

CHAPTER TWO

GENERAL METHODS

Introduction

Puerto Rican Parrots are monomorphic cavity nesters and it is believed that pair-bonds between mated adults are stable from one breeding season to the next. However, without marked birds this can not be confirmed and is at best a generally accepted assumption. Although there are no marked birds, i.e. birds with color bands that can be easily identified using a pair of binoculars, a number of individuals in this study could be identified by other means, i.e. two males had radio-collars from an earlier radio-telemetry study and one male had a misplaced red cheek feather which persisted through successive moults.

According to Snyder et al. (1987), pair members stay together at all times of the year. During the non-breeding season, reproductive pairs, young of the year and non-breeding birds form larger flocks, while during the breeding season, with a few exceptions, mated pairs separate from the larger flock and defend a nest site. However, the male of a mated pair frequently leaves with a larger group of birds during the day to forage while the female remains in the nest cavity. Non-breeding birds, which often form “floater” flocks during the breeding season, are thought to consist largely of (1) sub-adults (Puerto Rican Parrots do not generally form stable pair-bonds until they are at least two years old) and (2) unpaired adults (Snyder et al. 1987). Unpaired adults enter the breeding population by pairing with an individual of an established pair after the loss of its mate or by usurping an individual already a member of an established mated pair. It appears that some sub-adult pairs actually establish a territory before searching for a nest cavity. These pairs tend to settle next to already established territorial pairs and this accounts for the long term stability of parrot nesting areas (Snyder et al. 1987). However, these areas are by no means permanent. In the years following Hurricane Hugo in 1989, one traditional nesting area was deserted and two new ones were established.

Stages of the Breeding Cycle

In the following section I will give a general description of each stage of the breeding cycle as I observed them during this study. I have split the reproductive cycle into five generally accepted divisions: nest inspection, incubation, nestling, and fledging.

Nest Inspection. Breeding activities begin with inspection of the potential nest cavities. The male usually enters a potential nest cavity first, followed by the female. This inspection is accompanied by chewing on the bark inside the cavity and an almost continuous string of soft vocalizations audible only with the use of the microphone inserted into each nest cavity. At this stage in the cycle the pair usually roosts in their nesting area overnight, leaving it early in the morning to forage and returning two or three times throughout the day to inspect the cavity and engage in vocal interactions with neighboring pairs or intruders. Both pair members defend their breeding territory together and this stage is marked by loud vocal duets between neighboring pairs and conflicts with Pearly-eyed Thrashers vying with the parrots for nest cavities. After the cavity has been selected by the pair, copulation takes place and eggs are laid, demarcating the beginning of the incubation stage.

Incubation. Immediately prior to laying eggs the female begins to spend a large part of the day in the nest cavity. After the first egg is laid the female will also spend the night in the cavity. Eggs are hatched asynchronously, usually about two days apart, and clutch sizes average three eggs per clutch. The incubation period, usually 26 days, is thought to be highly synchronized seasonally with most clutches produced in late February to early March. This stage generally coincides with the peak fruiting period for the sierra palm, the primary fruit of the breeding season (Snyder et al. 1987).

During incubation females generally will not leave the nest cavity other than to be fed by the male or assist the male in territorial defense. Occasionally the female will come to the lip of the cavity if a Pearly-eyed Thrasher has tried to enter the cavity but generally at this stage a female sitting on eggs will rarely respond to a Pearly-eyed Thrasher in the nest tree. The Pearly-eyed Thrasher is apparently no match for an incubating female and there are reports of thrasher remains being found in a nest cavity during a routine nest check.

The male spends the majority of time foraging during this stage. He returns to the vicinity of the nest tree at least three to seven times a day to feed the female. Males normally do not enter the nest cavity during incubation, though there are exceptions to this. Usually, upon the male's return to the vicinity of the nest tree, he will call loudly to the female until she leaves the nest cavity. They then fly a short distance together. The pair may vocalize loudly for a short time, sometimes intensely if there is a neighboring pair nearby. The feeding is usually brief, and as the possibility of losing eggs to thrashers entering the nest cavity at this time is great. If there are hawks circling the area or other possible dangers the male will enter the area silently and call softly while he is perched in or beside the nest tree, presumably to avoid giving away the location of the nest cavity to potential predators.

Nestling Stage. At the beginning of this stage the female remains in the nest cavity for most of the day. After about a week, when all chicks have hatched, the female begins to accompany her mate on foraging trips. Most of these trips are away from the nesting area. At this time the female once again takes part in vocal duets with the male, most often in response to hearing vocalizations produced by neighboring pairs. In certain areas where a nesting pair has no neighbors, these bouts seemingly serve no purpose outside of communication between pair-mates, and the vocal bouts tend to be shorter in duration in these areas.

Fledging. Chicks fledge at approximately nine weeks. Once they have flown from the nest cavity they do not return. However, the adults and chicks appear to remain in the nesting territory for several days before joining foraging flocks which are thought to form after chicks in an area have fledged. Details about activities in the post-fledging stage are not well known. At this stage, while chicks and adults are still within their nesting areas, vocalizations, the majority being squeaks and contact calls, are kept to a minimum and are given very softly. Whether there is a change in vocal behavior later when chicks and adults form flocks is not known.

Study Area

This study was conducted in the Caribbean National Forest in the Luquillo Mountains of Puerto Rico. Recording was carried out at six known nest sites, four of these located in palo colorado forest on the west side of the forest in the El Verde region, and two located on the eastern side of the forest in the Bisley sector. One of these nests was in palo colorado forest while the other was

in the tabonuco forest zone. All nest cavities were located in palo colorado trees except for the one located in the tabonuco zone. This nest cavity was in a tabonuco tree.

Recording was carried out in blinds, approximately 30 m from nest trees, most of which were elevated approximately 2-3 m above the ground. The support structures for the blinds were constructed of aluminum posts painted green. The blind itself was a wooden skeleton 2 m high by 2 m long by 1.5 m wide, constructed from wooden planks draped by camouflage canvas and/or netting. One-way mirrors were installed on three sides of the blind for viewing the nest tree and the surrounding area. Although an effort was made to conceal the blinds it was apparent that the nesting pairs, especially the females, were aware of their existence (pers. obs.). The original blinds were constructed as close as 6m from the nest tree and as a result any noise made by an observer in the blind, i.e. a sneeze or dropped pen, would often bring the female to the lip of the nest cavity. The female would then typically spend 5-10 minutes staring directly at the blind before returning into the cavity. The blinds used in this study were newly constructed to avoid disturbance to the nesting pair and while they have achieved this for the most part, the parrots still exhibited awareness of the blind's existence.

Subjects

Six nesting pairs were recorded over two breeding seasons from January - July or from the beginning of the nest inspection stage to the post-fledgling stage. Located on the west side of the forest were four breeding pairs. I will briefly describe the breeding chronology of each.

South Fork 2B. 1992 Breeding Season: No unusual events; Three eggs were layed, one egg did not hatch and two chicks fledged successfully.

1993 Breeding Season: No unusual events; Three eggs were layed and three chicks hatched. One of the chicks was placed in a nest on the eastern side of the forest and the chicks all fledged successfully.

Quebrada Grande. 1992 Breeding Season: This pair was one of the new breeding pairs established after Hurricane Hugo in an area near the other three nesting territories in this region, but in which no parrots had been sighted in recent years. Three eggs were layed and hatched,

and one chick was placed in a nest on the eastern side of the mountains in East Fork 3. All chicks fledged successfully.

1993 Breeding Season: No unusual events; Two chicks hatched and fledged successfully.

South Fork 2A. 1992 Breeding Season: No unusual events; From three eggs, one chick died while two fledged successfully.

1993 Breeding Season: Three eggs were laid in mid-February; On February 19th U.S. Fish and Wildlife Service biologists performed an experimental procedure in which eggs were dipped in a solution to prevent the growth of a fungus, aspergillus, thought to account for a number of dead-in-shell embryos in another nest on the opposite side of the forest (East Fork 3).

Unfortunately the fungicidal solution, which required heating before use, was not allowed to cool adequately, and two embryos died in the shell. One chick hatched, but died soon after from pneumonia probably as a result of this procedure. It is not clear why this procedure was used at a nest that had never exhibited any signs of aspergillus growth. This pair produced a second clutch from which two chicks fledged successfully, but only after expending a considerable amount of energy conflicting with a resident pair of thrashers for its nest cavity. Thrasher boxes had been removed at the beginning of the year and this thrasher pair had not yet found a suitable replacement cavity. Three eggs were laid in mid-February; This clutch was lost due to the use of an experimental management procedure. This pair produced a second clutch from which two chicks fledged successfully, but only after expending a considerable amount of energy conflicting with a resident pair of thrashers for its nest cavity. Thrasher boxes had been removed at the beginning of the year and the resident thrasher pair had not yet found a suitable replacement cavity.

South Fork 1A. 1992 Breeding Season: This pair had recently moved to a cavity close to their original cavity. This pair's new cavity was topped with a metal overhanging "roof" to prevent rain from accumulating inside. The original cavity had been destroyed during Hurricane Hugo and although U. S. Fish and Wildlife Service biologists had replaced the original cavity with one constructed from PVC (polyvinyl chloride), it was not used. Experiments conducted to determine optimum nest cavity dimensions for parrots confirmed that pairs generally search out deep, dark cavities which, often because of the direction they are facing, let in little if any

sunlight (Snyder et al. 1987). The bright white interior of the replacement cavity therefore may have inhibited its use as a nest cavity. This pair produced four eggs. Pearly-eyed Thrashers took one egg, one chick died, one chick was placed in a nest on the eastern side of the forest and a third chick survived to fledge successfully. Pearly-eyed Thrasher harassment was particularly evident this year. The thrasher box had been placed directly next to the entrance vine that led to the parrot's cavity, which may have facilitated interaction between thrashers and parrots (See Snyder et al. 1987). In addition this pair of parrots nested later in the season than usual and the laying of their eggs coincided with the peak reproductive period for thrashers thus rendering their nest more vulnerable to predation by thrashers in search of a suitable cavity.

1993 Breeding Season: U. S. Fish and Wildlife Service biologists removed the thrasher box used by thrashers in the area in 1992. However, conflict continued in 1993, and this pair is thought to have lost one to two clutches early in the season to thrashers. The third clutch produced was also partially predated but one chick survived to fledging.

The nest cavity of the SF1A pair was located in an area of fruiting trees used by the parrots and it was not uncommon for a flock of five to ten individuals to be foraging in this area. The nesting pair was tolerant of this flock unless individuals from the flock approached the nest tree, at which point they were generally chased by the male of the nesting pair. During the early part of the nesting season in 1993, one individual was observed in the flock with a bulge around its neck and some accompanying feather loss. Late in the season (approximately June) the resident South Fork 1A male disappeared and was very quickly replaced (over a matter of two to three days) by the male described above. The bulge was ascertained to be a radio-collar which had been placed on this individual in the late 1980s as part of a radio-telemetry experiment. The collar was designed to fall off the subjects within a year but at least two birds still had these collars attached four years later. This new male was apparently replaced in the 1994 breeding season by yet a third male.

Located on the east side of the forest were two pairs:

East Fork 3. 1992 Breeding Season: This nest was thought to be contaminated with *Aspergillus*. Although this pair lays three eggs each year, for a number of years only one chick per year has hatched successfully. Three eggs were produced, from which one embryo was dead-in-shell, one

chick died while pipping and the third chick survived and was later joined by another chick translocated from the western side of the forest (a chick from the Quebrada Grande pair). These chicks fledged successfully.

1993 Breeding Season: Three eggs were laid. One egg didn't hatch, one chick died and a third survived. The surviving chick was later joined by a chick from the western side of the forest (a chick from the South Fork 2B pair) and they fledged successfully.

East Mountain. 1992 Breeding Season: This was the second ostensibly new pair established in an area that had not been occupied by parrots for a number of years. Apart from occupying a new area, this pair was unusual in that it had chosen a tabonuco tree for a nest cavity. While tabonuco trees had been used by parrots in the past for nest sites most of the larger tabonucos had been cut down and the remaining trees were not old enough to develop cavities of the size found in palo colorado trees. The cavity used by this pair was only 48 cm deep, much shallower than the optimal depth of greater than 60 cm suggested by Snyder et al. (1987). In addition the cavity was narrow, which may have been an indirect cause of chick mortality in the following year. No thrashers have been sighted in this area to date, thus reducing the potential threats to the nests of this pair. The possibility that this pair or members of it have bred before in a different location can not be ruled out. The male was at least four years old, verifiable by reactivating a transmitter which had fallen off the male's neck during the breeding season and which was later found in the nest cavity by biologists. Four eggs were produced but three nestlings died as a result of a severe warble fly (*Philornis pici*) infestation in the nest cavity. Flies had been heard in the cavity several days before the death of the chicks, a generally accepted indication of warble fly activity. The fourth chick died some days later. In order to prevent the nest pair from abandoning its nest cavity, biologists placed a chick translocated from South Fork 1A, on the western side of the forest in the nest and this chick fledged successfully.

1993 Breeding Season: The male of this pair disappeared after the 1992 breeding season and the female subsequently re-paired with a new male banded on the left leg. The female was banded on the right leg (same as the previous year). This pair began the breeding season somewhat later than usual in late February, as is often the case with new pairings. Four eggs were laid. Two chicks died, possibly due to the narrowness of the nest cavity, which may have caused some chicks to be trapped under their siblings during feedings, and two survived. Of the two chicks

that survived one was taken to the aviary and two aviary chicks were translocated to the East Mountain nest cavity. The three chicks raised by this pair fledged successfully.

Thus there were 14 subjects in this study, six females and eight males making up a total of six pairs. One additional individual, the third mate of the SF1A female, was included in analyses where there was enough data but recording sessions were limited to three days in March of 1994 and this significantly reduced the amount of information that could be extracted from the recordings of this individual. Although it is generally accepted that these breeding pairs were composed of the same individuals over the course of this study, except where a documented change in individuals took place, I can not prove that this is the case. Therefore for the purpose of testing the plausibility of individual identification through an individual's vocalizations, I did not assume that the individuals of the four stable pairs were the same individuals from one breeding season to the next. It was assumed that the same individuals remained paired over the course of a single breeding season as it is possible to tell by changes in behavior of the pair, vocal and otherwise, that a member of an established pair is lost during the breeding season and the surviving mate re-pairs with a new mate (pers. obs).

Data Collection

Breeding season stages. The breeding season was separated into four stages, pre-laying or nest inspection, incubation, nestling and fledging (these stages are described above). Most recording was carried out during the nest inspection, incubation and nestling stages. Few recordings were made after the chicks had fledged because pairs and their chicks tended to vocalize very little during this time and when they did the vocalizations made were very soft and often at too great a distance from the blind to be recorded successfully.

The six nest sites were visited roughly every two weeks so that equal numbers of recordings could be made at each stage. However, due to some unusual events at certain nest sites, (e.g. see South Fork 2A, East Mountain), vocalizations and interactions between members of a pair were not always representative of a particular stage. Therefore more emphasis is placed on the context in which calls are made rather than the stages in which they occur.

Recording Procedures. Recordings were made using a Marantz cassette recorder, 20dB pre-amplifier, Sennheiser ME-80 shot-gun microphone and TDK 60 minute cassette tapes.

Observation blinds were entered between 0300-0330 hours and exited between 1930-2000 hours in order to set up and dismantle equipment with the least amount of disturbance to the resident pair. Data sheets documenting daily time activity budgets of the resident pair were filled out by U.S. Fish and Wildlife Service personnel upon using a particular blind and these were left in the blind. These time activity budget data sheets provided information regarding when the female left the nest cavity, how long she was away from the nest cavity, how many minutes she was inside the cavity, how many times the male returned to the vicinity of the nest tree presumably to feed the female, if the male entered the nest cavity to feed chicks, and so forth. Under normal circumstances the male returned regularly to the vicinity of the nest tree to feed the female and depending on the stage of the reproductive cycle he may or may not have entered the nest cavity. Although there was slight day to day variation in these times based on factors such as weather condition, these times were relatively consistent within a given stage of the reproductive cycle. These times sometimes changed significantly from one stage to the next. Based on times recorded in the data sheets, the tape-recorder would be started approximately fifteen minutes before the male was to call for the first time in the morning.

From this time on the Marantz tape-recorder was in use while there were parrots within hearing range of the observer in the blind and off or paused when vocalizations had ceased for more than an hour or when parrots had left the area. The "area" is defined as the area surrounding the nesting tree of a particular pair within which vocalizations could be heard.

Upon leaving an area the residents would often make series of two call types, a series of take-off squawks followed by a series of bugles. These call types in combination indicated that an individual would probably be making a long-distance flight or flight longer than a few meters, so that most often the parrot would be moving out of hearing range. Thus upon hearing these calls the tape-recorder could be stopped if the parrot could no longer be heard when the bugle series had ended.

Sometimes however, a parrot would leave the area silently. If a parrot hadn't been heard in the area in an hour, i.e. vocalizations had ceased, the tape-recorder was paused or stopped. The time activity budget data sheets gave a rough estimate as to when a male would normally be foraging and for how long. This could be used to estimate how long the male might be out of the area. It was often possible to hear resident parrots returning to their territory as they would usually return

to an area bugling. However, silent arrivals by resident males were not uncommon. Usually in these cases the female would begin making soft contact calls within the nest cavity. Each nest cavity was equipped with a microphone making it possible for the observer in the blind to hear activity in the nest cavity through a telephone listening device. Due to the distortion of vocalizations when recording from this device, it could not be used in data collection, however, it was possible to estimate the time of the male's arrival by the vocal reaction of the female heard through the listening device. This method was very reliable for predicting when the tape-recorder should be reactivated.

The following information was recorded in a field notebook for each day of observation:

Miscellaneous information:

Date, location of nest cavity (e.g. South Fork 1A, East Fork 3 etc.), weather conditions;

Vocalization information:

1)Time of vocal bouts (e.g. when a bout began, when a bout ended).

2)Identity of bird(s) calling. Usually it was possible to ascertain if it was the resident pair by their proximity to the nest tree. If one pair member could be seen it was assumed that the other pair member was answering its calls. For distant bouts it was difficult to determine the identity of the bird(s) calling, so these bouts were noted and details surrounding the bouts were recorded if possible, but these data were not used in analyses and callers were labeled as unknowns.

3)The individual(s) distance from the nest tree. This was estimated roughly as no measurements could be taken without considerable disturbance to the nest pair. These measurements were relative and because of the inaccuracy associated with them they were used for no more than describing whether the male or female was closer to the shot-gun microphone. For example, if the female was visible from the blind and closer to the blind than the male, her calls would elicit sharper and darker sonographs than those of the male. She would also sound louder on tape than the male. Thus these data could be used later for detailing any sex-specificity in vocal repertoires that exist for a particular pair.

4)Direction of vocalizations relative to the nest tree were taken with a compass. This provided information as to the possible identity of intruder pairs heard answering the resident pair. There

were a number of nesting territories adjacent to each other and this gave an approximation as to which pair may be interacting with the resident pair.

5) Time-activity data were taken from the resident pair. For the male this usually included information as to when he was leaving to forage, in which direction he tended to fly when leaving an area and when he was thought to have returned from foraging, if he fed the female and for how long the pair was together (based on their vocal behavior). For the female, information such as time spent in the nest cavity, how many times and for how long chick(s) were fed by the female, and if there were any unusual events that were causing the female to come to the nest lip frequently (e.g., Pearly-eyed Thrashers entering the nest cavity) was recorded.

6) Contextual information. In some instances the resident pair may have been responding to certain stimuli by vocalizing and these contexts were noted. Some examples include harassment by thrashers in or around the cavity, neighboring conspecific pairs vocalizing etc.