What is an endangered plant ?

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EXISTING KNOWLEDGE AND CURRENT AWARENESS

THE Threatened Plants Committee (TPC) of the International Union for Conservation of Nature and Natural Resources, is based at the Royal Botanic Gardens, Kew, England. In May and June 1979 the TPC Secretariat prepared and issued pro forma lists of Trinidad and Tobago flowering plants which should be considered for inclusion (or exclusion after study) in the Red Data Categories: extinct; endangered; vulnerable; rare; indeterminate; insufficiently known; see Appendix I. The source of the names of plants to be selected for the preliminary list was primarily the published parts of the definitive Flora of Trinidad and Tobago. The criteria were, other than that a species is endemic to one or both of our islands, that the flora indicated a limited distribution elsewhere or stated specifically or implied that the species is rare or uncommon in Trinidad and Tobago.

Unfortunately, the Flora is incomplete and also, through changes of style over the long period of its publication, inconsistent in the amount of detail included, especially on internal and external distributions. Over the many years since the first parts of the Flora were issued, several additions have been made and these are verified by specimens at St. Augustine and elsewhere of which the Kew Secretariat may not be aware.

In the TPC lists a number of species appear which were undoubtedly originally attributed to Trinidad in error. Some of Lockhart's 'unlocalised' plants came from Venezuela, and most of those included in the Flora based on Sieber numbers were collected in Martinique. In early parts of the Flora, many of these were given full entries; in later parts firmer judgments have been made with regard to their claim for inclusion and some have been relegated to footnotes or mentioned as 'doubtful records'. The true distribution status of some of these reported species may remain in doubt indefinitely and it is unrealistic to continue to regard them as belonging to the Flora, and wasteful of effort to consider them further in the conservation exercise. If they are rediscovered they can always be re-admitted and would then automatically have a high risk-rating. Plants included in a Flora which are known only in cultivation should also be omitted if the assessment is to deal primarily with the condition of native and naturalised species. Cultivated plants may warrant conservation in their own right as rare, useful or otherwise desirable introductions.

While the status of an endemic species is clearly that of a plant which by definition has a limited known distribution, it need not necessarily be rare or local within the circumscribed area. Study will show that some of the endemic species of Trinidad at least are common and not at risk; they must, however, all be included in preliminary lists for checking. *Ilex aripoensis* is an example of a common endemic species.

Whether accurate or not, the Kew lists are daunting. The numbers of flowering plants seeming to deserve some further consideration are 581 dicotyledons (158 being endemic) and 155 monocotyledons (29 being endemic), making a total of 736 out of an overall complement of 2281 species recently estimated for the two islands; see Appendix II. As we shall see, this proportion of 32.3 per cent is low, mainly because the Kew investigators did not have access to up-to-date statements about grasses, sedges and palms.

The TPC lists were sent to Trinidad for 'Red Data' categorisation. This means FIELD STUDY to determine the population statistics and, although that is a very big job indeed, it is an essential and ultimately unavoidable task to be undertaken. Existing procedures leading to categorisation decisions differ very widely in different countries. Perhaps this is only to be expected in view of the many circumstances that apply. Countries of different sizes, habitat variety, human population dispersal, with varied types and areas of agricultural and industrial activity, do not have the same bases for decisions, but all experience special difficulties in devising convincing comparative methods. Some features, such as the accessibility of sites and whether the plants are particularly attractive or desirable and encourage commercial collectors, are useful but none-the-less non-comparable as measures. Where there are old records and definite localities or rare or local plants are known, or where detailed mapping has been done, as in parts of Europe, a more objective methodology can be worked out; numbers of map squares in which a species no longer occurs can be used as a positive measure of threat.

NEW APPROACHES TO THREAT PREDICTION

In view of the discrepancies in the TPC lists, the demonstrated need for a plan leading to some positive investigative procedure, and the opportunity to work from a small but comprehensive herbarium comprising both classic and modern collections, the authors decided to use their local facilities to prepare an independent list. It was agreed that only factual information would be used in the first instance and any expression of opinion as to the presumed rarity of a plant would be ignored for the time being. Any arbitrary standards adopted would, as far as possible, be applied equally to all taxa.

Sources of Information

The selection of species meriting further study to establish their rare or threatened status was made by using the following sources: —

1. The collections in the National Herbarium of Trinidad and Tobago at St. Augustine; combined as appropriate with,
2. The collections cited in the published parts of the *Flora of Trinidad and Tobago;* combined as necessary with,
3. Collections mentioned in other available literature.

Criteria for Preliminary Selection

Species with three or fewer seen or recorded collections

were listed and any with four or more collections from three or fewer localities were also considered and listed if the locations were vague or general and in need of investigation. Species of non-endemic status but known only from the larger areas of more or less uniform distinct ecology, such as the Aripo Savanna, Chacachacare Island or the Nariva Swamp, were not listed if the number of collections indicated that the plants were, and still are, locally abundant in those places. Some very common species, poorly represented in the herbarium because collectors have stopped bringing them in, have been omitted. All endemic species have been included.

The results of this survey are as follows: — 524 dicotyledons (166 being endemic) and 339 monocotyledons (49 being endemic), making a total of 863 species, or 37.8 per cent of the flora. This total of possibly threatened species excludes specifically 86 'rare' species believed to have been reported erroneously, and all species known only in cultivation.

Criteria for Ranking the Selected Species

For each species listed, the localities where collections were made, the habitat characteristics of the sites, the dates of first and last collection and the regional distribution were noted as completely as possible. Species represented only by unlocalised undated specimens have almost all been excluded unless there is firm evidence to suggest that they should be included. These data were mustered because it was felt that they could be used to take a further step in the direction of determining the extent of the risk to the future existence of the species. To this end it is necessary to discuss the meaning and significance of each of these four elements before explaining a numerical method of representing them, leading to a relative assessment of Risk Index.

Local Distribution — Element 1

The proper representation of localities entails mapping. This must ultimately be done species by species. Areas delineated can be political (county, borough, parish, ward, etc.), physiographic (natural features, such as hills and valleys, or swamps, distinguished by contour lines) or by means of artificial grid. There will always be reinforcement between any kind of map position and ecological data so, for ease of handling and comparability, a regular grid system is probably preferable to any other. As physiography is often directly responsible for the basic characteristics of ecological habitats, the grid provides a more independent method of establishing locations. It remains to be seen what resources can be deployed to achieve the detailed mapping of the rare and threatened plants of Trinidad and Tobago.

Ecological Tolerance — Element 2

Enough is known about the general ecology of these islands for it to be feasible to make definite statements about species indicating their habitat preferences. Some species are so specialised that they can occupy only one main kind of biological niche; a clear example of this could be cited in the woody mangrove species, although *Rhizophora mangle* may grow naturally in freshwater swamps as well as in undiluted seawater. Most epiphytes grow on trees but some of them thrive equally on rocks. Comparison of the flora of the St. Joseph, Aripo and Piarco Savannas shows some quite remarkable differences and a high level of mutual exclusivity suggesting that the physical characteristics of these savannas are not the same. It is easy to appreciate in what ways the St. Joseph Savanna differs from the other two, but it is not so obvious how those two differ from one another. A species that can occupy all three savannas has a higher survival potential than a species limited, for whatever environmental reasons, to only one of them. The mountains of Trinidad are not high enough to provide totally exclusive habitats at highest and lowest elevations and many species can tolerate the whole range of temperature and humidity conditions pertaining. There are, however, some especially rare species which occupy only the highest and coolest places and seem not to be able to thrive in warmer ones. The point of ascertaining the ecological distribution and tolerance of a species is related to knowing the alternative niches it can occupy and hence to have another measure of its survival capability.

When were the Collections Made? — Element 3

Active and systematic collection of the native flora of Trinidad can be said to have begun with Herman Crueger in the early 1840s. With peaks of interest, displayed mainly by particularly dedicated individuals, from time to time, this collecting continues to the present. Some species collected by Crueger have not been seen since and these may be extinct; others found by him have been re-collected in natural areas for the second time quite recently; yet others have been brought in regularly over the intervening years. Allowing that accidents of chance and non-related events may influence collecting opportunity, dates of collection are taken to reflect the presence and availability of native plants — whether they were present and available or not at other times. With this information to indicate the commonness or rarity of a species, an early date of first collection and a late date of last collection suggest commonness; a late date of first collection and an early date of last collection indicate rarity; a narrow span of years between first and last collections points to a species possibly more rare than one collected over a wide span of years.

External Distribution — Element 4

Every non-endemic species has by definition a distribution outside the two islands to at least one other place. The further extension of range may be to any other place or places where suitable conditions for the growth of that species may exist. Given natural settings and influences, the present known range and distribution of a species is a measure of its ecological tolerance and its dispersal history. A species with a wider range can be assumed to possess attributes enhancing its survival potential more positively than those of a species with a narrow or limited range, accepting also that suitable habitats may vary greatly in number, size and distance from one another. It is safe to assume that no two species have exactly the same range and so a simplification is called for. As a working start, the geographical position of Trinidad and Tobago offers the use of the cardinal points singly or in combination to express distributions as follows: — North = Distribution includes the West Indian Islands (Antilles); South = Distribution includes South America; East = Distribution reaches any trans-Atlantic (Old World) country; West = Distribution extends to Central America (Panama to Mexico).

The distribution characteristics of 648 non-endemic species that are deemed to require further investigation are set out in Table I. The groups of species treated in Vols. I, II and III of the definitive Flora have been presented separately. Each group, which can be regarded as a random independent sample, shows a remarkably similar expression of the fifteen possible distribution patterns to each of the other two groups. It is not necessary to discuss these close approximations in detail at this time but some of the reasons for them are obviously geographical. The table can be condensed as total numbers of species, irrespective of their other associations, having distributional affinity with South America (512), West Indies (351), Central America (256) and the Old World (74). These sorts of proportions are, in terms of dispersal opportunity and distance, no more nor less than what one would expect.

All endemic species have been listed in the preliminary survey and this information is summarised in Table II. Following from the observation that some endemic species are common in Trinidad, it may be supposed that further exploration elsewhere, particularly in the north-eastern mainland areas of South America, will reveal the occurrence of some of these species there, in which case they automatically will cease to be endemic.

TABLE I

Distribution Patterns of 648 Non-endemic Species of Trinidad and Tobago possibly meriting threatened status.

Cardinal Directions of other distribution	Volume of Flora in which species is catalogued			Total	Per cent
	I	II	III		
ONE direction	(665)	(737)	(664)	(2066)	
South America only	51	56	78	185	28.5
Central America only	1	—	5	6	0.9
Antilles only	17	26	14	57	8.8
Old World only	3	3	1	7	1.1
TWO directions					
C.A. & S.A.	19	17	26	62	9.6
A & S.A.	25	24	40	89	13.7
S.A. & O.W.	—	—	—	—	—
C.A. & A.	2	5	8	15	2.3
C.A. & O.W.	—	—	—	—	—
A. & O.W.	6	1	8	15	2.3
THREE directions					
A., C.A. & S.A.	26	35	64	125	19.3
C.A., A. & O.W.	—	—	1	1	0.2
A., O.W. & S.A.	1	2	1	4	0.6
C.A., S.A. & O.W.	—	—	1	1	0.2
FOUR directions					
A., C.A., S.A. & O.W.	16	10	20	46	7.1
UNKNOWN	4	8	23	35	5.4
TOTAL in each Volume	171	187	290	648	
Per cent in each Volume	25.7	25.3	43.7	31.4	

TABLE II

Distribution Patterns of 215 Endemic Species of Trinidad and Tobago

Endemism Status	Volume of Flora in which species is catalogued			Total	Per cent
	I	II	III		
TRINIDAD only	57	53	36	146	67.9
TOBAGO only	8	19	5	32	14.9
TRINIDAD & TOBAGO	16	13	8	37	17.2
TOTAL endemics in Volume	81	85	49	215	

Future taxonomic revisions may also have the same effect of increasing the known area of distribution and thus, notionally through the amalgamation of taxa hitherto believed to be distinct, the survival potential. A species endemic to Tobago may be more at risk than a species confined to Trinidad because of the differences in size and ecological opportunities of the islands.

Assessment of Risk Index

By applying numerals to the various states and conditions of the foregoing data it is possible to formulate a Risk Index for each threatened species. This, if applied consistently, should be at least a relative measure if not an absolute one. By reason of the fact that the method entails entering numerals for diffferent types of data into the same total, and that the actuarial assessment depends on attributing negatives for states which diminish the risk and positives for states which increase the risk, different species may have the same numerical risk-rating for different reasons. Because of this, it is desirable to back up the total assessment with details of the individual scores.

Such a system, of which there could be many because the actual numerical values assigned are arbitrary, is offered here.

Because the number of collections was used in making the selection for the survey, this information is not used again.

Element I

Number of Distinct Localties (discussed on p. 10). (This could, when known, be a number of grid-squares or some other bounded area which separates one area of collection from another; obviously the comparative densities of locations as against squares or areas, must be taken into account). Because every species must have ONE locality, the total of localities minus ONE is entered negatively. If the species is in both Trinidad and Tobago deduct TWO from the total of localities.

Element II

Number of Ecological Niches (discussed on p. 10). Because every species must occupy ONE ecological niche, the total of niches minus ONE is entered negatively.

Element III

Dates of First and Last Collection and Span of these Dates (explained on p. 10). The numerals to be awarded in consideration of the earliest and latest known dates of collection in Trinidad and Tobago are set out in Table III.

TABLE III

DATES OF COLLECTION

First (A)		Last (B)	Span (B − A)	
+0	< 1880	+5	< 10	+4
+1	1880 − 1910	+3	11 − 20	+3
+2	1911 − 1940	+1	21 − 40	+2
+3	1941 − 1970	+0	41 − 80	+1
+4	> 1970	+0	> 80	+0

Element IV

External distribution is scored as follows: −

The species is ENDEMIC to TOBAGO	+7
The species is ENDEMIC to TRINIDAD	+5
The species is ENDEMIC to BOTH ISLANDS	+3
The species is distributed in: −	
ONE Cardinal direction	− 0
TWO Cardinal directions	− 2
THREE Cardinal directions	− 4
FOUR Cardinal directions	− 6

Application of this scheme to particular species will enable one to be distinguished from another on a relative basis and be a guide to future action. If one starts with a score of ten (10) and adds or subtracts the numerals indicated by each of the Elements above (there are THREE components to Element III), a score of ten (10) or more should suggest that the species is at some risk. The highest possible score is for an endemic to Tobago known from only one collection before 1910 (there were no collections from Tobago before 1880) − an accumulation of twenty-five points (10 − 0 − 0 + (1 + 3 + 4) + 7). A recently collected non-endemic (collected say from two localities, in one kind of niche, in 1957 and 1969, and also known from Venezuela) would score 10 − 1 − 0 + (3 + 0 + 3) − 0 = 15. A commoner better-known non-endemic (collected from six localities, in two niches, first in 1875 and last in 1970, and also known from South and Central America and Cuba) scores 10 − 5 − 1 + (0 + 0 + 0) − 4 = 0. An even commoner species would have a negative total score and would be that much less at risk. A species endemic to both Trinidad and Tobago must have at least two localities, one in each island, and so an example (with two known localities in Trinidad and one in Tobago, one niche, the first collection in 1912 and a last in 1935) would accrue a total of 17, i.e. 10 − 1 − 0 + (2 + 1 + 2) + 3.

WHAT CAN BE DONE NOW?

As well as supporting any action serving to prevent or diminish the wanton or avoidable destruction of natural vegetation anywhere in these islands, the concerned member of the public can improve his awareness of the task involved in conserving the flora and fauna.

Plant collecting that has resulted in the recording of presence and distribution of native species has been haphazard and sporadic and, although many years have passed since the early collectors were active, some places have never been visited at all with a view to systematic appraisal. In fact, hardly a single area has been exhaustively combed and even the much explored Aripo Savannas may yet yield additional rare species. Information about

insufficiently worked areas and inadequately known species can be obtained from the National Herbarium in renewed steps towards completing a survey of the existing flora as a first priority. Two obvious localities are the Trinity Hills and the south-eastern concession lands, and the easternmost parts of the Northern Range above about 300 m of altitude. The remaining forested parts of the south-west peninsula and the Erin Savanna area also require more study. Chacachacare Island is relatively well known but the other Bocas islands, Monos and Huevos, have hardly been collected on at any time. Tobago is in need of systematic collecting especially along the Main Ridge.

The second priority is to review the state of the flora in areas of particularly localised ecological character. Some of these, such as the Heights of Aripo on the limestone geology have been searched in the past, but not at all times of the year. El Tucuche is rather better known but there are many rare species to become better acquainted with there. In recent years, more intensive activity in the Nariva Swamp area has lengthened the list of freshwater swamp species, or extended their known ranges, in Trinidad considerably. These places harbour species which, because of altitude (lower temperature/higher humidity) or swampiness respectively, are unlikely to occur elsewhere.

Conservation tasks present themselves as more knowledge is gained. As a species is mapped, expeditions can go to likely places whence it has not so far been reported. The known range may then indicate an area of special floristic or ecological interest where other species of limited habitat preference occur — it is always easier to formulate a case to preserve an area of vegetation of multifarious attributes rather than a single species.

A third need is to keep existing information in constant review and to incorporate new information so as to either bring the Risk Indexes up to date or to revise the methods of computing them. When a method has been tested, and shown to be realistic, then the promotion of conservation awareness, and possibly even positive action, will be that much easier to achieve.

Detailed information about some examples of native species, selected for their moderately or very high Risk Indexes, is set out in Appendix III. These summaries are based on existing facts and may imply the level of threat and possibly a clue as to how that might be averted or clarified.

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WILLIAMS R.O. & E.E. CHEESMAN, et al. Flora of Trinidad and Tobago, Vol. I (complete), Vols. II & III (in progress). Ministry of Agriculture, Lands and Fisheries, Trinidad and Tobago. 1928 —. (Vol. I deals with polypetalous Dicotyledons, Vol. II with gamopetalous Dicotyledons and Vol. III with Monocotyledons).

APPENDIX I. The Red Data Book Categories (Designated by the Survival Service Commission of IUCN — with some slightly modified wording).

Extinct: Requires no explanation.

Endangered: Survival is unlikely if the factors causing reduction of numbers continue to operate. Numbers have been reduced to a critical level or habitats have been so drastically reduced that the species (taxa) restricted to them are deemed to be in immediate danger of extinction.

Vulnerable: Taxa believed likely to move into the endangered category in the near future if the causal factors continue operating. Adverse factors have been or can be identified and continue to threaten populations.

Rare: Taxa with small world populations that are not at present endangered or vulnerable, but are at risk. These taxa are usually localised within restricted geographical areas or habitats.

Indeterminate: Taxa known to be endangered, vulnerable or rare but where there is not enough information to say which of the three categories is most appropriate.

Out of danger: Taxa formerly included in one of the above categories, but which are now considered relatively secure because effective conservation measures have been taken or the previous threat to their survival has been removed.

Insufficiently known: Taxa that are suspected but not definitely known to belong to any of the above categories because of lack of information.

APPENDIX II. Estimates of the number of species of flowering plants recorded for Trinidad and Tobago can be made from existing literature. At various times in the past the counts were: —

Author	Families	Genera	Species
Grisebach (1864)	—	—	1187
Hart (1908)	126	805	1866
Britton (1921)	162*	998*	2197*
Adams & Baksh (1980 unpub.)	158	959	2281

** Britton's list includes about 60 species attributed to Trinidad through probably erroneously localised Sieber collections.*

APPENDIX III. A Selection of Native Flowering Plants of Trinidad and Tobago with high Risk Indexes.

Dicotyledons (Vols. I and II of the Flora of Trinidad and Tobago)

Chimarrhis microcarpa Standley (Rubiaceae)

	Score
1. Known only from Maraval (1 locality)	0
2. Growing in forest (1 ecological niche)	0
3. i. First collected in 1904	+1
ii. Last collected in 1904	+3
iii. Span zero years	+4
4. Endemic to Trinidad	+5
	10 + 13 = 23

Justicia laevilinguis (Nees) Lindau (Acanthaceae)

1. Known from Nariva Swamp (1 locality)	0
2. Growing in freshwater swamp (1 ecological niche)	0
3. i. First collected in 1961	+3
ii. Last collected in 1977	0
iii. Span 16 years	+3
4. Northern South America (1 cardinal point)	0
	10 + 6 = 16

Odontonema brevipes Urb. (Acanthaceae)

	Score
1. Easterfield, Great Dog R., Pigeon Hill and Parlatuvier (4 localities)	−3
2. Growing in shady forest (1 ecological niche)	0
3. i. First collected in 1889	+1
ii. Last collected in 1959	0
iii. Span 70 years	+1
4. Endemic to Tobago	+7
	10 + 6 = 16

Omphalea megacarpa Hemsl. (Euphorbiaceae)

1. Tabaquite and Tobago (2 localities)	0
2. Climber (1 ecological niche)	0
3. i. First collected in 1892	+1
ii. Last collected in 1955	0
iii. Span 63 years	+1
4. Endemic to Trinidad and Tobago	+3
	10 + 5 = 15

Paullinia excisa Radlk. (Sapindaceae)

1. Bacolet R., Castara-Parlatuvier Trace (2 localities)	−1
2. Climber (1 ecological niche)	0
3. i. First collected in 1889	+1
ii. Last collected in 1937	+1
iii. Span 48 years	+1
4. Endemic to Tobago	+7
	10 + 9 = 19

Securidaca lophosoma (Blake) Cheesman (Polygalaceae)

1. Road to Maracas Bay (1 locality)	0
2. Climber (1 ecological niche)	0
3. i. First collected in 1924	+2
ii. Last collected in 1924	+1
iii. Span zero years	+4
4. Endemic to Trinidad	+5
	10 + 12 = 22

Tococa broadwayi Urb. (Melastomataceae)

1. Charlotteville to Parlatuvier (1 locality)	0
2. In shady damp wood (1 ecological niche)	0
3. i. First collected in about 1913	+2
ii. Last collected in about 1913	+1
iii. Span zero years	+4
4. Endemic to Tobago	+7
	10 + 14 = 24

Monocotyledons (Vol. III of the Flora of Trinidad and Tobago)

Dicranopygium insulare (Gleason) Harling (Cyclanthaceae)

	Score
1. 8 localites in Tobago	−7
2. Growing in woodlands (1 ecological niche)	0
3. i. First collected in 1889	+1
ii. Last collected in 1937	+1
iii. Span 48 years	+1
4. Endemic to Tobago	+7
	10 + 3 = 13

Eleocharis elegans (Kunth) Roem. & Schult. (Cyperaceae)

1. Caroni Swamp (1 locality)	0
2. Growing in ditch (1 ecological niche)	0
3. i. First collected in 1975	+4
ii. Last collected in 1975	0
iii. Span zero years	+4
4. West Indies, Central and South America (3 cardinal points)	−4
	10 + 4 = 14

Philodendron fendleri Krause (Araceae)

1. Mathura Forest, Sans Souci, St. Ann's, Valencia (4 localities)	−3
2. Climber on cliffs and trees (2 ecological niches)	−1
3. i. First collected in 1890	+1
ii. Last collected in 1947	0
iii. Span 57 years	+1
4. Endemic to Trinidad	+5
	10 + 3 = 13

N.W. Simmonds (J. Ecol. 38 (2): 289, 1949) reported this species as "Frequent in the wetter forests . . . ".

Sacciolepis indica (L.) A. Chase (Gramineae)

1. Aripo Savanna (1 locality)	0
2. Roadside weed (1 ecological niche)	0
3. i. First collected in 1979	+4
ii. Last collected in 1980	0
iii. Span 1 year	+4
4. Old World tropics and Central America (2 cardinal points)	−2
	10 + 6 = 16

Omission of any specific examples of orchids and bromeliads is deliberate, the reason being that they are almost all at risk because of the special interest taken in them by collectors.