Species

DEFINITION

Convention Definition

"Species" means any species, subspecies, or geographically separate population thereof;

Convention on International Trade of Endangered Species of Wild Fauna and Flora (CITES) Article 1, Use of Terms[1]

Scientific Definition: Biological Species Concept

Groups of actually or potentially interbreeding natural populations, which are reproductively isolated from other such groups.

Mayr 1942[2]

NOTES ON DEFINITION

The CITES definition is a legal clarification for the purposes of the Convention and is therefore not specifically a definition of a species [2]. A species is, by definition, not a subspecies or a population. In subsequent documents CITES states that their use of the term species refers to the 'biological species concept' [3].

FURTHER DEFINITIONS

Biological species concept in more detail

An interbreeding group of organisms that is reproductively isolated from all other organisms, although there are many partial exceptions to this rule in particular taxa. Operationally, the term species is a generally agreed fundamental taxonomic unit, based on morphological or genetic similarity, that once described and accepted is associated with a unique scientific name.

Millennium Ecosystem Assessment: Ecosystems and Human Wellbeing, Volume 1, Current State and

Trends. [5]

KEY POINTS

- The concept of species makes it possible to identify and quantify wildlife.
- There is considerable philosophical debate in the scientific literature of what a species actually is. This is termed the ‘species problem’.
- Only a small fraction of the total species on earth have been discovered. It is estimated that the over 1.2 million species known to science only represents 14% of terrestrial species and 9% of marine species.
- Two international Multilateral Environmental Agreements (MEA) are in place to protect biodiversity at the species level: The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and the Convention on the Conservation of Migratory Species of Wild Animals (CMS or Bonn Convention).

INTRODUCTION

The concept of species allows us to identify and quantify the wildlife we see around us. The use of species as a unit of quantification provides a way of understanding the diversity of the world around us. It also provides a way of recording its loss. Scientifically, species have a specific nomenclature which provides clarity on what is being discussed. Conservation often focuses on the species level and there are two international Multilateral Environmental Agreements which are particularly focused on the species level.

THE SPECIES PROBLEM

There is considerable debate in the scientific literature of what constitutes a species. This is a separate issue from the taxonomic naming mechanism. The debate around the definition of a species is sometimes known as the 'species problem'. There are numerous concepts of how species should be defined include the morphological species concept, evolutionary species concept, genetic species concept, phenetic species concept, reproductive competition concept and the taxonomic species concept [6]. Originally articulated by Ernst Mayr, one of the most commonly used definitions [7] follows the biological species concept and defines species as “groups of actually or potentially interbreeding natural populations, which are reproductively isolated from other such groups” [4]. The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) highlight that the use of species and subspecies refers to the biological species concept [3] and is broadly based on this idea of reproductive isolation. Many issues, such as how to classify asexual species [8] or those only known from the fossil record [9], are primarily relevant to taxonomy.

DEFINING AND RECORDING SPECIES

Taxonomy is a formal mechanism of classifying life, which arose in the 18th Century with Carl Linnaeus. Species are one level in the hierarchical taxonomic structure. In this structure the highest level is ‘domain’ following in descending order towards species and sub-species:

- domain
- kingdom
- phylum

- class
- order
- family
- genus
- species
- sub-species [10].

The benefit of a classification system is that it allows the application of known information about one taxon (species) to provide predictions about other species which are new to science or about which there is very little information [11].

NAMING CONVENTION (NOMENCLATURE)

Formal nomenclature provides a mechanism to communicate between scientists, lawyers, governments, companies and individuals about a particular species without confusion related to multiple common names and the pitfalls of translation [11].

Linnaeus provided the foundations for all modern classifications including the concept of binomial species nomenclature [11]. Species names are all treated as if they are Latin [10]. Species are commonly referred to using the last two levels of the taxonomic ranking system (described above) as a binomial shorthand process. The first part refers to the genus level and the second part associated with the species e.g. cheetah is *Acinonyx jubatus* [12]. The combination of these two names is unique to each species [13]. There are a number of International Codes for Nomenclature governing the naming of species [14]. In addition a Draft BioCode, containing a set of rules for the naming organisms, has been produced [13]. Species names are not static, biological nomenclature is dynamic to reflect the fact that, as more information is discovered, the understanding of species groupings will change.

SPECIES RICHNESS

The taxonomic and nomenclature work mean that there is a mechanism available to count the number of species on earth. However, this number is the subject of considerable debate and estimates range widely. Over 1.2 million species are already catalogued [15]. However it is thought that this represents only a fraction of the total biodiversity on earth with 86% of the existing terrestrial species, and 91% of the species within the ocean, yet to be discovered. This leads to a prediction that there may be a global species count of over 8.7 million [15]. Species continue to be discovered today, many come from comparatively poorly studied taxa such as micro-organisms, invertebrates or deep ocean species. However, new species are discovered even in well studied taxa such as mammals [16]. Some new species are discovered in threatened habitats, for example a new species of porcupine recently discovered in the threatened Atlantic forest of North-East Brazil [17]. Discoveries such as these show that the amount of biodiversity that could be lost from the destruction of such habitats is higher than simply the number of species already recorded there.

CONSERVATION RELEVANCE: IMPLICATION OF CLASSIFICATION

The precise definition of species is important because species are often seen as the fundamental units of conservation. Classification of species has implications on conservation strategies [18, 19]. The level of isolation between populations can have implications for management and captive breeding programmes [20]. Hybridisation between domestic and wild populations of the same species, or subspecies, is also an issue, causing a potential loss in the genetic fitness of the wild population [21, 22, 23, 24].

CONSERVATION RELEVANCE: FLAGSHIP SPECIES

Some conservation organisations highlight the profile of particularly charismatic or symbolic species, known as flagship species, to leverage funding which may be invested into conservation actions which also benefit a range of other species which exist alongside the flagship species [25]. While this practice has merit because of the social engagement the flagship species can generate [24, 25], this practice has also been criticized, as the use of flagship species to direct in-situ conservation may not lead to protection of the maximum amount of biodiversity [28].

CONVENTIONS

There are two international Multilateral Environmental Agreements (MEA) in place to protect biodiversity which have a particular focus at the species level: CITES and Conservation of Migratory Species of Wild Animals (also known as CMS or Bonn Convention). CITES aims to ensure that international trade in specimens of wild animals and plants does not threaten their survival [29], whilst CMS aims to conserve terrestrial, aquatic and avian migratory species throughout their range [30]. CITES works by subjecting international trade in specimens of selected species to certain controls. Species is the level at which judgement is made for the purposes of implementing CITES [31]. When a species is proposed for listing the Parties to the Convention must agree that it is a 'species'. In some cases CITES will list groups of related species, for example the Order 'Primates' is listed rather than include all species individually. In order to manage the issues of species naming, CITES have the Animals and Plants Committees who deal with nomenclatural issues [32]. Both CITES and CMS contain Appendices with lists of species. However, their taxonomies are not harmonized. Work is ongoing to provide clarity and harmonization of species nomenclature used [33].

SPECIES AND THE STRATEGIC PLAN FOR BIODIVERSITY

The Strategic Plan for Biodiversity 2011-2020 Strategic Goal 'C' is to improve the status of biodiversity by safeguarding ecosystems, species and genetic diversity. There are associated targets with the Strategic Plan called the Aichi Targets. Target 12 and 13 relate to the conservation of species, prevention of extinction and maintenance of genetic diversity of cultivated, domesticated, wild, culturally and economically valuable species [34].

REFERENCES & WEBSITE

1. CITES (1973) Convention on International Trade in Endangered Species of Wild Fauna and Flora. Convention on International Trade in Endangered Species of Wild Fauna and Flora, Washington, USA
2. Hassel AR (2013) Protection of Endangered Species. The interplay between aesthetics, law, economics and evolution. SIAK-Journal - J Police Sci Pract (International Ed 3:84–94
3. CITES Secretariat (2010) Resolution Conf. 9.24 (Rev. CoP15)- Criteria for amendment of Appendices 1 and 2. Secretariait of the Convention on International Trade in Endangered Species of Wild Fauna and Flora, Doha, Qatar
4. Mayr E (1942) Systematics and the Origin of Species, from the Viewpoint of a Zoologist. Harvard University Press, Harvard, USA
5. Hassan R, Scholes R, Ash N (eds) (2005) Millenium Ecosystem Assessment: Ecosystems and Human Wellbeing, Volume 1, Current State and Trends. Island Press, Washington

6. Hey J (2001) The mind of the species problem. Trends Ecol Evol 16:326–329
7. De Queiroz K (2005) Ernst Mayr and the modern concept of species. Proc Natl Acad Sci U S A 102 Suppl :6600–7
8. Schloegel JJ (1999) From Anomaly to Unification: Tracy Sonneborn and the Species Problem in Protozoa, 1954-1957. J Hist Biol 32:93–132
9. Wilkins JS (2009) Species: A History of the Idea. University of California Press, California, USA
10. Hawksworth DL (2001) Nomenclature, systems of. In: Levin SA (ed) Encycl. Biodivers. Vol 4. Academic Press, San Diego, USA, pp 389–402
11. Wheeler QD (2001) Systematics, Overview. In: Levin SA (ed) Encycl. Biodivers. Academic Press, San Diego, USA, pp 569–88
12. UNEP (Comps) (2011) Checklist of CITES species. CITES Secretariat & UNEP-WCMC, Geneva, Switzerland
13. Greuter W, Garrity G, Hawksworth D, et al (2011) Draft BioCode (2011) Principles and Rules regulating the naming of organisms. Bionomina 3:26–44
14. Hawksworth DL (2010) Terms Used in Bionomenclature: The Naming of Organisms and Plant Communities Including Terms Used in Botanical, Cultivated Plant, Phylogenetic, Phytosociological, Prokaryote (bacteriological), Virus, and Zoological Nomenclature. 215
15. Mora C, Tittensor DP, Adl S, Simpson AGB, Worm B (2011) How many species are there on Earth and in the ocean? PLoS Biol 9:e1001127
16. Ceballos G, Ehrlich PR (2009) Discoveries of new mammal species and their implications for conservation and ecosystem services. Proc Natl Acad Sci U S A 106:3841–6
17. Pontes ARMP, Gadelha JR, Melo ERA, Bezerra de Sa F, Loss AC, Junior VC, Costa LP, Leite YR (2013) A new species of porcupine, genus Coendou (Rodentia: Erethizontidae) from the Atlantic forest of northeastern Brazil. Zootaxa 3636:421
18. Frankham R, Ballou JD, Dudash MR, Eldridge MDB, Fenster CB, Lacy RC, Mendelson JR, Porton IJ, Ralls K, Ryder OA (2012) Implications of different species concepts for conserving biodiversity. Biol Conserv 153:25–31
19. Mace GM (2004) The role of taxonomy in species conservation. Philos Trans R Soc Lond B Biol Sci 359:711–9
20. Zachos FE (2013) Taxonomy: Species splitting puts conservation at risk. Nature 494:35
21. Allendorf FW, Leary RF, Spruell P, Wenburg JK (2001) The problems with hybrids: setting conservation guidelines. Trends Ecol Evol 16:613–622
22. Kidd AG, Bowman J, Lesbarrères D, Schulte-Hostedde AI (2009) Hybridization between escaped domestic and wild American mink (Neovison vison). Mol Ecol 18:1175–86
23. Oliveira R, Godinho R, Randi E, Ferrand N, Alves PC (2007) Molecular analysis of hybridisation between wild and domestic cats (Felis silvestris) in Portugal: implications for conservation. Conserv Genet 9:1–11
24. Randi E, Lucchini V (2002) Detecting rare introgression of domestic dog genes into wild wolf (Canis lupus) populations by Bayesian admixture analyses of microsatellite variation. Conserv Genet 3:29–43
25. Walpole MJ, Leader-Williams N (2002) Tourism and flagship species in conservation. Biodivers Conserv 11:543–547
26. Xiang Z, Yu Y, Yang M, Yang J, Niao M, Li M (2011) Does flagship species tourism benefit conservation? A case study of the golden snub-nosed monkey in Shennongjia National Nature Reserve. Chinese Sci Bull 56:2553–2558
27. Caro T, Engilis A, Fitzherbert E, Gardner T (2004) Preliminary assessment of the flagship species concept at a small scale. Anim Conserv 7:63–70
28. CITES (2013) How CITES works. http://www.cites.org/eng/disc/how.php. Accessed 30 Jul 2013

29. Convention on the Conservation of Migratory Species of Wild Animals (1979) Convention on the Conservation of Migratory Species of Wild Animals. Convention on Migratory Species Secretariat, Bonn, Germany
30. Favre DS (1989) International Trade in Endangered Species: A Guide to CITES. Kluwer Academic Publishers, Dordrecht, Netherlands
31. Wijnstekers W (2011) The Evolution of CITES. International Council for Game and Wildlife Conservation, Budakeszi, Hungary
32. CITES Secretariat (2010) Harmonization of nomenclature and taxonomy with other multilateral environmental agreements. CoP15 Doc.12. Secretariat of the Convention on International Trade in Endangered Species of Wild Fauna and Flora, Doha, Qatar
33. CBD Secretariat (2010) The Strategic Plan for Biodiversity 2011-2020 and the Aichi Biodiversity Targets. Document UNEP/CBD/COP/DEC/X/2. Secretariat of the Convention on Biological Diversity, Nagoya, Japan

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