

Reproduction in Dominican Amazon Parrots – Implications for Conservation

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Abstract

Bi-parental care is described in one Red-necked Amazon (*Amazona arausiaca*) parrot nest and one Imperial Amazon (*A. imperialis*) parrot nest from the Morne Diablotin area on Dominica. Both Red-necked and Imperial parents provided vigilant care from hatching to post-fledging. Male and female Red-necks fed chicks in the nest from dawn until dusk, unlike the Imperial parents, in which the male regurgitated only to the female, never entering the nest cavity unless the female was within. Large clutch size, strong bi-parental care, and range expansion into agricultural areas bear upon conservation strategies for Red-necked Amazons, and are discussed in light of population resilience following disturbance. In contrast, bi-parental care may be requisite to successful recruitment in the critically endangered Imperial Amazon, reproduction in which has yet to be fully described. Conservation of Dominica's endemic parrots prioritizes continued habitat protection via protected areas and a broader scope of *in situ* research.

Enigmatic by virtue of their rarity, the



Photos courtesy of Paul Reillo

First time ever footage of wild Sisserou nesting. First active nest discovered in 10 years. Discovered May 1999.

endemic Amazon parrots of Dominica, the Red-necked (*Amazona arausiaca*) and Imperial (*A. imperialis*, Dominica's national bird), known locally as the Jaco and Sisserou, respectively, have been of continuous ornithological and conservation interest since the mid-1970's. The Jaco, a gregarious and vocal parrot, though threatened, is well distributed across Dominica's rain forests, particularly in areas adjacent to agriculture where it has been implicated in seasonal citrus crop destruction (Evans 1988, Durand and Zamore 1996). The shy and elusive Sisserou is highly endangered, since 1979 confined to mature rain forest between 600-1100 m elevation on the slopes of Morne Diablotin in Dominica's Northern Forest Reserve (Gregoire 1981; Collar et al. 1992). Accessing foraging and nesting areas in mountainous terrain and dense forest cover has proven historically difficult for researchers. Quantitative information about population sizes and life histories is scant, and ecological specu-

lation, much of it conflicting, surrounds both species (Collar et al. 1992). Ecological data on Jaco and Sisserou parrots derive primarily from field observations by researchers working with Dominica's Forestry Division (Durand and Zamore 1996). Jaco reproduction in natural nest cavities was documented only recently (Reillo et al. 1999), while Sisserou eggs and chicks remain undescribed.

Sisserou and Jaco parrots have become prominent flagship species for Dominica's imperiled oceanic rain forest ecosystems, recently inspiring the creation of the Morne Diablotin National Park, which complements the Morne Trois Pitons and Cabrits National Parks within Dominica's National Parks System (Reillo 2000). Morne Diablotin National Park encompasses vital parrot habitat, providing research opportunities in protected areas. As quantitative life history information is fundamental to developing effective parrot conservation strategies,

here we document reproduction in wild Jacos using time-lapse video surveillance, and discuss bi-parental care and recruitment. The first successful Sisserou reproduction to be observed since 1989 is also described.

Methods

Jaco Observations

In February 1998, a time-lapse video surveillance system was installed 25 m from an active Jaco nest tree located in the Syndicate Estate area 2 km southwest of Morne Diablotin. This tree was discovered by Dominica's Forestry Division in 1996 and has been monitored since. Details about the tree and nest cavity can be found in Reillo et al. (1999). Activity near the nest cavity entrance was video-recorded from 6 February-4 May 1998 using a 12-volt DC, VHS time-lapse recorder coupled to a digital, color video camera with a wide-angle, auto-iris lens. The recorder was set to 24-hr mode and programmed to record daily over a 12-hour photo-period. Start and stop times were adjusted during the season to match dawn and dusk. Cassettes, each holding two consecutive days of recording, were changed between dusk and dawn every second day. Power for the system was supplied by a rechargeable, 1200 amp-hour, deep-cycle battery, changed weekly.

Tapes were reviewed in slow-motion playback. The precise times when parent birds entered or exited the nest cavity was noted from dates and times encoded on the recorded tapes. Time spent in the nest cavity during each visit was calculated from these entrance and exit times, collated on a Microsoft Excel 97 SR-1 spreadsheet, and compiled for statistical analysis and graphical presentation using StatView 5 for Windows (SAS Institute 1998). Means are accompanied by ± 1 standard error of the means.

Sisserou Observations

Sisserous were observed directly over the period 25 March-6 June 1999 from a lookout point ~100 m from a Chataignier (*Sloanea caribaea*) nest tree located on the southwest slope of Morne Diablotin. Notes taken during



Dominica's second threatened amazon Parrot, the Red-necked or Jaco Parrot. Photo taken at Parrot Aviary, Roseau, Dominica.

monitoring sessions of less than four hours each were compiled for descriptive purposes. On 7 October 1999, during the non-breeding season, the cavity was inspected using tree-climbing equipment and single-rope technique (Jepson 1997).

Results

Jaco Nest Tree

Periodic monitoring of the nest tree revealed Jacos mating nearby during the first week of January 1998, with the female spending many daylight hours in the cavity from 8-15 January. Sexes were readily distinguished by mating behavior (male to the rear and side,

with right foot on female's back), size (male larger), and method of entering the cavity (female always entering head-first, male always turning around at the opening and entering tail-first). Early observations suggested that the female was incubating eggs through the end of January, with hatching likely over the period 5-12 February, based upon known incubation times for similarly sized Amazona species (Forshaw 1989; Jordan 1989; Schubot et al. 1992). Time-lapse recording commenced on 6 February. Intra-cavity video inspections in early April detected two live chicks ~8 weeks old and a deceased chick ~5 weeks old at time of death (Reillo et al.

1999). The first chick fledged just before dawn on 6 May (no video) and the second at 0634 h EST on 9 May (captured on video). Observations suggest a hatch-to-fledge time of 93 days.

A total of 33,846 minutes were video-recorded over 56 days at the Jaco nest tree. Several significant gaps in the video record caused by equipment failure and weather demanded that analyses be restricted to cavity visits of known duration by each parent. Only visits that could be clearly observed, with entrances and exits that could be assigned to a parent with certainty, were used. The resultant data include the number of minutes spent inside the cavity per visit, coded by time of entrance, date, and parent identification.

Both parents were dutiful in providing food for chicks from hatching through fledging. Up until 24 February, the male fed the female outside the cavity, typically in a nearby tree. Thereafter, he entered the cavity to either regurgitate directly to the chicks or to the female; chicks were fed directly when the female was absent. The hen was clearly vigilant in providing support, and stayed with the chicks in the nest cavity from dusk to dawn until the last chick fledged on 9 May. Within 10 days of fledging, chicks appeared at the cavity entrance and were often fed there by the female. From mid-April through fledging, both parents' arrivals were greeted with loud begging calls by chicks; begging was not heard when parents were absent. Bi-parental care continued post-fledging, with both parents observed foraging and roosting with the juveniles through July.

Nest visits by the male were significantly shorter in duration (15.1 ± 1.3 min, $n = 241$) than those by the female (46.1 ± 3.1 min, $n = 352$) throughout the recording period ($F = 28.509$, $df = 1$, $P < 0.0001$, ANOVA). Male visits did not significantly vary in duration over the course of the breeding season ($F = 0.524$, $df = 1$, 239, $P = 0.47$, ANOVA), unlike female visits, which became significantly shorter with time ($F = 250.2$, $df = 1$, 350, $P < 0.0001$, ANOVA). Both sexes shortened their visits from dawn to dusk each day (for male, $F = 6.97$, $df = 1$, 239, $P = 0.01$; for female, $F = 8.24$, $df = 1$, 350, $P = 0.004$; ANOVA).

Sisserou Nest Tree

On 25 March 1999, a female Sisserou was seen entering a cavity 24 m from the ground in a Chataignier (*Sloanea caribaea*) on the Syndicate Estate side of Morne Diablotin; the mate perched nearby. The nest tree, over 65 m in height, ~3 m dbh, and branching over 50 m in canopy diameter, was located on a gently sloping plateau of primary rain forest at 785 m elevation. The main trunk was heavily overgrown with epiphytes, mostly bird-nest *Anthurium* (*A. bookeri*), *Clusia* vine and opportunistic *Ficus*. The cavity entrance, facing south, was cloaked beneath several large *Anthurium*, and consisted of a deep, weathered depression ~0.3 m in diameter at the first major crotch of the tree, where a large limb had broken from the tree's central trunk years before. Direct inspection of the cavity was hampered by vegetation, and since this was the first active Sisserou nest tree to be located in 10 years, a conservative investigative approach was

adopted. Without disturbing the cloaking vegetation, we determined that the chamber narrowed toward the center of the tree within 0.5 m of the entrance, and then turned sharply downward. No attempts were made to probe the cavity or measure dimensions out of concern that we would impact surrounding vegetation and alter the appearance of the nest site.

The nest tree was monitored weekly with observation sessions of four hours or less. A total of 14 sessions, spanning 1,492 min was logged from 25 March-6 June. Copulation, lasting several min, was observed at 0840 h on 25 March on a large limb of the nest tree, 25 m from the ground. The position assumed for mating was typical of other *Amazona* species: female lordosed with both feet gripping, male positioned behind and to the female's left with his right foot on the female's back. On 21 April, the male was observed entering the cavity, confirming successful incubation and the presence of one or more chicks. Loud begging calls from a chick lasting ~4 min were heard at 1659 h and again at 1746 h on 21 May, indicating a well-developed nestling within. The nest was abandoned on 6 June, at which time two adult Sisserous and a single, clumsy juvenile, presumed to be the family from the nest tree, were detected ~300 m up-slope in a Gommier tree (*Dacryodes excelsa*).

Throughout the season, activity was greatest at the tree in the early daylight hours, 0630-1000, with the male frequently visiting the nest vicinity to regurgitate to the female. Such feeding bouts lasted several minutes, with up to 10 regurgitations each. Both parents also rested and stretched for up to 15 minutes at a time on small branches (typically *Ficus*) near the cavity entrance. After 21 April, the male continued to regurgitate to the female outside the cavity entrance but also entered the cavity, staying no longer than 15 minutes (one observation) and typically 7 minutes or less (9 observations). The male never entered the cavity unless the female was within, suggesting he always regurgitated to the female, who fed the chick(s). Twice we witnessed territorial defense by both parents against a Jaco perching

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within 30 m of the nest tree: both birds vocalized loudly and chased the intruder for several hundred meters before returning to the nest tree.

Discussion

The inaccessibility of parrot habitat, and nest trees in particular, has limited the scope of quantitative research on Jacos and Sisserous. Since 1981, Forestry officers with Dominica's Parrot Monitoring Program have located dozens of nest cavities, but confirmed activity in or around only 12 since 1994 (9 Jaco, 3 Sisserou). Parrot nest searches are extremely time-consuming and require extended days in remote forest areas (Durand and Zamore 1996). Prior to video surveillance and video probes, observations were made from blinds placed near nest trees; reproductive success had to be inferred from parent behaviors unless fledging was witnessed. Current technological challenges, such as the need for transportable, efficient power sources for remote video systems, and stiff, telescoping masts for video probes that can reach 30 m, compel direct observation for most parrot studies on Dominica. However, where feasible, video surveillance provides valuable insights into parrot life histories.

Bi-parental care is a crucial component to recruitment, with parents at our study Jaco nest actively engaged in care and feeding of young from hatching to well past fledging. The most severe limitation of our study is the incomplete video record, which precludes analyzing parents' visitation frequencies over time. Still, visitation duration provides a valuable index of parental care, and sheds light on Jaco fledging success. The male's uniform allocation of time within the cavity over the course of the season contrasts sharply with the hen's significant decrease in visit duration. A reduction in visitation time over the season would be expected, driven by chicks' growing food demands, which can only be met by increasing the number of visits and reducing cavity time during daylight hours, when all foraging occurs. A suggestion that the male's steady investment is driven by a constant food-volume demand by

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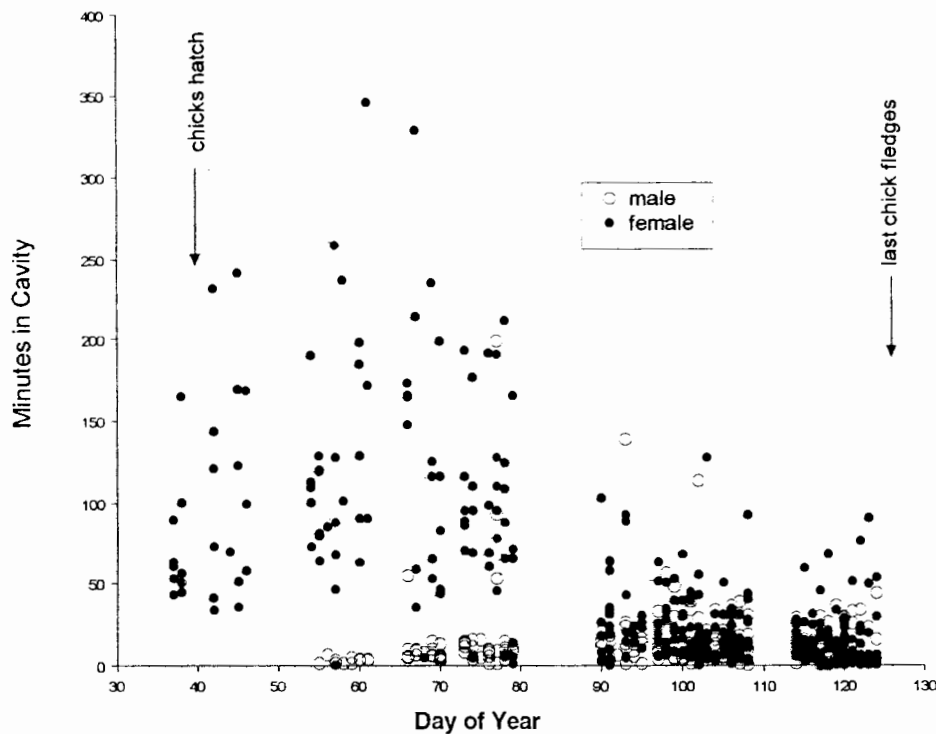
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Scattergram of time spent by Jaco parents in nest cavity over chick-rearing period, as revealed by time-lapse video surveillance.

the female (as sole feeder of chicks), fixed by her crop size, is rejected by numerous visits by the male to feed chicks when the female is absent. Both parents shorten visits from dawn to dusk, suggesting both greater food demands by chicks in the morning (following 10-12 h without fresh food) and a need for parents to maximize food intake in the afternoon prior to roosting for the night (male) or sleeping with the chicks (female). These data corroborate patterns of parental care inferred from field observations at several Jaco nests over the period 1994-1996. Strong bi-parental care exhibited by Jacos likely explains the consistent fledging of two chicks per year at our study site from 1996-1999, and several other Jaco nests in 1994 and 1995 (Durand and Zamore 1996).

Investment in rearing by both parents helps to explain how such a large Amazon parrot, with altricial young and high metabolic demand, can rebound quickly, both in range expansion and overall population size, following hurricane-induced population crashes (Gregoire 1981; also see discussion in Collar et al. (1992)). Other ecological factors add to resilience. The Jaco clutch size is three, verified by intra-cavity inspection (Reillo et al.

1999) and egg-laying in the aviary at Dominica's Botanical Garden (Reillo 2000), providing considerable reproductive potential compared to other large, island Amazons (Snyder et al. 1987; Forshaw 1989).

As with our study nest tree, Jacos often occupy nest cavities near agricultural areas where citrus is plentiful, augmenting their natural diet of 30+ species of rain forest fruits and flowers (Durand and Zamore 1996) with readily accessible oranges and grapefruit. Decreased foraging time and high-quality yield likely contributes to high rates of fledging success even when rain forest foods are in short supply. As both Amazon parrot species are fully protected on Dominica and internationally (Butler 1989; U.S. Fish and Wildlife Service 1996), Jacos have capitalized on agriculture to leverage large clutches into large numbers of recruits. Based upon recent local density estimates in the Syndicate Estate and Carholm areas, we speculate an average population density of roughly one Jaco per 25 hectares; when extrapolated over total available Jaco habitat, this figure projects a population of ~1300 birds. A nest with three successful fledges has yet to be witnessed, but we have observed three chicks raised to full-feather (Reillo et al. 1999). Long-

term, island-wide conservation and management strategies for the Jaco clearly must take its reproductive potential and exploitative tendencies into account (Collar et al. 1992; Durand and Zamore 1996).

Like the Jaco, the Sisserou exhibits strong bi-parental care, but its shy personality, tendency to occupy camouflaged nest sites, and critical conservation status hamper comprehensive investigation. Our qualitative observations document the first witnessed, successful Sisserou nest since 1989, despite many observations of Sisserou foraging and territorial behavior (Durand and Zamore 1996). Considering when copulation, begging calls, and fledging were detected, we surmise that the Sisserou clutch size is one and hatch-to-fledge time is approximately 12 weeks. Our study Sisserous exhibited defined care-provider roles, with the male regurgitating only to the female, whether in or out of the nest cavity, never entering the nest unless the female was within. This behavior contrasts with that of Jaco parents, who both feed chicks directly, and may explain Sisserou nest failure when one parent disappears (Durand and Winston, Forestry Division, pers. obs.). The theorized requirement of season-long, bi-parental care for fledging in Sisserous may have profound implications for recruitment and population growth, and demands further study. Research on many contemporaneous nest sites is requisite to understanding basic life-history parameters for both *A. arausiaca* and *A. imperialis*.

Central to growing concern over the Sisserou's conservation status and its apparent failure to rebound following Hurricane David in 1979 are questions about reproductive physiology and habitat requirements (Gregoire 1981; Evans 1988; Collar et al. 1992; Reillo 2000).

Captive breeding is not currently an option, as a lone male in the Botanical Gardens in Roseau represents the only known captive specimen; its mate died egg-bound in June 1998. The nest described here offers hope that Sisserous are successfully reproducing

on Morne Diablotin, and our rough, field estimate of average population density of one bird per 250 hectares, yielding a total population estimate of ≥ 200 , may be significantly corrected by presently unknown areas with high local population densities. Many hours must be invested in nest searches across Dominica's northern forests during the January-June breeding season if additional Sisserou nests are to be discovered. Additional nests afford opportunities for clutch manipulations and removal of chicks for captive breeding, techniques that have enhanced reproduction in other Caribbean Amazons (Snyder et al. 1987; Stoodley and Stoodley 1990). Until then, the Sisserou may benefit most from growing public awareness about its plight, and the legal protection extended to all of its known habitat via the new Morne Diablotin National Park, a product of joint efforts between the Dominican Government and the Rare Species Conservatory Foundation, declared by Government on 21 January 2000.

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