

The Decline, Recovery, and Captive Management Potential of the Puerto Rican Parrot¹

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Abstract: Puerto Rican parrot (*Amazona vittata*) numbers declined precipitously and the species was on the verge of extinction by 1971 when the population fell to 19 birds, leaving only 16 remaining in the wild. An extensive study of the species was undertaken in 1968 and intensive wild and captive management was initiated. Both wild and captive populations have fluctuated but have demonstrated a trend toward moderately increasing numbers over the ensuing 25 years. This recovery and the role and potential of the captive breeding strategy for enhancing the recovery of this species is addressed. The Río Abajo Aviary, established in 1990 as a second captive breeding site, is examined with a look toward the future of the captive program and the Puerto Rican parrot.

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The Puerto Rican parrot, one of the most critically endangered species in the world, is endemic to Puerto Rico. It was once abundant throughout Puerto Rico and the adjacent islands of Vieques, Culebra, and Mona. Destruction of its forest habitat through conversion to agricultural use, destruction of nesting sites by logging, hunting for sport and food, capture for use as pets, natural disasters such as hurricanes, predations by exotic rats and the red-tailed hawk (*Buteo jamaicensis*), parasites such as the warble fly (*Philornis pici*), and nest-site competition by the pearly-eyed thrasher (*Margarops fuscatus*) have all taken their toll on the once extensive population of Puerto Rico's only surviving native parrot species (Wiley 1980, 1985; Snyder et al. 1987). The Puerto Rican Parrot population has been restricted to no more than a quarter of 1 percent of its former range for several decades and recently to as few as 1,430 ha (Lindsey et al. 1991), an insufficient area to provide a buffer against adversity.

The Puerto Rican parrot has received intensive management since 1968, and while wild and captive populations have fluctuated, both have demonstrated a trend toward moderately increasing numbers. Captive production, however,

¹ Río Abajo Aviary is a cooperative effort between the Puerto Rico Department of Natural Resources and Environment and the U.S. Fish and Wildlife Service.

persistently lags significantly behind fecundity in the wild. Over the years, increase in the captive flock was probably suppressed by both physical plant limitations and managerial practices such as delayed pairing for breeding of reproductively mature birds, not dissolving incompatible or non-productive pairs, close density housing of breeding pairs, frequent human disturbance, and by concerns for wild flock maintenance which resulted in premature depletion of captive breeding stock. While progress has been made, the level of overall success and the captive increase achieved invite critical review.

Decline and Recovery

At the time Columbus arrived in Puerto Rico in 1493 there may have been over a million parrots. From 1937 to 1968, despite some attempts at habitat preservation and management of the species based on information obtained from earlier field studies, the numbers plummeted. By 1968 only 24 Puerto Rican parrots remained, marooned in the only habitat remaining for them, the Luquillo Forest (Wiley 1980, 1985; Snyder et al. 1987).

A study of the Puerto Rican parrot was undertaken in 1968 by the U.S. Fish and Wildlife Service (USFWS), the U.S. Forest Service (USFS) and the World Wildlife Fund (WWF). The wild birds were studied intensively, the remaining habitat protected, existing nests guarded, and captive management begun. Through these efforts decline in the wild was reversed, and by the end of 1979 the number of parrots in the wild had risen to 25 despite increasing the number in captivity to 15 (Wiley 1980, Snyder et al. 1987). In 1979 the first Puerto Rican chick produced in captivity hatched, but recovery of the Puerto Rican parrot during more than 25 years of interagency management has remained slow. The multi-agency team of USFS, International Institute of Tropical Forestry (IITF), and the Puerto Rico Department of Natural Resources and Environment (DNRE) spearheaded by the USFWS has not experienced quick or strong indication of recovery success. At the beginning of 1994 there were only 38 birds living in the wild in the Caribbean National Forest in Luquillo, and a total of only 64 in captivity (F. Vilella, USFWS unpubl. rep.).

Prior to a survey in 1969–1971, the extent of the captive population was unknown, except that the Puerto Rican parrot was likely a common pet among the Indians and those who followed. A few were believed transported to Europe in the 1800s, and there is a report (c. 1896) of 100 nestlings from the Río Abajo area being harvested and transported for sale to Spanish soldiers garrisoned on the eastern end of the island. One had been in private possession as a pet since 1955, but this bird had severe physical deformities and was never considered for the captive breeding program (Wiley 1980, Snyder et al. 1987). There may have been others, but they were never discovered. As many as 6 chicks were likely stolen from wild nests between 1963 and 1969, but these were never found (Snyder et al. 1987).

Luquillo Aviary

An attempt to assemble a captive breeding flock was made in 1971 at Patuxent Wildlife Research Center in Laurel, Maryland, with 2 females from the Mayagüez Zoo collected from the Luquillo Forest in 1956, and 1 Luquillo-caught male which survived quarantine. To avoid risk of quarantine-related deaths by exporting Puerto Rican parrots to Patuxent and to facilitate creation of a captive flock from eggs and nestlings and simplify transfers from a captive flock to the wild, an on-island aviary was developed in 1973. The captive flock was originally intended to both bolster the wild population and serve as the primary source for creating new wild populations. Captive breeding was sanctioned because there was little hope for survival of the wild population given the recent history of drastic decline (Wiley 1980, 1985; Snyder et al. 1987).

The captive breeding flock was built from the wild beginning with the 2 birds trapped for Patuxent in 1972. At the end of that year 16 birds comprised the wild flock and 3 existed in captivity. In 1973 there were 3 fledglings in the wild population; 4 eggs and 1 chick were removed from the wild that year. In 1974 and 1975 there were losses and gains in the wild, but even with the removal of eggs for captivity, the number held at 19. There was an overall net increase in 1976 and 1978, when the number climbed to 27 in the wild, and by 1979 the captive population had reached 15 although the wild flock dropped to 25. Over the 7-year period from 1973 to 1979, 34 eggs and 5 chicks taken from the wild resulted in the net addition of 14 birds to the captive flock. These, along with the sole surviving Puerto Rican parrot from the remaining 2 returned from Patuxent in 1973, founded the captive breeding flock (Wiley 1980, 1985; Snyder et al. 1987). In 1989 the number in captivity had risen to 46 and the number in the wild had reached 47, but Hurricane Hugo destroyed nearly half the wild population later that year (Meyers et al. 1993).

The captive flock was first successfully bred at Luquillo in 1979 (Table 1). A second pair began breeding in 1981 (Wiley 1980, 1985; Snyder et al. 1987), but despite registering from 5–8 pairs during the following 6 years, it was not until 1987 and with the use of visual barriers between the cages (Lindsey et al. 1989) that 2 additional pairs began laying fertile eggs (Snyder et al. 1987). From then to the present (1994) the number of established Puerto Rican parrot pairs at the Luquillo Aviary has ranged from 6 to 17, the number of pairs producing fertile eggs from 3–9. The most statistically productive captive year was 1985, when 2 pairs yielded 8 fledglings, for an average of 4 chicks per fertile pair. Captive production since that time has ranged from 0.33–2.0 fledglings per fertile pair (0.08–1.33 per total pairs) for an average of 1.27 fledged chicks per fertile pair per year (0.58 per total pairs). The wild population figures yield an average production range of perhaps as low as 0.33 to a high of 2.25 fledglings per fertile pair, averaging a minimum of approximately 1.5 fledglings per fertile pair annually. The natural fecundity of wild pairs during the past 4 years (1991–1994) has increased from 1.33 to 2.17, averaging 1.83 fledglings annually. Since

Table 1. Partial summary^a of wild and captive breeding history of the Puerto Rican Parrot Project 1972–1994 (in part after Snyder et al. 1987).

Year	Location ^b	Species ^c	N Laying pairs	N Eggs laid	N Fledglings produced		N PR captive deaths
					Wild	Captive	
1972	wild	PR	2	2	2	0	
	LU	PR	0	0	0	0	1
1973	wild	PR	2	6	0	0	
	LU	PR	0	0	5	0	0
1974	wild	PR	2	6	4	0	
	LU	PR	0	0	2	0	0
1975	wild	PR	5	13	6	0	
	LU	PR	0	0	3	0	1
1976	wild	PR	4	12	8	0	
	LU	PR	0	0	0	0	1
1977	wild	PR	3	10	3	0	
	LU	PR	0	0	3	0	0
1978	wild	PR	4	14	9	0	
	LU	PR	1	3	1	0	0
1979	wild	PR	4	12	5	1	
	LU	PR	1	3	1	0	1
1980	wild	PR	3	13	6	2	
	LU	PR	5	23	0	0	1
	LU	HP	3	21	0	9	
1981	wild	PR	4	12	9	1	
	LU	PR	5	22	0	1	3
	LU	HP	3	32	0	8	
1982	wild	PR	4	11	5	3	
	LU	PR	7	59	1	2	0
	LU	HP	5	42	0	16	
1983	wild	PR	4	16	3	3	
	LU	PR	7	43	3	4	0
	LU	HP	6	24	0	9	
1984	wild	PR	5	22	1	3	
	LU	PR	6	34	0	4	0
	LU	HP	5	34	0	8	
1985	wild	PR	4	13	7	5	
	LU	PR	8	49	5	3	3
	LU	HP	5	22	0	9	
1986	wild	PR	4	17	9	0	
	LU	PR	7	53	7	3	6
	LU	HP	5	27	0	10	
1987	wild	PR	4	21	9	0	
	LU	PR	8	37	4	4	4
	LU	HP	4	19	0	12	
1988	wild	PR	4	8	4	0	
	LU	PR	6	64	8	8	11
	LU	HP	8	32	0	11	
1989	wild	PR	4	4	0	0	
	LU	PR	8	59	0	6	7
	LU	HP	10	62	0	22	
1990	wild	PR	3	3	1	0	
	LU	PR	9	45	0	5	2
	LU	HP	9	30	0	19	
1991	wild	PR	6	20	7	0	
	LU	PR	7	24	1	6	3

Table 1. (continued)

Year	Location ^b	Species ^c	N Laying pairs	N Eggs laid	N Fledglings produced		N PR captive deaths
					Wild	Captive	
1992	LU	HP	8	30	0	12	5
	RA	HP	9	45	0	6	
	wild	PR	6	18	10	1	
	LU	PR	8	38	0	0	
	LU	HP	8	29	0	7	
1993	RA	HP	10	53	0	14	1
	wild	PR	6		12	3	
	LU	PR	11		1	6	
	LU	HP	6		0	10	
1994	RA	HP	9	53	0	19	4
	wild	PR	6	18	12	2	
	LU	PR	11	61	1	4	
	LU	HP	11	38	0	9	
	RA	PR	4	19	0	2	
	RA	HP	13	59	0	23	0

^aDetailed breeding data available from author.

^bLU = Luquillo Aviary; RA = Río Abajo Aviary.

^cPR = Puerto Rican parrot; HP = Hispaniolan parrot.

1985 the captive Hispaniolan parrots (*Amazona ventralis*) maintained as surrogates at Luquillo Aviary have achieved a fecundity ranging from 0.82 to 3.0 Hispaniolan fledglings per egg-laying pair and average 1.67 Hispaniolan fledglings per total number of egg-laying pairs. The captive Hispaniolan average over the past 4 years is 1.41 Hispaniolan fledglings per fertile pair.

The 1994 pre-breeding season count of 38 wild Puerto Rican parrots remained short of the pre-Hugo high as did the post-breeding season count which, despite the net addition of 14 chicks to the wild flock, reported a maximum of 42 parrots in the August census (F. Vilella, USFWS unpub. rep.). The combined post-breeding season captive total was 71.

Río Abajo Aviary

Even before the 1989 Hurricane Hugo, the importance of dividing the captive flock to protect the species from natural disaster was realized, and through involvement of federal, commonwealth, and private agencies, a cooperative program between USFWS and DNRE was undertaken. Construction of a facility devoted to captive increase of the Puerto Rican parrot was begun. Conceived prior to the 1980s, it was not until August 1990 that breeding operations began at a new site in the Río Abajo Forest, an area where the Puerto Rican parrot existed in abundance before suffering greatly from hurricanes in 1899 and 1928, extensive deforestation between 1910–1920, collection for food, and sale as pets. Reports of small flocks of parrots in the area continued until about 1925, but the hurricane of 1928 is considered a likely cause of ultimate extirpation of the species in west-central Puerto Rico (Snyder et al. 1987).

Río Abajo Aviary is managed by the Bureau of Fish and Wild Life, Division of Ecology, of the newly reorganized DNRE with financial support from USFWS. Río Abajo Aviary is a fully equipped and staffed modern avicultural facility. It was established to ensure the preservation of genetic diversity of the species by providing protection from natural disasters and eventually, as breeding success permits, to return the species to former abundance in the wild. The Río Abajo Aviary is run under the "closed aviary" concept as a protection from avian diseases, human access to the premises is also strictly controlled.

The aviary extends over an area of about 1.2 ha. The entire perimeter is fenced, and includes a main aviary building with a well equipped avian hospital; artificial incubation and nursery rooms; residences for the resident aviculturists; volunteer quarters, which function foremost as a hardened physical area which can provide shelter for aviculturists and birds in case of a hurricane; and a holding building for housing birds during cleaning of the breeding areas and during hurricanes. A recently completed dedicated quarantine facility will permit isolation of sick birds or of new arrivals from the Luquillo captive flock. The aviary compound has its own water supply and backup generator. The Río Abajo Aviary currently includes 31 breeding cages and 3 flight cages, with additional caging and breeding areas planned as needed.

Río Abajo Aviary is founded on the principle of surrogate use, utilizing the closely related Hispaniolan parrot to assist in the incubation and rearing of Puerto Rican eggs and chicks. Through judicious use of replacement clutching techniques the number of Puerto Rican offspring produced per year may be greatly increased. Only Puerto Rican parrot pairs which are proven to be good parents by raising Hispaniolans are permitted to hatch and rear their own offspring at Río Abajo. The $1.2 \times 1.2 \times 2.4$ m breeding cages at Río Abajo mirror those used successfully for parrots by aviculturists world-wide. They are elevated approximately 1.3 m above the ground to provide a sense of security for the birds and effect protection from rats, and provide sheltered areas at both ends to give protection from excess rain and sun. Both hollowed palm-log and plywood nest enclosures are offered to each pair. Breeding cages are typically sited no less than 3 m apart in as natural a setting as can be provided, with vegetation barriers and cloth screening used as options to further enhance the privacy of each pair. Alternation of species within the cages can effectively increase the separation distance between pairs of the same species. The basic captive diet is a commercially pelleted formulation specially created for psittacines, supplemented with fresh fruits and vegetables and native foods from the forest.

Potential of Captive Management

The potential of captive breeding of the Puerto Rican parrot has never been the complete focus of captive management under the direction of the USFWS. Emphasis was placed on immediate increase of the wild flock, not the captive one (Wiley 1985, Lindsey et al. 1989), and from the beginning captive production was extensively siphoned off into the wild. The extent to which cap-

tive production was to be directed toward bolstering the wild population versus establishing a vigorous and productive captive population has remained at the center of debate (Wiley et al. 1991). In the first 3 years of captive production, 4 of the 5 chicks produced were returned to the wild. Since 1979 at least 25 Puerto Rican parrot chicks have been fostered to the wild, and three fledglings released. Because of the releases and other practices, contention developed early between aviculturists concerned for the conservation of the Puerto Rican parrot and USFWS biologists charged with captive production of the species. An assessment by Low (1984), an internationally recognized psittacine captive breeding specialist, was that basic techniques for increasing the species' numbers were not being carried out and that from the beginning the breeding program was administered by personnel lacking familiarity with psittacine husbandry and expertise in psittacine captive breeding. Their experience has been gained with one of the most critically endangered birds in the world.

Differences between the 2 groups may have centered on differing interpretations of the purpose of the captive management program; however, the detrimental "genetic bottleneck" suffered by the species also resulted from extended non-productivity within the captive group (Wiley et al. 1991, Wilson et al. 1994). Delays in the initiation of captive breeding can greatly reduce its chances of success (Wiley et al. 1991), and whether through genetic deterioration or inadequate husbandry techniques, the captive resource is of dubious value and of greatly constrained potential if it is not reproducing maximally. The best production year so far, 1993, yielded 13 wild-produced and 9 captive-produced offspring from 6 wild and 13 captive pairs, respectively (Vilella and Arnizaut 1994). Wild production continues to exceed captive production at Luquillo Aviary despite all the hazards of existence in the wild. Husbandry of a captive flock is presumed to eliminate detrimental factors through proper diet, veterinary care, predator control, and genetic management, thereby enhancing reproduction. Captive management should meet or exceed the reproductive success of the wild population.

Other factors that have contributed to low breeding success in the captive flock at Luquillo Aviary include husbandry shortcomings such as the effects of territorial aggression described as psychological castration (Lindsey et al. 1989) resulting from housing pairs too closely together, improper and delayed pairing (e.g., same-sex pairs were left together for years; 19 reproductively mature Puerto Rican parrots over 3 years of age were not set up for breeding in 1994), flock-disruptive artificial insemination research that retarded or eliminated breeding in nearly all captive pairs (Snyder et al. 1987:267), and experiments with double and sequential clutching (Snyder et al. 1987:266-267) which kept the captive parrots continually disturbed. Behavioral problems such as nervousness and aggressiveness have plagued the captive production effort (Wiley 1985, Snyder et al. 1987). Such behaviors may result from excessive disturbance or handling of parrots due to the frequent nest checks and research (including morphometric) studies (J. Rodríguez-Vélez and A. Smith, pers. commun.) which

were conducted and can contribute measurably to decreased reproductive success.

Of at least 175 fertile Puerto Rican parrot eggs produced at the Luquillo Aviary since 1978, 113 chicks resulted (a 65% chick/fertile egg ratio), of which 24 went to the wild, 57 were retained in captivity, and 32 died before fledging, remaining unreflected in captive population numbers. In addition, 16 wild chicks have been added to the captive population and 11 adult birds over 3 years of age have died there. Persistent return of offspring to the wild, and especially the return of so many offspring early in the program when the known survival rate for all fledglings was only 1 in 3 for the first year of a formerly-captive bird in the wild (Snyder et al. 1987) undermined the success of the captive program. Only two of the released birds likely became breeding members of the wild flock (Brock and White 1993). Because the sex ratio of the original captive founder flock of 15 Puerto Rican parrots was 1 male to 2 females, captive production was probably retarded by the prolonged imbalance which resulted. The captive population ultimately proved to be the repository of genotypes no longer in the wild (Wiley 1980, 1985; Snyder et al. 1987), yet these genes did not increase due to absence of mates. Additional wild chicks were eventually taken captive and some captive-produced chicks were retained, but at the additional delay of several years to attain reproductive maturity.

The objective of the Río Abajo Aviary is to apply avicultural techniques of management to achieve the potential numerical increase possible within the captive population. The Río Abajo Aviary received the first of its 12 Puerto Rican parrots on 30 April 1993. However, the necessities of quarantine and pair-bonding made it too late for breeding that year. Río Abajo Aviary has, in its 4-year experience of captive management of the surrogate and similar Hispaniolan parrot, reached a success of 53% fertility of all eggs produced, hatching and fledging 39% of all eggs laid, and up to 74% of all fertile eggs, for production ratios of up to 2.22 fledged chicks per total number of pairs and 2.55 per fertile pair annually. In 1993 and 1994 the 13 fledglings which resulted annually from 6 fertile pairs of wild Puerto Rican parrots represented an average reproductive rate of 2.17 per fertile pair.

Aviculturists at Río Abajo Aviary facilitated the formation of 4 pairs within the first year from 10 unpaired birds, and 3 of 4 egg-laying pairs produced a total of 6 fertile eggs resulting in 2 Puerto Rican parrot fledglings. Production numbers for the Puerto Rican parrot in 1994 at Río Abajo Aviary are comparable to the first-year production experience for the Hispaniolan parrot, and approximate 1994 Luquillo Aviary figures at 32% fertility and 11% chicks fledged per total number of eggs produced. As the birds become more settled, have time to accrue the benefits of a well-managed and stable captive environment, and as the behavior and tolerance for manipulation of each pair becomes better known to the Río Abajo aviculturists, these numbers are expected to increase appreciably, as has been the case with the Hispaniolan parrots. The number of fertile pairs of captive Hispaniolan parrots at Río Abajo increased from 6 to 9 between 1991 and 1994, and the number of fledglings from 6 to 23, respectively. If suc-

cessfully imposed on the Puerto Rican parrot, such demonstrated production increase at the Río Abajo Aviary portends a brighter future for the species recovery effort. In fact, the first Puerto Rican parrot offspring produced at Río Abajo Aviary resulted from 8- and 9-year-old birds, neither of which had ever reproduced.

Based on the assumptions of starting with 4 fertile pairs, averaging only 1 chick per pair per year, and retaining all offspring for future captive production, after 5 years there could be 10 pairs and 24 immatures comprising the captive population; in 10 years, 37 pairs and 87 immatures; in 15 years, 145 pairs and 349 immatures. These calculations are based on an average minimum increase of only 1 chick per pair per year (a number consistently exceeded at Luquillo) and sexual maturity being reached at 3 years of age (Río Abajo has successfully produced chicks from 2-year-old Hispaniolan Amazons). The potential for reintroduction and forming additional wild flocks by captive propagation of more than 100 birds annually makes a strong case for the potential contribution of captive management.

The Puerto Rican parrot has continued to survive against all odds, but a species recovery program should race headlong toward accomplishing its goal. Captive breeding, once implemented, should be permitted to achieve its full potential toward safeguarding species survival and ensuring recovery through strong numeric increase. There is increased hope toward that objective for the Puerto Rican parrot in the form of the Río Abajo Aviary.

Literature Cited

- Brock, M. K. and B. N. White. 1993. The Puerto Rican parrot: Genetic assessment of the captive breeding program. *Watchbird* 20:58-63.
- Lindsey, G. D., W. Arendt, J. Kalina, and G. W. Pendleton. 1991. Home range and movements of juvenile Puerto Rican parrots. *J. Wildl. Manage.* 55:318-322.
- , M. K. Brock, and M. H. Wilson. 1989. Current status of the Puerto Rican Parrot Conservation Program, wildlife management in the Caribbean islands. *Proceedings of the Fourth Meeting of Caribbean Foresters, 1989. U.S. For. Serv., Inst. Tropical For. and the Caribbean Natl. For., Río Piedras, Puerto Rico.* 129pp.
- Low, R. 1984. *Endangered parrots.* Sterling Publ. Co., New York. 160pp.
- Meyers, J. M., F. J. Vilella and W. C. Barrow, Jr. 1993. Positive effects of Hurricane Hugo: Record years for Puerto Rican parrots nesting in the wild. *U.S. Dep. Int., Fish and Wildl. Serv. Endangered Species Tech. Bul.* 18(1).
- Vilella, F. J. and A. B. Arnizaut. 1994. Making the best of Mother Nature: Managing the Puerto Rican parrot after Hurricane Hugo. *Endangered Species Tech. Bul.* 19(2).
- Snyder, N. F. R., J. W. Wiley, and C. Kepler. 1987. *The parrots of Luquillo: Natural history and conservation of the Puerto Rican parrot.* Western Found. Vert. Zoo., Los Angeles. 384pp.
- Wiley, J. W. 1980. The Puerto Rican parrot (*Amazona vittata*): its decline and the program for its conservation. Pages 133-159 in R. E. Pasquier, ed., *Conservation of new world parrots.* Internatl. Counc. for Bird Preserv. Tech. Publ. No. 1, Smithsonian Inst. Press, Washington, D.C.

- . 1985. Bird conservation in the United States Caribbean. Pages 107–159 in Stanley A. Temple, ed., *Bird Conservation 2*. Internatl. Counc. for Bird Preserv., Univ. Wis. Press.
- , N. F. R. Snyder, and R. S. Gnam. 1991. Reintroduction as a conservation strategy for parrots. Pages 165–200 in S. Beissinger and N. F. R. Snyder, eds., *Crisis in new world parrot conservation*. Smithsonian Press, Washington, D.C.
- Wilson, M. H., C. B. Kepler, J. W. Wiley, N. F. R. Snyder, J. M. Wunderle, Jr., A. E. Lugo, S. R. Derrickson, D. L. Graham, F. J. Dein, and W. D. Toone. 1994. Puerto Rican parrots and potential limitations of the metapopulation approach to species conservation. *Conserv. Biol.* 8:114–123.