Chapter

Diversity of the Owl Species in the Amazon Region

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Abstract

The Amazon basin is the largest tropical rainforest in the world covering almost 40 per cent of the South American continent. For centuries, its vastness and inaccessibility have been protecting this area. The general belief is that the Amazonia region has unparalleled biodiversity which means that one in five of all bird species known in the globe lives in the Amazon Jungle. The author is testing this claim against the known occurrence of the world owl species. There are fewer owl species in Amazonia than expected namely 34 (against 54 expected). Two possible reasons are that our knowledge of the Amazon region species is still incomplete as may be indicated that new owl species have been found recently. The other reason could be that the rainforest is not after all the most wanted biotope for many of the owl species which often depend on the prey available in the bottom tier of the forest which is flooded during the wet season. Whatever the reason is, more detailed research is needed on all species of the Amazon region as there must be many new owls and other animal species out there waiting to be discovered. We have no idea how many of those new species have been or will be lost due to the rainforest destruction before they can be discovered. Therefore, it is necessary to stop deforestation in the Amazonia, be it due to forest logging, uncontrolled fires (often deliberately set) agriculture expansion or industrial development. Deforestation is not the only reason that the Amazon basin is changing. The rainforest suffers also from the global climate change when the higher temperatures reduce the rainfall in the tropical Atlantic region, causing drought and increasing the fire susceptibility of the rainforest. Luckily the owls are not so sensitive to surrounding forest cover as many other tropical forest-dependent bird species, like the large-bodied avian frugivores. Impacts of forest fragmentation on owls will need additional research.

Keywords: Amazonia, conservation, owl species, number of wildlife species, climate change

1. Introduction

The history of geology tells us that at one time Amazon River flowed westward when it was still inside the Gondwana continent and part of the proto-Congo River system [1]. Later the African and South American continents separated and the Atlantic Ocean widened enough to provide a moist and warm climate to the Amazon region. The rainforest formed during the Eocene era between 56 and 34 million years ago [2]. The Andes have formed 15 million years ago and some 5 million years later the Amazon River began to flow eastward [1].

Now the Amazon River is the largest of the world's rivers in terms of water volume discharged into the sea, carrying more than five times the volume of the Congo River

or twelve times that of the Mississippi River [1]. The Amazon River basin covers almost 40 per cent of the South American continent and the main river is some 4080 miles long, second only to the River Nile in length [3]. The Amazon river and its 1100 tributaries have a drainage area covering 2.7 million square miles belonging to nine nations: (the percentage share of each nation is shown in brackets) Bolivia (7.7%), Brazil (58.4%), Colombia (7.1%), Ecuador (1%), French Guiana (1.4%), Guyana (3.1%), Peru (12.8%), Surinam (2.5%) and Venezuela (6.1%) [4]. Even in this book, the percentages vary as the perceived extent of the Amazon depends on the definition. Often people as well include areas outside the basin and that biogeographic Amazon ranges 3–3.2 million sq. mi, of which just over 80 per cent is forested [1]. Whatever definition is used the Amazon basin has the world's largest rainforest, bigger than the next two largest rainforests – in the Congo River basin and Indonesia – combined. The moist broadleaf forest comprises an estimated 390 billion individual trees representing some 16,000 species [5]. Billions of trees pump daily huge quantities of water vapour into the atmosphere. A large part of this water rains down locally, but part of this moisture is carried in the air to other areas including the agricultural heartland of South America. It has been estimated that two-thirds of Brazil's national product comes from the areas that receive Amazon rainforest generated rainfall [1].

It was for a long time a general belief that the Amazon rainforest has been always only sparsely populated by the humans due to the poor soils. Recent archaeological findings, however, suggest that the Amazon was earlier densely populated and that up to 5 million people were living in the region in 1500 AD. However, by 1900, the population had fallen to one million and by the early 1980s, it was estimated to be less than 200,000. Indigenous civilizations were devastated by the spread of new diseases like smallpox and typhus after the arrival of the first Europeans, in 1542 and after [6]. The UK broadcaster BBC 4 presented evidence that the Amazon rainforest has been shaped by humans for at least 11,000 years through activities like forest gardening and'terra preta' indigenous soil management, instead of being only a pristine wilderness [7]. In recent decades the human population has accelerated and incoming people have introduced mechanised agriculture and integrated the region into the global economy. Large quantities of the Amazon-produced commodities like cattle beef and leather, timber, soy, oil and gas, and minerals are sold to China, Europe, Russia and the U.S. [1].

Number of plants/and animal group species	**Butler/Mongabay [1]**	**Wikipedia [2]**	**WWF [9]**	**Ascent of the Amazon [10]**
Plant species	40,000	At least 40,000	40,000	Na
Mammals	430+	427	427	More than 1400
Birds	1300	1294	1300	1500
Fishes	3000	2200	ca. 3000	2200
Reptiles	400+	378	378	Na
Amphibians	1000+	428	Over 400	More than 1000
Invertebrates	Na	96,660 – 128,843 Brazil alone	ca. 100,000	Na
Insects	Na	2.5 million	Na	90% of all animal species are insects

Na = Not available.

Table 1.
Biodiversity of Amazonia plant and wildlife [1, 2, 9, 10].

The wet forests in Amazon have consistently higher species diversity than any comparable forests in Africa and Asia [8]. The Amazonia Region is home to a large collection of living plants (40,000 or more) and animal species in the world. However, **Table 1** above shows considerable discrepancies in the stated species diversity.

The largest discrepancies seem to be in the numbers of mammals and amphibians whilst the number of birds and reptiles is relatively uniform. It is possible that the highest numbers represent the number of South American species in its entirety and not just in Amazonia.

It has been said that one in ten known species in the world occurs in the Amazon region and one in five of all bird species are found in the Amazon rainforest [11]. The author knows best "Owls of the World" [12] and compares here how these statements hold for the world owls.

2. Material and methods

The history of owls in the Amazon region is far less known than that of human history. Fossil records of the Amazon owls are very few if any [13] so we do not know what kind of owls lived in the region before the present species. Even today, Amazonian owl species are not well known, and few studies have focused on the species from the region (see [14–24]. In the nine countries sharing the Amazon basin the number of owl species is on average 22 species ranging from 13 to 30 per country (**Table 2**).

However, it is important to note that only part of the above-listed owl species lives in the Amazon basin of that country. In the following, the scientific names are in the same form as in the "Owls of the World" [34] to avoid the complicated taxonomic discussions. In Bolivia, the tropical lowland evergreen forests are found in all the Amazonian ecoregions of the country. They represent the habitat with the second highest diversity of owls, with the following species: *Tyto furcata*, *Mecascops choliba*, *M. watsonii*, *M. hoyi*, *M. guatemalae*, *Pulsatrix perspicillata*, *Bubo virginianus*, *Strix chacoensis*, *S. virgata*, *Glaucidium brasilianum* and *Aegolius harrisii* [25]. In Brazil, there are five owl species, which occur exclusively in this biome: *Megascops watsonii*, *M. usta*, *M. roraimae*, *Glaucidium hardyi* and *Lophostrix cristata* [26]. From Colombian 28 owl species 10 are found in the Amazon area of the country. This corresponds well with the fact that in the Amazon region Colombia represents 30% of the national territory. Amazon species include *Tyto furcata*, *Megascops choliba*, *M.*

Country	Number of owl species	Source of information
Bolivia	25	[24]
Brazil	23	[25]
Colombia	28	[26]
Ecuador	28	[27]
French Guiana	13	[28]
Guyana	16	[29]
Peru	30	[30]
Suriname	15	[31]
Venezuela	22	[32]
Average 22.		

Table 2.
A total number of owl species listed in the 9 countries sharing the Amazon basin. Sources of information [25–33].

watsonii, *Lophostrix cristata*, *Pulsatrix perspicillata*, *Pulsatrix melanota*, *Strix virgata*, *Strix huhula*, *Glaucidium brasilianum*, and *Athene cunicularia* [27]. In Ecuador, the rather homogenous forests of the Amazon lowlands are home to nine species mostly distributed throughout the entire region including *Tyto furcata*, *Megascops choliba*, *M. watsonii*, *Lophostrix cristata*, *Pulsatrix perspicillata*, *Strix virgata*, *Strix huhula*, *Glaucidium brasilianum*, and *Asio clamator* [28].

Unfortunately, there is no available specific study on owls in Guyana, Peru and Venezuela. Also in the French Guiana and Surinam the total of 13 and 15 owl species sounds very small and it is equally not well defined which owls live in the Amazon basin of the country.

The occurrence of different owl species in the comparison of this chapter is based entirely on the latest known distribution maps [12, 13] and no new field research was undertaken in the region. Therefore, especially in the Andean region, it was not so easy to decide which "Pacific side" owls may or may not belong to the Amazonian fauna. As all these owl distribution maps are still in a state of flux so one can expect that the total numbers may hold up very well as any mistakes have most likely been made in both directions.

3. Results

There are some 268 owl species in the world [12] and as **Table 3**. shows that a new Pygmy Owl (yet to be validated) has been discovered by Luis Fabio Silveira, Curator of Birds at the Museum of Zoology, the University of São Paulo by its call during an ongoing expedition to the Neblina National Park area, in Brazil. Provisionally this

1. American Barn Owl *Tyto furcata* LC Stable
2. Tropical Screech Owl *Megascops choliba* LC Stable
3. Maria Koepcke's Screech Owl (Koepcke's Screech Owl) *Megascops koepckeae* LC Stable
4. Peruvian Screech Owl *Megascops roboratus* LC Stable
5. Rufescent Screech Owl *Megascops ingens* LC Decreasing
6. Cinnamon Screech Owl *Megascops petersoni* LC Stable
7. Cloud-forest Screech Owl *Megascops marshalli* NT Stable but in Bolivia classified as vulnerable [24]
8. Northern Tawny-bellied Screech Owl *Megascops watsonii* LC Stable
9. Southern Tawny-bellied Screech Owl *Megascops usta* Na
10. Roraima Screech Owl (Foothill Screech Owl) *Megascops roraimae* Na
11. Rio Napo Screech Owl *Megascops napensis* Na
12. White-throated Screech Owl *Megascops albogularis* LC Stable
13. Great Horned Owl *Bubo virginianus* LC Stable
14. Magellanic Horned Owl (Magellan Horned Owl or Lesser Horned Owl) *Bubo magellanicus* Na
15. Spectacled Owl *Pulsatrix perspicillata* LC Stable
16. Band-bellied Owl *Pulsatrix melanota* LC Stable
17. Mottled Owl *Strix virgata* LC Decreasing
18. Rufous-banded Owl *Strix albitarsis* LC Stable
19. Black-and-White Owl *Strix nigrolineata* LC Stable
20. Black-banded Owl *Strix huhula* LC Decreasing
21. Crested Owl *Lophostrix cristata* LC Stable

22. Amazonian Pygmy Owl *Glaucidium hardyi* LC Stable
23. Ferruginous Pygmy Owl *Glaucidium brasilianum* LC Decreasing
24. 'Neblina Pygmy Owl' *Glaucidium* spp. Nov. [35] Na
25. Subtropical Pygmy Owl *Glaucidium parkeri* LC Stable
26. Andean Pygmy Owl *Glaucidium jardinii* LC Stable
27. Yungas Pygmy Owl *Glaucidium bolivianum* LC Decreasing
28. Chaco Pygmy Owl (Tucuman Pygmy Owl) *Glaucidium tucumanum* Na
29. Long-whiskered Owl (Long-whiskered Owlet) *Xenoglaux loweryi* EN
30. Burrowing Owl *Athene cunicularia* LC Decreasing
31. Buff-fronted Owl *Aegolius harrisii* LC Stable but in Ecuador ranked as vulnerable [27]
32. Stygian Owl *Asio stygius* LC Decreasing
33. Striped Owl *Asio clamator* LC Decreasing
34. Short-eared Owl *Asio flammeus* LC Decreasing
Note that all listed 'species' are not, yet, fully approved by the taxonomists. Known conservation status is indicated for those species listed to be in danger [36]. CR = Critical; EN = Endangered; LC = Least concern;Na = No conservation status given; NT = Near-threatened and VU = Vulnerable.

Table 3.
List and scientific names of Amazon region owl species [12, 13] (+one new species proposed after 2012 and referenced separately in the table).

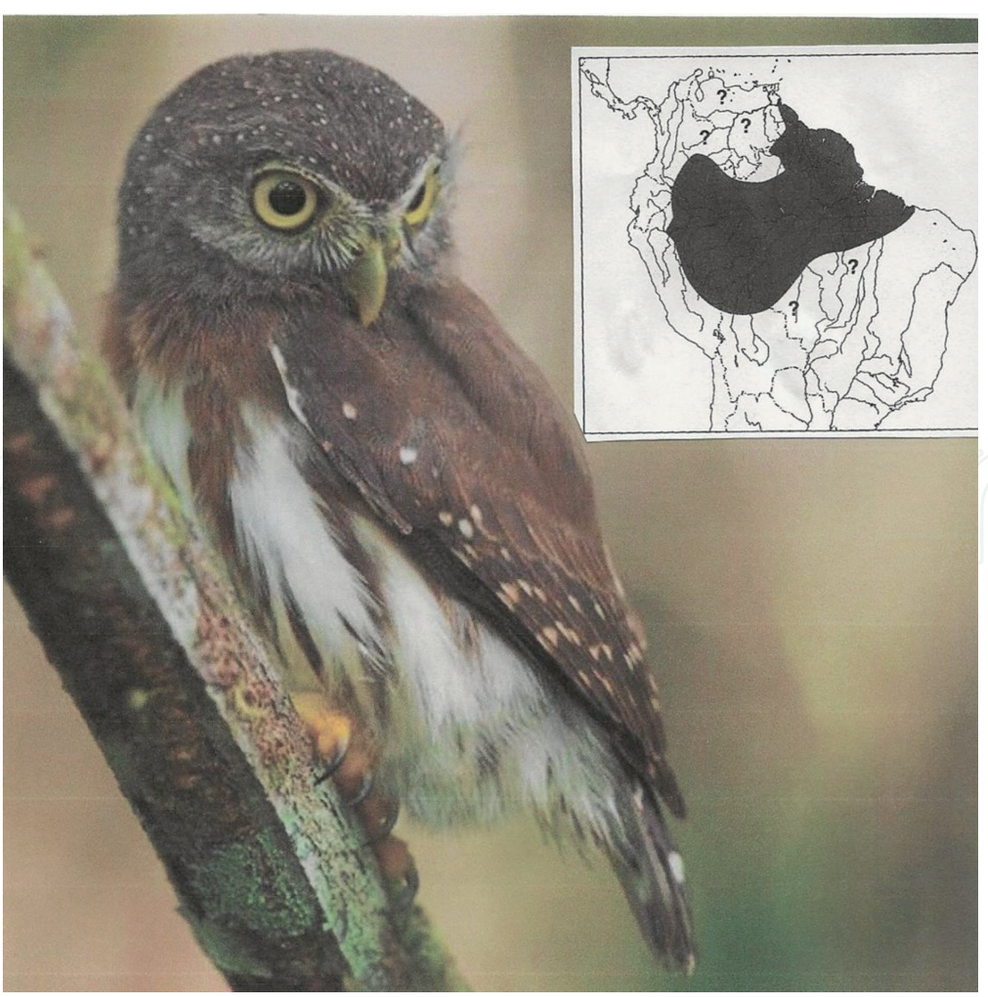

Figure 1.
Amazonian pygmy owl Glaucidium hardyi distribution map [from 34] with a scan of an excellent photo of Kurazo Okada from Macapá, Brazil.

new owl has been named the 'Neblina Pygmy Owl' [35]. That brings the total of the world owl species to 269, so 34 species listed for Amazonia represent 12.6 per cent. Similarly, 88 owl species of the world lives in the Neotropical zone of the world. This is 32.7 per cent of the world species. Amazon Region owls make 38.6 per cent of the Neotropical owls, respectively [12, 13]. There is only one owl species that has been nominated due to the region as Amazon Pygmy Owl *Glaucidium hardyi*. Its distribution map shows very well how difficult it is to know the exact limits of some species in the Amazon region (**Figure 1**). This tiny owl is difficult to observe in the rainforest canopy [12]. The latest book on Colombian owls [37] does not include this species, so the presented map extends a little too much to the west.

4. Discussion

Based on the assumption that one in five, i.e. 20 per cent of the world owl species should live in the Amazon Region we can see that the rainforest has twenty species less (34 *vs.* 54) than expected. There can be at least two very distinct reasons for this. Firstly, we may not know, yet, all of the owl species living in the Amazon region. The practical limitations of calculating and identifying birds, especially night-time, mean that data collection is often very difficult if not impossible. This explanation is supported by the owl study difficulties summarised below:

Compared with other avian groups, owls are difficult to study	[13, 38, 39]
Studying them is a challenge because..... Owls are typically not covered by land bird monitoring programmes because of	[13] [38]
• they are uncommon • their low densities	[13] [38]
• elusive behaviour	[38]
• nocturnal habits	[13, 38]
• usually go unnoticed • incomplete detectability or false absences	[13] [39]
• and live in places difficult to access	[13]

The second reason could be that the rainforest may not be the most ideal biotope for many of the owl species which often depend on the prey available in the bottom tier of the forest which is flooded during the wet season. The wet rainforest prey availability and catch-ability can be very different from the dry forest environment. In Ecuador, it has been noted that owl diversity is higher in forested ecosystems than in open areas and in humid forests than in dry forests. However, even in Ecuador the Pacific lowlands harbour more species than the Amazon lowlands [28] somewhat supporting my second reason. It gains further support at the end of the conclusions.

5. Conclusions

More detailed research is needed on all species of the Amazon region. Only a small percentage of the basin's plant life has been documented or studied for their potential medicinal value [40]. Much of the ecology of this ecosystem remains unknown, and one can suspect that there must be many new owls and other animal

species out there waiting to be discovered. It may be the only area in the world where you can still hope to find a new owl species, as the recently found and not, yet, officially described new *Glaucidium* spp. Nov. owl shows (**Table 3**). Also, we will have no idea how many of those new species were or will be lost through rainforest destruction before they can be discovered. Therefore, stating the obvious, it is necessary to stop deforestation in the Amazon. South America's natural wonder may be perilously close to the tipping point beyond which its gradual transformation into something closer to steppe cannot be stopped or reversed, even if people lay down their axes. An area equivalent to the size of Turkey, and bigger than that of Texas has been lost to logging, farming, mining, roads, dams, and other forms of 'development'. Between only August 2017 and July 2018, Brazil lost 7900 km^2 of Amazon forest – nearly a billion trees – the highest rate of deforestation for a decade [41]. And in the following year in Brazil, alone, deforestation rose more than 88 per cent in June 2019 compared with the same month in 2018 [42]. Since then deforestation has again been steadily rising in the Brazilian Amazon, with deforestation alerts from August 2019 to July 2020 and is 33 per cent higher than in the same period of the previous year [43]. Unfortunately, it is not Brazil alone burning and deforesting the Amazon region. After two years in Colombia, I sadly concluded with my biologist wife that people in that country have very little respect for the forests and wildlife [44]. Since that time deforestation has increased especially in the Amazon region of the country. In 2017 alone, deforestation destroyed 60,300 hectares in Caquetá (one Amazon department) [45]. If current trends in the Amazon region continue, millions of extra tonnes of carbon dioxide will be released in the atmosphere with devastating long-term consequences. There will be immediate impacts like decimating biodiversity, and vital ecosystem destruction. The impact on regional economies could also be substantial due to the dramatic implications for regional rainfall, leading to drier conditions across South America's breadbasket and major urban areas [1]. Deforestation is not the only reason that the Amazon region is changing. Global climate change is having an important impact because the higher temperatures reduce the rainfall in the tropical Atlantic. This is causing regular drought periods over years thus increasing the susceptibility of the rainforest to fire [1]. This widespread devastation in the natural habitats is likely to have deleterious implications for the Amazon basin owl populations due to the sensitivity of many owl species to habitat disturbance [46]. A recent study in Ecuadorian owls found no relationship between species richness and the amount of surrounding forest cover [47] which tends to support my second hypothesis that the rainforest environment may not be the first choice of the owls. However, another concurrent study in Ecuador noted that the large-bodied frugivores birds in the same fragmented forests showed that frugivore richness corresponded strongly and positively to surrounding forest cover [48]. Clear discrepancies between different bird groups suggest that additional research is needed to evaluate how the impacts of forest fragmentation may vary among the bird guilds.

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