Puerto Rican Parrot
(Amazona vittata)

5-Year Review:
Summary and Evaluation

U.S. Fish and Wildlife Service
Southeast Region
Ecological Services
Rio Grande, Puerto Rico

5-YEAR REVIEW
Puerto Rican Parrot (*Amazona vittata*)

I. GENERAL INFORMATION

A. Methodology used to complete the review: This 5-year review was prepared by the lead Service recovery biologist for the parrot and summarizes new information that the Service has gathered in the construction of the draft revised Recovery Plan approved and released on June 17, 2008. Public notice of this review was given in the *Federal Register* on September 12, 2005, with a 60-day public comment period. The notice requested new information concerning the biology and status of the species. A 60-day comment period was opened. No information on the Puerto Rican parrot was received from the public.

B. Reviewers

Lead Region: Kelly Bibb, Southeast Region, (404) 679-7132

Lead Field Office: Pablo Torres-Báez, Caribbean Ecological Services Field Office, Río Grande, Puerto Rico.(787) 887-8769, extension 226.

C. Background

1. FR Notice citation announcing initiation of this review: September 12, 2005; 70 FR 53807.

2. Species Status: 2007, 2008 Recovery Data Call - Stable. The population of Puerto Rican parrot in the wild has remained around 50 individuals. This includes the historical population at El Yunque National Forest or YNF (known before as the Caribbean National Forest) and the recently introduced population in the northern karst region in the Río Abajo Forest (RAF). During 2007- 2008 surveys, we detected 26-30 birds at El Yunque National Forest. The last survey for the northern karst region detected 26 birds. The captive populations at both aviaries have increased during the past year, especially during 2007 and 2008 when both aviaries produced a total of 50 and 40 chicks respectively. The captive populations consist of 228 birds.

3. Recovery Achieved: 1 (0-25%) of species' recovery objectives achieved.

4. Listing History
Original Listing
FR notice: 32 FR 4001
Date listed: March 11, 1967
Entity listed: Species
Classification: Endangered

5. Associated Rulemakings: None.

6. Review History: Since 1973, the Service has conducted periodic surveys to determine the Puerto Rican parrot population trends (Appendix 1). These surveys are conducted by Service biologists from the Puerto Rican Parrot Recovery Field Office, and personnel from the YNF and Puerto Rico Department of Natural and Environmental Resources (DNER).

The Service approved and signed the Puerto Rican Parrot Recovery Plan on April 8, 1987. In July 1989, the captive Breeding Specialist Group published the Population Viability Analysis (PVA) for the species. The PVA analysis was based on the information and expert opinion of the parrot field biologists and population biology of the parrot. The aviary personnel provided information on the captive flock, which proved to be the key for the development of a master plan for the captive population. The final report provided recommendations and identified management needs for the wild and captive populations. The proposal to establish a second captive and wild population to reduce the risk of losing the species to the effects of catastrophic events was among the most important recommendations.

The Service conducted a five-year review for the parrot in 1991 (56 FR 56882). In this review, the status of many species was simultaneously evaluated with no in-depth assessment of the five factors or threats as they pertain to the individual species. The notice stated that the Service was seeking any new or additional information reflecting the necessity of a change in the status of the species under review. The notice indicated that if significant data were available warranting a change in a species' classification, the Service would propose a rule to modify the species' status. No change in the parrot's listing classification was found to be appropriate.

The Service announced the technical agency draft revised recovery plan for the Puerto Rican parrot on June 17, 2008 (73 FR 34313).

7. Species' Recovery Priority Number at start of review (48 FR 43098): 2 The Puerto Rican Parrot is recognized as a species with high degree of threat and high recovery potential.

8. Recovery Plan or Outline:
Name of plan: Puerto Rican Parrot Recovery Plan.
Date issued: April 8, 1987.
The Service recently released a draft revised recovery plan for the parrot as stated above.

II. REVIEW ANALYSIS

A. Application of the 1996 Distinct Population Segment (DPS) policy:

1. Is the species under review listed as a DPS? No.

2. Is there relevant new information that would lead you to consider listing this species as a DPS in accordance with 1996 policy? No.

B. Recovery Criteria

1. Does the species have a final, approved recovery plan containing objective, measurable criteria? The 1987 Plan contained objective measurable criteria. The recently released Technical Agency/Draft Recovery Plan contains objective, measurable criteria for both downlisting and delisting.

2. Adequacy of recovery criteria.

a. Do the recovery criteria reflect the best available and most up-to-date information on the biology of the species and its habitat? Yes.

b. Are all of the 5 listing factors that are relevant to the species addressed in the recovery criteria (and there is no new information to consider regarding existing or new threat)? Yes.

3. List the recovery criteria as they appear in the recovery plan, and discuss how each criterion has or has not been met, citing information.

Downlisting the Puerto Rican parrot from endangered to threatened will be considered when:

1. A wild population in the Luquillo Mountains exists with a population size (yet to be determined) that exhibits vital parameters consistent with a trajectory towards maintenance. At present, population growth in the YNF could be expected if the breeding productivity is at least 1.56 chicks per nesting attempt (average rate for the 1990s) and their survival rates should not drop below 90 percent for adults and 50 percent for juveniles. These rates assume that sub-adult survival rates are around 85 percent, age of first breeding is four years old, and at least 60 percent of the adults engage in reproduction each year. A higher number of breeding pairs is essential for vigorous population growth and historically has been stagnant at 2-6 pairs.
2. A second wild population in the northwestern karst region exists with a population size (yet to be determined) that exhibits vital parameters consistent with a trajectory towards maintenance.

3. The reintroduction or creation of at least a third population has been achieved in a suitable forested area in the island reflecting lessons and demographic expectations stemming from work with wild populations and release programs in RAF and YNF.
4. Nesting and foraging habitats (yet to be determined) are protected to support growing populations.

The Puerto Rican parrot will be considered for delisting when:

1. At least three interacting populations exist in the wild and population growth is sustained for 10 years after downlisting has occurred. This length of time will allow monitoring recruitment events and other population attributes in a species that has been characterized by highly variable reproductive and survival rates, at least in the YNF (Snyder et al. 1987, Muiznieks 2003, Beissinger et al. in press). Reviews of the recovery program prior to making a delisting determination will help define more explicitly the range of vital parameter values of a recovered population (see milestones 2 and 3).
2. Long term protection of the habitat occupied by each wild population is achieved.
3. The effects of disease and predation factors are controlled to allow for population viability.

Recovery criteria have not been met. Efforts are underway to address downlisting recovery criterion 1 and 2. Presently, a minimum of 25 individuals survive in the wild in the El Yunque National Forest (YNF) in eastern Puerto Rico and 22 in the Río Abajo Forest (RAF) in north central Puerto Rico. We continue to make progress in the recovery of the species but still have much to learn about the Puerto Rican parrot. As we continue to work towards each of the recovery criteria, we will adapt to information that is gained about the Puerto Rican parrot's basic biology, life history, habitat requirements etc.

C. Updated Information and Current Species Status

1. Biology and Habitat

a. Species' abundance, population trends, demographic features, or demographic trends

The Puerto Rican parrot is considered one of the 10 most endangered birds in the world (Wiley et al. 2004). Currently, a wild population of 25-28 individuals survives in the El Yunque National Forest (YNF), located within the Luquillo Mountains. Efforts to establish a second wild population began on November 19, 2006 with the release of 22 parrots in the Río Abajo Forest (RAF) located in the karst region of north central Puerto Rico. At present time, 22-28 individuals survive in the RAF. Two captive population facilities hold more than 228 individuals: the Iguaca Aviary

and the José L. Vivaldi Aviary in eastern and west-central Puerto Rico, respectively.

This last aviary is owned and managed by the Puerto Rico Department of Natural and Environmental Resources.

All indications suggest that the parrot was once abundant and widespread on the Puerto Rican Archipelago's major islands (Snyder et al. 1987). The size of historical populations is highly speculative, but may have exceeded a million individuals. The parrot population probably remained reasonably stable until about 1650, when the human population began to increase rapidly. The decline assumed catastrophic proportions in the latter half of the 19th and early 20th centuries when most deforestation of the island took place (Birdsey and Weaver 1982, Snyder et al. 1987). By the early 20th century, the species had disappeared from all of the offshore islands and was restricted to five known areas on the mainland. By about 1940, the only remaining population was in the Luquillo Mountains of eastern Puerto Rico, the largest area of native vegetation left on the island. A summary of population counts in the Luquillo Mountains since 1954 is presented in Appendix 1.

Since 1973, the population has increased 1% annually ($\lambda = 1.01$, Appendix 2). Over the last 10 years, however, there has been an annual decrease of eight percent ($\lambda = 0.92$). The number of wild parrots has never surpassed 47 birds, and currently stands at a minimum of 26 individuals (Appendix 1). Due to the nature and behavior of these parrots, surveying the population is challenging. Surveys are regularly conducted in areas currently used by parrots and areas also used by parrots in the past. However, we cannot assume that all individuals are always counted because birds have been known to use other areas in the YNF or adjacent areas in which their presence is sporadic and unpredictable. The most abrupt change in population numbers since 1973 was caused by hurricane Hugo in 1989. It reduced the wild population size from 47 to about 23 individuals. Increases in the number of wild parrots have not been followed by proportional increases in the number of breeding individuals, which has never exceeded 12 (Appendix 2, Appendix 1). Prevalence of low numbers of individuals over a long period of time could lead to problems associated with genetic depression (e.g., survival, reproduction) as documented for other endangered species (e.g., Guam rail, Haig and Ballou 1995). Judging by measurable parameters like fertility and hatching success of the wild population over a 30-year period, there is as yet no indication of such problems (Haig et al. 2004). However, Beissinger et al. (in press) provide documentation regarding egg hatchability that might indicate inbreeding effects in the Puerto Rican Parrot, drawing attention to the importance of a genetic management plan and recovery actions to minimize this problem. Fertility of wild nesting pairs ranged from 66 percent to 100 percent from 1991 to 2002 (Muiznieks 2003, Wunderle et al. 2003).

Only 2 to 6 pairs in the wild population have attempted to breed each year during the history of the parrot recovery program. Appendix 3 summarizes information on breeding productivity from 1985 to 2008. Productivity from 1973 to 2002 was 1.48-chicks/nesting attempt (Appendix 4, Muiznieks 2003). Productivity peaked during

the early 1990s when 1.88-chicks/nesting attempt were produced, but dropped again during the second half of the decade (1.23). Variability in reproductive output remains high, but decreased from before 1989 to an average of 77 percent during the 1990s (Appendix 4). Variability in the 1990s was due to nest failures caused by ectoparasites, nest predation, and difficulties in fostering chicks to the wild during the second half of the 1990s (Muiznieks 2003). Wunderle et al. (2003) summarized individual nest histories from 1973 to 2000.

b. Genetics, genetic variation, or trends in genetic variation

Genetic problems, although suspected (Snyder et al. 1987, Brock and White 1992), have not been documented in the wild or captive Puerto Rican parrot populations. Recent analyses of fertility rates at J. L. Vivaldi aviary suggest there were no negative effects of maternal, paternal, or zygotic inbreeding on egg fertility or hatching rate in the reproductive success data (Daniels et al. 2001). Failure to find negative inbreeding effects remained true whether the dependent observation was each egg, the proportion of eggs in each year that were fertile or hatched, or the proportion of eggs in each pair's reproduction to date that were fertile or hatched.

Molecular work using microsatellite and ISSR markers suggests a high degree of relatedness among all parrots in wild and captive populations (Haig et al. 2004). Comparison of the same loci in Hispaniolan Parrots (*A. ventralis*) indicated much lower levels of diversity in Puerto Rican parrots. Pedigree analyses including wild and captive birds (see Haig and Ballou 2002 for summary of techniques) indicated that the overall mean effective size (Ne) for the current living population of 43 male breeders and 40 female breeders over the past 2.65 generations was 82.9, thus Ne/N = 0.37. The closer this ratio is to 1.0, the more viable the population is. Hence, this result was not indicative of a robust population. This was also a most optimistic estimate as many founders (i.e., birds with no ancestors in the pedigree who have produced offspring) were assumed to be unrelated when, in reality, they most likely were closely related.

There were 37 birds defined as founders to the captive population (Haig et al. 2004). Pedigree analyses identified an additional 12 birds that could be considered founders if they bred (Appendix 5). There were 178 birds that descended from these founders but the genetic contribution of individual founders has varied greatly, further reducing Ne. Gene diversity or heterozygosity among the living population was 0.93. Pedigree models begin by assuming 100 percent heterozygosity; hence this result represents a 7 percent loss of heterozygosity over a relatively short period of time. A general goal for the maintenance of genetic diversity has been identified as retention of 90 percent original heterozygosity for 200 years (Soule et al. 1986, Ballou and Foose 1996).

The number of founder genome equivalents (i.e., a measure of founder contribution and allelic diversity that potentially equals the number of founders in the pedigree) in the living population was low at 7.03. The gene drop model indicated this value

could increase to 49 with better population management. Conversely, overall mean kinship (i.e., the mean of kinship coefficients between one individual and all other potentially reproducing members of a population; the higher the value, the more related birds are to each other) was 0.07 and the associated mean inbreeding coefficient was 0.04, neither of which suggests a problem with too close breeding. Unfortunately, this may be an overly optimistic view of mean kinship and inbreeding as the founders brought in from the wild were defined as being unrelated when they were most likely related.

The two flocks should be managed to minimize mean kinship as much as possible. Any parrot targeted for reproduction should be offered a choice of at least 3 individuals of equivalent mean kinship values. This scheme increases the probability of producing genetically, as well as behaviorally, compatible pairs.

c. New information regarding taxonomic classification or changes in nomenclature

There is no new information regarding taxonomy for the Puerto Rican parrot.

d. Spatial distribution, trends in spatial distribution (e.g. increasingly fragmented, increased numbers of corridors, etc.), or historic range (e.g. corrections to the historical range, change in distribution of the species within its historic range, etc.)

The Puerto Rican parrot is currently present in the wild in both YNF and RAF, including the recently reintroduced population in the latter. Additional details on its spatial distribution are presented under I.C.a. above.

e. Habitat or ecosystem conditions (e.g. amount, distribution, and suitability of the habitat or ecosystem)

As we continue to learn more about the Puerto Rican parrot and additional information for improved survey techniques for this bird, we expect to gain a better understanding of its suitable habitat and habitat needs.

f. Other information

Population Viability Analyses: In June 1989, the Captive Breeding Specialist Group conducted a Puerto Rican parrot population viability analysis (PVA) workshop (Lacy et al. 1989). The analysis was based on the information and expert opinion of the parrot field biologists and population biology of the parrot. The aviary personnel provided information on the captive flock key to the development of a master plan for the captive population. The final report provided recommendations and identified management needs for the wild and captive populations. The proposal to establish a second captive and wild population to reduce the risk of losing the species to the effects of catastrophic events was among the most important recommendations.

In 2003, updated demographic and environmental parameter estimates, and pertinent data from the 1989 PVA were used to conduct a second viability analysis assessing the status of the species from 1989 to 2002 (Muiznieks 2003). The process involved creating a BASE model to assess population persistence and sensitivity analyses using program Vortex. Model projections over 100 years were of a declining population (stochastic r = -0.066). The population went extinct in 997 of 1000 simulations and the persistence of the population was 0. The bleak prognosis results primarily from the low estimates of juvenile survivorship. Other parameters whose estimates changed to the detriment of the species (vis-à-vis more modest estimates used in the 1989 PVA) were severity of catastrophes (changed from 25 percent to 50/60 percent) and age of first breeding (empirical evidence suggested that it is 4 or 5, not 3).

In 2006, comprehensive demographic modeling of limiting factors to Puerto Rican parrot population growth (1973-2000) was conducted by Beissinger et al. (in press). Many of the conclusions of their work were in harmony with previous assessments (Lacy et al. 1989, Muiznieks 2003). This is not surprising given that the analysis by Muiznieks (2003) and Beissinger et al. (in press) were based on the same dataset up to year 2000. However, for the first time, Beissinger and colleagues assessed the relative importance of various factors suspected of limiting population growth in the YNF, and raised the possibility that inbreeding might be limiting population growth. The primary factors maintaining the population bottleneck were hurricanes (and extreme rainfall events), via its influence on parrot survival, failure of a larger proportion of the adult population to breed annually, and inbreeding effects manifested in egg hatchability problems. Factors that contribute to stall population growth, but are not as important, included changes in annual survival of juveniles and adults, and individual nest failures.

Re-assessments of the population demography, status and persistence will be conducted in 2008 and 2011. These re-assessments are necessary because new data on vital parameters (e.g., juvenile survival), which also helps reduce parameter uncertainty (e.g., precision), help fine tune our understanding of the factors impinging upon the species demography and provide insights on how recovery actions might be modified to foster population growth and recovery. For example, data on juvenile survival since 2000, for wild or captive reared birds, suggest that annual survival rates have hovered around 0.40 vis-à-vis higher values (0.6) used in several assessments in the past (T. White, USFWS-Rio Grande Field Office, pers. comm. 2007).

Sensitivity analyses indicated that none of the values for the 7 parameters used in the model scenarios yielded a positive, mean stochastic growth (see Appendix 6 for description of the analyses). Low juvenile mortality (32 percent) produced the best average stochastic growth rate (Figure 5). Available data suggest that, on average, juvenile survival is substantially lower (about 40 percent) than the 67 percent estimated from 1973-1989 (Snyder et al. 1987). It is likely that red-tailed hawk predation continues to be a major factor influencing juvenile survival (Snyder et al.

1987, White et al. 2005a), although concerns about some fledglings leaving the nest prematurely might be another factor contributing to lower juvenile survival (T. White, USFWS-Rio Grande Field Office, pers. comm. 2007). Certainly, the impact of red-tailed hawks has become easier to discern in recent years with the implementation of the release program and use of radio telemetry (Nimitz 2005, White et al. 2005a). It remains unclear whether red-tailed hawks are exacting a higher mortality rate on juvenile parrots in recent years as compared to prior to 1989. These results underscore the importance of better data to assess the relative importance of age-specific survival rates, particularly during non-hurricane years. Annual survival rates of parrots during the intervening years between hurricanes were not deemed important as a factor limiting population growth (Beissinger et al. in press)

2. Five-Factor Analysis (threats, conservation measures, and regulatory mechanisms)

(a). Present or threatened destruction, modification, or curtailment of its habitat or range:

Protection was afforded in view of the parrots' dramatic range contraction and population decline particularly during the 20th century (Snyder et al. 1987). The destruction of the native forests was unquestionably a major factor influencing both parameters. By 1912, the island was more than 80 percent deforested, and of the remaining forests, only about 45,000 acres (18,220 hectares [ha]) remained in virgin condition (Murphy 1916). By 1922, only about 20,000 acres (8,097 ha) in the Luquillo Mountains remained forested, and nearly all of it had been cut to extract timber (Wadsworth 1949, 1951). Parrots are dependent on large diameter trees for nesting cavities (although one former population is known to have also used cliff pot-holes; Wiley 1980, Snyder et al. 1987). The limited availability of cavity trees was invoked to explain poor population growth and lack of new nesting areas (Snyder and Taapken 1977, Wiley 1985).

At present time, the species is mostly found in a portion of YNF (11,274 ha) located within the Luquillo Mountains, which encompass a total of 19,656 ha. We have also documented parrots using private areas bordering the southern, western and northern parts of the Forest. Additional observations have been made near the eastern boundary of the forest, within the township of Naguabo. During the past several decades, portions of the Luquillo Mountains outside of the YNF have become more forested due to a decline in agricultural practices on former pastures and farmlands. Since the mid-1950's, when the parrot population was determined to number only 200 birds, land management activities by the responsible agencies, such as the US Forest Service, have included parrot recovery activities. These include locating parrot nest sites, improving nests, determining parrot range, and ensuring that other future forest management actions do not adversely affect parrots or parrot habitats. In 1986, the YNF Land and Resource Management Plan gave direction for long-term parrot habitat maintenance and improvement, and placed high emphasis on Puerto Rican parrot recovery.

Efforts to establish a second wild population began on November 19, 2006 with the release of 22 parrots in the Río Abajo Forest (RAF), followed by a second release of 24 parrots in December 2007. At present time, around 22-28 individuals survive in the RAF. The RAF is approximately 2,340 ha and is located between Dos Bocas Lake and the Tanamá River in the municipalities of Utuado and Arecibo. This moist limestone forest with very irregular topography, subterranean drainage, caves, natural depressions or sinkholes and haystack hills all characteristic of karst geological development provide suitable habitat for the parrot. Since 1989, the Puerto Rico Department of Natural and Environmental Resources entered an agreement with the Service to manage the RAF consonant with the future parrot recovery activities. Currently, efforts are underway to prepare a management plan focused on watershed areas that will encompass land outside the forest boundaries.

(b). Overutilization for commercial, recreational, scientific or educational purposes:

Other factors that may have contributed to the decline of the parrot population in the island and the Luquillo Mountains were nest robbing, crop protection and hunting for food, road construction (e.g., PR-191), guerrilla warfare maneuvers and radiation experiments (Snyder et al. 1987, FWS 1999). Over the past 25 years, these factors have been reduced or eliminated completely. This species is listed and protected by C.I.T.E.S. (Appendices 1 Convention on International Trade in Endangered Species of Wild Fauna and Flora). We believe that overutilization for commercial, recreational, scientific or educational purposes should not be considered a threat.

(c). Disease or predation:

Due to the recent documentation of the presence of West Nile Virus in the captive and wild populations, this pathogen presents a potential threat to the welfare of the species.

Red-tailed hawks are the primary avian predator of parrots, an important cause of juvenile and adult mortality (Snyder et al. 1987, Wiley et al. 2004, Nimitz 2005). There is also evidence that red-tailed hawks will enter nest cavities to kill parrots (Wiley 1980). Between 2000 and 2004, 40 captive-reared parrots were released in the Luquillo Mountains. The majority (54 percent) of the documented deaths were due to predation by red-tailed hawks, which claimed at least 21 percent of all released parrots, reaffirming the contention that this raptor was a primary source of mortality for parrots (White et al. 2005a, USFWS unpubl. data).

Other predators affect parrot demography through their impact on breeding productivity (e.g., pearly-eyed thrashers (*Margarops fuscatus*), black rats (*Rattus rattus*)), but intense management practices have curbed their impact. Pearly-eyed thrashers, which were not present in notable numbers in the YNF until the 1950's (Snyder et al. 1987), harass breeding parrots to obtain nest cavities. Thrashers will

also attack parrot eggs and nestlings while exploring unattended nests (Snyder and Taapken 1977). Since 1976, modifying nest sites for parrots and installing thrasher-preferred nest boxes close to parrot nests have largely controlled thrasher depredations. Consistent management protocols have been implemented to reduce the impact of thrashers on the reproductive success of wild parrots, including the use of cameras and active control (White and Vilella 2004). Black rats are normally controlled through the use of poison bait stations strategically located near active parrot nests.

Honeybees (*Apis mellifera*) compete with parrots for nest sites (Wiley 1980, Wiley 1985, Snyder et al. 1987, Lindsey et al. 1994). Although there is no record of honeybees evicting nesting parrots, they take over nest cavities after the breeding season. Often it has been difficult to maintain each of the modified or natural cavities available for prospecting breeding parrots, although currently nests are closed as soon as possible following the nesting season to avoid usurpation by honeybees. The threat posed by bees has been exacerbated since the arrival of Africanized honeybees. Late nesters may be particularly vulnerable to honeybees as occurred in 1994. In this instance, the rapid intervention of a nest guard and subsequent cleaning by US Forest Service (USFS) and USFWS staff personnel saved two parrot chicks.

Sometimes, parrot nests become infested with parasites such as the botfly (*Philornis pici*) and the soldier fly (*Hermetia illucens*). *Philornis* ectoparasitic larvae significantly retard development and can result in death of parrot nestlings and adults (Arendt 1985, Snyder et al. 1987, Arendt 2000). Soldier fly larvae have been implicated in the death of at least one, and possibly two, nestlings. Current nest management practices, such as the use of palo colorado wood chips as nest material in conjunction with the application of carbaryl insecticide (e.g., Sevin), have resulted in the reduction of the presence of insect larvae in nest material.

Other possible predators of parrots in the YNF are the federally listed Puerto Rican broad-winged hawk (*Buteo platypterus brunnuscens*), peregrine falcons (*Falco peregrinus*), and Puerto Rican boa (*Epicrates inornatus*). Although predation of parrots by broad-winged hawks has not been documented in the YNF, the deaths of at least 6 captive-reared parrots released in the RAF between 2006-2007 were attributed to this raptor. This is consistent with reports from Dominica, where broad-wings have been reported preying on chicks of the red-necked parrot (*Amazona arausiaca*; Christian et al. 1996). Boas are predators of parrot nestlings in Jamaica and Dominica (J. Wunderle, USFS, pers. comm., 2004, Koenig et al. 2007). The Puerto Rican boa is not very abundant in the YNF, although its poor detectability likely results in biased-low estimates of the population (Wunderle et al. 2004, Koenig et al 2007). Although vines are used by boas to access tree cavities (Wunderle et al. 2004), there have been no documented deaths of parrots caused by boas in the YNF.

(d). Inadequacy of existing regulatory mechanisms:

The Puerto Rican parrot is currently protected by both Commonwealth and Federal regulations. In 1999, the Commonwealth of Puerto Rico approved the Law # 241 known as the "Nueva Ley de Vida Silvestre de Puerto Rico" (New Wildlife Law of Puerto Rico). The purpose of this law is to protect, conserve and enhance both native and migratory wildlife species; declare property of Puerto Rico all wildlife species within its jurisdiction, regulate permits, regulate hunting activities, and regulate exotic species among others. The Puerto Rico Department of Natural and Environmental Resources approved in 2004 the "Reglamento para Regir el Manejo de las Especies Vulnerables y en Peligro de Extinción en el Estado Libre Asociado de Puerto Rico" (Regulation 6766 to Regulate the Management of threatened and endangered species in Puerto Rico). The Puerto Rican Parrot has been included in the list of protected species and designated as "critically endangered". Based on the existence of local laws and regulations protecting this species, we believe that inadequacy of existing regulatory mechanisms should not be considered a threat.

(e). Other natural or manmade factors affecting its continued existence:

Additional stressors impinging upon the demography of Puerto Rican parrots are local weather conditions and hurricanes. Weather in the Luquillo Mountains is extremely wet and humid. Exposure to rain limits the adequacy of nesting cavities as chicks and eggs can be lost due to rainwater entering nest cavities (Snyder et al. 1987). Occasionally, parrot chicks also suffer from respiratory diseases acquired in the dampened nest environment. Recent management techniques and new nest design have reduced the incidence of such events (White et al. 2005b).

The dependence of parrots on natural vegetation for food, shelter, and nest sites makes them particularly vulnerable to the impacts of hurricanes (Wiley and Wunderle 1993). Reduced survival and increased movements in search of food were documented for captive-reared Hispaniolan parrots released in Parque Nacional del Este, Dominican Republic, in the aftermath of hurricane Georges in 1998 (Collazo et al. 2003, White et al. 2005c). Circumstantial evidence suggests that Puerto Rican parrots were forced to lowlands in search for food when major hurricanes hit the Luquillo Mountains earlier in the 20th century (Snyder et al. 1987). Given the small size of the wild population, a single, strong hurricane could potentially wipe out the entire current wild population. The frequency of major hurricanes in Puerto Rico (category 3 or higher) is 3 every 100 yrs (Lacy et al. 1989). Hurricane Hugo, in September 1989, illustrated the possibility of catastrophic losses. The wild population in the YNF was reduced to 23, or nearly half of the 47 individuals reported before the hurricane. After a comprehensive review of the demography of parrots since 1973, hurricanes emerged as the single most important factor impeding population growth in the YNF (Beissinger et al. in press).

3. Synthesis

Currently, a wild population of 25 to 28 individuals survives in the El Yunque National Forest (YNF), located within the Luquillo Mountains. Efforts to establish a second wild population began in 2006 with the release of 22 parrots in the Río Abajo Forest (RAF) located in the karst region of north central Puerto Rico. At present time, 22-28 individuals survive in the RAF. Two captive population facilities hold more than 228 individuals: the Iguaca Aviary and the José L. Vivaldi Aviary in eastern and west-central Puerto Rico, respectively. The limited distribution and small populations render the Puerto Rican Parrot vulnerable to random natural events such as the hurricanes.

Only 2 to 6 wild pairs have attempted to breed each year during the history of the recovery program. Genetic problems, although suspected, have of yet not been documented in the wild or captive Puerto Rican parrot populations.

The movements and habitat use of the Puerto Rican parrot have been altered in recent years, but these changes are mainly limited to within the YNF.

Although recent significant progress in recovery efforts for the Puerto Rican Parrot has been documented, including improved nesting success in the wild, advances in captive-rearing techniques, and a recently reintroduced second wild population, this species continues to exist as only two small populations in the wild. As such, the Puerto Rican Parrot remains extremely vulnerable to habitat destruction due to increasing rates of urban development in Puerto Rico, the ever-present threat of introduced diseases such as West Nile Virus, and random natural events such as hurricanes. Thus, the Puerto Rican Parrot continues to meet the definition of an endangered species under the Act.

III. RESULTS

A. Recommended Classification:

_____ **Downlist to Threatened.**
_____ **Uplist to Endangered.**
_____ **Delist**
__X__ **No change is needed.**

IV. RECOMMENDATIONS FOR FUTURE ACTIONS

1. Continue with the releases of the recently introduced population in the northern karst region in the Río Abajo Forest (RAF).
2. The establishment of the third wild population is a high priority in the recovery program.
3. Continue release of captive-reared parrots to promote growth of the wild population in the YNF using procedures developed to maximize survival.
4. Conduct updated Population Viability Analysis (PVA) for the Puerto Rican Parrot

V. REFERENCES

Arendt, W. J. 1985. *Philornis* ectoparasitism of pearly-eyed thrashers. I. Impact on growth and development of nestlings. Auk 102:270-280.

Arendt, W. J. 2000. Impact of nest predators, competitors, and ectoparasites on Pearly-Eyed Thrashers, with comments on the potential implications for Puerto Rican Parrot recovery. Ornitologia Neotropical. 11:13-63.

Ballou, J. D., and T. J. Foose. 1996. Demographic and genetic management of captive populations. Pp. 263-283 in D. G. Kleiman, M. E. Allen, K. V. Thompson, and S. Lumpkin, eds. Wild Mammals in Captivity: Principles and Techniques. University of Chicago Press, Chicago, IL.

Birdsey R. A. and P. L. Weaver. 1982. The forest resource of Puerto Rico. USDA Forest Service Resource Bulletin, SO-85. New Orleans, LA, Southern Forest Experiment Station.

Brock, M. K., and B. N. White. 1992. Application of DNA fingerprinting to the recovery program of the endangered Puerto Rican parrot. Proc. Natl. Acad. Sci. 89:11121-11125.

Christian, C. S., T. E. Lacher, Jr., M. P. Zamore, T. D. Potts, and W. Burnett. 1996. Parrot conservation in the Lesser Antilles with some comparison to the Puerto Rican efforts. Biological Conservation 77:159-167.

Collazo, J. A., T. H. White, F. J. Vilella, and S. Guerrero. 2003. Survival of captive-reared Hispaniolan Parrots released in Parque Nacional del Este, Dominican Republic. Condor 105: 198-207.

Daniels, S., S. M. Haig, and J. A. Collazo. 2001. Preliminary Pedigree Analyses for the Puerto Rican Parrot. Report to the U.S. Fish and Wildlife Service, Atlanta, GA. 35 pp.

Haig, S. M., and J. D. Ballou. 1995. Genetic diversity between two avian species formerly endemic to Guam. Auk 112: 445-455.

Haig, S. M., J. Collazo, H. Draheim, and S. Daniels. 2004. Population structure and pedigree definition in captive and wild Puerto Rican Parrots (*Amazona vittata*). Conservation Genetics. Report to USFWS-Rio Grande Field Office and the PR Department of Natural and Environmental Resources. 2 November. 30 pp.

Hengstenberg, D. W. 2003. Reproductive biology, abundance, and movement patterns of the Puerto Rican Broad-winged Hawk in a limestone forest of Puerto Rico. M.S. Thesis, Mississippi State University, Mississippi. 114 pp.

Lacy, R. C., N. R. Flesness, and U. S. Seal. 1989. Puerto Rican Parrot population viability analysis. Captive Breeding Specialist Group, Apple Valley, MN 55124. FWS Cooperative Agreement 14-16-0004-89-927. 97 pp.

Lindsey, G. D., Arendt, W. J., and Kalina, J. 1994. Survival and causes of mortality in juvenile Puerto Rican Parrots. J. Field Ornithol. 65:76-82.

Muiznieks, B. D. 2003. Population viability analysis of the Puerto Rican Parrot: an evaluation of its current status and prognosis for recovery. M.S. Thesis, North Carolina State University. 88 pp. (http://www.lib.ncsu.edu/ETD-db/ETD-browse/browse).

Murphy, L. S. 1916. Forests of Porto Rico, past, present and future, and their physical and economic environment. USDA Agricultural Bulletin No. 354, Washington, D.C.

Snyder, N. F. R., and J. D. Taapken. 1977. Puerto Rican parrots and nest predation by pearly-eyed thrashers. Pp. 113-121 *In* S. A. Temple (ed.), Endangered Birds. Univ. Wisconsin Press, Madison, Wisconsin.

Snyder, N. F. R., J. W. Wiley, and C. B. Kepler. 1987. The parrots of Luquillo. West. Found. Vert. Zool., Los Angeles.

Soule, M. E., M. Gilpin, W. Conway, and T. J. Foose. 1986. The millennium ark: how long a voyage, how many staterooms, how many passengers? Zoo Biology 5:101-113.

Wadsworth, F. H. 1949. The development of the forest land resources of the Luquillo Mountains. Ph.D. Dissertation, Univ. Michigan, Ann Arbor. 481 pp.

Wadsworth, F. H. 1951. Forest management in the Luquillo Mountains, I. The setting. Caribbean Forests 12:92-114.

White, T. H., Jr. and F. J. Vilella. 2004. Nest management for the Puerto Rican Parrot (*Amazona vittata*): gaining the technological edge. Ornitología Neotropical 15 (suppl.):467-476.

White, T. H., Jr., W. Abreu-González, Miguel Toledo-González, Pablo Torres-Báez 2005b. From the Field: Artificial nest cavities for Amazona parrots. Wildl. Soc. Bull. 33:000-000.

White, T. H., Jr., F. J. Vilella, J. A. Collazo, and S. A. Guerrero. 2005c. Effects of Hurricane Georges on habitat use by captive-reared Hispaniolan Parrots released in the Dominican Republic. Ornitologia Neotropical.16(3): 405-418.

Wiley, J. W. 1980. The Puerto Rican Amazon (*Amazona vittata*): Its decline and the program for its conservation. Pp. 133-15g *In* R. F. Pasquier, ed., Conservation of New World Parrots. International Council for Bird Preservation. Tech. Publ. No.1.

Wiley, J. W. 1985. The Puerto Rican parrot and competition for its nest sites. Pp. 213-223 *In* P. J. Moore (ed.), Conservation of Island Birds. ICBP Tech. Publ. No. 3.

Wiley, J. W. and J. Wunderle 1993. Hurricane effects on bird populations in general. Bird Conservation International 3:319-349.

Wiley, J. W., R. S. Gnam, S. E. Koenig, A. Dornelly, X. Galvez, P. E. Bradley, T. White, M. Zamore, P. Reillo, and D. Anthony. 2004. Status and conservation of the family Psittacidae in the West Indies. J. Caribbean Ornithology (Special Issue Honoring Nedra Klein) :94-154.

Wunderle, J. M., Jr., N. F. R. Snyder, B. D. Muiznieks, J. W. Wiley, and J. M. Meyers. 2003. Histories of Puerto Rican parrot nests in the Caribbean National Forest/Luquillo Experimental Forest 1973-2000. General Technical Report IITF-GTR-21. Rio Piedras, Puerto Rico, U.S. Department of Agriculture, Forest Service, International Institute of Tropical Forestry. 28 p.

Wunderle, J. M., Jr., J. E. Mercado, B. Parreso, and E. Terranova. 2004. Spatial Ecology of Puerto Rican Boas (*Epicrates inornatus*) in a Hurricane Impacted Forest. Biotropica 36:555-571.

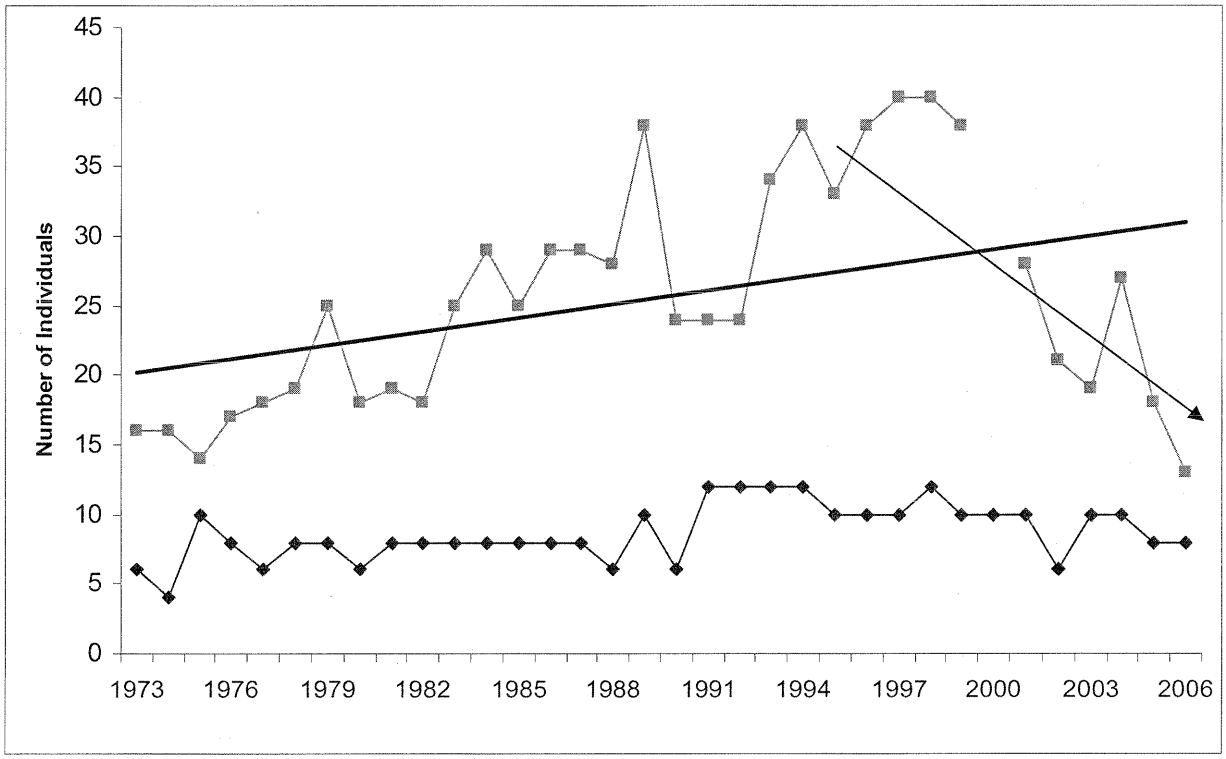
Appendix 1. Historical summary of minimum counts of Puerto Rican parrots from 1954 to 2007 in YNF, Luquillo Mountains. The month in which the surveys were conducted is indicated parenthetically. Since 1990 pre- and post-breeding surveys were consistently conducted. Pre-breeding surveys are generally conducted early in the year; post-breeding in mid to late summer. Personnel conducting surveys prior to 1989 are identified by Snyder et al. 1987. Since 1989, surveys have been conducted and coordinated by personnel with the RGFO.

Year (month)	Count
1954 (October)	200
1963 (May)	130
1966 (December)	70
1968 (November)	24
1971 (January)	16
1975 (March)	14
1975 (May)	13
1980 (January)	19
1982 (July)	29
1985 (July)	35

Year	Pre-breeding Count	Post-breeding Count
1986	29 (April)	31 (August)
1986		31 (November)
1989	*	47 (August [bH])
1989	*	23 (September [aH])
1990	24 (January)	21 (September)
1991	24 (April)	30 (September)
1992	24 (February)	28 (October)
1993	34 (January)	42 (September)
1994	38 (March)	40 (August)
1995	33 (February)	44 (September)
1996	38 (January)	42 (August)
1997	40	40 (July)
1998	42 (March)	36 (September [aG])
1999	38	38 (May)
2000		21 (September)
2001	28 (March)	31 (September)

2002	21 (March)	28 (July)
2003	24 (March)	17
2004	26 (March)	31 (July)
2005	27 (March)	17 (August)
2006	16 (February)	23 (June)
2007	18 (January-February)	25 (July)
2008	13 (January)	26 (August)

[bH] before hurricane Hugo, [aH] after hurricane Hugo, [aG] After hurricane Georges,



λ = 1.01

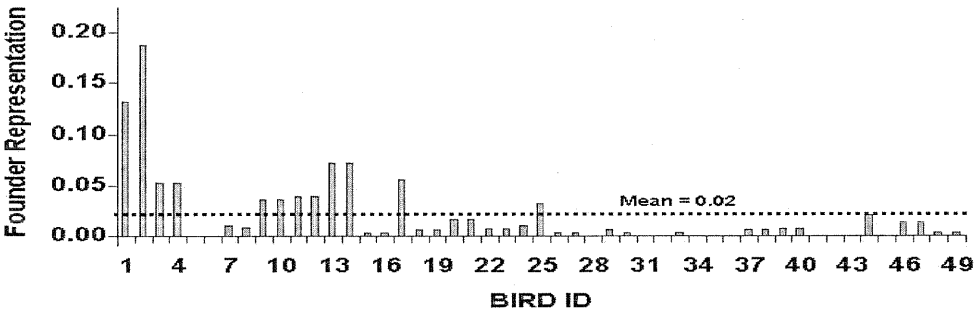
Appendix 2. Number of Puerto Rican parrots counted during pre-breeding surveys (march-april) in the EL Yunque National Forest from 1973 to 2006. The number of breeding individuals recorded each year are also depicted. The average observed rate of increase (see Caughley 1977) is expressed as the finite rate (λ).

Appendix 3. Breeding productivity of Puerto Rican parrots in the El Yunque National Forest 1985-2008. A detailed account of each nest history was summarized by Wunderle et al. (2003).

Year	Total Fledglings	Number of Active Nests	Fledglings/nest attempt
1985	12	4	3
1986	9	4	2.25
1987	4	4	1
1988	8	4	2
1989	9	3	3
1990	2	3	0.666667
1991	7	6	1.166667
1992	11	6	1.833333
1993	15	6	2.5
1994	14	6	2.333333
1995	15	5	3
1996	7	5	1.4
1997	7	5	1.4
1998	9	6	1.5
1999	3	5	0.6
2000	8	5	1.6
2001	5	5	1
2002	2	3	0.666667
2003	8	5	1.6
2004	7	5	1.4
2005	6	4	1.5
2006	9	4	2.25
2007	8	4	2
2008	6	4	1.5

Appendix 4. Mean productivity (number of chicks/nesting attempt) of Puerto Rican parrots from 1973 to 2002. Values for selected time periods of interest are also presented. The 1973-1989 period ends with the year of hurricane Hugo); 1990-2002 is the period since; the 1990s were divided into two periods because management techniques (e.g., fostering, double clutching) were applied differently. Standard deviations and coefficient of variations are listed for the various time periods.

Year	**1973-2002**	**1973-1989**	**1990-2002**	**1990-1995**	**1996-2002**
N	**113**	**76**	**68**	**34**	**34**
Mean Productivity (SD)	**1.48** (1.26)	1.41 (1.31)	1.56 (1.32)	1.88 (1.01)	1.23 (1.33)
Coefficient of Variation	0.85	0.93	0.85	0.54	1.08



Appendix 5. Founder contribution in Puerto Rican parrots. Those individuals whose contribution is under represented need to be selectively paired to increase their contribution to the flock (Haig et al. 2004).

U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of PUERTO RICAN PARROT (*Amazona vittata*)

Current Classification ___E_____

Recommendation resulting from the 5-Year Review

_____ **Downlist to Threatened**
_____ **Uplist to Endangered**
_____ **Delist**
__X__ **No change is needed**

Review Conducted By: Pablo Torres, Fish and Wildlife Biologist, Rio Grande Office, Caribbean Field Office.

FIELD OFFICE APPROVAL:

Lead Field Supervisor, U.S. Fish and Wildlife Service

Approve Edwin Muñiz Date 9/26/08

Lead Field Offices must ensure that all other Field Offices within the range of the species' have been provided an adequate opportunity to review and comment prior to the reviews' completion. For all species where a change in classification is recommended, written concurrence from other Field Offices is required.

REGIONAL OFFICE APPROVAL:

for **Lead Regional Director, Fish and Wildlife Service**

Approve Marvin E Walls Date 9/24/08

The Regional Director must sign all 5-year reviews, unless the authority has been delegated by the Regional Director to the Field Supervisor.