

STATUS AND CONSERVATION OF THE FAMILY PSITTACIDAE IN THE WEST INDIES

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Abstract.—The status of native West Indian parrots (*Amazona*; n = 12) and parakeets (*Aratinga*; n = 3) is reviewed, as are the environmental problems that have affected the species and the current and planned conservation efforts. All parakeet species are in decline and are of great concern. The four Lesser Antillean species of amazon parrots have shown increasing populations since the 1970s, the result of aggressive habitat protection and vigorous environmental education campaigns. Amazon parrot populations in the Bahamas (Abaco and Inagua), Cuba, Cayman Islands, and perhaps Jamaica are stable, but most continue to be at varying risk to declines resulting from further habitat loss and other environmental problems. The Cuban Parrot (*Amazona leucocephala*) population in the Isla de Pinos has shown substantial population growth, resulting from a vigorous management effort. The Puerto Rican Parrot (*A. vittata*) continues as the species at greatest risk of extinction, with the wild population fluctuating from 30 to 48 individuals since Hurricane Hugo (1989) caused severe damage to the species' habitat. Recent successes in saving some parrot populations from probable extinction (e.g., Puerto Rican Parrot) or the substantial recovery of some small, local populations (e.g., Red-necked Parrot) give conservationists guarded optimism that these species will recover. Other populations, though showing stable population levels (e.g., Cayman Brac Parrot), are at great risk to rapid extinction and pose substantial conservation challenges. We present points to consider in developing conservation strategies for the region's parrots and parakeets. It is of particular concern that recovery programs are initiated sufficiently early to avoid the desperate and expensive measures needed to recover severely reduced populations. Conservation efforts must not fall into a state of complacency based on limited successes, which may prove to be short-lived. Also, successful parrot conservation programs may lead to new problems that will challenge the ingenuity of the conservation community, including renewed conflicts between newly expanding parrot populations and agriculture. Perhaps the most daunting of the new threats is disease, carried to naïve island populations by the largely uncontrolled proliferation of exotic parrots and other cage birds. West Nile virus and equine encephalitis represents new, unmeasured, and currently uncontrollable threats across the Caribbean.

Key words: *Amazona*, *Aratinga*, Caribbean, conservation, parakeet, parrot, status, West Indies

Resumen.—ESTADO Y CONSERVACIÓN DE LA FAMILIA PSITTACIDAE EN LAS INDIAS OCCIDENTALES. Se analiza el estado de las cotorras (*Amazona*; n = 12) y pericos (*Aratinga*; n = 3) nativos de las Indias Occidentales, al igual que los problemas ambientales que han afectado a las especies y los esfuerzos actuales y previstos de conservación. Todas las especies de pericos están en declive y son de gran preocupación. Las cuatro especies de amazona en las Antillas Menores han aumentado sus poblaciones desde la década de 1970 como resultado de la protección energética del hábitat y vigorosas campañas de educación ambiental. Las poblaciones de amazonas en las Bahamas (Abaco e Inagua), Cuba, las islas Caimán, y quizás Jamaica, son estables, pero la mayoría siguen estando en peligro de experimentar declives como resultado de la pérdida adicional de hábitat y otros problemas ambientales. La población de la Cotorra Cubana (*Amazona leucocephala*) en la isla de Pinos ha aumentado considerablemente como resultado de esfuerzos de manejo agresivos. La Cotorra Puertorriqueña (*A. vittata*) sigue siendo la especie en mayor riesgo de extinción, con la población salvaje fluctuando entre 30 y 48 individuos desde que el huracán Hugo (1989) causara severos daños al hábitat de la especie. Los éxitos recientes en el rescate de algunas poblacio-

nes de cotorras de una probable extinción (e.g., Cotorra Puertorriqueña) o la recuperación sustancial de algunas poblaciones locales pequeñas (e.g., Cotorra Cuellirroja) le ofrecen a los conservacionistas cierto optimismo que estas especies se recuperarán. Otras poblaciones, aunque presentan niveles poblacionales estables (e.g., Cotorra de Cayman Brac), se encuentran seriamente amenazadas de extinguirse rápidamente y suponen retos conservacionistas considerables. Presentamos factores que se deben considerar al desarrollar estrategias de conservación para las cotorras y pericos de la región. Es particularmente importante que los programas de recuperación se inicien lo suficientemente temprano para evitar las medidas desesperadas y costosas que se necesitan para recuperar poblaciones severamente diezmadas. Los esfuerzos conservacionistas no se pueden considerar como exitosos si se basan en éxitos limitados que pueden demostrar ser de breve duración. Además, los programas exitosos de conservación con cotorras pueden resultar en nuevos problemas que desafiarán el ingenio de la comunidad conservacionista, incluyendo conflictos renovados entre poblaciones de cotorras en expansión y la agricultura. Quizás la más desalentadora de las nuevas amenazas sean las enfermedades, transportadas a poblaciones indefensas en las islas gracias a la proliferación, en gran parte sin control, de cotorras exóticas y otras aves de jaula. El virus del Nilo Occidental y la encefalitis equina representan nuevas amenazas, aún sin estudiar y actualmente incontrolables, a través de todo el Caribe.

Palabras clave: Amazona, Aratinga, Caribe, conservación, cotorra, estado, Indias Occidentales, perico

Résumé.—STATUT ET CONSERVATION DE LA FAMILLE DES PSITTACIDAE DANS LES ANTILLES. Le statut des perroquets des Antilles (*Amazona*, $n = 12$; *Aratinga*; $n = 3$) est analysé, parallèlement aux difficultés environnementales qui affectent l'espèce, ainsi que les efforts de conservation actuels et planifiés. Toutes les espèces du genre *Aratinga* sont en régression et posent de sérieuses inquiétudes. Les 4 espèces d'amazones des Petites Antilles sont en augmentation depuis les années 1970, grâce à des mesures drastiques de protection et d'efficaces actions d'éducation à l'environnement. Les populations d'amazones des Bahamas (Abaco et Inagua), de Cuba, des îles Cayman et peut-être de Jamaïque sont stables mais la plupart continuent à être exposées à des risques variables de déclin en raison de la poursuite de la régression de leur habitat et d'autres problèmes environnementaux. La population d'Amazone de Cuba (*Amazona leucocephala*) de l'Île des Pins a progressé de manière significative à la suite d'un effort considérable de gestion. L'Amazone de Porto Rico (*A. vittata*) est toujours l'espèce la plus menacée d'extinction avec une population sauvage fluctuant entre 30 et 48 individus depuis que l'ouragan Hugo (1989) a provoqué des dommages sévères à son habitat. Les succès récents de sauvegarde de certaines populations de perroquets d'une extinction probable (par exemple l'Amazone de Porto Rico) ou la forte augmentation locale de certaines petites populations (par exemple l'Amazone de Bouquet) permettent aux acteurs de la conservation d'avoir un optimisme mesuré sur leur avenir. D'autres populations, bien que présentant des effectifs stables (comme la population d'Amazone de Cuba à Cayman Brac), restent exposées à des risques élevés de disparition rapide et suscitent des questions complexes de conservation. Les points à considérer pour le développement de stratégies de conservation des Psittacides de la région sont présentés. Il est particulièrement important que les programmes de conservation soient initiés suffisamment tôt pour éviter de prendre des mesures désespérées et coûteuses nécessaires à la sauvegarde des populations très réduites. Les mesures de conservation doivent éviter de tomber dans un état d'autosatisfaction basé sur des succès, limités, qui seraient de courte durée. Mais, les programmes de conservation de perroquets qui réussissent peuvent aussi faire apparaître de nouvelles difficultés qui mettront au défi la naïveté des protecteurs. Celles-ci comporteront la réapparition de conflits entre les populations de perroquets en expansion et l'agriculture. Une des nouvelles menaces parmi les plus insidieuses concerne les maladies, apportées aux populations insulaires jusqu'alors non exposées par la prolifération largement non contrôlée de perroquets exotiques et d'autres oiseaux de cage. Le virus du West Nile et l'encéphalite équine sont de nouvelles menaces pour toute la Caraïbe non évaluées et aujourd'hui incontrôlables.

Mots-clés: Amazona, Antilles, Aratinga, Caraïbe, conservation, perroquet, statut

INTRODUCTION

AT THE TIME of Columbus's arrival in the West Indies, the psittacine fauna was rich, consisting of as many as 34 species (up to eight parakeets, 12 macaws, and 14 amazon parrots; Williams and Steadman 2001; Table 1; Figs. 1 and 2). Interpretations of parrot biogeography are particularly difficult in the West Indies, because many of these birds were kept as pets by Amerindians and were likely transported as human populations expanded and journeyed

among islands. Indeed, many species (e.g., *Ara au-thothon*, unidentified *Ara* from Puerto Rico) are known from kitchen middens because, aside from serving as companions, they served as meals when needed. These early man-aided translocations may have affected the present day distribution of psittacids and, with the absence of a complete specimen record, further complicate the already difficult puzzle of species' original distributions based on the sketchy descriptions of early European colonists.

Table 1. Known psittacine fauna of the West Indies, with current status of species and populations. Status includes IUCN Red List (Hilton-Taylor 2000) abbreviations and appendix designation in CITES. Only native species and species introduced more than 75 years ago are included.

Island	Species ¹	Status
Bahama Islands	<i>Amazona leucocephala bahamensis</i>	LR/NT ² , I ³ ; common on Great Inagua, threatened on Abaco, extirpated on other islands
Turks & Caicos Islands	<i>Amazona</i> undescribed sp.†	Extinct; Grand Turk; prehistoric remains
Cuba	<i>Ara tricolor</i> †	Extinct; range included Isla de Pinos
	<i>Amazona leucocephala leucocephala</i>	LR/NT ² , I ³ ; declining
	<i>Amazona leucocephala palmarum</i>	LR/NT ² , I ³ ; declining
	<i>Aratinga euops</i>	VU ² , II ³ ; declining, extirpated from Isla de Pinos
Grand Cayman	<i>Amazona leucocephala caymanensis</i>	LR/NT ² , I ³ ; ca. 2000 birds, stable
Cayman Brac	<i>Amazona leucocephala hesternana</i>	LR/NT ² , I ³ ; 300–430 birds; stable, but because of so few birds and the tiny range of this population, considered in danger of rapid extinction
Little Cayman	<i>Amazona leucocephala hesternana</i>	Extirpated
Jamaica	<i>Ara erythrocephala</i> †	Extinct
	<i>Ara gossei</i> †	Extinct
	<i>Ara erythrura</i> †	Extinct; questionable
	<i>Ara tricolor</i> †	Extinct; presence in Jamaica questionable
	<i>Amazona collaria</i>	VU ² , II ³ ; small population, declining
	<i>Amazona agilis</i>	VU ² , II ³ ; small population, declining
	<i>Forpus passerinus</i>	Introduced, locally common
	<i>Aratinga nana</i>	II ³ ; declining, but still locally common
Hispaniola	<i>Ara unknown</i> sp.†	Extinct
	<i>Ara tricolor</i> †	Extinct; questionable
	<i>Amazona ventralis</i>	VU ² , II ³ ; widespread and locally common, but declining rapidly
Puerto Rico	<i>Aratinga chloroptera</i>	VU ² , II ³ ; declining
	<i>Ara unknown</i> sp.†	Extinct; known from aboriginal middens; possibly <i>A. autochthonos</i> or <i>A. tricolor</i>
	<i>Amazona vittata vittata</i>	CR ² , I ³ ; tiny population; aggressive conservation program
Culebra Island	<i>Aratinga [chloroptera] maugei</i> †	Extinct
Virgin Islands	<i>Amazona vittata gracilipes</i> †	Extinct
	<i>Ara autochthonos</i> †	Extinct; St. Croix
	<i>Aratinga pertinax</i>	II ³ ; common, believed introduced from Curaçao
Antigua	<i>Amazona vittata</i>	Extirpated; prehistoric remains
Barbuda	<i>Amazona vittata</i>	Extirpated
Montserrat	<i>Aratinga</i> undescribed sp.†	Extinct; prehistoric remains
	<i>Ara</i> undescribed sp.†	Extinct; prehistoric remains
	<i>Amazona</i> undescribed sp.†	Extinct; prehistoric remains
Guadeloupe	<i>Ara guadeloupenis</i> †	Extinct
	<i>Anodorhynchus purpurascens</i> †	Extinct; validity of species in doubt
	<i>Amazona violacea</i> †	Extinct
	<i>Aratinga labati</i> †	Extinct
Marie Galante	<i>Ara</i> cf. <i>guadeloupenis</i> †	Extinct; prehistoric remains
	<i>Amazona</i> cf. <i>violacea</i> †	Extinct; prehistoric remains
Dominica	<i>Ara atwoodi</i> †	Extinct
	<i>Amazona imperialis</i>	VU ² , I ³ ; 150 individuals
	<i>Amazona arausiaca</i>	VU ² , I ³ ; 800+ individuals
St. Lucia	<i>Aratinga</i> undescribed sp.†	Extinct
	<i>Amazona versicolor</i>	VU ² , I ³ ; ~800 individuals
Martinique	<i>Ara martinicus</i> †	Extinct; validity of species in doubt; also possibly another undescribed <i>Ara</i> species
	<i>Amazona martinicana</i> †	Extinct
	<i>Aratinga</i> undescribed sp.†	Extinct
St. Vincent	<i>Amazona guildingii</i>	VU ² , I ³ ; 519 individuals
Grenada	<i>Amazona</i> undescribed sp.†	Extinct
Barbados	<i>Aratinga</i> undescribed sp.†	Extinct

¹† = extinct.

²IUCN Red List (Hilton-Taylor 2000) status: CR = Critically Endangered, EN = Endangered, VU = Vulnerable, LR = Lower Risk, NT = Near Threatened.

³CITES Appendix.

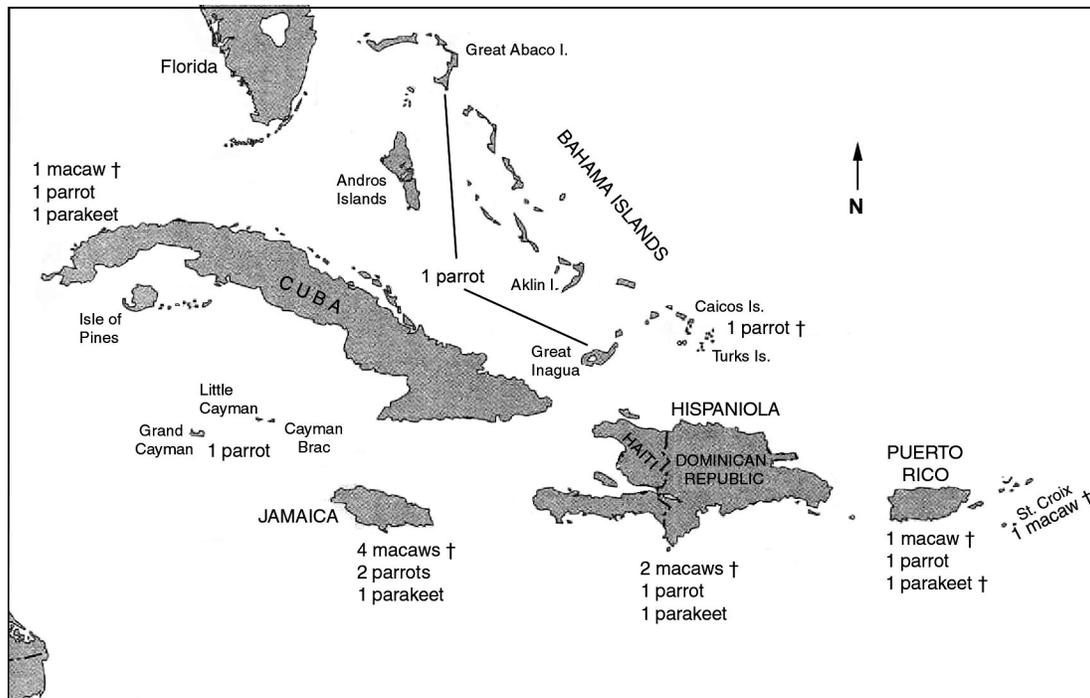


Fig. 1. Early macaw, parrot, and parakeet distribution in the Greater Antilles at the time of Columbus's arrival (1492). Numbers represent known forms from the islands, † = extinct.

Certain, however, is that in less than 500 years the parrot diversity of the region has been vastly reduced: all 12 macaw species have disappeared, 63% of the native parakeet species have become extinct, and 36% of the amazon parrot species have been lost (Table 1; Figs. 1 and 2). Thus, only 35% (15) of the original psittacine species survive today.

The Greater Antilles (Cuba, Hispaniola, Jamaica, Puerto Rico, Virgin Islands), Cayman Islands, and Bahama Islands were home to at least 13 psittacine species (four macaws, four parakeets, and five amazon parrots; Table 1). Although the parrot fauna of these northern islands fared better than the Lesser Antillean parrots, 38% of the species are now extinct. The psittacine fauna of the Lesser Antilles suffered greater losses, with an overall 78% extinction rate (14 of 18 species), including macaws (5 of 5), parakeets (5 of 5), and amazon parrots (4 of 8; 50%) (Table 1). Whereas all parakeets and parrots in the region exhibit varying risk of further decline through accelerating habitat loss and other human-related activities, the three surviving parakeet species seem to be especially vulnerable, judging from this group's history of extinction in the West Indies. Native *Aratinga* parakeets survive only in Cuba (*Aratinga euops*), Jamaica (*A. nana*), and Hispaniola (*A. chloroptera*).

Each of the inhabited islands has one native species of Amazon parrot, except Jamaica, with *Amazona agilis* and *A. collaria*, and Dominica, with *A. imperialis* and *A. arausiaca*. Among the other islands *A. ventralis* occurs in Hispaniola, *A. vittata* in Puerto Rico, *A. guildingii* in St. Vincent, *A. versicolor* in St. Lucia, and the *A. leucocephala* complex in Cuba (nominate *leucocephala*), Bahama Islands (race *bahamensis*), and the Cayman Islands (Grand Cayman with *caymanensis*, Cayman Brac with *hesterna*).

During the last quarter of the twentieth century, several exotic psittacine species became established in the region, particularly in Puerto Rico and the U. S. Virgin Islands (Philibosian and Yntema 1977, Raffaele 1983). Two species, however, were established in the region considerably earlier. The Brown-throated Parakeet (*Aratinga pertinax*) may have been introduced to St. Thomas from Curaçao over a century ago (Philibosian and Yntema 1977, Forshaw 1978, Wiley 1993a). The Green-rumped Parrotlet (*Forpus passerinus*) was introduced to Jamaica in 1918 (Bond 1956, Lack 1976), and has since steadily increased its range and is now widespread in wooded cultivation from sea level to around 500 m elevation. The parrotlet is unusual among introduced species in the West Indies in that

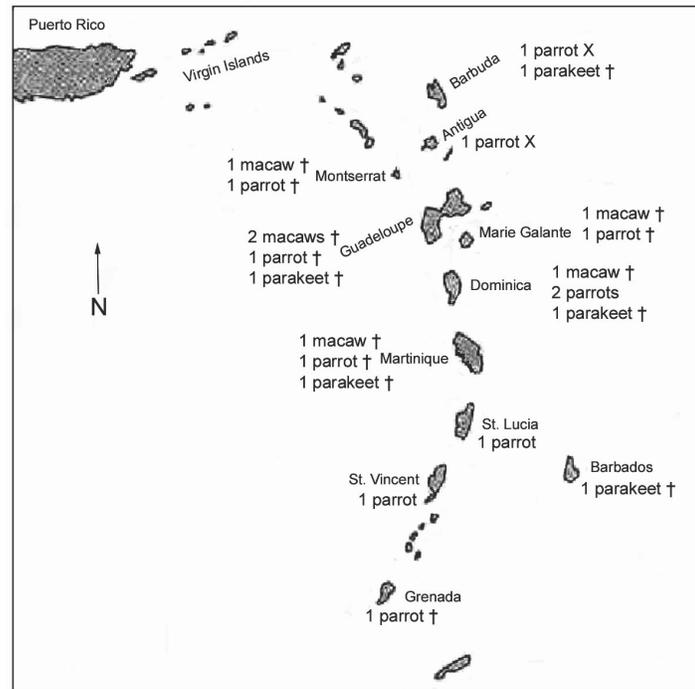


Fig. 2. Early macaw, parrot, and parakeet distribution in the Lesser Antilles at the time of Columbus's arrival (1492). Numbers represent known forms from the islands, † = extinct, X = extirpated.

it occurs to some extent in natural forests.

This report updates the status and trends of psittacines in the Caribbean islands as reported by Butler (1991, 1992a) and Wiley (1991), presenting summaries of the efforts on behalf of the region's parrots and reporting on new problems associated with the positive reversal of fortunes, albeit tenuous in some cases, of parrots in the West Indies. We also summarize refinements in earlier population estimates and distributions. First we present general information on threats to the region's parrots, then examine each extant, native taxon, island-by-island, giving special attention to those islands that have made substantial efforts in parrot conservation and to species that have exhibited population changes. We use the term parrot for members of the genus *Amazona*, parakeet for *Aratinga* spp., and macaw for the genera *Ara* and *Anodorhynchus*.

ORIGINAL ECOSYSTEMS

Habitat diversity before Columbus's arrival in the West Indies ranged from simple to complex. Some islands that are small and low, like the Bahamas and Cayman Islands, have always had relatively little vegetational diversity compared to the larger islands. Hispaniola, with an area of 81,000 km² and

two peaks higher than 3000 m, has multiple vegetational zones ranging from cactus scrub woodland in the arid coastal regions to alpine cloud-forest with extensive broadleaf forests. West Indian psittacids originally occupied essentially all habitat types with food-bearing plants, including arid cactus woodlands, wet and xeric broadleaf forests, palm savannas, pine woodlands, coppice, and mangrove forest. However, as land was cleared for cultivation, habitats were either destroyed or greatly altered, with moist forests of the coastal and lowland montane zones disappearing first. Today, only remote forests in the most rugged areas — predominantly in island interiors — have escaped cutting, and only in these areas have parrots survived in substantial numbers.

CAUSES OF DECLINES IN PARROT POPULATIONS

Environmental assaults, almost all of which are tied to human activities, have driven parrot population declines and extinctions across the West Indies. The most widespread and important of the causes of decline are summarized below.

Habitat loss. Undoubtedly, habitat degradation, fragmentation, and loss resulting from agricultural and timber activities and urban development have been the most important factors in the decline of

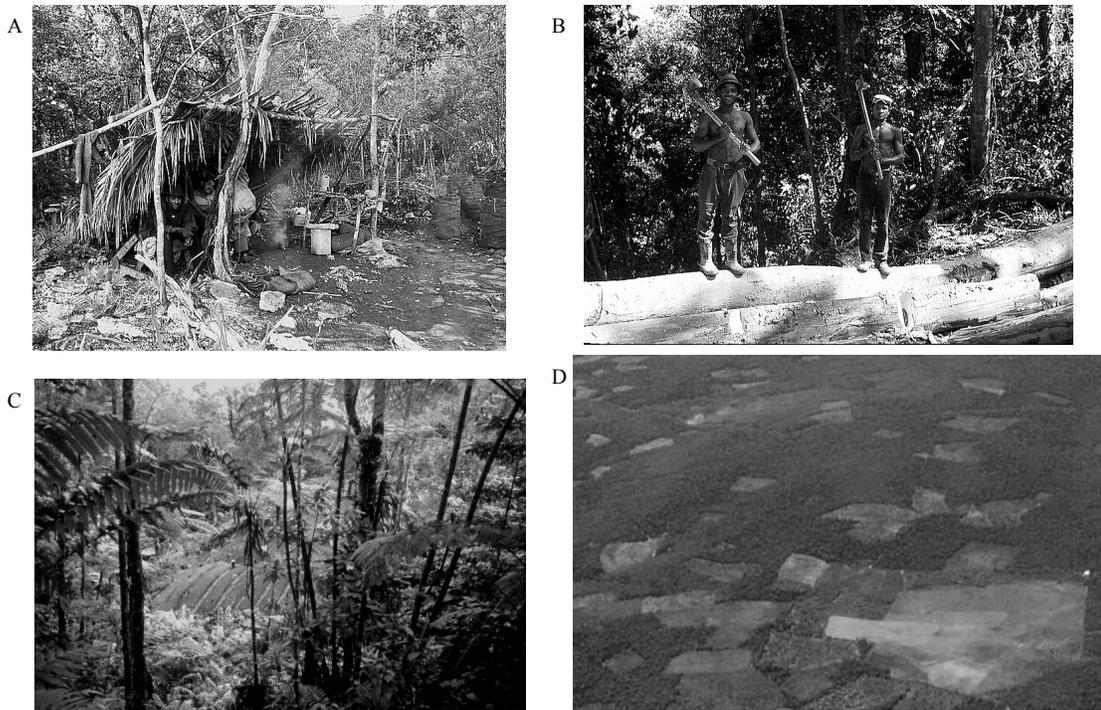


Fig. 3. Habitat loss: A. “carboneros” (charcoal makers) in eastern Dominican Republic; B. woodsmen cutting forest above Miches, Dominican Republic; C. small “conuco” (cultivation) in Los Haitises, Dominican Republic; D. aerial view of fragmentation of habitat as progressively more forest is cut to allow cultivation, Dominican Republic (photos by J. Wiley).

parrot populations (Fig. 3). With few exceptions, West Indian psittacines require tree cavities for nesting. Cutting of mature forests has left birds without suitable nesting sites and, to a lesser extent, food and shelter. As mature forests disappeared, so did parrots. However, timber and agricultural deforestation are, to a great extent, reversible for some species as seen in the case of Puerto Rico (see below). In contrast, current economic pressures throughout the region favor accelerated urbanization and development of tourism-based infrastructures, which permanently converts forested areas.

Persecution as agricultural pests. As agriculture spread into psittacine habitat, farmers and birds came into conflict over crops. Both parrots and parakeets are still vigorously controlled through shooting and poisoned baits to protect crops, but parakeets, particularly, are considered more serious crop predators.

Conflicts with exotics. European settlers and modern, mobile humans helped introduce an array of alien species, some of which have been instrumental in the decline and extinction of psittacids. European honeybees (*Apis mellifera*) and rats (especially *Rat-*

tus rattus) compete with parrots for nest cavities (Wiley 1980, 1985a; Snyder *et al.* 1987). There are instances in St. Vincent of nine-banded armadillos (*Dasypus novemcinctus*) undermining buttresses of nest trees, accelerating their decay and fall (Reillo, pers. obs.). Exotic feral cats (*Felix catus*) and Javan mongooses (*Herpestes javanicus*) are predators of parrot eggs, chicks, and adults under some circumstances (Rodríguez-Vidal 1959; Snyder *et al.* 1987; Reillo, pers. obs.; White, pers. obs.).

In more recent years, with more extensive networks of rapid conveyances, many of the islands have seen considerable importation and establishment of exotic psittacine species; e.g., particularly Puerto Rico. More recently, introduced parrots have posed a threat to native populations through competition, hybridization, and disease (Snyder *et al.* 1987). In Puerto Rico, at least 11 psittacines, including five amazon parrots, are established (Raffaele 1983; Wiley, pers. obs.), and threaten the native Puerto Rican Parrot (*Amazona vittata*).

Harvesting for pets. Harvesting of chicks for the pet trade has seriously affected many of the region’s parrot species, although most West Indian govern-

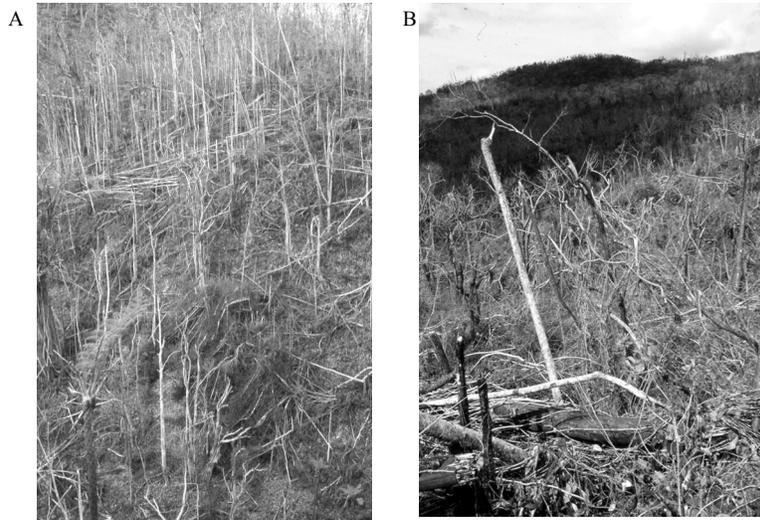


Fig. 4. Hurricane damage: A. forest damage after Hurricane David (1979), Dominica; B. aftermath of Hurricane Hugo (1989) in Caribbean National Forest, Puerto Rico (photos by J. Wiley).

ments have made substantial improvements in regulating this activity. As important as traditional local markets have been, the addition of new lucrative international markets has greatly increased pressures on some parrot populations. Aside from the immediate effect of removing chicks from nests, harvesting can have long-lasting consequences on parrot populations, including the destruction of parrot nest cavities in the harvesting process, thereby reducing available nesting habitat (Todd 1916, Wiley 1980, 1985a; Snyder *et al.* 1987, Wright *et al.* 2001). Although not considered as valuable as parrots, parakeets have been under local harvesting pressure for the pet trade in some islands; e.g., Isla de Pinos (now Isla de la Juventud) (Todd 1916) and Dominican Republic (Wiley, pers. obs.).

Natural disasters. Hurricanes are a constant threat to island populations of psittacines (Fig. 4). When populations were large and widespread, these tropical storms had little long-term effect at the species level. However, once populations became restricted in range through habitat loss and were reduced to many fewer individuals, hurricanes accelerated the reduction, extinction, or extirpation of both local populations and species and their nesting habitat (Wiley and Wunderle 1994).

SPECIES ACCOUNTS

BAHAMA ISLANDS

The Bahama archipelago comprises some 13 sizeable islands or island groups, and about 700 low-

lying islands and 2000 or so cays, covering the political units of the Bahamas and the Turks and Caicos Islands (a United Kingdom dependent territory). With a total surface area of some 13,940 km² (slightly smaller than the state of Connecticut), the islands are spread across about 960 km of the Atlantic Ocean, from Bimini in the north, which is just 80 km east of Florida, to Great Inagua in the south, which is only 80 km north of Haiti. There are no major watercourses and little fertile soil; hence, only about 1% of the land is cultivated and over 80% is forested, mainly with Caribbean pine (*Pinus caribaea*) and coastal scrub, mangrove forests and broadleaved evergreen forest, or “coppice” (Food and Agriculture Organization 2003). The major Caribbean pine areas are confined to the northern islands of Abaco, Andros, Grand Bahama, and New Providence, where they are often extensive.

Parrots survive on only two of the islands. Abaco is a narrow twin-island, consisting of the 32 km-long Little Abaco to the north and the 180 km-long Great Abaco to the south. Abaco is the second largest island in the Bahamas archipelago and lies at the western end of the Little Bahama Bank. It contains an excellent mix of habitats, which include extensive, but mainly secondary, Caribbean pine forests, native broadleaved coppice forests, mangroves, and mudflats along the western coasts, and many cays and rock islets to the east. Inagua is in the southern-most area of the Bahamas archipelago. It is comprised of two islands — Little Inagua and Great Inagua. Great Inagua is the third largest is-

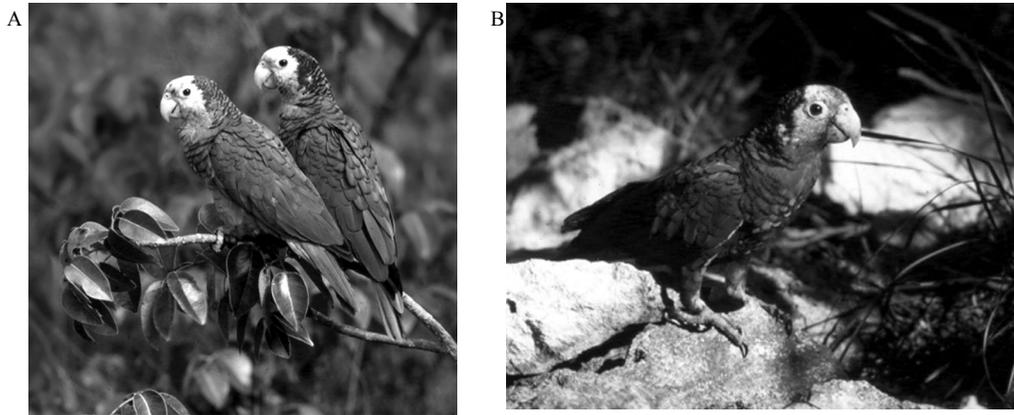


Fig. 5. Bahama Parrot (*Amazona leucocephala bahamensis*), Abaco Island, Bahamas: A. adult breeding pair in *Metopium*; B. adult female at ground nest entrance (photos by J. Wiley).

land in the Bahamas, covering 1544 km². Most of Great Inagua is protected as a national park (74,360 ha), whereas all of Little Inagua (30 km²) is a national park. Great Inagua is a low lying limestone island with much of its interior occupied by a saline lake, Lake Rosa (a designated RAMSAR wetland area of importance) and salt evaporators of Morton's Bahama Salt Works (11,332 ha). Freshwater is limited and much of Inagua's vegetation is xeric scrub and broad-leaved coppice (Campbell 1978).

Bahama Parrot *Amazona leucocephala bahamensis*

Distribution and habitat. The Bahama Parrot (Fig. 5) was once plentiful and probably present on all major islands of the Bahama Archipelago, although records exist only for Abaco, New Providence, San Salvador, Long, Crooked, Acklin's, and Great Inagua Islands, Long Cay (Fortune Island), as well as Grand Turk (King 1978–1979, Buden 1979, Snyder *et al.* 1982, Williams and Steadman 2001; Fig. 6). By the 1940s, its occurrence was limited to

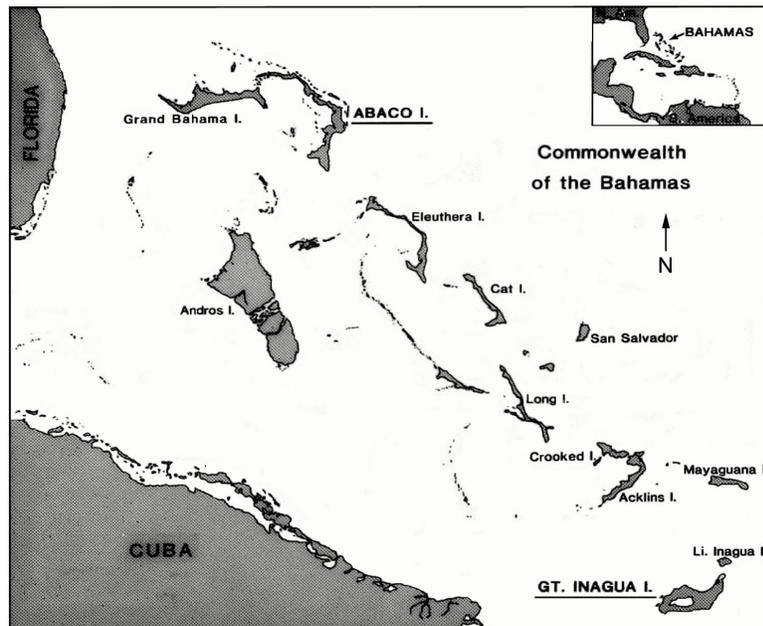


Fig. 6. Bahama Islands, showing present and former distribution of the Bahama Parrot (map by Stephan Nash).

Abaco, Acklin's, and Great Inagua. The Acklin's population was extirpated shortly thereafter.

The southern third of Abaco (1681 km²) is considered the parrot's primary stronghold on that island (Snyder *et al.* 1982). Parrots occur islandwide on Great Inagua, but are patchy in distribution. They formerly visited nearby Little Inagua and may continue to do so today (Snyder *et al.* 1982).

The parrot uses native broadleaf and pine woodlands (King 1978–1979). The Abaco population is unique among parrots in that it nests in limestone solution holes in the ground, whereas the Inagua population uses tree cavities as nest sites.

Status. The Bahama Parrot is listed by IUCN as Near Threatened, and in Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) (Hilton-Taylor 2000, Snyder *et al.* 2000). King (1978–1979) described the parrot as rare throughout its range. Buden (1979) stated that the Inagua and Abaco populations each consisted of around 400–500 birds, an estimate close to Attrill's (1981) suggestion of several hundred to 1000+ for both islands. Snyder *et al.* (1982) conducted the first structured surveys of the Abaco population, using roost counts, from which they estimated 450–800 individuals. Gnam and Burchsted (1991) refined the surveys in Abaco, estimating 830–1082 birds in January 1989. Point-transect surveys conducted by Frank Rivera-Milán and Jaime Collazo in May and June 2002 produced an extrapolated estimate of 1578 parrots (95% CI = 1072–2322) for southern Abaco (Gnam *et al.*, in press).

Buden (1979) considered the parrot common on Great Inagua, as did Snyder *et al.* (1982). Frank Rivera-Milán conducted point-transect surveys throughout Great Inagua, from which he estimated a population of 4880 (95% CI = 3050–7808) parrots (Gnam *et al.*, in press).

Population trend. The extant Bahama populations of *Amazona l. bahamensis* have been described as stable (King 1978–1979, Snyder *et al.* 1982, Gnam 1991) but vulnerable to exotic predators, poaching, possible habitat loss, and hurricanes. With its small population size, restricted distribution, and several threats, the Bahama parrot cannot be considered secure.

Demography. From 1985 to 1988, Gnam (1991) located and monitored 76 parrot nests in two nesting areas on South Abaco. On Abaco, Bahama Parrots nested from May through early September (Gnam 1991). Eggs hatched asynchronously, 26–28 days

after the female began incubation. Chicks fledged asynchronously, 56–58 days after hatching. Gnam (1988, 1991) reported an average of 3.6 eggs produced per pair, with a mean of 0.8 fledged per egg-laying pair; i.e., a 77% loss in pair initial reproductive investment. Successful pairs which hatched at least one chick fledged a mean of 1.8 chicks. Losses were highest during the hatching and post-hatching stages; partial hatching failure and total brood failure, respectively, were the primary loss at these stages (Gnam 1991).

Gnam (1990a) reported on the nesting of Bahama Parrots in Great Inagua, where she observed nine nests. All nests were in tree cavities and in both dead and live trees. Eggs were laid during the end of April to early May, somewhat earlier than in Abaco, and clutch size was 2–3 eggs. Nests of successful pairs contained one, two, and three chicks in July. Several pairs (44%) were observed to defend tree cavities and hold nesting territories, but failed to lay eggs.

Threats. A reduction in farming on Great Inagua has taken the pressure off that island's parrots, which were formerly persecuted as crop pests. The human population declined from 5000 around 1900 to some 1200 in the 1970s (Attrill 1981). Today, the human population on Inagua is less than 1000, numbering 969 persons who mainly work in the salt extraction process, fishing, and ecotourism (Bahamas Census 2000, Department of Statistics, Bahamas; unpubl. data). Roads are few in Inagua, so access into most areas used by parrots is poor.

Abaco is sparsely and unevenly populated. Its population, however, is steadily increasing as Bahamians relocate from Nassau to live on Abaco and tourism development increases. Abaco's population grew 30% from 10,000+ individuals in 1990 to over 13,000 individuals in 2000 (Bahamas Census 2000, Department of Statistics, Bahamas; unpubl. data). Aside from harvesting of Caribbean pine, the economy is based on fishing, agriculture, and tourism. Threats to the Abaco parrot, which has been better studied than the population in Inagua, include:

1. Habitat alteration. Destruction of pines and associated road construction in the 1950s and 1960s were major intrusions into the primary habitat of Abaco parrots. Current pine management calls for cutting regenerating pines on an approximately 20-year rotation, which is certain to affect some parrot habitat.
2. Hunting. Most of the island was inaccessible until the 1950–1960s, but new road systems con-

- structed for the lumber industry have allowed hunters to penetrate the parrot's habitat. Shooting of parrots has perhaps declined as awareness of Bahamian laws protecting parrots has increased (although see comments on use of fire by hunters, below).
3. Pet trade. Young of the now-extirpated population on Acklin's Island were "regularly" transported to Nassau for sale (Allen 1905). The Abaco population was subjected to some harvesting of birds for a local (domestic) trade, but its magnitude and effects remain largely unknown. Elderly residents remember having parrots as pets and Gnam (1991) recorded poaching of chicks from her study nests. Recently, the Bahama National Trust, working in partnership with government ministries and the RARE Center for Tropical Conservation, launched a successful "national pride" education campaign that resulted in a heightened awareness for the parrot's status and legal protection. Harvesting for the international pet trade remains lucrative enough to entice some illegal activity, although at an unknown level.
 4. Feral mammals. Fortunately, the Javan mongoose has not been introduced into the Bahamas, but feral cats are abundant on Abaco, where they are important predators of the vulnerable ground-nesting parrots (Gnam and Burchsted 1991, Gnam and Rockwell 1991). Recent introductions of the northern raccoon (*Procyon lotor*) to Abaco (Eric Carey, pers. comm.) adds an additional danger to the ground-nesting parrots. Campbell (1978) discussed the introduction of raccoons to New Providence and Grand Bahama by Amerindians and European settlers and their successful colonization of these islands. Given their opportunistic feeding and foraging behaviors and their ability to breed several times a year (Campbell 1978), raccoons are quite adaptable to a variety of Bahamian habitats.
 5. Fires continue to be a plague on Abaco, with pig hunters using burning as a means of improving access to their prey. Although Caribbean pinelands are described as "fire climax communities," where periodic fires are needed to remove the shading broad-leaved understory so that juvenile pines can receive sufficient light to take hold and thwart succession by the hardwood coppice species (Henry 1974, Campbell 1978), the intentional setting of fires on Abaco can adversely damage the pine forest ecosystem. These intentional fires can differ from natural fire disturbances in intensity, seasonality, periodicity, and duration. In May 2002, extensive fires that burned over several days were reported inside the Abaco National Park and outlying areas (Elwood Bracey and Sandra Buckner, pers. comm.). These fires caused damage to the vegetation just before Bahama Parrots nested.
 6. Hurricanes. Hurricane Betsy (1965) had a massive negative effect on parrot habitat in southern Abaco. Since then, hurricanes that have affected Abaco include: category one, Hurricane Erin (1995), with minimal damage; Hurricane Bertha (1996) was 64 km northeast of Abaco, but its winds of 150 kph caused substantial flooding; Hurricane Dennis (1999) hit northern Abaco with 130 kph winds that caused flooding, crop damage, and boat sinkings; and Hurricane Floyd (1999) with its 230 kph winds and an eye passage of one hour in duration, caused heavy damage on the entire island; and Hurricane Michelle (2001) brushed 96 km south of Abaco with 130 kph winds. Hurricane Floyd did cause damage to the parrot's habitat and adversely affected the availability of food for bird populations (Elwood Bracey, pers. comm.). Long-term impacts on parrots are unknown, but these were strong storms that caused considerable damage to vegetation, and thereby likely affected parrots (Wiley and Wunderle 1994, Collazo *et al.* 2003).
- Conservation efforts.** Although the Bahamian government, as early as 1952, set a \$500 fine for molesting parrots, it has not been until recently that the fine has been widely respected. The important Wild Birds Protection Act (1965, amended 1977) protects all wild birds, including parrots, whose numbers have perhaps increased since the 1960s. The Bahama Parrot has been recognized as at risk by the International Council for Bird Preservation (ICBP) and International Union for Conservation of Nature (IUCN) since 1966 (Vincent 1966–1971), and by the U. S. Department of the Interior since 1970 (U. S. Bureau of Sport Fisheries and Wildlife 1970). The Bahamian government ratified CITES in 1979.
- The Great Inagua National Park is the largest of the Bahamas parks, and includes part of the parrot's range in that island (Attrill 1981). The Bahamas National Trust, a non-governmental conservation organization, manages the National Parks throughout the Bahamas (www.bahamasnationaltrust.com/nationalparks.html). In the 1990s, a 6880-ha parrot reserve was incorporated into a 27,519-ha (16.4% of the island) forest reserve for southern Abaco Island after considerable encouragement and public education by the Bahamas National Trust and the Department of Lands and Surveys (Forestry Section). The

Trust initiated an unneeded captive-breeding program in 1977 and also sponsored educational programs to increase concern for the parrot. Gnam (1988, 1990b) and Gnam and Burchsted (1991) conducted a comprehensive study of the Bahama Parrot's biology in Abaco Island from 1985 to 1990. That research produced sound recommendations for the conservation of the species (Gnam 1990b). In late 1990, RARE Center for Tropical Bird Conservation, in partnership with the Bahamas National Trust, government ministries, and Friends of the Environment on Abaco, initiated an education program in the Bahama Islands modeled on successful efforts for parrots in St. Lucia, Dominica, Cayman Islands, and St. Vincent (Butler 1992b; Hunter 2002:396–397). The parrot became the symbol for the Quincentennial Columbus celebration in 1992. “Quincy” the parrot visited over 25,000 schoolchildren in Nassau and the family islands and created a furor of support with his musical video on national television to promote understanding for the parrot's conservation (www.rarecenter.org). As a result of this successful “national pride” education campaign, then Prime Minister Hubert Ingraham created in 1994 the Abaco National Park in southern Abaco. The Abaco National Park consists of 8300 ha of mostly Caribbean pine forest and encompasses the southeastern portion of Great Abaco. It was created to protect the parrot's habitat including nesting areas on Abaco and is designated as an “Important Bird Area” of the Bahamas.

In 2000, the University of Florida and the Bahamas National Trust, with funding from the Disney Foundation, launched the “People and Parrots” project in Abaco. This project is aimed at increasing awareness about Abaco National Park and heightening appreciation of the park's values (www.bahamasnationaltrust.com). Dr. Susan Jacobson of the University of Florida and Bahamas National Trust Education Officers Lynn Gape and Monique Sweeting have conducted a community-based needs assessment. Seven groups from different communities in Abaco participated in the assessment. All agreed that the top benefit or opportunity offered by Abaco National Park was protection of the Bahamas Parrot. The second most important benefit was the potential for education — education that targets schoolchildren, the general public, and tourists. The groups were also in agreement in identifying the presence of exotic or feral animals (such as cats) as the top threat, with frequent fires, not all of which are natural, being the second most pressing threat. Three brochures have been produced to support educational objectives: a general brochure on the

Abaco National Park, an in-depth brochure on the endangered parrot, and a publication outlining the importance of fire for healthy pine forests. A new poster promoting the park and its resources has been produced. The Trust's Education Officer has also produced a Pine Forest Teacher's Resource Kit.

A current study of the Abaco population of the parrot, initiated by the Bahamas National Trust and Bahamas Department of Agriculture, was undertaken in 2001, and includes re-evaluations of population size, population dynamics, and threats of exotic predators. The project involves local and foreign undergraduate and graduate students. The goals include development of a strategy for re-introduction of parrots to other islands, with the first site possibly being North Abaco.

Most recently, the “Prescribed Fire Project – Southern Abaco Pine Forests” was initiated (www.bahamasnationaltrust.com). The project will involve staff from Bahamian natural resources agencies (including the Trust, Department of Agriculture, and Department of Lands and Surveys), the Marsh Harbour Volunteer Fire Department, Abaco Friends of the Environment, and The Nature Conservancy, with assistance from the US Forest Service and the US National Park Service. The main objective of the project is to plan and implement several prescribed burns on Abaco. The project is intended as a pilot project to be used as the basis for the development of ecological fire management capacity for the pine forests of The Bahamas.

Recommendations. Development of effective population survey methods to efficiently determine population size, reproductive success, survivorship, and distribution is needed. These survey methods should be easily implemented, replicable, and comparable through the years. Data should be archived and a Bahama Parrot database and information sharing mechanism should be developed. Once practical methodology is available, periodic (alternate years) monitoring of the parrot populations should be performed to ensure the early detection of population change that would warrant further investigation and management responses. A comprehensive long-range management plan based on sound knowledge of parrot biology is needed for both Abaco and Great Inagua. This management plan should include the development of an ecotourism plan for both the Abaco and Great Inagua National Parks, with active management (park wardens, visitor center, educational efforts, stakeholder and advisory participation) to ensure long-term sustainability of these parks and parrot populations. Current education,

research, and prescribed fire studies should be continued on Abaco and Inagua. Additional parrot habitat on Abaco should be evaluated for its ability to enhance parrot conservation and assessed for possible inclusion into the existing national park. Noteworthy is the Hole-in-the-Wall area on the southeastern tip of Abaco that also includes an extensive limestone cave system, unique dry scrub plants, and archaeological settlements. Since existing forestry legislation in the Bahamas is inadequate to manage and conserve existing forest cover, development is often undertaken without any value placed on existing forest resources. Efforts to develop a forestry management strategy and implementation plan for the Bahamas need to be encouraged and integrated forestry management approaches supported. Without such efforts, national parks for the parrots will be surrounded by development or agriculture and their forest habitats fragmented.

An immediate and aggressive control program for removal of feral cats and exotic raccoons from the nesting areas of the Abaco population is critical to that population's survival (Gnam 1990b, Gnam and Burchsted 1991).

In view of the increasing threats of exotic mammalian predators, and the always-present risk of severe losses to tropical storms, it seems timely and prudent to re-establish *A. l. bahamensis* on other islands (Snyder *et al.* 1982, Gnam 1990b, Wiley *et al.* 1992). A reintroduction on northern Abaco or Acklin's Island now appears particularly feasible in view of the parrot's recent extirpation from the region, stability of habitat in these areas, and the present respect by Bahamians of bird protection laws. The great strength of reintroduction is its power to rally public support for conservation.

CAYMAN ISLANDS

Parrot populations in the small, rapidly developing Cayman Islands (combined area of 263 km²) are at an accelerating risk to habitat loss, particularly as a result of a rapidly expanding population (i.e., from 18,000 in 1982 to 45–50,000 in 2004) and tourism. The islands' habitats are typical of low elevation (maximum elevation of 46 m) tropical islands, with dry forest originally covering most "uplands" and mangrove forest in lowlands (minimally in Cayman Brac). Historically, selective felling of large trees, capable of housing parrot nest cavities, occurred throughout the three islands to support ship-building and other construction activities. Extensive mangrove forest, underlain by mangrove peats and Iron-

shore Formation, which once covered *ca.* 70% of Grand Cayman, including most of the western half (Swabey and Lewis 1946), is now reduced to around 40%; a similar percentage covers Little Cayman. Cayman Brac has only 3% wetlands behind the beach ridge to the southwest.

Grand Cayman (area 197 km²), the largest and most westerly of the islands, is 35 km long and *ca.* 8 km wide. It supports 96% (*ca.* 39,000 in 1999; Bradley 2000) of the total human population of the Cayman Islands, of which the majority live on the western half of the island. Whereas some important mangrove habitat (e.g., west of Savannah) has been cleared, almost all of the 3400 ha Central Mangrove Wetland still remains in its natural state. Aside from development for housing, there has been an effort to increase the supply of locally grown food, which placed new interest in crop and livestock husbandry in the 1990s.

Little Cayman (area 28 km²) lies 7 km west of Cayman Brac and is 16.3 km long and 1–3 km wide. The extensive mangrove wetlands occur around the entire coast except in the east and inland areas of dwarf red mangrove (*Rhizophora mangle*) and buttonwood mangrove (*Conocarpus erectus*). The central bluff area is dry forest and scrubland with mangrove wetlands. Booby Pond Nature Reserve (113 ha), the Cayman Islands' only Ramsar site, protects the largest colony of Red-footed Booby (*Sula sula*) in the Caribbean, and includes 35 ha of forest. In 2004, about 90% of the island remained undeveloped and in its natural state with only *ca.* 150 people resident. Tourism, however, is expected to expand rapidly with the construction of a new airport scheduled to begin in 2004 and future development constitutes a major threat.

Cayman Brac (area 38 km²) is the most easterly of the islands and is 20 km long and 1–3 km wide, with a human population of about 1500 in 1999 (Bradley 2000). A new economic initiative has resulted in an increase in property sales and road and urban building, including on the bluff. Dry forest and shrubland cover around 70% of the bluff with cattle pastures and subsistence agriculture in the east and central areas, where there are sufficient soils.

Human-modified vegetation, including low second growth, comprises almost the entire area south of the Central Mangrove Wetland and west of Bodden Town, and most of the west end and coastal plains of Cayman Brac.

Grand Cayman Parrot *Amazona leucocephala caymanensis*

Distribution and habitat. The majority of the population occurs east of Savannah and, increasingly since the mid-1990s, birds occur on the West Bay Peninsula, with probably no more than 40 pairs breeding west of Savannah. The parrot forages in all habitats, including low (<1 m) beach ridge shrubland, plantations and, since 1990, in urban areas including the capital city of George Town. It is absent from the interior of the Central Mangrove Wetland. In surveys conducted in 1985 and the 1990s, highest densities of nesting birds were in black mangrove forest around the perimeter of the Central Mangrove Wetland (Bradley 1986, 1994, 1995, 2000; Bradley, pers. obs.). Inland dry forest supported lower nest densities, with the main areas at Hutland, Forest Glen, and Mastic (The Mastic Reserve Area) in royal palm (*Roystonea regia*) stands and dry forest close to buttonwood mangrove wetlands in the eastern districts, west of Franklin's Farm, and east of the quarry at East End.

Status. The Grand Cayman Parrot is listed by IUCN as Near Threatened and in Appendix I of CITES (Hilton-Taylor 2000, Snyder *et al.* 2000). It is a protected species (since 1989) under the Animals Law (2001 Revision), and trapping and hunting are illegal. Bradley (1986) conducted the first intensive surveys of the population in 1985, when she estimated the total wild population at 1351. Thereafter, the National Trust for the Cayman Islands organized island-wide counts, resulting in *ca.* 1414–1755 birds in 1991, and 1408–1935 birds in 1995 (National Trust, unpubl. report). Along with the overall growth in population size, flock sizes have increased. In 1985, the maximum flock size was 55 at Forest Glen and 60 west of High Rock road, whereas in 1996 members of the Cayman Island Bird Club counted over 130 individuals in one flock at Franklin's Farm, eastern districts. Bradley (pers. obs.) observed 150–200 at Franklin's Farm (the largest fruit tree plantation in the islands) in July 2002 and Mat Cottam (pers. comm.) saw a large flock there in 2002.

Population trend. The population is considered stable or increasing. Since its removal from the list of game birds in 1989, *Amazona l. caymanensis* numbers have increased to the point where it is fairly common to locally abundant in appropriate habitat. Because of substantial forest clearing in the eastern districts, plus increased shooting, increases may not be occurring there.

Demography. Breeding occurs from March to

June. An average of 3.2 eggs ($n = 25$, range = 2–5) are laid per clutch, with a mean success of 1.8 (range = 2–4) fledglings per nest. The percentage of juveniles in 24 flocks was 44.5% (Bradley, unpubl. data). The reproductive biology is yet to be studied for the Grand Cayman parrot, and few data are available on population dynamics.

Threats. Loss of forest habitat, mainly by clearing for urban development to accommodate the rapidly expanding human population, continues to be the greatest threat to parrots in Grand Cayman and Cayman Brac. The outer black mangrove zone of the Central Mangrove Wetland has around 600–700 parrots and this habitat is under imminent threat of development of a new highway. The dry forest in the eastern districts is undergoing rapid fragmentation and shows a decline in parrot numbers (Bradley, pers. obs.).

In 2001, the Cayman Islands government removed the proposed Environmental Zones from the Development Plan. The Department of the Environment and the National Trust lodged an appeal in 2003, which has yet to be heard. In addition, the proposals by the Wetlands Committee to protect areas of the Central Mangrove Wetland, following a two-year study, were rejected by the government.

Also in both islands, harvesting of parrot chicks for pets for local use is a serious concern and continues illegally. The number of chicks harvested relative to the populations' productivity is not trivial. In 1985, when selling parrots was a major source of revenue in the Cayman Islands, the number of captives in Grand Cayman was estimated at *ca.* 500 (Bradley 1986). Each district in the parrot's breeding range has had one or two expert collectors; e.g., North Side, East End, and Bodden Town in Grand Cayman, and Stake Bay, Creek and Spot Bay in Cayman Brac (Bradley 1986; Wiley 1991; Wiley *et al.* 1991a,b). Eight trappers estimated 104–149 chicks were removed from *ca.* 70 nests in Grand Cayman in 1983, whereas 20 young were removed from 11 nests in the eastern district in one year (Bradley 1986). Illegal export by cruise ship and air passengers was common in the 1980s and may continue, although enforcement is strict.

Harvesters often cut into the bole of the nest tree to access the young, thereby destroying prime breeding cavities in mature trees. Not only does this practice reduce population productivity, but also the number and quality of nesting cavities is reduced year after year resulting in the use of sub-optimal cavities that place eggs and chicks at risk to predation and drowning in the early summer rains.

Important potential and actual predators of both parrot races in the Cayman Islands include exotic rats (*Rattus rattus*, *R. norvegicus*) and feral cats, as well as native predators: Barn Owl (*Tyto alba*), Smooth-billed Ani (*Crotophaga ani*), Greater Antillean Grackle (*Quiscalus niger*), and hermit crab (*Coenobita clypeatus*) (Bradley 1986; Wiley 1991; Wiley *et al.* 1991a,b); migrant Peregrine Falcons (*Falco peregrinus*) have been observed to cause panic among parrots in Cayman Brac (Bradley, pers. obs.). Whereas depredation has not been shown to be a major threat in itself, its effect in combination with other sources of mortality must be considered important.

The introduction of another cavity nester, Yellow-crowned Parrot (*Amazona ochrocephala*), breeding in the wild in Grand Cayman since 1995, presents a new threat of competition for *caymanensis* (Bradley 1995). Fortunately, these exotics have not increased much and only three to four pairs have been observed in Grand Cayman in the last three years (Bradley, pers. obs.). Exotic Monk Parakeet (*Myiopsitta monachus*) and Red-masked Parakeet (*Aratinga erythrogenys*) breed in Grand Cayman and pose threats as vectors of exotic disease, as do non-breeding introduced Rose-ringed Parakeet (*Psittaculular krameri*), Cockatiel (*Nymphicus hollandicus*), Budgerigar (*Melopsittacus undulates*), macaws (*Ara* spp.), and cockatoos (*Cacatua* spp.) (Bradley 2000).

Legal shooting of parrots was commonly used to control crop pests in Grand Cayman and Cayman Brac. In addition, the parrot was considered a game species throughout Grand Cayman and regularly eaten at East End (not at North Side or Bodden Town, or on Cayman Brac). One hunter shot 14 parrots on 14 March 1985 at Great Bluff, Grand Cayman, and claimed to have shot more than 120 in one week in 1982 (Bradley 1986). That hunter continued illegally killing parrots until 2001. Overall, illegal shooting has declined on Cayman Brac, but the activity has persisted on Grand Cayman, where it is again on the increase by local farmers; e.g., 150 parrots were shot at Furtherland Farm in April 1999, and a farmer at North Side admitted shooting “a good lot” on his mango plantation in 2000.

Conservation efforts. The Cayman Islands government became a signatory to CITES in 1976, via the United Kingdom. Still, it was not until 1989 that the Caymans Islands government declared *Amazona leucocephala* a protected species. Research, first by Bradley and continued, with her involvement, by F.



Fig. 7. Adult Cayman Brac Parrot (*Amazona leucocephala hesterna*) at nest cavity entrance (Photo by J. Wiley).

Burton, E. J. Williams, and J. Wiley, has provided much-needed information on population size and distribution, as well as habitat requirements and population dynamics. In 1992 RARE assisted in a successful conservation education program, using the parrot as a focal point, with the National Trust of the Cayman Islands on Grand Cayman and Cayman Brac (Scharr *et al.* 1992). By 2002, the Trust had purchased 253 ha of dry forest at the Mastic Reserve, and was granted by Cayman Islands government 16 ha of forest in the Botanic Park, and 153 ha in the salina on Grand Cayman. In 2004 the Trust launched its “Forests for Life” campaign to purchase an additional 180 ha of dry forest in the Mastic Reserve.

Although the protected parrot continues to be shot and harvested from nests, no prosecutions have resulted, partly because the government is reluctant to address the highly political problem of crop damage claimed by farmers, who demand the right to shoot parrots on their plantations unless awarded compensation by the government. The Department of Agriculture considered protecting fruit trees with nets, but rejected the idea as too expensive and impractical because the trees are often dispersed. The government has purchased Furtherland Farm as a prison farm and it is hoped to protect the adjacent forest and to prevent any more shooting of parrots.

Cayman Brac Parrot *Amazona leucocephala hesterna*

Distribution and habitat. The parrot population in Cayman Brac has been more difficult to study than the Grand Cayman population, in part because of its more cryptic behavior, but also because of the difficulty in penetrating its habitat in earlier years. The Cayman Brac Parrot forages in all habitats, although earlier reports did not include the xeric shrubland (foraging on *Cocothrinax procterii*) of the extreme eastern bluff or close to the westerly ponds and hotels in the extreme southwest. Breeding only occurs in dry forest on the bluff.

The habits of *hesterna* differ substantially from *caymanensis*. Whereas *caymanensis* is obvious and noisy in its habits, *hesterna* is more typically silent and secretive for much of the year, flying below the canopy, and creeping up to nests along branches, having landed a distance away. It seldom is heard or observed from late November to the end January, when it appears to cease foraging on the northern coastal plain, and retires to the forest on the bluff, where an entire day may be spent without seeing a bird or hearing its call. It becomes highly vocal pre-breeding from January to March, and after the young have emerged from the nest (late July through early November).

The Cayman Brac Parrot (Fig. 7) formerly occurred in Little Cayman. On 25 July 1911, W. W. Brown collected the first and only specimen on Little Cayman. Residents reported parrots breeding up to 1940, but absent after a 1944 hurricane (G. Banks, pers. comm.; *contra* Johnston 1975); its demise was certainly accelerated by the devastating hurricanes of 1932 and 1935. Bond (1945) reported the parrot as “very rare” in Little Cayman, although there are no records of his visit to that island. Johnston *et al.* (1971) described it as “not uncommon” although only one was noted during two visits to Little Cayman in June 1970 and 1971 (D. W. Johnston, unpub. field notes). Diamond (1980) recorded one in the center of Little Cayman, 27 July 1975, “a few” were seen inland at east end, May 1984 (farmer to Bradley), and three were observed at Snipe Point, February 1985 (John Mulak, local resident and birder). A single parrot resident from March 1998 to early 2001 was thought to be an escaped captive (Nancy Norman, resident and professional birder; Bradley, pers. obs.). Pairs and small flocks occasionally fly from Cayman Brac to forage in eastern Little Cayman during the day, although no resident individuals persisted (Bradley, pers. obs.). Six parrots took up residence in Little Cay-

man in January 2003; of the four that remained in March 2004, two were young birds and two were an adult pair (Bradley, pers. obs.).

Status. Listed by IUCN as Near Threatened and in Appendix I of CITES (Hilton-Taylor 2000, Snyder *et al.* 2000). The population size of Cayman Brac Parrot has been difficult to characterize, having been reported as “not uncommon in western Cayman Brac” (Bond 1945), “very rare” (Bond 1956), “not uncommon” (Johnston *et al.* 1971), and “rare” (Noegel 1980, 1983). Noegel (1977) estimated 130 birds in 1977, based on his nine months of observation in 1976 and 1977. Bradley (1986) conducted the first systematic surveys of parrots in the island, reporting a minimum wild population of 26–30 adults. Subsequent surveys covered more of the island, because of access improvement, resulting in an estimated population of 299–430 individuals (Wiley *et al.* 1991a). Similar results were obtained from surveys conducted by the National Trust of the Cayman Islands and Georgia Wildlife Resources Division in 1994 and 1997 (National Trust surveys, unpubl. report).

Population trend. The population in Cayman Brac is stable.

Demography. Intensive studies of Cayman Brac parrots have not been conducted, so little information is available on reproductive biology and population dynamics. In the 1985 survey, 12 pairs were seen and nine nests were located; four young fledged from three nests, and five juveniles were seen with four adult pairs, for a fledging success of 1.25 (Bradley 1986). The same number of active nests was identified in 1992; seven were in cavities in West Indian birch (*Bursera simarubra*) (Wiley *et al.* 1991b). The June 1999 breeding survey yielded six active nests, all at sites different from those recorded in 1992 (Burton *et al.* 1999), and all in dead or dying West Indian cedar (*Cedrela odorata*). This is approximately one nest per 7.6 ha, extrapolated over the available dry forest habitat to a maximum of 61 nests for the entire population (Burton *et al.* 1999). In 2000, an additional six active nests were located in an area similar to that used in 1999 (E. J. Williams, pers. comm.) and three nests were located in 2003 (*fide* Mat Cottam). One pair hatched young successfully in a partially dead cedar at the Parrot Reserve in 1986 and 1994–2003 (Bradley, pers. obs.).

Threats. The Cayman Brac Parrot is under great threat of “overnight” extinction because of its small population and restricted breeding range on the bluff of Cayman Brac, where development of roads

and house building began in 1995 and has accelerated since. Much of the Planning Law for Grand Cayman does not apply in Cayman Brac but is set by a local Development Control Board, so fragmentation of endemic forest and parrot breeding habitat continues unchecked. Also, the Brac has rejected a Development Plan and instead has proposed a Sustainable Development Plan which, to date, omits any environmental overlay. The high cost of land in Cayman Brac makes purchase extremely difficult for the only non-government organization, the National Trust. Tragically, but unless more forest is protected, the parrot population faces decline and probable extirpation.

Tree cutting, combined with the effects of hurricanes in 1980 and 1988, have reduced considerably available nest sites for parrots. A dearth of suitable nesting cavities, combined with human exploitation, resulted in no observed nesting activity or territorial behavior in *ca.* 500 ha of the central forest north of the central Major Donald Drive in 1999. Fred Burton and E. J. Williams have conducted annual 7–10-day surveys of breeding activity, accruing a total of about 25 nests. Only a few active nests are found each year, although pairs hold territories at empty nest sites. This situation may be analogous to the behavior observed in Puerto Rican Parrots, wherein several pairs maintain territories but do not produce eggs (Snyder *et al.* 1987).

Additional threats include the introduction of *A. l. caymanensis* to Cayman Brac, probably as accidental escapes of pet birds imported from Grand Cayman (Bradley 1986; Wiley 1991; Wiley *et al.* 1991a,b), which may set up competitive interactions over limited resources (e.g., nesting cavities) and perhaps interbreed with the native population.

Legal shooting (i.e., before 1989) was a source of parrot loss in Cayman Brac; e.g., 12 were shot there in 1982. Since its removal from the game bird list, shooting has not been a problem compared with the situation in Grand Cayman.

Historically, parrots were collected as pets (and probably also eaten) on Cayman Brac and Little Cayman. In 1985, the number of captives was estimated at *ca.* 200 on Cayman Brac (Bradley 1986). Trapping for the cage bird trade continues illegally.

Unlike Grand Cayman, Cayman Brac does not offer cavity-forming black mangrove forest nor resident woodpeckers; these absences are major constraints on developing new breeding habitat for *hesterna*, which is entirely dependent on dead or partially dead trees for cavity nests. A concern over the availability of suitable nesting sites spurred tree

surveys conducted in 1998 and 1999, which revealed that seedlings, sapling, and young healthy *Cedrela odorata* were almost entirely absent in Cayman Brac (Burton *et al.* 1999). Thus, the lack of recruitment for this important parrot nest tree poses a major threat to the survival of *hesterna*.

In the past three years, tropical storms have felled many old and dead trees, including several known sites used by nesting parrots. The greatest threat, particularly in combination with the several other problems listed above, is a direct hit by a hurricane. Cayman Brac is only 16 km long, so the savage winds of a large hurricane would extensively damage the entire island. Obviously parrots have recovered from earlier storms, but now their habitat is considerably reduced and more controlled by man, so that parrot recovery is not as certain.

Conservation efforts. In 1992, The Nature Conservancy donated to the National Trust 73 ha of prime breeding habitat of *hesterna* on the bluff, now the Brac Parrot Reserve; the land is in two strips. In 2004, as part of its “Forests for Life” campaign, the Trust began an effort to purchase the additional 60 ha of dry forest in the center of the Reserve. In addition to irregular monitoring of the parrot population and surveying for cavity availability in Cayman Brac, tree and cavity surveys were conducted in Little Cayman. The National Trust of the Cayman Islands has collaborated with Partners-in-Flight (Georgia Wildlife Resources Division) in conducting population and nesting surveys, 1997–2003. Intensive studies of breeding biology and ecology were undertaken in the early 1990s. Also, see the Conservation Efforts section for the Grand Cayman Parrot.

Recommendations. An urgent need exists for a long-term study of the breeding biology and foraging ecology of this race to determine the strategies necessary to plan for its survival. Further, the taxonomic status of the Cayman Brac Parrots needs re-examination, using modern tools of assessment; e.g., DNA sequencing to determine degree of relatedness to, or uniqueness from, other populations (see Ottens-Wainright *et al.* 2004).

The hope for the parrot’s survival lies in a land stewardship that incorporates the needs of the species. To prevent fragmentation of breeding habitat, the National Trust, Cayman Islands government Department of the Environment, and international organizations must achieve protection, within five years, of continuous tracts of forest on the bluff, especially where parrot nests have been monitored since 1995. A new policy is needed for the Planning

Department and the Sustainable Development Plan Committee to ensure environmental zones on the bluff are incorporated into a land-use plan. Also, a new public education campaign by the National Trust is needed to ensure that the old Cayman Brac community structure on the northern coast is continued, where exotic fruit trees and flowering shrubs are planted amid indigenous trees. This would allow foraging habitat for parrots to remain plentiful over much of the Island.

Up to 2004, mature forest land on the bluff continued to be cleared completely on new subdivisions and individual house sites, with parrot breeding and foraging habitat being replaced by lawns and exotic shrubs. New planning regulations should permit removal of trees only within the footprint of the building and ban whole-scale clearing of large areas of land for development. Enforcement of present and future regulations is necessary (and would be unpopular politically) and, realistically, unlikely to occur unless there is a change of development policy in the Cayman Islands.

Aggressive management strategies need to be considered; e.g., artificial nest boxes, and a program to control cats and rats (also to protect other native vertebrates, including the scarce rock iguana *Cyclura nubila caymanensis*), and, as insurance against a catastrophic loss of the wild population (e.g., direct hit by a hurricane), captive breeding for *hesternia* should also be considered. Further, thought should be given to enhancing habitat in Little Cayman to allow re-introduction of a breeding population there.

Recommendations for Both Parrot Forms

We recommend the following in developing an effective conservation program for both the Grand Cayman and Cayman Brac parrots.

1. A Development Plan should include environmental overlays as supported by the National Trust of the Cayman Islands and the Cayman Islands Department of the Environment.
2. Tracts of critical habitat (e.g., black mangrove in the Central Mangrove Wetland, Grand Cayman; dry forest in the Mastic Reserve, Grand Cayman, and adjoining the Parrot Reserve, Cayman Brac) should be purchased through the Environmental Fund by the Cayman Islands government if the National Trust is unable to raise sufficient funding.
3. Conduct comprehensive studies of both parrot races, emphasizing habitat requirements, reproductive biology, and ecology.
4. Continue intensive surveys to monitor the parrot

populations.

5. Accomplish the passage of the new conservation law
6. The issue of parrots as crop pests and illegal shooting should be addressed with the Cayman Islands government and farmers, and regulations regarding illegal shooting of parrots should be enforced by the Department of the Environment.
7. Enforce and widen controls on the import of exotic species into and between the three Cayman Islands by the Department of Agriculture.
8. Planning needs to follow regulations regarding clearing land by mechanical means.
9. Continue public education in environmental awareness and concern using the parrots as flagships for conservation.

Outlook for Cayman Island Parrots

Following legal protection and public education campaigns, greater respect and affection for the parrot, despite its assault on fruit trees in gardens, is evident among the general public in both islands, especially among the young. It is a remarkable sight to see a pair of parrots fly through the center of George Town, alight in a tree on the waterfront, and pose for tourists to photograph! Farmers, however, take a different view, regarding the parrot as a crop pest and believe illegal shooting is justified until the government introduces compensation, although there are probably fewer than five commercial fruit farmers and mangos rot on the ground at the height of the fruiting season. Shooting (at the current level) does not threaten the present robust population of *caymanensis* on Grand Cayman but, combined with continuing habitat loss, it could soon become a major threat. The government must address enforcement of the law against trapping and shooting.

Habitat loss is the major threat to both races. Increasingly, *caymanensis* breeds close to dwellings because new urban developments abut traditional breeding areas in the black mangrove belt of the Central Mangrove Wetland, the dry forest of the Mastic Reserve in the central districts, and forest remnants in the eastern districts. More breeding habitat protection is essential if this population is to survive. A major concern is that the prime black mangrove breeding habitat will not be within the protected area proposed for the Central Mangrove Wetland in the environmental overlay of the 2003 Development Plan for Grand Cayman, making purchase of this habitat an essential, yet fiscally challenging, management strategy.



Fig. 8. Adult Cuban Parrot (*Amazona leucocephala leucocephala*) at natural nest cavity, Los Indios Ecological Reserve, Isla de Pinos (Photo by J. Wiley).

On Cayman Brac, the future of *hesterna*, with its small population and restricted range, remains much less certain, even beyond five years. The breeding pool is probably 70 pairs maximum and, with the accelerated fragmentation of the mature dry forest, the Cayman Brac Parrot is at very high risk of a rapid extinction. The National Trust must buy the land to enlarge the Parrot Reserve, but even that may not provide sufficient habitat for long-term survival.

CUBA

The Cuban archipelago is comprised of two principal islands, Cuba and the Isla de Pinos, and 4195 smaller islands and cays. At the time of European discovery (1492), perhaps 70–90% of Cuba was covered with forests (Instituto Cubano de Geodesia

y Cartografía 1978). Since then, almost all of Cuba and its major satellites have been extensively modified. By 1900 only 54% was under forest, and by 1959 forested areas were reduced to only 13% of the land area. Since then, a national policy of reforestation has resulted in an increase in forest surface area, which in 1990 stood at about 18.7% (Cuevas 1997).

As habitat was altered, so were faunal communities. In addition, many species were important as game or had commercial value. Still other species depredated crops and were vigorously controlled. As a result, several species became extinct, most notably the Cuban Macaw (*Ara tricolor*). Of the surviving animals, many were reduced in numbers and range, particularly with the increasing use of land for agriculture. Fully 22.8% (129 of 565 species) of Cuba's reptiles, amphibians, birds, and mammals are considered in danger of extinction (Perera *et al.* 1993). The two surviving psittacid species are of special concern to Cuba's conservation agencies.

Cuban Parrot *Amazona leucocephala leucocephala*

Distribution and habitat. The Cuban Parrot (Fig. 8) was formerly widespread and common throughout Cuba and Isla de Pinos (Garrido and García Montaña 1975). Currently, the species is found locally in all Cuban provinces in its preferred habitats of well-preserved forests and remote woodlands with mature trees and snags, in mountains and lowlands, as well as savanna with palm groves (Garrido and Kirkconnell 2000).

Status. The Cuban Parrot is listed as Near Threatened by IUCN and appears in Appendix I of CITES (Hilton-Taylor 2000, Snyder *et al.* 2000). It is a protected species and hunting and trapping are illegal. The parrot is generally considered to be locally

Table 2. Record of protective status and Cuban Parrots (*Amazona leucocephala*) harvested from the Isla de Pinos, Cuba, 1900–1914.

Date	Number of birds	Source
>1909	3000–5000 pairs shipped to USA each year	Anonymous 1910a
1909	Cuban government imposes ban on exportation	Anonymous 1910a
1910	In response to pressure from fruit-growers, ban lifted, export allowed	Anonymous 1910a
1910	“Large shipments” made	Anonymous 1910b
1910	ca. 2500 shipped to USA	Anonymous 1910c
July 1912	ca. 2100 young birds shipped by one dealer	Link <i>in</i> Todd 1916
1913	Control of parrot because of crop damage recommended	Read 1913
July 1914	ca. 1000 shipped to USA	Anonymous 1914

Table 3. Habitat use and status of the Cuban Parrot (*Amazona leucocephala*) in regions of Cuba and Isla de Pinos under study by the Empresa para la Protección de la Flora y la Fauna, 2000–2002.

Region	General habitat	Status
Guanahacabibes	Forest on karst plain	Populations apparently recuperating. Illegal harvesting controlled beginning in 1999. The region is a protected area.
Mil Cumbres	Secondary forests	The region is a protected area, but the only population has been in decline for more than 10 years and only six breeding pairs actually exist.
Isla de Pinos	Northern area: savannas with palms; Southern area: forests on karst plain	Northern area: populations increasing in numbers as a result of habitat management and protective measures, with 60% of populations within one protected area, where it is monitored annually. Southern area: status currently unknown, but the area and parrot are protected. The parrot is illegally harvested throughout the Isla de Pinos.
Ciénaga de Zapata	Forests and savannas with palms in wetlands	Populations have been affected by two recent hurricanes, the last in 2001. Current status unknown. This is a center of reproduction for the species. Considerable illegal harvesting. Coexists with the Cuban Parakeet (<i>Aratinga euops</i>).
Escambray	Montane forest with palms	Several population nuclei, which are apparently stable. Illegally harvested throughout the region. Populations exist within protected areas, which have environmental education plans. Coexists with the Cuban Parakeet in some localities.
Morón	Forests and savannas with palms in wetlands	Populations appear stable, based on a census conducted in 1998. A healthy population of more than 100 individuals exists in the Cunagua protected area. Illegal harvesting persists. Coexists with the Cuban Parakeet.
Alturas de Najasa	Secondary forest with palms	Population stable and within the Sierra del Chorrillo protected area. Monitored since 1996. Coexists with the Cuban Parakeet.
Granma	Lowland forests	Population with few individuals within the Desembarco del Granma protected area. Current status unknown.
Montañas de Sagua Baracoa	Montane forests with palms	Status unknown. Apparently relatively abundant and with some populations in the Parque Nacional Alejandro Humbolt. Considerable illegal harvesting. Coexists with the Cuban Parakeet.

common in remote areas of Cuba with suitable habitat; i.e., Ciénaga de Zapata, Península de Guanahacabibes, Sierra de Najasa (Camagüey), southern and western Isla de Pinos, Macizo de Guamuhaya, Loma de Cunagua, Sierra de Escambray, and the forests of western Sierra de Maestra and Cuchillas del Toa (Garrido and García Montaña 1975, Garrido 1985, García Montaña 1987, Gálvez Aguilera and Berovides Alvarez 1994, Garrido and Kirkconnell 2000). Elsewhere it is considered rare or extirpated (Bond 1956, Garrido and García Montaña 1975, King 1978–1979; Gálvez and Wiley, in prep.). Some recognize two races: *Amazona l. leucocephala* of eastern Cuba, and *A. l. palmarum* of

western Cuba and Isla de Pinos (Snyder *et al.* 1987; see Barbour 1943, Garrido and García Montaña 1975, García Montaña 1987 for alternative opinion).

The parrot was once abundant throughout Isla de Pinos (Poey 1851, Gundlach 1875), but the population underwent massive declines from the late nineteenth century through the 1960s (García Montaña 1987). Aside from extensive habitat loss, the parrot was heavily persecuted for its depredation of citrus crops (Anonymous 1909, Todd 1916). During the 1930s, citrus plantation owners established a bounty of 30 centavos per head for fruit-eating birds, including the parrot (Gálvez 1996). Further population declines resulted from the harvesting of chicks



Fig. 9. Provisioning of nest sites for Cuban Parrots (*Amazona leucocephala leucocephala*) at Los Indios Ecological Reserve, Isla de Pinos: A. Adolfo Piñero using hammer and chisel to excavate a cavity in palm (*Colpothrinax wrightii*); B. raising the palm with created cavity; C. pair of adult Cuban Parrots inspecting newly provided palm (Photos by J. Wiley).

for the pet trade. In fact, the Isla de Pinos birds made up a large proportion of those for sale in La Habana markets in the early twentieth century, because the parrot had disappeared from all but the most remote parts of Cuba (Smith 1943, 1944). Truly astonishing numbers of parrots were harvested for the pet trade, mainly for export to the United States (Table 2). With large-scale harvesting, the parrot populations decreased in Isla de Pinos. By 1945, Walkinshaw and Baker (1946) described only small flocks of 2–25 parrots in grapefruit orchards in a few localities in Isla de Pinos. Recent surveys of parrots in northern Isla de Pinos have revealed a minimum of 1100 birds (Gálvez *et al.* 1999), mostly within the Los Indios Ecological Reserve.

Population trend. Whereas numbers of parrots are declining in unprotected areas of Cuba, the species is considered stable or increasing in numbers in protected areas (Table 3). Barbour (1943) noted that the number of parrots was declining annually, and stated that within “a few years, parrots will be excessively rare in Cuba and its dependencies.” The parrot continued to decline in range and numbers throughout Cuba until the late 1970s. Notable increases in several parrot populations occurred in the 1980s through the present (O. H. Garrido, pers. comm.). The Isla de Pinos population is considered to be recuperating from its 1960s low point (García Montaña 1987, Gálvez *et al.* 1999).

Demography. The Cuban Parrot nests from March through July. Three to four eggs comprise most clutches. Incubation period at Los Indios ranged from 24 to 27 days, with a nestling period of 56–63 days. In Isla de Pinos, an average of 2.5

chicks hatched and 1.8 fledged from 35 nests, 1997–1998.

Threats. Habitat loss is the most critical threat facing parrots in Cuba. Outside of government protected areas, habitat destruction continues in all arable lands. However, under current economic constraints and shift away from large-scale sugarcane production, however, clearing of land for agriculture has slowed. But, the same economic problems that have restricted availability of petroleum-based fuel sources have resulted in natural areas being ravaged for fuelwood at an unprecedented level.

Poaching of parrot chicks for the pet trade contributes substantially to loss of productivity (Wright *et al.* 2001). Although the Cuban Parrot is protected from capture and shooting by national and international law, it is still marketed in East European countries and good numbers reach the United States. In 1988, US Fish and Wildlife Service agents seized 49 Cuban parrots en route to the United States. A lively trade in parrots as local pets also continues. Recently, illegal shooting has not been an important factor in parrot conservation because of the prohibitively high cost of arms and ammunition.

Conservation efforts. Early attempts to protect the parrot were often reversed because of its depredation of crops and pressure by a strong local lobby to continue the lucrative pet trade; e.g., after parrots in Isla de Pinos were protected against shooting and capture in the early twentieth century, their numbers immediately increased as did the incidence of crop depredations (Anonymous 1909, 1910a). Farmers called for a lifting of the ban, whereupon legislation allowing export of parrots was enacted in 1910

(Anonymous 1910a, b). In 1913, legislation allowed the take of parrots outside the breeding season (Anonymous 1913). Reports of large numbers of young birds being shipped from the Isla de Pinos were recorded (Table 2). In Cuba, several workers (e.g., Barbour 1943, Smith 1943) warned of declining parrot populations, but it was not until the end of the 1970s that the government established effective legislation to limit export for the pet trade and, in the 1980s, to initiate a program for re-establishment of parrots in the protected areas administered by the Empresa para la Protección de la Flora y la Fauna [Empresa]. These efforts have resulted in the stabilization or increase of many populations (Gálvez Aguilera and Berovides Alvarez 1994). Further protection has come from international concerns; Cuba became a signatory of CITES in 1990.

The Cuban government has established several areas important to wildlife conservation as national parks and natural reserves; e.g., Península de Guanahacabibes National Park, Ciénaga de Zapata National Park, Ciénaga de Lanier National Park, and La Plata (Sierra de Maestra) National Park have been created in the main island and Isla de Pinos. Additional areas have been set aside as wildlife refuges, incorporating more of the Ciénaga de Zapata and Isla de Pinos, among others. These protected areas are important refugia for the parrot.

Although legal protection from harvesting and establishment of several reserves in Cuba and Isla de Pinos have resulted in reversals of the downward trend of some populations, until recently little information has been available for the management of the species (although see de las Pozas and Gonzalez

1984, Berovides Alvarez 1986). At the Los Indios Ecological Reserve, Isla de Pinos, however, the parrot has been the subject of major conservation efforts, where it has benefited from an aggressive management program (Acosta *et al.* 2004). Gálvez *et al.* (1998) examined the parrot's food habits during the breeding season to determine the major foods used by the parrots in the Los Indios Ecological Reserve. Intensive studies of reproductive biology began there in 1995 (Gálvez and Wiley, in prep.). Natural nest habitat has been augmented by provisioning with artificial nest sites, resulting in substantial growth of the parrot population in the Reserve (Acosta *et al.* 2004) (Fig. 9).

Realizing that many efforts to save endangered species are dependent on public support, beginning in December 1995, the Empresa has conducted several public education campaigns in important parrot and parakeet habitats in Cuba and Isla de Pinos. All of these efforts have involved establishing a conservation ethic among the public for the parrot and its ecosystem (Gálvez *et al.* 1999) (Fig. 10). Further, the programs involve local communities in determining psittacid population size and distribution, by training and using local residents as active participants in parrot and parakeet surveys. The first public-involved, intensive survey of the parrot population of northern Isla de Pinos was conducted in December 1995, with a follow-up festival and survey in November 1998 (Gálvez *et al.* 1999). Additional surveys and conservation festivals were conducted for populations centered on Morón (February 1997), Jaguajay (February 1998), Ciénaga de Zapata (February 1999), and Camagüey (February 2004).

Concern over low numbers and the few scattered

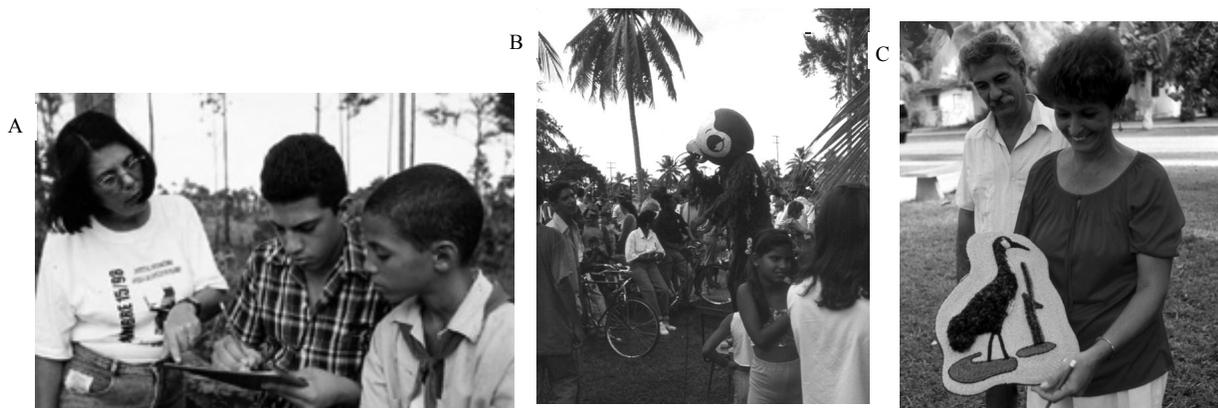


Fig. 10. Conservation festival at Isla de Pinos, Cuba: A. Xiomara Gálvez helping student volunteers during survey of parrot population (photo © Robert Rattner); B. fiesta, with parrot rapper disk jockey, to celebrate the week of conservation education, Nueva Gerona; C. artisan displaying her work (Cuban Sandhill Crane, *Grus canadensis nesiotis*, which is of special concern to the Cuban government) as part of the conservation theme of the festival (Photos B & C by J. Wiley).

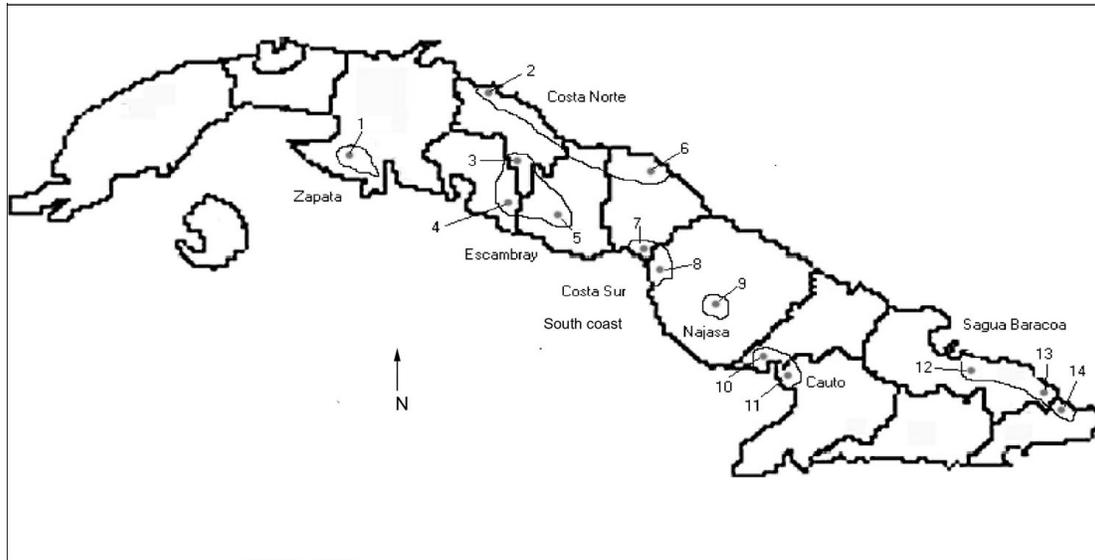


Fig.11. Geographical regions of Cuba with populations of the Cuban Parakeet (*Aratinga euops*). Numbered points are protected areas within these regions where the parakeet has been studied. Numbers refer to the following sites: 1. Ciénaga de Zapata, 2. Mogotes de Jumagua (Villa Clara), 3. Hanabanilla (Mundo Nuevo), 4. Yaguababo (Trinidad), 5. Naranja (Espíritu Santo), 6. Cunagua (Morón), 7. Júcaro (Ciego de Ávila), 8. Vertiente (Cunagua), 9. La Belén (Camagüey), 10. Monte Cabaniguán (Las Tunas), 11. Biramas (Granma), 12. Sierra Cristal, 13. Parque Humboldt, 14. Cuchillas del Toa.

populations of parrots in fragmented habitat prompted several efforts focused on captive propagation of the species (e.g., Rodríguez and Acosta 1986, Noegel 1977). The Academia de Ciencias de Cuba had an active government-supported captive-breeding program with the objective of returning offspring to the wild. Captive breeding success has been achieved at several sites, including in Cuba by Zaya Pérez (2002), in Florida, USA, by Noegel (both *A. l. leucocephala* and *A. l. palmarum*; Noegel 1980), two East German zoos, an East German aviculturist, and the Moscow Zoo. Recent evaluations, however, have led to an abandonment of the national captive program and other captive propagation efforts, with emphasis shifted to conservation of the extant wild populations.

Recommendations. Although Ciénaga de Zapata and other habitats critical to parrot and parakeet survival are legally protected, additional large conservation areas are needed in sites where the species survives. Even within the best protected of conservation areas, illegal parrot harvesting continues at a disturbing rate. Given Cuba's economic limitations, control of harvesting of natural resource is minimal and it is unlikely that parrot harvesting can be reduced substantially in the near future. Perhaps the best hope is through a vigorous public education

program, building and expanding on the education efforts of the Empresa, that would instill a conservation ethic and community rejection of the illegal parrot trade.

Although no substantial populations of exotic psittacids have become established in Cuba yet, the island is ripe for such invasions, given the indigenous desire for captive birds and the rapid proliferation of feral populations of exotic estrildid finches in the island. Effective protective legislation and mechanisms should be developed in anticipation of the problem, which is likely to lead to a critical situation such as in Puerto Rico (Long 1981, Raffaele 1983, Lever 1987, Pérez-Rivera 1992, Raffaele and Kepler 1992).

Cuban Parakeet *Aratinga euops*

Distribution and habitat. The endemic parakeet was abundant and widespread in Cuba and Isla de Pinos through the nineteenth century (Poey 1851, Gundlach 1893, Barbour 1943). It was extirpated from the Isla de Pinos at the beginning of the twentieth century (Bangs and Zappey 1905), and its current distribution in Cuba is confined mainly to the central and eastern parts of the country, including the Zapata Peninsula, mountains of Trinidad, Peralejo, Guasimal, Loma de Cunagua, Sierra de Najasa, and some areas of the eastern mountain ranges

Table 4. Cuban Parakeet (*Aratinga euops*) habitat, population status, research efforts (by the Empresa para la Conservación de la Flora y la Fauna), and investigators, by region.

Region	General habitat	Population status	Investigations and protected areas	Source
Montañas del Escambray	Mountain forests with palms	Several populations, fluctuating in number, some breeding in potholes in cliff faces. Illegally harvested.	1. Reproduction in artificial nests (Alturas de Banao). 2. Population survey, monitoring of nests, and environmental education (Hanabanilla). 3. Population survey in 1996 (Villa de Yaguanabo). 4. Population survey and nest monitoring, 2000–2002 (Valle de Yaguanabo).	M. Cañizares R. Garcia I. Figueroa R. Chamizo, W. Lamela
Ciénaga de Zapata	Savannas with palms and wetland forests	Populations affected by two recent hurricanes. Considerable illegal harvesting.	None	—
Northern coast of Villa Clara to Camagüey	Savannas with palms and wetlands	About six population nuclei. Illegally harvested.	1. Population survey in 1997 (Loma de Cunagua). 2. Population survey, feeding ecology, movements, and reproduction; management of nests; and environmental education (Mogotes de Jumagua).	X. Gálvez. J. Rivera, J. Castillo, R. Díaz
Southern coast, Ciego de Ávila to Camagüey	Savannas with palms and wetlands	Two population nuclei with unknown status, possibly with high illegal harvesting.	None	—
Alturas de Najasa	Secondary forest with palms	Only one isolated population.	Population survey, feeding ecology, reproduction and behavior (La Belén).	P. Regalado
Mouth of the Río Cauto	Savannas with palms and wetlands	Several population nuclei with high abundance of individuals, relatively well protected from illegal harvesting.	1. Population survey; studies on breeding, growth, nest selection (Monte Cabaniguan). 2. Population survey, group dynamics (Delta del Cauto).	M. Alonso, R. Olano E. Pompa
Mountains of Sagua – Baracoa	Montane forest with palms	Several population nuclei, apparently abundant and stable. Extensive illegal harvesting.	Only population counts in 1996 (Parque Humbolt).	G. Bequer, N. Garcia, M. Rojas

(Garrido and Kirkconnell 2000) (Fig. 11). The parakeet inhabits remote mountain habitat with undisturbed forest, although it also occurs in palm savannas (Barbour 1943, Bond 1956, Garrido and Kirkconnell 2000).

Status. The parakeet is considered rare and Vulnerable (IUCN), and is listed in Appendix II of CITES (Garrido and Kirkconnell 2000, Hilton-Taylor 2000, Snyder *et al.* 2000). The parakeet is locally protected, but enforcement is not vigorous. Few structured surveys to determine population sizes have been conducted and those surveys that have been completed are yet to be analyzed by the Empresa. No range-wide estimates of population

size are available.

Population trend. The Cuban Parakeet has not survived as well as the parrot and has undergone a distressingly rapid decline in numbers. It now has a small and fragmented range and population. The rate of decline is likely to have slowed with a reduction in trapping pressure, but habitat loss continues and is an even more serious source of population deterioration. Whereas large flocks of parakeets were reported in the past (Gundlach 1873, 1876, 1893; Barbour 1943) smaller bands of 1–4, the majority certainly containing less than 30 individuals, are observed today.

Demography. The Cuban Parakeet breeds from

May through August, laying 2–5 eggs per clutch. Reproductive biology studies have been undertaken by Empresa biologists.

Threats. The main cause of its decline has been large-scale destruction of habitat, which has had its greatest effect on parakeet populations that once spanned Cuba's extensive palm savannas, much of which have been converted to sugarcane cultivation (Barbour 1943). Cutting of palms, critical to nesting parakeets, continues in the lowlands, now mainly to provide building materials. Degradation and destruction of fragmented mountain habitats continues from timber interests, as well as small-scale attrition by local need for fuelwood.

The parakeet is also the victim of intensive control as a crop pest and harvesting for the pet trade. Unfortunately, it is a serious predator of corn and other crops, and farmers use all means to control the parakeet. Although not as popular as the parrot, the Cuban Parakeet is kept occasionally as a cage bird (Link in Todd 1916, Barbour 1943, García Montaña 1980). Gundlach (1893) had predicted that, at the rate of harvest as cage birds, the formerly abundant parakeet would soon disappear from the Isla de Pinos, a prediction soon fulfilled (Bangs and Zappey 1905). Although the extent of the parakeet market was not documented, an indication of the numbers of birds taken can be inferred from the traffic for the more resilient parrot (Table 2).

Conservation efforts. The parakeet's dramatic decline and disappearance from broad areas of Cuba, as with the parrot, impelled the Cuban government to develop protective legislation and mechanisms. The parakeet benefits from habitat protection and management within the Ciénaga de Zapata National Park and Refuge, and other managed natural sites. Also, the Cuban Parakeet has been recognized as in need of international concern (Snyder *et al.* 2000).

Since 1992, Empresa researchers have conducted studies of the ecology, behavior, and reproduction of the parakeet in protected areas (Table 4). [Also see Cuban Parrot section].

Recommendations. See recommendations for the Cuban Parrot, which apply to the parakeet. In addition, with the recent successful education and habitat protection efforts in Isla de Pinos, this would be an auspicious time to re-establish the parakeet in that island. That effort could be centered at the Los Indios Ecological Reserve, where the Empresa has developed a recovery project for the parrot, including the enhancement of nesting (supplying artificial cavities) and feeding habitat.

JAMAICA

As with the rest of the West Indies, Jamaica has undergone extensive conversion of natural forests to cultivation, pasture, and human settlements. The most recent assessment of forest cover and land use, completed in 1998, classified about 30% (approximately 336,000 ha) of the island as forest. This percentage unfortunately includes *Bambusa vulgaris* (approximately 5% of forest cover), a non-native insidious bamboo, yet recognized as a "forest type" by international guidelines. Further, the majority of remnant native forest has been disturbed and degraded, and about only 8% of the island remains as natural forest showing minimal evidence of human disturbance (Forestry Department 2001). Such forest is found in the most rugged, difficult-to-access terrain (e.g., Cockpit Country, John Crow Mountains). Habitat loss and fragmentation has contributed to reduced populations of all of Jamaica's native psittacines and isolated the *Amazona* parrots into discrete subpopulations.

Jamaica hosts the richest native psittacine avifauna in the West Indies, with two species of endemic *Amazona* parrot (Black-billed Parrot *Amazona agilis* and Yellow-billed Parrot *A. collaria*) and one native parakeet (Olive-throated Parakeet *Aratinga nana*). At least one species of small green macaw (*Ara* sp.) existed up until the early nineteenth century (Lack 1976, Wetherbee 1985, Williams and Steadman 2001). Additionally, the Green-rumped Parrotlet (*Forpus passerinus*), introduced in 1918, has become naturalized. We first present information pertinent to all three native psittacines, then specifics for the native and non-native species. Finally, we present collective information on conservation efforts and recommendations for the three native species.

Conservation of Jamaican Psittacines

Under the Forest Act of 1937, the government of Jamaica gazetted 98,962 ha as Forest Reserves and 10,522 ha as Crown Lands; both designations are managed by the Forestry Department. Forest Reserves are classified further as Wildlife Sanctuaries under the Wildlife Protection Act (1945). The Forest Act of 1996 repealed the act of 1937 and provided a stronger mandate for the Forestry Department to develop management plans aimed at conservation, reforestation, and sustainable management. The larger Forest Reserves, which include much of the habitat important for Jamaica's native psittacines, have been identified as candidate national parks under the National System of Parks and Protected Areas (National Resources Conservation Authority

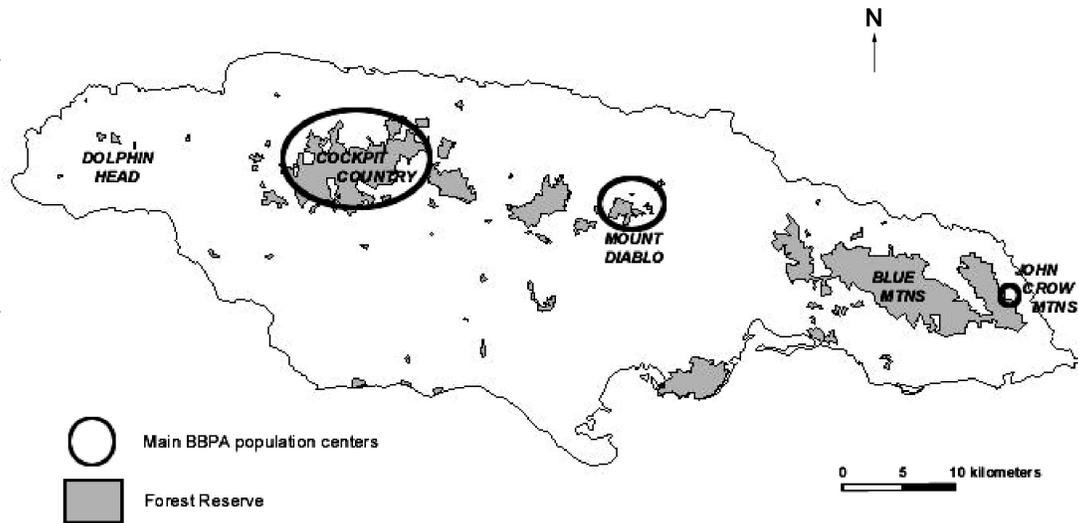


Fig. 12. Black-billed Parrot (*Amazona agilis*) distribution in Jamaica.

1997). Pilot national parks (e.g., Blue and John Crow National Park), however, have experienced difficulties with the sustainability of non-governmental management organizations, and there is increasing support for retaining areas as Forest Reserves, with co-management by the Forestry Department and Local Forest Management Committees of community-based organizations.

The National Environment and Planning Agency (NEPA; formerly Natural Resources Conservation Authority) is responsible for wildlife protection. All of Jamaica's native psittacines have full protection under section six of the Jamaican Wildlife Protection Act (1973 and Amendment Order 198). The government of Jamaica listed both *Amazona agilis* and *A. collaria* as Threatened in 1986. Jamaica has ratified CITES (1997) and the Convention on Biological Diversity (National Environment and Planning Agency 2001). Despite legal protection, small-scale poaching of parrots and hunting of parakeets for food occurs. However, unlike many mainland psittacid species, poaching is minimal; none of the Jamaican species is highly desired in the international trade and most nestlings are poached for the local market (Wright *et al.* 2001).

Black-billed Parrot Amazona agilis

Distribution and habitat. The Black-billed Parrot is found primarily in mid-elevation moist and wet closed broadleaf forest on limestone (Fig. 12). Formerly recorded as common in Portland Parish (Scott 1892), by the mid-1970s the Black-billed

Parrot had become rare in eastern Jamaica (Cruz and Gruber 1981). Systematic surveys in the late 1990s recorded a small population persisting in the John Crow Mountains. The parrot is still locally common in Cockpit Country, an area encompassing approximately 25,000 ha of primary and secondary forest. This region is also the only location where both the Black-billed and Yellow-billed parrots occur sympatrically in large numbers.

Status. The Black-billed Parrot is considered Threatened by the Jamaican government, Vulnerable by IUCN, and is listed in Appendix II of CITES (Hilton-Taylor 2000, Snyder *et al.* 2000).

Despite considerable concern for Black-billed Parrot populations following Hurricane Gilbert (1989; e.g., Varty 1991), the Cockpit Country population survived the storm well and should be considered locally common. Parrots are absent in many of the smaller peripheral forest patches, however, and forest managers must question what is the minimum-sized area required for viable populations.

Recent surveys produced an estimated 8500 ± 1500 territorial pairs of Black-billed Parrots in Cockpit Country (Davis 2002), much higher than previous estimates of 1500 individuals for the entire island (Cruz 1980). Previous counts may have underestimated the population size of Black-billed Parrots because surveys were not conducted extensively throughout Cockpit Country and because of flocking differences between Black-billed and Yellow-billed parrots; i.e., Black-billed Parrots rarely



Fig. 13. Susan Koenig in blind observing Black-billed Parrot nesting pair in Cockpit Country, Jamaica (photo © Robert Rattner).

fly in flocks larger than 20, even during the non-breeding season, whereas yellow-bill flocks exceeding 70 are not uncommon as birds assemble and leave the forest to feed in edge agriculture habitats. These larger flocks may contribute to the misperception of greater numbers of Yellow-billed Parrots. Further, the survey location can contribute to biased population estimates because Black-billed and Yellow-billed parrots are not distributed evenly across Cockpit Country. Territorial pairs occur at a ratio of 1:1 in the forested center but Black-billed Parrots

occur with greater frequency than Yellow-billed Parrots in edge habitat. On the northern edge of Cockpit Country, Black-billed Parrot pairs are more abundant than Yellow-billed Parrot pairs at a ratio of 3:1, and in the south by a ratio of 2:1. In the east, however, territorial Yellow-billed Parrots outnumber Black-billed Parrots by two to one (Davis 2002).

Population trend. Based on the recent surveys conducted by Davis (2002) and on-going point count surveys in selected areas of Cockpit Country, the Black-billed Parrot population there appears stable.

Demography. Detailed studies of breeding biology from 1995 through 1998 recorded 42% of egg-laying pairs successfully fledging at least one chick (Koenig 1999, 2001; Fig. 13). Clutch size was 3–4 (mean 3.1 ± 0.5 ; $n = 20$), the incubation period was 24 days, and the nestling period was approximately 55 days. Successful nests produced 2.1 fledglings whereas the overall number of fledglings per egg-laying pair was 0.95 (Koenig 2001). Further analysis of nesting success by habitat type (interior forest and forest edge) revealed that the effects of edge habitat (i.e., source-sink dynamics) might be relevant for habitat management. Of Black-billed Parrots attempting to nest in regenerating edge habitat in northern Cockpit Country, approximately 20% of nests succeeded in fledging at least one chick. In contrast, nearly 50% of pairs nesting in the interior were successful. Using standard population viability analysis (PVA) modeling techniques, and assuming Black-billed Parrot survival rates and lifespan were comparable to the congeneric Puerto Rican Parrot,

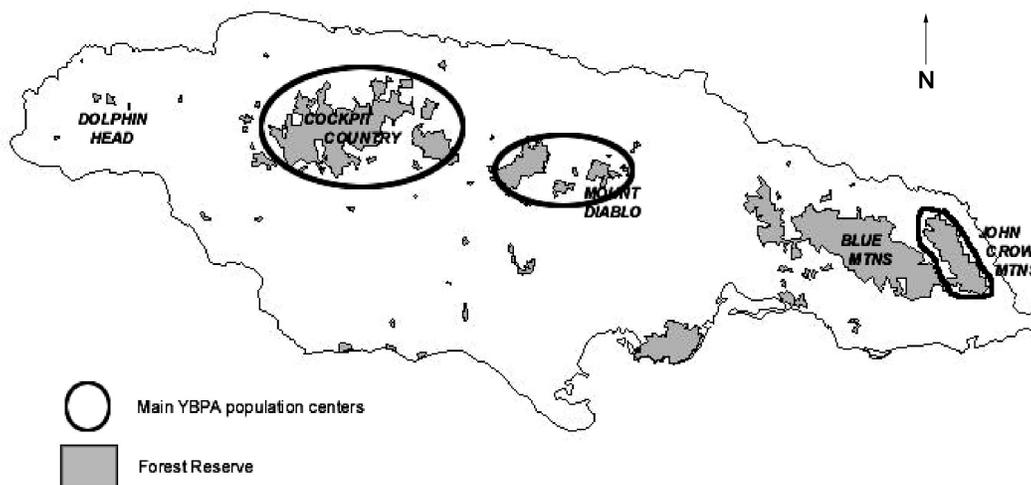


Fig. 14. Yellow-billed Parrot (*Amazona collaria*) distribution in Jamaica.



Fig. 15. Herlitz Davis conducting fieldwork in the Cockpit Country of Jamaica (photo © Robert Rattner). Herlitz completed his graduate work on Jamaican parrots with support from WPTI and the Grambling Wildlife Research Project.

the estimated population growth rate in disturbed edge habitat was 0.98 compared to estimated growth rate in interior forest of 1.05, where 1.0 is a stable population (Koenig 1999).

Yellow-billed Parrot *Amazona collaria*

Distribution and habitat. The Yellow-billed Parrot has a wider distribution than the Black-billed Parrot (Fig. 14). Populations are concentrated in two regions: (1) the central limestone plateau extending from Cockpit Country east to Mount Diablo and Worthy Park, and (2) the wet limestone forest of the John Crow Mountains. In contrast to Black-billed Parrots, which appear to be restricted to moist and wet closed-canopy limestone forest in the interior of the island, Yellow-billed Parrots are observed occasionally in dry and moist coastal limestone forest and open woodland. Yellow-billed Parrots rarely are seen in the Blue Mountains, west of the John Crow Mountains. Jamaican ornithologists have speculated that both *Amazona* species may be restricted to forest on limestone bedrock; the Blue Mountains are igneous shale. A small breeding population (est. 30–40 individuals) of Yellow-billed Parrots is resident in Hope Gardens, Kingston. The source of this population is believed to be escaped and intentionally released caged parrots.

Status. The Yellow-billed Parrot is considered Threatened by the Jamaican government, Vulnerable by IUCN, and is listed in Appendix II of CITES (Hilton-Taylor 2000, Snyder *et al.* 2000). Although Yellow-billed Parrot populations are reduced in range and numbers from the pre-Columbian period, the species should be considered

locally common where it still occurs and is in no immediate risk of extinction. Davis's (2002) surveys of the Cockpit Country population yielded an estimated 6500 ± 1500 Yellow-billed Parrots, higher than the previous estimate of 2500 for the entire island population (Cruz 1980) (Fig. 15). Surveys of the John Crow Mountains are expected to yield comparable numbers to, if not more individuals than, estimates for the Cockpit Country.

Population trend. Based on the recent surveys conducted by Davis (2002), surveys conducted in 2002 for Jamaica's Important Bird Areas program, and on-going point count surveys in selected areas of Cockpit Country, the Yellow-billed Parrot population appears stable.

Demography. Data on reproductive performance of Yellow-billed Parrots in the wild are not as detailed as for Black-billed Parrots. The breeding survey of 1995–1998 was centered on the northern edge of Cockpit Country, where the number and density of Yellow-billed Parrot nest sites were low. Relative to Black-billed Parrot nest site needs, Cruz and Gruber (1981) suggested that Yellow-billed Parrots required larger trees in which to successfully rear young and this may account for their low numbers in northern Cockpit Country, which has been logged intensively over the past 100 years compared to the southern periphery where the hillsides are steeper. Yellow-billed Parrot clutch size in northern Cockpit Country was three ($n = 3$) (Koenig 2001); Cruz and Gruber (1981) reported clutch size as 3–4. The duration of incubation and nestling periods, and reproductive performance remains to be documented for wild Yellow-billed Parrots.

Olive-throated Parakeet *Aratinga nana*

Distribution and habitat. The Olive-throated Parakeet was once found across nearly all of Jamaica, from coastal habitat and lowland plains through mid-elevation (<1500 m) broadleaf forests. At present the species is most common in mid-elevation moist limestone forest, woodland, and wooded cultivation. It also occurs frequently in open shrubland in humid and semi-arid areas of both the northern and southern lowlands and less frequently in the arid natural forest of the Hellshire Hills and Portland Ridge on the southern coast (Lack 1976, Downer and Sutton 1990). It is occasionally seen in mixed fruit tree plantations in the lower elevations of the Blue Mountains but is absent from the wet John Crow Mountains.

Status. The Olive-throated Parakeet is listed in Appendix II of CITES. *Aratinga nana*, formerly

known as the Jamaican Parakeet, was recently combined with *A. astec* (Aztec Parakeet) under *A. nana*, to include populations of Jamaica and Middle America from southern Tamaulipas to western Panama (American Ornithologists' Union 1983). The Jamaican population is considered a distinct race (*A. n. nana*). The parakeet has never been systematically surveyed across Jamaica. Populations appear to go through natural fluctuations and, consequently, multi-year surveys will be required to determine population trends. The range of the Olive-throated Parakeet appears to have become restricted through habitat loss. Scott (1892) described it as local in distribution but still common where it occurred. More-recent authors (Downer and Sutton 1990; Koenig, pers. obs.) believe the Olive-throated Parakeet is widespread and common. The 'parquet' is listed as a pest species under Part 2 of the Second Schedule of the Wildlife Protection Act. Legally, a permit is required from NEPA to shoot pest species.

Population trend. Numbers are likely decreasing because of continuing habitat loss, particularly in coastal areas.

Demography. Demographic parameters are unknown for the Olive-throated Parakeet. The species nests in active arboreal termite nests or tree cavities and produces a clutch of 3–5 eggs (Downer and Sutton 1990).

Threats. In addition to those mentioned as generally affecting Jamaican psittacids, the Olive-throated Parakeet continues to be persecuted for its depredations of corn and guava (*Psidium guajava*).

Non-native Psittacines

The naturalized Green-rumped Parrotlet (*Forpus passerinus*) is now widespread at all elevations, although it is most common in open habitats, particularly drier lowlands and wooded cultivations through an elevation of 500 m. It nests in tree cavities, decaying fence posts, and eaves of houses. Because of its small size (13 cm) and foraging ecology (grass seeds, small fruits, and grains), it is not believed to compete with the larger Olive-throated Parakeet (31 cm) or either *Amazona* species. Nor does the parrotlet appear to have displaced Jamaica's native grassquits (*Tiaris* spp., *Loxipasser anoxanthus*), with which it most likely would compete for food resources.

Fortunately, the Green-rumped Parrotlet appears to be the only non-native psittacine that has become established in Jamaica. Other non-native psittacines are reported infrequently in Kingston, including the

Budgerigar, Cockatiel, Peach-faced Lovebird (*Agapornis roseicollis*), and Rose-ringed Parakeet. These species are imported from the United States, bred locally, and sold in local pet stores, but none has become established in the wild. Other incidental escaped or released non-native psittacines include cockatoos (*Cacatua* spp.) and Senegal Parrot (*Poicephalus senegalus*); the latter escaped from Hope Gardens Zoo during Hurricane Gilbert (1989) and was still associating with the feral flock of Yellow-billed Parrots in 1997.

The government of Jamaica continues to permit the importation of non-native psittacines, despite the recognition in Jamaica of the deleterious effects of non-native species on native flora and fauna; e.g., 10 years after the introduction of the Javan mon-goose in 1874, a commission was convened that determined not only was the introduction a mistake but it also recommended that no species be introduced for biological pest control. Each Jamaican household is permitted to import two psittacines per year. This includes permission to import *Amazona* species which, if they escape and become established as has occurred elsewhere in the West Indies, would present a threat to native parrots through direct competition for resources and, most important, by increasing the risk of exotic diseases being introduced into wild populations. With the current importation laws and with the recognition that Jamaica is in a major hurricane zone where caged animals escape during tropical storm events, it is a question of "when" not "if" non-native psittacines will become established and introduce potentially lethal diseases into the wild.

Conservation efforts

From 1995 through 2000 BirdLife Jamaica coordinated and supported the Jamaica Parrot Project, a research and community outreach program that collected new information on the ecological requirements of both *Amazona* species, including identifying critical factors limiting reproductive performance, evaluating habitat quality, and developing a better understanding of the interactions of parrots with competitors and predators (Koenig 2001). The Jamaica Parrot Project also supported systematic, island-wide surveys, which provided more-accurate estimates of population sizes and distributions (Davis 2002). These studies provide baseline information for long-term monitoring and will facilitate developing realistic conservation strategies, particularly for the Cockpit Country populations.

The data generated from the breeding surveys

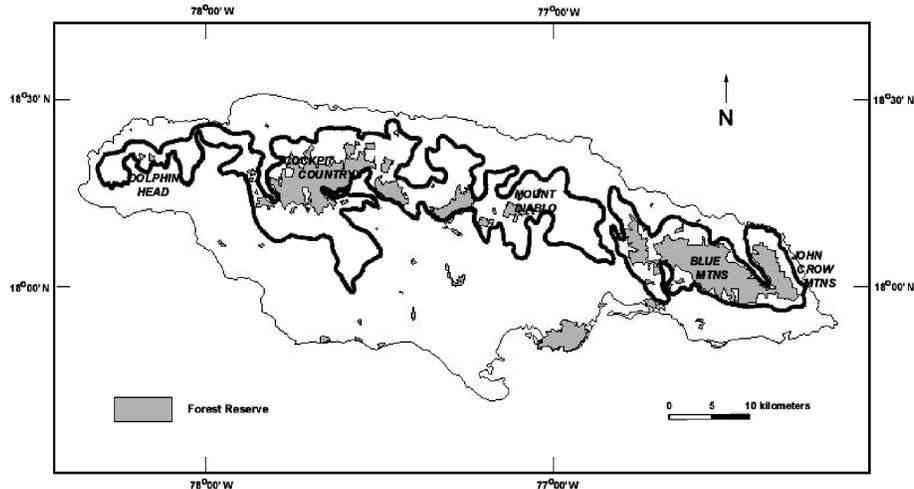


Fig. 16. Proposed spinal forest project to restore closed-canopy forest to mid- and upper-elevation degraded habitat across Jamaica. Successful habitat restoration would facilitate the expansion in ranges of both *Amazona agilis* and *A. collaria*. Adapted from the Proposed Spinal Forest Project, a joint effort between the Environmental Foundation of Jamaica and the Forestry Department; Proposed Spinal Forest Project Map prepared by the Trees for Tomorrow Project – Phase II, Forestry Department, Government of Jamaica.

challenge Jamaica's natural resource officers to effectively manage both single species and biological diversity overall – the maintenance of species, their functional relationships, and the specific habitat features that shape these relationships. For example, Black-billed Parrots experienced substantially greater predation of nestlings by the yellow boa (*Epicrates subflavus*) in regenerating edge forest habitat compared to core forest in Cockpit Country. This presents a complex conservation challenge. The yellow boa is also endemic to Jamaica and is the largest native terrestrial predator. As habitat loss contributed to the decline and isolation of parrot populations, so too has it led to isolated population of yellow boas. The boa's conservation status is Vulnerable (Hilton-Taylor 2000) and it is persecuted heavily by fearful humans (Oliver 1982; Koenig, pers. obs.). Cockpit Country is considered to be the stronghold of the boa and nestling parrots represent an important prey item (Cruz and Gruber 1981, Koenig 1998). High predation rates of parrot nests in edge habitat may be a function of high densities of yellow boas, which may be artificially maintained by access to reliable prey base associated with human activities (e.g., non-native rats *Rattus* spp.). Alternatively, boas may benefit from the structural complexity of edge habitat. To what extent regenerating forest represents sink habitat for parrots and source habitat for yellow boas is not

clear. Equally important, the core forest habitat likely represents a balance in the predator-prey dynamics of these endemic and vulnerable species and should be viewed as the minimum condition for habitat renewal projects.

Jamaica is recognizing the need not only for habitat preservation but also the importance of habitat renewal. This stems from the evidence that, despite the legal system of forest reserves and national parks, all remnant forest is eroding over time through human disturbance and that natural renewal rates are not sufficient to offset current rates of habitat loss (see also Sinclair *et al.* 1995). Jamaica's Forestry Department has recently received funding from the Environmental Foundation of Jamaica (EFJ) to implement its "Spinal Forest Project," a project to repair and restore forest connectivity across central Jamaica, from Dolphin Head in the west, across the central limestone plateau of Cockpit Country to Worthy Park and through to the Blue Mountains (Fig. 16). Although initial funding is for five years, EFJ recognizes that this effort will take some five decades to restore habitat destroyed over the last five centuries (I. Gage, pers. comm.).

Recommendations

Cruz and Gruber (1981) presented recommendations that continue to be applicable to Jamaica's native psittacines: (1) preserve and actively protect

habitat, (2) maintain preserves of areas as large as possible, (3) keep preserves roadless to minimize human encroachment and reduce penetration by non-native species, (4) prevent importation of non-native species, (5) institute education programs, (6) enforce existing wildlife protection legislation, and (7) establish a monitoring program to continue surveys of distribution and population trends. This last recommendation is critical for assessing the efficacy of any conservation strategy implemented by resource managers.

HISPANIOLA

The Dominican Republic and Haiti, which comprise Hispaniola, were heavily forested when discovered by Europeans in 1492. Furthermore, the island contained every habitat type and landscape feature known in the Caribbean islands, including three life zones that occur in no other island in the New World (Grupo Jaragua, Inc. 1994). From 1630 to the 1880s, lowland forests were gradually converted to agriculture, primarily sugar cane plantations worked by African slaves. Following the abolition of slavery, conversion of montane forests began as freed slaves moved into the mountains and cultivated the land, especially in Haiti. Also, large quantities of timber were being exported from Haiti as early as the mid 1800s (Paryski *et al.* 1989). In 1900, about 80% of the Dominican Republic was still in primary forest (Garcia *et al.* 1997). A worldwide demand for sugar following World War I resulted in an increase in the area under sugar cultivation and cleared for pastures. By 1954, only 6.7% of the land area of Haiti had forest with 60% or greater canopy coverage (Burns 1954), and by 1988 that had shrunk to 1.5% or less of land area (Paryski *et al.* 1989). The Dominican Republic has fared somewhat better, with primary forest reduced to *ca.* 14.1% of its land area by 1980 (CRIES 1980, Garcia *et al.* 1997).

Although substantial changes in forest protection and management policies in both countries occurred during the 1990s, such efforts were largely ineffective because of little or no enforcement, lack of clear forest management and protection policies, inadequate funding, and little political will. This is particularly true in the Dominican Republic where, despite extensive legislation, institutional reorganization, and military involvement, the forest sector has been characterized by a history of poor achievement and policy ineffectiveness, so the net rate of deforestation continues at an estimated 2.8% annually (Food and Agriculture Organization 1993).



Fig. 17. Hispaniolan Parrot (*Amazona ventralis*) (photo © Robert Rattner).

In the Dominican Republic, a total ban on tree cutting was ordered in 1967, all sawmills were closed, and reforestation programs have been proposed and executed from time to time by both the government and private sector organizations, particularly in the 1970–1985 period. Approximately 280 ha per year were reportedly planted in this period. Inadequate budgets and insufficient trained personnel, however, have hampered program implementation and enforcement of regulations.

In Haiti the picture is even more grim, as the country is now virtually totally deforested. There may be little hope, under present conditions, for recovery of this extensive environmental damage (Grupo Jaragua, Inc. 1994). The country's high population density (>200 people/km² in 1982), poverty (mean per capita income of US \$150 per year for rural residents), and political instability, in addition to low budgets for resource entities, absence of trained staff, lack of clear policies, and shifting government priorities have prevented any serious conservation efforts (Harcourt and Ottenwalder 1996). Furthermore, although the Dominican Republic is a signatory of CITES (1987), Haiti has not signed.

Two native psittacines survive in Hispaniola, Hispaniolan Parrot (*Amazona ventralis*) and Hispaniolan Parakeet (*Aratinga chloroptera*). We first present information related to each species, followed by material that applies to both forms.

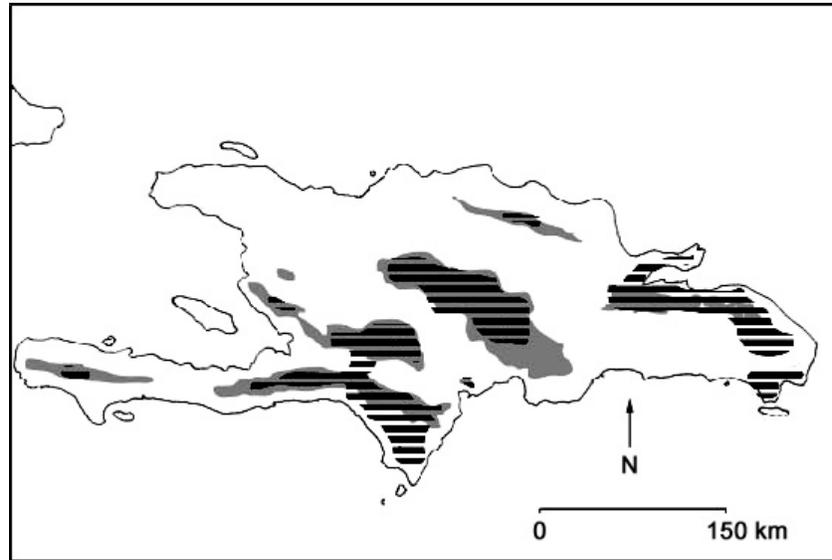


Fig. 18. Hispaniola (Haiti and Dominican Republic) showing distribution of Hispaniolan Parrot (*Amazona ventralis*), depicted by bold bar shading. Lighter shaded areas are major mountain ranges.

Hispaniolan Parrot *Amazona ventralis*

Distribution and habitat. The Hispaniolan Parrot (Fig. 17) was formerly common and widespread in most habitats throughout Hispaniola and its satellites, inhabiting arid lowland, palm savannas and, more commonly, high mountain forests (Wetmore and Swales 1931; Bond 1956; Dod 1978; Wiley, pers. obs.). It is now primarily restricted to the remoter forested areas (Fig. 18).

Status. The Hispaniolan Parrot is considered Vulnerable and listed in Appendix II of CITES (Hilton-Taylor 2000, Snyder *et al.* 2000). It is now extirpated or uncommon in most areas (Raffaele *et al.* 1998). The Hispaniolan parrot is locally common in the Dominican Republic, but is uncommon or rare over much of its former range (Dod 1978; Woods 1987; Wiley, pers. obs.). Hartshorn *et al.* (1981) listed the parrot as in danger of extinction in the Dominican Republic. Woods (1987), using U. S. legal terminology described the parrot as Endangered throughout Haiti, except in the Plains of Formon and the surrounding mid-elevation areas of southern Haiti. In these locales, he reported the bird uncommon, but Threatened, rather than Endangered.

The range-wide size of populations and the extent of the decline are undetermined, and clarification may lead to the species being reclassified as Near Threatened (BirdLife International 2000).

Population trend. Except in some protected areas, the Hispaniolan Parrot is rapidly decreasing in

distribution and numbers (Dod 1978, 1981; Woods 1987; JWW, pers. obs.). This species is seriously at risk if present trends continue. Dod (1978) reported that its numbers declined dramatically in the 1970s and that the parrot was on the way to extinction in the Dominican Republic. Parrot populations surveyed in 1975 through 1996 showed moderate to substantial declines in examined areas in the Dominican Republic; e.g., southern Los Haitises — 99% decline in numbers; eastern Parque Nacional del Este — 30% decline; Sierra de Bahoruco — 30% decline (Wiley, unpubl. data).

Demography. The mean clutch size for Hispaniolan parrots at three Dominican Republic study sites was 2.8 ($n = 33$, range = 2–4; Snyder *et al.* 1987; Wiley, unpubl. data). Incubation periods averaged 25.5 ± 1 to 27.5 ± 1 days (4 nests, 11 eggs; Snyder *et al.* 1987). All of 91 eggs examined were fertile, whereas hatchability was 93% (85 of 91 fertile eggs). Of pairs that laid eggs, 82% were successful in producing young, with an average of 2.2 young per egg-laying pair and 2.7 chicks per successful pair.

Threats. Hispaniolan Parrots are hunted for food, shot as crop pests, and taken for pets (Wiley, pers. obs.). Although all of these activities are regulated, legal protection is not enforced. Still, habitat destruction is the most important factor in the parrot's past and present decline.

Conservation efforts. In the Dominican Republic

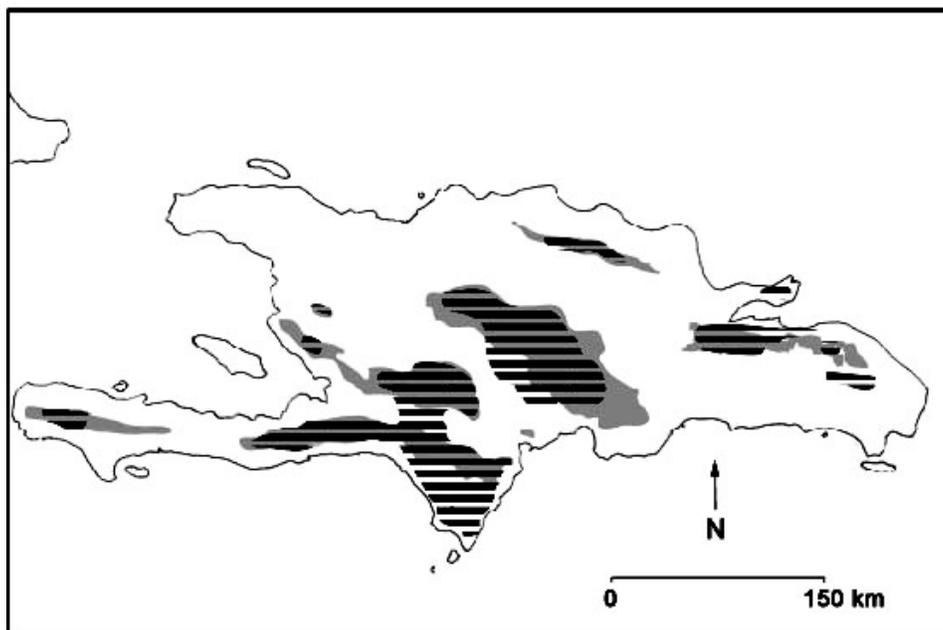


Fig. 19. Hispaniola (Haiti and Dominican Republic) showing distribution of Hispaniolan Parakeet (*Aratinga chloroptera*), depicted by bold bar shading. Lighter shaded areas are major mountain ranges.

the parrot is protected against chick harvesting and hunting by law DR-1975-Regulation 601.

Hispaniolan Parakeet Aratinga chloroptera

Distribution and habitat. The parakeet was formerly common throughout Hispaniola and on several of the offshore islands with suitable habitat; i.e., all natural wooded and forest habitats, but especially pine forests and high montane forests of the interior (Bond 1928, 1956; Wetmore and Swales 1931; Dod 1978; Keith *et al.* 2003; Wiley, pers. obs.). In the Dominican Republic, it is now mostly confined to remoter areas, particularly the Sierra de Baoruco, Sierra Neiba, Cordillera Central, and lowlands around Lago Enriquillo, but it also occurs sparsely in hills around agricultural areas (e.g., San Juan; Wiley, pers. observ.) (Fig. 19). A pair was regularly seen within Parque Nacional del Este until the passage of Hurricane Georges (September 1998; White, pers. obs.). Parakeet populations are smaller and more restricted in range in Haiti, where they perhaps reach highest densities in the Massif de la Selle and Massif de la Hotte. Now they are found relatively seldom in lowlands, and flocks of over 50 individuals are unusual anywhere, though numbers of *ca.* 100 are occasionally found in communal roosts, even in cities, including Santo Domingo (Keith *et al.* 2003).

Status. The parakeet is considered Vulnerable by

IUCN and is listed in Appendix II of CITES (Hilton-Taylor 2000, Snyder *et al.* 2000). Dod (1981) and Hartshorn *et al.* (1981) considered the parakeet declining toward extinction in the Dominican Republic. The species has a small and fragmented range and population, which continues to decline as a result of habitat loss and persecution. Woods and Ottenwalder (1986) reported it as common in La Visite National Park, Haiti, though much less numerous than in the 1930s.

Population trend. The parakeet is rapidly declining in numbers (Dod 1981; Wiley, pers. obs.). Population surveys in the Dominican Republic from 1976 through 1996 revealed dramatic declines in most populations; e.g., southern Los Haitises where parakeets have been extirpated (Wiley, unpubl. data). Even the most robust of populations, in the Sierra de Bahoruco, declined by 24% in that period.

Demography. The mean clutch size at 22 nests was 3.2 ± 0.53 (range = 2–4), with an average of 3.0 ± 0.63 ($n = 16$, range = 2–4) chicks hatched per successful nest (Wiley, unpubl. data). An average of 2.6 ± 0.89 (range = 2–4) chicks fledged from five successful nests watched through the breeding period, whereas the overall fledging rate (all [$n = 22$] nests) was 0.6 chicks per active nest with a nest success of 22.7%. Further studies are needed to determine population dynamics of the parakeet.

Threats. Hispaniolan parakeets are inferior to parrots as captives, but nevertheless are harvested as household pets and for international trade, as well as being severely persecuted as crop pests (Dod 1978; JWW, pers. obs.). The parakeet is especially vulnerable to hunting. Although parakeet hunting is outlawed and firearms are rare in the countryside, slingshots and snares are frequently and expertly used. Furthermore, enforcement of wildlife laws remains lax or nonexistent, and recently the laws themselves have been under attack. The Olive-throated Parakeet has recently been reported in the Dominican Republic (Smith 1996; Hess 1997; Keith *et al.* 2003), with the population spreading and possibly competing with native *A. chloroptera*, particularly in the Sierra de Bahoruco, Dominican Republic.

Conservation measures. The parakeet is protected by law against shooting and harvesting for pets in the Dominican Republic, although this legislation is not adequately enforced to ensure the species' continued survival.

Conservation of Parrots in Hispaniola

Because bird conservation efforts in Haiti are only recent and embryonic (Paryski *et al.* 1989, Raffaele *et al.* 1998), our comments here apply primarily to the Dominican Republic.

Woods (1987) presented recommendation vital to the conservation of the parrot and parakeet in Haiti. Perhaps the most important of these recommendations was that mature broadleaf forest habitat, particularly in regions of the national parks, must be preserved and provided with greater protection. Haiti created La Visite National Park and Pic Macaya National Park in 1983 in the southern mountains to protect flora, fauna, and important watersheds. Despite the preparation of excellent management plans (Woods 1982, 1986, 1987, 1989; Woods *et al.* 1992), the resources to ensure protection of these sites have not been made available. A modestly optimistic report on conservation conditions in Haiti is that of Sergile and Woods (2001).

Considerable commitment has been made to establishing protected areas in the Dominican Republic, where more than 40 protected areas, comprising more than 10% of its territory, have been established. The system of national parks and protected areas now covers representative parcels of nearly all of the diverse ecosystems and most outstanding landscape features; the system includes several areas of importance to parrots and parakeets. Among these protected areas is Jaragua National Park

(137,400 ha), which is the largest insular park in the Caribbean. The government, along with non-governmental organizations, is actively investigating various protected area management models that incorporate buffer zones and cooperative associations with local residents. Distressingly, recent government efforts to partially dismantle some protected areas to allow development pose an ominous threat to such areas and the species they harbor.

The risk of competition between introduced exotic bird species and native psittacids is high, as is the associated threat of introduced exotic diseases. Sánchez (1999) reported 2017 individual birds of 102 species imported into the Dominican Republic from 1994 to 1998, of which 1615 individuals were intended for sale. Nine species of non-native birds have already become established and another four (including Canary-winged Parakeet *Brotogeris versicolurus* and Budgerigar) may be in the process of becoming established. The collective competitive effects and disease threat of these 13 species on the native fauna is unknown but is worthy of great concern. Greater efforts, including conservation legislation, are needed to prevent the importation of potential pest species or those which could have an adverse impact on indigenous species should they become established.

PUERTO RICO

Puerto Rico experienced early and extensive habitat modification that had profound effects on native wildlife (Wiley 1985b, Snyder *et al.* 1987), including psittacids. Most original forests were cut or substantially modified by the beginning of the twentieth century. Soon thereafter, the native parakeet (*Aratinga maugaei*) and a distinct race of the Puerto Rican Parrot (*Amazona vittata gracilipes*) disappeared. With a movement away from an agrarian economy, much of the formerly denuded hillsides returned to woodland and forest in the second half of the twentieth century, but not before the parrot population had been reduced to only a few birds, surviving in a tiny fraction of its former range. The insularity of the relict population is exacerbated by current patterns of continuing urbanization, steadily reducing landscape connectivity with other potentially suitable habitats.

Puerto Rican Parrot Amazona vittata

Distribution and habitat. Once widespread and abundant throughout the Puerto Rican archipelago, the parrot is now found only in the Caribbean National Forest (CNF) in northeastern Puerto Rico, the

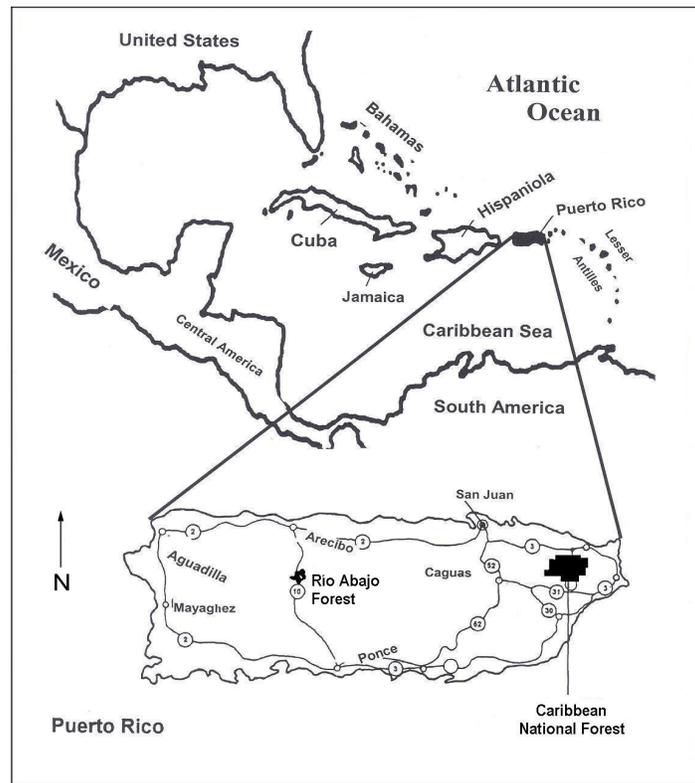


Fig. 20. Caribbean Islands showing location of the Caribbean National Forest and the Rio Abajo Commonwealth Forest in Puerto Rico (after U. S. Fish and Wildlife Service 1999).

best remaining representation of original forest in Puerto Rico (Fig. 20).

Status. The Puerto Rican Parrot is listed in Appendix I of CITES, and categorized as Critically Endangered in the IUCN Red List (Mace and Stuart 1994, Hilton-Taylor 2000, Snyder *et al.* 2000). It was designated as an endangered species in 1967 and, despite more than 35 years of recovery effort, is still considered one of the 10 most endangered birds in the world (Snyder *et al.* 1987, U. S. Fish and Wildlife Service 1999). The species reached its nadir in 1975, when only 13 parrots existed in the wild (Snyder *et al.* 1987). Only continuous intensive management and captive breeding have kept the species from extinction. The current (2004) wild population estimate is *ca.* 28–34 individuals, with an additional 152 individuals held in the two captive propagation facilities (U. S. Fish and Wildlife Service, unpubl. data).

Population trend. The wild population has fluctuated from 20 to 47 individuals over the past 25 years (Fig. 21) (U. S. Fish and Wildlife Service 1999), whereas the captive flock has show a steady,

albeit slow, increase.

Demography. All (67) Puerto Rican Parrot eggs laid from 1973–1979 were fertile, 56 (84%) hatched. Clutch size has averaged 3.0 (range = 2–4) eggs. The incubation period is about 26 days, with a fledging period of about 9 weeks (8–11 weeks). During the period 1990–2001, hatching rate (85%) remained the same, although fertility (83%) showed a slight decline. Of those eggs that hatched, 65% of the chicks fledged from 1990 to 2001 (U. S. Fish and Wildlife Service, unpubl. data). Juvenile mortality, particularly from predation, is greatest during the post-fledging period (Snyder *et al.* 1987; Lindsey *et al.* 1994; U. S. Fish and Wildlife Service, unpubl. data). Juvenile mortality normally ranges from 35% to 67% (Snyder *et al.* 1987, Lindsey *et al.* 1994), although in some years has been as high as 87.5% and as low as 14% (U. S. Fish and Wildlife Service, unpubl. data).

Threats. Historical threats included massive deforestation of Puerto Rico, as well as nest robbing for pets, and the shooting of parrots for food or to control crop depredation (Snyder *et al.* 1987). Even

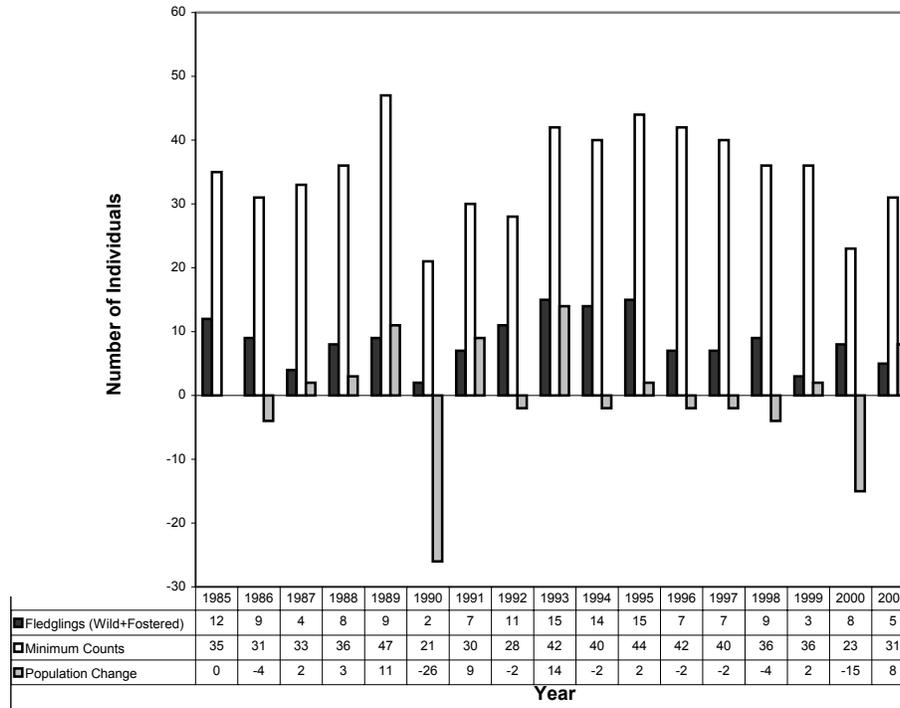


Fig. 21. Numbers of Puerto Rican Parrots (*Amazona vittata*) in the wild population, Caribbean National Forest, Puerto Rico, 1985–2001.

within the protected CNF, parrots apparently still suffer from the selective habitat destruction of the last century, in the form of extensive destruction of optimal cavities. This has resulted in aggressive competition by parrots over the few optimal natural nest cavities. Although virtually all natural nest cavities are in mature palo colorado (*Cyrilla racemiflora*) trees, the parrots have also used cavities in laurel sabino (*Magnolia splendens*), caimitillo (*Micropholis* spp.), and tabonuco (*Dacryodes excelsa*) trees (Snyder *et al.* 1987, U. S. Fish and Wildlife Service 1999). In all observed cases, newly territorial pairs have settled adjacent to established pairs, a tendency that may explain the long-term stability of Puerto Rican Parrot nesting areas (U. S. Fish and Wildlife Service 1999).

Once habitat loss had reduced the Puerto Rican Parrot to a single isolated population, a plethora of other factors began to work synergistically to further threaten the species. These factors included natural enemies, such as European honeybees and Pearly-eyed Thrashers (*Margarops fuscatus*), which compete with parrots for nest cavities (Wiley 1985a). Thrashers will also attack parrot eggs and nestlings in unattended nests (Snyder and Taapken 1977, Snyder *et al.* 1987). Problems with honeybees have become more serious since the arrival in Puerto Rico of the more aggressive Africanized

honeybees (U. S. Fish and Wildlife Service 1999). Direct predation of parrots has also been attributed to black rats (*Rattus rattus*) and Red-tailed Hawks (*Buteo jamaicensis*). Black rats will opportunistically consume parrot eggs, whereas Red-tailed Hawks actively prey on free-flying parrots (Rodríguez-Vidal 1959, Snyder *et al.* 1987, Lindsey *et al.* 1994). There also is strong evidence suggesting that hawks will occasionally enter nest cavities to attack parrots (Wiley 1980, Snyder *et al.* 1987). Recently, the introduced Javan mongoose has killed and consumed parrot fledglings that alighted on the ground (U. S. Fish and Wildlife Service, unpubl. data). Given the small number of parrots that fledge annually (1 to 12 per year since 1979), this is a significant source of juvenile mortality. Another important stressor acting on the parrot is parasitism of nestlings by botflies (*Philornis pici*) and soldier flies (*Hermetia illucens*). Larvae of these ectoparasites can substantially retard growth and muscular development of nestlings, and cause life-threatening secondary infections; heavy infestations of larvae can also directly cause nestling mortality.

Although the aforementioned factors can, in large part, be predicted and controlled or ameliorated by management actions, hurricanes are both stochastic and uncontrollable. Effects of hurricanes such as Hugo (1989), which caused the loss of 49% of the

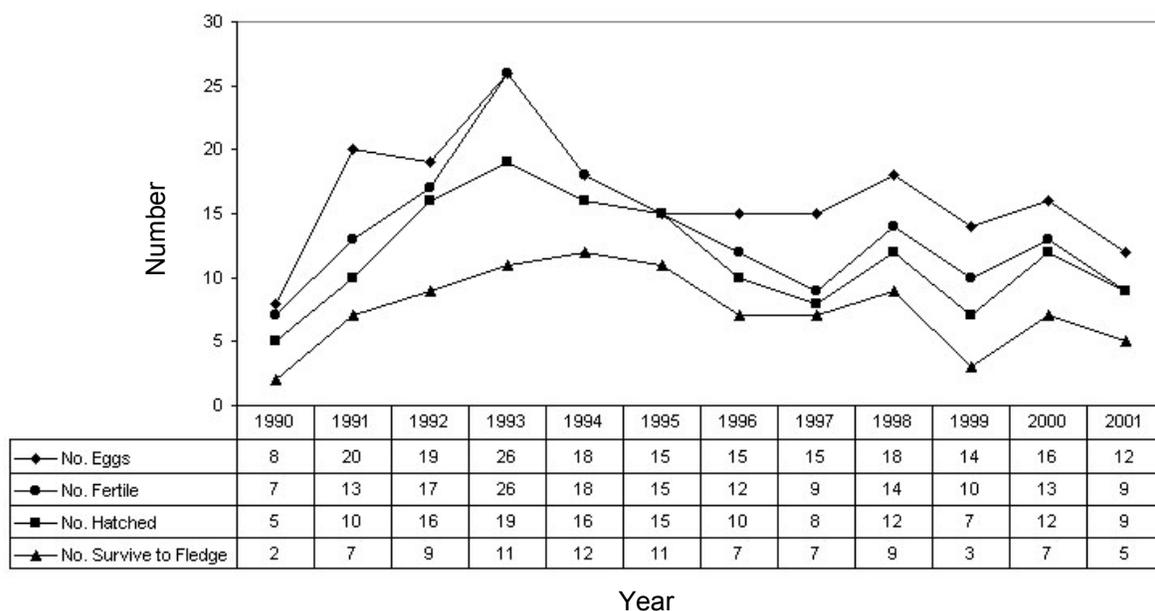


Fig. 22. Egg production and success of the wild Puerto Rican Parrot (*Amazona vittata*) population, Caribbean National Forest, Puerto Rico, 1990–2001. Data exclude 14 wild Puerto Rican Parrot (*Amazona vittata*) eggs hatched in the aviary in 2000 and 2001.

wild parrot population (U. S. Fish and Wildlife Service 1999), indicate that these tropical storms are probably the most dangerous natural enemy of the Puerto Rican Parrot. Hurricanes cause parrot mortality not only directly, but also indirectly through extensive habitat destruction and subsequent resource depletion (Wiley and Wunderle 1994, Collazo *et al.* 2003). It is conceivable that a single powerful hurricane could eliminate the entire wild Puerto Rican Parrot population as it is now restricted to the CNF.

In summary, the Puerto Rican Parrot faces a variety of factors that threaten its survival. With the notable exception of major hurricanes, none of the individual factors alone appear to be capable of causing the demise of the species, but in concert constitute a real and continuing danger. Current management and recovery efforts are directed at countering these and other threats.

Conservation efforts. Although concern for the parrot began much earlier, and some efforts to reverse the population decline were initiated (e.g., Rodríguez-Vidal 1959), it was not until 1968 that intensive recovery efforts began. Captive breeding was initiated in 1973, with the establishment of the Luquillo Aviary in the CNF. A second captive flock was established in 1993 at the José Vivaldi Aviary in the Río Abajo Commonwealth Forest of northwestern Puerto Rico to guard against the possibility

of losing the entire captive flock to a single catastrophic event, such as a hurricane or disease.

Early efforts focused on systematic surveys of the wild population and intensive observations and monitoring of wild parrot nesting activities from blinds. Concurrent implementation of protective measures resulted in a dramatic increase in wild parrot nesting success. For example, before 1973, overall nest success (i.e., percentage of active nests which fledge chicks) of the wild population varied from 11 to 26%. Following intensive management activities initiated in 1973, overall nest success averaged 81% (U. S. Fish and Wildlife Service 1999), although individual nest productivity (i.e., number of fledglings per nest) has remained highly variable (Fig. 22). These management activities include improvement and maintenance of natural nest cavities, construction and maintenance of artificial nest cavities, fostering chicks from the aviary into wild nests, removing bee swarms, controlling rats, and use of carbamate insecticide inside nest cavities to discourage botfly and soldier fly infestations. Problems with Pearly-eyed Thrasher usurpations of parrot nests have largely been controlled by converting parrot nests into deep, dark structures with bottoms not visible from the entrances. These nest characteristics are unattractive to thrashers, but seem favored by parrots (Snyder *et al.* 1987). Moreover, thrashers were also provided with alternative nest boxes adja-



Fig. 23. Tom White and Iris Rodríguez conducting telemetry for Puerto Rican Parrots from canopy platform, Caribbean National Forest, Puerto Rico (photo by Roland Seitre).

cent to active parrot nests and, because thrashers are aggressively territorial, thrashers pairs that occupied the alternative nest sites tended to exclude other thrashers from the vicinity of the parrot nests. However, intensive and vigilant monitoring of parrot nesting activity from observation blinds has been, and continues to be, the most effective tool for ensuring parrot nest success (Lindsey 1992). In recent years, efficacy of this management practice has been greatly increased by the placement of electronic listening devices inside all active nests (U. S. Fish and Wildlife Service 1999). These devices al-

low the entire nesting process to be closely monitored with minimal disruption to the nesting pair and also allow early detection of any potential problems within nests, such as botfly invasions. Electronic monitoring of wild nests was carried a step further in 2003, when closed-circuit infrared video cameras were experimentally installed in two wild nests, yielding detailed additional data on the behavioral and reproductive ecology of the species (White and Vilella 2004).

From 1985 to 1987, several wild parrot fledglings were radio-tracked to monitor post-fledging movements and survival. Findings suggested low survival of fledglings due, in part, to raptor predation. However, mortalities also were attributed to other unidentified factors (Lindsey *et al.* 1994). Further radiotelemetry of wild Puerto Rican Parrots began in 2000, when yearly systematic telemetry of wild parrot fledglings was again initiated (Fig. 23).

One of the most important measures taken to date for continued survival of the Puerto Rican Parrot has been the establishment of a captive flock. Initiated in 1973 using eggs and chicks obtained from wild nests and hand-reared in the Luquillo Aviary, the captive flock has now evolved into a self-sustaining captive breeding program conducted at the Luquillo Aviary and the José Vivaldi Aviary. The U.S. Fish and Wildlife Service (USFWS) administers the Luquillo Aviary, whereas the Puerto Rico Department of Natural and Environmental Resources (DNER) administers the José Vivaldi Aviary. Both captive flocks, however, are jointly man-

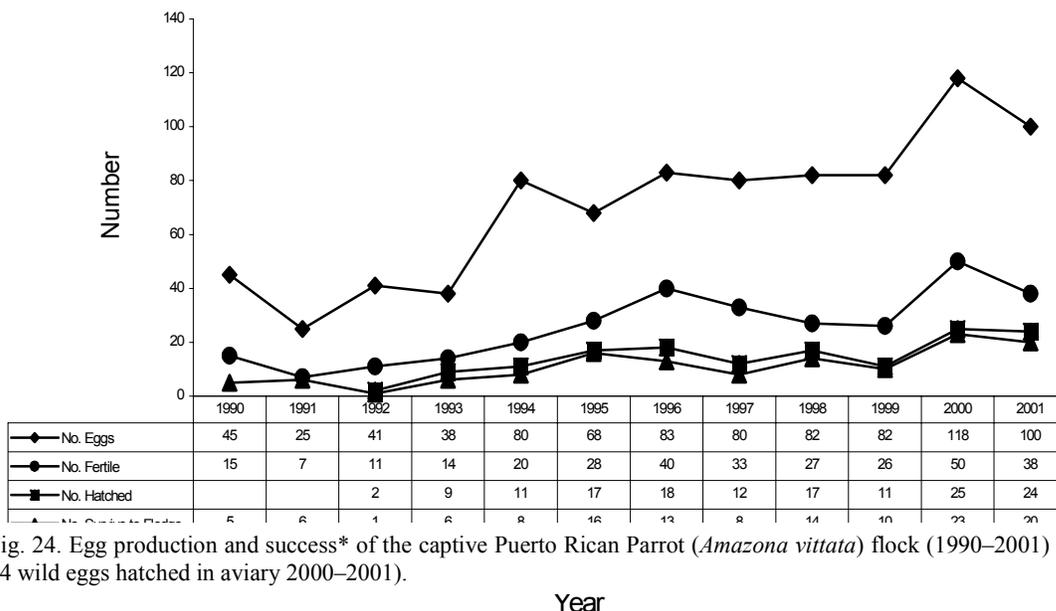


Fig. 24. Egg production and success* of the captive Puerto Rican Parrot (*Amazona vittata*) flock (1990–2001) (*including 14 wild eggs hatched in aviary 2000–2001).

aged as a single captive population. The aviaries are a source of parrots for release into the wild, a safe haven for parrot chicks suffering from mishaps in the wild, and a genetic reservoir of Puerto Rican Parrot genotypes. Although initially comprised of hand-reared parrots, the captive flock is now comprised almost entirely of parent- or foster-reared (using *A. ventralis*) birds to avoid human imprinting and maladaptive behavioral traits within the captive population.

Both captive flocks are managed using open exchange of individuals to minimize loss of genetic heterozygosity. This exchange occurs not only between aviaries, but also between the aviaries and the wild population. Pair-bonding to produce new breeding pairs is managed as to produce behaviorally compatible pairs comprised of the most distantly related individuals. Productivity of both aviaries has increased over the last few years, averaging over 14 total chicks (range = 8–23) successfully fledged each year since 1995 (Fig. 24). Although productivity of certain pairs has been increased through clutch manipulations (i.e., double-clutching), the overall increase in productivity has resulted mainly from pair-bonding management based on genetic and behavioral criteria as well as structural improvements in the aviary facilities.

Although the captive population has for some time contributed individuals for release into the wild, until recently the primary method for doing so has been to foster captive-born chicks into wild nests, where wild parents rear them to the fledgling stage. Although intuitively this technique should result in maximal survival because captive chicks undergo what must be the optimal pre-release training, there are practical limitations. One is that the number of wild nesting pairs in a given year limits the number of captive-produced birds that can be introduced into the wild. Furthermore, chick availability for fostering is limited by the number of captive breeding pairs that are in reproductive synchrony (i.e., laying and hatching dates) with wild pairs. At present, only a few captive-produced birds (1–3) can be fostered annually into the wild population. This results in a steady accumulation of parrots in captivity that otherwise would be suitable for release. These parrots then become subjected to prolonged exposure to a captive environment with attendant deleterious physical and behavioral effects (Derrickson and Snyder 1992, Wiley *et al.* 1992) that, over time, may preclude them from ever being released into the wild.

Biologically, there are two primary objectives of

the captive releases. One is *numerical supplementation* of the extant wild population through increase in individuals (i.e., population size) attained via survival of released birds. The second, and most biologically important, is *demographic augmentation* of the wild population through increased numbers of breeding pairs (i.e., population growth) when released parrots begin reproducing. Of three captive-reared Puerto Rican Parrots experimentally released in the CNF in 1985, one survived and later reproduced (U. S. Fish and Wildlife Service 1999). This parrot also dispersed and established a nesting territory in a new area and habitat type following hurricane Hugo (F. J. Vilella, pers. comm.). Dispersal and colonization of new breeding territories is a key aspect of metapopulation dynamics (Ebenhard 1991) and essential if the wild population is to expand its range in the CNF and elsewhere (Collazo *et al.* 2000). Thus, the potential exists for released parrots to substantially contribute to future wild population dynamics if adequate survival is attained. Moreover, recent experimental releases of captive-reared Yellow-shouldered Parrots (*A. barbadensis*) in Venezuela (Sanz and Grajal 1998), and captive-reared Hispaniolan Parrots in the Dominican Republic (Collazo *et al.* 2000, 2003) have conclusively demonstrated that captive-reared parrots can be successfully introduced into habitat occupied by wild conspecifics. The Dominican Republic releases were particularly relevant to the Puerto Rican Parrot because the Hispaniolan Parrots released during that study were reared in both the Luquillo and José Vivaldi Aviaries under similar conditions as Puerto Rican Parrots destined for release in the CNF (Collazo *et al.* 2000).

Given the availability of now substantial numbers of Puerto Rican Parrots for release, and the encouraging information and experience gained from similar efforts, a release program was launched in June 2000, with an initial single release of 10 captive-reared Puerto Rican Parrots. These parrots ranged from one to four years in age and were drawn from both captive flocks. All parrots were subjected to an intensive training and acclimation process (White *et al.* 2000) before release in an area of the CNF occupied by the existing wild population. The location and timing of the release was specifically selected to maximize probability of integration of released parrots into the wild population (i.e., after breeding season), and to allow time for adjustment to the wild before the peak of hurricane season (i.e., September). Each parrot also was equipped with a radio-transmitter to allow monitoring of post-release movements and survival. First-year survival of this

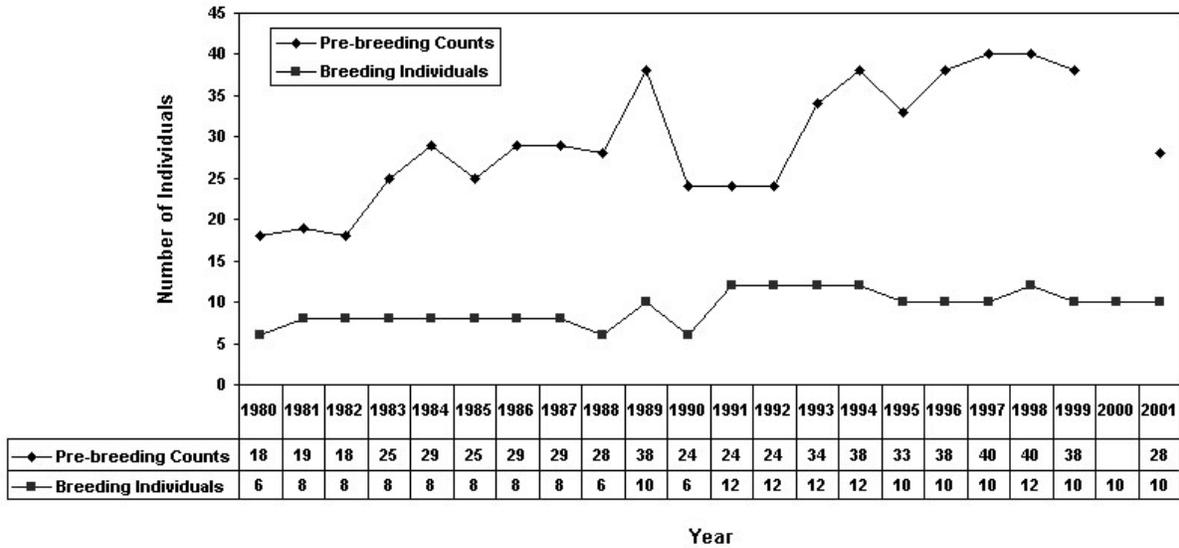


Fig. 25. Wild Puerto Rican Parrot (*Amazona vittata*) breeding population, Caribbean National Forest, Puerto Rico, 1980–2001.

initial release group was 50%, of which 90% survived for at least two months post-release (White *et al.* 2002), suggesting that the parrots were released in good physical condition and apparently capable of locating adequate food resources. At least 60% of the first-year mortalities were directly attributable to depredation by Red-tailed Hawks. Released parrots also were documented using other areas of the CNF historically occupied by Puerto Rican Parrots (Snyder *et al.* 1987) and gradually integrating into the extant wild population.

Encouraged by these results, a second larger release of 16 captive-reared Puerto Rican Parrots was conducted in late May 2001. Pre-release training and acclimation of this group was the same as the previous release, except for addition of an intensive predator aversion-training component (White 2002). Only one (6.3%) of the released parrots was lost to raptor predation during the first three months post-release, compared to three (30%) during the same time period following the first (2000) release. The 2001 pre-release training was repeated before a third release of nine captive-reared parrots in May 2002. Of the year-2002 group, at least two (22.2%) were depredated by Red-tailed Hawks during the first year post-release. Overall, at least 54% of all documented mortalities of the released Puerto Rican parrots have been the result of raptor predation (White *et al.*, in prep.).

Recommendations. Some of the perplexing problems facing the Puerto Rican Parrot, as described by Snyder *et al.* (1987), remain to be solved. Foremost among these is the continued low number

of breeding pairs (i.e., 3–6), regardless of past increases in total population size (Fig. 25). Various theories have been put forth, ranging from lack of suitable nest sites to negative intraspecific social dynamics. Complex social dynamics of highly social or colonial species can be disrupted when populations fall below some “critical” level (Schorger 1955, Walters 1991, Bucher 1992). Below this critical level, subtle group behavioral cues or stimuli are either altered or absent, interfering with normal social behaviors such as breeding (Caughley and Gunn 1996). If this is the case with the Puerto Rican Parrot, then a substantial numerical increase in total population size would be required to break this apparent demographic inertia. Given the observed low reproduction and apparently high mortality, especially of juveniles, this may prove difficult without supplemental measures such as captive releases. Moreover, releasing captive-reared parrots may aid in ways other than simple numerical increase. Recent observations of the wild parrots have documented apparent pairings among not only released captive-reared parrots, but also captive-reared parrots and wild parrots (U. S. Fish and Wildlife Service, unpubl. data). Because the idiosyncratic nature of Puerto Rican Parrot mate selection is well known from aviary experiences, perhaps the arrival of “new faces” in the wild may break some previous impasses. Although it is still too early to draw definitive conclusions, the evolving patterns are cause for optimism.

Assuming numbers of breeding pairs will eventually increase, ensuring availability of suitable nest

sites must be a management priority. Current field management activities are focused on locating and improving, if necessary, naturally occurring tree cavities not only in the current parrot nesting area, but also in adjacent areas into which the breeding population may expand. Also underway is the construction of additional canopy-level observation platforms from which parrot movements can be better observed to detect potential new nesting sites.

Intensive guarding of existing active nests, although logistically challenging, must continue until a viable alternative is developed or the wild population attains a size that can absorb losses from natural predation and competition. Over the past 30 years, there have been numerous incidents of parrot chicks or nests that would have been lost without active monitoring and timely intervention. Given the clear need to maximize productivity of wild nests (Fig. 22), nest guarding should remain a management priority for the foreseeable future.

Radiotelemetry of wild fledglings should be continued, as too many unknowns remain regarding mortality factors acting on the wild population. Accurately identifying and quantifying these factors is the first step towards ameliorating them. To date, telemetry is the best way to acquire such data on known individuals. Additionally, because most parrots spent much of their time in flocks, telemetry provides a method to indirectly monitor additional individuals (Meyers *et al.* 1996).

Although currently there is no direct evidence of such, the presence of an underlying disease process limiting population growth cannot be discounted. Puerto Rico is home to numerous exotic psittacines, many of which are frequently sighted near the CNF. Scarlet Macaws (*Ara macao*), Blue-and-gold Macaws (*A. ararauna*), and various parakeets (*Aratinga* spp.) have been seen within areas occupied by wild Puerto Rican Parrots. These alien psittacines could potentially transmit exotic disease to the wild parrot population (Derrickson and Snyder 1992). The disease danger is exacerbated because the Puerto Rican Parrot has been through a genetic bottleneck with at least some attendant loss of genetic diversity. Loss of genetic diversity experienced by small populations can increase their susceptibility to disease (Thorne and Williams 1988, Derrickson and Snyder 1992). Furthermore, recent years have seen a marked increase in airborne dust with exotic bacteria and fungal spores, including the soil fungus *Aspergillus*, arriving in eastern Puerto Rico because of increased deforestation in sub-Saharan Africa (Shinn *et al.* 2000, Stallard 2001).

Implications of these findings for the Puerto Rican Parrot remain speculative. In response to the generalized threat of potential disease in the wild population, routine disease (bacterial and fungal) screening of all wild parrot chicks, initiated in 2002, should be continued.

A standardized census methodology for the wild population should be established and methodological continuity maintained over time. Past censuses of the wild population have been based on a variety of methods, resulting in potentially inaccurate counts and reduced precision in assessing actual population trends. Accurately determining the slope (positive or negative) of population growth is far more important than random, temporal “snapshots” of estimated abundance. Accordingly, efforts are currently underway to develop a new and reliable standard census methodology.

Efforts to further increase productivity of both the Luquillo and José Vivaldi aviaries should continue. As examples, studies are being conducted to assess optimal nutritional composition of diet, as well as detailed genetic analyses of all captive parrots, and of those wild parrots for which genetic material is available. Results of the genetic analyses should be used to further refine pair-bond management, and to detect and quantify any loss of heterozygosity in both the wild and captive populations.

Increased aviary productivity will eventually translate into more substantial releases of captive-reared birds to further augment the wild population, and to start other wild populations. Furthermore, plans are underway for construction of a completely new state-of-the-art aviary to replace the venerable Luquillo Aviary. The new aviary will also be in the CNF, but at a more amenable site in terms of logistics and environmental conditions.

It has long been recognized that establishment of a second wild population of Puerto Rican Parrots is a critical and essential element for recovery of this species (U. S. Fish and Wildlife Service 1982, 1999; Snyder *et al.* 1987; Wiley *et al.* 1992; Wunderle 1996). Effects of recent catastrophic hurricanes (e. g., Hugo in 1989, Georges in 1998) on the sole wild population clearly indicate the urgency of establishing a second population (Vilella and Garcia 1995). Even without the constant threat of hurricanes, an outbreak of a serious avian pathogen in the CNF could quickly result in the complete loss of the only wild population and with it hopes for successful recovery of the species (Warner 1968, Scott 1988, Wiley *et al.* 1992). Furthermore, establishment of a second Puerto Rican Parrot population must also

occur before deleterious effects of inbreeding and random genetic drift result in an unfit founder source (Danielle and Murray 1986, Derrickson and Snyder 1992, Ford 2002).

For as long as the necessity of a second population has been acknowledged, it also has been recognized that the most promising area for successful establishment of this population is the karst forest region of north-central Puerto Rico (Snyder *et al.* 1987, Wunderle 1996, U.S. Fish and Wildlife Service 1999). Outside the CNF, the karst region was one of the last known areas occupied by Puerto Rican Parrots, where reportedly they were abundant (Snyder *et al.* 1987). Although heavily deforested during the early twentieth century, the karst region has since become largely reforested and is currently the largest contiguously forested region in Puerto Rico (China 1980, Snyder *et al.* 1987, Rivera and Aide 1998). Moreover, an approximately 2340-ha forested area surrounding the José Vivaldi Aviary is under protection by the Puerto Rico DNER as the Río Abajo Commonwealth Forest (Fig. 20). Recent studies have indicated an abundance of potential food sources for parrots in the Río Abajo forest (China 1980, Cardona *et al.* 1986, Collazo and Groom 2001). Additionally, because no exotic psittacine populations have become established in the Río Abajo area, released captive-reared Puerto Rican Parrots should not face substantial interspecific competition for niche reoccupancy. Current DNER and USFWS plans include further acquisition and protection of additional forested tracts adjacent to this area. A six-year strategic management plan has been developed to guide the initiation of this second wild population of Puerto Rican Parrots. Barring unforeseen circumstances, the target date for initial release of parrots in the Río Abajo Commonwealth Forest is 2006.

DOMINICA

Dominica's topography and climate, along with far-sighted conservation policies, have discouraged wholesale forest exploitation. Consequently, Dominica has lost forest cover at a slower rate than its regional neighbors. Large tracts of contiguous, mature forest account, in large measure, for the richness of Dominica's biological diversity and its distinction within the Lesser Antilles in supporting two endemic Amazon parrots, the Imperial Parrot (*Amazona imperialis*) and the Red-necked Parrot (*Amazona arausiaca*). These species have benefited from substantial local and international concern and conservation efforts. We first present information

common to both species, then specific and unique information for the two parrots.

Some 65% or 51,800 ha of Dominica is covered in some sort of vegetative cover that includes the most extensive tracts of virgin wet montane forest in the Caribbean. Some 21,044 ha of forest, or 28% of Dominica's area, are state owned. These forests include centuries-old tabonuco-chataignier (*Dacryodes-Sloanea*) rainforest with dominant *Dacryodes excelsa* trees measuring 50 m in height and well over 1.5 m in diameter. Plant diversity is impressive at 155 families, 672 genera, and 1226 species of vascular plants and trees (Ministry of Agriculture, Dominica). Animal biodiversity is equally remarkable with 20 species of freshwater and land crabs, 17 species of amphibians and reptiles, 176 species of birds, 55 species of butterflies, and 15 species of terrestrial mammals (of which 12 are bats). The island's rugged beauty and diverse terrestrial and marine natural resources have helped earn its nickname, "Nature Island of the Caribbean."

Dominica's challenging terrain boasts interior mountains over 1200 m and slopes of 30° or greater. A north-to-south ridge with outriders divides the island into windward and leeward sections through several mountain peaks and ridges. From the air Dominica appears as a steeply rising, deeply dissected landmass blanketed with dense tropical vegetation (Beard 1949).

Dominica has been able to preserve large tracts of prime forest habitat currently totaling 21% of its landmass, including the Central Forest Reserve (established 1952), Morne Trois Pitons National Park and World Heritage Site (1975), Northern Forest Reserve (1977), and Cabrits National Park (1986). The most recent addition to that list is Morne Diablotin National Park (2000) within the Northern Forest Reserve. The Forestry, Wildlife and Parks Division of the Ministry of Agriculture and the Environment has been charged with the administration and management of Dominica's forest, wildlife, and national park resources since its inception in 1949. Habitat protection and law enforcement traditionally formed the brunt of parrot management efforts in Dominica before the mid-1980s. Since then the return of college-trained local staff led to increased emphasis on forest resource management and environmental education.

Wildlife protection legislation in Dominica dates back more than 100 years with the introduction of the Mongoose Ordinance in 1902, followed by the Wild Birds Protection Ordinance in 1914, and the Wild Birds (Close Season) Proclamation in 1931.

These and other wildlife legislation were repealed and replaced by the Forestry and Wildlife Act in May 1976. This Act has been amended on three occasions, the last being a general revision of the laws of Dominica in 1990 (A. James, pers. comm.). A comprehensively revised Wildlife Act is currently (August 2003) in review with Cabinet.

The Dominican government has legally protected parrots since the early 1900s (Swank and Julien 1975). The parrots have been afforded international protection through Dominica becoming a signatory of CITES (1987). Occasional hunting of both species for food and for the pet trade largely ended in the early 1980s, although some localized shooting of crop-depredating Red-necked Parrots continues. Whereas the parrots may no longer be specific hunting targets, hunting in the forest for game during the declared open season poses a serious threat to parrot welfare. This human presence has opened pathways through deep forest and introduced varying degrees of stress on the parrots. Government has recently imposed a hunting moratorium (Cabinet decision in March 2004), stemming from a noticeable decline in several game species.

Public awareness has long been an integral part of the island's conservation program (Butler 1992a, Christian *et al.* 1994), and environmental education and research have been emphasized since the mid-1980s. The Forestry and Wildlife Division (Division) coordinates an island-wide awareness campaign using many media and targeting many audiences. A weekly radio program, initiated in 1975, has been the primary medium used to educate the public and spearhead environmental education efforts.

The Forestry and Wildlife Division also organizes annual exhibitions and environmental contests as part of Forestry Week, and guided trips to natural areas in its environmental awareness drive. In the past, the Division has used local sports personalities and musicians to spearhead efforts to get members of the public to visit, enjoy, and learn about the island's natural resources. One of the Division's environmental awareness publications, *Vwa Diablotin*, that was made available, at no cost, to every elementary school and copies of which were placed in the local news media, is no longer in print. However, a new series of radio and television public service announcements, print media, roadside billboards, and television environmental programs has broadened the Division's environmental awareness efforts.

The Division has a long history of collaborative

work with international research institutions and academia. The most recent, substantial effort was initiated in 1997 with the Rare Species Conservatory Foundation (RSCF). This joint program has established the Imperial Parrot as a flagship species for the eastern Caribbean's largest, intact rainforest system, thereby establishing a program template for replication across the region. The initial objective was to obtain quantitative data that would provide a better understanding of the distribution, abundance, demographics, and reproduction of the two parrot species. To date, the partnership has integrated field research, protected-area legislation, conservation education, staff training, and captive population research into a long-term, *in situ* conservation commitment. In practical terms, RSCF was instrumental in raising US\$750,000 for essential land acquisition to enable the creation of Morne Diablotin National Park, and generated an additional US\$200,000 to support the Division's program costs, conservation education outreach programs, research vehicles and equipment, local staff travel, and miscellaneous land purchases to augment the Morne Diablotin National Park (Reillo 2001, Reillo *et al.* 2002).

Co-registered satellite, topographic, and land-cover images prepared by the U.S. Geologic Survey (EROS Data Center) have enabled the Forestry Division-RSCF team to employ GPS and GIS to conduct the most recent and thorough parrot population surveys in Dominica (Reillo *et al.* 2002). The team has surveyed over 18,212 ha of state and private forest in the remote terrain of Dominica's forest interior since 2000. Reillo *et al.* (2002) conducted repeatable, GPS-based parrot surveys where position data and observations were downloaded to topographic, LANDSAT, or SPOT maps. Discreet local density estimates were obtained for both parrot species by combining GIS, line-of-sight estimates from the field, and known topographical boundaries such as ridges lines and river basins.

The partnership has obtained and made available to local managers the most intensive parrot conservation data to date. These data include the first intra-cavity video recordings of natural nests of Dominica's parrots, obtained in 1999. The partnership also has time-lapse recorded several seasons' of Red-necked Parrot nesting behaviors in natural nest trees, helping quantify bi-parental care and reproduction. The program recently started captive breeding research at the Parrot Conservation and Research Centre (PCRC) in the Botanical Gardens in Roseau. RSCF and Forestry staffs have completed the overhaul and enhancement of the facility to en-



Fig. 26. Adult male Imperial Parrot (*Amazona imperialis*) (photo by Paul Reillo).

able it to function as a self-contained parrot incubation and research laboratory, and as headquarters for the parrot field program. The PCRC now has the capability to properly treat ill, rescued, or confiscated animals for extended periods, and to rehabilitate them as appropriate (Reillo *et al.* 2002).

There is an urgent need to provide Division staff with capacity-building to include formal, degree-level training so that Dominicans can be recruited into public service prepared to manage the island's resources. In addition, because Dominica is a poor country carrying a large international debt, government must encourage a diversified non-government organization (NGO) and inter-institutional support base to help the Division achieve full governing authority over Dominica's wildlife and natural areas.

Imperial Parrot *Amazona imperialis*

Distribution and habitat. The Imperial Parrot (Fig. 26) generally occurs in sheltered valleys across montane and higher elevation forests (550 to 825 m) and at mid-to-upper elevations of Dominica's main peaks. From these mountain valleys it forages in tropical rainforest at lower elevations (460 m) and in elfin woodland (generally above 915 m).

Recent research revealed that the greatest concentration of Imperial Parrots recorded, and the highest recruitment of any surveyed area, was in the upper Dublanc River valley west of the summit of Morne Diablotin, between Syndicate and Morne Les Resources (Reillo, unpubl. data). Other concentrations occur in protected valleys west, south, and east of the summit of Morne Diablotin (e.g., Macatrin to the foothills of Mosquito Mountain in the heights of Salisbury, between Caholme and Gommier Ellick, near the base of Mangle Peak in the heights of Concorde, and in the upper Melville Hall, Londonderry, Hodges, and Hampstead river valleys). The southern population, decimated by Hurricane David (1979), has become reestablished at the base of Morne Watt and Morne John, within the Morne Trois Pitons National Park (Reillo 2001, Reillo *et al.* 2002). The lower portion of its range is overlapped by the Red-Necked Parrot.

Status. The parrot is considered Endangered by IUCN and is listed in Appendix I of CITES (Hilton-Taylor 2000, Snyder *et al.* 2000). The Imperial Parrot's reclusive nature and its sparse distribution over large tracts of upper elevation forests in difficult terrain have combined to make systematic research into its ecology difficult. Consequently, although field research has been ongoing for many years, population surveys have been infrequent and estimates of population size vary widely among researchers (Reillo *et al.* 2000). In 1992 the population was estimated at only *ca.* 80 individuals (80–100 in 1993; Evans 1991). Observations in early 1994 suggested higher numbers than previously (N. F.R. Snyder, pers. comm.). The 2000 population was estimated at 200–250 individuals (Zamore 2000). Recent local density estimates based on GPS surveys by the Division-RSCF parrot team have lowered this estimate to a conservative 150, pending the collection and analysis of further field data (Reillo *et al.* 2002).

Population trend. Increasing. The population has apparently never been large and has always been concentrated in montane and higher forest elevations. Densities of Imperial Parrots in Morne Diablotin National Park averaged three birds per 405 ha, and rarely exceeded five birds per 405 ha surveyed (Reillo *et al.* 2002). With an estimated 20,235 ha of suitable Imperial Parrot habitat island-wide, a population ceiling of between 150 and 250 can be extrapolated.

Fieldwork has shown clear signs that the Imperial Parrot has expanded into its pre-Hurricane David range and that the southern population has become



Fig. 27. Training Division of Forestry technicians and biologists, Dominica, 1980: A. practicing tree climbing techniques; B. constructing platform for tree-top lookout, Syndicate Estate (photos by J. Wiley).

re-established after a 20-year hiatus. The bird's comeback from a small remnant population on the slopes of Morne Diablotin following Hurricane David to near pre-hurricane levels has been gradual, but highlights the effectiveness of Dominica's long-term parrot conservation efforts (Reillo 2001).

Demography. Field observations suggest a clutch size of one, with breeding possibly occurring every second year; only one fledgling per nest has been observed (Durand and Zamore 1996, Reillo *et al.* 2000). Time-lapse and intra-cavity video surveillance is expected to definitively answer questions about clutch size and recruitment.

Threats. A combination of threats, including habitat loss, hunting, and hurricanes, has affected the Imperial Parrot. Hunting parrots for food was prevalent through the mid- to late 1940s, before the establishment of the Forestry and Wildlife Division. The species continued to be hunted for the pet trade in the 1970s up to the late 1980s, but hunting is no longer a serious threat to the species. From the late 1980s an increasing parrot population size and the expansion of agriculture into lower and upper regions of montane forests have brought the Imperial Parrot into increasing conflict with humans. This situation is readily seen at Batalie heights and in the Bense to Woodford Hill heights areas. Intraspecific competition from the more aggressive and more numerous Red-necked Parrot population has become an increasing problem, because physical confrontation occurs between the species when the Imperial Parrot forages at lower elevations. Conversion of lowland forest to agriculture has also forced the Red-necked Parrot into the lower portions of Impe-

rial Parrot habitat where the two species compete for nest cavities. Although most crop depredations are the results of Red-necked Parrot activities, the Imperial Parrot probably also suffers from local ad hoc control measures (Wiley 1993b).

Seasonal variation in weather patterns can also be a limiting factor. Periods of intense drought, as occurred in 2001, retard fruiting of rainforest trees essential to the Imperial Parrot's food supply, so that a reliable food source is not available until almost mid-year, months after the typical egg-laying period (Reillo *et al.* 2002). For example, in 2001, Red-necked Parrot nesting was four to six weeks delayed, whereas no Imperial Parrot nesting activity was observed. On the other hand, an unusually wet season can result in flooded nest cavities and affect egg incubation and chicks at their most vulnerable stage.

Conservation efforts. Conservation action has begun to improve the status of this parrot. Numbers have increased in recent years, but the population estimate of *ca.* 150 and its restricted range still qualify the species as Endangered. If the population continues to increase, it will be downlisted eventually to Vulnerable unless there are concomitant decreases in available habitat. Dominica is a signatory of CITES (1995).

The Imperial Parrot has benefited from Dominica's long history of forest conservation, especially the establishment of the island's two forest reserves and three national parks. In recent years the parrot has benefited from intensified joint government and non-government efforts to protect its habitat and sensitize local citizens to its needs (Butler 1989,



Fig. 28. Red-necked Parrot (*Amazona arausiaca*) at nest entrance (photo by Paul Reillo).

Collar *et al.* 1992, Reillo *et al.* 2002). Recent creation of the Morne Diablotin National Park has preserved a significant portion of Imperial Parrot habitat and confirmed Dominica's commitment to protecting the Imperial Parrot through ecosystem management and broad-scale protected-area legislation.

Recommendations. A critical measure to further provide for the recovery of the Imperial Parrot lies in institutional strengthening to include baccalaureate-level and beyond training for Dominican nationals (Fig. 27). Such efforts should target both eligible Division staff and high school graduates, and ensure that Dominican researchers can play a more active role in developing management plans and conservation strategies for the species. Although the Dominican government has made far-sighted commitments to conservation of habitat important to parrots, government must set a clear land use and agriculture policy especially determining the use of currently unallocated state or Crown lands. Also, environmental education must continue to focus on preserving all available Imperial Parrot habitat. Permanently prohibiting hunting in Dominica should be evaluated and debated.

Consideration should be given to Red-necked Parrot population management, especially efforts to restrict their competition for Imperial Parrot nest trees. Further, methods for quantifying population sizes of both species should continue to be refined,

and field survey efforts intensified, especially maintaining GPS-based population surveys for the foreseeable future. Finally, the Dominican government should encourage and recruit additional extramural NGO aid, and pursue broad-based United Nations support for Morne Trois Pitons World Heritage Site and all protected forest in Dominica.

Red-Necked Parrot *Amazona arausiaca*

Distribution and habitat. The Red-necked Parrot (Fig. 28) is a mountain-dwelling species occurring predominantly in tropical wet forest (275 to 730 m elevation) throughout the island. It may occasionally forage in montane forests at higher elevations, and in secondary and seasonal forests under 300 m elevation. The Red-necked Parrot is far more tolerant of human presence than is the Imperial Parrot and will readily depredate citrus crops where such plantations encroach into parrot habitat. Whereas vast Red-necked Parrot habitat has been lost to agriculture, current studies suggest that some sub-populations may experience enhanced recruitment by foraging and nesting adjacent to citrus plantations, particularly near the Northern Forest Reserve (Reillo *et al.* 2002). In recent years small bands of Red-necked Parrots have foraged on fruit of Bois Mangle (*Pterocarpus officinalis*) near sea level at Woodford Hill, Anse Soldat, and the Indian River. This probably occurs more commonly during periods of intense drought. Red-necked Parrots are not as discriminating as Imperial Parrots in selecting nest sites, occasionally occupying cavities along public roads and near farms.

Status. The Red-necked Parrot is considered Vulnerable by IUCN and is listed in Appendix I of CITES (Hilton-Taylor 2000, Snyder *et al.* 2000). The population has been traditionally larger than that of the Imperial Parrot and is now estimated at 800 or greater. It still qualifies as Vulnerable because numbers and range remain small. If declines occur in available habitat, however, it will automatically be listed as Endangered (Hinton-Taylor 2000). Field surveys show that the Red-necked Parrot has re-established its former, pre-Hurricane David range. It is common throughout the interior forests of Dominica with large concentrations from Bense heights to D'leau Gommier and west to Bambou Etor and Carholm. Local densities in forests near agricultural areas may exceed eight birds per ha (Reillo *et al.* 2002). The species is in no immediate danger, although severe storms have the potential to substantially reduce local populations and constrict the species' range, requiring several years for recovery.

Population trend. Increasing, in part because of its tolerance of humans, its reproductive potential, resilience in the face of natural disasters, and its rapid recovery from deforestation and other man-made disturbances. Its numbers have risen from possibly as few as 150 in 1980, to perhaps more than 500 in 1992 and 1993 (Collar *et al.* 1992, Evans 1991), and 800 or more currently.

Demography. The Red-necked Parrot clutch size is three eggs, with most pairs probably nesting every year (Reillo *et al.* 1999). There is strong biparental care throughout nesting and past fledging (Reillo *et al.* 2000). Recent observations by RSCF and Forestry staffs have shown consistent fledging of one or two chicks per successful nesting attempt (Reillo *et al.* 2000, 2002).

Threats. The Red-necked Parrot has suffered from a combination of habitat loss at lower elevations, hunting, trade, and hurricanes, but has shown more tolerance toward human disturbance than the Imperial Parrot. Although the conversion of lowland rainforest into citrus farms has deprived the Red-necked Parrot of both foraging and nesting range, the situation has also aided the parrot in providing a supplemental food source especially during periods when the forest food source is limited. Crop depredation, however, has placed the Red-necked Parrot at risk to control measures of farmers (Wiley 1993b).

Conservation efforts. The Red-necked Parrot has benefited from joint government and non-government efforts to protect its habitat and sensitize local citizens to its needs. Conservation action has helped this species recover from an all-time population low in 1980.

Recommendations. In addition to those recommendations presented for the Imperial Parrot, consideration for the management of Red-necked Parrot populations should include the use of artificial nesting cavities to increase nest-site availability in lowland forests, in forest patches adjacent to agriculture or, with farmers' approval, within agricultural fields.

ST. LUCIA

St. Lucia (616 km²) is a mountainous island dominated by two clusters of mountains (maximum elevation 950 m) in the south-central part of the island. The majority of the island was formerly covered in forest and woodland habitats. Those extensive areas of contiguous habitat have been considerably fragmented as large and small-scale agricul-

ture, grazing, and urban development have increased, particularly in lower elevations and moderate mountain slopes. Of the 295 km² of habitat available in 1950, only 65–70 km² remained in forest and woodland by the mid-1970s. Only the St. Lucia Parrot (*Amazona versicolor*) is known from the island, with no evidence of parakeets or macaws ever present.

St. Lucia Parrot *Amazona versicolor*

Distribution and habitat. The St. Lucia Parrot occurs in moist forest within the central-southern mountains of St. Lucia. Butler (1980, 1987) reported the greatest concentration of parrots was within the Quillesse and Edmund Forest reserves. The eastern portion of the forest falls within the Quillesse area and is joined to the Edmund Forest in the west by the 6-km-long Central Rainforest Trail. These areas are dominated by steep mountainous terrain, which in some areas exceeds 600 m above sea level (Keith 1997). Many deep river valleys, streams, and gorges converge to form part of the watershed area. The vegetative cover is primarily sub-tropical forest in low areas, and montane thicket on ridge tops. Dominant indigenous species include *Dacryodes excelsa*, bois pen marron (*Talauma decapitala*), and balata (*Manilkara bidentata*), all of which attain heights of up to 50 m.

Status. The St. Lucia Parrot is listed as Vulnerable by the IUCN and is included on Appendix I of CITES (Hilton-Taylor 2000, Snyder *et al.* 2000).

Population trend. The parrot is increasing in number and expanding in area. Before 1850, the St. Lucia Parrot apparently was abundant and, like today, occupied the mountainous region of St. Lucia (Keith 1997). Since the early twentieth century, the parrot population generally declined, but fluctuated variably through the century. Porter (1930) reported that in 1910 the bird was practically extinct, but that by 1930 it was fairly common, with flocks of 20 observed. In the 1950s, the parrot population was estimated at 1000, and not as rare as was previously judged. In the mid 1970s, however, Jeggo (1975) estimated the parrot population to be about 100–150 birds. The most-recent population survey, conducted in August 2000, yielded an estimated 800 ± 50 St. Lucia Parrots. Despite an apparent increase in the population of *A. versicolor* from 100 to 800 over the period 1975–2000, parrot distribution is patchy. It is encouraging that parrots are now being seen in other areas where they had not been recorded for over two decades. However, the area of apparently suitable (but unoccupied) habitat may be decreasing.



Fig. 29. Nestling St. Lucia Parrot (*Amazona versicolor*) about to fledge from nest (photo © Robert Rattner).

Demography. The breeding season begins as early as January, when birds inspect nest sites, and extends well into August. Most pairs reuse nests from previous years. Clutch size varies from 1 to 3 eggs, with an overall average of 2.3 eggs per clutch. Successful pairs usually fledge 1–2 chicks, for an overall fledging rate of 60% (Fig. 29). This represents a low rate when compared with other Amazon parrots in the Caribbean (Snyder *et al.* 1987). Three of the 13 (23%) nesting pairs studied in 2000 fledged chicks, which was consistent with results in previous years. Two pairs fledged two chicks each, and the third fledged one chick, for a mean of 1.6 chicks per successful female. Four additional pairs laid eggs, but failed to produce chicks. One of those failed attempts contained a parrot egg that had been

punctured by a Pearly-eyed Thrasher. Two former parrot cavities were occupied by nesting thrashers.

Threats. According to Butler (1987), the leading causes of the low parrot population were widespread hunting and habitat destruction. But later studies revealed that competition by the Pearly-eyed Thrasher, also a cavity nester, is a substantial source of reproductive failure, with low success per parrot nesting attempt mainly the result of nest predation by thrashers (Dawson 1995). In 1996 and 1997, substantial evidence of thrasher involvement was determined in the failure of several parrot nests (Dornelly and Anthony, unpubl. data). These observations strongly support the conclusion that parrots and thrashers vigorously compete for nesting cavities. Other threats include hurricanes, predation by exotic mammals, and harvesting for the pet trade.

Conservation efforts. With the recognition that the parrot was on the brink of extinction in the 1970s, immediate conservation measures had to be adopted to safeguard the species. The Wildlife Protection Act of 1980 gave exclusive protection to all wildlife species on the island, except rats (*Rattus rattus*), mice (*Mus musculus*), Javan mongooses, and fer-de-lance (*Bothrops caribbaeus*). St. Lucia became a signatory of CITES in 1983. That protection, along with national and international efforts to save the parrot through intensive conservation measures, have resulted in a program to sensitize the nation to the importance of the species, resulting in a steady increase in the parrot population (Collar *et al.* 1992).

Perhaps the most visionary effort has been the training of Forestry Department biologists through their undergraduate program, supported by the St. Lucian government and Wildlife Preservation Trust

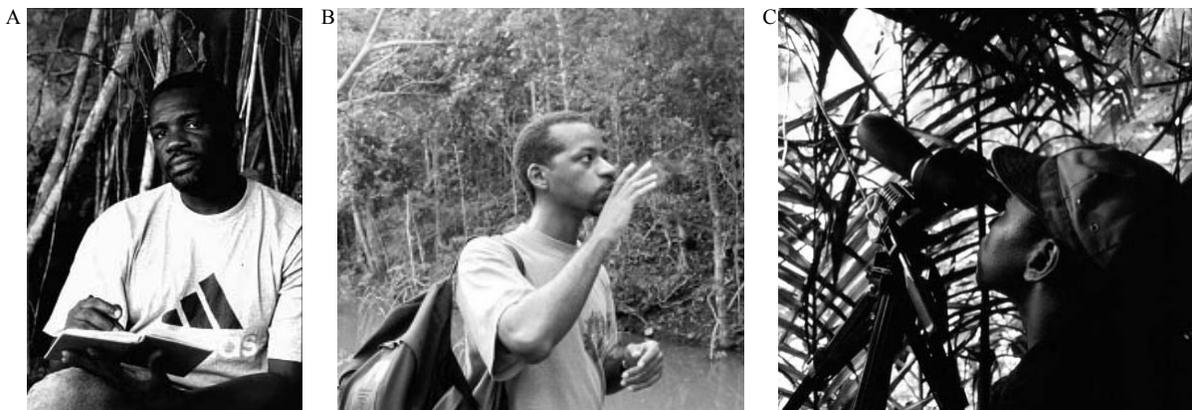


Fig. 30. St. Lucia Division of Forestry biologists who have received field training and university degrees through international support: A. Michael Bobb, B. Lyndon John, and C. Alwin Dornelly (photos © Robert Rattner).

International support (Fig. 30).

Recommendations. The reproductive success of the St. Lucia Parrot has remained consistently low. Of particular concern is the fact that many pairs have continued to show interest in cavities, but failed to lay eggs. In spite of the low nest success, the parrot has continued to expand into several forested areas of the island, consistent with the steady increases in the numbers of individuals in recent years. Nevertheless, the current programs of habitat protection, regular population surveys, intensive research, public education, and enforcement of the Wildlife Protection Act must be continued with vigor. Further, additional college and post-graduate level training of Forestry Division personnel is needed to ensure maximum participation and involvement of island biologists.

ST. VINCENT

St. Vincent is so rough and mountainous that no roads yet cross the body of the island. Since colonial days, rainforest recession in St. Vincent has been driven primarily by clear-cutting for settlement and agriculture. Timbering, charcoal production, and farming converted most of the lowland forest by the early 1900s, after which the total area of moist forest remained relatively constant until the 1980s banana boom (Lambert 1983, 1984; Butler 1988). By the mid-1980s, less than 25% of St. Vincent's 340 km² was in forest suitable for parrot foraging, with less than 5% under old growth capable of supporting nesting trees (Butler 1988). Whereas traditional agriculture has decreased measurably since 1990, illegal marijuana plantations have proliferated across state lands since the 1980s, and may now occupy 2833+ ha of interior forest (St. Vincent and the Grenadines Forestry, pers. comm.).

St. Vincent Parrot *Amazona guildingii*

Distribution and habitat. In the pre-Columbian period, the parrot (Fig. 31) likely occurred island-wide and may have occupied at least some satellite islands that now comprise the 33-island nation of St. Vincent and the Grenadines. Today, the parrot is found only in interior montane and sub-montane rainforests along the slopes of the island's central mountain range, from *ca.* 100 to 800 m elevation, being best represented in the Buccament, Cumberland, and Wallilibou valleys, with patchy occurrences elsewhere (Raffaële *et al.* 1998). The parrot preferentially nests in large *Dacryodes excelsa* trees.



Fig. 31. St. Vincent Parrot (*Amazona guildingii*) (photo © Robert Rattner).

Status. The St. Vincent Parrot is listed as Vulnerable by IUCN and in Appendix I of CITES (Hilton-Taylor 2000, Snyder *et al.* 2000). Over the past 20 years, population size estimates have varied with observers, methodology, and genuine fluctuations in flocks, but remarkably hovered around 400–600 birds (Collar *et al.* 1992), with a suggested increase to possibly 800 in 1999 (Stattersfield and Capper 2000), a number that was later revised to 553 (F. Providence, *in litt.*). The most recent surveys (2002) produced an estimated 519 parrots (Forestry Department 2002; F. Providence, pers. comm.).

The parrot's resilience in the face of environmental disaster and human disturbance can be attributed to its large size, territoriality, reproductive potential, and general assertiveness. Parrots forage socially in secondary forest and near plantations, and exhibit a boldness rivaling that of *A. arausiaca* on Dominica (Reillo, pers. obs.). Even with increasing human presence in the forest (e.g., from marijuana cultivation), the birds have benefited from a general decline in traditional agriculture along forest reserve margins, and the lack of a major hurricane or volcanic eruption for over 20 years has facilitated secondary forest succession and a general population recovery. Nesting has not been quantified recently, yet old-growth tracts, particularly in the Vermont and Buccament valleys, consistently support nesting pairs (Reillo, pers. obs.). Nest-site availability, correlated with the extent of undisturbed, mature forest, is the single greatest limiting factor facing the *A. guildingii* population today.

Population trend. Probably increasing.

Demography. Nesting commences in January and February (Butler 1988) but, depending on rain-

fall and the fruiting phenology of rainforest trees, may be delayed until late spring (Nichols 1974a,b; 1976). Typically two, and occasionally three, eggs are laid in deep, natural cavities, after which females incubate for 26–28 days. St. Vincent Parrots exhibit strong bi-parental care of young, facilitating high recruitment rates; one or two chicks usually fledge within 14 weeks of hatching. Conspicuous nest-site fidelity and territoriality during the breeding season enables established pairs to reproduce successfully for many years.

Threats. Habitat destruction and degradation have had a substantial negative effect on St. Vincent Parrots. Of recent concern is the organized campaign by government to construct a cross-island road in 2004–2005, whose proposed alignment cuts through some of the best remaining parrot habitat in the upper Buccament area (St. Vincent and the Grenadines Forestry, pers. comm.). St. Vincent forest habitats have been degraded through the extensive marijuana industry, which has been particularly difficult to control.

Natural catastrophes and agents have also taken their toll. St. Vincent is dominated by the Morne Soufriere volcano, which has erupted five times since 1717 (Butler 1992a), with ash and gas killing many parrots directly and displacing populations from affected forest as recently as 1979 (Nichols 1980). Hurricanes pose a constant danger, whose damage may hinder substantially the population's recovery from volcanic eruptions and other events (Snyder *et al.* 2000). Recent evidence of such cumulative effects is the succession of Soufriere's eruption (1979) and Hurricane Allen (1980), which independently killed many parrots and devastated vast expanses of forest (Nichols 1980, Collar *et al.* 1992). Natural nest-cavity competitors, including southern opossums (*Didelphis marsupialis*), introduced rats (*Rattus* spp.), and European honeybees, and predators such as boas (*Constrictor* sp.) may affect nesting success and recruitment in sub-populations that have become nest-site limited (Collar *et al.* 1992). The alien nine-banded armadillo may have a more profound, cosmopolitan effect on the parrot by undermining rainforest trees island-wide, thereby weakening resistance to storms and hastening natural decay processes (St. Vincent and the Grenadines Forestry, pers. comm.).

The St. Vincent Parrot was harvested for food through the 1970s, after which trapping for the bird trade supplanted hunting as the most prevalent form of direct persecution (Snyder 1973, Nichols 1976). Long coveted as a cagebird, countless nestling *A.*

gouldingii were poached, and adults were “winged” by shooting, to supply the international bird trade through the early 1980s (Nichols 1974a,b, 1976; Lambert 1983, 1984). Illegal harvesting for export remains a serious, unquantified threat (Raffaele *et al.* 1998, Woolcock 2000).

Conservation efforts. The St. Vincent Parrot is ranked as Vulnerable by the IUCN and is included in Appendix I of CITES (Hilton-Taylor 2000, Snyder *et al.* 2000). The St. Vincent Parrot has long been protected formally from hunting, capture, and export (Nichols 1977), but laws have only been enforced seriously since the mid-1980s (Collar *et al.* 1992). Extramural support for St. Vincent's Forestry Department launched ecological field research in the mid-1970s (Nichols 1974a,b), helped establish a captive management and breeding consortium in 1980 (Collar *et al.* 1992), and mobilized a far-reaching environmental awareness, conservation education, and national bird pride campaign (Butler 1988). Most importantly, concentrated international NGO support throughout the 1980s (sources including the RARE Centre for Tropical Bird Conservation, World Wildlife Fund, Jersey Wildlife Preservation Trust, Wildlife Preservation Trust International, and Canadian International Development Agency [CIDA] helped government adopt the Wildlife Protection Act (1987), create a parrot aviary in the public botanical gardens, and delineate a 40 km² parrot reserve (Collar *et al.* 1992).

The intense flurry of activity during the 1980s contrasts sharply with the paucity of NGO support since 1990. Whereas environmental awareness remains an effective cultural mainstay and element of the local academic curriculum, field research, monitoring, and protected-area strategies have largely stalled. The St. Vincent Amazon Consortium and foreign zoological institutions have focused on managing and maintaining captives *in situ* and *ex situ*. Sadly, the proliferation of *ex situ*, unregistered birds beyond the consortium's control, smuggling, institutional disagreements, poor funding, and disputes about program infrastructure have limited the consortium's ability to effectively coordinate inter-institution captive management with the St. Vincent government, much less address wild bird conservation (Collar *et al.* 1992, Woolcock 2000). In 2003, the Wildlife Conservation Society completed genetic identity analysis for all consortium birds and delivered a genetic management computer program to Forestry, enabling staff to independently manage captive birds in St. Vincent for the foreseeable future (Russello 2003).

Semi-quantitative assessments are principally derived from watch-point censuses, which extrapolate total population size from multi-observer records of parrot movements across delineated vistas. The accuracy and repeatability of such censuses have long been questioned (Collar *et al.* 1992, Snyder *et al.* 2000), but the Forestry Department's limited staff and resources coupled with St. Vincent's challenging, inaccessible interior forest thwarted the development of more reliable population estimation techniques until recently. In 2003, the Rare Species Conservatory Foundation, collaborating with the US Geologic Survey EROS Data Center, delivered GPS and GIS technology and training to the Forestry Department, along with geo-referenced, high-resolution topographic images. These tools permit replicable parrot surveys and substantially enhance Forestry's biodiversity assessments and land-management capabilities.

Recommendations. Habitat conservation, law enforcement, and public awareness campaigns have slowed the St. Vincent Parrot's slide toward extinction, and even reversed the previous declines in some areas. Still, the parrot qualifies as Vulnerable because it has a small range and population, and continues to suffer from human and environmental assaults. To ensure its future, monitoring vigilance, broad-based ecological research, and an aggressive, government-driven, protected-area policy must be implemented quickly. St. Vincent's Forestry Department must be empowered with real governing authority over all of St. Vincent's wildlife resources, both on- and off-island, and substantial outside support must be directed now to assist Forestry in all aspects of management and protection for the species. Conservation priorities should include increasing Forestry Division staff capacity for field research, and implementing progressive data collection techniques to comprehensively quantify population densities, habitat use, and essential life-history parameters. Also the parrot's survival depends on stimulating development of a broad-based field conservation program, attracting diverse, international support and funding—especially from conservation NGO's and zoological institutions holding the species. Finally, conservation efforts should use real-time population assessments to define protected areas, and encourage government to adopt formal National Parks and Protected Areas legislation.

CONCLUSIONS

All native psittacines in the Bahama Islands and West Indies have experienced substantial population

declines or extinctions, beginning at least as early as the period of European exploration and colonization (Table 1). Recent successes in salvaging populations from probable extinction (e.g., Puerto Rican Parrot) or substantial recovery from small, local populations (e.g., Red-necked Parrot) give conservationists guarded optimism that these species will recover (Table 5). Other populations, though showing steady population levels (e.g., Cayman Brac Parrot), are at great risk to rapid extinction and pose a substantial challenge to ensuring their survival. It is important that conservation efforts do not fall into a trap of complacency based on successes, which might prove to be short lived. It is of particular concern that the desperate measures needed to recover severely reduced populations, and the expense incurred, are avoided by initiating recovery programs early enough to better ensure success (Soulé 1986). In developing conservation programs for the region's parrots and parakeets, the following points need to be considered:

1. A vigorous program of field research is essential to determine the ecological requirements for each psittacine species. Long-term, multigenerational projects are vital for providing suitable data for developing realistic conservation programs for any species.
2. Conservation efforts should evaluate habitat quality, including availability of suitable nest cavities and feeding resources, and the nature of interactions of parrots with competitors and predators. Feral predators and competitors should be vigorously controlled and the use of artificial nests explored as a means of alleviating some predator and competitor threats, as well as increasing the numbers of optimal nest sites available, if limiting.
3. Countries should be encouraged to ban the importation of birds, particularly psittacines, to reduce the risk of non-native competitors becoming established and to diminish the risk of harmful pathogens and parasites becoming established in wild populations.
4. A system of secure forest reserves, each of a size capable of supporting ecosystems to allow for viable self-sustaining populations of psittacids, should be established on all islands with native parrot and parakeet populations. Protected feeding, nesting, and shelter habitat should be established within reserves.
5. Realistic legislation suitable for protection of parrots, including regulations to control the harvest

Table 5. Summary of population size, status, trend, and outlook for parrots and parakeets in the West Indies.

Species	Population	Year of population estimate	Population			
			Size	Status	Trend	Outlook
<i>Amazona leucocephala bahamensis</i>	Abaco Island	2002	~1600	Restricted to South Abaco	Stable	Tenuous
	Great Inagua	2003	~4900	Patchy distribution	Stable	Optimistic
<i>Amazona leucocephala caymanensis</i>	Grand Cayman	1995	2000	Common; expanding range	Stable (perhaps increasing)	Tenuous
<i>Amazona leucocephala hesternana</i>	Cayman Brac	1997	300–430	Widespread and common over tiny range	Stable	Tenuous
	Little Cayman			Extirpated		
<i>Amazona leucocephala leucocephala</i>	Cuba			Locally abundant	Stable	Optimistic
	Isla de Pinos	1995	1100 ¹	Locally abundant	Increasing	Optimistic
<i>Aratinga euops</i>	Cuba			Locally common in fragmented range	Decreasing	Pesimistic
<i>Amazona agilis</i>	Jamaica	2000	8500 ± 1500 ²	Locally common	Stable?	Optimistic
<i>Amazona collaria</i>	Jamaica	2000	6500 ± 1500 ²	Locally common	Stable?	Optimistic
<i>Aratinga nana nana</i>	Jamaica			Locally common	Decreasing	Optimistic
<i>Amazona ventralis</i>	Dominican Republic			Locally common	Decreasing	Pesimistic
	Haiti			Uncommon	Decreasing	Pesimistic
<i>Aratinga chloroptera</i>	Hispaniola			Small, fragmented populations; rare	Decreasing	Pesimistic
<i>Aratinga nana</i> spp.	Hispaniola			Locally common	Increasing	
<i>Amazona vittata</i>	Puerto Rico					
	Wild	2003	30–35	Only one locality	Fluctuating	Guarded optimism
	Captive	2003	156	Two populations	Increasing	
<i>Amazona imperialis</i>	Dominica	2002	150	Locally common	Increasing	Optimistic
<i>Amazona arausiaca</i>	Dominica	2002	800+	Not uncommon; expanding range	Increasing	Optimistic
<i>Amazona versicolor</i>	St. Lucia	2000	800±50	Expanding range	Increasing	Optimistic
<i>Amazona guildingii</i>	St. Vincent	2002	519	Local	Increasing	Optimistic

¹North of Ciénaga de Lanier, minimum population estimate.

²Cockpit Country only.

of parrots, should be developed and rigorously enforced.

6. The effects of poaching and habitat encroachment on natural resources and agriculture should be determined. The economic effects of parrots as crop pests need regional attention, study, and assessment.
7. Approaches that are culturally, politically, and economically sensitive to human needs should be developed and conservation-oriented education programs must be formulated and implemented. These approaches must include the formal training of Caribbean nationals.
8. Where small populations of parrots are threatened with extirpation or population growth is limited by extent of habitat, serious consideration should be afforded to reintroduction of birds to other islands within their natural range. Important consideration should be given to re-establishing *Amazona leuco-*

cephala bahamensis populations in other islands of the Bahamas, and for re-establishing *A. l. hesternana* in Little Cayman. Furthermore, a plan to re-establish the Cuban Parakeet in Isla de Pinos should be developed. Genetic, ecological, and behavioral parameters must be evaluated before individuals from unique populations are used to establish new or replacement stocks.

9. Better data are needed on numbers, distribution, habitat status, and population trends for all populations. Surveys of representative wild populations at reasonable intervals are critical for the development of a conservation strategy for each species and for parrots region-wide, and are especially important in assaying the effectiveness of management efforts.
10. Careful consideration should be given to the value of captive propagation to a species' recovery. Captive-breeding programs can be costly

long-term commitments and, too often, are conducted at the expense of much-needed research on the wild populations while those populations continue to decline (Derrickson and Snyder 1992). The potential of reintroduction from captive-bred stock to rebuild the natural world should not be overstated (Wiley *et al.* 1992). Specific husbandry details may be needed, but general husbandry protocols will serve for most species. Captive-breeding programs, when determined to be essential and feasible for a species' recovery, should begin before it becomes necessary to remove stock from the wild at the expense of the wild population's health. Captive flocks should consist of a wide diversity of individual lines (founder stocks) from the wild. Whereas captive breeding has been critical to the recovery of the Puerto Rican Parrot, and may be needed to ensure the survival of the tiny population of Cayman Brac Parrot, this device does not appear warranted with other populations, including all those in the Lesser Antilles, Cuba, Jamaica, Bahamas, and Hispaniola.

11. Special note should be made of the historical pattern of extinction, with macaws disappearing completely from the West Indies, most species of parakeets being lost, and about a third of the parrot forms lost. Surviving populations of parakeets are, in general, at greater risk to extinction than are parrots, yet have not received the same local and international conservation interest as have the larger parrots. Local and regional populations of parakeets have been extirpated almost overnight; e.g., Cuba and Hispaniola. Conservation strategies should be developed accordingly; e.g., establish programs for *Aratinga* species, even though they are not as showy nor as exciting to local communities as are *Amazona* parrots.
12. Human population growth and associated habitat conversion threatened psittacids on all islands where these birds survive. Human populations must be at least stabilized if parrots and parakeets are to have any hope of continued existence in the region. Island governments should consider requiring some form of environmental mitigation by tourism-based and urbanizing development projects.

NEW CHALLENGES

Through the use of parrots as symbols of conservation need, many other species and, indeed, their supporting ecosystems have received a new appre-

ciation by local peoples and the international community. Now, however, we stand on the brink of new challenges as several species begin the recovery conservationists have so long desired. As those populations recover and expand beyond the physical limits of the often small remnants of reserved habitats, parrots and parakeets will interface with humans — and conflict will result. This is already occurring in Dominica, where the Red-necked Parrot is raising the ire of local citrus growers as birds depredate crops. We are facing the challenge of too many parrots — of being too good at reversing the downward trends. The conservation community must rally to provide local farmers with a means of thwarting nuisance birds as they expand their ranges with increasing population sizes (Wiley 1993b). If this challenge is not met immediately, decades of conservation efforts will be lost as farmers take direct and drastic measures to protect their livelihood, and governments allow control measures.

The future of none of the West Indian psittacids is secure although we can look back and say our conservation efforts have, for the most part, had positive effects. Yet, new challenges will continue to arise, and we cannot become complacent. Too much habitat continues to disappear each year, too many birds are taken for the pet trade, too many remnant populations are at risk to the stochastic effects of hurricanes, and too many face real threats of exotic competitors and predators. Yet, the most serious threat may yet to have surfaced — exotic diseases. Island populations, small and restricted in space because of extensive habitat loss, are particularly at risk to extinction by disease. Disease has become a more serious threat to native parrots because of recent introductions of exotic parrot species to the region. Extremely pathogenic psittacine diseases, such as proventricular dilatation syndrome (PDS), West Nile parrot Virus, and avian pox, all of which are viral, currently are beyond detection by most island veterinary authorities. Lovebirds, Cockatiels, and Budgerigars are notorious, asymptomatic carriers of avian poxvirus, which quickly devastates immunologically naïve species, particularly Amazon parrots. Island endemics are at great risk because they have evolved in isolation, and are immunologically less robust than comparable species from the Central or South American mainland.

The mode of disease transmission from exotic birds to native parrots may be complicated. Direct infection from pet birds typically requires escaped pets to become sufficiently established as feral flocks to interact with wild parrots. Avian poxvirus,

however, is easily carried by mosquitoes and other blood-sucking vectors, and may travel through intermediate bird and mammalian hosts (including bats), reaching wild parrots via many other vertebrate species. Native parrots held illegally also pose a problem, as they are rarely reported to authorities, and if infected and released, may interact with wild parrot flocks. West Nile Virus and Equine Encephalitis are exotic diseases that native psittacines unlikely have defenses against. It is particularly frightening that West Nile Virus and Equine Encephalitis have been found as far south as Puerto Rico (Dupuis *et al.*, in press; Anonymous 2003; P. Mara, pers. comm.) and Guadeloupe, an amazingly rapid spread of these potentially deadly diseases. Carried to the islands by Neotropical migrant birds, the diseases have the potential of devastating naïve populations that carry no defenses against the pathogens. No means for control of disease spread or infection of native birds are known. Regional conservationists should, nevertheless, be alert to the potential of this issue and follow developments to protect native species.

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