Potentially Threatened – a Data Deficient flag for conservation management

Ivan Jarić[1,2*], Franck Courchamp[3], Jörn Gessner[1] and David L. Roberts[4]

[1] Leibniz-Institute of Freshwater Ecology and Inland Fisheries, Müggelseedamm 310, 12587 Berlin, Germany

[2] Institute for Multidisciplinary Research, University of Belgrade, Kneza Viseslava 1, 11000 Belgrade, Serbia

[3] Ecologie, Systématique and Evolution, Univ. Paris-Sud, CNRS, AgroParisTech, Université Paris-Saclay, 91400, Orsay, France

[4] Durrell Institute of Conservation and Ecology, School of Anthropology and Conservation, Marlowe Building, University of Kent, Canterbury, Kent, CT2 7NR, United Kingdom

[*] Author to whom correspondence should be addressed: Leibniz-Institute of Freshwater Ecology and Inland Fisheries, Müggelseedamm 310, 12587 Berlin, Germany; E-mail: jaric@igb-berlin.de; phone: +49 (0)30 64181 766, fax.: +49 (0)30 64181 626

Abstract

Data Deficient species (DD) comprise a significant portion of the total number of species listed within the IUCN Red List. Although they are not classified within one of the threat categories, they may still face high extinction risks. However, due to limited data available to infer their extinction risk reliably, it is unlikely that the assessment of the true status of Data Deficient species would be possible before many species decline to extinction. An appropriate measure to resolve these problems would be to introduce a flag of Potentially Threatened species within the Data Deficient category (i.e., DD(PT)). Such a flag would represent a temporary Red List status for listed Data Deficient species that are, based on the available direct evidence and/or indirect indices, likely to be assigned to one of the threat categories, but where current data remains insufficient for a complete classification. The use of such a flag could increase the focus of the scientific community and conservation decision-makers on such species, thus avoiding the risk that necessary conservation measures are implemented too late. As such, establishment of the DD(PT) category as a kind of alarm for priority species could be beneficial.

Keywords: Data Deficient; endangered species; extinction risk; IUCN Red List; threatened species.

The IUCN Red List of Threatened Species is considered as one of the most relevant information sources and decision-making support tools for conservation management (Rodrigues et al. 2006; IUCN 2015). However, for many species, limited or insufficient data are available on their geographic distribution, abundance, population trends and threats to infer their extinction risk reliably. This leaves those conducting assessments in a dilemma: based on available data and acknowledging the associated uncertainties, can a classification other than Data Deficient (DD; IUCN 2001) be made? How assessors incorporate and handle the uncertainties associated with poorly known species can result in the difference between a species being listed as Data Deficient or as threatened.

Data Deficient species represent as much as 16% of the total number of species listed within the IUCN Red List (i.e., approximately 13,000 out of the 80,000 species assessed so far are classified as Data Deficient; IUCN 2015). Although they are not classified within the threat categories, Data Deficient species may still face high extinction risks, and may actually be more frequently threatened than successfully evaluated species (Howard and Bickford 2014; Bland et al. 2015; Jetz and Freckelton 2015; Roberts et al. 2016). This problem was also illustrated by recent population declines reported in some Data Deficient species (Morais et al. 2013). Many of these species may in fact be perilously close to extinction (Schipper et al. 2008).

At the same time, such species may be neglected by research and conservation programs, with funding rarely being directed to address specifically the problem of Data Deficient species (Morais et al. 2013; Bland et al. 2015). Lack of conservation focus is mainly driven by their uncertain conservation status (Bland et al. 2015), as well as by the tendency of conservation managers to prioritize well-studied species (Sitas et al. 2009). The Data Deficient category is essentially different from the other categories, since its listing does not imply that a taxon is not threatened, but represents an expression of necessity for additional efforts by researchers.

Assessment of the true status of Data Deficient species could be achieved through focused field surveys (Bland et al. 2015). However, given the necessary time, man-power and monetary implications in collecting baseline data on all Data Deficient species, it is unlikely that this would be possible before populations of many species decline, potentially to extinction (Howard and Bickford 2014; Bland et al. 2015). Given the very large number of species classified as Data Deficient, there is also a need to prioritize those that should be studied first and removed from this category, with prioritization primarily on the grounds of potential threat.

We suggest that one of the appropriate measures to resolve this problem would be to introduce a flag of Potentially Threatened species within the Data Deficient category (i.e., DD(PT)), as a temporary Red List status that would warn that such species are potentially threatened and that monitoring, research and conservation attention are required. The idea behind such a flag follows the establishment of the flag of potentially extinct species within the Critically Endangered category (CR(PE); Butchart et al. 2006), as both flags represent temporary classifications until more detailed information are made available to confirm suspected species status.

We define Potentially Threatened Data Deficient species as those that are, based on available direct evidence and/or indirect indices, likely to be assigned to one of the threat categories (i.e., VU, EN or CR), but where current data remains insufficient for a complete classification. It is important to emphasize that the liberal use of the Data Deficient category should be discouraged, and all species with sufficient information for their inclusion within one of the threat categories should be classified as such (IUCN 2001). Furthermore, we advise against the direct use of DD(PT) flag for newly assessed species, to avoid further inflation of the Data Deficient category; it should be preferably applied only to the current Data Deficient species, i.e. those that have been classified as such within previous assessments.

Although Data Deficient species lack information needed for a Red List classification, large amounts of life-history, ecological, and phylogenetic information may be available for many of these species (Bland et al. 2015). While these data alone can be technically insufficient for making a standardized decision on classifying a species into one of the 'data-sufficient' categories, they can be nevertheless used for indirect threat assessments. In recent years, a number of indirect assessment methods have been applied to Data Deficient species within different groups, mainly mammals and amphibians, to infer their likely threat level (Table 1). Most frequently used approaches were machine-learning methods, largely based on information related to geographic range, life-history and ecological data, phylogeny, environmental data and threat intensity (Howard and Bickford 2014; Bland et al. 2015). The general characteristic of all the methods was their attempt to model the relationship between different types of information related to 'data-sufficient' species and their Red List classification, and to apply it thereafter to Data Deficient species based on the available information. Such methods should be considered as sufficient evidence for classifying assessed species within the DD(PT) category. The proportion of Data Deficient species considered to be potentially threatened varied between studies; for instance, predictions for Data Deficient mammal species ranged from 35% (Jones and Safi 2011) to 69% (Jetz and Freckelton 2015; Table 1). However, in accordance with the precautionary principle, each species identified as potentially threatened with extinction by one or several of the applied methods should be a candidate for the DD(PT) category. From a conservation perspective, it would be more problematic to incorrectly deny the DD(PT) status to a species than to incorrectly attribute it. Conversely, species identified by all the methods as likely to be not-threatened would remain within the general Data Deficient category until sufficient data and analyses can identify their adequate threat category.

Beside the methods listed in Table 1, other methods designed for extinction risk assessment of data-poor species could also be applied, based on the type and the amount of available data. For instance, for many Data Deficient species, biological collections or sighting records represent the only available data (Roberts et al. 2016). In such situations, application of methods that infer threat based on the observation records would be appropriate (e.g. Burgman et al. 1995, 2000; McCarthy 1998; Regan et al. 2000; McInerny et al. 2006; Robbirt et al. 2006).

However, the recognition of DD(PT) flag for species already in the Data Deficient category would contribute to the better research and conservation prioritization of those species for which a sound classification other than Data Deficient cannot be made. The use of such a flag would reduce the risk of these species being neglected by the scientific community and conservation decision-makers, to the point when postponed conservation measures are implemented too late. Establishment of the DD(PT) flag could be highly beneficial as a temporary measure, designed to highlight the status of such species. Given that they are also likely to be threatened with extinction, species classified as DD(PT) should be recognised as a major research priority. Research efforts are expected to be more effective and yield more critical knowledge if they are directed to the least known species (de Lima et al. 2011). Given that they are also likely to be threatened with extinction, species classified as DD(PT) should be recognised as a major research priority.

Classification of DD(PT) species could also serve as a platform to instigate and enhance communication within the scientific community on the true status of such species. One of the primary roles of the IUCN Red List is to contribute to conservation efforts, as a communication tool for decision-makers, funding sources, scientific community and the general public. Establishment of the DD(PT) category as a kind of alarm for potential priority species would fit this purpose and likely prove to be a highly beneficial tool, with the scientific community and managers involved in monitoring programs as its major end-users.

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Table 1. Examples of studies that involved indirect estimation of extinction threat for Data Deficient species.

Reference	Assessed DD species	Method	Used data	Results
Davidson et al. 2009	Mammals	Decision-tree modelling, classification tree and random forest modelling	11 explanatory variables; geographic range, density, group size, mass-specific production, home range, body mass, habitat mode and activity period identified as relevant predictors	28 out of 341 assessed species (8%) determined to be at high extinction risk
Jones and Safi 2011	Mammals	Combination of spatial eigenvector estimation and phylogenetic eigenvectors	Phylogenetic, distribution and environmental data	35% of 481 assessed species determined to be threatened with extinction
Morais et al. 2013	Brazilian anuran species	Quantile regression to model a relationship between the time since species discovery and range-size	Time since species description and current species distribution	37 of 231 assessed species (16%) determined to be threatened with extinction, overall rate likely 57%
Howard and Bickford 2014	Amphibians	Machine-learning method, random forest models	Extinction risk data and distribution ranges	63% of 1249 assessed species determined to be probably threatened with extinction
Quintero et al. 2014	Mexican amphibians	Machine-learning method, random forest models	14-15 explanatory variables, including data on species' life history and population trends, environmental data and negative impacts	18 out of 24 assessed species (75%) determined to be declining
Bland et al. 2015	Terrestrial mammals	Seven machine learning methods: classification tree, random forest, boosted tree, k nearest neighbours,	29-36 explanatory variables, including data on species' life history and ecology, environmental data and	313 of 493 assessed species (63%) determined to be threatened with extinction

		support vector machine, neural network, and decision stumps	measures of threat intensity	
Jetz and Freckelton 2015	Mammals	Spatial-phylogenetic statistical framework, generalized linear models, generalized least-squares approach	Body mass, distribution and encroachment (anthropogenic habitat transformation) data	331 of 483 assessed species (69%) determined to be threatened with extinction
Luiz et al. 2016	Groupers (Teleostei: Epinephelidae)	Ordinal analytical approach, cumulative link mixed-effects modelling	Body-size, maximum depth of occurrence, breadth of habitat use, geographic range size, aggregative spawning behaviour, and biogeographical region	6 of 50 assessed species (12%) determined to be endangered or vulnerable