CHAPTER 2.

A GENERAL ACCOUNT ON THE CATEGORIES AND CRITERIA OF THREATENED PLANTS AND CATEGORIES OF ENDEMIC PLANTS
Chapter 2: A General Account on the Categories and Criteria of Threatened Plants and Categories of Endemic Plants

The identification and protection of species facing a high risk of extinction in the near future is one of the central objectives of modern conservation and the categories and criteria for classifying the threatened plants. It seems to be the basic pre-requisite of any conservation assessment, because it provides the mechanism for identification of the threatened species.

2.1. CATEGORIES AND CRITERIA OF THREATENED PLANTS:

The IUCN Red List Categories and Criteria were first published in 1994 (IUCN 1994). In order to stabilize the assessment procedure these Categories and Criteria were extensively reviewed between 1997 and 1999. The revised Categories and Criteria (IUCN Red List Categories and Criteria version 3.1) were adopted by IUCN Council in February 2000 which are as follows.

2.1.1 THE CRITERIA FOR CRITICALLY ENDANGERED, ENDANGERED AND VULNERABLE PLANTS (AFTER IUCN, 2001):

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

A. Reduction in population size based on any of the following:

1. An observed, estimated, inferred or suspected population size reduction of ≥90% over the last 10 years or three generations, whichever is the longer, where the causes of the reduction are clearly reversible AND understood AND ceased, based on (and specifying) any of the following:

(a) direct observation
(b) an index of abundance appropriate to the taxon
(c) a decline in area of occupancy, extent of occurrence and/or quality of habitat
(d) actual or potential levels of exploitation
(e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.
2. An observed, estimated, inferred or suspected population size reduction of ≥80% over the last 10 years or three generations, whichever is the longer, where the reduction or its causes may not have ceased OR may not be understood OR may not be reversible, based on (and specifying) any of (a) to (e) under A1.

3. A population size reduction of ≥80%, projected or suspected to be met within the next 10 years or three generations, whichever is the longer (up to a maximum of 100 years), based on (and specifying) any of (b) to (e) under A1.

4. An observed, estimated, inferred, projected or suspected population size reduction of ≥80% over any 10 year or three generation period, whichever is longer (up to a maximum of 100 years in the future), where the time period must include both the past and the future, and where the reduction or its causes may not have ceased OR may not be understood OR may not be reversible, based on (and specifying) any of (a) to (e) under A1.

B. Geographic range in the form of either B1 (extent of occurrence) OR B2 (area of occupancy) OR both:

1. Extent of occurrence estimated to be less than 100 km², and estimates indicating at least two of a–c:
   a. Severely fragmented or known to exist at only a single location.
   b. Continuing decline, observed, inferred or projected, in any of the following:
      (i) extent of occurrence
      (ii) area of occupancy
      (iii) area, extent and/or quality of habitat
      (iv) number of locations or subpopulations
      (v) number of mature individuals.
   c. Extreme fluctuations in any of the following:
      (i) extent of occurrence
      (ii) area of occupancy
      (iii) number of locations or subpopulations
      (iv) number of mature individuals.

2. Area of occupancy estimated to be less than 10 km², and estimates indicating at least two of a–c:
   a. Severely fragmented or known to exist at only a single location.
   b. Continuing decline, observed, inferred or projected, in any of the following:
      (i) extent of occurrence
      (ii) area of occupancy
      (iii) area, extent and/or quality of habitat
      (iv) number of locations or subpopulations
(v) number of mature individuals.

c. Extreme fluctuations in any of the following:
   (i) extent of occurrence
   (ii) area of occupancy
   (iii) number of locations or subpopulations
   (iv) number of mature individuals.

C. Population size estimated to number fewer than 250 mature individuals and
   either:
   1. An estimated continuing decline of at least 25% within three years or one
      generation, whichever is longer, (up to a maximum of 100 years in the future) OR
   2. A continuing decline, observed, projected, or inferred, in numbers of mature
      individuals AND at least one of the following (a–b):
      a. Population structure in the form of one of the following:
         (i) no subpopulation estimated to contain more than 50 mature individuals,
         OR
         (ii) at least 90% of mature individuals in one subpopulation.
      b. Extreme fluctuations in number of mature individuals.

D. Population size estimated to number fewer than 50 mature individuals.

E. Quantitative analysis showing the probability of extinction in the wild is at
   least 50% within 10 years or three generations, whichever is the longer (up to
   a maximum of 100 years).

2.1.1.2. Endangered (EN):

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

A. Reduction in population size based on any of the following:
   1. An observed, estimated, inferred or suspected population size reduction of ≥70%
      over the last 10 years or three generations, whichever is the longer, where the
      causes of the reduction are clearly reversible AND understood AND ceased, based
      on (and specifying) any of the following:
      (a) direct observation
      (b) an index of abundance appropriate to the taxon
      (c) a decline in area of occupancy, extent of occurrence and/or quality of habitat
      (d) actual or potential levels of exploitation
      (e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors
         or parasites.
   2. An observed, estimated, inferred or suspected population size reduction of ≥50%
      over the last 10 years or three generations, whichever is the longer, where the
      reduction or its causes may not have ceased OR may not be understood OR may not
      be reversible, based on (and specifying) any of (a) to (e) under A1.
3. A population size reduction of ≥50%, projected or suspected to be met within the next 10 years or three generations, whichever is the longer (up to a maximum of 100 years), based on (and specifying) any of (b) to (e) under A1.

4. An observed, estimated, inferred, projected or suspected population size reduction of ≥50% over any 10 year or three generation period, whichever is longer (up to a maximum of 100 years in the future), where the time period must include both the past and the future, and where the reduction or its causes may not have ceased OR may not be understood OR may not be reversible, based on (and specifying) any of (a) to (e) under A1.

B. Geographic range in the form of either B1 (extent of occurrence) OR B2 (area of occupancy) OR both:

1. Extent of occurrence estimated to be less than 5000 km², and estimates indicating at least two of a–c:
   a. Severely fragmented or known to exist at no more than five locations.
   b. Continuing decline, observed, inferred or projected, in any of the following:
      (i) extent of occurrence
      (ii) area of occupancy
      (iii) area, extent and/or quality of habitat
      (iv) number of locations or subpopulations
      (v) number of mature individuals.
   c. Extreme fluctuations in any of the following:
      (i) extent of occurrence
      (ii) area of occupancy
      (iii) number of locations or subpopulations
      (iv) number of mature individuals.

2. Area of occupancy estimated to be less than 500 km², and estimates indicating at least two of a–c:
   a. Severely fragmented or known to exist at no more than five locations.
   b. Continuing decline, observed, inferred or projected, in any of the following:
      (i) extent of occurrence
      (ii) area of occupancy
      (iii) area, extent and/or quality of habitat
      (iv) number of locations or subpopulations
      (v) number of mature individuals.
   c. Extreme fluctuations in any of the following:
      (i) extent of occurrence
      (ii) area of occupancy
      (iii) number of locations or subpopulations
      (iv) number of mature individuals.

C. Population size estimated to number fewer than 2500 mature individuals and either:

1. An estimated continuing decline of at least 20% within five years or two
generations, whichever is longer, (up to a maximum of 100 years in the future) OR

2. A continuing decline, observed, projected, or inferred, in numbers of mature individuals AND at least one of the following (a–b):
   a. Population structure in the form of one of the following:
      (i) no subpopulation estimated to contain more than 250 mature individuals,
      OR
      (ii) at least 95% of mature individuals in one subpopulation.
   b. Extreme fluctuations in number of mature individuals.

D. Population size estimated to number fewer than 250 mature individuals.

E. Quantitative analysis showing the probability of extinction in the wild is at least 20% within 20 years or five generations, whichever is the longer (up to a maximum of 100 years).

2.1.1.3. Vulnerable (VU):

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

A. Reduction in population size based on any of the following:
   1. An observed, estimated, inferred or suspected population size reduction of ≥ 50% over the last 10 years or three generations, whichever is the longer, where the causes of the reduction are: clearly reversible AND understood AND ceased, based on (and specifying) any of the following:
      (a) direct observation
      (b) an index of abundance appropriate to the taxon
      (c) a decline in area of occupancy, extent of occurrence and/or quality of habitat
      (d) actual or potential levels of exploitation
      (e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.

   An observed, estimated, inferred or suspected population size reduction of ≥ 30% over the last 10 years or three generations, whichever is the longer, where the reduction or its causes may not have ceased OR may not be understood OR may not be reversible, based on (and specifying) any of (a) to (e) under A1.

   A population size reduction of ≥ 30%, projected or suspected to be met within the next 10 years or three generations, whichever is the longer (up to a maximum of 100 years), based on (and specifying) any of (b) to (e) under A1.

   An observed, estimated, inferred, projected or suspected population size reduction of ≥ 30% over any 10 year or three generation period, whichever is longer (up to a maximum of 100 years in the future), where the time period must include both the
past and the future, and where the reduction or its causes may not have ceased OR may not be understood OR may not be reversible, based on (and specifying) any of (a) to (e) under A1.

B. Geographic range in the form of either B1 (extent of occurrence) OR B2 (area of occupancy) OR both:

1. Extent of occurrence estimated to be less than 20,000 km$^2$, and estimates indicating at least two of a–c:
   a. Severely fragmented or known to exist at no more than 10 locations.
   b. Continuing decline, observed, inferred or projected, in any of the following:
      (i) extent of occurrence
      (ii) area of occupancy
      (iii) area, extent and/or quality of habitat
      (iv) number of locations or subpopulations
      (v) number of mature individuals.
   c. Extreme fluctuations in any of the following:
      (i) extent of occurrence
      (ii) area of occupancy
      (iii) number of locations or subpopulations
      (iv) number of mature individuals.

2. Area of occupancy estimated to be less than 2000 km$^2$, and estimates indicating at least two of a–c:
   a. Severely fragmented or known to exist at no more than 10 locations.
   b. Continuing decline, observed, inferred or projected, in any of the following:
      (i) extent of occurrence
      (ii) area of occupancy
      (iii) area, extent and/or quality of habitat
      (iv) number of locations or subpopulations
      (v) number of mature individuals.
   c. Extreme fluctuations in any of the following:
      (i) extent of occurrence
      (ii) area of occupancy
      (iii) number of locations or subpopulations
      (iv) number of mature individuals.

C. Population size estimated to number fewer than 10,000 mature individuals and either:

1. An estimated continuing decline of at least 10% within 10 years or three generations, whichever is longer, (up to a maximum of 100 years in the future) OR

2. A continuing decline, observed, projected, or inferred, in numbers of mature individuals AND at least one of the following (a–b):
a. Population structure in the form of one of the following:
   (i) no subpopulation estimated to contain more than 1000 mature individuals,
   
   OR

   (ii) all mature individuals are in one subpopulation.

b. Extreme fluctuations in number of mature individuals.

D. Population very small or restricted in the form of either of the following:

   Population size estimated to number fewer than 1000 mature individuals.

   Population with a very restricted area of occupancy (typically less than 20 km²) or
   number of locations (typically five or fewer) such that it is prone to the effects of
   human activities or stochastic events within a very short time period in an uncertain
   future, and is thus capable of becoming Critically Endangered or even Extinct in a
   very short time period.

E. Quantitative analysis showing the probability of extinction in the wild is at
   least 10% within 100 years.

2.2. APPLICATION IUCN CRITERIA AT REGIONAL LEVEL:

The word regional is means any subglobal geographically defined area, such as a
continent, country, state, or province and regional assessment denotes process for
determining the relative extinction risk of a regional population according to the
guidelines. According to IUCN (2003) regional assessments should be carried out in a
two-step process. In step one, the IUCN Red List Criteria are applied to the regional
population of the taxon, resulting in a preliminary categorization. All data used in this
initial assessment – such as number of individuals and parameters relating to area,
reduction, decline, fluctuations, subpopulations, locations, and fragmentation– should be
from the regional population.

In step two, the existence and status of any conspecific populations outside the
region that may affect the risk of extinction within the region should be investigated. If
the taxon is endemic to the region or the regional population is isolated, the Red List
Category defined by the criteria should be adopted unaltered. If, on the other hand,
conspecific populations outside the region are judged to affect the regional extinction
risk, the regional Red List Category should be changed to a more appropriate level that
reflects the extinction risk as defined by criterion E (IUCN 2001). In most cases, this will
mean downgrading the category obtained in step one, because populations within the
region may experience a “rescue effect” from populations outside the region. In other
words, immigration from outside the region will tend to decrease extinction risk within the region. Normally, such a downgrading will involve a one-step change in category, such as changing the category from Endangered (EN) to Vulnerable (VU) or from VU to Near Threatened (NT). If the region is very small and not isolated by barriers from surrounding regions, downgrading by two or more steps may be necessary.

2.3. ADJUSTMENTS TO CATEGORIES:
The IUCN Red List Categories (IUCN 2001) should be used unaltered at regional levels, with three exceptions or adjustments. 1). Taxa extinct within the region but extant in other parts of the world should be classified as Regionally Extinct (RE). 2). The category of Extinct in the Wild (EW) should be assigned only to taxa that are extinct in the wild across their entire natural range, including the region, but they are extant in cultivation, in captivity, or as a naturalized population outside the past range. 3). Taxa not eligible for assessment at the regional level (mainly introduced taxa and vagrants) should be assigned the category Not Applicable (NA).

2.3.1. REGIONAL CATEGORIES: Keeping the above three statements in mind, the regional taxa may be categorized into the following categories, but only three of these qualify as threatened categories viz. Critically Endangered (CR), Endangered (EN) and Vulnerable (VU) (see Table 5).

2.3.1.1. 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 cycle and life form.

2.3.1.2. Extinct in the Wild (EW): A taxon is Extinct in the Wild (EW) means that the taxa that are extinct in the wild across their entire natural range, including the region, but that are extant in cultivation, in captivity, or as a naturalized population (or populations) outside the past range.
2.3.1.3. **Regionally Extinct (RE):** A taxon is RE when there is no reasonable doubt that the last individual potentially capable of reproduction within the region has died or disappeared from the region or, in the case of a former visiting taxon, individuals no longer visit the region.

2.3.1.4. **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 (see Section 2.1.1.1), and it is therefore considered to be facing an extremely high risk of extinction in the wild.

2.3.1.5. **Endangered (EN):** A taxon is Endangered when the best available evidence indicates that it meets any of the criteria A to E for Endangered (see Section 2.1.1.2), and it is therefore considered to be facing a very high risk of extinction in the wild.

2.3.1.5. **Vulnerable (VU):** A taxon is Vulnerable when the best available evidence indicates that it meets any of the criteria A to E for Vulnerable (see section 2.1.1.3), and it is therefore considered to be facing a high risk of extinction in the wild.

2.3.1.6. **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.

2.3.1.7. **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.

2.3.1.8. **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, and a considerable period of time has elapsed since the last record of the taxon, threatened status may well be justified.

3.3.1.9. Not Applicable (NA): Taxa not eligible for assessment at the regional level mainly introduced taxa and vagrants.

2.3.1.10. Not Evaluated (NE): A taxon is Not Evaluated when it has not yet been evaluated against the criteria.

2.4. CATEGORIES OF ENDEMISM:
2.4.1. THEORETICAL ASPECTS OF ENDEMISM: In modern usage the terms Palaeoendemic, Neoendemic and Holoendemic find a very broad acceptance. These are elucidated below.
2.4.1.1 Palaeoendemics: These are ancient endemics representing remnants of older floras and usually occurring in land masses of geological antiquity. A large number of endemics are supposed to be palaeoendemics or their derivatives. According to Bramwell (1972) the characteristic features of palaeoendemic elements are: (i) taxonomically isolated complements having no closely related species, (ii) presence of woody life forms in isolated taxa occurring in islands and mountain summits, (iii) low level of polyploidy, (iv) major disjunction in the distribution and (v) possible fossil evidence.

2.4.1.2. Neoendemics: These are newly evolved endemic taxa of relatively recent origin possibly from an actively evolving genetic stock occurring in a particular ecotone. Neoendemics have closely related taxa occurring in the same area. They also develop through speciation. A high level of polyploidy is found among neoendemics. They generally have herbaceous or shrubby forms and occur in an area which are often subject to environmental or climatic stress.

2.4.1.3. Holoendemics: These are endemics that are in an intermediate stage between neoendemics and palaeoendemics. All endemics start as neoendemics and end as palaeoendemics. Under favourable conditions neoendemics stabilize and diversify. This is the stage of holoendemics. The pathway of neoendemics becoming palaeoendemics is: origin, expansion, stabilization, diversification, migration, fragmentation, contraction and extinction. There is no time scale for this pathway and taxa pass along the evolutionary pathway at different rates and a holoendemic could only be one step removed from the ancestor of the group, i.e. have a few ‘advance’ or ‘derived’ characters, while contemporaneous role would be many steps removed, with numerous such character (Richerdson, 1978).

2.4.2. CATEGORIES OF ENDEMISM BASED ON THE RANGE OF OCCURRENCE: The occurrence of an endemic species may vary from a very small and localized area to a larger geographical region comprising of several countries. Depending on the range of occurrence, Chowdhery & Murti (2000) classified the endemic species into the following categories:
2.4.2.1. **Point endemism**: In this category a species is restricted to a specific habitat.

2.4.2.2. **Biotope endemism**: It is also called geographic endemism. In this category the endemic species are found in a particular geographic region such as mountain ranges, islands, lakes etc.

2.4.2.3. **Biogeographic region endemism**: Such taxa are endemic to broader regions encompassing a broad range of habitats with a common bio-climatic characteristics.

2.4.2.4. **Political area endemism**: These endemics occur in the political boundary of a country, province or administrative units.

2.4.2.5. **Regional endemism**: These endemics are restricted to a very large phytogeographical region, subcontinent etc encompassing more than one country.

2.4.3. **CATEGORIES OF ENDEMICS BASED ON CYTOLOGY**: Favarger and Contrandropolous (1961) studied endemism applying cytotaxonomic methods since cytological data can throw the light on the relative age and mode of speciation of an endemic taxa. The classification of endemics are given below.

2.4.3.1. **Paleoendemics**: Those endemics, which are isolated taxonomically, show no variation and occur in isolated areas.

2.4.3.2. **Schizoendemics**: Which are produced by gradual speciation having common origin, but isolated in different ecological niches. They usually have identical chromosomes.

2.4.3.3. **Patroendemics**: Parent endemics, *i.e.* diploids which give rise to polyploides.

2.4.3.4. **Apoendemics**: Which are polyploides usually of hybrid origin, arising from widely distributed diploids.