J. Field Ornithol., 63(4):466-472

NEST GUARDING FROM OBSERVATION BLINDS: STRATEGY FOR IMPROVING PUERTO RICAN PARROT NEST SUCCESS

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Abstract.—The effectiveness of 17 yr of nest guarding from observation blinds for increasing reproductive success of the endangered Puerto Rican Parrot (*Amazona vittata*) is described. As personnel and time allowed, active nests were guarded part-time during the nest site-exploration and selection stage of the breeding cycle, and part-time to full-time when a nest contained eggs or chicks. Biologists identified nine categories of threat to the success of parrot nests. Since 1973, a minimum of 20 nests, which otherwise would have failed, successfully produced fledglings as a direct result of nest guarding and intervention. Nest success averaged 66% with nest guarding compared to an estimated 38% without guarding. Nest guarding from blinds can help maintain a wild population of a critically endangered species while other management techniques are being developed to stimulate population growth.

VIGILANCIA DE NIDOS DESDE ESCONDITES: ESTRATEGIA PARA MEJORAR EL ÉXITO DE ANIDAMIENTO DE *AMAZONA VITTATA*

Sinopsis.—En este trabajo se describe la efectividad de la vigilancia (por 17 ãnos) desde escondites, para incrementar el éxito reproductivo de la amenazada con desaparecer, Cotorra de Puerto Rico (*Amazona vittata*). De la manera que lo permitiera el tiempo y la disponibilidad de personal, los nidos activos fueron vigilados a tiempo parcial, durante el periodo de exploración de sitios para anidar, y la etapa de selección de estos; a tiempo parcial y a tiempo completo cuando los nidos contenían huevos o pichones. Los biólogos identificaron nueve categorías de amenazas al éxito reproductivo de las cotorras. Desde el 1973, un mínimo de 20 nidos, que de otra forma hubieran fracasado, produjeron volantones como resultado directo de la vigilanca e intervenciones necesarias. El éxito de anidamiento promedió 66% en los nidos vigilados, comparado con un estimado de 38% en los nidos sin vigilancia. La vigilancia de nidos desde escondites, puede ayudar a mantener una población, mientras se desarrollan otras técnicas que estimulen el crecimiento poblacional.

Management of endangered bird species involves addressing factors limiting survival and productivity in the population (Temple 1977). The endangered Puerto Rican Parrot (*Amazona vittata*) is an example of a secondary cavity-nesting species that has suffered from high mortality, especially during the mid-1960s, and from consistently poor productivity (Wiley 1981). Factors affecting productivity of the parrot include nest-site limitation (Snyder 1977) and failure of active nests (i.e., nests with eggs or chicks). The Puerto Rican Parrot exhibits strong nest-site tenacity (Snyder et al. 1987) and will reuse the same nest tree in successive years. Nests are subject to a number of threats, including nest-robbing of eggs and chicks by humans, inadequate and wet nest cavities, predation of eggs and chicks by Pearly-eyed Thrashers (*Margarops fuscatus*) and black rats (*Rattus rattus*), predation of immatures and adults by Red-tailed Hawks

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(*Buteo jamaicensis*), and parasitism of chicks by warble flies (*Philornis pici*) (Rodriguez-Vidal 1959; Snyder and Taapken 1977; Snyder et al. 1987; Wiley 1981, 1985). Between 1954 and 1956, five of 16 (31%) parrot nests found in the egg or chick stage fledged young (Rodriguez-Vidal 1959). Between 1955 and 1972, the success rate of 19 nests found in the egg stage only was 11–26% and the annual production of young per active nest averaged 0.26–0.58 (Snyder et al. 1987).

Nest guarding by observers in blinds was developed to improve Puerto Rican Parrot nest success and productivity (Wiley 1981, 1985). Guarding of nests began in 1973 when biologists started dawn-to-dark observations of active nests ($n = 2$) as part of studies of parrot breeding biology. As personnel and time allowed, guarding of nests has continued each year thereafter. Wiley (1981) recommended all Puerto Rican Parrot nests be guarded whenever possible during nesting activities. In 1987, the Puerto Rican Parrot Working Group recommended that nest guarding not drop below 40% of the nest days (a nest day is a day in which a nest contained eggs or chicks) (U.S. Fish and Wildlife Service 1987). Here I report the results of 17 yr of nest guarding to improve reproductive success of the Puerto Rican Parrot.

STUDY AREA AND METHODS

The study area was in the Caribbean National Forest, an 11,330-ha subtropical rainforest centrally located in the Luquillo Mountains of northeastern Puerto Rico. The Luquillo Mountains, which encompass 19,648 ha and range in elevation from about 100 to 1075 m, are dissected with steep upper slopes. Five ecological life zones, ranging from subtropical moist forest to subtropical lower montane rainforest, are found in the mountains (Ewel and Whitmore 1973). Annual rainfall ranged from 300 cm in the foothills to >500 cm on the higher peaks. The annual average temperature is about 21 C (range 11–32 C). Detailed descriptions of the Luquillo Mountains were published by Wadsworth (1949) and Odum and Pigeon (1970).

Puerto Rican Parrot nests were at elevations ranging from 490 to 665 m in cavities of palo colorado (*Cyrilla racemiflora*) and laurel sabino (*Magnolia splendens*) trees. Cavity heights above ground level averaged 9.2 ± 3.6 (SE) m ($n = 9$, range = 6.1–16.8 m). Permanent 1.2 × 2.4 × 2.1-m observation blinds with plywood floors, burlap cloth sides lined inside with plastic and corrugated metal roofs were located 15–30 m from nest trees.

Observers in blinds guarded all known parrot nests each year from 1973 through 1989 during the breeding season (January through June). Before 1987, only staff biologists and technicians guarded nests. Starting in 1987, volunteers recruited first through the National Audubon Society (MacPherson and Tilt 1987) and later through the Student Conservation Association, assisted with nest guarding. Nest guarding procedures were developed over the years as data on parrot breeding behavior and factors limiting nest success were obtained (Wiley 1981). Observers guarded

TABLE 1. Nine categories of threats to nest success identified during nest guarding and number of Puerto Rican Parrot (*Amazona vittata*) nests affected, Luquillo Mountains, Puerto Rico, 1973–1989.

Category	Number of Nests[a]		
	1973–1979 (n = 25)	1980–1989 (n = 46)	Total (n = 71)
Natural deterioration of nest cavities	7	17	24
Wet nest cavity	6	14	20
Internal ladder destroyed by parrots	1	0	1
Rain visor dislodged, partially blocking cavity entrance	0	1	1
Hole developed in side of cavity	0	1	1
Termites in cavity	0	1	1
Predators	13	8	21
Pearly-eyed Thrasher	6	5	11
Red-tailed Hawk	2	1	3
Black rat	4	1	5
Puerto Rican boa (*Epicrates inornatus*)	0	1	1
Unidentified	1	0	1
Parasites	6	13	19
Soldier fly	0	9	9
Warble fly	6	4	10
Inadequate care	1	13	14
Chicks/eggs not properly attended	0	8	8
Breeding female injured	1	1	2
Member of breeding pair died	0	3	3
Chicks died in nest	0	1	1
Eggs not viable	2	8	10
Poor growth of chicks	0	8	8
Unsuccessful fledging of chicks	2	1	3
Human intrusion at nest site	1	2	3
Competition with another breeding pair	1	0	1

[a] Some nests were affected by more than one type of threat.

nests part-time during the exploration and nest site-selection stage (mid-January to mid-February) and part-time to full-time from egg-laying through fledging of the nestlings (mid-February through June). Part-time coverage included half-day (dawn-to-noon; 5–7 h) observations or full-day (dawn-to-dark; 14 h) observations one to several days per week. Full-time coverage included daily dawn-to-dark (14 h) observations of each active nest.

During all years, nest guards recorded breeding behavior of each pair, conducted periodic inspections of the nest cavity, observed for problems at the nest cavity, and responded to emergencies. During 6 yr (1981, 1985–1989), we collected data on the total number of nest days and days of guarding to determine the intensity of guarding. Nest guards inspected nests when the female was out of the nest to determine when the first egg was laid, number of eggs in the clutch, fertility of eggs, dates of hatching and fledging, growth and physical condition of the chicks, and the status of the nest cavity (i.e., cavity dry, no light or water leaks,

TABLE 2. Intensity and results of nest guarding efforts at Puerto Rican Parrot (*Amazona vittata*) nests, Luquillo Mountains, Puerto Rico, 1981, 1985–1989.

	1981	1985	1986	1987	1988	1989
No. active nests	4	4	4	4	4	5
No. of nest days	301	349	299	331	257	425
Days of observation	55	154	180	294	242	354
% nest days monitored	18	44	60	89	94	83
% nest days w/problems	10	14	13	6	10	5
No. nests successful						
With guarding	3	4	2	3	2	4
Without guarding[a]	2	4	0	3	1	4

[a] Nest success without guarding estimated based on evidence indicating that nest failure would have occurred.

presence of parasites). Inspections were conducted once per week during the incubation period and a maximum of three times per week during the chick stage.

A nest was considered successful (i.e., at least one fledgling produced) because of guarding if it was subjected to a threat that was known to cause nest failure in past years and required intervention by guards to correct the problem.

RESULTS

Nine categories of threat to nest success have been identified during >30,000 h of observations (Table 1). Since 1981, the percentage of nest days with such threats averaged 9.4 (range = 5–14) (Table 2). Nest guards monitored active nests during 65% (range = 18–94) of nest days and spent up to 4956 h (354 nest days) per year in observation blinds.

Threats to nests identified during guarding caused embryonic mortality and the injury or death of chicks that resulted in fewer fledglings per nest or total nest failure. From 1973 through 1989, a minimum of 20 from a total 71 active nests, which otherwise would have failed, successfully fledged young as a direct result of guarding. Nest success averaged 66% (47/71) with guarding compared with an estimated 38% (27/71) without guarding.

From 1973 to 1979, nine of 25 (36%) active nests were saved by guarding (Snyder et al. 1987). These nests included six with wet cavities, two with eggs or chicks preyed on by Pearly-eyed Thrashers, and one with chicks threatened by a Red-tailed Hawk. In three additional nests that guards determined would have been successful without intervention, three chicks parasitized with warble fly larvae and one chick injured by a black rat survived because of emergency actions by guards.

From 1980 to 1989, 11 of 46 (23%) active nests were saved by guarding and fledged 20 parrots (average of 1.8 parrots per active nest). These nests included seven with inviable eggs (captive-raised or wild-produced chicks were fostered into these nests), three with wet cavities (one also

had a member of the breeding pair die), and one infested with soldier fly (*Hermetia illucens*) larvae. Two additional nest cavities found with wet bottoms during the nest site-exploration and selection stage of the breeding cycle were repaired by guards. Breeding pairs nested in these two cavities the same year that improvements were made. In eight other nests where guarding and intervention did not affect nest success, 10 chicks and one egg survived because of emergency action by the guards. The 10 chicks included five for which breeding females could not adequately care after their mates died, two that were unable to compete with their nest mates, two infested with warble fly larvae and one that fell to the ground when it fledged prematurely. The viable egg hatched in captivity after it was removed from a nest that had been abandoned.

DISCUSSION

Research and management conducted during the last 40 yr have prevented the extinction of the Puerto Rican Parrot. Since 1975, the wild flock has been increasing at an annual rate of 1.6 parrots (Lindsey et al. 1989). In 1989, the prebreeding population was 36 birds. Nest succcess has increased from an estimated annual rate of 11–26% before 1973 (Snyder et al. 1987) to 66% for 1973–1989. With a wild population of 36 parrots, an average of only four pairs breeding per year, and an annual survival rate of nonbreeding parrots of 65% (Snyder et al. 1987), however, it is vital that a high reproductive rate be maintained and that the number of breeding pairs in the wild be increased. The longer the effective size of the wild population remains small, the more rapid the loss of heterozygosity (Chesser et al. 1980), which might lead to genetic depression.

Although nest success without guarding could have been underestimated (i.e., some nests may have been successful without intervention), evidence obtained by guards indicated that nest failure would have otherwise occurred. The two major sources of mortality in saved nests were inviable eggs (seven nests) and wet nest cavities (nine nests). Water entered nest cavities through exposed cavity entrances, through holes that developed in cavity walls and from gravitational flow of water inside the stem. Examples of the danger of wet cavities to nest success include feathers of three nestlings in one nest covered with slime that rendered them incapable of flight (Snyder et al. 1987), chicks in one nest drowned when the nest flooded (Rodriguez-Vidal 1959), and eggs in two nests buried or covered with a thick, brownish muck.

Nest guarding is one of 12 procedures included in a management program directed toward improving reproductive success of the parrot (Lindsey et al. 1989; Wiley 1981, 1985). Four of these procedures (replacement clutching, fostering of captive-raised chicks into wild nests, "evening out" of broods and clutches among nests, and removal of eggs and nestlings from nests during periods of endangerment), along with emergency repairs of nest cavities, were used to save endangered nests identified during guarding. Three other procedures (rat control and sexing and marking of nestlings) require information obtained by guards to

determine the optimal time for implementation. These management procedures, along with procedures to reduce interspecific and intraspecific nest competition (i.e., improvement and maintenance of existing nest cavities, establishment of additional parrot nest cavities, establishment of alternative nest sites for the Pearly-eyed Thrasher, and protection of nests against honeybee takeovers), are undoubtably responsible for the Puerto Rican Parrot's present level of reproductive success.

Nest guarding from observation blinds can help maintain a wild population of a critically endangered bird species while procedures such as reduction of nest-site limitations (Snyder 1977), translocation of captive-reared individuals (Griffith et al. 1989) and integrated management techniques (Plunkett 1977) can be developed to stimulate population growth. In particular, nest guarding from blinds would be advantageous with other critically endangered bird species with small effective population sizes that exhibit a preference for traditional nest-sites and where previous nesting success plays a role in nest site selection during future nesting seasons.

ACKNOWLEDGMENTS

I thank the many U.S. Fish and Wildlife Service, U.S. Forest Service and Puerto Rico Department of Natural Resources personnel and volunteers who assisted in nest guarding. The National Audubon Society and Student Conservation recruited volunteers for the nest guarding program. Dr. James W. Wiley, Dr. Marcia Wilson and Paul W. Sykes, Jr. provided valuable suggestions for improvements of earlier versions of this paper.

LITERATURE CITED

CHESSER, R. K., M. H. SMITH, AND I. L BRISBIN. 1980. Management and maintenance of genetic variability in endangered species. 1980 Int. Zoo Yearbook 20:146–154.

EWEL, J. J., AND J. L. WHITMORE. 1973. The ecological life zones of Puerto Rico and U.S. Virgin Islands. U.S. For. Serv. Res. Pap. ITF-18. U.S. Dep. Agric., For. Serv., Inst. Tropical Forestry, Rio Piedras, Puerto Rico. 72 pp.

GRIFFITH, B., J. M. SCOTT, J. W. CARPENTER, AND C. REED. 1989. Translocation as a species conservation tool: status and strategy. Science 245:477–480.

LINDSEY, G. D., M. K. BROCK, AND M. H. WILSON. 1989. Current status of the Puerto Rican Parrot conservation program. Pp. 89–99, *in* A. E. Lugo, and L. B. Ford, eds. Wildlife management in the Caribbean Islands, Proc. Fourth Meeting of Caribbean Foresters. U.S. Dep. Agric., U.S. For. Serv., Inst. of Tropical Forestry and the Caribbean Natl. For., Rio Piedras, Puerto Rico.

MACPHERSON, S. L., AND W. C. TILT. 1987. *Amazona vittata*: a status report for 1987. Parrotletter 1(1):8–9.

ODUM, H. T., AND R. F. PIGEON (Eds.) 1970. A tropical rainforest: a study of irradiation and ecology at El Verde, Puerto Rico. Washington, D.C., U.S. At. Energy Comm. 1500 pp.

PLUNKETT, R. L. 1977. Integrated management of endangered birds: a review. Pp. 387–396, in S. A. Temple, ed. Endangered birds: management techniques for preserving threatened species. Univ. Wisconsin Press, Madison, Wisconsin.

RODRIGUEZ-VIDAL, J. A. 1959. Puerto Rican Parrot (*Amazona vittata vittata*) study. Monogr. Dep. Agric. Comm. Puerto Rico No. 1. 15 pp.

SNYDER, N. F. R. 1977. Increasing reproductive effort and success by reducing nest-site limitations: a review. Pp. 27–33, *in* S. A. Temple, ed. Endangered birds: management techniques for preserving threatened species. Univ. Wisconsin Press, Madison, Wisconsin.

———, AND J. D. TAAPKEN. 1977. Puerto Rican Parrots and nest predation by Pearly-eyed Thrashers. Pp. 113–120, *in* S. A. Temple, ed. Endangered birds: management techniques for preserving threatened species. Univ. Wisconsin Press, Madison, Wisconsin.

———, J. W. WILEY, AND C. B. KEPLER. 1987. The parrots of Luquillo: natural history and conservation of the Puerto Rican Parrot. Western Foundation of Vertebrate Zoology, Los Angeles, California. 384 pp.

TEMPLE, S. A. 1977. The concept of managing endangered birds. Pp. 3–8, *in* S. A. Temple, ed. Endangered birds: management techniques for preserving threatened species. Univ. Wisconsin Press, Madison, Wisconsin.

U.S. FISH AND WILDLIFE SERVICE. 1987. Recovery plan for the Puerto Rican Parrot, *Amazona vittata*. U.S. Fish Wildl. Serv., Atlanta, Georgia. 69 pp.

WADSWORTH, F. H. 1949. The development of forest land resources of the Luquillo Mountains, Puerto Rico. Ph.D. thesis, Univ. Michigan, Ann Arbor, Michigan. 481 pp.

WILEY, J. W. 1981. The Puerto Rican Parrot (*Amazona vittata*): its decline and the program for its conservation. Pp. 133–159, *in* R. F. Pasquier, ed. Conservation of new world parrots: Proc. ICBP Parrot Working Group meeting, St. Lucia, 1980. Smithsonian Institute Press, Washington, D.C.

———. 1985. The Puerto Rican Parrot and competition for its nest sites. Pp. 213–223, *in* P. J. Moors, ed. Conservation of island birds: case studies for the management of threatened island birds. Cambridge, England, August 1982. ICBP Tech. Publ. 3.

Received 9 Nov. 1990; accepted 31 Dec. 1991.

TIOF ENDOWMENT FUND PROPOSAL

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Applicants should submit a proposal outlining their project and the intended use of the funds by December 31, 1992. The grant will be awarded on March 31, 1993. Please send a project description of no more than two pages. Also provide an itemized estimate of expenses and the name, address and phone number of the graduate supervisor. Send applications to: TIOF, Endowment Fund, P.O. Box 250, Sanibel, Florida 33957-0250 USA.