release, food was offered twice daily in the vicinity of the aviary. Afterwards, supplemental food was offered once daily (in the afternoon); and after a month supplemental food was eliminated.

The parrots were radio-tracked upon release until 18 August 1993 for one parrot (C6) in which the radio battery ceased to work and until 10 October 1993 for the remaining three parrots. The parrots were located four to six times a week, twice each day, from 0600 to 1100 hours and then from 1530 to 1900 hours. The birds were tracked by means of a portable receiver (Telonics, Mesa, Arizona) and a manual three-element Yagui directional antenna. During the first 4 months the parrots were located by triangulation; afterwards they were located with the help of the radio signal until the parrots were within sight through use of a spotting scope or binoculars. Their position was later determined to the nearest 100 m with a global positioning system unit (Trimbell Navigation). In each visual encounter, the position of the parrot was recorded, as was the time of day, group size, and activity. If the parrots were feeding, food items were recorded for the released parrot and for the wild parrots in the vicinity.

During triangulation, the location polygons were plotted on a 1:5000 map of the area to determine the coordinates of the parrot's position. We followed the method of White and Garrott (1990) to measure the reception error by the equipment in the area, using 32 reception samples in 10 different locations. Measurement errors ranged between 0° and 20°, with an average of 0.63°, which was considered negligible and thus not taken into consideration in the calculations.

The adaptation period was quantitatively monitored by measuring (1) cumulative home range size, defined by the minimum convex polygon system (Mohr 1947), using the computer software package Wildtrack 1.1 (Todd 1992) for the 11 months of the study; (2) temporal variation of habitat use, measured as weekly variation up to 45 days after the parrots were released; and (3) the period of integration into wild groups and period to form permanent pairs, estimated from the first day that the parrots were seen together with wild parrots. Subsequent observations included information on the number of parrots in the group, social interactions with members of the group, vocalizations, joint flights, common use of feeding sites, allopreening, copulation attempts, nest exploration, and reproduction.

Following the existing reintroduction and captivity guidelines from the Margarita parrots, the Blanquilla parrots were successfully reared in captivity, and the surviving five individuals were reintroduced in 1993 in Blanquilla Island. All of these parrots were fitted with numbered stainless steel rings around the tarsus. They were transported by ship from Margarita; given the remoteness of the Blanquilla island, the monitoring was limited to one census in 1994. Therefore, most of the monitoring described below refers to the Margarita parrots.

Given the parameters to measure the adaptation period, reintroduction was considered successful by the following criteria: survival for at least a year after release, use of feeding area and food items similar to those of wild parrots, integration to social groups, use of communal roosting areas, and pair formation and reproduction attempts. Integration to social groups, pair formation, and the production of fertile eggs or fledglings were considered the best indicators of successful adaptation to wild conditions.

Results

Survival

The large outdoor aviaries were helpful in teaching predator avoidance. Not only were the young parrots able to see and hear wild parrot behavior during encounters with predators, but they experienced predator pressures themselves. During captivity, one of the young Blanquilla parrots was killed and eaten by a *Boa constrictor* at night. On another occasion, the same Blanquilla group aviary was attacked by a pair of hawks (*Parabuteo unicinctus*), who reached through the wire mesh, killing one parrot and injuring another. These accidents, even with the resulting deaths, were a learning experience for the surviving parrots, who learned predator avoidance and alarm behaviors—including fleeing the site with loud vocalizations—similar to behaviors reported for White-fronted Amazons (*A. albifrons*; Levinson 1980).

All four birds with radio transmitters survived during the 1-year monitoring period. Parrot C8 was seen alive at least until November 1995, 37 months after release (Table 2), whereas C4 was seen alive in April 1994, 18 months after release. One of the Margarita parrots without a radio transmitter was seen in June 1993, 8 months after release, although it could not be individually identified from the distance observed. All five Blanquilla birds were seen feeding with a social group of 16 individuals 1 year after release.

At a minimum, 10 out of 12 parrots survived the first year after reintroduction. Two of the Margarita birds without radios could not be located after the release. It is possible that the missing parrots survived through the study period but were not detected. Bands are difficult to observe on *Amazona* parrots because these birds have short tarsi that are usually covered by feathers.

Dispersal Patterns

One of the parrots without a radio transmitter flew out of the aviary the first few minutes after the release. All other parrots remained around the aviary during the first day, after the second day the two other parrots without radio transmitters abandoned the area around the aviary.

Even though the birds were of similar size and shared captive conditions for more than a year in the aviary, the group did not stay together after the release, except for the two siblings born in 1991 (C4 and C8). In 21 instances during the monitoring period, up to three radio-collared parrots were simultaneously using common feeding areas, including the same tree, but once integrated to wild groups the reintroduced parrots never abandoned their group to accompany their former captive companions.

The process of dispersal from the release site was slower for the two youngest parrots (C4 and C8). One of them (C4) dispersed more than 1 km from the release point during the first week, but finally returned to the immediate release area (Fig. 2). These two parrots were received with their wings clipped very short, and two or three wing primaries grew back almost white or clear, indicating feathers growing under stress. Early flights after release were clumsy, with awkward landings, which might be the reason why these parrots were so late in joining wild groups to distant roosting sites. Wallace and Temple (1987) observed that the youngest captive-bred, reintroduced Andean Condors (*Vultur gryphus*) were the ones that showed the longest readaptation period. Parrots, like condors, have a long period of parental care that seems to go from 3 months to several years, depending on the species (Cruz & Gruber 1980; Saunders 1982; Snyder et al. 1987; Enkerlin 1995, personal observation).

During the monitoring period, all parrots remained in the eastern portion of the Macanao peninsula, with great home range overlap (Fig. 3). One of the parrots (C6) had the largest home range and used three different communal roosting areas, whereas all other parrots used only one or sometimes two roosting areas.

Table 2. Parameters measured during the adaptation period of reintroduced Yellow-shouldered Amazon (*A. barbadensis*) in days (or months for confirmed survival) after the release date.

	Individual						
Adaptive process	*C2*	*C6*	*C4*	*C8*	*CJ30*[a]	*CT30*[a]	*CP18*[a]
Confirmed survival (months)	11	10	18	37	8	?	?
Abandonment of aviary area[b]	5	9	98	37	1	>1	1
Join social groups	6	14	288	288	>125	?	?
Communal roosting	10	20	306	306	>125	?	?
Pair formation[c]	95	91	?	870	?	?	?
Reproduction[d]	?	?	?	870	?	?	?

[a]*Parrots without radio transmitters; these parrots were not actively monitored, and information represents occasional sightings.*
[b]*Aviary area is the immediate area (100 m diameter) around the aviary.*
[c]*Confirmed and repeated sightings of the released parrots with another wild parrot during morning and afternoon flights.*
[d]*Confirmed and successful egg production.*

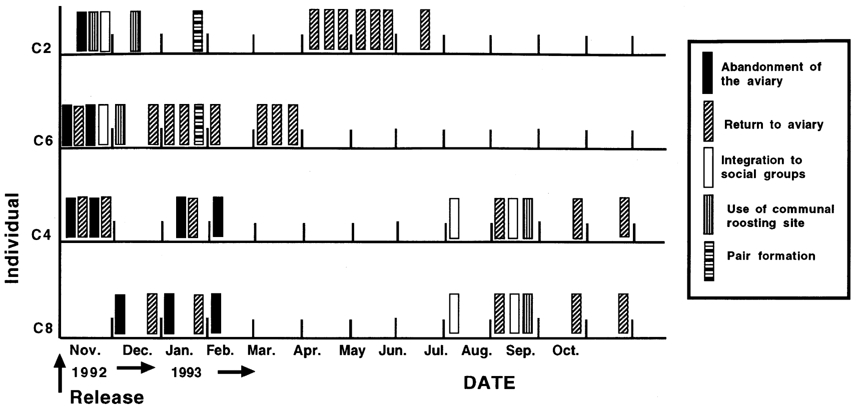

*Figure 2. Chronological representation of the adaptation process for four reintroduced Yellow-shouldered Amazon (*A. barbadensis*) fitted with radio collars from November 1992 to October 1993 on Margarita Island, Venezuela.*

Site Fidelity and Foraging Behavior

Although the parrots stayed around the release area, they spent most of the first few days directly on top of the aviary that held another group of captive *A. barbadensis* or feeding on plants in the immediate vicinity or on bits of food that fell through the floor of the aviary. The youngest parrots (C4 and C8) demonstrated the highest fidelity to the aviary and its surroundings, during the post-release period of adaptation and during the first 8 months of the monitoring period (Table 3).

Often groups of wild parrots came to the immediate release area early in the morning, feeding on wild plants and landing on the aviary that held the other group of *A. barbadensis*. During these visits, the radio-collared parrots vocalized and interacted with the wild parrots and even fed on the same branch. On other occasions, however, the radio-collared parrots were indifferent to the wild group. Beginning at day 20 after release, the parrots started to foray farther and farther from the release point, until they joined wild groups permanently. Even then, frequent visits to the release site were common (Fig. 2).

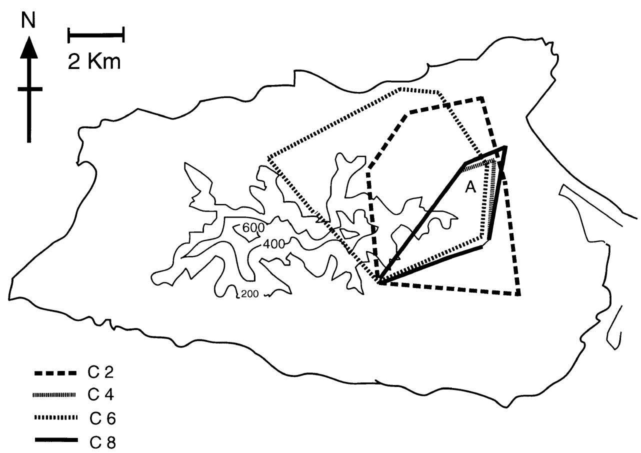

Figure 3. Macanao Peninsula, with the cumulative home range for each of the four radio-tracked parrots (C2, C4, C6, and C8) during the 11-month monitoring period from November 1992 to October 1993. A *indicates the aviary position.*

Recognition of food items by the released parrots was facilitated by the exposure to wild food items during the captive period. From the first day of release the parrots were eating wild foods and were able to manipulate different food items. All released parrots were seen feeding on the same food items as wild parrots (n = 121 sightings). During the 11 months of radio tracking, the released parrots consumed all 24 wild species of plants that were offered while in captivity plus three plants species that were unknown to them. In fact, C6 fed for 6 weeks mostly on the seeds of a plant, *Piptademia flava*, from higher mountain areas that was not previously offered in captivity.

Social Integration and Pair Formation

The process of social integration to wild groups varied among the reintroduced parrots (Fig. 2). Wild group size varied from 2 to 62 birds—and possibly larger during the afternoon flights to the communal roosting sites. Both young parrots (C4 and C8) presented some aberrant tame behavior for the first 8 months, allowing close proximity of humans (<15 m), but they eventually began to fly away to a safe distance (>50 m) when approached by humans.

Although pair formation is difficult to determine with precision, our observations indicated that the two older parrots (C2 and C6) formed stable pairs with wild birds beginning at 3 months after release (Fig. 2). Thereafter it was common to see them with another parrot, particularly during the morning feeding flight and the afternoon flight to the roosting area. Other observed behaviors suggest pair formation. For example, 6 months after release C2 performed the typical mating behavior of *A. barbadensis*, vocalizing like a young fledging and begging for food, while its presumed partner was feeding on the fruits of the columnar Cardón cactus (*Stenocereus griseus*). Later that month, C2 and C6 were seen inspecting potential nesting holes near the aviary area, each accompanied by a wild parrot.

Both older parrots (C2 and C6) were seen on at least two occasions in allopreening behavior with their wild partner. None of the released parrots reproduced the first year of field monitoring. In April 1995 a nest attended by C8 was found with three eggs within 200 m from the aviary. Parrot C8 was one of the younger birds with the longest adaptation period. By the time this nest was found C8 was 4 years old and our observations indicated that it was a male. Two eggs hatched and both chicks fledged from this nest.

The released parrots without radio transmitters were almost impossible to identify individually. One of them, however, was seen with a group of four wild parrots within 5 days after release, another was seen near the aviary flying with its wild partner 8 months after release, and a third was seen feeding with a wild group 5 months after release.

Discussion

Previous attempts to reintroduce captive-raised parrots with wild populations (Hispaniolan Amazon [*A. ventralis*] and Puerto Rican Amazon [*A. vittata*]) or without wild populations (Thick-bill Parrots in Arizona [*Rynchopsitta pachychyncha*]) have had limited success (Wiley et al. 1992; Snyder et al. 1994; Meyers & Lindsey 1996). For example, in reintroduction efforts with Thick-bill Parrots in Arizona, high predation by raptors, poor food-processing ability, and aberrant behavior reduced survival to nearly zero (Derrickson & Snyder 1992; Wiley et al. 1992; Snyder et al. 1994). Our study indicates that reintroduction is feasible when captive-raised parrots are introduced in an area with a resident population (Wiley et al. 1992; Association for Parrot Conservation 1994*b*). The presence of a wild population increases the probability of success because wild parrots have well-developed capacities for finding food and roosting sites and for avoiding predators.

The reintroduced parrots adapted successfully to their natural environment. The confirmed reproduction by at least one of the parrots indicates that some reintroductions can be successful. Their survival during the monitoring period indicates that the parrots were able to find food, develop a social life, and avoid predators. In fact, predator avoidance is a crucial behavior for the survival of reintroduced parrots (Snyder et al. 1994). For example, the most important cause of death in fledglings of the Puerto Rican Parrot (*A. vittata*) seems to be attacks by raptors (Lindsey et al. 1994). Potential parrot predators in the Macanao Peninsula include several species of large snakes (*Boa constrictor, Epicrates cenchria, Spillotes pullatus*, and *Corallus enidrys*; the last two are egg and chick specialists) and two species of hawks (*Buteo albicaudatus* and *Parabuteo unicinctus*). Potential mammalian predators include ocelots (*Felis pardalis*) and skunks (*Conepatus semiestriatus*). Our observations during the last 5 years, however, seem to indicate that adult parrots experience little predation, except occasional snake predation on incubating females.

The released parrots showed high site fidelity. Of 300 km^2 of available habitat, the released parrots used only the eastern half of the Macanao Peninsula; eventually, one of them nested very near the release site. It is probable that the released parrots will eventually use all the available habitat as they follow spatial variations in food resources. Our observations of other parrots that were tagged as chicks however, seem to indicate that these parrots nest in areas very near the site where they were born, which has been reported for other parrot species (Saunders 1982; Snyder et al. 1987).

The fast integration to social groups of at least three of the seven released animals reveals that these parrots did not display many aberrant behaviors common in other reintroductions of parrots or birds (Wiley et al. 1992). For example, from the beginning of the release period, the parrots showed typical behaviors, such as allopreening and a wide range of vocalizations, including more specialized social or sexual behaviors (e.g., food requests by females). These behaviors have been reported for other birds as a way to strengthen the links between the pair and as part of the repertoire of reproductive behaviors (Lack 1940; Cruz and Gruber 1980; Jeggo 1980; Levinson 1980; Saunders 1982; Snyder et al. 1987; Waltman & Beissinger 1992). Another indication of the development of reproductive behaviors is that three of the reintroduced parrots were seen scouting tree cavities with their wild partners. This is a typical pair behavior among parrots and an indication of interest in reproduction (Cruz & Gruber 1980; Saunders 1982; Lanning & Shiflett 1983; Snyder et al. 1987; Waltman & Beissinger 1992; Martuscelli 1995). The two parrots that scouted tree cavities did not reproduce in the first year after the release, even though they were of reproductive age (Rodriguez & Rojas-Suárez 1994). It is possible that the pairs were still not ready or experienced enough to reproduce. Indeed, Puerto Rico Amazons that form new pairs do not reproduce during the first year of pair formation (Snyder et al. 1987).

No aggressive interactions were seen between captive and wild parrots. On one occasion, however, we saw a group of parrots (including three with radio transmitters) chasing a lone Orange-winged Amazon (*A. amazonica*), which had probably escaped from captivity, not being a natural resident of the Macanao Peninsula.

Viability and Conservation Value of Reintroductions

Reintroductions are usually mentioned as an integral part of ex situ conservation programs and as an alternative to population management of endangered species. Few of these programs, however, include direct implementation of reintroductions, nor do they discuss the economic, social, or political issues affecting the viability of a reintroduction program.

It is common to underestimate the cost of a well-designed reintroduction project; considerable time and money are required for a long-term program. This reintroduction project was a portion of a larger program for the conservation of *A. barbadensis* and its natural habitat on Margarita Island. A significant portion of the success of this program rests on 5 years of previous work on environmental education, public awareness, and ecological studies of the parrots' behavior, habitat use, and diet. For example, *A. barbadensis* was officially declared the state bird by the governor of the island, and in most years there is a parrot float during the annual carnival parade. Similarly, the larger project provided transportation and training funds for field assistants and volunteers.

Excluding funds allocated to biological research, environmental education, or community outreach, we estimated an overall expenditure of about U.S. $2827 per reintroduced parrot. Economies of scale would reduce the costs per animal if the number of released animals were greater. Although it is difficult to compare this study to others, because costs and opportunities are different in each case, it is important to show these expenditures to provide a reference point for other reintroduction studies (Kleiman et al. 1991). Expenditures for this project were modest because we provided entry-level salaries, recruited assistants from the local community, and avoided paying large sums in consultancy fees. Other factors that helped reduce costs were the low costs of fuel and energy, in general, in Venezuela.

Given the economic costs of every reintroduction conservation project, it is important to decide the size of the maximum installed capacity and how many animals can be received and maintained at the captive-rearing facilities. This decision is difficult to make because such projects are confronted by the fact that enforcement regulations can provide more animals than recommended for the holding facilities. Similarly, reintroductions are vaguely referred to in conservation plans, but seldom if ever are the actual costs and long-term commitment specifically addressed from the beginning (Snyder et al. 1996).

It is also relevant to mention that not all confiscated parrots can be returned to their wild environment. Releases of confiscated parrots usually have been driven more by humanitarian or public relations goals than by conservation biology criteria, resulting in releases under conditions that do not assure the parrots' survival and that in some instances result in stressful deaths by predators or even a slow death from hunger. Several conservation organizations and specialists groups have issued recommendations for the treatment and destiny of confiscated animals (World Conservation Union 1987; Lambert et al. 1993; Association for Parrot Conservation 1994*a*, Ginsberg & Brautigan 1995). Given the potentially serious consequences of an irresponsible reintroduction program, it is important to follow these recommendations. Otherwise, the damage can easily be greater than the conservation value of the reintroductions.

Although the primary objective of our reintroduction experience was to study the economic and technical viability of reintroductions of captive-bred *A. barbadensis* in Margarita Island, our results and protocols are relevant to conservation programs for small populations of critically endangered parrots for which the pet trade, extraction of young, and low or negligible population recruitment preclude the application of cheaper and safer management techniques. Reintroductions of critically endangered species can also be important because the return of confiscated animals provides a direct contribution to the gene pool of the species, where each individual has a high value to the overall population genetic viability. For example, the *A. barbadensis* population in La Blanquilla Island has an estimated population size of 80–100 individuals, suffers low recruitment from nest poaching by fishermen and predation by feral cats, and has a low dispersal area in a small island (Rojas-Suárez 1994). Preliminary population viability analysis of this population indicates a probability of extinction of about 99.2% in 44 years if new individuals are not incorporated into the population (Rodriguez & Rojas-Suárez 1994). Given the results of this study and other recommendations on this subject (Wiley et al. 1992; Association for Parrot Conservation 1994*b*; Snyder et al. 1996), we suggest the following criteria to increase the chances of success in a parrot reintroduction program:

(1) The reintroduction program should be part of a research and conservation program that provides basic natural history information on the ecological requirements of the species, public awareness, and habitat protection.

(2) The origin of the confiscated animals should be known, so that the animals can be reintroduced in their natural range. This is especially important to avoid hybridization with different species or subspecies. When the genetic validity of a subspecies category is in doubt, genetic analysis should be performed (Amato 1995).

(3) Reintroductions of birds originating from the international pet trade should be carefully evaluated (and usually avoided) because these birds probably have been in direct contact with lethal diseases carried by exotic birds or domestic animals. If reintroduction is seen as a viable alternative, then quarantines should be strictly maintained and birds should be monitored for a long period of up to 2 years before their release. In this study the birds were confiscated before they reached the international trade and were housed only temporarily by

rural trappers, so they had less chance to be exposed to exotic diseases. The importance of monitoring diseases in confiscated birds cannot be underestimated because the risks of disease transmission may outweigh the conservation benefits of reintroductions (Derrickson & Snyder 1992; Beck et al. 1994).

(4) Reintroductions should be made in areas with some degree of protection, or at least the initial causes for the population decline should be addressed in the release area (Caughley 1994). In the Macanao Peninsula, awareness of the endangered status of the parrot among land owners, local villagers, and decision makers has increased greatly. In an ongoing process, local land owners and local and national authorities are now exploring new ways to increase habitat protection, decrease the pressure on the population, and ultimately create or expand protected areas.

(5) Reintroductions have the side benefit of contributing to environmental education goals and increasing the general awareness of the conservation needs of a species. It is important to take advantage of these opportunities with public media and awareness programs because of the emotional value to the general public. Media campaigns can also be used to draw public attention to the problems involving the illegal pet trade and maintaining wild animals as pets. For example, during the study, several talks and field demonstrations were offered to primary school children, high schools students, and volunteer youth conservation brigades as part of a larger environmental education program sponsored by Margarita Island environmental organizations, the Ministry of the Environment, and Provita (a national environmental nongovernmental organization). Local television, radio, and newspapers reported on the reintroduction project.

(6) Under critical situations (e.g., extremely small population sizes), reintroductions can be used to increase subadult recruitment rates and therefore the genetic variability of a wild population (Franklin 1980; Saunders 1982; Lindsey et al. 1994; Kuehler et al. 1995).

Our study provides a precedent for the successful readaptation of confiscated or captive-raised parrots to wild conditions, and it represents one of the first times that a successful reintroduction has been recorded in such detail. Given that nearly 20% of the world's 330 species of psittacines are globally endangered (Collar & Andrew 1988; Collar & Juniper 1992), we consider it important to try a variety of population recovery techniques that can increase conservation options and that can be differentially applied under different circumstances. Our study validates a captive raising and monitoring protocol that can be used for the reintroduction of parrots of the genus Amazona. To apply our results to other psittacines, these techniques should be tried in other species and the importance of various factors to reintroduction techniques should be analyzed. Previous experiences have shown that some of the most critical issues are predation by raptors, existence of a wild population within the reintroduction range, and diseases transmitted to confiscated animals from the international pet trade (Wiley et al. 1992; Snyder et al. 1994). If these factors can be controlled—by carrying out reintroductions in areas with low predation pressure or by locally confiscating animals before they get in contact with the international trade—then the probability of success seems to be high. We hope that more studies with other species of psittacines and under different ecological situations will provide further experiences upon which to base the management of endangered parrots and other birds.

Even with the restriction of imports of wild birds to the United States, the demand by national and international markets is still a significant pressure on wild populations. For example, from 1994 to 1996 a total of 119 chicks of *A. barbadensis* were confiscated from Aruba, Curaçao, and Caracas, presumably destined for European markets. All these confiscated parrots came from the less-protected western population of Falcon and Lara states of mainland Venezuela. Similarly, in July 1992 Venezuelan authorities confiscated a group of 10 *A. barbadensis* from Blanquilla Island, which has a total population of less than 100 individuals (Rojas-Suárez 1994). With larger confiscations, however, health issues and logistical and financial factors can limit the applicability of reintroduction as a viable alternative.

Whereas reintroduction can reduce the chances of extinction of this and other parrot species, this methodology still carries substantial risks. No instant conservation results can be achieved, so long-term protection from extinction will be a combination of scientific understanding of the biological and ecological requirements of the species, conservation awareness by local human communities, a termination of the demand for wild bird trade, and the continued commitment of enforcement and conservation agencies (Snyder et al. 1996).

Table 3. Weekly changes in home range size (ha) of reintroduced Yellow-shouldered Amazon (*A. barbadensis*) during the adaptation period.

	*Individual**			
Week after release	*C2*	*C6*	*C4*	*C8*
1	129.5	1.4	7.0	0
2	801.3	926.2	0	0
3	713.6	251.5	0	0
4	648.3	315.6	8.1	0
5–6	2932.0	1370.5	0.6	8.4
7–8	52.4	2326.2	0	3.0

**Home range increased abruptly when C2 and C6 joined two wild groups and followed the groups to communal roosting areas and new feeding areas. During week 6 the parrots changed feeding groups, which in turn increased the C2 home range to nearly 3000 ha, representing 10% of the total land surface of the Macanao peninsula. Meanwhile C4 and C8 remained in home ranges smaller than 10 ha for the first 9 months until they joined wild groups, which resulted in an increase in their home ranges. Zeros represent no measurable change in home range.*

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Literature Cited

Albornoz, M., F. Rojas-Suárez, and V. Sanz 1994. Conservación y manejo de la cotorra cabeciamarilla (*Amazona barbadensis*) en la isla de Margarita, Estado Nueva Esparta. Pages 197–207 in G. Morales, I. Novo, D. Bigio, A. Luy, and F. Rojas-Suárez, editors. Biología y conservación de los psitácidos de Venezuela. Gráficas Giavimar, Caracas, Venezuela.

Amato, G. 1995. Genetics of *Amazona barbadensis*. Report. Wildlife Conservation Society, New York.

Association for Parrot Conservation. 1994*a*. Policy statement on confiscated parrots. Association for Parrot Conservation, Arlington, Virginia.

Association for Parrot Conservation. 1994*b*. Policy statement on reintroductions for parrot conservation. Association for Parrot Conservation, Arlington, Virginia.

Beck, B. B., L. G. Rapaport, M. R. Stanley Price, and A. C. Wilson. 1994. Reintroduction of captive born animals. Pages 265–285 in P. J. S. Olney, G. M. Mace, and A. T. C. Feistner, editors. Creative conservation: interactive management of wild and captive animals. Chapman and Hall, London.

Bull, J. 1973. Exotic birds in the New York City area. Wilson Bulletin **85:**501–505.

Caughley, G. 1994. Directions in conservation biology. Journal of Animal Ecology **63:**215–244.

Collar, N. J., and P. Andrew 1988. Birds to watch: the ICBP world checklist of threatened birds. Technical publication 8. ICBP, Cambridge, United Kingdom.

Collar, N. J., and A. T. Juniper 1992. Dimensions and causes of the parrot conservation crisis. Pages 1–24 in S.R. Beissinger and N.F.R. Snyder, editors. New world parrots in crisis: solutions from conservation biology. Smithsonian Press, Washington, D.C.

Cruz, A., and S. Gruber. 1980. The distribution, ecology, and breeding biology of Jamaican Amazon parrots. Pages 103–131 in R. F. Pasquier, editor. Conservation of New World parrots. International Council for Bird Preservation Smithsonian Press, Washington, D.C.

Derrickson, S. R., and N. F. R. Snyder 1992. Potentials and limits of captive breeding in parrot conservation. Pages 133–163 in S. R. Beissinger and N. F. R. Snyder, editors. New World parrots in crisis: solutions from conservation biology. Smithsonian Press, Washington, D.C.

Desenne, P., and S. Strahl. 1991. Trade and conservation status of the Family Psittacidae in Venezuela. Bird Conservation International **1:** 153–169.

Desenne, P., and S. Strahl. 1994. Situación poblacional y jerarquización de especies para la conservación de la familia Psittacidae en Venezuela. Pages 231–272 in G. Morales, I. Novo, D. Bigio, A. Luy, and F. Rojas-Suárez, editors. Biología y conservación de los psitácidos de Venezuela. Gráficas Giavimar, Caracas, Venezuela.

Enkerlin, E. C. 1995. Comparative ecology and reproductive biology of three species of Amazona parrots in Northeastern Mexico. Ph.D. thesis. Texas A&M University, College Station.

Forshaw, J. M. 1989. Parrots of the world. 3rd edition. Landsdowne Editions, Willoughby, Australia.

Franklin, I. R. 1980. Evolutionary change in small populations. Pages 135–150 in M. E. Soulé and B. A. Wilcox, editors. Conservation biology: an evolutionary-ecological perspective. Sinauer Associates, Sunderland, Massachusetts.

Ginsberg, J. A., and A. Brautigan 1995. Disposal of confiscated animals: developing guidelines for the placement of confiscated animals. Re-introduction News **10:**4–5.

Hardy, J. W. 1973. Feral exotic birds in southern California. Wilson Bulletin **85:**506–512.

Hoyos, J. 1985. Flora de la Isla de Margarita. Sociedad Fundación La Salle de Ciencias Naturales, Caracas, Venezuela.

Jeggo, D. F. 1980. The captive breeding programme for Caribbean Amazons at the Jersey Wildlife Preservation Trust. Pages 181–196 in R. F. Pasquier, editor. Conservation of New World parrots. Smithsonian Institution Press, Washington, D.C.

Kleiman, D. G., B. B. Beck, J. M. Dietz, and L. A. Dietz. 1991. Costs of reintroduction and criteria for success: accounting and accountability in the Golden Lion Tamarin Program. Symp. Zoological Society London **62:**125–144.

Kuehler, C., P. Harrity, A. Lieberman, and M. Kuhn. 1995. Reintroduction of hand-reared Alala *Corvus hawaiiensis* in Hawaii. Oryx **29:** 261–266.

Lack, D. 1940. Courtship feeding in birds. Auk **57:**169–178.

Lambert, F., R. Wirth, U. S. Seal, J. B. Thomsen, and S. Ellis-Joseph. 1992. Parrots, an action plan for their conservation and management 1993–1998. BirdLife International, World Conservation Union, Species Survival Commission, Traffic, World Wildlife Fund, Economic European Community, Oman Sultanate.

Lanning, D. V., and J. T. Shiflett. 1983. Nesting ecology of Thick-billed Parrots. Condor **85:**66–73.

Levinson, S. T. 1980. The social behavior of the White-fronted Amazon (*Amazona albifrons*). Pages 403–417 in R. F. Pasquier, editor. Conservation of new world parrots. Smithsonian Institution Press, Washington, D.C.

Lindsey, G. D., W. J. Arendt, and J. Kalina. 1994. Survival and causes of mortality in juvenile Puerto Rican parrots. Journal of Field Ornithology **65:**76–82.

Martuscelli, P. 1995. Ecology and conservation of the Red-tailed Amazon *Amazona brasiliensis* in South-eastern Brazil. Bird Conservation International **5:**225–240.

Meyers, J. M., W. J. Arendt, and G. D. Lindsey 1996. Survival of radio collared nestlings of Puerto Rican Parrot. Wilson Bulletin **108:**159–163.

Mohr, C. O. 1947. Table of equivalent populations of North American small mammals. American Midland Naturalist **37:**223–249.

Owre, O. T. 1973. A consideration of the exotic avifauna of southeastern Florida. Wilson Bulletin **85:**491–500.

Rodriguez, J. P., and F. Rojas-Suárez. 1994. Analisis de viabilidad poblacional de tres poblaciones de Psitácidos insulares de Venezuela. Pages 97–114 in Biología y conservación de los Psitácidos de Venezuela. G. Morales, I. Novo, D. Bigio, A. Luy, and F. Rojas-Suárez, editors. Gráficas Giavimar, Caracas, Venezuela.

Rojas-Suárez, F. 1994. Evaluación de la población de cotorra (*Amazona barbadensis*) en la isla de la Blanquilla, Venezuela. Pages 89–113 in G. Morales, I. Novo, D. Bigio, A. Luy, and F. Rojas-Suárez, editors. Biología y conservación de los psitácidos de Venezuela. Gráficas Giavimar, Caracas, Venezuela.

Sanz, V., and F. Rojas-Suárez. In press. Los nidos nodriza como técnica para aumentar el reclutamiento de la cotorra cabeciamarilla (*Amazona barbadensis*). Vida Silvestre Neotropical.

Saunders, D. A. 1982. The breeding behavior and biology of the short-billed form of the White-tailed Black Cockatoo, *Calyptorhynchus funereus*. Ibis **124:**422–456.

Silvius, K. M. 1989. Resultados preliminares del Proyecto. Ecología, biología y situación actual de la Cotorra (*Amazona barbadensis*) en la isla de Margarita, Nueva Esparta. Report. Foundation for the Defense of Nature FUDENA, Caracas, Venezuela.

Silvius, K. M. 1992. Frugivory in semiarid habitats: avian consumers of Cardón Cactus (*Stenocereus griseus*) fruits on Margarita Island, Venezuela. M.S. thesis. University of Florida, Gainesville.

Snyder, N. F. R., J. W. Wiley, and C. B. Kepler. 1987. The parrots of Luquillo: natural history and conservation of the Puerto Rican Parrot. Western Foundation of Vertebrate Zoology, Los Angeles.

Snyder, N. F. R., S. E. Koenig, J. Koshmann, H. A. Snyder, and T. B. Johnson. 1994. Thick-billed Parrot releases in Arizona. Condor **96:** 845–862.

Snyder, N. F. R., S. R. Derrikson, S. R. Beissinger, J. W. Wiley, T. B. Smith, W. D. Toone, and B. Miller. 1996. Limitations of captive breeding in endangered species recovery. Conservation Biology **10:**338–348.

Todd, I. A. 1992. Wildtrak, a non-parametric home range analysis for Macintosh computers. Department of Zoology, University of Oxford, Oxford, United Kingdom.

Ulloa, G., and A. Fernandez-Badillo. 1987. El perico monje y el peligro de importar aves sin control. Natura **81:**15–17.

Wallace, M. P., and S. A. Temple, 1987. Releasing captive-reared Andean Condors to the wild. Journal of Wildlife Management **51:**541–550.

Waltman J. R., and S. R. Beissinger. 1992. Breeding behavior of the Green-rumped Parrolet. Wilson Bulletin **104:**65–84.

White, G. C., and R. A. Garrott. 1990. Analysis of wildlife radio-tracking data. Academic Press, San Diego.

Wiley, J. W., N. F. R. Snyder, and R. S. Gnam. 1992. Reintroduction as a conservation strategy for parrots. Pages 165–200 in S. R. Beissinger and N. F. R. Snyder, editors. New world parrots in crisis: solutions from conservation biology. Smithsonian Press, Washington, D.C.

World Conservation Union. 1987. The IUCN position statement on translocation of living organisms. Gland, Switzerland.