Chapter

Introductory Chapter: Why the Number of Owl Species in the World Continues Increasing?

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1. Introduction

Owls comprise a distinct and easily recognized group of birds. However, similarities in plumage and morphology, coupled with general lack of knowledge of the ecology and behaviour of many species, have led to considerable uncertainty regarding species and even generic limits. The internal taxonomy of owls (*Strigiformes*) may be in a greater state of flux than in any other family of non-passerine birds. The meaning of the term 'species' has gone through many changes, driven onwards by new methods, the differing priorities of each scientific age and the varied field of biological research. Four basic species definitions will be given but there are nowadays at least 26 different definitions. Owls have the lowest hybridization rate amongst studied bird groups being only about 1%, whilst game birds are hybridizing over 20% and the swan, geese, and duck group over 40%. Therefore, the biological species concept (BSC) serves still quite well with owls. However, all species definitions have been shown to have their limitations. The BSC shows that species are the real and fundamental units of evolution. The main problem with the morphological species concept is the question of how different two groups must be before they can be called separate species. Evolutionary species concept is very appealing but discovering the precise evolutionary history of organisms is practically impossible. Many owls are so rare that it has not been possible to get blood samples to examine nucleotide sequences in the cytochrome-b gene. Molecular data exists this far only for some 175 species, so 100 or more species waits for official confirmation when new material for DNA-testing becomes available. The discovery of the DNA code revolutionized taxonomy, but the problem is that variability in DNA is often not correlated to variability in morphology or reproductive compatibility. It is obviously unrealistic to assume that we can impose and apply any single definition on a natural world made restless by evolutionary change.

The number of world owl species has gone up from 109 to 268 between 1972 and 2014. This chapter seeks to answer the question: "Why we are getting so many new owl species every year?" One of the main reasons for this is that many owls live on small islands where they develop slight differences from their close relatives on the nearby mainland. It then becomes a matter of taste as to whether you consider one of these isolated populations of owls as a distinct species or not. If you are an objective zoologist you will likely lump the two together as subspecies, but if instead you are a passionate conservationist you will view the island form as a very rare and full species that needs urgent protection.

To significant extent these 'new owls' have been known to the scientific community as subspecies correctly (or erroneously!) declared as such. To a much smaller

degree there are still completely unknown owl species being identified in the tropical forests. However, only some 15 totally new owl species have been described after 2001. Details will be given on most recent of these new species. What is sure that we may lose some of the rarest owls very easily if not taking care of the habitat destruction and climate change. If describing them as new species rather than new subspecies helps our conservation efforts—so be it. With the present rate of habitat loss and climate change we will soon lose species faster than to describe the new ones.

Although owls comprise a distinct and easily recognized group of birds, similarities in plumage and morphology, coupled with general lack of knowledge of the ecology and behaviour of many species, have led to considerable uncertainty regarding species and even generic limits. The internal taxonomy of owls may be in a greater state of turmoil than in any other family of non-passerine birds.

2. What are 'species'

The meaning of the term 'species' has gone through many changes, driven onwards by new methods, the differing priorities of each scientific age and the varied field of biological research. The issue of species delimitation has long been confused with that of species conceptualization, leading to a half century of controversy concerning both the definition of the species category and methods for inferring the boundaries and numbers of species. The biggest problem is that currently many biologists advocate different and at least partially incompatible species concepts [1]. Mayden [2] listed 22 named species concepts, and now there are even more alternative definitions (see Appendix 1). This is encouraging biologists to develop new methods of species delimitation that are not tied to traditional species concept; species criteria; species delimitation. Therefore, I will present here only four basic species definitions:

- Biological species concept—a group of actually or potentially interbreeding populations, which are reproductively, isolated from other such groups
- Morphological species definition—a species is defined by a given set of common morphological features not shared by other groups
- Evolutionary species concept—a species is defined by its shared evolutionary history and descent from a common ancestor
- Genotypic cluster definition—a recently introduced definition, which is essentially a genetic version of the morphological definition. Genetic rather than morphological gabs identify the distinctions between species.

3. Problems with these definitions

Owls have the lowest hybridization rate amongst studied bird groups being only about 1%, whilst game birds are hybridizing over 20% and the swan, geese, and duck group over 40% [3]. Therefore, the biological species concept (BSC) serves still quite well with owls. However, all species definitions have been shown to have their limitations. The BSC encapsulates the idea that species are the real and fundamental units of evolution, while higher taxonomic categories such as genera, families and orders are more artificial collection made for convenience, though loosely reflecting

evolutionary relationships. Several authors have called attention to the situations in which adoption of the BSC leads to the recognition of fewer species taxa than adoption of one of the alternative species concepts, such as the diagnosable version of the phylogenetic species concept (e.g. [4, 5]). The main problem with the morphological species concept is the question of how different two groups have to be before they can be called separate species. Evolutionary species concept is very appealing but discovering the precise evolutionary history of organisms is practically impossible. The discovery of the DNA code revolutionized taxonomy, but the problem is that variability in DNA is often not correlated to variability in morphology or reproductive compatibility. It is obviously unrealistic to assume that we can impose and apply any single definition on a natural world made restless by evolutionary change. All the species concepts seem to have some merits and they are all based on important biological properties [6]. Unfortunately, distinct species concepts, despite sharing a common fundamental element, can often lead to different conclusions concerning which population lineages deserve to be recognized as species.

4. First 'Owls of the World'

In 1972 I was invited to participate in writing the first 'Owls of the World' edited by John A Burton [7]. That was a team of 15 people and we attempted to write about and to illustrate every known species of owl. That time it was quite easy to agree that there some 130–140 species of owls, although same year two East German scientists came with a revolutionary reduction of owl species to 109 [8, 9]. They united for instance Barred Owl (*Strix varia*) and Ural Owl (*Strix uralensis*) and had only nine Tytonidae owls (when the number nowadays is 26 or 27 as in **Table 1**). They also correctly united *Bubo* and *Ketupa* but not *Bubo* and *Nyctea*, and included *Ciccaba* to *Strix* and *Rhinoptynx* to *Asio*, etc.

5. Handbook of the birds of the world

In the Handbook [10] I was asked to compile a list for the owls, and ended up in having 205 species in 1999, but König et al. [11] lifted same year the number of species to 212 (**Table 1**). To question this 'fabrication' of new species I wrote already in 2000 on the subject "Owl Taxonomy—Where have all the "lumpers" gone [12].

Author	1	2	3	4	5	6	7	8	9
Tytonidae	11	10	16	11	26	16	16	26	27
Strigidae	133	120	189	201	224	183	192	223	241
Total	144	130	205	212	250	198	208	249	268

1 = 1940 [17], 2 = 1973 [7], 3 = 1999 [18], 4 = 1999 [11], 5 = 2008 [15], 6 = 2009 [14], 7 = 2011 [19], 8 = 2012 [20] and 9 = 2013 [21].

Table 1.
Number of owl species in the world from 1940 to 2013.

6. Taxonomists

Taxonomy is a scientific discipline that has provided the universal naming and classification system of biodiversity for centuries and continues effectively

to accommodate new knowledge [13]. However, there is a saying that if there are two taxonomists in one room, they cannot agree on anything. So, no wonder that owl taxonomy is still in a state of flux and the number of acceptable species varies between 200 and 270. In his book 'Owl' renowned Oxford based Dr. of Zoology, Desmond Morris [14] gave a new classification which accepted 198 kinds of owls as genuine species. But the latest 'Owls of the World' König et al. [15] listed already 250 owl species and 29 subspecies which could be considered as new and valid species. Personally, I found Morris' list more appealing [16].

7. First 'Owls of the World—A Photographic Guide'

But then 2010 I was asked to write Owls of the World—A Photographic Guide [20] with the instructions from my publisher to write about and to illustrate every known species of owls of the world. So, after König's [15] 250 species I ended up in having 249 by expecting that the New Zealand Laughing Owl *Sceloglaux albifacies* is extinct as there are no records since the 1930s.

8. Second 'Owls of the World—A Photographic Guide'

More than 15 new owl species were proposed immediately after the first edition was printed in 2012. As the book missed so many new species the publisher decided that there was a need to produce a second edition which I did next year with 268 species [21].

9. Future 'Owls of the World—A Photographic Guide'

After writing the second edition at least five certainly new species have been described as Walden's Scops Owl *Otus modestus* from the Andaman Islands in the Indian Ocean [22] and Rinjani Scops Owl *Otus jolandae* from Lombok island, Indonesia [23]. Interestingly a thought to be new species as Omani Owl *Strix omanensis* from Oman [24] has now been reidentified as Hume's Owl *Strix butleri* first described by A. Hume in 1878 [25] based on a single specimen from Pakistan.

Figure 1.
Desert Tawny Owl Strix hadorami *in Israel. Photo: Courtesy of Amir Ben Dov.*

The other, more familiar species (**Figure 1**), earlier believed to be *Strix butleri*, from Middle East has accordingly been renamed as the Desert Owl or Desert Tawny Owl *S. hadorami* [26].

Even Europe got recently a new owl species, when the taxonomy of Cyprus Scops Owl *Otus cyprius* (**Figure 2**) was reprised in 2015 [27]. And Maghreb (Coastal plains from Morocco to Libya) got its own Tawny Owl as Maghreb Wood Owl *Strix mauritanica* first proposed by Robb et al. [24] and confirmed by Isenmann and Thévenot [28].

Finally, we have now a long waited official confirmation for a new *Megascops* from the Sierra Nevada de Santa Marta (**Figure 3**), Colombia as *Megascops gilesi* [29]. In South America there are still likely to be some new owl species in Brazil, Colombia, Costa Rica, Ecuador, Panama, Peru and Venezuela. It is very promising that the Neotropical Ornithologists are very active and productive so very soon we will hear more about these new owl species in South America [30, 31].

Figure 2.
Latest new owl species in Europe: Cyprus Scops Owl Otus cyprius. *Photo: Courtesy of Tasso Leventis.*

Figure 3.
Santa Marta Screech Owl Megascops gilesi*, Colombia. Photo: Courtesy of Jon Hornbuckle.*

10. Why so many new owls?

One might ask where all the newly discovered owl species come from. Is it because of the new genetic research?

Many owls are so rare that it has not been possible to get blood samples to examine nucleotide sequences in the cytochrome-b gene. Molecular data exists this far only for some 175 species, so 100 or more species waits for official confirmation when new material for DNA-testing becomes available.

To significant extent these 'new owls' have been known to the scientific community as subspecies erroneously (or correctly?) declared as such. To a much smaller degree there are still completely unknown owl species being identified in the tropical forests. However, only 15 'new' owl species have been described after 2001 as shown below:

Number of owls described:

1800	23
1900	173
2000	62
2013	10
2019	5

Desmond Morris [14] has presented a very good reasoning why we are getting so many new owl species every year: "Today authorities vary considerably in their opinions concerning exactly how many species of owls there are. Some accept as few as 150, while others list as many as 220 (and as stated above—the latest 'Owls of the World' even 268—Authors' comment). One of the main reasons for this huge discrepancy is that many owls live on small islands where they develop slight differences from their close relatives on the nearby mainland. It then becomes a matter of taste as to whether you consider one of these isolated populations of owls as a distinct species

or not. For example, there is kind of barn owl that is found on the Andaman Islands in the Indian Ocean. It is significantly smaller than the mainland form, but because the two never encounter one another in the wild it is impossible to tell whether, if they did meet, they would freely interbreed or remain separate. So, one can only guess as to whether they are genuinely distinct species or not. If you happen to be an objective zoologist you are likely to lump the two together as races of the same species, but if instead you are a passionate conservationist you are more likely to view the island form as a distinct and therefore very rare species that needs urgent protection.

11. So how many owl species we have?

It seems to be impossible to answer that question with our present knowledge and it may take some time to find a balance between the two extremes as they are so far apart; i.e., 198 vs. 268. Personally, I find Morris' number [14] more appealing than my own [21] but due to 'political pressure' I am likely to write third edition of 'Owls of the World' with some 275 species! What is sure that we may lose some of the rarest owls very easily if not taking care of the habitat destruction and climate change. If describing them as new species rather than new subspecies helps our conservation efforts—so be it. With the present rate of habitat loss and climate change we will soon lose species faster than we are able to describe the new ones.

A. Appendix 1. A list of 26 species "Concepts" [32]

1. Agamospecies

Synonyms: Microspecies, paraspecies, pseudospecies, semispecies, quasispecies, and genomospecies

2. Autapomorphic species (see Phylospecies)

3. Biospecies

Synonyms: Syngen, speciationist species concept

Related concepts: Biological species concept, genetic species, and isolation species

4. Cladospecies

Synonyms: Internodal species concept, Hennigian species concept, Hennigian convention

5. Cohesion species

Synonyms: Cohesive individual (in part)

6. Compilospecies

Synonyms: None

Related concepts: Introgressive taxa

7. Composite species

   Synonyms: Phylospecies (in part), internodal species (in part) and cladospecies (in part)

8. Ecospecies

   Synonyms: Ecotypes

   Related concepts: Evolutionary species

9. Evolutionary species

   Synonyms: Unit of evolution, evolutionary group

   Related concepts: Evolutionary significant unit

10. Evolutionary significant unit

    Synonyms: Biospecies (in part) and evolutionary species (in part)

11. Genealogical concordance species

    Synonyms: Biospecies (in part), cladospecies (in part), and phylospecies (in part)

12. Genic species

    Synonyms: None

    Related concepts: Genealogical concordance species, genetic species (in part), biospecies (in part), and autapomorphic species (in part)

13. Genetic species

    Synonyms: Gentes (sing. Gents)

    Related concepts: Biospecies, phenospecies, morphospecies and genomospecies

14. Genotypic cluster

    Synonyms: Polythetic species

    Related concepts: Agamospecies, biospecies, genetic species, Hennigian species, morphospecies, non-dimensional species, phenospecies, autapomorphic phylospecies, successional species, taxonomic species, and genomospecies

15. Hennigian species

    Synonyms: Biospecies (in part), cladospecies (in part), phylospecies (in part), and internodal species

16. Internodal species

    Synonyms: Cladospecies and Hennigian species (in part), and phylospecies

17. Least inclusive taxonomic unit (LITUs)

    Synonyms: Evolutionary group (in part), and phylospecies

18. Morphospecies

    Synonyms: Classical species, Linnaean species

    Related concepts: Linnean species, binoms, phenospecies, monothetic species, monotypes, and taxonomic species

19. Non-dimensional species

    Synonyms: Folk taxonomical kinds

    Related concepts: Biospecies, genetic species, morphospecies, paleospecies, successional species, and taxonomic species

20. Nothospecies

    Synonyms: Hybrid species, and reticulate species

    Related concepts: Compilospecies, horizontal or lateral genetic transfer

21. Phylospecies and phylogenetic taxon species

    Synonyms: Autapomorhic phylospecies, monophyletic phylospecies, minimal monophyletic units, monophyletic species, lineages

    Related concepts: Similar to internodal species, cladospecies, composite species, and least inclusive taxonomic units

22. Phenospecies

    Synonyms: Phena (sing. Phenon), operational taxonomic unit

    Related concepts: Biospecies, genetic concordance species, morphospecies, non-dimensional species, phylospecies (in part), phenospecies, successional species, taxonomic species, quasispecies, viral species, and genomospecies (bacterial)

23. Recognition species

    Synonyms: Specific mate recognition system

    Related concepts: Biospecies

24. Reproductive competition species

    Synonyms: Hypermodern species concept, and biospecies (in part)

25. Successional species

    Synonyms: Paleospecies, evolutionary species (in part), and chronospecies

26. Taxonomic species

Synonyms: Cynical species concept

Related concepts: Agamospecies, genealogical concordance species, morphospecies, phenospecies, and phylospecies

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