Final Report

Nido Adoptivo™

2016 – 2017

Artificial Nest Boxes to improve the reproductive success of the Critically Endangered Blue-throated Macaw in the Loreto area of El Beni, Bolivia.

Project conducted by:

Armonía

CONSERVACIÓN DE AVES EN BOLIVIA

With the support of:

BIRD ENDOWMENT

LORO PARQUE FUNDACIÓN

In 2017 we recorded the first pair of **banded** Blue-throated Macaws that established a nest within one of the artificial nest boxes we installed. Though we are not sure in which nests they hatched, we know that both birds were raised seven years ago in two of our artificial nests (left).

This pair produced a chick (right) that fledged successfully.

This is the first time we recorded a second generation of this species fledging from our nest boxes.

INTRODUCTION

It is widely known that availability of suitable reproductive sites (holes in tree trunks) for the Critically Endangered Blue-throated Macaw is an important limiting factor that slows down the population increase of this Bolivian endemic macaw in the wild. Most natural nest sites are frequently affected by uncontrolled fires that are provoked by cattle ranchers to renew pasture. Moreover, the more abundant Blue-and-Yellow Macaw (which is locally more abundant, and present throughout most of Central and northern South America) frequently outcompetes the Blue-throated Macaw in the use of the reduced number of available nesting sites.

Thanks to the support of the Bird Endowment and the Loro Parque Fundación, Armonía started a program with artificial nest boxes in 2005. During the first year only 20 artificial nest boxes were installed in the Loreto area. Today we have 80 nests boxes located in the Loreto area, plus 15 in el Ciervo area and 60 in the Barba Azul Nature Reserve (Fig 1). The Loreto area is where the Blue-throated Macaw southern subpopulation resides. El Ciervo area and Barba Azul Nature Reserve are located within the distribution area of the northern subpopulation of this species. To date, only macaws of the southern population have used our nest boxes.

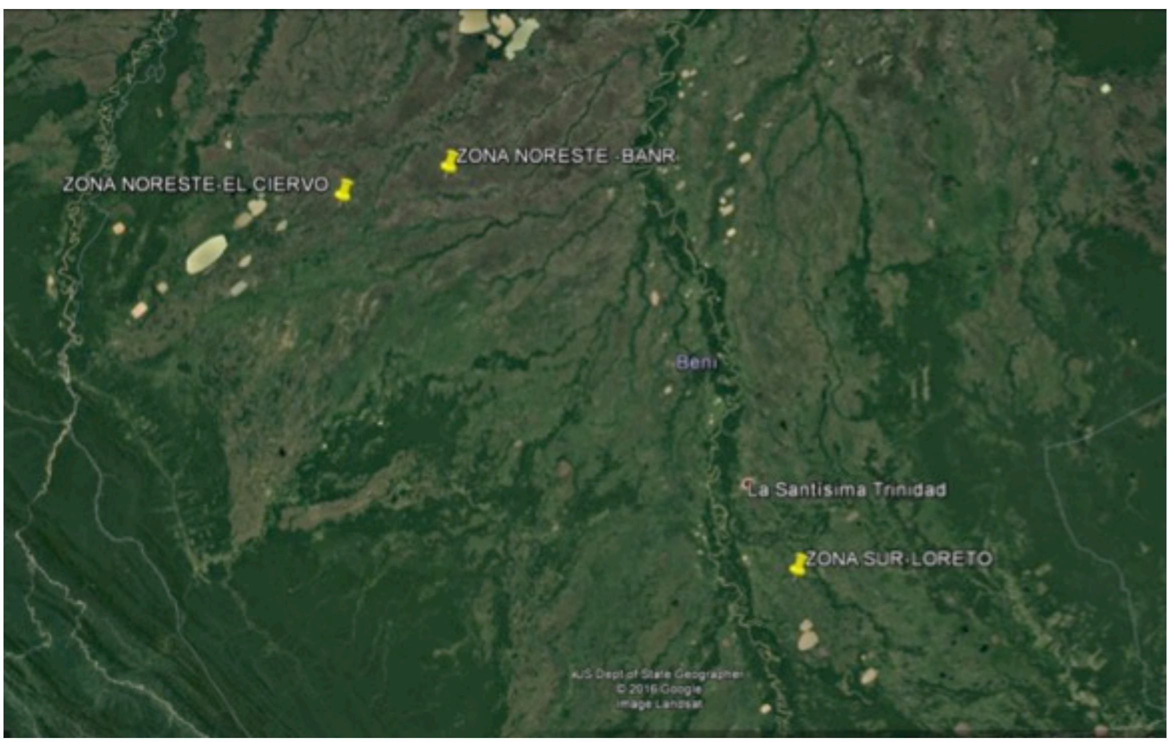

Figure 1. Location of the three areas where we have nest boxes installed

(BANR = Barba Azul Nature Reserve)

ACTIVITIES

As Blue-and-Yellow Macaws frequently outcompete the Blue-throated Macaws for nest boxes as secure reproductive sites (from 2006 to 2011), in 2012 we started to experiment with different designs of the nests. One of the most important modifications was the reduction of the diameter of the entrance hole to 10 cm. As a result of these modifications in the architecture of the nests, we recorded a reduction in the number of Blue-and-Yellow Macaws using our artificial nest boxes, thus decreasing the competition between both species.

The appearance of the nest boxes also changed to make them look more like their natural breeding trees (Fig 2). Nests are constructed with two different types of wood. The front is made from Palo María wood. Palo María is a locally abundant tree (*Calophyllum brasiliense*) and its wood is hard enough to prevent macaws from gnawing easily. The remaining sides of the nest are made of Ochoo (*Hura crepitans*) wood. Ochoo is also a locally abundant tree whose wood is softer, lighter and therefore cheaper.

Nests were cleaned and fixed between September and November 2016. From December to May, two team members monitored each nest every 15 days. During each monitoring round the nest was carefully reviewed.

Figure 2. The three types of nest we have developed and installed across the 11 years of our artificial nest box program. Left is the classic model. Center is the hexagonal model. Right is the octagonal model.

RESULTS

A total of 80 nest boxes are distributed among four ranches in the Loreto area (Fig 3). From these nest boxes, five were used by Blue-throated Macaws, twenty three were used by other bird species and fifty two remained empty throughout the entire reproductive season. White-eyed Parakeet (*Psittacara leucophthalmus*) and Black-bellied Whistling-Duck (*Dendrocygna autumnialis*) used eight nest boxes each. Blue-and-Yellow Macaw used three (one of them previously used by White-eyed Parakeet). Two artificial nest boxes were used by Chestnut-fronted Macaws (*Ara severus*). Two nests were used by two unidentified bird species, one belonging to the woodpecker family and the other to the group of blackbirds. Table 1 below shows a list of all nests used by birds during the last reproductive season (2016-2017).

Figure 3. Pins indicate the location of nest boxes installed in the Loreto area. The red pins show the locations of nests where Blue-throated Macaw produced offspring.

The village of Loreto can be seen on the upper left side.

Table 1. Summary of the 28 nest boxes occupied by birds as nesting sites in the Loreto area during the 2016-2017 breeding season. The sponsor code column contains the acronym of the sponsor (person or institution) that sponsored the nest during the present reproductive season. (See Appendix for sponsor names.) The nest code column is a fixed code that identifies each nest, and remains permanent across the breeding seasons. The column "number of times the nest was used" indicates the number of times the nest was used during the present breeding season.

Sponsor code	Nest code	Number of times the nest was used	Coordinates		Ranch	Description
AL	PBA4	2	15°11'23.60"	64°43'15.40"	Esperancita	3 eggs of *Ara severus* laid ------------- 30 eggs of *Dendrocygna autumnialis* laid
E4	PBA5	1	15°11'21.30"	64°43'13.60"	Esperancita	3 chiks of *Ara severus*
KS	PBA7	1	15°11'22.00"	64°43'11.30"	Esperancita	2 chicks of *Ara arauna*
AR	PBA9	1	15°11'24.80"	64°43'10.40"	Esperancita	3 eggs of *Psittacara leucophthalmus*
JAN	PBA10	1	15°11'25.20"	64°43'11.40"	Esperancita	3 eggs of *Psittacara leucophthalmus*
ES	PBA11	2	15°11'28.40"	64°43'8.40"	Esperancita	2 eggs of *Psittacara leucophthalmus* ------------- 16 eggs of *Dendrocygna autumnalis*
#1	PBA12	1	15°11'30.00"	64°43'7.80"	Esperancita	2 chicks of *Ara glaucogularis*. One of them died.
AZ	PBA14	1	15°11'31.20"	64°43'7.90"	Esperancita	3 eggs of *Psittacara leucophthalmus*
PBA18	PBA18	1	15°11'32.90"	64°43'7.90"	Esperancita	1 egg of *Psittacara leucophthalmus*
A2	PBA20	1	15°11'35.90"	64°43'14.20"	Esperancita	2 eggs of *Psittacara leucophthalmus*; and 1 chick
PB	PBA21	1	15°11'36.60"	64°43'16.10"	Esperancita	1 chick of *Ara glaucogularis*
BI	PBA23	1	15°11'37.40"	64°43'15.90"	Esperancita	3 chicks of *Psittacara leucophthalmus*
SM	PBA24	1	15°11'39.30"	64°43'16.40"	Esperancita	40 eggs of *Dendrocygna autumnalis*
ME	PBA26	1	15°11'41.20"	64°43'16.80"	Esperancita	52 eggs of *Dendrocygna autumnalis*

Sponsor code	Nest code	Number of times the nest was used	Coordinates		Ranch	Description
PC3	PBA28	2	15°11'43.80"	64°43'22.10"	Esperancita	1 chick of *Psittaca leucophthalmus* -------------- 15 eggs of *Dendrocygna autumnalis*
JW	PBA30	1	15°11'43.10"	64°43'23.50"	Esperancita	31 eggs of *Dendrocygna autumnalis*
PC2	PBA31	1	15°11'42.80"	64°43'24.50"	Esperancita	2 unfertile eggs and 1 chick of *Ara glaucogularis*
E1	PBA32	1	15°11'42.40"	64°43'23.70"	Esperancita	47 eggs of *Dendrocygna autumnalis*
AD	PBA33	1	15°11'41.70"	64°43'22.40"	Esperancita	1 unfertile egg and 2 chicks of *Ara glaucogularis*
CA	PBA43	1	15°11'46.00"	64°43'21.30"	Esperancita	2 eggs of *Psittacara leucophthalmus*
JG	PBA45	1	15°12'48.70"	64°40'42.60"	La Cantina	1 chick of *Psittaca leucophthalmus*
PC1	PBA48	1	15°12'53.80"	64°40'48.70"	La Cantina	8 eggs of *Dendrocygna autumnalis*
E3	PBA51	1	15°12'52.59"	64°40'28.27"	La Cantina	3 chicks of *Psittacara leucophthalmus*
KC	PBA53	1	15°13'2.00"	64°40'18.80"	La Cantina	3 chicks of *Ara glaucogularis*
BF	PBA54	1	15°13'2.30"	64°40'19.40"	La Cantina	1 predated egg of *Dendrocygna autumnalis*
JB	PBA57	1	15°15'8.00"	64°41'28.40"	Las Trancas	2 eggs of an unidentified woodpecker
PBA60	PBA60	1	15°15'9.50"	64°41'31.60"	Las Trancas	10 eggs of *Dendrocygna autumnalis*
GI	PBA64	1	15°18'16.30"	64°38'9.60"	Santa Rosa de Justiniano	4 chicks of an unidentified blackbird

Nine Blue-throated Macaw fledglings left our nest boxes during the 2016/2017 breeding season. Four were located in the "Esperancita" ranch and one in the "La Cantina" ranch (Table 2; Fig 4 and 5). Five nest boxes is the highest amount of artificial nests ever used by Blue-throated Macaws in a single breeding season (Fig 6). However, the number of Blue-throated Macaw fledglings during this breeding season (2016-2017) was not the highest we recorded since the beginning of this conservation program (10 is the highest number of Blue-throated Macaw chicks that fledged in a single breeding season; see Fig 6). We recorded a pair of banded Blue-throated Macaws successfully raising their offspring (one chick) in one of our artificial nests (nest box PB in Fig 4). As we know that both parents were born in our nest boxes seven years ago (some fledglings were ringed), we can confirm that this is the first record of a second generation Blue-throated Macaw using our artificial nests. Therefore, we can confidently state that young Blue-throated Macaws are learning that artificial nests we placed in the area are secure sites to produce their own offspring.

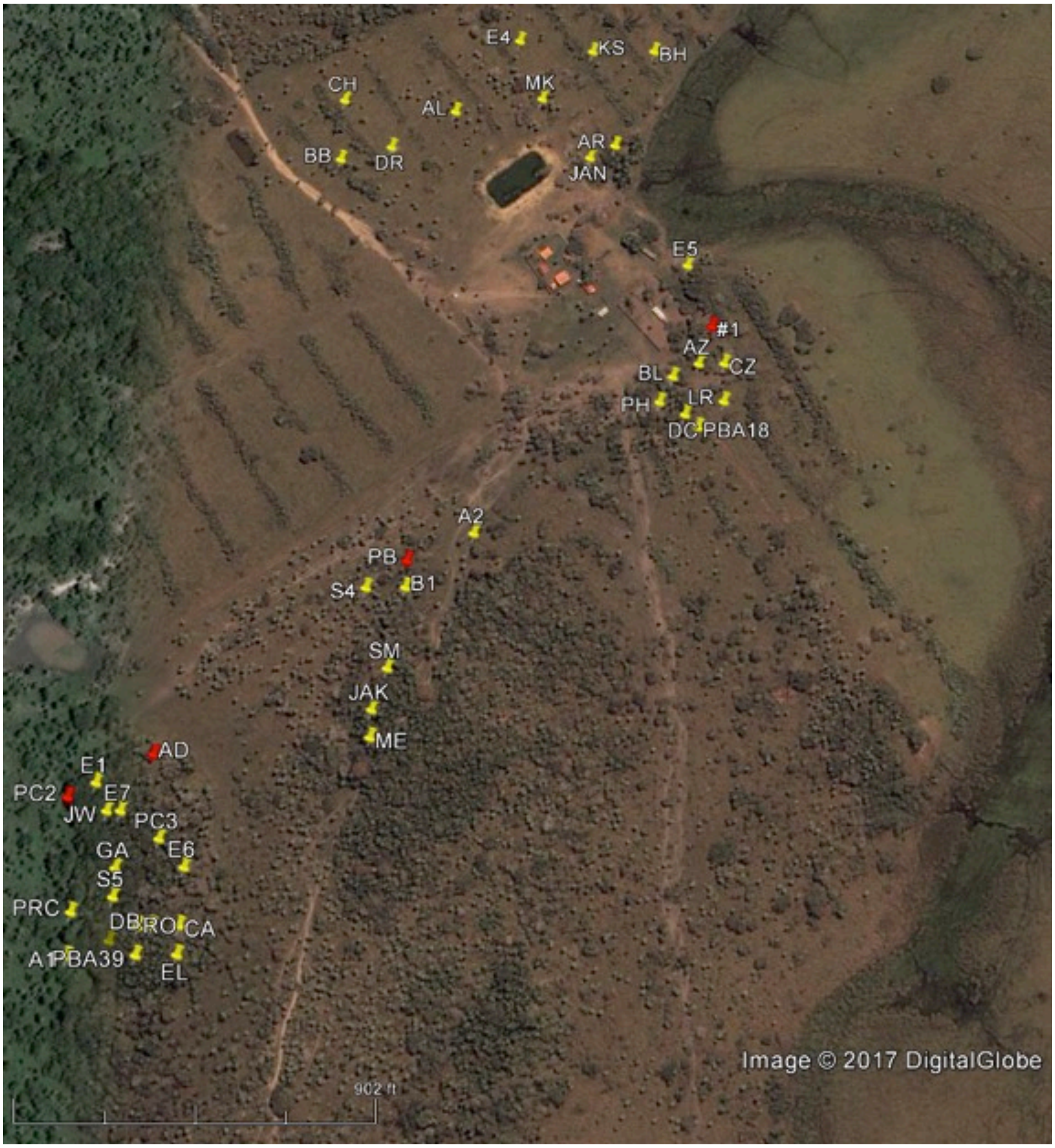

Figure 4. Pins indicate the location of artificial nests within the Esperancita ranch.

Red pins show the location of nests that were used by Blue-throated Macaws.

Nest PB (in the center) is where the banded Blue-throated Macaws raised their offspring.

Table 2. Summary of nest boxes used by Blue-throated Macaws during the 2016-2017 breeding season

Sponsor code	Nest code	Ranch	# fledglings
#1	PBA12	Esperancita	2
PB	PBA21	Esperancita	1*
PC2	PBA31	Esperancita	1
AD	PBA33	Esperancita	2
KC	PBA53	La Cantina	3
		Total	**9**

*represents the number of fledglings raised by banded parents

Figure 5. The red pin shows the location within the La Cantina ranch of the nest box where a pair of Blue-throated Macaws raised successfully their offspring in "La Cantina" ranch.

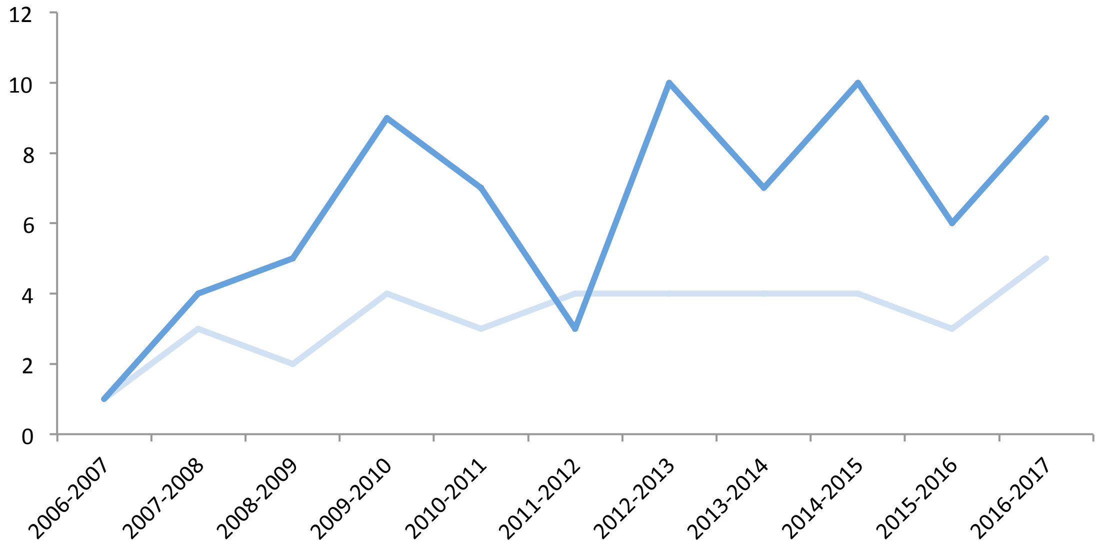

Figure 6. The light-blue line shows the number of nest boxes used by Blue-throated Macaws throughout the breeding seasons 2006-2007 to 2016-2017. The dark-blue line shows the number of chicks that successfully fledged from Armonía's nest-boxes during the same number of breeding seasons.

Description of nest boxes used by Blue-throated Macaws

Sponsor code: #1
Nest code: PBA12

Three eggs were initially laid. All eggs hatched in December 2016 (chicks were recorded on December 30, 2016). In January 2017 one chick was found dead (January 13, 2017). Both chicks grew healthy until March 1, 2017. Both chicks fledged the nest by the end of March (Fig 7).

Figure 7. Development of Blue-throated Macaw offspring produced in nest PBA 12 (sponsor code: #1)

Sponsor code: PB
Nest code: PBA21

This nest was used by a banded pair of Blue-throated Macaws. Only one egg was produced in December 2016. The egg hatched in January (Jan 29, 2017), and the chick occupied the nest until April 20, 2017. (Fig 8).

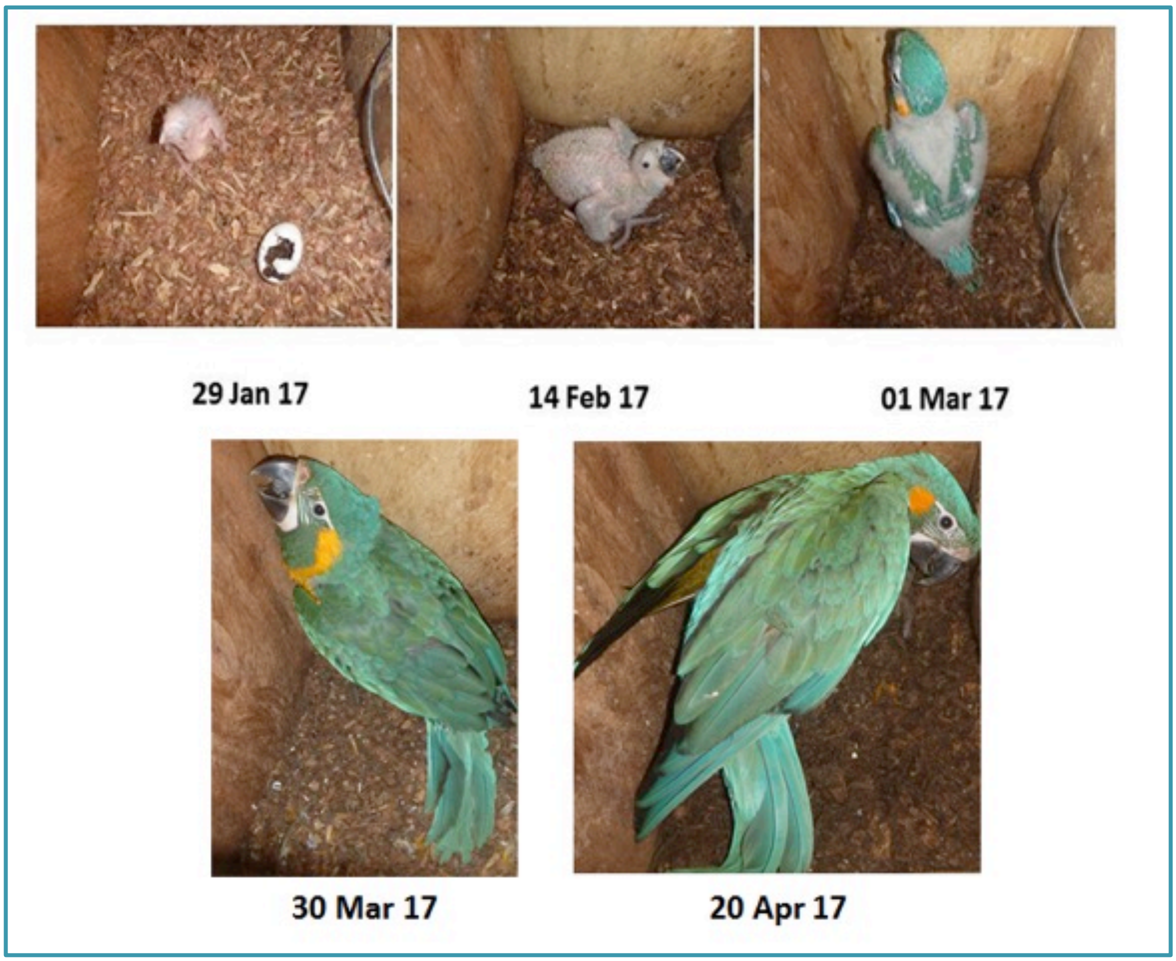

Figure 8. Development of the Blue-throated Macaw offspring produced in nest PBA 21 (sponsor code: PB)

Sponsor code: PC2
Nest code: PBA31

Three eggs were recorded in late January (January 29, 2017). Only one chick hatched (February 14, 2017). The surviving chick grew healthy in the nest until early May (May 6, 2017).

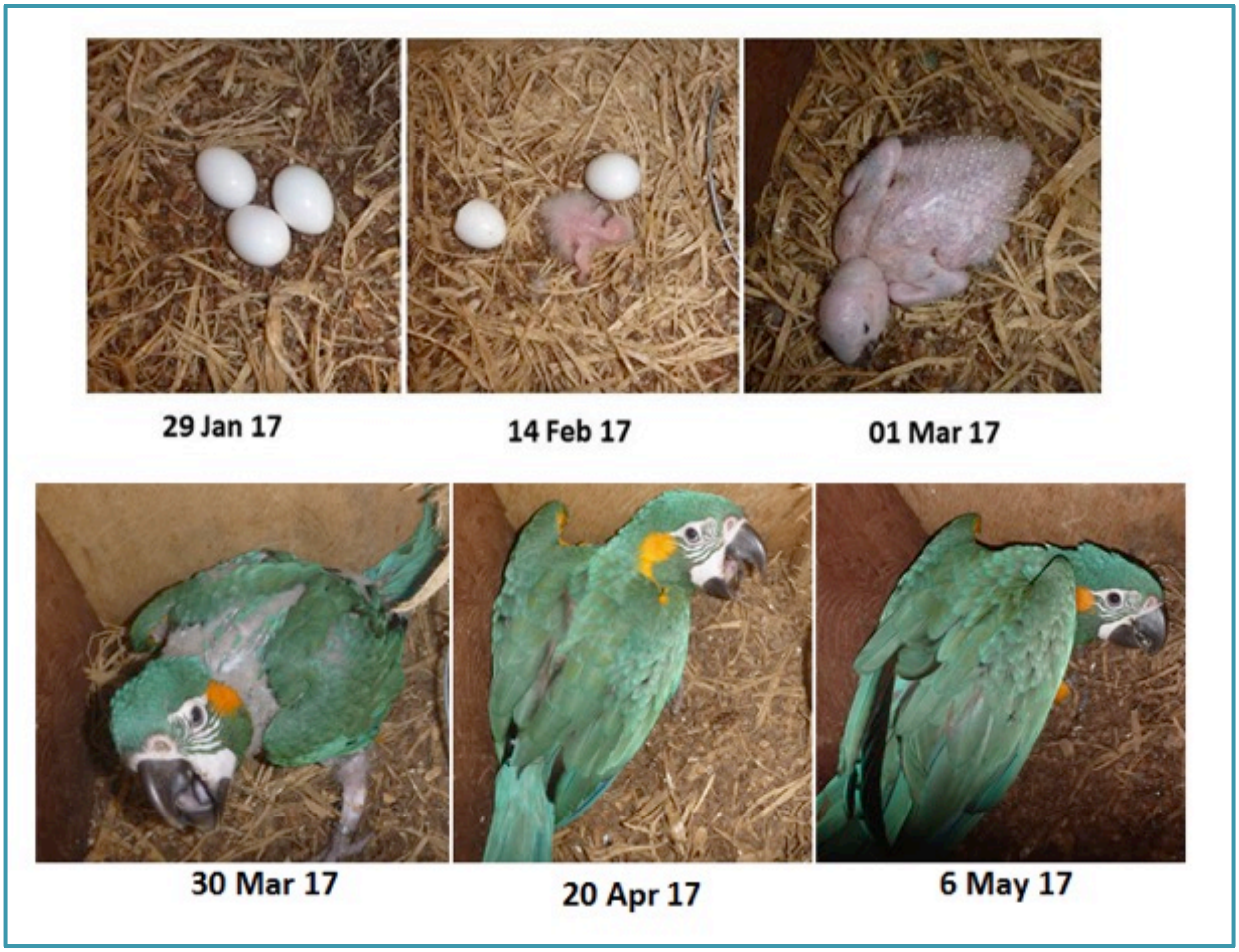

Figure 9. Development of Blue-throated Macaw offspring produced in nest PBA 31 (sponsor code: PC2)

Sponsor code: AD
Nest code: PBA33

Three eggs were produced in this nest (December 22, 2016). Only two chicks hatched by late January (January 29, 2017). Both chicks grew healthy and left the nest by early April (March 31, 2017)(Fig 10).

Figure 10. Development of the Blue-throated Macaw offspring produced in the nest PBA 33 (sponsor code: AD)

Sponsor code: KC
Nest code: PBA53

Three eggs were produced in early December. Two chicks hatched by late December (recorded on December 24, 2016). By mid January we recorded the three chicks healthy. All chicks grew healthy from in the nest until early March (March 3, 2017)(Fig 11).

Figure 11. Development of the Blue-throated Macaw offspring produced in the nest PBA 53 (sponsor code: KC)

It is important to highlight that one of the five nest boxes used by Blue-throated Macaws during this breeding season was octagonal. This is the last model of nests we developed (nests on the right side in fig. 2). The two new models (hexagonal and octagonal) were installed for the 2015-2016 breeding season, and this is the second time this nest is used by Blue-throated Macaws so far (until the 2014-2015 breeding season we used only one model). This evidence a level of acceptance (preference) by the Blue-throated Macaws for the octagonal-shaped nest box so far. However, we still need to collect data for more years. Finally, table 3 shows the number of nests used by other species of birds.

Table 3. Summary of bird species using Armonía's nest boxes as breeding sites during the 2016-2017 breeding season. Note that (1*) means a pair of Blue-and-Yellow Macaw used a nest previously used by a Black-bellied Whistling-Duck.

Scientific name	**English name**	**No. of used nests**
Psittacara leucophthalmus	White-eyed Parakeet	8
Dendrocygna autumnalis	Black-bellied Whistling-Duck	8
Ara glaucogularis	Blue-throated Macaw	5
Ara ararauna	Blue-and-yellow Macaw	3(1*)
Ara severus	Chestnut-fronted Macaw	2
Picidae sp	Woodpecker	1
Icteridae sp	Blackbird	1
	TOTAL	**28 (1)***

CONCLUSION

Between 2006 and 2012 only 26 Blue-throated Macaw chicks successfully fledged from Armonía's nests (average of 4.8 fledglings per year). This number almost doubled between 2013-2017 breeding season, where 45 chicks successfully fledged from our nest boxes (average of 8.4 fledglings per year). The increase of Blue-throated Macaws raised in Armonía's nests coincides with the installation of new nest box design we implemented, and the increase in the number of nests installed. The most important event of this year is the first confirmed record of a second generation of Blue-throated Macaws raising their offspring in our nest boxes. Moreover, with the number of Blue-throated Macaw chicks that fledged this year we contributed a total of 71 throughout the 11 years of this conservation program (http://bit.ly/2ujr2WA). This is a significant contribution to the wild population of this species, especially considering that its global population is estimated to range between 250 to 300 individuals.

RECOMMENDATION AND FUTURE ACTIONS

To date, we successfully managed to reduce the level of competition between Blue-and-Yellow Macaw and Blue-throated Macaw due to modifications in the artificial nesting sites design. However, other smaller species (e.g. the Chestnut-fronted Macaw, White-eyed Parakeet and the Black-bellied Whistling-Duck) still use the artificial nests to raise their offspring. It is unclear whether these species represent as strong competitors as there are a high number of unused nests every year. With data we have at hand (11 breeding seasons), we will conduct a detailed study to identify whether there is in fact a great percentage of overlap between nests used by the Blue-throated Macaw, and nests used by these other species.

Mortality rate of Blue-throated Macaw offspring raised in our artificial nest boxes throughout the time we have this program (11 breeding seasons) varied from 0 % (the first and third breeding seasons) to as high as 69% (breeding season 2011-2012) (Fig 12). Though we are still learning about causes behind such variable mortality rates across the time we are implementing the program. We are certain that actions can be implemented to decrease the mortality rate. A proposed action is to monitor the nests more frequently to identify those chicks with higher probability to die, and help them to improve their survival rates. In the next months we will contact experts from diverse zoos to learn more about possible actions to be implemented.

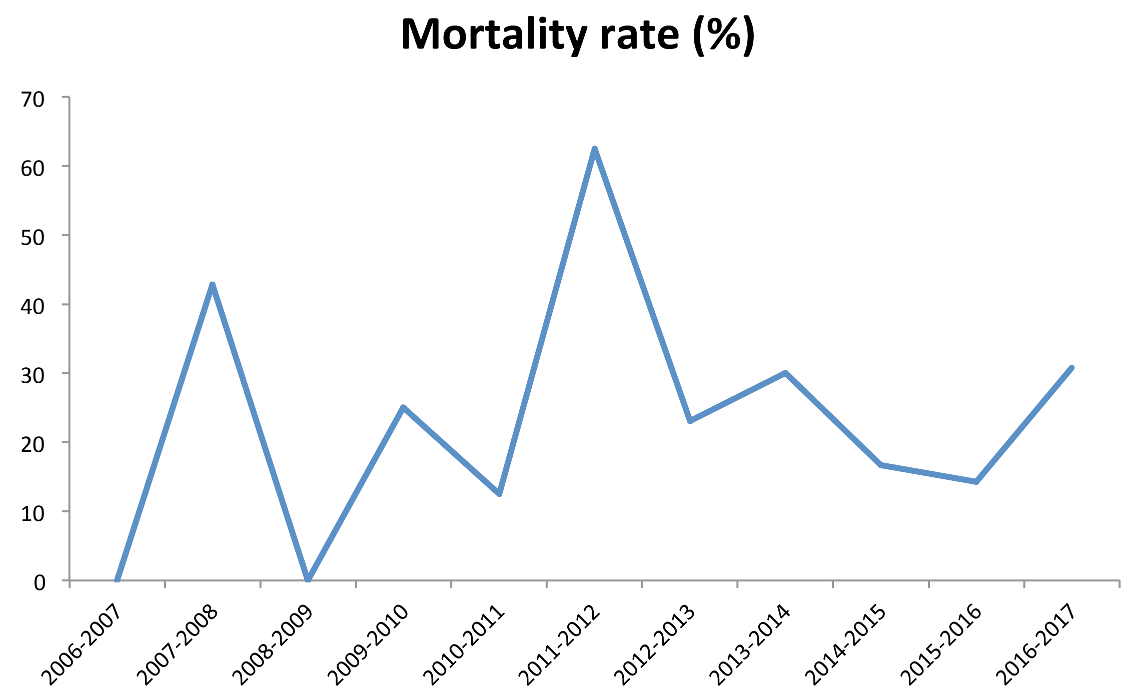

Figure 12. Annual mortality rates (%) recorded since the beginning of the present conservation program.

Appendix

ARTIFICIAL NEST BOXES IN LORETO

N°	Artificial Nest boxes	Nest code	Sponsor code
1		PBA1	B B In Honor of Beamer Blues, by Judy and Buddy Waskey of East Wings Freeflight Club
2		PBA2	C H Kitty Harvill
3		PBA3	D R In Honor of J. E. J. Moore Middle School, by Duct Cleaners of Richmond

N°	Artificial Nest boxes	Nest code	Sponsor code
4		PBA4	A L Anne Lyon
5		PBA5	E 4 Earth Limited @ Southwick's Zoo
6		PBA6	M K Mike Keens / Jungle Toys

N°	Artificial Nest boxes	Nest code	Sponsor code
7		PBA7	K S Kelley Story, Pet Bird Assoc. of VA, East Wings Freeflight Club
8		PBA8	B H Brenton Head
9		PBA9	A R In Honor of J. E. J. Moore Middle School, by Andrades Restaurant

N°	Artificial Nest boxes	Nest code	Sponsor code
10		PBA10	J A N Jan Schottenloher
11		PBA11	E 5 Earth Limited @ Southwick's Zoo
12		PBA12	# 1 Katy Secor

N°	Artificial Nest boxes	Nest code	Sponsor code
13		PBA13	C Z Cincinnati Zoo & Botanical Garden
14		PBA14	A Z Arizona Seed Crackers Society
15		PBA15	B L In Honor of Blu Lu, by Barbara Heidenreich's Force Free Animal Training

<table>
<tr><th>N°</th><th>Artificial Nest boxes</th><th>Nest code</th><th>Sponsor code</th></tr>
<tr><td>16</td><td>
</td><td>PBA16</td><td>P H
Parrots of the Hills Bird Club</td></tr>
<tr><td>17</td><td>
</td><td>PBA17</td><td>D C
Dema Clark</td></tr>
<tr><td>18</td><td></td><td>PBA18</td><td></td></tr>
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N°	Artificial Nest boxes	Nest code	Sponsor code
19		PBA19	L R Laurel Rohrer
20		PBA20	A 2 Avitech Exotic Birds
21		PBA21	P B Pet Bird Assoc. of VA, Parrots Breeders Assoc. of VA, East Wings Freeflight Club

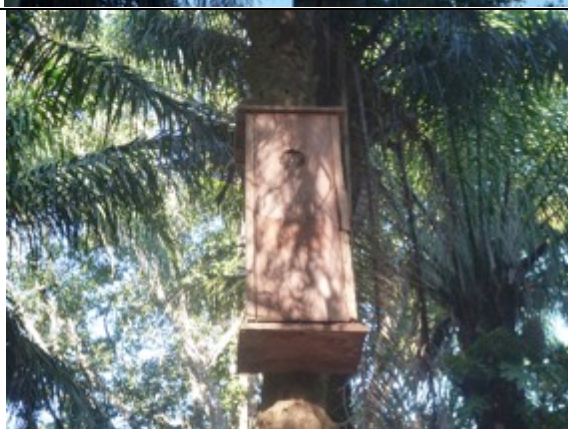
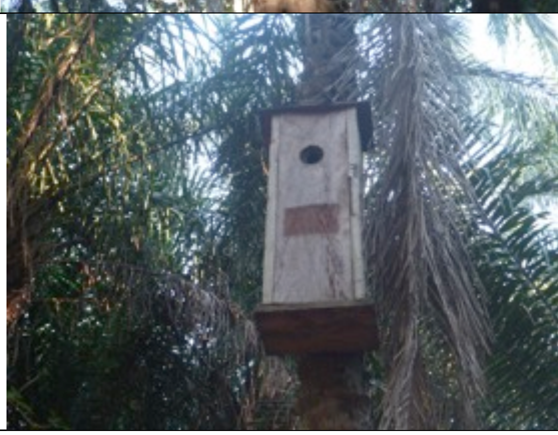
N°	Artificial Nest boxes	Nest code	Sponsor code
22		PBA22	S 4 Sacramento Zoo Conservation Fund
23		PBA23	B I Birblr, The Bird Blogging Community on Tumblr
24		PBA24	S M In Memory of Santana Malowski

N°	Artificial Nest boxes	Nest code	Sponsor code
25		PBA25	J A K Marion Schön
26		PBA26	M E Mary Ellen LePage
27		PBA27	E 6 Earth Limited @ Southwick's Zoo

N°	Artificial Nest boxes	Nest code	Sponsor code
28		PBA28	P C 3 Peninsula Cage Bird Society, East Wings Freeflight Club
29		PBA29	E 7 Earth Limited @ Southwick's Zoo
30		PBA30	J W Jennifer White

N°	Artificial Nest boxes	Nest code	Sponsor code
31		PBA31	P C 2 Peninsula Cage Bird Society, East Wings Freeflight Club
32		PBA32	E 1 Earth Limited @ Southwick's Zoo
33		PBA33	A D In Memory of Dr. Al DeCoteau, by Roger O'Connell

N°	Artificial Nest boxes	Nest code	Sponsor code
34		PBA34	G A Gabriele Alexander/Avian Conservation & Education
35		PBA35	S 5 Sacramento Zoo Conservation Fund
36		PBA36	P R C Parrot Resource Centre

N°	Artificial Nest boxes	Nest code	Sponsor code
37		PBA37	A 1 Avitech Exotic Birds
38		PBA38	
39		PBA39	

N°	Artificial Nest boxes	Nest code	Sponsor code
40		PBA40	R O Roger O’Connell
41		PBA41	D B In Memory of Donna Bumgarner, by East Wings Free Flight Club
42		PBA42	E L Ellyn Lentz

N°	Artificial Nest boxes	Nest code	Sponsor code
43		PBA43	C A Carol Houlihan, East Wings Freeflight Club, Peninsula Cage Bird Society
44		PBA44	S 3 Sacramento Zoo Conservation Fund
45		PBA45	J G Jim and Ginger Payant, Utah

N°	Artificial Nest boxes	Nest code	Sponsor code
46		PBA46	This code is from 2015-2016 breeding season
47		PBA47	A 3 Avitech Exotic Birds
48		PBA48	P C 1 Peninsula Cage Bird Society, East Wings Freeflight Club

N°	Artificial Nest boxes	Nest code	Sponsor code
49		PBA49	This code is from 2015-2016 breeding season
50		PBA50	
51		PBA51	E 3 Earth Limited @ Southwick's Zoo

N°	Artificial Nest boxes	Nest code	Sponsor code
52		PBA52	A S In Memory of Peggy Sanford and Dot Slator, by Andy Sanford
53		PBA53	K C In Honor of Buddy Waskey, by Quaker Parakeet Society
54		PBA54	B F Barbara Heidenreich / Barbara's Force Free Animal Training

N°	Artificial Nest boxes	Nest code	Sponsor code
55		PBA55	S 6 Sacramento Zoo Conservation Fund
56		PBA56	
57		PBA57	J B John Brasaemle

N°	Artificial Nest boxes	Nest code	Sponsor code
58		PBA58	S 2 Sacramento Zoo Conservation Fund
59		PBA59	P & P Birblr, The Bird Blogging Community on Tumblr
60		PBA60	

N°	Artificial Nest boxes	Nest code	Sponsor code
61		PBA61	E 2 Earth Limited @ Southwick's Zoo
62		PBA62	S 7 Sacramento Zoo Conservation Fund
63		PBA63	E O Evan Ogawa, Marian Goldeen, Rachel Goldeen

N°	Artificial Nest boxes	Nest code	Sponsor code
64		PBA64	G I Grace Innemee
65		PBA65	
66		PBA66	

N°	Artificial Nest boxes	Nest code	Sponsor code
67		PBA67	A 4 Avitech Exotic Birds
68		PBA68	R D Raleigh Durham Caged Bird Society
69		PBA69	M C Minnesota Companion Bird Association

N°	Artificial Nest boxes	Nest code	Sponsor code
70		PBA70	
71		PBA71	
72		PBA72	

N°	Artificial Nest boxes	Nest code	Sponsor code
73		PBA73	
74		PBA74	S 1 Sacramento Zoo Conservation Fund
75		PBA75	S 8 Sacramento Zoo Conservation Fund

N°	Artificial Nest boxes	Nest code	Sponsor code
76		PBA76	
77		PBA77	
78		PBA78	

N°	Artificial Nest boxes	Nest code	Sponsor code
79		PBA79	
80		PBA80	