Will Atlantic Forest birds survive the next 50 years?

Introduction

The easy answer to the question in this chapter's title is, no. Many, perhaps most, of the Atlantic Forest birds will not survive the next 50 years. The simple problem is that most of their habitat, the Atlantic Forest in its many forms, is gone. The estimates vary, but somewhere between 5% and 10% of the forest remains and that is often in poor condition. The situation appears bleak.

Of course, this bleak scenario assumes one thing, that we do nothing to change the situation. The fact that someone is reading this chapter, of which I am grateful, means that some parts of society want to improve the situation. This gives me cause for optimism. Also pushing me towards unusual optimism is that it seems unlikely that the situation could get much worse. Anything you or I do can only help. Over the next several pages, I will discuss the Atlantic Forest and its birds, and where and how we might save them from extinction.

The chapter begins with an explanation of why the Atlantic Forest, and Rio de Janeiro within it, is an important place for conservation. It continues with a summary of the forest in Rio de Janeiro and how it relates to the conservation status of birds. I then discuss both conceptual and practical solutions for preventing bird extinctions in Rio de Janeiro.

The Atlantic Forest is a special place in the world

The Atlantic Forest is certainly not the only threatened ecosystem in the world. Why focus on it rather than a place where "success" might be easier? The reasons are many. Several scientific studies identify the Atlantic Forest ecosystem as a place where conservation efforts can make an exceptional contribution to global biodiversity conservation.

The Atlantic Forest has very high levels of endemism. That is, it has many species, including birds, found nowhere else in the world. In the biodiversity hotspot analyses by Norman Myers and colleagues (1,2,3), the Brazilian Atlantic Forest regularly appears near the top of the list in numbers of endemic species, both in total number and number per unit area.

The ecoregion analyses by the World Wildlife Fund (4) confirm the importance of the area, as do several studies by Birdlife International that identify important areas specifically for bird conservation (5,6). Also for birds, a study by Manne et al. (7) shows the Atlantic Forest to have more threatened passerine birds, about two-thirds of all birds, than any other place in the Americas (Figure 1). The biological reasons for focusing on the Atlantic Forest are clear. Biologically, it is a special place in the world.

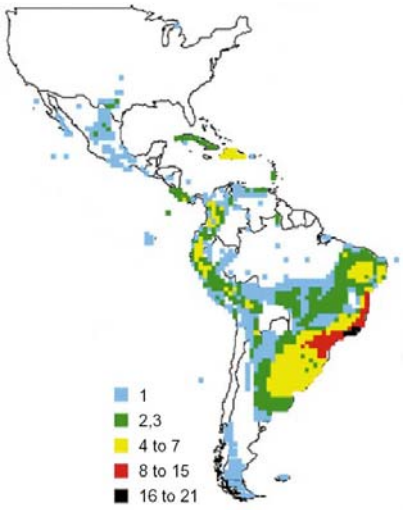

Figure 1. The number of threatened passerine birds in the Americas. Colors indicate the number of threatened birds (IUCN Red List) found in each 1 degree latitude / longitude grid cell. The Atlantic Forest, and especially Rio de Janeiro state (~black), has more threatened birds than any other region of the Americas. Reprinted from Manne et al. 1999 (7).

Rio de Janeiro is a special place in the Atlantic Forest

The Atlantic Forest is a rather large area to conserve (>1 million km^2). Moreover, most of it is already gone. Where are the best sites within it to focus conservation efforts?

For birds, Rio de Janeiro is an obvious choice. Manne et al. (7) show that Rio de Janeiro has more threatened birds, by a wide margin, than any other place in the Atlantic Forest and by extension the Americas (Fig. 1). Part of the explanation is that Rio de Janeiro also has the most bird species overall, and so we should

expect it to have the most threatened ones. If everything else were equal, the area with the most species should always have the most threatened ones.

The ultimate question is: Why does Rio de Janeiro have so many species? I will not explore all of the possibilities, but mention only two likely ones. One is the varied topography and climate. Multiple mountain ranges cross the region, creating a complex series of bioclimatic zones. Within a few tens of kilometers, you can travel from wet, humid forest into elfin forest and high-altitude grasslands, and then cross over the mountain into the rain shadow where cacti dot the landscape.

Another explanation is less aesthetically appealing, but perhaps just as likely. Rio de Janeiro is centrally located in the Atlantic Forest. It is the northern boundary for many southern ranging species, and the southern boundary for many northern ranging species. In this sense, it may just be luck that Rio de Janeiro has so many species. Whatever the explanation, Rio de Janeiro does have many species, making it a special place in the Atlantic Forest.

The state of the state

The state of Rio de Janeiro is certainly a priority for bird conservation, but a state is still too large an area to conserve, in this case about 50,000 km^2. The details of where forest remains within the state are critically important for birds and conservation planning.

Given the overall condition of the Atlantic Forest, Rio de Janeiro is doing quite well. About 20% of the state remains forested (8,9,10), far better than most areas. Most of this forest occurs in three areas, indicated in Figure 2. Two of these, the Central Axis and Serra do Mar, are large and reasonably contiguous fragments. The Rio de Janeiro area is broken into three major fragments, each surrounded by heavily developed urban areas.

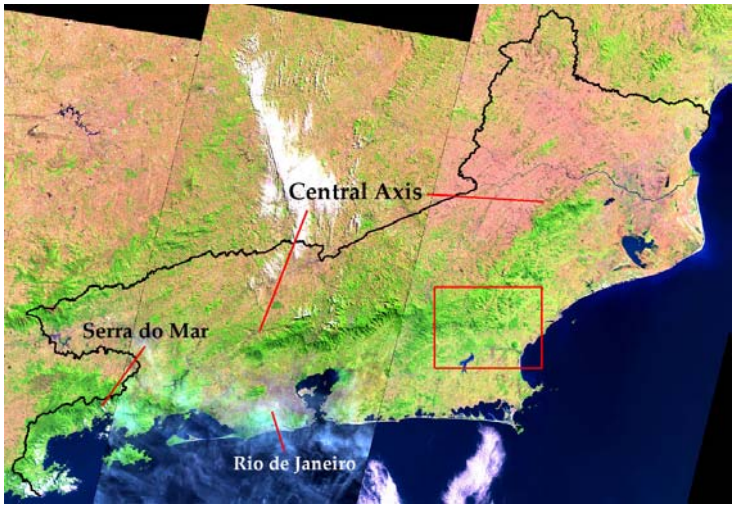

Figure 2. Landsat 7 ETM+ satellite imagery of Rio de Janeiro state (black line). Forest (green) occurs primarily in three areas, the Central Axis, Serra do Mar, and Rio de Janeiro city. Clouds partially obscure Rio de Janeiro city. The red box indicates the magnified view shown in Figure 5.

The distribution of forest has a bias towards high elevations, usually in inaccessible areas (blue and green in Fig. 3). It is not a surprising pattern, for it happens in deforested areas around the world. People clear the forest that is easy first. What is surprising is how much forest does remain in the lowlands (red in Fig. 3), especially considering the large human population in the region.

Not all of the news is good. Much of the lowland forest is in a narrow band along the southern boundary of the Central Axis region (Fig. 3). On closer inspection, this band of forest is highly fragmented. Some lowland areas maintain connections to each other only through higher elevation forest. Others are completely isolated. This is a concern for two reasons. One, some Atlantic Forest birds are altitudinal migrants. That is, they spend different parts of the year at different elevations. For these species, it is essential to have forest in the lowlands and the higher elevations, and a way to travel between them. Two, some birds occur only in the lowlands, especially the threatened species. For these species, a connection through higher elevations may be of no use. They will only move through the lowlands.

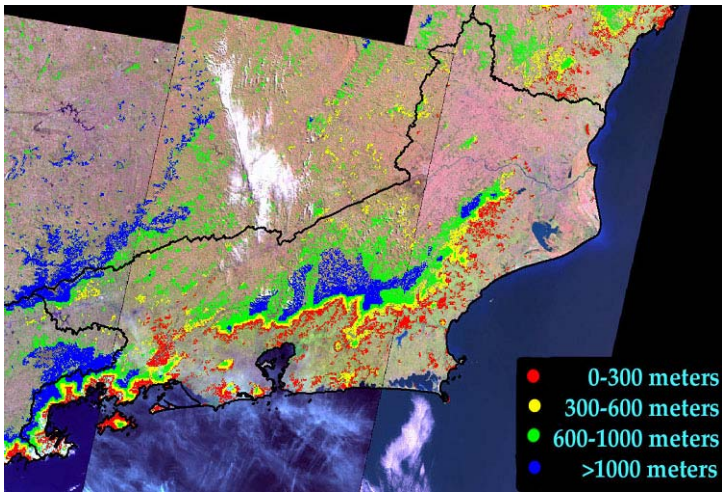

Figure 3. The distribution of forest by elevation in the state of Rio de Janeiro.

The problems of migration and fragmentation

These two cases, the altitudinal migrants and lowland restricted species, deserve further attention. These characteristics are not unique to birds, and the conceptual solutions to their problems are likely similar to those needed to conserve other animals.

First is the problem of altitudinal migrants. If a species migrates between lowland forest (< 300 meters) and highland forest (> 1000 meters), then it obviously needs forest at both elevations. However, if open pastureland separates the lowland and highland forest, then that species may still not survive, even if its habitat does. Some species, such as some forest interior birds, have behaviors that prevent them from leaving the forest and crossing open areas. For species evolving in a contiguous forested landscape, this is sensible. Open areas are full of predators and it is safer to travel around them through the forest. The consequence now is that these species need forest corridors through which they can travel, but they are not always available. For other species, such as some parrots, open areas may present less of a problem. The reality for most species, including most birds, is that we do not know.

The second, and more complex problem, is that of lowland restricted species. The lowlands are the most fragmented and have the most threatened species. The general problem is isolation of populations in small fragments. When deforestation isolates a fragment from the rest of the forest, the population in that

fragment becomes more at risk to chance events driving them extinct. These could be fires, disease, demographic accidents, or any number of unpredictable events. The scientific literature is rich with explanations and I will not describe them all here. A general rule is that large fragments retain most of the species present in the original contiguous forest, whereas small fragments may lose almost all of the species. Scientists argue about exactly how many species will survive in a fragment of a given size, but they do agree that the relationship is true. For simplicity, remember the following: small fragments retain fewer species than large fragments.

This is not the only problem faced by small fragments. They also lose their species faster. Figure 4 shows the time needed for a fragment of a given size to lose half of the species it will lose after isolation. Note that this is not half of the total species, for small fragments lose more than large ones. As a hypothetical example, imagine a forest with 100 species reduced to two fragments of 10,000 and 100 hectares. The larger fragment will lose 10 species and the small fragment will lose 50 (this is only an example, for details of the estimation process, see reference 11). From Figure 4 we see that a 10,000 ha fragment will lose half of its "extinct" species (5) in about 90 years. The 100 ha fragment will lose half of its "extinct" species (25) in about 12 years. In 24 years, the 100 ha fragment will lose 38 species (25 + 25/2), in 36 years it will lose 44 (25+25/2+(25/2)/2), and so on. In fact, the 100 ha fragment will reach its extinction equilibrium, all 50 species gone extinct, in about 80 years. That is 10 years before the larger fragment loses even half of its 10 "extinct" species.

So small fragments lose more species and they lose them faster. Why is that important for the lowland species? The lowlands are where most of the small, isolated fragments occur. It is the lowlands where the most species will go extinct and where they will go extinct the fastest. It is there that conservationists must act quickest.

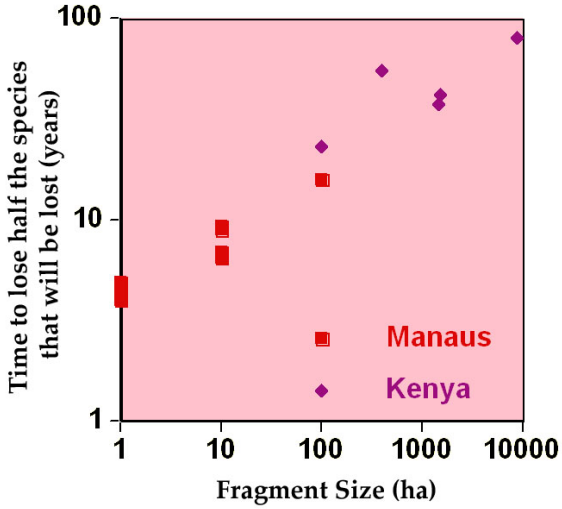

Figure 4. Relationship between forest fragment size and time to species extinction. In forest fragmentation studies in the Amazon Forest (Manaus, red) and Kakamega Forest (Kenya, purple), smaller fragments lose bird species to extinction faster than larger fragments. They also lose more species overall. Continuing studies suggest that other taxa follow a similar pattern. (unpublished Ph.D. dissertation of Gonçalo Ferraz)

Cause for optimism and some solutions

The previous section may have caused readers to worry, as they should, but cause for optimism remains. A significant amount of lowland forest survives and much of it remains connected to the highlands. Some of it, such as in Reserva Biológica Poço das Antas and Reserva Biológica União, already has official protection. Much of it does not. Some cautious optimism also comes from the fact that no Atlantic Forest bird has yet gone extinct, at least officially. The official list of threatened birds in Rio de Janeiro does list 20 species as probably extinct (8), but some of these may survive in other states. Extinction is a notoriously difficult thing to document.

Some solutions are clear as well. Preventing bird extinctions, and likely the extinction of many other organisms, requires large areas of forest. These forests need to span altitudinal gradients while also maintaining connections through the lowlands. Figure 5 shows some examples of where we could restore connectivity within the forest and reduce the chance of extinctions. REBIO União and REBIO Poço das Antas are both biological reserves with relatively good protection. Each is a lowland forest fragment of about 3,000 ha and is close to larger forest fragments. Morro do São João, an extinct volcano, is 1,500 ha and

unprotected, although some of the landowners are considering the establishment of private reserves (RPPNs).

União supports 17 officially threatened birds (8), the highest concentration this author knows of in the Americas. However, it has no connection to higher elevation forest. The closest it comes is a 20-hectare gap of pasture, highlighted with a red circle in Figure 5. The area is owned by a single family of farmers and has one small dirt road, easily crossed by most wildlife. Reforesting that area would restore connectivity to the most important bird reserve in the Americas.

Poço das Antas is more difficult. Its nearest connection to larger forest fragments requires crossing one of the main highways of Brazil, BR101. Removing the highway is not a viable option, but neither is going around it. Reforesting to the edge of the highway may enable some species to move between Poço das Antas and the forest to the north. However, the gap from the highway may still be too wide for some species and automobile traffic will certainly cause mortality. Having forest close to a highway also causes practical problems of trees and tree limbs falling into the highway.

Morro do São João is also difficult. Agricultural land surrounds the forest and it is much more isolated than either União or Poço das Antas. Reconnecting this forest fragment to anything will require extensive restoration of the surrounding landscape. One possibility is a forest corridor along the São João River to the south. This would restore connectivity to a forest fragment to the west while improving water quality in the river.

Figure 5. Three examples of isolated forest fragments in need of forest corridors. REBIO União and REBIO Poço das Antas are both biological reserves and relatively well protected. Morro do São João is an extinct volcano and remains forested because of its rugged topography. A 20-hectare gap of pasture (red circle) separates REBIO União from larger areas of forest nearby. Highway BR 101 separates Poço das Antas from nearby forest. Agricultural land surrounds Morro do São João. See Figure 2 for a larger view of the region.

Another consideration is the time needed to grow a corridor. Consider the 20-hectare gap near União. If restoration began today, it may take 15 or more years for a decent forest to return. That means 15 more years of extinctions even if actions start today. For places like Morro do São João, it may be decades of extinctions. This should not be a source of discouragement. Past events have probably made some extinctions unavoidable. Nobody can change the past, but the actions of today can prevent the extinctions of tomorrow.

This time lag between corridor action and conservation effect has a serious consequence. Remember that the smaller the fragment the faster it loses its species. This means that very small fragments will lose many species faster than we could possibly reconnect them with corridors. How small is too small? Let us assume that it takes 20 years to make a corridor, five years to identify the need and design a plan, plus 15 more for it to grow. From Figure 4, we can estimate that a 1-hectare fragment will lose half its extinction-destined species every 2 years. That means it will lose them all in just over 10 years, less time than it takes to make a corridor. A 10-hectare fragment loses about 80% of its extinct species in 20 years. Again, most of the extinctions will occur before completing the

corridor. A 100-hectare fragment loses a little more than half its extinct species in 20 years, and a 1,000-hectare fragment still has most of them after 20 years. Considering this, making corridors to fragments smaller than 100-hectares is unlikely to prevent many extinctions.

That does not mean that small fragments are not useful. Their presence between two larger fragments can make building a corridor much easier. They may also serve as "stepping stone" corridors for some species. Nevertheless, the large fragments should be the main targets for corridors.

Conclusions

Let us return to the original question, Will Atlantic Forest birds survive the next 50 years? My first answer was no, but it assumed that we did nothing. Over the last several pages, I have described some conceptual solutions as well as specific actions that can improve the situation. The existing evidence suggests that linking forest fragments through corridors will benefit biodiversity. This is especially true for large fragments. In some places, such as the União reserve, small actions can make a big impact. In other places, the task will be more difficult. Another chapter in this volume, "Cordão de Mata…" by Anderson et al., describes some recommended biological corridors and conservation actions consistent with the ideas presented here.

It may take 20 years to design and fully implement such corridors. We should not expect immediate, measurable effects on biodiversity. Some species will continue to go extinct. However, not taking action guarantees even more extinctions. We must also act on incomplete data. For birds and some other groups, it may be possible to define the best possible corridor. For most organisms, we will need to make educated guesses. The prudent choice is to plan using what we do know. Corridors designed around birds may, or may not, benefit other organisms, but they are unlikely to hurt them. One thing is certain; they can help birds survive the next 50 years.

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