LIVING WORLD
Journal of the Trinidad and Tobago Field Naturalists' Club
admin@ttfnc.org

ISSN 1029-3299

TRINIDAD AND TOBAGO
FIELD NATURALISTS' CLUB

Status of Blue-and-yellow Macaws *Ara ararauna* Reintroduced to the Nariva Swamp, Trinidad and Tobago

Bernadette L. Plair, Motilal Lal, Audho Ramadhar and Sham Ramsubage

Plair, B.L., Lal, M., Ramadhar, A., and Ramsubage, S. 2013. Status of Blue-and-yellow Macaws *Ara ararauna* Reintroduced to the Nariva Swamp, Trinidad and Tobago. *Living World, Journal of The Trinidad and Tobago Field Naturalists' Club*, 2013, 19-28.

Plair, B.L., Lal, M., Ramadhar, A., and Ramsubage, S. 2013. Status of Blue-and-yellow Macaws *Ara ararauna* Reintroduced to the Nariva Swamp, Trinidad and Tobago. *Living World, Journal of The Trinidad and Tobago Field Naturalists' Club*, 2013, 19-28.

Status of Blue-and-yellow Macaws *Ara ararauna* Reintroduced to the Nariva Swamp, Trinidad and Tobago

Bernadette L. Plair[1], Motilal Lal[2], Audho Ramadhar[3] and **Sham Ramsubage[4]**

1. 9690 Shawnee Trail, Centerville, Ohio 45458, USA.

2. 8 Sooknanan Street, Biche, Trinidad and Tobago, W.I.

3. 2 Kernahan Trace, Mayaro, Trinidad and Tobago, W.I.

4. Picton Road, Sangre Grande, Trinidad and Tobago, W.I.

Corresponding author: *bplaircrestt@gmail.com*

ABSTRACT

The Blue-and-yellow Macaw, once native to the island of Trinidad, was extirpated in the early 1960s primarily due to nest poaching of chicks for the pet trade. Between 1999 and 2004, the Cincinnati Zoo and Botanical Garden, Trinidad and Tobago's Ministry of Environment and the Centre for the Rescue of Endangered Species of Trinidad and Tobago (CRESTT) reintroduced wild-caught birds from Guyana to the Nariva Swamp in Trinidad. After quarantines, testing and physical examinations, the birds were acclimated in a pre-release flight cage and the flight readiness of the first 14 birds was monitored as the main criterion for release. Nine of the 14 birds released (64%) survived and produced 12 chicks in three nesting seasons. Three years later 20 additional wild-caught birds were imported from Guyana and the criterion for their release was expanded to include social behaviors such as pair bonding and compatible groups. There was 100% survival of the 17 flight-ready birds released from the second flock. Bonded pairs and compatible groups that were released stayed together and exhibited behaviors indicating healthy social structure. Fourteen additional chicks were produced in three more nesting seasons. Twenty-six of the 31 birds released (84%) survived. Nesting success continued with the surviving population now estimated at 86 birds. This represents a 230% increase over 12 nesting seasons. Several factors have contributed to the survival and reproductive success of the reintroduced birds. This status report identifies some of these factors and suggests that Blue-and-yellow Macaws can be successfully reintroduced to a habitat from which they were extirpated when conditions are favorable.

Key words: acclimation, behavioral monitoring, bonded pairs, social groups, nesting success, post-release monitoring, pioneer group, community involvement.

INTRODUCTION

As the percentage of threatened and endangered species worldwide keep increasing, the development of conservation strategies for their management is becoming more important (Olney *et al*. 1994; Serena 1994). The family Psittacidae comprises nearly 350 species worldwide and of these, approximately 28% are considered threatened (IUCN 2010). There is high demand for psittacines in the pet trade and aviculture because these birds make sociable companions and have colorful plumage (Collar and Juniper 1992; Wright *et al.* 2001; Carrete and Tella 2008). These demands in addition to widespread habitat loss are the main threats to these birds worldwide (Snyder *et al*. 2000; Wright *et al*. 2001; Wiley *et al*. 2004). As a result, reintroductions and supplementations have been used as a conservation strategy to restore or establish new populations of psittacines, or to bolster existing populations (e.g. Clubb and Clubb 1992; Snyder *et al*. 1994; Sanz and Grajal 1998; Oehler *et al*. 2001; Collazo *et al*. 2003; Ziembicki *et al.* 2003; Brightsmith *et al.* 2005; Collar 2006; Adams and Cash 2010).

The Blue-and-yellow Macaw is found in eastern Panama, Guyana, east and south Venezuela, western Colombia, western Ecuador and most of the Amazon Basin (Juniper and Parr 1998; Restall *et al.* 2006). This species was also found in Trinidad until the 1960s, when the island population was extirpated due to over-collecting for the pet trade and habitat alteration (Brown 2000). Collar (1997) lists the species as apparently extinct in Trinidad and extinct in many areas in Ecuador, Colombia and Brazil. Between 1999 and 2004, the Cincinnati Zoo and Botanical Garden, Trinidad and Tobago's Ministry of the Environment and the Centre for the Rescue of Endangered Species of Trinidad and Tobago (CRESTT) reintroduced a small population of Blue-and-yellow Macaws to the Nariva Swamp in Trinidad (Oehler *et al*. 2001; Plair *et al*. 2008).

The Blue-and-yellow Macaw and the Nariva Swamp offer a unique opportunity to provide much needed research on the reintroduction of a threatened avian species to its historic range. The 6,234 hectare Nariva Swamp

(10^0 23' N, 61^0 04' W), is a permanent brackish lagoon on the East Coast of Trinidad with an extensive complex of freshwater swamp forests, permanent herbaceous swamp and mangrove forest, separated from the Atlantic Ocean by two parallel sandbars and a large area of seasonally flooded marshes (elevation 0-10 m above sea level). The swamp became a protected wetland under the Ramsar Convention in 1993 and the 1,544 hectare Bush Bush Wildlife Sanctuary, established in 1968 (Bacon and ffrench 1972), remains a prohibited area under the Forest Act of Trinidad and Tobago requiring government permits for visitor entry, fishing and hunting.

The palm swamp forest has an open canopy with *Roystonea oleracea* palms (Royal palms) up to 26 m tall and a density of 380 trees with diameter at breast height (dbh) above 10 cm per hectare. *R. oleracea* comprised 56% of individuals with peak ripe fruit availability from August to November correlating with rainfall (Bonadie 1998). *Mauritia sertigera* palms (Moriche palms) up to 22 m tall and a density of 344 trees ≥10 cm dbh per hectare contributed 43% of individuals with peak ripe fruit availability from September to May. Both palms are a very important source of food and nesting sites for parrots and macaws in the Nariva Swamp (Bonadie and Bacon 1999). Three psittacine species still occupy the Nariva Swamp: Red-bellied Macaws, *Ara manilata*; Orange-winged Parrots, *Amazona amazonica* and Green-rumped Parrotlets, *Forpus passerinus* (Bonadie and Bacon 2000). More recently, there have been regular sightings of Yellow-crowned Parrots, *Amazona ochrocephala* and occasional sightings of Blue-headed Parrots, *Pionus menstruus* and Lilac-tailed Parrotlets, *Touit batavicus* (Kenefick, personal communication).

Wild populations of parrots and macaws frequently suffer from a lack of nest sites (Abramson *et al*. 1995; Nycander *et al*. 1995). Blue-and-yellow Macaws normally nest at heights of about 15 meters in hollow palm trees. Their nests are usually formed when palms die. The leafed crowns dry out and fall and the soft palm heart from the trunk's interior desiccates and recedes, leaving a hollow vertical tube with hard walls. Because of the scarcity of natural nesting sites in South America, only 10 to 20% of adult macaws attempt to breed in any given year (Munn *et al.* 1991). Thus the productivity of a population of wild macaws is naturally very low.

The Nariva Swamp lends itself to a productive study of the nesting success of the Blue-and-yellow Macaws. The limited range of the flock on the island allows for a much better chance to study the birds during their nesting season between January and June. Trained villagers in communities that border the swamp, Kernahan to the south-east, Plum Mitan to the north-west, Biche to the west and Manzanilla/Cocal to the east, already play a leading role in protecting the habitat against forest fires and poaching. Select teams from these areas were specially trained to monitor and collect data on the reintroduced Blue-and-yellow Macaws.

The data collected on the released birds has been totally dependent on these nearby communities with supervision from project personnel. Although poaching has not been eliminated, its frequency has been minimized by the involvement of the villagers in monitoring and protecting the birds and their habitat. In addition, integrating conservation education into the curriculum of schools bordering the swamp and raising national and international awareness of conservation efforts has increased national pride and garnered interest and support worldwide (Butler 1992). This report is an update on two groups of wild-caught Blue-and-yellow Macaws reintroduced to the Nariva Swamp and suggests factors that may play a role in their survival, adaptation and reproductive success in the wild.

METHODS

Aerial and ground surveys conducted in the Nariva Swamp by the government's Forestry Division, Wildlife Section, and the first author in 1999 and 2003 determined that there were suitable food sources and potential nesting sites to support a population of Blue-and-yellow Macaws. In October 1999, 18 wild-caught Blue-and-yellow Macaws were imported from Guyana to Trinidad following the protocols described in IUCN/SSC Guidelines for Reintroduction, prepared by the SCC Reintroduction Specialist Group and approved by the 41st Meeting of the IUCN Council, Gland Switzerland, May 1995. The birds were trapped by licensed dealers in Guyana in August 1999. Laparoscopic sexing was used to identify nine males and nine females between one and four years old for reintroduction to Trinidad. Transponder chips inserted into the chest muscles of each bird provided a method of permanent identification while a small band around the right or left leg identified males from females.

Following guidelines established by the Trinidad and Tobago Government, the birds were quarantined in Guyana for a period of at least 28 days, under veterinary supervision. They were certified free of endoparasites and ectoparasites prior to importation into Trinidad and tested negative for Psittacosis/Ornithosis, Avian Influenza, and Newcastle's disease. To reduce the stress of relocation, the birds were fed a high carbohydrate diet, supplemented with sunflower seeds and vitamins. Upon entry into Trinidad, the birds were further quarantined at the government's Wildlife Section for 21 days.

The macaws to be released were acclimated for four weeks from November to December 1999 in a 5.5 m x 7.3 m x 6.4 m pre-release flight cage in the protected Bush

Bush Wildlife Sanctuary where they were to be released. During this period their diet consisted of commercial dog chow supplemented with natural fruits and seeds found in the Nariva Swamp e.g. *M. sertigera*, *R. oleracea*, *Hura crepitans* (Euphorbiaceae), *Sterculia caribaea* (Sterculiaceae), *Spondias mombin* (Anacardiaceae), *Rollinia exsucca* (Annonaceae), *Maximiliana elegans* (Palmae) and *Manilkara bidentata* (Sapotacea). Trained villagers from a nearby community fed and observed the birds for flight capability during the pre-release phase. Government veterinarians performed health assessments on the macaws for overall fitness, and birds were selected for release based on the re-growth of their primary feathers and their flight capability. No behavioral monitoring was done on this group of birds.

Four male macaws were released in December 1999, three males and five females in January 2000, and one male and one female in March 2000. One of five males selected for release in December 1999 did not leave the release site and was returned to the flight cage on the same day. This bird was later released in March 2000. Four of the 18 birds did not re-grow their primary feathers and were never released. Supplemental food was made available to the released birds for one week following their release. Trained villagers monitored the survival, flight patterns, feeding and range of the released birds three to four days per week during the dry season from January to June each year. Between April and May of 2001, reports from villagers in a fishing camp suggested nesting activity among three pairs of Blue-and-yellow Macaws in an area of the swamp where there was a thick stand of *Mauritia* palms.

In order to collect data on the availability and use of macaw nesting sites in the Nariva Swamp, a nesting site study was implemented from March 2002 to June 2003. Select teams of villagers from communities bordering the swamp were trained to use variations of standard rock climbing techniques, to collect data on trees with natural nest cavities that were explored or used by four established pairs of Blue-and-yellow Macaws. The monitors recorded the tree species noting location, proximity to other trees and surrounding vegetation. They noted whether trees were alive or dead, had lost their crowns or had holes in their trunk. Measurements were taken of tree height, diameter of the trunk at breast height (dbh), and the orientation and diameter of the holes on the trunk. A qualitative assessment of the degree of decomposition of the hollow trunk and measurement of the depth of the nest cavity was also part of the data collection.

In September 2003, a second group of 20 wild-caught macaws (12 females and 8 males), sexed via laparoscopy, was imported from Guyana. This was critical for establishing a wider genetic base that could evolve into a self-sustaining wild population. The group consisted of four mature females (>3 years old), four adolescent females (2 years old), four immature females (1 year old), two mature males, one adolescent male and five immature males. Following the same guidelines established by the Trinidad and Tobago Government in 1999, the birds were quarantined and tested prior to their importation to Trinidad.

Upon entry into Trinidad in September 2003, the birds were transferred directly to the release site in Bush Bush Wildlife Sanctuary and acclimated for three months in a large 18.3 m x 8.5 m x 6.1 m pre-release flight cage. Cage dimensions were increased from the original flight cage to provide the birds more space to strengthen their flight muscles and to develop social interactions. The birds were fed diets of natural fruits and seeds from the surrounding area, as well as sunflower seeds and seasonal local beans and fruit. A protein enriched plumage enhancer, Nekton Bio (Nekton Products, Germany), was added to their diet to facilitate re-growth of the cut primary feathers.

Prior to the release of this second group, social behaviors of the birds were documented in contrast to the first group of birds released in 1999-2000. The birds were observed for one hour each morning and afternoon, weather permitting. Specific social behaviors such as pair bonding and compatible or aggressive interactions with one another were recorded based on instantaneous scans of the whole group of birds every five minutes during each 1-h observation period (Plair *et al.* 2008).

In December 2003, three bonded pairs and a group of three birds including two females and a male were selected for release. In addition, three individual females that showed no particular affinity to each other but integrated well with the group were chosen for release. All showed strong flight capability and had re-grown their primary feathers. Of the remaining eight birds, three had re-grown their primary feathers but these birds displayed aggressive tendencies towards some of the birds chosen for release and they were not released with the group of twelve. Supplemental food was provided for three days following the release. The birds were released in December when both *Roystonea* and *Mauritia* palm fruit were available. Since the birds foraged in flocks, integration of the newly released birds with the existing wild population seemed feasible.

Following the December 2003 release, data on the eight birds remaining in captivity were not collected daily. The birds were observed weekly for additional pair bonding, socialization and flight readiness. In June 2004, two male and three female macaws were released. There was no pair bonding or serious aggression among these five birds. Of the three birds not released, one male died

due to an infected wing follicle and the remaining pair of birds had poor re-growth of their primary feathers.

Following the final release in 2004, trained villagers continued to monitor the survival, flight patterns, feeding and range of the birds during the dry season from January to June each year until 2006. They did not collect specific data on the nesting sites as was done during the nesting site study in 2002 to 2003. Instead, they recorded sightings of bonded pairs, single or social groups of adult birds and any young birds that were seen in flight, perching or feeding with adult birds following each nesting season. In 2007, the responsibility for funding and data collection on the reintroduction project was transferred from the Cincinnati Zoo and Botanical Garden to the Trinidad and Tobago Government. The author still maintains personal contact with the macaw monitors and villagers in the communities, and receives updates on the status of the birds through telephone communications and annual visits to the reintroduction area.

RESULTS

There was 50% survival of the four male macaws released in December 1999. The four males were observed at the flight cage eating the supplemental food for two days after the release. Vocalizations of the released birds were heard in the area of the flight cage up to one week later, but they did not return to the cage or the supplemental food. Five days later two males were observed actively foraging in an area 13 to 14 km from the release site. Two males were spotted in the south-west region of the swamp about 9 km from the release site less than three weeks later. The other two males were neither seen nor heard.

There was 100% survival of the eight birds released in January 2000 for at least four weeks post-release. Among them were two bonded pairs, one female that was bonded to a non-flighted male and three unpaired birds. Following the release, two pairs of macaws were observed above the forest canopy, flying distances of approximately 10 km within 24 hours of the release. For four days following the release a female and male macaw returned to the enclosure for supplemental feeding and to perch in close proximity to individual birds remaining in the flight cage. Two weeks after the release, one female macaw found perched outside a private aviary on the south-east corner of the island, some 26 km away, was captured, kept isolated and released on the day after her return. For one month after the release, sightings of pairs of macaws were reported as far as 27 km north and 24 km north-west of the release site. Frequently, two unpaired macaws were observed feeding on *Mauritia* palm fruit in an area approximately 16 km north of the release site.

In February 2000, villagers in the areas bordering the swamp were still seeing 10 of the 12 released birds. The deteriorated body of a male macaw identified by its leg band to be one that was released in December 1999 was found on 2 May, 2000 by a farmer in a village 14 km from the release site. Nine out of 14 birds (64%) released between December 1999 and March 2000 continued to be sighted between May 2000 and December 2003. Four birds remained of unknown status.

In Trinidad the Blue-and-yellow Macaws nest during April and May (Forshaw 1989). No nesting was observed following the releases between December 1999 and March 2000. During the 2001 nesting season three pairs of macaws produced five chicks. Nest sites were not located and monitored but in September 2001, six adults and five young were observed feeding together on fruiting *Cordia alliodora*. Based on this success, a nesting site assessment was implemented in March 2002 to June 2003. During this time, four pairs of Blue-and-yellow Macaws successfully used seven of 22 explored nest sites and produced seven chicks (Plair, unpublished). This brought the number of surviving chicks to12 after three nesting seasons.

Four of the nest sites located in dead *Roystonea* palms each fledged one chick, one live *Roystonea* palm yielded one chick, a dead *Mauritia* palm fledged two chicks and a dead *Spondias mombia* tree fledged one chick. Three eggs were laid in the nest of a dead *Roystonea* palm but this tree was deliberately felled by a poacher looking for young nestlings. The felled *Roystonea* palm tree provided the only accessible data on the depth of the nest and the degree of decomposition inside the nest cavity. The nest hole was 107 cm deep, and the cavity of the hollow trunk consisted of fine wood chips from the inner bark as well as refined wood dust.

There was 100% survival of the eight female and four male macaws released in December 2003. There were approximately 26 birds in the wild prior to the December 2003 release. With the survival of all 12 birds released in December 2003, the total population increased to 38 birds. The five macaws released in June 2004 also had 100% survival. The three female and two male macaws, did not return to the empty pre-release cage on the days following their release. Those birds integrated with the macaws already established in the area. The population in the wild increased to 43 birds.

Nesting success continued with five more chicks in 2004 and three chicks in 2005. Two eggs were lost presumably to nest predation in 2005 when shells were found at the base of a nest site tree. Eight pairs fledged six chicks in 2006 bringing the total population to 52 birds consisting of 26 adults and 26 chicks. Between 2007 and 2010, 22 surviving chicks were added to the population. Nine pairs of birds fledged 12 additional chicks between 2011 and

2012. Nest poaching has not been eliminated. Occasionally two to three young chicks appear for sale in pet shops or open markets. Overall, there has been a 230% increase in the original surviving population of 26 birds. With a total of 60 chicks surviving over 12 nesting seasons, there is an estimated population of 86 birds in the wild (Table1).

During the first year after the 1999 to 2000 releases, the nine surviving birds explored areas well beyond the boundaries of the swamp. Three pairs established a range that encompassed the swamp and areas 27 km north, 24 km north-west and 20 km west of Nariva. Three macaws flew south near a private aviary and established a range between the south-east and south-central coast of the island between 26 and 40 km from the release area. From January to June of 2001, the three pairs of macaws were routinely seen in a flight pattern that terminated in an area dominated by thick *Mauritia* palms 4 km to 5 km from the release site. In February 2002, the three macaws that occupied the south-east and south-central range in 2000 and 2001 integrated with the three pairs of macaws within the swamp and a fourth pair was formed. These birds remained within the boundaries of the swamp and, with successful nesting, began to establish a pioneer flock.

None of the birds from the groups released in December 2003 and June 2004 explored beyond the boundaries of the swamp as did the original flocks. For two to three days after the release, all 12 birds returned in pairs or groups to the flight cage. Several perched on top of the cage, eating supplemental food and interacting with the eight remaining birds in the flight cage. When supplemental feeding was ceased after three days they dispersed, flying distances up to15 km, but returning in pairs or groups to areas around the pre-release cage.

Macaw monitors from communities around the swamp noticed an increase of two or more birds normally observed in their particular range following the December 2003 release. This suggests that the newly released birds were integrating with the established flock. Birds from the first translocation returned with the newly released birds to the release site. A banded female with a juvenile bird (identified by its short tail and no band) was observed perched on a tree close to the pre-release cage about three weeks after the December 2003 release. This bird appeared to be the offspring of parents from the first reintroduction. Between January and June 2004, some of the released birds continued to visit and perch on trees above and around the pre-release cage which still housed the eight remaining birds.

In 2006, monitors within the swamp recorded the flight patterns of eight pairs of macaws in areas between 8 km and 15 km from the release site. Two pairs were frequently seen within 4 km of the release site. Between 2007 and

Table 1. Survival and reproduction of wild-caught Blue-and-yellow Macaws reintroduced to the Nariva Swamp, Trinidad.

Year	# Birds Released	% Surviving	# Surviving Male/Female	# Pairs Established	# Young Produced	# Eggs/ Chicks Lost	Total Population
1999	4	50	2/0	0	0		2
2000	10	80	5/4	2	0		9
2001	0		5/4	3	5		14
2002	0		5/4	4	3	3	17
2003	12	100	9/12	4	4		33
2004	5	100	11/15	7	5		43
2005	0			7	3	2	46
2006	0			7	6		52
2007	0			8	7	2	59
2008	0			8	3		62
2009	0			8	6		68
2010	0			8	6	3	74
2011	0			9	5		79
2012	0			9	7	2	86
Total	**31**	**84**	**11/15**	**9**	**60**	**12**	**86**

2012, the birds began to expand their range to areas bordering the swamp. Forest fires resulting in smoke within the swamp appear to be one of the factors that influence the dispersal of the birds to areas beyond the swamp. Access to food on nearby cultivated lands bordering the swamp seems to be another factor. Following fires in an open area of the swamp during the dry season, a flock of nine birds was frequently observed feeding on *Roystonea* palm fruit and *Hura crepitans* seeds in a populated area about 6 km south of the swamp. Another flock of 11 birds frequented an area to the south-west, about 8 km outside the borders of the swamp. Six to eight birds were reported about 26 km to the south-east and three birds were observed in the south-central area as far as 40 km from the swamp. These areas all supported stands of *Roystonea* palm. Small flocks of five to seven birds were observed feeding on non-palm fruit such as *Syzygium malaccense*, *Mangifera indica* and *Spondias dulcis* in cultivated areas 6 km north and 9 km north-east of the swamp. Flocks of Blue-and-yellow Macaws ranging in size from 15 to 18 birds continue to be seen within the swamp when food is abundant and the area is smoke free (Fig. 1).

DISCUSSION

This study suggests that Blue-and-yellow Macaws can be successfully reintroduced to their historic range when conditions are favorable (White *et al*. 2012). Factors that may have contributed to this success include the use of wild-caught birds for translocation (Snyder *et al.* 2000; Wiley *et al*. 1992); releasing birds within their historical range (Sanz and Grajal 1998); the availability of suitable habitat (IUCN 1995); low competition for food and nesting sites (Griffith *et al*. 1989); and reduced threat of predation (Butler 1992).

A key factor in gaining high survival of birds reintroduced to the wild is the establishment of a pioneer group. When the first group of reintroduced Blue-and-yellow Macaws was released within the Nariva Swamp, the birds explored up to 40 km beyond their historic range during the first year. The survival rate of this first group was 64%. Birds released from a second translocation two years later, did not explore beyond the boundaries established by the pioneer group but instead integrated with the wild group for up to three years after release. There was 100% survival of the birds released from the second translocation. Between 2007 and 2012, small flocks of birds began to expand their range to areas from 6 km to 40 km beyond the swamp when fires occurred within its boundaries.

Macaws face many threats including clearing for agriculture, logging and the pet trade. Logging often targets

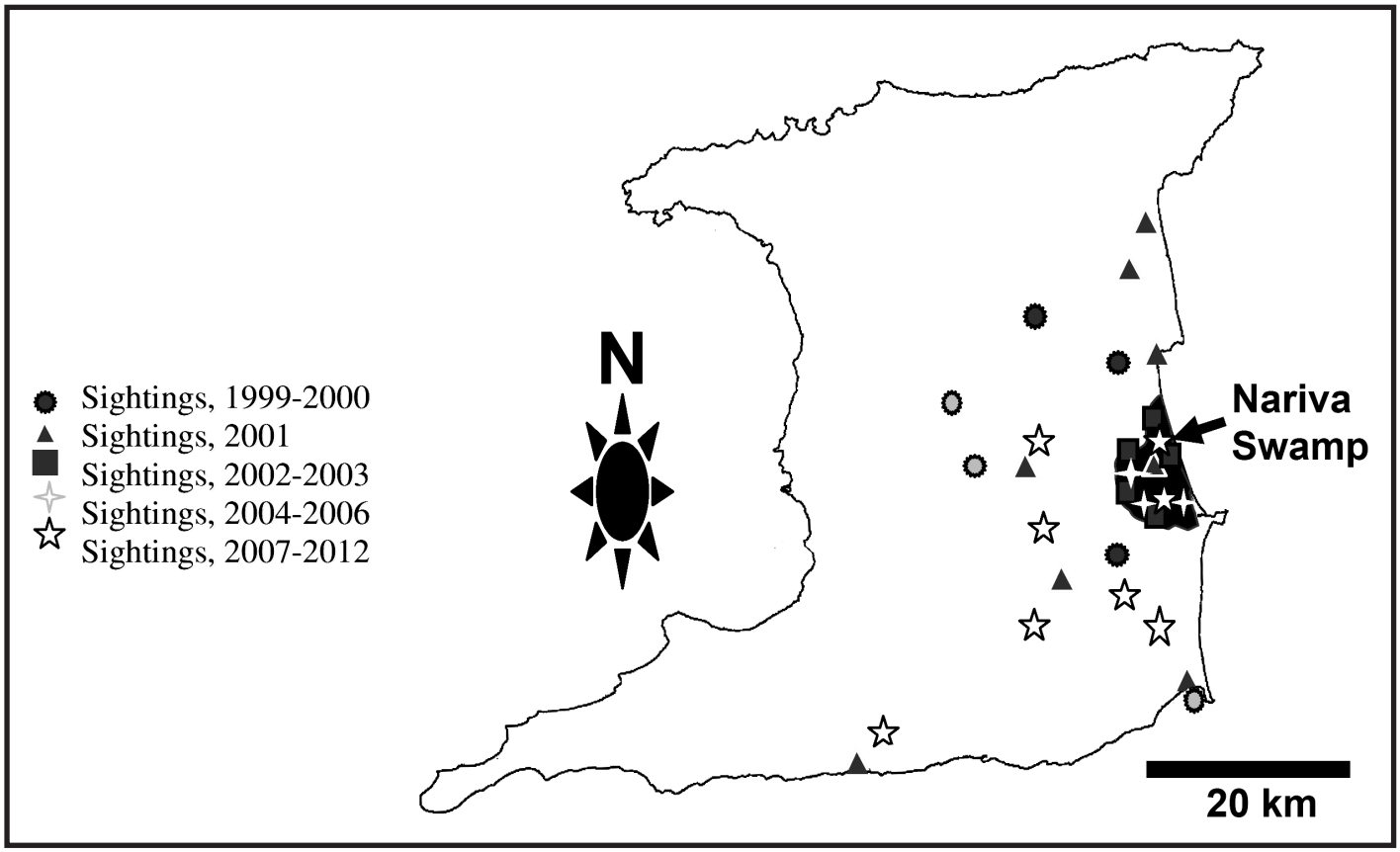

Fig. 1. Dispersal of Blue-and-yellow Macaws released in the Nariva Swamp, their historic range in Trinidad.

the biggest trees, with large cavities that macaws need to nest. In addition, many collectors cut down nest trees to get to the young. As a result, the number of available nest sites for macaws has been greatly reduced in recent years. This is compounded by the fact that suitable natural cavities are often very rare even in pristine old growth forests that have not suffered any real impacts from logging (Munn *et al*. 1991). Researchers at Tambopata Research Center in south-eastern Peru have been studying the availability and use of natural as well as artificial nest sites in that area for the past fifteen years (Nycander *et al*. 1995; Brightsmith and Bravo 2006). Their findings suggest that macaws prefer to nest in the hollow cavities of dead palms and that Blue-and-yellow Macaws are very selective about the depth and degree of decomposition of the nest cavities that they choose.

Blue-and-yellow Macaws have reproduced at a high rate in the Nariva Swamp. The birds nested in hollow *Roystonea* and *Mauritia* palms as well as in hard wood trees. There was little or no competition for nest sites with the Red-bellied Macaws that also occupy the swamp. Red-bellied Macaws nest in hollow palms with holes on the sides of the trunk. These nest sites are commonly found in the swamp. The Blue-and-yellow Macaws showed preference for tall topless palms with wide openings at the top and deep well-rotted cavities. In Peru, Blue-and-yellow Macaws nested predominantly in *Mauritia* palm trees (Brightsmith and Bravo 2006*)* whereas in Trinidad five of seven successful nests were in *Roystonea* palms and one in a *Mauritia* palm. One of the seven nest sites used in Trinidad was in a live *Roystonea* palm trunk.

Dead tree trunks used were hollow and a long nail could easily be pushed into the trunk by hand. With the exception of one nest in a felled *Roystonea* tree, heavy rainfall during the study period prevented the collection of data on the depth of nest cavities and the degree of decomposition of the hollow trunks. Examination of the nest cavity in the felled tree supported the findings in Peru that nest cavities chosen by Blue-and-yellow Macaws are deep and well decomposed on the inside (Nycander *et al.* 1995). Three eggs found in this nest cavity confirmed that it was a preferred nesting site for the macaws. In the nest site study conducted from March 2002 to April 2003, four adult pairs of Blue-and-yellow Macaws had seven surviving chicks over the two nesting seasons. They used seven of 22 explored nest sites. None of the nest sites explored or used in 2002 were revisited or used in 2003. Overall, the success of natural nests was higher in Trinidad with 1.2 chicks/nest compared to natural nests in Peru 0.71 chicks/nest (Nycander *et al*. 1995). In contrast, reproductive success has been minimal for captive raised Scarlet Macaws released in Costa Rica but at Tambopata, Peru, hand-raised macaws bred successfully with wild mates (Brightsmith *et al*. 2005). The use of wild-caught birds and lack of competition for nest sites, in addition to behavioral monitoring of social interactions during pre-release acclimation facilitating the release of bonded pairs and compatible groups of birds, may have aided in the high reproductive rate achieved in Trinidad (Plair *et al*. 2008).

Raptor predation has plagued reintroductions of smaller psittacines like Puerto Rican and Thick-billed Parrots (Snyder *et al*. 1994; USFWS 2002; White *et al*. 2005). Large macaws may avoid high rates of raptor predation due to the fact that there are relatively few avian predators large enough to capture adult macaws and these occur at naturally low densities (Willis and Eisenmann 1979; Terborg *et al*. 1996; Thiolly 1994). In Trinidad there are no serious threats from raptor predation, and loss of eggs and chicks is mainly due to poaching by humans (Wright *et al*. 2001). Using trained villagers from communities bordering the swamp to monitor and protect the birds, promoting increased public awareness through conservation education and encouraging national pride in the restoration of an extirpated species aid in mitigating the effect of nest site poaching of macaws (Butler 1992).

In 2004, the Cincinnati Zoo and Botanical Garden partnered with the Miami University of Ohio to launch a global field program called Earth Expeditions to work with scientists in different countries and raise global awareness of ongoing conservation projects. The first 10-day field expedition of this program was conducted in Trinidad in June 2004, where the participants witnessed the release of the last five Blue-and-yellow Macaws translocated from Guyana to the Nariva Swamp. To date, there have been nine field expeditions to Trinidad led by the author. One hundred and ninety-eight Earth Expedition participants have visited the macaw reintroduction site and the communities bordering the swamp. Macaw monitors serve as field guides during these 10-day field expeditions and the communities and local schools play a significant role in the in-country experience and cultural immersion of the Earth Expedition participants (Janzen *et al.* 1993). After more than twelve years of spearheading this conservation effort, funding and management of data collection for the Blue-and-yellow Macaw reintroduction program was handed over from the Cincinnati Zoo and Botanical Garden to the Trinidad and Tobago Government in 2007. Since then, official reports on data collection are no longer submitted to the Cincinnati Zoo. However, the author still maintains close contact with the macaw teams and community people through the Earth Expeditions program and CRESTT, and continues to monitor the survival and nesting success of the birds through telephone communication with the team leaders and annual in-country visits.

It should also be noted that in addition to the release of wild-caught birds from Guyana between 1999 and 2004 as noted in this report, there have been releases of captive-bred Blue-and-yellow Macaws in the Nariva Swamp. The author first learned through media reports that the Emperor Valley Zoo released six to eight captive-bred birds in July 2009. The details of this release and the status of the birds have not been shared with the author. Similarly, in April 2011 the Pointe-à-Pierre Wild Fowl Trust (PWFT) released ten captive-bred birds into the swamp. I first learned of this release through reports in the local media and later found information about it on the PWFT website.

Despite the seeming success of the Blue-and-yellow Macaw reintroduction program in Trinidad, considerable improvement needs to be made in order to make this a sustainable conservation effort. A consistent and co-operative level of systematic and detailed documentation of all methods used in the reintroduction process must be implemented. A practical and effective plan for post-release monitoring should be established in order to provide the information necessary to accurately assess both short and long-term results of all releases (White *et al*. 2012). In addition, better communication and collaboration between organizations involved in the reintroduction and supplementation of Blue-and-yellow Macaws in Trinidad is of paramount importance to the successful development and implementation of a long-term management plan for this species on the island. Further releases need to be carefully considered based on the "carrying capacity" of the habitat. Releases should follow established IUCN protocols and must be thoroughly documented. It is disastrous to release birds without ensuring that they are disease-free. Post-release monitoring should also be implemented and documented.

Finally, there needs to be an assessment of the Nariva Swamp in its current state to determine if it can support the new population of Blue-and-yellow Macaws or whether some mitigation is needed to ensure the continued survival of the species in Trinidad.

ACKNOWLEDGEMENTS

I am grateful to the Trinidad and Tobago Field Naturalists' Club for requesting this report on the status of the Blue-and-yellow Macaws reintroduced to the Nariva Swamp, Trinidad. This work would not have been possible without the financial support of the Cincinnati Zoo and Botanical Garden, Talisman Petroleum Ltd., BHP Billiton, British Gas of Trinidad and Tobago, the Cleveland Zoological Society, the Miami University of Ohio and many private donors in the USA and Trinidad. Thanks to the Forestry Division, Ministry of Public Utilities and the Environment, Trinidad and Tobago, the Centre for the Rescue of Endangered Species of Trinidad and Tobago and Veterinarians in the USA, Trinidad and Guyana for their assistance with this project. Thanks also to the Emperor Valley Zoo, the Manatee Conservation Trust and BPTT for their support during the 1999-2000 reintroductions. Most importantly, we thank the monitoring teams and villagers in the communities and schools bordering the swamp for their invaluable commitment and contribution to this reintroduction program.

REFERENCES

Abramson, J., Spear, B.L. and **Thomsen, J.B.** 1995. p. 423-443. *In* The Large Macaws: Their care, Breeding and Conservation. Raintree Publications: Ft. Bragg, CA.

Adams, L. and **Cash, B.** 2010. Reintroduction of Yellow-crowned Kakariki to Long Island (Marlborough), Mana Island (Wellington) and Motuara Island (Marlborough), New Zealand. p. 160-164. *In* **P. S. Soorae,** ed. Global Re-Introduction Perspectives: Additional Case-Studies from Around the Globe. IUCN/SSC. Re-Introduction Specialist Group, Abu Dhabi, UAE.

Bacon, P.R. and **ffrench, R.P.** 1972. The Wildlife Sanctuaries of Trinidad and Tobago. Trinidad and Tobago Wildlife Conservation Committee, Ministry of Agriculture, Lands and Fisheries.

Bonadie, W.A. 1998. The ecology of *Roystonea oleracea* palm swamp forest in the Nariva Swamp, Trinidad. *Wetlands*, 18: 2.

Bonadie, W.A. and **Bacon, P.R.** 1999. The structure and ecology of *Mauritia sertigera* palm swamp forest in Nariva Swamp, Trinidad. *Journal of Tropical Ecology*, 40: 199-206.

Bonadie, W.A. and **Bacon, P.R.** 2000. Year-round utilization of fragmented palm swamp forest by Red-bellied Macaws, *Ara manilata* and Orange-winged Parrots, *Amazona amazonica* in the Nariva Swamp, Trinidad. *Biological Conservation,* 95: 1-5.

Brightsmith, D. and **Bravo, A.** 2006. Ecology and management of nesting Blue-and-yellow Macaws (*Ara ararauna*) in *Mauritia* palm swamps. *Biodiversity and Conservation*, 15: 4271-4287.

Brightsmith, D.J., Hilburn, J., del Campo, A., Boyd, J., Frisius, M., Frisius, R., Janik, D. and **Guillen, F.** 2005. The use of hand-raised psittacines for reintroduction: a case study of Scarlet Macaws *(Ara maco*) in Peru and Costa Rica. *Biological Conservation*, 121: 465-472.

Brown, N.A. 2000. Environmental Advocacy in the Caribbean: The Case of the Nariva Swamp, Trinidad. CANARI Technical Report No. 268.

Butler, P.J. 1992. Parrots, pressures, people, and pride. p. 25-46. *In* **S.R. Beissinger** and **N.F.R. Snyder,** eds. New World Parrots in Crisis. Smithsonian Institution Press: Washington, D.C.

Carrete, M. and **Tella, J.L.** 2008. Wild-bird trade and exotic invasions: a new link of conservation concern? *Frontiers in Ecology and the Environment*, 6: 207-211.

Clubb, K. J. and **Clubb, S. L.** 1992. Reintroduction of Military Macaws in Guatemala. Chapter 23. *In* R**.M. Shubot, K.J.**

Clubb and **S.L. Clubb,** eds. Psittacine aviculture: perspectives, techniques and research. Avicultural Breeding and Research Center, Loxahatchee, Florida.

Clubb, S.L. 1995. A rescue and release program: friends of Portobello National Park, Panama. *Proceedings of the International Avicultural Society,* January 11-15, 1995.

Collar, N. 1997. Family Psittacidae. p. 280-477. *In* **J. del Hoyo, A. Elliot** and **J. Sargatal,** eds. Handbook of the Birds of the World. Volume 4: Sandgrouse to Cuckoos. Lynx Edicions: Barcelona, Spain.

Collar, N.J. 2006. Parrot reintroduction: towards a synthesis of best practices. p. 82-107. *In* The Pleasure of Parrots: Proceedings of VI International Parrot Convention. Loro Parque Fundacion, Puerto de la Cruz, Tenerife.

Collar, N.J. and **Juniper, A.T.** 1992. Dimensions and causes of the parrot conservation crisis: solutions from conservation biology. p. 1-24. *In* **S.R. Beissinger** and **N.F.R. Snyder,** eds. New World Parrots in Crisis. Smithsonian Institution Press: Washington, DC.

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

Forshaw, J.M. 1989. Parrots of the world. Landsdowne Editions: Melbourne, Australia.

Griffith, B., Scott, J. M., Carpenter, J.W. and **Reed, C.** 1989. Translocation as a species conservation tool: status and strategy. *Science*, 245: 477-480.

IUCN/SSC 1995. Guidelines for reintroductions. Approved by the 41st Meeting of the IUCN Council, Gland, Switzerland.

IUCN 2010. The IUCN Red List of Threatened Species. Version 2010.02. [Online]. Available at: http://www. iucnredlist. org/apps/redlist

Janzen, D.H., Hallwachs, W., Jimenez, J. and **Gamez, R.** 1993. The Role of Parataxonomists, Inventory Managers and Taxonomists in Costa Rica's National Biodiversity Inventory. *In* **W.V. Reid, S.A. Laird, S.A. Meyer, C.A. Gamez, R. Sittenfeld, D.H. Janzen, M.A. Gollin** and **G. Juma,** eds. Biodiversity Prospecting. Washington, D.C.

Juniper, T. and **Parr, M.** 1998. Parrots: A Guide to Parrots of the World. Yale University Press: New Haven, Connecticut.

Munn, C.A., Blanco, D.H., Nycander, E. and **Ricalde, D.G.** 1991. Prospects for sustainable use of large macaws in south-eastern Peru *In* **J. Clinton-Eitniear,** ed. The First Mesoamerican Workshop on the Conservation and Management of Macaws. Center for the Study of Tropical Birds, Inc., Tegucigalpa, Honduras.

Nycander, E., Blanco, D.H., Holle, K.M., Campo, A.D., Munn, C.A., Moscoso, J.I. and **Ricalde, D.G.** 1995. Manu and Tambopata: Nesting success and techniques for increasing reproduction in wild macaws in south-eastern Peru. p. 423-443. *In* **J. Abramson, B.L. Spear** and **J.B. Thomsen,** eds. The Large Macaws: Their care, Breeding and Conservation. Raintree Publications: Ft. Bragg, California.

Oehler, D.A., Boodoo, D., Plair, B., Kuchinski, K., Campbell, M., Lutchmedial, G., Ramsubage, S., Maruska, E.J. and **Malowski, S.** 2001. Translocation of Blue-and-gold Macaws, *Ara ararauna* into its historical range on Trinidad. *Bird Conservation International*, 11: 129-141.

Olney, P.J.S, Mace, G.M. and **Feistner, A.T.C.** eds.1994. Creative conservation: interactive management of wild and captive animals. Chapman and Hall: London.

Restall, R., Rodner, C. and **Lentino, M.** 2006. Birds of Northern South America. Yale University Press.

Plair, B.L., Kuchinski, K., Ryan, J., Warren, S., Pilgrim, K., Boodoo, D., Ramsubage, S., Ramadhar, A., Lal, M., Rampaul, B. and **Mohammed, N.** 2008. Behavioral monitoring of Blue-and-yellow Macaws (*Ara ararauna*) reintroduced to the Nariva Swamp, Trinidad. *Ornitologia Neotropical*, 19 (Suppl.), 113-122.

Sanz, V. and **Grajal, A.** 1998. Successful reintroduction of captive-raised Yellow-shouldered Amazon Parrots on Margarita Island, Venezuela. *Journal of the Society for Conservation Biology*, 12: 430-441.

Serena, M. 1994. Reintroduction Biology of Australian and New Zealand Fauna. Surrey Beatty and Sons, Chipping Norton, Australia.

Snyder, N. F., Wiley, J.W. and **Kepler, C.B.** 1987. The Parrots of Luquillo: Natural History and Conservation of the Puerto Rican parrot. Western Foundation of Vertebrate Zoology, Los Angeles, California.

Snyder, N., Koenig, S., Koschmann, J., Snyder, H. and **Johnson, T.** 1994. Thick-billed Parrot releases in Arizona. *The Condor*, 96: 845-862.

Snyder, N. F. R., McGowan, P., Gilardi, J. and **Grajal, A.** 2000. eds. Parrots: Status Survey and Conservation Action Plan 2000-2004. IUCN. The World Conservation Union, Gland, Switzerland and Cambridge, UK.

Terborg, J., Robinson, S.K., Parker III, T.A. and **Moskovits, D.K.** 1996. Structure and organization of an Amazonian forest bird community. *Ecological Monographs*, 60: 213-238.

Thiolly, J.M. 1994. Structure, density and rarity in an Amazonian rainforest bird community. *Journal of Tropical Ecology*, 10: 449-481.

USFWS 2009. Recovery Plan for the Puerto Rican Parrot *(Amazona vittata)*. Atlanta, Georgia, USA.

White, T.H., Collazo, J. A. and **Vilella, F.J.** 2005. Survival of captive-reared Puerto Rican Parrots released in the Caribbean National Forest. *The Condor*, 107: 424-432.

White Jr., T.H., Collar, N.J., Moorhouse, R.J., Sanz, V., Stolen, E.D., Brightsmith, D.J. 2012. Psittacine reintroduction: Common denominators of success. *Biological Conservation*, 148: 106-115.

Wiley, J.W., Gnam, R.S., Koenig, S.E., Dornelly, A., Galvez,

X., Bradley, P.E., White, T., Zamore, M., Reillo, P.R., Anthony, D. 2004. Status and conservation of the family Psittacidae in the West Indies. *Journal of Caribbean Ornithology*. 17 (Special issue): 94-154.

Wiley, J.W., Snyder, N.F.R. and **Gnam, R.S.** 1992. Reintroduction as a conservation strategy for parrots. p.165-200. *In* **S.R. Beissinger** and **N.F.R. Snyder,** eds. New World Parrots in Crisis. Smithsonian Institution Press: Washington, D.C.

Willis, E.O., Eisenmann, E. 1979. A revised list of the birds of Barro Colorado Island, Panama. Smithsonian Institution Press: Washington, D.C.

Wright, T.F., Toft, C.A., Enkerlin-Hoeflich, E., Gonzalez-Elizondo, E., Albornoz, M., Rodriguez-Ferrado, A., Rojas-Suarez, F., Sanz, V., Trujillo, A., Beissinger, S.R., Berovides, V., Galvez, X., Brice, A.T., Joyner, K., Eberhard, J., Gilardi, J., Koenig, S.E., Stoleson, S., Martuscelli, P., Meyers, J.M., Renton, K., Rodriguez, A.M., Sosa-Asanza, A.C., Vilella, F.J., Wiley, J.W. 2001. Nest Poaching in Neotropical Parrots. *Journal of the Society for Conservation Biology*, 15: 710-720.

Ziembicki, M., Raust, P. and **Blanvillain, C.** 2003. Drastic decline in the translocated ultramarine lorikeet population on Fatu Iva, Marquesas Islands, French Polynesia. *Reintroduction News*, 23: 17-18.