THE ILLEGAL PARROT TRADE IN THE NEO-TROPICS:

THE RELATIONSHIP BETWEEN POACHING AND ILLICIT PET MARKETS

By Stephen Ferreira Pires

A dissertation submitted to the

Graduate School – Newark

Rutgers, the State University of New Jersey

in Partial Fulfillment of requirements

for the degree of

Doctor of Philosophy

Graduate Program in Criminal Justice

Written under the direction of

Dr. Ronald Clarke

and approved by

____

____

____

____

Newark, New Jersey

January, 2012

Abstract

Due to the global illegal parrot trade in conjunction with habitat loss, parrots are among the most threatened bird species in the world. Despite laws against parrot poaching throughout the neo-tropics, the lack of enforcement in the wild and in city pet markets enables poachers, itinerant fences (i.e. middlemen), and sellers to continue in the illegal wildlife trade while parrot populations further decline. Recent publications, which take account of parrot poaching variation in Mexico, Bolivia, and Peru, have enabled criminologists to attempt to explain why some parrot species tend to be poached more often than others. Using two recent studies that look at illicit pet markets in 7 cities within Peru and Bolivia (Gastanaga et al., 2010; Herrera and Hennessey, 2008), this dissertation will analyze why some parrot species end up on any of the seven illicit pet markets (*N=50*) and why some species were never found on any illicit pet market despite their close proximity to one (*N=17*).

Using the CRAVED model (Clarke, 1999) and the Choice-Structuring Properties (Clarke and Cornish, 1987) concept to examine the illegal parrot trade, this study finds that illicit parrot markets are not homogenous in nature. Using GIS data on where parrot ranges are relative to the illicit markets they appear on, this study reveals there are three types of illicit parrot markets: local, regional, and feeder markets. Local markets will mostly be comprised of highly local species, whereas regional markets will obtain species from very far off distances via *itinerant fences*. Feeder markets on the other hand, are mostly responsible for creating a large internal parrot trade within countries such as Peru and Bolivia. They supply not only local demand, but also supply other cities with parrots.

This study also finds support for opportunity-based factors such as *availability* and *abundance* in relation to poaching risk. This is now the third study to substantiate these concepts as the most important factors related to poaching. Other CRAVED factors such as *enjoyability* and *removability* were not found to be significantly related to poaching, despite previous findings in Bolivia and Mexico showing otherwise.

Table of Contents

PART D: POLICY IMPLICATIONS

List of Tables

List of Figures

Chapter 1: Introduction

Parrots are one of the most threatened bird species in the world (Wright et al., 2001; Juniper and Parr, 1998). Unlike many other birds, parrots stand out due to their bright feathers, uncanny intelligence, and ability to mimic human voices. For these reasons, demand for parrots as household pets remain high, especially in regions where they are found in the wild. This has led to the global illegal wildlife trade where parrots are routinely poached, traded, and sold on open markets. Over several decades of this unsustainable practice, parrot populations have diminished in the wild to a great extent, with some species facing near extinction (Cantu et al., 2007; Howell and Webb, 1995; Juniper and Parr, 1998).

Many laws and international treaties have been implemented to protect parrots from being killed or poached from the wild. One such law is the Wild Bird Conservation Act (WBCA), which was enacted by the United States Congress in 1992. This law made it illegal to import wild parrots from the neo-tropics[1] which led to an immediate decline of smuggled parrots into the United States (Armstrong et al., 2001; Beissinger, 2001, cited in Pain et al., 2006). If the illegal parrot trade was mostly an international problem, this should have greatly reduced poaching within range countries (i.e. where parrots are found). Yet, the trade continues unabated. Recent evidence reveals that the internal parrot trade within range countries is a more prevalent phenomenon as compared to the international trade in parrots (Cantu et al., 2007; Herrera and Hennessey, 2007;

---

[1] The neo-tropics refer to the eco-zone beginning in southern Mexico and ending in the southern tip of South America.

Gastanaga et al., 2010). This is a significant finding since much of the conservation efforts in reducing the illegal trade have focused on the international aspect of the trade.

Anti-poaching laws have done little to stifle the illegal parrot trade within range countries. Tens of thousands of parrots are annually poached in neo-tropical countries such as Mexico, Peru and Bolivia (Cantu et al., 2007; Herrera and Hennessey, 2007; Gastanaga et al., 2010). Police in the neo-tropics tend to ignore the problem of the trade given: (1) their inadequate resources; and (2) their perception that it is not a serious offense (Herrera and Hennessey, 2007). Evidence shows that even when law enforcement within range countries have taken the problem more seriously, there were negligible effects on the trade (Cantu et al., 2007).

The illegal parrot trade presents itself as a conservation problem that needs alternative solutions. Trade bans and regulatory schemes have already been implemented, however, the illegal parrot trade continues in an unsustainable fashion. In order to save endangered parrots from extinction, the illegal wildlife trade should be seen from a lens other than biology and economics. Environmental criminology can provide such a solution because it focuses on the contextual factors of the criminal act that may facilitate or hinder such crimes. Since not all parrot species are equally poached for the illegal wildlife trade, it would be more prudent to examine parrot species as individual products separate from one another, rather than as a homogenous bird that has equal risk to be poached spread across its many species.

'Hot products' research analyzes the variation in theft to shed light on why some products are stolen in much higher frequencies than other comparable products. For instance, items like alcohol, cigarettes, beauty products, and contraceptives are shoplifted from convenience stores in much higher quantities than other items (Clarke, 1999). Knowing why these items are specifically targeted by thieves can provide preventive solutions in reducing the theft in these hot products. Parrots, like other hot products, are stolen and sold at a high rate and demonstrate remarkable variation in theft. For example, evidence from poaching estimates in Mexico show that the Orange-Fronted Parakeet is poached 470 times more often than the Scarlet Macaw (Cantu et al., 2007; Pires and Clarke, 2012). This study aims to investigate why some parrot species end up on illegal pet markets in South America, and why some parrot species never end up on these markets to begin with. In doing so, one can understand how, why, and where parrot poaching is conducted, and explore the necessary steps to disrupt illicit wildlife markets and prevent parrot poaching.

Recent criminological analyses of the illegal parrot trade in the neo-tropics have shown that wildlife crimes, such as poaching, are influenced by environmental factors much like traditional property crimes. Exploratory research by the candidate and Ronald Clarke (In Press a; In Press *b*) suggests that environmental factors, such as *abundance* and *accessibility*, play a part in parrot poaching variation in two different neo-tropical countries. In addition to these two factors, *removability* was also found to be related to poaching in Mexico, where parrot species that nested closer to the ground in termitariums - as opposed to nesting in tree cavities or cliff crevices that are very high up - were more likely to be poached in higher quantities (Pires and Clarke, 2012). This implies that there is little to no difference in theft trends between animate (e.g. parrots) and inanimate 'hot products' (e.g. cars); opportunistic factors play a part in both types of property crimes.

This finding should come as a surprise to many in the conservation field, since there is scant mention of how 'opportunity' plays a part in many of these wildlife crimes. Conservationists have generally focused much of their efforts in studying and trying to protect the most endangered species, especially species that are threatened because of the illegal trade (Wright et. al., 2001). In part because of this partiality towards threatened species, the conventional wisdom in the field contends that the most rare and expensive parrot species will be the most poached in the wild. However, preliminary research in the illegal parrot trade shows this is not so; the most poached species are typically inexpensive and quite abundant (Pires and Clarke, 2011; 2012; Herrera and Hennessey, 2007). This implies that poachers are less inclined to go after the most expensive parrot species when they can settle for parrot species that are easy to poach and can easily be sold to a market or middleman.

Given the evidence thus far, one should expect to find opportunistic environmental factors to explain much of the poaching variation of parrot species found on illegal pet markets. This dissertation builds upon the previous research by Pires and Clarke (2011; 2012) in a number of ways. **First**, this dissertation examines 7 illegal pet markets throughout Peru and Bolivia that sold a variety of parrot species over a one-year period[2]. Studying multiple markets allows for more generalizeable conclusions about the way in

[2] The market in Santa Cruz, Bolivia is the only exception, which was studied for two and half years.

which illicit parrot markets function and which species are more at-risk of becoming poached. **Secondly**, this dissertation examines whether heterogeneous illicit parrot markets exist. In Santa Cruz, Bolivia, the Candidate and Clarke (In Press *b*) concluded that most parrots are caught within a 100-mile catchment area surrounding the Los Pozos market, which was mostly comprised of local species. This dissertation investigates whether the market dynamics of the Santa Cruz market is the norm or the exception, by comparing it to six more markets in neighboring Peru. And, if illicit parrot markets are indeed heterogeneous, then what makes a city market more 'regional' as opposed to 'local'? Does it have to do more with *supply* (i.e. abundance of species in the area) or *demand* (i.e. human population in each respective city)?

And finally, this dissertation improves upon past variables of measurement by refining them in three important ways. *Value* is measured by the street prices species are sold for in addition to threatened status of species. Secondly, this study refines measuring poaching risk by creating a new variable, *Percentage of Range within National Parks*. Previous research has found that rainforest habitats may decrease the likelihood of poaching for species primarily residing in those areas (Pires and Clarke, 2011; 2012). National Parks, which are primarily located in rainforests, may even further protect species located within them because *accessibility* into such parks is difficult, and park rangers can possibly deter poachers from entering. Thirdly, *availability* is measured in a new way, *Presence on Other Markets*. Since this dissertation will focus on the interaction of markets, this measure will examine why some species travel great lengths to reach markets. Are some species more likely to be poached and transported far distances because of their beauty and value (demand), or is it because they are present on other nearby markets (supply)?

This dissertation is divided into four sections: Part A, Background; Part B, Research Problem; Part C, Analysis & Results; Part D, Policy Implications. In Part A, the illegal trade in parrots throughout the world will be the focus of Chapter 2. Chapter 3 focuses on the response to the illegal wildlife trade by Peru and Bolivia as well as international treaties. In Part B, the theoretical framework will be laid out in Chapter 4. In Part C, Chapters 5 though 7 will lay out the research methodology for each set of analyses prior to performing the analysis. Chapter 5 focuses on the catchment areas of each illicit pet market in Bolivia and Peru. Chapter 6 examines the interaction between markets and Chapter 7 explores the role of opportunity in parrot poaching. Finally, in Part D, the limitations and implications of this dissertation are the focus of Chapter 8.

Chapter 2: The Illegal Parrot Trade

Throughout the neo-tropics, parrots are common household pets much like cats and dogs are in the Unites States (Cantu et al., 2007; Gonzalez, 2003; Drews, 2002 cited in Weston and Memon, 2009). Parrots have been taken from the wild for hundreds of years, dating back at least to the Aztec empire in Mexico when, in addition to serving as pets, they were eaten and their feathers were used for clothing and decoration. Taking parrots from the wild only began to arouse concern when it was turned into an organized business with thousands of parrots being captured and exported overseas to Europe and the United States (Cantu et al., 2007; Pires and Clarke, 2012). In the 1980s and early 1990s, the U.S. was the largest importer of neo-tropical parrots. Roughly, 50,000-150,000 neo-tropical parrots were being brought into the United States each year (Thomsen in James, 1992, cited in Cantu et al., 2007).

Partly as a result of this trade, many species became threatened with extinction, including such iconic parrots as the Hyacinth Macaw (Juniper and Parr, 1998; Howell and Webb, 1995). Parrots have the largest proportion of endangered species among all birds worldwide (Collar, 1997, cited in Cockle et al., 2007; Wright et al., 2001; Juniper and Parr, 1998). Approximately thirty-six percent of the 330 parrot species in the world are threatened to some degree of extinction (Pain et al., 2006).

The first legislative act attempting to halt the illegal parrot trade coming into the United States was the Wild Bird Conservation Act (WBCA), which was passed in 1992 (Wright et al., 2001; Armstrong et al., 2001). There was an immediate reduction in parrots imported into the United States following the WBCA[3], and four studies in the neo-tropics found a dramatic reduction in nest poaching[4] (Wright et al., 2001). This trend in declining imports, as well as parrot smuggling into the United States has continued to-date. This may be in part because of the post-9/11 border security increases, which inadvertently also reduced the illegal parrot trade (Cantu et al., 2007).

Despite these legislative accomplishments, the illegal trade in parrots continues unsustainably even after countries, such as the United States, have dramatically diminished its role in driving the trade. From 1991 to 1996, the global legal trade in parrots reached 1.2 million, or about 240,000 parrots traded each year (Bessinger, 2001, cited in Gastanaga, 2010). Between 1998 and 2000, the World Wildlife Fund (WWF) estimates the trade in parrots to be in the area of one million parrots, or 333,000 a year (WWF, 2010, cited in Gastanaga et al., 2010). Since this last estimate, there is no indication that the trade in parrots has reduced. In fact, recent evidence from Mexico, Bolivia, and Peru reveals that the illegal parrot trade continues unabated within these range countries.

Many of the earlier research studies on the illegal parrot trade focused on the extent of the international trade, while neglecting the more significant problem of the domestic

---

[3] Cooney and Jepson (2006) have argued this correlation could be due to Mexico joining the Convention on the International Trade in Endangered Species (CITES) in 1991 which would have increased more protection of species with a catch-quotas system. This seem unlikely though given the recent report in Mexico that up to 78,500 parrots were being over-trapped and poached even as catch-quotas were enforced (Cantu et al., 2007).

[4] Nest poaching has been found to be the most common form of poaching parrots. When looking at this form of poaching, researchers found an average of 30 percent decline in nest poaching in Mexico (Wright et al., 2001).

wildlife trade. In a report jointly published by the Washington-based *Defenders of Wildlife* and *Teyeliz*, a Mexican conservation organization, Cantu et al. (2007) estimated that 65,000 to 78,500 parrots continue to be poached each year within Mexico. Contrary to popular belief, most of these parrots (an estimated 86-96%) are sold within Mexico and not exported to the U.S. or Europe. Their estimates were based on detailed interviews with large samples of licensed trappers and inspectors of the environmental police. Similar findings have been revealed in Peru and Bolivia as well. Herrera and Hennessey (2007) analyzed one of the five illegal pet markets in the city of Santa Cruz, Bolivia, and found 7,277 parrots appearing over a one-year period. If all pet markets are equal in size in the city of Santa Cruz, one could expect up to 35,000 parrots being sold in Santa Cruz alone. Herrera and Hennessey (2007) also point out that the nearest large city of Chochabamba also has illegal pet markets, which would make the domestic illegal trade in parrots quite substantial in Bolivia.

In the most recent study, Gastanaga et al. (2010) replicated the Santa Cruz, Bolivia study in analyzing illicit parrot markets in eight Peruvian cities. Peru, like its South American eastern neighbor Bolivia, also has a substantial domestic trade in parrots. Unlike the Santa Cruz market study, Gastanaga et al. (2010) used a quarterly survey method. This method is conducted by visiting markets every three months throughout the year and directly counts the number of parrots in each market by species type. From these counts, researchers can then project the number of parrots that appear on each market throughout the full year. Through the use of this method, researchers directly counted 4,722 parrots in six cities in which pet markets were active. Gastanaga et al. (2010) estimate 80,000 to

90,000 parrots are being sold on markets on an annual basis throughout Peru. At this rate, the illegal trade quickly becomes unsustainable and will threaten the existence of several parrot species that have a distribution in or around Peru.

This latest research reveals that the problem of the illegal parrot trade is much more complex than previously thought. The international demand for parrots has always been thought of as the driving force for poaching in the neo-tropics, but recent evidence suggests otherwise. Range countries are responsible for poaching, distributing and selling parrots on local and regional illicit markets. Very few parrots and parrot species will ever cross national borders compared to the numbers that are sold internally.

The Decimation of Parrot Populations

One of the most detrimental consequences of the illegal trade is the ability to eliminate species from the wild through extensive poaching. According to the IUCN Red List (2010), the Spix's Macaw is the latest victim of the trade and is now thought to be extinct in the wild. Parrot species, like the Spix's Macaw, suffered from a combination of threats in the wild, namely that of habitat loss and the illegal parrot trade (Wright et al., 2001). While other threats to parrots include natural predators (Monterrubio et al., 2002), climate change and hurricanes (Christian et al., 1996, cited in Wright et al., 2001), diseases (Snyder et al., 1987, cited in Wright et al., 2001), and hunting (Cantu et al., 2007; Juniper and Parr, 1998; Cockle et al., 2007), habitat loss and the illegal parrot trade are the most severe threats to parrot survival (Juniper and Parr, 1998).

Of the 330 parrot species in existence, 66 are directly threatened due to the illegal parrot trade (Gastanaga et al., 2010), while even more suffer from habitat loss (Cantu et al., 2007; Juniper and Parr, 1998). These threats are not exclusive to parrots only; habitat loss, followed by the illegal wildlife trade, threatens many different kinds of species throughout the world. The deforestation phenomenon that has plagued much of the developing world is the main reason why habitat loss affects the conservation of so many species, precisely because it is indiscriminate toward all species that claim the forest as their primary habitat. The illegal wildlife trade, on the other hand, only affects the species that are craved by humans for pet ownership, bush meat, medicine or luxury products (e.g. tiger skins, ivory). However, not all species of a particular animal will be equally exploited for the wildlife trade. In the context of parrot poaching, the trade may only affect the species that are the most beautiful or easier to capture. For instance, the Socorro Parakeet does not appear in the Mexican illegal parrot trade primarily because it is found on a remote island off the coast of Mexico (Cantu et al., 2007; Pires and Clarke, 2012).

The impact of threats, such as habitat loss and the illegal parrot trade on parrot populations is difficult to assess because they often both work in combination. For example, 13 of the 22 parrot species found in Mexico suffer from both threats (Cantu et al., 2007). Secondly, defining the *impact* on species can be a subjective assessment. Does one count the number of parrot species that are more affected by habitat loss versus the illegal trade *or* is it better to quantify the sheer number of parrots that have been removed from the wild due to the illegal trade as compared to habitat loss (i.e. breeding ability)? More *species* may be affected by habitat loss, but the illegal parrot trade may have removed more *parrots* from the wild. Thus, each threat is seriously impacting parrot species and populations.

As for the impact of the global illegal parrot trade, it is well documented that millions of parrots have been poached and traded over the past few decades. Over time, this has caused some of the most beautiful parrot species, such as the Blue-throated Macaw, to disappear from their ranges (Juniper and Parr, 1998). The Red Crowned Parrot, for instance, once had a population of 100,000 and now has a population between 1,000 and 6,500 in the wild (Cantu et al., 2007; Juniper and Parr, 1998). In addition to removing parrots from the wild, the fatality rate from smuggling parrots is extraordinarily high. In Mexico, an estimated 75 percent of parrots (50-60,000 birds per year) that are poached die in their transit from natural habitat to their black market destination (Cantu et al., 2007). Similar high fatality rates have been found elsewhere (Low, 2003; Juniper and Parr, 1998; Inigo-Elias and Ramos, 1991, cited in Wright et al., 2001). Even the parrots that do survive the horrid conditions of being transported in small boxes, many can become “sick, stressed, injured and malnourished” (Cantu et al., 2007, pg. 62). Feather-plucking is an immediate sign that a parrot is stressed, and this is often seen in illegal pet markets (Dauphine, 2008; Low, 2003).

The illegal parrot trade directly affects parrots by removing them from the wild, but it also affects parrot populations indirectly. Most often, poachers will hack at tree cavities with machetes in order to obtain parrot nestlings. By doing this, they are removing parrots from the wild while at the same time, destroying a viable nest for future breeding parrots' (Cantu et al., 2007; Pain et al., 2006; Pires and Clarke, 2012). This is because most parrot species do not have suitable beaks to excavate holes within trees so they must rely on other bird species, like woodpeckers, to create tree cavities for them (Cockle et al., 2007). In the event a parrot is not able to find a suitable nest, they do not breed. Macaws, for instance, may not breed every year and only produce a few chicks per occasion (Juniper and Parr, 1998; Tambopota Macaw Project, 2011). The combination of destroying tree cavity nests and de-forestation can have significant impacts on future breeding patterns of parrots, as can be seen with Macaws, which already have a slow reproduction rate.

The direct and indirect effects of the illegal parrot trade substantially reduce parrot populations in the wild. Parrot species that suffer from both the illegal trade and habitat loss are at the most risk of being endangered because these two threats can work in combination to intensify poaching and reduce normal reproduction rates. For example, the practice of clearing rainforest into farmland severely threatens parrots in two significant ways: (1) it reduces the number of viable nests for parrots, which can greatly reduce offspring for following years; and (2), it brings humans closer in contact to parrot ranges. Pires and Clarke (2011; 2012) found parrots whose ranges overlapped more with human populations were more likely to be poached in Mexico and in Bolivia. In addition, when turning rainforests into farmland, parrots in the area may turn into crop pests, which can increase their share in the illegal trade. This is what happened in Bolivia to the Monk Parakeet and the Yellow-Chevroned Parakeet, making them amongst the most traded species in an illicit pet market in Santa Cruz (Herrera and Hennessey, 2008).

Prices

Media stories on the illegal wildlife trade tend to concentrate on the species that are the most rare and valuable, giving the impression that these species are the most heavily poached and traded. However, the few research studies that have examined the illegal parrot trade in the neo-tropics reveal a different story. The most heavily poached and traded species are amongst the least expensive on illegal pet markets. In Mexico, Cantu et al. (2007) found the Orange-Fronted Parakeet and the Mexican Parrotlet - two of the three of the most poached species - sell for an average of (U.S.) $18 and $5 on the street, respectively[5]. In Northern Peru, the Canary-Winged Parakeet is the most poached parrot species and sells for only (U.S.) $0.33 (Dauphine, 2008). In the Santa Cruz, Bolivian market, three of the four most frequently seen species on the market are sold for (U.S.) $5-10 (Herrera and Hennessey, 2007).

A number of factors influence the prices of parrots on markets, some of which are dynamic in nature. These factors include: abundance in the wild, accessibility, longevity, mimicry ability, intelligence, parrot genus, beauty, and distance found from market. Dynamic factors such as abundance and accessibility should have an inverse relationship with prices on a market; that is, the more abundant and accessible species are, the more

[5] This is compared to the Scarlet Macaw, the most expensive species sold in Mexico, which sells for an average of (U.S.) $564 (Cantu et al., 2007).

inexpensive they should be controlling for all other factors. The fact that the most poached parrot species on markets tend to be relatively inexpensive is a preliminary indicator that such parrot species are abundant and accessible in the wild. Rare birds on the other hand, should command a higher price on average because they are hard to come by. For example, the Military Macaw is uncommon and can sell for anywhere between (US) $600-1800 (Cantu et al., 2007).

As for type of parrot, there are four main genera found in the neo-tropics: Parrotlet, Parakeet, Amazon, and Macaw. The first two tend to be the most inexpensive because they are smaller[6] and generally do not have the ability to mimic human voices. Amazons are priced higher than the former two genera, because they can be fairly large and are known to be the best talkers. Lastly, Macaws are generally the most expensive species (Cantu et al., 2007) given their bright colors, ability to talk, intelligence, longevity[7] and large size. For example, the Hyacinth Macaw is the largest parrot in the world, which can grow up to 100cm (Juniper and Parr, 1998) and can fetch up to $10,000 in the U.S. (Herrera and Hennessey, 2007).

Before the 1990s, more beautiful and expensive species were more numerous in the illegal parrot trade. Such species were targeted for the trade in the 1980s, especially for international markets, such as the U.S. and Europe (Cantu et al., 2007; Juniper and Parr, 1998). After such heavy poaching of iconic parrot species, their ranges became diminished and their numbers became smaller in the wild. Therefore, it should be

[6] The Blue-Winged Parrotlet is one of the smallest species measuring 12cm.
[7] The Scarlet Macaw is known to live up to 70 years in captivity, sometimes outliving its human owner (Brouwer et al., 2000).

expected that these species are less likely to be poached due to their remoteness in the wild coupled with smaller populations, despite their higher price tag.

Since smuggling wild-caught parrots into the U.S. has significantly ebbed from the early 1990s, captive breeding has become a viable alternative for U.S. parrot demand. Although captive bred parrots are much more expensive, they are more popular in developed countries, such as the United States. This is primarily the case because Americans can afford to pay for the overhead costs of breeding species. In neo-tropical countries where parrots are found, the illegal parrot trade has continued to thrive partly because captive-bred parrots are six times more expensive than parrots taken from the wild (Cantu et al., 2007). For the average citizen in poor countries, such as Mexico, Peru and Bolivia[8], it merely comes down to an economic choice to buy the cheaper parrot despite its ill-gotten origins.

The Poachers and Middlemen

The wildlife trade can be seen as a multi-level chain that typically involves poachers, middlemen, processing centers, and markets. It appears that much of *wildlife poaching* is committed opportunistically by peasants rather than professional poachers or members of organized crime. This can not only be seen with parrot poaching in neo-tropical countries (Pires and Clarke, 2011; 2012), but also with turtles, tortoises, sea horses, and reptiles in East Asia (TRAFFIC, 2008); with bush meat in Africa (Roe 2008); with cacti

[8] The 2009 estimated GDP per capita for Mexico is (U.S.) $13,200, $4,700 in Bolivia, and $8,500 in Peru. Relative to the U.S. ($46,000) (CIA, 2010), one can see that the average person in neo-tropical countries would not be able to afford captive-bred parrots in comparison to wild-caught one's.

in North America (Robbins and Barcenas, 2003); and in many cases, overfishing (Putt and Nelson 2008; EJF, 2007). Although there are exceptions to this rule, namely tiger poaching and some proportion of abalone and sturgeon poaching (TRAFFIC, 2008; Vaisman, 1997; Tayler, 2001; Saffron, 2002; Carey, 2005; Hauck and Sweijd, 1999; Hauck and Kroese, 2006; Putt and Nelson, 2008; White, 2008), the accumulated evidence thus far points to local villagers as the largest contributor to poaching wildlife around the world. Once poaching occurs, depending on the region and species involved, the subsequent stages in the wildlife trade tend to be more organized, especially when smuggling wildlife across national borders.

The notion that much of the wildlife poaching is committed by locals and not professional poachers or organized criminals, is in contradiction to a widely held view in the field of conservation (TRAFFIC, 2008; Lin, 2005; Cook et al., 2002; U.S. Congress, 2008; Zimmerman, 2003; Cantu et al., 2007). This is in part due to the media's desire to make a story more attention-grabbing by including an "organized" element to the piece (see McDermott, 2010; Delaney, 2009), as well as law enforcement agencies' desire to receive more resources to combat crimes that have an "organized" element involved.

Parrot experts and recent reports on the illegal parrot trade reveal that opportunistic poaching by villagers is far more common and accounts for a much higher proportion of the parrots taken from the wild than by professionals (Pires and Clarke, 2011; 2012). Evidence from Peru (Gastanaga et al., 2010; Dauphine, 2008), Bolivia (email comm., Hennessey, 10/22/2009), and Mexico (Cantu et al., 2007) suggests that local villagers are responsible for much of parrot poaching. For instance, one source estimates that there are up to 20,000 opportunistic nest poachers in Mexico (Groselet cited in Velazquez, 2004, cited in Cantu et al., 2007), in comparison to only 787 professional trappers and street salesmen that are unionized in Mexico (Semarnat, 2005c, cited in Cantu et al., 2007). Of these 787 trappers, less than 200 of them exclusively focus on trapping parrots (Cantu et al., 2007). Furthermore, expensive and rare species are infrequently found in illegal parrot markets. This indicates that poaching is not being committed overwhelmingly by professional poachers - who would search for the most expensive species to poach - but rather villagers who see parrots in the local area and take advantage of this.

Villagers who poach opportunistically will target nestlings in the breeding season. They would know which birds breed nearby[9] because parrots often return to the same nesting site year after year (Collar and Juniper 1992; Monterrubio et al. 2002; Enkerlin-Hoeflich, 1995, cited in Wright et al., 2001). However, poaching parrots might be considerably easier than actually selling them. In rural areas where many of the parrots are poached, neighbors may not want them or may already own a parrot. The poacher might live too far from an urban market to make the journey economically feasible – especially as many of them might lack personal means of transportation (Pires and Clarke, 2011). "However, the needs of the market seem to have provided the solution in the form of *itinerant fences*, otherwise known as wildlife traders." (Pires and Clarke, 2011, 316) Itinerant fences collect and trap parrots along with other wild animals that can be sold on markets. They travel to small towns where they can expect to collect parrots that were poached by villagers, often from communities that harvest young parrots from the nest and keep them like chickens until the trader appears (Dauphine, 2008; Gonzàlez, 2003; email comm., Hennessey, 10/22/2009). "This greatly eases the poacher's problem of

[9] A notable exception has been described in northern Peru, where the men of a particular farming village travel 8-hours by canoe in the breeding season to poach nestlings in a remote swamp (Gonzàlez, 2003).

disposing of the parrot for an acceptable price and it greatly simplifies the task for traders of finding and obtaining wildlife." (Pires and Clarke, 2011, 317).[10] A worthwhile profit can be made if the traders can collect enough parrots and dispose of them either directly to an urban pet market or to other “higher order” fences who, in turn, sell them at local or regional urban markets. Although any single individual might make a small amount from participating in the trade, this can still provide a useful income supplement in the neo-tropics where poverty is widespread (Pires and Clarke, 2011).

Poaching Methods

Parrots tend to breed for life with the same partner (Collar and Juniper, 1992) and while they might not breed every year, they breed in the same three-month period each year within a particular region. Their eggs, which are incubated for one month, are rarely taken by poachers because they are difficult to incubate artificially. Once hatched, the nestlings will continue to be dependent on their parents for another month (Collar and

[10] Information about parrot traders was provided by David Wiedenfield of American Bird Conservancy, and Bennett Hennessey, one of the authors of the Los Pozos market study in Santa Cruz, Bolivia. In his email of 27/8/2009, Wiedenfeld stated that: “It’s really just too easy for a parrot trader (a middleman) to pay, say $2 to buy parrots from the opportunistic trappers, who are mostly extremely poor peasants. The middlemen often have known routes and schedules (i.e., they travel a certain circuit of towns and arrive on certain market days), and the local people come bring what they’ve caught to sell when they know he’s going to be in town. From the middleman’s point of view, it’s very easy: 1) he can get a lot of birds; 2) doesn’t have to get out and get sweaty—he can stay at the bar and drink beers as the people come by with their birds to sell; and 3) it doesn’t really cost much (he can buy lots of birds for $200 or $300 dollars, which he can then sell up to the next larger middleman above him for $1000 - $1500, a pretty good rate of return).” Hennesey supplemented this picture in his email of 22/10/2009 with the following: "The scenario is that indigenous families will take chicks when possible. They keep them, like they keep chickens, until a day when a middleman passes by offering to buy their pets for a certain fee.”

Juniper, 1992; Monterrubio et al., 2002). This is the pivotal period where nestlings are most vulnerable to becoming poached, given their inability to fly away.

The type of nest used by parrot species will dictate the methods used by poachers. Most parrot species nest high up in tree cavities, with only a few nesting in cliff crevices or in ground or arboreal termitariums (Cockle et al., 2007; Rodriguez Castillo and Eberhard, 2006; Pires and Clarke, 2011; 2012). Cliff nests are generally the most difficult to access because the cliffs can be high and dangerous to climb. For tree cavity nests, the poacher will usually have to climb the tree – perhaps using ropes and primitive ladders (Vaughan et al., 2003) – and reach into the cavity for the nestlings. They will sometimes use a machete to enlarge the cavities or cut the tree down, which can kill the nestlings (Cantu et al., 2007; Gonzalez, 2003; Rodriguez Castillo and Eberhard, 2006; Bucher et al., 1992 cited in Engebretson, 2006). The latter method should be fairly uncommon given the high probability that the nestlings will not survive the fall.

Ground termitariums (i.e. termite mounds), arboreal termitariums, and burrows are the easiest nests for poachers to exploit. Arboreal termitariums are generally closer to the ground than tree cavities and will be easier to reach and see (email comm., Wiedenfeld, 3/4/2009). For burrows, used for example by the Canary-winged Parakeet (the most poached species within Peru), the poachers can simply reach into the nest holes and remove the nestlings, though they might have to bring along children whose small hands can do this more easily.

Because nest poaching requires no special equipment apart from a rope and a machete, this appears to be the most widely used poaching method in the neo-tropics, Africa and Asia (Wright et al., 2001; Low, 2003; Gonzalez, 2003; Kockle et al., 2007; Juniper and Parr, 1998; Pain et al., 2006; Rodriguez Castillo and Eberhard, 2006; Dauphine, 2008; Bucher et al., 1992, cited in Low, 2003). The other methods – netting parrots in flight and setting cage traps – require special equipment and special expertise[11]. Cantu et al. (2007) state that netting is the most common method used by professional trappers in Mexico[12], but they also suggest that this tends to be the case outside the breeding season when they employ nest poaching. Other experts doubt that trapping and netting are much used at all, even by professional trappers, compared with taking young birds from their nests (email comm., Wiedenfeld, 8/27/2009; Gilardi, 8/19/2009, Salinas, 8/20/2009). Not only is nest poaching much easier and cheaper, most parrot buyers prefer young parrots that can more easily be domesticated and trained to "talk". Law enforcement seizures suggest this is the case as well. Most of the poached parrots seized by the authorities and brought to illegal markets are nestlings or juvenile birds (Herrera and Hennessey, 2007; email comm., Gilardi, 8/19/2009; Cantu, 8/19/2009). Finally, Wright et al. (2001) have shown in their meta-analysis of 23 studies conducted in the neo-tropics that nest poaching has become a significant source of parrot decline. They found that about 30 percent of parrot nestlings are taken by poachers and, for some species, more than 70 percent of nestlings were poached. Pain et al. (2006) performed a similar analysis in Africa, Asia, and Australia, and found nest poaching to be frequent, especially in underdeveloped

---

[11] Professional trappers buy "mist nets" made in Indonesia for about $70, which they set in trees, or they might tie a parrot to a branch to attract other parrots into a net (email comm., Cantu, 8/19/09).

[12] Nets are used in Africa to capture wild parrots while eating or drinking (May & Hovetter, 2002, cited in Engebretson, 2006) and are also used at tree cavity entrances in Argentina (Bucher et al.,1992 cited in Engebretson, 2006), but there is no evidence of these practices in Mexico.

countries with little protection, supporting the findings of Wright et al. (2001). Evidence from Bolivia shows that nest-poaching is the most common method, and only two species (i.e. the Monk Parakeet and the Yellow-Chevroned Parakeet) are targeted by mist nets because they are seen as crop pests (Herrera and Hennessey, 2008). This is most likely because these two species spend much of their time in agricultural lands and may be easier to capture with mist nests while feeding on crops.

Poaching Variation in Parrot Species

Earlier research by the candidate and Ronald Clarke (In Press *a*; In Press *b*) have applied criminological models, such as CRAVED, to better understand the illegal parrot trade and why some species are much more prone to becoming poached. The CRAVED model (Clarke, 1999) can help explain theft variation in the most stolen products by examining the attributes of 'hot products' as well contextual factors (see a complete explanation of CRAVED in Chapter 4). In their first research study, Pires and Clarke (2012) were able to use GIS methods to measure exposure to poaching risk for each parrot species within Mexico. In doing so, the study was able to identify three environmental factors that were significantly related to national poaching estimates. Species that were more *available*, in terms of *abundance* and *accessibility*, were more likely to be poached. In addition to this finding, parrot species that nested closer to the ground (i.e. removable) were often poached more in Mexico. Measures of *beauty* and *value* were found to be unrelated to poaching. This should come as a surprise to many, since conventional wisdom in the field assumes these two factors are the driving forces behind the illegal parrot trade.

In a second study, Pires and Clarke (2011) found data on parrot species passing through an illegal pet market in Santa Cruz, Bolivia. In contrast to the previous study, this study found it more appropriate to examine poaching risk in the area surrounding the city market, as opposed to the risk of becoming poached generally throughout Bolivia[13]. With this approach, it was necessary to determine the catchment area where many of the species are poached for the Santa Cruz market. After a careful analysis, it was found that the majority of parrot species found on the market were poached within a 100-mile radius surrounding the city. Thus, parrots found within this catchment area were at a much higher risk of becoming poached for the Santa Cruz market than species outside the catchment area.

In addition, this second research study included a second set of parrot species that never appeared in the Santa Cruz market, but have ranges within Bolivia. With the addition of these 20 parrot species added to the original sample of 27 parrot species, this study was able to better understand variation in poaching for an illegal pet market. Parrot species that were more *abundant* and *accessible* were significantly more likely to be poached for the market, substantiating earlier findings in Mexico. In addition to this finding, the more *beautiful* species were also significantly more likely to be poached, contrasting with what was found in Mexico. In both countries though, the more valuable species, as measured

[13] Species that are 400 miles away from the Santa Cruz market for instance, would be less likely to appear on this particular market because the distance to bring species that far would be too costly for any middleman. Thus, species within a much closer proximity should be more likely to appear on this illegal market.

by prices in Mexico and threatened status in Bolivia[14], were less likely to be poached (although there was no significant relationship).

Summary

The demand for parrots as household pets has led to the endangerment of a large proportion of parrot species in the world. Parrot poaching has resulted in a significant decrease in species' ranges as well as overall parrot populations. At this rate, many of the parrot species that are routinely poached will become extinct in the near future. In addition to this threat, other human-influenced threats, such as habitat loss, adversely affect parrot species as well. While the latter threat is rarely a crime, the former threat is. Reducing the illegal wildlife trade can substantially increase parrot populations.

While the international demand for parrots exists, the domestic demand for parrots is largely the driving force behind the illegal trade. Species that appear on illegal markets more frequently tend to be relatively inexpensive and are generally widely available. This indicates, amongst other factors, that the illegal parrot trade is largely opportunistic. Evidence so far suggests parrots that are more abundant and accessible, are more likely to be poached when compared to the more expensive species.

The next chapter will highlight the responses that have been implemented in light of the worldwide illegal wildlife trade and what Bolivia and Peru have done to reduce the illegal parrot trade.

[14] Price data was not available for parrot species sold in a Santa Cruz market in Bolivia.

Chapter 3: Combating the Illegal Parrot Trade in Peru & Bolivia

A general response to the illegal wildlife trade has been the creation of laws forbidding the poaching and trading of species, penalizing offenders with fines and imprisonment, and increasing the presence of law enforcement in the wild. While the latter two options have not been linked to substantially reducing the illegal wildlife trade (Cantu et al., 2007), the former option shows some evidence of reducing the illegal wildlife trade. For instance, the United States enacted the Wild Bird Conservation Act (WBCA), which reduced the importation of wild-caught parrots brought into the United States. In place of poached parrots, bird breeding facilities have been able to fill the void and create a sufficient supply for United States demand for parrots, albeit at higher prices (Cantu et al., 2007).

Many of the countries in the neo-tropics have already implemented laws forbidding the taking of parrot species from the wild, including Mexico, Bolivia and Peru. Some countries such as Peru, implement a regulatory scheme that enacts catch-quotas for healthy species and bans the trade in threatened species. Prior to 2008, Mexico had a similar system (Cantu et al., 2007; Pires and Clarke, 2012). The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) works in much the same way. This international trade agreement creates trade bans for species that are threatened, and regulatory schemes for species that can be sustainably traded. The next section will focus on the creation of CITES, its objectives and its ability to reduce the illegal trade in threatened species.

CITES

CITES was created in 1973 to regulate the international trade in species in order to ensure that species commonly targeted for the wildlife trade would not go extinct. At the time, 80 countries around the world became signatories to the trade agreement and thereby regulated the export and import trade in wildlife products within these countries. Thus, member countries of CITES must file CITES paperwork in order to legally export and import wildlife products showing that they have not been illegally taken from the wild. The strength of the CITES legislation inherently rests on the cooperation by member countries and the amount of countries willing to be CITES members. Currently, there are 175 countries that have agreed to the CITES legislation which only leaves a few countries in the world outside its regulation (CITES, *What is CITES?*, 2010).

CITES regulates the trade in approximately 33,000 species of flora and fauna categorized by three CITES Appendices (CITES, *The CITES species*, 2010). Species within Appendix I are highly endangered and only traded in "exceptional circumstances". There are over 900 species listed in Appendix I including, most notably, elephants and tigers (CITES, *How CITES works*, 2010). In addition to these mammals, over 40 parrot species are categorized in Appendix I and can only be traded if they are bred in an authorized facility (WWF, *Wildlife Trade: Parrot Trade FAQs*, 2010). Appendix II species are not endangered of extinction at the moment, but their trade needs to be heavily controlled since their populations are unstable. Most parrot species fall within this category primarily because habitat loss and the wildlife trade are constant threats to many of these species. Lastly, Appendix III species are the least endangered, and permit standards for these species are the least restrictive (CITES, *How CITES works*, 2010). Only two parrot species are categorized as Appendix III specimens, the budgerigar and the cockatiel, which appear in Australia (WWF, *Wildlife Trade: Parrot Trade FAQs*, 2010).

Although CITES has made great strides in raising awareness in the exploitation of wildlife by regulating the international wildlife trade, its ability to conserve the most endangered species remains unclear. A primary problem with introducing trade bans is the lack of scientific evaluations in determining if the illegal wildlife trade has been reduced (Smith and Walpole, 2005, The Economist, 2008; Roe, 2008). Where evidence does exist, the results are mixed. For instance, some species appear to have benefited from international bans such as parrots, big cats, whales, African elephants, and vicunas. On the other hand, species such as rhinos, tigers, and pangolins, seem to have suffered from trade bans (The Economist, 2008; Pantel and Yun, 2009; Lemieux and Clarke, 2009; Pires and Moreto, 2011). "The ineffectiveness of some trade bans can be explained by the rising price for an animal product on the black market when demand continues unabated. This gives more incentive to hunt threatened species, as well as more power to corrupt officials who will seize this opportunity in countries with little transparency or oversight." (Pires and Moreto, 2011, 105)

An additional limitation CITES has in conserving endangered species is that it cannot regulate the domestic wildlife trade. As can be seen with the illegal parrot trade, the internal wildlife trade in range countries can be a much larger problem. Even if CITES is successful in reducing the international trade in endangered species, domestic markets can easily offset any gains achieved from international reductions. This is a particular difficulty with parrots because they remain abundant in the wild, and neo-tropical citizens enjoy them as household pets. Trade bans on the international market will not stop ordinary peasants from poaching, selling and buying parrots at the local level, unless the national government makes it more difficult to do so by imposing their own anti-poaching laws and cracking down on open-air pet markets.

The Problem in Peru

Until the mid-1970s, there were no laws to suppress the wildlife trade for domestic and international markets (Gastanaga et al., 2010). In 1975, Peru had become one of the first signatories of the CITES Treaty (CITES, *Member countries*, 2010). In addition, local laws had become implemented at this time to try and control the wildlife trade, but to no avail (Gastanaga et al., 2010). The parrot trade dramatically increased in Peru during the 1980s in large part due to international demand (Rosales et al., 2007, cited in Gastanaga et el., 2010), much like in Mexico (Cantu et al., 2007). In response to this, Peru's environmental government organization INRENA, created a catch-quota system for parrot species with healthy populations, as well as requirements for harvesting and transporting parrots (Gastanaga et al., 2010). Unfortunately, these regulatory rules and laws appear to have not curtailed the illegal parrot trade.

Peru, like other neo-tropical nations, is rich in parrot diversity. According to the IUCN (2010), 50 parrot species have a range within Peru (Appendix I). Of these 50 species, a majority are parakeets and amazons (Table 3.1). The type of parrot species that exist in Peru appears to be strongly related to length and average prices on illicit markets. The smallest of the species, parrotlets, demand the lowest prices on markets while the largest species, macaws, exact the highest prices on markets. Nevertheless, other factors are at play in predicting average prices. For instance, macaws and amazons are more likely to be very colorful and intelligent (see Chapter 2). This can also affect average prices of species in addition to length.

Table 3.1 – Peruvian Parrot Species' Figures

Types of Parrot Species	Numbers in Peru	Length	Average Peruvian Prices* (Cases)
Parrotlet	8	14.2	$17 (3)
Parakeet	18	25.2	$43 (11)
Amazon	16	28.8	$69 (11)
Macaw	8	62.1	$227 (5)

Source: Gastanaga et al. (2010)
* Unfortunately, data is missing for some species that appear on markets in Peru.

A majority of the 50 species that have a range in Peru have been found in the illegal trade. For example, Gastanaga et al. (2010) researched six cities in Peru with active parrot markets over a one-year period and found 34 parrot species with a total of 4,722 parrots appearing in these cities (Figure 3.1). Because the authors of the study used a quarterly survey method to investigate illegal pet markets, the total number of parrots found is only a small sliver of what would appear in a year's time. All but one species found in Peruvian markets are distributed within Peru[15]. The one species that was not local, the Monk Parakeet, is said to be the only species captive-bred in Peru.

[15] Although that does not imply Peruvian species were not poached in a bordering country, but it is highly unlikely.

Figure 3.1 –Illicit Parrot Markets in Peru & Bolivia
Annually Estimated Number of Parrots on Each Market

Source: Gastanaga et al. (2010) & Herrera and Hennessey (2008).
* For the Santa Cruz market in Bolivia, the actual number of parrots is an exact figure as opposed to an estimated total.

Table 3.2 shows 4 parrot species that are threatened to some degree appearing on at least one of the Peruvian markets. The Military Macaw and the Scarlet Macaw, both Appendix I species under CITES, are found on several city markets in Peru. The absence of endangered species from other countries is a positive sign that Peru is not a hub for internationally rare species like its neighbor Bolivia. However, it is difficult to confirm this, because rare and endangered species from neighboring countries may be sold privately rather than in open-air markets (Gastanaga et al., 2010).

Table 3.2 - Threatened Species Appearing in at Least 1 of 6 Peruvian Markets

Parrot Species	IUCN Red List[16]	CITES Appendix	N. of Markets Appearing on
Grey-cheeked Parakeet[17]	Endangered	II	4
Military Macaw	Vulnerable	I	2
Yellow-faced Parrotlet	Vulnerable	II	1
Red-masked Parakeet	Near Threatened	II	3
Scarlet Macaw	Least Concern	I	2

Source: (Gastanaga et al., 2010)

The Problem in Bolivia

Bolivia signed the CITES treaty in 1979 to regulate the wildlife trade and protect the most vulnerable species within its borders (Herrera and Hennessey, 2007). By 1985, it banned the export of live birds to try and reduce the size of the illegal parrot trade (Herrera and Hennessey, 2008). Although there are no evaluations that measured the

[16] IUCN stands for the International Union for Conservation of Nature, which categorizes the world's flora and fauna by their risk of extinction.

[17] It is not clear why an endangered species such as the Grey-cheeked Parakeet is not in Appendix I under CITES. Its range is quite small now, because it's being poached for the trade as well as suffering from habitat loss. Generally, all endangered Red List parrot species are within Appendix I.

illegal parrot trade before and after 1985, there is no indication this reduced the trade. According to Bolivian Environmental Law #1333, Article 111, persons caught in the illegal trade can be punished up to two years in prison and pay a fine that amounts to the cost of the species. Like the CITES legislation Bolivia has signed onto, laws on the books are rarely enforced. There are four illegal pet markets in the city of Santa Cruz alone that operate in open-air markets without interference from the police. Illegal pet markets such as these, tend to be ignored by police because they are not perceived as a law-enforcement priority (Herrera and Hennessey, 2007; 2008).

Bolivia, like Peru, has a wide variety of parrot species within its borders. Forty-seven species can be seen in Bolivia (IUCN, 2010; Pires and Clarke, 2011) and many of them have very large ranges in the neo-tropics. For example, 32 of the 47 species in Bolivia can also be seen in Peru (Appendix I). Of these 47 species, most are parakeets and amazons reflecting a similar pattern to Peruvian species (Table 3.3). Yet, there are some disparities between species in both countries. For one, there are a larger proportion of macaws and considerably less parrotlets in Bolivia. And secondly, amazons in Bolivia sell for a much higher price on average as compared to amazons in Peru.

Table 3.3 – Bolivian Parrot Species' Figures

Types of Parrot Species	Numbers in Peru	Length	Average Bolivian Prices* (Cases)
Parrotlet	4	13.0	$12 (1)
Parakeet	17	25.6	$27 (9)
Amazon	14	30.4	$220 (10)
Macaw	12	64.7	$369 (7)

Source: Herrera and Hennessey (2008).
* Unfortunately, data is missing for some species that appear on the Santa Cruz market.

Like Peru, a majority of the species in Bolivia are found in the illegal parrot trade. For example, in Herrera and Hennessey's (2008) second study of the Loz Pozos pet market in Santa Cruz, they counted thirty-six different species and a total of 27,535 parrots that passed through the Loz Pozos market from July 2004 to December 2007[18]. At least five of the species had been transported from neighboring countries since they do not reside within Bolivia. Moreover, Bolivia's lack of enforcement of treaties and national laws means seven Appendix I species appear on the Loz Pozos market, six of which are threatened to some degree (Table 3.4).

Table 3.4 - Threatened Species appearing on the Loz Pozos Market, Bolivia

Parrot Species	IUCN Red List	CITES Appendix	N. Appearing on Market
Lear's Macaw	Critically Endangered	I	2
Blue Throated Macaw	Critically Endangered	I	2
Hyacinth Macaw	Endangered	I	10
Red-fronted Macaw	Endangered	I	47
Military Macaw	Vulnerable	I	4
Yellow-faced Parrot	Near Threatened	II	3
Tucuman Parrot	Near Threatened	I	44
Scarlet Macaw	Least Concern	I	50
Total	---		161

Source: (Herrera and Hennessey, 2008)

[18] This study is an extension of their original study, which examined the Loz Pozos market for a one year period. Unlike the Gastanaga et. al. (2010) study in Peru, Herrera and Hennessey (2008) counted parrots coming through the market on a daily basis for two and half-years.

Summary

The illegal wildlife trade has been addressed with a number of policies, some traditional (e.g. increasing law enforcement and making wildlife crime punishments more severe) and some more innovative as seen by the creation of CITES and the IUCN. For the countries under study, Peru and Bolivia have already implemented policies that have made parrot poaching and the subsequent trade illegal. Unfortunately, and not surprisingly within this field, this has not curbed the domestic trade in parrots within these two neo-tropical countries. Tens of thousands of parrots are being poached and traded in both countries every year, including threatened species that appear on Appendix I within CITES. Without a change in policy in these range countries, the illegal parrot trade will continue to thrive while endangering many more species to the brink of extinction.

The following section will lay out the theoretical framework of the dissertation, highlighting the criminological theories being applied and the design of the research study.

Chapter 4: Theoretical Framework

Studying variation in theft of hot products can clarify why some products are more prone to being stolen than others. For instance, the theft of cars is not equally distributed amongst all models. The Cadillac Escalade has consistently been one of the most stolen cars in the U.S. for the past 7 years and is roughly 13 times more likely to be stolen compared to the Toyota Prius (HLDI, 2010). Studying illegal wildlife markets and in particular, the trade of wild parrots, is a logical extension of the hot products research that would broaden the field to include non-traditional property crimes. Parrots, like other hot products, are stolen and sold at a high rate and demonstrate remarkable variations in theft. Evidence from poaching estimates in Mexico show that the Orange-fronted Parakeet is poached 470 times more often than the Scarlet Macaw (Cantu et al., 2007). By looking at both species, this would come as a surprise to many, since the Scarlet Macaw is one of the most beautiful parrots in the world. Conventional explanations for variation in poaching would suggest that factors such as 'beauty' and 'value' would be the key reasons in explaining disparities. However, this may be too simplistic and would not explain the disparity, for instance, in the aforementioned example.

This study aims to investigate why only *some* parrot species end up on illegal pet markets in South America. In doing so, one can understand how, why, and where parrot poaching is conducted, and explore the necessary steps to disrupt illicit wildlife markets and prevent parrot poaching.

To examine the variation in parrot species appearing on illicit pet markets, previous research has utilized the CRAVED model in developing independent variables that can explain poaching variation (Pires and Clarke, 2012), and Optimal Foraging Theory (OFT) to help understand foraging by poachers as well as "itinerant fences" (Pires and Clarke, 2011). OFT was developed by biologists in the 1960s to see how animals forage for food. Felson (2006) and Bernasco (2009) have suggested OFT can be a useful model to complement opportunity crime theories to better understand how criminals seek targets. For instance, the decision making process offenders make can be clarified through the lens of OFT to explain "when, where, how and against what target an offense will be committed" (Bernasco, 2009, 6).

While the CRAVED Model has been extremely useful in thinking of environmental factors that play a part in poaching, OFT has been more difficult to operationalize into measures. For these reasons, Optimal Foraging Theory will not be used in this dissertation and will be replaced by the concept of 'choice-structuring properties' (Cornish and Clarke, 1987) which emanates from Rational Choice Theory (Cornish and Clarke, 1986), in addition to using the CRAVED model.

Rational Choice Theory

The Rational Choice Theory (RCT) developed by Cornish and Clarke (1986) focuses on the decision making process offenders make when conceiving of their targets. Unlike traditional criminological theories, which are far more concerned with the predisposition to commit crime, RCT is more concerned with the rationality of target selection and the contextual environment that may facilitate or inhibit these acts. Cornish and Clarke point out that it is not to be understood that the predisposition to commit crimes is irrelevant[19], but rather, this alone cannot explain why certain targets are chosen over others. That is why RCT emphasizes the rational decision-making process more so than the predisposition to commit offenses.

For each crime that can be committed, the crime offers a specific purpose for the offender (e.g. money, pleasure, status), and different crimes offer different costs, benefits and risks. When potential offenders are thinking of committing a certain crime, they are contemplating the costs and rewards of committing such a crime at the most basic level (e.g. are witnesses present?). Thus, offenders are rational, but only to an extent. Cornish and Clarke (1985, 1986) call this "bounded rationality"; or decisions that are based on limited information at the time of the offense and may very well be ill-planned. Based on this bounded rationality, offenders will be partial to crimes in which the risk of detection is low, there is a relative ease in committing the crime and there is a beneficial reward.

Within RCT, 'choice-structuring properties' of offenses was developed to better understand why certain crimes are attractive to offenders (Cornish and Clarke, 1987). Crimes that have properties such as a good payoff, low risk of detection and minimal skills required for carrying out the crime, would imaginably be more common than

[19] RCT does discuss certain "background factors" that might make one more inclined to commit crimes such as self-control, intelligence, upbringing, gender, etc.

crimes that have the opposite properties. This concept may also help to explain why some crimes will not be displaced spatially, temporally or to similar crimes because offense properties can be quite different and unappealing to a potential offender. For example, when domestic gas was the primary method of committing suicide in the U.K. some decades ago, this method was appealing for individuals because it "was painless, very widely available, required little preparation, was highly lethal, was not bloody, and did not disfigure" (Cornish and Clarke, 1987, 937). After the supply of oven gas changed to natural gas and thereby disallowing suicide by 'sticking one's head in the oven', very little displacement to alternative methods was detected with an overall reduction in suicides by a third (Cornish and Clarke, 1987). By understanding the attractive properties of offenses (or unwanted behavior such as suicide), policy-makers can make better informed decisions on the potential for displacement when implementing crime preventive measures.

The Choice-Structuring Properties of the Illegal Parrot Trade

For the present issue, the choice-structured properties of the illegal parrot trade are numerous and will differ between species, as well as from other fauna commonly poached for the trade[20]. There are two sets of factors that can help explain why poaching for the illegal parrot trade is popular in range countries, and these are, *static* and *variance* factors. Static factors (Table 4.1) are key reasons why parrot poaching is common practice in the neo-tropics, but will not help shed light on poaching variation amongst

[20] In the neo-tropics, one might find monkeys and reptiles on illicit markets along with other bird species.

species. For instance, poachers are cognizant there is little risk of being detected when poaching parrots, but that does not differ between species.

Variance factors on the other hand, can help explain why some species are more prone to becoming poached than others. If significant differences exist between the species that are more likely to appear on illicit markets from the ones that never do, it will be because of variance factors that make some species more *attractive*, or CRAVED, to poachers. Given this is the case, then preventive solutions targeting the most poached species should bring about a net reduction in poaching with minimal displacement to other parrot species.

Table 4.1 - Choice Structuring Properties of Parrot Poaching

Static Factors

- Not considered a 'real crime' by many locals
- Parrots are widely available
- There is minimal risk of detection
- Lack of enforcement and prosecution of individuals in the trade
- Few skills are required to poach
- Household tools only needed (e.g. machete)
- A good secondary income can be made by catching and selling parrots to neighbors, middlemen or markets that are nearby.

Variance Factors

- Availability
- Accessibility
- Abundance
- Valuable
- Enjoyable
- Removable
- Disposable
- Concealable

CRAVED Model

The CRAVED model builds upon the concept of 'suitable target' (Cohen and Felson, 1979) in helping explain theft variation of "hot products" (Clarke, 1999). Before the CRAVED model, Cohen and Felson (1979) had devised the VIVA model to explain what makes people or objects suitable targets from the perspective of offenders. In regards to inanimate targets, products that had high: *value*, *inertia*, *visibility* and *accessibility* were thought to be more likely to be stolen. The rising crime the United States experienced from the 1960s onward could be explained by American households owning more electronic devices, as well as these devices becoming smaller in nature. This allowed burglars to find valuable products in most American homes, that were readily visible and easy to carry out (e.g. TVs, stereos, VCR's, etc.).

The CRAVED model expands upon the VIVA model in a number of ways. Products that will be more stolen, as the acronym details, will also be more likely to be: *concealable*, *removable, available, valuable*, *enjoyable* and *disposable* (Table 4.1). The CRAVED model enhances the understanding of theft preferences by not only focusing on target attributes, but on contextual factors that help explain variation in product theft. For instance, shoplifters may steal some of the same products as commercial burglars, but commercial burglars will steal it in bulk.

In many instances, some of these concepts may not be pertinent in explaining variation in theft (e.g. the Ford Taurus was one of the most *available* cars in the 1990s, but the least stolen in the U.S.), while in other instances, all of the concepts in conjuncture can explain, for example, why 'cash' is the most stolen item (Clarke, 1999). Early research by Clarke (1999) shows the CRAVED model can explain variation in car theft, shoplifting and residential burglary. More recent research has applied the CRAVED model to: cell phone theft (Whitehead et al., 2008), timber theft in the Appalachians (Baker, 2003), bag theft in licensed premises (Smith et al., 2006) and domestic burglary patterns (Wellsmith and Burrell, 2005).

Table 4.2 - CRAVED Model Definitions

Concealable	Products that can be concealed easily will be more likely to be stolen. For instance, research shows cars stolen for export to Mexico will be more likely to be models that are legitimately sold there and will therefore not be conspicuous.
Removable	Products that are lighter will be stolen more often, though this is also contingent on the context. Commercial burglars will often steal the same products as shoplifters, but in much greater quantities because they are doing it after-hours.
Available	When attractive novel products, such as mobile phones and laptops, become widely available, this can promote an illicit market for these products. Availability also includes accessibility, the notion that if products are easier to get to (e.g. old cars parked on the street), they will also be more likely to be stolen.
Valuable	What is valued by the thief and the value of the product can dictate which products become 'hot'. For instance, joyriders will choose fast cars to steal whereas a thief looking for car parts will choose an older car where the parts cost more than the car itself.
Enjoyable	What is often enjoyed by thieves will more likely be stolen. This can explain why cigarettes, alcoholic drinks, condoms and music cd's are commonly stolen.
Disposable	This may be the most important component of the CRAVED model, because what can be disposed of easily on a fencing market, will be targeted more for theft. Evidence from a police sting operation revealed that car theft increased in the local area after the police set up a fencing market.

Source: (Clarke, 1999)

Although the CRAVED model was intended to explain variation in traditional forms of property theft, its applicability is not limited to this. Pires and Clarke (2012) have shown its applicability to a more exotic crime, such as the illegal parrot trade. In their analysis, they found much of parrot poaching in Mexico is conducted by opportunistic peasants. Peasants can augment their meager incomes by poaching nearby parrot nests and selling their parrots off to itinerant fences when they make routine stops in their village. They found that parrots that are more *accessible*, *abundant*, and *removable* were more likely to be poached. In a second study analyzing the Santa Cruz pet market in Bolivia, Pires and Clarke (2011) found the more *accessible*, *abundant*, and *enjoyable* species to be the most likely to end up on an illegal pet market[21].

This study will further advance research on parrot poaching in the neo-tropics by being able to generalize which CRAVED-derived independent variables matter the most in explaining poaching variation. Previous findings (Pires and Clarke, 2011; 2012) have suggested the concept of *availability* needs to be broken down to more specific concepts, such as *abundance* and *accessibility*. Some parrot species can be theoretically widely abundant in the wild, but are in areas that are inaccessible to humans such as national parks. Thus, suggesting that these species are widely available does not take into account all relevant contextual factors.

Unfortunately, because of data limitations, two CRAVED model concepts cannot be operationalized for this study. C*oncealable* and *disposable* cannot be used in this study because no uniform data exists for each species that states: (1) that some species are more concealable in transport (e.g. quieter); and (2), that some species are less likely to die in transport or are in more demand by illicit markets (varying proxy measures of disposability). Therefore, this study is only a partial examination of why some species are poached more often than others because the operationalized CRAVED variables are primarily focused on the preliminary stage of poaching. That being said, this study does

[21] Neither *concealability* nor *disposability* was operationalized in both studies due to the lack of data.

look at the decision making process that middlemen make when transporting species to other markets. Since some species end up being transported to very distant markets (as this study will clarify), CRAVED variables may help distinguish which species are more likely to become transported. For instance, are the more valuable and enjoyable species more likely to be traded to other markets or are the more available species on the market? The former finding would suggest *demand* is the key reason, in which middlemen are responding to the needs of buyers. Whereas the latter finding suggests *supply* is more of a factor in transporting wildlife. Supply and demand are both at play in the illegal parrot trade, but this study can illuminate which matters most at the poaching and inter-city transportation stage.

Overview of Research Design

This research study intends to clarify how the illegal parrot trade operates in the neo-tropics by examining each stage of the trade (i.e. poaching, transportation of species, and selling on markets). Due to the many divergent research questions focusing on each stage of the trade, this dissertation methodology will be divided into three sections/chapters: the ***first*** section will examine the catchment area around each of the seven markets (six in Peru and one in Bolivia); the ***second*** section will analyze the interaction between markets; and the ***third*** section will focus on the opportunity-based factors that are at play in parrot poaching. A total of 67 parrot species will be examined, of which 50 appear on at least one of the seven illicit markets, while the remaining 17 species are in close proximity to at least one market, but do not appear on any. The **dependent variable** will be the "number of parrots appearing on markets" classified by parrot species (see Appendix II), while the independent variables will be the CRAVED-derived measures created by Pires and Clarke (2011; 2012).

For all three sections of the study, each of the seven markets will be analyzed independent of other markets. The *range* of species appearing on each market varies from six species in Iquitos, Peru to 35 species in Santa Cruz, Bolivia (Table 4.3). However, only examining species *on* markets for poaching variation completely neglects parrot species that are found in the nearby area, but do not appear on a market at all. For this reason, 'comparison birds' that did not end up on a market, but are within a poaching distance[22], will be added to each market's total number of species to help fully understand variation in poaching.

With the addition of comparison parrot species, the range of species that can possibly appear on each market will vary from 43 species in Lima, Peru, to 55 species in Santa Cruz, Bolivia. Due to the dependent variable having a non-normal distribution, non-parametric and parametric tests will be employed in this dissertation. A t-test (parametric) will be used to compare species on the market to those not on the market, as well as a Spearman Rho correlation (non-parametric) with a host of various independent variables. A final analysis will include aggregating all the data from the seven markets and running parametric tests, such as multiple regression, to find more generalizeable patterns on the markets' influence on poaching parrots.

[22] Since most species appear within 400 miles from every market, it is more realistic to only include comparison species within this distance of 400 miles to actually appear on a market.

Table 4.3 - Number of Species Examined for Each of the Seven Markets

Market	Study Period	N. of Species Appearing	N. of Comparison Species	Total Species
Arequipa, Peru*	3-months	21	28	49
Chiclayo, Peru	4 quarters	21	30	51
Pucallpa, Peru	4 quarters	20	30	50
Iquitos, Peru	4 quarters	6	45	51
Lima, Peru	4 quarters	12	31	43
Puno, Peru	4 quarters	12	38	50
Santa Cruz, Bolivia	2 1/2 years	35	20	55

* Market count is used instead of quarterly survey method due to more species appearing. The quarterly survey method only found eight species.

In order to help the reader focus on the many divergent sets of questions and variables that will be analyzed in this study, the research methodology will be laid out over the following three chapters. Each chapter will be in the following order: Research Questions, Overview of Methods, Variables, and Findings.

Chapter 5: The Catchment Area

Section 1 Research Questions & Findings

This section will be concerned with the reach of each individual market on parrot poaching (H^1-H^3). The following chapter (H^4-H^6) will look more closely at how markets interact with each other.

Research Questions

Research indicates that a key factor in what makes a product ‘hot’ is the existence of a nearby fencing market that has a particular interest in obtaining certain products (Clarke, 1999). Due to the ease of disposal, the offender is incentivized to steal more of a particular product in return for quick cash. In the case of illicit pet markets in the neo-tropics, one should expect that the existence of a market should create an extra incentive for locals to poach parrots, as well as for itinerant fences who go from town to town to collect these parrots to dispose of on illicit markets. Anecdotal research throughout the conservation literature suggests that illicit pet markets are local; that is, the wildlife that appears on the market come from the local area. But how local is 'local'? Pires and Clarke's (2011) analysis of a Santa Cruz market in Bolivia reveals the catchment area, or where parrots are poached for a market, is roughly 100 miles outside the city. This suggests that parrot species that are within a vicinity of roughly 100 miles of a large illicit pet market, should have a considerably heightened risk of being poached as opposed to species outside of this catchment area. This makes sense for two reasons: (1) most parrots will be caught quite close to markets because villagers can dispose of parrots themselves on markets (the *cost* would be little in transportation terms); and (2), in the interests of reducing *cost* and *risk*, itinerant fences[23] would be more likely to travel to towns that are in closer proximity to markets as well. At the same time, the reach of the market is extended further outside the immediate area around cities because of itinerant fences. If fences were absent in the trade, locals who are poaching would not have the means or the incentive to travel more than 20-50 miles each way to dispose of parrots. Itinerant fences have the means in terms of transportation and money, to travel farther outside the city if the benefits (e.g. numerous parrots or very expensive species) outweigh the costs of traveling (Pires and Clarke, 2011).

It should also be expected that there are different types of illicit pet markets within both Peru and Bolivia in regards to their catchment reach. By examining the species that are found on markets, one can see that there will be markets more local in reach, as well as markets that are regional. Shedding light on these distinctive types of markets can enable researchers to find itinerant fence patterns of travel (e.g. where species are most likely collected and where they finally end up on markets). The following hypotheses will be examined that are consistent with the CRAVED model and RCT:

> ***H^1*** *The average catchment area around markets should not extend beyond 100 miles.*
>
> ***H^2*** *Parrot species whose ranges are closer to markets appear more often in markets than species that are farther away.*

[23] Itinerant fences are also known as "wildlife traders".

H^3 *The larger the proportion of the catchment areas that overlaps with a parrot range, the more likely the parrots from this range will appear in markets and the greater will be their quantities.*

Overview of methods

When an illicit pet market exists, one would expect that parrots closest to the market will be poached more often because of the ease of disposal for the offender and the itinerant fence. It would also be expected that the market in closest proximity to where parrots are poached, will become the destination end-place for itinerant fences and poachers to dispose of their parrots. In order to test these hypotheses, the catchment area within each of the seven illicit pet markets must be established by: (1) measuring the distance between markets to see where "circular buffer" overlap begins; and (2) measuring the distance between each species' ranges to the markets they appear on. This can be done by using ArcGIS software to create circular "buffers" around each city market and to measure the closest distances between species' ranges and the respective markets they appear on and do not appear on.

Once a catchment area is established, H^2 can be tested by running a Spearman Rho correlation between the distance to market and the number of parrots appearing on markets (Dependent Variable). H^3 can be tested by quantifying the number of square miles within the catchment area overlapping with a given parrot range, and seeing if this measure has a relationship with the number of parrots appearing on markets.

Variables

The CRAVED model has already assisted Pires and Clarke (2011; 2012) in operationalizing factors that facilitate parrot poaching in Mexico and Bolivia. These same explanatory variables will be used in this study. All variables are listed in Appendix II.

Available*:* Availability is measured in two different ways: (1) calculating the closest distance parrot species appear from markets; and (2) calculating the area each species range is within a catchment area.

Distance of Parrot Ranges from the Market: It is hypothesized that the species that are closer to markets will be more likely to appear on them and in greater quantities. This variable measures the closest point the range of a species is in relation to a city market (in miles). To do so, parrot species "shapefile" data were retrieved from the SEDAC website[24] and laid over the maps of Peru and Bolivia. "Shapefiles" of city markets and South American countries can be uploaded from the ArcGIS software directly. Figure 5.1 illustrates how this variable is measured for the Yellow-Crowned Parrot. Notice where the range of a species overlaps a city market, the distance is calculated as "0" miles from market.

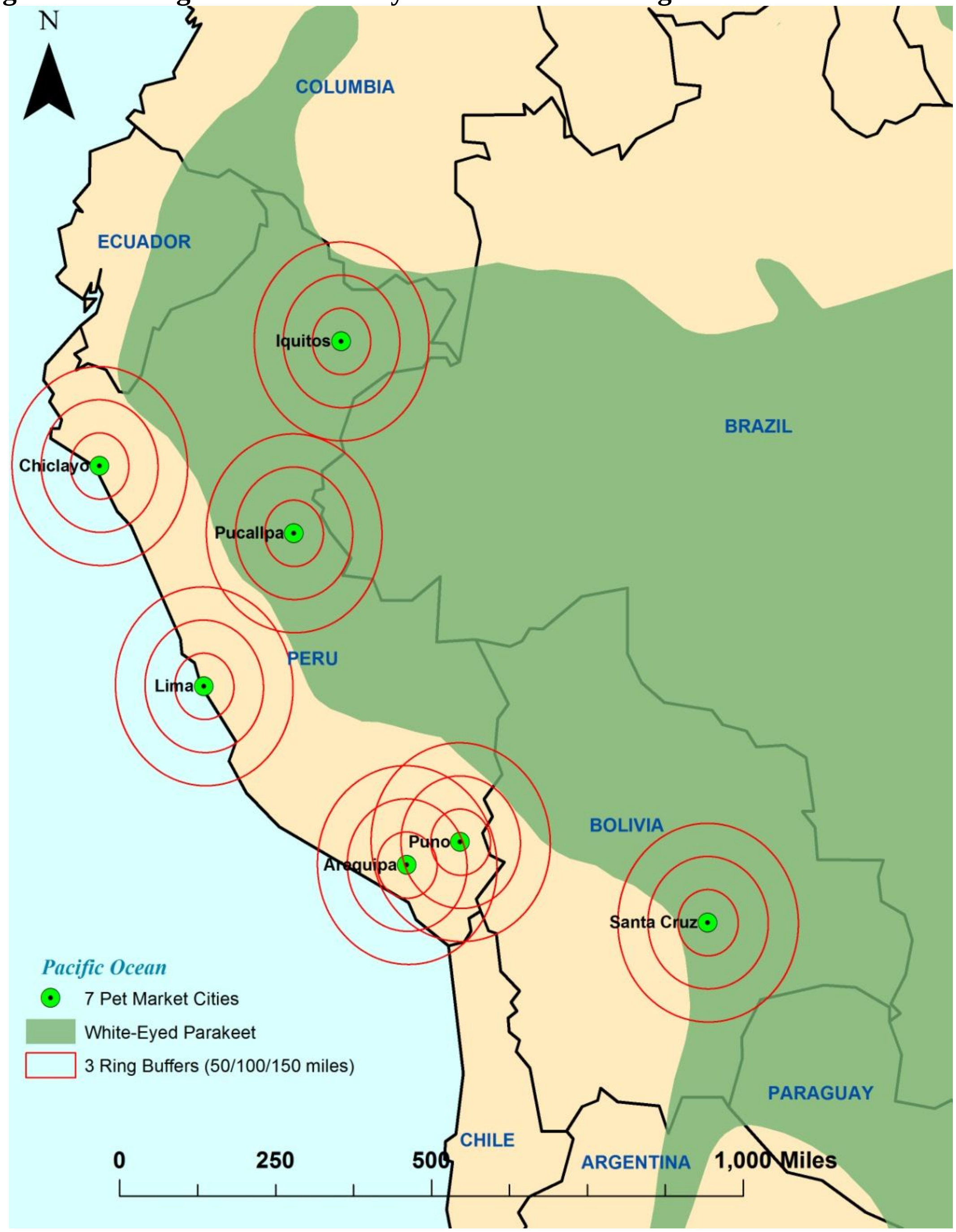
---

[24] http://sedac.ciesin.columbia.edu/species/

Figure 5.1 - Range of the Yellow-Crowned Parrot & Distance to Each Market

Buffers around Markets: Distance from a market has been shown to be an important predictor of poaching variation. Nevertheless, *distance* lacks measuring the vast range some species have within a close distance of a market. This variable measures the square miles of each species within a circular buffer around each city. Buffers have been created in 50-mile intervals up to 150 miles outside city markets. Species that do not appear within buffers have received a score of zero. In Figure 5.2, the White-eyed Parakeet can be seen to have a substantial range within the catchment areas around Iquitos, Pucallpa and Santa Cruz. Therefore, it should be more likely to appear in these markets as opposed to the other four markets where little or no distribution is found.

Figure 5.2 - Range of the White-Eyed Parakeet & 3-Ring Buffers around Each City



Section I – Analysis & Results

The existence of city pet markets incentivizes locals to poach hot products such as parrots. In addition to locals poaching parrots, peasants in areas farther outside the city, possibly up to 150 miles, will also be incentivized to poach parrots because of itinerant fences' willingness to travel far distances and purchase parrots off villagers. In order to understand where most parrots are poached for the seven markets analyzed in this study, four criteria will be assessed to establish catchment area sizes:

1. How far are the seven city markets from each other?
2. What percentages of species on a market have ranges within a given buffer (e.g. 50, 100, 150 miles) from that market?
3. Of the market species that have ranges within each buffer (e.g. 50, 100, 150 miles), what percentage of all parrots on the market do they represent for each respective buffer?
4. Where are most *comparison species'* ranges relative to markets?

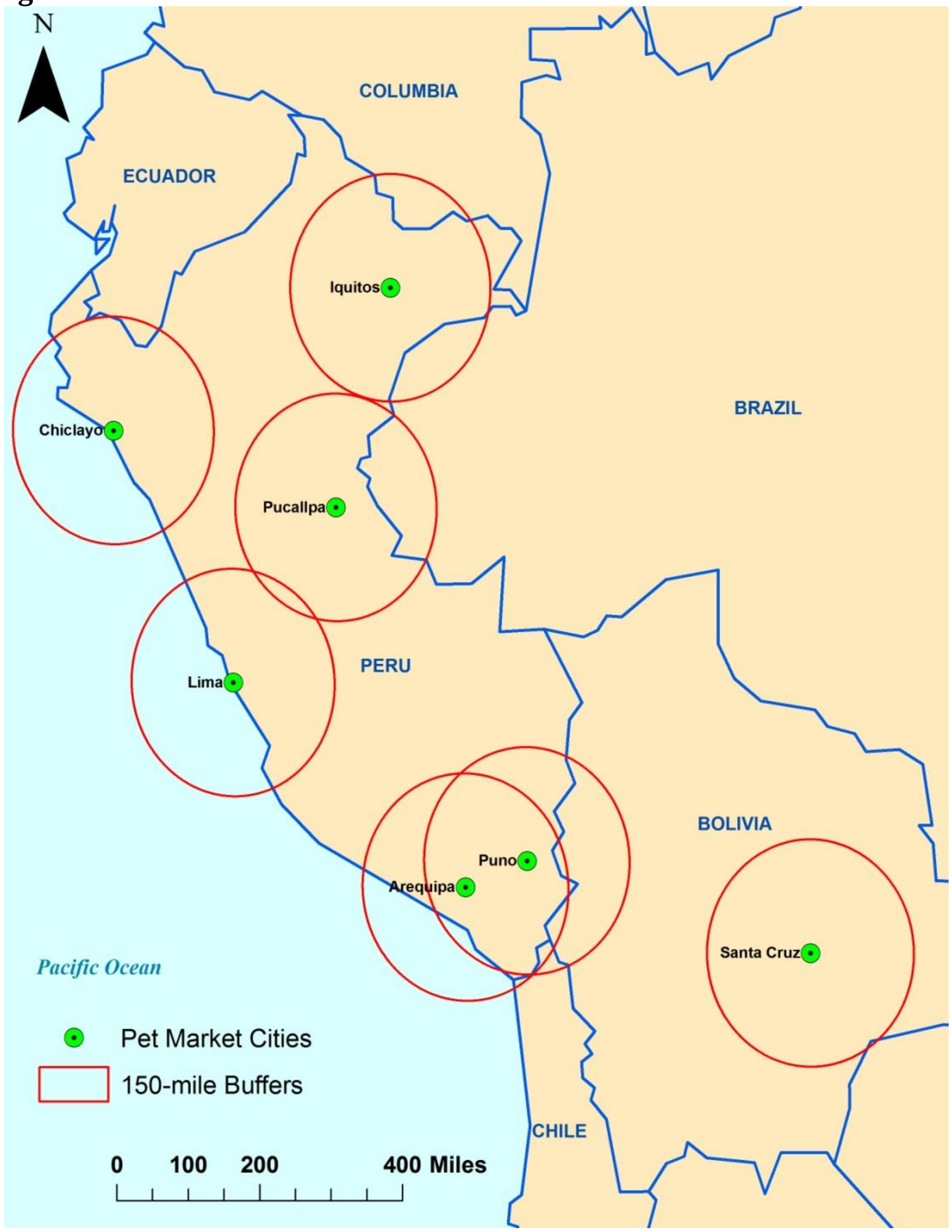
In Figure 5.3, one can see that overlap between cities mostly begins to happen at roughly 150 miles. With the exception of Arequipa and Puno, parrots poached within a distance of up to 150 miles from any given market should appear on those markets. For instance, a parrot poached within 150 miles of Chiclayo should be much more likely to appear on

Chiclayo's market than Pucallpa or Lima because the proximity to Chiclayo's market is much closer[25].

Now that it is established that catchment areas should not be larger than 150 miles due to market catchment area overlap, the next step in understanding the average catchment area size around markets is to examine where most parrot species' ranges are relative to the markets they appear on. In Table 5.1, it is clear that there is not a one-size fits all type of catchment area in the neo-tropics. It is also clear that for many markets, a good proportion of species are coming from outside the catchment areas. Only 60 percent of parrot species on these neo-tropical markets have ranges within 150 miles of each city, indicating that 40 percent of market species are coming from very far distances via middlemen.

[25] Not seen in this picture are the Bolivian cities of Sucre and Chochabamba that are west of Santa Cruz, Bolivia. Herrera and Hennessey (2007) noted these cities would also have pet markets. In the Pires and Clarke (In Press *b*) analysis of Bolivian parrot poaching, they found that there is catchment area overlap beginning at around 100 miles with these three Bolivian cities.

Figure 5.3 - 150-Mile Buffers around Each of the Seven Pet Market Cities



For markets such as *Iquitos* and *Pucallpa* in Peru, a 50-mile catchment area is likely to explain where most parrots are poached for these markets. For instance, in *Iquitos*, six out of the six species on the market are all found within zero miles from the city and thus explain 100 percent of the number of parrots found on the market (Table 5.2). In Pucallpa, 17 of the 20 species found on the market have ranges within 50 miles of the city, and they explain 87 percent of the market total. The remaining three species come from far off distances and are likely outliers. Therefore, markets like Pucallpa and Iquitos are highly local with very small catchment areas.

Table 5.1 - The Number of Parrot Species Found within Each Buffer Around 7 Illicit Parrot Markets in Peru & Bolivia (Species Found within Buffer/Total Species on Market)

Market	50 miles	100 miles	150 miles	Catchment Area
Iquitos	6/6	6/6	6/6	50 miles
Pucallpa	17/20	17/20	18/20	50 miles
Santa Cruz	21/35**	26/35**	26/35	100 miles
Lima	2/12	3/12	4/12*	100 miles
Chiclayo	2/21	5/21	11/21	150 miles
Arequipa	2/21	2/21	4/21	150 miles
Puno	0/12	3/12	8/12	150 miles
Total (mean)	**39%**	**49%**	**60%**	**100 miles**

* The fourth species only begins to appear 150 miles from Lima.
** This includes the Blue-Fronted Parrotlet.

Table 5.2 - The Percentage of Total Parrots Found on Each Market by Buffer Size

Market	50 miles	100 miles	150 miles	Catchment Area
Iquitos	100%	100%	100%	50 miles
Pucallpa	87%	87%	88%	50 miles
Santa Cruz	99%	99%	99%	50 miles
Lima	9%	9%	10%	100 miles
Chiclayo	56%	61%	75%	150 miles
Arequipa	9%	9%	13%	150 miles
Puno	0%	29%	61%	150 miles
Total (mean)	**-----**	**-----**	**-----**	**100 miles**

A 100-mile catchment area is likely to explain markets in *Lima, Peru* and *Santa Cruz, Bolivia*. The market in *Santa Cruz* operates much like the earlier two local markets, albeit in a larger buffer (i.e. up to 100 miles). Twenty-six of the thirty-five species that appear on this market are found within 100 miles of the city, and these 26 species represent 99.8 percent of the total market share. The remaining 10 species come from far distances, but represent very few parrots of the total (i.e. 0.2 percent). Thus, Santa Cruz is a local market that also attracts inter-city fences. From time to time, rare species such as the Lear's Macaw will appear on markets like this. *Lima*, on the other hand, is a drastically different market from Santa Cruz, despite having the same catchment area size. The reason is because only three of the twelve species that are on the market appear within 100 miles. These three species only represent nine percent of the market total. The remaining nine species that appear on the market have an average distance of 255 miles from the Lima market (*Range* is 150-546 miles). This is fairly strong evidence that these species are not being poached for the Lima market, but are being poached for other city markets in Peru and then being transported to Lima. This makes sense because Lima has the largest human population of any Peruvian city with nine million people. Therefore, Lima is considered a regional market despite having a 100-mile catchment area.

The remaining three markets (*Chiclayo, Arequipa,* and *Puno*) have a 150-mile catchment area, but are not exclusively regional markets. Quite the opposite actually, *Arequipa* is the only regional market of the three. Only four of the twenty-one species appearing on this market appear within 150 miles. Moreover, these four species only represent 13 percent of the market total. The remaining 17 species have an average distance of 327 miles from the market (*Range* is 170-952 miles). This implies that most parrots appearing in Arequipa are not poached for this market, but are brought by middlemen from other markets (or *inter-city fences*).

Puno also has a 150-mile catchment area, but is classified as a local market. Eight of the twelve species on this market appear within 150 miles and represent 61 percent of the total market share. Thus, a majority of species on the Puno market are found in a somewhat local area and represent a majority of parrots on the market. The remaining four species are most likely coming from other markets given their average distance is 348 miles from *Puno* (*Range* is 164-537 miles). The species that appears most on this market is the Canary-Winged Parakeet (n=57), despite its closest range to Puno occurring 485 miles away. Therefore, Puno is a local market with evidence of inter-city fences traveling there.

The last market, *Chiclayo*, operates much in the same as Puno. Eleven of twenty-one species on the market appear within the 150-mile catchment area. These 11 species make up 75 percent of all parrots on the market. The other 10 species that appear on the market come from farther off distances, ranging from 159 miles to 366 miles (*mean* is 231 miles). Chiclayo can be considered a local market, despite having a large catchment area because: (1) a majority of parrot species are found within 150 miles of the market; and (2) they represent a large majority of parrots found on the market.

Table 5.3 - *Market Types and Catchment Area Sizes*

Market	Catchment Area	Type of Market
Iquitos	50 miles	Local
Pucallpa	50 miles	Local
Santa Cruz	100 miles	Local
Lima	100 miles	Regional
Chiclayo	150 miles	Local
Arequipa	150 miles	Regional
Puno	150 miles	Local

Comparison Species & Catchment Areas

Comparison species are close enough to a market to appear on one (up to 400 miles), yet do not get poached for those markets. Table 5.4 examines where the ranges of comparison species are relative to markets. A key reason why comparison species are not seen on markets is that a majority of them do not appear close enough to a market. Only 15 percent of all comparison species are found within 50 miles of an illicit market. Even when looking within each market's catchment area, only 31 percent of comparison species have a range within them. (A raster map comparison of species on and not on markets is located in Appendix IV for all seven markets).

Table 5.4 - *Ranges of Comparison Species within Each Buffer (N within Buffer/Total N)*

Market	50 miles	100 miles	150 miles	Catchment Area
Iquitos	18/45	18/45	18/45	50 miles
Pucallpa	9/28	11/28	18/28	50 miles
Santa Cruz	4/18	8/18	9/18	100 miles
Lima	0/31	4/31	9/31	100 miles
Chiclayo	0/30	4/30	11/30	150 miles
Arequipa	0/29	0/29	0/29	150 miles
Puno	2/38	8/38	18/38	150 miles
Total (mean)	**15%**	**24%**	**38%**	**31% within CA's**

Distribution of Species & Poaching

For H^2 and H^3, it is thought that species that are closer to city markets and that have large distributions within catchment areas should be more likely to appear in markets and in greater quantities. To test these hypotheses, a Spearman Rho correlation is used to see if *distance* and *range within buffer* is related to the number of parrots found on markets or close enough to appear on a market. A second analysis will make use of a t-test to compare species on markets to species not on markets on the same measures of *distance* and *range within buffer*.

In Table 5.5, *distance* only appears to matter for the most local of illicit parrot markets, in which the catchment area is 100 miles or less. The same picture is seen when looking at Table 5.5 as well; species that have ranges closer to Iquitos and Pucallpa are more likely to appear on the market. In Santa Cruz (Table 5.6), there is no significant difference between both sets of species because there are five non-Bolivian species that appear on the market that travel an average distance of 1,211 miles to reach Santa Cruz. This effectively skews the average distance from range to market for species appearing in Santa Cruz. Moreover, these five species are clear outliers since they represent less than 0.1 percent of the market total[26].

Table 5.5 - *The Relationship between Parrot Ranges and Number of Parrots Found in 7 Markets (including Comparison Species)*

Markets	Catchment Area	Market Type	N of Total Species	Distance†	Range Within Buffer†
Iquitos	50 miles	Local	51	-.374**	.304*
Pucallpa	50 miles	Local	48	-.483***	.533***
Santa Cruz	100 miles	Local	53	-.585***	.673***
Lima	100 miles	Regional	43	.062	.194
Chiclayo	150 miles	Local	51	-.207	.256
Arequipa	150 miles	Regional	50	-.012	.386**
Puno	150 miles	Local	50	-.075	.188

† Spearman Rho Correlation
* Significant $p < 0.05$
** Significant $p < 0.01$
*** Significant $p < 0.001$

Table 5.6 - *The Relationship between Parrot Ranges and Appearing on a Market: Using a T-Test to Compare Species on Markets to Species Not on Markets.*

Markets	Catchment Area	Market Type	N of Cases (On/Not on)	Distance	Range Within Buffer
Iquitos	50 miles	Local	6/45	.000*	.000*
Pucallpa	50 miles	Local	20/28	.008*	.000*
Santa Cruz	100 miles	Local	35/18	.478	.000*
Lima	100 miles	Regional	12/31	.675	.204
Chiclayo	150 miles	Local	21/30	.192	.031*
Arequipa	150 miles	Regional	21/29	.444	.168
Puno	150 miles	Local	12/38	.570	.603

* Significant $p < 0.05$

---

[26] If these five species were eliminated from the analysis, a t-test would find a significant difference between both sets of species on the distance from market measure ($p < .003$).

Species' ranges within catchment areas are also significantly related to parrot counts on certain markets. Like the measure of distance, the distribution of species appears to matter only in local markets. That is, species that have large ranges within catchment areas of local markets are more likely to appear on markets (Table 5.6) and in greater quantities (Table 5.5). One exception to this finding is that of Arequipa's market (Table 5.5). Despite Arequipa being a regional market, a Spearman Rho correlation finds *range within buffer* related to poaching. This is because of the four species that have ranges within the 150-mile catchment area of Arequipa, all four appear on the market. Nevertheless, Arequipa is a regional market, since 17 other species appear on this market which comes from very far distances (ranging from 170 to 952 miles).

Range within the catchment area is significantly related to poaching in four markets (i.e. Santa Cruz, Chiclayo, Iquitos, Pucallpa), which happen to be all local markets. For these markets, distribution of species within the catchment area should matter since they are dependent on locally available species as opposed to species from faraway cities. Two of the three other markets are largely dependent on parrots that come from other markets, so local ranges of species (where they do appear) do not have a large influence on predicting species' variation on these markets.

Summary of Findings

This study finds that there is not one type of illicit parrot market in the neo-tropics. Of the seven markets studied, five appear to be local markets while two are regional. When examining the catchment areas around each market, the picture is even more nuanced. Catchment areas range from as small as 50 miles to as large as 150 miles around city markets.

Since many markets in this study sample are regional or have large catchment areas, distribution within catchment areas (i.e. *distance* and *range*) alone is not a good indicator of which species are at more risk in appearing on a market. In some instances, some of the most distant species will appear on regional markets in the highest quantities. This is a result of itinerant fences - or inter-city fences - traveling from market to market, bringing species from far off distances.

For the local markets with smaller catchment areas, distribution is significantly related to parrot numbers on markets. Within these markets, parrot species that have ranges closer to markets and have larger ranges will be more likely to appear on markets and in greater numbers. For the top three local markets (i.e. Pucallpa, Iquitos, Santa Cruz), 80 percent of species on these markets appear within their respective catchment areas. This is compared to a 39 percent average for the other four markets in Peru. Therefore, *distance* and *range within buffers* can be useful measures in predicting poaching risk for more localized markets.

The next chapter will examine the interaction of markets and why some species are more likely to be transported to other markets.

Chapter 6 – Interaction between Markets

Section 2 Research Questions & Findings

This chapter will focus on the types of markets that exist in the neo-tropics and the interaction between them via itinerant fences (H^4-H^6). As in the previous chapter, the research questions are first discussed followed by the overview of methods, variables and the findings. The following chapter (H^7-H^9) will look more closely at how opportunity plays a role in poaching variation.

Research Questions

Illicit parrot markets in the neo-tropics are heterogeneous in nature, making it difficult to predict what type of market exists in any given city. However, there are patterns that emerge from analyzing city markets in how they operate. Some markets will capture much of its parrots from a close area (local), while other markets will obtain a large proportion of parrots from very far distances (regional). For example, the Canary-winged Parakeet is the most poached species on the Arequipa, Peru market, and yet, its closest range to this market is over 900 miles away. This appears to be typical of this illicit market, in part, because there are very few parrot species in the near area (supply) and it is the second most populated city in Peru (demand). Thus, despite having a small supply of parrots around Arequipa, an illicit parrot market exists because: (1) there is a demand for parrots; and (2), itinerant fences are willing to travel there from other cities. Without itinerant fences in the illegal trade, city markets that lack species in the local area would largely not exist.

A majority of the species that appear on regional markets are also found on other markets. This indicates that itinerant fences may be obtaining most of their parrots from just a few markets. Examining the ranges of *distant species* and the markets they appear can reveal so-called 'source markets' – markets that are feeding other city markets with poached parrots. This third type of an illicit parrot market is called a *feeder market*. Feeder markets are local markets that distribute poached parrots to other cities, as well as supply parrots for local demand. A clear sign that an illicit market is a feeder market is by the sheer quantity of parrots on the market. Feeder markets will have the highest total parrots on a yearly basis because they must supply local demand, as well as regional city markets.

Table 6.1 – *Predicting the Types of Illicit Markets*

Predictive Measures	**Market Type**
Human Population Available Species within 150 miles % of Parrot Species on Market within 150 miles (*Ch.5*) % of Parrots on Market within 150 miles (*Ch.5*) Distributing Parrots to Other Markets Total Parrots on Market	**Local** **Regional** **Feeder**

In addition to determining what type of illicit market each city has in Peru and Bolivia, this set of research questions will also investigate the importance of supply and demand in the parrot trade. In this study, it is found that many parrot species travel far distances to reach certain markets within Peru. Typically, one would think that species that are more in *demand* (e.g. the more beautiful and valuable), would be more likely to be transported to other cities after appearing on feeder markets. However, a supply-side argument would suggest that species that are more available on markets would be more likely to be traded to other markets. If this is the case, then itinerant fences are operating much in the same as poachers, they are taking advantage of an opportunity (Pires and Clarke, 2011; 2012). The following hypotheses will be tested to verify how illicit markets operate and how they interact with each other:

H^4 *The largest illicit parrot markets (i.e. total parrot counts) are more likely to be feeder markets with a large variety of species in the local area (i.e. 150-mile buffer).*

H^5 *The smallest illicit markets are more likely to be local markets.*

H^6 *Parrot species that travel the farthest to appear on markets will be ones that are widely available on markets already, not the most beautiful or valuable species.*

Overview of methods

For H^4 and H^5, it should be expected that feeder markets will have the highest parrot total of all markets and should be in areas where there is a high density of parrot species. Local markets should have the smallest total number of parrots and should also have a high density of species in the area. To test these hypotheses, a descriptive analysis will be done[27] looking at the human population of each city (demand), total parrots on market,

[27] Since the number of markets is only seven, no statistical analyses can be done.

and available species surrounding each city market (supply). For the latter figure, a raster map will be computed based on the ranges of 84 parrot species found in north-west South America. This will indicate where the highest density of species exists in the north-western section of South America (see Appendix II for more details on how the raster map was computed).

For H^6, parrot supply on markets should dictate which species are more likely to be transported to other cities. A t-test will be performed between two sets of species that *only* appear on markets: the first set of species are ones that have ranges within the catchment area of each market they appear on (n=15); the second set of species include ones that have ranges outside the catchment areas of markets they appear on (n=19). This dichotomization effectively separates the species that are poached for nearby markets only and species that are poached for multiple markets via middlemen. After creating these two groups of parrots, a t-test will examine if there are significant differences between both sets on a number of independent variables including, value and beauty.

Variables

Availability:

Presence on Other Market: Market interaction will be examined to see why some species travel so far to reach markets from their habitat. It is hypothesized that parrot species that appear *on other markets* are more likely to be traded to other illicit markets as well. Therefore, for each individual market analysis, parrot species are coded "1" if they are present on another market in which they have a range within 150 miles of the market, and coded "0" if they are not. Making sure species are within 150 miles of a market they appear on indicates that they are locally poached, rather than being transported from another market.

Valuable*:* Valuable is measured in two different ways, market prices of species and the threatened status of each bird. Both measures should be inversely related to poaching counts on illicit markets because they are generally less available in the wild.

Value: This would be the average price of parrot species sold on the street in Bolivia and Peru. Although this data was not published by Herrera and Hennessey (2008) and Gastanaga et al. (2010), it has been made available to the author of this study by Bennett Hennessey who works for Asociacion Armonia in Santa Cruz, Bolivia.

IUCN Threatened Status: The International Union for Conservation of Nature (IUCN) has systematized the world's flora and fauna by their threatened status on a global scale. This list, otherwise known as the IUCN Red List, has seven mutually exclusive threat categories a specimen can be listed under, ranging from *least concern* to *extinct* (Table 6.2). In this dissertation, 67 parrot species are examined that show up on or are near seven of the illegal pet markets found in Peru and Bolivia. Of these 67 species, 17 species are threatened to some degree.

Table 6.2 - IUCN Red List of Threatened Species in this Study (N=67)

IUCN Red List Categories	Coding	N. of Parrot Species
Least Concern	1	50
Near Threatened	2	7
Vulnerable	3	5
Endangered	4	3
Critically Endangered	5	2
Extinct in the Wild		0
Extinct		0

Enjoyable

Beauty: Conventional wisdom in the field views the most beautiful species to be the most likely to be poached because they are more enjoyed by pet owners, and come with a higher profit margin for the poacher. To objectively measure the beauty of species, a composite measure is created that combines length of species with two attractiveness measures (Table 6.3). Parrot length is categorized into a scale from 1-3 (the longest species will receive a score of 3). Attractiveness takes into account the proportion of a species body that is brightly colored as well as the number of different colors it possesses. Each of these measures is dichotomized into a score from 1-2 (low-high) and then added to the length score. The total *beauty* values can range from 3-7, the most beautiful receiving a score of 7. Table 5.4 shows how this is assessed for one of the most beautiful parrots in the neo-tropics, the Blue-and-Yellow Macaw.

Table 6.3 - Enjoyable Coding (Coding for the Blue-and-Yellow Macaw as Example)

Measures of Beauty	Range of Scores	Composite Measure Scores	Blue-and-Yellow Macaw	Composite Measure Score
Length	10-95cm	1-3	79cm	3
N. of Colors	2-6	1-2	5 colors	2
Proportion of body that is bright	1-2	1-2	100% bright	2
Total	----	**3-7**	**----**	**7**

Section 2 – Analysis & Results

In the previous chapter, it was found that there are two types of illicit parrot markets in the neo-tropics - local and regional. Based on the examination of the species appearing on markets, local markets tend to be mostly comprised of species in the near area, while regional markets attract inter-city fences that bring species from far distances. Without middlemen, regional markets would largely not exist. Regional markets may largely depend on *feeder* markets to obtain parrots through the use of middlemen. Feeder markets are a third type of illicit parrot markets. They will supply parrots for local demand as well as other markets in the country, and possibly across national borders. Figuring out which markets are feeder markets can have the biggest impact on reducing the domestic illegal parrot trade, since many parrots in the trade can originate from these markets.

In this chapter, contextual factors of cities will be explored to see why markets are local, regional and feeder markets. Factors such as total number of parrots on market, density of parrot species in the local area, source of distant species on markets, and human population of cities will be examined to see the relationship they have with illicit market types. In pursuing this endeavor, the following questions will be answered:

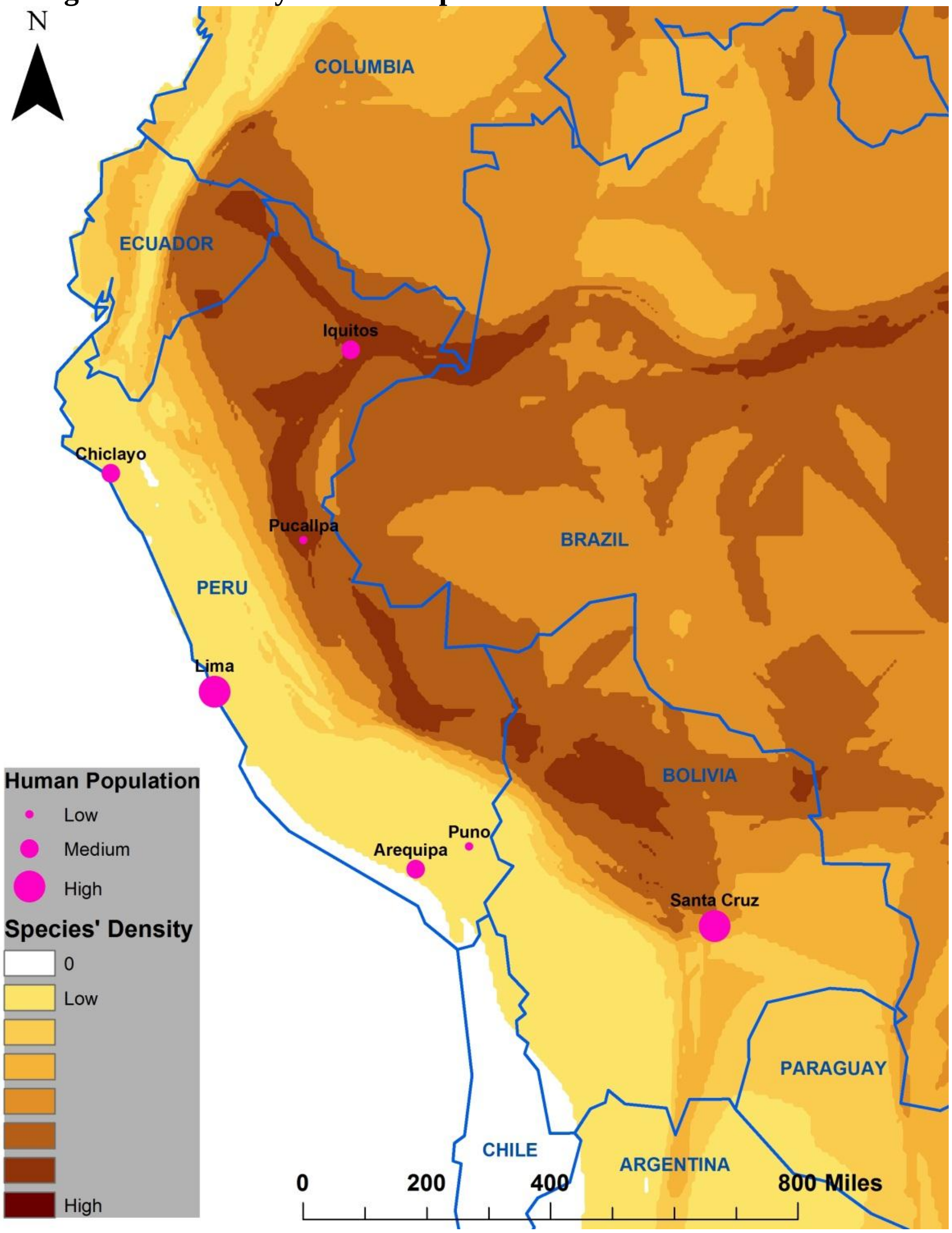
1. Where is the highest density of species in or around Peru and Bolivia?
2. What is the human population of each parrot market city?
3. How does availability of species and human population explain what type of market will take hold in any given city?
4. Why are some species traveling so far to get to some markets?

Predicting the Types of Illicit Parrot Markets

In Figure 6.1, it can be seen that the highest density of parrot species lies in the eastern side of Peru, and in the northern section of Bolivia. More specifically, the cities of Iquitos, Pucallpa, and Santa Cruz have the highest density of species within 50 miles (respectively 24, 26, and 24 species). The Peruvian coastal cities have the lowest density of species, yet the highest density of humans (Figure 6.1 & 6.2). For instance, Arequipa only has two parrot species within a 50-mile buffer of the city and is one of the largest human populated cities in Peru. Despite having very little variety of parrot species in the area, illicit parrot markets exist in these coastal cities due to customer demand.

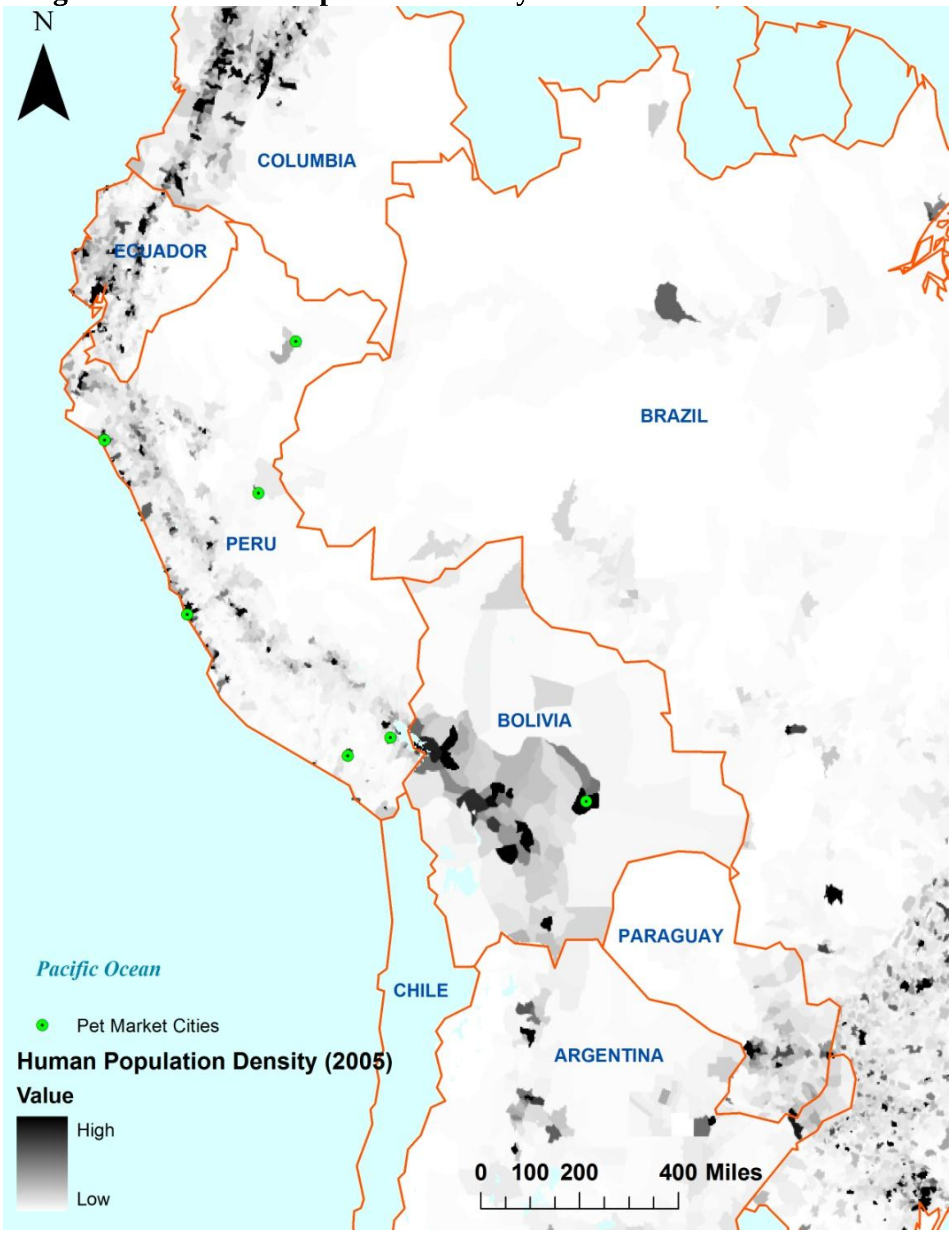
Not surprisingly, density of parrot species has a high correlation with habitat (Figure 7.2). In areas where the rainforest is still intact, there is a higher density of species. Semi-open habitats such as savannahs and plantations have a low variety of species, and generally more people inhabiting these areas. This indicates that most neo-tropical parrots still tend to thrive in rainforest habitats where there are less people.

Figure 6.1 - Density of Parrot Species in North-West South America



Examining Table 6.4, patterns begin to emerge as to why cities have particular markets. *Local* markets have a large variety of species in the area, ranging from 20 to 36 species (mean is 30). Exclusively local markets, such as Iquitos and Puno, have the lowest quantity of parrots appearing on markets (mean is 5,050), and have very low human populations. This makes sense because these markets only need to meet local demand (human population), which is very small. On the other hand, *regional* markets have very few local species (mean is 10) and large human populations. The only two regional markets in this sample also have the largest human populations within Peru (mean is over 4.2 million people). With this type of demand for parrots, one should expect regional markets to have higher parrot counts than exclusively local markets.

Figure 6.2 - Human Population Density in North-West South America



* Human population density is only calculated for border countries of Peru and Bolivia where parrots have ranges in. Chile has no parrots in the northern and mid sections of the country.
** Map shapefiles were obtained from the Socio-Economic Data & Applications Center, retrieved at http://sedac.ciesin.columbia.edu/gpw/country.jsp?iso=PER#download.

Feeder markets can be distinguished in a number of ways. First, the Chiclayo and Pucallpa markets have the highest projected total parrot counts of all seven markets. The average for both feeder markets is 26,904 parrots, which is nearly triple the average size of the other five markets (i.e. 9,003). Despite having relatively smaller human populations in both Chiclayo and Pucallpa, feeder markets must supply local demand, as well as regional markets. Thus, poachers have to over-poach. Second, these types of markets should have a high density of species in the local area in order to distribute to multiple markets. Chiclayo and Pucallpa both have a large diversity of species with an average of 28 species between both of them. Third, proximity to other markets can be a key feature of which markets become feeders. Pucallpa is centrally located in Peru, within a distance of 278 miles from Lima (the largest human populated city), and 327 miles from another large city, Chiclayo. Chiclayo is also in a key location because it can disseminate species from northern Peru (and even Ecuador) down along the coastal road to Lima and Arequipa.

Table 6.4 - *Explaining Types of Illicit Markets with Proxy Measures of Supply & Demand*

City	**Market Type**	**Catchment Area**	**Human Population**	**Available Species***	**Total Parrots****
Iquitos	Local	50	370,000	24	3400
Puno	Local	150	100,000	33	6700
Santa Cruz†	Local	100	1,756,000	35	11013
Chiclayo	Local-Feeder	150	738,000	20	18233
Pucallpa	Local-Feeder	50	204,000	36	35574
Arequipa	Regional	150	904,000	4	13335
Lima	Regional	100	7,605,000	16	10567

* 150-Mile Buffer

** These are estimated projections for all Peruvian markets. For Santa Cruz, the total number is an actual count.

† It is very possible Santa Cruz is a feeder market as well, but no data exists on which species are appearing on other Bolivian markets. Herrera and Hennessey (2007) suggest parrots from Santa Cruz do get transported to other markets in Bolivia though.

Lastly, feeder markets can also be distinguished by examining market species that are not locally poached. Establishing the likeliest source of where these distant species come from (via middlemen) can clarify trade routes between cities. In order to determine which cities are feeder markets, the following criteria will be investigated for each distant species on all markets:

1. Is a distant species found on another market?

2. If so, does the species have a range within 150 miles of the market it appears on? This establishes if it is locally poached and not just being transported to another market. If so, then this market is the source for distributing a parrot species.

3. If the first two criteria find multiple markets as possible sources, then two more criteria will be examined:

1. If one market dramatically has more of a particular species, then this market is most likely the feeder market.
2. Feeder markets will be more likely to be in close proximity to the markets where distant species end up. In the event there are multiple possible source markets, the closest market will be chosen as the source market. In cases where many possible source markets are within a close distance of the destination market, then all relevant markets will be classified as feeders.

Table 6.5 - *Examining Where Distant Species Come From*

Markets	**Market Species Not Within 150 Miles of Market**	**N of Species Feeding to Other Markets[c]**	**N of Markets Distributing Species to**	**N of Markets Receiving Species From**
Iquitos	0	2	2	0
Pucallpa	2	29	5	1
Santa Cruz	9	2	2	2
Lima	9	1	1	2
Chiclayo	10	10[a]	4	5[b]
Arequipa	17	0	0	4
Puno	4	5	2	2

[a] This includes the Gray-cheeked Parakeet and the Bronze-winged Parrot, which are just outside the 150-mile buffer of Chiclayo, but can only be poached for this market given the absence of other nearby markets.
[b] One parrot species, the Mitred Parakeet, can possibly come from four different markets. Because of this, it overinflates the possible markets feeding the market of Chiclayo.
[c] This column's sum is lower than the previous column (Market species not within 150 miles) because some distant species are not found on other markets.

In Table 6.5, evidence suggests that the markets of Pucallpa and Chiclayo are indeed feeding other markets with locally poached species. Pucallpa possibly distributes up to

29 parrot species to all other markets in this study except for Iquitos[28]. Chiclayo is possibly distributing up to 10 parrot species to four different markets. This includes the market of Santa Cruz, Bolivia, which received at least three parrot species from the Chiclayo market[29], and one species from the Pucallpa market. This is quite remarkable given the distance between Chiclayo and Santa Cruz is over 1,200 miles. Furthermore, trading amongst these three markets implies that international trafficking of species exists to some extent, which wasn't acknowledged by the authors of the Peruvian study (Gastanaga et al., 2010), with the possible exception of the Monk Parakeet.

Table 6.6 - *Characteristics of Illicit Market Types*

Market Type	Human Population	Available Species	Market Parrots within 150m	Source of Distribution	Total Parrots
Local	low	high	high	low	low
Regional	high	low	low	low	medium
Feeder	------†	high	high	high	high

† This can be any size. Pucallpa and Chiclayo both have relatively small human populations within Peru, but it is also suspected Santa Cruz is a feeder market within Bolivia. Santa Cruz is a very large city with nearly two million people. Unfortunately, there is no data on other markets within Bolivia to prove that Santa Cruz is indeed a feeder market.

Why Some Species Get Traded to Other Markets

Although trafficking of species by inter-city traders occurs to a large degree in Peru and Bolivia, some poached parrot species never end up being transported to other markets. Conventional wisdom in the field would presume that the most valuable and beautiful

[28] Based on the data, the Iquitos market does not receive species from other markets. Therefore, 5 is the maximum number of markets that a feeder market can distribute species to in this study.

[29] These species are the endangered Gray-cheeked Parakeet, the vulnerable Yellow-faced Parrotlet, and the Bronze-Winged Parrot.

parrot species would be more often traded once found on a market. Due to demand for more rare and beautiful species throughout the neo-tropics, inter-city fences would choose these species because the profit margin would be more for fewer parrots transported. An opposing argument would suggest that inter-city fences will often take more of the abundant species already on markets and distribute these species to other markets. Rare and beautiful species will likely get sold quickly once on a market, making it less likely for inter-city fences to transport them to other markets.

To test this research query, a t-test will be conducted on two groups of Peruvian market species[30]. The first group of species are all locally poached on the markets they appear on (n=13). The second group of species are not found within a 150-mile buffer of some markets they appear on (n=21). Table 6.7 reveals there are no significant differences between both groups of species on both supply and demand variables. However, there is dramatic difference between both groups of species when looking at the average numbers of parrots found on markets and Peruvian prices for species. Species that are traded tend to be more abundant on markets and lower-priced.

To see if these two measures can partially explain why some species get traded to other cities and why others do not, a Spearman Rho analysis will be conducted where the dependent variable is the number of markets parrot species appears in when not within 150 miles of a market. In this analysis, Table 6.8 shows that the most poached parrot

[30] This only tests Peruvian species because the number of parrots on market was counted differently for Peruvian market species compared to Bolivian market species. Peruvian markets were studied in a quarterly method (Gastanaga at al., 2010), whereas the Santa Cruz market was studied continuously over two and half years (Herrera and Hennessey, 2008). Therefore, the number of parrots in both countries cannot be added together.

species will be more likely to be transported to other markets, whereas *demand* measures are not significantly related to trafficking.

Table 6.7 - *Using a T-Test to Compare Locally Poached Species to Traded Species*

		Supply	Demand		
Species	*N*	N on Markets (*mean*)	Beauty	Threatened Status	Peruvian $
Locally Poached	13	31.0†	5.1†	1.2†	123.7†
Traded to Other MKs	21	103.4†	4.9†	1.3†	59.2†

† No significant difference.

Table 6.8 - *A Spearman Rho Analysis of Factors Related to Transporting Parrot Species*

		Supply	Demand		
Species	*N*	N on Markets	Beauty	Threatened Status	Peruvian $
Number of Distant Markets On	34	.472**	.079	.202	-.135

** Significant at $p < 0.01$

Summary of Findings

This study has identified three kinds of illicit parrot markets - local, regional, and feeder markets. Local markets such as Iquitos and Puno, are small in size and have a large diversity of species in the area. Regional markets such as Arequipa and Lima, tend to be bigger (due to demand), and have very few species in the local area. These types of markets only exist because feeder markets are able to supply parrots to these markets through inter-city fences. Pucallpa and Chiclayo are clearly the feeder markets in Peru because: (1) they are the largest markets; (2) have a high abundance of local species; (3) are situated in key locations in the country; and most importantly (4), are found to be the source markets for the majority of species that travel great distances to appear on other markets.

Most species in Peru are transported to at least one other market, yet some never get transported after becoming poached. The species that do get trafficked to other markets are more likely to be abundant on markets. Thus, inter-city fences are consciously choosing[31] the more available species to transport to other markets rather than the most valuable or rare. In a way this should be expected for two reasons: (1) rare and valuable species probably get sold very quickly once on markets, so there are very few left when inter-city fences come around; and (2), transporting large quantities of abundant species can possibly have the same profit margin as transporting a small quantity of valuable species.

Another way of looking at which species are more likely of becoming transported to other markets is by identifying the feeder markets. Species that appear in the vicinity of Pucallpa and Chiclayo are more likely to get poached, and in greater quantities than comparable markets[32]. Moreover, once poached they are also more likely to get

[31] Based on this analysis, it appears that choices are being made by inter-city fences when collecting parrots from markets. The more abundant species are more likely to be transported to other markets.

[32] 52 percent of species appearing within 150 miles of the Pucallpa and Chiclayo markets are poached for these markets, whereas only 42 percent of species surrounding the other five markets become poached.

distributed to other markets. Pucallpa and Chiclayo together have distributed as many as 39 parrot species to all possible markets with the exception of Iquitos. The other five markets combined have only distributed as many as 10 parrot species to an average 1.4 markets. Thus, the illegal parrot trade in Peru is predominantly a Pucallpa and Chiclayo problem, in which there seems to be a high activity of poaching, itinerant fences and inter-city fences.

The next chapter will examine how opportunity plays a part in parrot poaching.

Chapter 7: Opportunity & Parrot Poaching

Section 3 Research Questions & Findings

This chapter will focus on a third set of hypotheses, H^7 to H^9, that posit opportunity-based factors are responsible for much of parrot poaching variation. If these factors are indeed related to poaching variation in the seven markets analyzed in this study, it would further support the view that parrot poaching is mostly committed by peasants and not professional poachers.

Research Questions

Previous research in Mexico and Bolivia have found the most valuable and rare species in the illegal parrot trade tend to show up in the smallest numbers (Pires and Clarke, 2011; 2012). The least valuable and more available species were the most likely to be poached and this was concentrated in just a few species. This is indicative that professional poachers are largely absent from the trade, and that much of the poaching is committed opportunistically by 'campesinos' near their homes. In addition to these findings, the more removable species in Mexico (Pires and Clarke, 2012) and the more enjoyable species in Bolivia were also more likely to be poached (Pires and Clarke, 2011).

If parrot poaching in the neo-tropics is largely similar in how it is committed, it should be expected that opportunity-based factors are significantly related to poaching. The following hypotheses will be tested about the species that appear on the seven markets in addition to the comparison species that do not show up:

***H*[7]** *Only a small subset of species make up the majority of parrots found on illicit markets in Peru and Bolivia.*

***H*[8]** *Parrot species appearing in the market are more likely to be poached because of opportunity-based factors, such as abundance, availability and removability. Accessibility should not be related to poaching for Peruvian markets since most markets are almost exclusively surrounded by either a rainforest or semi-open habitat.*

***H*[9]** *Parrot species whose ranges have a higher proportion within protected national parks are less likely to show up on markets.*

Overview of methods

The first analysis will examine whether a small set of species makes up the majority of parrots poached for markets, otherwise known as the 80-20 rule[33] (Clarke and Eck, 2005). Thus, the 80-20 rule will be tested for each individual market, as well as for the Peruvian and Bolivian species separately. In the second set of analyses (H^8-H^9), parrot species that appeared on a market will be compared to species that did not appear on a market on a number of CRAVED-derived independent variables with the use of a t-test and a Spearman Rho's analysis. Independent variables are based on information found in scientific articles and reports, parrot guidebooks and GIS data free to the public[34].

Variables

[33] When a small percentage of something (i.e. 20 percent), represents a large proportion of an outcome, or 80 percent.

[34] This will be further elaborated on in the following section when discussing each CRAVED measure.

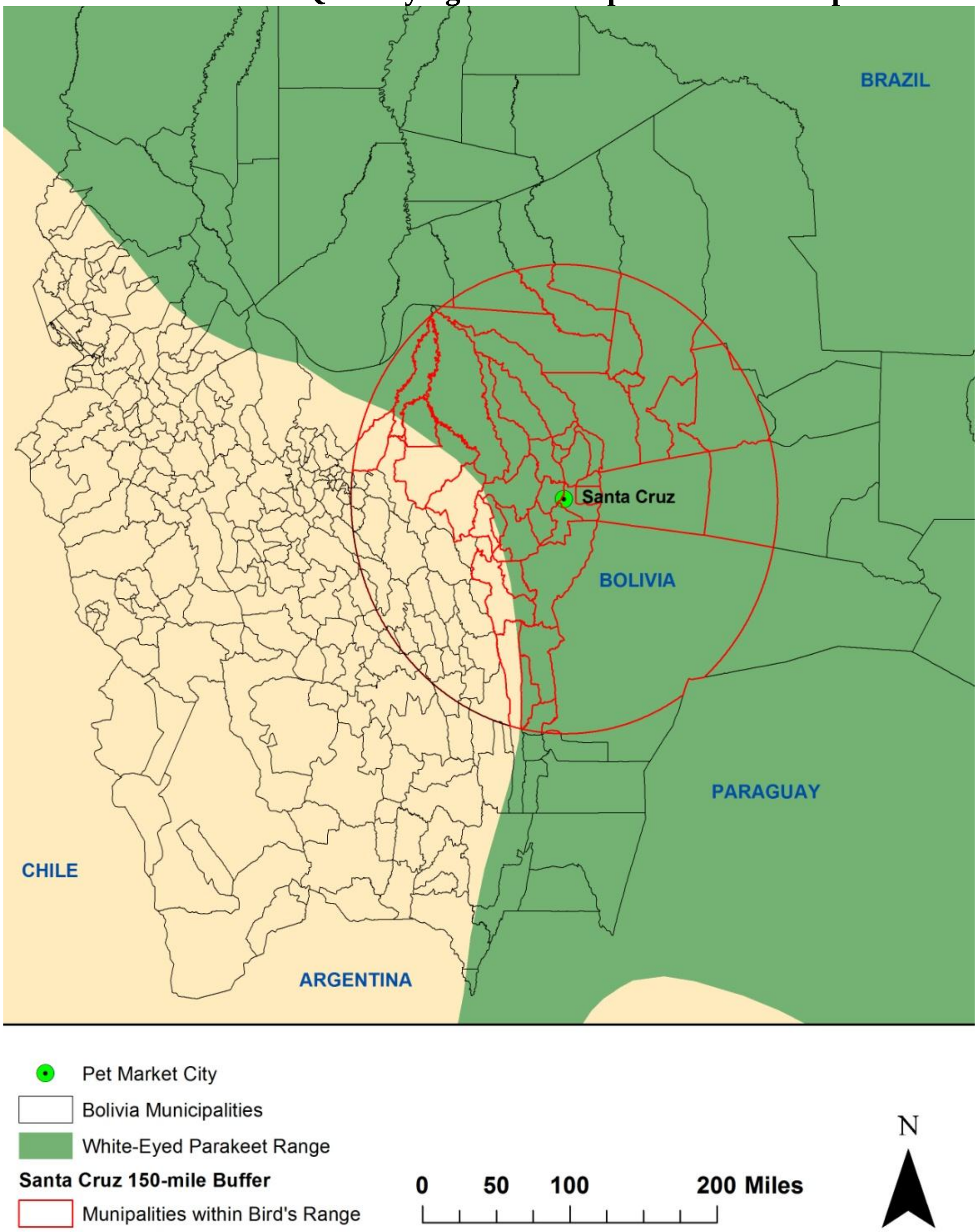
***Abundance**:* Species that are more abundant in the wild should be more likely to show up on illicit markets. Three parrot guidebooks are used for this analysis so that the data is as accurate as possible for the countries being studied. For species outside of Peru and Bolivia, Juniper and Parr's (1998) guidebook to Parrots of the World is used to see how common species are within their respective range on a scale of 1-5 (1-vagrant; 2-rare; 3-uncommon; 4-fairly common; 5-common)[35]. For Peruvian species, Schulenberg et al.'s (2007) guide book to Birds of Peru is used to rate how common species are on the same scale as Juniper and Parr's (1998). And lastly, for the Bolivian analysis, Hennessey et al.'s (2003) scale of "detectability" (1=rare , 2=common, 3=very common)[36] is used to code the abundance of Bolivian species.

***Accessible**:* In previous studies (Pires and Clarke, 2011; 2012), accessibility was measured in two distinct ways - *Overlap Between Parrots and People* & *Percentage of Range Within Semi-Open Habitats*. The 'overlap between parrots and people' variable is largely the same measurement as *buffers around markets*, which calculates the square miles a species is within a catchment area. The only difference is that the *overlap* measure also considers the human population within that defined area. In Mexico and Bolivia, the differences between both of these measures and parrots poached (dependent variable) were mostly negligible. Both measures had very high inter-correlations suggesting they were both measuring the same phenomena.

[35] Because many parrot species have ranges within multiple countries, Juniper and Parr's (1998) detectability scale is generalized over the entire range for each species, unless specified for some species. For this reason, a Peruvian and Bolivian guidebook to birds is used to accurately capture how common these species are within these two countries.
[36] The scale is changed from 1-3 to 1-5 to complement the other two guidebooks' scales. Thus, 1 remains 1 (rare), but 2 (common) changes to a 3 coding, and 3 (very common) changes to a 5 coding.

In addition to this finding, there is an inherent limitation in measuring the overlap between parrots and people. Parrot ranges are devoid of boundaries such as municipalities, countries and continents. In order to aggregate the total human population within a parrot's range (inside of a catchment area), one must consider all municipalities that a species range touches. As can be seen in Figure 7.1, the White-eyed Parakeet has a range that partially covers many municipalities (highlighted in red). If one counts every municipality that a species has a range in, it would be an overcount of humans, since many municipalities are only partially covered. Therefore, the accuracy of aggregating the human population within a parrot species range will fall short of the exact human population that can theoretically poach a particular species. For these reasons, the *overlap between parrots and people* variable will not be used in this study, and instead, will analyze *percentage of range within semi-open habitat* and *percentage of range within protected forest* as proxy measures of accessibility.

Figure 7.1 - Limitations of Quantifying Human Population within Species' Ranges



Percentage of Range Within Semi-Open Habitat: It is hypothesized that species that inhabit areas that are more open such as savannas, will be more likely to be poached because: (1) it is easier for them to be spotted by humans; and (2) the accessibility to poach them is easier than foraging through a rainforest. To calculate the percentage of a species range that is within a semi-open habitat, the habitat shapefile must be dichotomized between rainforests and semi-open areas. From there, a species shapefile is layered onto the habitat shapefile in which the proportion inhabiting rainforest and semi-open areas can both be calculated at the same time (Figure 7.2).

Percentage of Range within Protected Forest: It is thought that a rainforest can protect parrots from being poached because it is less accessible for humans to enter, and parrots are camouflaged better in a dense rainforest (Pires and Clarke, 2011). Protected national forests would have less humans living in the area and be more likely to have forestry officers patrolling the land. Preliminary evidence in Bolivia shows that parrot species were unlikely to show up on the Santa Cruz market if they mostly resided in the national park of *Amboro.* Therefore, this variable measures the percentage of each species range within a protected forest shapefile[37] (Figure 7.2). Species that have a higher proportion within protected forests are hypothesized to be less likely to appear on illicit markets. There are a total of 125 protected parks within both Bolivia and Peru (see Appendix V for list of parks).

[37] See www.protectedplanet.net for free shapefile data.

Figure 7.2 - Protected Parks Within Bolivia & Peru

Removable

Nest Access: If the most common method of poaching parrots is by nest poaching, then where species nest may affect their numbers appearing on markets. Therefore, using the Juniper and Parr (1998) guidebook, where species' nests are coded as follows from easiest to most difficult: 1= termitariums and burrows; 2= tree cavities and termitariums; 3= tree cavities/palm stumps; 4= cliff crevices/tree cavities.

Table 7.1 - *Summary of CRAVED Variables*

Variable	CRAVED	Measured
Distance of Parrot Ranges from the Market	Available	GIS
Buffers around Markets	Available	GIS
Presence on Other Market	Available	0-1 scale (1: on other market)
Percentage of Range in Rainforest Habitat	Accessible	GIS
Percentage of Range in Protected Forest	Accessible	GIS
How Common	Abundance	1-5 scale (5: very common)
Nest Access	Removable	1-4 scale (4: least difficult)
Value	Valuable	Average Market Prices
IUCN Threatened Status	Valuable	1-5 scale (5: critically endangered)
Beauty	Enjoyable	3-7 scale (7: most beautiful)

Section 3 - Analysis & Results

If poaching in Peru is similar to poaching in Mexico and Bolivia, then opportunity should play a role in poaching variation of species within this study. In Chapter 5, it was found that availability within catchment areas of local markets is associated with the likelihood of species being poached. In addition, the closer the ranges of species are to local markets, the more likely these species appear in markets. For regional markets, which largely depend on distant species, these opportunity-based factors are not relevant. Species that appear on regional markets tend to be more abundant on other markets though, giving inter-city fences incentive to transport these species. Thus, measures of opportunity have already been found to be related to poaching variation in Peru and in Bolivia. This chapter will further explore other CRAVED-derived measures of opportunity and the relationship they have with the number of parrot species found on markets.

Before examining the relationship between measures of opportunity and poaching for each individual market, H^7 will be tested first to see if a small subset of species makes up the majority of parrots in the illegal trade, in conformity with the 80-20 rule (Clarke and Eck, 2005). It is clear from looking at Table 7.2 that the 80-20 rule is applicable to each market within Peru and Bolivia. Within Peru alone, just seven species, or 14 percent of all species in Peru, make up the majority of parrots in the trade (86 percent).

Table 7.2 - *80-20 Rule Explains All Markets and the Peruvian Trade*

Market	Total Species†	Top poached	% of Species	% of Total Parrots
Arequipa	50	6	12%	74%
Chiclayo	51	7	14%	86%
Iquitos	51	2	4%	79%
Lima	43	3	7%	81%
Pucallpa	48	4	8%	87%
Puno	50	6	12%	92%
Santa Cruz, Bol.	53	5	9%	86%
PERU	51	7	14%	86%

† Total possible species that can appear on market.

A closer examination of the most poached species in each market also gives clues as to why they represent so much of the illegal trade. In Peru, seven species can be legally trapped up to a certain quantity every year because they exhibit healthy populations in the wild (Appendix I). However, market data clearly shows that catch-quotas are being ignored for these species (Gastanaga et al., 2010). These seven species are in the top eleven most poached species in Peru. Thus, the system of banning the trapping and trade of some species and allowing catch-quotas for others only seems to offer an opportunity to excessively poach legally trapped species.

Parrot species considered 'crop pests' can be another factor that explains 80-20 species in the neo-tropics. In Peru, only two species are considered crop pests - the Gray-Cheeked Parakeet and the Orange-Winged Parrot. Both species are in the top eight most poached birds in Peru and cumulatively appear on 10 markets in both Bolivia and Peru. In Bolivia, five species are considered crop pests[38] and all five appear on the Santa Cruz market (Table 7.3). Furthermore, three of the top four most poached species in Santa Cruz are considered crop pests[39].

Table 7.3 - *Crop Pests Make Up a Disproportionate Share of the Illegal Parrot Trade*

Market	Crop Pests	% of Species	% of Total Parrots
Santa Cruz, Bol.	5	9%	64%
Peru	2	4%	15%

[38] These species are the Monk Parakeet, Yellow-Chevroned Parakeet, Blue-Winged Parrotlet, Orange-Winged Parrot and the Dusky-Headed Parakeet.

[39] Bennett Hennessey explains that crop pest species make up a large proportion of the trade because they are abundant where sorghum cultivations exist. Rather than shooting these species as they have in the past, Mennonites capture them for the illegal parrot trade (email comm. 10/29/2010).

Measures of Opportunity

If opportunistic variables are significantly related to parrot species appearing on markets, it would suggest that peasants are committing much of parrot poaching in the neo-tropics as opposed to professional poachers. Professional poachers would be more interested in valuable, beautiful and rare species. Table 7.4 shows the relationship between these measures and poaching for each of the seven markets. No single variable is consistently significant in all markets, revealing the heterogeneity of illicit markets. Nonetheless, some measures are significant more often, indicating that these measures might be generalizeable to all parrot markets in the neo-tropics. For example, the more *common* parrot species and their *presence on other markets* are significantly related to an increase in poaching in the majority of markets studied. Other measures of opportunity, such as *nesting*, *percentage of range within parks* and *percentage of range within rainforests*, are not consistently (or theoretically) related to poaching variation. For instance, ranges within rainforest and parks should be inversely related to poaching, since these places tend to be in very inaccessible areas, yet are positively related in the Iquitos and Pucallpa markets.

While opportunity measures are far more likely to be related to poaching variation in this analysis, measures of professional poaching are for the most part, not related to poaching variation. Where significance is found, it is inversely related to poaching variation (with the exception of *beauty*). The least *valuable* species in Puno and Santa Cruz are more likely to appear in those markets. This confirms previous analyses in Mexico and Bolivia that inexpensive species, which tend to be more abundant and available near markets, are more likely to show up in greater numbers on markets.

Table 7.4 - *The Relationship between CRAVED Measures and Poaching (Spearman Rho)*

		Opportunistic					Professional		
City	**N**	**How Common**	**% Rain-forest**	**% Parks**	**N of Other MKs†**	**Nest**	**Value**	**Threat Status**	**Beauty**
Iquitos	51	.168	-----	.460*[c]	-----	-.061	-.267	-.179	-.124
Puno	50	-.024	-.089	.029	.743***	.044	-.516*	-.223	-.262
Santa Cruz	55	.453***	-.405*	-.154	-.024	-.009	-.655***	-.171	.329*
Chiclayo	51	.566***	-.014	-.191	.676***	-.063	-.196	.031	.215
Pucallpa	50	.375**	.422**[a]	.177	.113	-.100	.049	-.257	.266
Arequipa	49	.082	na [d]	na [d]	.572***	-.040	-.144	.017	.030
Lima	43	.474***	-.679**[b]	-.175	.421*	-.089	-.234	-.016	.072

*$p < .05$; **$p < .01$; ***$p < .001$

† For species that have ranges outside 150 miles of a market, the number of other markets they appear on are correlated with their appearance on the market under study (1 = yes, 0 = no) as opposed to the traditional dependent variable - number of parrots on markets.

[a] A positive relationship implies that increased presence in rainforests correlates with appearing on Pucallpa's market, which is in contradiction to H^8. A closer look at the data reveals why this is. Within the 150 mile buffer surrounding Pucallpa, it is predominantly rainforest habitat with the exception of the most western side of the buffer (beginning at around 130 miles from the city). Species that exclusively appear in this semi-open region do not appear on Pucallpa's market. Therefore, the positive correlation between rainforest and poaching is really a proxy measure of distance. Species that have ranges at a distance of over 100 miles from Pucallpa's market do not appear on it, regardless of habitat. This is even more substantiated by the fact that Pucallpa's catchment area is only 50 miles surrounding the city.

[b] This correlation should be taken with caution given Lima's habitat resembles Pucallpa's (see footnote above) with the caveat that the rainforest begins at around 130 miles east of the city of Lima. Therefore, the correlation could be due to distance rather the type of habitat species reside in (i.e. species are less likely to appear on Lima's market when their distance is greater than 100 miles from the market regardless of habitat).

[c] Ranges within national parks should be inversely related to poaching, yet in Iquitos, it is the opposite. This could be the case because: (1) Iquitos has a very small catchment area that extends up to 50 miles; (2) there is large national park (Allpahuayo Mishana) that is completely within the 50-mile catchment area; and (3), all 6 parrots that appear on the Iquitos market have a range within the national park. This particular park could be highly accessible to locals, making poaching more likely.

[d] Not applicable because of too few cases (4).

Aggregating Data for the Seven Markets

To be able to generalize findings from the previous analysis, GIS data from all markets can be aggregated together in order to look for significant patterns. For this analysis, the dependent variable will be the *number of markets parrot species appear on* rather than the number of parrots found on markets. This is because the Peruvian market counts of parrots were conducted differently from the Bolivian analysis[40]. In changing the dependent variable, parametric statistical tests can now be used, given the data is normally distributed.

Table 7.5 confirms previous findings that the most available and abundant species are more likely to become poached for markets in Peru and Bolivia. Despite some markets being regional in scope, the range of species within 150 miles of markets is significantly related to poaching overall. Other measures of CRAVED are not significantly related to poaching, despite some sporadic significant relationships in some individual markets. Notably missing in Table 7.5 is the variable *Presence on Other Markets*, despite being significantly related to poaching variation in three out of six markets. This is because *Presence on Other Markets* is not independently measured from the dependent variable here, the number of markets species appear on. Due to this, this measure cannot be used in the following two analyses.

---

[40] The former is a sample count completed within a year while the latter method was counted daily over a two and half year period. In order to combine both studies to look for generalizeable patterns, a consistent metric must be used as a dependent variable. Therefore, the number of markets species appear on is a good indicator of which species are more or less likely to become poached given the spearman rho correlation between both measures is highly significant for Peruvian species ($r_s(51) = .911$, $p < .001$).

Table 7.5 - *The Relationship between Number of Markets Species Appear On and CRAVED Measures*

	Measures[a]	Pearson Correlation	N
Opportunistic	**Total Range in 150m Buffers**	.562***	67
	How Common	.261*	67
	% Rainforest (150m)	.178	57
	% Parks (150m)	.105	57
	Nest	.005	57
Professional	**Value**[b]	-.017	44
	Threat Status	-.149	67
	Beauty	.068	67

*$p < .05$; ***$p < .001$

a The *Distance* measure is excluded from the analysis because *Total Range in 150-mile Buffers* not only measures distance implicitly (i.e. appearing within 150 miles or not), but it also measures how available a species is within a close distance of markets.

b All prices were converted to US dollars. For species in which Peruvian and Bolivian prices were both available, the value was averaged together.

To predict the number of markets a species will appear on based on a combination of variables, a multiple regression model can be performed. Since some variables in Table 8.4 have missing values, only four variables will be used in the model to predict poaching (*total range*, *how common*, *threat status* and *beauty*[41]). In doing so, no parrot species will be eliminated from the analysis given all four variables have no missing values.

Table 7.6 shows the product of this analysis. The combination of these four variables significantly predicts parrot poaching ($F(4,62) = 9.40$, $p < .001$) and explains 34 percent of the variance in parrot poaching. While *beauty* and *threat status* are not related to

[41] Beauty and Value have a high inter-correlation (r (44) = .555, p <.001), so in a way, value is being considered in this model.

poaching, *availability within buffers* and *how common* species are in the wild significantly predicts parrot poaching when controlling for all other variables.

Table 7.6 - *Predicting the Number of Markets Species Appear On (Multiple Regression)*

Variable	N	CRAVED	*B*	*SEB*	β
Total Range in 150-miles	67	*Available*	1.81	0.00	0.62***
How Common	67	*Abundance*	0.43	0.20	0.22*
Beauty	67	*Enjoyable*	-0.18	0.18	-0.11
Threat Status	67	*Valuable*	0.25	0.20	0.15
Constant			-0.45	1.04	

Note: Adjusted R^2 = .34; $F(4,62) = 9.40$, $p < .001$.
*$p < .05$; ***$p < .001$

Summary

Like previous studies on parrot poaching variation (Pires and Clarke, 2011; 2012), this study finds evidence that opportunistic factors play a major role in the illegal parrot trade. First, the 80-20 rule finds support within all seven markets, and in general, for the Peruvian parrot trade. Just seven species make up 86 percent of the trade in Peru; five of which can be legally trapped within Peru. This should not be much of a surprise given legally trapped species should be more abundant in the wild. However, market counts by Gastanaga et al. (2010) found excessive poaching of these particular species. This is the second study that has found excessive poaching of legally trapped species in the neo-tropics (see Cantu et al., 2007). Therefore, one must question the assumption that catch-quotas are a better national policy as opposed to complete trade bans.

In Bolivia, many of the 80-20 species are considered crop pests. In some Mennonite communities in the area surrounding Santa Cruz, crop-eating species are routinely captured for the trade (email comm., Hennessey, 10/28/2010). In previous decades, these species were shot by farmers (Juniper and Parr, 1998). Now, farmers have found a way to profit off of them through the illegal parrot trade.

Second, this study finds conclusive support for measures of opportunity and their relationship to poaching. Even controlling for other measures, such as threatened status and beauty, parrot species that are more common in the wild and have larger ranges surrounding city markets are more likely to appear on illicit markets. This confirms two previous studies, one in Mexico (Pires and Clarke, 2012) and one in Bolivia (Pires and Clarke, 2011), which have shown abundance and availability to be the best explanation of parrot poaching variation. While beauty was found to be associated with poaching in Bolivia, and removability in Mexico, neither measure is consistently related to poaching in the present study. In fact, removability was not significantly related to poaching in any present market. This could possibly be due to a lack of data, specifically for species not found on any market[42].

Lastly, a newly created measure, *Presence on Other Markets*, is able to explain why markets receive species that are outside the market's catchment area, often times, from very far distances. *Presence on other markets* is a proxy measure for availability of species on nearby markets. Part of the reason why some species travel so far to get to

[42] Six of the 17 species not found on any market have no nesting data, whereas only 4 of the 50 species found on markets have missing nesting data. It is plausible that species that are not poached are in highly inaccessible areas where they nest.

markets is because inter-city fences buy them in one market and bring them to others. In the instance of regional markets, such as Lima and Arequipa, this is the chief explanation of which species appear on these markets - because these markets have very few species close by, they must rely on other markets to distribute species to them.

Chapter 8: Limitations & Implications

Summary

The findings of this dissertation are largely similar to previous findings of the illegal parrot trade in Mexico and in Bolivia (Pires and Clarke, 2011; 2012). In Peru, peasants are taking advantage of locally abundant parrot species, especially when in close proximity to a city market. In some instances, locals will bring parrots to city markets themselves to sell. At other times, and probably more commonly, itinerant fences will collect parrots from villagers and sell them for a higher price at a city market. On the other hand, this study paints a more nuanced picture of the illegal parrot trade than previous research has been able to do. This is primarily because this study focuses on multiple markets in two neo-tropical countries where the interaction of city markets are clearly occurring.

The average catchment area around illicit markets is roughly 100 miles. In some markets, it is as small as 50 miles (see Iquitos and Pucallpa), and in others, as large as 150 miles (see Puno, Arequipa, and Chiclayo). Yet, in nearly all markets, most poached parrots have ranges within 50 miles of the cities they are found on. This leads one to conclude that most poaching is completed within a relatively close distance to illicit markets. But not every market is the same. This study reveals that there are three different kinds of illicit parrot markets: local, regional, and feeder markets. The size of the market (i.e. number of parrots found on the market) is the factor that reveals the most about market type. The largest markets - Pucallpa and Chiclayo - are feeder markets because they supply local demand, as well as feed other markets with parrots. Both cities also have the advantage of being situated in areas where there is a high species density[43]. The smallest markets are local markets, since they need only supply a very small human population (see Iquitos and Puno). In contrast, regional markets will be those that have very few species in the near area, and in which most species on the markets come from very far distances. For instance, the average distance for species that appear in Arequipa's market is 276 miles from their range.

With the exception of one market, Iquitos, all other markets receive species from far distances. Fencing species from one market to another is constantly taking place in Peru and in Bolivia. When analyzing species that are not found within 150 miles from markets they appear on (i.e. distant species), this study finds that these species are more likely to be abundant on markets rather than valuable. In fact, these distant species tend to be very inexpensive because they are abundant in the wild as well. This suggests that forces of supply are more at play than demand, or otherwise there would be a positive relationship between market prices of species and their presence on distant markets. In addition to this finding, this research has found that species poached for the Pucallpa and Chiclayo markets are more likely to be taken and fenced to other markets when compared to all other markets in the study. This is because these two markets are feeder markets, which

[43] It should be noted that Santa Cruz may be a feeder market given the large size of its market, species density in the area and evidence that parrots are being transported to other cities (Herrera and Hennessey, 2007). Yet, unless parrot data is obtained from other Bolivian cities, there's no way of knowing for sure whether Santa Cruz is truly a feeder market and distributing large numbers of parrots to multiple cities.

undoubtedly increases a species likelihood of being poached in the near area and traded to multiple markets.

Supply-sided measures not only explain which species are more likely to travel to multiple cities, but they also explain which species are more likely to become poached. Of the CRAVED variables applied to this analysis, only the *availability* concept is consistently related to poaching variation. *Availability*, as measured by the size of species' ranges within catchment area buffers, as well as *abundance* of species in the wild, are both positively related to poaching counts on markets and the number of markets species appear on. Even when controlling for other measures, such as enjoyability and value in a regression model, availability and abundance are still associated with poaching. Thus, poachers and itinerant fences are both exploiting the most available species that are closer to markets, even though they might have hopes of capturing and trading the more valuable and rare species.

Other measures of opportunity, such as accessibility, were not related to poaching in Peru despite previous finding in Mexico and in Bolivia showing otherwise. In this study, accessibility was measured in two ways: (1) the type of habitat species reside in, and (2), the percentage of species' ranges that are within protected parks. Both measures had no relationship to variation in poaching. One reason that may explain why habitat has no relationship to poaching in Peru is because many pet market cities in Peru are almost exclusively rainforests (see Iquitos and Pucallpa) or semi-open areas (see Lima, Arequipa, Puno). As for the protected parks measure, it is still not clear why parks do not reduce poaching. This might be because protected parks are not well patrolled and/or accessibility into parks is quite easy in Peru and Bolivia.

Demand-sided measures, such as valuable and enjoyable, were not found to be related to poaching variation. Pires and Clarke (2011) found the more beautiful species in the Santa Cruz market were more likely to be poached (and this study's re-analysis confirms this), but no market in Peru substantiates this finding. Therefore, it appears that Santa Cruz may be an outlier in terms of the number of beautiful species that appear on the market. As for value, this study was able to obtain market prices for most species in both countries, which was not possible in a prior study of Bolivia. Only two markets found a significant relationship between value and poaching, and they were both inversely related to poaching. However, when all data was aggregated for all markets, this relationship was no longer significant. Nevertheless, the most poached species on all markets were quite inexpensive, ranging from (U.S.) $2.37 to $7.42 per parrot[44].

Lastly, applying the 80-20 rule to illicit parrot markets proves once again that only a few species make up the majority of the illegal parrot trade. In Peru, just seven species out of fifty-one altogether, make up 86 percent of the illegal parrot trade. In Bolivia, only five species represent 86 percent of the trade. This confirms previous research in Mexico (Pires and Clarke, 2012) and other hot product analyses (see Clarke and Eck, 2005) that show that a small percentage of items can account for a majority of thefts.

[44] This includes the Canary-Winged Parakeet in five markets, the Pacific Parrotlet and the Monk Parakeet.

Strengths & Limitations of Study

Over the past three years, two different methodologies have attempted to quantify the illegal parrot trade in the neo-tropics to find the "true" number of parrots in the trade. Interviewing parrot trappers was the method employed by Cantu et al. (2007) in Mexico, which asked trappers how many parrots they captured in a year and projected these estimates to all of Mexico. The alternative method is to research parrot markets and hand count the number of parrots on each market classified by species. This was done in Peru and Bolivia respectively by Gastanaga et al. (2010) and Herrera and Hennessey (2007; 2008). The latter methodology provides several advantages in obtaining the "true" number of parrots poached because:

1. Most parrots end up on city markets. Open-air markets provide the best way of selling a parrot to a potential customer given the number of people that walk by. If poachers had to rely on selling parrots from their rural homes, they would not find it economically beneficial for them to poach parrots.

2. Asking trappers how many parrots they have caught and of which species can lead to inaccurate estimates because they can forget, lie, or simply not know the difference between some parrot species. The latter problem is an especially difficult issue in Bolivia and Peru where there are significantly more parrot

species than in Mexico[45], and many of these species are distinguished by very small differences.

3. And finally, interviewing trappers can lead to a biased sample because it ignores the enormous population of opportunistic villagers who appear to do much of the poaching in the first place. One estimate from Mexico reveals that there are roughly 20,000 opportunistic villagers who poach parrots (Grosselet cited in Velazquez, 2004, cited in Cantu et al., 2007).

As can be seen, researching illicit parrot markets provides several advantages over interviewing poachers alone. However, investigating illicit markets also has some drawbacks that need to be noted. Anecdotal evidence suggests that the most rare and expensive species might be traded by phone calls with affluent customers (Gastanaga et al., 2010) rather than selling these species in open-air markets. Thus, investigating markets may be skewed towards less expensive and more abundant species. This may help explain why only one non-native species appears in Peruvian markets out of a total of 34 species. However, in light of the market analysis in Santa Cruz, Bolivia, several different threatened species, as well as expensive species appeared on the market (Herrera and Hennessey, 2007; 2008), which questions the assumption that markets have a general bias toward more abundant and inexpensive species[46].

[45] 50 parrot species have ranges within Peru and Bolivia as opposed to 22 in Mexico.
[46] This may also be the case because the Santa Cruz market was studied daily rather than by a quarterly method. Expensive, rare species may be sold very quickly in markets and might not be captured accurately by a quarterly survey method.

A second limitation of researching illicit markets is that they only include parrots that are still alive. Evidence from Mexico and elsewhere show that many parrots die prior to reaching potential consumers. It is estimated in Mexico that 75 percent of parrots poached will never reach the consumer because the clandestine nature of the illegal trade results in the death of numerous parrots *en route* from habitat to markets (Cantu et al., 2007). However, if one wants to look at poaching variation amongst parrot species, high mortality rates should not be a limitation on the validity of the study. To date, there is no evidence that some parrot species are more prone to die *en route* to markets than other species (which would be a measure of *disposability*[47]). However, it is certainly plausible that parrots that come from farther distances to reach markets are more likely to experience attrition as compared to parrots within close distances of markets.

A third limitation of this study is the lack of complete data for the independent variables. For example, *value* of species can only be assessed for species that were sold on markets. There are no price data for those species that never appeared on any illicit parrot markets[48]. For this reason, correlations between *value* and parrot species appearing on markets should be treated with caution. On the other hand, for the measurement of *disposability*, no complete data exists that differentiates species as being more or less likely to die in transit, or even in more demand by illicit markets. The same limitation goes for concealability, in which no data exists that can differentiate which species are possibly quieter in transport. Due to these limitations, disposable and concealable could not be operationalized for this study.

[47] If some species are notorious for dying quickly, they might be avoided by poacher's altogether. This would especially be the case if these species are at a far distance from an illicit market.
[48] Price data is missing for 21 of 50 Peruvian species and 27 out of 47 Bolivian species.

A last limitation of this study is that there is a finite number of 'comparison birds' that are included for each markets' analysis. Any species that has a range within 400 miles of a city market is included in each analysis of a market, because this is a reasonable distance[49] that a bird can travel to appear on a market. Due to this, this study inherently underestimates the effect of distance on poaching because unpoached parrot species outside a 400-mile radius are not included in a market analysis. In other words, this study is controlling for distance to some degree by only looking at species that are closer to the market, rather than all parrot species in a geographically defined area, such as North-West South America. The advantage of this method, however, is that one can compare species on other attributes while controlling for the confounding factor of distance from market.

GIS Limitations

As beneficial as GIS is as an analytical tool in measuring poaching risk, it also presents some limitations that need to be outlined. Firstly, parrot range shapefiles are not completely accurate. For the most part, ranges are based on sightings by conservationists, scientists and bird watchers. They are rarely based on attaching GPS monitors onto species in order to track movements. Using sightings as the primary method of delineating ranges, biologists then draw ranges as to where species have been sighted onto maps. These maps have then been digitized and superimposed onto GIS

[49] The average distance of parrot species ranges' to markets they appear on is roughly 400 miles when looking at all seven markets.

world maps as early as 2002. Thus, the parrot range shapefiles used in this study have been digitized from world parrot guidebooks (and verified by experts in the field), rather than by using GPS monitors to track bird movements. It has been made aware to the candidate that at least one parrot range shapefile is not completely accurate. The shapefile of the Blue-fronted Parrotlet suggests its closest point to the city of Santa Cruz is 103 miles away, when in reality, it has a range over the city (Pires and Clarke, 2011). This could be because the 'sightings' method is imperfect, or because ranges of species change over time[50]. This shows that on-the-ground knowledge should corroborate parrot range shapefiles to make this study as accurate as possible.

A second limitation of using GIS with the use of secondary data is that it can only assess risk of poaching. GIS methods cannot predict where poaching will exactly occur, because there is no data that specifies x-y coordinates as to where parrots are poached. With only knowing poaching counts for each species and where markets are located, all that can be assessed is how large catchments areas are around city markets and where parrot species might be poached based on proximity to markets.

Policy implications

Increasing penalties, prosecution, and protecting parks is generally recommended by conservationists in the field to thwart the illegal parrot trade (Pires and Clarke, 2011).

[50] Ranges of species do change over time especially when threatened by the illegal trade and habitat loss. Other times, they get bigger because they quickly become over-populated.

However, the traditional law enforcement approach will have limited effectiveness, if any, in reducing the trade. This is in part because numerous countries in the neo-tropics have had anti-poaching laws on the books for decades now (including Peru, Bolivia, and Mexico) without seeing subsequent declines in poaching. Cantu et al.'s (2007) analysis of the Mexican parrot trade shows that when enforcement was increased, there was a negligible effect on the trade. In addition, it is locals who are committing most of the poaching in the neo-tropics and not professional poachers. Campesinos will poach from time to time in order to make some secondary income, but they are not dependent on it. Prosecuting campesinos in large numbers would inevitably create animosity towards law enforcement, which could hinder any working relationship law enforcement has with communities in order to reduce the trade.

A more efficient approach to the illegal parrot trade consists of a three-pronged approach: (1) applying situational crime prevention; (2) encouraging eco-tourism; and (3), improving CITES legislation and national policy.

Situational Crime Prevention

Situational crime prevention (SCP) is an efficient method of reducing opportunities that are integral for the occurrence of crime. Rather than focusing on the offender, SCP focuses on the contextual factors that allow crime to occur. When reducing criminal opportunities through "environmental and managerial changes" (Clarke, 1997, 2), crime is often drastically reduced. Over the years, SCP has grown to include 25 techniques that have been proven to reduce a myriad of crimes (Clarke and Eck, 2005), which are summarized in Table 9.1.

Table 8.1 - *25 Techniques of Situational Crime Prevention*

Increase the Effort	Increase the Risks	Reduce the Rewards	Reduce Provocations	Remove Excuses
1. *Target harden:* • Steering column locks and immobilisers • Anti-robbery screens • Tamper-proof packaging	6. *Extend guardianship:* • Take routine precautions: go out in group at night, leave signs of occupancy, carry phone • "Cocoon" neighborhood watch	11. *Conceal targets:* • Off-street parking • Gender-neutral phone directories • Unmarked bullion trucks	16. *Reduce frustrations and stress:* • Efficient queues and polite service • Expanded seating • Soothing music /muted lights	21. *Set rules:* • Rental agreements • Harassment codes • Hotel registration
2. *Control access to facilities:* • Entry phones • Electronic card access • Baggage screening	7. *Assist natural surveillance:* • Improved street lighting • Defensible space design • Support whistleblowers	12. *Remove targets:* • Removable car radio • Women's refuges • Pre-paid cards for pay phones	17. *Avoid disputes:* • Separate enclosures for rival soccer fans • Reduce crowding in pubs • Fixed cab fares	22. *Post instructions:* • "No Parking" • "Private Property" • "Extinguish camp fires"
3. *Screen exits:* • Ticket needed for exit • Export documents • Electronic merchandise tags	8. *Reduce anonymity:* • Taxi driver IDs • "How's my driving?" decals • School uniforms	13. *Identify property:* • Property marking • Vehicle licensing and parts marking • Cattle branding	18. *Reduce emotional arousal:* • Controls on violent pornography • Enforce good behavior on soccer field • Prohibit racial slurs	23. *Alert conscience:* • Roadside speed display boards • Signatures for customs declarations • "Shoplifting is stealing"
4. *Deflect offenders:* • Street closures • Separate bathrooms for women • Disperse pubs	9. *Utilize place managers:* • CCTV for double-deck buses • Two clerks for convenience stores • Reward vigilance	14. *Disrupt markets:* • Monitor pawn shops • Controls on classified ads • License street vendors	19. *Neutralize peer pressure:* • "Idiots drink and drive" • "It's OK to say No" • Disperse troublemakers at school	24. *Assist compliance:* • Easy library checkout • Public lavatories • Litter bins
5. *Control tools/ weapons:* • "Smart" guns • Disabling stolen cell phones • Restrict spray paint sales to juveniles	10. *Strengthen formal surveillance:* • Red light cameras • Burglar alarms • Security guards	15. *Deny benefits:* • Ink merchandise tags • Graffiti cleaning • Speed humps	20. *Discourage imitation:* • Rapid repair of vandalism • V-chips in TVs • Censor details of modus operandi	25. *Control drugs and alcohol:* • Breathalyzers in pubs • Server intervention • Alcohol-free events

Source: Cornish and Clarke (2003).

What is known is that illicit markets operate with impunity, and by existing, they create incentives for locals to poach, as well as creating itinerant fences. One way of drastically reducing the problem in Peru is by focusing resources on the most problematic markets and parrots (i.e. 80-20 solution). To do this, one can target the feeder markets of Chiclayo and Pucallpa. These two markets are responsible for 61 percent of all parrots in the Peruvian parrot trade. They not only feed local demand, but are also distributing parrots to distant markets such as Lima and Arequipa, which lack local species. Thus, rather than attempting to eliminate all illicit markets in Peru, which may be very difficult and expensive for law enforcement to accomplish, they are best off shutting down these two markets[51] and patrolling their respective catchment areas to discover poaching hot spots.

In addition to focusing on the two most problematic illicit markets, law enforcement could focus resources on the 80-20 species that are the most poached. In Peru, just seven species make up the majority of the trade. The Canary-Winged Parakeet is by far the most poached species in Peru, yet only has a small range in the area around the Pucallpa and Iquitos markets. Nevertheless it is found on all six markets in Peru. This might be a species worth diverting resources to during the breeding season in order to prevent poaching. Other species might be easier to poach since they are considered crop pests. This is the case for two species in Peru and five species in the Santa Cruz area. In these particular cases, poaching methods can include 'netting' in the crop fields, since this may be an easier way of poaching numerous birds all at once. This explains why crop pests

[51] This is a situational crime prevention technique classified as ‘disrupting markets’, which is under *Reducing the Rewards* of crime.

make up such a large proportion of the Santa Cruz market. Solutions to this may include eliminating sales of mist nets or instead, allowing licensed capture quotas of these crop pest species. In previous decades, crop pests were more likely to be shot by farmers. Without reducing the provocations that some species cause to farmers, eliminating mist nets might have the unintended consequences of bringing this tradition back. Thus, allowing a well-regulated capture quota system[52] of crop pest species might be the best solution.

In addition to these methods, law enforcement may want to focus on itinerant and inter-city fences by delineating the most widely used roads for trafficking species to illicit markets. Setting up a road block on a major road is one such solution to arrest individuals who are trafficking species. This was exactly the operation that took place in Indonesia, which was able to *increase the risk* of transporting wildlife on a major highway that connected the products (in south-west Sulawesi) to the consumer (in north Sulawesi) (Lee et. al., 2005).

All of these strategies in combination are a perfect illustration of increasing the "effective price" of the illegal parrot trade. In the literature on the illegal drug trade, Moore (1990) explains that a strategy of 'supply reduction' (e.g. eradicating crops in source countries as well street-level drug enforcement) should increase the price as well the convenience in obtaining illegal drugs. To see if supply reduction strategies have had a positive effect on consumption, the *effective price* of illegal drugs can be measured in three different ways:

---

[52] A well regulated system would include regular check in's with farmers to verify quota systems are being abided by in addition to providing cages for transportation to ensure parrots are being handled in the most humane way.

1) monetary costs; 2) "search time" to acquire drugs by an individual user; and 3) the risk of arrest or being "ripped off" in attempting to purchase drugs (Moore, 1973). If drug supply reduces, there should be a noticeable reduction in consumption as well. When prices increase for goods such as alcohol, cigarettes, and gasoline, there is a significant reduction in consumption of such products (Moore, 1990; Nicholson, 1985).

The aforementioned situational crime prevention techniques are all methods of supply reduction. With less parrots in the trade, one should expect to see less consumption of parrots as household pets. If police were to shut down the feeder markets in Chiclayo and Pucallpa and locate hot spots for poaching in the surrounding areas of these cities, the *effective price* of parrots would increase within Peru for multiple reasons. Firstly, a majority of the Peruvian supply of parrots has been reduced, especially to regional markets which wholly depend on feeder markets. Secondly, the *search time* would increase for all players in the illegal trade: poachers will have to find newer hotspots; middlemen will have to make new connections in order to obtain a regular supply of parrots; and consumers in the Chiclayo and Pucallpa areas would no longer have the ease of going into the city and purchasing parrots in an open-air market. If consumers really wanted a parrot, they would have to resort to less preferential methods such as finding a wandering salesman in the city[53], locating a secretive black market, or possibly even poaching a bird themselves. Thirdly, the risk of arrest increases for middlemen and consumers given both of their search time's increase (this assumes police would be

[53] There are many drawbacks in purchasing parrots from a wandering salesman. For one, their supply and diversity of species is low. And second, they are sporadic and cannot be counted on being at one place at any given time. This is why open-air markets are much more popular for consumers to purchase wildlife from.

vigilant about parrot poaching in these two cities). With middlemen in particular, longer distances traveled to transport species will generally correlate with a higher fatality rate of parrots. Through these multiple mechanisms, the prices of parrots would effectively increase. With a significant increase in parrot prices, one would expect to see fewer citizens buying parrots[54].

Likelihood of Displacement

Displacement is always a concern and can effectively reduce the gains from any of these SCP measures[55]. However, when examining the 'choice-structuring properties' of the illegal parrot trade, it appears displacement is unlikely in light of the aforementioned policy implications. *First*, poachers and to a lesser extent, fences, are not wholly dependent on the illegal parrot trade as primary income. Therefore, disrupting feeder markets, increasing the risk of trafficking and increasing the effort of poaching can all considerably reduce the trade. *Second*, if law enforcement can reduce the trade in the 80-20 species, displacement is unlikely to transfer to other species since they are less abundant and available around markets. *Thirdly*, if feeder markets can be shut down, it is unlikely that any other market can replace Pucallpa and Chiclayo. This is because these two markets have: (1) vast availability of species in the local area; (2) close proximity to other markets with major roads connecting cities[56]; and (3), possibly a culture of

[54] Another consequence of this outcome can make breeding parrots, a legitimate enterprise, a viable alternative to the illegal parrot trade. This assumes that prices of poached parrots and bred parrots are roughly the same.
[55] A recent meta-analysis of crime prevention studies shows that displacement only happens in limited cases, and diffusion of benefits is almost as likely to occur as displacement (Guerette and Bowers, 2009).
[56] Although Iquitos has a large availability of species in the local area, it is the smallest market in the study. This may be because there are no major highways connecting Iquitos to other cities. In one study

poaching and fences. As can be seen in the Gastanaga et al. (2010) study, two cities in Peru no longer had illicit markets despite having a large abundance of species in the area. A culture of poaching may be a key ingredient for why some cities have illicit markets and others do not.

It is also possible that substantially reducing the illegal parrot trade could result in other fauna becoming poached. Monkeys, reptiles and other birds are vastly abundant in these areas of the neo-tropics, so it is certainly plausible that poachers can target these species as well. Yet this is unlikely as well for several reasons: (1) parrots are symbolic of the neo-tropical culture; (2) parrots can be domesticated easily; and (3), other animals may be more difficult to catch, such as monkeys.

Eco-Tourism

A second approach to reducing the trade is to encourage and invest in more eco-tourist lodges in the neo-tropics. Eco-tourist lodges have become widely popular in species-rich countries in Central and South America, Africa and Australia (Pires and Clarke, 2011). For instance, Peru has a well-established eco-tourism business that is built around clay-licks, in which various species of Macaws feed on daily (Munn, 1992). A similar program has been implemented for the Red-Fronted Macaw in Bolivia through Asociacion Armonia (http://www.armonia-bo.org/). Programs like these can possibly reduce poaching in the immediate area because: (1) it gives locals an economic incentive

(Gonzalez, 2003), it was found that poachers in the Iquitos area were sending poached parrots via rivers to connect to middlemen. This is presumably the case since roads do not connect to other major cities so rivers are the best alternative.

to protect parrots rather to poach them; and (2), it increases capable guardianship in the wild (Pires and Moreto, 2011).

Strengthening CITES & National Policies

The CITES Treaty is intended to protect the most vulnerable species by regulating, and sometimes banning, the international trade of such species. An obvious limitation of this accord in regards to the illegal parrot trade is that much of the problem is within range countries such as Peru and Bolivia. Therefore, enforcement must be left to nations to police their own wilderness and protect vulnerable species from poaching and trafficking.

Two policy recommendations can be implemented that could decrease the illegal parrot trade within borders, as well as strengthen CITES. First, in countries with capture-quotas for parrot species, sustainable trade must be based on scientific estimates. According to Low (2003), Argentina and Guyana were overestimating the amount of parrots that could be trapped in the wild, while Mexico's government was often not basing their annual quotas on scientific data at all. Even with the sustainable catch Mexico proposed for each non-threatened parrot species, over-trapping was common, including poaching of threatened species (Cantu et al., 2007). This has been the same result in Peru as well (Gastanaga et al., 2010). This may be in part due to many parrot species having similar color characteristics; so it may be difficult for the ordinary law enforcement agent to differentiate between what is a threatened species and what is permissible for trapping.

For instance, in Peru alone, there are 50 different species of parrots, and many of these look remarkably similar.

Secondly, a way of improving CITES legislation is by tackling fraud in permit declarations. Nijman and Shepherd (2009) have shown that many of the reptiles *legally* exported from Indonesia to the European Union have actually been poached in the wild and laundered via authorized breeding facilities. Exporting wild-caught species and declaring them as "bred" is not exclusive to the reptile trade though. Evidence suggests that this problem occurs in the parrot trade as well (Low, 2003). One of the most efficient methods to reduce laundering of wild parrots would be to visit authorized breeding facilities and check if they have the capabilities to breed as many species as they have declared as "bred" for export. An onsite inspection can detect this quite easily, and if the facility does not have the capabilities, it is an indication they are poaching species and laundering them through CITES permits (Nijman and Shepherd, 2009).

The CITES system is not perfect, but it has helped to conserve some species. One way to improve policy making on behalf of CITES is to research the effects of trade bans on a species population for the short and long term. If trade bans is the most powerful weapon CITES can utilize to reduce poaching, it would be beneficial to see when it works, with what species and why. One factor that can explain a positive response from trade ban legislation is if the people of range countries support the ban on poaching and the subsequent trade (The Economist, 2008). Part of the reason why the poaching of tigers, elephants and parrots is a common occurrence is that people who inhabit the same lands as these species do not feel it is wrong to poach them. They are considered natural resources, in which inhabitants feel they can exploit for economic gain. Without changing this mentality, trade bans may not be successful in these contexts (Pires and Moreto, 2011).

Theoretical Implications

This is only the second research study to use the 'choice-structuring properties' of the Rational Choice Theory as a theoretical framework (see Truc-Nhu Thi, 1992). In doing so, this study substantiates RCT as a more general theory of criminal behavior by applying it to an exotic crime such as the illegal parrot trade. Through the use of choice structuring properties, the illegal parrot trade can be viewed as an attractive crime due to its *static* and *variance* factors. Static factors are those that make poaching any parrot species attractive, such as the ease of nest poaching when no capable guardians are around. Variance factors, on the other hand, are factors that will explain parrot poaching variation such as market value and availability. These factors are operationalized CRAVED concepts, in which this study finds that availability and abundance are the two most important reasons why some species are more likely to become poached. This confirms prior research findings from Mexico and Bolivia (Pires and Clarke, 2011; 2012) that the CRAVED model should change to CRAAVED. Earlier findings have shown *abundance* and *accessibility* are two separate measures that emanate from the *Availability* concept in the original CRAVED model. Species that are abundant in the wild may not be accessible for people to find them or be situated near markets and vice versa. Thus, only measuring availability would not capture the whole picture of the illegal parrot trade. This may also have more general implications for theft variation beyond wildlife crimes. For instance, car theft research may also benefit from these findings. Some vehicle models may be abundant in a city, but may not be as accessible to steal if they are more often parked in home garages and driveways.

Examining the choice structuring properties of the illegal parrot trade also suggests the limitations of displacement. Displacement is unlikely if prevention is targeted at the most poached species, the largest markets that distribute parrots, and the most widely used roads by middlemen. Opportunistic factors such as availability and abundance determine which species are more likely to be poached and traded from city to city. If these opportunities are removed, poachers and middlemen will not necessarily work harder or take higher risks to continue their endeavors.

Lastly, this study gives criminologists a better understanding of itinerant fences in Peru and Bolivia. Pires and Clarke's (2011) research showed the Santa Cruz, Bolivia market had a catchment area of roughly 100 miles outside the city, in part due to the activities of itinerant fences. These middlemen would travel well beyond the local area of the city to collect parrots and bring them back to Santa Cruz. This dissertation shows variation on the size of catchment areas, ranging from 50 miles to 150 miles outside city markets. In markets with small catchment areas such as Iquitos, itinerant fences may not exist. It may be solely up to poachers to transport species to market. In cities with larger catchment areas, it may indicate that there may be numerous fences willing to travel such far distances. In addition to these findings, this study reveals that city markets are interacting with each other via inter-city fences. These may be the same individuals that are fencing parrots within a catchment area of an illicit market, but also can be a different type of fence, one who only travels long distances between city markets to traffic species. Based on the present study, this question cannot be resolved without doing a qualitative study examining the types of middlemen involved in the trade.

Conclusions

Understanding how illicit wildlife markets operate can provide informed solutions towards reducing the illicit trade in fauna. Despite having a small sample of species, this dissertation has discovered a number of novel findings that can enable policy makers to reduce the trade immediately with little cost. In all likelihood, these findings would not be realized if this dissertation were grounded from a more traditional perspective, such as conservation or economics. Applying 'crime science' theories to the field of conservation is beneficial in a number of ways. For one, it provides a foundation in how to examine the problem of poaching variation. Two, it reveals that situational crime prevention is a universal toolset, which can be applied to unusual crimes such as wildlife poaching. And finally, studying unusual topics enriches the general field of crime science. In this dissertation, utilizing the choice structuring properties of the illegal parrot trade has led to the development of static and variance factors. These two sets of factors can explain the attractive properties of parrot poaching, as well as provide operationalizeable measures that can explain theft variation. To the candidate's knowledge, this is the first time a researcher has used the concept of static and variance factors to explain theft variation. Furthermore, this dissertation also shows that the CRAVED model is not limited to analyzing poaching variation only where parrots are sold. The CRAVED model can be used to examine which species are more likely to be transported from city to city. Availability not only explains which species are more likely to become poached, but also explains which species are more likely to be transported. Because of this latter analysis and the possibilities in using GIS software, this study finds itinerant fences may also be transporting species from one city market to another. Alternatively, this may imply that itinerant fences and inter-city fences are two separate wildlife traders that amplify the size of the illegal parrot trade.

References

Armstrong, M.C., Farinato, R.H., & Telecky, T.M. (2001). A wing and a prayer: Birds and their protection under law. *Journal of Avian Medicine and Surgery, 15*(4), 310-315.

Baker, S. (2003). *An Analysis of Timber Trespass and Theft Issues in the Southern Appalachian Region*. Masters in Science in Forestry, Blacksburg, VA: Virginia Polytechnic Institute.

Brouwer. K., Jones, M. L., King, C. E., and H. Schifter. (2000). Longevity Records for Psittaciformes in Captivity. *International Zoo Yearbook,* 37: 299-316.

Cantu, J. C. G., Saldana, M. E. S., Grosselet, M., and Gamez, J. S. (2007). *The Illegal Parrot Trade in Mexico: A Comprehensive Assessment*. Mexico and Washington, DC: Defenders of Wildlife.

Carey, R.A. (2005). *The Philosopher Fish: Sturgeon, Caviar, and the Geography of Desire.* New York, NY: Counterpoint.

CIA. The World Factbook. https://www.cia.gov/library/publications/the-world-factbook/index.html. Date accessed 22 September 2010.

CITES. *How CITES works,* Convention on International Trade in Endangered Species of Wild Fauna and Flora. Geneva: CITES Secretariat, www.cites.org/eng/disc/how.shtml . Date accessed 1 September 2010.

——— *The CITES species,* Convention on International Trade in Endangered Species of Wild Fauna and Flora. Geneva: CITES Secretariat, www.cites.org/eng/disc/species.shtml . Date accessed 1 September 2010.

——— *What is CITES?,* Convention on International Trade in Endangered Species of Wild Fauna and Flora. Geneva: CITES Secretariat, www.cites.org/eng/disc/what.shtml . Date accessed 1 September 2010.

Clarke, R. V. (1999). *Hot Products: Understanding, Anticipating and Reducing Demand for Stolen Goods.* Police Research Series, Paper 112. Policing and Reducing Crime Unit, Research Development and Statistics Directorate. London: Home Office.

Clarke, R.V., & Eck, J. E. (2005), *Crime Analysis for Problem Solvers*. In 60 Small Steps. Office of Community Oriented Policing Services. Washington, DC: US Department of Justice.

Cockle, K., G. Capuzzi, A. Bodrati, R. Clay, H. D. Castillo, M. Velazquez, J. I. Areta, N. Farina, and R. Farina. (2007). Distribution, Abundance, and Conservation of Vinaceous Amazons (Amazona Vinacea) in Argentina and Paraguay. *Journal of Field Ornithology* 78 (1):21-39.

Cohen, L. E. and M. Felson. (1979). Social Change and Crime Rate Trends: A Routine Activity Approach. *American Sociological Review* 44: 588-605.

Collar, N. J. and A. T. Juniper. (1992). Dimensions and Causes of the Parrot Conservation Crisis, in S. R. Beissinger & N. F. R. Snyder, ed., *New World Parrots in Crisis: Solutions from Conservation Biology*, 1-24. Washington and London: Smithsonian Institution Press.

Cook, D., Roberts, M., Lowther, J. (2002). *The International Wildlife Trade and Organized Crime: A Review of the Evidence and the Role of the UK*. Wolverhampton, UK: WWF-UK.

Cooney, R. and Jepson, P. (2006). The International Wild Bird Trade: What's Wrong with Blanket Bans. *Oryx*, 40 (1): 18-23.

Cornish, D.B. and R.V. Clarke. (1986). *The Reasoning Criminal: Rational Choice Perspectives on Offending*. New York: Springer-Verlag.

Cornish, D., & Clarke, R.V. (1987). Understanding crime displacement: An application of rational choice theory. *Criminology, 25*, 933-947.

Cornish, D., & Clarke, R.V. (2003). Opportunities, precipitators and criminal decisions: A reply to Wortley's critique of situational crime prevention, in M. Smith & D.B. Cornish, eds., *Theory for Situational Crime Prevention*, Crime Prevention Studies, (16): 41-96. Monsey, New York: Criminal Justice Press.

Dauphine, N. (2008). Notes on the live bird trade in northern Peru. *Proceedings of the Fourth International Partners in Flight Conference: Tundra to Tropics*: 220-222.

Delaney, J. (2009, Mar 18). Wildlife smuggling nets big bucks for organized crime. *The Epoch Times*. Accessed at: http://www.theepochtimes.com/n2/content/view/13914/.

EJF. (2007). *Pirate fish on your plate – Tracking illegally-caught fish from West Africa into the European market.* London, UK: Environmental Justice Foundation.

Engebretson, M. (2006). The welfare and suitability of parrots as companion animals: A review. *Animal Welfare*, 15: 263-276.

Felson, M. (2006). *Crime and Nature*. California, USA: Sage Publications.

Gastanaga, M., Macleod, R., Hennessey, B., Nunez, J. U., Puse, E., Arrascue, A., Hoyos, J., Chambi, W. M., Vasquez, J. and G. Engblom. (2010). A Study of the Parrot

Trade in Peru and the Potential Importance of Internal Trade for Threatened Species. *Bird Conservational International*: 1-10.

Gonzàlez, J. A. (2003). Harvesting, Local Trade, and Conservation of Parrots on the Northeastern Peruvian Amazon. *Biological Conservation,* 114: 437-446.

Guerette, R., K. Bowers. (2009). Assessing the extent of crime displacement and diffusion of benefits: A review of situational crime prevention evaluations. *Criminology*, 47: 1331-68.

Hauck, M., N. A. Sweijd. (1999). A case study of abalone poaching in South Africa and its impact on fisheries management. *ICES Journal of Marine Science*, 56: 1024-1032.

Hauck, M., & Kroese, M. (2006). Fisheries compliance in South Africa: A decade of challenges and reform 1994-2004. *Marine Policy*, 30, 74-83.

Hennessey, B., Herzog, S. K., Sagot, F. (2003). *Lista Anotada de las Aves de Bolivia*. Santa Cruz, Bolivia: Asociacion Armonia / Birdlife International.

Herrera, M., & B. Hennessey. (2007). Quantifying the illegal parrot trade in Santa Cruz de la Sierra, Bolivia, with emphasis on threatened species. *Bird Conservation International*, *17*, 295-300.

Herrera, M. and Hennessey, B. (2008). Monitoring Results of the Illegal Parrot Trade in the Los Pozos Market, Santa Cruz De La Sierra, Bolivia. *Proceedings of the Fourth International Partners in Flight Conference: Tundra to Tropics*: 232-234.

Highway Loss Data Institute. (2010, Aug 3). Cadillac Escalade, Ford F-250 pickup, and Infiniti G37 Top List of Highest Insurance Claims for Theft. Retrieved at: http://www.iihs.org/news/rss/pr080310.html

Howell, S.N.G., & Webb, S. (1995). *A Guide to the Birds of Mexico and Northern Central America*. New York: Oxford University Press.

(IUCN) International Union for Conservation of Nature. Red List of Threatened Species. http://www.iucn.org/about/work/programmes/species/red_list/. Date accessed 1 September 2010.

Juniper, T., & Parr. M. (1998). *Parrots: A Guide to Parrots of the World*. New Haven: Yale University Press.

Lee, R., Gorog, A., Dwiyahreni, A., Siwu, S., Riley, J., Alexander, H., Paoli, G. D., Ramono, W. (2005). Wildlife trade and implications for law enforcement in Indonesia: a case study from North Sulawesi. *Biological Conservation*, 123: 477-488.

Lemieux, A. M., Clarke, R. V. (2009). The international ban on ivory sales and its effects on elephant poaching in Africa. *British Journal of Criminology*, 49: 451-471.

Lin, J. (2005). Tackling Southeast Asia's Illegal Wildlife Trade. *Singapore Yearbook of International Law and Contributors*, 9: 191-208.

Low, R. (2003). The worldwide trade in wild-caught parrots. *Proceedings of the International Aviculturists Society*.

McDermott, M. (2010, Sep 16). Wildlife trafficking, organized crime and you: Without demand from rich nations there's no profit in it. Accessed at: http://planetgreen.discovery.com/travel-outdoors/wildlife-trafficking-organized-crime-and-you.html

Monterrubio, T., Enkerlin-Hoeflich, E., Hamilton, R. B. (2002). Productivity and Nesting Success of Thick-Billed Parrots. *The Condor*, 104: 788-794.

Moore, M. H. (1973). Achieving Discrimination on the Effective Price of Heroin. *American Economic Review 63*(2): 270-277.

Moore, M. H. (1990). Supply Reduction and Drug Law Enforcement. In Michael Tonry and James Q. Wilson, ed., *Drugs and Crime*, 109-157. Crime and Justice: A Review of Research, Vol. 13, edited by Michael Tonry and Norval Morris. Chicago: University of Chicago Press.

Munn, C. A. (1992). Macaw Biology and Ecotourism or "When a Bird in the Bush is Worth Two in the Hand." In S.R. Beissinger and N. F. R. Snyder, eds, *New World Parrots in Crisis: Solutions from Conservation Biology*, 47-72. Washington and London: Smithsonian Institution Press.

Nicholson, W. (1985). *Microeconomic Theory*. 3rd ed. Chicago: Dryden.

Nijman, V. and Shepherd, C. R. (2009). *Wildlife trade from ASEAN to the EU: Issues with the trade in captive-bred reptiles from Indonesia.* TRAFFIC Europe Report for the European

Commission, Brussels, Belgium.

Pain, D. J., & 18 authors. (2006). Impact of protection on nest take and nesting success of parrots in Africa, Asia, and Australia. *Animal Conservation*, *9*, 322-330.

Pantel, S. and Yun, C. S. (2009). Proceedings of the workshop on trade and conservation of pangolins native to Southeast Asia, 30 June - 2 July 2008, Singapore Zoo, Singapore. TRAFFIC Southeast Asia, Petaling Jaya, Selangor, Malaysia.

Pires, S. F. and Clarke, R. V. (2012). Are Parrots CRAVED? An Analysis of Parrot Poaching in Mexico. *Journal of Research in Crime and Delinquency*, doi: 10.1177/0022427810397950.

Pires, S. F. and Clarke, R. V. (2011). Sequential Foraging, Itinerant Fences and Parrot Poaching in Bolivia. *British Journal of Criminology, 51: 314-335.*

Pires, S. F. and W. Moreto. (2011). Preventing wildlife crimes: Solutions that can overcome the 'tragedy of the commons'. *European Journal on Criminal Policy and Research,17: 101-123.*

Putt, J., & Nelson, D. (2008). Crime in the Australian fishing industry. *Trends & issues in crime and criminal justice*, no.366. http://www.aic.gov.au/publications/current%20series/tandi/361-380/tandi366.aspx

Robbins, C., Barcenas, R. T. (2003, Jan). *Prickly Trade: Trade and conservation of Chihuahuan desert cacti*. Washington, DC: TRAFFIC North America.

Rodriguez Castillo, A. M. and J. R. Eberhard. (2006). Reproductive Behavior of the Yellow-Crowned Parrot (Amazona Ochrocephala) in Western Panama. *The Wilson Journal of Ornithology* 118 (2):225-236.

Roe, D. (2008). *Trading nature: A report, with case studies, on the contribution of wildlife trade management to sustainable livelihoods and the Millennium Development Goals*. Traffic International and WWF International.

Saffron, I. (2002). *Caviar: The Strange History and Uncertain Future of the World's Most Coveted Delicacy.* NY: Broadway Books.

Schulenberg, T. S., Stotz, D. F., Lane, D. F., O'Neill, J. P., and T. A. Parker III. (2007). *Birds of Peru*. Princeton, NJ: Princeton University Press.

Smith, C., K. J. Bowers and S. D. Johnson. (2006). Understanding Bag Theft within Licensed Premises in Westminster: Identifying Initial Steps towards Prevention. *Security Journal* 19:3-21.

Smith, R.J., & Walpole, M. J. (2005). Should conservationists pay more attention to corruption? *Oryx, 39,* 251-256.

(2011). Tambopota Macaw Project. Retrieved on August 30, 2011: http://www.macawproject.org/about/project-in-details

Tayler, J. (2001). The Caviar Thugs: Poverty, corruption, and crime are threatening to destroy a Russian institution. *Atlantic Magazine* (June 2001). Retrieved on Oct 15, 2009: http://www.theatlantic.com/magazine/archive/2001/06/the-caviar-thugs/2252/

(2008, Mar 8). Call of the wild. *The Economist*, pgs. 85-87.

TRAFFIC. (2008). *What's driving the wildlife trade? A review of expert opinion on economic and social drivers of the wildlife trade and trade control efforts in Cambodia, Indonesia, Lao PDR and Vietnam.* East Asia and Pacific Region Sustainable Development Discussion Papers. East Asia and Pacific Region Sustainable Development Department, World Bank: Washington, DC.

Truc-Nhu Thi, H. (1992). Art theft in New York City: An exploratory study in crime-specifity. *ProQuest*, *53*(05), 1677. (AAT 9227550) Retrieved January 20, 2011, from Dissertations and Theses database.

U.S. Congress. (2008). Poaching American Security: Impacts of Illegal Wildlife Trade: Oversight Hearing Before the Committee on Natural Resources, 110th Cong., 2nd Sess., Wednesday, March 5, 2008

Vaisman, A. (1997). *Sturgeon catch and trade in the Russian part of the Caspian Sea.* Brussels: TRAFFIC Europe.

Vaughan, C., N. Nemeth, and L. Marineros. (2003). Ecology and Management of Natural and Artificial Scarlet Macaw (Ara Macao) Nest Cavities in Costa Rica. *Ornitologia Neotropical*, 14:1-16.

Wellsmith, M. and A. Burrell. (2005). The Influence of Purchase Price and Ownership Levels on Theft Targets. *British Journal of Criminology*, 45:741-764.

Weston, M. K. and Memon, M. A. (2009). The Illegal Parrot Trade in Latin America and its Consequences to Parrot Nutrition, Health and Conservation. *Bird Populations*, 9: 76-83.

White, R. (2008). *Crimes Against Nature: Environmental criminology and ecological justice*. Devon: Willan Publishing.

Whitehead, S., J. Mailley, I. Storer, J. McCardle, G. Torrens and G. Farrell. (2008). In Safe Hands: A Review of Mobile Phone Anti-theft Designs. *European Journal on Criminal Policy and Research*, 14:39-60.

Wright, T. & 24 authors. (2001). Nest poaching in Neotropical parrots. *Conservation Biology*, *15*, 710-720.

WWF. *Wildlife Trade: Parrot Trade FAQs*, World Wildlife Fund. Accessed at: http://www.worldwildlife.org/what/globalmarkets/wildlifetrade/faqs-parrot.html. Date accessed 1 September 2010.

Zimmerman, M. (2003). The Black Market for Wildlife: Combating Transnational Organized Crime in the Illegal Wildlife Trade. *Vanderbilt Journal of Transnational Law*, 36: 1657-1689.

Appendix I – List of Peruvian & Bolivian Species

Peruvian Parrot Species	IUCN Red List	CITES Appendix	N. of Markets on
Amazonian Parrotlet	Near Threatened	II	0
Andean Parakeet	Least Concern	II	1
Barred Parakeet	Least Concern	II	0
Black-capped Parakeet	Least Concern	II	0
Black-headed Parrot	Least Concern	II	2
Black-winged Parrot	Least Concern	II	0
Blue-headed Macaw	Vulnerable	II	0
Blue-and-yellow Macaw	Least Concern	II	4
Blue-headed Parrot	Least Concern	II	5
Blue-winged Parrotlet	Least Concern	II	1
Bronze-winged Parrot	Least Concern	II	0
Canary-winged Parakeet**	Least Concern	II	6
Chestnut-fronted Macaw	Least Concern	II	2
Cobalt-winged Parakeet**	Least Concern	II	4
Dusky-billed Parrotlet	Least Concern	II	2
Dusky-headed Parakeet**	Least Concern	II	3
Festive Parrot	Least Concern	II	4
Golden-plumed Parakeet	Vulnerable	II	0
Gray-cheeked Parakeet	Endangered	II	4
Maroon-tailed Parakeet	Least Concern	II	0
Mealy Parrot	Least Concern	II	3
Military Macaw	Vulnerable	I	2
Mitred Parakeet**	Least Concern	II	5
Mountain Parakeet	Least Concern	II	2
Orange-cheeked Parrot	Least Concern	II	0
Orange-winged Parrot	Least Concern	II	3
Pacific Parrotlet**	Least Concern	II	2

Painted Parakeet	Least Concern	II	3
Peach-fronted Parakeet	Least Concern	II	0
Red-bellied Macaw	Least Concern	II	1
Red-and-green Macaw	Least Concern	II	2
Red-Billed Parrot	Least Concern	II	1
Red-faced Parrot	Vulnerable	II	0
Red-fan Parrot	Least Concern	II	0
Red-masked Parakeet	Near Threatened	II	3
Red-shouldered Macaw	Least Concern	II	0
Saphire-rumped Parrotlet	Least Concern	II	0
Scaly-naped Parrot	Least Concern	II	2
Scarlet Macaw	Least Concern	I	3
Scarlet-fronted Parakeet**	Least Concern	II	3
Scarlet-shouldered Parrotlet	Least Concern	II	0
Short-tailed Parrot	Least Concern	II	2
Speckle-faced Parrot	Least Concern	II	0
Spot-winged Parrotlet	Near Threatened	II	0
Tui Parakeet**	Least Concern	II	4
White-bellied Parrot	Least Concern	II	2
White-eyed Parakeet	Least Concern	II	6
White-necked Parakeet	Vulnerable	II	0
Yellow-crowned Parrot	Least Concern	II	4
Yellow-faced Parrotlet	Vulnerable	II	1

** Legally permissible to trap species up to a quota.

Bolivian Parrot Species	IUCN Red List	CITES Appendix	Numbers Poached
Andean Parakeet	Least Concern	II	0
Amazonian Parrotlet	Near Threatened	II	0
Black-capped Parakeet	Least Concern	II	0
Black-hooded Parakeet	Least Concern	II	11
Black-winged Parrot	Least Concern	II	0
Blue-headed Macaw	Vulnerable	II	0
Blue-and-yellow Macaw	Least Concern	II	228
Blue-crowned Parakeet	Least Concern	II	1819
Blue-fronted Parrot	Least Concern	II	4417
Blue-headed Parrot	Least Concern	II	451
Blue-throated Macaw	Critically Endangered	II	2
Blue-winged Parrotlet	Least Concern	II	3814
Chestnut-fronted Macaw	Least Concern	II	190
Cobalt-winged Parakeet	Least Concern	II	26
Crimson-bellied Parakeet	Least Concern	II	0
Dusky-billed Parrotlet	Least Concern	II	0
Dusky-headed Parakeet	Least Concern	II	216
Golden-collared Macaw	Least Concern	II	87
Gray-hooded Parakeet	Least Concern	II	0
Green-cheeked Parakeet	Least Concern	II	800
Hyacinth Macaw	Endangered	II	11
Mealy Parrot	Least Concern	II	59
Military Macaw	Vulnerable	II	4
Mitred Parakeet	Least Concern	II	670
Monk Parakeet	Least Concern	II	6934
Mountain Parakeet	Least Concern	II	0
Orange-cheeked Parrot	Least Concern	II	0
Orange-winged Parrot	Least Concern	II	61
Painted Parakeet	Least Concern	II	0

Peach-fronted Parakeet	Least Concern	II	280
Red-bellied Macaw	Least Concern	II	0
Red-and-green Macaw	Least Concern	II	113
Red-Billed Parrot	Least Concern	II	0
Red-fronted Macaw	Endangered	II	47
Red-shouldered Macaw	Least Concern	II	40
Scaly-headed Parrot	Least Concern	II	143
Scaly-naped Parrot	Least Concern	II	0
Scarlet Macaw	Least Concern	II	50
Scarlet-shouldered Parrotlet	Least Concern	II	0
Speckle-faced Parrot	Least Concern	II	0
Tucuman Parrot	Near Threatened	II	44
Tui Parakeet	Least Concern	II	0
White-bellied Parrot	Least Concern	II	14
White-eyed Parakeet	Least Concern	II	267
Yellow-chevroned Parakeet	Least Concern	II	6693
Yellow-crowned Parrot	Least Concern	II	18
Yellow-faced Parrot	Near Threatened	II	3

Appendix II

Santa Cruz, Bolivia	**Parrots on Market**	**Distance of Range From Market**	**Range Within 150-Mile Buffer**	**How Common**	**% Rainforest**	**% Parks**	**Beauty**	**Threat Status**	**Access to Nest**	**Bolivian $$**	**N of Other Markets***	**On Market***	**Crop Pest**
Monk PK	6934	45	6827	5	46.8	30.4	5	1	2	16.6		1	yes
Yellow-chevroned PK	6693	0	29688	5	67.2	15.9	5	1	2	19.7		1	yes
Blue-fronted PT	4417	0	30783	5	67.4	20.1	6	1	3	118.2		1	
Blue-winged Ptlet	3814	103	0	4	98.1	0.2	4	1	2	11.8		1	yes
Blue-crowned PK	1819	0	30780	5	62.2	20.9	5	1	4	32.3		1	
Green-cheeked PK	800	0	31771	5	71.7	16.8	6	1	3	11.1		1	
Mitred PK	670	26	8449	5	93.3	25.7	5	1	4	30.5		1	
Blue-headed PT	451	0	11364	5	97.5	15.4	4	1	3	57.2		1	
Peach-fronted PK	280	0	23603	4	62.3	15.2	6	1	2	42.5		1	
White-eyed PK	267	0	27181	4	63.7	16.7	5	1	4	52.3		1	
Blue-and-yellow MC	228	0	18048	4	97.6	11.4	7	1	3	374.8		1	
Dusky-headed PK	216	33	4495	5	97.0	3.6	6	1	2	20.0		1	yes
Chestnut-fronted MC	190	56	4153	4	97.7	0.0	7	1	3	128.8		1	
Scaly-headed PT	143	0	29633	5	66.0	17.7	4	1	3	44.6		1	
Red-and-green MC	113	9	14389	4	95.0	3.2	7	1	4	533.1		1	
Golden-collared MC	87	0	23162	5	64.4	11.8	7	1	3	84.5		1	
Orange-winged Parrot	61	0	16518	3.5	98.1	8.5	5	1	3	151.3		1	yes
Mealy PT	59	15	6932	4	97.6	4.4	6	1	3	244.6		1	
Scarlet MC	50	0	15974	3	97.9	12.6	7	1	3	880.0		1	
Red-Fronted MC	47	52	2040	5	99.2	0.9	7	4	4	532.5		1	yes
Tucuman PT	44	73	806	5	100.0	13.5	5	2	3	162.5		1	
Red-shouldered MC	40	93	508	3	96.6	0.0	6	1	2	50.0		1	
Cobalt-winged PK	26	0	10861	4	97.6	11.5	4	1		20.0		1	
Yellow-crowned PT	18	58	3953	3.5	97.5	0.0	5	1	2	210.0		1	

White-bellied PT	14	0	8991	4	94.5	18.5	4	1	3	480.0		1
Black hooded PK	11	269	0	4			6	1	2		0	1
Hyacinth MC	11	262	0	5			6	4	3		0	1
Gray-cheeked PK	8	1336	0	4			5	4	2		4	1
Yellow-faced Ptlet	8	1042	0	4			4	3	2		1	1
Military Macaw	4	46	4442	4	98.4	19.7	7	3	4			1
Yellow-faced PT	3	226	0	4.5			4	2	2	280.0	0	1
Blue-throated MC	2	202	0	5			6	5	3		0	1
Bronze-Winged PT	2	1335	0	3			5	1	3	450.0	0	1
Lears MC	2	1527	0	2			6	5	4		0	1
Black-headed PT	1	817	0	4			4	1	3		2	1
Andean PK	0	49	2587	3.5	90.3	50.7	4	1	1			0
Black capped PK	0	263	0	3.5			4	1			0	0
Black-winged PT	0	60	806	3	100.0	78.5	3	1				0
Blaze-Winged PK	0	267	0	5			6	2	3		0	0
Blue headed MC	0	363	0	3.5			6	3	3		0	0
Blue-Winged MC	0	352	0	3			5	2	3		0	0
Crimson bellied PK	0	164	0	5			6	1	3		0	0
Dusky-billed Ptlet	0	0	8895	3	96.9	4.4	4	1	3			0
Gray-hooded PK	0	11	8775	5	89.8	25.8	4	1	1			0
Mountain PK	0	93	108	4	88.4	18.8	4	1	4			0
Orange-cheeked PT	0	240	0	4			5	1			1	0
Painted PK	0	130	0	3	90.7	0.0	4	1	3			0
Red bellied MC	0	184	0	5			6	1	3		1	0
Red-Billed PT	0	40	2606	3.5	98.1	50.3	4	1	3			0
Red-Fan PT	0	355	0	2			6	1	3		0	0
Scaly-naped PT	0	51	1957	4	96.0	52.3	4	1	4			0
Speckle-faced PT	0	55	688	3	98.8	89.5	4	1				0
Tui PK	0	237	0	4			4	1	2		4	0

Arequipa, Peru	Parrots on Market	Distance of Range From Market	Range Within 150-Mile Buffer	How Common	% Rainforest	% Parks	Beauty	Threat Status	Access to Nest	Peru $$	N of Other Markets*	On Market*
Canary-winged PK	135	478	0	4			5	1	2	15.5	5	1
Monk PK	98	220	0	5			5	1	2	24.0	0	1
Dusky-billed Ptlet	90	187	0	3			4	1	3	21.7	1	1
Red-masked PK	67	777	0	4			5	2	2	32.5	2	1
Gray-cheeked PK	50	952	0	4			5	4	2	35.0	3	1
Mountain PK	30	0	39987	4	5.3	9.7	4	1	4		**	1
Scarlet-fronted PK	24	0	7916	4	0.0	2.2	5	1	3.5	120.0	**	1
Blue-headed PT	20	174	0	5			4	1	3	50.0	4	1
Yellow-crowned PT	20	234	0	3.5			5	1	2	90.0	3	1
Mitred PK	16	125	4222	5	25.6	0.0	5	1	4	53.8	**	1
Andean PK	15	112	5663	3.5	13.6	0.0	4	1	1		**	1
Festive PT	15	527	0	4			5	1		100.0	3	1
Tui PK	12	210	0	4			4	1	2	35.5	3	1
White-eyed PK	10	191	0	4			5	1	4	38.8	5	1
Chestnut-fronted MC	8	170	0	4			7	1	3		1	1
Mealy PT	8	183	0	4			6	1	3	143.3	2	1
Blue-and-yellow MC	6	177	0	4			7	1	3	370.0	3	1
Scarlet MC	4	211	0	3			7	1	3	142.5	2	1
White-bellied PT	4	203	0	4			4	1	3	15.0	1	1
Black-headed PT	2	451	0	4			4	1	3	50.0	3	1
Military Macaw	1	220	0	4			7	3	4	400.0	1	1
Amazonian Ptlet	0	207	0	3.5			4	2	3		0	0
Barred PK	0	265	0	2.5			4	1	3		0	0
Black capped PK	0	199	0	3.5			4	1			0	0

Black-winged PT	0	183	0	3	3	1			0	0
Blue headed MC	0	201	0	3.5	6	3	3		0	0
Blue-fronted PT	0	213	0	5	6	1	3		0	0
Blue-throated MC	0	365	0	5	6	5	3		0	0
Blue-winged Ptlet	0	175	0	4	4	1	2		0	0
Cobalt-winged PK	0	192	0	4	4	1		12.0	4	0
Dusky-headed PK	0	209	0	5	6	1	2	86.7	3	0
Golden-collared MC	0	257	0	5	7	1	3		0	0
Golden-Plumed PK	0	215	0	3	5	3	3		0	0
Gray-hooded PK	0	193	0	5	4	1	1		0	0
Green-cheeked PK	0	204	0	5	6	1	3		0	0
Maroon-tailed PK	0	381	0	3	5	1			0	0
Orange-cheeked PT	0	157	0	4	5	1		70.0	0	0
Orange-winged Parrot	0	316	0	3.5	5	1	3	100.0	3	0
Pacific Ptlet	0	687	0	5	4	1	2	20.3	2	0
Painted PK	0	163	0	3	4	1	3	23.3	3	0
Peach-fronted PK	0	223	0	4	6	1	2		0	0
Red bellied MC	0	169	0	5	6	1	3	70.0	1	0
Red-and-green MC	0	163	0	4	7	1	4	151.7	2	0
Red-Billed PT	0	220	0	3.5	4	1	3	30.0	1	0
Red-shouldered MC	0	240	0	3	6	1	2		0	0
Scaly-headed PT	0	189	0	5	4	1	3		0	0
Scaly-naped PT	0	168	0	4	4	1	4	50.0	2	0
Scarlet-shouldered Ptlet	0	204	0	2.5	4	1			0	0
Speckle-faced PT	0	169	0	3	4	1			0	0
Yellow-chevroned PK	0	241	0	5	5	1	2		0	0

Chiclayo, Peru	**Parrots on Market**	**Distance of Range From Market**	**Range Within 150-Mile Buffer**	**How Common**	**% Rainforest**	**% Parks**	**Beauty**	**Threat Status**	**Access to Nest**	**Peru $$**	**N of Other Markets***	**On Market***
Pacific Ptlet	254	0	20297	5	66.2	0.3	4	1	2	20.3		1
Canary-winged PK	56	260	0	4			5	1	2	15.5	5	1
Red-masked PK	52	7	9714	4	94.1	0.5	5	2	2	32.5		1
Cobalt-winged PK	30	108	3480	4	98.6	9.7	4	1		12.0		1
Gray-cheeked PK	29	159	0	4			5	4	2	35.0	3	1
Scarlet-fronted PK	27	57	14262	4	91.9	2.4	5	1	3.5	120.0		1
Mitred PK	24	292	0	5			5	1	4	53.8	4	1
Yellow-faced Ptlet	16	105	1146	4	92.6	0.0	4	3	2	9.0		1
Orange-winged Parrot	13	121	3187	3.5	100.0	10.7	5	1	3	100.0		1
Dusky-headed PK	10	188	0	5			6	1	2	86.7	3	1
White-bellied PT	8	366	0	4			4	1	3	15.0	1	1
Blue-and-yellow MC	6	145	1	4	100.0	100.0	7	1	3	370.0	3	1
Blue-headed PT	6	128	1325	5	100.0	0.0	4	1	3	57.5		1
Mealy PT	3	178	0	4			6	1	3	143.3	2	1
Red-and-green MC	3	189	0	4			7	1	4	151.7	1	1
Scarlet MC	3	196	0	3			7	1	3	142.5	2	1
White-eyed PK	3	105	5497	4	99.4	6.2	5	1	4	38.8		1
Festive PT	1	244	0	4			5	1		100.0	3	1
Military Macaw	1	62	8773	4	98.1	2.1	7	3	4	400.0		1
Scaly-naped PT	1	71	7495	4	93.3	5.0	4	1	4	50.0		1
Yellow-crowned PT	1	240	0	3.5			5	1	2	90.0	3	1
Andean PK	0	60	1163	3.5	81.2	12.6	4	1	1			0
Black-headed PT	0	219	0	4			4	1	3	50.0	2	0
Blue-winged Ptlet	0	134	609	4	100.0	12.6	4	1	2			0

Chestnut-fronted MC	0	144	0	4			7	1	3		2	0
Dusky-billed Ptlet	0	152	7	3	100.0	0.0	4	1	3	21.7		0
Mountain PK	0	97	4182	4	37.6	5.2	4	1	4			0
Orange-cheeked PT	0	231	0	4			5	1		70.0	0	0
Painted PK	0	162	0	3			4	1	3	23.3	3	0
Red bellied MC	0	210	0	5			6	1	3	70.0	1	0
Red-Billed PT	0	85	3970	3.5	100.0	3.0	4	1	3	30.0		0
Short-tailed PT	0	263	0	4			4	1		53.3	2	0
Tui PK	0	255	0	4			4	1	2	35.5	4	0
Amazonian Ptlet	0	331	0	3.5			4	2	3		0	0
Barred PK	0	117	625	2.5	67.2	0.0	4	1	3			0
Black capped PK	0	344	0	3.5			4	1			0	0
Black-winged PT	0	281	0	3			3	1			0	0
Blue headed MC	0	225	0	3.5			6	3	3		0	0
Blue-fronted Ptlet	0	209	0	2.5			4	1	2		0	0
Bronze-Winged PT	0	171	0	3			5	1	3		0	0
Golden-Plumed PK	0	108	2811	3	90.6	2.8	5	3	3			0
Maroon-tailed PK	0	141	74	3	100.0	75.7	5	1				0
Red Lored PT	0	212	0	2			6	1	3		0	0
Red-Faced PT	0	108	912	2.5	78.3	4.1	5	3	3			0
Red-Fan PT	0	294	0	2			6	1	3		0	0
Rose Faced PT	0	212	0	3			5	1			0	0
Saphire Rumped Ptlet	0	259	0	2.5			5	1	2		0	0
Scarlet-shouldered Ptlet	0	164	0	2.5			4	1			0	0
Speckle-faced PT	0	90	5331	3	87.8	5.0	4	1				0
Spot-Winged Ptlet	0	107	1212	2.5	100.0	3.2	4	2				0
White-necked PK	0	158	0	4.5			5	3			0	0

Iquitos, Peru	Parrots on Market	Distance of Range From Market	Range Within 50-Mile Buffer	How Common	% Rainforest	% Parks	Beauty	Threat Status	Access to Nest	Peru $$	N of Other Markets	On Market
Canary-winged PK	64	0	5064	4	NA	17.6	5	1	2	15.5	NA	NA
Cobalt-winged PK	17	0	7794	4		7.2	4	1		12.0		
Short-tailed PT	7	0	7222	4		14.8	4	1		53.3		
Tui PK	7	0	5245	4		10.8	4	1	2	35.5		
Orange-winged Parrot	6	0	7774	3.5		9	5	1	3	100.0		
White-eyed PK	1	0	7794	4		7.5	5	1	4	38.8		
Amazonian Ptlet	0	281	0	3.5			4	2	3			
Andean PK	0	320	0	3.5			4	1	1			
Barred PK	0	309	0	2.5			4	1	3			
Black capped PK	0	293	0	3.5			4	1				
Black-headed PT	0	20	2228	4		7.6	4	1	3	50.0		
Blue headed MC	0	248	0	3.5			6	3	3			
Blue-and-yellow MC	0	0	7794	4		7.2	7	1	3	370.0		
Blue-fronted Ptlet	0	364	0	2.5			4	1	2			
Blue-headed PT	0	0	7794	5		7.2	4	1	3	57.5		
Blue-winged Ptlet	0	0	7794	4		7.8	4	1	2			
Bronze-Winged PT	0	370	0	3			5	1	3			
Brown-throated PK	0	397	0	4.5			5	1	2			
Chestnut-fronted MC	0	0	7794	4		7.2	7	1	3			
Dusky-billed Ptlet	0	0	7794	3		7.2	4	1	3	21.7		
Dusky-headed PK	0	0	7794	5		7.2	6	1	2	86.7		
Festive PT	0	0	5750	4		14.8	5	1		100.0		
Golden-Plumed PK	0	300	0	3			5	3	3			
Gray-cheeked PK	0	368	0	4			5	4	2	35.0		

Kawalls PT	0	264	0	NA		5	1	3	
Maroon-tailed PK	0	2	4062	3	10.6	5	1		
Mealy PT	0	0	7794	4	7.2	6	1	3	143.3
Military Macaw	0	267	0	4		7	3	4	400.0
Mountain PK	0	354	0	4		4	1	4	
Orange-cheeked PT	0	0	7794	4	7.2	5	1		70.0
Pacific Ptlet	0	325	0	5		4	1	2	20.3
Painted PK	0	0	6171	3	10.9	4	1	3	23.3
Red bellied MC	0	0	7794	5	7.2	6	1	3	70.0
Red Lored PT	0	360	0	2		6	1	3	
Red-and-green MC	0	0	7794	4	7.2	7	1	4	151.7
Red-Billed PT	0	283	0	3.5		4	1	3	30.0
Red-Faced PT	0	317	0	2.5		5	3	3	
Red-Fan PT	0	192	0	2		6	1	3	
Red-masked PK	0	393	0	4		5	2	2	32.5
Rose Faced PT	0	368	0	3		5	1		
Saphire Rumped Ptlet	0	0	7771	2.5	9	5	1	2	
Scaly-naped PT	0	265	0	4		4	1	4	50.0
Scarlet MC	0	0	7794	3	7.2	7	1	3	142.5
Scarlet-fronted PK	0	287	0	4		5	1	3.5	120.0
Scarlet-shouldered Ptlet	0	205	0	2.5		4	1		
Speckle-faced PT	0	281	0	3		4	1		
Spot-Winged Ptlet	0	238	0	2.5		4	2		
White-bellied PT	0	0	3449	4	0	4	1	3	15.0
White-necked PK	0	299	0	4.5		5	3		
Yellow-crowned PT	0	0	7794	3.5	7.2	5	1	2	90.0
Yellow-faced Ptlet	0	352	0	4		4	3	2	9.0

Lima, Peru	Parrots on Market	Distance of Range From Market	Range Within 100-Mile Buffer	How Common	% Rainforest	% Parks	Beauty	Threat Status	Access to Nest	Peru $$	N of Other Markets*	On Market*
Canary-winged PK	129	209	0	4			5	1	2	15.5	5	1
Pacific Ptlet	91	274	0	5			4	1	2	20.3	2	1
Red-masked PK	36	368	0	4			5	2	2	32.5	2	1
Mountain PK	26	0	15124	4	8.4	5.4	4	1	4			1
Blue-headed PT	17	159	0	5			4	1	3	57.5	4	1
Dusky-headed PK	4	170	0	5			6	1	2	86.7	3	1
White-eyed PK	4	155	0	4			5	1	4	38.8	5	1
Gray-cheeked PK	3	546	0	4			5	4	2	35.0	3	1
Mitred PK	2	67	2622	5	55.4	4.5	5	1	4	53.8		1
Painted PK	2	150	0	3			4	1	3	23.3	2	1
Scarlet-fronted PK	2	19	3903	4	0.0	0.7	5	1	3.5	120.0		1
Festive PT	1	265	0	4			5	1		100.0	3	1
Amazonian Ptlet	0	215	0	3.5			4	2	3		0	0
Andean PK	0	77	1565	3.5	65.6	2.4	4	1	1			0
Barred PK	0	130	0	2.5	79.2	0.0	4	1	3			0
Black capped PK	0	98	2	3.5	96.2	10.2	4	1				0
Black-headed PT	0	207	0	4			4	1	3	50.0	2	0
Black-winged PT	0	104	0	3	79.7	2.2	3	1				0
Blue headed MC	0	145	0	3.5	100.0	60.5	6	3	3			0
Blue-and-yellow MC	0	173	0	4			7	1	3	370.0	4	0
Blue-winged Ptlet	0	141	0	4	100.0	34.4	4	1	2			0
Chestnut-fronted MC	0	112	0	4	95.4	9.7	7	1	3			0
Cobalt-winged PK	0	138	0	4	100.0	28.4	4	1		12.0		0
Dusky-billed Ptlet	0	268	0	3			4	1	3	21.7	2	0

Golden-Plumed PK	0	111	0	3	88.5	3.5	5	3	3			0
Maroon-tailed PK	0	168	0	3			5	1			0	0
Mealy PT	0	167	0	4			6	1	3	143.3	3	0
Military Macaw	0	116	0	4	95.7	11.7	7	3	4	400.0		0
Orange-cheeked PT	0	182	0	4			5	1		70.0	0	0
Orange-winged Parrot	0	240	0	3.5			5	1	3	100.0	3	0
Red bellied MC	0	239	0	5			6	1	3	70.0	1	0
Red-and-green MC	0	170	0	4			7	1	4	151.7	2	0
Red-Billed PT	0	264	0	3.5			4	1	3	30.0	1	0
Scaly-naped PT	0	89	482	4	74.5	2.0	4	1	4	50.0		0
Scarlet MC	0	186	0	3			7	1	3	142.5	2	0
Scarlet-shouldered Ptlet	0	137	0	2.5	100.0	33.9	4	1				0
Short-tailed PT	0	275	0	4			4	1		53.3	2	0
Speckle-faced PT	0	84	754	3	68.9	0.0	4	1				0
Spot-Winged Ptlet	0	387	0	2.5			4	2			0	0
Tui PK	0	226	0	4			4	1	2	35.5	4	0
White-bellied PT	0	256	0	4			4	1	3	15.0	3	0
Yellow-crowned PT	0	186	0	3.5			5	1	2	90.0	4	0
Yellow-faced Ptlet	0	253	0	4			4	3	2	9.0	1	0

Pucallpa, Peru	**Parrots on Market**	**Distance of Range From Market**	**Range Within 50-Mile Buffer**	**How Common**	**% Rainforest**	**% Parks**	**Beauty**	**Threat Status**	**Access to Nest**	**Peru $$**	**N of Other Markets***	**On Market***
Canary-winged PK	537	0	5323	4	100.0	6.5	5	1	2	15.5		1
Cobalt-winged PK	175	0	7839	4	100.0	11.0	4	1		12.0		1
Gray-cheeked PK	125	426	0	4			5	4	2	35.0	3	1
Tui PK	99	0	7205	4	100.0	1.0	4	1	2	35.5		1
Orange-winged Parrot	29	0	4999	3.5	100.0	13.4	5	1	3	100.0		1
Mealy PT	23	0	7839	4	100.0	9.5	6	1	3	143.3		1
Festive PT	18	0	3930	4	100.0	1.1	5	1		100.0		1
Dusky-headed PK	14	0	7839	5	100.0	7.1	6	1	2	86.7		1
Mitred PK	13	134	0	5	91.1	0.0	5	1	4	53.8		1
Yellow-crowned PT	11	0	7600	3.5	100.0	4.2	5	1	2	90.0		1
Blue-headed PT	7	0	7839	5	100.0	10.1	4	1	3	57.5		1
Painted PK	5	0	7839	3	100.0	10.2	4	1	3	23.3		1
Blue-and-yellow MC	4	0	7839	4	100.0	10.1	7	1	3	370.0		1
Red-and-green MC	4	0	7839	4	100.0	7.7	7	1	4	151.7		1
White-eyed PK	4	0	7839	4	100.0	10.3	5	1	4	38.8		1
Black-headed PT	3	0	4284	4	100.0	13.5	4	1	3	50.0		1
Red-Billed PT	3	215	0	3.5			4	1	3	30.0	0	1
Chestnut-fronted MC	2	0	7839	4	100.0	11.0	7	1	3			1
Red bellied MC	1	0	5450	5	100.0	1.8	6	1	3	70.0		1
Scarlet MC	1	0	7839	3	100.0	4.1	7	1	3	142.5		1
Amazonian Ptlet	0	1	2868	3.5	100.0	0.0	4	2	3			0
Andean PK	0	127	0	3.5	60.5	0.0	4	1	1			0
Barred PK	0	137	0	2.5	83.8	0.0	4	1	3			0
Black capped PK	0	23	1446	3.5	100.0	11.6	4	1				0

Black-winged PT	0	115	0	3	83.6	0.0	3	1				0
Blue headed MC	0	0	7839	3.5	100.0	13.0	6	3	3			0
Blue-winged Ptlet	0	0	7839	4	100.0	10.8	4	1	2			0
Dusky-billed Ptlet	0	28	1416	3	100.0	0.3	4	1	3	21.7		0
Golden-Plumed PK	0	112	0	3	85.6	0.0	5	3	3			0
Kawalls PT	0	313	0	NA			5	1	3		0	0
Maroon-tailed PK	0	0	4458	3	100.0	21.3	5	1				0
Military Macaw	0	92	0	4	97.6	8.3	7	3	4	400.0		0
Mountain PK	0	133	0	4	52.3	0.0	4	1	4			0
Orange-cheeked PT	0	0	7287	4	100.0	4.2	5	1		70.0		0
Pacific Ptlet	0	231	0	5			4	1	2	20.3	3	0
Red-Faced PT	0	350	0	2.5			5	3	3		0	0
Red-Fan PT	0	385	0	2			6	1	3		0	0
Red-masked PK	0	283	0	4			5	2	2	32.5	3	0
Saphire Rumped Ptlet	0	195	0	2.5			5	1	2		0	0
Scaly-naped PT	0	112	0	4	79.6	0.0	4	1	4	50.0		0
Scarlet-fronted PK	0	167	0	4			5	1	3.5	120.0	3	0
Scarlet-shouldered Ptlet	0	0	7839	2.5	100.0	15.1	4	1				0
Short-tailed PT	0	0	2802	4	100.0	1.0	4	1		53.3		0
Speckle-faced PT	0	126	0	3	79.4	0.0	4	1				0
Spot-Winged Ptlet	0	192	0	2.5			4	2			0	0
White-bellied PT	0	60	0	4	100.0	0.0	4	1	3	15.0		0
White-necked PK	0	363	0	4.5			5	3			0	0
Yellow-faced Ptlet	0	170	0	4			4	3	2	9.0	1	0

Puno, Peru	**Parrots on Market**	**Distance of Range From Market**	**Range Within 150-Mile Buffer**	**How Common**	**% Rainforest**	**% Parks**	**Beauty**	**Threat Status**	**Access to Nest**	**Peru $$**	**N of Other Markets***	**On Market***
Canary-winged PK	57	485	0	4			5	1	2	15.5	5	1
Mitred PK	51	60	9946	5	40.0	16.0	5	1	4	53.8		1
Cobalt-winged PK	29	106	6121	4	100.0	67.4	4	1		12.0		1
Dusky-billed Ptlet	17	126	4194	3	96.6	65.2	4	1	3	21.7		1
Tui PK	16	164	0	4			4	1	2	35.5	3	1
Blue-headed PT	14	102	9795	5	94.7	45.1	4	1	3	57.5		1
Painted PK	4	82	12688	3	88.1	43.3	4	1	3	23.3		1
Short-tailed PT	4	537	0	4			4	1		53.3	1	1
Blue-and-yellow MC	3	120	5017	4	90.3	48.9	7	1	3	370.0		1
Scaly-naped PT	3	95	9001	4	85.7	23.8	4	1	4	50.0		1
White-eyed PK	2	102	8271	4	99.9	54.4	5	1	4	38.8		1
Yellow-crowned PT	1	207	0	3.5			5	1	2	90.0	3	1
Andean PK	0	40	16629	3.5	24.6	7.9	4	1	1			0
Blue-winged Ptlet	0	108	8152	4	95.6	51.0	4	1	2			0
Chestnut-fronted MC	0	109	7013	4	84.5	45.8	7	1	3			0
Dusky-headed PK	0	128	2945	5	100.0	93.9	6	1	2	86.7		0
Mealy PT	0	103	8096	4	97.5	53.0	6	1	3	143.3		0
Military Macaw	0	189	0	4			7	3	4	400.0	3	0
Monk PK	0	148	1	5		0.0	5	1	2	24.0		0
Mountain PK	0	0	48826	4	9.2	7.2	4	1	4			0
Orange-cheeked PT	0	89	7509	4	75.5	35.7	5	1		70.0		0
Orange-winged Parrot	0	225	0	3.5			5	1	3	100.0	3	0
Red bellied MC	0	98	7264	5	90.1	50.4	6	1	3	70.0		0
Red-and-green MC	0	89	13111	4	82.6	39.5	7	1	4	151.7		0

Red-Billed PT	0	140	49	3.5	100.0	0.0	4	1	3	30.0		0
Scarlet MC	0	132	2683	3	100.0	93.0	7	1	3	142.5		0
Scarlet-fronted PK	0	74	4983	4	0.0	0.7	5	1	3.5	120.0		0
White-bellied PT	0	130	1586	4	100.0	83.4	4	1	3	15.0		0
Amazonian Ptlet	0	149	559	3.5	100.0	95.5	4	2	3			0
Barred PK	0	296	0	2.5			4	1	3		0	0
Black capped PK	0	118	4784	3.5	100.0	66.5	4	1				0
Black-winged PT	0	91	1558	3	87.8	2.2	3	1				0
Blue headed MC	0	135	1998	3.5	100.0	92.9	6	3	3			0
Blue-crowned PK	0	327	0	5			5	1	4		0	0
Blue-fronted PT	0	120	1760	5	100.0	28.1	6	1	3			0
Blue-throated MC	0	274	0	5			6	5	3		0	0
Crimson bellied PK	0	369	0	5			6	1	3		0	0
Golden-collared MC	0	166	0	5			7	1	3		0	0
Golden-Plumed PK	0	180	0	3			5	3	3		0	0
Gray-hooded PK	0	107	2298	5	71.1	10.4	4	1	1			0
Green-cheeked PK	0	111	4365	5	100.0	61.0	6	1	3			0
Maroon-tailed PK	0	386	0	3			5	1			0	0
Peach-fronted PK	0	128	1362	4	100.0	83.3	6	1	2			0
Red-Fronted MC	0	348	0	5			7	4	4		0	0
Red-shouldered MC	0	156	0	3			6	1	2		0	0
Scaly-headed PT	0	103	4334	5	88.4	24.0	4	1	3			0
Scarlet-shouldered Ptlet	0	138	1348	2.5	100.0	87.2	4	1				0
Speckle-faced PT	0	77	1968	3	61.4	13.0	4	1				0
Tucuman PT	0	376	0	5			5	2	3		0	0
Yellow-chevroned PK	0	148	1	5			5	1	2		0	0

All 7 Markets	N of Markets	Range Within 150-Mile Buffer	How Common	% Rainforest	Beauty	IUCN Threat Status	Access to Nest	Peru and Bol Average $$	Crop Pest
Canary-winged PK	6	35955	4	100.0	5	1	2	5.6	
White-eyed PK	6	201683	4	89.6	5	1	4	10.8	
Blue-headed PT	5	163752	5	99.0	4	1	3	14.5	
Cobalt-winged PK	5	160771	4	99.4	4	1		3.6	
Dusky-headed PK	5	136814	5	99.5	6	1	2	17.1	In Bol
Gray-cheeked PK	5	0	4	100.0	5	4	2	12.7	In Peru
Mitred PK	5	40640	5	73.0	5	1	4	11.9	
Blue-and-yellow MC	4	168936	4	99.0	7	1	3	94.0	
Mealy PT	4	150069	4	99.4	6	1	3	43.6	
Orange-winged Parrot	4	112435	3.5	99.5	5	1	3	29.0	Both
Yellow-crowned PT	4	130601	3.5	99.5	5	1	2	31.4	
Festive PT	3	32257	4	100.0	5	1		36.2	
Pacific Ptlet	3	20297	5	70.1	4	1	2	7.4	
Painted PK	3	114649	3	98.7	4	1	3	8.5	
Red-and-green MC	3	171803	4	97.0	7	1	4	65.9	
Red-masked PK	3	9714	4	95.3	5	2	2	11.8	
Scarlet MC	3	151851	3	99.0	7	1	3	89.3	
Tui PK	3	78147	4	100.0	4	1	2	12.9	
Black-headed PT	2	52315	4	100.0	4	1	3	18.1	
Blue-winged Ptlet	2	142831	4	99.0	4	1	2	1.7	In Bol
Chestnut-fronted MC	2	162257	4	98.2	7	1	3	18.6	
Military Macaw	2	34058	4	98.6	7	3	4	144.9	
Monk PK	2	22162	5	46.8	5	1	2	5.5	In Bol

Scaly-naped PT	2	33492	4	84.7	4	1	4	18.1	
Scarlet-fronted PK	2	33691	4	38.8	5	1	3.5	43.5	
Short-tailed PT	2	35420	4	100.0	4	1		19.3	
White-bellied PT	2	57086	4	97.5	4	1	3	37.3	
Yellow-faced Ptlet	2	1146	4	89.5	4	3	2	3.3	
Andean PK	1	36763	3.5	63.3	4	1	1		
Black hooded PK	1	0	4		6	1	2		
Blue-crowned PK	1	53781	5	62.2	5	1	4	4.7	
Blue-fronted PT	1	63503	5	67.4	6	1	3	17.1	
Blue-throated MC	1	0	5		6	5	3		
Bronze-Winged PT	1	0	3		5	1	3	64.9	
Dusky-billed Ptlet	1	119329	3	99.5	4	1	3	7.9	
Golden-collared MC	1	45995	5	64.4	7	1	3	12.2	
Green-cheeked PK	1	66533	5	73.5	6	1	3	1.6	
Hyacinth MC	1	0	5		6	4	3		
Lears MC	1	0	2		6	5	4		
Mountain PK	1	127266	4	19.4	4	1	4		
Orange-cheeked PT	1	123227	4	98.9	5	1		25.4	
Peach-fronted PK	1	52940	4	63.0	6	1	2	6.1	
Red bellied MC	1	116982	5	99.5	6	1	3	25.4	
Red-Billed PT	1	9262	3.5	98.9	4	1	3	10.9	
Red-Fronted MC	1	3515	5	99.2	7	4	4	76.8	In Bol
Red-shouldered MC	1	8112	3	96.6	6	1	2	7.2	
Scaly-headed PT	1	60799	5	66.0	4	1	3	6.4	
Tucuman PT	1	3256	5	100.0	5	2	3	23.4	
Yellow-chevroned PK	1	58313	5	67.2	5	1	2	2.8	In Bol
Yellow-faced PT	1	0	4.5		4	2	2	40.4	
Amazonian Ptlet	0	10444	3.5	100.0	4	2	3		
Barred PK	0	1288	2.5	85.5	4	1	3		
Black capped PK	0	30607	3.5	99.8	4	1			
Black-winged PT	0	7139	3	93.0	3	1			

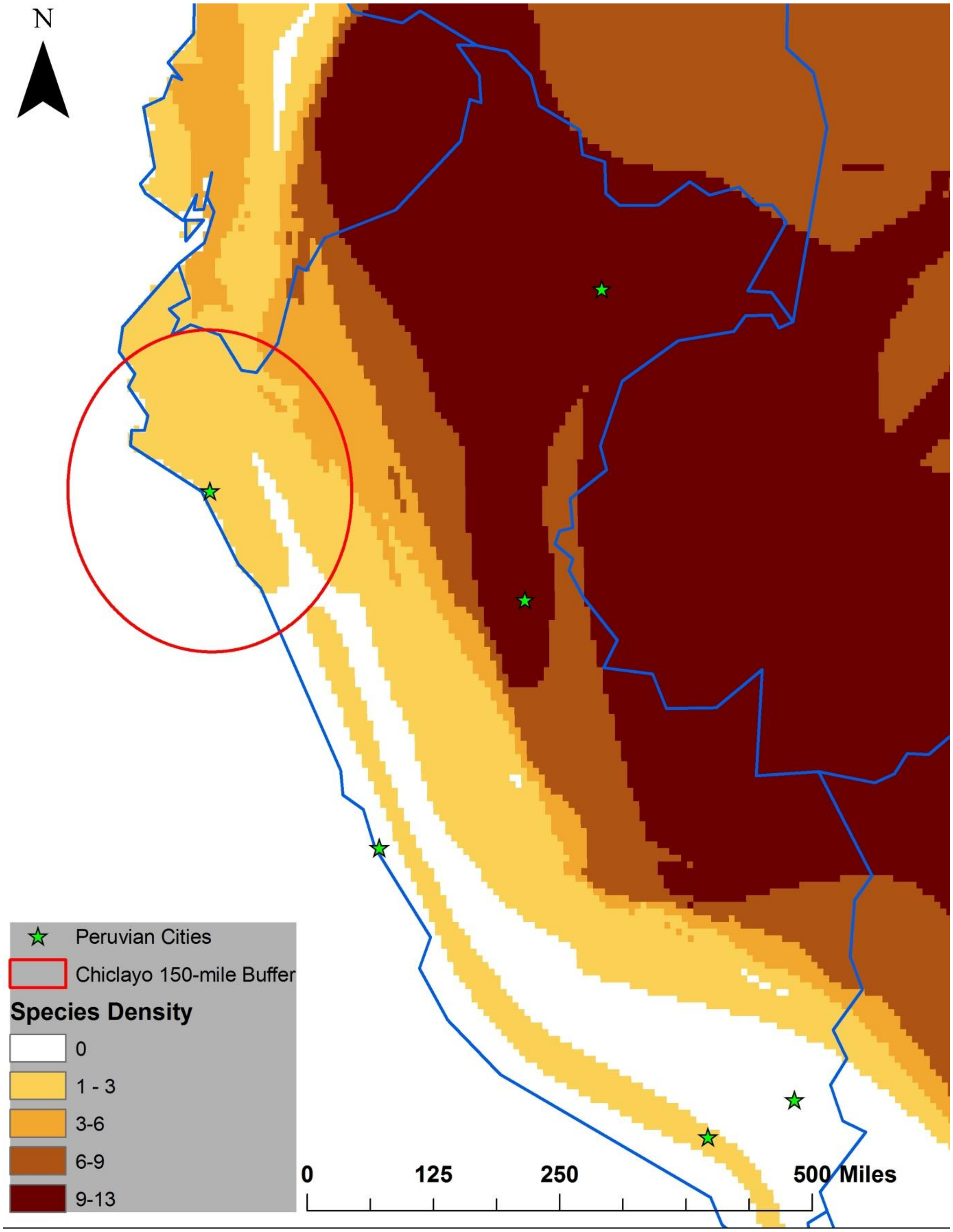
Blaze-Winged PK	0	0	5		6	2	3
Blue headed MC	0	42905	3.5	99.9	6	3	3
Blue-Winged MC	0	0	3		5	2	3
Crimson bellied PK	0	0	5		6	1	3
Golden-Plumed PK	0	8779	3	92.3	5	3	3
Gray-hooded PK	0	17955	5	89.8	4	1	1
Maroon-tailed PK	0	75057	3	100.0	5	1	
Red-Faced PT	0	912	2.5	71.4	5	3	3
Red-Fan PT	0	0	2		6	1	3
Saphire Rumped Ptlet	0	54038	2.5	100.0	5	1	2
Scarlet-shouldered Ptlet	0	47625	2.5	100.0	4	1	
Speckle-faced PT	0	14444	3	83.0	4	1	
Spot-Winged Ptlet	0	1212	2.5	100.0	4	2	

Appendix III

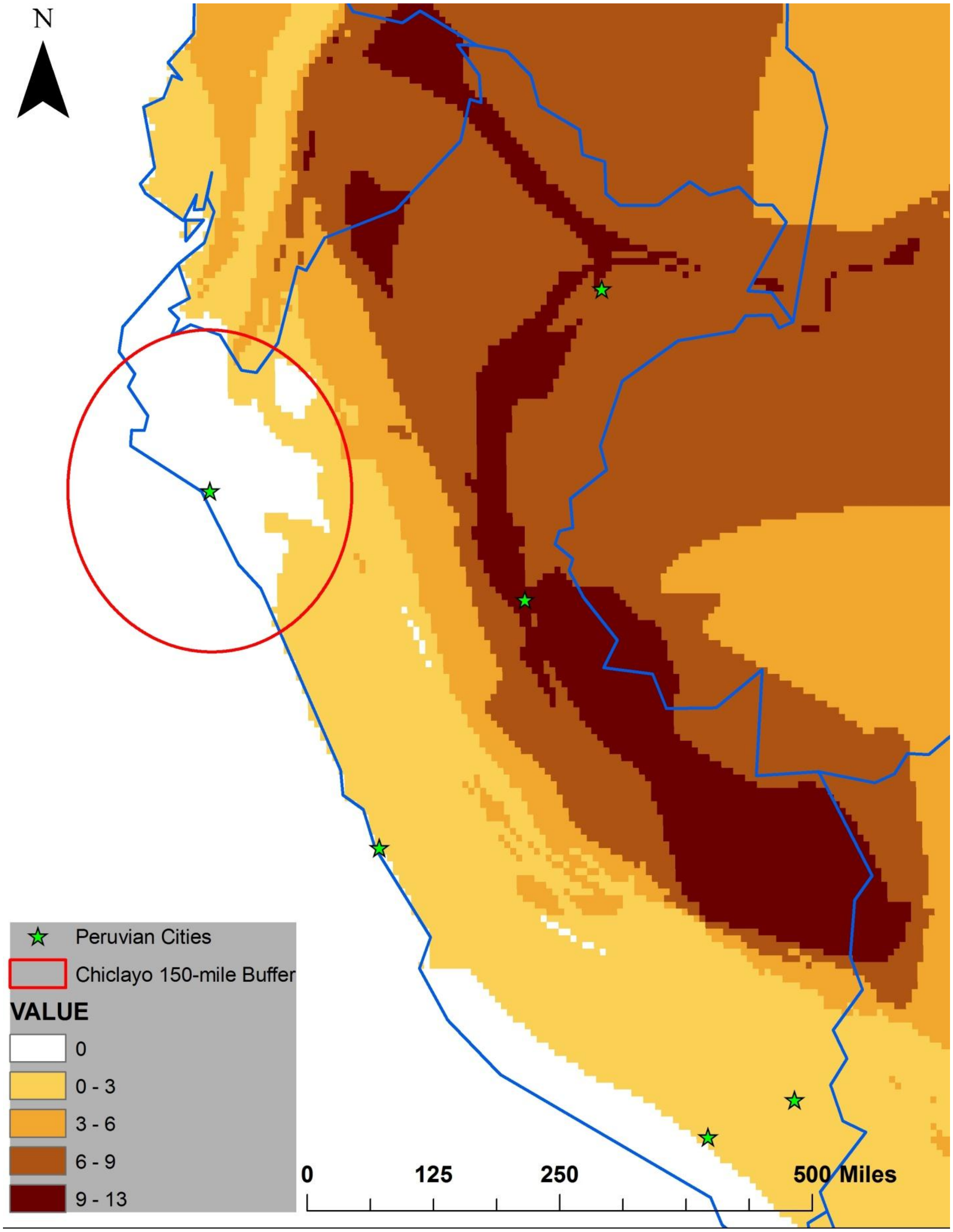
These are the necessary steps to create a raster map of parrot species' density.

1. For each species shapefile, click on "polygon to raster" within the ArcToolbox.
2. The "cell output" should be standard for all species at 0.10. This is small enough so it is not as pixilated, and not too small that it overloads the computer.
3. After creating a raster file for each species shapefile, one needs to "reclassify" each file so that the range of the parrot species equals "1", and any area outside that range equals "0".
4. Finally, use the "raster calculator" under the spatial analyst tab in order to add all shapefiles together to see a density map of north-western South America.

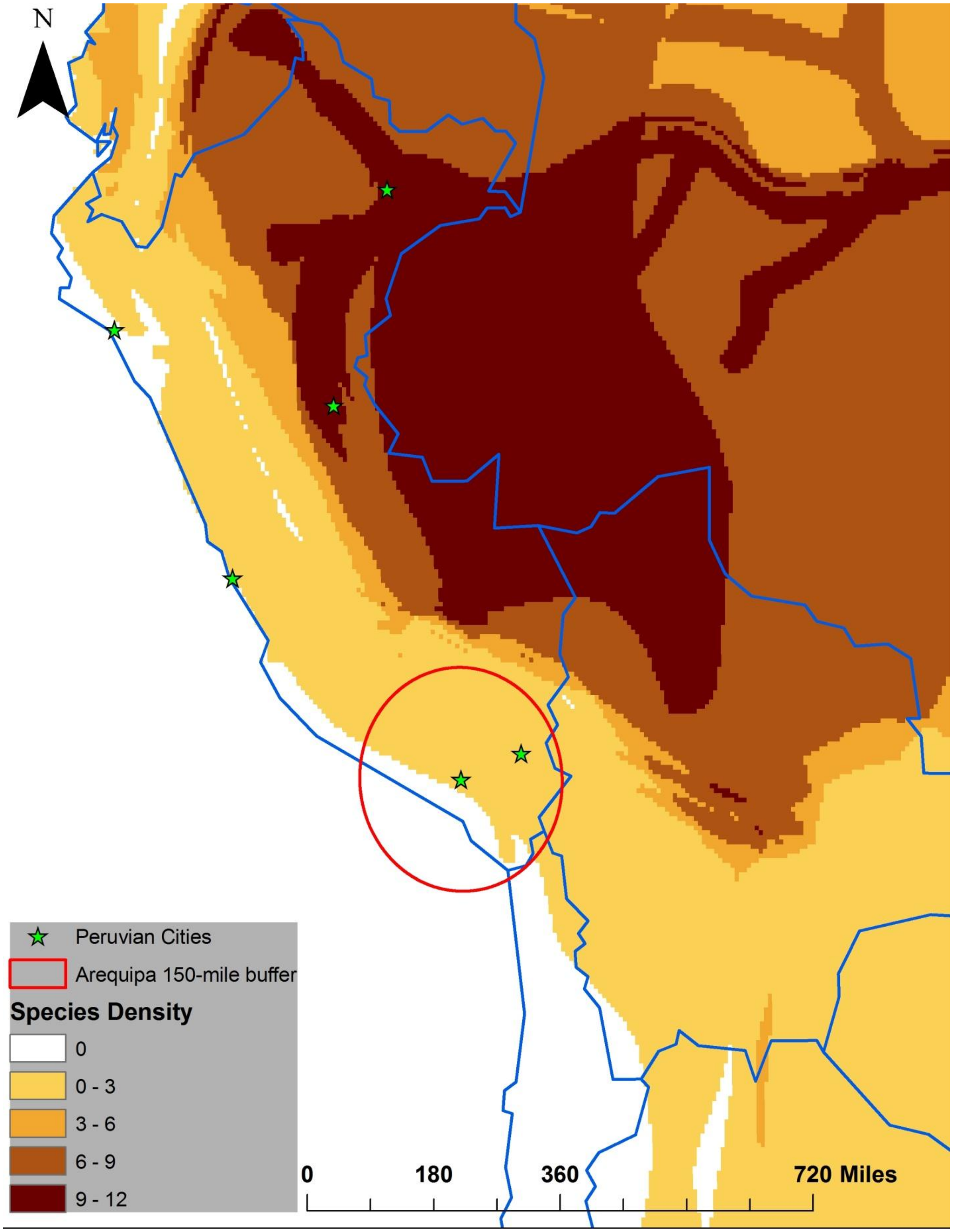
Appendix IV
Species Distribution on Chiclayo Market (N=21)



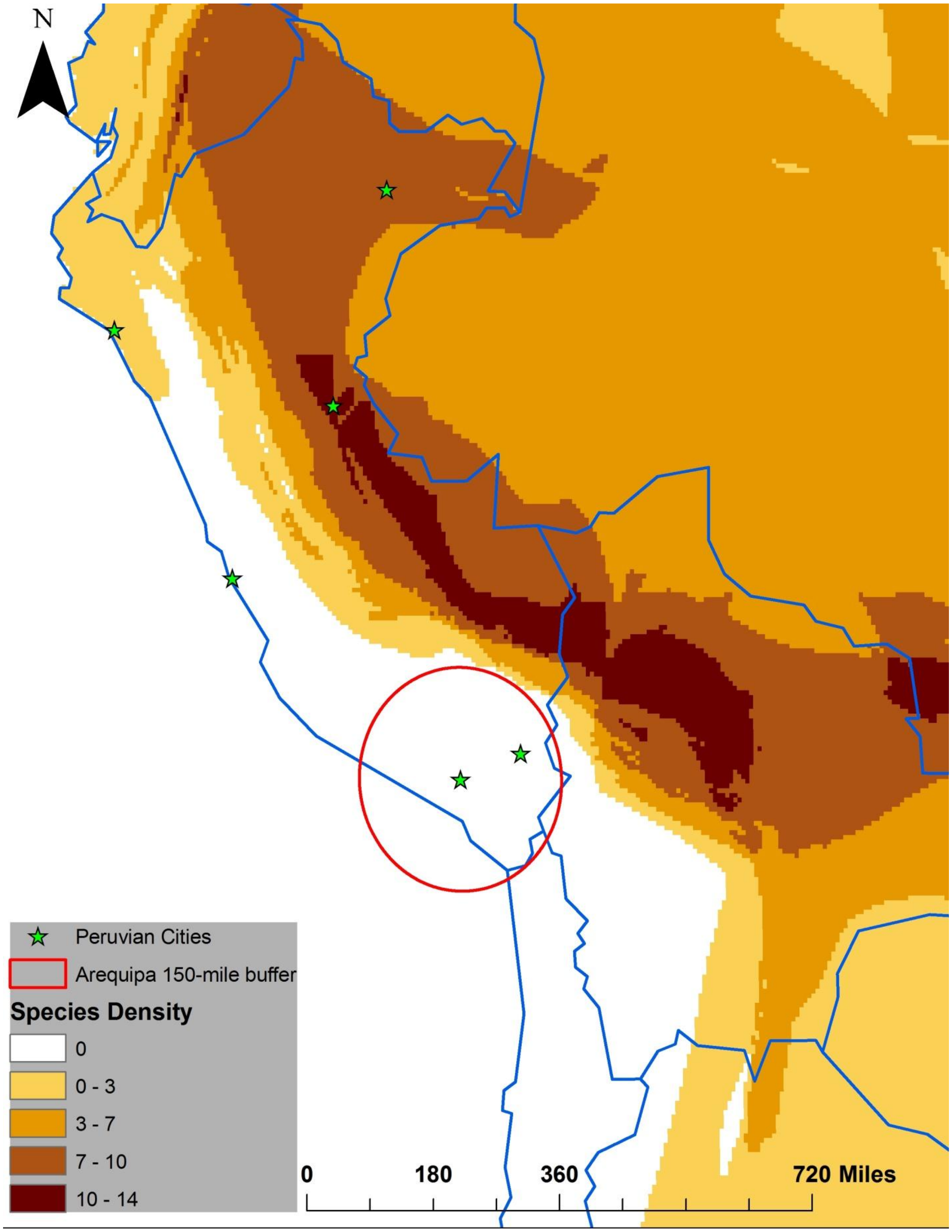
Species Distribution *Not* on Chiclayo Market (N=30)



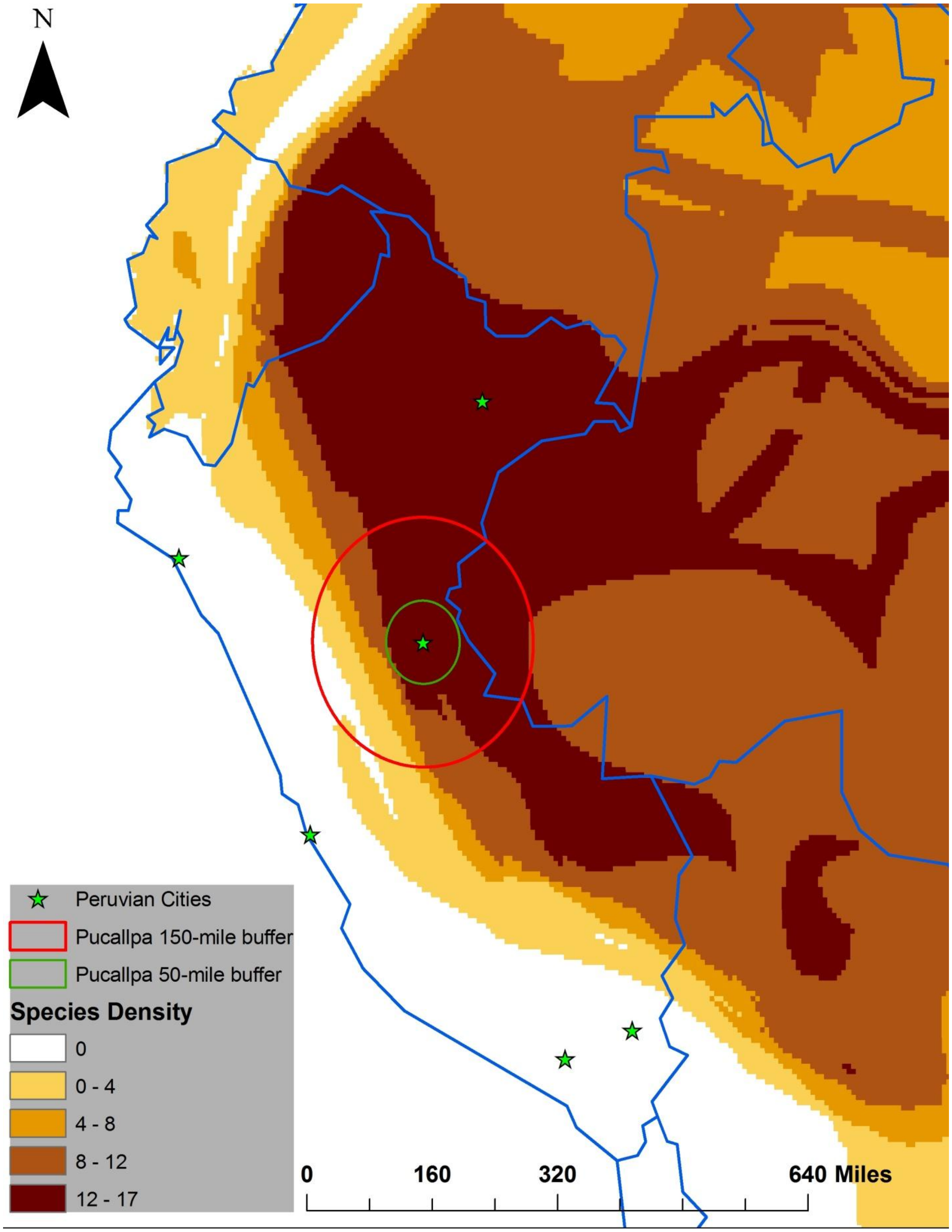
Species Distribution on Arequipa Market (N=21)



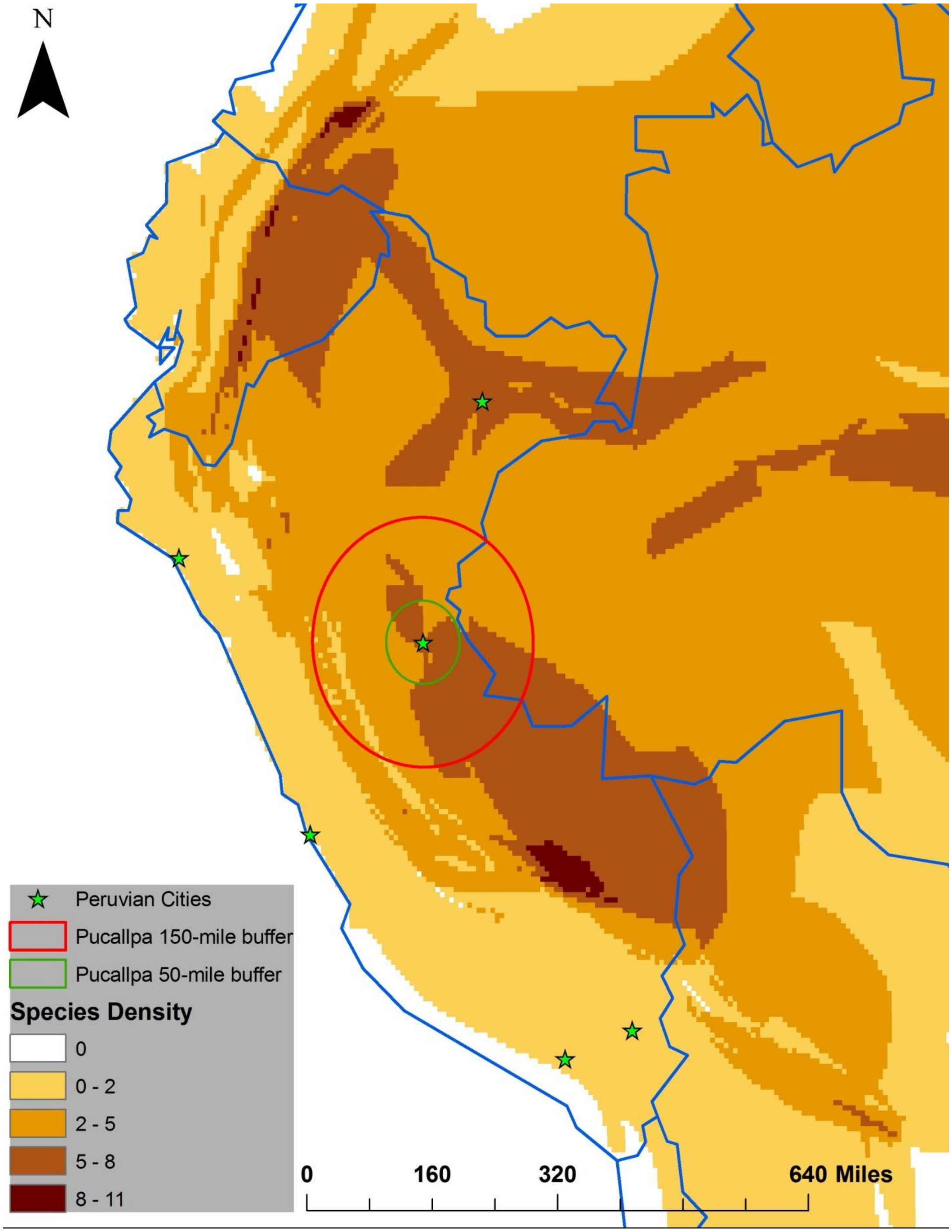
Species Distribution *Not* on Arequipa Market (N=29)



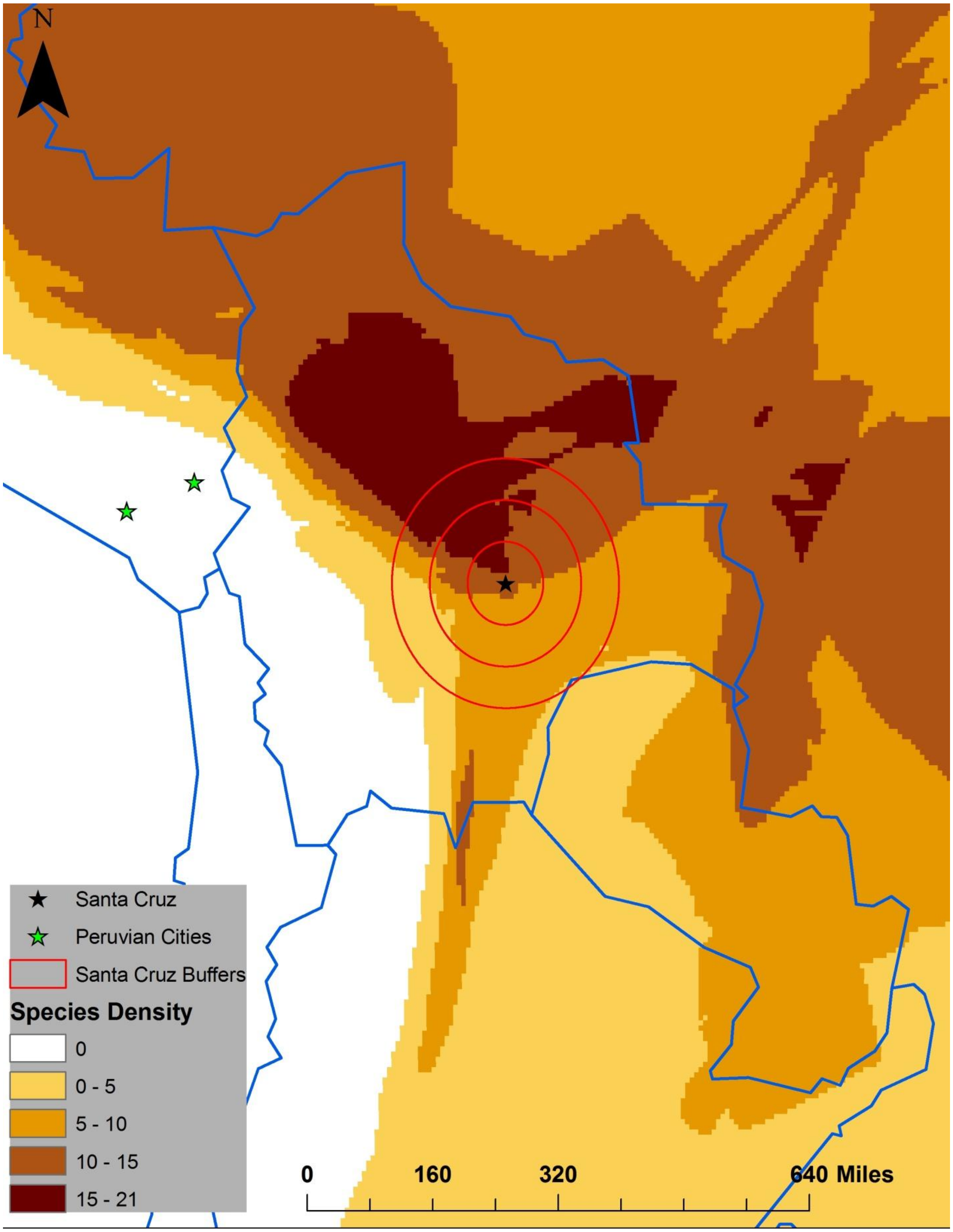
Species Distribution on Pucallpa Market (N=20)



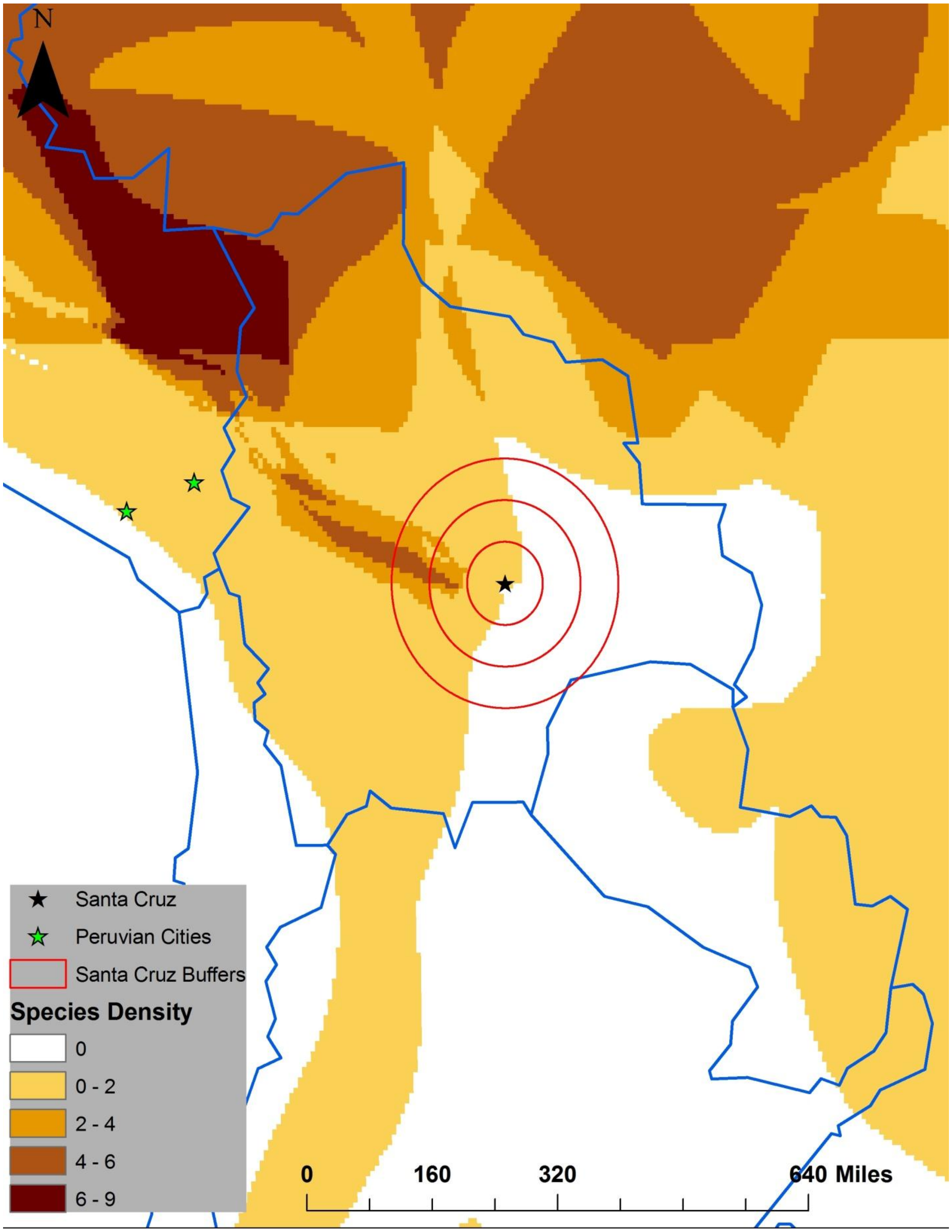
Species Distribution *NOT* on Pucallpa Market (N=28)



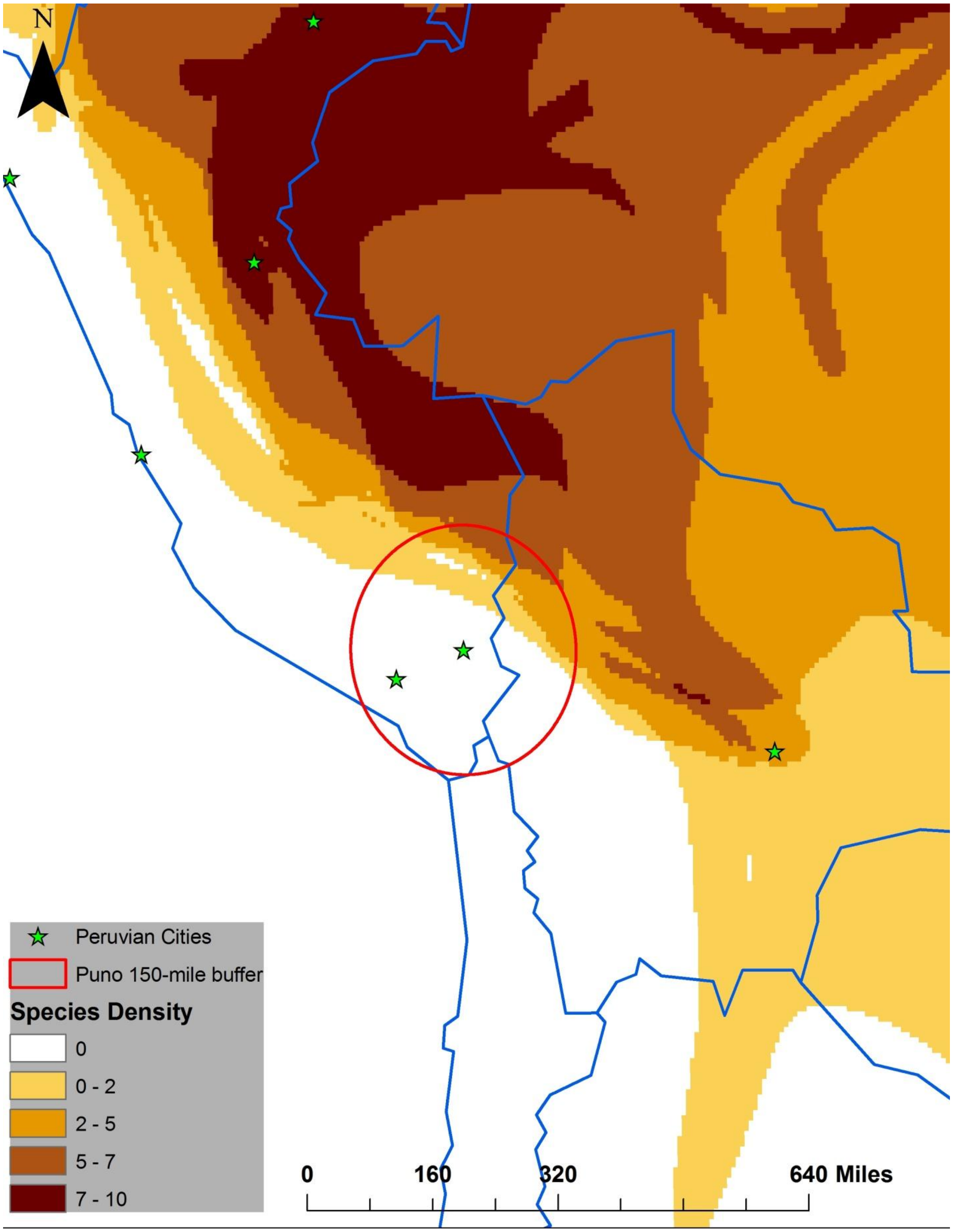
Species Distribution on Santa Cruz Market (N=35)



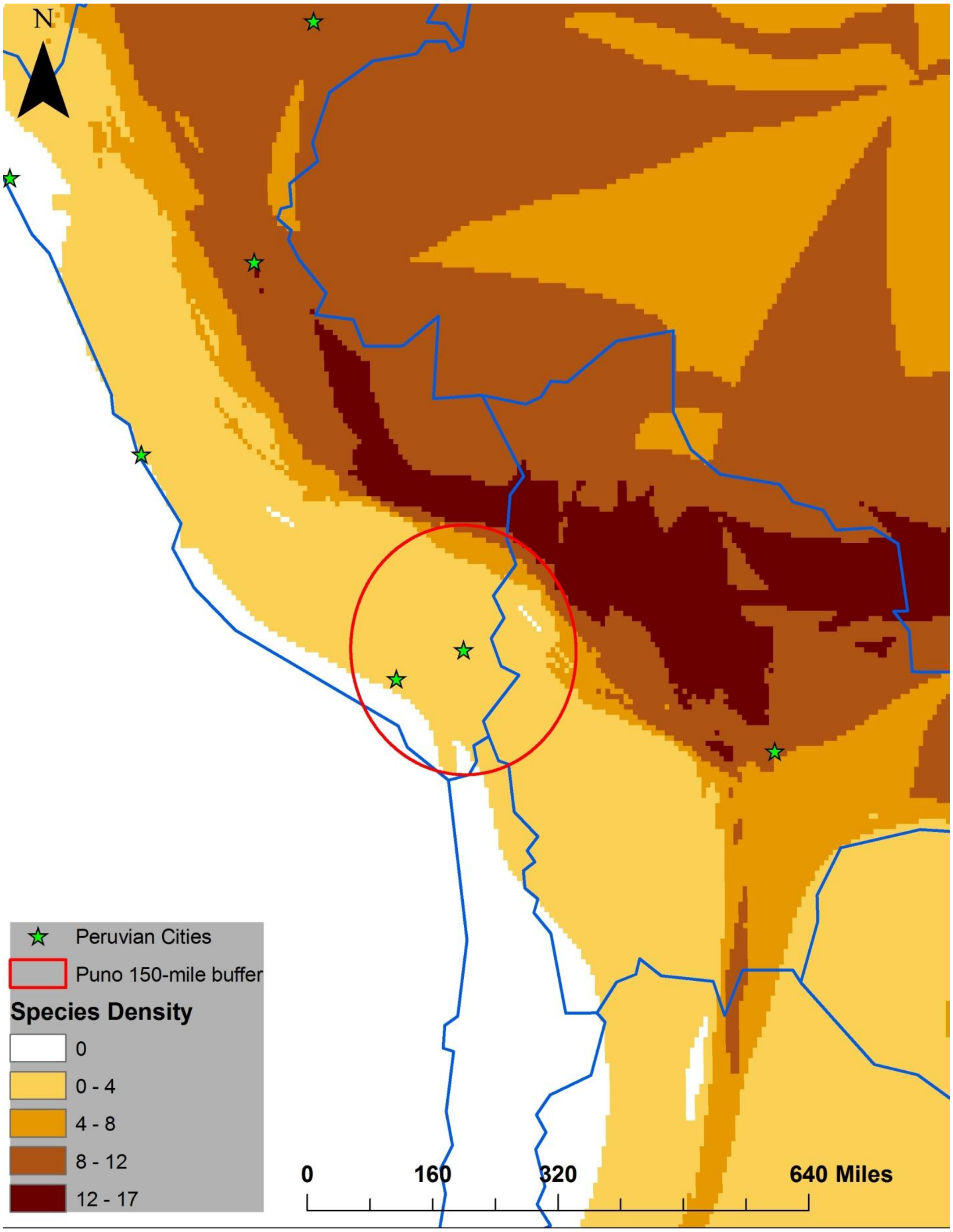
Species Distribution *NOT* on Santa Cruz Market (N=18)



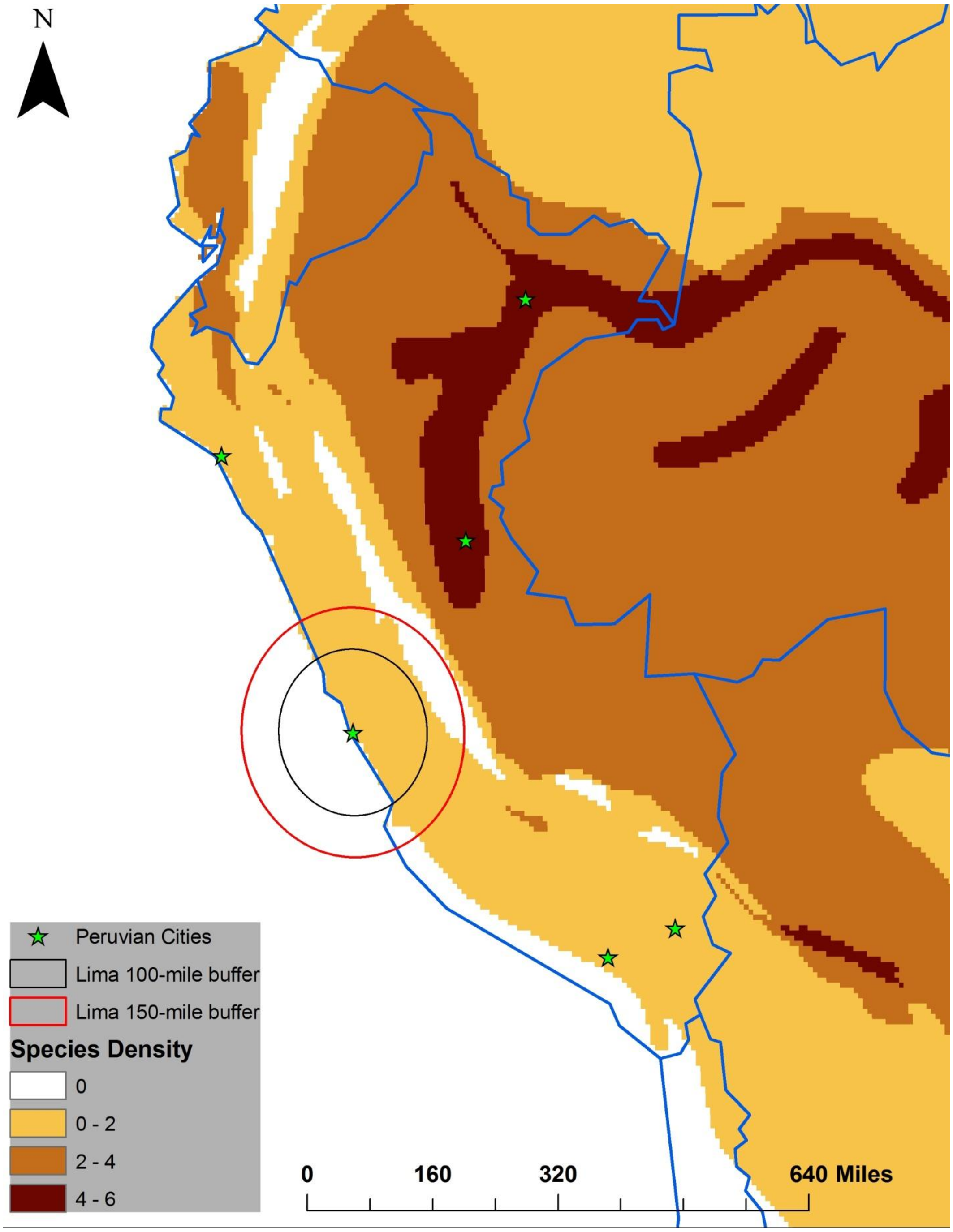
Species Distribution on Puno Market (N=12)



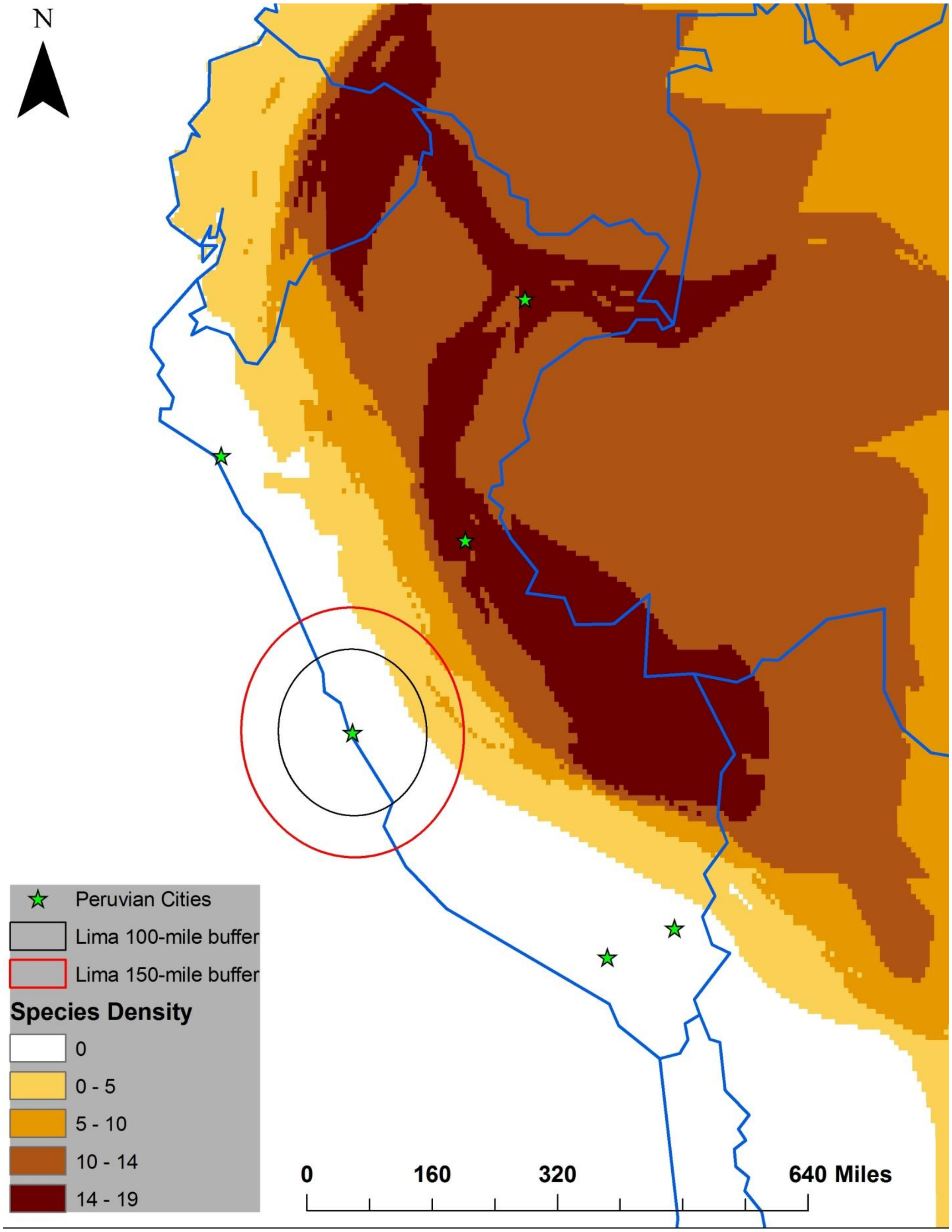
Species Distribution *NOT* on Puno Market (N=38)



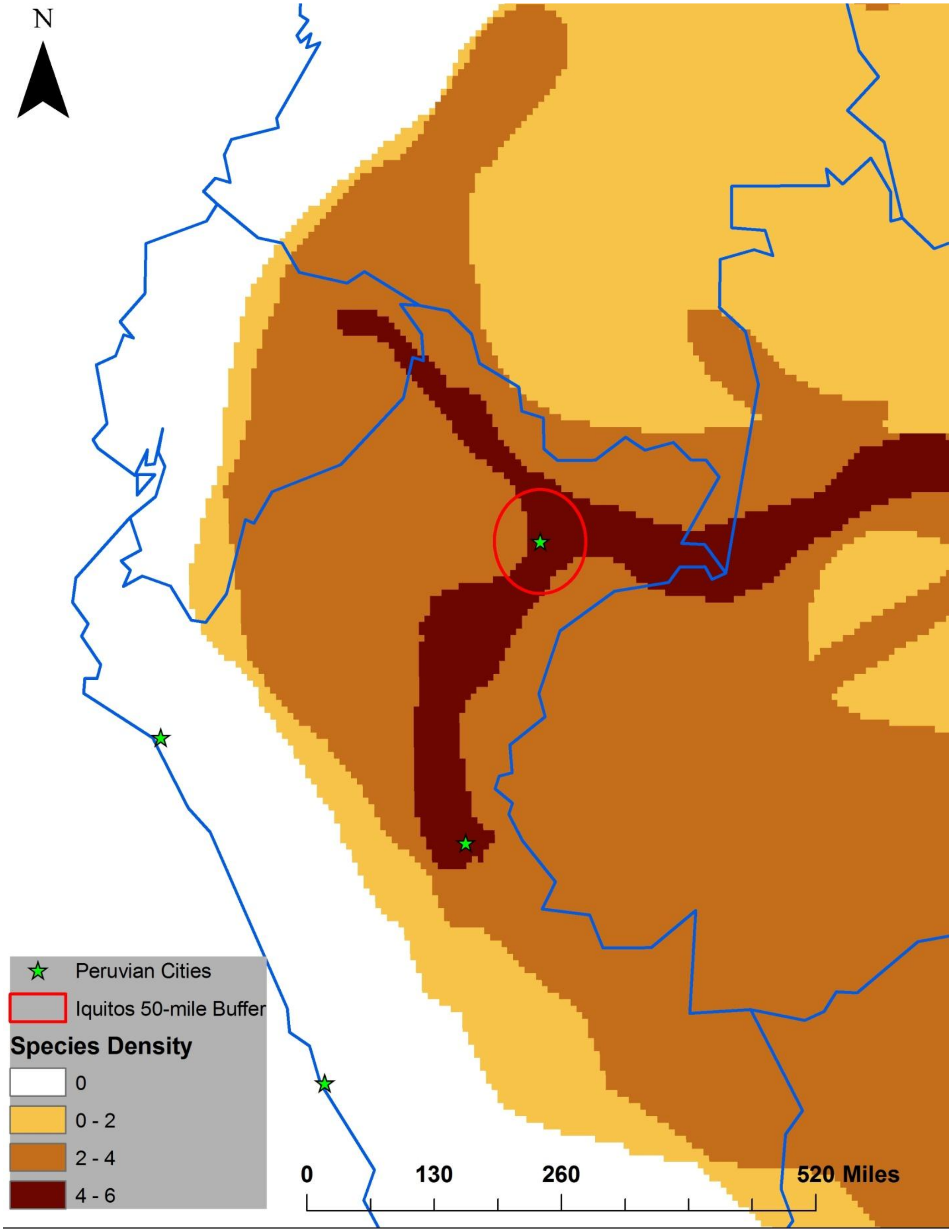
Species Distribution on Lima Market (N=12)



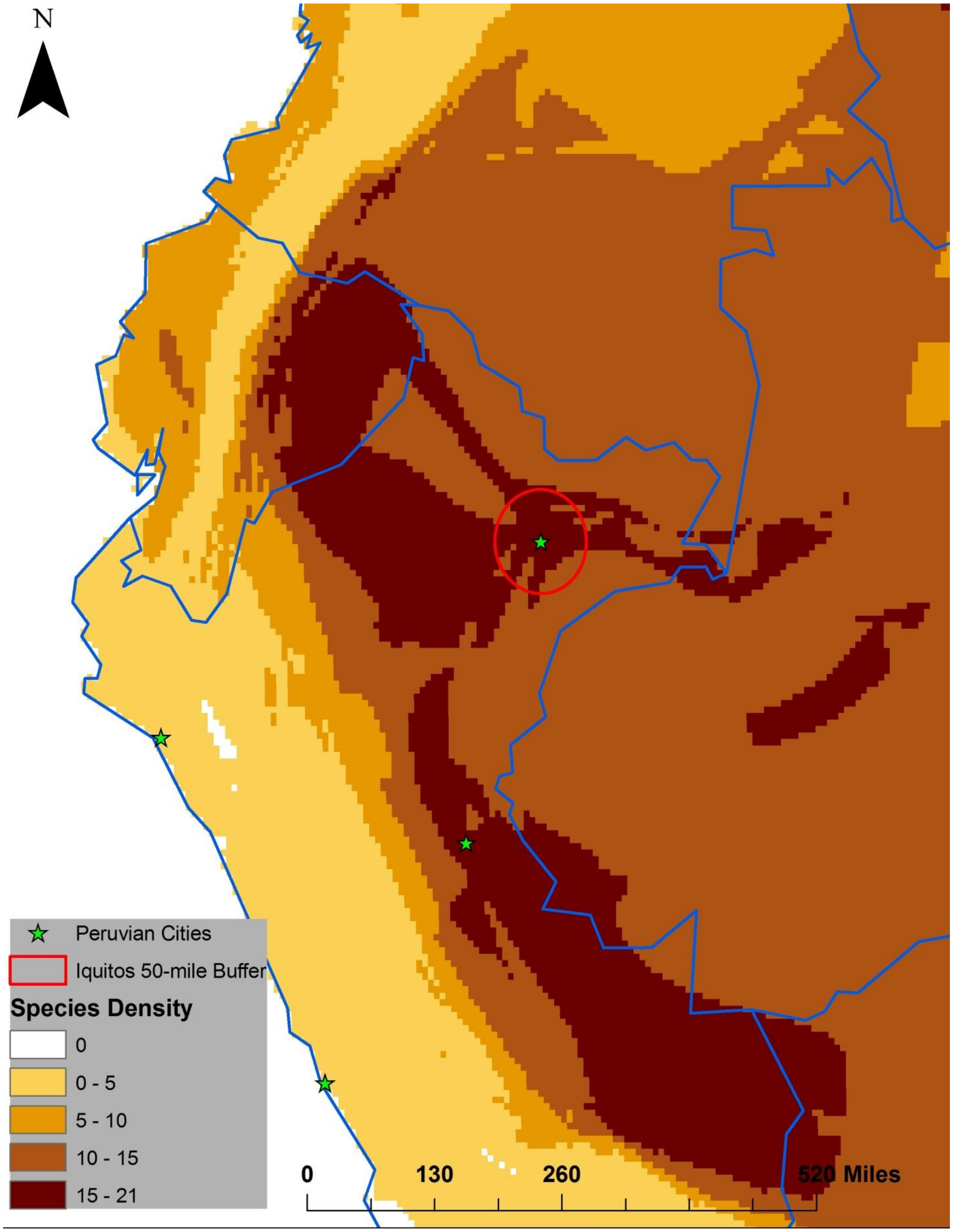
Species Distribution *NOT* on Lima Market (N=31)



Species Distribution on Iquitos Market (N=6)



Species Distribution *NOT* on Iquitos Market (N=45)



Appendix V

Protected Parks (N=125)	Designated Type	Country
Manuripi	Amazonian National Wildlife Reserve	Bolivia
Area 1 Madre de Dios	Area of Immobilization	Bolivia
Area 2 Madre de Dios	Area of Immobilization	Bolivia
Area 3 Madre de Dios	Area of Immobilization	Bolivia
Area 4 Madre de Dios	Area of Immobilization	Bolivia
Cordillera de Sama	Biological Reserve	Bolivia
Amarakaeri	Communal Reserve	Peru
Ashaninka	Communal Reserve	Peru
El Sira	Communal Reserve	Peru
Machiguenga	Communal Reserve	Peru
Purus	Communal Reserve	Peru
Yanesha	Communal Reserve	Peru
Cerro Tapilla	Fiscal Reserve	Bolivia
Bosque de Pomac	Historical Sanctuary	Peru
Chacamarca	Historical Sanctuary	Peru
Pampa de Ayacucho	Historical Sanctuary	Peru
El Angolo	Hunting Reserve	Peru
Sunchubamba	Hunting Reserve	Peru
Aguaragiue	Integrated Management National Natural Area	Bolivia
Altamachi	Integrated Management Natural Area	Bolivia
Amboro	Integrated Management Natural Area	Bolivia
Apolobamba	Integrated Management Natural Area	Bolivia
Cotapata	Integrated Management Natural Area	Bolivia
El Palmar	Integrated Management Natural Area	Bolivia
Madidi	Integrated Management Natural Area	Bolivia
Otuquis	Integrated Management Natural Area	Bolivia

San Matias	Integrated Management Natural Area	Bolivia
Nor Yauyos-Cochas	Landscape Reserve	Peru
Sub Cuenca del Cotahuasi	Landscape Reserve	Peru
Huallatani Pampa	Municipal Park	Bolivia
Huaripampa	Municipal Park	Bolivia
Lomas de Arena	Municipal Park	Bolivia
Tariquia	National Fauna and Flora Reserve	Bolivia
Santa Cruz la Vieja	National Historic Park	Bolivia
Alto Purus	National Park	Peru
Amboro	National Park	Bolivia
Bahuaja Sonene	National Park	Peru
Carrasco	National Park	Bolivia
Cerros de Amotape	National Park	Peru
Cordillera Azul	National Park	Peru
Cotapata	National Park	Bolivia
Cutervo	National Park	Peru
Isiboro Secure	National Park	Bolivia
Las Barrancas	National Park	Bolivia
Llica	National Park	Bolivia
Madidi	National Park	Bolivia
Mallasa	National Park	Bolivia
Mirikiri	National Park	Bolivia
Noel Kempff Mercado	National Park	Bolivia
Otishi	National Park	Peru
Otuquis	National Park	Bolivia
Sajama	National Park	Bolivia
Tingo Maria	National Park	Peru
Toro Toro	National Park	Bolivia

Tunari	National Park	Bolivia
Tuni Condoriri	National Park	Bolivia
Yanachaga-Chemillen	National Park	Peru
Yura	National Park	Bolivia
Inao	National Park and Integrated Management Natural Area	Bolivia
Kaa-iya del Gran Chaco	National Park and Integrated Management Natural Area	Bolivia
Allpahuayo Mishana	National Reserve	Peru
Calipuy	National Reserve	Peru
Junin	National Reserve	Peru
Lachay	National Reserve	Peru
Pacaya Samiria	National Reserve	Peru
Pampa Galeras Barbara D' Achille	National Reserve	Peru
Salinas y Aguada Blanca	National Reserve	Peru
Tambopata	National Reserve	Peru
Titicaca	National Reserve	Peru
Eduardo Avaroa	National Reserve for Andean Fauna	Bolivia
Incacasani Altamachi	National Reserve for Andean Fauna	Bolivia
Ampay	National Sanctuary	Peru
Calipuy	National Sanctuary	Peru
Huayllay	National Sanctuary	Peru
Lagunas de Mejia	National Sanctuary	Peru
Megantoni	National Sanctuary	Peru
Tabaconas Namballe	National Sanctuary	Peru
Bruno Racua	Natural Reserve of Immobilization	Bolivia
Altamachi	Park	Bolivia
Corvalan	Private Protected Area	Bolivia
A.B. Canal Nuevo Imperial	Protection Forest	Peru
Alto Mayo	Protection Forest	Peru

Pagaibamba	Protection Forest	Peru
Pui Pui	Protection Forest	Peru
Puquio Santa Rosa	Protection Forest	Peru
San Matias San Carlos	Protection Forest	Peru
Pedro Ignacio Muiba	Regional Park	Bolivia
Yacuma	Regional Park	Bolivia
Algarrobal El Moro	Reserved Zone	Peru
Aymara Lupaca	Reserved Zone	Peru
Chancaybanos	Reserved Zone	Peru
Cordillera de Colan	Reserved Zone	Peru
Cordillera Huayhuash	Reserved Zone	Peru
Gueppi	Reserved Zone	Peru
Laquipampa	Reserved Zone	Peru
Pampa Hermosa	Reserved Zone	Peru
Pantanos de Villa	Reserved Zone	Peru
Pucacuro	Reserved Zone	Peru
Rio Rimac	Reserved Zone	Peru
Santiago Comaina	Reserved Zone	Peru
Tumbes	Reserved Zone	Peru
Kenneth Lee	Scientific, Ecological and Archaeological Reserve	Bolivia
Estacion Biologica del Beni	UNESCO-MAB Biosphere Reserve	Bolivia
Parque Nacional Pilon-Lajas	UNESCO-MAB Biosphere Reserve	Bolivia
Bofedales y Laguna de Salinas	Wetlands of International Importance	Peru
Humedal Lucre - Huacarpay	Wetlands of International Importance	Peru
Laguna del Indio - Dique de los Espanoles	Wetlands of International Importance	Peru
Lagunas Las Arreviatadas	Wetlands of International Importance	Peru
Manglares de San Pedro de Vice	Wetlands of International Importance	Peru
Pacaya Samiria	Wetlands of International Importance	Peru

Reserva Nacional de Jun├¡n	Wetlands of International Importance	Peru
Area de proteccion del Pino del Cerro	Wildlife Refuge	Bolivia
Area de proteccion del Quebracho Colorado	Wildlife Refuge	Bolivia
Cavernas del Repechon	Wildlife Refuge	Bolivia
El Dorado	Wildlife Refuge	Bolivia
Estancias Elsner Espirir	Wildlife Refuge	Bolivia
Estancias San Rafael	Wildlife Refuge	Bolivia
Huancaroma	Wildlife Refuge	Bolivia
Rios Blanco y Negro	Wildlife Reserve	Bolivia
Flavio Machicado Viscarra	Wildlife Sanctuary	Bolivia
Manu National Park	World Heritage Site	Peru
Parc national de Huascaran	World Heritage Site	Peru
Parc national Noel Kempff Mercado	World Heritage Site	Bolivia
Parc national Rio Abiseo	World Heritage Site	Peru
Sanctuaire historique de Machu Picchu	World Heritage Site	Peru

CURRICULUM VITAE

Date and Place of Birth
August 30, 1983
Bridgeport, Connecticut, United States of America

Secondary School Attended
Bunnell High School, Stratford, Connecticut
High School Diploma (June, 2001)

Universities Attended
John Jay College (CUNY), New York, New York (2001-2005)
Bachelor of Arts (May, 2005)
Criminal Justice

Rutgers University, Newark, New Jersey (2006-2011)
Master of Arts (May, 2008)
Criminal Justice

Occupations
Research Assistant to Dr. Ronald Clarke
Rutgers University (2008-2009)

Teaching Assistant, School of Criminal Justice
Rutgers University (2009-2010)

Adjunct Professor, School of Criminal Justice
Rutgers University (2008-2011)

Assistant Professor, Criminal Justice
Florida International University (2011-present)

List of Publications

Pires, S. F. and R. V. Clarke. (2012). Are Parrots CRAVED? An analysis of Parrot Poaching in Mexico. *Journal of Research in Crime and Delinquency,* doi: 10.1177/0022427810397950.

Pires, S. F. and R. V. Clarke. (2011). Sequential Foraging, Itinerant Fences and Parrot Poaching in Bolivia. *The British Journal of Criminology,* 51: 314-335.

Pires, S. F. and Moreto, W. (2011). Preventing Wildlife Crimes: Solutions That Can Overcome the 'Tragedy of the Commons'. *European Journal on Criminal Policy and Research*, 17:101-123.