CHAPTER 1

GENERAL INTRODUCTION

Purpose

The purpose of this study is to document the vocal repertoire and behavior of the Puerto Rican Parrot (*Amazona vittata*). Emphasis was placed on examining those call features that may be used in individual, sexual and geographic identification. Few studies have been conducted on the vocal behavior of wild Psittacidae and of those that have focused on description and categorization of repertoires, i.e. Brockway (1969), Pidgeon (1981), Saunders (1983) none have described repertoires as extensive as that used by the Puerto Rican Parrot. Furthermore this study attempts to illustrate the degree of complexity in vocal behavior that exists within at least one species in the genus *Amazona* and to provide a data base of vocalizations that may be compared to that of other species in this genus, possibly illuminating the phylogenetic relationships among the species. Additional objectives included compiling a detailed description of the vocal repertoire of this species with emphasis placed on the use of dialects, antiphonal duets between pair-mates and graded vocalizations.

This chapter serves as a general introduction to the study species. The second chapter describes the reproductive biology of *A. vittata* and general methods utilized in this study. Subsequent chapters address each objective introduced in this first chapter completely and independently. Objectives addressed in this study include: 1) Characterization of the vocal repertoire with emphasis placed on graded call features (chapter three); 2) Dialects (chapter four); 3) Sex-specificity within the vocal repertoire and how this is utilized in pair-mate communication (chapter four); 4) Individual-specificity within the vocal repertoire (chapter five); Management recommendations for the release of captive bred parrots (chapter 6).

In the last 50 years data have been collected on many aspects of the Puerto Rican Parrot's (*Amazona vittata*) life history. The earliest data were collected simply to describe the morphological and behavioral attributes of *A. vittata* (Rodriguez-Vidal 1959). However, as it became more evident that numbers of this critically endangered parrot were steadily decreasing, the motivation behind the research began to change. The decrease in population size was due largely to habitat loss and taking of birds for the pet trade (Snyder et al.

1987). Birds are no longer taken as pets, but habitat loss was permanent. Today there exists only a small population, fewer than 40 birds, in the rainforest of northeastern Puerto Rico (Snyder et al. 1987). In addition to the wild population, there are two aviaries which when combined house fewer than 90 birds (pers. comm. M. Meyers). These aviaries are part of a captive breeding program initiated in the 1970s in an effort to enhance the wild population. This captive breeding program provide a means for boosting numbers in the wild population, and provides a method for enhancing genetic diversity (Snyder et al. 1987; Brock 1994) . Some diversity is lost through death of wild birds especially since there is some spatial segregation within the breeding population. Recently, as a result of increased concern over the Puerto Rican Parrots' declining population size, research has been focused on improving the chance for successful reintroduction and recovery of the species. In light of its possible relevance to reintroduction a study of the vocal behavior of *A. vittata* may prove invaluable.

*A. vittata'*s vocal behavior may play a major role in flock cohesion and coordination and is undoubtedly essential for territorial defense, and pair maintenance and stimulation during the breeding season. In a number of other species for which the above statement is true, some degree of sex- or individual-specificity has been found in the vocal repertoire. Bertram (1970) cites a number of advantages to having a sex-specific repertoire. First, such a repertoire could provide a means of preventing pair-mates from sharing calls with each other. According to Bertram (1970), if any other individual makes one of a bird's call types, it may be mistaken for a rival neighbor. A sex-specific repertoire precludes the mate from producing these call types and thereby triggering aggression. Second, having a sex-specific repertoire would allow an individual to determine the sex of a caller without actually having to see it. This would be advantageous for species such as the Puerto Rican Parrot where the habitat in which they live often makes visual contact between individuals difficult.

In a study on the vocal behavior of the Short-billed White-tailed Black Cockatoo (*Calyptorhynchus funereus latirostris* Carnaby) Saunders (1983) found that both sexual and individual recognition are possible based on an individual's vocal repertoire. Saunders (1983) hypothesized that individual recognition was useful in cavity nesters such as the cockatoo where the female needs to be able to recognize the call of her mate when she hears it from inside the nest cavity. The female's recognition of her mate allows the female to leave the nest only in response to her mate's calls and reduces the time she must spend out of the nest cavity. Female Puerto Rican Parrots inside their nest cavities may possess the ability to recognize their mates by their vocalizations. However, in the absence of play-back experiments it is not known if there is more than one

characteristic in a call that is unique to an individual and if so which one or ones the female uses to identify her mate.

An objective of this study is to identify at least one characteristic of the parrots' vocal repertoire that could be used by biologists, as well as the birds, for recognition of individuals. With a comprehensive knowledge of the species' vocal repertoire, biologists may be able to replace or at least enhance the current method for identifying individual parrots and/or sexing them (Gilbert & MCGregor 1994). Due to a perceived risk of injury or death, it is not permissible to capture and band adult parrots. However, since the mid 1980s young birds have been routinely banded just prior to fledging. Occasionally, a banded bird may be observed perched in trees in the vicinity of a nesting territory but because *A. vittata* occupies large areas of fairly dense vegetation neither the parrots nor their bands (if they're banded) are easily seen. The aluminum bands used do not identify birds individually except in the hand, and therefore can serve to identify birds in the field only in combination with other information.

In addition, an understanding of the vocal behavior of *A. vittata* may help biologists better prepare the birds for release. Puerto Rican Parrots are thought to rely heavily on vocal cues for flock cohesion and group coordination as visual communication between largely green parrots in a densely vegetated rainforest is not always feasible. These parrots roost, forage and move in flocks during the non-breeding season and parts of the breeding season as a defense against predators such as hawks. Therefore knowledge of the vocalizations and vocal behavior of conspecifics in a flock aid in group maintenance during daily activities. In other programs aimed at reintroducing endangered species to areas within their historic range, it appears that if inadequate attention is paid to developing flocking and group coordination skills in individuals to be released, these programs ultimately fail (Snyder 1995). Although lack of flock cohesion and group coordination skills may not be the direct cause of mortality, these skills would raise survival rates of captive-bred individuals. These individuals often lack a natural tendency to flock, leaving them vulnerable to attacks by predators and reducing their chances of encountering potential mates (Snyder 1995). Also lack of appropriate vocal behavior could preclude successful pairing in the wild, or interfere with the coordination between mates required for successful reproduction.

Description and Origin

The Puerto Rican Parrot is generally green in color, the outer primaries are blue, the forehead and lores are red, the feet and bill are flesh colored and a white eye-ring is present. The adult is about 30-33 cm in length and weighs roughly 240 g (Snyder et al. 1987). The sexes are monomorphic and, aside from

behavioral differences observed during the breeding season, there are no reliable, non-invasive methods for telling them apart short of using DNA-sexing techniques. In addition to *Amazona vittata vittata* there is at least one now extinct smaller subspecies, *A.v. gracilipes,* described from Culebra and Vieques, islands off the eastern shores of Puerto Rico (Wadsworth, 1952).

According to Snyder et al. (1987) there were probably 12 species of West Indian *Amazona* parrots of which nine persist today. Most of these nine species are presently threatened with extinction due primarily to deforestation and taking of birds for the pet trade. Based on external features, Snyder et al. (1987) place the West Indian *Amazona* species into two groups, a Lesser Antillean group of seven large species and a Greater Antillean Group of five smaller species with white eye-rings. Parrots in the Greater Antillean group including *A. vittata* closely resemble Central American species. Species in the Lesser Antillean group are much larger, weighing close to ten times as much as Greater Antillean species. The size differential, and differences in coloration between the two groups have led to speculation that the Lesser Antillean species originated elsewhere, probably in South America. However, there are no extant relatives found in South America and only one species, *A. dufresniana dufresniana*, vaguely resembles members of the Lesser Antillean group(Snyder et al. 1987).

There is much debate about which Central American species may have given rise to the Greater Antillean group. Existing phylogenies are based on external morphology alone and until a definitive phylogeny is created for this genus based on more reliable techniques the debate can not be settled. Bond (1963) and Lack (1976) chose *A. albifrons* as the common ancestor of all Greater Antillean Parrots. Lack (1976) based his claims on four plumage colors (forewing, forehead, chin, and abdomen) and two series of measurements (bill depth and wing length). He devised the following evolutionary scenario: The White-fronted Amazon (*A. albifrons*) gave rise to the Cuban Amazon (*A. leucocephala*) which in turn gave rise to the Jamaican Yellow-billed Amazon (*A. collaria*) and the Hispaniolan Amazon (*A. ventralis*). *A. ventralis* then gave rise to *A. vittata*. The Black-billed Amazon of Jamaica (*A. agilis*) was considered to be the result of a separate invasion by *A. albifrons* from the "Honduran-Nicaraguan bulge".

Snyder et al. (1987) state that "while much of Lack's analysis appears reasonable there are a number of shortcomings." Lack based most of his analysis on size and according to Snyder et al. (1987) this is extremely unreliable as a guide to relationships. In addition Lack failed to consider what Snyder et al. (1987) describe as a "remarkable similarity of the Puerto Rican Parrot to the Jamaican Black-billed Parrot." Snyder et al. (1987), in an effort to sort out some of the evolutionary relationships in this genus,

examined 369 sexed specimens in 1976. After extensive analysis of these skins which involved comparisons of coloration of certain body elements, Snyder et al. (1987) concluded that the balance of evidence from color patterns favors a common ancestry with *A. agilis*.

Present Distribution

The Puerto Rican Parrot was thought to have inhabited all forest types that once covered the island (Snyder et al. 1987). However, around 1650 a major increase in the island's human population resulted in a rapid loss of these forested habitats previously used by the parrot. By the beginning of the 20th century the species had become extinct on all offshore islands and was restricted to five areas on the mainland. Two of these areas were in Karst-limestone habitat, two were located in high montane rain forests and one was located in a mangrove forest at the foot of the Luquillo Mountains. By the 1940s the range of the last population was reduced to an area of primary forest in northeastern Puerto Rico, the Luquillo rainforest (Snyder et al. 1987).

The Luquillo Mountains contain two percent of the total surface area of the island. The average rainfall is 457 cm, the highest of any habitat type on the island and the humidity remains generally between 90-100 percent. The average temperature is 21 degrees Celsius (Rodriguez-Vidal 1959).

Vegetation types occupied by the parrot in the Luquillo rainforest include: tabonuco forest, palo colorado forest and sierra palm forest (Wadsworth 1952). Tabonuco forest comprises tall trees limiting light penetration at ground level. Approximately 168 species of hardwood trees make this forest type the most diverse of the three forest zones. It covers lower mountain slopes extending over some 5430ha and does not extend above 600 m in elevation. Tabonuco (*Dacryodes excelsa*), the most abundant tree of this zone, can grow to heights exceeding 35-40 m and trunk diameters occasionally grow upwards of 1.5 m. Prior to the logging of larger individuals this species was likely of great utility to the parrots for fruit during the fall and winter and nest sites during the breeding season (Snyder et al. 1987).

The sierra palm zone is located within both the tabonuco zone and the zone above this, the palo colorado forest, and covers about 2050 ha within the national forest. Sierra palm forest is most dominant just below the dwarf forest, and is also commonly prominent locally along streams dropping to elevations as low as the mid-tabonuco zone. Sierra palm (*Prestoea montana)*, provide fruit which parrots and other frugivorous species depend on heavily, especially during their reproductive seasons. The parrots'

breeding season coincides closely with the fruiting season of sierra palm and parrot movements can be traced according to the seasonal availability of this food (Snyder et al. 1987).

The palo colorado forest covers about 3400 ha and generally occurs above 600m in elevation. It is comprised of mostly short trees, under 15 m in height, which permit the penetration of high light intensities at ground level. This forest type supports about 53 species, but is dominated by the palo colorado (*Cyrilla racemiflora*). This species susceptibility to heartrot has make it invaluable to the parrots as a source of nest sites. (Snyder et al. 1987)

Conservation Efforts

The first research program for the Puerto Rican Parrot began in 1953 and was funded by the Pittman-Robertson Aid Program (Snyder et al. 1987). Results from a study conducted by Rodriguez-Vidal from 1953-1956 as part of this program, estimated the population to be approximately 200 individuals. Also revealed by this study was a major cause of high nest failure rate, rat predation. In 1956, at the end of this program, Rodriguez-Vidal began eradication of rats in parrot nesting areas, a practice that has continued to the present (Rodriguez-Vidal 1959).

In subsequent years, a program was initiated for the purpose of reintroducing the parrot to areas it had once inhabited (Snyder et al. 1987). Nestling parrots were removed from the Luquillo forest each year and hand-raised to be used in this program. These birds were then released in several reforested sites around the Island. No attempt was made to make these parrots self-sufficient. They were completely dependent on humans and most if not all were thought to have died soon after their release. Not only did the releases fail, but the harvesting of numerous chicks from the wild over a number of years likely resulted in a significant reduction in the wild population (Snyder et al. 1987).

In 1967, a year after the endangered species act was passed, the Puerto Rican Parrot was placed on the endangered species list. This listing provided the justification necessary for the initiation of a federally funded research program. The original support for the program came from the US Fish and Wildlife Service, the US Forest Service and the World Wildlife Fund. Improved nest success rates have resulted from efforts to improve existing nest cavities, to provide additional cavities, and to reduce the impacts of the Pearly-eyed Thrasher (*Margarops fuscatus*) by deepening parrot cavities and providing nest boxes for the thrashers.

In providing one nest box for a pair of thrashers within the territory of each breeding pair of parrots, biologists assumed territorial behavior of resident thrashers would prevent others from using the parrot cavity, a technique first tested by Grabill (1977) as a solution to European Starling (*Sturnus vulgaris*) depredations on Wood Ducks (*Aix sponsa*). In addition to limiting the number of thrasher pairs per territory to one, boxes provided for resident thrasher pairs also reduced competition between the thrasher pair and the resident parrots for tree cavities. Synder et al. (1987) found that when the thrasher boxes were placed at a sufficient distance from parrot cavities, overt aggression was greatly reduced. The need for more drastic means of thrasher control such as pellet guns used earlier by biologists was eliminated (Snyder et al. 1987).

However, at the beginning of 1993, under new supervision, U.S. Fish and Wildlife personnel removed thrasher boxes for undisclosed reasons. Conflict between thrashers and parrots immediately increased and a number of clutches were lost to thrashers that year. Pellet guns were used by biologists in the observation blinds to ward off or kill resident thrashers. However, it appears that biologists succeeded only in disturbing the resident parrot pair. When one pair of thrashers was removed from the area it was replaced by another pair hours later (pers. obs).

In addition to improving conditions for the wild population, those concerned with the steady decline in the parrot population initiated a captive breeding program. An aviary was opened in the Luquillo Forest in 1973 in an effort to captively propagate the species and to provide facilities in which injured or infirmed wild birds could be rehabilitated and returned to the wild. There were plans for the establishment of a captive population from which individuals could be released successfully into the wild, thereby supplementing the dwindling Luquillo population. However, this planned release program has been plagued by high nest failure rates of the few pairs that pair-bonded in captivity, and low fertility rates. One factor that likely had a significant impact on reproductive success was the conditions under which captive birds were raised and maintained. It was thought that tame birds, accustomed to being handled by their human keepers would adapt more readily to captive conditions, facilitating care and, ultimately, successful reproduction in captivity. However, characteristics that promote adapting to captivity may preclude adapting to the wild upon release, so that releases of birds such as these is likely to fail as did the releases of the late 1950s (Snyder et al. 1987).

In 1992 the U. S. Fish and Wildlife Service proposed a study to determine methods for reintroducing parrots or supplementing an already existing population with captive bred individuals. The proposal

suggested the use of a non-endangered species of *Amazona* parrot, such as *A. ventralis*, raised at an aviary located in the Rio Abajo forest, for an experimental release in occupied and unoccupied habitat. To ensure success it is necessary to consider a number of factors in the life history of the species being released and to raise young captive-bred birds in an environment that simulates the conditions under which they would be raised in the wild as closely as possible. Key factors would include the following: 1) social behavior in the wild (i.e. interactions within a flock and between individuals); 2) vocal behavior - among many species in the genus *Amazona* vocal communication is often the primary form of communication as visibility is frequently limited or not possible in many of the environments inhabited by these birds; 3) foraging habits - what and how fruit is eaten and where it is found; 4) reproductive habits - again vocal behavior may influence reproductive success, thus it may be important to ensure that aviary raised birds have developed the vocal skills of wild conspecifics. By studying all aspects of a species' natural history it may be possible to better prepare young captive-bred birds for release into the wild by exposing them to conditions not unlike those they might encounter at their release site, i.e. exposing them to food resources that they will encounter in the wild, allowing adults of their own species to raise them or if this is not possible at least reducing human contact to a minimum, and then as they fledge placing them in an environment with other young birds raised in a similar manner.

The following study is part of a larger study examining techniques that might be of use in the release program, including marking, capturing, and radio-tracking. The portion of the study reported here documents the vocal behavior of *A. vittata* during the reproductive season and examines the possibility of using vocalizations to identify individuals, determine the sex of individuals and determine the location of an individual's breeding territory.