



**MINISTRY OF ENVIRONMENT AND SPATIAL PLANNING**

**THE RED BOOK OF VASCULAR FLORA OF THE REPUBLIC OF KOSOVO**

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**FADIL MILLAKU (EDITOR-IN-CHIEF)**

**FERAT REXHEPI, ELEZ KRASNIQI, QAZIM PAJAZITAJ, XHAVIT MALA, NAIM BERISHA**

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**REVIEWER**

**Alfred Mullaj**

**Andraz Carni**

**PREPARATION OF MAPS**

**Ass. Dr. Ferim Gashi**

**ALBANIAN-ENGLISH TRANSLATION**

**Ilir Selmanmusaj**

**Editor**

**Ilir Selmanmusaj**

## Preface

Although world governments support the ideas for the conservation of global biodiversity, many of those governments, while protecting their economic interests use technologies that cause pollution and often negative impacts on biodiversity. In many countries of the world, including Kosovo, as a consequence of failing to implement global conventions on conservation of biodiversity, *considerable losses of biodiversity, including changes of habitat, its extreme usages, pollution, as well as climatic changes have taken place.*

*In its tenth meeting, the Conference on Biological Diversity adopted a consolidated document dealing with the Global Strategy for Plant Conservation (GSPC<sup>1</sup>) 2011 - 2020, which in its vision provides for a positive and sustainable future where human activities will support the diversity of plant life (including the endurance of plant genetic diversity, survival of plant species and communities together with their associated habitats and ecological associations), whereby the diversity of plants takes the role of supporting and improving our livelihoods and well-being. The second objective, out of 16 objectives of GSPC in total, is an assessment of the conservation status of all known plant species with the purpose of guiding the conservation action.*

Today, there are many environment associations distributed worldwide, which play an important role in national or international level in the preservation of rare and endangered species. These organizations and associations of regional, national or international nature in cooperation with governments of developed countries are working to prevent or at least to slow down the extinction of rare and endangered species. The education of population in general, and in particular of rural population, living close to rich biodiversity areas is critically important in the conservation of the plant life. It is also very crucial to undertake measures in protecting species that may have international, national or regional importance and to determine to what extent they are threatened. To this end, a database for endangered species is established. This would have high impact in determining the priorities for conservation of certain species.

Environmental protection experts, after collecting the adequate literature and other necessary data on certain species and habitats in which they grow, would be able to undertake adequate measures in their conservation and preservation.

Based on the field research, we have concluded that the main factor in the Republic of Kosovo that influences the reduction of many species is the human one. Over the last decade, in Kosovo's forests and pastures fires have been frequent, which were usually caused from negligence or in some cases they were set on purpose. Some areas saw habitat degradation as a consequence of fires and erosion. In these degraded localities, certain plant species could not be revived, and their place was taken from other (invasive) vegetative species that can influence in the change of floristic structure of ecosystems.

*The Red List of Vascular Flora of the Republic of Kosovo is important since it focuses the attention of all those who deal with nature on the threat posed to biodiversity, it detects those species that need protection measures and puts in place an information basis for further monitoring. The Red Book has critical importance because it provides the information that helps in compiling the protection priorities at local level and enables a genuine cooperation with international organizations dealing with environment protection, such as the Convention on Biological Diversity and the Convention on International Trade in Endangered Species of Wild Fauna and Flora.*

*The selection of plant taxa for this volume is based on the data available in existing literature, the list of plants included in the "Administrative Instruction No. 18/2012 for the Declaration of Protected and Strictly Protected Wild Species that are assessed as endangered, rare or very rare species, as well as on the current state of the species in the field.*

*In drafting the Red Book of Vascular Flora of the Republic of Kosovo, we consulted the European Red List of Vascular Plants (Bilz, M. et al. 2011). Based on the "Guidelines for Using the IUCN Red List Categories and Criteria - Version 8.1 (2010)", there are nine categories in the Red List System: Extinct (EX), Extinct in the Wild (EW), Critically Endangered (CR), Endangered (EN), Vulnerable (VU), Near Threatened (NT), Least Concern (LC), Data Deficient (DD) and Not Evaluated (NE). The categories: Vulnerable, Endangered and Critically Endangered are based in their decline scale, the size of population, the space of geographic distribution and in the evaluation of distribution fragmentation of the assessed species. All species inserted in the Red Book of the Republic of Kosovo have been seen in their habitats and their current state has been assessed, namely notes have been taken for the population, subpopulation, extent of occurrence (EOO), area of occupancy (AOO), the mature individuals of the population/subpopulation were counted, where possible, and the risk causes were explored.*

*Since this is the first Red Book compiled in the Republic of Kosovo, we have not had preliminary data for the state of certain taxon populations. This has disabled us to give accurate figures for many taxa in respect of their size of populations/subpopulations in the past, and whether their habitats have been decreasing or increasing.*

Authors

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<sup>1</sup> Global Strategy for Plant Conservation (GSPC)

## Acknowledgment

The project "The Red Book of Vascular Flora of the Republic of Kosovo" was carried out with the support of "German Cooperation" implemented by "Deutsche Gesellschaft für Internationale Zusammenarbeit"(GIZ) through the project "Rural Economic Development" in Kosovo.

Ministry of Environment and Spatial Planning (MESP) gave its contribution to the implementation of this project through the publication of this Book.

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Directorate of the National Park (Sharri);

Ministry of Agriculture, Forestry and Rural Development (MAFRD), and within it the Kosovo Forestry Agency and its staff. Particularly we thank the head of the Agency, Eng. Ahmet Zejnullahu, who through "Deutsche Gesellschaft für Internationale Zusammenarbeit" (GIZ) provided the program "RAMAS" Red List Professional on Data Processing for the included species in the Red Book of Vascular Flora of the Republic of Kosovo.

We would also like to thank all forestry directorates in Kosovo and the forests rangers for the assistance provided during the fieldwork.

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Përparim Gashi – MESP

Qenan Maxhuni – MESP

Fadil Bajraktari – MESP

Rizah Hajdari – MESP

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Mr. Halit Avdijaj - Agroproduct "Ltd" Istog and Mr. Nuredin Bajrami "HIT" Dragash

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Last but not least, we would also like to thank all those who in one way or another contributed in the finalization of the first Red Book of Vascular Flora of the Republic of Kosovo.

Authors

## Introduction

***“All the conditions for Kosovo to have the Red Book of Vascular Flora were established after the declaration of Kosovo as independent and democratic state on 17 February 2008”.***

The Red Book of Vascular Flora of the Republic of Kosovo is a document on the flora present but that can be extinguished. The preservation of floristic diversity and undertaking prevention measures is a very important task influencing directly in the global environment protection. Destruction of flora and fauna occurs as a consequence of the action of anthropogenic factor related to the negligence, lack of interest and lack of knowledge. Consequently, nowadays in the world, and in Kosovo, various habitats have been destructed, where also plant and animal species that are unknown for the science have extinguished. Today we have scientific data teaching us how to conserve ecosystems, habitats and the biodiversity in general. The conditions for the conservation of plant and animal species are created through the conservation of these resources.

The Republic of Kosovo, although a state with small territory (10.908 km<sup>2</sup>), is rather rich in its plant diversity. The flora of the Republic of Kosovo consists of algae, lichens, mushrooms, *ferns, gymnosperm and angiosperm that are the basis of life and create the green layer of the earth that has direct impact in the life of human beings and animals. Without negating the importance of any vegetative group for the life in our planet, including life in Kosovo; vascular plants, in particular seed plants (gymnosperm and angiosperm) have the main role in the vegetation of Kosovo with a direct impact in its climate, air, water and soil.*

Although research of the flora and vegetation in Kosovo have been conducted by various local and international authors, still there is no inventory of flora, and the exact number of vegetative taxa in Kosovo is not known. According to data available by various authors, it is thought that in Kosovo there are approximately 2800-3000 species of vascular flora.

This floristic diversity comes as a result of geographical position of Kosovo in Balkans, the historical background of flora and vegetation of Kosovo, diversified pedological and geological composition, climate factor, the position of mountains surrounding Kosovo and impacts of floristic elements from Mediterranean, Europe and Asia. Indiscriminant wood-cutting, degradation of habitats and global climate changes are factors that have direct impact in the extinction of various plant and animal species. *Important habitats are being damaged and degraded, and ecosystems are being destabilized as a consequence of human intervention, particularly in the ecosystems near settlements. In the last years, as a consequence of indiscriminant wood-cutting and fires, various species are faced with the danger of losing their habitat and incoming invasive species that often change the floristic structure of ecosystems.*

*In the aspect of floristic diversity, the Sharri Mountains, the Albanian Alps (Cursed Mountains), Koritnik and Pashtrik are particularly distinguished with endemic, relict and endemic-relict plant species, without leaving aside the Northern and Central Kosovo that are also rich in endemic and relict species.*

It is the first time that in the Republic of Kosovo a Red Book is elaborated in which 237 plant taxa are included, the majority of which are rare, endemic plants of Balkans and endemic plants of Kosovo. Information for the Red Book of Vascular Flora of Kosovo have been gathered from the field since 2000, but the intensive work in its finalization was carried out during 2011-2013.

Out of 237 taxa elaborated in the Red Book, 3 species are Pteridophyta, 4 species are Gymnosperm, 210 taxa are Dicotyledonae and 20 taxa are Monocotyledonae.

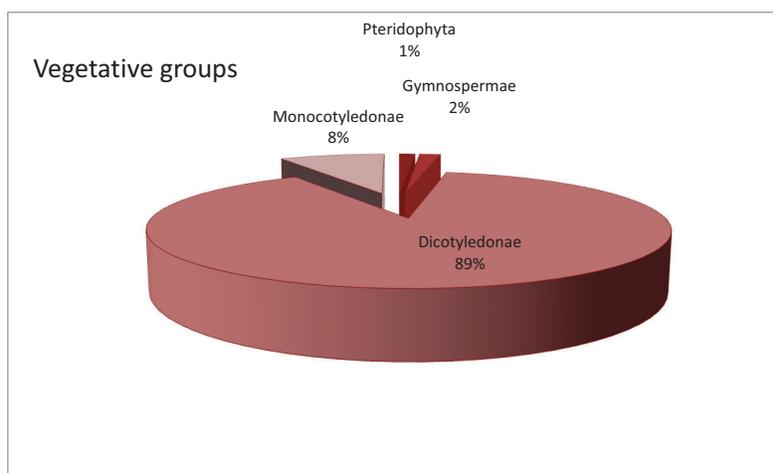


Fig.1. Main vegetative groups included in the Red Book

Considering that developed countries of Europe and wider have published the red lists and red books in which the data on rare and endangered species, as well as on the already extinct species are presented, it was time to publish a Red Book of Vascular Flora also in the Republic of Kosovo, which would include data from the field on plant species which are extinct, critically extinct, endangered, vulnerable or for which in one way or another there is a possibility to be at risk or to be extinguished.

The publication of the Red Book of Vascular Flora of the Republic of Kosovo will more or less influence the prevention of negative activities of humans towards nature and in this case towards the flora of Kosovo.

Various international documents have been approved in order to prevent the negative activity of humans towards nature, such as: Bern Convention (1979) on the Conservation of Flora, Fauna and Habitats; Bonn Convention (1979) on the Conservation of Migratory Species; Convention of Washington (1973) on International Trade in Endangered Species of Wild Fauna and Flora, etc. The first step in the conservation of species either in the global, regional or local aspect is the recognition of the species threatening statute. This is enabled by the Red Book

which gives sufficient data for endangered species. These data included in this text will provide data to adequate ministries that deal with environment protection for taking measures in the conservation of these species and biodiversity in general. Only scientific data for the noticed and assessed species in the field will be published in this book. Data on the Red Book will be a good basis for undertaking measures and establishing programs for the conservation of rare and endangered species.

Out of 275 000 species of vascular flora of the world, approximately 34 000 species and subspecies are endangered. According to Walter, K. S. & Gillett H. J. (1998) out of this number: 6522 species are endangered from extinction (EN), 7950 have the statute of vulnerable species (VU), 14 504 are rare species (R) and 4070 species are indeterminate (I).

Based on the newest biodiversity-related data, there are many causes influencing the decrease of number of species in our planet. Developments of industry, infrastructure, increase of the number of inhabitants, global warming, etc. are the main factors endangering the biodiversity.

According to Walter, K. S. & Gillett H. J. (1998) from the total flora with endangered species is distributed as follows: USA 25%, Europe 20%, Australia 15%, Southern Africa 10%, Central America 7%. In Balkans there are no exact data related to the state of endangered species. According to Stevanovic, V. (1999) around 3% are endangered in Albania, in Greece 11.5%, Serbia and Montenegro around 20%.

The first Red Book was published in Switzerland (Red Data Book) in 1955. The idea for the elaboration of a Global Red Book arose in 1960 (International Union Commission of Nature, Species Survival Commission-IUCN-SSC). In 1978 the first Global Book was published including 250 species out of 25 000 that were presented as endangered. Although it was a book where the number of species was very small when we take into consideration the number of endangered species in the earth, this was a good initiative since it was ensued with the publication of many national red books. The Red Book has ethical, economic, educational, practical and institutional importance. The Red Book of Vascular Flora of the Republic of Kosovo will provide data on the priorities of nature protection, identification of endangered zones, objective data on endangered species using global standards, motivation of people to protect the nature through different activities, data on endangered species, the threatened level, factors endangering species and habitats, a database to monitor the state of endangered species.

We consider that this Book is valuable for the institutions dealing with environment protection (MESP, MAFRD), schools, and associations dealing with environment protection as well as companies dealing with the usage of medical and aromatic plants. This Book could be used also by all nature lovers. We consider that our data related to the assessment of species included in this Book are close to the real state of species, but based on the fact that this is the first Book of its kind in Kosovo, there was no possibility of comparison of the state with the previous period, thus this Book will be a basis for further research in this field.

Based on the nature protection experience of advanced countries in this field, we consider that this work should continue in the future with new supplements on the current state of plant species, as well as by creating possibilities for more rational conservation and usage of this national wealth that remains for the next generations. We are aware that we could not include all endangered vegetative species in the territory of the Republic of Kosovo in this volume, thus this remains to be done in the future.

The included species in the Red Book of Vascular Flora of Kosovo according to Raunkjær are presented in figure 2. The figure shows that Hemicryptophytes dominate with 155 taxa, then Geophytes with 32 and Chamaephytes with 27. Phanerophytes with 19 taxa are in a smaller number and with the least Therophytes with just 4 taxa.

*During intensive research conducted in the field, the working group has noticed some new species for the flora of Kosovo in general, but also in certain cases even wider – for the flora of South-Eastern Europe. We have noticed 9 new plant taxa for the flora of Kosovo. These species are: *Crocus flavus*, *Quercus robur* subsp. *pedunculiflora*, *Cyanus lingulatus*, *Juniperus sabina*, *Ranunculus degenii*, *Viola herzogii*, *Pulsatilla alpina*, *Minuartia baldaccii* subsp. *baldaccii* and *Gypsophila spergulfolia*.*

Fadil Millaku

## STATUTE OF ASSESSED SPECIES

For this purpose, 237 taxa have been processed in the Red Book of Vascular Flora of the Republic of Kosovo, out of which, based on the IUCN Criteria (based on the "Guidelines for Using the IUCN Red List Categories and Criteria - Version 8.1 (August, 2010)", they have been assessed and categorized as follows: Extinct (EX) 1 species, Extinct in the Wild (EW) 1 species, Critically Endangered (CR) 61 taxa, Endangered (EN) 86 taxa, Vulnerable (VU) 19 taxa, Near Threatened (NT) 34 taxa, and Least Concern (LC) 35 taxa, while for the category Data Deficient (DD) and Not Evaluated (NE) we have not put any taxon. Figure 3 presents the number of plant taxa included in the Red Book belonging to different threat categories.

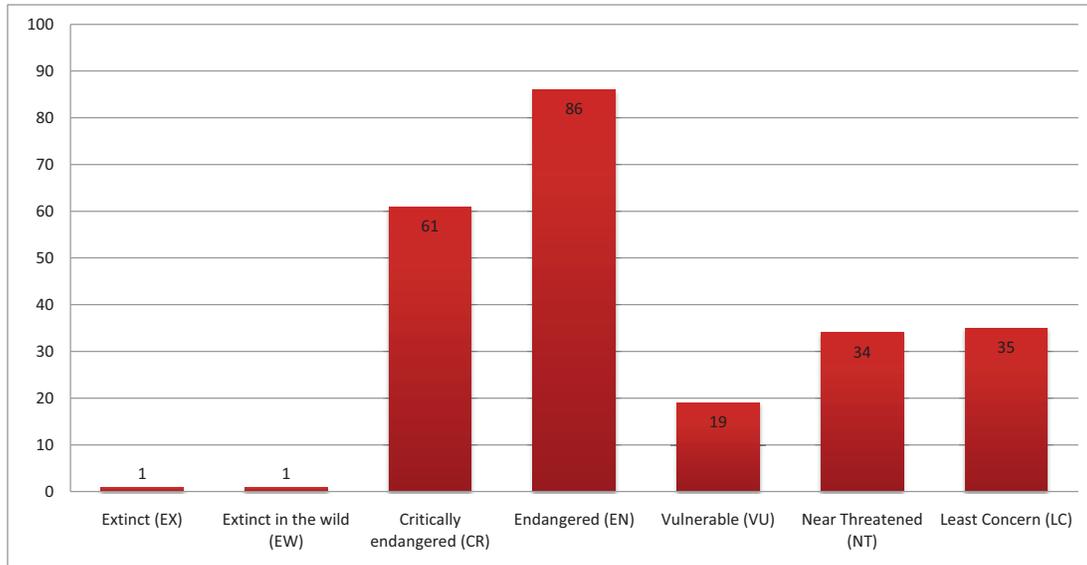


Fig.2. Graphical presentation of the number of vegetative species belonging to different threat categories.

Out of 237 plant taxa assessed in compliance with the IUCN Criteria: in the category of Extinct (EX) there is 0.4% (1 species), Extinct in the Wild (EW) there are also 0.4% (1 species), Critically Endangered - 26% (61 species), Endangered (EN) - 36% (86 taxa), Vulnerable (VU) - 8% (19 taxa), Near Threatened - 18% (34 taxa), and Least Concern - 16% (35 taxa) (Fig. 2).

## Main Risks Threatening the Plants Included in the Red Book of the Republic of Kosovo

By using Annex III (List of risks used from the IUCN Red List), namely the listed and coded risks in it, we have continuously compared the dominating and potential risks threatening the plants of our country. Strategies and plans on the conservation of plant species should put special attention to main risks that can be found in this separate paragraph. Although risks that threaten plants differ among species, the dominant ones would be the following: limited coverage, limited distribution, low density, avalanches /landslides, livestock, fire, degradation of the habitat by human factor, etc.

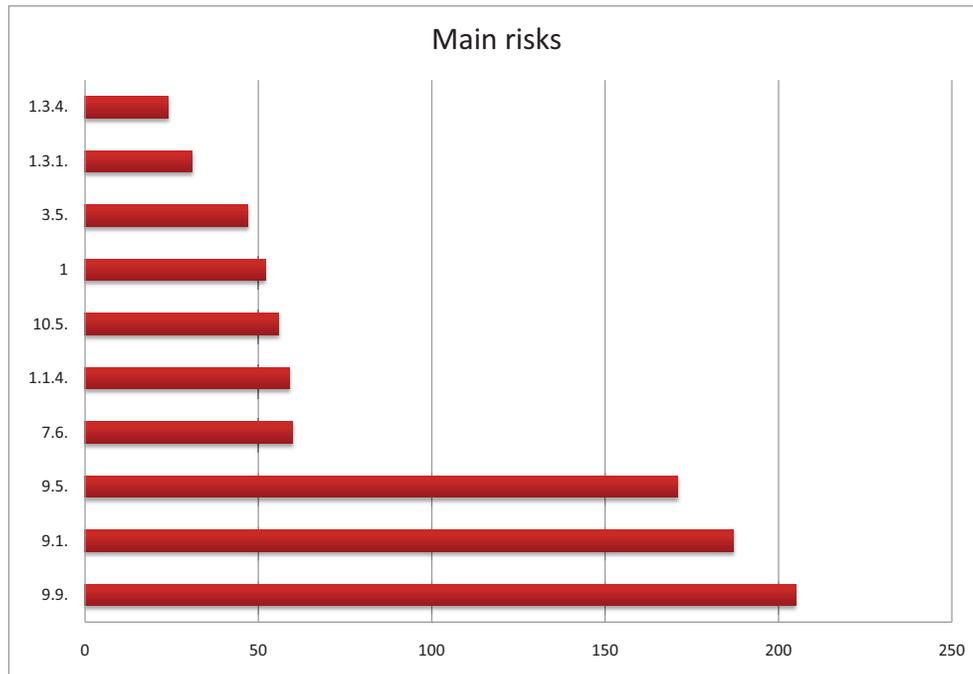


Fig.3. Main risks threatening plants (9.9. Limited coverage, 9.1. Limited distribution, 9.5. Low density, 7.6. Avalanches/Landslides, 1.1.4. Livestock, 10.5. Fire, 1. Habitat loss and degradation (human factor), 3.5. Scientific/cultural activities and leisure activities, 1.3.1. Mines, 1.3.4. Collection of non-wood vegetation)

## Guidelines for the Definitions of Terms Used in the Criteria for the Assessment of the Threat Scale

*The following definitions have been taken from the IUCN Guidelines (Version 8.1 – 2010).*

*The terms used in the IUCN Red List Categories and Criteria must be clearly understood to ensure that taxa are correctly assessed. The following terms are defined in the IUCN Red List Categories and Criteria (version 3.1) on pages 10-13. These definitions are interpreted with additional guidelines that assist enough in their interpretation.*

### *Population and Population Size (Criteria A, C and D)*

*"The term 'location' defines a geographically or ecologically distinct area in which a single threatening event can rapidly affect all individuals of the taxon present. The size of the location depends on the area covered by the threatening event, and may include part of one or many subpopulations. Where a taxon is affected by more than one threatening event, location should be defined by considering the most serious plausible threat." (IUCN 2001)*

*The term 'population' is used in a specific sense in the Red List Criteria that is different to its common biological usage. Population is here defined as the total number of individuals of the taxon. For functional reasons, primarily owing to differences between life forms, population size is measured as numbers of mature individuals only. In the case of taxa obligatory dependent on other taxa for all or part of their life cycles, biologically appropriate values for the host taxon should be used.*

*The interpretation of the definition into question depends fundamentally in the understanding of the definition of "mature individuals", which has been given in the explanation and is discussed in the section below.*

### *Subpopulations (Criteria B and C)*

*"Subpopulations are defined as geographically or otherwise distinct groups in the population between which there is little demographic or genetic exchange (typically one successful migrant individual or gamete per year or less)." - IUCN 2001.*

*The significance of subpopulations in the criteria relates to the additional risks faced by taxa where the population is either fragmented into many small units or where most individuals are concentrated into one unit. Operational methods for determining the number of subpopulations may vary according to the taxon; in the case of tree species, for example, a subpopulation can be defined as a spatially distinct segment of the population that experiences insignificant seed or pollen migration from other subpopulations within a generation.*

### *Mature individuals (Criteria A, B, C and D)*

*"The number of mature individuals is the number of individuals known, estimated or inferred to be capable of reproduction.*

*Mature individuals that will never produce new recruits should not be counted (e.g., densities are too low for fertilization);*

*Where the population size fluctuates, use a lower estimate - in most cases this will be much less than the mean;*

*In the case of taxa that naturally lose all or a subset of mature breeding individuals at some point in their life cycle, the estimate should be made at the appropriate time, when mature individuals are available for breeding;*

*Notes on defining mature individuals*

*The definition of mature individuals differs slightly from that given in version 2.3 of the Red List Categories and Criteria (of 1994). Some groups have found the more recent definition of mature individuals to be less conservative and less precise, leading to a potential down-listing of some taxa (e.g., obligate co-operative breeders) even though their extinction risk has not changed. The ability of an assessor to estimate or infer which individuals are capable of reproduction is paramount and highly contingent on the particular features of the taxon or group.*

## Working Methodology

Drafting the Red Book of Vascular Flora of the Republic of Kosovo was based on the “Guidelines for Using the IUCN Red List Categories and Criteria - Version 8.1 (August, 2010)”.

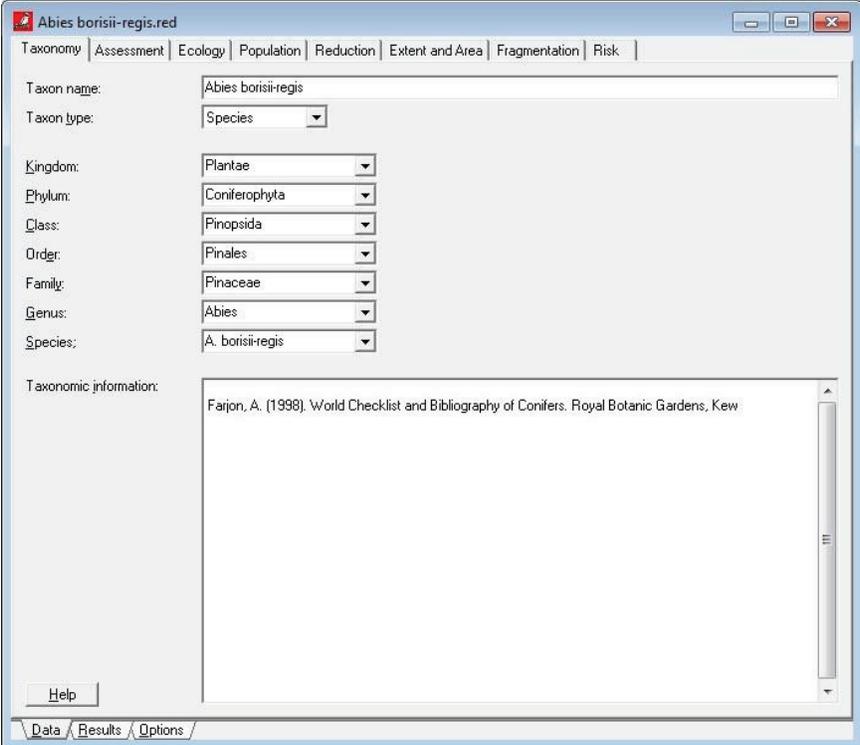
The forms with necessary data for the assessment of threat categories have been filled in for all species noticed in the field. Ten samples have been taken for each assessed species in the field (with exemption of species with small number of mature individuals) that have been put in herbarium and are found in the Faculty of Natural and Mathematical Sciences –Department of Biology in Prishtinë. The assessed species for the Red Book have been photographed with digital camera, the coordinates (GPS) have been recorded, the mature individuals have been counted where it was possible, the causes of threatening of species, the area of occupancy (AOO) has been measured, the habitat type has been noted, the accompanying species, the geological-pedological composition, the altitude, inclination, aspect as well as the habitat degradation scale. The extent of occurrence (EOO) has been measured using the UTM system. Determination of points in the map was realized based on the coordinates taken from the localities of distribution of species included in the Red Book.

The scientific names of plants have been processed according to The Plant List (working list of all plant species), Euro+Med PlantBase and Flora Europea (I-V). The species that have not been included in the abovementioned literature are named using the literature, such as: Flora of the SR of Albania (I-IV), Flora of Bulgaria (I-XI), Flora of Serbia (I-X), Flora of Macedonia (I-VI) etc. Naming of the species in Albanian language has been done according to the Flora of Albania (I-IV) and the Dictionary for the Names of Plants (Krasniq, F. et al. 2003). Listing of taxa within threat categories is done on alphabetic order.

In order to assess the threat statute of vegetative species analyzed at national level, we have used an explicit spatial approach, allowing also the insertion of certain obscurities in the entry data (IUCN 2003, Mace et al. 2008). Initially, the working team, taking into consideration the assessed state and the collected data in the field, has given a preliminary assessment (separately) of the threatened statute for each species separately, always based on the IUCN Red List Criteria (Guidelines for Using the IUCN Red List Categories and Criteria, Version 8.1). Further on, these assessments have been reprocessed taking into consideration the general opinion in an open discussion manner. After this, we continued with the following elaboration of these data through the specific software program for Red List – known as RAMAS.

The elaboration of data on the species included in the Red Book of Vascular Flora of the Republic of Kosovo with the Program RAMAS Red List Professional (Akçakaya & Root 2007) was done from the research team.

The analysis has been conducted by using the program RAMAS Red List Professional (Akçakaya & Root 2007), where a special importance has been given to the following data: species taxonomy, generation length, geographical distribution, data on population (number of mature individuals), Extent of Occurrence (EOO) and Area of Occupancy (AOO) in km<sup>2</sup>, number of populations/subpopulations, number of locations, main risks, length of generation, number of mature individuals, size of population and bigger subpopulation (expressed in number of mature individuals), the extinction probability of the wild species (within 15, 25, 100 years) etc.



The screenshot shows the 'Abies borisii-regis.red' window in the RAMAS Red List Professional software. The window has a menu bar with 'Taxonomy', 'Assessment', 'Ecology', 'Population', 'Reduction', 'Extent and Area', 'Fragmentation', and 'Risk'. Below the menu bar, there are several input fields for taxonomic information: 'Taxon name' (Abies borisii-regis), 'Taxon type' (Species), 'Kingdom' (Plantae), 'Phylum' (Coniferophyta), 'Class' (Pinopsida), 'Order' (Pinales), 'Family' (Pinaceae), 'Genus' (Abies), and 'Species' (A. borisii-regis). Below these fields is a 'Taxonomic information' section with a text area containing the citation: 'Farjon, A. (1998). World Checklist and Bibliography of Conifers. Royal Botanic Gardens, Kew'. At the bottom of the window, there is a 'Help' button and a status bar with 'Data / Results / Options'.

Fig. 4. Preview from the species statistical data of the RAMAS Red List Professional

Although the advanced bio-mathematical program RAMAS had big space for data entry, thus increasing the percentage of accuracy in the final threat assessment, we had a significant limitation in this regard, since we were doing an assessment of species for the first time and we were faced with considerable lack of data from the past (e.g. in the section of populations, number of mature individuals of species 15 years ago) – what disabled thus to do an accurate forecast of extinction of the species in the future.

For detailed data on the program, see the section Summary - RAMAS Red List Professional

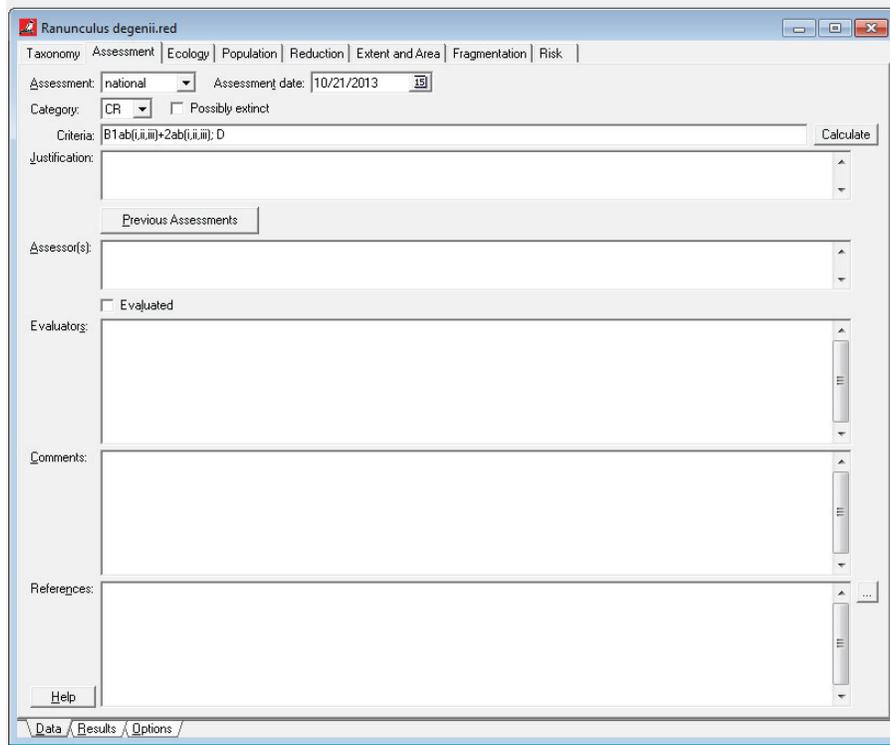


Fig.5. Preview from the species risk assessment part of the RAMAS Red List Professional.

## RAMAS® Red List Professional

(Spatial and Temporal Data Analysis for Threatened Species Classifications Under Uncertainty)

### Description of the programme

Ramas Red List Professional consists of three integrated modules: RAMAS Red List 3.0, Temporal Analysis Module and Spatial Analysis Module. The first of these is the main program that is used to make threatened species assessments; the other two are data analysis modules used to estimate the parameters required for a red list assessment.

RAMAS Red List 3.0 implements IUCN (2001) threatened species criteria, which are rules for assigning species into categories representing different levels of threat in the nature. The IUCN rules are based on information about such characteristics as number and distribution of individuals, fluctuations and decline in abundance and distribution, and risk of extinction. These characteristics are used as input data; the output is a classification into one of the categories, such as Critically Endangered (CR), Endangered (EN), Vulnerable (VU), Near Threatened (NT), and Least Concern (LC).

When any method for classification of conservation status is used, the user confronts several kinds of uncertainty. These uncertainties arise from natural variability (resulting from the fact that species' life histories and the environments in which they live are changing over time), measurement error (i.e., the variability in parameter values that results from inaccuracies in estimating them) and semantic uncertainty (i.e., a lack of precision in the definition of terms or a lack of consistency in different assessors' usage of them).

RAMAS Red List implements the IUCN criteria for classifying species into threat categories, but meantime it allows for explicit incorporation of uncertainties in the input data. In other words, input data, such as the number of mature individuals, can be specified either as a number, or as a range of numbers, or a range of numbers plus a best estimate. RAMAS Red List propagates these uncertainties. Depending on the uncertainties, the resulting classification is often a single category, accompanied by a range of plausible categories.

RAMAS Red List Professional also includes two modules for estimating the variables (such as range area and population reduction) needed for an IUCN assessment. These modules, named Spatial Analysis and Temporal Analysis, estimate these variables based on survey or recorded data, and put them into the Red List assessment in the correct format.

<b>Aneks I. Summary of the five criteria (A-E) used to evaluate if a taxon belongs in a threatened category (Critically Endangered, Endangered or Vulnerable).</b>			
Use any of the criteria A–E	<b>CR</b>	<b>EN</b>	<b>VU</b>
<b>Population reduction</b> (A1,A2,A3,A4)	Declines measured over the longer of 10 years or 3 generations		
<b>A1.</b> Population reduction observed, estimated, inferred, or suspected in the past where the causes of the reduction are clearly reversible <b>AND</b> understood <b>AND</b> have ceased, based on and specifying any of the following: <i>(a). direct observation</i> <i>(b). an index of abundance appropriate to the taxon</i> <i>(c). a decline in area of occupancy (AOO), extent of occurrence (EOO) and/or habitat quality</i> <i>(d). actual or potential levels of exploitation</i> <i>(e). effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.</i>	≤90% ≤80%	≤70% ≤60%	≤50% ≤30%
<b>A2.</b> Population reduction observed, estimated, inferred, or suspected in the past where the causes of reduction may not have ceased <b>OR</b> may not be understood <b>OR</b> may not be reversible, based on (a) to (e) under A1.	≤90% ≤80%	≤70% ≤60%	≤50% ≤30%
<b>A3.</b> Population reduction projected or suspected to be met in the future (up to a maximum of 100 years) based on (b) to (e) under A1.	≤90% ≤80%	≤70% ≤60%	≤50% ≤30%
<b>A4.</b> An observed, estimated, inferred, projected or suspected population reduction (up to a maximum of 100 years) where the time period must include both the past and the future, and where the causes of reduction may not have ceased <b>OR</b> may not be understood <b>OR</b> may not be reversible, based on (a) to (e) under A1.	≤90% ≤80%	≤70% ≤60%	≤50% ≤30%
<b>B. Geographic range in the form of either B1 (extent of occurrence) AND/OR B2 (area of occupancy)</b>			
<b>B1.</b> Extent of occurrence (EOO)	<100 km <sup>2</sup>	<5000 km <sup>2</sup>	20.000 km <sup>2</sup>
<b>B2.</b> Area of occupancy (AOO)	<10 km <sup>2</sup>	<500 km <sup>2</sup>	2000 km <sup>2</sup>
<b>AND at least 2 of the following:</b>			
a. Severely fragmented, <b>OR</b> Number of location	= 1	≥ 5	≤ 10
<b>(b)</b> Continuing decline in any of: <b>(i)</b> extent of occurrence; <b>(ii)</b> area of occupancy; <b>(iii)</b> area, extent and/or quality of habitat; <b>(iv)</b> number of locations or subpopulations; <b>(v)</b> number of mature individuals.			
<b>(c)</b> Extreme fluctuations in any of: <b>(i)</b> extent of occurrence; <b>(ii)</b> area of occupancy; <b>(iii)</b> number of locations or subpopulations; <b>(iv)</b> number of mature individuals.			
<b>C. Small population size and decline</b> Number of mature individuals	<250	<2500	<10.000
<b>AND either C1 or C2:</b>	25% in 3 years or 1 generation	20% in 5 years or 2 generations	10% in 10 years or 3 generations
<b>C1.</b> An estimated continuing decline of at least:			
<b>C2.</b> A continuing decline <b>AND</b> (a) and/or (b):			
<b>(a i)</b> Number of mature individuals in each subpopulation:	<50	<250	<1000
<b>(a ii)</b> % individuals in one subpopulation =	90-100%	95-100%	100%
<b>(b)</b> Extreme fluctuations in the number of mature individuals.			
<b>D. Very small or restricted population</b> <b>Either:</b> Number of mature individuals	<50	<250	<b>D1.</b> < 1,000 <b>AND/OR</b>
<b>VU D2.</b> Restricted area of occupancy or number of locations with a plausible future threat that could drive the taxon to CR or EX in a very short time.			<b>D2.</b> typically: AOO<20 km <sup>2</sup> or number of locations ≤ 5
<b>E. Quantitative Analysis</b>			
Indicating the probability of extinction in the wild to be:	≥ 50% in 10 years or 3 generations (100 years max.)	≥ 20% in 20 years or 5 generations (100 years max.)	≥ 10% in 100 years

## Annex III. List of threats used by IUCN Red List

- 0. No threats**
- 1. Habitat Loss and Degradation (human-induced)**
  - 1.1. Agriculture**
    - 1.1.1. Crops**
      - 1.1.1.1. Shifting agriculture
      - 1.1.1.2. Small-holder farming
      - 1.1.1.3. Agro-industry farming
    - 1.1.2. Wood plantations**
      - 1.1.2.1. Small-scale
      - 1.1.2.2. Large-scale
    - 1.1.3. Non-timber plantations**
      - 1.1.3.1. Small-scale
      - 1.1.3.2. Large-scale
    - 1.1.4. Livestock**
      - 1.1.4.1. Nomadic
      - 1.1.4.2. Small-holder
      - 1.1.4.3. Agro-industry
    - 1.1.5. Abandonment
    - 1.1.6. Marine aquaculture
    - 1.1.7. Freshwater aquaculture
    - 1.1.8. Other
    - 1.1.9. Unknown
  - 1.2. Land management of non-agricultural areas**
    - 1.2.1. Abandonment
    - 1.2.2. Change of management regime
    - 1.2.3. Other
    - 1.2.4. Unknown
  - 1.3. Extraction**
    - 1.3.1. Mining**
    - 1.3.2. Fisheries**
      - 1.3.2.1. Subsistence
      - 1.3.2.2. Artisanal /small-scale
      - 1.3.2.3. Large-scale/industrial
    - 1.3.3. Wood**
      - 1.3.3.1. Small-scale subsistence
      - 1.3.3.2. Selective logging
      - 1.3.3.3. Clear-cutting
    - 1.3.4. Non-woody vegetation collection
    - 1.3.5. Coral removal
    - 1.3.6. Groundwater extraction
    - 1.3.7. Other
    - 1.3.8. Unknown
  - 1.4. Infrastructure development**
    - 1.4.1. Industry
    - 1.4.2. Human settlement
    - 1.4.3. Tourism and recreation
    - 1.4.4. Transport - land/air
    - 1.4.5. Transport – water
    - 1.4.6. Dams
    - 1.4.7. Telecommunications
    - 1.4.8. Power lines
    - 1.4.9. Other
    - 1.4.10. Unknown
  - 1.5. Invasive alien species (directly impacting habitat)
  - 1.6. Change in native species dynamics (directly impacting habitat)
  - 1.7. Fires
  - 1.8. Other causes
  - 1.9. Unknown causes
- 2. Invasive alien species (directly affecting the species)**
- 2.1. Competitors**
- 2.2. Predators**
- 2.3. Hybridizers**
- 2.4. Pathogens/parasites**
- 2.5. Other**
- 2.6. Unknown**
- 3. Harvesting [hunting/gathering]**
  - 3.1. Food**
    - 3.1.1. Subsistence use/local trade
    - 3.1.2. Sub-national/national trade
    - 3.1.3. Regional/international trade
  - 3.2. Medicine**
    - 3.2.1. Subsistence use/local trade
    - 3.2.2. Sub-national/national trade
    - 3.2.3. Regional/international trade
  - 3.3. Fuel**
    - 3.3.1. Subsistence use/local trade
    - 3.3.2. Sub-national/national trade
    - 3.3.3. Regional/international trade
  - 3.4. Materials**
    - 3.4.1. Subsistence use/local trade
    - 3.4.2. Sub-national/national trade
    - 3.4.3. Regional/international trade
  - 3.5. Cultural/scientific/leisure activities**
    - 3.5.1. Subsistence use/local trade
    - 3.5.2. Sub-national/national trade
    - 3.5.3. Regional/international trade
  - 3.6. Other**
  - 3.7. Unknown**
- 4. Accidental mortality**
  - 4.1. By-catch**
    - 4.1.1. Fisheries-related**
      - 4.1.1.1. Hooking
      - 4.1.1.2. Netting
      - 4.1.1.3. Entanglement
      - 4.1.1.4. Dynamite
      - 4.1.1.5. Poisoning
    - 4.1.2. Terrestrial**
      - 4.1.2.1. Trapping/snaring/netting
      - 4.1.2.2. Shooting
      - 4.1.2.3. Poisoning
    - 4.1.3. Other**
    - 4.1.4. Unknown**
  - 4.2. Collision**
    - 4.2.1. Pylon and building collision
    - 4.2.2. Vehicle collision
    - 4.2.3. Other
    - 4.2.4. Unknown
  - 4.3. Other**
  - 4.4. Unknown**
- 5. Persecution**
  - 5.1. Pest control
  - 5.2. Other
  - 5.3. Unknown
- 6. Pollution (affecting habitat and/or species)**
  - 6.1. Atmospheric pollution**
    - 6.1.1. Global warming/oceanic warming
    - 6.1.2. Acid precipitation
    - 6.1.3. Ozone hole effects

- 6.1.4. Smog
- 6.1.5. Other
- 6.1.6. Unknown
- 6.2. Land pollution
  - 6.2.1. Agricultural
  - 6.2.2. Domestic
  - 6.2.3. Commercial/Industrial
  - 6.2.4. Other non-agricultural
  - 6.2.5. Light pollution
  - 6.2.6. Other
  - 6.2.7. Unknown
- 6.3. Water pollution
  - 6.3.1. Agricultural
  - 6.3.2. Domestic
  - 6.3.3. Commercial/Industrial
  - 6.3.4. Other non-agricultural
  - 6.3.5. Thermal pollution
  - 6.3.6. Oil slicks
  - 6.3.7. Sediment
  - 6.3.8. Sewage
  - 6.3.9. Solid waste
  - 6.3.10. Noise pollution
  - 6.3.11. Other
  - 6.3.12. Unknown
- 6.4. Other
- 6.5. Unknown
- 7. Natural disasters**
  - 7.1. Drought
  - 7.2. Storms/flooding
  - 7.3. Temperature extremes
  - 7.4. Wildfire
  - 7.5. Volcanoes
  - 7.6. Avalanches/landslides
  - 7.7. Other
  - 7.8. Unknown
- 8. Changes in native species dynamics**
  - 8.1. Competitors
  - 8.2. Predators
  - 8.3. Prey/food base
  - 8.4. Hybridizers
  - 8.5. Pathogens/parasites
  - 8.6. Mutualisms
  - 8.7. Other
  - 8.8. Unknown
- 9. Intrinsic Factors**
  - 9.1. Limited dispersal
  - 9.2. Poor recruitment/reproduction/regeneration
  - 9.3. High juvenile mortality
  - 9.4. Inbreeding
  - 9.5. Low densities
  - 9.6. Skewed sex ratios
  - 9.7. Slow growth rates
  - 9.8. Population fluctuations
  - 9.9. Restricted range
  - 9.10. Other
  - 9.11. Unknown
- 10. Human disturbance**
  - 10.1. Recreation/tourism
  - 10.2. Research
  - 10.3. War/civil unrest
  - 10.4. Transport
  - 10.5. Fire
- 10.6. Other
- 10.7. Unknown
- 11. Other
- 12. Unknown

## The IUCN Red List Categories

### **EXTINCT (EX)**

A taxon is Extinct when there is no reasonable doubt that the last individual has died. A taxon is presumed Extinct when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycles and life form.

### **EXTINCT IN THE WILD (EW)**

A taxon is Extinct in the Wild when it is known only to survive in cultivation, in captivity or as a naturalized population (or populations) well outside the past range. A taxon is presumed Extinct in the Wild when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.

### **CRITICALLY ENDANGERED (CR)**

A taxon is Critically Endangered when the best available evidence indicates that it meets any of the criteria A to E for Critically Endangered, and it is therefore considered to be facing an extremely high risk of extinction in the wild.

### **ENDANGERED (EN)**

A taxon is Endangered when the best available evidence indicates that it meets any of the criteria A to E for Endangered, and it is therefore considered to be facing a very high risk of extinction in the wild.

### **VULNERABLE (VU)**

A taxon is Vulnerable when the best available evidence indicates that it meets any of the criteria A to E for Vulnerable, and it is therefore considered to be facing a high risk of extinction in the wild.

### **NEAR THREATENED (NT)**

A taxon is Near Threatened when it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future.

### **LEAST CONCERN (LC)**

A taxon is Least Concern when it has been evaluated against the criteria and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened. Widespread and abundant taxa are included in this category.

### **DATA DEFICIENT (DD)**

A taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. A taxon in this category may be well studied, and its biology well known, but appropriate data on abundance and/or distribution are lacking. Data Deficient is therefore not a category of threat. Listing of taxa in this category indicates that more information is required and acknowledges the possibility that future research will show that threatened classification is appropriate. It is important to make positive use of whatever data are available. In many cases great care should be exercised in choosing between DD and a threatened status. If the range of a taxon is suspected to be relatively circumscribed, if a considerable period of time has elapsed since the last record of the taxon, threatened status may well be justified.

### **NOT EVALUATED (NE)**

A taxon is Not Evaluated when it has not yet been evaluated against the criteria.

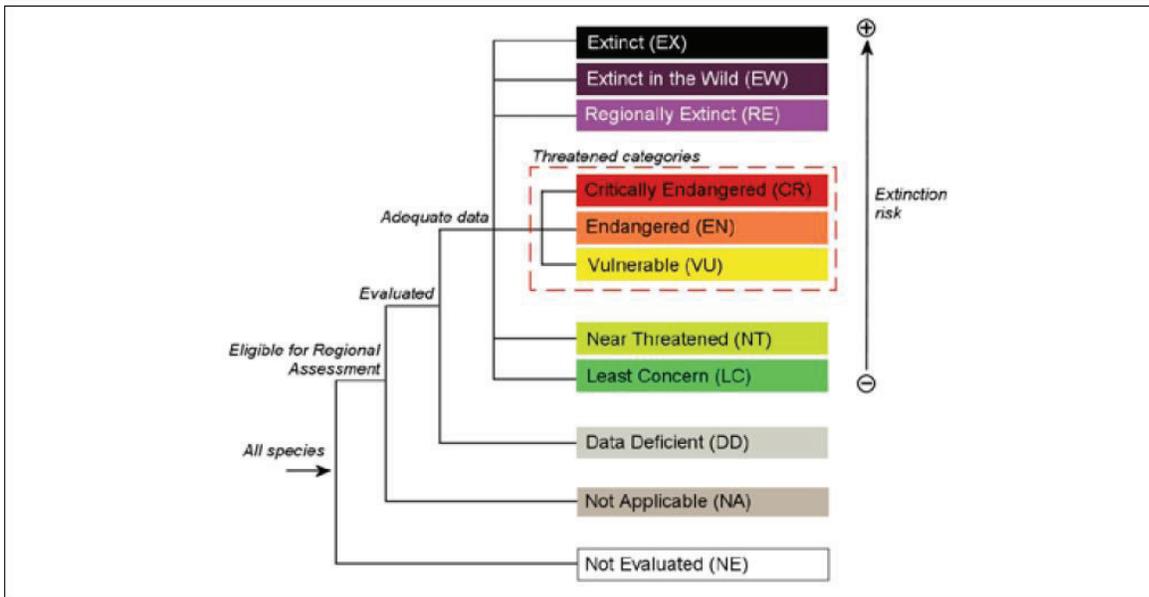


Figure 6. IUCN Red List Categories at regional scale