Testing Satellite Telemetry Tags For Psittacines in Petén, Guatemala

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Introduction

The northern Central American Scarlet Macaw (***Ara macao cyanoptera***) is a distinct subspecies that was once widespread throughout southern Mexico and northern Central America (Wiedenfeld 1994). This subspecies now exists mainly in the tri-national forests of Belize, Guatemala, and Mexico in subpopulations estimated to total less than 1000 birds, suggesting that the subspecies is extremely vulnerable to extinction. Based on records of active nests and sightings, Wildlife Conservation Society field biologists estimate that at best just over 300 wild macaws persist within the country of Guatemala, the vast majority of which nest within the two million hectare Maya Biosphere Reserve (MBR) – the largest protected area in Mesoamerica. Ironically, the most threatened "core zone" of this massive reserve, Laguna del Tigre National Park, comprises the most critical nesting stronghold for this species in Guatemala. Over the last 5 years, WCS has been engaged in this area through a number of field projects that have helped to stabilize the eastern section of the park and adjacent community-managed areas containing the majority of the known nests remaining within Guatemala. Field interventions have included efforts to curb poaching, protect nesting habitat, increase nesting cavity availability, monitor macaw reproductive success, and involve local communities through local protection and environmental education initiatives. Despite these advances and WCS's commitment to continued implementation of an integrated field conservation strategy, field scientists and national park service managers fear that efforts to conserve the species remain incomplete due to a lack of knowledge about Scarlet Macaw habitat use during the non-breeding season. Some incomplete and anecdotal evidence exists that at least some of the macaws seasonally migrate southwest to riparian habitats (and possibly to Mexico). Clearly, the probability of Scarlet Macaw conservation in Guatemala will be greatly enhanced if more precise annual habitat-use patterns can be identified to inform national authorities, target habitat protection and management efforts in regions that are under threat, and recruit local communities as allies in the conservation of the species.

Radio telemetry with large parrots and macaws became possible about a decade ago with production of a VHF unit that could withstand the destructive force power of their bills. Prototype testing and the first successful radio tracking of a large psittacine was conducted in

1995 with Great Green Macaws (Bjork and Powell 1995). This transmitter design is the design currently used for telemetry on large psittacines. However, searching from small aircraft for missing birds that range widely in unknown geographic patterns is expensive, and often birds cannot be located. Important research on ranging patterns of many species of psittacines is not conducted or is not successful due to these methodological and logistical problems.

Satellite PTT (Platform Terminal Transmitter) technology has only recently become more commonly used for tracking migratory wildlife species. This technology offers promise for uncovering many of the mysteries of psittacine ranging patterns. Similar to the obstacles encountered with traditional VHF technology, PTT technology was not possible with psittacines until the very recent innovation of a parrot-proof PTT unit by North Star Science and Technology, LLT. The new design has been successfully tested on a pair of captive macaws and is now ready for field testing on free-ranging birds. The current report presents the results of accuracy tests on this prototype in the Petén forest of Guatemala.

Objectives

1) Determine the accuracy of positions registered by this new satellite tag design
2) Determine the rate at which the satellite records locations in Petén, Guatemala

Methods

We tested a single satellite transmitter designed and built for use on macaws by North Star Science and Technology. The transmitter is a collar design with rigid antenna (Fig. 1) that weighs 31 g and has a reported battery life of up to 500 transmission hours (Blake Henke pers. comm.). However, the manufacturer warns that the actual battery life may be greatly reduced in warm tropical environments (350 – 450 hours).

The current accuracy test was conducted in Petén, Northern Guatemala (Appendix 1). The region is in tropical evergreen forest. The test was conducted from 28 November – 16 December 2006. A detailed time table of the collar's locations on each day is given in Appendix 2. The protocol used for the test is also provided (Appendix 3). The collar was hung in 4 different emergent trees (Table 1). In all cases the transmitter was at least 15 m from the ground. The transmitter was always covered from above by the canopy of the emergent tree. *This is a good approximation of where macaws perch in this environment. In fact, the birds often perch higher and more exposed in the tree than the location where the transmitter was hung for this test* (Brightsmith & Boyd, 2006).

Figure 1: Satellite transmitter (PTT) designed and built for use on macaws by North Star Science and Technology

The transmitter was hung at least 2 – 3 m away from any large trunks or branches to ensure that the tree did not interfere with the transmission. However to test the impact of tree interference, the transmitter was hung directly up against a large thick tree trunk. In most trees, the antenna was hung with the antenna pointing straight up (as the manufacturer recommends for best reception). In one test, the collar was hung from one tree with the antenna at a 45 deg angle.

Table 1: Sites of emergent trees where tests were done

Site Name	TreeName	Tree sp	masl	Lat (N)	Long (W)
Tikal NP	Tikal	No identified	240	17°13'28''	89°36'45''
Poptún	ICAVIS	Pinus caribea	520	16°19'56''	89°25'03''
Laguna del Tigre NP	Peñón BV	Acacia glomerosa	170	17°17'40''	90°08'07''
Altar del Sacrificio	Estrella	Acacia glomerosa	120	16°29'05''	90°32'11''

The transmitter was programmed to transmit on a time schedule that allowed it to cover different parts of the day on a 3 day cycle. Starting from the time it was turned on it transmitted for 5 hours then was off for 23 hours, then on for 5 then off for 23, and finally on for 5 then off for 11. In the current study the collar was turned on at 6:00 AM which resulted in the following repeating 3 day transmission schedule:

Day 1 06:00 am - 11:00 am
Day 2 10:00 am - 03:00 pm
Day 3 02:00 pm – 07:00 pm
Day 4 06:00 am - 11:00 am
Day 5 10:00 am - 03:00 pm
Day 6 02:00 pm – 07:00 pm

Results

Locations per day & Location Class

Using only the data generated by the PTT with the antenna at 90° and hanging at least 3 meter away from any really large tree branches or tree trunks, we had a total of 12 transmitter days. A total of 37 locations were recorded (3.08 per day) of which 16 (1.33 per day) had a location class (LC) of 3, 2 or 1 and are considered "good locations." Good locations were recorded on 75% of the 12 days of transmission (Table 2). The number of locations recorded per transmitter-hour was slightly higher in the afternoon (Fig. 2, Table 3). This trend is apparent when the data are analyzed by hour of the day (Fig. 2). The number of locations registered was apparently related to the time of day when the transmitter was transmitting. There were marginally significantly more locations in the afternoon (16 locations) than the morning (7) and mid-day (14).

Table 2: Number of locations per day received from a satellite transmitter placed in emergent trees at Petén, Guatemala. Note: "Good locations" are defined as those with Argos location classes of 3, 2, or 1 (see also Table 3 for Argos estimated errors associated with each location class).

Transmit hours	Total days	Days with = 1 good locations	Days with any location
06:00 - 11:00	4	1	4
10:00 - 15:00	4	4	4
14:00 - 19:00	4	4	4

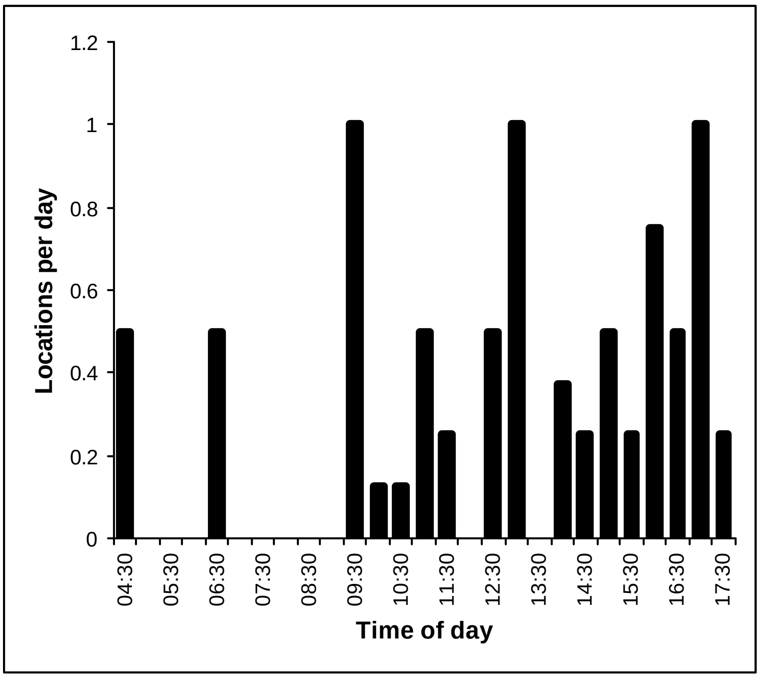

Figure 2: Number of locations logged per day by the satellite transmitter by time of day. Note: The data are lumped in to half hour intervals and scaled for the number of days on which the transmitter was transmitting during that half hour period. The sample size is 4 days for each time except for 10:00, 10:30, 14:00, 14:30 for which the sample size is 8 days. This graph includes all 37 locations generated while the transmitter was at Petén, Guatemala (PTT with the antenna at 90° and hanging at least 3 meter away from any really large tree branches or tree trunks)

Table 3: Number of locations received from a satellite transmitter placed in emergent trees at Petén, Guatemala. Note: The location classes are those given by Argos with 3 representing the most accurate locations and Z the least (see also Table 3 for Argos estimated errors associated with each location class).

	Total	Location class							
Transmit hours	days	3	2	1	0	A	B	Z	Total
06:00 - 11:00	4	0	2	0	0	2	2	1	7
10:00 - 15:00	4	1	3	2	5	1	2	0	14
14:00 - 19:00	4	4	2	2	3	2	2	1	16
Total	12	5	7	4	8	5	6	2	37

Location errors

There is only one location that is off by > 100 km (169.6 Kms and LC code B, see Figure 3), 43% of the locations have error distance less than 1 km, 30% between 1 and 5 kms, and only 5.4% with distance error more than 20 kms (Figure 3 and Table 4). And 62% of the data with error distance less than 5 kms have a "good location class" (3, 2, 1).

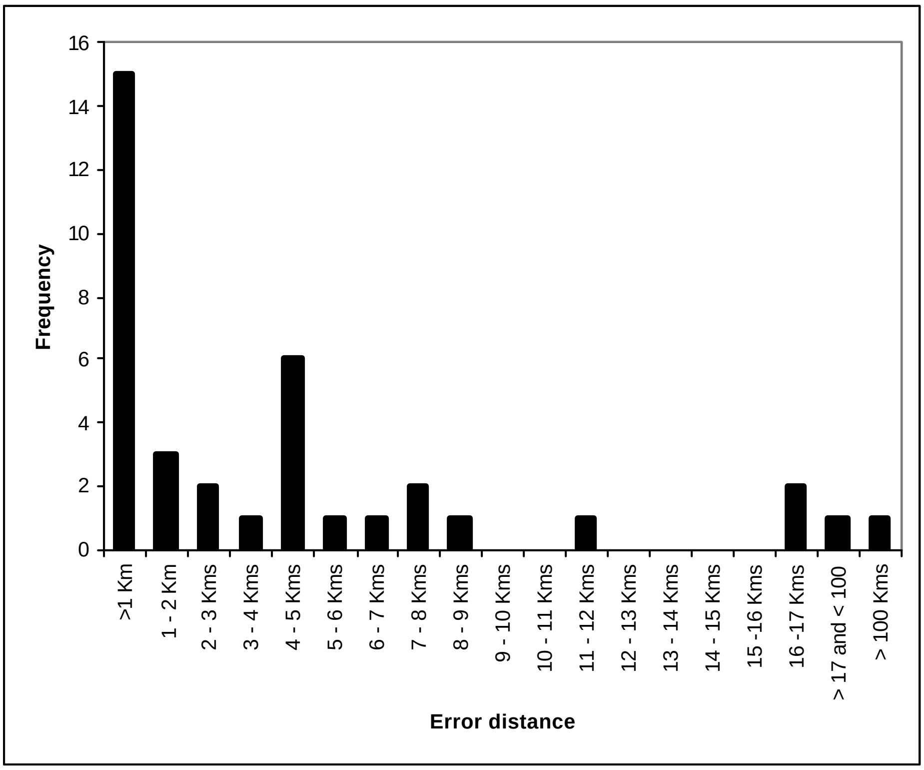

Figure 3: Error distances of the data obtained from a satellite transmitter placed in emergent trees at Petén, Guatemala.

The 37 locations obtained during the test at Petén had an average error of 8.82 ±27.8 kms (Table 5). The location class (LC) only explain the 20% of variation in the data (ANOVA: $F_{6,36}$ = 1.18, p=0.35). The locations with LC codes of 3, 2, and 1 had a combined average error of 1.08 ±1.18 kms (N=16)

Table 4: Distance Error and Number of locations classes received from a satellite transmitter placed in emergent trees at Petén, Guatemala.

	Location class							
Distance Error	3	2	1	0	A	B	Z	Total
< 1 Km	5	6	1	0	3	0	1	16
1 - 5 Kms	0	2	3	2	2	1	1	11
5 - 10 Kms	0	0	0	3	0	3	0	6
10 - 15 Kms	0	0	0	0	0	0	0	0
15 - 20 Kms	0	0	0	2	0	0	0	2
> 20 Kms	0	0	0	1	0	1	0	2

Table 5: Location errors of a satellite telemetry collar hung from emergent trees at Petén, Guatemala. Note: The "Argos estimated error" is the estimated error provided by Argos for each LC code

LC	Argos estimated error (Kms)	Distance Error Average (Kms)	Stdev	N	Min	Max
3	< 0.15	0.29	0.29	5	0.07	0.79
2	< 0.35	0.85	0.53	7	0.17	1.65
1	< 1.0	2.48	1.58	4	0.60	4.35
0	> 1.0	11.14	8.82	8	3.77	28.60
A	No estimate	1.65	1.85	5	0.27	4.27
B	No estimate	34.46	66.27	6	4.51	169.63
Z	Invalid location	2.48	2.97	2	0.38	4.58
Total		8.82	27.80	37	0.07	169.63

Antenna angle and locations

Comparing the distance error when the transmitter was hung at 45 degree angle between the distance error when the transmitter was hung at 90 deg angle, these distances did not differ significantly (ANOVA: $F_{1,17}$=0.62, p=0.44)

Discussion

This prototype holds great promise to determine the movements of the macaws throughout the Selva Maya landscape because it had at least one “good location” per day (1.33 good loc/day). In addition, our tests revealed that the majority of the locations were obtained during the afternoon - when the macaws are more likely to be resting in the trees. Almost 50% of the locations have errors of 1 km or less, and the antenna position (45-90°) was not revealed as a serious problem. In conclusion, there is a very low probability of including a location reading with error >5 km within our landscape analyses if we only accept the locations classes (LCs) of 1, 2, or 3.

Literature Cited

Bjork, R. & G.V.N. Powell (1995). Great Green Macaw (*Ara ambigua*): Some observations on the Costa Rican population and their lowland forest habitat and on their conservation. *In*: J. Abramson, B.L. Speer, and J.B. Thomsen (Eds.), *The Large Macaws: Their Care, Breeding and Conservation*. Cambridge University Press.

Brightsmith D. & J. Boyd (2006). Testing Satellite Telemetry Tags for Psittacines in Tambopata, Peru. A report to Loro Parque Foundation, North Star Science and Technology, Amigos de las Aves, USA, Parrot Conservation Research Fund

Morales, R., Molina, O. and G. Rivera (2001). Uso de Hábitat y Patrones Migratorios de la Guacamaya Roja (*Ara macao cyanoptera*, Psittacidae) en el Parque Nacional Sierra del Lacandón, La Libertad, Petén, 2001-2001. Fundación Defensores de la Naturaleza.

Powell, G.V.N. & R. Bjork. 1995. Implications of intratropical migration on the design of protected natural areas: a case study using *Pharomachrus mocinno*. Conser. Biol. 9:354-362.

Wiedenfeld D. (1994). A New Subspecies of Scarlet Macaw and its status and conservation. Ornitología Neotropical 5: 99-104