

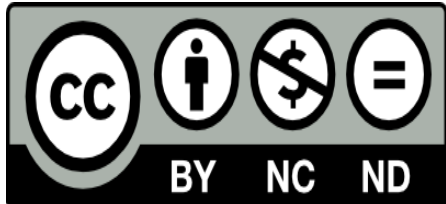
MULTIPLE POINT FIXED TRANSECTS IN PARROT MONITORING: A CASE STUDY OMETEPE ISLAND, NICARAGUA 2014-2020



**LoraKim Joyner, Norlan Zambrana Morales, Levis Hernández,
Emerson Urtecho**



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www.oneearthconservation.org

info@oneearthconservation.org

+1 (718) 776-7284

Cover photo: From left to right Levis Hernandez, Abel Gonzales, LoraKim Joyner, Norlan Zambrana, and Emerson Urtecho, with volcano Concepción in the background.

We dedicate this work, and our very lives, to the
people and parrots of Nicaragua

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Summary

The primary aim of this paper is to demonstrate how the methodology described in “Guide to Multiple Fixed Point Transects in Parrot Monitoring” was used on Ometepe Island, Nicaragua between the years 2014-2020. In particular, we want to highlight how this methodology reduces the error of counting birds twice and removes duplicates to arrive at the MNDI (Minimum Number of Distinct Individuals) We initially used this technique to see how many yellow-naped amazons, roughly, might be on the island, and where we might concentrate future conservation efforts.

Preliminary counts in 2014 and 2015 suggested that there was a high number on the island, at least in comparison to population densities in other parts of their home range. The highest concentrations of parrots were in the Peña area; thus, we began nest monitoring efforts there in 2015. In 2018, we counted fourteen different multiple point fixed transects interspersed across the island. We found an MNDI of 1869 yellow-naped amazons, 783 red-lored amazons, 2828 Pacific parakeets, 597 orange-chinned parakeets, and 27 orange-fronted parakeets. With this information we decided to increase our conservation activities in four principal areas that had the highest numbers of parrots. We then repeated the 2018 counts in these four principal areas in 2019 and 2020. Our four main areas were the communities Merida, Playa de Santa Domingo in the Refugio de Vida Silvestre Peña Inculta (Peña), Palma (La Palma) and Totoco (Balgue/Finca Magdalena). During our last regular count in July 2020, we found 1028 yellow-naped amazons, 821 red-lored amazons, 35 unknown amazons, 1268 Pacific parakeets, 142 orange-chinned parakeets and 11 orange-fronted parakeets.

In these four areas we concentrate our conservation activities of nest monitoring and protection, education and awareness campaigns, capacity building, and livelihood support; all efforts are aimed at reducing poaching, and protect individual birds as well as the overall populations. Our hopes are that this population data will help confirm the success of our conservation efforts, or the reverse, so that we can adjust conservation strategies as needed. Also, by concentrating on understanding the local parrot species, which are the prime tourist island attractions, we advance the possibility of a long-term sustainable conservation effort supported by ecotourism income.

Before the economic recession of 2018 and the recent Covid-19 pandemic beginning in 2020, Ometepe was a primary destination for international tourists. This made it a great place to generate income to support local conservationists and their efforts, as well as spread the word around the world about the status of parrots and the need for conservation.

This Case Study is descriptive in nature, only suggesting possible conclusions and causal relationships. Without repeated counts we cannot obtain the precision necessary for hypothesis-based research, and for that we need more financial support. Perhaps with the public availability of this data, others can build on our work. Researchers are invited to contact us directly if they wish for more specific information and to discuss further projects.

How to Use this Case Study

This Case Study is meant as a supplement to “A Guide to Multiple Fixed Points in Parrot Monitoring.”² Other methods exist for counting parrots which may serve a particular conservation need better.^{1,3} This data was all derived using the methodology in the Guide; it shows the various outputs and uses of that method beyond the primary benefits of quickly discerning important conservation areas and involving and training locals. This method also provides basic information about the parrots, which is presented here as descriptive statistics meant as a snapshot of the parrot populations on Ometepe Island over a seven-year period. This data does not have the robustness to make any hypothesis-driven conclusions because the data did not arrive from repeated counts so as to increase precision. We did learn a great deal about the parrots, however, and feel that this data provides a basic understanding of the variety of species on this island. The data also guided us in what we didn’t know and what we needed to do, so that we could adapt conservation plans to fill in the gaps in our knowledge and shift our conservation activities for a more positive outcome. This Study also shows the evolution of the methodology and how it expanded over the years to meet our needs, and hence might serve as a guide in itself to help other conservation projects. Finally, we present this Study to honor the hard work of the people who conducted the research, and the parrots they are committed to protecting.

The Methodology section in this Study is brief, as it is described at length in the Guide. Our results are presented as figures and tables for each year. There are multiple other ways to present population data, and we suggest these references for your review.⁴⁻¹⁵ As there was abundant data, the raw data and additional tables are located in the appendices grouped according to year. It is possible that this data could serve other research projects, and if you use this data, please cite this document. For each year we have a discussion section, which briefly points out the highlights of the results and poses possible conclusions that might be drawn. The final section covers trends over the seven years, and although we can’t say precisely what is happening with the birds, we can make some educated guesses.

We consider this Case Study as a work in progress, but wanted to get the information out and feedback as soon as possible. If you find any discrepancies or have any suggestions on how to handle or interpret the data, please contact the main author at: info@oneearthconservation.org.

Currently we only have this in one language, but hope to translate it into Spanish in the future.

For printing, the color-coded graphs will not display the various categories in black and white. If you would like to print in black and white, we suggest altering the graphs so that they are keyed not to color, but to a design (see Figure 2014-1 as an example). For more information on this: <https://support.microsoft.com/en-us/office/format-elements-of-a-chart-b6c787d5-f90a-41d2-a901-9d3ed9f0dbf0>.

Each graph also used abbreviations for each species. The key to identification of species is here, and also repeated in Appendix 1.

Species in Study	Local	English	Scientific
NA	Nuca amarilla	Yellow-naped Amazon	<i>Amazona auropaliata</i>
FR	Frente rojo	Red-lored Amazon	<i>Amazona autumnalis</i>
PV	Perico verde	Pacific parakeet	<i>Psittacara strenuus</i>
BN	Barba naranja	Orange-chinned parakeet	<i>Brotogeris jugularis</i>
CP	Cabeza pardo	Orange-fronted parakeet	<i>Eupsittula canicularis</i>
WFA	Frente blanco	White-fronted Amazon	<i>Amazona albifrons</i>
UNA	Loro desconicido	Unknown amazon parrot	
UNP	Perico desconicido	Unknown parakeet	

Introduction and History

Ometepe Island is located in Lake Colcibolca (Nicaragua) which is the largest fresh water body in Central America. It is approximately nine km from the mainland. It is comprised of two volcanoes, Maderas and Concepción, joined by a wetland isthmus. The island encompasses a dramatic range of altitude, topography, and climate within its 276 square kilometer area. In recognition of its ecological value the island was awarded UNESCO Biosphere Reserve status in 2010.

The mainland has low numbers of yellow-naped amazons whose populations have decreased remarkably in the last decade.¹¹ Preliminary research conducted by Fauna and Flora International (with special thanks to Salvadora Morales and Norlan Morales for initiating this effort!) showed that in one location on Ometepe, Playa de Santa Domingo which includes the Refugio de Vida Silvestre Peña Inculca, there were significant numbers of birds coming into roost. I was ecstatic on my first trip there to see that this one roost area had over 300 yellow-naped amazons, something I had personally not seen for decades. To get a better understanding of this population, we held on-site training for six counters in order to estimate the number of birds there in 2014. We then took our team to six other areas where the local eco-guides had seen birds (the eco-guides were also counters). We did two years of counts in April and November in 2014 and 2015. Initially, morning counts were done at some places, and evening counts at others, but by the end of 2015, both morning and evening were done at both locations. We also counted all the parrot species and not just the amazons as we did in 2014.

Admittedly our methodology was not as accurate as it could have been because some transects we counted in the morning and some in the evening in April 2014. Regardless, we found that the MNDI of yellow-naped amazons was 1005 in our seven sites, an unheard of and joyful density! We immediately began nest monitoring and protection, because we didn't know if there was any poaching on this island; we were later able to confirm this. We didn't continue the counts as we had limited resources, which we decided were better spent on protecting the nests and learning about the poaching rate. Our first targeted conservation area was where we had counted the most birds, Peña, and we began nest monitoring in December of 2016.

During 2016-2018, we continued to protect nests at Peña, and in 2018, we added Merida. During this whole time, we continued yearly spot counts at these two sites. Then, in 2019, we added the area that includes Balgue, Totoco, and Finca Magdalena and Palma to our nest-protecting sites. Community meetings, education, and awareness-raising activities also occurred at these sites. These four sites represent the largest concentrations of yellow-naped amazons currently on the island. existence. Results of nest monitoring and protection for these four sites will be published in a later paper (Island of Hope: The Parrots and Their Conservation on Ometepe Island).

Due to the economic recession as a result of civil unrest in 2018, we received a donation to help employ the young tour guides outside of the nesting season. We decided to conduct an island-wide count with fourteen different transects, all counted in the evening and within the month of July when the young birds would still be flying with their families. This was an immense effort involving approximately sixteen, mostly young, people all trained and placed in teams of multiple counters. Unable to be present, I worked painstakingly with the leader online to remove

duplicates within the transects and between transects, and we were able to document an MNDI of 1869 yellow-naped amazons on the island. This was an even more amazing number than our previous MNDI.

During all of our counts we had placed people between transects and had seen very little movement between transects, indicating that we were probably not double counting between transects. Birds were mostly going up and down the volcanic slopes or staying within their transect areas, so we were fairly confident in the level of birds counted. We assumed 2018 would be our final count for some years, as we wanted to extend our resources to nest monitoring and protection in the four most populous areas of parrots, as indicated by the MNDI of each transect.

To gain clarity on how much movement might exist between different transects or with the same transect on different days, we counted our four transects more than once during the same week and all at the same time the following July (2019) again involving more than 16 people. It was an immense and complicated effort, requiring much use of bikes, walking, trucks, and motorbikes to place our people by the required time each evening. Given the results, we felt confident with our estimation of roughly 2000 yellow-naped amazons on the island and decided to put our resources into nest protecting and monitoring, education, and awareness.

Knowing that we needed to continue regular yearly counts to evaluate the success of our activities, our strategy then became counting each of the four transects in every year in July as a baseline. This would give us an idea of the percentage of young birds in the flock. This yearly survey was also a means to involve and train more local people. We wondered though if our plan to count each area once per year would reveal accurate enough information to assess trends and conservation measures.

Attempting to begin to answer this question we strove to count each of the four sites three times on consecutive days to assess quickly the variability between successive days of counts in July of 2020. Though we needed our resources to protect nests, we also wanted to supply stipends for as many people as we could during the continued tourist slump now caused by the COVID-19 pandemic. As before, we supported more than 16 people to do these counts, aiming to continue reinforcing commitment from as many people as possible and offering stipends in this harsh economic environment.

There are still many unanswered questions as we begin 2021, and thanks again to old and new donors, we have a plan to count Peña twice a month for all twelve months that will help us understand ever more this technology and these parrot populations.

Even still, these seven years of counting parrots has enabled us to target the primary conservation sites to emphasize education and awareness programs, as well as nest monitoring and protection. We have gained an understanding of the ecology and behavior of the parrot species, and established a baseline for observed trends and counting methodologies used. This research set a standard for involving locals in the conservation of their local species, contributing to local capacity, directing economic income, and opening up future possibilities for ecotourism. Those involved are responded with uncommon effort, organizing themselves into Biometepe, a cooperative seeking to develop agriculture, science, conservation, and ecology tourism.

Methodology

The methodology for these counts followed that of the “Guide to Multiple Point Fixed Transects in Parrot Monitoring,” with a few differences between some of the years as we perfected our understanding of the techniques and terrains.

Variability in counters

All parrot species were counted starting in 2015, but before then we only counted the amazon parrots. As the years went by, the counters improved their ability to identify parrots correctly. For instance, in the first few years it was harder to tell the difference between the two large amazons, the yellow-naped amazon, and the red-lored amazon. We thus had higher numbers of “unknown amazons” in the years 2014-2017 (See Appendix 1 for species nomenclature).

We also had various numbers of counters at each site; they varied in ability to quickly, and at a distance, identify parrots at each site. We always tried to have at least one trained person per point and two others, but in the earlier years of 2014-2017, we frequently only had one person per point. In 2018, we had one to four people per point. In 2019, we usually couldn’t have more than one at each site, although sometimes we had more. In 2020, we consistently had 2 people per site.

From 2014-2018, we always did a preliminary count all together so we could standardize and re-familiarize ourselves with the counting methodology before undertaking the official counts. In 2018, we recruited many new counters, who were teamed up with the experienced counters to learn from them. They held a training workshop before the official counts. In 2019, we had a 1-day training and on the first night of counts, we teamed up the newer counters with seasoned counters for training. In 2020, there was only a brief meeting to re-familiarize everyone with the counting methodology as nearly everyone was a returning counter.

Variability in time of day and year counting

Counts in 2014-2017 were conducted during various times of the year as we were learning about the species and the area. In 2014, we counted birds in April and May, which corresponded with the peak fledgling time for the yellow-naped amazon, and then again in November. In April 2014, we counted some transects in the morning and some in the afternoon for no other reason than having limited time and resources while wanting to get in as many different transects in one day. In November 2014, we counted each of the seven sites both times in the evening, consecutively. We were attempting to determine what the difference was so we could streamline when we counted in the future, as counting in the morning involves more resources and time to place people before daylight. We also wanted to see what times of day might be the best for estimating the MNDI. In 2015, we counted seven transects in April, both in the morning and afternoon at each site. During this time and until 2018, various counts were conducted at the largest roost areas. We sought to standardize the counting to reflect what we assumed to be the time when we would observe the greatest number of family groups: the time when that year’s amazon chicks are still flying with their parents. We choose July as most birds fledge by mid-

May of each year, except in Peña where chicks fledge in December/January of each year. The second week of July became our standard time for counting, though there were some staggered counts throughout later July and in a few cases until early August when we realized some counts needed to be repeated because of earlier rain outs.

Variability in number and location of points and transects

In all cases, we attempted to count at the exact same point as the previous count, and to have the same numbers of points per transect. However, as we were learning the terrain and flight patterns, we had some variability in numbers of points and exact locations of points between 2014-2017. By 2018, we did not move the points or have different number of points, except by a few meters due to foliage or other disturbances in the area (such as construction of a house in Peña which moved one point 100 meters from the location used the years before).

In 2014 and 2015, we counted seven different areas (transects). We thought we had covered the largest areas of amazon abundance, but slowly learned that there were other pockets of parrots on the island, leading to an additional fourteen transects in 2018. Thereafter we restricted our counts to our four largest roosting and primary conservation areas due to limited resources.

Initially, and to investigate bird movement patterns, the number of points varied per transect to get a better idea of the number of parrots in the area. Some counts had as many as seven points and we never had less than four. By 2019, we used a standard four points for each of the primary roosting and conservation areas. After the additions in 2018, we had a total of 60 counting points, which can be seen along with the Escupulis transect that was counted in 2014 and 2015, for a total of 15 counted transects on Ometepe over seven years.

Figure Methodology-1: Location of counting points in 15 transects

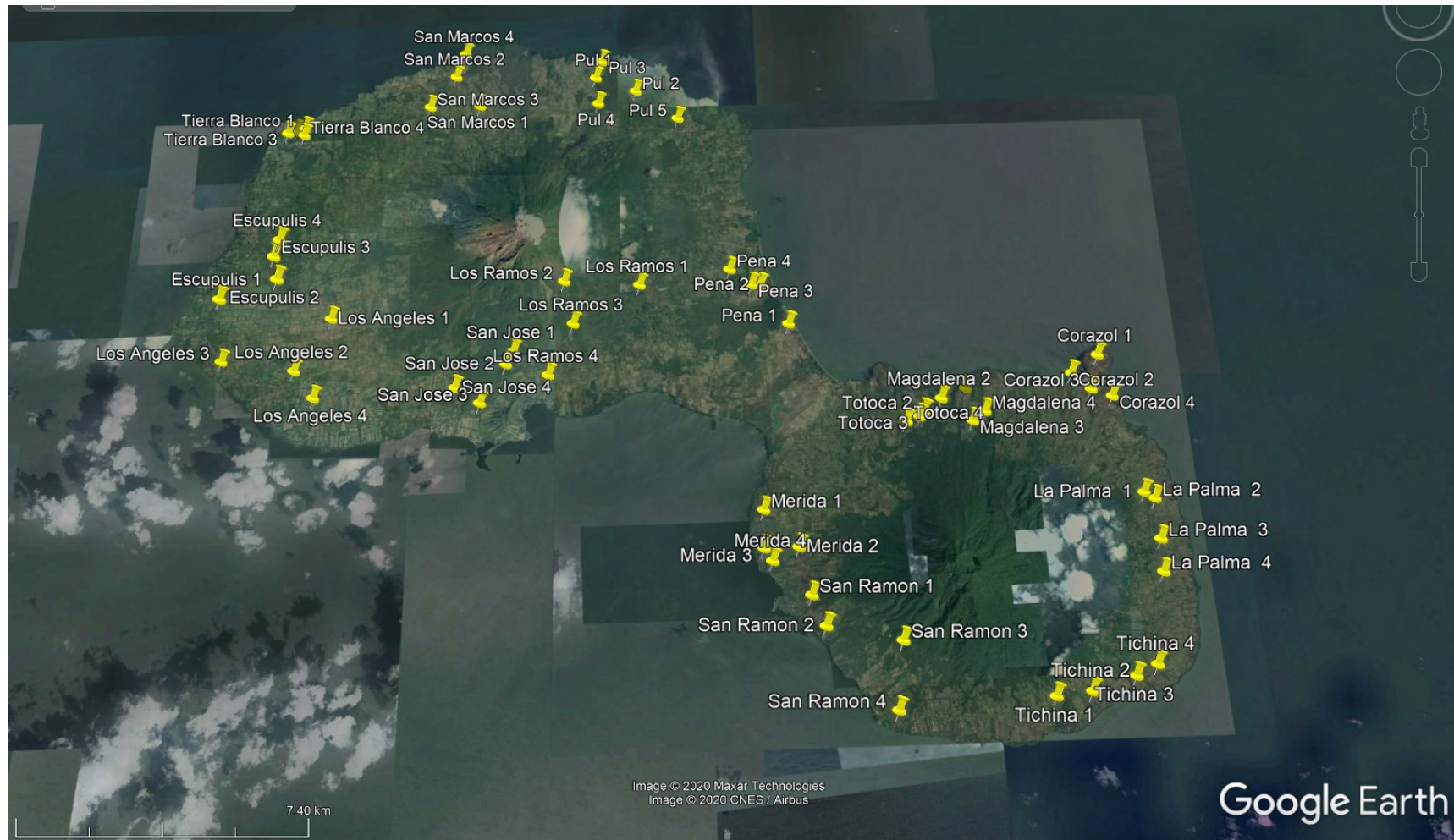


Figure Methodology-2: Location of original 7 transects 2014-2015



Results

For each year between 2014-2020, we summarized the data as such: 1) total numbers of each species, 2) species relative density, 3) size and percentages of flock size (flocks are singles/solos, pairs, 3s, 4s, 5s, and groups of 6 or more), 4) percentage of suspected fledglings, and 5) how many birds that could have crossed over from other transects. The tables of the summarized data are in the Appendices and the figures are found before the discussion section for each year. Prior to 2018, we noticed that very few birds entered or left a transect area that could have come from or gone to other transect areas. This was confirmed in 2018 when we kept track of birds that left and entered a transect. For this reason, in 2018, we have two different totals of birds. One number is the total of all the 14 transects combined and the second number reduces this number by removing any possible birds seen leaving or entering a transect. In this way, we estimated the Minimum Number of Distinct Individuals (MNDI) not only within one transect but between transects. We end the results section arranging the data so as to look for trends in population numbers by comparing each of the four largest roost areas from 2014-2020.

2014 Results

This was our first year to begin to figure out what was going on throughout the island and to begin to establish a counting methodology. We counted seven different transects at either a two-hour morning or two-hour evening count, four to five points per location. The first four locations were counted 10-11 April after we held two practice counts together as training. There were counted at the following times of day: Peña a.m., Merida p.m., Totoco a.m., Pul p.m. The remaining 3 locations, Corazol, Tichana, and Esquipulas, were counted in early May mostly in the afternoon. In 2014, we only counted the red-lored and yellow-naped amazons, and did not keep a record of how many birds were seen at each point in the transects. We also lumped family groups together of both species along with the unknown amazon species. The only reason we did this was because we were learning how to use the methodology and how to quickly discern species identity and record the results. We removed duplicates between points in the same count to arrive at a MNDI for each transect but did not record birds that might be moving between transects, although it seemed that few if any amazons moved between transects. In November 2014, we counted the same seven transects with little variability in the location and numbers of points. We still only counted the amazon parrots and lumped their group distribution together. The one big difference between April and November counts is that we counted each site twice, in the morning and in the afternoon in November, to gain an understanding of when might be the best time of day to count birds to get the highest MNDI.

April/May

Figure 2014-1: Total number of amazon parrots counted (N=844) at each site April/May 2014

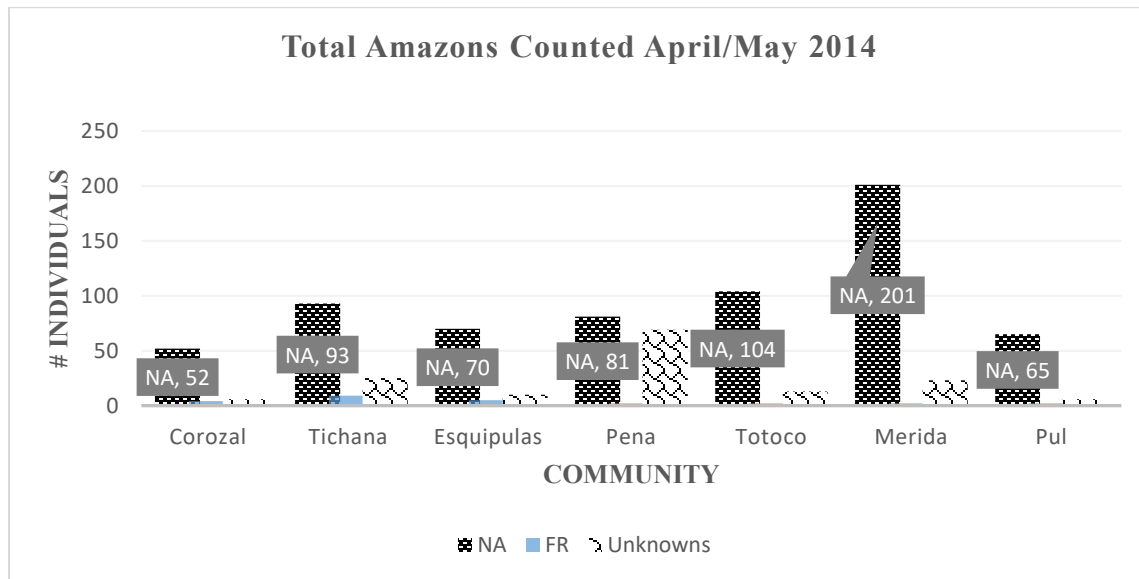


Figure 2014-2: Relative density of amazons counted (N=844) April/May at all sites

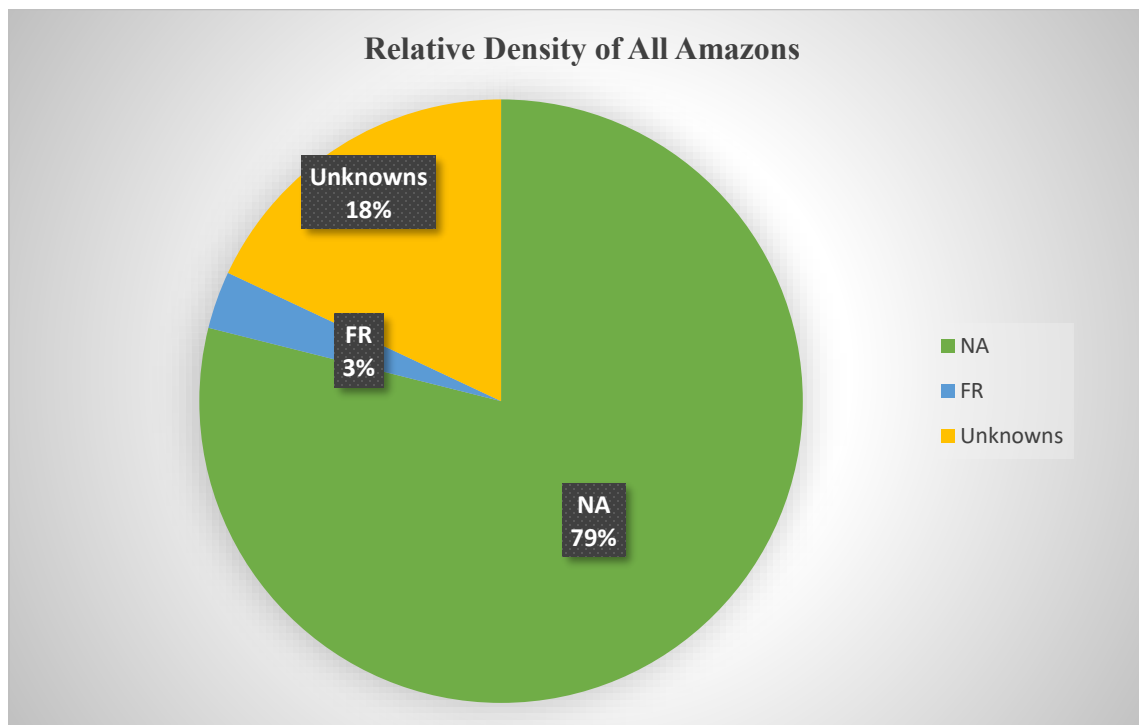


Figure 2014-3: Percentage of groups in all amazons counted (N=844) April/May 2014 by site

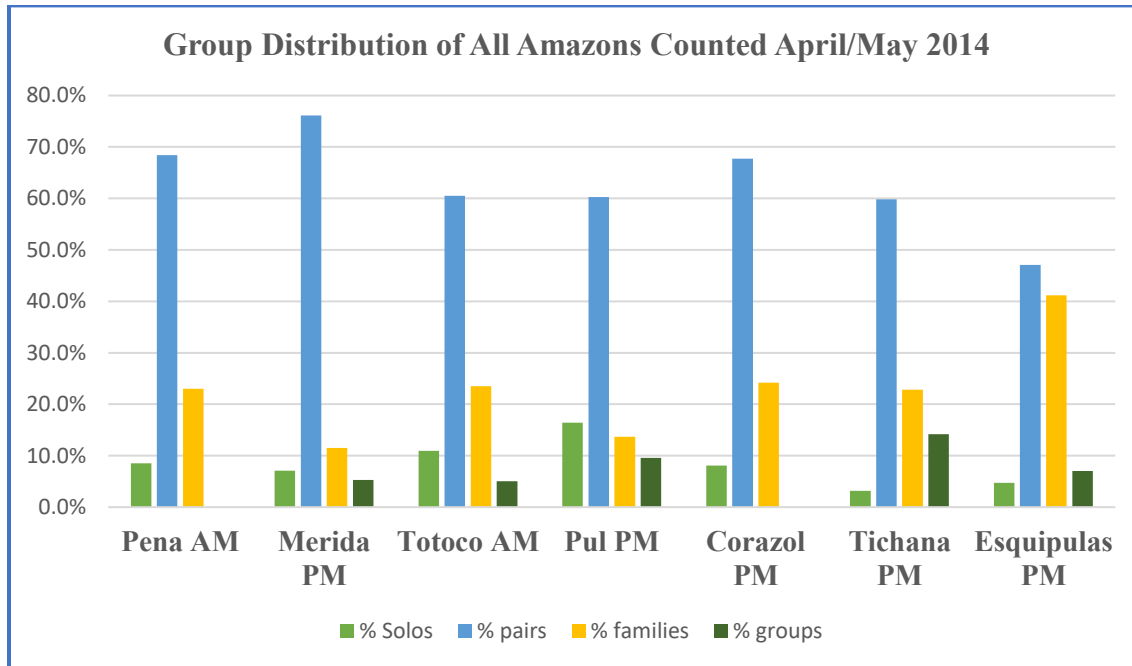
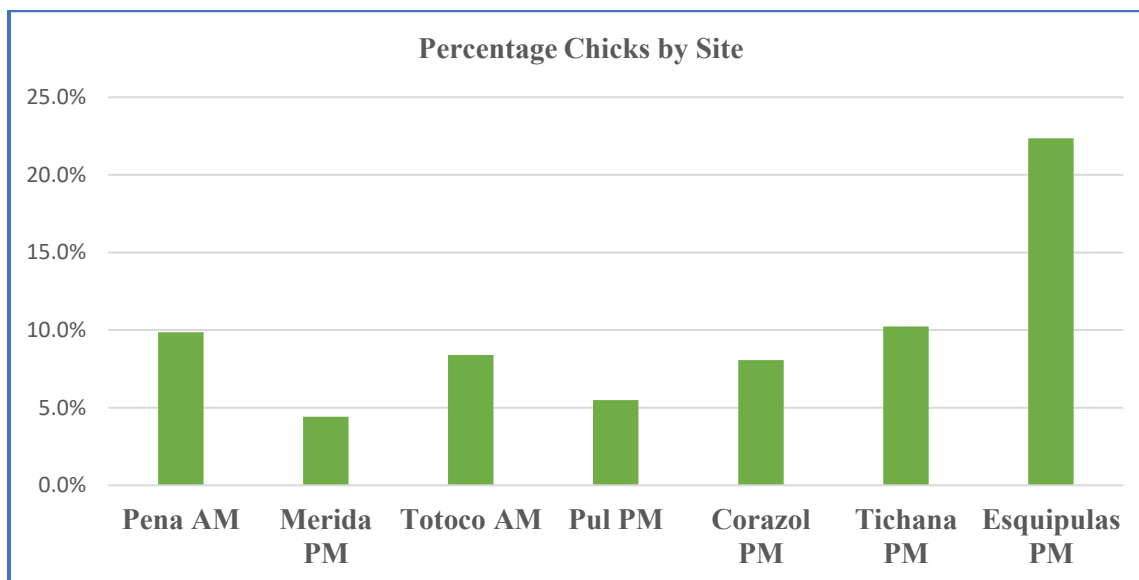


Figure 2014-4: Percentage of chicks of total population of all amazons (N=76) counted by site April/May 2014



November 2014

Figure 2014-5: Total number of amazon parrots counted November 2014 (N=3034) at each site

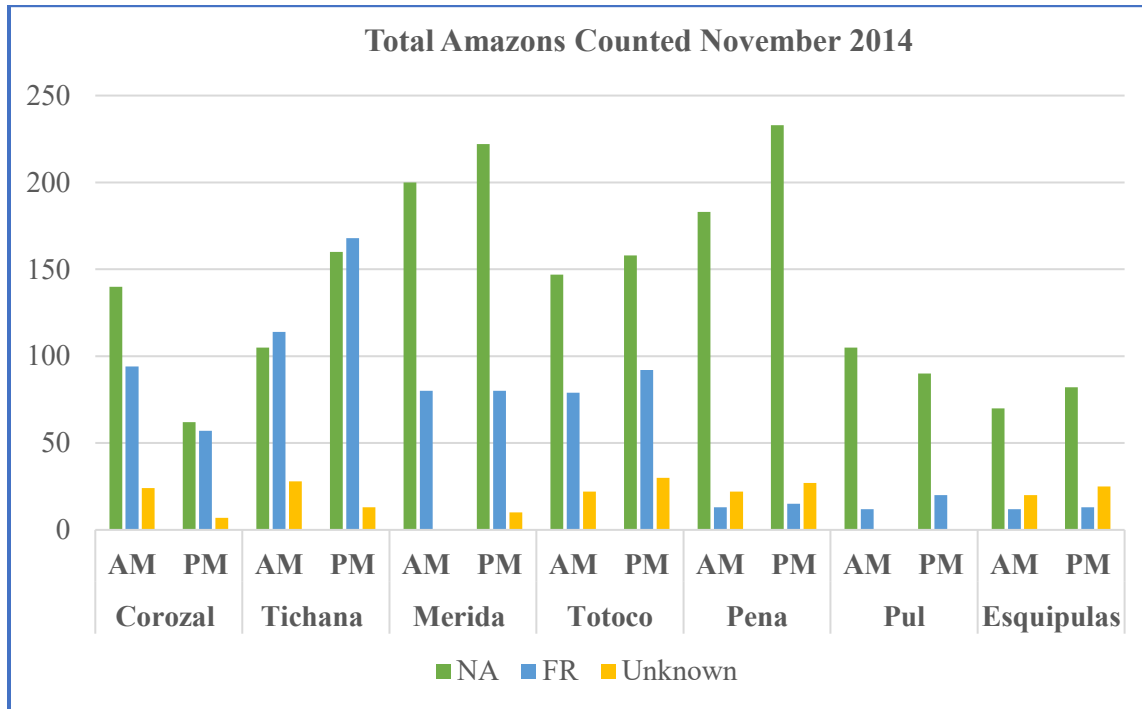


Figure 2014-6: Relative density of amazons counted (N=3034) November 2014

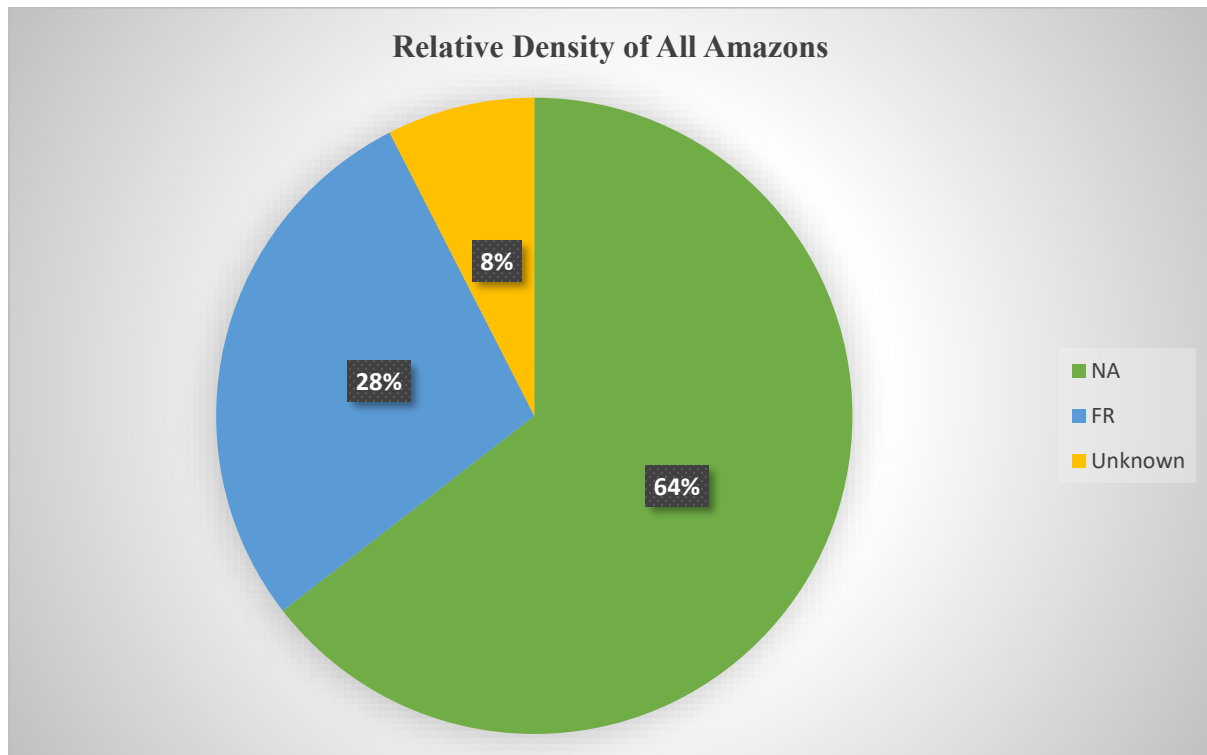


Figure 2014-7: Percentage of each group in all amazons counted (N=3034) November 2014 by site

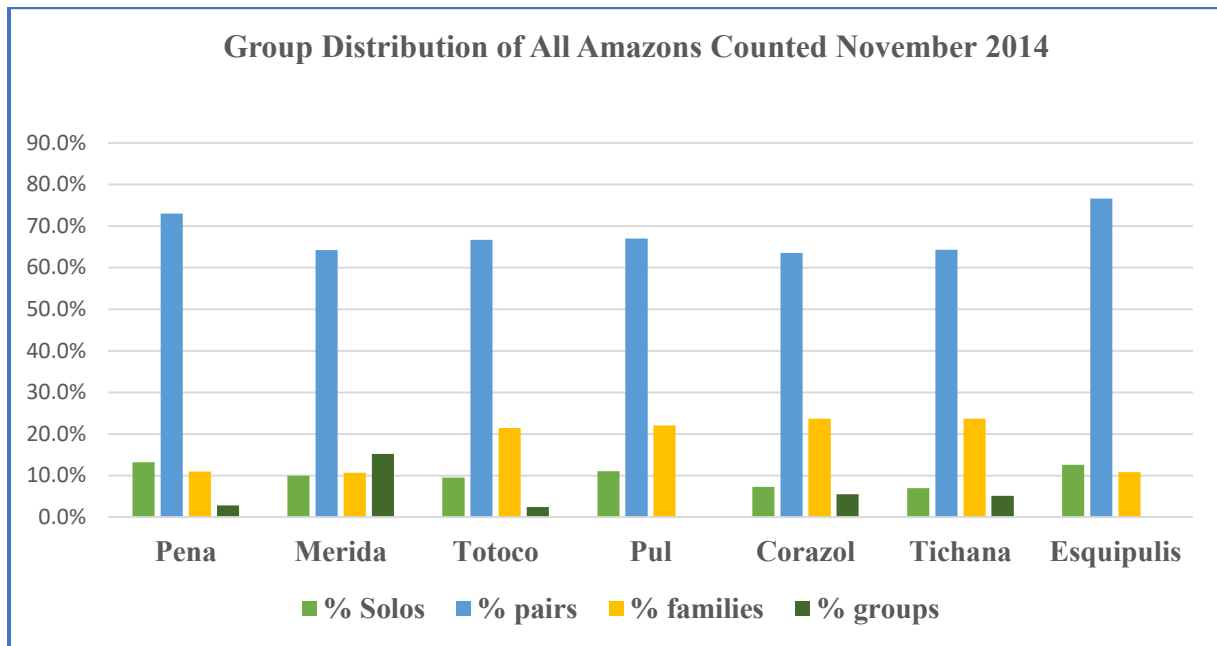


Figure 2014-8: Percentage of chicks (N=224) of total population of all Amazons counted by site November 2014.

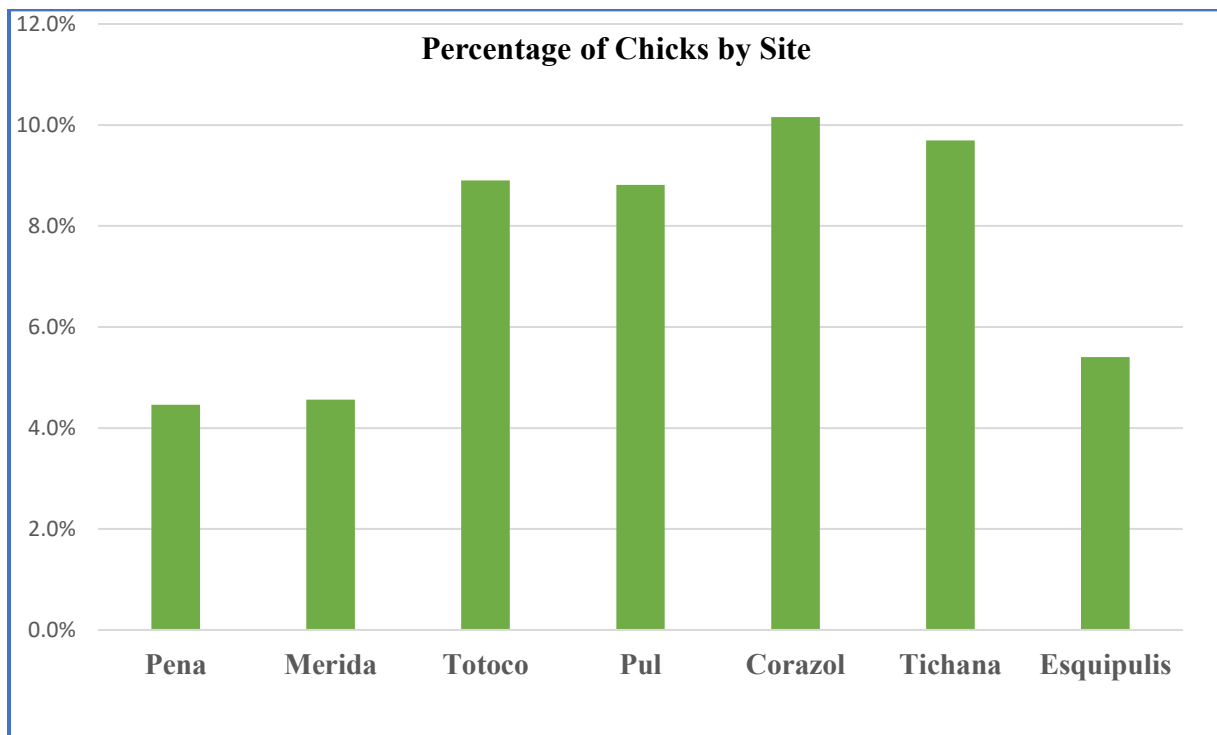


Figure 2014-9: Comparison of time of day counting (AM vs PM) for each type Amazon counted (N=3034) November 2014

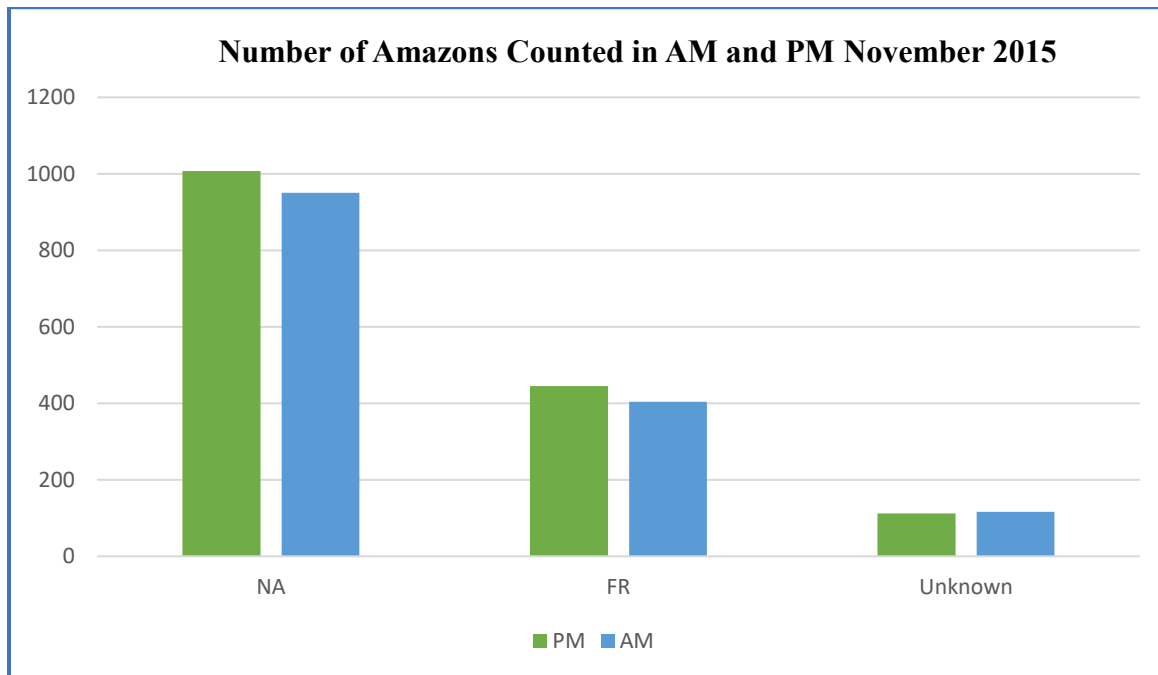
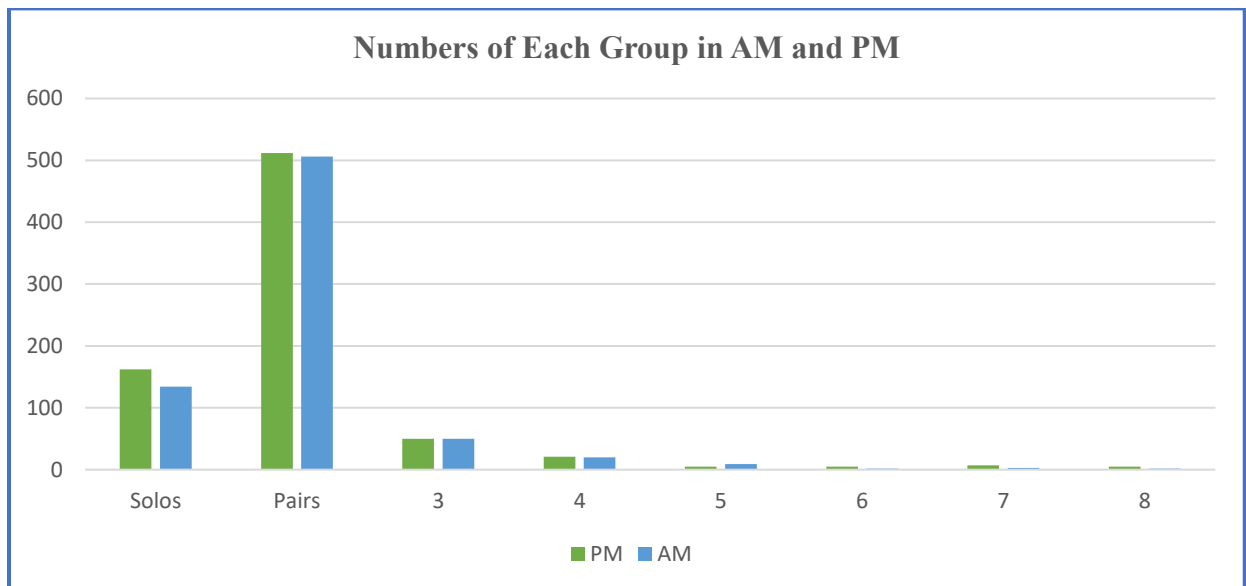


Figure 2014-10: Comparison of group distribution compared to time of day counting (AM vs PM) November 2014



2015 Results

In April, we counted the same seven transects as the year before, counting each site in both the afternoon and morning. We also began counting all parrot species as the team of counters was improving in their identification skills and could more easily handle the numerous sightings of various species. We still included all amazons together when recording group sizes, and began keeping track of the counts per point in some transects (essentially making 4-5-point counts per transect that could be compared year to year). In one transect, Esquipulas, we only nearly completed the morning count because some local community members objected to our presence and we did not return to this community to count, nor in succeeding years. We counted three transects April 8 – 11, and the remaining four transects in early May.

Figure 2015-1: Total number of each species counted April/May 2015 (N=4889) at each site

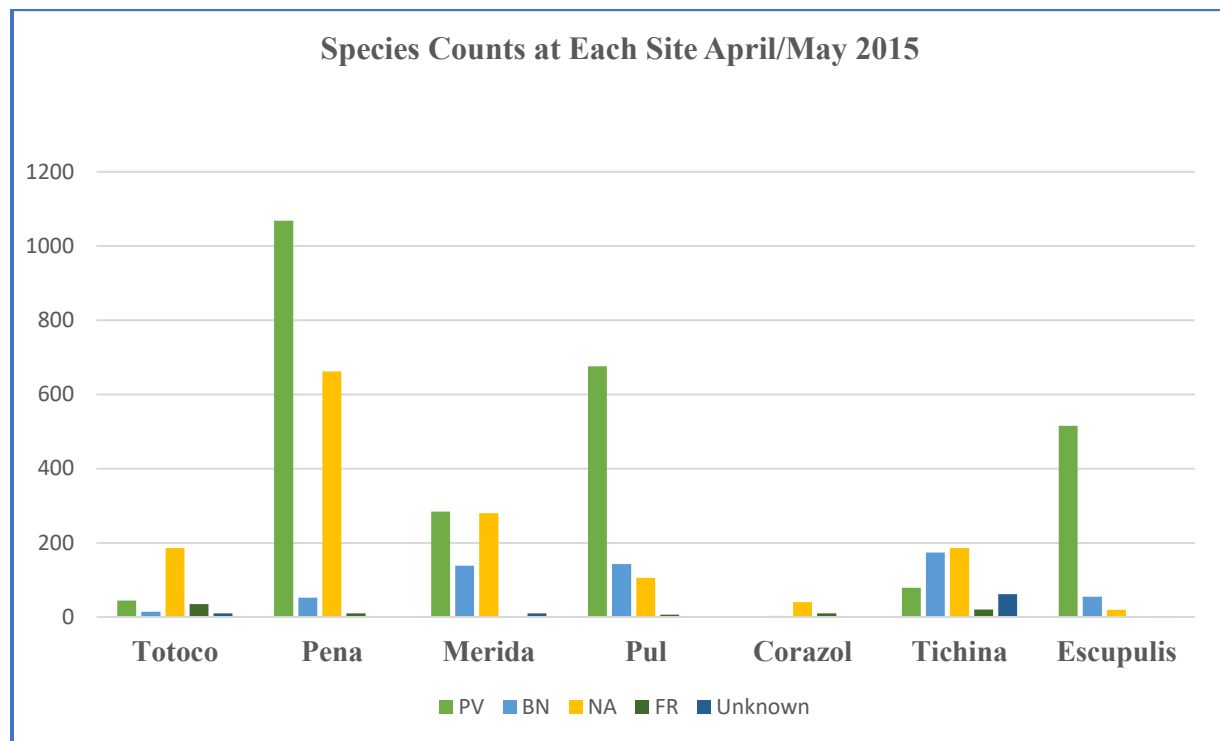


Figure 2015-2: Relative density of each species counted (N=4889) April/May 2015

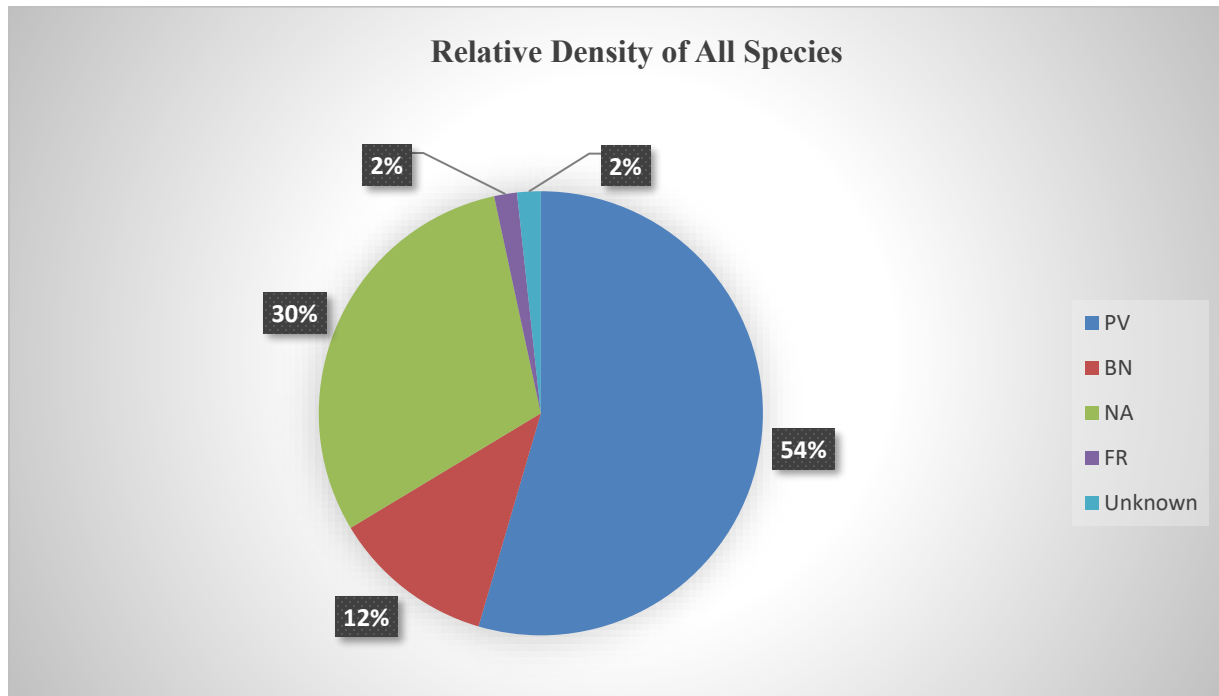


Figure 2015-3: Percentage of each group in all amazons counted (N=1644) April/May 2015 by site

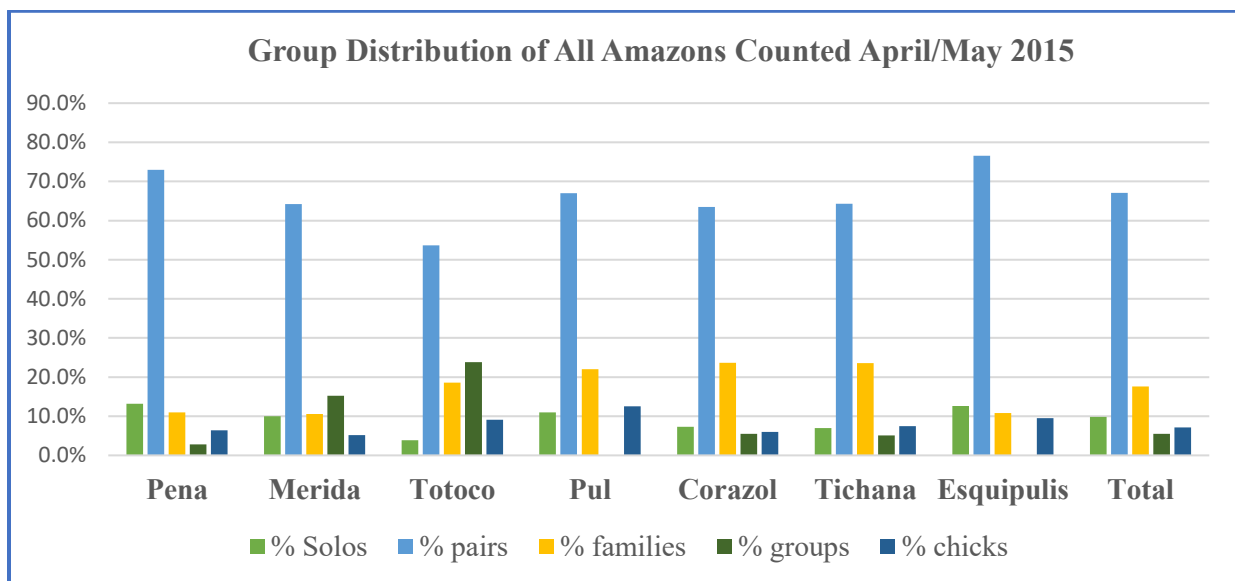
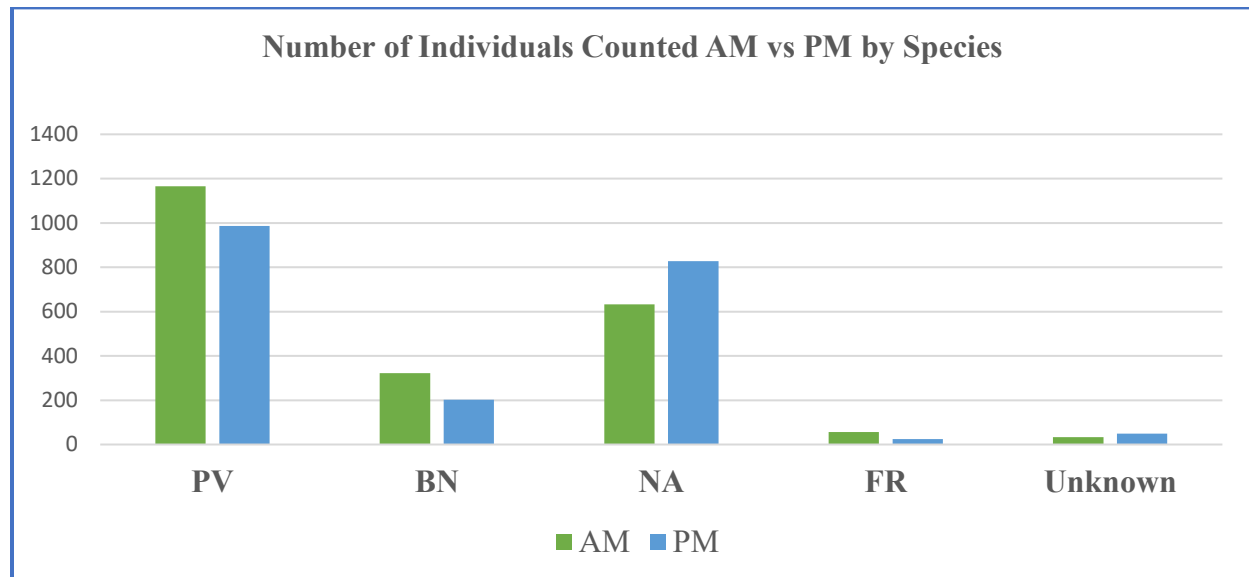


Figure 2015-3: Comparison of time of day counting (AM vs PM) for each species counted April/May 2015 (not including site Escupulis because only did a partial AM count)



Various Counts 2016-2017

In 2016, we did partial counts in various areas to see what number of points were ideal for each transect and where best to place them before settling into a methodology that could be repeated for decades.

In 2017, we counted three transects in early December of 2017: Merida, Peña, and Tierra Blanco. We had two to three people per point during the Merida and Peña counts as we were hosting ecotourists. Tierra Blanco just had one person per point. Each transect had four points, the same that we used in 2018-2020. All these counts were in the afternoon from November 29 – December 5 2017.

Figure 2017-1: Total number of each species counted (N=1159) December 2017 at each site

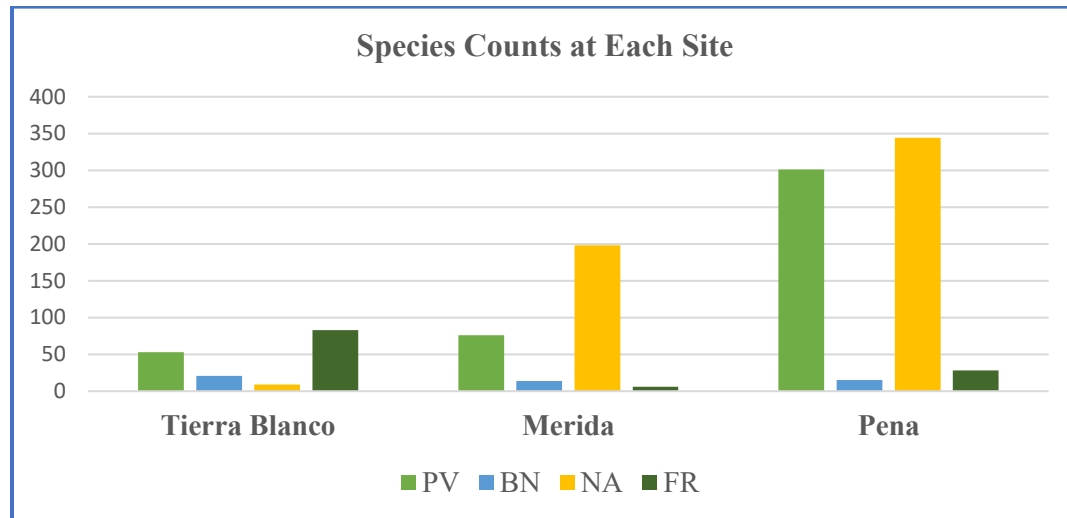
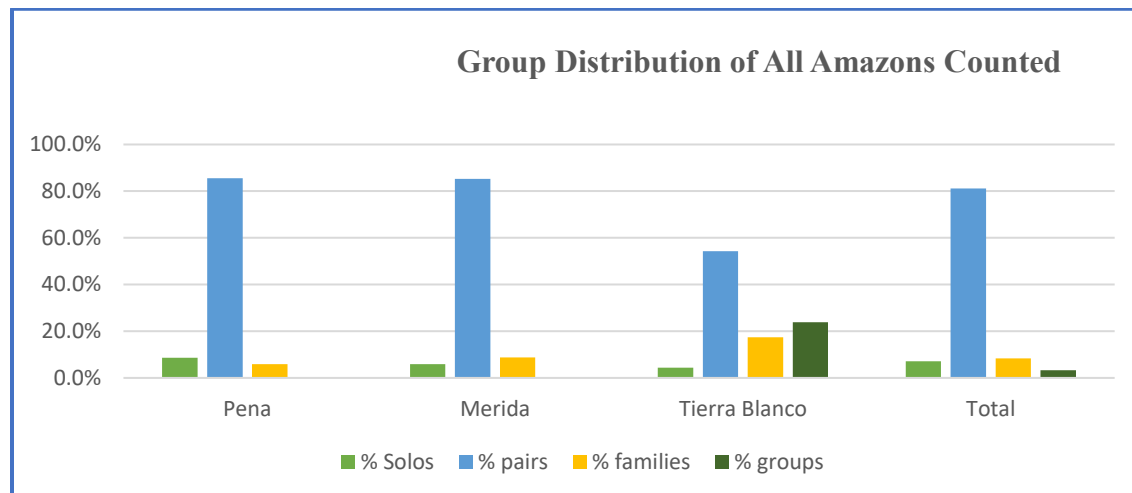


Figure 2017-2: Percentage of each group in all amazons counted (N=668)) December 2017 by site



Discussion 2014-2017 Results

The methodology for counting in this particular terrain was being investigated throughout these years, along with training various counters. By the end of 2017, we had settled closely on the point transect system for Ometepe, leading us to choose Peña for our first concentrated nest monitoring and protection program for the endangered yellow-naped amazon in 2015. Our counts indicated that this site had the highest population of this species and they were likely being easily poached due to the nests being close to a paved road system. It also had a trail system, designed for tourists. The town of Playa Santa Domingo, located where the Peña forest patch existed, was a center for visitors, making this an attractive conservation area to preserve the parrots while raising awareness and possible funds/jobs for locals .

We will discuss in greater detail the results of these years as they intersect with the results of 2018-2020, especially in the section on trends.

We now discuss in greater detail each year as a means to show the development of the methodology and commitment of funds to the parrot conservation project on Ometepe. Also, as this was a mix of morning and afternoon counts spread out during a month's time, it is challenging to draw any accurate conclusions. Furthermore, distinguishing between red-lored and yellow-naped amazons was at its worse level of competency, with 152 out of 844 amazons not identified as either red-lored or yellow-naped amazons. We did not count any other parrot species but amazons in 2014.

Nevertheless, there are a few highlights worth mentioning for 2014. The location of our highest amazon counts in April and May of 2014 were located on the Madera volcano side: Tichina, Peña, Totoco, and Merida. Peña, Totoco, and Merida would later become three of our four conservation sites due to their high population numbers, but also because of ease of access. Tichina had higher numbers, but as it was located further away along a dirt road, we did not choose it as a conservation site. Our lowest numbers were in Corazol, Esquipulas, and Pul, with Pul and Esquipulas on the Concepción volcano. The lower numbers in Corazol could be because it is close to a major roost area of Totoco and Magdalena and most birds go there, and also because it is furthest from the more forested slopes of Madera and centered in an agricultural area close to the lake.

Peña had been casually counted in previous years, but we did not know that it wasn't the only sight of higher amazon concentrations. We discovered that the Merida community, centered in an old mango plantation, was also a large roost site. We also learned that amazons mostly moved up and down the volcano during the counts, instead of moving horizontally to other transect areas.

April and May are times of fledging for most areas of the island for yellow-naped amazons ; fledglings are thus still not moving much with their parents. We would expect the chick percentage to be low during this count and it was, ranging from 4.4%-22.4%, the highest being in Pul (Figure 2014-4). We cannot explain the high percentage of chicks there at Pul. Chick number is determined by assuming that groups of three, fours, and fives are family groups, with two parents and the rest being their young.

In November, we often see the largest numbers of yellow-naped amazons coming into roost areas in other parts of their natural range. Their young are flying adequately by then and the parents have not yet returned to staying the night at their nest sites, so we tend to see the highest numbers at roost sites October – November. We did see higher numbers in all transect counts in November either in the morning or afternoon, except for one morning count in Esquipulas which was similar to April counts (Figure 2014-5). In April of 2015 we saw again a decreased number of amazon parrots (Figure 2015-2). We will say more about these changes in the trend section

The Peña transect encompasses yellow-naped amazons that breed earlier than in other parts of the island, with a breeding season from late September through early January. We would then

expect November counts to show breeding status group distribution, and this was supported by an increased number of single birds (males foraging for the female back at the nest), more pairs (females foraging with males when the chicks are older), less families (the chicks have not yet fledged), and less chicks; this all indicated that pairs have separated from their fledglings of the year before and are in the nesting season (Figures 2014 – 7, 2014-8). Overall, in all seven transects, we saw a similar pattern, perhaps because pairs in November are still moving away from their increasingly independent chicks and getting ready to lay eggs in January.

The decreasing number of unidentified amazon parrots (unknowns) dropped from 18% in April 2014 to 7.5% six months later. Then in April 2015, it dropped to 5.1%, indicating an improvement in counters' identification ability (Figures 2014-2, 2014-6, 2015-2).

We repeated counts in the morning and evening and found similar numbers and distributions of amazon species and group size overall (Figure 2014-9), although the evening counts in November of 2014 yielded more birds (we were only counting Amazons). In April 2015, there were again more yellow-naped amazons in the afternoon, but this balanced out the total numbers of parrots counted due to fewer Pacific parakeets and red-lored amazon counts in the afternoon (Figure 2015-3). We also counted in the morning and afternoon in April of 2015 and found similarities, although there were fewer parakeets and red-lored amazons in the afternoon than in the morning with the reverse for yellow-naped amazons. Seeing no clear trends between morning and evening counts except for more numerous yellow-naped amazons during the evening counts, we decided to only count in the evenings in the future as a means to conserve resources. It may be that in some areas it is better to count in the morning than in the evening, but throughout the study we never had the resources to do extensive repeated counts in each area to understand the variance between different times of day .

In April 2015, for the first time we counted all possible parrot species. We found higher numbers of parakeets, with the Pacific parakeet accounting for 54% of all individuals counted. Numbers of yellow-naped amazons, orange-chinned parakeets, and red-lored amazons were lower than the more abundant Pacific parakeets.

We saw more red-lored amazons in April of 2015 than in April of 2014, with 26 for one count per transect in April 2014 and 84 for two counts per transect in 2015. Admittedly with such scant data we cannot infer that the number of red-lored amazons are increasing, but we speculate that the decreasing numbers of unknown amazon might in fact be indicative of positive identification as red-lored amazons, especially as the total numbers of amazons is similar between April 2014 (n=844) and April 2015 (1644/2 for an average of 822).

In 2016, we concentrated on starting a nest monitoring and protection program, along with educational activities. We also experimented with various ways to count the transects, by placing points at different locations and by further describing the mango roost area at Merida, which didn't seem to share yellow-naped amazons much with the neighboring roost areas of Totoco and Peña.

In 2017, we counted for the first time in early December at only three sites, and only once per site in the afternoon. Two of the counts were in our largest roost areas of Peña and Merida.

Numbers of yellow-naped amazons for Merida were the lowest in April of 2015 (120 and 160 for two counts) but otherwise, there were consistently around 200 yellow-naped amazons roosting in Merida. In Peña, the yellow-naped amazons were the highest in April of 2015 and December of 2017 in the afternoon counts. We will comment further about these trends after discussing the 2019 and 2020 results.

2018 Results

In 2018, we performed fourteen different transects, only counting each transect once on July 10 and August 10 2018 (Figure 2018-9). Transects were selected based on local knowledge of parrot presence and flight patterns, and by investigating possible parrot presence based off terrain and foliage characteristics. We did not place transects higher up on the volcanic slopes due to the difficulty and time needed to place people and have them return after dark. Previous counts have shown that most roost sites are not at higher altitudes because we can see them flying up and down the slopes. We likely missed some birds, especially depending on the time of year; the Trends section suggests birds do move around and we aren't sure where they are roosting all year round.

Differences from other year's counts included increasing the number of transects from seven to fourteen, and only counting in the afternoons. We also collected group size data not just for the amazons, but for all species. Detailed and specific group size information can be found in the Trend section. Birds were categorized as being a single bird (solo), in a pair, in a family group (3s, 4s, 5s), and in larger groups of six or more. It's possible that the groups of six could be a pair with four chicks, but as four chicks is rare in the amazon species, we excluded groups of six from our family group designation (although in 2019 we did have two nests of yellow-naped amazons that successfully fledged four chicks, one each in Balgue/Totoco and Merida).

Figure 2018-1: Total number of each species counted (N=7481) July 2018 at 14 sites, not including 15 unknown amazons and 15 unknown parakeets

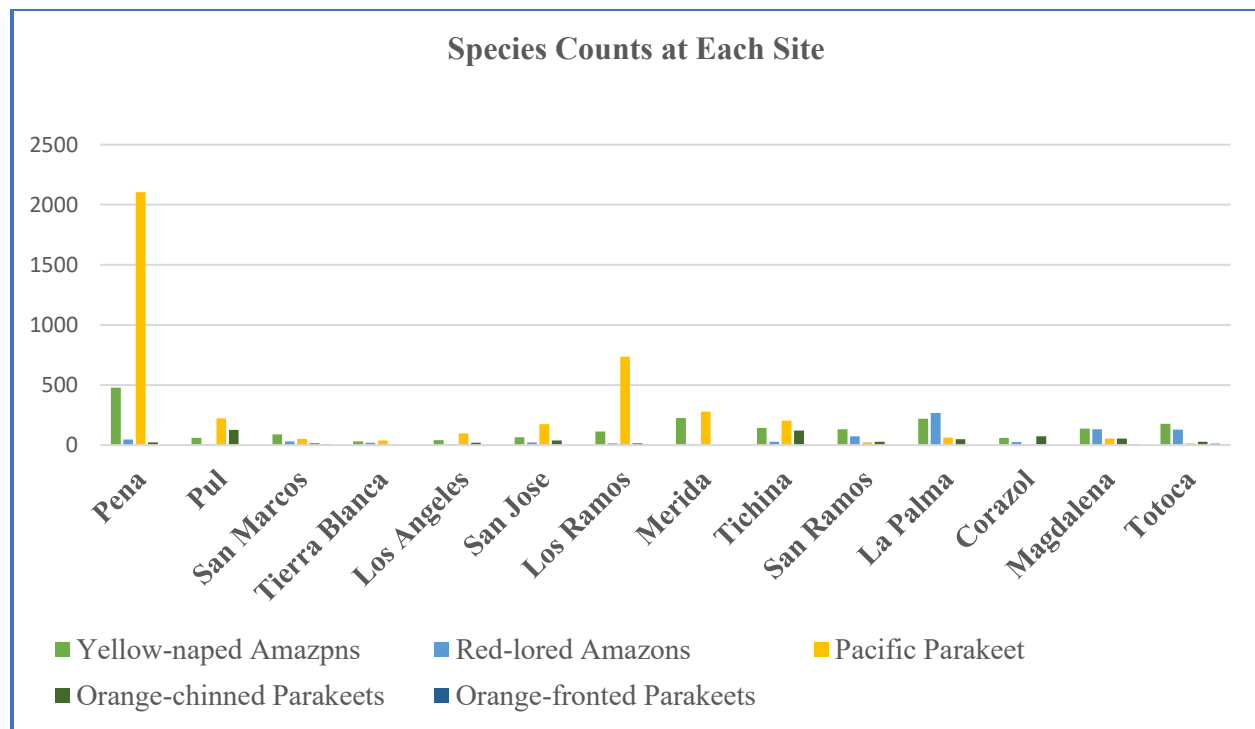


Figure 2018-2: Location of unknown amazons (15) and parakeets (15), and orange-fronted parakeets (27) July 2018

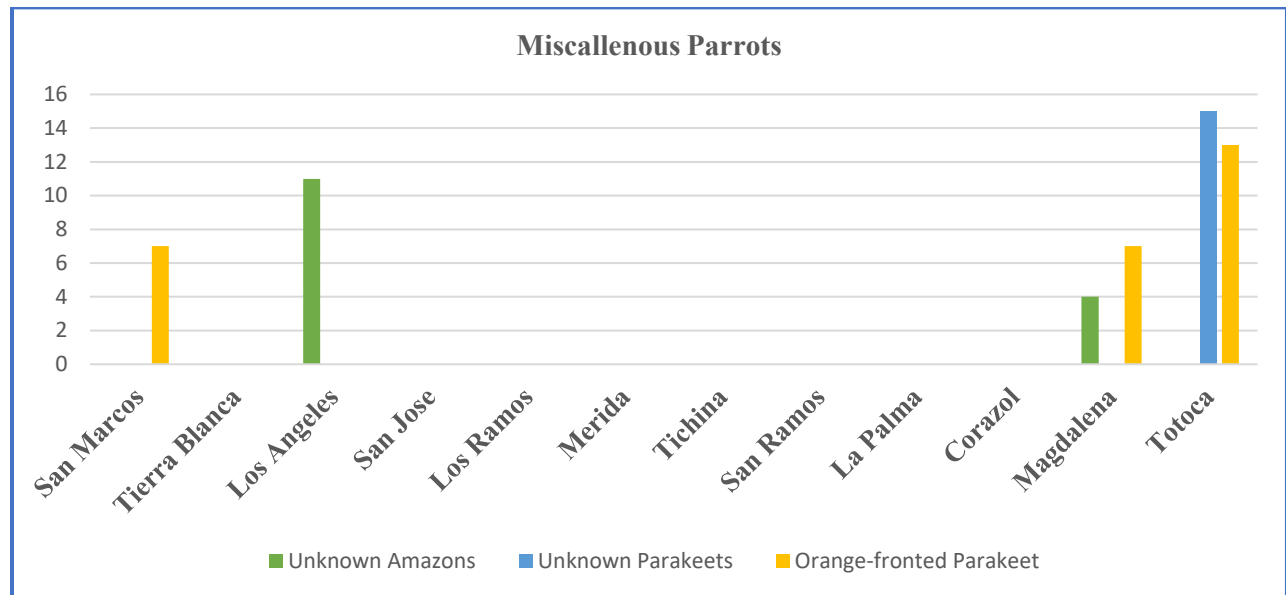


Figure 2018-3: Relative density of each species counted (N=7511) July 2018

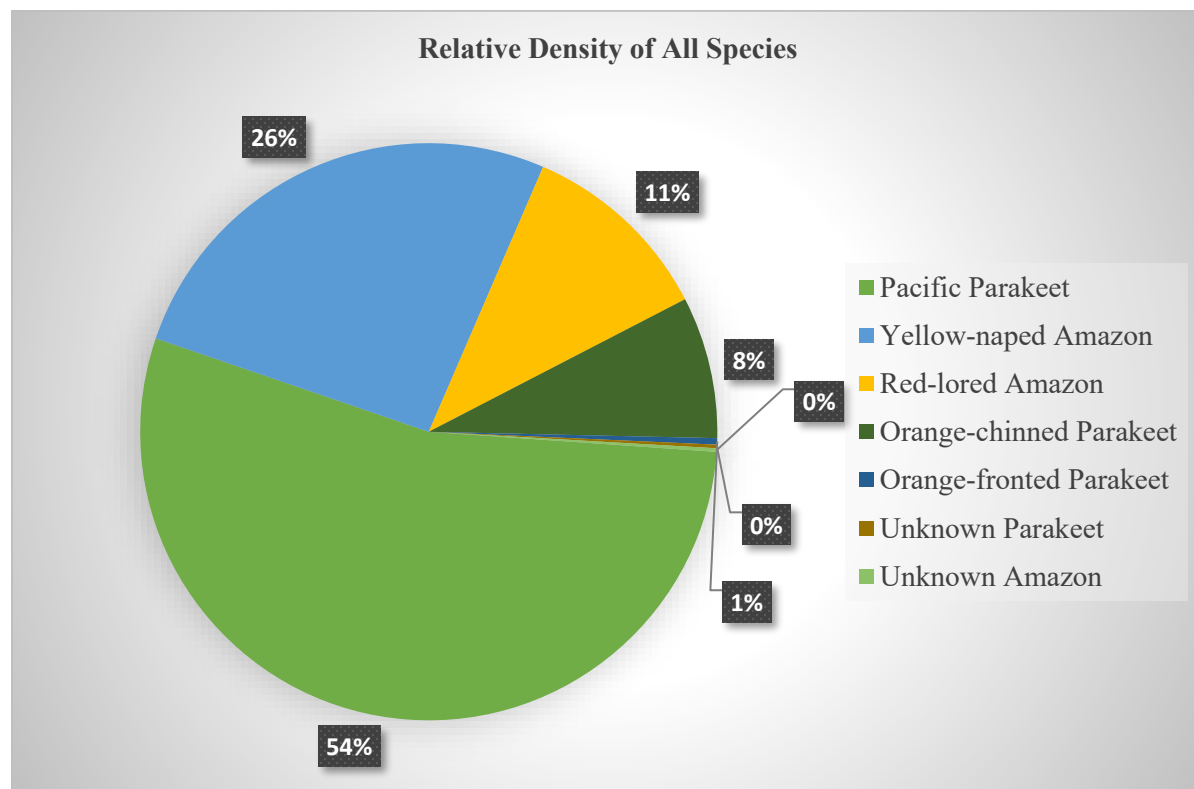


Figure 2018-4: Percentage of each group in four species counted, not including 30 unknowns and 27 orange-chinned parakeets (N=7454) July 2018

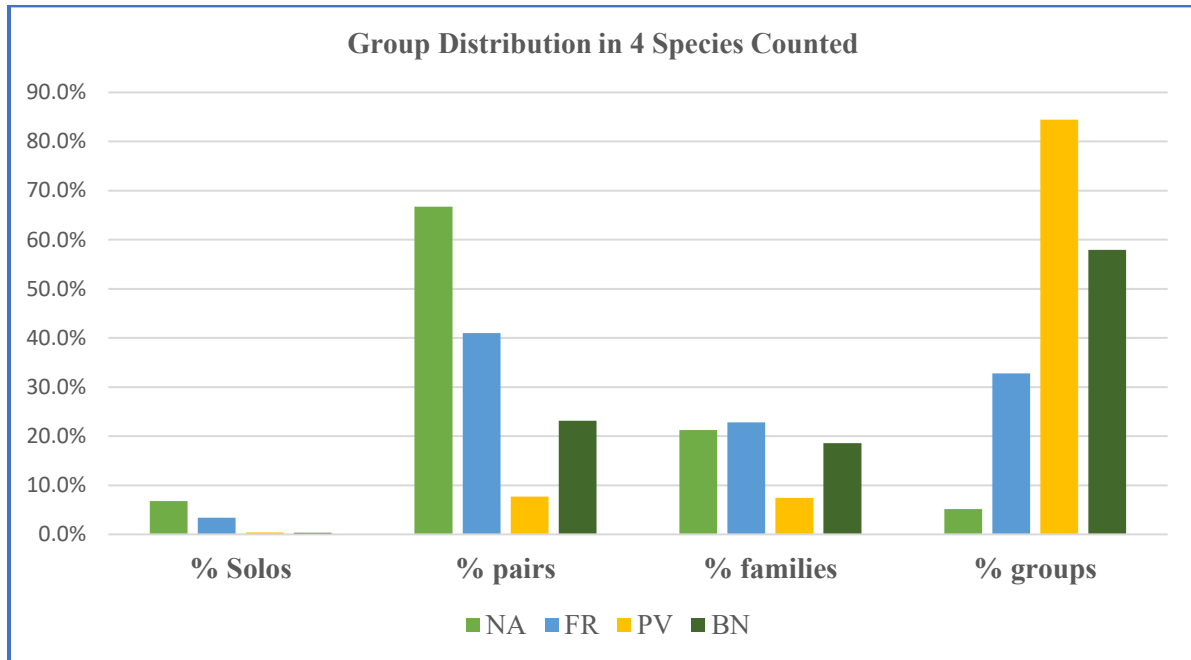


Figure 2018-5: Percentage of yellow-naped amazon chicks (N=179) at 14 sites July 2018

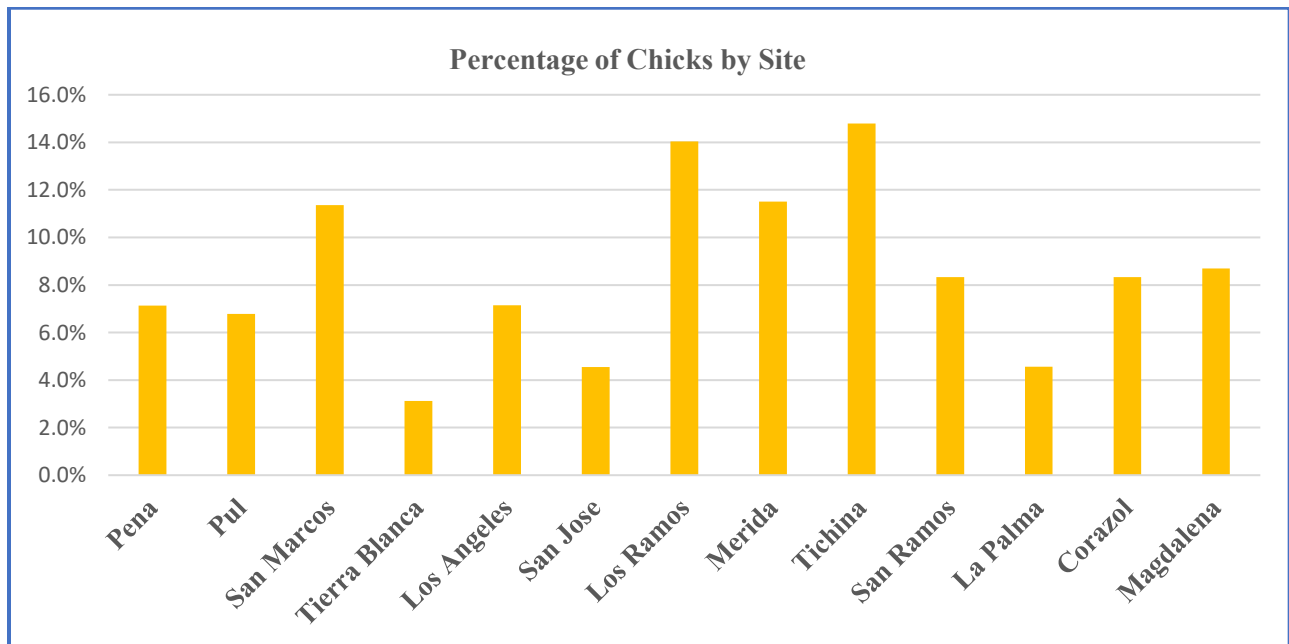


Figure 2018-6: Number of chicks (N=179) compared to total number of all yellow-naped amazons counted (N=1971) at 14 sites

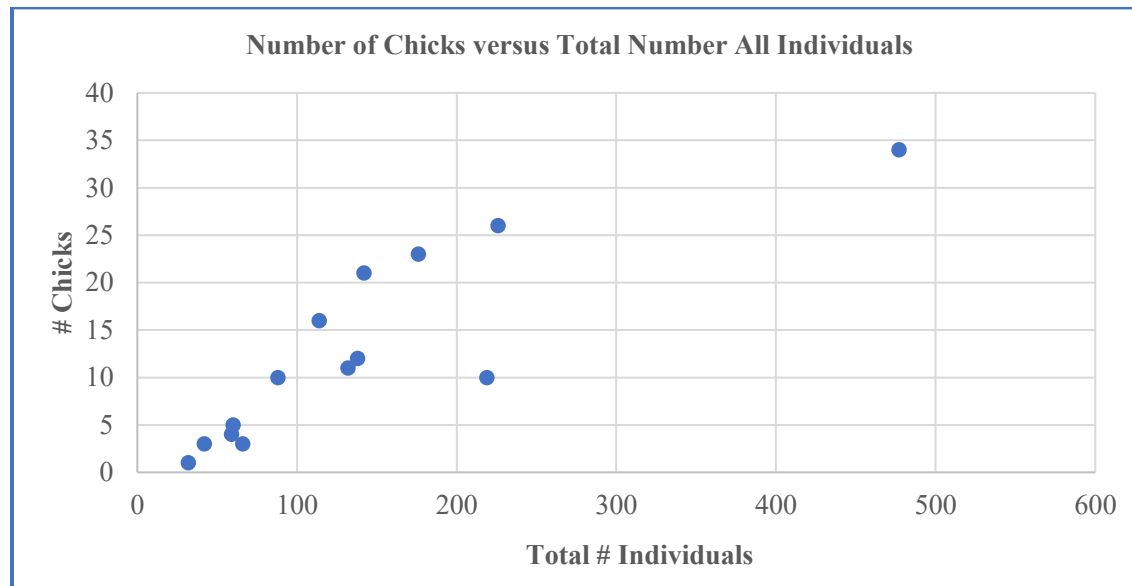
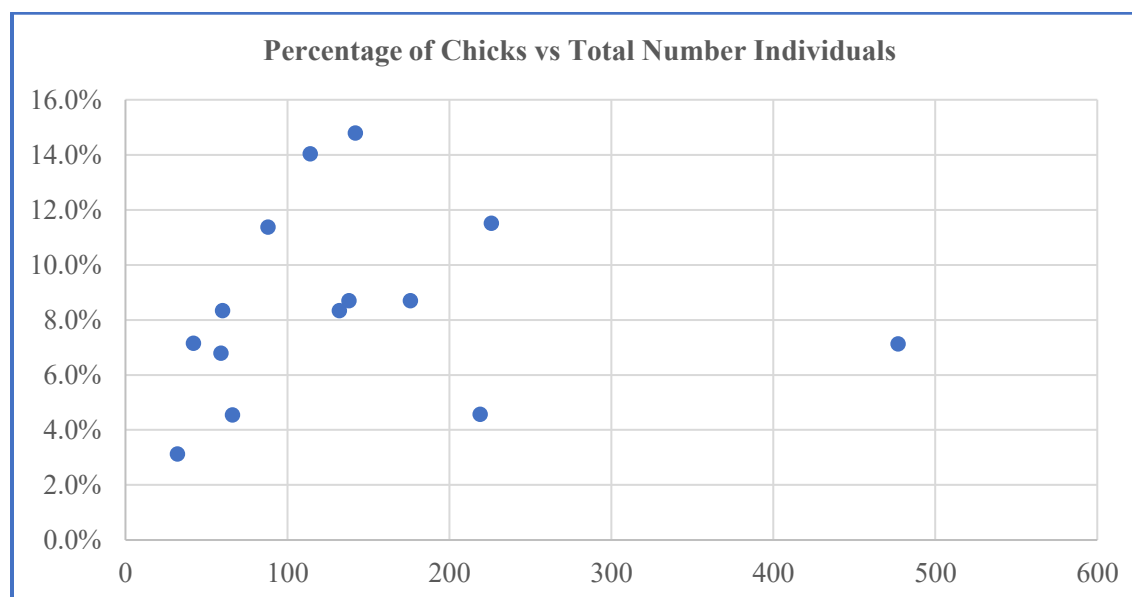


Figure 2018-7: Percentage of chicks compared to total number of all yellow-naped amazons counted (N=1971) at 14 sites



Removing Duplicates

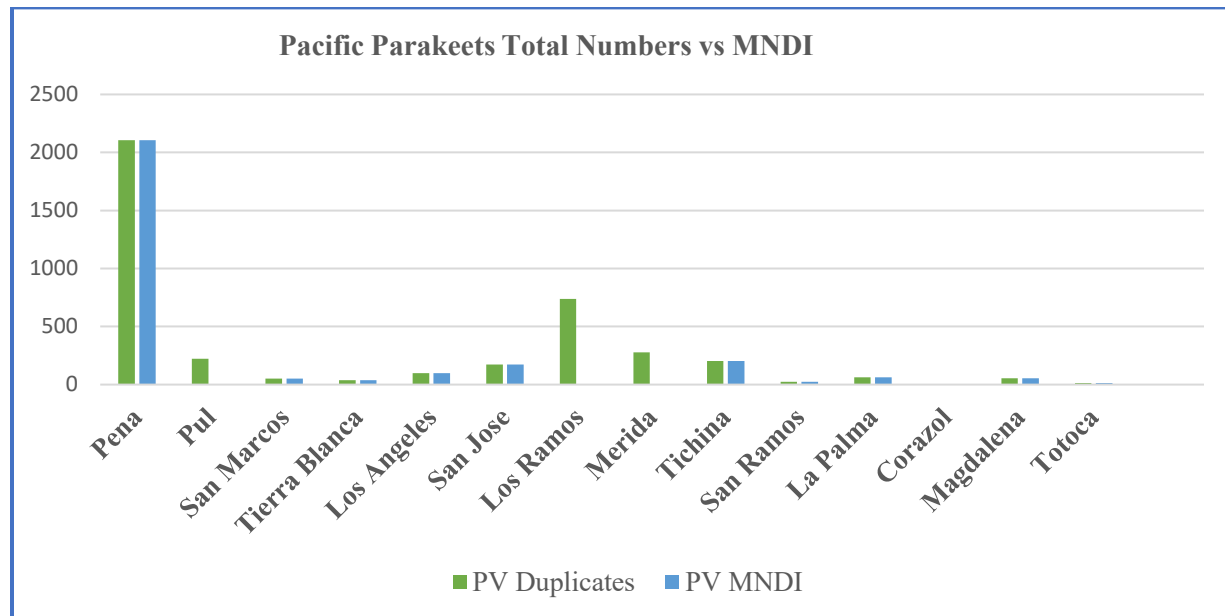
We kept track of how many parrots came and went from any particular transect, so as to determine roughly how many individuals might be shared with other transects. The orange-chinned and orange-fronted parakeets in this area generally fly low (at or below tree canopy height of approximately 25 meters) and did not appear to be moving outside of their particular

transect. Generally, over the years we have seen that the amazons are also flying somewhat low (slightly above tree canopy height 30-40 meters) compared to some areas where this species flies very high (100 meters and above) when covering greater distances. The amazons on Ometepe generally fly more up and down the volcanos, staying within one transect instead of crossing from one transect to another. The major exception to this is the area of Peña which is in the isthmus between the two volcanoes. Here we discovered there is a large roost site of Pacific parakeets (Figure 2019-8) where parakeets come into this area from other transects. To estimate the total number of Pacific parakeets, we counted how many parakeets left each of the nearby transects to roost in the Peña roost site, and then subtracted that from the total number of Pacific parakeets on Ometepe (Table 2018-6). We found that all the parakeets (1238) from Pul, Los Ramos, and Merida went to roost in Peña. To arrive at a rough MNDI, we removed them from the island tally, but left them in the total count so we could estimate group sizes. We followed the same procedure for the amazons, determining a MNDI but leaving in possible duplicates when analyzing group distribution because there is no way to discern which family groups on different nights of counting might be the duplicates seen. This means that our group size distribution, especially for the Pacific parakeets where they often fly in groups, could include certain group sizes twice in the final analysis of group size distribution.

Table 2018-6: Removing probable Pacific parakeet duplicates from sites that share them with other transect sites, thus we arrive at the Minimum Number of Distinct Individuals (MNDI)

	PV Duplicates	PV MNDI		Location Island
Peña	2106	2106		Isthmus/Concepción
Pul	223		Went to Peña to Roost	Near Isthmus/Concepción
San Marcos	51	51		Concepción
Tierra Blanca	38	38		Concepción
Los Angeles	98	98		Concepción
San Jose	174	174		Concepción
Los Ramos	737		Went to Peña to Roost	Near Isthmus/Concepción
Merida	278		Went to Peña to Roost	Merida
Tichina	203	203		Merida
San Ramos	23	23		Merida
La Palma	63	63		Merida
Corazol	4	4		Merida
Magdalena	54	54		Merida
Totoco	14	14		Merida
Total	4066	2828		

Figure 2018-8: Comparison of total numbers of Pacific parakeets (4066) to the Minimum Number of Distinct Individuals (MNDI) (N=2828)



Removing possible duplicates for the amazons was relatively straight forward between transects and within transects, except in the Peña area where flight patterns are irregular. We have determined that this is because there is a different breeding season in the Peña forest patch than in other parts of the island, making it both a nesting and roosting area with different group size distributions. The Peña area also has two roost areas for yellow-naped amazons, and the birds do a lot of flying back and forth between these two areas during the evening, making it hard to remove duplicates. Frequently I have said that in all my experience this is the hardest roost area to count as well as the most difficult to understand. By 2020, we had figured most of this out though removing duplicates within the transects will always be a challenge if only four points are used. In 2019, we practiced counting this area with eight points and this helped us determine more accurately what was going on in this area. Ideally, it would be optimum to count the Peña area with eight points every time; however, limited resources of placing and paying that many people is a challenge and we have elected to not use this many points on a regular basis.

For the entire fourteen transects, we repeated this same process for amazons that we used for the Pacific parakeets (Tables 2018-7). Compared to the Pacific parakeets, we had very few birds entering a transect from other transects. As the birds fly rather energetically in the Peña roost area, we did a special count with placing points in different locations a few weeks later in August of 2018 to estimate double counting. We found that up to 63 individuals could be counted twice due to the exuberant activity of birds coming and going between roost sites, which are approximately one kilometer apart. By extrapolating from one day's count to another, we were trying to see if we were in the same order of magnitude considering how much sharing and movement there is within this area. The final MNDI for yellow-naped amazons was 1869 for this period of counting. We arrived at this number by removing the 63 duplicates within Peña and 39 others that moved between other transects on the island (Table 2018-7).

Table 2018-7: Removing probable yellow-naped and red-lored duplicates from sites that share them with other transect sites, thus arriving at the MNDI (duplicates of FR within sites had already been removed when tallying the transect count)

	NA with Duplicate s	# Duplicates within site	# Duplicates that come from another site	FR with Duplicates	# Duplicates that come from another site
Peña	477	63	5	48	0
Pul	59		0	9	0
San Marcos	88			31	0
Tierra Blanca	32		2	19	0
Los Angeles	42			10	0
San Jose	66			23	0
Los Ramos	114			16	0
Merida	226		9	8	0
Tichina	142			29	0
San Ramos	132			72	0
La Palma	219			269	0
Corazol	60			25	0
Magdalena	138		19	133	37
Totoco	176		4	128	0
Total with Duplicates	1971	63	39	820	37
Total MNDI	1869			783	

Discussion of 2018 Results

We used the 2018 results to get a general idea of how many parrots were on Ometepe and where the largest concentrations were located so we could choose which conservation sites upon which to concentrate. For that aim, we used MNDI based on only one evening count because the evening time is usually the easiest to count. Previous years' counts had given us a good idea that in the evening, the birds do less moving around (again except in the Peña area) and head directly from foraging to roost areas. This reduced the chance of counting duplicates in the evening as compared to the morning where there can be greater movement, especially of the smaller parrots. As each transect was only counted once, we do not know for sure if there might have been a sudden shift of birds coming into one roost area in successive days. Seeing a sudden, major shift of birds from one day to the next had not been experienced up to 2018, but we didn't really look at this until 2019 and 2020 where we did see a few shifts of birds between neighboring transects on the same day. The use of MNDI for each single transect is a good number for identifying locations for further study and conservation activities. By using MNDI to summarize the entire island from a month's counting, it is difficult to speculate on an accurate total number of parrots. Even still, the numbers of amazon parrots are quite high compared to other areas in Central America, though we suspect they might be comparable to other islands where yellow-naped amazons appear.

Our goal was not to state indefinitely what the relative density and group size distribution might be given as we only counted one night; however, given that we did fourteen transects on the island we can say something about the population as a whole. We counted 5 species, as well as a small number of unknown amazon species (15), and unknown parakeet species (15), for a total of 7511 individuals: 1971 yellow-naped amazons, 820 red-lored amazons, 4066 Pacific parakeets, 597 orange-chinned parakeets, and 27 orange-fronted parakeets.

The five species we observed in 2018 were not surprising for this area, although eBird (Figure 2018-10) suggests more species live on the island, including the white-fronted amazon (*Amazona albifrons*), of which a few were seen by our team in another year. Also noted in eBird is the white-crowned parrot (*Pionus senilis*), the brown-hooded parrot (*Pyrrhula haematotis*), and the crimson-fronted parakeet (*Psittacara finshchi*). The last three we have never seen on any of our counts, although we observed a crimson-fronted parakeet in Merida during 2018 nest observations and not during a count (see Photograph 1). In eBird, there is one observer who saw a brown-hooded parrot¹⁶ and one sighting of a green parakeet (*Psittacara holochlorus*).¹⁷ We did have a total of 30 birds that could not be identified: 15 amazons and 15 parakeets, which is .4% of all birds counted.

Breaking down observations of parrots seen at volcanos, we see that the average number of parrots of each species is lower in sites on the Concepción volcano than on the Merida volcano, with the exception of Pacific parakeets which are more numerous on Concepción and in the isthmus area of Peña (Figure 2018-9, Table 2018-3). Anecdotally, we have assumed this is because Merida has more tree coverage, is less populated, and is more difficult to access, with mostly a dirt road as compared to the paved road in Concepción; it also does not have a ferry landing receiving traffic from the mainland.

We looked at the results to see the distribution of group size for each of the species (Figure 2018-4, Table 2018-2). For the yellow-naped amazon, the overall percentage of pairs with young was 18.2% (120/658), similar to the 15% found as a mean per site of yellow-naped amazons in one study¹¹ and 17% in another.⁴ Pairs with young corresponds to our categories of family groups (birds flying in groups of 3, 4, 5), where it is assumed that this is a pair with 1, 2, or 3 recently fledged chicks.

Looking at the all sites together and individually, 8.8% of the yellow-naped amazon flock was composed of yellow-naped amazon chicks (± 3.65) with a range of 3.1% -14.8%, and 10.6% (± 6.8) with a range of 0-20% for red-loreds (Table 2018-5). This roost site in Costa Rica had 12.5% young, higher than what we found for yellow-naped amazons. Some of the young of the red-lored amazons might also be in the larger groups of six or more, and from observation, it seems that red-lored amazons move in larger groups as compared to the more pair oriented yellow-naped amazons. Hence, we might be undercounting red-lored amazon chicks. It is our general sense on Ometepe, and in other areas where we have counted birds (La Moskitia, Honduras), that red-lored amazons fly in larger groups than yellow-naped amazons, meaning that their behavior (flight and foraging) bunches family groups together in larger units. Yellow-naped amazons are more highly prized in the illegal wildlife trade and may not produce enough young to be grouping with other family groups or other juveniles after dispersing from their nuclear

family unit. We have yet to count one site every month to see exactly when is the peak time of fledglings flying with their parents, so we may not be recording the maximum amount of young in the area, although in the Costa Rican study⁴, they found the highest percentage of young in June and July. Ometepe might be different, however, especially in the Peña area, where the peak flying time of chicks with parents would be several months earlier due to the earlier breeding season. We did not emphasize family size in the smaller species because according to what is known about their flying patterns, families mix readily into larger flocks and it would be difficult to determine the percentage of young in a count.

There was a difference in flock size distribution between the different sites (Tables 2018-4, 5 and Figures 2018-6, 7). Higher numbers of chicks increased as a function of total bird count in yellow-naped amazons, but so did the percentage, suggesting that greater numbers of roost areas had a larger percentage of chicks. We don't know why this is, but it might have something to do with parents preferring to bring their chicks to larger roosting areas for safety and abundance of food. This trend, however, had two outliers, Peña and Palma, both of which should have had a higher percentage and number of chicks given their greater overall population numbers. We speculate that this is because of the higher poaching rates in Palma, which we documented in later years; there appears to be easy access for poaching in Peña, and in 2019, a higher failure rate of nests. In these two areas, there might be fewer chicks because of a lower reproductive output specific to these sites. Another explanation for a lower percentage of chicks in Peña is that the isthmus area has a different breeding season with most chicks fledging in December and January, four months earlier than the other sites. This means that to capture the greatest number of yellow-naped amazon chicks in Peña, we would need to count in March and April. We did count in April 2014 and 2015, but the Peña area did not show any consistent patterns of having a higher percentage of family groups than other areas, perhaps because of the mix of populations with different breeding seasons.

One use of the multiple point method of fixed transects is to obtain not only an MNDI for one transect, but for a region where you are doing a rapid assessment. To get this number, you have to track how many parrots are entering and leaving from one transect to another, and these birds are removed from the final tally. This method presupposes that birds will move similarly on the night you count the first transect and the second night when you count. Generally, we have observed that the amazons, the orange-chinned, and orange-fronted parakeets do not move much between transects during one afternoon's count, and that flight patterns are often similar every time we do the count. However, we have never confirmed this, especially in the eight new transects that we counted in 2018 and have yet to repeat it. Regardless, we wanted to see what the MNDI might be for the entire island, and so we used this methodology. Unfortunately, we added some transects that were counted several weeks after the first round of counts, and this is enough time for birds to have shifted their flight patterns. Normally, when using this method to obtain an MNDI combining multiple transects, we try to do all the counts within a week's time, assuming that the food availability, daylength, and climate would not have changed significantly. These are some of the presumed factors that cause a shift in bird foraging and roosting patterns.

We found that few birds came into a transect area that were not already there, and when we did discover these, we were still able to get the MNDI for the red-lore and yellow-naped amazons, and the Pacific parakeets. The other two smaller parakeets did not seem to move between

transects and hence, the MNDI did not shift. The biggest change from the total number of individuals and the MNDI was with the Pacific parakeets who have flight patterns that are generally higher and longer; in this case, they were coming in from other transects from the agriculturally-rich area of the volcano Concepción to roost in the Peña area.

Figure 2018-9: Location of 14 transects counted in 2018. (Blue circle is volcano Concepción, black circle is volcano Maderas, and red triangle is the isthmus between the two)

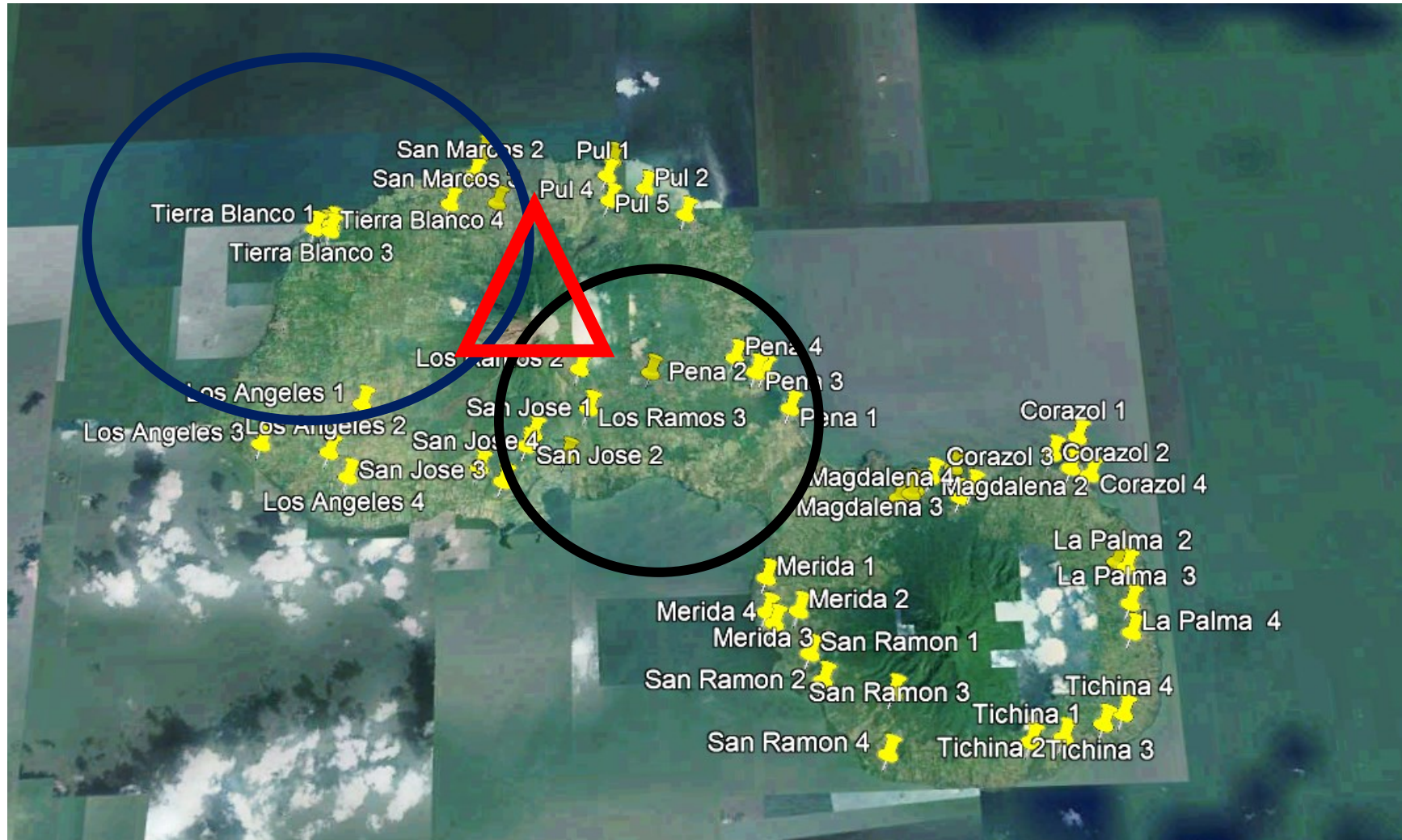
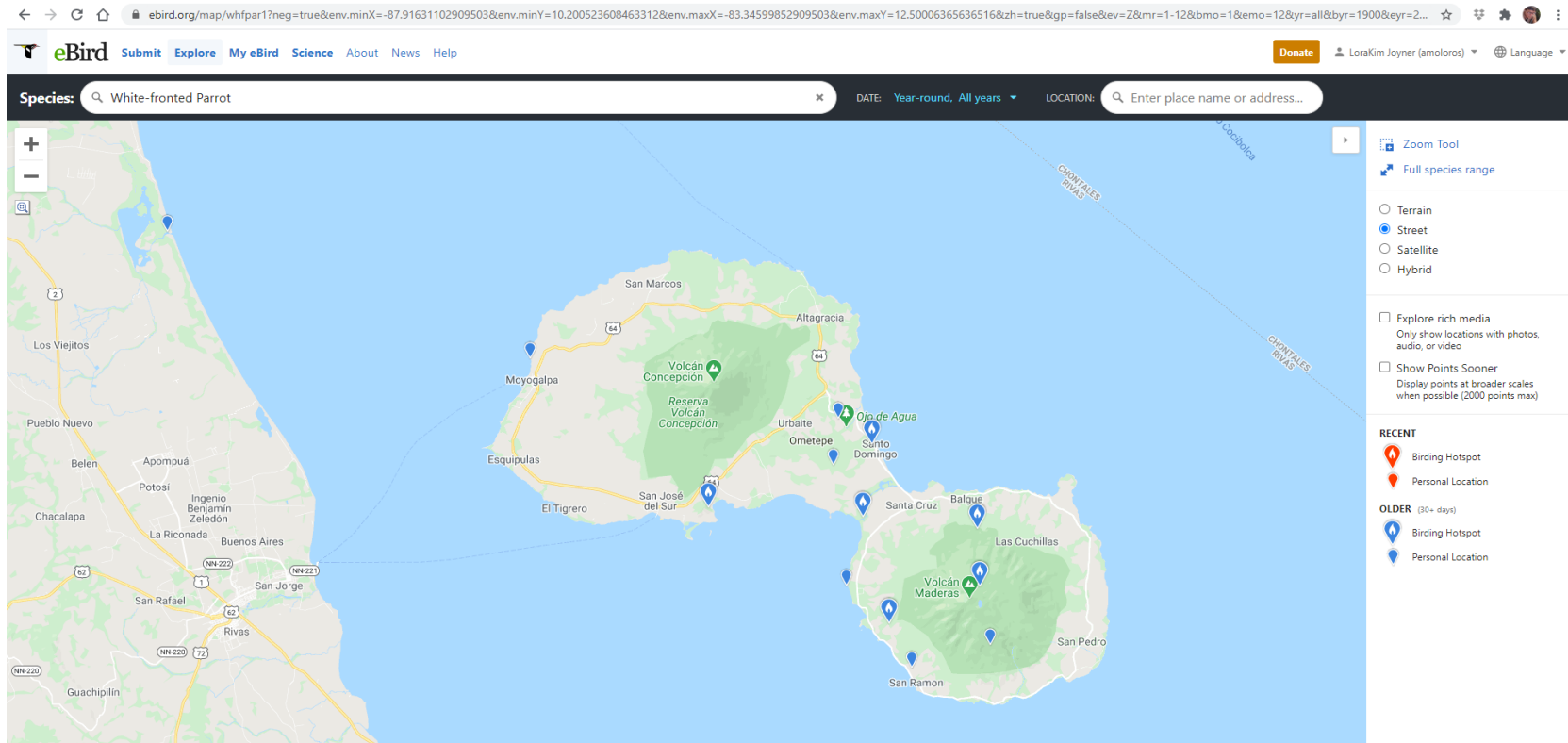


Figure 2018-10: Search window on eBird for looking for various species of parrots on Ometepe Island, highlighting the white-fronted amazon (<https://ebird.org/map>)



2019 Results

This was the year when we attempted to count our four conservation areas (Totoco, Peña, Palma, Merida) all at one time on the same day. Each conservation area had one transect with the same four points that we had used in 2018 and would use again in 2020. Our purpose was to see how much movement there might be between each transect as counters recorded if birds entered or left the transect to and from other transects. Like in 2018, we were able to get a total count for each transect, a total count for all the transects, and an MNDI for each transect as well as for the all four transects with removed any possible birds moving between the transects.

Before the counting, we did a day-and-a-half classroom training and two afternoon practice counts on July 16 and 17, grouping people into teaching sessions. The two official counts occurred on July 18 and 19. We then did follow up counts in the Peña and Totoco areas.

Background to Peña Counts 2019

We continue to find the most movement of birds within a transect occurring in Peña. As in 2018, we discovered two roosting areas that they move back and forth between, which increased the chance for duplicates. In all my 34 years of counting roosting areas, Peña has proven the most difficult and puzzling. Not only is there a lot of movement between these roost sites causing possible confusion of duplicates, but there is also a different breeding season (young fledge in December in the Peña forest patch) than in other areas of the island. This means that we have a breadth of observable family groups for a longer period of time, as well as single males. This adds to the fluctuation of bird movement and tree patches they choose to inhabit, because they are nesting, roosting, foraging, and with young fledglings at different times. In 2018, we did a separate count of just this area with six points, and on that day, were able to see that we had 63 yellow-nape individuals duplicated within the transect. Six points gave us greater visibility and observation of birds coming and going within the transects.

In an attempt to understand this area better we did a larger count with eight points this year on July 27. Four points were the same, and we added two that were on either side of the second roost area to the north of the Peña roost area (#7, #8): one was up on the volcano slopes able to observe everything from a distance (#5) and another was closer to the Merida transect (#6) where we could see birds coming and going from Peña to either Totoco to Peña (Figure 2019-8).

Background to Magdalena-Totoco Counts 2019

Although not as puzzling as the Peña area, the Totoco counts seem to show variation from year to year that we could not explain. For this reason, we repeated the Totoco count, but instead of just four points, we did a seven point count on July 29. Then on August 3, we did same-night counting for the Totoco transect's four points with the Magdalena four points used in 2018 (Figure 2019-7).

Figure 2019-1: All species counted (N=5992) in two counts each at 4 transects

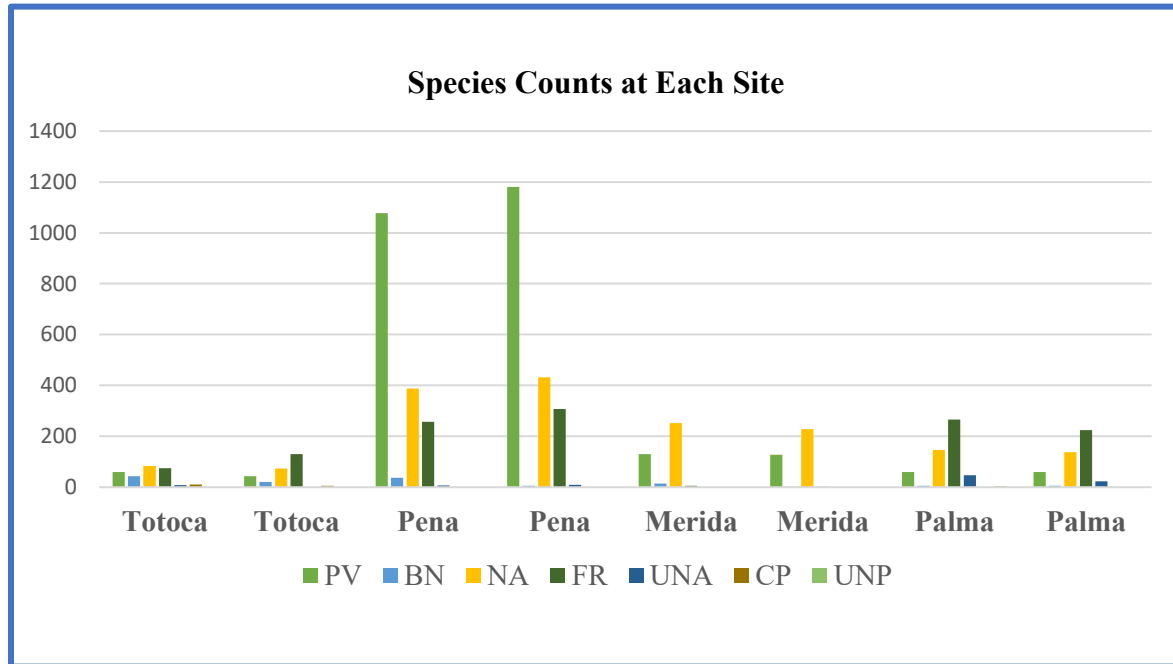


Figure 2019-2: Relative density of each species counted; two counts combined (N=5592) July 2019

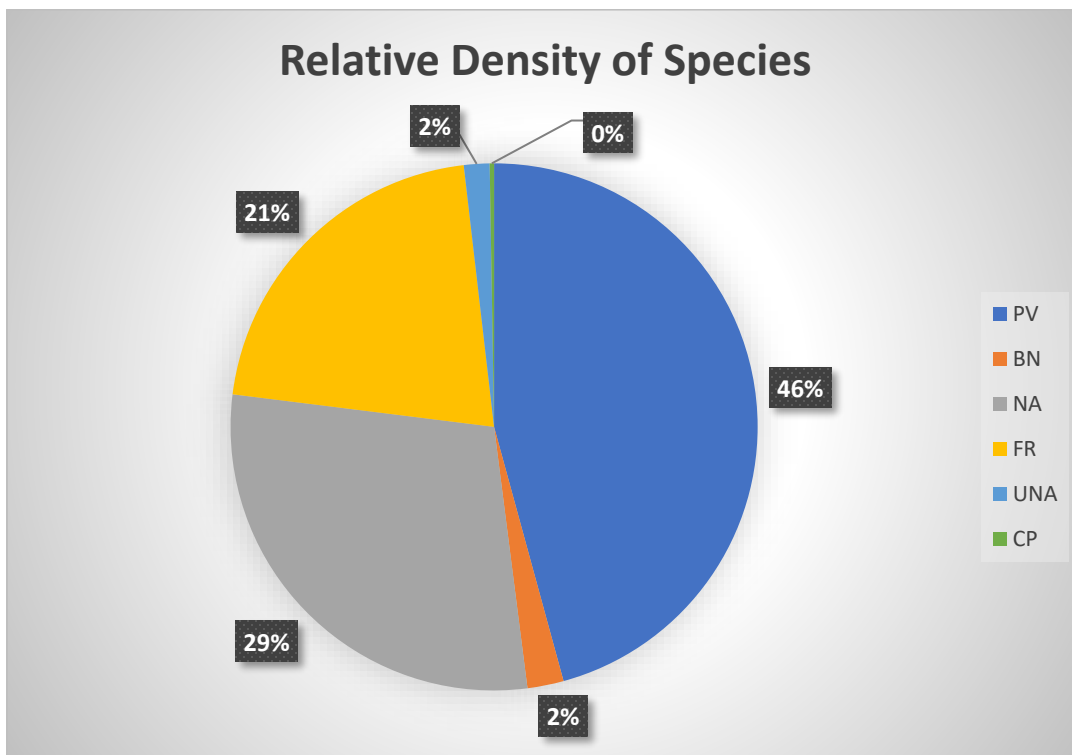


Figure 2019-3: Group distribution and chicks in all amazons, both counts combined (N=3005)

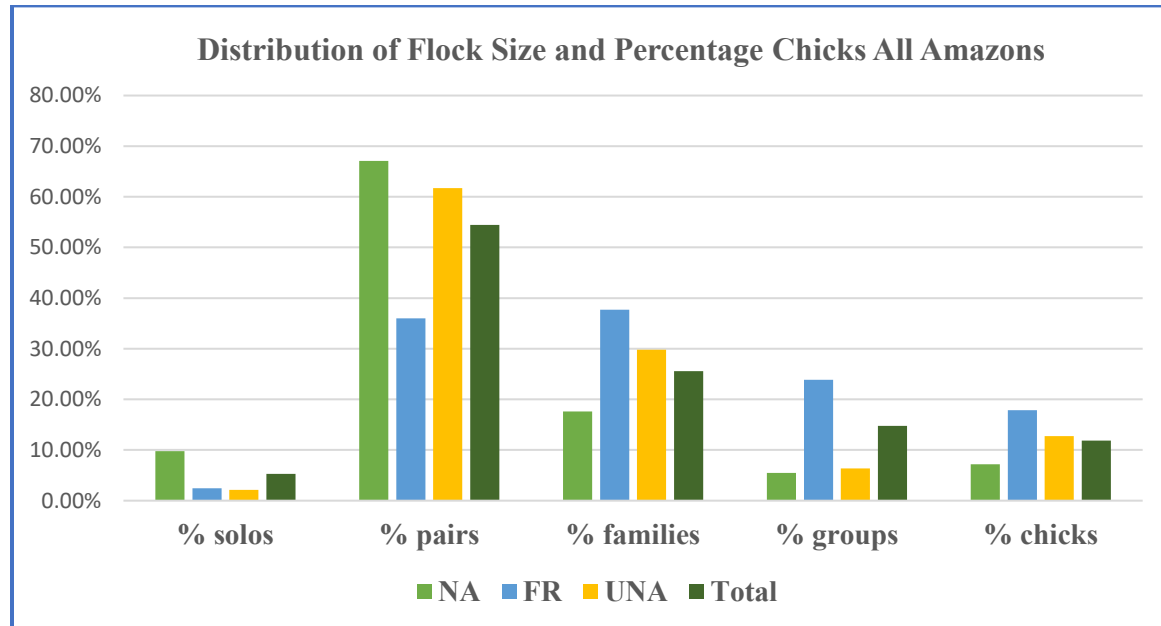


Figure 2019-4: Group Distribution and Chicks in All Non-Amazons, both counts combined (N=2875)

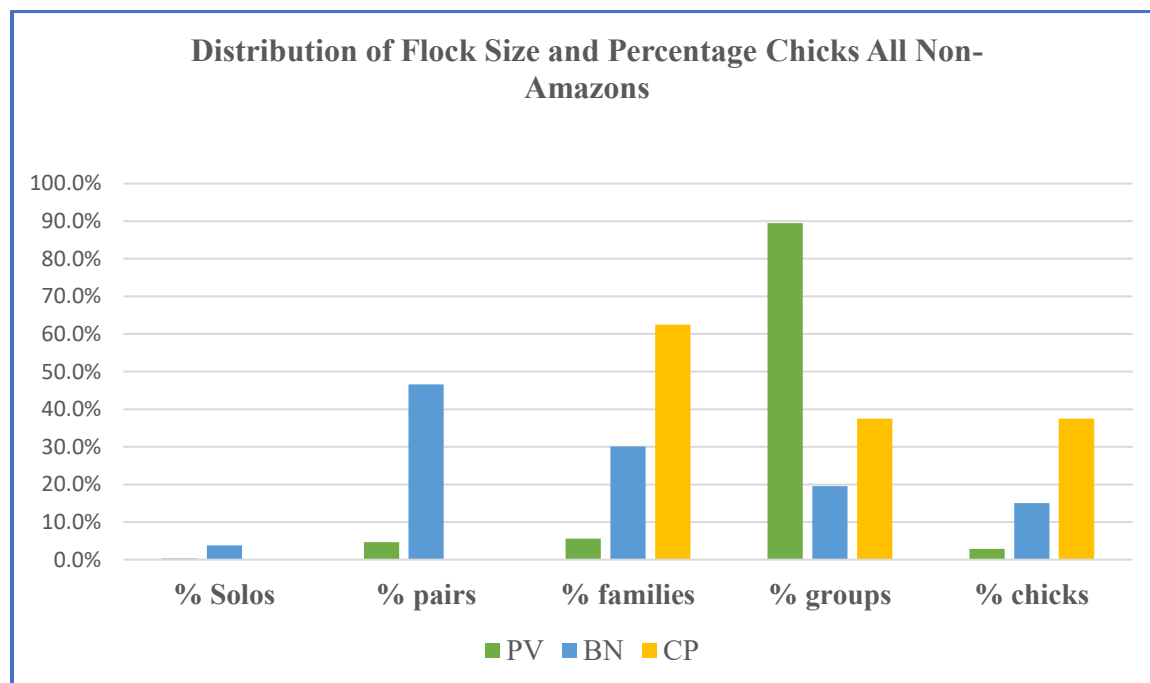


Table 2019-1: 7-point Totoco Count July 29, 2019

Species	Total	Share
NA	182	18 to Magdalena
FR	220	50 to Magdalena
PV	122	All to Peña
BN	70	All to Peña
CP	23	
UNA	6	

Table 2019-2: Summary of all Totoco and Magdalena Counts 2019 (4-points unless otherwise stated)

	PV	BN	NA	FR	UNA	CP	Total
Totoco July 18	59	43	84	75	8	11	280
Totoco July 19: 4 points	43	21	74	130	0	5	273
Totoco July 29: 7 points	122	70	182	220	6	23	623
Totoco August 3: 4 points	8	10	66	159	2	11	256
Magdalena August 3: 4 points	16	24	206	179	2	0	427
Totoco and Magdalena August 3 - 7 points	24	34	272	338	4	11	683

Table 2019-3: Amazons shared between transects Magdalena and Totoco August 3, 2019

	Totoco NA	Mag NA	Totoco FR	Mag FR
Total	66	206	159	179
Went to Mag	5		0	
Went to Totoco		3		6
Went to Corazol	0	23	0	20
Came from Mag	0		0	
Came from Totoco		27		39
Came from Corazol	0	35	0	8
Share with Palma	3	35	6	8

Figure 2019-5: Total number of each species counted for Totoco and Magdalena counts July and August 2019

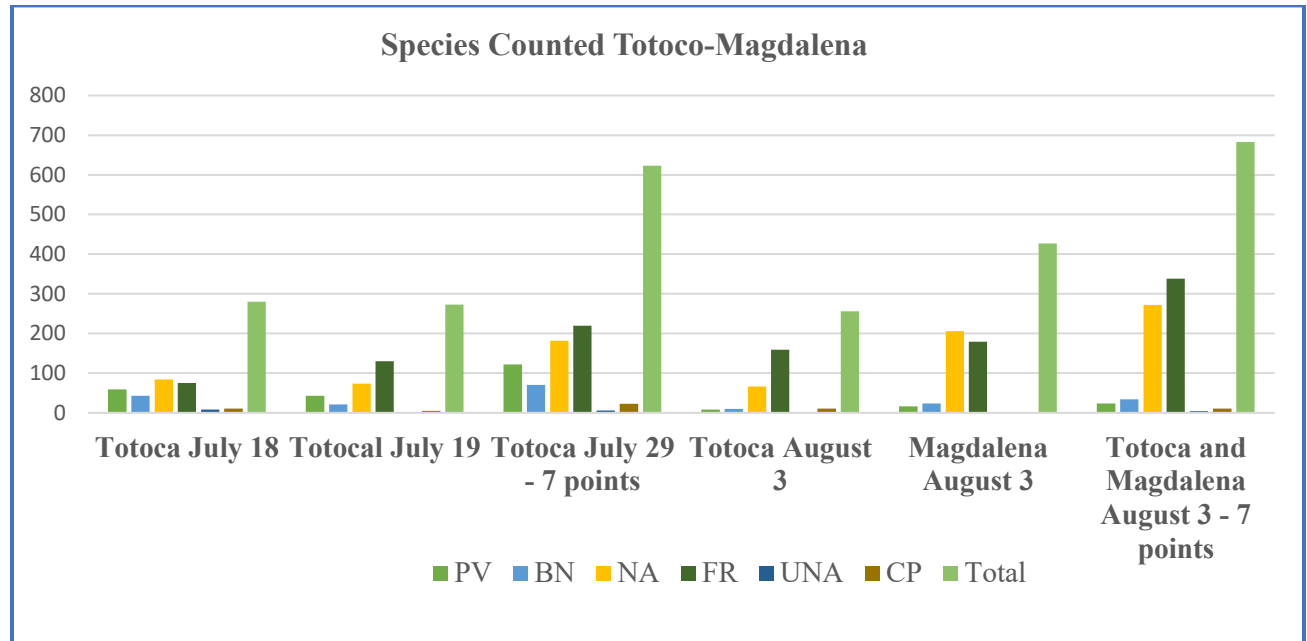


Figure 2019-6: All species counted for Totoco and Magdalena counts (N=682) August 3

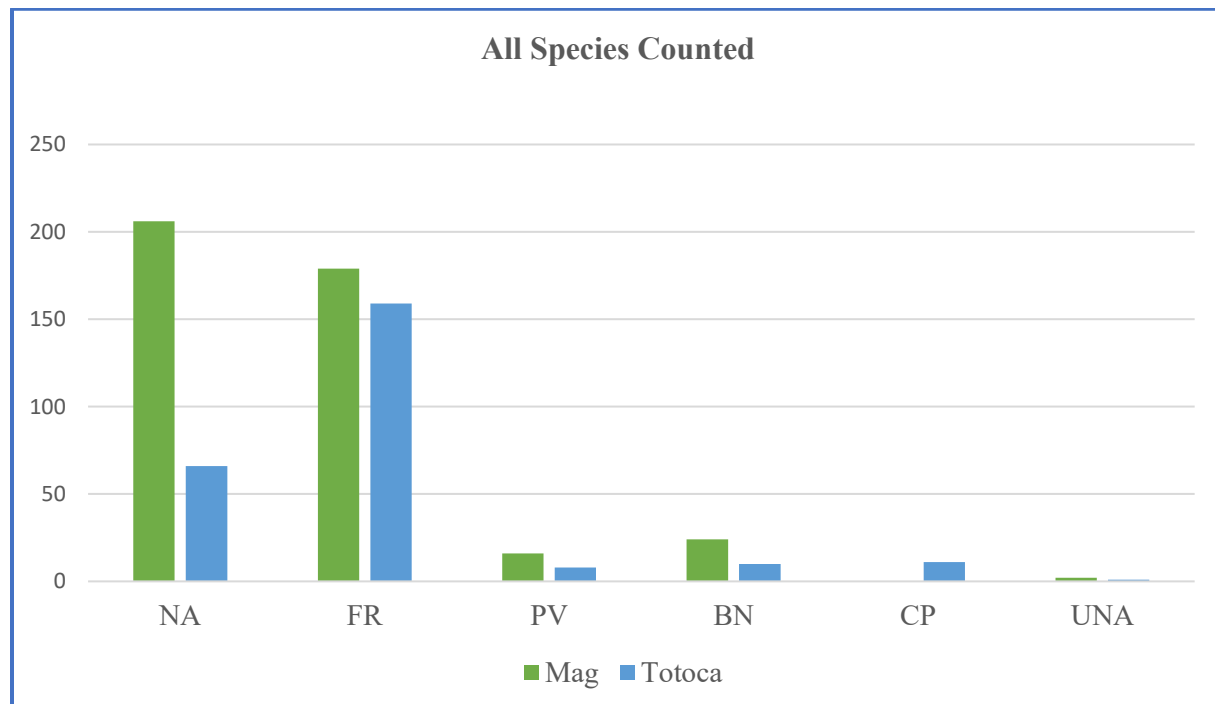


Table 2019-4: All species counted during 8-point Peña count July 27, with distribution of group sizes and numbers shared with other transects to arrive an MNDI and roosts observed

Species	Total	Solos	Pairs	3	4	5	Groups	Shared within transect	MNDI	Shared outside transect	Roosts
NA	608	40	232	24	8	0		75	533	29 to Maderas, 13 come from Maderas (point #6 data)	40 roost at Oja
FR	285	4	57	11	9	4	78	122	163		All roost in Peña
PV	2445	5	28	2	8	2	2336		2336		All roost Concepción
BN	159	0	3	2	4	2	121		121		All roost Concepción
CP	0	0	0	0	0	0					
UNA	22	1	5	1	2	0			22		

Figure 2019-7: Map of points counted during the Totoco and Magdalena counts 2019, and roost sites in 2018, 2019, and 2020



Figure 2019- 8: Map of 8-point Peña count with observed roosting areas



Discussion 2019 Results

This year we counted the four conservation area transects at the same time so that we could get a reliable number not only for the MNDI for each transect, but also between transects as we had people who could see birds entering and leaving all transects from other transects. We had 98 individuals we could not identify: 94 amazons and four parakeets, .2% of all parrots (N=5992) and 3% of all amazons (N=3103).

In Table 2019-15, we show the total results by site and by species, as well as those individuals that could have been shared between each of the four transects. The MNDI was only 33 less than the total of all transects before throwing out possible duplicates, a .5% difference. The only birds possibly shared were 13 yellow-naped amazons and 20 red-lored amazons between Totoco and Palma, although the distance is over 6 kilometers and the direction of flight is slightly off. We assume that most of the birds leaving and entering Totoco are coming to and from Magdalena and Corazol, two roost/transects areas between Totoco and Palma. We checked our assumption

when counting the Tattoo and Magdalena transects on August 3 and calculated that the numbers of birds that could have been shared with Palma were likely 3 yellow-naped and 6 red-loreeds (Table 2019-3). These simultaneous counts show that there is little exchange between transects over several years, and although Totoco and Magdalena exchange birds, it is as if it is one large roost area separated by 500 meters (Figure 2019-7). Flight patterns of the birds show some coming and going between these two transects, as well as with Corazol, which is further north and down by the coast, and was only counted in 2018 (Figure Methodology-1).

Because we counted much fewer yellow-naped amazons in the two Totoco counts in 2019 (84 and 74 on two different evenings) compared to 2018 (176 in one evening's count), we suspected that perhaps the birds had moved their flight patterns and could not be observed from Totoco, but only from Magdalena. We were also concerned that there had been some logging in Totoco near the roost site which might have disturbed the local birds. To understand this, we first counted just in Totoco with seven points to see if the birds might have shifted to Magdalena. We found that we were able to observe more yellow-naped amazons (182), because some of these points' vista can pick up birds that cannot be seen from just a four point transect (Table 2019-2). Of these, only 18 exited this seven-point transect to go towards the Magdalena points (Table 2019-2). More red-loreeds (50 of 220 total) moved towards Magdalena.

We then repeated the Totoco four point count and added Magdalena's four points and counted them together on August 3rd. Here we picked up the most amazons for 2019 (272 yellow-naped amazons with 206 in Magdalena and 66 in Totoco) and 338 red-loreed amazons with 179 in Magdalena and 159 in Totoco (Table 2019-2). In 2018, we saw more yellow-naped amazons in these two transects combined: Totoco (176) and Magdalena (138) for a total of 314 yellow-naped amazons plus fewer red-loreed amazons with 133 in Magdalena and 128 in Totoco. Because we had such few counts (only one evening's worth) and the combined Totoco-Magdalena count was conducted several weeks later, we can't really confirm if the Totoco-Magdalena area is seeing fewer or more amazons. We were able to confirm that during the two transect count, there was an estimated three yellow-naped amazons and five red-loreed amazons seen by both Magdalena and Totoco. Overall, we believe there may have been a shift from birds roosting within sight of the original four-point Totoco count towards Magdalena. There seemed to be more or less similar number of yellow-naped amazons but more red-loreed amazons between 2018 and 2019.

The eight-point Peña count revealed more yellow-naped amazons (MNDI of 533 after removing the 123 duplicates) then we saw early in the month for any given count (380, 432) – (Table 2019-4). This could be because we covered more ground or simply a factor of the normal variance between counts. We did count significantly less red-loreed amazons (163) then earlier (257 and 307). We believe that the red-loreed amazons do shift after July to other areas, as we saw in 2020. We were able to see there were 16 amazons (this is subtracting the 13 that come from Maderas from the 29 that went to Maderas) shared on a given day with the volcano Maderas transects (Merida and Totoco). We also were able to determine the roost sites of amazons within this transect – the red-loreed roost in the Peña forest patch and the yellow-naped roost in the Oja de Agua roost area, as well as in the Peña patch (Figure 2019-8). We also were able to reaffirm the large Pacific parakeet roost site on the Concepción slopes and find indications that there is an orange-chinned parakeet roost site also in this area (but as yet with no precise location determined).

As we counted each site twice on consecutive days, we were able to see what the difference was between two counts. This is not enough data to make an overall conclusion, although we get some idea of the difference (Figure 2019-2, Table 2019-5). They show that the overall difference in total numbers of birds counted each of the nights is 3 out of 5992 birds, which is a 1.3% overall difference between the two nights. Of the four more common species, the greatest difference was in the orange-chinned parakeet at 65.7%, possibly because there were only 133 individuals and they are easily missed as they fly so low. The next biggest difference was in red-shouldered amazons (9.8%), followed by Pacific parakeets (6.3%), and then yellow-naped amazons (.9%). We need to do more evening counts to truly understand the variance between nights and to determine if counting only one night is sufficient for our purposes.

Our highest percentage of yellow-naped amazon chicks (Figure 2019-3, Table 2019) occurred in Merida (12.5%) and our lowest occurred in Peña (4.9%). Peña has a different fledging season and this might explain why there are fewer chicks as they are likely older and flying apart from their parents. The percentage of red-shouldered chicks was much higher, ranging from 25% in Merida and 15.6% in Totoco. We counted in Totoco on August 3 and found the percentage of chicks to be 16.7%, more than double what it was 15 days earlier (8.2%). We do not know how to explain this, other than perhaps in Totoco parents aren't taking their families there as much in July as in August. It may be that August is a better time to survey for the maximum number of chicks, but we are not sure as we haven't counted each site all year round to determine when is the best time to count.

We will discuss how these results compare to previous years and to 2020 in the section on trends.

2020 Results

As in 2018 and 2019, we only counted in July the four main conservation areas: Peña, Totoco, Merida, and Palma. Our goal was to count each site on three consecutive nights to assess variability. Instead, we ended up counting on only two nights in July, except for Peña where we did manage three counts. We then counted again one night in August to observe the variability a month later.

Figure 2020-1: All species counted for all four sites (N=3305) July 2020

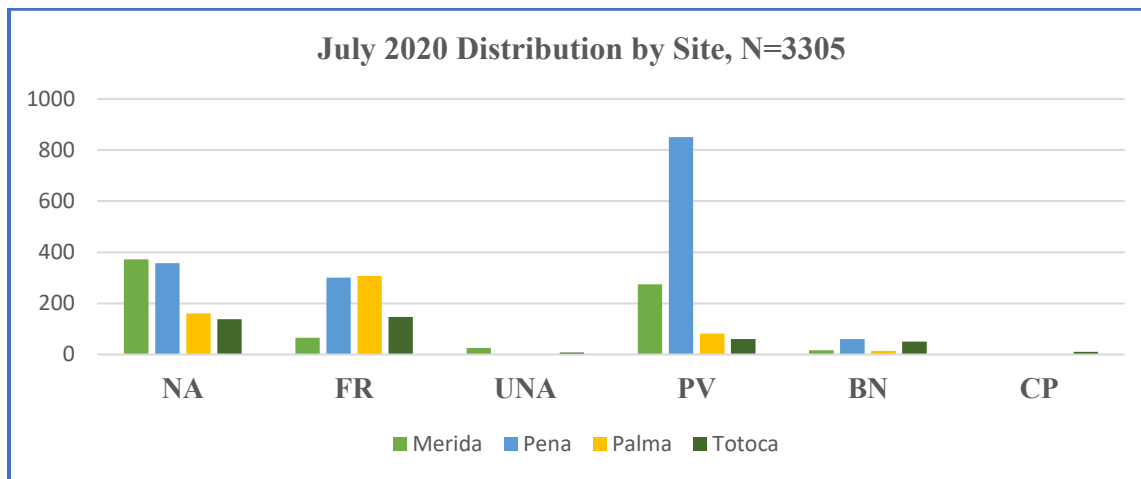


Figure 2020-2: All species counted for all four sites (N=2034) August 2020

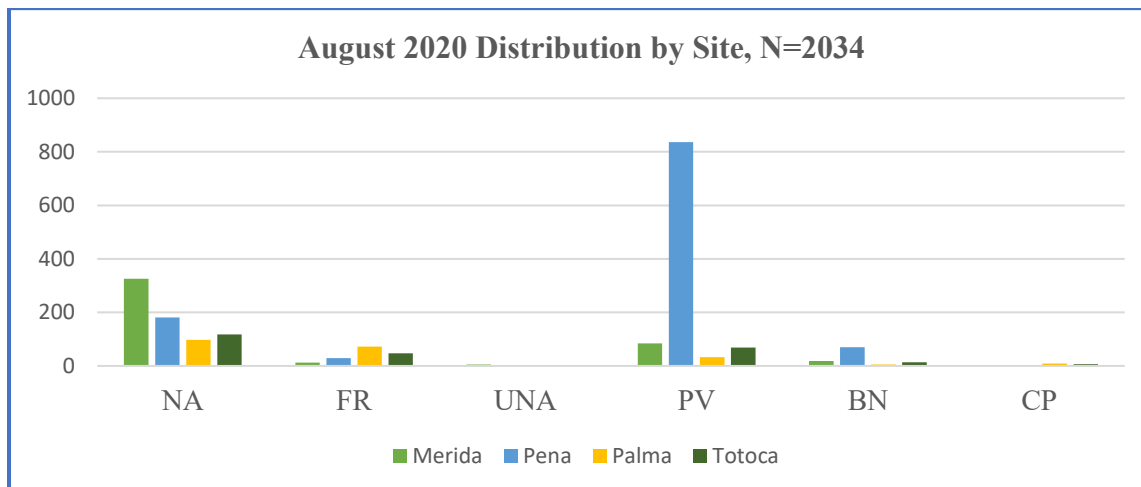


Figure 2020-3: Relative density of all species counted July 2020

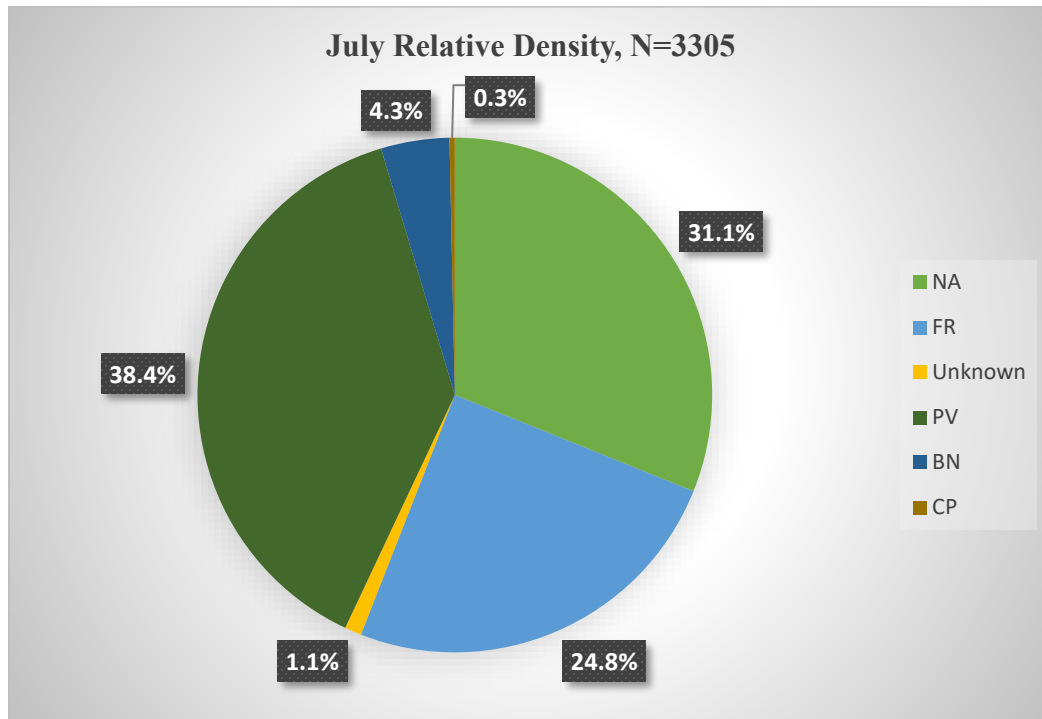


Figure 2020-4: Relative density of all species counted August 2020

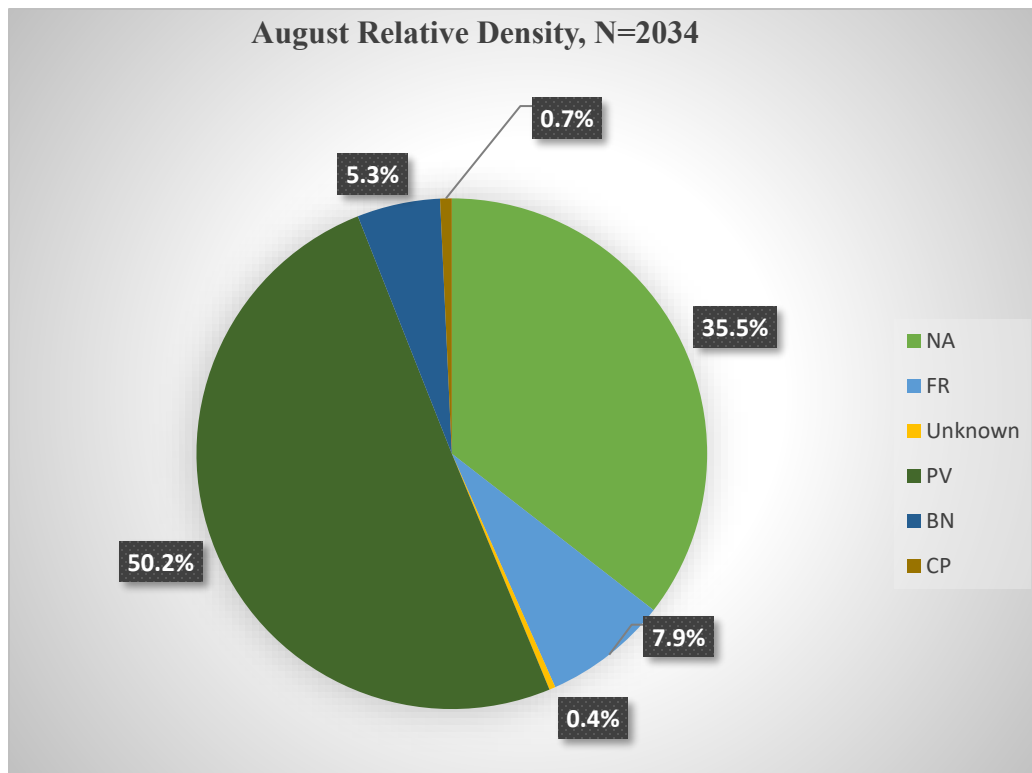


Figure 2020-5: Total individuals counted by site in July and August

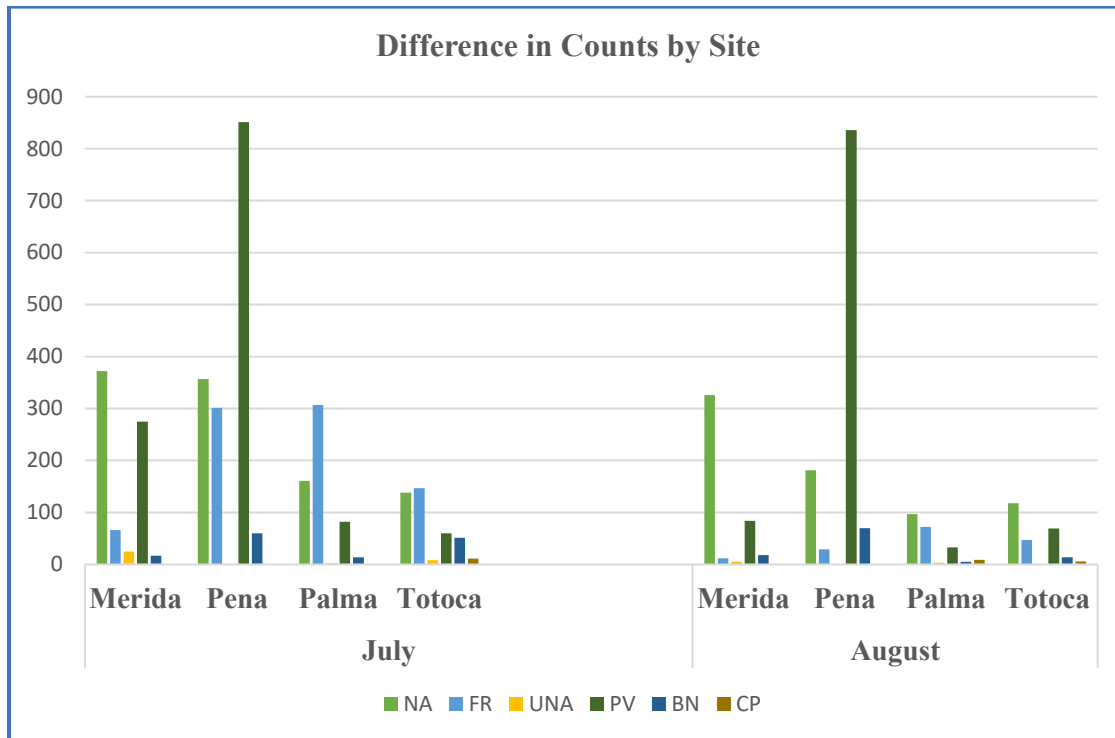


Figure 2020-6: Distribution of yellow-naped amazon groups in July 2020

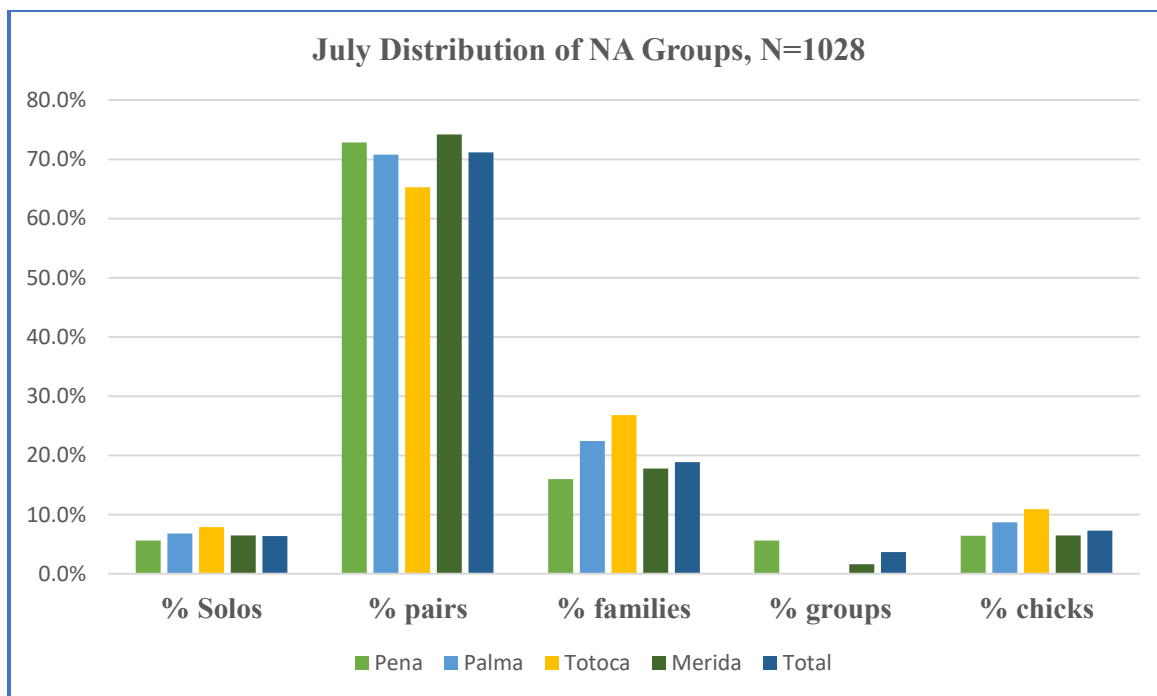


Figure 2020-7: Distribution of yellow-naped amazon groups in August 2020

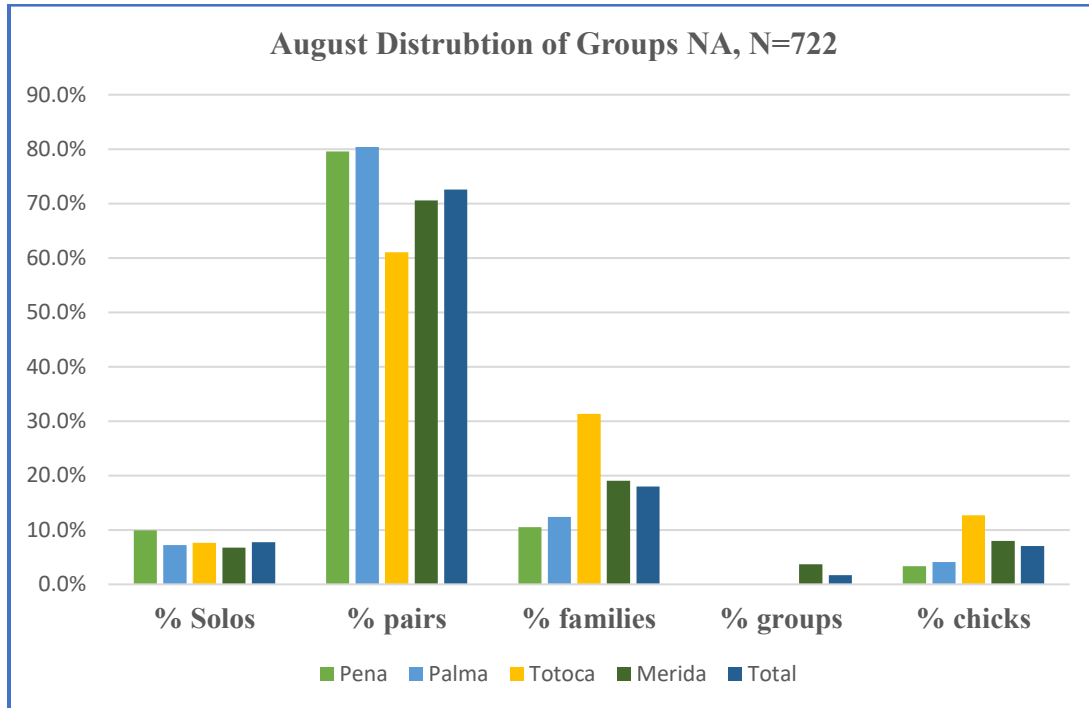


Figure 2020-8: Combined July and August counts of yellow-naped amazons and their distribution of group (N=1750)

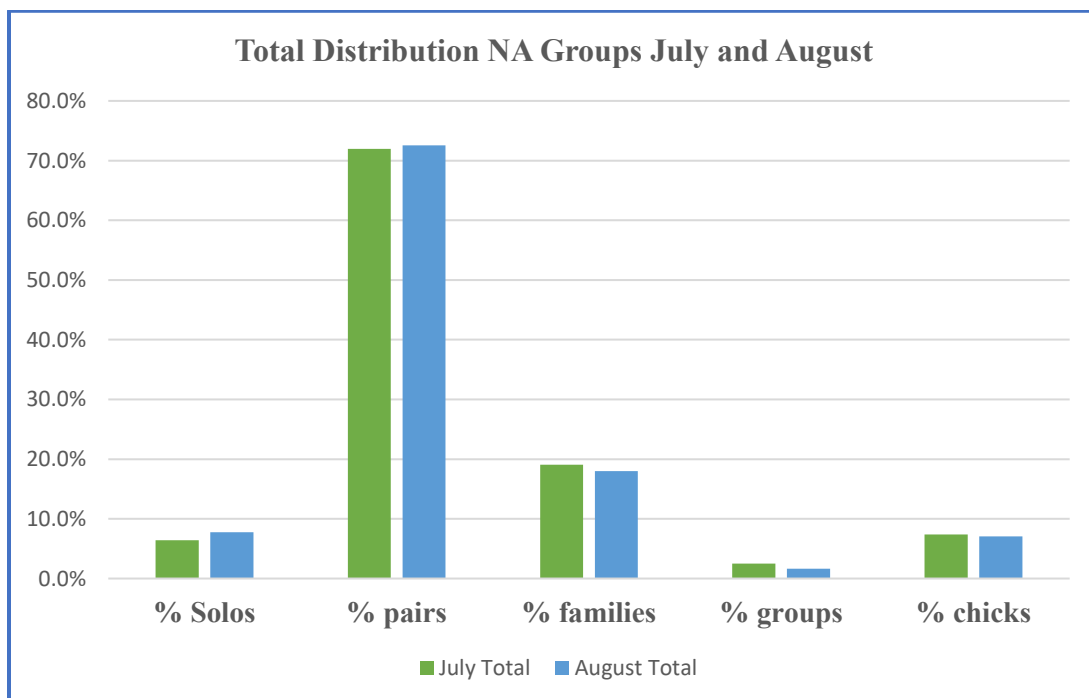


Figure 2020-9: Distribution of red-lored amazon groups in July 2020 (N=1268)

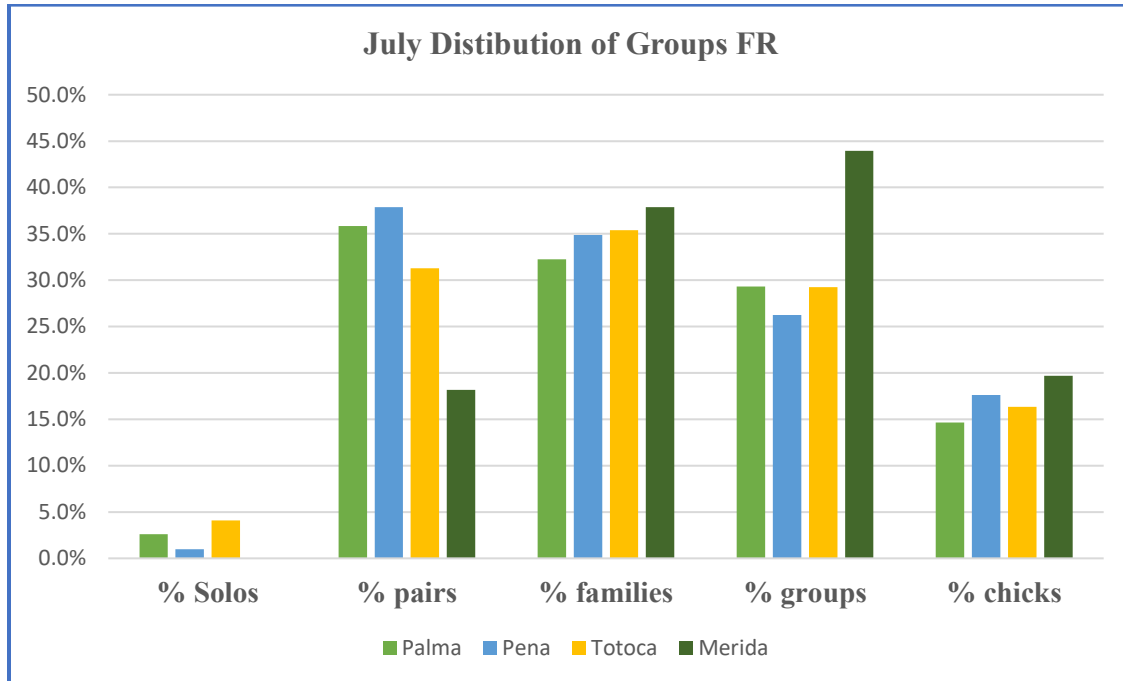


Figure 2020-10: Distribution of red-lored amazon groups in August 2020 (N=160)

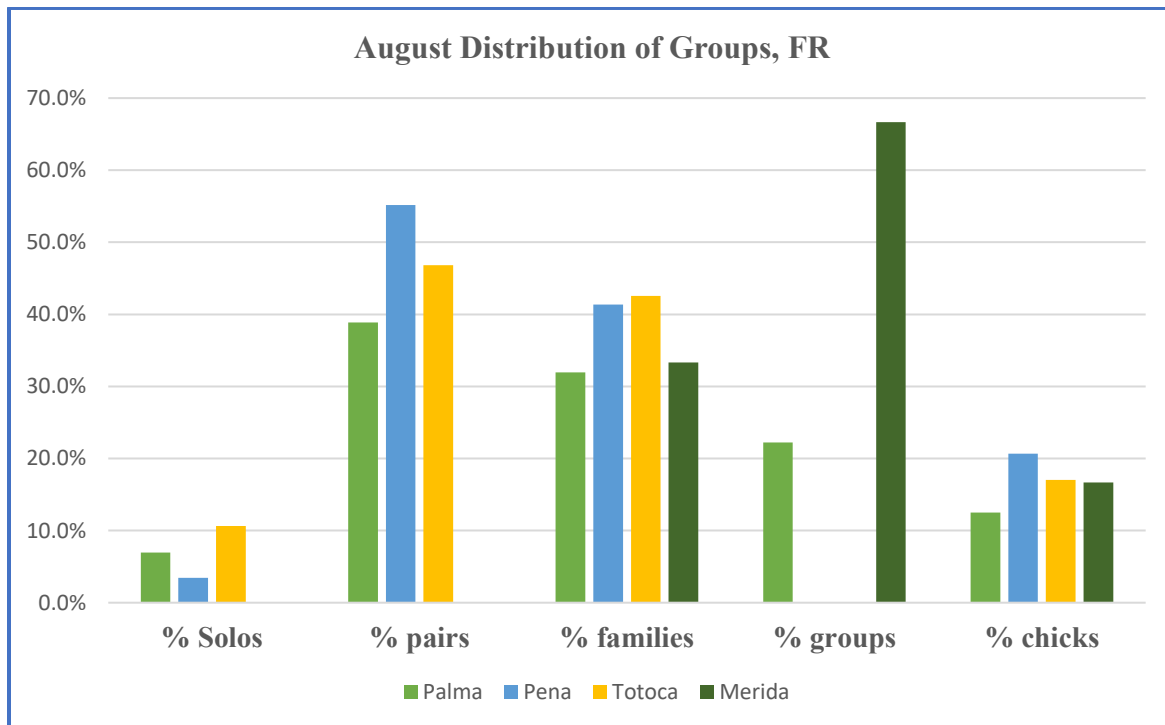


Figure 2020-11: Combined July and August counts of red-lored amazons and their distribution of group (N=981)

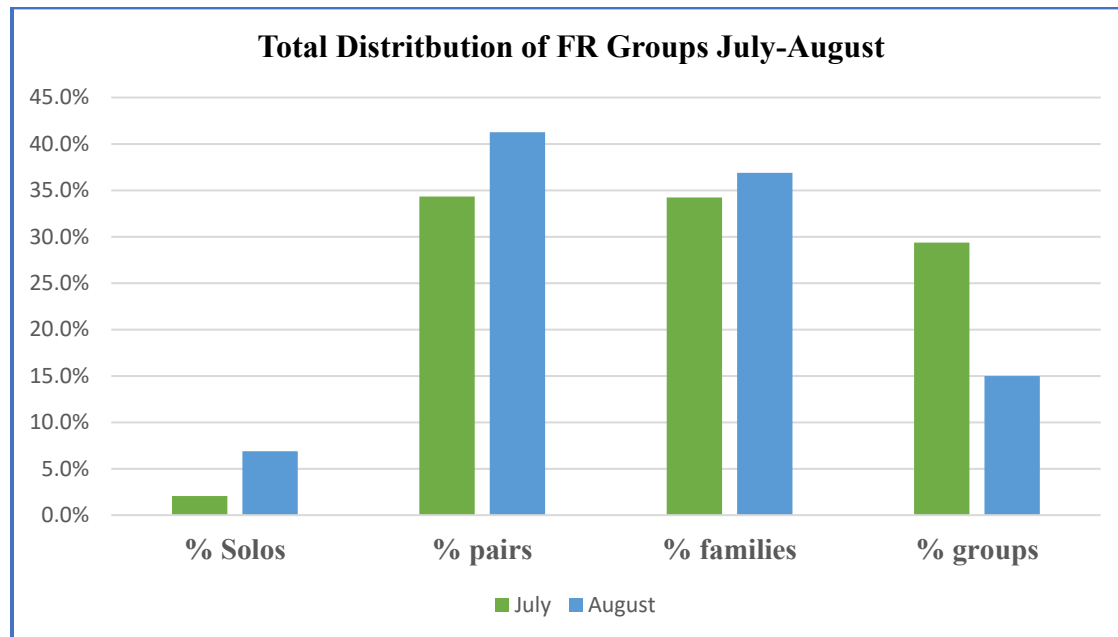


Figure 2020-12: Percentage of chicks in all amazons, combined July (N=219) and August 2020 (N=80)

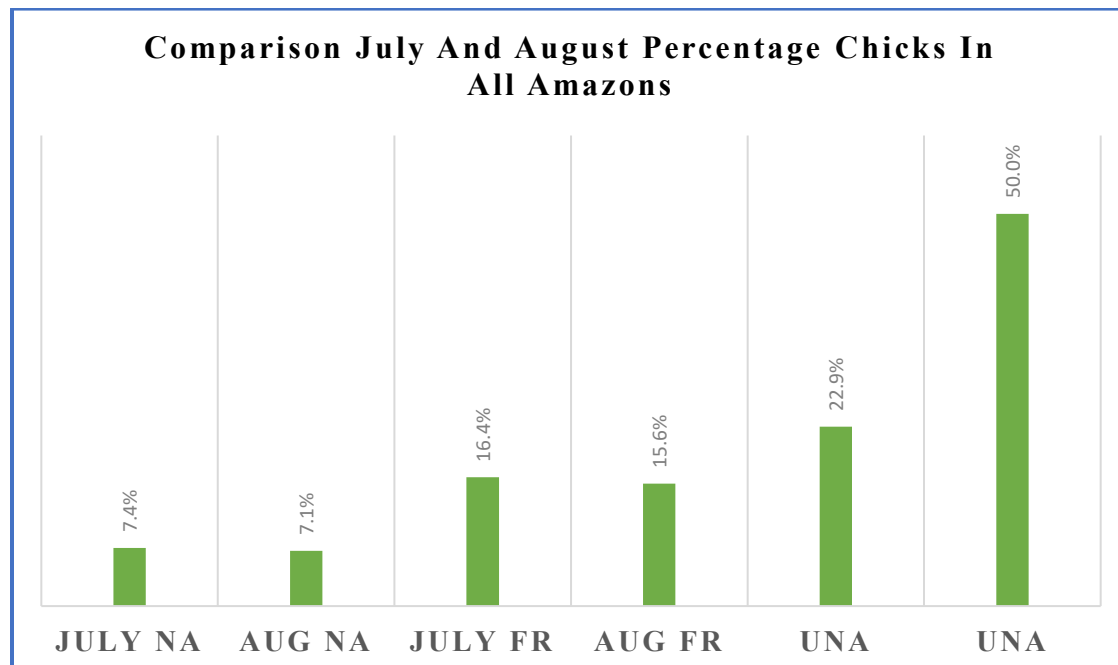


Figure 2020-13: Distribution of Pacific parakeet, orange-chinned parakeet, and orange-fronted parakeet groups in August 2020 (N=1421 – PV=1268, BN=142, CP=11)

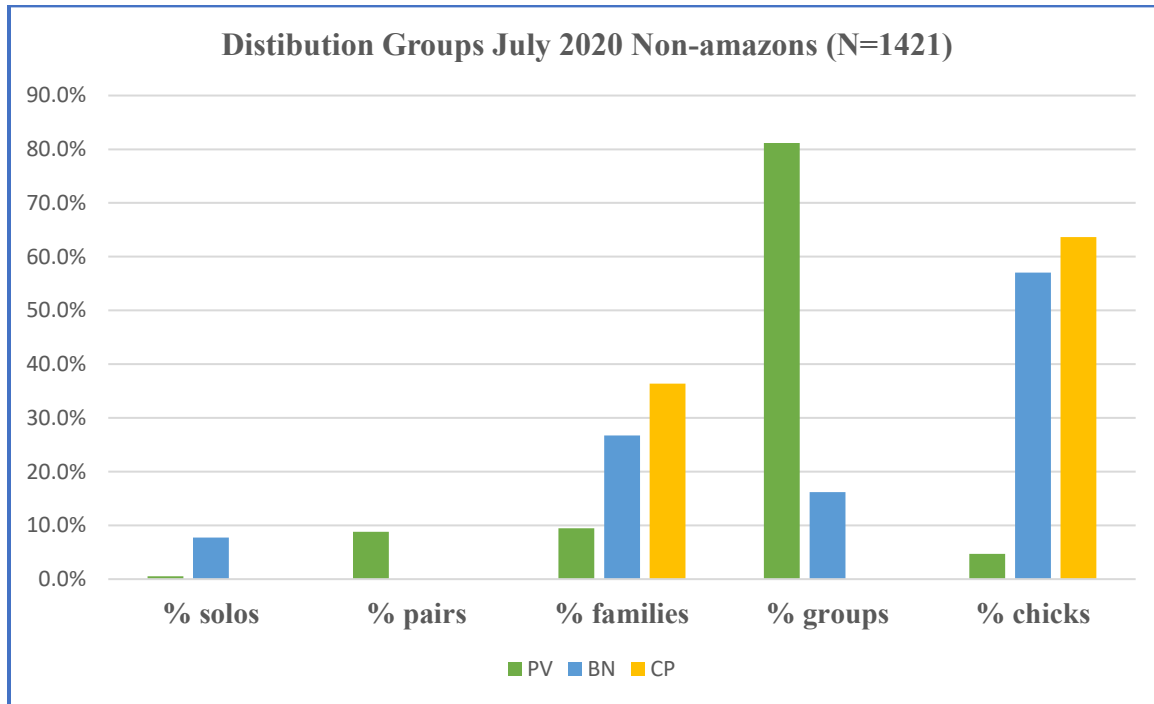


Figure 2020-14: Distribution of Pacific parakeet, orange-chinned parakeet, and orange-fronted parakeet groups in August 2020 (N=1141 – PV=1022, BN=107, CP=15)

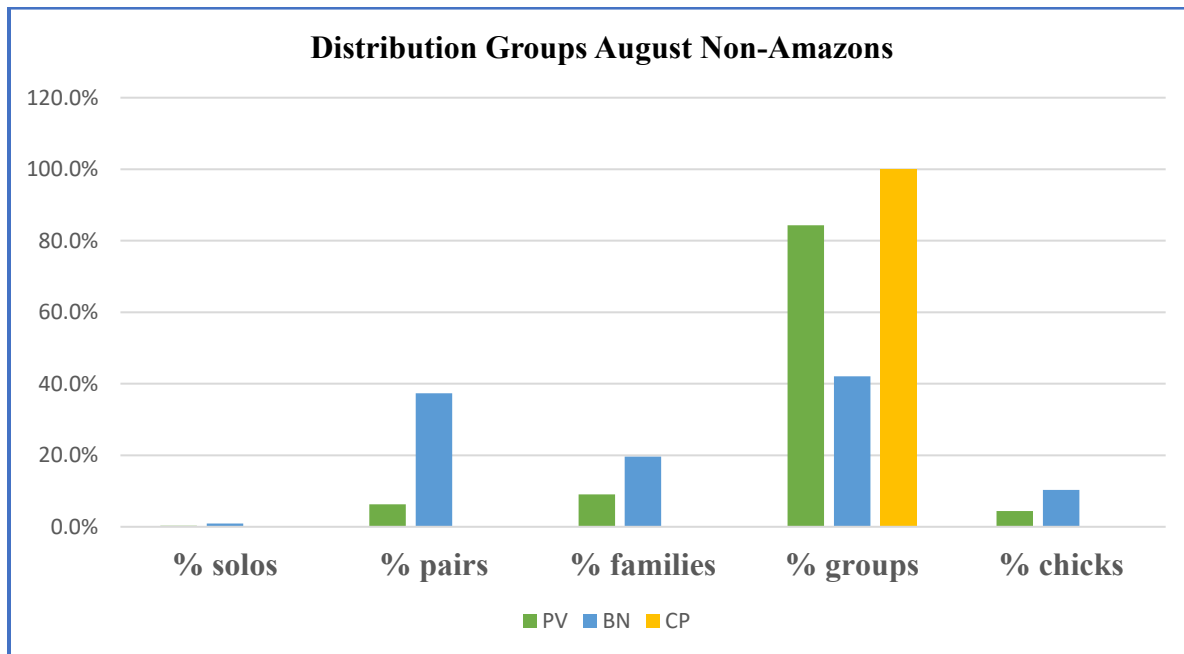


Table 2020-1: Total numbers of individuals counted in the Peña transect over three days in July 2020

	NA	FR	UNA	PV	BN	CP	Total
18-Jul	508	153	0	1090	180	0	1931
23-Jul	357	301	0	851	60	0	1569
24-Jul	350	215	2	661	29	8	1265

Figure 2020-15: Total individuals counted in the Peña transect during 3 different days of counting July 2020

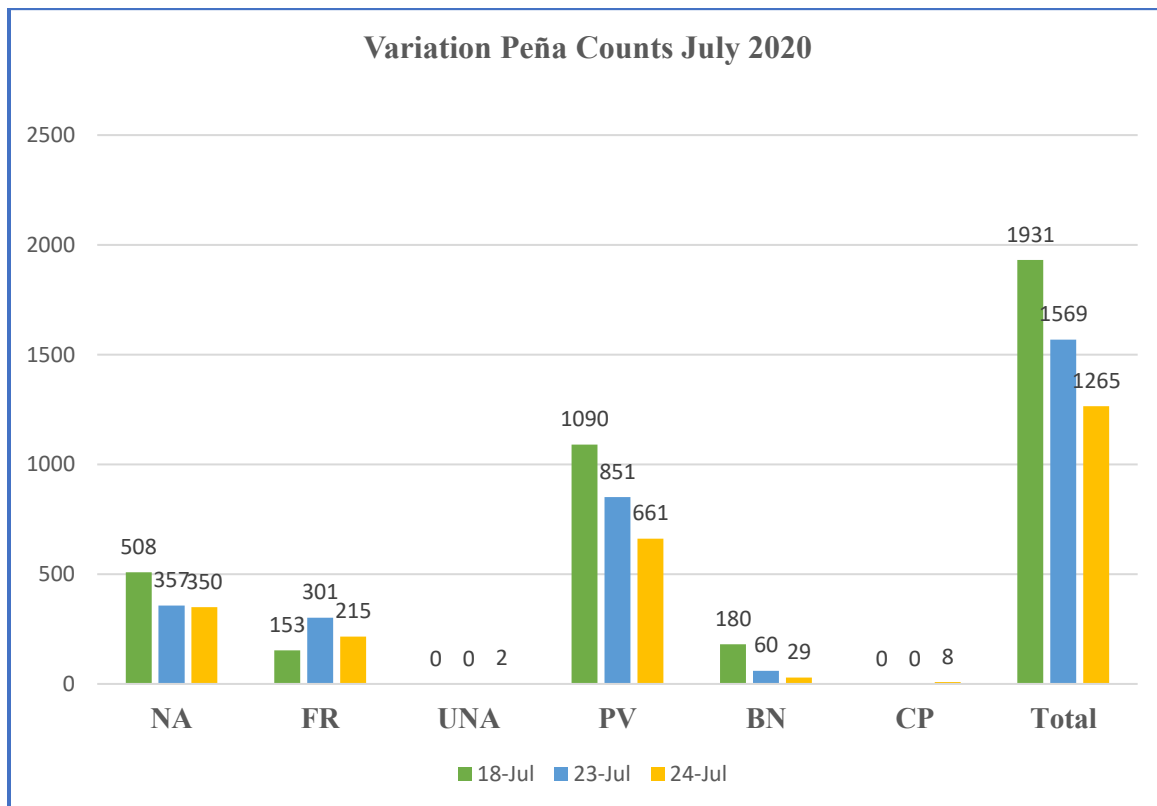


Table 2020-2: Species possibly double counted by estimating if they could be shared between other transects

	NA Share	FR Share	PV Share	BN Share
Merida July	0	0	0	0
Merida August	24	0	22	0
Totoco July	0	0	0	0
Totoco August	12	17	60	2
Peña July	27	0	0	0
Peña August	0	0	0	0
Palma July	0	0	40	0
Palma August	0	0	2	0
Total Shared July	27	0	40	0
Total Shared August	36	17	84	2
Original Total July	1028	821	1268	142
Original Total August	722	160	1022	107
Adjusted Total July	1001	821	1228	142
Adjusted Total August	686	143	938	105
Percentage Shared July	2.6%	0.0%	3.2%	0.0%
Percentage Shared August	5.0%	10.6%	8.2%	1.9%

Discussion 2020 Results

In July, we set out to count each transect 2-3 times to assess variability within a week's time. We did not count all the transects at once as we did in 2019. Some of the counts were conducted by mistake (off by 30 minutes), and we also used a different way of removing duplicates between points; thus, we discarded these counts and had to extend our counting dates later than the second week of July as planned. We did not include them in this summary. Counts that were kept for this summary were Merida on July 22 and August 8, Totoco on July 25 and August 26, Peña on July 23 and August 27, and Palma July 20 and August 27. For Peña, however, we have 3 counts in July where we can look for variability within a week's time (July 18, 23, and 24). We conducted counts in August to see how these might compare to the July counts.

In July and in August, we had 35 individual amazons that we could not identify (Table 2020-8). These numbers are included in the total amazon tables.

Total numbers and relative density are described in the tables listed in the appendix and the preceding figures. Data is arranged to show total numbers, relative density, group size distribution, differences between sites, difference between days in July, and differences between July and August counts. We highlight the following observations.

Merida consistently had more yellow-naped amazons than the other three transects in both July and August (Figures 2020-1, 2020-2). As before, the Pacific parakeets are concentrated in

Peña where there is a large roost site. We still found a higher percentage of chicks in red-lored amazons (16.4% and 15.6%) than in yellow-naped amazons (7.4% and 7.1%), which was more than double (Tables 2020-2, 3, 4, 5). We suspect this might be because the yellow-naped amazons are selectively poached as they are perceived as being more desirable pets. There might be other reasons including differences in foraging and roosting patterns, as well as flocking behavior.

There were differences between the July and August counts (Table 2020-3, Figure 2020-5). There were significantly fewer amazons, Pacific parakeets, and orange-chinned parakeets in August compared to July. We don't know where the birds went between July and August as the decrease in number was not correlated with any increases in other sites in August. In other words, we could not detect that birds moved from one transect to another. The relative densities also shifted with there being a larger percentage of Pacific parakeets in August (50.2%) compared to amazons (43.8%), then in July (38.4% to 57.0%) – (Figures 2020 3, 4). Although there were fewer individuals of nearly all the species, the biggest changes was in amazon parrots. The three days we counted in Peña in July (Table 2020-1) showed a decrease in the numbers of individuals counted, mostly due to a drop of yellow-naped amazons and Pacific parakeets for unknown reasons.

Group distribution between the two months were similar, though there were slightly fewer amazon chicks in August as a percentage of the population (Figure 2020-12)

Any birds that possibly moved between transects are shown in Table 2020-2. These transects were not counted on the same night so we can't be sure that flight patterns were the same from one day to the next. The numbers of birds moving between transects indicated for those particular nights counted what percentage of the birds could have been double counted. In July and August, 2.6% and 5.0% yellow-naped amazons could have moved between transects, 0% and 10.6% red-loreds, 3.2% and 8.2% Pacific parakeets, and 0 and 1.9% orange-chinned parakeets (Table 2020-2). In 2018, fourteen transects were counted, so there was a greater probability of sharing between transects because the Palma transect was bordered by two other transects not counted in 2019 and 2020, (Corazol and Tichina); this was the same case for Peña (Los Ramos and Pul) (Figure Methodology – 1). Indeed, we did document more possible sharing in 2018: 39 of 1971 (1.97%) for yellow-napes, 37 of 829 (4.51%) for red-loreds and 1238 of 4066 (30.44%) for Pacific parakeets. The high percentage of Pacific parakeets shared was because Los Ramos and the general area of the south side of volcano Concepción near Peña fed into the Peña Pacific parakeet roost site. We did not observe any orange-chinned parakeets crossing to other transects in 2018, although there was less attention placed on this species' movements between transects when compared to 2019 and 2020. These results support our theory that there is not much sharing between transects, especially between our four conservation areas. In 2019, we counted all the transects on the same night and were able to more clearly see what birds moved between transects. In this year, no Pacific parakeets or orange-chinned parakeets moved between these four transects. In 2019, for red-lored amazons, only 20 of 604 (3.3%) moved between transects during one count, with 0% on another day's count. For yellow-naped amazons, 4 of 863 (.46%) and 9 of 871 (1.03%) were shared. These results also suggest that for the four sites both in 2019 (when we counted all transects on the same night) and 2020 (when we did not), we tended to overestimate the amount of possible sharing of birds. This fits

with our goal of seeking to determine the MNDI because we would rather underestimate the number of birds. Clearly repeated counts to obtain precision is needed to conclude if this tendency is to prove true.

Trends Results

In this section, we did some slight data tabulation and further rearrangements so we could compare the years. To compare the group distribution of amazons and compare Peña counts to all other years, we had to remove the two extra points of the six-point count that year. We compared four-point Peña counts with numbers and group distribution of all amazons because in 2014 we did not separate yellow-naped from red-lored when tabulating group distribution (Table Trends-2). Starting in 2015, we compared four-point Peña counts with numbers and group distribution of each species (Table Trends-3).

We tabulated total numbers of birds over the seven years and their relative density 2015-2020. Because we did not count non-amazon species in 2014, we could not use that year's data to look at relative density in comparison to other years.

Our comparisons included looking at our four conservation areas year by year according to numbers, relative density, and group distribution; we compared years as well as sites. We also broke down numbers and group distribution by lumping all amazons together (yellow-naped, red-lored, and unknowns), so we could include the 2014 data.

We took a careful look at chick percentage to see if it could tell us anything about the success of our nest protection program or if nest success rate had altered over the years.

Finally, we arranged the data with more details about group size. Previously, we reported groups as those with six or more birds. In this trend section, we listed the exact numbers of each group size (Table Trends-12). We did this so we could see if there were any trends in group size across all species starting in 2015.

Figure Trends-1: Relative density for all birds counted 2015-2020. 2014 omitted because only amazons were counted (N=19022)

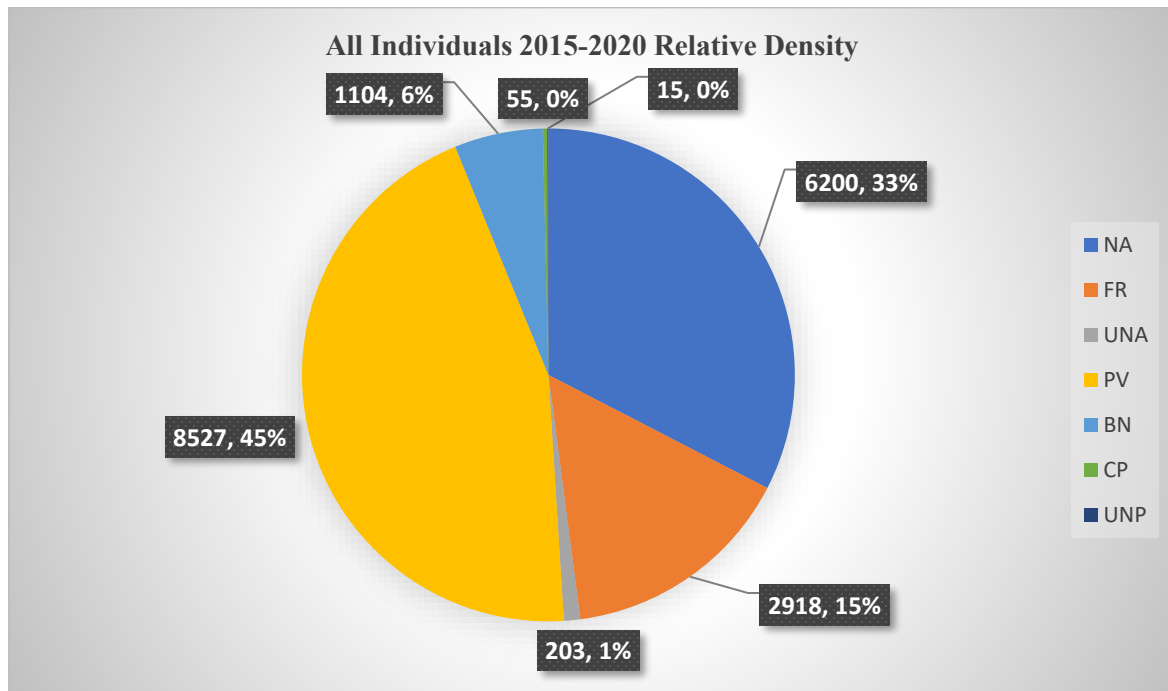


Figure Trends-2: Total species counted in four main conservation areas 2018-2020

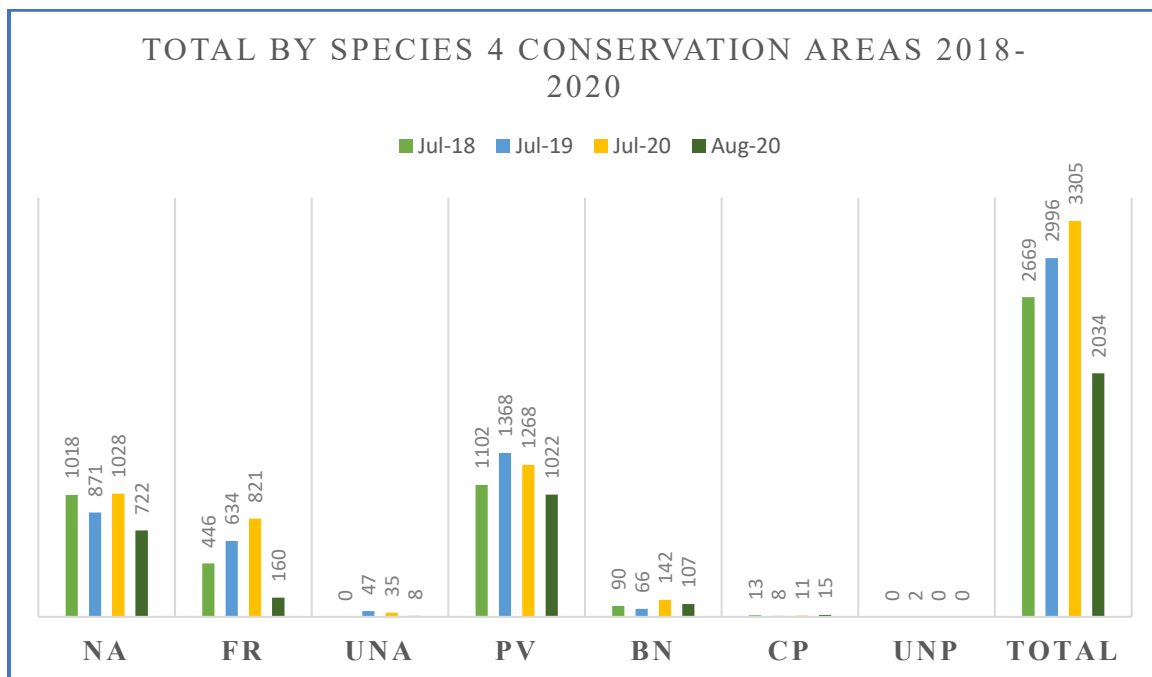


Figure Trends-3: Relative density of all four conservation areas combined compare by year

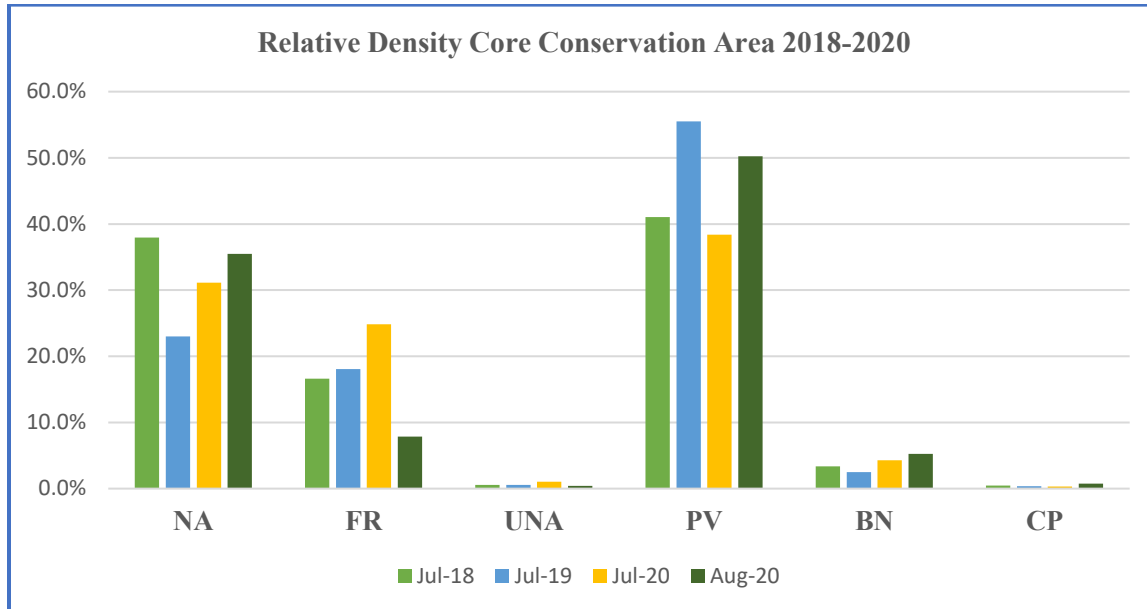


Figure Trends-4: Relative density of all species counted in Merida compared by year from May 2015-August 2020

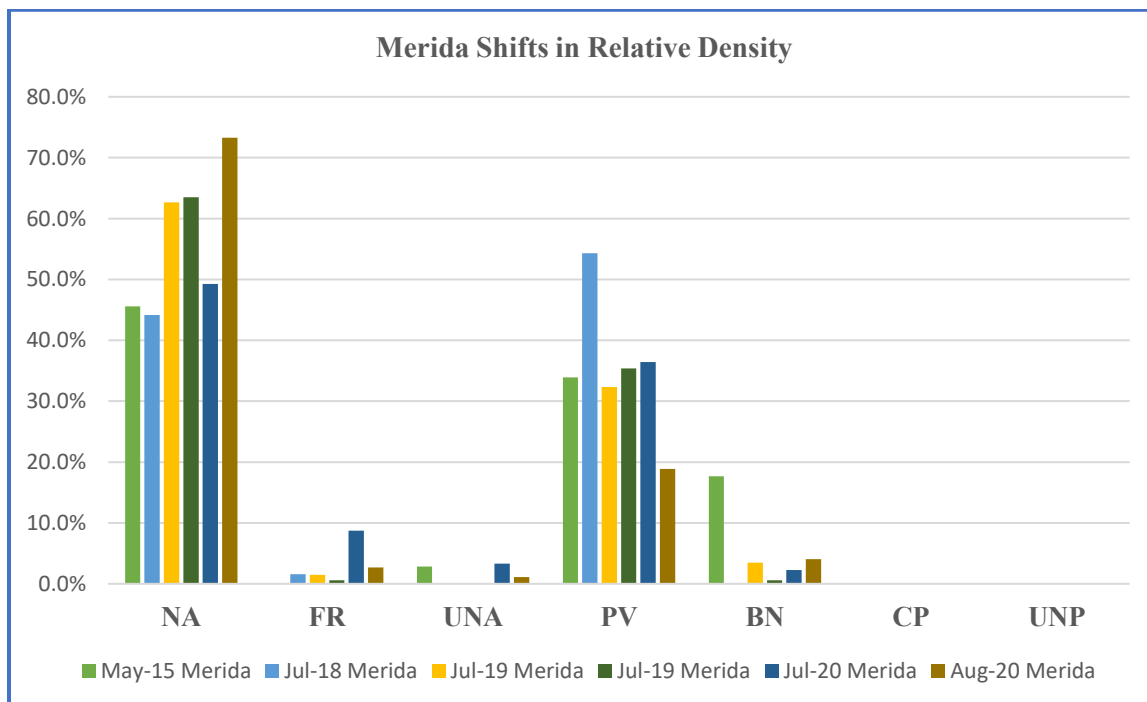


Figure Trends-5: Relative density of all species counted in Palma compared by year from July 2018 - August 2020

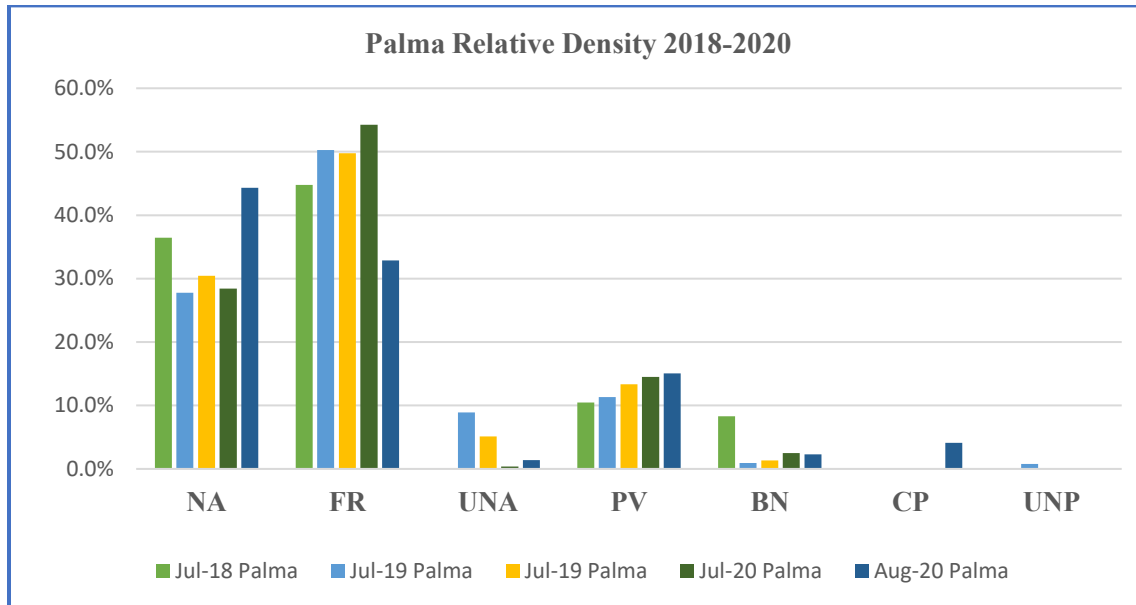


Figure Trends-6: Relative density of all species counted in Peña compared by year from May 2015 - August 2020

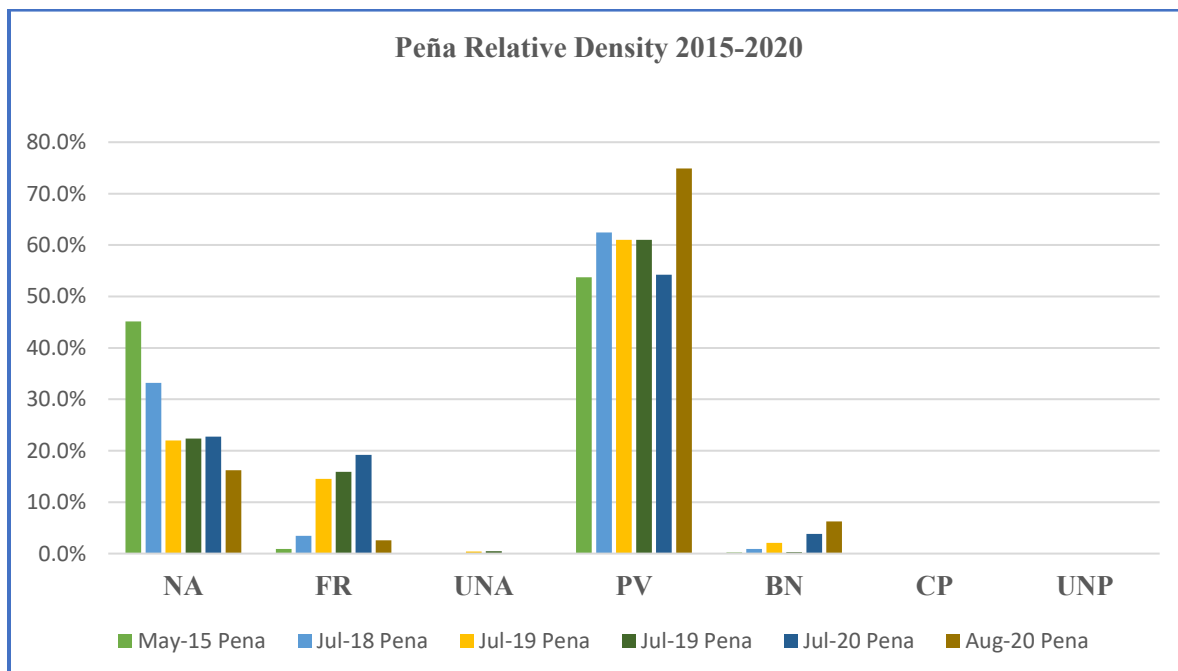


Figure Trends-7: Relative density of all species counted in Totoco compared by year from May 2015 - August 2020

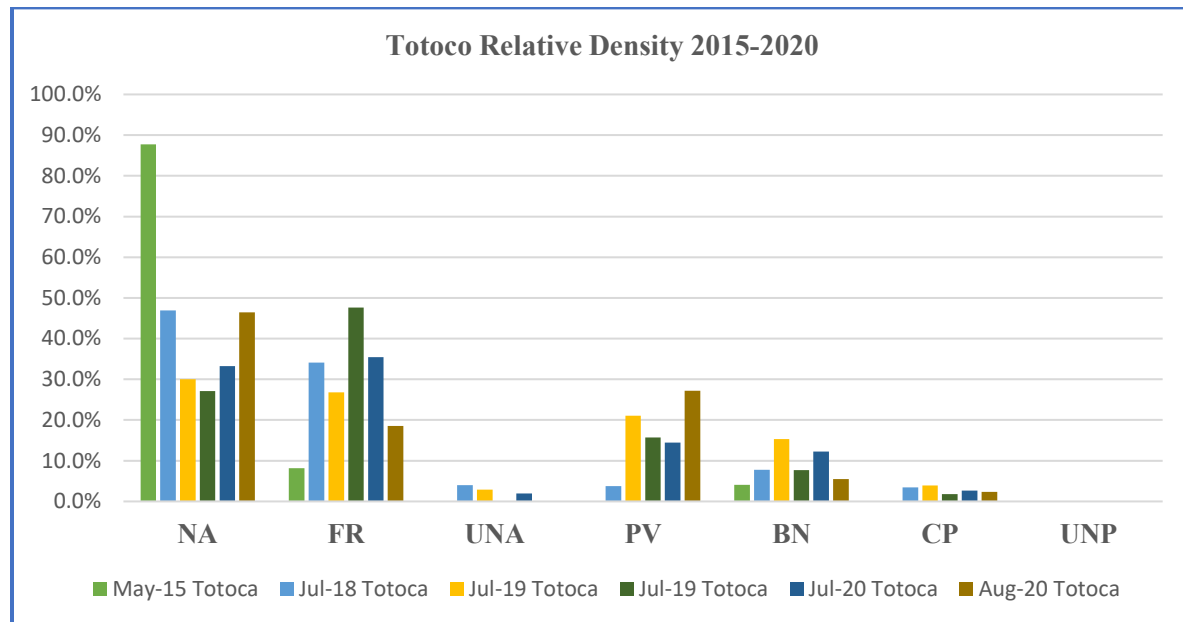


Figure Trends-8: Numbers of yellow-naped and red-lored amazons counted in four areas April 2014 – August 2020

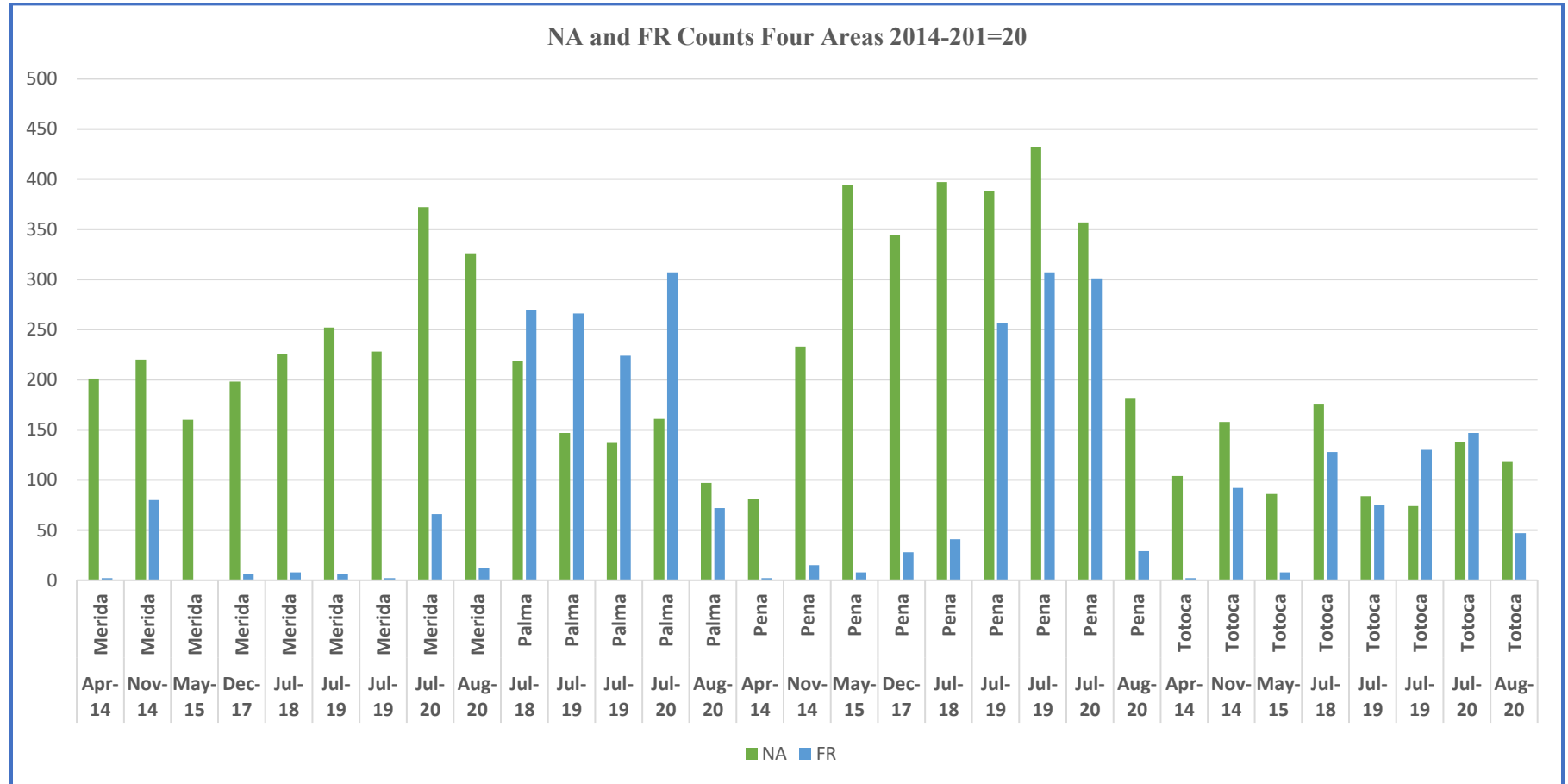


Figure Trends-9: Group distribution of all amazons April 2014-August 2020

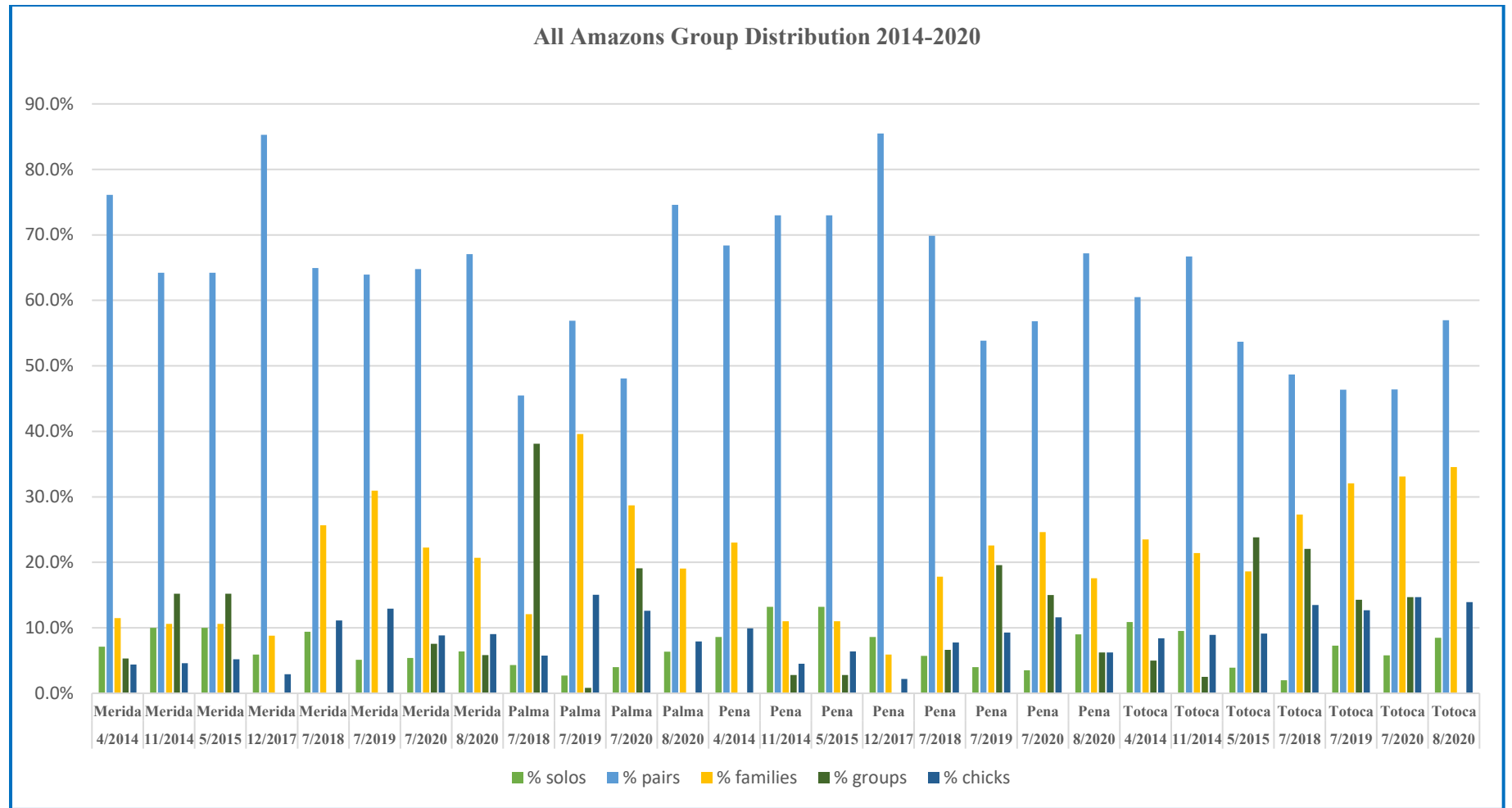


Figure Trends-10: Percentage of yellow-naped amazon chicks in four conservation areas 2018-2020 -each point corresponds to one of the areas in that particular year in July

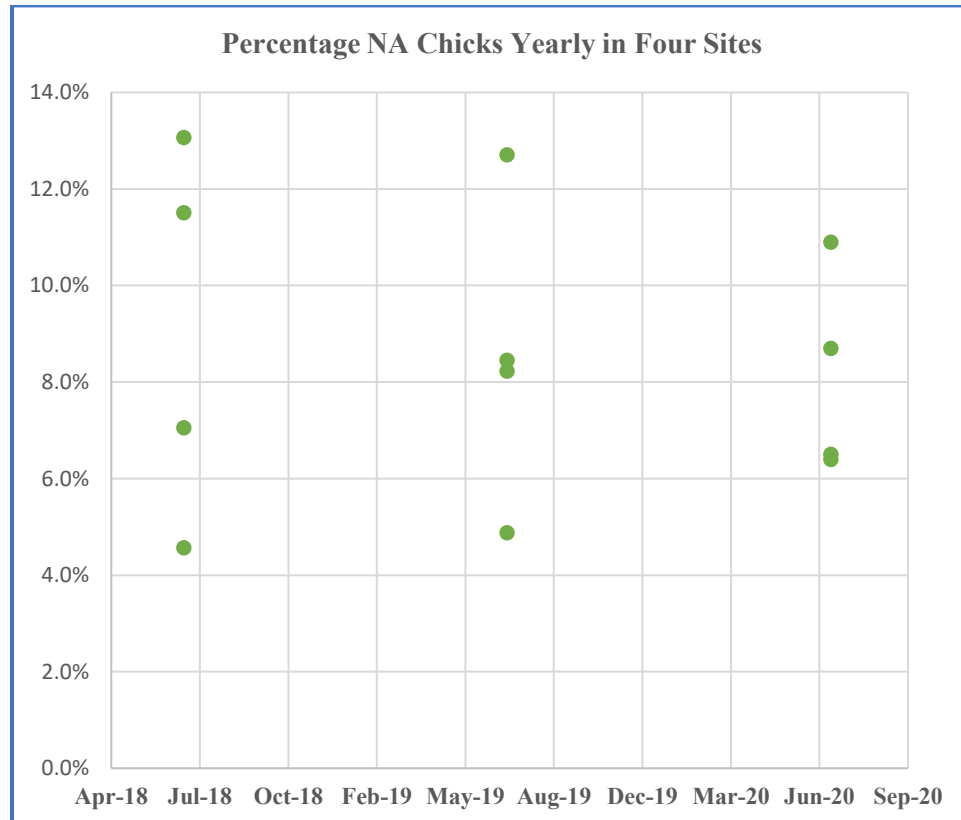


Figure Trends-11: Percentage of yellow-naped amazon chicks each year by each of the four sites

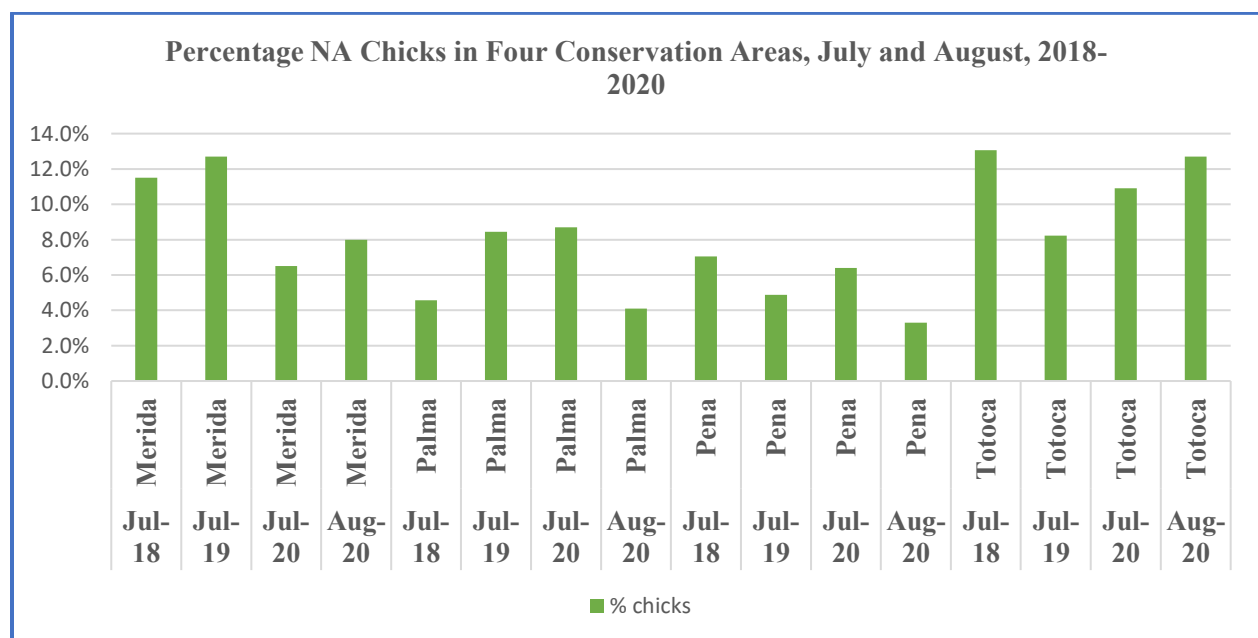


Figure Trends-12: Percentage of red-lored amazon chicks in four conservation areas 2018-2020
-each point corresponds to one of the areas in that particular year in July

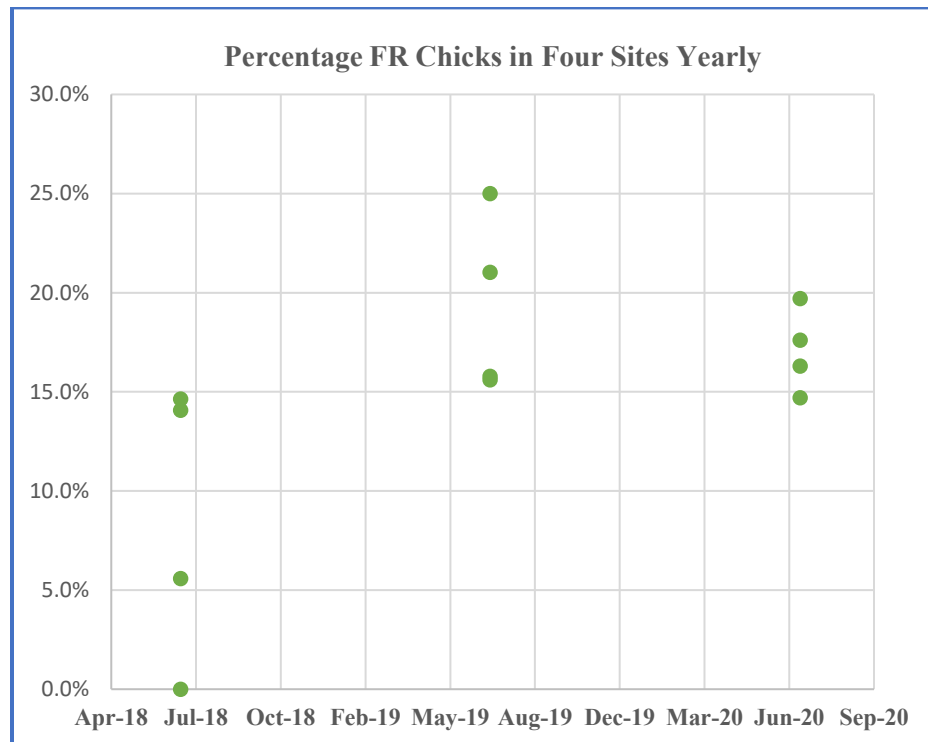


Figure Trends-13. Percentage of red-lored amazon chicks each year by each of the four sites

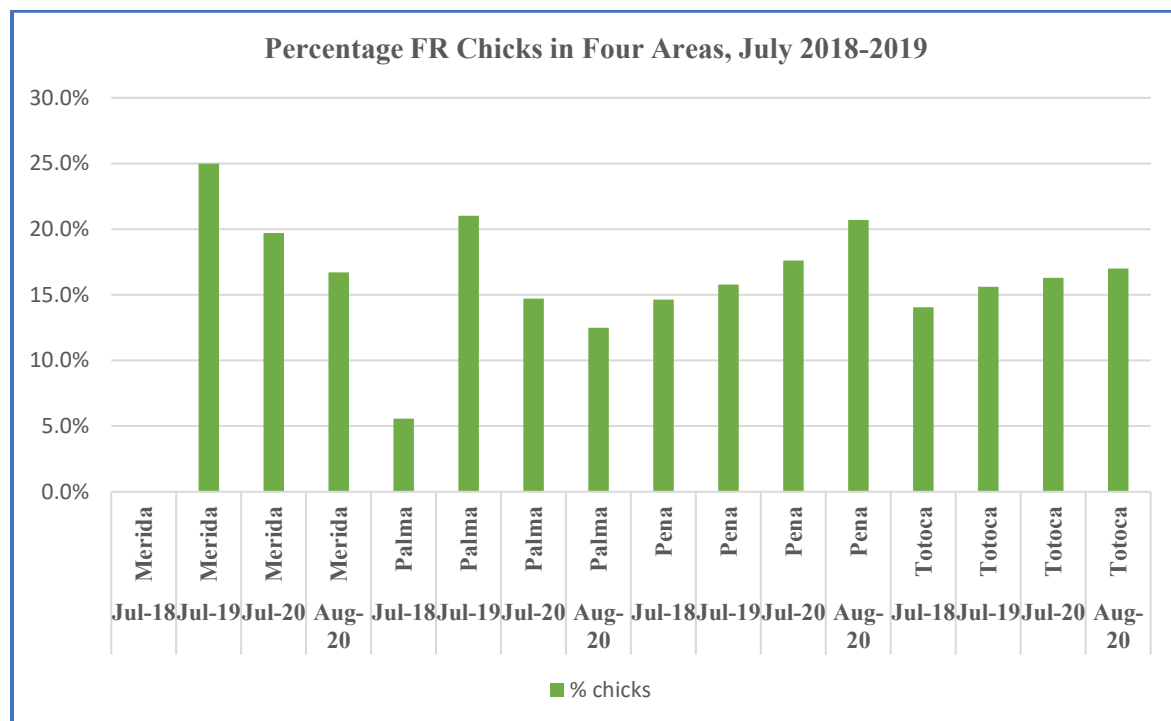


Figure Trends-14. Percentage of chicks in all amazons at each of the four sites 2015-2020

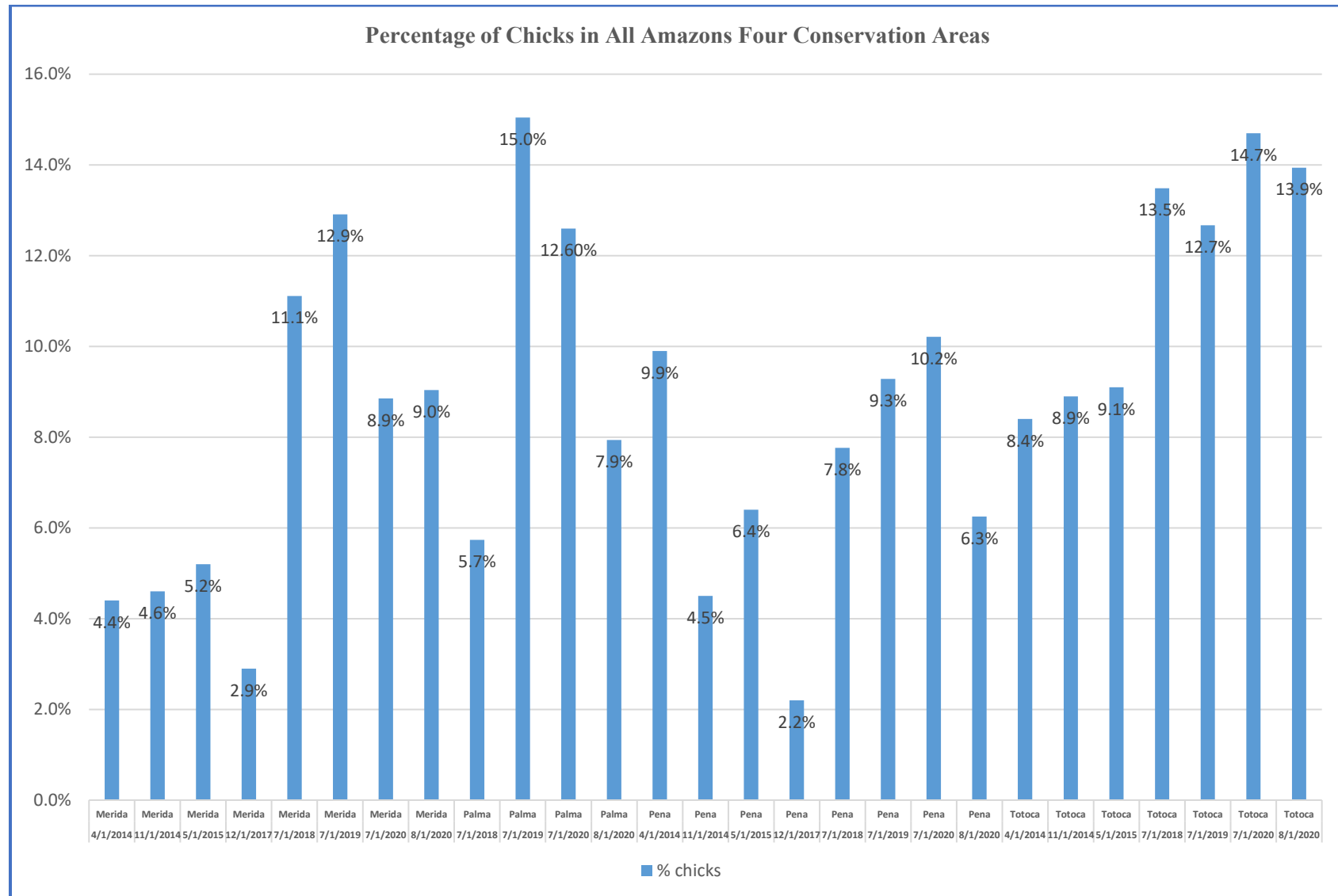


Table Trends-1. Percentage of yellow-naped and red-lored chicks 2018-2020 in four conservation areas

NA		FR	
Date	% chicks	Date	% chicks
Jul-18	11.5%	Jul-18	0.0%
Jul-18	4.6%	Jul-18	5.6%
Jul-18	7.1%	Jul-18	14.6%
Jul-18	13.1%	Jul-18	14.1%
Average	9.0%	Average	8.6%
STD	3.9%	STD	7.1%
Jul-19	12.7%	Jul-19	25.0%
Jul-19	8.5%	Jul-19	21.0%
Jul-19	4.9%	Jul-19	15.8%
Jul-19	8.2%	Jul-19	15.6%
Average	8.6%	Average	19.4%
STD	3.2%	STD	4.5%
Jul-20	6.5%	Jul-20	19.7%
Jul-20	8.7%	Jul-20	14.7%
Jul-20	6.4%	Jul-20	17.6%
Jul-20	10.9%	Jul-20	16.3%
Average	8.1%	Average	17.1%
STD	2.1%	STD	2.1%
Aug-20	8.0%	Aug-20	16.7%
Aug-20	4.1%	Aug-20	12.5%
Aug-20	3.3%	Aug-20	20.7%
Aug-20	12.7%	Aug-20	17.0%
Average	7.0%	Average	16.7%
STD	4.3%	STD	3.4%

Figure Trends-15: Group Distribution of yellow-naped amazons four areas 2018-2020

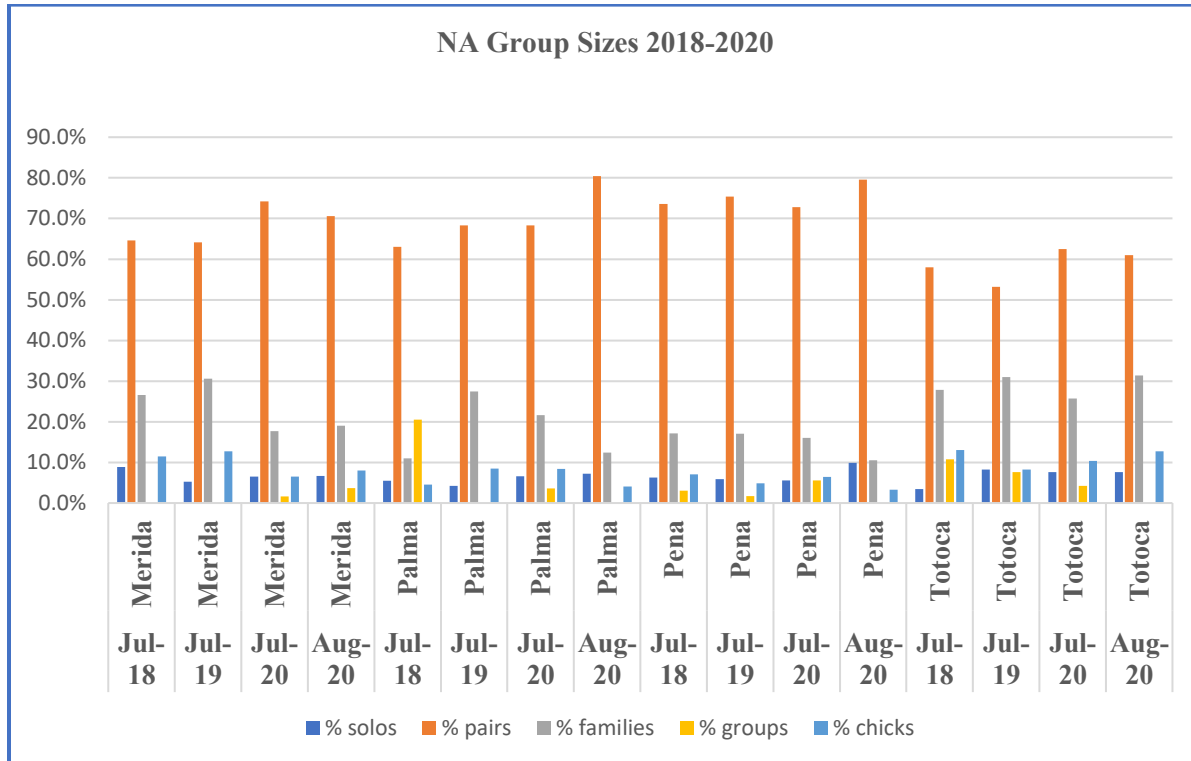


Figure Trends-16. Group distribution of red-lored amazons four areas 2018-2020

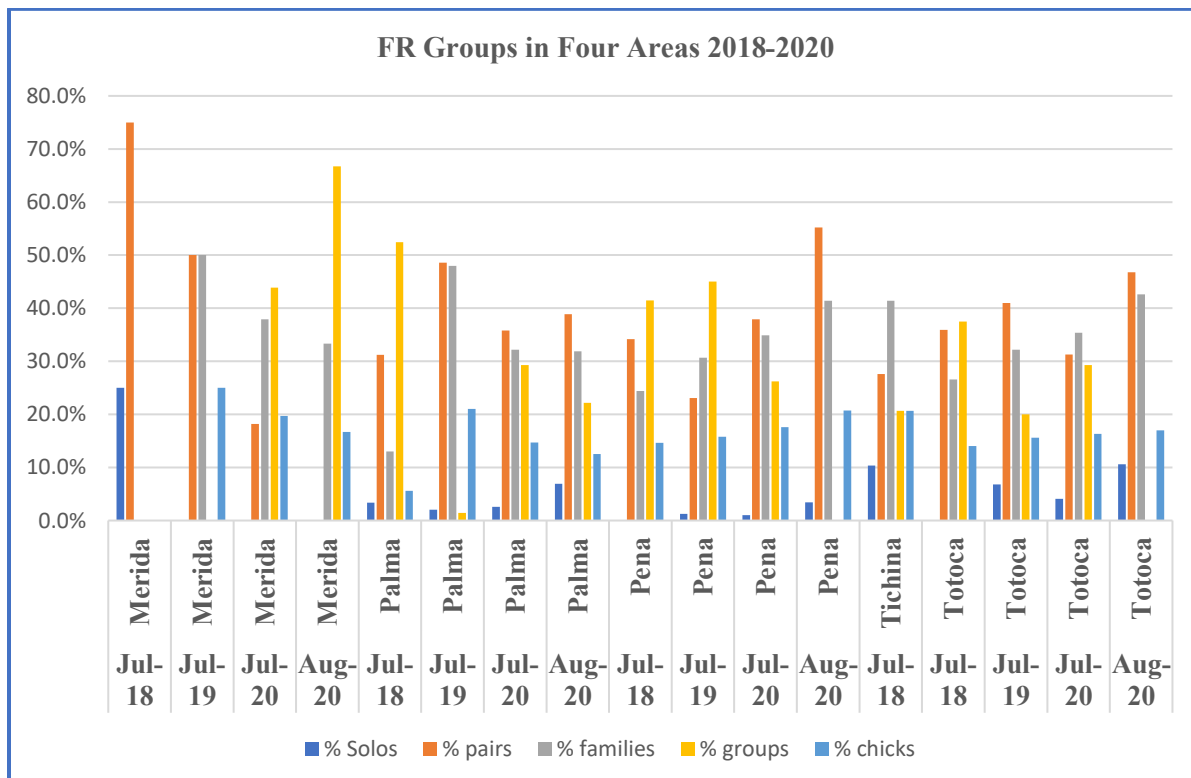


Figure Trends-17: Group distribution (all species) July 2018 14 sites

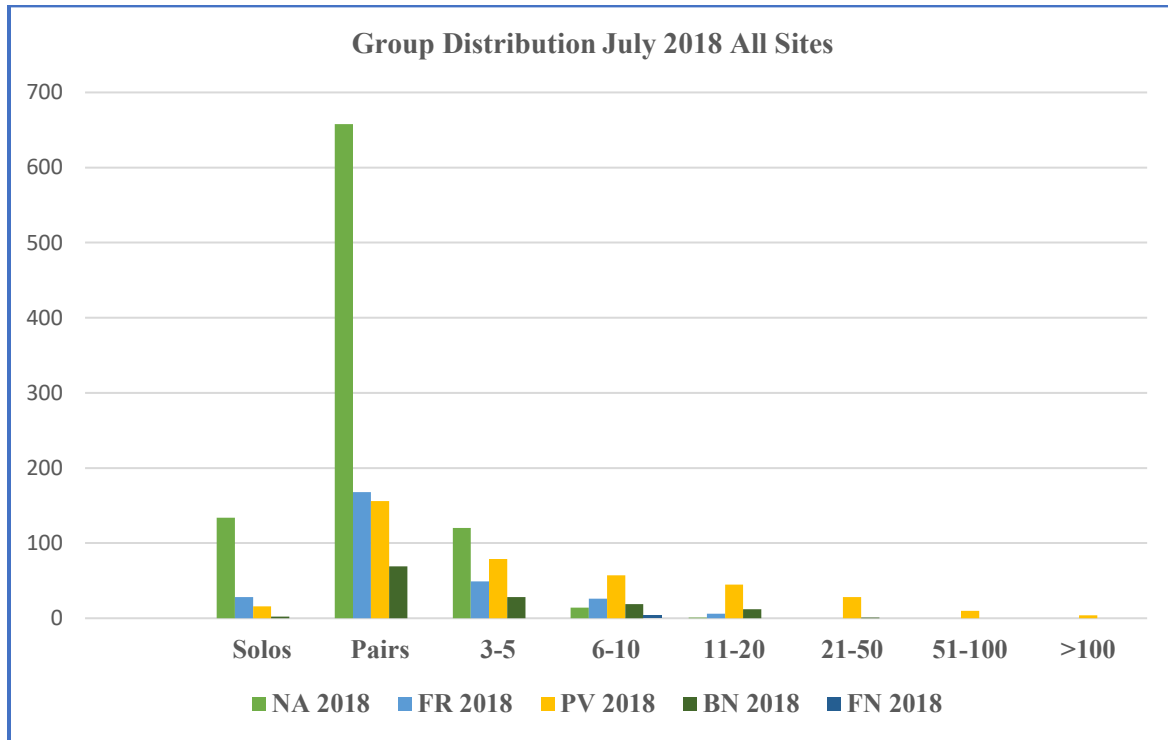


Figure Trends-18: Group distribution (all species) July 2018 four conservation areas

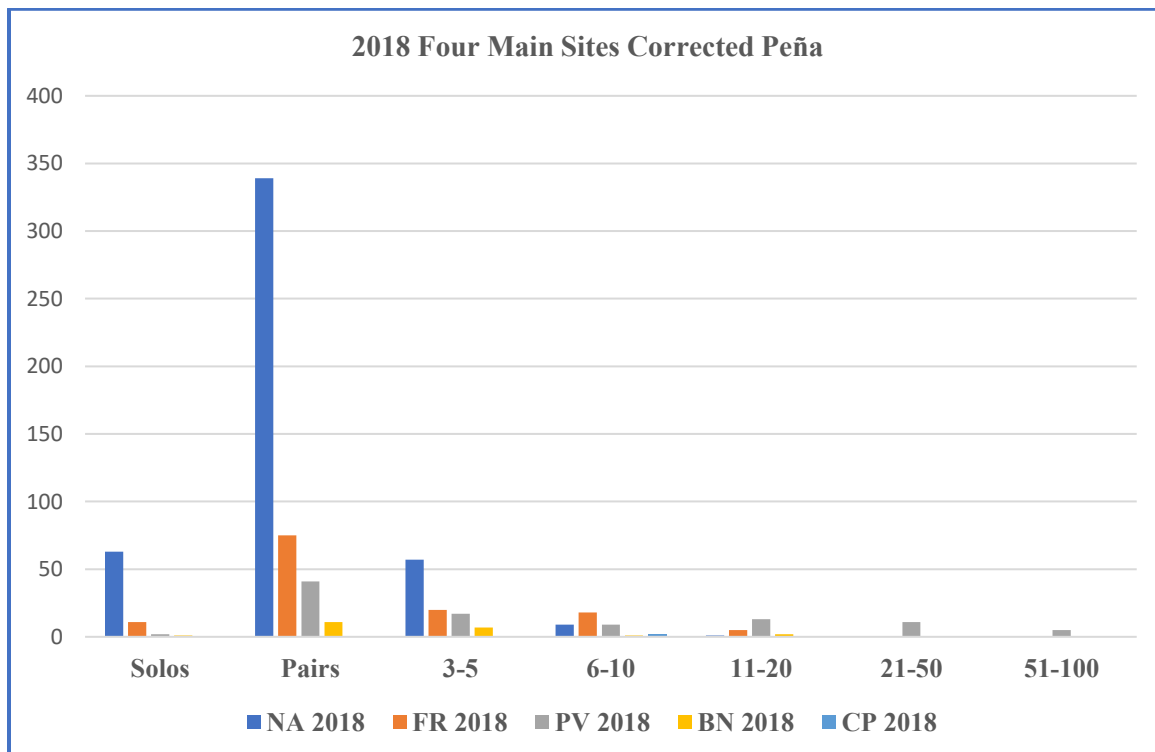


Figure Trends-19: Group distribution (all species) July 2019 four conservation areas (average two counts per site)

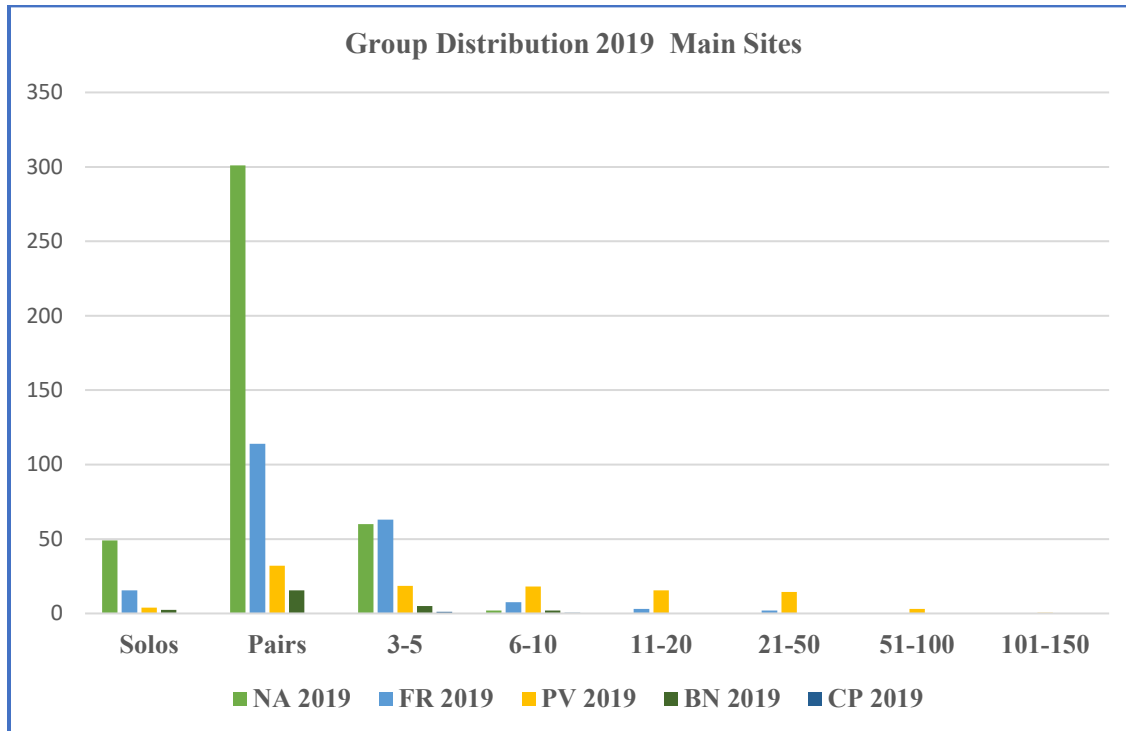


Figure Trends-20: Group distribution (all species) July 2020 four conservation areas (average two counts per site)

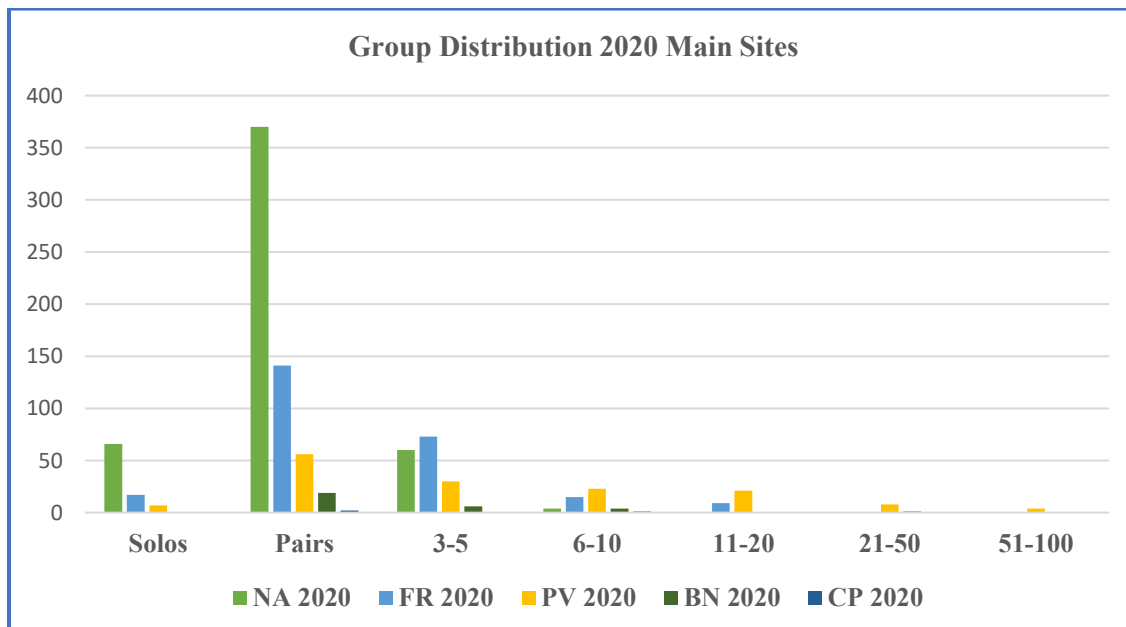


Figure Trends-21: Group distribution yellow-naped amazons all four sites combined 2018-2020

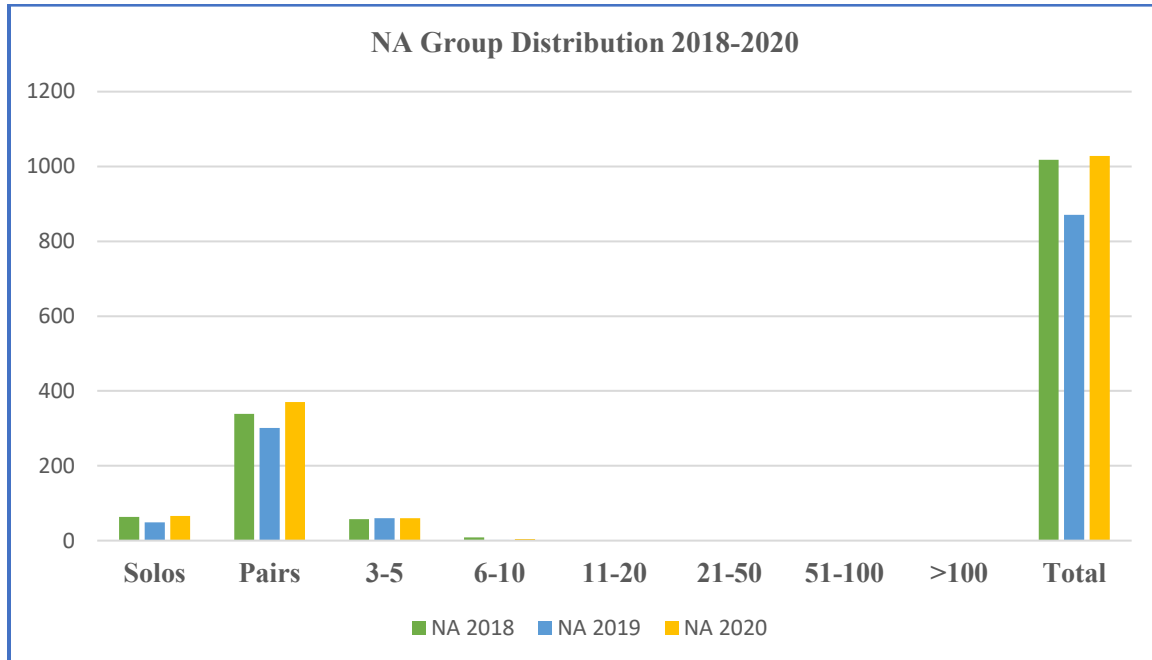


Figure Trends-22: Group distribution red-lored amazons all four sites combined 2018-2020

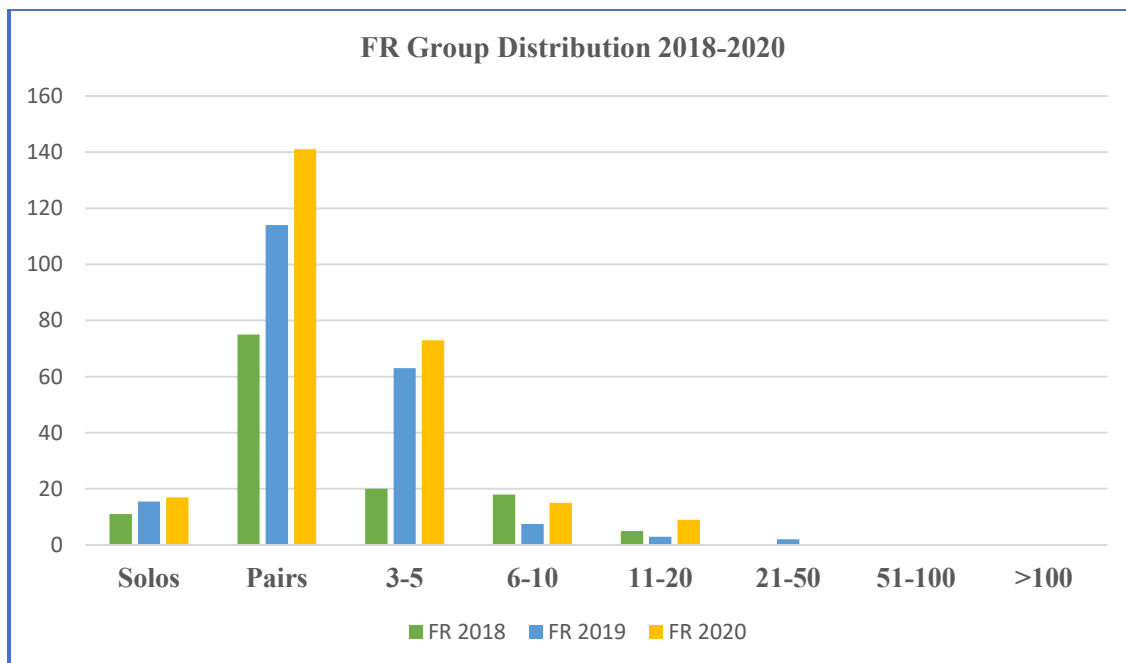


Figure Trends-23: Group distribution Pacific parakeets all four sites combined 2018-2020

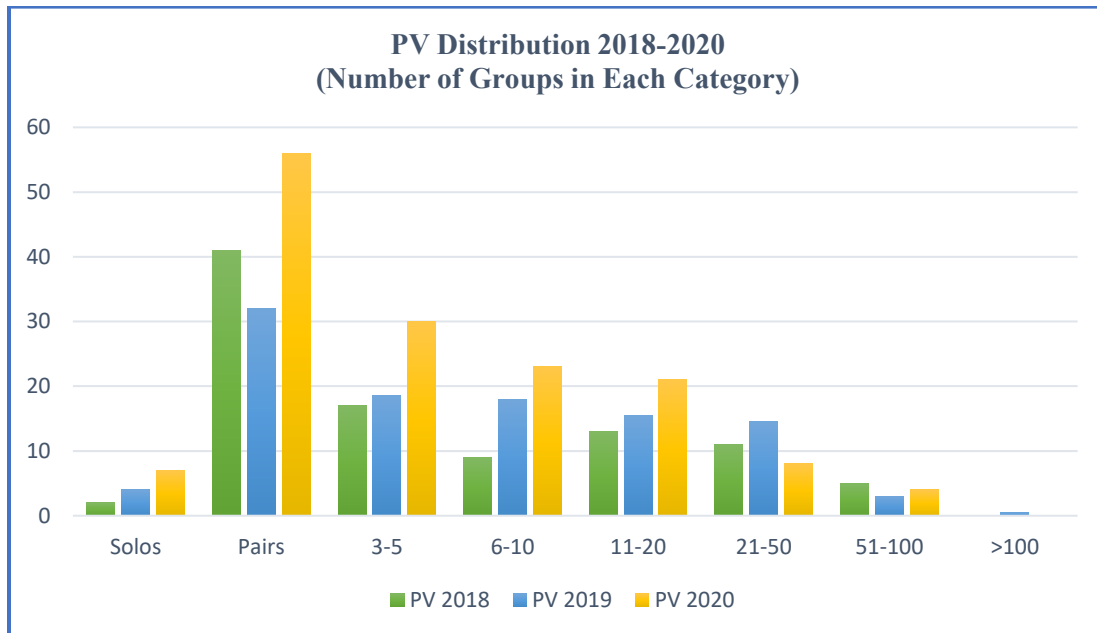


Figure Trends-24: Group distribution orange-chinned parakeets all four sites combined 2018-2020

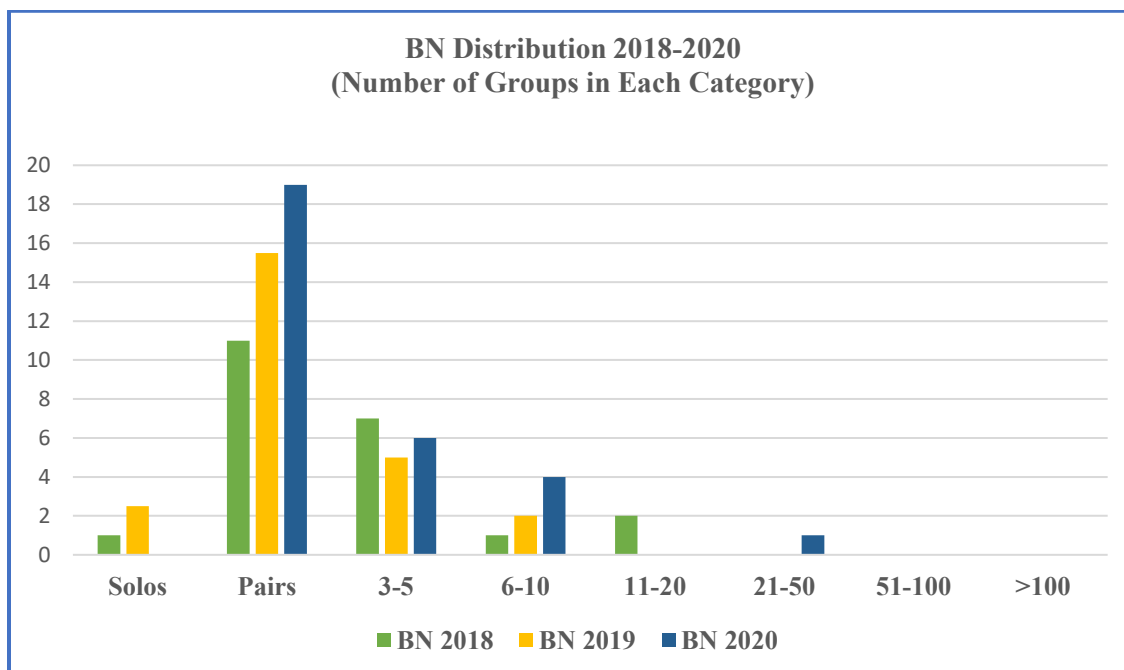
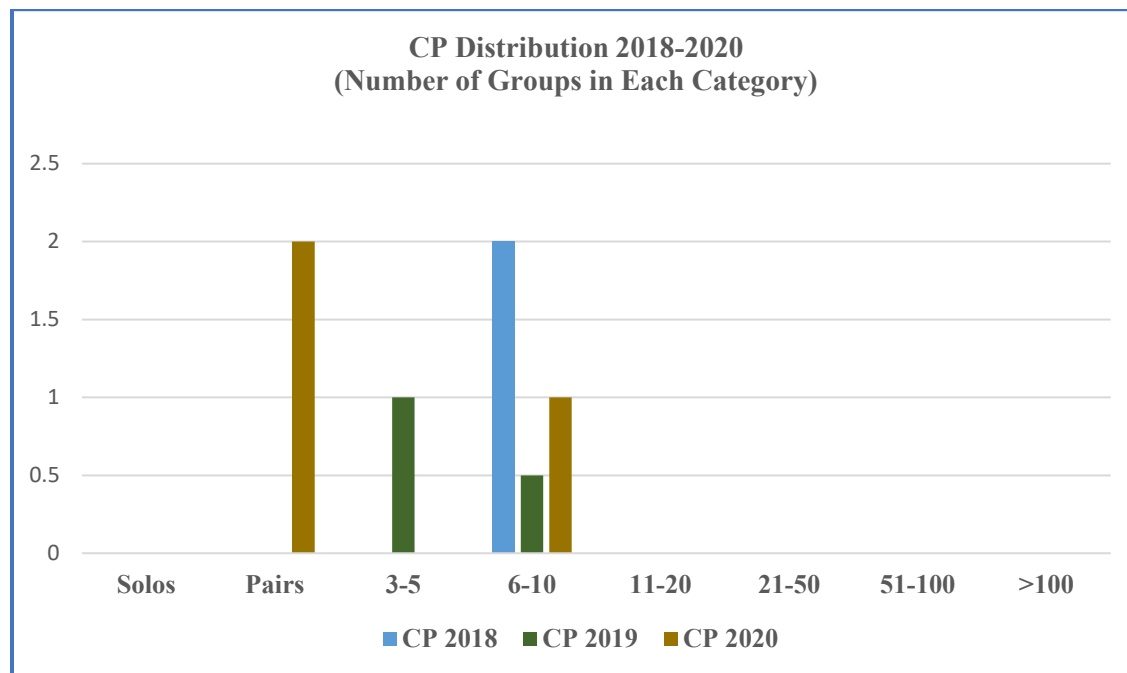


Figure Trends-25: Group distribution orange-fronted parakeets all four sites combined 2018-2020



Discussion Trends

In the seven years of counts, we documented 21436 individuals in our formal counts with fixed points at a total of 15 different areas (Table Trends-4). There were an additional two thousand individuals approximately in investigative counts that were in experimental transects but not reported here as the counts were more casual in nature. Of these 21436 individuals, we had 7883 yellow-naped amazons, 3389 red-lored amazons, 467 unknown amazons (due to mostly the first two years of counting), 8523 Pacific parakeets, 1104 orange-chinned parakeets, 55 orange-fronted parakeets, and 15 unknown parakeets. We did not estimate the relative density of this data set because in 2014 we only counted amazon parrots. From 2015-2020, we counted all species, for a total of 19022, for which we could track the relative density (Figure Trends – 1).

As we counted more often in our four core conservation areas, we cannot say the proportions of 2015-2020 is representative of the island as a whole, or of any one region. For that we would need to repeat the island wide count each year, which we only did once in 2018, or compare shifts in numbers of relative density only by each area, which we did (Figures 2,3,4,5,6,7)). Some trends are apparent. Peña seems to be increasing in red-lored amazons and orange-chinned parakeets, which confirms casual observations. Merida also had an increase in red-lored amazons in 2020. It may also be true that Palma had an increase in Pacific parakeets and red-lored amazons. Overall, combining all four transect areas and comparing years, we see red-lored amazons increased.

We also looked at the absolute numbers in each of the four conservation areas for 2018 -2020 (Figures 4,5,6,7). These numbers also reflect the increase in red-lored amazons, as well as an overall increase in numbers of birds counted, mostly due to the increase in red-lored amazons. We don't know the significance of this other than we are aware that the yellow-naped amazons are the more targeted pet species, though their overall number did not drop. There may be habitat or climate changes bringing red-lored amazons into our core conservation area.

Because of the poaching pressure on yellow-naped amazons, we looked at the overall total of numbers in our four core areas from 2015 to 2020 of both species of amazons (Table Trends-6, 9, Figure 9). Merida shows a slight increase in yellow-naped amazons, while Palma and Totoco decreased in 2019, possibly due to local deforestation. We also see an increase in red-lored amazons in all four regions from 2019 to 2020, although both Totoco and Palma decreased in 2019, possibly again to the deforestation occurring near their roost sites. In this same year, there was a fire in Peña during the nesting season, though no active nests were lost.

One way to study the impact of the illegal wildlife trade and chick extraction is to see how the percentage of chicks might be changing over the years (Figure 10,11, 12,13). Yellow-naped amazon chick percentage of the total flock dropped the most dramatically in Merida by nearly half from July 2019 to July 2020. We saw an increase in overall yellow-naped amazon numbers during the same time, so perhaps more nonbreeding and nonfamily birds are congregating in Merida than before, hence reducing the percentage of chicks. In the other areas, the shift was harder to discern if there was any trend given the methodology and natural variability, although it's possible that Peña's slight decrease in 2019 might have been due to the high natural nest failure rate that year of 35.%. and a local fire. Peña also had a consistently lower percentage of chicks in the population than other areas, possibly due to Peña chicks having already dispersed from their families and the high natural nest failure rate. Palma had a big jump from 2018 to 2019, perhaps as a response to our beginning efforts in a community that anecdotally had higher rates of poaching than in other areas. Totoco dropped in 2019, perhaps a response to the deforestation that happened near the roosting area although it seems like it has come up since then. In 2020, red-lored amazon chick percentage dropped in Palma but slightly increased in Peña and Totoco.

Looking at the average between the four conservation areas across the seven years, we do see a slight decrease in yellow-naped amazon chick percentage from 9% to 8.1% (Figure Trends-10, Table Trends-1). The red-lored amazon chicks increased significantly in 2019 (nearly doubled) and then stayed high.

Grouping all amazon chicks, we see a steady increase of chicks in Peña, an increase then decrease in Merida and Palma, and a decrease then increase in Totoco. In the last year, we saw a drop in Merida from 12.9% to 8.9%, perhaps because it experienced the highest poaching in our area (2019 = 40%, 2020 = 44%).

Overall, we can only make guesses about the positive impact of our conservation efforts as it relates to population increases through the analysis of chick percentage as we can't always confirm that group composition of threes, fours, and fives mean a pair of adults with that year's fledglings, though it might be more achievable with this species as juveniles don't have a yellow

nape. However, in fading light at a distance ages of birds are hard to discern. We saw a significant drop in percentage of chicks in July 2020 in Merida, increasing numbers in chick percentage in Palma, and variable drops in 2019 in Peña and Totoco. Our total population numbers are also difficult to interpret over such a short term and given the variability that exists between days and times of year; however, it seems clear that Merida is increasing in yellow-naped amazon numbers, Peña is increasing in red-lored amazon numbers, and Totoco has dropped, perhaps because the birds have shifted to roosting in Magdalena (Figure Trends-11).

Groups

We have group data distribution since 2014 for all amazons for our four conservation areas (Figure Trends-9). Pair percentage is the highest for Merida in December 2017 (right before egg laying when pairs may break off from their chicks and larger foraging flocks) as well as in Peña; we do have birds in pairs nesting in Peña during this time (16 nests in 2020). Totoco's highest pair percentage is in November 2015, again just as birds shift from families back to pairs. We also see a trend towards increasing pairs in August 2020. This was the first time we counted all four areas this far from fledging, perhaps suggesting that some chicks have already left their parents, or that families have moved off to another location. We see the lowest numbers of families in Peña and Merida in December 2017 as compared to other months. In Peña, Totoco, and Merida, family percentage is also low in November 2015 compared to July counts. Percentage of solo birds also seems to decrease at times as we move away from the breeding season of January – April in all areas except for the unusual patch in Peña that breeds September – December. These shifts in demographics confirm what we see in other yellow-naped amazon group distributions through the years: solo birds increase in January when the males are out by themselves and the females are incubating; families increase after chicks are able to fly after fledging (May – July) and thereafter, there may be increasing number of pairs as chicks become more independent. Without doing counts every month, we cannot be sure if there are site differences and cannot be more precise about the breeding cycle, although we have confirmed through our nest monitoring program that most nests fledge in late April or early May (except in Peña when they mostly fledge in December).

We do not have data for our fourth conservation area, Palma, until 2018 and only with counts in July and August. In July, family percentage dropped in Palma over the three years and increased in Peña and Totoco. It was variable in Merida.

We only have data for group sizes 2018-2020 for the two amazon species separately (Tables Trends-6,7). The percentages seem variable with no apparent trends for yellow-napes. Merida had increased group percentage for red-lored amazons and Palma in 2019 had a dramatic drop-in group percentage, maybe indicating that the more mobile juvenile flocks departed for other areas in this one year.

We then compared the group distribution by more finely breaking down the group sizes so that we could see how group sizes might have shifted for the Pacific parakeets, which often move in larger groups. Given that we only have data for 3 years, it is unclear if we can say much. We do want to point out that the yellow-naped numbers between 2018 and 2020 were similar in the four sites, but that there were only two groups in 2019 and four in 2020 greater than 5 and

none in the 11-20 in 2018, while in 2018 there were 10 groups and 1 in the 11-20 range. We want to keep a close look out for flock sizes as these could represent juvenile flocks, which are more abundant when there are more juveniles actually recruiting in the population (Figure Trends-17-25). Juvenile flocks of yellow-naped amazons are not seen in many places in the main author's experience.

From 2018-2020 with our smaller birds, we do not have many occurrences of orange-fronted parakeets and so cannot infer any trends. Pacific parakeets increased in pairs and group sizes up to 20 and decreased in groups larger than that. Orange-chinned parakeets increased in pairs and groups of 6-10. We do not know if these are true trends or simply normal variances.

Conclusion

The main purpose of this Case Study is to show how it is possible to use multiple point transects in parrot conservation. One way that we do this is by showing how the technique developed over the years, pointing out how much we learned and grew better at the methodology. By showing this process we hope to show how others can use the method without having to go through the years of learning

This Case Study also shows primarily how we could quickly identify the greatest concentration of amazon parrots on the island so that we could immediately target them for conservation efforts. We used four established transects, keeping the points the same from 2018 forward, as a standard methodology to compare trends over the years. We also used the transects as a basis for identifying the many things we didn't know about the parrots, further work that needed to be done to understand the parrots and adapt conservation plans accordingly, and where we might concentrate repeated counts so as to gain precision.

One thing that we do know is that there is variability between one day and the next in a particular transect, and this it changes throughout the year. What we don't know is how great the variability is in total numbers of birds and in relative density between species. Limited financial resources have kept us from repeating counts more frequently in a short period of time, and then on a regular basis throughout the year (such as a monthly count). Because of this, we don't know how many counts we need to do at what time of year to capture the greatest understanding of long-term trends.

We do feel that we have a general understanding that there is a low percentage of parrots that are shared between the transects during one given count, and that our methods are likely undercounting the birds as we only use four points at each transect. When we placed more points in the Totoco/Magdalena roost area and in the Peña area, we captured more distinct individuals. Roost counts could possibly count more birds, but there are challenges to the roost areas in Ometepe: they are large and spread out over many trees, sometimes up to a kilometer between trees, meaning that we need many points to capture all the individuals. The birds seem to move where they roost and we have not determined which roost areas to count at which times of the year; the roost areas are also often on the higher slopes of the volcano, making it more time-consuming and dangerous to get to points.

This work has also revealed a general picture of parrots on the island, and a snapshot of nest success from group size distribution. It appears that some transects have higher percentages of recently fledged juveniles. The percentage of young in a population does not appear high or that it is even increasing due to our efforts. We have only been monitoring and protecting nests since 2017, and that year, only in Peña. To truly understand if our conservation efforts are successful it would take more years and repeated counting to obtain higher precision.

We have to consider if our limited resources should be moved from nest monitoring and protection to other activities, such as education, awareness, and the many other components of our conservation plan. It may be that we have proportioned our resources as well as we can, providing as much community involvement and employment as possible, while also ensuring

the greatest possibility of population stabilization/improvement through our nest protection and monitoring program. Poaching remains a serious concern and we feel that our presence near nests is helping, as well as the hiring of ex-poachers to work in the field, (except possibly in the Merida region which has high poaching). We may never have the resources to truly know if our conservation plan is the best that it could be.

Though we may not have arrived at the precision that is perhaps just a dream in parrot conservation, we have been able to involve large numbers of community members, provide employment, and protect nests. The baseline of information that we have gathered can fuel ecotourism (as soon as civil unrest and the Covid-19 pandemic passes) for we have many trained people who know a lot about the parrots and who can seek livelihoods as tour guides to the expected high number of international and domestic tourists who visit the island every year .

An economic analysis should also be part of any long-term study. The deforestation events in Totoco in 2019 and 2020, and a general increase of habitat loss on the island, could be correlated with numbers of birds, nests poached, and the well-being of people. For instance, more trees could come down when there is a greater need to plant crops because of the drop in ecotourism.

We have also honored the birds by doing our best to understand them, and to share with the world what we have done through this Case Study. In doing so, this Case Study demonstrates the high commitment and capacity of those Ometepians who have given so much for their island, their parrots, and their ecosystems. This Case Study is a testament to their work, without which we would not have an abundance of hope and future possibility.

Recommendations

1. Continue to count the four major areas in July, during the same week for at least one night with two counters per point. This is the minimum that should continue but may not give us the data we need to evaluate efforts to produce successful nests, because there may be too much variability to know if there are more family groups or distinct individuals.
2. If there are sufficient resources, count each of the four areas for three days within the same two weeks in July to help us obtain higher precision in evaluating nest success and population trends.
3. Publish alongside this case study the results of the nest monitoring program in the 4 areas, and see how population numbers, trends, family group size, and relative density intersect with nest success and failure.
4. If there are sufficient resources, count each of the four main areas for five days every month for a year. This would give us variability between days so we could understand how many days in any given season we needed to count birds. It would also increase our precision from year to year so we could more clearly evaluate trends of total numbers of birds, relative density, and group size distribution; therefore, we can evaluate if our conservation efforts are successful.

5. If there are resources, attempt to conduct yellow-naped amazon roost counts, which would mean more counters on the volcanic slopes to count the roost areas of Palma and Totoco, the two roost areas in Peña, and the expansive roost area of Merida.
6. Repeat an island wide count every five years and if possible, count transects that are in close proximity on the same night. This will help us understand what might be going on island wide and to identify dead spots of yellow napes, roost areas to count, or new areas to target for conservation.
7. Set up a study to determine if any of the fluctuation in species and numbers might be from migration from the mainland. We have heard reports of the occasional Pacific parakeet flock flying over the water while traveling on the ferry, but perhaps they do it more frequently than we imagine. We have never seen birds come from the lake during a formal count.
8. Encourage domestic and international research to fulfill these recommendations, as there is a need for more human and financial resources.

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We offer deep thanks to Fauna and Flora International, their donors and their staff, especially Angelica Valdivia and Keyla Mena (<https://www.fauna-flora.org/>). Angelica has a license in agronomy and is the National Director of Fauna and Flora International. In the past she has worked with the government, including INTA and MAGFOR. She serves as an advisor for Biometepe and joins with them to work for the conservation of the yellow-naped amazon on Ometepe. Keyla has a license in agronomy and has worked for the government of Nicaragua in the areas of the environment. She has worked with non-profits such as Fundación Entre Voclanes and Fauna and Flora International. She is the president of Biometepe.

Biometepe deserves a special acknowledgement, for this the agricultural tourist cooperative (RL) is the organizational foundation upon which the project is growing into sustainability. Founded in 2018 by ten young professional with experience in conservation, natural resources, and tourism, it is dedicated to developing the local economy through agricultural products and ecological and conservation tourism. Specifically, it works towards conservation of natural resources by focusing on the yellow-naped amazon, diversifying agriculture and implementing techniques to diminish climate change with 200 producers, and to increase income in conservation tourism that supports the environment and its wildlife (<https://biometepe.org/>)

One Earth Conservation led the scientific effort for the counts, and we are so grateful for the many volunteers, donors and funders who have helped grow this parrot project on Ometepe through the years. Soledad Diaz and Amanda Puitiza gave scientific and editorial input. (<https://www.oneearthconservation.org>)

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The counts we perform are so much more than they seem: yes, there is data produced, but most of all, there is enduring commitment that has led to this maturing project that is the saving of this species, and hence of our hearts and this earth. Ultimately then our deep gratitude goes to the parrots and the earth over which they fly.

About the Authors



LoraKim Joyner combines her experience as a wildlife veterinarian, Unitarian Universalist minister, and Certified Trainer in Nonviolent Communication to address the importance of both human and nonhuman well-being in living a deeply meaningful and vibrant life, as well as caring for self, family, relationships, organizations, and life all around. She serves as a Community Minister affiliated with the Community Unitarian Universalist Congregation at White Plains, NY, and Co-Director of One Earth Conservation. She is an inspiring speaker and leads nation-wide workshops and webinars in Compassionate Communication and Nurturing Nature. With over 34 years' experience working with parrot conservation in the Americas, she currently leads projects in Guatemala, Honduras, Nicaragua, Guyana, and Paraguay, and is developing projects or consulting with Suriname, French Guiana, Brazil, and El Salvador. You can read about her life and work in her memoir, "Conservation in Time of War." With Gail Koelln, Co-director of One Earth Conservation, she has authored, "Nurturing Discussions and

Practices," and recently released her first novel, "Prion: A Futuristic Fable of Parrots, Pandemics, and Promise-makers."

Norlan Zambrana Morales has been the field project leader since its conception. He is a tourist guide at both the national and local level with a certificate in English. He has studied migratory birds since 2008 and journeyed to Canada to study there. He has worked in conservation for more than ten years, working with non-profits, including Fundación entre Volcanes, and Fauna y Flora International. He participated in environmental studies for the Inter-ocean canal and is currently the vice president of Biometepe. He along with Levi and Emerson were the founders of the LOCOS (Loreros Observando y Conservando Ometepe), the beginning group of this parrot conservation effort on Ometepe.

Levis Hernández is an Agronomist Technician, having worked for years on ecological farms. His specialty is in native plants and began working as a volunteer with the project in 2014. He is currently a member of Biometepe.

Emerson Urtecho is a Master Environmental Technologist having studied in the USA for two years. He is a tourist guide in Ometepe, and began working as a volunteer with the project in 2014. He is currently a member of Biometepe.

Appendices

Appendix 1: Names of Species in Study

Species in Study	Local	English	Scientific
NA	Nuca amarilla	Yellow-naped Amazon	<i>Amazona auropaliata</i>
FR	Frente rojo	Red-lored Amazon	<i>Amazona autumnalis</i>
PV	Perico verde	Pacific parakeet	<i>Psittacara strenuus</i>
BN	Barba naranja	Orange-chinned parakeet	<i>Brotogeris jugularis</i>
CP	Cabeza pardo	Orange-fronted parakeet	<i>Eupsittula canicularis</i>
WFA	Frente blanco	White-fronted Amazon	<i>Amazona albifrons</i>
UNA	Loro desconicido	Unknown amazon parrot	
UNP	Perico desconicido	Unknown parakeet	

Appendix 2: 2014 Data

Table 2014-1: Total number of birds counted April/May 2014

Site	NA	FR	UNA	Total
Corozal	52	4	6	62
Tichana	93	9	25	127
Esquipulas	70	5	10	85
Peña	81	2	69	152
Totoco	104	2	13	119
Merida	201	2	23	226
Pul	65	2	6	73
				0
Total	666	26	152	844

Table 2014-2: Group distribution of birds counted (all Amazons) April/May 2014 by site

	Peña AM	Merida PM	Totoco AM	Pul PM	Corazol PM	Tichana PM	Esquipulas PM	Total
Total #:	152	226	119	73	62	127	85	844
Total # solos	13	16	13	12	5	4	4	67
Total # of pairs	52	86	36	22	21	38	20	275
Total # in pairs	104	172	72	44	42	76	40	550
Total # of families	6	4	9	4	3	8	8	42
Total # in families	35	26	28	10	15	29	35	178
Total # of groups	0	2	1	1	0	3	1	8
Total # in groups	0	12	6	7	0	18	6	49
Range of groups	0	6	6	7	0	6	6	31
Average size groups	0.0	6.0	6.0	7.0	0.0	6.0	6.0	6.1
Total # chicks	15	10	10	4	5	13	19	76
% solos	8.6%	7.1%	10.9%	16.4%	8.1%	3.1%	4.7%	7.9%
% pairs	68.4%	76.1%	60.5%	60.3%	67.7%	59.8%	47.1%	65.2%
% families	23.0%	11.5%	23.5%	13.7%	24.2%	22.8%	41.2%	21.1%
% groups	0.0%	5.3%	5.0%	9.6%	0.0%	14.2%	7.1%	5.8%
% chicks	9.9%	4.4%	8.4%	5.5%	8.1%	10.2%	22.4%	9%

Table 2014-3: Group distribution of total birds counted in both AM and PM November 2014 by site

	Peña	Merida	Totoco	Pul	Corazol	Tichana	Esquipulas	Total
Total #:	493	592	528	227	384	588	222	3034
Total # solos	65	59	50	25	28	41	28	296
Total # of pairs	180	190	176	76	122	189	85	1018
Total # in pairs	360	380	352	152	244	378	170	2036
Total # of families	16	18	33	15	26	41	6	155
Total # in families	54	63	113	50	91	139	24	534
Total # of groups	2	13	2	0	3	4	0	24
Total # in groups	14	90	13	0	21	30	0	168
Range of groups	6-8	6-8	6-7	0	6-8	7-8	0	6-8
Average size groups	7.0	6.9	6.5	0.0	7.0	7.5	0.0	7.0
Total # chicks	22	27	47	20	39	57	12	224
% solos	13.2%	10.0%	9.5%	11.0%	7.3%	7.0%	12.6%	9.8%
% pairs	73.0%	64.2%	66.7%	67.0%	63.5%	64.3%	76.6%	67.1%
% families	11.0%	10.6%	21.4%	22.0%	23.7%	23.6%	10.8%	17.6%
% groups	2.8%	15.2%	2.5%	0.0%	5.5%	5.1%	0.0%	5.5%
% chicks	4.5%	4.6%	8.9%	8.8%	10.2%	9.7%	5.4%	7.4%

Table 2014-4: Total number of birds counted in both AM and PM November 2014

	Time Count	NA	FR	UNA	Total
Corozal	AM	140	94	24	258
	PM	62	57	7	126
Tichana	AM	105	114	28	247
	PM	160	168	13	341
Merida	AM	200	80	0	280
	PM	220	80	10	312
Totoco	AM	147	79	22	248
	PM	158	92	30	280
Peña	AM	183	13	22	218
	PM	233	15	27	275
Pul	AM	105	12	0	117
	PM	90	20	0	110
Esquipulas	AM	70	12	20	102
	PM	82	13	25	120
Total		1955	849	228	3034

Appendix 3: 2015 Data

Table 2015-1: Total number of birds counted April/May 2015 by site

	PV	BN	NA	FR	UNA	Total
Totoco AM	44	10	100	27	10	191
Totoco PM	0	4	86	8	0	98
Peña AM	599	50	268	2	0	919
Peña PM	469	2	394	8	0	873
Merida AM	165	76	120	0	0	361
Merida PM	119	62	160	0	10	351
Pul AM	340	132	32	0	0	504
Pul PM	336	11	74	6	0	427
Corazol AM	0	3	25	10	0	38
Corazol PM	0	0	15	0	0	15
Tichina AM	17	51	88	17	23	196
Michiana PM	62	123	98	3	39	325
Escupulis AM	515	55	19	0	2	591
Total	2666	579	1479	81	84	4889

Table 2015-2: Group distribution of total amazons counted in both AM and PM April/May 2015
by site

	Peña	Merida	Totoco	Pul	Corazol	Tichana	Esquipulas	Total
Total #:	672	290	231	112	50	268	21	1644
Total # solos	46	20	9	14	5	30	1	125
Total # of pairs	246	99	62	32	19	95	8	561
Total # in pairs	492	198	124	64	38	190	16	1122
Total # of families	26	11	11	7	2	14	1	72
Total # in families	95	37	43	28	7	48	4	262
Total # of groups	6	0	6	1				13
Total # in groups	39	35	55	6	0	0	0	135
Range of groups	6-8	12-23	6-20	6	0	0	0	6-8
Average size groups	7	6.9	9.2	0	0	0	0	7
Total # chicks	43	15	21	14	3	20	2	118
% solos	13.2%	10.0%	3.9%	11.0%	7.3%	7.0%	12.6%	9.8%
% pairs	73.0%	64.2%	53.7%	67.0%	63.5%	64.3%	76.6%	67.1%
% families	11.0%	10.6%	18.6%	22.0%	23.7%	23.6%	10.8%	17.6%
% groups	2.8%	15.2%	23.8%	0.0%	5.5%	5.1%	0.0%	5.5%
% chicks	6.4%	5.2%	9.1%	12.5%	6.0%	7.5%	9.5%	7.2%

Appendix 4: 2017 Data

Table 2017-1: Total number of individuals counted at 3 sites in December 2017 by site

	PV	BN	NA	FR	UNA	UNP	Total
Tierra Blanco	53	21	9	83			166
Merida	76	14	198	6		11	305
Peña	301	15	344	28			688
Total	430	50	551	117		11	1159

Table 2017-2: Group distribution of amazons counted December 2017 by site

	Peña	Merida	Tierra Blanco	Total
Total #:	372	204	92	668
Total # solos	32	12	4	48
Total # of pairs	159	87	25	271
Total # in pairs	318	174	50	542
Total # of families	7	6	5	18
Total # in families	22	18	16	56
Total # of groups	0	0	2	2
Total # in groups	0	0	22	22
Range of groups	0	0	11	
Average size groups	0	0	11.0	
Total # chicks	8	6	6	20
% solos	8.6%	5.9%	4.3%	7.2%
% pairs	85.5%	85.3%	54.3%	81.1%
% families	5.9%	8.8%	17.4%	8.4%
% groups	0.0%	0.0%	23.9%	3.3%
% chicks	2.2%	2.9%	6.5%	3.0%

Appendix 5: 2018 Data

Table 2018-1: Total number of individuals counted (N=7511) at 14 sites in July 2018 by site

	NA	FR	PV	BN	CP	UNA	UNP	Total
Peña	477	48	2106	23				2654
Pul	59	9	223	127				418
San Marcos	88	31	51	14	7			191
Tierra Blanca	32	19	38	2				91
Los Angeles	42	10	98	20		11		181
San Jose	66	23	174	39				302
Los Ramos	114	16	737	14				881
Merida	226	8	278	0				512
Tichina	142	29	203	122				496
San Ramos	132	72	23	27				254
La Palma	219	269	63	50				601
Corazol	60	25	4	74		4		167
Magdalena	138	133	54	56	7			388
Totoco	176	128	14	29	13		15	375
Total	1971	820	4066	597	27	15	15	7511

Table 2018–2: Group distribution of total species counted (N=7511) in July 2018 by site

	NA	FR	PV	BN	FN	UNA	UNP	Total
Total #:	1971	820	4066	597	27	15	15	7511
Total # solos	134	28	16	2	0		0	180
Total # of pairs	658	168	156	69	0	1	0	1052
Total # in pairs	1316	336	312	138	0	2	0	2104
Total # of families	120	49	79	28	0	1	0	277
Total # in families	419	187	307	111	0	4	0	1026
Total # of groups	15	32	146	32	4	1	1	224
Total # in groups	102	269	3431	346	27	9	15	4203
Range of groups	6-11	6-18	6-292	6-24	6-7	9	15	6-120
Average size groups	6.8	8.4	23.5	10.8	6.8	9.0	15.0	18.8
Total # chicks	179	89	145	55	0	2	0	470
% solos	6.8%	3.4%	0.4%	0.3%	0.0%	0.0%	0.0%	2.4%
% pairs	66.8%	41.0%	7.7%	23.1%	0.0%	13.3%	0.0%	28.0%
% families	21.3%	22.8%	7.5%	18.6%	0.0%	26.7%	0.0%	13.7%
% groups	5.2%	32.8%	84.5%	58.0%	100%	60.0%	100.0%	56.0%
% chicks	9.1%	10.9%	3.6%	9.2%	0.0%	13.3%	0.0%	6.3%

Table 2018-4: Total numbers of birds counted grouped by location on island - on slopes of Concepción, on slopes of Maderas, or on the isthmus between the two volcanoes

Location	Site	NA	FR	PV	BN	CP
Concepción	Pul	59	9	223	127	
	San Marcos	88	31	51	14	7
	Tierra Blanca	32	19	38	2	
	Los Angeles	42	10	98	20	
	San Jose	66	23	174	39	
	Los Ramos	114	16	737	14	
	Average	66.8	18.0	220.2	36.0	7.0
Isthmus	Peña	477	48	2106	23	
Maderas	Merida	226	8	278	0	
	Tichina	142	29	203	122	
	San Ramon	132	72	23	27	
	La Palma	219	269	63	50	
	Corazol	60	25	4	74	
	Magdalena	138	133	54	56	7
	Totoco	176	128	14	29	13
	Average	156.1	94.9	91.3	51.1	10.0

Table 2018-3: Total numbers of amazons counted (July 2018) in 7 sites used in 2014-2015

	Peña	Merida	Totoco	Palma	Pul	Corazol	Tichana	Total
Total #:	438	234	304	488	68	89	171	1792
Total # solos	25	22	6	21	7	8	18	107
Total # of pairs	153	76	74	111	23	28	46	511
Total # in pairs	306	152	148	222	46	56	92	1022
Total # of families	22	17	21	17	5	8	14	104
Total # in families	78	60	83	59	15	25	55	375
Total # of groups	4	0	8	22	0	0	1	35
Total # in groups	29	0	67	186	0	0	6	288
Range of groups	6-9	0	6-18	6-15	0	0	6	6-18
Average size groups	7.3	0.0	8.4	8.5	0.0	0.0	6.0	6.0
Total # chicks	34	26	41	28	25	19	5	178
% solos	5.7%	9.4%	2.0%	4.3%	10.3%	9.0%	10.5%	6.0%
% pairs	69.9%	65.0%	48.7%	45.5%	67.6%	62.9%	53.8%	57.0%
% families	17.8%	25.6%	27.3%	12.1%	22.1%	28.1%	32.2%	20.9%
% groups	6.6%	0.0%	22.0%	38.1%	0.0%	0.0%	3.5%	16.1%
% chicks	7.8%	11.1%	13.5%	5.7%	36.8%	21.3%	2.9%	9.9%

Table 2018-5: Total number of yellow-naped (N-1971) and red-fronted amazons (820) in all sites with percentage of chicks

	Total	# chicks	% chicks		FR	Total	# chicks	% chicks
Peña	477	34	7.1%		Peña	48	7	14.6%
Pul	59	4	6.8%		Pul	9	1	11.1%
San Marcos	88	10	11.4%		San Marcos	31	2	6.5%
Tierra Blanca	32	1	3.1%		Tierra Blanca	19	2	10.5%
Los Angeles	42	3	7.1%		Los Angeles	10	2	20.0%
San Jose	66	3	4.5%		San Jose	23	1	4.3%
Los Ramos	114	16	14.0%		Los Ramos	16	0	0.0%
Merida	226	26	11.5%		Merida	8	0	0.0%
Tichina	142	21	14.8%		Tichina	29	6	20.7%
San Ramos	132	11	8.3%		San Ramos	72	13	18.1%
La Palma	219	10	4.6%		La Palma	269	15	5.6%
Corazol	60	5	8.3%		Corazol	25	2	8.0%
Magdalena	138	12	8.7%		Magdalena	133	20	15.0%
Totoco	176	23	13.1%		Totoco	128	18	14.1%
Total	1971	179			820	89		
		Average	8.8%			Average		10.6%
		STD	3.6%			STD		6.8%
		Range	3.1-14.8			Range		0-20.7%

Appendix 6: 2019 Data

Table 2019-5: All species counted during July 18 and 19 counts at 4 sites, and comparing the two counts at each site

Site	PV	BN	NA	FR	UNA	CP	UNP	Total	Mean	Difference	% Difference	STD
Totoco	59	43	84	75	8	11	0	280	553	7	2.5%	4.9
Totoco	43	21	74	130	0	5	0	273				
Peña	1077	37	388	257	7	0	0	1766	3699	167	8.6%	118.1
Peña	1180	5	432	307	9	0	0	1933				
Merida	130	14	252	6	0	0	0	402	761	43	10.7%	30.4
Merida	127	2	228	2	0	0	0	359				
Palma	60	5	147	266	47	0	4	529	979	79	14.9%	55.9
Palma	60	6	137	224	23	0	0	450				
Total	2736	133	1742	1267	94	16	4	5992	2996	38	1.3%	26.9
First count	1326	99	871	604	62	11	4	2977				
Second count	1410	34	871	663	32	5	0	3015				
Difference	84	65	0	59	30	6	4	38				
% Difference	6.3%	65.7%	0.0%	9.8%	48.4%	-54.5%	-100.0%	1.3%				

Table 2019-6: All amazons counted in both counts (4 sites counted twice) by site

	Peña	Palma	Totoco	Merida	Total
Total #	1400	844	371	488	3103
Total # solos	56	23	27	25	131
Total # of pairs	377	240	86	156	859
Total # in pairs	754	480	172	312	1718
Total # of families	83	44	31	44	202
Total # in families	316	334	119	151	920
Total # of groups	22	1	7	0	30
Total # in groups	274	7	53	0	334
Range of groups	6-26	7	6-11	0	6-26
Average size groups	12.5	7.0	7.6	0.0	11.1
Total # chicks	130	127	47	63	367
% solos	4.0%	2.7%	7.3%	5.1%	4.2%
% pairs	53.9%	56.9%	46.4%	63.9%	55.4%
% families	22.6%	39.6%	32.1%	30.9%	29.6%
% groups	19.6%	0.8%	14.3%	0.0%	10.8%
% chicks	9.3%	15.0%	12.7%	12.9%	11.8%

Table 2019-7: All yellow-naped amazons counted in both counts (4 sites counted twice) by site

	Peña	Palma	Totoco	Merida	Total
Total #:	820	284	158	480	1742
Total # solos	48	12	13	25	98
Total # of pairs	309	97	42	154	602
Total # in pairs	618	194	84	308	1204
Total # of families	40	24	13	43	120
Total # in families	140	78	49	147	414
Total # of groups	2	0	2	0	4
Total # in groups	14	0	12	0	26
Range of groups	6-8	0	6	0	6
Average size groups	7	0	6	0	13
Total # chicks	40	24	13	61	138
% solos	5.9%	4.2%	8.2%	5.2%	5.6%
% pairs	75.4%	68.3%	53.2%	64.2%	69.1%
% families	17.1%	27.5%	31.0%	30.6%	23.8%
% groups	1.7%	0.0%	7.6%	0.0%	1.5%
% chicks	4.9%	8.5%	8.2%	12.7%	7.9%

Table 2019-8: All red-lored amazons counted in both counts (4 sites counted twice) by site

	Peña	Palma	Totoco	Merida	Total
Total #:	564	490	205	8	1267
Total # solos	7	10	14	0	31
Total # of pairs	65	119	42	2	228
Total # in pairs	130	238	84	4	456
Total # of families	42	14	17	1	74
Total # in families	173	235	66	4	478
Total # of groups	19	1	5	0	25
Total # in groups	254	7	41	0	302
Range of groups	6-26	7	6-11	0	6-26
Average size groups	7	0	6	0	12.08
Total # chicks	89	103	32	2	226
% Solos	1.2%	2.0%	6.8%	0.0%	2.4%
% pairs	23.0%	48.6%	41.0%	50.0%	36.0%
% families	30.7%	48.0%	32.2%	50.0%	37.7%
% groups	45.0%	1.4%	20.0%	0.0%	23.8%
% chicks	15.8%	21.0%	15.6%	25.0%	17.8%

Table 2019-9: All amazons counted in both sites

	NA	FR	UNA	Total
Total #:	1742	1267	94	3103
Total # solos	98	31	2	131
Total # of pairs	602	228	29	859
Total # in pairs	1204	456	58	1718
Total # of families	120	74	8	202
Total # in families	414	478	28	920
Total # of groups	4	25	1	30
Total # in groups	26	302	6	334
Range of groups	6-8	6-26	6	
Average size groups	6.5	12.08	6	
Total # chicks	138	226	12	376
% Solos	9.8%	2.4%	2.1%	4.2%
% pairs	67.1%	36.0%	61.7%	55.4%
% families	17.6%	37.7%	29.8%	29.6%
% groups	5.5%	23.8%	6.4%	10.8%
% chicks	7.2%	17.8%	12.8%	12.1%

Table 2019-10: Unknown species in all counts with their distribution by site

	Amazons							Parakeets	Total
	Total	solos	pairs	3	4	5	6		
Merida	0								
Merida	0								
Totoco	8		2		1				
Totoco	0								
Peña	7		2	1					
Peña	9	1	1				1		
Palma	47		13	4	1	1		4	
Palma	23	1	11						
Total	94	2	29	5	2	1	1		
# Amazons	94	2	58	15	8	5	6	4	98
% Total Birds									0.2%
% Total Amazons									3.0%

Table 2019-11: Total of all non-amazon species counted in both counts

	PV	BN	CP
Total #:	2736	133	16
Total # solos	8	5	0
Total # of pairs	64	31	0
Total # in pairs	128	62	0
Total # of families	37	10	2
Total # in families	153	40	10
Total # of groups	94	4	1
Total # in groups	2447	26	6
Range of groups	6-150	6-8	6
Average size groups	26.0	6.5	6
Total # chicks	79	20	6
% solos	0.3%	3.8%	0.0%
% pairs	4.7%	46.6%	0.0%
% families	5.6%	30.1%	62.5%
% groups	89.4%	19.5%	37.5%
% chicks	2.9%	15.0%	37.5%

Table 2019-12: Results of 7-point Totoco count July

	NA	FR	PV	BN	CP	UNA
Total #:	182	220	110	70	23	6
Total # solos	24	16		0	0	0
Total # of pairs	67	56	14	13	0	1
Total # in pairs	134	112	28	26	0	2
Total # of families	8	21	3	5	3	1
Total # in families	24	79	11	22	13	4
Total # of groups	0	21	5	3	1	0
Total # in groups	0	13	70	22	10	0
Range of groups	0	6-7	6-20	6-10	10	0
Average size groups	0.0	6.5	14	7.3	10	0
Total # chicks	8	34	5	12	7	2
% Solos	13.2%	7.3%	0.9%	0.0%	0.0%	0.0%
% pairs	73.6%	50.9%	25.5%	37.1%	0.0%	33.3%
% families	13.2%	35.9%	10.0%	31.4%	56.5%	66.7%
% groups	0.0%	5.9%	63.6%	31.4%	43.5%	0.0%
% chicks	4.4%	15.5%	4.5%	17.1%	30.4%	33.3%

Table 2019-13: All amazons counted in the two transect count July (4-point Totoco combined with 4-point Magdalena)

	Totoco NA	Mag NA	Totoco FR	Mag FR	Totoco UNA	Mag UNA	Total
Total #:	66	206	159	179	2	2	614
Total # solos	7	13	11	7	0	0	38
Total # of pairs	16	57	24	32	1	1	131
Total # in pairs	32	114	48	64	2	2	262
Total # of families	8	24	15	20	0	0	67
Total # in families	27	79	60	72	0	0	238
Total # of groups	0	0	4	5	0	0	9
Total # in groups	0	0	40	36	0	0	76
Range of groups	0	0	6-14	6-11	0	0	0
Average size groups	0	0	10	7.2	0	0	17.2
Total # chicks	11	31	30	32	0	0	104
% Solos	10.6%	6.3%	6.9%	3.9%	0.0%	0.0%	6.2%
% pairs	48.5%	55.3%	30.2%	35.8%	100.0%	100.0%	42.7%
% families	40.9%	38.3%	37.7%	40.2%	0.0%	0.0%	38.8%
% groups	0.0%	0.0%	25.2%	20.1%	0.0%	0.0%	12.4%
% chicks	16.7%	15.0%	18.9%	17.9%	0.0%	0.0%	16.9%

Table 2019-14: All non-amazons counted in the two transect count July (4-point Totoco combined with 4-point Magdalena)

	PV Totoco	PV Magdalena	BN Totoco	BN Magdalena	CP Totoco	CP Magdalena
Total #:	8	16	10	24	11	0
Total # solos	2	1	1	1	0	0
Total # of pairs	3	6	2	4	0	0
Total # in pairs	6	12	4	8	0	0
Total # of families	0	1	1	1	1	0
Total # in families	0	3	5	3	5	0
Total # of groups	0	0	0	2	1	0
Total # in groups	0	0	0	12	6	0
Range of groups	0	0	0	6	6	0
Average size groups	0	0	0	6	6	0
Total # chicks	0	1	3	1	3	0
% Solos	25%	6.2%	10%	4.2%	0	0
% pairs	75%	75%	40%	33.3%	0	0
% families	0	18.8%	50%	12.5%	45.5%	0
% groups	0	0	0%	50.0%	54.5%	0
% chicks	0	6.2%	30%	4.2%	27.2%	0

Table 2019-15: Numbers of individuals shared (S) with other counted transects to arrive at the MNDI

Site	PV	S	MNDI	BN	S	MNDI	NA	S	MNDI	FR	S	MNDI	UN A	CP	UNP	Total	MNDI
Totoco	59	0	59	43	0	43	84	4	80	75	20	55	8	11	0	280	256
Totoco	43	0	43	21	0	21	74	9	65	130	0	130	0	5	0	273	264
Peña	1077	0	1077	37	0	37	388	0	388	257	0	257	7	0	0	1766	1766
Peña	1180	0	1180	5	0	5	432	0	432	307	0	307	9	0	0	1933	1933
Merida	130	0	130	14	0	14	252	0	252	6	0	6	0	0	0	402	402
Merida	127	0	127	2	0	2	228	0	228	2	0	2	0	0	0	359	359
Palma	60	0	60	5	0	5	147	0	147	266	0	266	47	0	4	529	529
Palma	60	0	60	6	0	6	137	0	137	224	0	224	23	0	0	450	450
Total	2736	0	2736	133	0	133	1742	13	1729	1267	20	1247	94	16	4	5992	5959

Appendix 7: 2020 Results

Table 2020-3: All individuals counted in 4 core sites, July and August 2020

July					
	Merid a	Peña	Palm a	Totoco	Total
NA	372	357	161	138	1028
FR	66	301	307	147	821
UNA	25	0	2	8	35
PV	275	851	82	60	1268
BN	17	60	14	51	142
CP	0	0	0	11	11
Total	755	1569	566	415	3305
August					
	Merid a	Peña	Palm a	Totoco	Total
NA	326	181	97	118	722
FR	12	29	72	47	160
UNA	5	0	3	0	8
PV	84	836	33	69	1022
BN	18	70	5	14	107
CP	0	0	9	6	15
Total	445	1116	219	254	2034

Table 2020-4: Distribution of group size of yellow-naped amazons by site July 2020

	Peña	Palma	Totoco	Merida	Total
Total #:	357	161	138	372	1028
Total # solos	20	11	11	24	66
Total # of pairs	130	57	45	1138	1370
Total # in pairs	260	114	90	276	740
Total # of families	17	11	11	21	60
Total # in families	57	36	37	66	196
Total # of groups	3	0	0	1	4
Total # in groups	20	0	0	6	26
Range of groups	6-8	0	0	6	6-8
Average size groups	6.7	0	0	6	6.3
# chicks	23	14	15	24	76
% solos	5.6%	6.8%	8.0%	6.4%	6.4%
% pairs	72.8%	70.8%	65.2%	74.2%	72.0%
% families	16.0%	22.3%	26.8%	17.7%	19.1%
% groups	5.6%	0.0%	0.0%	1.6%	2.5%
% chicks	6.4%	8.7%	10.9%	6.4%	7.4%

Table 2020-5: Distribution of group size of yellow-naped amazons by site August 2020

	Peña	Palma	Totoco	Merida	Total
Total #:	181	97	118	326	722
Total # solos	18	7	9	22	56
Total # of pairs	72	39	36	115	262
Total # in pairs	144	78	72	230	524
Total # of families	5	4	11	18	38
Total # in families	19	12	37	62	130
Total # of groups	0	0	0	2	2
Total # in groups	0	0	0	12	12
Range of groups	0	0	0	6	6
Average size groups	0	0	0	6	6
# chicks	6	4	15	26	51
% solos	9.9%	7.2%	7.6%	6.7%	7.8%
% pairs	79.6%	80.4%	61.0%	70.6%	72.6%
% families	10.5%	12.4%	31.4%	19.0%	18.0%
% groups	0.0%	0.0%	0.0%	3.7%	1.7%
% chicks	3.3%	4.1%	12.7%	8.0%	7.1%

Table 2020-6: Distribution of group size of red-lored amazons by site July 2020

	Palma	Peña	Totoco	Merida	Total
Total #:	307	301	147	66	821
Total # solos	8	3	6	0	17
Total # of pairs	55	57	23	6	141
Total # in pairs	110	114	46	12	282
Total # of families	27	26	14	6	73
Total # in families	99	105	52	25	281
Total # of groups	7	9	5	3	24
Total # in groups	90	79	43	29	241
Range of groups	6-21	6-12	6-13	7-12	6-21
Average size groups	12.86	8.78	8.60	9.67	10.04
# chicks	45	53	24	13	135
% solos	2.6%	1.0%	4.1%	0.0%	2.1%
% pairs	35.8%	37.9%	31.3%	18.2%	34.3%
% families	32.2%	34.9%	35.4%	37.9%	34.2%
% groups	29.3%	26.2%	29.3%	43.9%	29.4%
% chicks	14.7%	17.6%	16.3%	19.7%	16.4%

Table 2020-7: Distribution of group size of red-lored amazons by site August 2020

	Palma	Peña	Totoco	Merida	Total
Total #:	72	29	47	12	160
Total # solos	5	1	5	0	11
Total # of pairs	14	8	11	0	33
Total # in pairs	28	16	22	0	66
Total # of families	7	3	6	1	17
Total # in families	23	12	20	4	59
Total # of groups	2	0	0	1	3
Total # in groups	16	0	0	8	24
Range of groups	8	0	0	8	16
Average size groups	8	0	0	8	8
# chicks	9	6	8	2	25
% solos	6.9%	3.4%	10.6%	0.0%	6.9%
% pairs	38.9%	55.2%	46.8%	0.0%	41.3%
% families	31.9%	41.4%	42.6%	33.3%	36.9%
% groups	22.2%	0.0%	0.0%	66.7%	15.0%
% chicks	12.5%	20.7%	17.0%	16.7%	15.6%

Table 2020-8: Total number of Amazon (yellow-naped, red-lored, and unknown) parrots by site counted July 2020

	Peña	Palma	Totoco	Merida	Total
Total #:	658	470	293	463	1884
Total # solos	23	19	17	25	84
Total # of pairs	187	113	68	150	518
Total # in pairs	374	226	136	300	1036
Total # of families	43	38	27	31	139
Total # in families	162	135	97	103	497
Total # of groups	12	7	5	4	28
Total # in groups	99	90	43	35	267
Range of groups	6-12	6-21	6-13	6-12	6-21
Average size groups	8	13	9	9	10
# chicks	76	59	43	41	211
% Solos	3.5%	4.0%	5.8%	5.4%	4.5%
% pairs	56.8%	48.1%	46.4%	64.8%	55.0%
% families	24.6%	28.7%	33.1%	22.2%	26.4%
% groups	15.0%	19.1%	14.7%	7.6%	14.2%
% chicks	11.6%	12.6%	14.7%	8.9%	11.2%

Table 2020-9: Total number of Amazon (yellow-naped, red-lored, and unknown) parrots counted August 2020

	Peña	Palma	Totoco	Merida	Total
Total #:	213	169	165	343	890
Total # solos	19	12	14	22	67
Total # of pairs	80	53	47	115	295
Total # in pairs	160	106	94	230	590
Total # of families	9	11	17	20	57
Total # in families	34	35	57	71	197
Total # of groups	0	2	0	3	5
Total # in groups	0	16	0	20	36
Range of groups	0	8	0	6-8	6-8
Average size groups	0	8	0	6.7	7.2
# chicks	13	13	23	31	0.795
% Solos	8.9%	7.1%	8.5%	6.4%	7.5%
% pairs	75.1%	62.7%	57.0%	67.1%	66.3%
% families	16.0%	20.7%	34.5%	20.7%	22.1%
% groups	0.0%	9.5%	0.0%	5.8%	4.0%
% chicks	6.1%	7.7%	13.9%	9.0%	0.1%

Table 2020-10: Distribution of all Amazons including unknowns counted July and August 2020

	July				August			
	July NA	July FR	UNA	Total	Aug NA	Aug FR	UNA	Total
Total #:	1028	821	35	1884	722	160	8	890
Total # solos	66	17	1	84	56	11	0	67
Total # of pairs	1370	141	7	1518	262	33	0	295
Total # in pairs	740	282	14	1036	524	66	0	590
Total # of families	60	73	6	139	38	17	2	57
Total # in families	196	281	20	497	130	59	8	197
Total # of groups	4	24	0	28	2	3	0	5
Total # in groups	26	241	0	267	12	24	0	36
Range of groups	6-8	6-21	0	6-21	6-8	16	0	6-21
Average size groups	6.3	10.0	0	9.3	6	8	0	9.3
# chicks	76	135	8	219	51	25	4	80
% solos	6.4%	2.1%	2.9%	4.5%	7.8%	6.9%	0.0%	7.5%
% pairs	72.0%	34.3%	40.0%	55.0%	72.6%	41.3%	0.0%	66.3%
% families	19.1%	34.2%	57.1%	26.4%	18.0%	36.9%	100.0%	22.1%
% groups	2.5%	29.4%	0.0%	14.2%	1.7%	15.0%	0.0%	4.0%
% chicks	7.4%	16.4%	22.9%	11.6%	7.1%	15.6%	50.0%	9.0%

Table 2020-11: Distribution of Pacific parakeets counted by site in July 2020

	Palma	Peña	Totoco	Merida	Total
Total #:	82	851	60	275	1268
Total # solos	0	3	2	2	7
Total # of pairs	14	24	5	13	56
Total # in pairs	28	48	10	26	112
Total # of families	5	14	0	11	30
Total # in families	20	57	0	43	120
Total # of groups	4	37	4	12	57
Total # in groups	34	743	48	204	1029
Range of groups	6-15	6-100	8-10	6-48	6-100
Average size groups	8.5	20.1	12	17	18.1
# chicks	10	29	0	21	60
% solos	0.0%	0.4%	3.3%	0.7%	0.6%
% pairs	34.1%	5.6%	16.7%	9.5%	8.8%
% families	24.4%	6.7%	0.0%	15.6%	9.5%
% groups	41.5%	87.3%	80.0%	74.2%	81.2%
% chicks	12.2%	3.4%	0.0%	7.6%	4.7%

Table 2020-12: Distribution of Pacific parakeets counted by site in August 2020

	Palma	Peña	Totoco	Merida	Total
Total #:	33	836	69	84	1022
Total # solos	0	1	0	2	3
Total # of pairs	5	18	3	6	32
Total # in pairs	10	36	6	12	64
Total # of families	2	15	1	6	24
Total # in families	7	60	4	22	93
Total # of groups	2	22	2	5	31
Total # in groups	16	739	59	48	862
Range of groups	6-10	6-44	24-35	6-20	6-44
Average size groups	8	33.6	29.5	9.6	27.8
# chicks	3	30	2	10	45
% solos	0.0%	0.1%	0.0%	2.4%	0.3%
% pairs	30.3%	4.3%	8.7%	14.3%	6.3%
% families	21.2%	7.2%	5.8%	26.2%	9.1%
% groups	48.5%	88.4%	85.5%	57.1%	84.3%
% chicks	9.1%	3.6%	2.9%	11.9%	4.4%

Table 2020 – 13: Distribution of all species counted in July and August 2020

	July							August						
	NA	FR	UNA	PV	BN	CP	Total	NA	FR	UNA	PV	BN	CP	Total
Total #:	1028	821	35	1268	142	11	3305	722	160	8	1022	107	15	2034
Total # solos	66	17	1	7	0	0	91	56	11	0	3	1	0	71
Total # of pairs	1370	141	7	56	19	2	1595	262	33	0	32	20	0	347
Total # in pairs	740	282	14	112	38	4	1190	524	66	0	64	40	0	694
Total # of families	60	73	6	30	6	0	175	38	17	2	24	5	0	86
Total # in families	196	281	20	120	23	0	640	130	59	8	93	21	0	311
Total # of groups	4	24	0	57	4	1	90	2	3	0	31	5	2	43
Total # in groups	26	241	0	1029	81	7	1384	12	24	0	862	45	15	958
Range of groups	6-8	6-21	0	6-100	6-50	6	6-100	6-8	8	0	6-44	6-12	6-9	6-44
Average size groups	6.3	10.0	0.0	18.1	20.3	6.0	15.4	6.0	8.0	0.0	27.8	9.0	7.5	22.3
# chicks	76	135	8	60	11	0	290	51	25	4	45	11	0	136
% solos	6.4%	2.1%	2.9%	0.6%	7.7%	0.0%	8.8%	7.8%	6.9%	0.0%	0.3%	0.9%	0.0%	3.5%
% pairs	72.0%	34.3%	40.0%	8.8%	0.0%	0.0%	2.8%	72.6%	41.3%	0.0%	6.3%	37.4%	0.0%	34.1%
% families	19.1%	34.2%	57.1%	9.5%	26.8%	36.4%	36.0%	18.0%	36.9%	100.0%	9.1%	19.6%	0.0%	15.3%
% groups	2.5%	29.4%	0.0%	81.2%	16.2%	0.0%	19.4%	1.7%	15.0%	0.0%	84.3%	42.1%	100.0%	47.1%
% chicks	7.4%	16.4%	22.9%	4.7%	57.0%	63.6%	41.9%	7.1%	15.6%	50.0%	4.4%	10.3%	0.0%	6.7%

Appendix 8: Trends Summary Tables

Table Trends-2: Corrected Peña counts of all amazons in 2018 (removed 2 extra points in transects so as to compare to 2014).

	Peña	Merida	Totoco	Palma	Pul	Corazol	Tichana	Total
Total #:	438	234	304	488	68	89	171	1792
Total # solos	25	22	6	21	7	8	18	107
Total # of pairs	153	76	74	111	23	28	46	511
Total # in pairs	306	152	148	222	46	56	92	1022
Total # of families	22	17	21	17	5	8	14	104
Total # in families	78	60	83	59	15	25	55	375
Total # of groups	4	0	8	22	0	0	1	35
Total # in groups	29	0	67	186	0	0	6	288
Range of groups	6-9	0	6-18	6-15	0	0	6	6-18
Average size groups	7.3	0.0	8.4	8.5	0.0	0.0	6.0	6.0
Total # chicks	34	26	41	28	25	19	5	178
% solos	5.7%	9.4%	2.0%	4.3%	10.3%	9.0%	10.5%	6.0%
% pairs	69.9%	65.0%	48.7%	45.5%	67.6%	62.9%	53.8%	57.0%
% families	17.8%	25.6%	27.3%	12.1%	22.1%	28.1%	32.2%	20.9%
% groups	6.6%	0.0%	22.0%	38.1%	0.0%	0.0%	3.5%	16.1%
% chicks	7.8%	11.1%	13.5%	5.7%	36.8%	21.3%	2.9%	9.9%

Table Trends-3: Corrected Peña counts of each species in 2018 (removed 2 extra points in transects) so as to compare to each species of Amazons in 2015 and 2019-2020 data

	Peña NA	Peña FR	Meri da NA	Meri da FR	Totoc o NA	Totoc o FR	Palm a NA	Palm a FR	Pul NA	Pul FR	Coraz ol NA	Coraz ol FR	Corazol UNA	Tichin a NA	Tichin a FR	Total
Total #:	397	41	226	8	176	128	219	269	59	9	60	25	4	142	29	1792
Total # solos	25	0	20	2	6	0	12	9	7	0	7	1	0	15	3	107
Total # of pairs	146	7	73	3	51	23	69	42	20	3	19	9	0	42	4	511
Total # in pairs	292	14	146	6	102	46	138	84	40	6	38	18	0	84	8	1022
Total # of families	20	2	17	0	13	8	7	10	4	1	5	2	1	11	3	104
Total # in families	68	10	60	0	49	34	24	35	12	3	15	6	4	43	12	375
Total # of groups	2	2	0	0	3	5	6	16	0	0	0	0	0	0	1	35
Total # in groups	12	17	0	0	19	48	45	141	0	0	0	0	0	0	6	288
Range of groups	6	8-9	0	0	6-7	6-18	6-11	6-15	0	0	0	0	0	0	6	6-15
Average size groups	6.0	8.5	0.0	0.0	9.5	9.6	7.5	8.8	0.0	0.0	0.0	0.0	0.0	0.0	6.0	8.2
Total # chicks	28	6	26	0	23	18	10	15	4	1	5	2	2	21	6	167
% solos	6.3%	0.0%	8.8%	25.0%	3.4%	0.0%	5.5%	3.3%	11.9%	0.0%	11.7%	4.0%	0.0%	10.6%	10.3%	6.0%
% pairs	73.6%	34.1%	64.6%	75.0%	58.0%	35.9%	63.0%	31.2%	67.8%	66.7%	63.3%	72.0%	0.0%	59.2%	27.6%	57.0%
% families	17.1%	24.4%	26.5%	0.0%	27.8%	26.6%	11.0%	13.0%	20.3%	33.3%	25.0%	24.0%	100.0%	30.3%	41.4%	20.9%
% groups	3.0%	41.5%	0.0%	0.0%	10.8%	37.5%	20.5%	52.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	20.7%	16.1%
% chicks	7.1%	14.6%	11.5%	0.0%	13.1%	14.1%	4.6%	5.6%	6.8%	11.1%	8.3%	8.0%	50.0%	14.8%	20.7%	9.3%

Table Trends-4: Summary of all species counted over seven years at all sites

Date	Location	NA	FR	UNA	PV	BN	CP	UNP	Total Ama	Total
May-14	Corozal	52	4	6					62	62
May-14	Tichana	93	9	25					127	127
May-14	Esquipulas	70	5	10					85	85
Apr-14	Peña	81	2	69					152	152
Apr-14	Totoco	104	2	13					119	119
Apr-14	Merida	201	2	23					226	226
Apr-14	Pul	65	2	6					73	73
Nov-14	Corozal	62	57	7					126	126
Nov-14	Tichana	160	168	13					341	341
Nov-14	Esquipulas	82	13	25					120	120
Nov-14	Peña	233	15	27					275	275
Nov-14	Totoco	158	92	30					280	280
Nov-14	Merida	220	80	10					310	310
Nov-14	Pul	90	20	0					110	110
Apr-15	Corozal	15	0	0	0	0	0	0	15	15
Apr-15	Tichana	98	3	39	62	123	0	0	140	325
Apr-15	Esquipulas	19	0	2	515	55	0	0	21	591
May-15	Peña	394	8	0	469	2	0	0	402	873
May-15	Totoco	86	8	0	0	4	0	0	94	98
May-15	Merida	160	0	10	119	62	0	0	170	351
May-15	Pul	74	6	0	336	11	0	0	80	427
Dec-17	Tierra Blanco	9	83	0	53	21		0	92	166
Dec-17	Merida	198	6	0	76	14	0	11	204	305
Dec-17	Peña	344	28	0	301	15	0	0	372	688
Jul-18	Peña	397	41	0	747	11	0	0	438	1196
Jul-18	Merida	226	8	0	278	0	0	0	234	512

Jul-18	Totoco	176	128	15	14	29	13	0	319	375
Jul-18	Palma	219	269	0	63	50	0	0	488	601
Jul-18	Corazol	60	25	0	4	74	0	0	85	163
Jul-18	Pul	59	9	0	223	127	0	0	68	418
Jul-18	Tichina	142	29	0	203	122	0	0	171	496
Jul-18	Tierra Blanco	32	19	0	38	2	0	0	91	91
Jul-19	Totoco	84	75	8	59	43	11	0	167	280
Jul-19	Totoco	74	130	0	43	21	5	0	204	273
Jul-19	Peña	388	257	7	1077	37	0	0	652	1766
Jul-19	Peña	432	307	9	1180	5	0	0	748	1933
Jul-19	Merida	252	6	0	130	14	0	0	258	402
Jul-19	Merida	228	2	0	127	2	0	0	230	359
Jul-19	Palma	147	266	47	60	5	0	4	460	529
Jul-19	Palma	137	224	23	60	6	0	0	384	450
Jul-20	Merida	372	66	25	275	17	0	0	463	755
Jul-20	Peña	357	301	0	851	60	0	0	658	1569
Jul-20	Palma	161	307	2	82	14	0	0	470	566
Jul-20	Totoco	138	147	8	60	51	11	0	293	415
Aug-20	Merida	326	12	5	84	18	0	0	343	445
Aug-20	Peña	181	29	0	836	70	0	0	210	1116
Aug-20	Palma	97	72	3	33	5	9	0	172	219
Aug-20	Totoco	118	47	0	69	14	6	0	165	254
Total	Not include 2014	6200	2918	203	8527	1104	55	15	9361	19022
Total	2014-2020	7871	3389	467	8527	1104	55	15	11767	21428

Table Trends-5: Distribution summary of all amazons counted over seven years at sites that can compare to other years (not include single transects counted in 2018 and not in other years)

Date	Location	Total	% solos	% pairs	% families	% groups	% chicks
April 2014	Peña	152	8.6%	68.4%	23.0%	0.0%	9.9%
April 2014	Merida	226	7.1%	76.1%	11.5%	5.3%	4.4%
April 2014	Totoco	119	10.9%	60.5%	23.5%	5.0%	8.4%
April 2014	Pul	73	16.4%	60.3%	13.7%	9.6%	5.5%
May 2014	Corazol	62	8.1%	67.7%	24.2%	0.0%	8.1%
May 2014	Tichina	127	3.1%	59.8%	22.8%	14.2%	10.2%
May 2014	Esquipulas	85	4.7%	47.1%	41.2%	7.1%	22.4%
November 2014	Peña	493	13.2%	73.0%	11.0%	2.8%	4.5%
November 2014	Merida	592	10.0%	64.2%	10.6%	15.2%	4.6%
November 2014	Totoco	528	9.5%	66.7%	21.4%	2.5%	8.9%
November 2014	Pul	227	11.0%	67.0%	22.0%	0.0%	8.8%
November 2014	Corazol	384	7.3%	63.5%	23.7%	5.5%	10.2%
November 2014	Tichina	588	7.0%	64.3%	23.6%	5.1%	9.7%
November 2014	Esquipulas	222	12.6%	76.6%	10.8%	0.0%	5.4%
May 2015	Peña	672	13.2%	73.0%	11.0%	2.8%	6.4%
May 2015	Merida	290	10.0%	64.2%	10.6%	15.2%	5.2%
May 2015	Totoco	231	3.9%	53.7%	18.6%	23.8%	9.1%
May 2015	Pul	112	11.0%	67.0%	22.0%	0.0%	12.5%
April 2015	Corazol	50	7.3%	63.5%	23.7%	5.5%	6.0%
April 2015	Tichana	268	7.0%	64.3%	23.6%	5.1%	7.5%
April 2015	Esquipulas	21	12.6%	76.6%	10.8%	0.0%	9.5%
December 2017	Peña	372	8.6%	85.5%	5.9%	0.0%	2.2%
December 2017	Merida	204	5.9%	85.3%	8.8%	0.0%	2.9%
December 2017	Tierra Blanco	92	4.3%	54.3%	17.4%	23.9%	6.5%
July 2018	Tierra Blanco	51	7.8%	78.4%	13.7%	0.0%	5.9%
July 2018	Peña	438	5.7%	69.9%	17.8%	6.6%	7.8%

July 2018	Merida	234	9.4%	65.0%	25.6%	0.0%	11.1%
July 2018	Totoco	304	2.0%	48.7%	27.3%	22.0%	13.5%
July 2018	La Palma	488	4.3%	45.5%	12.1%	38.1%	5.7%
July 2018	Pul	68	10.3%	67.6%	22.1%	0.0%	36.8%
July 2018	Corazol	89	9.0%	62.9%	28.1%	0.0%	21.3%
July 2018	Tichana	171	10.5%	53.8%	32.2%	3.5%	2.9%
July 2019	Peña	700	4.0%	53.9%	22.6%	19.6%	9.3%
July 2019	Palma	422	2.7%	56.9%	39.6%	0.8%	15.0%
July 2019	Totoco	186	7.3%	46.4%	32.1%	14.3%	12.7%
July 2019	Merida	244	5.1%	63.9%	30.9%	0.0%	12.9%
July 2020	Peña	660	3.5%	57.0%	24.5%	15.0%	11.5%
July 2020	Palma	468	4.1%	47.9%	28.8%	19.2%	12.6%
July 2020	Totoco	293	5.8%	46.4%	33.1%	14.7%	14.7%
July 2020	Merida	463	5.4%	64.8%	22.2%	7.6%	8.9%
August 2020	Peña	256	9.0%	67.2%	17.6%	6.3%	6.3%
August 2020	Palma	126	6.3%	74.6%	19.0%	0.0%	7.9%
August 2020	Totoco	165	8.5%	57.0%	34.5%	0.0%	13.9%
August 2020	Merida	343	6.4%	67.1%	20.7%	5.8%	9.0%

Table Trends-6: Distribution summary of all yellow-naped amazons counted at four main conservation sites 2018-2020

Date	Location	Total #:	% Solos	% pairs	% families	% groups	% chicks
Jul-18	Peña	397	6.3%	73.6%	17.1%	3.0%	7.1%
Jul-18	Merida	226	8.8%	64.6%	26.5%	0.0%	11.5%
Jul-18	Totoco	176	3.4%	58.0%	27.8%	10.8%	13.1%
Jul-18	Palma	219	5.5%	63.0%	11.0%	20.5%	4.6%
Jul-18	Pul	59	11.9%	67.8%	20.3%	0.0%	6.8%
Jul-18	Corazol	60	11.7%	63.3%	25.0%	0.0%	8.3%
Jul-18	Tichina	142	10.6%	59.2%	30.3%	0.0%	14.8%
Jul-19	Peña	410	5.9%	75.4%	17.1%	1.7%	4.9%
Jul-19	Palma	142	4.2%	68.3%	27.5%	0.0%	8.5%
Jul-19	Totoco	79	8.2%	53.2%	31.0%	7.6%	8.2%
Jul-19	Merida	240	5.2%	64.2%	30.6%	0.0%	12.7%
Jul-20	Peña	357	5.6%	72.8%	16.0%	5.6%	6.4%
Jul-20	Palma	161.00	6.8%	70.8%	22.4%	0.0%	8.7%
Jul-20	Totoco	144.00	7.6%	62.5%	25.7%	4.2%	10.4%
Jul-20	Merida	372.00	6.5%	74.2%	17.7%	1.6%	6.5%
Aug-20	Peña	181.00	9.9%	79.6%	10.5%	0.0%	3.3%
Aug-20	Palma	97	7.2%	80.4%	12.4%	0.0%	4.1%
Aug-20	Totoco	118	7.6%	61.0%	31.4%	0.0%	12.7%
Aug-20	Merida	326	6.7%	70.6%	19.0%	3.7%	8.0%

Table Trends-7: Distribution summary of all red-lored amazons counted at four main conservation sites 2018-2020

Date	Location	Total #:	% solos	% pairs	% families	% groups	% chicks
Jul-18	Peña	41	0.0%	34.1%	24.4%	41.5%	14.6%
Jul-18	Merida	8	25.0%	75.0%	0.0%	0.0%	0.0%
Jul-18	Totoco	128	0.0%	35.9%	26.6%	37.5%	14.1%
Jul-18	Palma	269	3.3%	31.2%	13.0%	52.4%	5.6%
Jul-18	Pul	9	0.0%	66.7%	33.3%	0.0%	11.1%
Jul-18	Corazol	25	4.0%	72.0%	24.0%	0.0%	8.0%
Jul-18	Tichina	29	10.3%	27.6%	41.4%	20.7%	20.7%
Jul-19	Peña	282	1.2%	23.0%	30.7%	45.0%	15.8%
Jul-19	Palma	245	2.0%	48.6%	48.0%	1.4%	21.0%
Jul-19	Totoco	102	6.8%	41.0%	32.2%	20.0%	15.6%
Jul-19	Merida	4	0.0%	50.0%	50.0%	0.0%	25.0%
Jul-20	Palma	307	2.6%	35.8%	32.2%	29.3%	14.7%
Jul-20	Peña	301	1.0%	37.9%	34.9%	26.2%	17.6%
Jul-20	Totoco	147	4.1%	31.3%	35.4%	29.3%	16.3%
Jul-20	Merida	66	0.0%	18.2%	37.9%	43.9%	19.7%
Aug-20	Palma	72	6.9%	38.9%	31.9%	22.2%	12.5%
Aug-20	Peña	29	3.4%	55.2%	41.4%	0.0%	20.7%
Aug-20	Totoco	47	10.6%	46.8%	42.6%	0.0%	17.0%
Aug-20	Merida	12	0.0%	0.0%	33.3%	66.7%	16.7%

Table Trends-8: Relative density summary for all species counted at the four main conservation sites arranged by year - 2015-2020

Date	Location	NA	FR	UNA	PV	BN	CP	UNP	Total
May-15	Merida	45.6%	0.0%	2.8%	33.9%	17.7%	0.0%	0.0%	351
May-15	Peña	45.1%	0.9%	0.0%	53.7%	0.2%	0.0%	0.0%	873
May-15	Totoco	87.8%	8.2%	0.0%	0.0%	4.1%	0.0%	0.0%	98
Jul-18	Merida	44.1%	1.6%	0.0%	54.3%	0.0%	0.0%	0.0%	512
Jul-18	Palma	36.4%	44.8%	0.0%	10.5%	8.3%	0.0%	0.0%	601
Jul-18	Peña	33.2%	3.4%	0.0%	62.5%	0.9%	0.0%	0.0%	1196
Jul-18	Totoco	46.9%	34.1%	4.0%	3.7%	7.7%	3.5%	0.0%	375
Jul-19	Merida	62.7%	1.5%	0.0%	32.3%	3.5%	0.0%	0.0%	402
Jul-19	Merida	63.5%	0.6%	0.0%	35.4%	0.6%	0.0%	0.0%	359
Jul-19	Palma	27.8%	50.3%	8.9%	11.3%	0.9%	0.0%	0.8%	529
Jul-19	Palma	30.4%	49.8%	5.1%	13.3%	1.3%	0.0%	0.0%	450
Jul-19	Peña	22.0%	14.6%	0.4%	61.0%	2.1%	0.0%	0.0%	1766
Jul-19	Peña	22.3%	15.9%	0.5%	61.0%	0.3%	0.0%	0.0%	1933
Jul-19	Totoco	30.0%	26.8%	2.9%	21.1%	15.4%	3.9%	0.0%	280
Jul-19	Totoco	27.1%	47.6%	0.0%	15.8%	7.7%	1.8%	0.0%	273
Jul-20	Merida	49.3%	8.7%	3.3%	36.4%	2.3%	0.0%	0.0%	755
Jul-20	Peña	22.8%	19.2%	0.0%	54.2%	3.8%	0.0%	0.0%	1569
Jul-20	Palma	28.4%	54.2%	0.4%	14.5%	2.5%	0.0%	0.0%	566
Jul-20	Totoco	33.3%	35.4%	1.9%	14.5%	12.3%	2.7%	0.0%	415
Aug-20	Merida	73.3%	2.7%	1.1%	18.9%	4.0%	0.0%	0.0%	445
Aug-20	Peña	16.2%	2.6%	0.0%	74.9%	6.3%	0.0%	0.0%	1116
Aug-20	Palma	44.3%	32.9%	1.4%	15.1%	2.3%	4.1%	0.0%	219
Aug-20	Totoco	46.5%	18.5%	0.0%	27.2%	5.5%	2.4%	0.0%	254

Table Trends-9: Relative density summary for all species counted at the four main conservation sites arranged by site - 2015-2020

Date	Location	NA	FR	UNA	PV	BN	CP	UNP
May-15	Merida	45.6%	0.0%	2.8%	33.9%	17.7%	0.0%	0.0%
Jul-18	Merida	44.1%	1.6%	0.0%	54.3%	0.0%	0.0%	0.0%
Jul-19	Merida	62.7%	1.5%	0.0%	32.3%	3.5%	0.0%	0.0%
Jul-19	Merida	63.5%	0.6%	0.0%	35.4%	0.6%	0.0%	0.0%
Jul-20	Merida	49.3%	8.7%	3.3%	36.4%	2.3%	0.0%	0.0%
Aug-20	Merida	73.3%	2.7%	1.1%	18.9%	4.0%	0.0%	0.0%
Jul-18	Palma	36.4%	44.8%	0.0%	10.5%	8.3%	0.0%	0.0%
Jul-19	Palma	27.8%	50.3%	8.9%	11.3%	0.9%	0.0%	0.8%
Jul-19	Palma	30.4%	49.8%	5.1%	13.3%	1.3%	0.0%	0.0%
Jul-20	Palma	28.4%	54.2%	0.4%	14.5%	2.5%	0.0%	0.0%
Aug-20	Palma	44.3%	32.9%	1.4%	15.1%	2.3%	4.1%	0.0%
May-15	Peña	45.1%	0.9%	0.0%	53.7%	0.2%	0.0%	0.0%
Jul-18	Peña	33.2%	3.4%	0.0%	62.5%	0.9%	0.0%	0.0%
Jul-19	Peña	22.0%	14.6%	0.4%	61.0%	2.1%	0.0%	0.0%
Jul-19	Peña	22.3%	15.9%	0.5%	61.0%	0.3%	0.0%	0.0%
Jul-20	Peña	22.8%	19.2%	0.0%	54.2%	3.8%	0.0%	0.0%
Aug-20	Peña	16.2%	2.6%	0.0%	74.9%	6.3%	0.0%	0.0%
May-15	Totoco	87.8%	8.2%	0.0%	0.0%	4.1%	0.0%	0.0%
Jul-18	Totoco	46.9%	34.1%	4.0%	3.7%	7.7%	3.5%	0.0%
Jul-19	Totoco	30.0%	26.8%	2.9%	21.1%	15.4%	3.9%	0.0%
Jul-19	Totoco	27.1%	47.6%	0.0%	15.8%	7.7%	1.8%	0.0%
Jul-20	Totoco	33.3%	35.4%	1.9%	14.5%	12.3%	2.7%	0.0%
Aug-20	Totoco	46.5%	18.5%	0.0%	27.2%	5.5%	2.4%	0.0%

Table Trends-10: Total numbers of species counted at four main conservation sites with relative density of each year (corrected Peña 2018)

Date	Location	NA	FR	UNA	PV	BN	CP	UNP	Total
Jul-18	Merida	226	8	0	278	0	0	0	512
Jul-18	Palma	219	269	0	63	50	0	0	601
Jul-18	Peña	397	41	0	747	11	0	0	1196
Jul-18	Totoco	176	128	15	14	29	13	0	375
Total 2018		1018	446	15	1102	90	13	0	2684
Total 2018 %		37.9%	16.6%	0.6%	41.1%	3.4%	0.5%	0.0%	
Jul-19	Merida	252	6	0	130	14	0	0	402
July 19	Merida	228	2	0	127	2	0	0	359
Jul-19	Palma	147	266	47	60	5	0	4	529
Jul-19	Palma	137	224	23	60	6	0	0	450
Jul-19	Peña	388	257	7	1077	37	0	0	1766
Jul-19	Peña	432	307	9	1180	5	0	0	1933
Jul-19	Totoco	84	75	8	59	43	11	0	280
Jul-19	Totoco	74	130	0	43	21	5	0	273
Total 2019		978	769	24	2359	106	16	0	4252
Total 2019 %		23.0%	18.1%	0.6%	55.5%	2.5%	0.4%	0.0%	
Jul-20	Merida	372	66	25	275	17	0	0	755
Jul-20	Palma	161	307	2	82	14	0	0	566
Jul-20	Peña	357	301	0	851	60	0	0	1569
Jul-20	Totoco	138	147	8	60	51	11	0	415
Total July 2020		1028	821	35	1268	142	11	0	3305
Total July 2020 %		31.1%	24.8%	1.1%	38.4%	4.3%	0.3%	0	
Aug-20	Merida	326	12	5	84	18	0	0	445
Aug-20	Palma	97	72	3	33	5	9	0	219
Aug-20	Peña	181	29	0	836	70	0	0	1116
Aug-20	Totoco	118	47	0	69	14	6	0	254
Total		722	160	8	1022	107	15	0	2034
Total %		35.5%	7.9%	0.4%	50.2%	5.3%	0.7%	0.0%	

Table Trends-11: Distribution of groups of all species all transects in 2018-2020. This is a more detailed description of groups than simply saying “groups” (First 2018 listing is for 14 transects, and the second only for the four main sites. In 2019 we counted each site twice so the second listing is the average between two counts conducted at the same site within a few days).

2018 All 14 Sites:										
	Solos	Pairs	3-5	6-10	11-20	21-50	51-100	>100	Total	
NA 2018	134	1316	419	91	11	0	0	0	1971	
FR 2018	28	168	49	26	6	0	0	0	820	
PV 2018	16	156	79	57	45	28	10	4	4066	
BN 2018	2	69	28	19	12	1	0	0	597	
CP 2018	0	0	0	4	0	0	0	0	27	
2018 Only 4 Main Sites										
	Solos	Pairs	3-5	6-10	11-20	21-50	51-100	>100	Total	
NA 2018	63	339	57	9	1	0	0	0	1018	
FR 2018	11	75	20	18	5	0	0	0	446	
PV 2018	2	41	17	9	13	11	5	0	1102	
BN 2018	1	11	7	1	2	0	0	0	90	
CP 2018	0	0	0	2	0	0	0	0	13	
2019 Two count per 4 Main Sites										

NA 2019	98	602	120	4	0	0	0	0	1742	
R 2019	31	228	126	15	6	4	0	0	1267	
PV 2019	8	64	37	36	31	29	6	1	2736	
BN 2019	5	31	10	4	0	0	0	0	133	
CP 2019			2	1	0	0	0	0	16	
2019 Average for 4 Main Sites										
	Solos	Pairs	3-5	6-10	11-20	21-50	51-100	>100		
NA 2019	49	301	60	2	0	0	0	0	871	
FR 2019	15.5	114	63	7.5	3	2	0	0	633.5	
PV 2019	4	32	18.5	18	15.5	14.5	3	0.5	1368	
BN 2019	2.5	15.5	5	2	0	0	0	0	66.5	
CP 2019	0	0	1	0.5	0	0	0	0	8	
2020 Only 4 Main Sites										
	Solos	Pairs	3-5	6-10	11-20	21-50	51-100	101-150		
NA 2020	66	370	60	4	0	0	0	0	1028	
FR 2020	17	141	73	15	9	0	0	0	821	
PV 2020	7	56	30	23	21	8	4	0	1268	
BN 2020	0	19	6	4	0	1	0	0	142	
CP 2020	0	2	0	1	0	0	0	0	11	

Table Trends-12. Exact breakdown of each group in four main areas 2018-2020

	Total #	Solos	Pairs	3s	4s	5s	6s	7s	8s	9s	10s	11	12	13	14	15	16	17	18	19	20
NA 2018	1971	134	658	74	33	13	8	5	1			1									
FR 2018	820	28	168	21	16	12	13	4	5	3	1	0	1	1	2	1	0	0	1		
PV 2018	4066	16	156	23	46	10	16	7	10	8	16	5	5	3	5	13	1	3	3	1	6
BN 2018	597	2	69	8	13	7	10	1	3	1	4	0	2	1	3	2	1	1	0	0	2
FN 2018	27	0	0	0	0	0	1	3													
NA 2019	1742	98	602	76	34	10	3	0	1												
FR 2019	1267	31	228	56	40	30	4	2	3	3	3	1	2	1				1			1
PV 2019	2736	8	64	8	16	13	18	3	7	2	6	4	5	1	4	8	4	1	1		3
BN 2019	133	5	31	2	6	2	3	0	1												
FN 2019	16					2	1														
July 2020																					
NA 2020	1028	66	370	46	12	2	3		1												
FR 2020	821	17	141	28	28	17	6	2	5		2		6	1			1	1			
PV 2020	1268	7	56	30	0	0	12	4	2	1	4	4	2	2	4	2	2	1	0	0	4
BN 2020	142	0	19	2	3	1	2			1	1										
FN 2020	11	0	2					1													
August 2020																					
NA 2020	722	56	262	26	8	4	2														
FR 2020	160	11	33	9	8	0	0		3												
PV 2020	1022	3	32	6	15	3	4	1	4	4	4	1	3		1	2	2		1	1	4
BN 2020	107	1	20	1	2	2	0	1	2		1		1								
FN 2020	15	0	0	0	0	0	1	0	0	1											

	21-30	40	50	60	70	80	90	100	101-150	151-200	201-250	251-300
NA 2018												
FR 2018												
PV 2018	(30)(25)(25)(21)(30)(26)(30)(22)(25)(30)(22)(23)(24)	(40)(40)(35)(31)(35)(34)(40)(40)(40)(33)(40)	(50)(44)(43)(50)	(60)(60)(60)(60)(60)	(70)(66)(70)	(80)(80)			(150)(120)(104)			292
BN 2018	(24)											
FN 2018												
NA 2019												
FR 2019	(26)(26)(25)(21)											
PV 2019	(26)(23)(26)(30)(30)(30)(25)(24)(24)(30)(24)(23)(30)(30)(25)(28)(30)	(40)(40)(40)(35)(34)(35)(40)	(50)(50)(50)(49)(50)	(60)(60)		(80)(80)		(100)(100)(100)	(150)			
BN 2019												
FN 2019												
July 2020												
NA 2020												
FR 2020	(21)											
PV 2020	(22)(22)(27)(30)(22)	(34)	(48)(49)	(54)	(68)	(72)		(100)				
BN 2020			(50)									
FN 2020												
August 2020												
NA 2020												
FR 2020												
PV 2020	(21)(22)(22)(26)(28)(25)(26)(25)(24)(24)(22)(23)(24)	(30)(35)	(44)(40)									
BN 2020												
FN 2020												

Photographs

(Rare sighting of crimson-fronted parakeet on Ometepe Island – photo by Norlan Zambrana)



2013

(Pacific parakeets in Peña, Andrea counting in Peña, Andrea and LoraKim counting in rain)





2014

(Counting early in the morning, - Emerson, Norlan, Levis, Abel Gonzalez, juvenile yellow-naped amazon flock Totoco)



2015

(Orange-chinned parakeets Merida, yellow-naped amazons with lots of yellow on neck Peña,
counting crew with beginning training Peña – Roxanne, Yilmer,, Levis, Norlan, Emerson)





2016

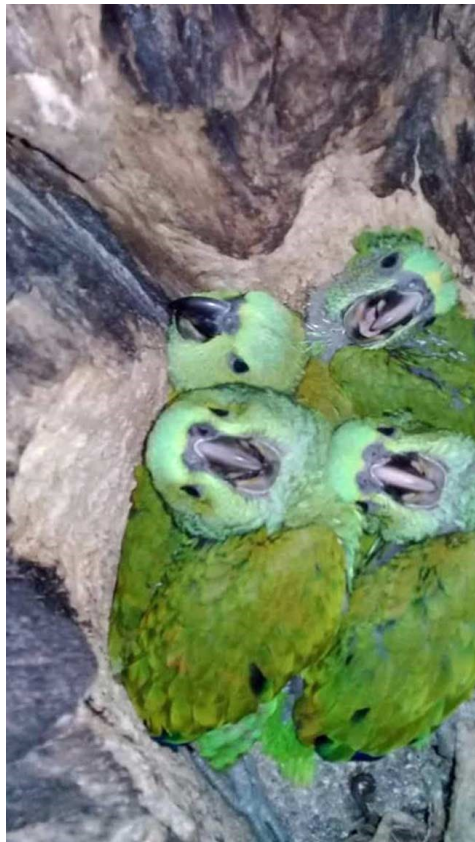
(LoraKim counting at a point in Totoco, Pacific parakeet eating flowers Merida, Tabulating results after the count – Marciel, Norlan, Levis, Yilmer)





2017

(Climb team Peña – LoraKim, Norlan, Francisco, Emerson, Hector rescuing Hector/Time Bomb
Remarkable nest with four Yellow-naped amazon chicks in Merida, FFI staff with governmental
employees, Counting in Peña – Julio)





2018

(Our first liberation Merida of Time Bomb - photo by Christiana Martynowski, education program Peña, count Palma)



2019

(Fighting wildfire Peña – Levis, Adonis, Marlon, Norlan, training pre-count 2019, training count
Palma – Enry, Heydi, Marlon, Numa)





2020

(Community gathering Palma, students with poster, female on nest with chicks Merida– photos by Norlan Zambrana)



