THE IUCN PLANT RED DATA BOOK

CONTENTS

INTRODUCTION

The Red Data Sheets in this book cover 250 of an estimated 20,000 - 25,000 vascular plant species falling into the four IUCN Red Data Book categories of Extinct, Endangered, Vulnerable or Rare*. The sheets are presented here as case histories, not only as a guide and stimulus for action on these species, but also, and more important, to highlight the growing and continuing threats to the world's natural ecosystems and the diversity of plants they contain.

The species have been selected as far as possible to illustrate the various types of threats, habitats, distributions, plant groups and protective measures, with the emphasis on species that are of particular interest or importance to mankind. They are not necessarily those in the most danger, though many of these have been included. There are still some very large gaps in our knowledge, but the aim is to build up sheets on additional species as time and resources permit, so that eventually the Plant Red Data Book will cover a fully representative and balanced selection of threatened species, with examples from all countries and floras.

It must be stressed that there is no intention, nor is it practical and possible, to cover all plant species identified as falling into the Red Data Book categories; in this respect the Plant Red Data Book differs in principle from the animal volumes, which aim at including all threatened vertebrate taxa within their respective classes. To emphasise this distinction, a bound format has been adopted instead of the loose-leaf arrangement of the animal Red Data Books. Further sheets will be issued in supplementary volumes. However, all sheets will be revised at regular intervals.

The information presented here has been compiled through the network of research workers who make up the Threatened Plants Committee (TPC), established in 1974 by IUCN's Survival Service Commission**. Given the present lack of knowledge on threatened plants, the TPC's first priority is to find out which plants are threatened, where they still occur, and how they can best be saved, with emphasis on those countries that do not have their own data-gathering programmes. The Red Data Sheets form only part of the TPC's output: other types of publication include the regional or continental list; so far a '_List of Rare, Threatened and Endemic Plants for the Countries of Europe_' has been completed (Council of Europe, Nature and Environment Series, No. 14, Strasbourg 1977); similar lists are underway for North Africa and the Middle East and for Africa South of the Sahara. In prospect are also Red Data Bulletins, each of which will cover a country, island or group of islands, and give detailed but concise information on each of the threatened species included for that area on the regional

* Defined on page 25.

** A detailed account of the work and aims of the TPC is given by the compilers in _Envir. Conserv._ 4(3): 179-187 (1977).

list, together with a general introductory text on the plant conservation needs and priorities. This latter approach is well suited to oceanic islands where there is often a high degree of endemism in the flora, and it is hoped can also be expanded to cover plant groups under particular threat, e.g. cacti, cycads, palms.

The work of the TPC grew out of the initial studies on threatened plants from 1968 to 1974 by Dr Ronald Melville. It is a pleasure for the compilers to acknowledge their debt to Dr Melville for his far-sighted pioneer work. This volume replaces that compiled by him and issued in 1970-1 as Red Data Book 5: Angiospermae, now out-of-print. The sheets presented here differ from those of the earlier volume in a few minor details of format, and also by covering all groups of vascular plants, i.e. by including species from the ferns (Pteridophyta), conifers and cycads (Gymnospermae), as well as from the flowering plants (Angiospermae). (The situation for lower (non-vascular) plants is usually much less well known, but one must anticipate that, in such groups as lichens, mosses and liverworts, species will be found meriting protection as much as any vascular species.) In addition, since the species chosen are essentially samples, the opportunity has been taken to include some information on the conservation requirements of the flora of the country concerned, preferably with an indication of the numbers of threatened species, in order to give some idea of the vast scale of the plant conservation problem.

Independently or in association with the TPC, it is very desirable that each country should prepare its own Red Data Book or equivalent publication, emphasising the threats and the remedial action required at national level, in addition to the Red Data sheets, bulletins and lists produced by IUCN. Whereas TPC only covers species threatened on a world (or sometimes regional) scale, national Red Data Books should aim to include all species rare or threatened within the country's boundaries, whether common elsewhere or not. The format will clearly vary from one country to another, being determined by available expertise and local needs. It is hoped, however, that the IUCN Red Data Book categories will be universally adopted. It is particularly encouraging that a great many countries are undertaking such projects, often through a small data-gathering unit in an appropriate herbarium or university, under the part-time direction of a senior botanist. This is a very effective approach, especially for gathering the more detailed information on sites, localities, populations and so on, from which precise remedial measures can be identified for action by the appropriate authorities.

On a world scale, accurate information on the status of reputedly threatened species is often scanty and difficult to obtain. The fact that 250 case histories of threatened plants could be put together is mainly the result of the generous and wholehearted collaboration provided by numerous botanists all over the world. These men and women, despite all their other primary commitments in research and teaching, have often made special efforts to obtain the data required, since threatened species tend to be the most obscure and least known botanically simply because of their rarity. The names of the principal collaborators are given individually at the end of each sheet; to

each we extend our sincere thanks and gratitude. Particular appreciation is extended to Dr Max Walters, whose knowledge of the European flora and interest in conservation is reflected in the large number of sheets for that region; to Dr John Dransfield for his special contribution on palms; and to the staff of the Smithsonian Institution's Endangered Flora Project in Washington, D.C., U.S.A., under the leadership of Dr Edward S. Ayensu, for their splendid contribution. We would also like to thank Sir Hugh Elliott, Scientific Editor of IUCN, for his kind and meticulous aid and guidance, and the staff of the Kew Conservation Unit, who individually have helped make this book possible, in particular Helen Flint, Rebecca Stewart, Carol Town, Phoebe Turpin, and, most important, our very expert and patient typist, Margaret Beyer. If there is one gleam of light in what otherwise must perforce be a gloomy book, it is the immense help and collaboration provided by virtually all departments and individuals who were approached. The availability of this great body of expertise to nature conservation efforts is a good omen for the future and a vital prerequisite for action.

G.L. H.S.
Kew, October 1978.

THE NEED FOR CONSERVATION

The plant world is essential to human life. Through the energy of the sun, the green leaves of plants convert basic elements from the soil and atmosphere into the first stage of most life-giving and sustaining food chains. All our food is ultimately a product of the plant world, either directly or indirectly, from cereal crops through to domestic and grazing animals. Plant cover protects soils from erosion and has a major effect on weather systems, as well as forming the central feature of our natural environment.

But it is the diversity of the plant world and threats to individual species that are the concern of this book. Because of the link between plant diversity and that of the dependent fauna, both vertebrate and invertebrate, it is likely that a high rate of extinction in the plant kingdom will cause an even greater loss among other organisms. Plants in their very variety supply people with food, but also with a cornucopia of useful and vital products to cover virtually every need: timbers, medicines, paper, contraceptives, fibres, spices, resins and many others. In addition, people delight in the charm of numerous widely differing species, both in gardens and in the wild. Through studies of plant taxonomy and biogeography, scientists can analyse the diversity and draw conclusions of great significance for the understanding of life processes, an understanding which can be further enhanced by investigation from a biochemical and physiological standpoint.

Extinction is perhaps more tragic with plants than with other forms of life since a much greater number of species is likely to be lost before their possible value to society is known; the economic potential of very few plants has been investigated in any detail. The chemical clues leading to the development of a great many synthetics - from aspirin to the oral contraceptive - were derived from plants, and it is doubtful whether manufactured compounds could have been made without the leads provided by their natural prototypes.

At present the greater part of man's agriculture is precariously based on less than 30 species of plants. The contrast between this statistic and the massive number of threatened species highlights the potential losses that could occur. Some of the threatened species may be potential crop plants in their own right; some may be near relatives of existing crops, and so particularly valuable for maintaining the genetic base available for future breeding and selection. Others may be needed as forage plants, for combating desertification, or for providing new drugs, medicines or other biochemicals. Others may prove valuable for their unique life form or ability to thrive in unusual or particularly harsh environments.

Every year, at a rate rather slower than that of plant extinctions but still with impressive regularity, new and vitally important uses for hitherto obscure and little-known plants are found. The story of jojoba illustrates how utterly unpredictable such finds are. Over the last ten years this plant, *Simmondsia chinensis*, from the south western states of the U.S.A., has excited a great deal of interest as its nuts are the only known source of oils similar in quality to

those obtained from the Sperm Whale, now very seriously threatened by over-exploitation. The oil has many potential uses and jojoba is being increasingly planted in arid regions as an experimental crop. Examples such as this greatly strengthen the general arguments for conservation of all individual plant species.

The green world of vascular plants includes some 250,000 species. Current indications are that 20-25,000 of these, that is an average of 1 in 10, are dangerously rare or coming under severe threat. The threatened plants are not evenly distributed around the globe; rather they are concentrated in the most vulnerable and species-rich habitats such as islands, rain-forest, arid lands, Mediterranean ecosystems, wetlands and coastal sites. As yet we do not know, or have adequate data on, the majority of the species that make up the estimated 25,000 although we are beginning to fill in the picture day by day. The 10% estimate, however, has been borne out at the continental level by current surveys for the United States by the Endangered Flora Project of the Smithsonian Institution and for Europe by the Threatened Plants Committee itself, in co-operation with the Council of Europe. The percentage may in reality be higher, since, in many tropical floras, we know that whole plant-rich ecosystems are in danger, but cannot even say which species they contain, let alone which species are imperilled. When an area of tropical rain-forest is felled, all of its flora may be lost: the problem is that we may well not know which species are Endangered until it is too late and they have been lost forever. In addition, in many of the more widespread vegetation types, the number of commoner plants is in a steady decline. With the fragmentation of the habitat, even the survival of widespread and hitherto common species becomes doubtful.

The scale of the information required, let alone the action needed, is thus a daunting one. The 250 threatened species covered here are the tip of an iceberg, in fact 1% of it. In addition, for a large number of these 250 species, which are among the best known of all threatened plants, a detailed ecological study may still be necessary before effective protection measures can be decided upon. In many cases recommendations amount to no more than a plea for further information-gathering and research rather than a detailed plan of action. In nearly all cases the means by which a recommendation can be implemented have still to be clarified. For example, what are the essential boundaries of the habitat necessary to ensure survival of the species? If a nature reserve is suggested, who owns the land? If a fence is needed, where will the money come from; and what management steps need to be taken? Such questions can only be answered by those on the ground.

Many of the 250 examples are already known to be of value to man. Details on the useful, potentially useful or especially interesting species are given on individual sheets, but the general picture is summarised in the table on the following pages. Included are plants that are already the source, past or present, of economic products (A), and near relatives of important crops, of value as potential sources from which vital characters such as disease or drought resistance

can be bred into the crop cultivars (B). Of the species so far identified as threatened, those with the greatest economic potential are perhaps *Diospyros* sp. nov., an endangered ebony from Mauritius, *Cordeauxia edulis*, the Yeheb Nut, and *Persea theobromifolia* from Río Palenque in Ecuador. Each of these plants is illustrative of major themes in this book. For example, the Yeheb Nut, an endangered bush from the Somali-Ethiopian border, has great potential as a Sahel crop plant since it produces nuts of relatively high protein content, which were formerly used for food, and it can grow in some of the most arid parts of the region where other crop legumes would be impossible. Once planted it does not require any tending or cultivation by man, a great advantage in a region where most of the population is nomadic.

Others of the 250 sample species are of evolutionary and scientific value either for the distinctness of their habit, for extraordinary details of their biology and pollination, or for the peculiarities of their distribution. Those listed overleaf under (C) are particularly worthy of conservation from a scientific point of view, since their nearest living relatives are distinct at the generic rather than the species level, indicating a higher degree of evolutionary divergence which may have important implications. Others are of great aesthetic interest, many being famous for their beauty or outstanding form in their native country (D). Others are already well-known garden plants; those listed under (E) in the table have great potential for horticulture, but for the most part are not grown in gardens nearly as widely as they should be - or are not even in cultivation. Some species in the book are of general interest: for example *Rheum rhaponticum* from the Rila Mountains is a rhubarb that figures in 17th Century botanical literature; the birch *Betula uber* was the subject of a detective-like story of rediscovery, as was the little shrub *Berberis sonnei* which was spotted by a keen school-girl after teams of botanists had failed to find it despite repeated searches over nearly 40 years; the insectivorous *Dionaea muscipula* is a plant described by Darwin as "one of the most wonderful in the world"; and fruits of the palm *Medemia argun* have been found in ancient Egyptian tombs. All these aspects are explored in more detail in the individual sheets.

There are even a few success stories which deserve attention as models for the future and examples of what can be done in conservation terms:

Astragalus physocalyx
Cordyline kaspar
Hibiscadelphus giffardianus
Orothamnus zeyheri
Ranunculus crithmifolius ssp. *paucifolius*
Stipa bavarica.

T A B L E

SPECIES IN THE RED DATA BOOK OF SPECIAL INTEREST OR VALUE TO MAN

A. Sources of economic products, past or present

Acacia peuce
Artemisia granatensis
Cladrastis lutea
Cordeauxia edulis
Cupressus dupreziana
Cupressus macrocarpa
Dracaena draco
Eucalyptus argophloia
Juniperus bermudiana
Lodoicea maldivica
Pseudophoenix ekmanii
Santalum fernandezianum
Vateria seychellarum

B. Crop relatives

Ceratonia sp. nov. (carob)
Diospyros sp. nov. (ebony)
Euchlaena perennis (maize)
Olea laperrinei (olive)
Persea theobromifolia (avocado)
Phoenix theophrasti (date palm)
Punica protopunica (pomegranate)
Rheum rhaponticum (rhubarb)

C. Monotypic genera

Cordeauxia
Degenia
Dendrosicyos
Dionaea
Dirachma
Franklinia
Hubbardia
Idiospermum
Juania
Jubaeopsis
Lactoris
Lebronnecia
Lodoicea
Medusagyne
Microcycas
Myosotidium
Naufraga
Neoveitchia
Orothamnus
Palaeocyanus
Rhapidophyllum
Streblorrhiza
Swallenia
Tetrataxis
Trilepidea
Whitesloanea

D. Beauty and aesthetic interest

Aeonium nobile
Aloe polyphylla
Caryota no
Crinum mauritianum
Cypripedium candidum
Doronicum cataractarum
Echium pininana
Epidendrum mutelianum
Erica jasminiflora
Glomeropitcairnia erectiflora
Iris lortetii
Johannesteijsmannia altifrons
Lilium rhodopaeum
Limonium arborescens
Myosotidium hortensia
Orothamnus zeyheri
Rafflesia arnoldii
Roystonea elata
Saxifraga florulenta
Sobralia xantholeuca
Trochetia erythroxylon
Xeronema callistemon

E. Potential for horticulture

Aloe squarrosa
Androsace brevis
Begonia socotrana
Berberis sonnei
Calandrinia feltonii
Camellia granthamiana
Caralluma tubiformis
Celmisia philocremna
Cereus robinii
Clianthus puniceus
Daphne arbuscula
Dianthus callizonus
Dionysia mira
Diplomeris hirsuta
Eucalyptus crenulata
Forsythia europaea
Fritillaria liliacea
Gladiolus aureus
Iris winogradowii
Kniphofia umbrina
Lotus berthelotii
Moraea loubseri
Notylia bicolor
Onosma tornensis
Paeonia cambessedesii
Pittosporum dallii
Primula palinuri
Saxifraga biternata
Silene viscariopsis
Tecomanthe speciosa
Vella pseudocytisus

In addition to the value of individual species, the flora as a whole is perhaps the most sensitive indicator of habitat change. The decline of species both in numbers and diversity can be used as an indication of ecosystem degradation. Species data are also important in highlighting the most valuable of what are apparently superficially similar habitats. They can provide a powerful argument to strengthen existing proposals for conservation of particular sites, complementing arguments based on ecosystem grounds where the principal aim is to ensure that adequate and representative samples of all ecosystems are protected. The strength of such arguments for countries taking steps to conserve their endemic species for their own benefit as well as that of the rest of the world is that they can be made to have considerable political and nationalistic appeal.

Accordingly, both of the major scientific approaches to conservation, of data-gathering on threatened species and of identifying key sites on an ecosystem basis, are essential and must go hand in hand. There is clearly no conflict between them, for how can one protect a species other than by protecting the ecosystem in which it occurs? Both approaches can and must be used, in order to determine which areas are the most vital to be conserved, and to provide accurate data on which to base the selection of suitable sites and their constant monitoring. The ecosystem survey approach is now underway in many areas and tends to receive more attention and prominence than the also important process of listing rare and threatened species, finding their localities and identifying the threats. It is increasingly urgent, therefore, to expand this survey, while constantly monitoring species already identified as threatened. Conservation of the world's plant resources will assume an ever-increasing importance as social and economic development continues.

THREATS AND HABITATS

A prime aim of this book is to give examples of types of threats to species in danger. Although great efforts have been made to fulfil this objective, the relevant data are sometimes not available. Similarly, the numbers of species in the Red Data Book representing each threat is an indication of our degree of knowledge rather than a reflection of the quantitive effect of that particular threat on the plant kingdom. The same imbalance applies to habitats: in particular it has been very difficult to obtain examples from the floras of arid lands and of tropical rain-forests, which are known to be among the most imperilled ecosystems in the world. There is an additional imbalance due to TPC's early involvement with European and North American rather than tropical floras: this, however, should be corrected in later supplementary volumes. It is hoped that over the next two years, case-histories will be forthcoming from many more countries, in order to fill some of the larger gaps, especially for continental land-masses of the tropics where so much fundamental botany remains to be done. A special attack has to be made to identify centres of endemism, with the production of Red Data sheets on selected species from each key area proposed for conservation, in order to highlight the importance of these areas.

Most of the threats to plants can be traced to man's need for food, both directly in searching for new land for his crops and indirectly through his animals. In many regions this is leading not only to loss of species and degradation of the vegetation over very extensive areas, but also to a loss in agricultural potential itself, both in the short and long term. Where this is happening, as in many of the ecologically unstable areas of the tropics, it is arguable that the problem of how to avoid an ecological and human catastrophe is more intractable, more complex and on a wider scale than ever before. Desertification is one example: an increase in human population leads inevitably to overcutting of the few trees available for firewood, and increased numbers of livestock lead to overgrazing which reduces the carrying capacity of the land. The pressure on the remaining grasses and unpalatable herbs intensifies. The process is accentuated by any cycle of dry years, which hitherto could have been absorbed by the ecosystem without permanent damage. With the vegetation severely degraded, it would appear that the climate becomes increasingly arid and eventually only unproductive desert remains.

A summary of the various threats to species illustrated in this book is given on the following pages. A quick perusal of individual sheets will show that threats cannot be quantified and subdivided easily, so the lists are given not as a precise analysis of the problem but more as a guide to those wishing to find examples of plants in danger from particular threats.

1. Browsing and overgrazing:

Island examples, mostly from introduced animals:	Continental examples:
Aeonium nobile	*Caralluma distincta*
Carlina diae	*Caralluma tubiformis*
Cordyline kaspar	*Centaurium namophilum*
Dendrosicyos socotranus	*Clianthus puniceus*
Dirachma socotrana	*Cordeauxia edulis*
Dudleya traskiae	*Cupressus dupreziana*
Hibiscadelphus spp.	*Doronicum cataractarum*
Hibiscus insularis	*Dracaena ombet*
Lebronnecia kokioides	*Euchlaena perennis*
Malacothamnus clementinus	*Euphorbia cameronii*
Myosotidium hortensia	*Olea laperrinei*
Nepeta sphaciotica	*Ranunculus godleyanus*
Passiflora herbertiana ssp. *insulae-howei*	*Whitesloanea crassa*
	Wissmannia carinensis
Pelagodoxa henryana	
Punica protopunica	
Ranunculus caprarum	
Silene holzmannii	
Streblorrhiza speciosa	
Trochetia erythroxylon	

2. Clearing of vegetation for agricultural crops:

Aeonium nobile	*Kniphofia umbrina*
Arbutus canariensis	*Lycaste suaveolens*
Casuarina fibrosa	*Medemia argun*
Chondropetalum acockii	*Neoveitchia storckii*
Dicliptera dodsonii	*Orcuttia mucronata*
Echium pininana	*Persea theobromifolia*
Elliottia racemosa	*Restio acockii*
Eucalyptus argophloia	*Serruria roxburghii*
Eucalyptus crenulata	*Sobralia xantholeuca*
Eucalyptus froggattii	*Trilepidea adamsii*
Euphorbia wakefieldii	*Yoania australis*

3. Changes in agricultural methods:

Astragalus phoenix	*Cypripedium candidum*
Bromus interruptus	*Linaria hellenica*

4. Species dependent on prevailing agricultural systems and under threat from factors such as regeneration of scrub and lack of grazing:

Degenia velebitica	*Silene viscariopsis*
Silene diclinis	

5. Logging and exploitation of forests for timber and firewood:

Caryota no
Ceratolobus glaucescens
Corybas fornicatus
Drypetes caustica
Elliottia racemosa
Euphorbia wakefieldii
Johannesteijsmannia altifrons
Notylia bicolor
Santalum fernandezianum
Vateria seychellarum
Vepris glandulosa
Zanthoxylum paniculatum

6. Forestry (e.g. changes in practice, monocultures of exotic species):

Cladrastis lutea
Diastella buekii
Dionaea muscipula
Iris lortetii
Sisymbrium cavanillesianum

7. Dam construction, hydro-electric schemes and/or associated flooding of large areas:

Aconitum noveboracense
Asplenium jahandiezii
Cladrastis lutea
Crinum mauritianum
Hubbardia heptaneuron
Leavenworthia torulosa
Lesquerella densipila
Pedicularis furbishiae

8. Drainage:

Areca concinna
Cyperus papyrus ssp. *hadidii*
Cypripedium candidum
Dionaea muscipula
Isoetes boryana

9. Water pollution:

Isoetes boryana
Zizania texana
(both are aquatic species)

10. Industrialisation and Urbanisation:

Asimina rugelii
Asimina tetramera
Astragalus physocalyx
Cereus robinii
Chondropetalum acockii
Eucalyptus curtisii
Fritillaria liliacea
Helianthemum sphaerocalyx
Leavenworthia torulosa
Mimosa lanuginosa
Nolina interrata
Oenothera deltoides ssp. *howellii*
Orcuttia mucronata
Restio acockii
Serruria ciliata
Thismia americana

11. Mining and quarrying:

Gunnera hamiltonii
Limonium recurvum
Maxburretia rupicola
Moraea loubseri
Onosma tornensis
Pittosporum dallii

12. Road building:

Acacia aphylla
Aechmea dichlamydea
Astragalus beatleyae
Eucalyptus curtisii
Eucalyptus rhodantha
Kniphofia umbrina
Pittosporum dallii
Roystonea elata
Sarracenia alabamensis ssp. *alabamensis*

13. Coastal pressures and developments, especially for tourism:

Asimina tetramera
Cereus robinii
Daphne rodriguezii
Gunnera hamiltonii
Helianthemum sphaerocalyx
Linaria hellenica
Myosotis ruscinonensis
Phoenix theophrasti
Primula palinuri
Rumex rothschildianus
Zamia floridana

14. Traditional rural uses, often greatly increased as a result of tourism, population increase, etc.:

Artemisia granatensis
Dendrosicyos socotranus
Dracaena draco
Dracaena ombet
Lodoicea maldivica
Ulmus wallichiana

15. Disturbance, especially from motor vehicles, and trampling:

Astragalus phoenix
Conradina verticillata
Fritillaria liliacea
Glomeropitcairnia erectiflora
Hudsonia montana
Passiflora herbertiana ssp. *insulae-howei*
Phoenix theophrasti
Stipa bavarica
Swallenia alexandrae

16. Fire:

Achyranthes mangarevica
Catharanthus coriaceus
Ceratolobus glaucescens
Corybas fornicatus
Erica chrysocodon
Maxburretia rupicola
Paphiopedilum druryi
Roystonea elata
Toxocarpus schimperianus

17. Pressures from introduced plants:

Chondropetalum acockii
Gladiolus aureus
Leucadendron verticillatum
Restio acockii
Sarracenia alabamensis ssp. *alabamensis*
Serruria ciliata
Tetrataxis salicifolia
Wahlenbergia linifolia

18. Selective removal as poisonous species:

Bowenia serrulata
Idiospermum australiense

19. Collecting for botanical specimens:

Iris winogradowii
Rafflesia arnoldii

20. Picking of the flowers:

Daphne arbuscula
Epidendrum mutelianum
Erica chrysocodon
Gladiolus aureus
Iris lortetii
Tibouchina chamaecistus

21. Collecting (usually uprooting) for horticulture:

Aeonium nobile
Aloe polyphylla
Ancistrocactus tobuschii
Ariocarpus agavoides
Bowenia serrulata
Cladrastis lutea
Cypripedium candidum
Dionaea muscipula
Doronicum cataractarum
Euphorbia handiensis
Franklinia alatamaha
Gaultheria sphagnicola
Iris lortetii
Iris winogradowii
Limonium arborescens
Lycaste suaveolens
Nolina interrata
Obregonia denegrii
Paphiopedilum druryi
Pediocactus knowltonii
Pittosporum dallii
Pritchardia macrocarpa
Rhapidophyllum hystrix
Roystonea elata
Sarracenia alabamensis ssp. *alabamensis*
Saxifraga florulenta
Zizania texana

22. Critically low population with subsequent danger of breeding collapse:

Agave arizonica
Aloe squarrosa
Andryala levitomentosa (3 patches)
Badula crassa (3)
Berberis sonnei (c. 50)
Betula uber (21)
Bupleurum kakiskalae (4-5)
Calyptronoma rivalis
Camellia granthamiana
Ceratolobus glaucescens
Cyphophoenix nucele
Dicliptera dodsonii (1)
Diospyros sp. nov. (1)
Drypetes caustica (c. 14)
Eucalyptus carnabyi (1)
Euphorbia abdelkuri (4)
Freziera forerorum (3)
Gladiolus aureus (18)
Globularia ascanii
Lactoris fernandeziana
Medemia argun
Medusagyne oppositifolia
Persea theobromifolia (c. 12)
Pritchardia munroi (1)
Prunus gravesii (1)
Punica protopunica (4)
Serianthes nelsonii (4)
Tecomanthe speciosa (1)
Tetrataxis salicifolia (7)
Vepris glandulosa (8 + seedlings)
Zanthoxylum paniculatum (2)

The figures in brackets indicate the most recent estimate of the number of individuals in the wild.

THE DISTRIBUTION OF TAXA IN THE RED DATA BOOK ARRANGED BY REGIONS

ASIA

Ailanthus fordii	Hong Kong
Areca concinna	Sri Lanka
Camellia crapnelliana	Hong Kong
Camellia granthamiana	Hong Kong
Caryota no	Indonesia, Malaysia
Ceratolobus glaucescens	Indonesia
Corybas fornicatus	Indonesia, Malaysia
Dendrobium pauciflorum	India
Diplomeris hirsuta	India
Hubbardia heptaneuron	India
Iris winogradowii	U.S.S.R.
Johannesteijsmannia altifrons	Indonesia, Malaysia
Maxburretia rupicola	Malaysia
Nenga gajah	Indonesia
Paphiopedilum druryi	India
Rafflesia arnoldii	Indonesia
Ulmus wallichiana	Afghanistan, India, Nepal, Pakistan

AUSTRALIA AND NEW ZEALAND

Acacia aphylla	Australia
Acacia peuce	Australia
Boronia keysii	Australia
Bowenia serrulata	Australia
Carmichaelia exsul	Lord Howe Island
Casuarina fibrosa	Australia
Celmisia morganii	New Zealand
Celmisia philocremna	New Zealand
Clianthus puniceus	New Zealand
Cordyline kaspar	Three Kings Islands
Diuris fastidiosa	Australia
Eucalyptus argophloia	Australia
Eucalyptus carnabyi	Australia
Eucalyptus crenulata	Australia
Eucalyptus curtisii	Australia
Eucalyptus froggattii	Australia
Eucalyptus rhodantha	Australia
Eucalyptus steedmanii	Australia
Gunnera hamiltonii	New Zealand
Helichrysum dimorphum	New Zealand
Hibiscus insularis	Philip Island
Idiospermum australiense	Australia
Livistona mariae	Australia
Marattia salicina subsp. nov.	Lord Howe Island
Myosotidium hortensia	Chatham Islands
Passiflora herbertiana ssp. *insulae-howei*	Lord Howe Island

Pittosporum dallii	New Zealand
Podolepis monticola	Australia
Ranunculus crithmifolius ssp. *paucifolius*	New Zealand
Ranunculus godleyanus	New Zealand
Streblorrhiza speciosa	Philip Island
Tecomanthe speciosa	Three Kings Islands
Trilepidea adamsii	New Zealand
Xeronema callistemon	Poor Knights Islands, Hen & Chickens Is.
Yoania australis	New Zealand

CARIBBEAN

Aechmea dichlamydea	Trinidad and Tobago
Calyptronoma rivalis	Puerto Rico
Cereus robinii	Cuba
Epidendrum mutelianum	Guadeloupe
Gaultheria sphagnicola	Guadeloupe, Martinique
Glomeropitcairnia erectiflora	Trinidad and Tobago
Juniperus bermudiana	Bermuda
Microcycas calocoma	Cuba
Pseudophoenix ekmanii	Dominican Republic
Tibouchina chamaecistus	Martinique

CENTRAL AND SOUTH AMERICA

Aechmea dichlamydea	Venezuela
Ariocarpus agavoides	Mexico
Dicliptera dodsonii	Ecuador
Euchlaena perennis	Mexico
Freziera forerorum	Colombia, Panama
Glomeropitcairnia erectiflora	Venezuela
Lycaste suaveolens	El Salvador
Mimosa lanuginosa	Brazil
Notylia bicolor	Costa Rica, El Salvador, Guatemala, Mexico
Obregenia denegrii	Mexico
Persea theobromifolia	Ecuador
Sobralia xantholeuca	El Salvador, Guatemala

EUROPE

Androsace brevis	Italy, Switzerland
Andryala levitomentosa	Romania
Artemisia granatensis	Spain
Asplenium jahandiezii	France
Astragalus arnacantha	Bulgaria, U.S.S.R.
Astragalus physocalyx	Bulgaria, Yugoslavia
Beta nana	Greece
Bromus interruptus	United Kingdom
Bupleurum kakiskalae	Crete
Carlina diae	Crete
Cytisus emeriflorus	Italy, Switzerland
Daphne arbuscula	Czechoslovakia

Daphne rodriguezii	Balearic Islands
Degenia velebitica	Yugoslavia
Dianthus callizonus	Romania
Dianthus urumoffii	Bulgaria
Doronicum cataractarum	Austria
Draba ladina	Switzerland
Euphrasia dunensis	Denmark
Forsythia europaea	Albania, Yugoslavia
Hutera rupestris	Spain
Isoetes boryana	France, Spain
Lilium rhodopaeum	Bulgaria, Greece
Limonium recurvum	United Kingdom
Linaria hellenica	Greece
Myosotis ruscinonensis	France
Naufraga balearica	Balearic Islands
Nepeta sphaciotica	Crete
Onosma tornensis	Czechoslovakia, Hungary
Paeonia cambessedesii	Balearic Islands
Palaeocyanus crassifolius	Malta
Papaver laestadianum	Norway, Sweden
Phoenix theophrasti	Crete
Primula palinuri	Italy
Rheum rhaponticum	Bulgaria, Norway
Rhynchosinapis wrightii	United Kingdom
Saxifraga biternata	Spain
Saxifraga florulenta	France, Italy
Silene diclinis	Spain
Silene holzmannii	Greece
Silene viscariopsis	Yugoslavia
Sisymbrium cavanillesianum	Spain
Stipa bavarica	Federal Republic of Germany
Vella pseudocytisus	Spain
Viola hispida	France

INDIAN OCEAN

Aloe squarrosa	Socotra
Badula crassa	Réunion
Begonia socotrana	Socotra
Catharanthus coriaceus	Madagascar
Crinum mauritianum	Mauritius
Dendrosicyos socotranus	Socotra
Diospyros sp. nov.	Mauritius
Dirachma socotrana	Socotra
Dorstenia gigas	Socotra
Drypetes caustica	Mauritius, Réunion
Euphorbia abdelkuri	Abd al Kuri
Lodoicea maldivica	Seychelles
Medusagyne oppositifolia	Seychelles
Peponium sublitorale	Aldabra
Punica protopunica	Socotra
Taverniera sericophylla	Socotra
Tetrataxis salicifolia	Mauritius

Toxocarpus schimperianus	Seychelles
Vateria seychellarum	Seychelles
Zanthoxylum paniculatum	Rodrigues
NORTH AFRICA AND THE MIDDLE EAST	
Aeonium nobile	Canary Islands
Aichryson bollei	Canary Islands
Arbutus canariensis	Canary Islands
Centaurea junoniana	Canary Islands
Ceratonia sp. nov.	Oman
Cupressus dupreziana	Algeria
Cyperus papyrus ssp. *hadidii*	Egypt
Dionysia mira	Oman
Dracaena draco	Canary Islands, Cape Verde Is., Madeira
Echium pininana	Canary Islands
Euphorbia handiensis	Canary Islands
Globularia ascanii	Canary Islands
Helianthemum sphaerocalyx	Egypt
Iris lortetii	Israel
Limonium arborescens	Canary Islands
Lotus berthelotii	Canary Islands
Medemia argun	Egypt
Olea laperrinei	Algeria
Rumex rothschildianus	Israel
Ruta pinnata	Canary Islands
Wissmannia carinensis	South Yemen
NORTH AMERICA	
Aconitum noveboracense	U.S.A.
Agave arizonica	U.S.A.
Ancistrocactus tobuschii	U.S.A.
Arctostaphylos densiflora	U.S.A.
Armeria maritima ssp. *interior*	Canada
Asimina rugelii	U.S.A.
Asimina tetramera	U.S.A.
Astragalus beatleyae	U.S.A.
Astragalus phoenix	U.S.A.
Berberis sonnei	U.S.A.
Betula uber	U.S.A.
Centaurium namophilum	U.S.A.
Cereus robinii	U.S.A.
Cladrastis lutea	U.S.A.
Conradina verticillata	U.S.A.
Cupressus macrocarpa	U.S.A.
Cypripedium candidum	Canada, U.S.A.
Dionaea muscipula	U.S.A.
Dudleya traskiae	U.S.A.
Elliottia racemosa	U.S.A.
Franklinia alatamaha	U.S.A.
Fritillaria liliacea	U.S.A.
Hudsonia montana	U.S.A.

Isoetes louisianensis	U.S.A.
Isotria medeoloides	Canada, U.S.A.
Leavenworthia torulosa	U.S.A.
Lesquerella densipila	U.S.A.
Malacothamnus clementinus	U.S.A.
Nolina interrata	U.S.A.
Oenothera deltoides ssp. *howellii*	U.S.A.
Orcuttia mucronata	U.S.A.
Pedicularis furbishiae	Canada, U.S.A.
Pediocactus knowltonii	U.S.A.
Phyllitis japonica ssp. *americana*	Canada, U.S.A.
Prunus gravesii	U.S.A.
Rhapidophyllum hystrix	U.S.A.
Roystonea elata	U.S.A.
Salix silicicola	Canada
Sarracenia alabamensis ssp. *alabamensis*	U.S.A.
Senecio newcombei	Canada
Swallenia alexandrae	U.S.A.
Thismia americana	U.S.A.
Zamia floridana	U.S.A.
Zizania texana	U.S.A.

PACIFIC OCEAN

Achyranthes mangarevica	Gambier Islands
Bidens hendersonensis	Henderson Island & Oeno Atoll
Burretiokentia hapala	New Caledonia
Cyphophoenix nucele	New Caledonia
Heritiera longipetiolata	Guam and other islands of the Marianas
Hibiscadelphus giffardianus	Hawaiian Islands
Hibiscadelphus wilderianus	Hawaiian Islands
Juania australis	Juan Fernández Islands
Lactoris fernandeziana	Juan Fernández Islands
Lebronnecia kokioides	Marquesas Islands
Neoveitchia storckii	Fiji
Neowawraea phyllanthoides	Hawaiian Islands
Pelagodoxa henryana	Marquesas Islands
Pritchardia macrocarpa	Hawaiian Islands
Pritchardia munroi	Hawaiian Islands
Ranunculus caprarum	Juan Fernández Islands
Santalum fernandezianum	Juan Fernández Islands
Serianthes nelsonii	Guam, Rota
Sophora fernandeziana	Juan Fernández Islands
Sophora masafuerana	Juan Fernández Islands
Sophora toromiro	Easter Island

(Species from Philip Island, Lord Howe Island, the Chatham Islands and offshore New Zealand islands are listed under 'AUSTRALIA AND NEW ZEALAND'.)

SOUTH ATLANTIC OCEAN	
Calandrinia feltonii	Falkland Islands
Pelargonium cotyledonis	St. Helena
Trochetia erythroxylon	St. Helena
Wahlenbergia linifolia	St. Helena
SOUTHERN AFRICA	
Aloe polyphylla	Lesotho
Chondropetalum acockii	South Africa
Diastella buekii	South Africa
Erica chrysocodon	South Africa
Erica jasminiflora	South Africa
Eumorphia swaziensis	Swaziland
Gladiolus aureus	South Africa
Jubaeopsis caffra	Transkei
Kniphofia umbrina	Swaziland
Leucadendron verticillatum	South Africa
Moraea loubseri	South Africa
Orothamnus zeyheri	South Africa
Restio acockii	South Africa
Serruria ciliata	South Africa
Serruria roxburghii	South Africa
TROPICAL AFRICA SOUTH OF THE SAHARA	
Caralluma distincta	Kenya, Tanzania
Caralluma tubiformis	Kenya
Cordeauxia edulis	Ethiopia, Somalia
Dracaena ombet	Djibouti, Ethiopia, Sudan
Euphorbia cameronii	Somalia
Euphorbia wakefieldii	Kenya
Gigasiphon macrosiphon	Kenya, Tanzania
Medemia argun	Sudan
Olea laperrinei	Niger, Sudan
Vepris glandulosa	Kenya
Whitesloanea crassa	Somalia
Wissmannia carinensis	Djibouti, Somalia

THE RED DATA BOOK CATEGORIES

As a guide to the status of the taxa included, the beginning of the first section of each sheet, Status, gives one of the following categories designated by the Survival Service Commission for plants and animals.

Extinct (Ex)*

Endangered (E)

Taxa in danger of extinction and whose survival is unlikely if the causal factors continue operating.

Included are taxa whose numbers have been reduced to a critical level or whose habitats have been so drastically reduced that they are deemed to be in immediate danger of extinction.

Vulnerable (V)

Taxa believed likely to move into the endangered category in the near future if the causal factors continue operating.

Included are taxa of which most or all the populations are *decreasing* because of over-exploitation, extensive destruction of habitat or other environmental disturbance; taxa with populations that have been seriously *depleted* and whose ultimate security is not yet assured; and taxa with populations that are still abundant but are *under threat* from serious adverse factors throughout their range.

Rare (R)

Taxa with small world populations that are not at present endangered or vulnerable, but are at risk.

These taxa are usually localized within restricted geographical areas or habitats or are thinly scattered over a more extensive range.

* In practice, the Extinct category is used for species not found after repeated searches of known and likely areas.

The Endangered and Vulnerable categories may include, temporarily, taxa whose populations are beginning to recover as a result of remedial action, but whose recovery is insufficient to justify their transfer to another category.

HOW TO PROMOTE THE SURVIVAL OF SPECIES

Each Red Data sheet, excepting those for species already believed extinct, includes a section on Conservation Measures Proposed, which comprises recommendations on the action required to improve the species' prospects of survival, or the gathering of further information, in particular about the species' distribution, habitat and the threats to its existence, on the basis of which conservation measures may be formulated.

The proposals are those that appeared to be most appropriate at the time when the sheet was compiled. It will be appreciated, however, that numerous other initiatives can be taken to improve the status of a plant species. In particular, it is hoped that the Red Data Book will help stimulate action by individuals, by groups such as Universities, schools and botanical clubs, and by governments. Individual and group action is only likely to be effective in the long-term if backed by a full and integrated range of government policies favourable to plant and habitat conservation. Since governments naturally have the capacity to be the biggest and most effective conservation agencies, the following paragraphs give priority to the governmental role and then take a look at what the individual can do to help in the conservation of threatened plant species.

Although many governments have promoted conservation measures in this field, the countries of the Council of Europe were among the first to accept full responsibility and to take action accordingly. During 1977, the Council's environment ministers, in endorsing the European List of Rare, Threatened and Endemic Species prepared by the TPC, adopted a strong and far-sighted resolution on the complete range of policies needed for plant conservation. A shortened version of this most important statement is given below (the full version is to be found in the published European List).

1. Ensure adequate legal protection for all plants identified as Endangered, with provision for licences to be issued for approved collection purposes;
2. Provide minimum legal protection for all plants against depredations not yet covered by law;
3. Institute or complete national surveys of plants that are rare or threatened for appropriate dissemination and publication (National Red Data Books).
   Such surveys should:
   - (i) Include plants that are rare or threatened only in particular countries and therefore not included in IUCN or other international lists;
   - (ii) Identify the principal threats to the plants so listed;
   - (iii) Specify the action needed to ensure their survival;

4. Establish nature reserves and designate areas in which vegetation and flora are protected by law and stimulate the setting up of nature reserves by private bodies, with the long-term aim of ensuring that all listed species can be found in such areas;
5. Incorporate safeguards in future planning strategies to protect all listed species, as the major threat to many plants is created by changing land use;
6. Stimulate, undertake or co-ordinate through competent organisations multidisciplinary research at national or international level, with a view to:
    (a) Extending and improving knowledge on the flora of those areas that are still insufficiently known botanically so as to be able to make constructive proposals for conservation and planning purposes;
    (b) Promoting studies on the habitat, autecology and population biology of listed species to provide the information needed from which integrated conservation management plans can be formulated;
    (c) Promoting studies on the dynamics and ecology of the vegetation types in which listed species occur;
7. Give appropriate support to scientifically based botanic gardens so that they have the facilities they need to propagate and grow the listed species and to distribute propagating material to other institutions and where appropriate for re-introduction to the wild, with the aim of reducing the pressure on wild populations and at the same time drawing attention to the aesthetic, cultural and scientific importance of these plants;
8. Ratify, if this has not already been done, the Convention on International Trade in Endangered Species of Wild Fauna and Flora.

It is important to note that the adoption of all these measures in other parts of the world is not necessarily a realistic goal, although various parts of the recommendations could certainly be widely applied and incorporated in appropriate legislation. In many areas, the decline and extinction of plants are part of a much larger process of degradation in which the whole environment is affected by dramatic land use changes; here it is the total reassessment of development strategies that needs to be undertaken, involving the integration of conservation measures within development plans to assure the long-term survival of the region concerned. For instance, in most areas of tropical rain-forest the scattered distribution patterns of species, in conjunction with threats endangering whole ecosystems, dictate different priorities: first and foremost, protection of as many diverse areas of forest as possible, with emphasis on larger areas which are easier to protect and more likely to be self-supporting without loss of diversity. Due to the imbalance of resources, particularly with regard to scientific expertise, it is highly desirable that wherever practicable such expertise should be made available to help in the development of strategies likely to ameliorate the situation. It is with this fundamental objective in mind that the TPC has undertaken the task of data-gathering

on a world scale, in the hope that it will serve to highlight areas where urgent action is most needed. Conservation must be built into long-term planning in these areas for, in both the short and the long term, it is upon the natural renewable resources such as forests and rangelands that their inhabitants will depend and must rely for continuing employment and income.

But if government policy is one essential ingredient in the process, so also is the support of individuals and local groups. Many species survival problems are particularly dependent on that support for, although the number of plant species may be large, the area in which each occurs may be small and its protection therefore within the resources and capabilities of such groups. Given below is a check-list of the types of initiative which have been found to be effective. It was compiled by the Survival Service Commission in 1966-7, primarily with threatened species of animals in mind, and is reproduced here from Red Data Book 1: Mammalia (IUCN, 1972-6), with modifications suited to the special needs of threatened plants.

1. Fact-Finding
   (1) A brief *status survey* to determine the status of the species and the current threats to its survival;
   (2) A longer *ecological study* to identify the requirements of the species, the factors limiting its population growth, and the relationship between it, its habitat and the local human population;
   (3) Assessment of the *legal* and *enforcement situation.*

2. Possible remedial measures
   (1) *Acquire land* as a *reserve;*
   (2) *Promote the formation* by a Government or other appropriate agency of: (a) a *national park,*
   (b) a *nature reserve;*
   (3) (a) *Promote new legislation,*
   (b) *Improve law enforcement,*
   (c) *Improve the legal situation* in any other way;
   (4) Establish a *research station* to study the flora, fauna and ecology of the region;
   (5) Establish a *research foundation* possibly within an existing organisation (such as a university) which will focus scientific attention on the species concerned;
   (6) Create a *continuing scientific presence* by any other means;
   (7) Bring the species into *cultivation* (after first checking whether cultivated material of known wild source is not already available from a botanic garden) and *bulk up the population* in order to:
      (a) *Re-introduce individuals* back into the wild,
      (b) *Supply* research workers and horticulturists with *propagating material* to reduce the collecting pressure on the wild populations,
      (c) Use the plant for *publicity and conservation education;*

(8) *Control:* (a) *feral and other grazing and browsing animals,*
(b) *vigorous introduced plants;*
(9) *Promote planning controls* to ensure the protection of the habitat;
(10) *Promote or carry out any management of the habitat* that is needed to ensure the survival and wellbeing of the species.

3. Publicity
(1) *Promote a publicity campaign;*
(2) *Propose the adoption* by a Group of:
(a) the *species,*
(b) the *project;*
(3) *Promote a programme of long-term education.*

CONCLUSIONS

1. Against the background of plants as man's life support system, the size of the worldwide plant conservation problem comes sharply into focus: as previously emphasised, the case histories presented here cover no more than about one percent of the rare and threatened species. Nevertheless, the material which has been or is in the course of being collected for this volume and for the various TPC lists, does prove that it is possible to provide the data upon which sound conservation measures can be based. In regions where it is likely that many species cannot be identified as threatened until it is too late to secure their survival, the centre of endemism approach, with case histories of selected species for each key site, seems the best available.

2. In some parts of the world, it would appear that there is a reasonable chance of success and that in predominantly temperate countries such as those of Europe and North America no further species need be lost. Relatively few of the listed species are Endangered and most are confined to very small areas which can usually be protected without anyone suffering serious economic hardship. Botanic gardens, moreover, are poised to play a major role not only in cultivating the plants concerned, but also in their re-introduction, in habitat management and even in owning and maintaining small reserves for particular species. Once the individual facts on threats, habitats, sites and populations are known, successful conservation of most plant species is likely to prove far less difficult and costly than that of animals.

3. In contrast, however, one has to recognise and regretfully accept that large species losses are now virtually unavoidable in many regions. The conflicts between day-to-day human survival and long-term ecological wellbeing and hence human prosperity, that face developing countries of the tropics, especially in humid forest and arid zones, with such great dilemmas, indicate that it is especially important that future options are not curtailed and that the species which have to be sacrificed are those whose loss will have minimal effects on future generations.

PREAMBLE TO THE SHEETS

As far as possible each sheet is self-explanatory. At the beginning of the Status section is the Red Data Book Category used by IUCN to indicate the degree of threat, assessed in the light of the information that follows. The categories are defined and explained on p. 25. In line with all TPC work, species and subspecies are covered but not varieties, forms or cultivars.

Sheets are also designed to be self-sufficient as they are intended to be used individually to promote the necessary conservation measures; there is, therefore, some repetition in sheets referring to the same sites or associated species, especially of References* and general notes under Distribution. Journal abbreviations are in accordance with the World List of Scientific Periodicals, 4th Ed. (Butterworths, London, 1963-1965 and Supplements).

At the bottom of each sheet is a line of IUCN codings, in particular the retention of copyright. The middle figure of (2) indicates that the species was covered in the former Red Data Book 5: Angiospermae (1970-1), or (1) that the sheet has not been issued before. At the extreme right of the front page of each sheet the Red Data Book category is quoted in summary form for easy reference.

The sheets are arranged by major groups, that is ferns (Pteridophyta) comes first, then cycads and conifers (Gymnospermae), followed by much the largest group, the flowering plants (Angiospermae). For only the first two groups is the name of the group added at the top right corner of the front half of each sheet. Within each group sheets are arranged alphabetically by family, genus and then species.

* The only intentional omissions here are other books by IUCN (in particular the World Directory of National Parks and Other Protected Areas), and the Flora Europaea (ed. T.G. Tutin *et al.*, 4 vols, 1964-76, vol. 5 in press, Cambridge University Press), which is the taxonomic base from which all the European sheets are derived.

ASPLENIACEAE PTERIDOPHYTA

STATUS Vulnerable. It is confined to a single gorge, in which it is almost continuous over c. 12 km and abundant in places. Of the outlying populations, 2 are extinct following the construction of a reservoir and the remainder are declining. The main population is threatened by planned hydro-electric schemes; however, several stands of the species are above the projected highest water-level.

DISTRIBUTION France. It occurs along part of the Verdon Gorge and adjacent ravines, in the Alpes de Provence.

Out of 73 species of flowering plants endemic to France, 7 are Endangered, 10 are Vulnerable and 23 are Rare. Three are Extinct *(Myosotis ruscinonensis* Rouy, also in the Red Data Book, *Minuartia olonensis* (Bonnier) P.Fourn. and *Viola cryana* Gillot). One *(Artemisia insipida* Vill.) is possibly Extinct.

HABITAT AND ECOLOGY On wet, shaded limestone cliffs; it was originally recorded from 400 and 520-700 m, growing with the widespread *A. trichomanes* L. (1).

CONSERVATION MEASURES TAKEN None known.

CONSERVATION MEASURES PROPOSED None on record.

BIOLOGY AND POTENTIAL VALUE It may possibly be of hybrid origin. Its possible only relative is *A. bourgaei* Milde from southern Turkey.

CULTIVATION It is very difficult to keep under cultivation.

DESCRIPTION Small fern with a short scaly rhizome bearing at its apex tufts of almost erect, pale green, pinnate fronds 3-10 cm long, linear-elliptic in outline, on green stalks 4-25 mm long. The pinnae are 5-10 mm long, oblong, irregularly toothed and joined throughout their width to the axis. Spores borne in numerous sporangia which are in indusiate sori arranged in a double row on the lower surface of the pinnae.

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The TPC is most grateful to Monsieur G.G. Aymonin, of the Muséum National d'Histoire Naturelle, Paris, for help in producing this sheet.

ISOETACEAE PTERIDOPHYTA

STATUS Vulnerable; a freshwater aquatic with a very restricted distribution. In the French localities it is threatened both by drainage and eutrophication of the habitat and may be extinct in some sites. Eutrophication increases the competition from algae and other vascular plants from which plants like *Isoetes* cannot survive. The two Spanish localites of ssp. *asturicensis* appear little threatened at present.

DISTRIBUTION France, Spain. The type subspecies (ssp. *boryana)* is known from 6 ponds and lakes over a range of c. 80 km on the Atlantic coast south of Arcachon in south west France. There are distinct populations in two lakes of the Sierra de Gredos of central Spain; these are known as *I. boryana* var. *lereschii* Reichenb.f., but it is not at present certain whether they belong to this species. Their two localities are menaced by progressive eutrophication and consequent changes in the ecosystem, caused by the addition of organic matter into the lakes partly as a result of tourism.

Ssp. *asturicensis* M.Laínz is recorded from two mountain lakes in north west Spain, one around Cangas de Narcea, Asturias, at 1750 m, and the other around Puebla de Sanabria, Zamora (4). The subspecies may, however, be more widespread and occur in other lakes in the region of Asturias.

HABITAT AND ECOLOGY It grows in a submerged community dominated by *Littorella uniflora* (L.) Aschers. near the margins of shallow lakes and ponds. This habitat is described in detail in (7) and (8). Ssp. *boryana* apparently occurs in depths of 20-80 cm, ssp. *asturicensis* in water less than 50 cm deep, emerging at the edge.

CONSERVATION MEASURES TAKEN None known.

CONSERVATION MEASURES PROPOSED Some of the localities in France occur in the area designated for the Parc d'Aquitaine. Some degree of protection would be desirable for the Spanish localities of ssp. *asturicensis*. (The Sierra de Gredos localities of *Isoetes*, mentioned in Distribution above, are included in the area proposed for the Gredos National Park.) In all cases, priority should be given to protection of the lakes from pollution and contamination.

BIOLOGY AND POTENTIAL VALUE No information. The group needs taxonomic revision.

DESCRIPTION Tufted, submerged or partly submerged, rush-like aquatic with leaves up to 20 cm long and 5 mm broad, tapering to the apex, almost circular in cross-section. Sporangia, containing micro (male) or mega (female) spores, are borne singly in the axils at the base of each leaf. Spore characters distinguish both the two subspecies

from each other (4) and this species from other members of the genus; in general the species is most similar to *I. echinospora* Durieu (1).

For a small colour illustration see (2) and a small line-drawing (3).

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This sheet is based upon information supplied by C.P. Moral (of the Instituto Botánico Cavanilles, Madrid) and Monsieur G.G. Aymonin (of the Museum National d'Histoire Naturelle, Paris), to both of whom the TPC is most grateful. Help is also gratefully acknowledged from Mr A.C. Jermy and from Monsieur J.Y. Lesouëf.

Louisiana Quillwort

ISOETACEAE PTERIDOPHYTA

STATUS Endangered. When this plant was first described, in 1973, it was known only from the *locus classicus*. Shortly afterwards, the site was destroyed by the construction of a new bridge. In the process, the creek bed was widened, increasing the water flow. Additional plants were searched for nearby, but without success. The plant was believed to be probably extinct until it was rediscovered in 1978 just north and upstream of the *locus classicus*. About 30 individuals were found in and along the original stream, and about 20 more in and along a small backwater creek off the main stream (2).

DISTRIBUTION U.S.A.; known from only one restricted area in Washington Parish, Louisiana.

HABITAT AND ECOLOGY In streams, either in quiet or moving water, or along the banks in sand and gravel (2). Associated aquatic species include Golden Club, *Orontium aquaticum* L.; the Pondweed *Potamogeton pusillus* L.; and Bur-reed, *Sparganium americanum* Nutt. (1).

CONSERVATION MEASURES TAKEN The species was proposed as 'Endangered' by the U.S Department of the Interior, Fish and Wildlife Service, on 16 June 1976. The Endangered Species Act of 1973 directs that no federally funded activity shall jeopardise the existence of species once officially determined as 'Endangered' or 'Threatened', as defined by the Act.

CONSERVATION MEASURES PROPOSED A search should be made of similar streams in the area to determine the full extent of this species' range.

BIOLOGY AND POTENTIAL VALUE It has been reported that the lower portions of various species of *Isoetes* are sometimes used as food by ducks (3).

CULTIVATION A potted specimen is growing in a greenhouse of the University of Southwestern Louisiana.

DESCRIPTION Tufted rush-like aquatic with a 2-lobed axis (or corm) bearing numerous leaves, usually 15-40 cm long, more or less flat on one side and rounded on the other. Oblong-elliptical sporangia 6.5-8.0 x 3-4 mm, covered with brown spots and containing micro (male) or mega (female) spores, are borne singly in the axils at the base of each leaf. The species is similar to *I. engelmannii* A.Brown var. *caroliniana* Eaton, differing mainly in its spotted sporangia (1).

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The material for this sheet was supplied by the Endangered Flora Project of the Smithsonian Institution, Washington, D.C., to whom the TPC is most grateful. Information is also gratefully acknowledged from M. Curry and G. Landry.

Horseshoe Fern

MARATTIACEAE PTERIDOPHYTA

STATUS Endangered; a subspecies endemic to a small island (c. 10 x 2-3 km) where it is restricted to a few individuals beyond the reach of feral pigs and collectors. Only 3 localities are known, one of which was only discovered in 1977.

DISTRIBUTION Lord Howe Island, Pacific Ocean (31° 35'S., 159° 05'E.). The localities are on Mounts Lidgbird and Gower, the highest peaks (776 and 803 m) on the island.

There are c. 75 species and subspecies of ferns and flowering plants endemic to Lord Howe Island, including 4 species of palms and 4 species of tree-ferns (4). Unlike most of the other subtropical and tropical islands with endemic species listed in the Red Data Book, nearly 70% of the original forest remains and this is reflected by the fact that none of the endemic plants are believed to be extinct. There are introduced goats and pigs on the island and their effects on the vegetation have been reviewed by Pickard (2). An airstrip has recently been built and the island will undoubtedly become subject to greater pressures from tourism in the future.

HABITAT AND ECOLOGY Currently confined to inaccessible terraces and ledges, this fern was formerly plentiful on moist sites in lowland rain-forest but was exterminated by pigs, collectors and possibly goats.

CONSERVATION MEASURES TAKEN An environmental survey of Lord Howe Island has been carried out and detailed recommendations made to conserve the remaining forests and promote wildlife tourism (3). The reserve proposed has not been dedicated and feral goats are still abundant on Mount Gower, although the majority of the goats on the island have been removed; only about 50 remained in 1975 (2).

CONSERVATION MEASURES PROPOSED As recommended by Recher and Clark in (3):- Reservation of parts of the island and complete removal of the pigs and goats.

BIOLOGY AND POTENTIAL VALUE It is a distinct subspecies and was very popular in cultivation about 60-70 years ago. As mentioned above, the flora of Lord Howe Island is of great biological interest; the island's great beauty, in conjunction with an almost intact array of endemic biota, make it a key area for wildlife tourism.

CULTIVATION It is still in cultivation.

DESCRIPTION Fern with a large fleshy tuberous rhizome producing large, arching, triangular, bi- to tri-pinnate fronds 3-4 m long, on fleshy stalks. Pinnae c. 30 cm long by 12 cm broad; ultimate segments

(pinnules) glossy, oblong, c. 8 cm long by 2 cm wide. Sori oblong, 2-3 mm long, arranged side by side along the secondary veins (at right angles to the margin) so forming 2 continuous submarginal rows along the pinnule. Oliver gives the difference from the type subspecies as short obtuse pinnules with the sori submarginal (1).

Although a distinct subspecies, it was originally described by Oliver in (1) as a variety (var. *howeana* W.R.B.Oliver) of *M. fraxinea* Smith. No combination has yet been made, at either varietal or subspecific rank, under the correct species name of *M. salicina* Smith.

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The material for this sheet was supplied by Mr J. Pickard (of the National Herbarium, Sydney), to whom the TPC is most grateful. Help is also acknowledged from Mr P.S. Green of the Royal Botanic Gardens, Kew, U.K.

POLYPODIACEAE PTERIDOPHYTA

STATUS Vulnerable. The major population of this species in Ontario has not received any official protection although it is regarded as rare in the province (1). Peripheral populations in the U.S.A. are endangered by habitat destruction.

DISTRIBUTION Canada, U.S.A. In Canada this fern is restricted to the Niagara escarpment of southern Ontario, from Bruce County to Halton County (9). The range in the United States includes three separate populations: upper peninsular of Michigan (5), central New York (2) and Tennessee (8). For a distribution map see (6).

HABITAT AND ECOLOGY Within cool, moist canyons and on cliffs in mature, deciduous forests. It is commonly associated with *Camptosorus rhizophyllus* (L.) Link, *Dryopteris goldiana* (Hook.) A.Gray and *Geranium robertianum* L. in the United States, and *Polystichum lonchitis* (L.) Roth in Canada. In New York it is restricted to Onondaga limestone outcrops; similarly in Ontario the majority of the sites are found on limestone and dolomite exposures (3).

CONSERVATION MEASURES TAKEN It is protected by law in New York, where the main United States population, consisting of about 1000 individuals, is within the Clark Reservation State Park (3). In Canada, the Ontario Ministry of Natural Resources has completed a survey of the natural areas along the Niagara escarpment; it is possible that some of the proposed reserves will afford protection to the species.

CONSERVATION MEASURES PROPOSED None apart from the proposals for reserves referred to in the previous section.

BIOLOGY AND POTENTIAL VALUE The existence of a disjunct population, ssp. *americana*, (2n=144) distinct from the typical European species, (2n=72) is of interest to studies of plant geography and is of evolutionary significance.

DESCRIPTION Terrestrial fern with undivided fronds on stalks 4-12 cm long, 1-2 mm thick, densely scaly when young. Fronds linear or linear-lanceolate, up to 35 cm long and 4 cm wide, pointed at the apex, cordate-auriculate at the base, sparsely scaly beneath especially along the midrib. Spores borne in numerous sporangia in paired linear sori up to 2 cm long parallel to the lateral veins and perpendicular to the midrib. (Syn. *Phyllitis scolopendrium* (L.) Newman var. *americanum* Fernald).

For an illustration see (4).

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The material for this sheet was supplied by Dr R.V. Maher (of the Rare and Endangered Plants Project, National Museum of Natural Sciences, Ottawa), to whom the TPC is most grateful. Help is also gratefully acknowledged from Dr G.W. Argus and Mr A.C. Jermy.

Tarout (local Touareg name)

CUPRESSACEAE GYMNOSPERMAE

STATUS Endangered. Only 153 living specimens are known in addition to many more dead ones. The living trees are in poor condition and are actively threatened. Nomads often shelter under the trees and their herds destroy any regeneration. Living branches are sporadically taken for firewood, but systematic cutting of the cypresses has ended because of their rarity and remoteness. There were still many living trees in 1863 according to the first European report, and they were then a major source of timber for local use. Very detailed accounts of this species, in particular of its habitat and its status in the wild, are given in (1), (4) and (8).

DISTRIBUTION Algeria; now confined to an area of about 200 sq. km on Edehi (or Tamrit) Plateau of the Tassili N'Ajjer massif in central Sahara, in the extreme south east of the country. However fossil pollen shows that the species was recently still widespread in the Sahara.

HABITAT AND ECOLOGY On alluvial gravels and sands in wadi bottoms, at 1000-1800 m. Only two cases of naturally occurring seedlings have ever been recorded and there are no trees younger than at least a century (only five trees are recorded with a diameter of 50 cm or less, the smallest being 13 cm). All fully grown trees are now too badly mutilated for the natural growth form to be seen. The trees are extremely long-lived, the oldest being probably at least 2000 years old. In the area frosts down to -7° C. are probable and average annual rainfall is perhaps 30 mm, with great irregularies.

CONSERVATION MEASURES TAKEN None for the wild populations.

CONSERVATION MEASURES PROPOSED Due to the very scattered distribution of the remaining trees, with an average density of less than one per sq. km, conservation in the field will clearly be difficult. As recommended by IUFRO, one priority should be to take cuttings from every specimen and to grow a complete set in several places. A collection of dead trees for dendrochronological purposes (see below) should be made as soon as possible; there is a danger that almost all the dead wood will be taken for local use before it can be examined scientifically.

BIOLOGY AND POTENTIAL VALUE It is one of the most drought-resistant species known, with considerable frost tolerance. The wood is suitable for the most exacting uses, being of medium density, stable and aromatic. The stems are straight in cultivation and the branches fine. Growth is reportedly a little slower than that of *Cupressus sempervirens* L. in similar conditions. *C. dupreziana* could be a valuable species for planting in arid regions. Due to the longevity of the tree and the durability of the wood, the older specimens and remaining dead

trunks and stumps are likely to be of great value to dendrochronology, the study of tree rings to elucidate past climates and to provide a standard for dating woods of historic interest.

CULTIVATION Many unsystematic collections of the cones have been made and seedlings raised at many botanic gardens in Algeria and France. The largest collection was made by the Algerian Forest Service in 1969, and several thousand trees were successfully germinated. The Forest Research Centre at Ariana, Tunis, possesses a good collection of young trees. Although the seeds are reputed to germinate only with difficulty, this is unlikely to be the general rule; thorough precautions should be taken against fungal infection. Cuttings can be rooted under mist, as with other conifers. Grafting has been successfully achieved on to *Cupressus sempervirens* by scion-budding, by crown-grafting and by in-arching. The latter method can be used for cuttings if the base of the scion dips into water, and is perhaps the most successful.

DESCRIPTION Medium-sized, coniferous tree up to 20 m or more high with a reddish-brown, deeply fissured bark. Dense mature foliage of numerous minute pointed scale-leaves, slightly appressed to the stems and 1-1.5 mm long, dull green and slightly glaucous; juvenile leaves sharp, 2-3 mm long. Branchlets distichous. Male cones terminal, yellow, elongated, c. 6 x 3 mm; female cones c. 18-24 mm long, grey-brown, ovoid, consisting of 10-12 scales. Seeds reddish-brown, oval, flattened, winged. For illustrations see (1), (6) and (8).

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This sheet is based on a data sheet compiled for the International Union of Forestry Research Organisations (IUFRO) by Mr P.J. Stewart. The TPC is most grateful for their help.

Monterey Cypress

CUPRESSACEAE GYMNOSPERMAE

STATUS Rare. In the wild it is only found in two groves, the largest being c. 4 km long by c. 180 m wide; both are protected and are considerable tourist attractions. The tree is widely grown in other parts of the world for ornament and for timber (2,5).

DISTRIBUTION U.S.A.; restricted to the wind-swept Pacific Coast in Monterey County, central California. The two groves are at Point Lobos near Monterey and at Point Cypress near Carmel (5). The trees are mostly in a belt a hundred or so metres wide along the coast, but also scattered further inland on the ridge of the peninsula (9).

HABITAT AND ECOLOGY On exposed headlands and in dry places, growing in Closed-cone Pine Forest (7). "The trees grow on the shore cliffs, and being undermined by the sea, occasionally fall into it" (2). It is found mainly in pure, more or less dense stands, but on the east, it is mingled with Monterey Pine, *Pinus radiata* D.Don, and an occasional Gowen Cypress, *Cupressus goveniana* Gordon. In this coastal habitat the annual rainfall is about 43 cm, the climate is mild, never freezing and rarely above 32° C. Cloudy or foggy days are frequent and strong sea winds keep the air humid during the greater part of the year. The soil is a clay loam with a layer of dry leaf litter when shaded and covered with grass and other herbs in openings. The soil is porous in the shade, but baked, cracked and much less moist in the open (9).

CONSERVATION MEASURES TAKEN The entire wild population is protected; one grove is within the Point Lobos Reserve, the other within the Del Monte Forest (5). Point Lobos Reserve is part of the State Park System which acquired the land in 1933. *C. macrocarpa* occupies only the seaward end of the c. 160 ha reserve (3).

CONSERVATION MEASURES PROPOSED None.

BIOLOGY AND POTENTIAL VALUE It is widely grown for ornament and timber, but is no longer recommended for California because of its high susceptibility to the cypress canker disease caused by the fungus *Coryneum cardinale* (5,6). It has been extensively planted in the State as a hedge and windbreak (1).

CULTIVATION It prefers a deep, sandy-loam soil and is easily grown from seed (1). It is one of the hardiest of the cypresses, although it does best in warm maritime localities. It is more tender when young (2). In cultivation it develops a much more symmetrical and uniform habit than in the wild (8).

DESCRIPTION "Tree to 20 or 25 m high, at first symmetrical and with central leader, or in old trees with broad flat-topped often asymmetrical crown; bark at first rich-brown, later ashy-gray, with flat connected ridges separating into thick persistent scales; branchlets 2-3 mm thick; foliage rich bright green; leaves scarcely 2 mm long, acute, ... or 5-10 mm long on vigorous shoots ... Female cones globose or slightly elongate, 25-35 mm long" (7).

For illustrations see (3), (6) and (9).

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The material for this sheet was supplied by the Endangered Flora Project of the Smithsonian Institution, Washington, D.C., to whom the TPC is most grateful.

Bermuda Cedar, Bermuda Juniper

CUPRESSACEAE GYMNOSPERMAE

STATUS Vulnerable. Approximately 90% of the trees died between 1944 and 1950, due to a severe infestation of two accidentally-introduced scale insects, the juniper scale (*Carulaspis visci*) and the oyster shell scale (*Lepidosaphes newsteadi*). Over the following decade "numerous exotics were planted to relieve the bleak appearance of the groves of dead trees" (2,4); other introduced and naturalised species have replaced the Cedar as the dominant forest tree on unplanted sites (2). However, a few of the old trees are still alive and young stands are developing well in undisturbed areas, but the species is no longer the dominant tree, and due in addition to the rapid development of the island as a tourist resort and the limited land area, there is no space available for a re-afforestation programme.

DISTRIBUTION Bermuda. It was formerly abundant throughout the island. It is naturalised and becoming common on the island of St Helena (N.M. Wace, pers. comm.).

HABITAT AND ECOLOGY In the past forming almost complete forests on the hillsides and along the marshes (1).

CONSERVATION MEASURES TAKEN Pure stands of the species are being established on Government land and particularly on the small Nonsuch Island at the eastern end of the Bermuda Islands. Nonsuch, once devastated by goats, now contains much of Bermuda's native flora and fauna, with the Bermuda Cedar as the dominant tree.

CONSERVATION MEASURES PROPOSED None on record.

BIOLOGY AND POTENTIAL VALUE The Bermuda Cedar produces a good wood for furniture making and also for the manufacture of souvenirs. The finished article is highly polished and the reddish-brown hue of the wood is most attractive. It is also a valuable firewood which is burnt in open fire grates during the cold evenings from December to April.

CULTIVATION The tree is easily propagated from seed, which is produced annually in the late autumn. The seed, however, takes from 3 to 5 months to germinate. Vegetative methods of propagation have not been successful.

DESCRIPTION Evergreen tree up to 20 m high and up to 1 m in diameter, forming a rather irregular and widely branched tree with a conical outline when young, that becomes round-topped with age. The spread of the branches is usually greater than the height; the bark is thin, grey and flaky. Leaves ascending, linear, awl-shaped, 5-15 mm long by c. 1 mm wide, whitish above and light green beneath; leaves of mature trees in contrast scale-like, very small, closely appressed

and imbricate. Cone depressed globular, usually with 2 seeds (1).

For illustrations see (1), (2), (5) and (8).

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This data sheet is based on one compiled for the International Union of Forestry Research Organisations (IUFRO) by G.R. Groves. The TPC is most grateful for their help.

Bowenia serrulata (Bull) Chamberlain

Byfield Fern

ZAMIACEAE GYMNOSPERMAE

STATUS Vulnerable; a cycad which is known from only a few localities. In the past it was exploited for its ornamental fronds. It is toxic to stock (2) and this also threatens its survival.

DISTRIBUTION Australia. It has a scattered, fragmented distribution from central eastern Queensland north to Kuranda near Cairns, and on some coastal islands. The largest population is found in a small area north of Yeppoon in the Port Curtis pastoral district.

HABITAT AND ECOLOGY Usually it occurs on the lower slopes and adjoining flats of coastal foothills and ranges, but it has been recorded from the upper slopes and associated tableland. The largest populations occur in the ground layer of Eucalyptus open forest, but there are also records from depauperate rain-forest. The soils in the area are usually rocky, grey-brown, sandy clay loams to sandy loams. The climate is tropical with an annual average rainfall from 1000 mm to 1500 mm with high variability.

CONSERVATION MEASURES TAKEN Some of the habitat is included in the Byfield State Forest. The species is present in the Hinchinbrook Island National Park (39,379 ha), but there is no indication of its abundance.

CONSERVATION MEASURES PROPOSED A proposal has been prepared to declare a National Park in the vicinity of Byfield which would include suitable habitat for *B. serrulata*. No action has been taken to date.

BIOLOGY AND POTENTIAL VALUE As with most cycads, this is an attractive species and has value as a cultivated plant. The genus *Bowenia*, containing 2 species, is of scientific interest as it is a very distinct genus among the *Zamiaceae* and possesses more advanced features than the other Australian genera (3). Its life history is described in detail by Anstruther Lawson in (4) who describes the genus "as perhaps the most interesting ... of the genera of Cycads". It appears to be related to such American genera as *Zamia* although some of the resemblances may be due to parallel evolution or convergence (3).

CULTIVATION It is grown in gardens and conservatories for its ornamental fronds (3). There are records of its presence in 10 Botanic Gardens throughout the world.

DESCRIPTION Plant consisting of a woody, subterranean, rounded 'trunk' (caudex) up to 20-25 cm (or more) in diameter, bearing 5-20 short slender branches with cones and fronds. Leaf a pinnate frond on a branching axis, up to 90 cm long, the pinnules broadly lanceolate, 6-12 cm long, sharply serrate (except in the lower ¼-½) with rather pungent teeth 1-3 mm long, sometimes also a few of them coarsely lacerate. Fronds

bright green, shiny and leathery in texture. Female cones usually rounded, 10-15 cm long, in groups at ground level. Seeds rounded, c. 2 cm long, usually dull grey in colour (3).

For a small photograph of this species see (1).

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The material for this sheet was supplied by Mr D.E. Boyland (of the Queensland Herbarium, Brisbane), to whom the TPC is most grateful.

Palma corcho

ZAMIACEAE GYMNOSPERMAE

STATUS Endangered. In 1907 Caldwell noted 4 locations for this famous cycad, in 3 of which the plants were few and distinctly local. In the fourth location, the plants were found one, 2 or 6 together at infrequent intervals over a distance of 2-3 km (4). Today the estimated number of existing trees is c. 600, with little regeneration, found in 4 small, distinct areas (2), where it is protected by forestry regulations. These small populations are especially vulnerable since the number of individuals of each sex is very unbalanced.

DISTRIBUTION Cuba; in the southern range of the Organas Mountains, between Santo Tomas and San Diego de los Banos, Pinar del Rio Province (9). Two of the areas where it occurs are in the triangle between Pinar del Rio, Santo Tomas and Vinales; in one of these areas there are 200 individuals. The other 2 are east of Vinales, between Consolación del Sur and San Andrés (7), where there are 6-7 small, dispersed populations. For distribution maps see (2) and (7).

HABITAT AND ECOLOGY In the hill region between 50 and 200 m, on a wide range of geological substrata. On the lower 'haystack' hills (mogotes) it grows on semi-arid, bare rocks of hard Jurassic limestone, or on the rendzinas developed from them, where it is found in deciduous tropical calcareous forests (3) associated with *Bombacopsis cubensis* A.Robyns, *Bursera shaferi* (Britton & P.Wilson) Urban, *Celtis trinervia* Lam., *Gaussia princeps* H.Wendl., *Hebestigma cubense* (H.B. & K.) Urban, *Tabebuia calcicola* Britton, *Thrinax morrisii* H.Wendl., etc. More frequently it grows on yellow siliceous clays developed from sandstones and shales, as described in (2). On the siliceous soils it mainly occurs in evergreen oak forests and oak-pine woodland of *Quercus oleoides* Muell. ssp. *sagraeana* (Nutt.) Borhidi and *Pinus caribaea* Morelet ssp. *caribaea*, together with *Amaioua corymbosaa* H.B. & K., *Hypericum styphelioides* A.Rich., *Pithecellobium obovale* (A.Rich.) C.Wright and *Xylopia aromatica* (Lam.) Mart. *Microcycas* has a wide tolerence of soil pH, growing in both calcareous and acid soils; it does, however, prefer habitats where competition is low.

CONSERVATION MEASURES TAKEN The species is protected in all its habitats, and the populations are regularly checked.

CONSERVATION MEASURES PROPOSED Three most important areas for the species have been proposed as Natural Conservation Areas.

BIOLOGY AND POTENTIAL VALUE It is a well known and important relict of the gymnosperms in the Antilles, probably dating from the Cretaceous (7); it is the only species in the genus and easily distinguised from the small *Zamia* species in the region by its larger size (6). According to A.Mercado (8), its mineral nutrition is controlled by symbiotic algae and bacteria. Cones are produced in April or May.

It has been suggested that the pollen is transported from the male to the female tree by ants. Pollination is not very effective, for often cones are found which contain one or two fertile seeds (7). According to the folklore of the region, the roots can be used as a rat poison (4).

CULTIVATION It is of outstanding ornamental value and despite the difficulties of cultivation is grown in several private gardens in Cuba and at least 8 botanic gardens throughout the world, in particular the Fairchild Tropical Garden (Florida) which has distributed germinating seeds to other institutions. Seeds are very liable to become infected with a bacterial rot at or just after germination.

DESCRIPTION Cycad with a branched or unbranched, stout, woody stem up to 3-12 m high, marked with conspicuous rings in younger plants and in shaded forms of older trees. The stem carries a crown of 6-40 pinnate leaves 60-120 cm long; leaf stalks 10 cm, with shield-like bases; leaflets 50-80 pairs, 8-12 cm, opposite or alternate, finely villous when young, hairless and glistening when mature, bright green and pointed. Male cones 25-30 x 5-8 cm, cylindrical; female cones 50-70 x 13-16 cm, also cylindrical but slightly tapering from the base to the tip (5).

For illustrations see (1) and (4)-(9).

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This sheet is based upon information provided by Dr A. Borhidi (of the Research Institute for Botany of the Hungarian Academy of Sciences, Vácrátót, Hungary), to whom the TPC is most grateful. Information is also gratefully acknowledged from Mr J. Keesing of the Royal Botanic Gardens, Kew, U.K., and from the Endangered Flora Project of the Smithsonian Institution, Washington, D.C., U.S.A.

Coontie, Wild Sago, Florida Arrowroot, Coontie-palm

ZAMIACEAE GYMNOSPERMAE

STATUS Vulnerable. Once abundant throughout the Florida peninsula, this species is now greatly reduced in its natural habitat. As late as the early 1900s its abundance in the Everglade Keys was described as phenomenal and for centuries before that it was so plentiful that early maps of the region illustrate the Keys as 'Koontee or Hunting Grounds' (7). 'Koontee', the flour prepared from the underground stem, was a staple source of food for the inhabitants (7-9). Now, no longer a major food source, the ever-expanding tourist industry and the development of resorts throughout Florida and in its Georgia range have claimed most of the natural habitat and population of this species.

DISTRIBUTION U.S.A.; Florida and Georgia. The range extends throughout Florida with largest populations near the northern and southern extremities of the state (4,7). There are also individuals on St. Simons Island, Georgia.

HABITAT AND ECOLOGY In dry sandy soils (3), flat pinelands (4) and coastal dunes (7) as well as shell mounds (9), palmetto and coastal hammocks (4), the latter being characterised by small areas of dense forests consisting of broad-leaved evergreen trees in association with palms (5); the most robust individuals of this species seem to occur on the upper west coast and hammocks to the south (9). In central Florida, the species may be found on sandy ridges dominated by pines. In Georgia, it is in forests of Live oak (*Quercus virginiana* Miller) and Laurel oak (*Q. laurifolia* Michaux); sometimes the oaks are mixed with pines.

CONSERVATION MEASURES TAKEN Under Florida state law plants on private land may not be injured or removed without the permission of the landowner, and if permission is given, the plants may not be transported or sold unless they have been under cultivation.

CONSERVATION MEASURES PROPOSED It is recommended that surveys be made to determine the exact localities, population sizes and critical habitat of this species. With such information, the establishment of reserves and refuges may be possible.

BIOLOGY AND POTENTIAL VALUE As with most cycads, *Zamia* contains a poison which must be removed before the starch can be eaten (2). During the Civil War (1861-5), many soldiers died from eating unprocessed tubers (2). The poisonous element is also present in the foliage and produces 'wobbles' (or 'staggers') in cattle, a disease characterised by unsteadiness of stance. The seeds may also be poisonous to humans (3). When properly treated, the extracted starch makes a palatable flour, which, as mentioned above, has been an important

food source for centuries as well as being used in the 19th Century to make alcohol and exported to Cuba to stiffen linen (8). The 16th Century aborigines called the bread *Kun-ti hat-ki*, meaning white bread, to distinguish it from *Kun-ti tscha-ti*, the red bread made from several species of *Smilax* (8). Although little used in industry today, the starch is readily digestible and still used in making 'Arrowroot biscuits' although true arrowroot is obtained from a species of *Maranta* (2). Today, the value of this species lies in the ornamental qualities that make it popularly cultivated throughout its range (2). The species is very variable and includes variants named as *Z. silvicola* Small and *Z. umbrosa* Small (6).

CULTIVATION Easily grown from seed or young plants, it is very decorative and thrives in cultivation (8).

DESCRIPTION Fern-like plant from a woody caudex, with pinnately compound leaves. Stems subterranean, stout, fleshy, simple or sometimes branched. Leaves erect or spreading, in a crown at, or slightly above, ground level, 0.5-1 m long; leaflets 7-17 cm long, the blades more or less linear. Cones stalked, the male ones cylindrical, 7-16 cm long, more slender than the female cones which when mature are erect, cylindrical to ellipsoid, 6.5-16.5 cm long (6,9). (Syn. *Z. integrifolia* Aiton).

For illustrations see (2), (7) and (9).

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ACANTHACEAE

STATUS Endangered. It apparently consisted of a single individual at the time of its discovery and description (1977). Its habitat of lowland wet forest has been almost entirely converted to plantations of bananas and oil palms in the decade between 1960 (when a new road was opened) and 1970. The only known plant is in a highly vulnerable and isolated 0.8 sq. km area of forest incredibly rich in species (see below).

DISTRIBUTION Ecuador. It is known from the Río Palenque Biological Center, the only remaining patch of the narrow strip of lowland wet forest along the western base of the Andes in central Ecuador (Los Ríos Province).

HABITAT AND ECOLOGY A vine in lowland wet forest, at c. 200 m. The small patch of forest at Río Palenque is conspicuous in a flat landscape otherwise converted to agriculture, and is highly vulnerable both to timber poaching and to squatters. The biological richness of the site is attested by the almost 50 new species of angiosperms that have been described from the locality, presumably all of them of a similar status to *D. dodsonii*. Most are listed in (2). The almost 600 species per sq. km recorded from Río Palenque is one of the highest known plant diversities in the world (2).

CONSERVATION MEASURES TAKEN Only the fortuitous preservation provided by the Río Palenque Biological Station preserved this species long enough for it to be described in 1977.

CONSERVATION MEASURES PROPOSED Protection of the field station must be maintained at all costs.

BIOLOGY AND POTENTIAL VALUE As a clambering vine with large orange flowers subtended by conspicuous greenish white bracts, *D. dodsonii* could be of horticultural value.

DESCRIPTION Rambling herb with more or less hexagonal stems bearing pairs of opposite lanceolate pointed leaves 5-6.5 x 1.9-2.2 cm, on short stalks. Flower clusters subtended both by linear or narrowly lanceolate bracts 10-12 mm long and by obliquely ovate bracts 2.5-3.5 cm long. In addition individual flowers are subtended by several pairs of lanceolate bracts 5-8.5 mm long. Calyx 6 mm long, densely hairy, with narrow segments 1 mm wide; corolla orange, 3.5 cm long, with 2 unequal lips, the upper oblong, the lower curving back and more rounded, minutely 3-lobed. Capsule ovate, flattened, 8 mm long by 4-5 mm broad (3).

For illustrations see (1) and (3).

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The material for this sheet was supplied by Dr A.H. Gentry (of the Missouri Botanical Garden, St. Louis, U.S.A.), to whom the TPC is most grateful.

AGAVACEAE

STATUS Endangered; known from only 12 to 14 sites, each with one to several individuals, all occurring within a radius of 3-5 km. It is regarded as one of the rarest of Arizona's plants (1,2). However, the inaccessibility of its habitat may ensure survival (4), despite the critically low population.

DISTRIBUTION U.S.A.; confined to the New River Mountains in central Arizona, along the boundary of Maricopa and Yavapai Counties (2).

HABITAT AND ECOLOGY The habitat of *Agave arizonica* is an open Chaparral composed of broadleaved evergreen shrubs. This association lies between 910 and 1830 m (1), and includes such species as Scrub Oak *(Quercus turbinella* Greene), Manzanita *(Arctostaphylos* spp.), Mountain Mahogany *(Cercocarpus)*, and Wild Lilac *(Ceanothus greggii* A.Gray) (3).

CONSERVATION MEASURES TAKEN The land on which it occurs is under the jurisdiction of the Tonto and the Prescott National Forests (4). *Agave arizonica* was proposed as 'Endangered' by the U.S. Department of the Interior, Fish and Wildlife Service, on 16 June 1976. The Endangered Species Act of 1973 directs that no federally funded activity shall jeopardise the existence of species once officially determined as 'Endangered' or 'Threatened', as defined by the Act.

CONSERVATION MEASURES PROPOSED Formal determination as an 'Endangered' species and hence protection under the Act.

BIOLOGY AND POTENTIAL VALUE It reproduces poorly both by seed and by suckers and appears to be a plant on the verge of extinction from natural causes. The developing flowering shoots are often eaten by deer and other animals; it is possible that local people may have, in the past, also used the shoots for food. All such foraging would adversely affect the reproduction of this small population (2).

CULTIVATION The *Agave* is being grown at the Desert Botanical Garden near Tucson, Arizona. One individual flowered in 1976, and although capsules developed, less than 1% of the ovules became fully matured seeds, the fertility of which appears to be very low. Differences in climate between the Garden and the plant's natural habitat may in part explain this low fertility level. In addition, cross-fertilisation may be required (2).

The Desert Botanical Garden plans to introduce additional individuals into the native population and to distribute the species to other botanic gardens and institutions (2).

DESCRIPTION Perennial with small, basal rosettes, single or clustered, c. 30 cm high by 40 cm across, of numerous, linear-lanceolate leaves, mostly 17-24 cm long by 2-4 cm broad, rigid, fleshy, fibrous, dark green, smooth above and below; leaf margin serrate, brown to reddish, and terminal spine 1-2.5 cm long, subulate, dark brown aging to grey. Flowering stems very tall and slender, 3-4 m high, more or less leafless, at the top bearing a narrow inflorescence of 35-50 short, small, lateral branches; flowers durable, 25-32 mm long, in close-set clusters of 10-20; perianth pale yellow, urn-shaped, exceeded by the 6 prominent stamens. Capsule 15-20 x 8-9 mm, beaked, with strong walls (1).

For illustrations see (1) and (2).

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The material for this sheet was supplied by the Endangered Flora Project of the Smithsonian Institution, Washington, D.C., to whom the TPC is most grateful.

AMARANTHACEAE

STATUS Extinct or possibly Endangered. When discovered in 1934 it was only found to be surviving in a small fragment of natural forest. The woody vegetation of the island where it occurred had been decimated by continual burning (2) and grazing by goats. The species was clearly Endangered then and since the fires have reputedly continued, it is probably now extinct. Its native name is 'teone pa akura' (3).

DISTRIBUTION Gambier Islands, South Pacific Ocean; confined to one locality on Mt. Mokoto, Mangaréva Island (c. 13 sq. km). This island is the largest of the Gambier group which consists of a barrier reef encircling a group of volcanic islands. The surviving flora of Mangaréva is at present a small one. Brown's Flora (1) included only 29 indigenous angiosperms for the area of the Gambier Islands, Oeno Atoll, Pitcairn Island and Henderson Island. Few species endemic to the Gambier Islands are known, one example besides this species being *Gouania mangarevica* Fosberg of the *Rhamnaceae*, which is only known from Mangaréva and probably also Extinct or Endangered.

HABITAT AND ECOLOGY After his visit to the Gambier Islands in 1934, Cooke wrote: "Nearly all the islands have been continuously burned over for years. The ridges are entirely bare of trees and are covered with coarse grass ... All the endemic forests have disappeared and with them the native fauna, except on the precipitous southern slope of Mt. Mokoto, where some of our party found a small remnant of native forest near the base of the cliff. A few scattered native shrubs and small trees were growing on the ledges above" (2). It was here that *Achyranthes mangarevica* was found growing in moist woodland on a shelf of the basalt cliff at 290 m (3).

CONSERVATION MEASURES TAKEN None.

CONSERVATION MEASURES PROPOSED The first priority is clearly to find out if it still survives. The last remnant of the natural vegetation on Mt. Mokoto should be fenced off and given full protection from grazing and fire.

BIOLOGY AND POTENTIAL VALUE The species is of scientific interest on account of its geographical isolation and as an arborescent member of a typically herbaceous family. It is related to *A. arborescens* R.Br. from Norfolk Island, the only other tree-like species of *Achyranthes* known (3), and to *A. marchionica* Forest Brown from the Marquesas Islands. "Without doubt these three species are relicts of an old Pacific flora and therefore of special phytogeographical interest" (3). *A. mangarevica* itself could also be of horticultural value in the tropics because of its habit and decorative, softly hairy panicles of flowers.

DESCRIPTION Small tree c. 5-7 m high with a green to grey bark and

oblong pointed leaves c. 8 cm long, in opposite pairs up the stems and leaving encircling scars on the branchlets. Flowers crowded in opposite spikes forming regularly branched, terminal panicles 10-15 cm or more long. Individual flowers c. 4 mm long with 5 straw-coloured, slender perianth segments densely bearded on the outside with long creamy white hairs, and enclosing 5 stamens which alternate with 5 palmate staminodes, united into a staminal ring at the base.

For an illustration see (3).

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AMARYLLIDACEAE

STATUS Endangered. Only about 100 individuals are known, all from a single locality. They are in grave danger and have only survived in recent years due to faults in a man-made reservoir (see below) which when corrected will flood the whole population of this species. The plant was refound in 1973, after a gap of over 150 years. There are unconfirmed reports of a second colony.

DISTRIBUTION Mauritius, Indian Ocean.

Out of 50 families revised so far for the Flore des Mascareignes, at least 25 angiosperm species endemic to Mauritius are Endangered or Extinct. Undoubtedly the pattern is similar for the c. 152 families still to be revised. Most of the island is under cultivation and the indigenous vegetation is irretrievably degraded, with only small fragments surviving. Most of these are now threatened by illegal woodcutting and invasion by vigorous introduced species. In several areas that appear at first sight to be original forest, these exotics have prevented regeneration of native plants for many years. The majority of the nature reserves established are being over-run by these species, spread in particular by alien animals such as pigs, Red-whiskered bulbuls *Otocompsa jocosa* and the Malaysian monkeys *Macacus irus irus* (4).

HABITAT AND ECOLOGY In shallow, still water or in muddy soil along its edge. Larger plants have their bases up to 20-25 cm deep in the mud (3). The site is the edge of a reservoir at c. 500 m, created presumably from an existing stream which was apparently the natural habitat. Due to geological faults, the reservoir leaks and so is only partly full. The *Crinum* population will be completely flooded if the reservoir is ever filled; since the surrounding area is moderately flat, water will then cover a large area. To some extent, due to the slowness of the filling process so far, the *Crinum* population has not been drastically damaged and the area flooded at present is small.

CONSERVATION MEASURES TAKEN None for the wild population.

CONSERVATION MEASURES PROPOSED None on record.

BIOLOGY AND POTENTIAL VALUE It is a large and spectacular bulbous plant with heads of whitish, delicate and very attractive flowers with prominent stamens. It is obviously a plant of horticultural interest. In cultivation on Mauritius, the flowers have been seen to open just before dusk, and Lorence suggests it is pollinated by hawk-moths.

CULTIVATION It is now in cultivation and propagating material has been distributed to botanic gardens. It grows readily in cultivation, flowering after c. 3 years and setting copious seed.

DESCRIPTION Bulb with a long neck, producing large clasping leaves whose bases form a stout false stem, the leaves extending to 100-130 cm by up to 8 cm across, strap-shaped, arching, channelled, yellow-green. Flowering shoots up to 1 m high bearing 4-12 large flowers. Perianth white tinged with purple, narrowly tubular below (c. 12 cm) with linear, spreading to recurved lobes up to 9 cm long. The inside of the tube is greenish-yellow. Fruits more or less spherical, 5-6 cm long, mostly smooth, turning yellow, with a long beak up to 10 cm long (the persistent perianth tube). Seeds large and soft, polygonal, greenish.

For illustrations see (1) and (3).

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North American Pawpaw (generic name)

ANNONACEAE

STATUS Vulnerable, due to destruction of the habitat for development, combined with the natural rarity and restricted range of the plant. The scrub vegetation near New Smyrna, close to the *locus classicus*, is at present being removed (1). According to Kral, this species is perhaps the rarest of the North American *Annonaceae* (2).

DISTRIBUTION U.S.A. It is known from only 2 counties in north eastern Florida. It was only known from the original gathering in 1848 by Ferdinand Rugel near New Smyrna in Volusia County (the type locality), until John K. Small in 1927 discovered populations in the same general area. It has also been found in Seminole County (2), but only once.

HABITAT AND ECOLOGY It occurs on poorly drained sands of slash (or longleaf) pine-saw palmetto flatwoods (*Pinus elliottii* Engelm., *Pinus australis* Michaux f. and *Serenoa repens* (Bartram) Small). It is a low inconspicuous shrub, difficult to find amidst a tangle of other more robust species such as *Befaria racemosa* Vent., *Lyonia* spp., *Vaccinium* spp. and *Ilex glabra* (L.) A.Gray (2). Fire disturbance may long have been a factor in the ecology of this species, as after a late summer or winter burn one may see an abundance of vigorously flowering shoots (2).

CONSERVATION MEASURES TAKEN None.

CONSERVATION MEASURES PROPOSED A detailed survey of the remaining populations is needed in order to formulate precise conservation measures.

BIOLOGY AND POTENTIAL VALUE With its fragrant, lemon-yellow flowers, it is potentially an interesting garden plant. It is of some interest ecologically in terms of its dependence on fire for flowering (see Habitat and Ecology, above).

CULTIVATION It is not in cultivation in any of the botanic gardens affiliated to the American Horticultural Society's Plant Service Data Center.

DESCRIPTION Small shrub 10-20 cm high with arching to decumbent (or occasionally erect) shoots with short red hairs towards the tips. Leaves leathery, alternate, oblong to oval or obovate, 1-7 cm long, the apex rounded to indented and the base narrowing abruptly into the leaf stalk 1-2 mm long. Flowers in the leaf axils, fragrant; sepals 2-3, c. 5 mm; petals 6-15, linear or oblong, fleshy, c. 9 mm. Fruit an unevenly oblong-cylindrical pulpy berry 3-6 cm long, yellow-green when ripe (2). (Syn. *Deeringothamnus rugelii* (B.L.Robinson) Small). The genus *Deeringothamnus* into which some authorities,

e.g. Kral in his revision of the group in (2), place this species is distinguished from *Asimina* by non-saccate inner petals and by characters of the stamens.

For a line drawing see (2) (as *Deeringothamnus rugelii*).

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The material for this sheet was supplied by the Endangered Flora Project of the Smithsonian Institution, Washington, D.C., to whom the TPC is most grateful.

Asimina tetramera Small

North American Pawpaw (generic name)

ANNONACEAE

STATUS Endangered, due to development of its coastal habitat. The dunes on which the species occurs have been extensively bulldozed (1). In 1970 J. Churchill failed to find it in the *locus classicus*, which had already gone over to development, but in 1975 did find four individual shrubs between a new residential street and a bowling alley (1). In 1976, J. Popenoe found a colony of 25-30 plants in a second locality (3).

DISTRIBUTION U.S.A.; in the dune-scrub country of the coastal strip of eastern Florida (Palm Beach and Martin Counties). Formerly, it ranged from just north of Stuart south to West Palm Beach, an area about 60 km long (2). The *locus classicus* is near the estuary of the St. Lucie River, near Rio, Martin County, and the principal surviving locality, where it was found in 1976, within the Jonathan Dickinson State Park, also in Martin County (3).

HABITAT AND ECOLOGY It is found in scrublands, growing in the sand of ancient coastal dunes (2).

CONSERVATION MEASURES TAKEN The species is protected in the Jonathan Dickinson State Park. It was proposed as 'Endangered' by the U.S. Department of the Interior, Fish and Wildlife Service, on 16 June 1976. The Endangered Species Act of 1973 directs that no federally funded activity shall jeopardise the existence of species once officially determined as 'Endangered' or 'Threatened', as defined by the Act.

CONSERVATION MEASURES PROPOSED Formal determination as an 'Endangered' species and hence protection under the Act. Popenoe plans to propagate this species from seed for distribution to botanic gardens. Establishment of the plant in favourable sites in the wild may also be attempted (3).

BIOLOGY AND POTENTIAL VALUE It reacts vigorously to disturbance, sprouting quickly from the cut or burned-back stumps to reach up to 2 metres in height in one growing season. The taste of the ripe fruit resembles that of the other Florida species of *Asimina* - palatable but not pleasant (2). The pollinating agent is unknown.

CULTIVATION Little is known about the cultivation of this species. It is not being grown in any of the botanic gardens affiliated with the American Horticultural Society's Plant Service Data Center.

DESCRIPTION Shrub 1-3 m tall, with irregularly placed, often virgate branches, the bark grey and hairless except on the red twigs. Leaves stalkless, spathulate to elliptic-spathulate, 3-13 cm long, bright

green, hairless and finely reticulate when mature. Flowers solitary in the leaf axils; sepals 3-4; petals 6-8, the outer 1.5-2.5 cm, lanceolate or elliptic-lanceolate, obtuse, white above, reddish-purple below the middle; the inner 9-11 mm, ovate or rhombic, obtuse, reddish-purple, constricted and saccate at the base. Stamens numerous, nearly 2 mm long. Fruit 5-9 cm, of 5-7 carpels, ellipsoid or ellipsoid-cylindrical, greenish-yellow (4).

Contrary to Small's original description (4), the parts of the flower are not exclusively in fours and eights, but also in threes, with apparently an equal number of both variants in one population (2).

For an illustration see (2).

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The material for this sheet was supplied by the Endangered Flora Project of the Smithsonian Institution, Washington, D.C., to whom the TPC is most grateful.

APOCYNACEAE

STATUS Endangered. Only a very small population of this species is known to exist in the wild, where it is likely to be critically endangered. Its area of distribution is very small. The forests in which it grows are intensely threatened by brush fires and are becoming further depleted in size each year.

DISTRIBUTION Madagascar. It is only known from a few localities in the centre of the island, west and south west of Tananarive. Maps of its distribution are given in (3) and (5).

The remarkable flora of Madagascar is acutely threatened, mainly by habitat destruction caused by grazing and burning. 70-80% of the known species of plants are endemic (1); about 5820 such species of angiosperms and pteridophytes were known in 1936 (4).

HABITAT AND ECOLOGY In rocky places in fragments of low deciduous sclerophyllous forest on the western slopes of the central plateau (3). One of the the 2 localities cited by Stearn (5) is at 1500-1700 m.

CONSERVATION MEASURES TAKEN None known.

CONSERVATION MEASURES PROPOSED None on record.

BIOLOGY AND POTENTIAL VALUE The genus *Catharanthus* is of great interest and pharmacological importance. *C. roseus* (L.) G.Don (=*Vinca rosea* L.), the Madagascan periwinkle commonly cultivated, "has become celebrated as the factory of some seventy alkaloids, these including a number with demonstrable oncolytic activity and a few with actual clinical value in the treatment of cancer" (5). No phytochemical work has yet been reported on *C. coriaceus* (6) which, according to Markgraf (3), is the most endangered species in the genus *Catharanthus*.

DESCRIPTION Small erect shrub up to 40 cm high, with stems bearing pairs of opposite leaves, leathery, hairless, 20-30 x 8-12 mm, the lower ones ovate, the upper linear. Flowers solitary in the upper leaf axils, on stalks 1 cm long. Sepals linear to thread-like, 8-10 mm long; corolla reddish violet, consisting of a narrow tube 15 x 1.5 mm and 5 spreading ovate lobes 15 x 5 mm. Fruit of 2, more or less parallel follicles 30 x 3 mm, directed downwards (2,3,5).

For a line drawing see (3).

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The TPC is most grateful to Professor W.T. Stearn for help in producing this sheet.

ASCLEPIADACEAE

STATUS Endangered. It is only known from three findings; the populations tend to be very small, often of less than 10 individuals, and are particularly susceptible to grazing as are all the smaller species of *Caralluma*. Further populations may exist elsewhere, but most of the vegetation in the region has been much altered by grazing and agriculture, and any surviving populations would be small and highly vulnerable.

DISTRIBUTION Kenya, Tanzania. It was discovered by P.J. Greenway in the Umba Steppe District between Moa and Mwakijembi, Tanzania, and the plant was subsequently cultivated at Amani. In 1940, Captain A.T.A. Ritchie found it at Kosi, west of the Tana River, in Kenya (3); more recently it has been found by P.R.O. Bally in the Teita District of Kenya.

HABITAT AND ECOLOGY For the three sites listed above as follows:

1. Under the shade of Acacias in open Acacia-Desert-grass country (3);
2. In the shelter of low bushes, on sandy soil in open desert scrub;
3. Growing on rocks with the fern ally *Selaginella*.

It is often associated with *Edithcolea grandis* N.E.Brown, another sprawling Stapeliad which grows in sandy soil under scrub, so giving some protection from grazing.

CONSERVATION MEASURES TAKEN None known.

CONSERVATION MEASURES PROPOSED Further searches of known and likely localities are the first prerequisite.

BIOLOGY AND POTENTIAL VALUE The species could be of horticultural interest for specialist growers of succulents, since the flowers are relatively large for the genus. The ring of down-pointing bristles near the base of the inside of the flower is believed to trap the insect pollinators.

CULTIVATION It is in cultivation in a few private collections and is reported as being moderately easy to grow, provided the plants are kept dry. "Unfortunately, like other *Stapelieae*, they are liable to attack by 'black rot' or 'black fungus' disease" (3).

DESCRIPTION Succulent herb with trailing segmented stems erect at their apices, pale green and mottled with darker green and maroon, each segment 6-8 cm long, with long alternating pairs of teeth representing the absent leaves. One or two flowers appearing singly from

the axils of teeth near the apex of the stems; corolla erect, bell-shaped, with a tube 1.5 cm long, 1 cm in diameter, and 5 erect or spreading lobes reflexed on the margin; pale pinkish white with purple markings outside, the lobes dark purple-brown on the inner surface and paler within the tube. Corona within the flower a cup c. 2 mm high.

For illustrations see (1), (2) and (3).

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The material for this sheet was supplied by Mr D.V. Field, of the Royal Botanic Gardens, Kew, U.K., to whom the TPC is most grateful.

ASCLEPIADACEAE

STATUS Endangered. It is only known from a few, very scattered localities, in only one or two of which it has been found recently. All but one of the known sites are in dry overgrazed savanna in which the vegetation is very largely degraded, becoming desert in places; the other site, discovered in 1977, is in a more arid area further north, which has been little explored botanically and is likely to harbour further populations of the species. *Caralluma* populations tend to be very small, often of less than 10 individuals; they are very susceptible to grazing since they are succulent, but do not have the protective spines as in the Cacti, nor the acrid corrosive latex of the Euphorbias.

DISTRIBUTION Kenya; discovered on the banks of the Uaso Nyiro River (north of Mt. Kenya) near Archer's Post, in December 1939. There are also records in 1939 for its presence to the north of Rumuruti. In 1977, it was found in desert country between Lodwar and Lokitaung, to the west of Lake Rudolf, some distance to the north of the previous localities.

HABITAT AND ECOLOGY *Caralluma* species tend to be found in rock crevices or under dense thorn bushes where they are protected from the grazing. The December 1939 locality of *C. tubiformis* was recorded as on a rocky river bank, where it grew under palms with *C. russelliana* (Courb. ex Brongn.) Cufod., *C. schweinfurthii* A.Berger and *C. speciosa* (N.E.Brown) N.E.Brown.

CONSERVATION MEASURES TAKEN None.

CONSERVATION MEASURES PROPOSED Further searches and surveys of known and likely localities are the first prerequisite.

BIOLOGY AND POTENTIAL VALUE The large conspicuous flowers and erect succulent stems would make this species a choice succulent for horticulture. The flower is covered with very distinct and prominent, down-pointing, white bristles which are believed to trap the pollinating insects.

CULTIVATION Material from the finding in December 1939 was brought into cultivation in Nairobi by P.R.O. Bally; that from the 1977 locality to the Royal Botanic Gardens, Kew, U.K., by P.E. Brandham.

DESCRIPTION Succulent herb with erect, 4-angled stems up to 15 cm high and 2 cm thick with alternating pairs of long pointed teeth representing the vanished leaves along the angles. One or two flowers appearing singly in the axils of the teeth near the apex of the stem. Corolla bell-shaped, with a tube c. 14 mm in diameter and c. 12 mm long with

5 spreading lobes each c. 14 mm long, pale green with purple markings on the outside and dark purple within; corona inside the flower a cup c. 2 mm high.

For illustrations see (1), (2) and (3).

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The material for this sheet was supplied by Mr D.V. Field, of the Royal Botanic Gardens, Kew, U.K., to whom the TPC is most grateful.

ASCLEPIADACEAE

STATUS Endangered, due to destruction of the habitat.

DISTRIBUTION Seychelles. It occurs on Curieuse Island (about 3 x 1 km), at c. 50-150 m. It was recorded in the past from Mahé and there are recent unconfirmed reports of its presence there, in a single locality.

There are at least 72 flowering plants endemic to the Seychelles (not including Aldabra) and nearly all are believed to be threatened (4). They are mostly plants of the forest, which has been severely affected by fire and over-exploitation, resulting in erosion, decrease in soil fertility and intensification of the adverse effects of drought (2).

HABITAT AND ECOLOGY On Curieuse, fire and erosion over many years have destroyed much of the vegetation, and only a few small pockets and a belt near the coast remains. The eastern peninsula was burnt in 1967 and, despite a rainfall of 250 cm per year, is now partly desert. The *Toxocarpus* occurs in small patches in the surviving remnants of forest, though it was formerly in forest clearings and in open communities. In one place it was found scrambling over *Pandanus multispicatus* Balf.f., surrounded by red badlands (with a reclamation scheme in progress).

Recently, however, lock and spill drains have been constructed in the burnt areas to reduce erosion and re-afforestation is being carried out.

CONSERVATION MEASURES TAKEN Curieuse Island is government land and is being managed by the Forestry and Conservation Division. Access to the public is restricted.

CONSERVATION MEASURES PROPOSED The island is being considered for National Park status and has already been surveyed. The species should also be brought into cultivation.

BIOLOGY AND POTENTIAL VALUE In common with other species of the *Asclepiadaceae* it may contain pharmacologically active substances, but this requires investigation.

DESCRIPTION Slender liane with twining stems bearing opposite pairs of narrowly lanceolate, leathery leaves 10-15 cm long with reddish midribs, and in the axils, small panicles 2-5 cm long of diminutive flowers, each only opening partially, 2-4 mm across; calyx c. 2 mm long (the lower half narrowly tubular); corolla white to pale rose, with elliptic lobes c. 2 mm long. Fruits each of two slender diverging follicles 6-9 cm long, spindle-shaped and tapering to a point, containing numerous flattened seeds 8-10 mm long, each with a tuft of silky hairs 20-25 mm long.

For an illustration see (1).

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The TPC is most grateful to Mr J. Procter and to the Conservation Officer, Ministry of Agriculture and Land Use, Republic of the Seychelles, for help in producing this sheet.

ASCLEPIADACEAE

STATUS Endangered or Extinct. A very unusual succulent which was discovered by Drake-Brockman in 1914. Between 1942 and 1957, Bally visited the *locus classicus* several times, searching for it but without success. In October 1957, Mr Roy Tribe, a forest officer, obtained several individuals but from a second locality; it has not been seen since, despite careful searches of both areas by Bally and Lavranos in recent years (1,2,3). It is particularly susceptible to grazing; with the continuing desertification throughout the Horn of Africa its survival in the wild is unlikely. It is believed to be extinct in cultivation also (6).

DISTRIBUTION Somalia. The *locus classicus*, where it was found by Drake-Brockman, is "near Odweina". The 1957 locality is to the north, just south of the Sheikh Pass in the Golis Mountains between Burao and Berbera.

HABITAT AND ECOLOGY Stony, very arid, semi-desert, where the species grows in bare ground among stones which it superficially resembles. Although much of the surrounding habitat is very similar, the plant was only found in a very small area. According to Bally, Horwood & Lavranos in (3), this restriction is due to the increase in grazing animals in the region over the past few decades and the growing aridity over the last 10 years. An account of the geography and natural history of this area, rich in endemic species, and of its degradation, is given by Bally in (1), reprinted in (3).

CONSERVATION MEASURES TAKEN None.

CONSERVATION MEASURES PROPOSED Further searches should be made, in order to bring the species into cultivation.

BIOLOGY AND POTENTIAL VALUE On account of the unique and peculiar structure of the corona, coupled with the unusual growth form, it has been assigned a genus of its own. It has been monographed in (3) with the related genus *Pseudolithos*, which includes the species previously known as *Whitesloanea migiurtina* Chiov.; the genus is also confined to Somalia, and it contains 4 species, all of which are rare and severely threatened. As a group the Stapeliads are particularly vulnerable to grazing, since they are succulent, but do not have any protective spines, as in the Cacti, nor the acrid corrosive latex of the Euphorbias (1,3).

CULTIVATION Drake-Brockman in 1915 sent live material of the species to the Royal Botanic Gardens, Kew, U.K. Under hot damp conditions the plant grew misleadingly tall with an elongate, tapering stem (2); this is illustrated in (3) and (7) and is very different from the

squat cubic shape of the plant in the wild. These plants have not survived; nor, it appears, have those gathered by Tribe in 1957 and circulated by Bally to various gardens.

DESCRIPTION Small succulent with unbranched stem 4-5 cm high by 5-5.5 cm in diameter, 4-angled with acute, crenate-dentate angles meeting at the apex. Leaves absent. Inflorescence developed from the base of the stem at ground level from a deciduous fleshy peduncle, to 17 mm long, developing several stalked flowers in succession; sepals 4 mm long, lanceolate; corolla 33 mm in diameter, whitish-green, spotted with purple on the outer surface, rugose and light yellow, dotted with dark red on the inner surface, with tube 10-12 mm long and as much across and pointed spreading recurved lobes c. 13 mm long. Outer corona arising at the base of the corolla, lobes dark purple, broadly linear, pointed, divided to the middle. Inner corona obconical, 5-lobed, slightly higher than outer corona lobes and enclosing the staminal column. Fruit of 1 or 2 spindle-shaped follicles (2,3).

For illustrations (1), (2), (3), (6) and (7).

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This sheet is based upon information provided by Dr P.R.O. Bally of Nairobi to whom the TPC is most grateful. Help is also gratefully acknowledged from Miss S. Carter and Mr D.V. Field of the Royal Botanic Gardens, Kew, U.K.

Saiberbher (local name)

BEGONIACEAE

STATUS Endangered. The population of this island endemic has reached critically low levels but it is now confined to high-altitude, mountain pinnacles virtually inaccessible to man and goat. Grazing by domestic livestock is presumably the reason for its decline, although in 1967 surprisingly little evidence of grazing was found at these altitudes. Nevertheless many species from this area were found to be greatly depleted and, like the *Begonia*, reduced to dangerously low populations. In 1967 nine endemic species from the mountains were not found at all despite extensive searches; some may be extinct.

DISTRIBUTION Socotra (an Island Territory of the People's Democratic Republic of Yemen, lying 225 km east of the Horn of Africa). The *Begonia* occurs in the Hajhir Mountains and was found on only two pinnacles in 1967. It was also recorded from a north-facing limestone slope in 1953 (5).

The flora of Socotra is critically threatened; out of 216 flowering plants endemic to Socotra and the neighbouring island of Abd al Kuri, 132 are believed to be rare or threatened, 85 of them in immediate danger of extinction (Endangered). This drastic situation is the result of grazing by excessive numbers of introduced livestock on an island flora which has presumably evolved partly in the absence of large mammals, unlike the flora of the African mainland.

HABITAT AND ECOLOGY In shady crevices beneath overhanging rocks on the summit pinnacles. The Hajhir Mountains are the highest peaks on Socotra and are formed of granite. Between 800 and 1000 m the vegetation is mostly evergreen thicket, but higher up the rugged slopes are covered by montane grassland or a community of low rounded shrubs such as *Hypericum scopulorum* Balf.f., or, on the higher peaks, lichens with small plants such as *Helichrysum* spp. (5). Six other endemics are confined to the tops of these pinnacles: *Exacum caeruleum* Balf.f., *Fabrisinapis fruticosus* C.C.Townsend, *Graderia fruticosa* Balf.f., *Helichrysum aciculare* Balf.f., *Nirarathamnos asarifolius* Balf.f. and *Thamnosma socotrana* Balf.f. All are Endangered; for example only two bushes of the *Fabrisinapis* have ever been found.

CONSERVATION MEASURES TAKEN None for the wild populations.

CONSERVATION MEASURES PROPOSED A strict reserve, protected from grazing, is needed on the higher parts of the Hajhir.

BIOLOGY AND POTENTIAL VALUE It is one of the parents of the fibrous-rooted Begonias, to which it gave the valuable winter-flowering habit. It has been used by breeders in the U.K., Holland, France and Scandinavia, and there is now a wide range of hybrids which are used

extensively in decorative horticulture. It has been awarded a First Class Certificate by the Royal Horticultural Society.

CULTIVATION It has been in cultivation since 1880. In Europe, where it starts into growth in summer and flowers in mid-winter, a warm greenhouse is needed. It is easily propagated by dividing up the 'tubers' and replanting the offsets. For details on the cultivation of the *B. socotrana* hybrids, see (2).

DESCRIPTION Sparsely hairy, herbaceous perennial with a tuber-like rootstock consisting of a cluster of fleshy buds which produce a loose rosette of rounded leaves each 5-20 cm across, with an undulating, irregularly toothed margin and a funnel-like centre where the stalk is attached (peltate). The flowering stems are erect, stout, slightly succulent and up to 25 cm high, carrying a panicle of several male flowers 3-4 cm across, each with 4, rose pink, spreading petals and a small round cluster of numerous stamens; and 1 female, slightly smaller but with 6 narrower petals, a similar colour; ovary 3-angled, winged on one side, containing 3 chambers.

For illustrations see (3) and (4).

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This sheet is based upon information provided by Mr A. Radcliffe-Smith (of the Royal Botanic Gardens, Kew, U.K.), to whom the TPC is most grateful.

Berberis sonnei (Abrams) McMinn

Truckee Barberry

BERBERIDACEAE

STATUS Endangered. Until refound in 1973, this *Berberis* had not been seen since 1884-1886 when it was discovered by Sonne. It is now known from only two small populations, in a narrow riverside habitat c. 50 m long by c. 5 m wide. The westernmost group of plants is composed of 8 or 9 small shrubs. The second population, to the east, consists of about 40 individuals. These populations are on private land and probably represent the *locus classicus* (3).

In 1935 the U.S. Forest Service, in its search for native plants which might prove useful in erosion control, initiated a programme to find the species and bring it into cultivation. Sporadic searches until 1941 and searches with the staff of the Regional Parks Botanic Garden, Berkeley, California, from 1948 proved unsuccessful. In 1973, plans were organised for a thorough search with the California Native Plant Society. On the day that the search was to take place, it was found that a student of the local secondary school, Catherine Kramer, had gathered *B. sonnei* at its *locus classicus* earlier that month. The shrubs were growing just behind, and some of them in, the back yards of a short row of houses. For this reason, and also due to the heavy growth of exotic weeds along the river at this point, the locality had been overlooked by botanists searching the area (3).

DISTRIBUTION U.S.A.; along the banks of the Truckee River, Nevada County, California. A record in the 1880s of a *Berberis* in Deer Creek Canyon, Placer County, which Sonne had referred to *B. aquifolium* Pursh, is not supported by herbarium specimens; this locality was searched in 1973 but no *Berberis* was found (3).

HABITAT AND ECOLOGY Just above the winter-spring flood zone of the Truckee River, growing in sandy silt-loam, sheltered by large boulders that stabilize the edge of the river. The soil is highly retentive of winter and spring moisture, and during the summer also draws water upwards by capillary action from sources just below the surface.

Native plant associates are Black Cottonwood, *Populus trichocarpa* Torrey & A.Gray; Mountain Alder, *Alnus tenuifolia* Nutt.; Western Choke-Cherry, *Prunus virginiana* L. var. *demissa* (Nutt.) Sarg.; a large species of willow *(Salix)*; and *Rosa woodsii* Lindl. var. *ultramontana* (S.Watson) Jepson. In addition, there are a large number of naturalised weeds which include Poison Hemlock, *Conium maculatum* L.; Prickly Lettuce, *Lactuca serriola* L.; and Rye, *Secale cereale* L. (3).

CONSERVATION MEASURES TAKEN The local community is aware of the presence of this rare shrub and inadvertant destruction of the habitat

is unlikely. The species was proposed as 'Endangered' by the U.S. Department of the Interior, Fish and Wildlife Service, on 16 June 1976. The Endangered Species Act of 1973 directs that no federally-funded activity shall jeopardise the existence of species once officially determined as 'Endangered' or 'Threatened', as defined by the Act.

CONSERVATION MEASURES PROPOSED The feasibility of protecting this small area (as a natural preserve) should be investigated.

BIOLOGY AND POTENTIAL VALUE Although it can produce new individuals from underground branches, the colonies have not spread much beyond the protective boulders of the riverside. Fertility appears to be low, as many of the fruits do not contain seed. The plants are free of wheat or apple rust, scale, and root disease. It should make an excellent landscape and garden plant; in addition it may prove useful in erosion control, especially in the semi-arid eastern flanks of the Sierra (3).

CULTIVATION It roots readily from cuttings. Plans are being made to distribute plants to botanic gardens and other plant sanctuaries throughout California.

DESCRIPTION Evergreen shrub 25-60 cm high with spreading rhizomes. Leaves 10-25 cm long, divided into 5 oblong-ovate leaflets 4-8 x 2.5-3.5 cm, glossy-green above, dull and paler beneath, with 12-20 bristle-like teeth on each margin. Flowers yellow, in drooping dense racemes 4-7 cm long. Berry ovoid, blue-black, c. 6 mm long (2).

For illustrations see (3).

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The material for this sheet was supplied by the Endangered Flora Project of the Smithsonian Institution, Washington, D.C., to whom the TPC is most grateful.

Virginia Round-leaf Birch, Ashe Birch

BETULACEAE

STATUS Endangered. For 60 years this birch was only known from the original gathering by Ashe in 1914. Johnson visited the locality in 1953, and, being unable to find any living trees, concluded that the plant was likely to have been an aberrant individual and did not deserve further consideration as a species. Several other botanists also visited the area but without success (2). In 1973 an overlooked herbarium specimen, collected by a contempory of Ashe, brought to light a second locality, a creek not far from the *locus classicus* (4,5).

In August 1975, *Betula uber* was refound in this second locality by Ogle, and subsequently by Reed (3,5,6,7). The population then consisted of 13 trees and 21 seedlings (5). Since then several seedlings have been removed for scientific purposes, several have been stolen, and all but 2 of the remaining 9 seedlings have been damaged by vandals but have since resprouted (8). Of the 13 trees, 2 died in the unusually severe winter of 1976-77, and one was washed away in a flood in November 1977. In addition to this population, which is on private land, 2 more trees were later found a short distance downstream, within the Jefferson National Forest.

DISTRIBUTION U.S.A.; in the southern Appalachian mountains, Smyth County, Virginia.

HABITAT AND ECOLOGY In mixed deciduous forest, a habitat similar to that of the other birches native in the area (*B. lenta* L. and *B. alleghaniensis* Britton). The associate canopy trees include, in addition to these 2 birches, species of *Acer, Carpinus, Carya, Fraxinus, Liriodendron, Nyssa, Platanus, Quercus, Robinia, Tilia* and *Tsuga,* as listed in (5). The soils belong to the DeKalb series (stony colluvium); they are strongly acid, rapidly permeable, and contain pieces of flagstone (5).

CONSERVATION MEASURES TAKEN The owners of the private lands on which most of the individual plants occur have erected fences around a majority of the mature trees and seedlings, to prevent damage from cattle and to deter thieves and vandals. The U.S. Forest Service have erected fences around the two trees in the Jefferson National Forest. *Betula uber* has been determined to be 'Endangered' under the Endangered Species Act of 1973 (8). The Act directs that no federally-funded activity shall jeopardise the existence of species once officially determined as 'Endangered' or 'Threatened', as defined by the Act. The U.S. Forest Service has developed protection plans and organised a *Betula uber* Protection, Management, and Research Co-ordinating Committee.

CONSERVATION MEASURES PROPOSED No further measures would seem to be necessary.

BIOLOGY AND POTENTIAL VALUE *B. uber* appears to be most closely related to shrubby birches in the series *Humilis*, the nearest of which is at least 800 km away. Reed has suggested that it is a hybrid between *B. pumila* L. var. *glandulifera* Rogel, a northern shrubby birch, and *B. lenta* or *B. alleghaniensis* (7). Studies are continuing: the population is very uniform, but the seedlings indicate it is reproducing and fertile material has been found.

CULTIVATION The U.S. Department of Agriculture, National Arboretum, has about 30 rooted cuttings in cultivation. Less than 1% of the seeds collected from the wild trees developed into *B. uber*, however, the rest being F_1 hybrids with *B. lenta*. Plants will be propagated for distribution and for the maintenance of the species in the wild.

DESCRIPTION Small slender tree 7.6-14 m tall with blackish-brown, rather thin, relatively smooth, aromatic bark. Leaves dark above, lighter below, generally suborbicular to cordate, 2.5-6.5 cm long; margin irregularly serrate. Fruit a broadly cuneate samara, the wings narrower than to nearly as broad as the nutlet. For fuller description see (5) and (7) from which the above is taken.

For illustrations see (4)-(6).

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The material for this sheet was supplied by the Endangered Flora Project of the Smithsonian Institution, Washington, D.C., to whom the TPC is most grateful. Information is also gratefully acknowledged from P.M. Mazzeo and F.G. Meyer, U.S. National Arboretum, and from the U.S. Forest Service.

BIGNONIACEAE

STATUS Endangered. Only a single individual was found of this climber when it was discovered in 1945 although all suitable habitats on the very small island where it occurs were searched (8). The flora of the island has been greatly degraded, firstly by the Maoris who inhabited the island for two centuries or more up to about 1840 and then by goats, introduced in 1889 to provide food for possible castaways (1), but possibly existing there before. The goats were killed in 1946 but the last report of this species (1951) is still of only one individual (2). It is hoped that the plant will now spread and can be transferred to a less severe category in the future.

DISTRIBUTION Three Kings Islands, New Zealand. The single plant is on Great Island (c. 355 ha), the largest of the group, lying about 55 km north west of Cape Maria van Diemen, virtually the northernmost point of New Zealand. There are 12 angiosperm species endemic to the Three Kings Islands (3) of which *Plectomirtha baylisiana* W.R.B. Oliver is also reduced to a single individual (seen in 1951); at that time there were only about 12 trees of another endemic, *Elingamita johnsonii* Baylis (2,3). Both *Plectomirtha* and *Elingamita* are monotypic genera (i.e. with only one species in each).

HABITAT AND ECOLOGY The single plant was found climbing to the top of a large tree of *Leptospermum ericoides* A.Rich., about 7.5-10 m high, growing in swamp soil by a stream, on greywacke, at 150 m (8).

It is believed that the major part of the island was originally covered by mixed coastal or semi-coastal forest, most of which was destroyed during the period of Maori occupation and was later prevented from regenerating by the goats. Low trees of the unpalatable *Leptospermum ericoides* have become the dominant vegetation with few other species being represented in the community. When the goats were eliminated, only very small remnants of the original forest remained (1). However by 1951 all the endemic species except the *Tecomanthe* and *Plectomirtha* had begun to occupy more ground (2). For an analysis of the vegetation in 1963 and of the changes that had occurred since 1951 see (4), although no mention is made of *Tecomanthe speciosa*.

CONSERVATION MEASURES TAKEN In 1946, the New Zealand Government eliminated the goats (393 individuals in all) from Great Island, bringing to an end the long period of threats to the flora and modification to the plant cover. The island is now uninhabited and rarely visited (1). The Three Kings Islands are designated a Flora and Fauna Reserve. The species is in cultivation.

CONSERVATION MEASURES PROPOSED None.

BIOLOGY AND POTENTIAL VALUE It is self-fertile as viable seed has been obtained from clones of the original plant. Abundant seed is set and germination in cultivation has been satisfactory. The species is of considerable interest to studies of plant geography being the only member of the *Bignoniaceae* in New Zealand and belonging to a genus that is otherwise tropical in distribution. It is an attractive evergreen vine with potential for horticulture in the subtropics.

CULTIVATION It is being increasingly grown in the warmer parts of New Zealand. It can be propagated by seed or vegetatively by cuttings or layers which occur naturally. Soil requirements do not appear to be critical. It is unlikely to be frost-hardy (6).

DESCRIPTION Woody liane with stems up to c. 10 m long, bearing pinnate leaves of 3-5 broadly elliptic to obovate, dark green, glossy leaflets c. 9 cm long by 7 cm wide. Flowers clustered, borne in the leaf axils or more often on the old wood above the leaf scars; calyx velvety, usually 4-lobed, tubular, c. 2.5 cm long; corolla tubular to funnel-shaped, 6-8 cm long, hairy on the outside, expanded into 5 rounded, acute, reflexed lobes, creamy-white with a flush of pale green. Capsule cylindrical, dark green, woody, up to 19 cm long by 3.5 cm wide, containing numerous, densely packed, flattened seeds with membranous wings.

For illustrations see (1), (3), (5), (6) and (7).

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The TPC is most grateful to Dr D.R. Given of the Botany Division, DSIR, Christchurch, for help in producing this sheet.

Pininana

BORAGINACEAE

STATUS Endangered; a very spectacular arborescent species only known from 3 localities (2). At the main site of one locality, a search in 1972 revealed only 2 mature individuals, one of which had had its top removed. About 1 km away an inaccessible group of about 35 mature individuals were seen in 1977, with a number of seedlings. At the second locality the species is "reduced to a few examples hidden away deep in the heart of the woodland" (2). Its status at the third is not known. The threats are not only destruction of the habitat but also grazing and possibly uprooting of the young plants by horticultural collectors.

DISTRIBUTION Canary Islands; in the north east of La Palma.

Out of 33 species of flowering plants endemic to La Palma, 8 are Endangered, 6 are Vulnerable and 10 are Rare. The north east coast of the island is still extensively forested (2) although much that remains is of secondary growth. However recent exploitation has cleared large areas at La Galga, Barlovento and Cumbre Nueva, areas close to where *Echium pininana* occurs.

HABITAT AND ECOLOGY On stony hillsides and in openings in the laurel forest, on basalt rocks. It is confined to the cloud zone and grows between 600 and 1000 m, accompanied by *Erica arborea* L. The laurel forests, a vegetation type unique to Madeira and the Canary Islands, and containing a particularly high percentage of rare and endemic species, are in great danger because of destruction for agriculture and coppicing for poles and firewood with subsequent loss of species diversity.

CONSERVATION MEASURES TAKEN None for the wild populations. Many of the threatened Canarian endemics, including this one, are in cultivation at the Jardín Botánico Viera y Clavijo on Gran Canaria. A seed bank for threatened Macaronesian and Iberian species has recently been set up at the Universidad Politécnica, Madrid.

CONSERVATION MEASURES PROPOSED The locality containing the largest population, recently surveyed by the staff of the Jardín Botánico Viera y Clavijo, should be declared a local nature reserve.

BIOLOGY AND POTENTIAL VALUE The plants remain in flower for 2-3 months and are bee-pollinated. Abundant seed is produced.

It is a magnificent species in flower and of horticultural value for Mediterranean-type climates. The genus *Echium* is remarkably diverse in the Canaries with at least 23 species, the majority being endemic. They range from unbranched arborescent species, like this one, and

branching shrubs 2.5 m high such as *E. giganteum* L.f., to small annuals, e.g. *E. bonnetii* Coincy. The arborescent species with their unusually tall, slender panicles of flowers are one of the great floristic attractions of the Canary Islands.

CULTIVATION It can be raised easily from seed, but must be regularly replaced as it dies after flowering. To prevent hybridisation it should not be grown close to related species.

DESCRIPTION Giant herb growing for two or more years before flowering, after which it dies (monocarpic). Stem unbranched, up to 150 cm long, woody below, bearing a large rosette of lanceolate leaves up to 50 x 10 cm, covered with rough silvery hairs. From the leaves emerges an erect single shoot up to 3.5 m long with a narrow panicle of flowering branchlets each 5-15 cm long, bearing numerous flowers; calyx 5-lobed, 6 mm long; corolla narrowly funnel-shaped, 10-13 mm long, purplish-red in bud, becoming pale blue when open. Fruit of 4 narrowly conical nutlets, c. 2 mm, with small spines (1). Hybrids with *E. callithyrsum* Webb ex Bolle and *E. wildpretii* Pearson ex Hook.f. are known (3).

For illustrations see (2), (3) and (4).

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The TPC is most grateful to Dr D. Bramwell, of the Jardín Botánico Viera y Clavijo, Gran Canaria, for help in producing this sheet.

Chatham Islands Forget-me-not

BORAGINACEAE

STATUS Vulnerable. Although it is widespread in cultivation as a most attractive garden plant, it has a very restricted coastal distribution in the wild and has become greatly depleted by grazing from introduced animals, in particular pigs which feed upon the stout fleshy rhizomes and sheep which graze the leaves (2,3). It is easily damaged both by trampling and by browsing. Although there are still many populations of the species, all are now small and it is a rare plant in most of its localities.

DISTRIBUTION Chatham Islands; recorded from Chatham, Pitt, South East, Mangere, Little Mangere and other islets. It is still locally common on some of the small islets.

The Chatham Islands (44° S., 850 km east of New Zealand) have an endemic flora of about 30 species which dominated more than half of the original vegetation. Unlike its rocky offshore islets, Chatham Island itself contains an extensive peatland bog/forest mosaic, which includes endemics such as *Aciphylla traversii* (F.Muell.) Hook.f. (Endangered) and *Myrsine coxii* Cockayne (Vulnerable); this habitat is a priority for conservation and is not covered by any of the existing reserves.

HABITAT AND ECOLOGY This species is always found close to the sea, occurring on coastal dunes, sandy beaches, cliff ledges and peat-covered rocks. Cheeseman in 1914 described how "it once formed an unbroken line ... on the seashore" in some localities (2), and as recently as 1952, Richards described it as "spread over many acres of the foreshore just above high-water mark, fed by rotting kelp; over the sand dunes further inland; through the coastal scrub and on peat-covered spray-dashed rocks" (7). On shingle above the high tide mark, *Myosotidium* may be associated with *Sonchus grandifolius* T.Kirk, *Urtica australis* Hook.f. and *Tetragonia trigyna* Banks & Solander ex Hook.f. On the rocky sites *Carex trifida* Cav., *Disphyma australe* (Solander) J.M.Black and *Festuca coxii* (Petrie) Cheeseman are characteristic.

CONSERVATION MEASURES TAKEN Mangere and South East islands are Flora and Fauna Reserves administered by the New Zealand Department of Lands and Survey. The species is slowly re-establishing itself on both islands, although the shorelines are not the most suitable. It is also protected in a private reserve on Te Whakuru Island (the north east cape of Chatham Island); this site is the only one where it can be seen as described by Richards and quoted above, and probably contains the largest surviving population.

A vegetation survey of the Chatham Islands was completed in 1969 and comprehensive recommendations made for 20 reserves (5).

CONSERVATION MEASURES PROPOSED As recommended by Given, Ritchie and Kelly:- "Wild populations should be monitored wherever possible particularly watching population changes in reserves" (3).

BIOLOGY AND POTENTIAL VALUE "This species is the sole member of the genus. It is well-known botanically and horticulturally as an outstanding member of the family and an exceptionally fine garden plant" (3).

CULTIVATION It is widespread in cultivation in New Zealand and elsewhere, and is available from the commercial trade. It propagates easily from seed and offshoots.

DESCRIPTION Succulent perennial with a stout fleshy cylindrical rhizome which produces a crowded rosette of large basal leaves 15-30 cm or more long, more or less broadly ovate to cordate, thick, fleshy, deeply grooved, on long stout stalks. Flowering branches up to 1 m high with oblong, stalkless stem leaves and bearing a dense inflorescence 10-15 cm across, the flowers on pedicels c. 1 cm long. Corolla pale to dark blue, saucer-shaped, c. 12-15 mm across, with a short tube and 5 rounded lobes. Fruit of 4 flattened, broadly winged nutlets c. 15 mm in diameter (1).

For illustrations see (2), (4) and (7).

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This sheet has been compiled from the account in (3) of *Myosotidium hortensia* by Dr D.R. Given, I.M. Ritchie & G.C. Kelly, to whom the TPC is most grateful.

BORAGINACEAE

STATUS Extinct. It was never known from more than one coastal locality in an area which has been greatly affected by tourism and much of which is now covered by buildings. It was last seen in 1960 and detailed searches since then by about 30 people have failed to find it. It is, however, being grown by Mme S. Blaise at the Botanical Institute, Orsay, and seeds are being distributed to other growers. Since the original habitat is now very seriously damaged, the only possibility for the survival of this species is in gardens and seed-banks.

DISTRIBUTION France; on one section of the Côte Vermeille, along the eastern part of the Albères mountains between the Pyrénées and the sea.

Out of 73 species of flowering plants endemic to France, 7 are Endangered, 10 are Vulnerable and 23 are Rare. 3 are Extinct, (this species, *Minuartia olonensis* (Bonnier) P.Fourn. and *Viola cryana* Gillot), and one (*Artemisia insipida* Vill.) is possibly Extinct.

HABITAT AND ECOLOGY It grew with grasses and other annuals in open communities on coastal sand-dunes.

BIOLOGY AND POTENTIAL VALUE No information.

CULTIVATION As an annual, it must be grown from seed.

DESCRIPTION Low-growing annual up to 40 cm across with rosettes of small, blunt-tipped, lanceolate leaves 4 cm long with soft spreading hairs. Flowers more or less irregularly arranged on the axis and often fused together, the axis often sharply bent. Corolla saucer-shaped, up to 3 mm in diameter, white to bright blue, with a short tube and spreading lobes.

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The TPC is most grateful to Monsieur G.G. Aymonin, of the Muséum National d'Histoire Naturelle, Paris, for help in producing this sheet.

BORAGINACEAE

STATUS Vulnerable. It is only known from a few closely adjacent localities. Previously the species was threatened from intensive grazing by sheep and pigs, but recently a greater danger has arisen in the construction of a large cement works close to all the localities. One of the sites is definitely threatened by quarrying of limestone and another has not been confirmed for about 40 years. One site, the *locus classicus*, is protected, but may be suffering from the impact of the increasing flow of visitors to a castle in the locality. In the one locality in Hungary, the habitat was afforested in 1952.

DISTRIBUTION Czechoslovakia, Hungary. It is confined to a limestone karst region, most of which is in extreme eastern Slovakia ('Slovenské Kras'), but extends into Hungary ('Tornai Karszt') c. 30 km south west of Košice. All the localities are in a strip c. 10 km long; for a distribution map see (7). The area is rich in rare and relict plants; some of them are confined in Czechoslovakia to this region, e.g. *Ajuga laxmannii* (L.) Benth., *Astragalus vesicarius* L. and *Euphrasia pectinata* Ten., all of which are (or were) associated with *Onosma tornensis*.

HABITAT AND ECOLOGY On arid, stony, south-facing slopes in crevices of Triassic limestone, at 230-280 m. It grows on sunny slopes in open grassland, where the neighbouring scrub cover is often of *Prunus mahaleb* L. and *Quercus pubescens* Willd., but as a sun-loving species it only occurs in open places unshaded by woody plants. Accompanying species tend to be those adapted to hot, dry conditions such as *Achillea nobilis* L., *Allium flavum* L., *Astragalus vesicarius* L., *Campanula sibirica* L., *C. xylocarpa* Kovanda, *Carex humilis* Leysser, *Dracocephalum austriacum* L., *Jovibarba hirta* (L.) Opiz, *Jurinea mollis* (L.) Reichenb., *Orobanche alba* Stephan ex Willd., *Sempervivum marmoreum* Griseb., *Teucrium botrys* L. and *T. montanum* L.

CONSERVATION MEASURES TAKEN In Czechoslovakia it is protected by law and the *locus classicus* has been declared a Protected Habitat according to the 1955 Slovak Nature Conservation Act. The wider area of Slovak Karst is now an area whose landscape is protected. In Hungary the species is protected by law.

CONSERVATION MEASURES PROPOSED None on record.

BIOLOGY AND POTENTIAL VALUE Pollination is by bees; seed production is adequate. Effective dispersal may be only by epizoochory, that is where parts of the fruiting inflorescence attach themselves to man or animals by their stiff bristly hairs. The populations are nearly all composed of older plants. When in flower it is a very decorative species and would be suitable for the rock-garden.

It belongs to the section *Stelligera* which includes species mainly occurring in the Mediterranean. *O. tornensis* is the most northern member of this section, its nearest relatives being in the north west part of the Balkan peninsula and in Southern Transylvania.

DESCRIPTION Hairy perennial with brown red, carmine-staining roots and several stems 15-30 cm high, simple or slightly branched above; leaves lanceolate to narrowly oblong, c. 50 x 2-3 mm, with stiff erect hairs 2-2.5 mm long arising from tubercles ringed by shorter spreading hairs. Flowers on very short stalks, with small bracts; calyx 6-10 mm in flower, up to 12 mm long in fruit, divided nearly to the base into linear-lanceolate lobes; corolla tubular, 15-20 mm long, yellow, with barely distinguished lobes. Fruit of 4 smooth shining nutlets 2.5-3 mm.

For illustrations see (4) and (5).

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BROMELIACEAE

STATUS Vulnerable; a spectacular bromeliad with 3 varieties: one, var. *trinitensis* L.B.Smith, is Endangered, the principal population being confined to two relatively small areas in Trinidad, one of which is critically threatened by road building (see below). Although the other locality is part of the Matura Forest Reserve, it is frequently affected by fire and also by logging of certain tree species, opening up the area for small farms and habitations, and thereby decreasing the natural host trees of this epiphytic plant. Var. *pariaensis* Pittendr. is only known from 4 recent gatherings on the adjacent South American mainland, some 20 km away, where it is believed to be very rare. Var. *dichlamydea* is confined to Tobago (c. 40 x 12 km) and is abundant in part of the island, but is considered as Rare because of the very small area of available forest habitat, part of which has been badly damaged by hurricanes.

DISTRIBUTION Trinidad and Tobago, Venezuela. Var. *trinitensis* is on the north coast of Trinidad and in the forest between Matura and Sangre Grande. It is becoming rarer in the former due to frequent road-building and widening and is even further threatened by the proposed major road construction linking Matelot with Blanchisseuse to the west, and by possible future widening of the road from Matelot to Toco, which would put the Grande Riviere and Sans Souci areas in danger. This variety is also recorded from the extreme east of the Paria Peninsula in the state of Sucre, Venezuela (5), where it is extremely rare. Var. *pariaensis* occurs in the vicinity of Cristóbal Colón, also in Sucre, and var. *dichlamydea* in eastern and central Tobago.

HABITAT AND ECOLOGY In Trinidad on open, dry, medium to tall, low altitude forests where the plant is found as an epiphyte on mature trees.

CONSERVATION MEASURES TAKEN One of the Trinidad localities is in the Matura Forest Reserve, but, as mentioned above, this does not ensure adequate protection to the species.

CONSERVATION MEASURES PROPOSED In the north coastal area of Trinidad, it is difficult to see how var. *trinitensis* can be effectively conserved, but extreme care should be taken in road-building activities not to destroy more of the habitat than is absolutely essential. In the Matura Forest Reserve stricter protection measures are needed. Further searches and surveys are needed of the Venezuelan populations.

BIOLOGY AND POTENTIAL VALUE This plant with its brilliant red bracts and blue inflorescences is very attractive but has not yet won much attention from horticulturists.

CULTIVATION It is grown in several of the larger European botanic gardens, being easily propagated by seed and also by removal of the sucker shoots after flowering of the parent plant. It thrives in hot humid glasshouses with a temperature range of 18-30° C. and a humidity of 60-85%, but it is not a house-plant under normal temperate domestic conditions like certain other bromeliads.

DESCRIPTION Monocarpic epiphyte up to 50 cm. Leaves 60-80 cm long with strap-shaped blades 4-7 cm wide, spiny-toothed. Flowers in a lax, doubly pinnate inflorescence on a stout erect stem emerging from the leaves, with entire, lanceolate, bright red bracts. Floral bracts short pointed, 12-15 mm long, strongly veined, bright Delft blue and purplish; sepals asymmetric, c. 14 mm long, generally exceeding the floral bracts, blue; petals white and blue-lilac. Fruit globose, 7 mm across, deep blue (6).

For illustrations see (3) and (4).

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The material for this sheet was supplied by Mr D. Philcox, of the Royal Botanic Gardens, Kew, U.K., to whom the TPC is most grateful.

BROMELIACEAE

STATUS Vulnerable. All the known populations are very low. On Mt. Tucuche (Trinidad), it is coming under threat from disturbance of the habitat by an increasing number of visitors climbing to the summit.

DISTRIBUTION Trinidad and Tobago, Venezuela. It is confined to cloud-bathed forest on the three tallest mountains of Trinidad: El Tucuche, Cerro del Aripo and Mt. Chaguaramal. It is also found in the extreme east of the Paria Peninsula in the state of Sucre, Venezuela, and on the Isla Margarita in the state of Nueva Esparta, just to the north of the Paria Peninsula (3,4).

HABITAT AND ECOLOGY In c. 15 m high closed forest, growing both as an epiphyte and on the ground, confined to a belt within 75 m of the mountain summits. Other rarities on these mountains are the small saprophyte *Marthella trinitatis* (Johow) Urban of the *Burmanniaceae*, endemic to Trinidad, and the bromeliads *Vriesia broadwayi* L.B.Smith, endemic to Trinidad and Tobago, and *V. johnstonii* (Mez) L.B.Smith & Pittendr., which has a similar distribution to *Glomeropitcairnia erectiflora*.

CONSERVATION MEASURES TAKEN None known.

CONSERVATION MEASURES PROPOSED Consideration should be given to declaring Tucuche a National Park, with possible control over access in some parts. The mountain rises from the north coast to an almost conical peak, and is forested from nearly sea-level to the summit; its wildlife and scenic beauty is one of the great tourist attractions of Trinidad.

BIOLOGY AND POTENTIAL VALUE The genus *Glomeropitcairnia* contains two species, *G. penduliflora* Mez being confined to Dominica and Martinique. Both are most attractive species, in part because of their large size. The spectacular inflorescence is up to 2 m tall, and the plant has a spread of 1 m or more, "all the more impressive because they are mostly epiphytic" (2).

CULTIVATION It is grown in a few botanic gardens; it can be easily propagated by seed and also by removal of the sucker shoots after flowering of the parent plant. It thrives in hot humid glasshouses with a temperature range of 18-30° C. and a humidity of 60-85%, but it is not a house-plant under normal temperate domestic conditions like certain other bromeliads.

DESCRIPTION Monocarpic herb with a basal cluster of numerous, erect to arching leaves c. 70 cm long, the blades strap-shaped, 8 cm wide, pointed but soon rounded by withering. Inflorescence slender, up

to 2 m, doubly pinnate on an unbranched stem which emerges from the leaves and is sheathed by tight red bracts. Flowers stalkless, erect, in compact clusters; floral bracts elliptic, rounded, shorter than the sepals, which are 21-28 mm long and lanceolate; petals up to 25 mm, yellow to white (3,4).

For an illustration see (3).

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The material for this sheet was supplied by Mr D. Philcox, of the Royal Botanic Gardens, Kew, U.K., to whom the TPC is most grateful.

BURMANNIACEAE

STATUS Extinct. It was only known from one locality where it was last seen in 1913 (4). The area is now under heavy industry (3). The species has been searched for repeatedly in the original area and in similar sites, but without success (3). It is not in cultivation.

DISTRIBUTION U.S.A. The locality was along the margin of a grass meadow in Cook County, Chicago, Illinois. The site has been identified as the bottom prairie swale on the east side of Calumet Lake, between Torrence Avenue and Nickel Plate Railroad, between the Ford factory and the Solway Coke factory (1).

HABITAT AND ECOLOGY It occurred in low, wet prairie grassland in a stream bed, growing with such plants as the composites *Solidago gigantea* Aiton, *S. media* (Greene) Bush, *Rudbeckia hirta* L., *Eupatorium perfoliatum* L., etc. Usually the *Thismia* grew in spots where the soil was not closely covered by the liverwort *Aneura pinguis* (L.) Dum. and the small fern ally *Selaginella*, but occasionally it was found among *Hypnum* moss (4). The habitat is in striking contrast to that of most of the other species of *Thismia*, which grow on decaying wood or decaying leaves in the shade of primary tropical forests, in regions of high rainfall (2,4).

BIOLOGY AND POTENTIAL VALUE It was a saprophyte (non-green plant living upon dead animal or plant material). The arrangement of the parts of the flower suggests that the plant was pollinated by insects. The mycelium of an intracellular fungus has been observed in the roots (4). The species appears to have been most closely related to *T. rodwayi* F.Muell. from Tasmania and New Zealand, these 2 species being the only members of the tribe *Thismieae* outside the tropics (2). This extraordinary distribution is of great interest.

CULTIVATION All attempts at seed germination have failed (4).

DESCRIPTION Very small white saprophyte with erect, one-flowered stems c. 6 mm high arising from a creeping root system with roots 1 mm in diameter; leaves reduced to minute, white, scale-like bracts. Flowers regular, white or greenish, 8-15 mm long, more or less urn-shaped with 6 small spreading lobes on top. The throat of the perianth is closed by an annulus to which the 6 pendent stamens are attached. Most individuals have only the upper portion of the flower above the surface of the soil, to a height of 4-6 mm (2,3,4).

For illustrations see (3) & (4).

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The material for this sheet was supplied by the Endangered Flora Project of the Smithsonian Institution, Washington, D.C., to whom the TPC is most grateful.

Bandera County Ancistrocactus

CACTACEAE

STATUS Endangered. This small cactus is a collector's item, which, because of its restricted range and great rarity, could be eliminated very easily (2,6). It is considered as acutely endangered in the list of rare and endangered plants native to Texas (4). Only scattered individuals are found and its principal population is estimated as in the low hundreds (6). The only other population known is some distance away, in a National Park (5), where it could become threatened by illegal collecting.

DISTRIBUTION U.S.A. It is known chiefly from an area not more than 50 km long in Bandera and Kerr County, in the hill country of Texas. The additional, disjunct population is in the Trans-Pecos region of Texas, in the Big Bend National Park (4).

HABITAT AND ECOLOGY On limestone at c. 450 m, in the environs of the canyons that cut into the edge of the Edwards Plateau, among junipers, oaks and grasses (1,3,6).

CONSERVATION MEASURES TAKEN A population occurs in the Big Bend National Park where the habitat is protected. The species was proposed as 'Endangered' by the U.S. Department of the Interior, Fish and Wildlife Service, on 16 June 1976. The Endangered Species Act of 1973 directs that no federally-funded activity shall jeopardise the existence of species once officially determined as 'Endangered' or 'Threatened', as defined by the Act.

CONSERVATION MEASURES PROPOSED Formal determination as an 'Endangered' species and hence protection under the Act.

BIOLOGY AND POTENTIAL VALUE An attractive species with bright yellow flowers.

CULTIVATION It is likely to be grown in a few private collections.

DESCRIPTION Small, ribbed, flat-topped, turbinate or obconical cactus 3.8-5 cm high by the same across. Central spines light yellow with red tips, changing to grey, 3 per cluster (areole); radial spines straight, 7-9 per cluster. Flowers 3-3.8 cm across; perianth segments yellow, elliptic oblong or oblanceolate, 10-15 mm long, spreading. Fruit ovoid, green tinged with red, with small scale leaves (1,3,6).

For a colour photograph see (6).

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The material for this sheet was supplied by the Endangered Flora Project of the Smithsonian Institution, Washington, D.C., to whom the TPC is most grateful.

CACTACEAE

STATUS Vulnerable, possibly Endangered, due to excessive collecting and illegal exporting of plants for sale to the horticultural trade. It is only known from one locality (1), where it has now been heavily depleted, but may occur in the neighbouring hills which are less well explored botanically. In recent years wild collected plants in abundance have been offered for sale by local villagers (5). As a rare and unusual cactus, which is very slow-growing from seed, live plants uprooted from the wild find a ready market among cactus enthusiasts in many countries.

DISTRIBUTION Mexico; Tamaulipas State, on the Sierra Madre Oriental. This region, between Monterrey and San Luis Potosí, contains a large number of rare cacti which have been overcollected for many years; a high proportion are likely to be Endangered or Vulnerable.

HABITAT AND ECOLOGY On dry, stony limestone hills at 1200 m, associated with *Koeberlinia spinosa* Zucc., *Jatropha spathulata* Muell. Arg. and *Prosopis* and *Condalia* spp. (1).

CONSERVATION MEASURES TAKEN The Mexican Government have prohibited the export of cacti collected from the wild except under licence. All cacti are included in Appendix 2 of the 1973 Convention on International Trade in Endangered Species of Wild Fauna and Flora.

CONSERVATION MEASURES PROPOSED Mexico should ratify the 1973 Convention as a matter of urgency and so benefit from the protection afforded by the controls imposed by the importing countries. In addition, national regulations should be more strictly enforced. The genus *Ariocarpus* should be considered for addition to Appendix 1 of the 1973 Convention.

BIOLOGY AND POTENTIAL VALUE This species is prized by cactus enthusiasts and there is a large potential market for it especially in Europe, Japan and the United States. Its appeal lies more in its unusual shape and habit and in its status as a collector's item than in any intrinsic beauty.

Alkaloids have been reported in *Ariocarpus* spp. of which hordenine appears to be the principal one in *A. agavoides* (1,3). Its phytochemistry has been studied by Bruhn, in a search for pharmacologically important alkaloids among the 'peyote' complex of cacti, in particular *Lophophora williamsii* (Lem.) J.M.Coulter, which have hallucinogenic properties. For details of its alkaloid chemistry see (3).

CULTIVATION It can be raised from seed but is very slow growing.

DESCRIPTION Small plant 5-8 cm across consisting of a stout, fleshy, spindle-shaped caudex from which arises an erect or spreading rosette of fleshy, rough-skinned, grey-green leaf-like organs, strap-shaped but somewhat semi-circular in cross-section and c. 4 cm long. These correspond with the tubercles of more typical cacti and bear a circular area (areole) c. 1 cm from the tip, covered with grey wool, from which the flowers arise in November or December. Flowers rose-pink to magenta, funnel-shaped, 4-5 cm long, with spreading lanceolate perianth segments. Fruits club-shaped, red to brownish, 2-2.5 cm long (4).

For illustrations see (1), (2), (4) and (5).

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The TPC is most grateful to Mr D.R. Hunt, of the Royal Botanic Gardens, Kew, U.K., for help in producing this sheet.

Tree Cactus, Jijira

CACTACEAE

STATUS Endangered. The type variety (var. *robinii*) of this coastal cactus is most probably now restricted to one locality off the coast of Florida, where it was last seen in 1965, and to a few localities in Cuba where it is also Endangered; in the Province of Habana almost all the habitat has been destroyed, including the famous population at Cojimar (5), by housing and by recreation along the coast. Most of the populations are small, with only a few individuals.

Var. *deeringii* (Small) L.Benson is endemic to Florida where its habitat has been depleted, largely for housing. It is mostly extinct outside state and federal land; the greatest threat to its survival at present is the removal of individual plants for horticulture.

DISTRIBUTION Cuba, U.S.A. In Cuba the type variety formerly occurred along the northern coastal region of the provinces of Habana and Matanzas, between Cojimar and Varadero (5). Its distribution is now much smaller, reduced to between Santa Cruz del Norte and the Hicacos Peninsula. In the U.S.A., the species is confined to a few localities in Florida; the type variety, now known from the one locality, formerly also grew on Key West where it was destroyed by clearing of land for a military base during World War I (8). Small (6) reported in 1917 that it once grew on Boca Chica Key, but is no longer found there. Var. *deeringii* is restricted to two of the upper Florida Keys; it has also been found in the past on Matecumbe and Lower Matecumbe Keys (8) but it is unlikely to survive there. A station has also been reported from Key Largo (4).

HABITAT AND ECOLOGY In the U.S.A. the type variety grows on rocky hammocks on oolite and var. *deeringii* on limestone. In Cuba the type variety occurs on dry coastal limestone, growing in littoral cactus scrub and thorn woodland, associated with *Erythroxylum rotundifolium* Lunan, *Eugenia maleolens* Pers., *Guaiacum sanctum* L., *Gymnanthes lucida* Swartz, *Opuntia dillenii* (Ker-Gawl.) Haw., *Savia bahamensis* Britton and *Selenicereus grandiflorus* (L.) Britton & Rose.

CONSERVATION MEASURES TAKEN None for the Cuban populations. The State of Florida has recently purchased a small site where both varieties are found (8). The species was proposed as 'Endangered' by the U.S. Department of the Interior, Fish and Wildlife Service, on 16 June 1976. The U.S. Endangered Species Act of 1973 directs that no federally-funded activity shall jeopardise the existence of species once officially determined as 'Endangered' or 'Threatened', as defined by the Act.

CONSERVATION MEASURES PROPOSED Additional areas should be protected, in both countries. Several localities in Cuba, between Santa Cruz

del Norte and Varadero, have been proposed for Natural Conservation Areas (Borhidi, pers. comm.).

BIOLOGY AND POTENTIAL VALUE This cactus is a true tree, reaching a height of 6-10 m (7). It is of horticultural value as a landscape ornamental.

DESCRIPTION Type variety (based on descriptions of *Cephalocereus robinii* and *C. keyensis* in 2): shrub or small tree with fluted stems and branches, becoming 5-8 m tall. Stems erect, becoming intricately branched, the branches light or bluish green; ribs 9-13. Spines in copiously hairy clusters (areoles) of 9-20. Flowers opening in the afternoon or evening, 5-6 cm long, bell-shaped; petals brownish green or brownish purple. Var. *deeringii* differs from the type variety by being taller (up to 10 m), having an erect stem that is simple or with only a few erect elongate fastigiate branches that are deep green; the hairs of the areole are persistent (rather than deciduous) with 25-31 spines (2,6,7). (Syn. *Cephalocereus keyensis* Britton & Rose, *Cephalocereus deeringii* Small, *Cephalocereus robinii* Britton & Rose.)

For illustrations see (2), (3), (4), (6) and (7).

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CACTACEAE

STATUS Vulnerable, possibly Endangered, due to excessive collecting and illegal exporting of plants for sale to the horticultural trade. It is only known from a few sites in one locality, where it has now been heavily depleted, but may occur in the neighbouring area which is less well explored botanically. In recent years large numbers of wild plants of the species have been uprooted by local villagers; on one occasion cited by Rowley in (7), over 100 heaps each averaging 30-40 rotting plants were seen in the area. As one of the choicer and more unusual cacti, and one that is very slow-growing from seed, live plants collected from the wild find a ready market among cactus enthusiasts in many countries.

DISTRIBUTION Mexico; Tamaulipas State, on the Sierra Madre Oriental. This region, between Monterrey and San Luis Potosí, contains a large number of rare cacti which have been overcollected for many years; a high proportion are likely to be Endangered or Vulnerable.

HABITAT AND ECOLOGY On dry, stony limestone hills at c. 800 m. Associates include species of *Acacia, Jatropha, Prosopis, Yucca* and other cacti such as *Mammillaria* and *Opuntia* (1).

CONSERVATION MEASURES TAKEN The Mexican Government have prohibited the export of cacti collected from the wild except under licence. All cacti are included in Appendix 2 of the 1973 Convention on International Trade in Endangered Species of Wild Fauna and Flora.

CONSERVATION MEASURES PROPOSED Mexico should ratify the 1973 Convention as a matter of urgency and so benefit from the protection afforded by the controls imposed by the importing countries. In addition, national regulations should be more strictly enforced. The genus *Obregonia* should be considered for addition to Appendix 1 of the 1973 Convention.

BIOLOGY AND POTENTIAL VALUE This species is prized by cactus enthusiasts and there is a large potential market for it, especially in Europe, Japan and the United States. Its appeal lies both in its unusual shape and habit and in its status as a collector's item.

The phytochemistry of *Obregonia* and related cacti has been studied by Bruhn, in a search for pharmacologically important alkaloids with hallucinogenic properties - for details see (5). *Obregonia* is not, however, employed in folk medicine as are other chemically active cacti such as 'peyote', *Lophophora williamsii* (Lem.) J.M. Coulter, which is used as a psychoactive drug.

CULTIVATION It can be raised from seed, but is very slow-growing and requires careful treatment.

DESCRIPTION Obconical cactus 8-12 cm across, consisting of a thick fleshy caudex which bears numerous grey green, fleshy tubercles 1-1.5 cm high, pointed at the tip, 2-2.5 cm across at the base, together forming a tight rosette. They are flattened to triangular in cross-section and at the tip each bears a small woolly areole which produces 2-4, slender, soft, curving spines 1-1.5 cm long, white but turning brown before falling. Flowers arising from the younger areoles, white, 2.5-3 cm long, with lanceolate perianth segments. Fruit white, fleshy.

For illustrations see (1), (2), (4), (6) and (7).

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The TPC is most grateful to Mr D.R. Hunt, of the Royal Botanic Gardens, Kew, U.K., for help in producing this sheet.

Knowlton Cactus

CACTACEAE

STATUS Endangered. It is only known from 2 small populations, each consisting of only a few hundred individuals, but it is a very small and inconspicuous plant whose populations are difficult to delimit exactly. It shrinks below ground for part of the year. In the event of an unusually heavy rainfall, these populations could be inundated by the back-up of the water behind the Navaho Dam. One of the 2 populations is in an area of intense recreational use. Commercial collectors for the horticultural trade have decimated the remainder of the population; if present trends continue, the species is unlikely to survive beyond the mid 1980s (4).

DISTRIBUTION U.S.A.; near the Los Piños River, along the New Mexico-Colorado border, occurring in both states (2). The Navaho Dam is below the confluence of the Los Piños with the San Juan River.

HABITAT AND ECOLOGY It grows in gravel soils on hills in dry areas at about 1800 m, in the Juniper-Pinyon Woodland (2).

CONSERVATION MEASURES TAKEN None for the wild populations. All *Cactaceae* are included in Appendix 2 of the Washington Convention on International Trade in Endangered Species of Wild Fauna and Flora, which was ratified by the U.S.A. in 1974. It was proposed as 'Endangered' by the U.S. Department of the Interior, Fish and Wildlife Service, on 16 June 1976. The Endangered Species Act of 1973 directs that no federally-funded activity shall jeopardise the existence of species once officially determined as 'Endangered' or 'Threatened', as defined by the Act.

CONSERVATION MEASURES PROPOSED Formal determination as an 'Endangered' species and hence protection under the Act. The possibility of decreasing the amount of recreational use in the immediate vicinity of the populations should be investigated.

BIOLOGY AND POTENTIAL VALUE It is a very small and inconspicuous cactus, with little outstanding for horticulture in its stems, spines or flowers. Its special interest, and indeed the threat to its survival, lies in its rarity (5). A study of its distribution, in conjunction with those of the other specialised and very rare species of *Pediocactus*, would add greatly to understanding the evolutionary history of the genus in relation to the geological and environmental history of the region; this is an additional reason for conserving the species in its native habitat.

CULTIVATION It is in cultivation at the Planting Fields Arboretum, Long Island, New York, and must presumably be also in some private collections in view of the observed decline due to collecting.

DESCRIPTION Very small plant with succulent stems, solitary or a few in a cluster, up to c. 38 mm high by c. 19 mm across, barely protruding above ground level. Spines radiating from the areoles, gradually recurving and finely white-hairy. Flower c. 2 cm across when spread open, c. 1 cm long; perianth spreading, outer perianth segments pink with white margins, inner perianth segments pink. Fruit green to tannish, dry at maturity, without scales, c. 4 mm long by 3 mm across (2,3).

For a colour illustration see (5) and a line drawing (2).

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CALYCANTHACEAE

STATUS Vulnerable; a tree known from a few localities. It occurs in rain-forest deemed suitable for development, and much of the habitat has been destroyed. It is known to be toxic to stock (1,3) and this also threatens its survival. It was discovered by Diels in 1902, but was not found again in the wild until 1971, when the seeds had caused cattle poisoning. 5 trees were discovered on this occasion, 2 of which were destroyed. Subsequently it was found in several other localities, but not in Diels' original locality, which is c. 160 km to the south (1).

DISTRIBUTION Australia; known only from Russell River, Noah Creek and Daintree area in the Cook pastoral district, between Cooktown and Cairns, north Queensland.

HABITAT AND ECOLOGY The tree occurs in rain-forest in lowland areas, growing on alluvial soil derived from metamorphic rocks (1). The average annual rainfall in the area exceeds 3000 mm with a relatively dry period from July to October. The average for the driest month is about 100-130 mm.

CONSERVATION MEASURES TAKEN None as yet.

CONSERVATION MEASURES PROPOSED Proposals have been prepared for an area containing the species to be declared a National Park and action is pending.

BIOLOGY AND POTENTIAL VALUE The species is of interest to studies of plant geography as the other members of the *Calycanthaceae* occur in North America and China. It is also of considerable taxonomic interest, especially in the characters of the seeds, and its position in the plant kingdom is still uncertain (4). Blake in (1) created the family *Idiospermaceae* for the species, placed in an isolated position in the Magnoliales, and gives a detailed discussion of its characters. The wood is described in detail and is reported to be very different from that of other members of the *Calycanthaceae*.

CULTIVATION It is in cultivation in Brisbane and seed has been distributed to the Bernice P. Bishop Museum, Honolulu, and to Hanover College, New Hampshire, U.S.A.

DESCRIPTION Buttressed, evergreen tree up to 40 m high with a trunk up to 1 m in diameter. Bark light grey, pale cream inside. Leaves opposite with oblong to elliptic blades 12-23 cm long, rather thin but stiff and tough, dark green above, paler below, shiny and predominantly veined on both surfaces. Flowers on short stalks in the leaf axils, each c. 2.5 cm across, consisting of numerous, dark red to purple, thick petals surrounding and covering a cup-shaped receptacle bearing

the stamens. Fruit olive-brown, more or less spherical, 5-5.5 cm high, 6-6.7 cm wide, containing one or sometimes 2 seeds each with 3 or 4 relatively large seed leaves (cotyledons) (1).

For illustrations see (1) & (3).

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The material for this sheet was supplied by Mr D.E. Boyland (of the Queensland Herbarium, Brisbane), to whom the TPC is most grateful.

CAMPANULACEAE

STATUS Endangered, possibly Extinct; an island endemic originally reduced by habitat destruction caused by goats introduced in the 16th century. These have been controlled since the 1950s but the species, if it still survives, is now severely threatened by competition from vigorous, introduced plants such as Blackberry *(Rubus)* and New Zealand flax, *Phormium tenax* J.R. & G.Forster. A detailed and exhaustive survey in 1970 uncovered only 5 specimens of this plant, one in a locality where it was frequent in 1956 and the 4 others together in a second locality (2). None have apparently been found since 1970.

DISTRIBUTION St. Helena, South Atlantic. It occurs on the central ridge of the island where in 1875 it was reported to be abundant, at 610-760 m (3).

Of around 30 endemic species of angiosperms (including 4 *Wahlenbergia* spp.) known from St. Helena, 10 are Extinct and 15 Endangered. J.D. Hooker (quoted in 3) estimated that there must have been over 100 endemic species in this "wonderfully curious little flora" since the forests which originally covered the island had been reduced by goats to a few high-altitude areas on the central ridge when the island was first thoroughly explored botanically in 1805-1810. Most of these species will never be known.

HABITAT AND ECOLOGY On rocky bluffs on the windward side of the central ridge. It is said to be sometimes epiphytic on the tree fern *Dicksonia arborescens* L'Hérit. As a low growing species less than 1 m high, it is easily swamped by the 3 m growth of flax and other tall growing exotics. Since the flax industry dwindled, the plants have not been cropped and so have seeded abundantly. The paths separating the plantations from the indigenous forest have become overgrown, allowing the flax to spread unchecked up the hillside on to the central ridge (2).

CONSERVATION MEASURES TAKEN Since the 1950s the ranging feral goats have been progressively cleared from specified areas of the island, resulting in their virtual extermination. A reserve is planned and has been marked out.

A detailed survey (2) of the St. Helena endemic flora was made in 1970 by Kerr, under the auspices of the Royal Society and the International Biological Programme. Considerable success was achieved in alerting the islanders to the international importance of the endemic flora and to the threats to its existence.

CONSERVATION MEASURES PROPOSED A reserve of about 200 ha is needed on the central ridge to preserve this and most of the other threatened

endemics, e.g. *Petrobium arboreum* R.Br., the Whitewood Cabbage Tree, of which only a few specimens were found in 1970. An active and continuing management programme is urgently needed to remove introduced plants from the area so as to allow the endemics to regenerate.

BIOLOGY AND POTENTIAL VALUE No information.

CULTIVATION Efforts at propagation have not yet been successful.

DESCRIPTION Small shrub to 1 m bearing smooth stalkless serrate linear leaves c. 3 cm long by 2-4 mm wide, densely crowded along the upper parts of the stems, leaving small but prominent scars on the bare lower wood. At the branch tips are loose clusters of a few nodding flowers, the calyx with 5 small ovate-lanceolate lobes 4-8 mm, and the corolla a white bell c. 2 cm long with short, recurved, bluntly pointed lobes. Fruit a small cup-shaped capsule 8-12 mm across, crowned by the sepals which persist and elongate after flowering.

For illustrations see (3).

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The TPC is most grateful to Mr N. Kerr, of Suffolk, England, and to Mr R.O. Williams, Agricultural and Forestry Officer, St. Helena, for help in producing this sheet.

CARYOPHYLLACEAE

STATUS Rare; a mountain species mostly growing in places difficult of access for grazing animals. The only danger would be from tourists or a gradual extinction because of some external factors. *Dianthus callizonus* is a very attractive species and may be considered as a symbol of the flora of the Romanian Carpathians, but its ecological and biological aspects have not been greatly studied, despite their great interest. It is protected by law, but must be considered as Rare because of its very limited area of distribution.

DISTRIBUTION Romania. It occurs on one isolated mountain, the Piatra Craiului, of the Southern Carpathians south west of Braşov (4). In addition there are old records, both in the literature (7) and in herbaria, for its presence in the Bucegi Mts.

Out of 48 species and subspecies of flowering plants endemic to Romania, one is Extinct, 6 are Endangered, 13 are Vulnerable, and 17 are Rare.

HABITAT AND ECOLOGY On rocks of the limestone crests and western slopes of the mountain, at 1650-2200 m. It occurs in several different plant communities and its associates include *Dryas octopetala* L., *Festuca versicolor* Tausch, *Salix retusa* L., *Cerastium transsilvanicum* Schur, *Scabiosa lucida* Vill., *Dianthus tenuifolius* Schur, *Festuca rupicola* Heuffel ssp. *saxatilis* (Schur) Rauschert, *Carduus kerneri* Simonkai and *Potentilla crantzii* (Crantz) Beck (2,5).

CONSERVATION MEASURES TAKEN It was declared a 'monument of nature', and is accorded special protection together with other Romanian species.

CONSERVATION MEASURES PROPOSED None on record.

BIOLOGY AND POTENTIAL VALUE It is taxonomically isolated, intermediate between the groups *Alpini* and *Glauci*, and hence is thought to be a relict which had evolved before the 2 series separated (2). However it does form natural hybrids with other species (e.g. *D. tenuifolius* Schur and *D. spiculifolius* Schur), and is hence of scientific interest, raising problems of genetics and taxonomy.

It is a small plant, each specimen bearing one large, very handsome flower, and so would be a possibility for the rock-garden, to be grown on limestone.

DESCRIPTION Delicate hairless perennial herb with stems 5-20 cm high, bearing pairs of linear to lanceolate, 3- to 5-veined, pointed leaves 2-4 cm long, scabrous on the margin, and a terminal, large and conspicuous, usually solitary flower (rarely 2-5). Calyx violet, tubular but widening upwards, c. 16 mm long, with ovate teeth. Enclosing the base

of the calyx are 1 or 2 pairs of long awned scales (epicalyx) up to 12 mm or more long. Petals with large spreading limbs, c. 10-15 mm long, widest and fringed at the tip, carmine in colour but blotched white and purple towards the base. Capsule c. 12-13 mm.

For small line drawing see (4) and for a popular account of this species see (3).

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The material for this sheet was supplied by Dr G. Dihoru (of the Institute of Biological Sciences, Bucharest), to whom the TPC is most grateful.

CARYOPHYLLACEAE

STATUS Endangered or Vulnerable. It has not been seen recently in the wild so its precise conservation status is uncertain. The most recent herbarium specimen was gathered in 1935. All the few localities known are close to Sofia, and are in areas often visited by tourists. The vegetation in parts of the area has been greatly affected by agriculture.

DISTRIBUTION Bulgaria; in the west of the country on Ljulin Mt. and near the village of Suhodol in Sofia district.

Out of 52 species of flowering plants endemic to Bulgaria, at least 4 are Vulnerable and 15 are Rare.

HABITAT AND ECOLOGY Ljulin is a low mountain up to 1250 m high, with mixed woods of oak (*Quercus cerris* L., *Q. conferta* Kit., *Q. sessiliflora* Salisb.) and hornbeam (*Carpinus betulus* L., *C. orientalis* Miller) on the upper part. In the grassland the main species include *Festuca heterophylla* Lam., *Agrostis canina* L. and *Agrostis capillaris* L. The climate is moderately continental with cold winters and not very hot summers. The annual rainfall is c. 730 mm.

CONSERVATION MEASURES TAKEN None.

CONSERVATION MEASURES PROPOSED A detailed study of the populations in the wild should be undertaken so that proposals for conservation can be put forward. It is suggested that most or all of the populations will need to be included in protected or reserved areas. The species should also be cultivated in botanic gardens.

BIOLOGY AND POTENTIAL VALUE As with most species of *Dianthus*, it might prove a good garden plant.

DESCRIPTION Slender, herbaceous, more or less hairless perennial with several erect stems 30-60 cm high. Leaves linear, erect, pale green, 7-veined, 8-16 mm long, in pairs up the stem. Flowers 2-7 in nearly spherical, terminal heads with linear-lanceolate, green or purple-veined bracts nearly as long as the calyx which is 16-20 mm, narrowly cylindrical and narrowed towards the apex; petals with spreading limbs that are 5-7 mm long, fringed at the tip, intensely red with a yellow spot on the inside at the base, and minutely glandular.

For a line drawing see (2).

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The material for this sheet was supplied by Dr B. Kuzmanov (of the Institute of Botany, Bulgarian Academy of Sciences, Sofia), to whom the TPC is most grateful.

CARYOPHYLLACEAE

STATUS Vulnerable; a mountain endemic particularly at risk because of its ecology and its dioecious habit (i.e. with male and female flowers on separate individuals). It appears to survive solely because of the agricultural system prevailing in its habitat. In a recent survey (1974) only about 500 mature plants were found, over an area of c. 1000 x 1500 m. No seedlings were seen, although copious good seed was produced by the female plants (3).

DISTRIBUTION Spain; in one locality at c. 300 m on the hills south of Játiva, Valencia Province. There are three main populations and these are partly linked by scattered individuals. In 1974 no plants were found in a second locality from where it had been recorded in 1967 by Galiano (2).

HABITAT AND ECOLOGY Mainly on dry terrace banks in carob and olive groves. Possibly it spreads vegetatively, encouraged by irregular ploughing. In contrast to other groves in the neighbourhood, the habitat has neither been intensively cultivated nor allowed to become invaded and overgrown by *Pinus halepensis* Miller. Thus the use of herbicides on the terrace banks (as in intensively cultivated groves), or the use of any means of ploughing other than a mule plough, could destroy many individuals. A fire could also have a disastrous effect as could an increase of grazing by goats. It is significant that no plants were found on the limestone of the ridge above the site, although this may have been the original habitat.

CONSERVATION MEASURES TAKEN None for the wild population. A detailed study of this species (3), in particular of its habitat and ecology as summarised above, was made by Prentice in 1974.

CONSERVATION MEASURES PROPOSED To ensure the survival of this species, it is essential that the present agricultural system is maintained in the small area where it occurs.

BIOLOGY AND POTENTIAL VALUE The species is biologically interesting as being dioecious and hence the minimum population size, to give a reasonable chance of survival, is likely to be higher than with a hermaphrodite species, since only about half of any population is seed-producing. With some dioecious plants, the ecological tolerances of the males and females are not identical and so the structure of the population can change in peculiar ways due to changes in selection pressures. However it is not known how this might work in the case of *Silene diclinis*. The Játiva population exhibits great variation in flower size and colour.

CULTIVATION It is in cultivation at the Instituto Botánico de

Barcelona (2) and the University Botanic Garden, Cambridge, U.K. Seed has been deposited in the seed-bank of the Royal Botanic Gardens, Kew, and with other Spanish endemics in the Universidad Politécnica, Madrid.

DESCRIPTION Perennial with a woody stock producing weakly trailing stems up to 30 cm long, which bear lanceolate leaves up to 9 cm long, clothed with long soft whitish hairs. The dioecious flowers, borne on long stalks, are 12-22 mm across, each with 5 spreading magenta petals indented at the tip and on erect claws c. 15 mm long forming a slender tube below; capsule globose, 5-12 mm long, containing numerous seeds each of 1.5-2 mm. Fertile hybrids have been produced between *S. diclinis* and *S. alba* (Miller) E.H.L.Krause, *S. dioica* (L.) Clairv. & *S. heuffelii* Soó.

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This sheet is based upon information provided by Mrs H.C. Prentice (of the Botany School, University of Cambridge, U.K.), to whom the TPC is most grateful.

CARYOPHYLLACEAE

STATUS Vulnerable. As an annual confined to minute islands in the east Mediterranean, it is very susceptible to short-term grazing. A few goats left on such an island for a short time can totally destroy the flora. It is likely that *Silene holzmannii* has been obliterated on several islands, particularly where grazing animals have been introduced.

DISTRIBUTION Greece. It is only known from 13 scattered localities in the Aegean from Attica to Crete, though it has never been found either on Crete itself or on the mainland of Greece (2,4).

HABITAT AND ECOLOGY It only occurs on very small islands. The best known site is a reef consisting of 2 rocks c. 150 m long, close to the Cretan coast. Here it grows in a precisely balanced but very diverse community of 14 angiosperm species, made up of 4 elements: halophytes such as *Mesembryanthemum nodiflorum* L.; members of the phrygana such as the shrubby *Pistacia lentiscus* L.; rupicolous elements such as *Scorzonera cretica* Willd.; and the characteristic small island element, the *Silene* and *Salsola carpatha* P.H.Davis. Thus the vegetation is surprisingly dissimilar to that of the Cretan coast. This delicate and unusual community is now becoming vulnerable to tourist pressures since it is within easy swimming distance of one of the most popular beaches on Crete (2). The flora of a similar island, described in 1895 (3), had been completely obliterated by 3 goats when visited by Greuter in 1963 (2).

CONSERVATION MEASURES TAKEN None for the wild populations. A detailed survey of this species (2), in particular of its ecology as summarised above, was made by Greuter.

CONSERVATION MEASURES PROPOSED Care should be taken that none of the islands on which it occurs are used for short-term grazing. It would be advisable for several of them to be declared as reserves.

BIOLOGY AND POTENTIAL VALUE It is a very interesting plant as it appears to be one of the few survivors of a 'sublittoral' flora, most of which has disappeared. Its distributional history has been the subject of speculation (2,4) and it is one of the examples on which Runemark based the theory of Reproductive Drift, in which the risk of random extinction of a small population can be estimated by evaluating the significance of numerical deviations in population size over successive generations (4). Random extinctions may well be a major factor in its strangely disjunct distribution. *Silene holzmannii* is also interesting as it is the only species of the genus with hard, indehiscent fruits, preadapted to floating and impermeable to salt water. The seeds, thus protected, can drift on the sea for up to 40 days without losing their viability (2).

DESCRIPTION Hairless annual up to 20 cm or more high bearing lanceolate leaves 2-3 cm long in pairs up the stout single stem. At the top are several small overlapping flowers on short stalks, arranged in a dichasium (the central ones opening first). Calyx green, somewhat inflated at flowering time, later papery and adpressed to the fruit; petals 5, small, dull-coloured, bi-lobed. Capsule ovoid, indehiscent, 10-12 mm long, containing black seeds with parallel-sided spines. The difference between this species and its close relatives, *S. behen* L. and *S. reinholdii* Heldr., are given in (2).

For a line drawing see (2).

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This sheet is based upon information provided by Dr W. Greuter (of the Conservatoire Botanique, Geneva), to whom the TPC is most grateful.

CARYOPHYLLACEAE

STATUS Endangered or Rare. It is only known from two localities. At one, the *locus classicus*, it was found in 1976 to be restricted to 2 discrete colonies with a few small outliers, the total cover being less than one hectare. The present light grazing by sheep seems to ensure its survival, but changes in grazing pressure in either direction could threaten it, as could any significant increase of public pressure, which, although not serious at present, could grow as the locality is an attractive view-point and an 'historical monument'.

DISTRIBUTION Yugoslavia. The two known localities, both in the extreme south of Yugoslavian Macedonia, are Markova Kula, near Prilep (the *locus classicus*) (2), and on the slopes of a mountain called Kozjak, near Pletvar, about 12 km east (Micevski, pers. comm.). No details are available for the Pletvar locality, except that the rock is limestone, in contrast to Markova Kula where it is volcanic. Bornmüller, who discovered and described this plant (2), searched several neighbouring hills in vain for more populations. The recent discovery at Kozjak, however, suggests that there may be other populations in Yugoslav Macedonia as yet undiscovered.

Out of 135 species of angiosperms believed to be endemic to Yugoslavia, at least one is Endangered, 5 are Vulnerable and 84 Rare. Many of these Rare species are montane plants with very restricted distributions but are not known at present to be under any immediate threat.

HABITAT AND ECOLOGY A detailed population survey and vegetation study was made on Markova Kula in June 1976 by Akeroyd *et al.* (1). The results can be summarised as follows: *Silene viscariopsis* grows in dry, species-rich grassland with broken turf, up to 25% bare soil, and rock outcrops, on north and north-east facing slopes, between 800 and 900 m. It seems to be absent from the more closed turf in the shade of rocks, and also from the very bare areas in which *Scleranthus perennis* L. is the most abundant species. The light grazing by sheep usually causes branching of the individual plants by stimulation of lateral shoots, many of which flower and set abundant seed. The first-year rosettes seem to escape grazing. Shrubs which are present on the site could spread and eliminate the *Silene* if all grazing were to cease.

CONSERVATION MEASURES TAKEN None, except for the registration of the hill as an 'historical monument'.

CONSERVATION MEASURES PROPOSED Monitoring, to find out whether there is a significant decline (or increase) with changing land-use, is recommended. The plant is likely to react quickly to a change in grazing regime, although it is encouraging that the main populations seem to be exactly as described by Bornmüller more than 50 years ago.

BIOLOGY AND POTENTIAL VALUE It is a remarkably distinct species, not obviously related to any other *Silene*. Cultivated material in the University Botanic Garden, Cambridge, U.K., has shown the following attributes:

1. All attempts to cross it with other *Silene* species have failed and no putative hybrid seedlings have even been seen.
2. The progeny of each generation is remarkably uniform, and no significant variation has yet been detected.
3. Seed production per capsule is high (50-100 seeds is estimated), germination is almost complete, and the seed retains its high viability for at least two years with no special precautions.

The apparent correlation between the genetic uniformity and easy self-pollination in this narrow endemic is in sharp contrast to the genetic variability and dioecism of another narrowly endemic *Silene, S. diclinis* (Lag.) M.Laínz (4), also in the Red Data Book. Such correlations are of considerable theoretical interest in micro-evolutionary studies.

CULTIVATION It is extremely easy to cultivate. In Cambridge stocks have been grown since 1967 from seed gathered at Markova Kula. Contrary to the original description (2), the plant behaves rather strictly as biennial (not perennial) in cultivation. However, in the wild, the frequent loss through grazing of the terminal stem seems to stimulate the laterals to produce a bushier, probably more perennial plant.

DESCRIPTION Biennial or short-lived perennial up to 30 cm tall, with an over-wintering rosette, a main flowering stem, and one or more lateral, potentially flowering branches. Rosette-leaves 1-4 cm long, linear-spathulate, hairy. Inflorescence a slender panicle with a viscid axis and 3-20 flowers on more or less horizontal pedicels; calyx 4-6 mm, inflated, with 10 green, prominent veins; petals 5, with deeply bifid, bright purple lamina c. 5 mm long and whitish claw. Ripe capsule c. 7 mm, conical, with deflexed teeth 1-1.5 mm long.

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This sheet, drafted by Dr S.M. Walters, is based upon information provided by Professor E. Mayer (of the Institute of Botany, University of Ljubljana), to whom the TPC is most grateful. Help is also acknowledged from J.R. Ackeroyd, R.W. Mellors & C.D. Preston (of the Botany School, University of Cambridge, U.K.).

CASUARINACEAE

STATUS Endangered. It is only known from a single, small area which is now protected in an A Class Reserve. However there are probably less than 100 individuals and so it is considered for the meantime as Endangered rather than Rare. If the population expands in the future, the latter category will become more suitable. It was presumably more widespread in the past, but the vegetation of the area surrounding the Reserve has been cleared for agriculture and little of the indigenous flora survives. The species was discovered in 1926 by Charles Gardner, after whom the Reserve was named. It was re-collected in 1928 and 1949, but thereafter for a time was believed extinct. It was rediscovered in 1970 during survey work in the newly created reserve.

DISTRIBUTION Australia. The only known locality is a low ridge near Tammin in the South Western Botanical Province of Western Australia (31° 47'S, 117° 28'E, not far east of Perth).

HABITAT AND ECOLOGY Tall open heath, in sand over laterite. The plants are not killed by fire but regenerate from lignotubers (the last fire was in 1965). Although seed set appears adequate, the population contains few young plants and appears to be static.

CONSERVATION MEASURES TAKEN The entire known population occurs within the Charles Gardner Flora Reserve (formerly the Tammin Flora Reserve). The Reserve is not included in the U.N. List, being only 583 ha in extent. Nevertheless it is an A Class Reserve (i.e. requires an Act of State Parliament to alter its purpose, status and vesting) and was gazetted under No. 20041 on 8 August 1969. Its purpose is Conservation of Flora, and it is vested in the National Parks Authority of Western Australia.

CONSERVATION MEASURES PROPOSED The reserve is surrounded by farms and needs to be carefully managed, especially as regards fire, but at present there is no management plan for it. Under natural conditions *Casuarina fibrosa* releases seed only after a fire. There should therefore be an interval between fires (which are necessary to maintain the vigour and diversity of the vegetation in the reserve) sufficient to allow adequate seed set to maintain the population. The minimum interval for this is unknown, but is probably at least 10 years. The species should be cultivated in appropriate botanic gardens.

BIOLOGY AND POTENTIAL VALUE As with other casuarinas, the species is wind-pollinated. It is a somewhat anomalous species which needs further study.

DESCRIPTION Small erect shrub 50-150 cm high, with many stems from a lignotuber, the branches densely covered with needle-like lateral branchlets giving the appearance of a dwarf pine. Lateral branchlets

slender, cylindrical, finely striate, sharply pointed, 2-5 cm long with 2-4 internodes and whorls of 4 small papery scale leaves at the nodes fused at their base to form a sheath. The ovoid to spherical, brown, woody, fruiting cones are 15-25 mm long and shaggy, with slender brown tips of scales (bracteoles) projecting. They are attached directly to the branches and nearly hidden by the branchlets. The ovoid, reddish-brown seeds have a wing 6-7 mm long, which is broader than the seed. Male spikes ovoid, terminal or axillary.

For illustrations of some of the parts of the plant see (1) and (2).

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The TPC is most grateful to Mr. A.S. George of the Western Australian Herbarium, Perth, for help in producing this sheet.

Dwarf Beet

CHENOPODIACEAE

STATUS Rare. It is restricted to the alpine zone of several Greek mountains. Although grazing has been practised since classical times, the increasing public pressure from tourism is now the more serious potential threat as these areas are becoming increasingly used for recreation. For instance, the Athens Ski Club has recently built a club house and chair lift on Mt. Parnassós, one of the localities.

DISTRIBUTION Greece. It occurs on a few mountains, being recorded from Mt. Parnassós (1), Taiyetos (2), Olympus (1,3), Kiona (4), and Chelmos (4).

HABITAT AND ECOLOGY It grows above the tree-line in short, closed turf in hollows where snow lies until midsummer (5). On Parnassós it also occurs in crevices in calcareous rock and as a member of disturbed, possibly overgrazed communities (1). The low stature of the plant allows it to withstand some grazing pressure; it is possible that it is actually favoured by a regime that includes a moderate amount of grazing, but more detailed field research is needed to establish this.

CONSERVATION MEASURES TAKEN It occurs within the Mount Olympus National Park (3,998 ha).

CONSERVATION MEASURES PROPOSED Action to protect the flora and vegetation of Parnassós is highly desirable. The mountain has an extremely rich flora including several endemic species not found elsewhere, e.g. *Huetia pumila* (Sibth. & Smith) Boiss. & Reuter (Rare), *Silene guicciardii* Boiss. & Heldr. (possibly Extinct), *Seseli parnassicum* Boiss. & Heldr. (Rare) and *Astragalus apollineus* Boiss. & Heldr.

BIOLOGY AND POTENTIAL VALUE *Beta nana* is the only montane species of the genus; it is also isolated taxonomically, being the only species of the section *Nanae*. Thus it is of considerable interest to studies of plant geography and taxonomy. As yet there has been no experimental study of the species (3). The genus *Beta* contains several important crop plants and *B. nana* is a potential source of genetic variation that might be exploited in future breeding programmes.

DESCRIPTION Small hairless perennial with a stout undivided cylindrical taproot. Leaves all basal, 15-20 x 8-10 mm, ovate-oblong, entire. Flowering stems prostrate to ascending, 5-10 cm long, leafless; inflorescence with small bracts and solitary insignificant stalkless flowers, the minute perianth segments being in fives. Receptacle hemispherical, strongly ridged, the segments incurved in the fruit.

For an illustration see (6).

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The material for this sheet was supplied by J.R. Akeroyd, R.W. Mellors and C.D. Preston (of the Botany School, University of Cambridge), to whom the TPC is most grateful.

CISTACEAE

STATUS Endangered. It is confined to about 150 km along the Mediterranean coast of Egypt, in an area planned for future development. It is severely threatened by tourism, human settlement and extraction of oil. It is reduced to a few small pockets in very rocky areas unsuitable as sites for building. About 10 sites are known and its population is believed to be in the low hundreds.

DISTRIBUTION Egypt. It occurs on the coastal strip from El Amria to Ras El Hekma, west of Alexandria.

HABITAT AND ECOLOGY It grows as a chasmophyte in calcareous rocky outcrops among white calcareous sand dunes, about 1-2 km from the sea, associated with *Fumana thymifolia* (L.) Spach, *Globularia arabica* Jaub. & Spach, *Helichrysum conglobatum* Steudel, *Minuartia procumbens* Graebner, *Phagnalon rupestre* (L.) DC. and *Thymus capitatus* (L.) Hoffmanns. & Link (1). This very specialised and precise habitat is similar to that of an Endangered species endemic to Marmarica, *Euphorbia punctata* Del., from the coast close to Alexandria.

CONSERVATION MEASURES TAKEN None.

CONSERVATION MEASURES PROPOSED A prerequisite is a detailed study of its distribution and of the existing sites, from which plans for its conservation could be made and incorporated in the development plan for the region.

BIOLOGY AND POTENTIAL VALUE It is a very distinct species, with large fragrant flowers. The slightly fleshy leaves and inflated spherical calyx in the fruiting stage are both very unusual features in the genus and of considerable interest. The plant is one of the best examples of a distinct species confined to Egypt and has been studied on field trips by many generations of botany students from Cairo University.

DESCRIPTION Dwarf olive-green shrub c. 10 cm high with hairless, somewhat fleshy, flat, ovate to ovate-lanceolate leaves 15-23 mm long by 7-10 mm wide, with large stipules to 10 mm long. Flowers fragrant, up to 3 cm across, on white-hairy stalks; petals spreading, broadly obovate, indented at the tip, 14-16 mm long, yellow. Calyx in the fruiting stage inflated, spherical, red-veined, white-hairy. Capsule ovoid-spherical, 5-8 mm long.

For illustrations see (1) and (2).

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This sheet is based upon information provided by Professor N. El-Hadidi (of the Department of Botany, Cairo University), to whom the TPC is most grateful.

Mountain Golden-heather, Mountain Hudsonia

CISTACEAE

STATUS Endangered. It is known only from three sites, all within an area that is becoming increasingly popular for recreational use. The species is very susceptible to disturbance and the three populations lie near heavily used trails and are threatened by rock climbers (1,2). Two of these populations contain c. 12 individuals with seedlings (7) and c. 15 individuals respectively (2). The third population, consisting of nearly a hundred, lies in an area now used for hiking, camping and climbing.

DISTRIBUTION U.S.A.; in Burke County, North Carolina. It had been believed to be extinct until refound at the *locus classicus*, Table Rock Mountain, in 1976.

HABITAT AND ECOLOGY In weathered rock soils (6), on mountain tops. It occurs in a zone midway between the high elevation 'heath bald' community dominated by *Rhododendron catawbiense* Michaux and the community lying along the edge of the bluff (2).

CONSERVATION MEASURES TAKEN All three sites are within the Pisgah National Forest and are hence accorded some degree of protection. The species was proposed as 'Endangered' by the U.S. Department of the Interior, Fish and Wildlife Service, on 16 June 1976. The Endangered Species Act of 1973 directs that no federally-funded activity shall jeopardise the existence of species once officially determined as 'Endangered' or 'Threatened', as defined by the Act.

CONSERVATION MEASURES PROPOSED Formal determination as an 'Endangered' species and hence protection under the Act. Future measures to protect the populations may require further restrictions on the use of particular sites within Pisgah National Forest, particularly with regard to rock-climbing, off-trail hiking and camping.

BIOLOGY AND POTENTIAL VALUE One researcher regards this as a primitive relict species, distinctly different from others in the genus (2,3). An earlier study suggested it may represent a relict population derived from hybridisation between *Hudsonia ericoides* L. ssp. *andersonii* Nickerson & J.Skog and ssp. *tomentosa* (Nutt.) Nickerson & J.Skog. Possibly because of post-glacial isolation, it may have remained an intermediate entity in which little selection for the presumably less well-adapted extreme parental types can be detected (6).

DESCRIPTION Low heath-like shrub less than 30–40 cm high. Adult plants partly smooth and caespitose, forming extensive patches. Leaves thread-like, awl-shaped, 3-7 mm. Flowers solitary, terminal, resembling those of *Cistus;* calyx 6-7 mm long, with lanceolate, villous lobes; petals 5, yellow (1,4-6).

For an illustration see (1).

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The material for this sheet was supplied by the Endangered Flora Project of the Smithsonian Institution, Washington, D.C., to whom the TPC is most grateful. Information is also gratefully acknowledged from L.E. Morse.

COMPOSITAE

STATUS Endangered. It is known from only 3 patches, each of c. 30 sq. m, within an area of 150 sq. m (5). It is a plant of particular scientific importance. When it was discovered in 1961, it excited a great deal of interest amongst Romanian botanists (1,2).

DISTRIBUTION Romania. It has only been found on the mountain of Pietrosul Broştenilor (Neamţ district) of the east Carpathians about 80 km south of the U.S.S.R. border.

Out of 48 species and subspecies of flowering plants endemic to Romania, one is Extinct, 6 are Endangered, 13 are Vulnerable and 17 are Rare.

HABITAT AND ECOLOGY In soil pockets on steep (35^{o} - 90^{o}) slopes or on vertical cliffs, facing south or south-east, at 1600-1700 m. The rocks are crystalline metamorphics, schists and gneisses, intruded by an acid dyke outcropping at the summit of Mt. Pietrosul. The soil in the locality is a product of the weathering of derital material from schists and psammites, and has a high proportion of carbonaceous material. It is acid (pH 4.34-4.35) and is relatively rich in potassium (0.95-0.97 milli-equivalents K per 100 g soil), probably due to continual falls of fresh muscovite from the schists above. This could be a reason for the very restricted habitat and distribution of the species since the leaves are also found to have a high potassium content (1.5%) (5). The plant is associated with *Juniperus communis* L. subsp. *alpina* (Gray) Celak., *Campanula kladniana* (Schur) Witasek, *Vaccinium vitis-idaea* L., *V. myrtillus* L., *Hypochoeris uniflora* Vill., *Luzula luzuloides* (Lam.) Dandy & Wilmott, and many lichens characteristic of bare soil and rock.

CONSERVATION MEASURES TAKEN None.

CONSERVATION MEASURES PROPOSED Care should be taken that the few plants surviving are safeguarded.

BIOLOGY AND POTENTIAL VALUE A strange species which is of great scientific interest. It is the only species of *Andryala* found so far north, the other species occurring in the Mediterranean basin. It appears to be a Tertiary relict.

In the wild it seems to only reproduce vegetatively, by detached buds forming new rosettes. No mature fruits with viable seeds have been found.

DESCRIPTION Perennial herb with a woody, often branched stock, covered with the persistent bases of leaf stalks, forming many rosettes. Basal leaves numerous, 10-100 x 10-25 mm, nearly rounded to obovate or broadly elliptical, densely covered by both unbranched and stellate, woolly

hairs, tapering at the base into a winged leaf stalk. Stems 6-20 cm, clothed similar to the leaves, with 1-4 small linear leaves and bearing 1 (or rarely 2) flower-heads 15-20 mm across, each with an involucre of hairy lanceolate bracts and yellow ray florets, the rays divided into 5-7 hair-like segments at the tip. Achenes c. 1.5 mm, obconical, with a 2-rimmed disc at the apex, the pappus exceeding the corolla tube; receptacle with fringed scales enfolding the florets. When discovered, it was assigned to a new genus, *Pietrosia*, by Nyárády. However, Sell in Flora Europaea (1976) assigns it to the Mediterranean genus *Andryala*.

For illustrations see (1), (2) and (5) and for a popular account see (3).

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The material for this sheet was supplied by Dr G. Dihoru (of the Institute of Biological Sciences, Bucharest), to whom the TPC is most grateful. Help with taxonomic details from Mr P.D. Sell, University of Cambridge, is also gratefully acknowledged.

COMPOSITAE

STATUS Endangered, due to continual collecting. The species was once common in the plant community which covers the upper part of the Sierra Nevada. Over several decades, the leaves and inflorescences of the plant became more and more popular as an ingredient of 'Artemisia Tea' and even for alcoholic drinks. By 1942 a kilogram of fresh material was worth 3,500 pesetas. Today the plant is extremely difficult to find, but there is still a strong desire to collect it and it is not legally protected.

DISTRIBUTION Spain; in the Sierra Nevada, restricted to altitudes above 3200 m (4), a potential range of no more than 6 sq. km.

More than 60% of the plant species occurring in this area are endemic to Spain and a high proportion are confined to the Sierra Nevada. Touristic development is a major threat, as is overgrazing by sheep and goats. Protection measures have enabled the feral goat population to increase and the number of sheep has not been correspondingly reduced.

HABITAT AND ECOLOGY It grows on acid schists at 3200 m or above. It is accompanied by many other endemics such as *Chaenorhinum glareosum* (Boiss.) Willk., *Ptilotrichum purpureum* (Lag. & J.D.Rodriguez) Boiss., *Saxifraga nevadensis* Boiss., *Sempervivum nevadense* Wale and *Viola crassiuscula* Bory.

CONSERVATION MEASURES TAKEN Some small reserves are maintained in the area by the staff of the University of Granada (4), but they are sometimes discovered by collectors. A small amount of seed is stored in the seed bank of the Universidad Politécnica in Madrid (but see below), and some re-introduction experiments are being carried out by Drs E. Hernández-Bermejo and H. Sainz-Ollero.

CONSERVATION MEASURES PROPOSED Both the number and size of the existing reserves should be increased and, if possible, the degree of protection afforded to the species improved. It is likely that if plant collecting could be stopped, the plant would be able to fully re-establish itself in a few decades.

Cultivation should be strongly encouraged, to take the pressure off the wild population. The storage of larger amounts of seed in the seed bank is desirable.

BIOLOGY AND POTENTIAL VALUE The very success of this plant as a constituent of drinkable infusions has been the cause of its near extinction. In the wild it can reproduce vegetatively but seed production

appears to be very poor and so only very small samples of seed have been put into the seed bank.

CULTIVATION This is a difficult species to grow, especially in respect of seed production.

DESCRIPTION Densely cushion-shaped, silvery-silky perennial up to 18 cm; leaves stalked, divided into up to 5, 3-fid segments, the lobes narrowly linear. Flower-heads solitary or in a terminal cluster, broadly hemispherical, 4-7 mm or more across, with up to 80 very small florets; involucral bracts ovate-lanceolate, acute, the centre often reddish; corolla dark purplish, the lobes with dense short hairs (Flora Europaea).

For illustrations see (2), (3) and (4).

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The material for this sheet was supplied by Professor C. Gómez-Campo (of the Universidad Politécnica, Escuela Tecnica Superior de Ingenieros Agronomos, Madrid), to whom the TPC is most grateful.

COMPOSITAE

STATUS Rare or possibly Endangered; the entire population is restricted to two small islands in the South Pacific. Goats were apparently introduced on to the larger island (Henderson) about 25 years ago but due to lack of fresh water it is not certain whether or not they have survived. If they have, the *Bidens* is likely to be Endangered.

DISTRIBUTION Henderson Island and Oeno Atoll, both in the Pitcairn Island District, Pacific Ocean. Var. *hendersonensis* and var. *subspathulata* Sherff are confined to Henderson Island; var. *oenoensis* Sherff is confined to the islets of Oeno Atoll where only a few individuals were found by St. John and Fosberg on a visit in 1934.

Henderson Island (24° 22' S., 128° 20' W.) is a raised coral island of about 30 sq. km. There is no fresh water on the island and the only regular visits are by Pitcairn islanders to collect timber of Sandalwood, *Santalum hendersonense* Forest Brown, and "milo", *Thespesia populnea* (L.) Solander ex Corr., which are used for carving. In 1934 St. John and Fosberg found the low forest vegetation was little disturbed by man. The flora contains 55 angiosperms of which 10 are endemic (3).

Oeno Atoll (24° 00' S., 130° 40' W.) is about 4 km across and rises to only 3.6 m above sea-level. It is also uninhabited. "The principal islet ... originally supported a vegetation with shrub thickets and trees. Later, part of the islet was exploited, and in 1902 planted to coconuts. This plantation was infrequently visited by people from the Gambier Is. Other parts of the islets were undisturbed. It was the impression of the collectors that the flora was well preserved". The flora contains 15 angiosperms of which one species, *Pandanus feruliferus* St. John, is endemic (2).

HABITAT AND ECOLOGY On Henderson Island it occurs in the dense forest of small trees about 5-10 m high which covers the deeply fissured, flat top of the island at about 3 m above sea-level. Undergrowth is sparse (3).

CONSERVATION MEASURES TAKEN None.

CONSERVATION MEASURES PROPOSED That Henderson Island be declared a nature reserve to protect this species and 9 other endemic plants as well as the unique but fragile ecosystem of what is probably the nearest to an untouched raised coral island that exists today.

BIOLOGY AND POTENTIAL VALUE The species is pollinated by short-tongued insects and judging by its local abundance, regeneration must be satisfactory. It is of considerable scientific interest as being not only

the most arborescent species in the large and predominantly herbaceous genus *Bidens*, but also the most geographically isolated of the woody *Campylotheca* section.

DESCRIPTION Shrub or small tree c. 4 m high, the stem c. 2.5 cm thick at the base and with pale brown bark. Leaves oblong-ovate, shallowly toothed, 5-8 cm long. Flower-heads numerous, on slender stalks mostly 1-4 cm long, forming large, loose, more or less flat-topped panicles. Each head c. 1 cm across by c. 7 mm long, with about 5 yellow rays. Fruits dry, black, single-seeded, 7-10 mm long by c. 1 mm wide (4).

Var. *subspathulata* Sherff differs from the above by its laxer panicles and its slightly differently shaped leaves (subspathulate). Var. *oenoensis* Sherff differs by its smaller size (1-3 m), smaller panicles of only 3-5 flower-heads but larger leaves (7-13 cm long)(4).

For illustrations see (4).

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The TPC is most grateful to Dr F.R. Fosberg (of the Smithsonian Institution, Washington, D.C.), for help in producing this sheet.

COMPOSITAE

STATUS Vulnerable. Two variants of this species are known; the original one is restricted to a single small island in the east Mediterranean, where it occurred in reasonably large numbers in 1962 when the island vegetation was a luxuriant low scrub (phrygana) after grazing had been forbidden for at least 10 years, following the establishment of the island as a nature reserve. However, in recent years, the introduction of the Cretan Ibex to the reserve and its subsequent rapid increase in numbers had, by 1973, reduced the population of *Carlina diae* to 3 individuals at the main locality, surviving on inaccessible sites on overhanging rock-faces. Several more may still exist in the cliff systems on the east side of the island, but the population is obviously Endangered.

The second variant is restricted to 2 small islands and 2 coastal localities. Although not at present Endangered, it is Vulnerable owing to the low number of individuals in each population (a single tuft in one instance) and owing to the grazing by goats brought on to the islands.

DISTRIBUTION Crete. The original variant is confined to Nisos Dia, an island measuring c. 4 x 4 km off the north coast, near Iráklion. The second, originally described as *Lyrolepis piae* Nordenstam (3), occurs in Sitía district of north east Crete, on the islets of Dragonáda and Gianisáda, and on 2 points of the Sidheros peninsula (1).

HABITAT AND ECOLOGY In crevices of steep calcareous rocks close to the sea (3), together with *Asperula tournefortii* Sieber ex Sprengel, *Muscari dionysicum* Rech. f., *Campanula creutzburgii* Greuter and other rare endemics.

CONSERVATION MEASURES TAKEN In 1938 the Dia Island Reserve was established, covering 1200 ha. The island is totally protected, uninhabited and closed to visitors. In about 1958 or just before, a breeding population of the Cretan Ibex, *Capra aegagrus cretensis*, was introduced from the Lefká Ori (White Mountains) of Crete where its population was threatened.

CONSERVATION MEASURES PROPOSED The Cretan Ibex should be moved from Dia on to another island where there are no endemic plants; possibly some could now be moved back to the Lefká Ori. Grazing by goats should be prevented on Dragonáda and Gianisáda. Consideration should be given to protecting the other localities where the species occurs.

BIOLOGY AND POTENTIAL VALUE It is a Tertiary relict of considerable scientific value; it belongs to the small, primitive sub-genus

Lyrolepis which is believed to "represent an ancient type as compared to (the rest of the genus) *Carlina*" (3). Like several other plants confined to rock-crevice communities it provides a model for studying the variational and evolutionary patterns in systems of small isolated populations (5). As a small shrub covered in white felt but bearing bright yellow flower-heads with decorative, radiating bracts it would look well in a rock-garden, but like many coastal plants from the Mediterranean it might not be easy to cultivate. More information is needed.

DESCRIPTION Densely white-felted dwarf shrub lacking spines, with a much-branched, woody stock bearing numerous, short, non-flowering branches densely crowded with entire lanceolate leaves 5-8 cm long. Flowering stems sparsely leafy, erect, 40-60 cm high, each with a small, flat-topped cluster of 1-4 flower-heads, each 15-35 mm across, with several rows of bracts, the outer leaf-like and 10-15 mm long, entire or with a few small lobes, and the inner, in contrast, bright yellow, shining, rigid and scarious, radiating 10-16 mm; these enclose a mass of tubular disc florets with yellow corollas and straw-coloured, feathery pappus (Flora Europaea).

For line drawings see (3) and (4).

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This sheet is based upon information provided by Dr W. Greuter (of the Conservatoire Botanique, Geneva), to whom the TPC is most grateful. Help is also acknowledged from Professor K.H. Rechinger of the Naturhistorisches Museum, Vienna.

COMPOSITAE

STATUS Rare. Only one population is known, consisting probably of several thousand individuals, confined to a single gorge. A tramway passes through the site and in the past this must have disturbed the population, but the ground has since been re-colonised. Collecting of the plants for cultivation and of the flowers may also have had some impact and could, in future, eliminate the species from accessible sites, as could widening of the present access track which follows the old tramway. Animal browsing does not seem to have affected its abundance.

An area nearby, at the confluence of Charming Creek and the Ngakawau River, has been proposed as the site for a thermal power station, but this is unlikely to proceed. If it does, flooding, road-making and disturbance during construction would have serious effects on the population.

DISTRIBUTION New Zealand; in part of the gorge of the Ngakawau River, Nelson, South Island. In the past it has also been reported from the lower Buller River, Nelson.

HABITAT AND ECOLOGY This is a species of rocky sites and is more or less confined to damp, nearly vertical rock faces and peaty soil. Most of the population is on cliffs near the level of the river. Although adjacent to dense forest, it does not occur beneath the tree canopy. Young plants are particularly frequent along the route of the old tramway passing through the site. The species is associated with a wide range of cliff species.

CONSERVATION MEASURES TAKEN The site has been well documented during a course of visits in 1974 and 1975.

CONSERVATION MEASURES PROPOSED The lower part of the Ngakawau River (downstream of Charming Creek), which would include much of the plant's known range, has been proposed as a Scenic Reserve. The upper part has been proposed for a New Zealand Forest Service Biological Reserve; the species probably occurs here also, but has not been searched for - the gorge is extremely difficult of access. As recommended by Given:- "A search should be made of the upper part of the Ngakawau River (and elsewhere) ... for further records of this species. If the lower Ngakawau River can be secured as a reserve from rim to rim of the gorge the *Celmisia* will be well protected although periodic monitoring will still have to be undertaken" (3).

BIOLOGY AND POTENTIAL VALUE It is an attractive species with considerable horticultural merit.

CULTIVATION This is a moderately easily grown species now cultivated at DSIR, Lincoln, and in several private and botanic gardens.

DESCRIPTION Small to rather large tufted herb, with numerous long-stalked leaves up to 45 cm long; blade narrowly lanceolate, the lower surface white tomentose hairy; leaf-stalk ribbed, widening into a long, softly hairy sheath. Stems slender, up to 35 cm long, also hairy, bearing flower-heads c. 3 cm across; bracts numerous, narrowly linear, ascending, tomentose; ray florets numerous, presumably white, c. 25 mm long; disc florets presumably yellow, c. 7-10 mm long (1,2).

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This sheet has been compiled from the 1977 account in (3) of *Celmisia morganii* by Dr D.R. Given, to whom the TPC is most grateful.

COMPOSITAE

STATUS Rare. Only about 5 populations are known, each of usually about 100 or more individuals. One population of several thousand individuals was recorded in about 1964. The only threat in the future would appear to be collecting. Although the area where the species occurs has suffered from high numbers of introduced herbivores and resulting erosion, the known populations are unlikely to have been greatly disturbed. Moreover the animals are now declining as a result of remedial action and the area is thought to be no longer under heavy grazing pressure.

DISTRIBUTION New Zealand; confined to one small area in the Eyre Mountains, Southland, South Island, on the south side of Lake Wakatipu opposite Queenstown.

HABITAT AND ECOLOGY Virtually restricted to crevices and ledges on steep rocky bluffs and ridges, at 900-1800 m (1), at one locality including well-drained rocky shutes with little or no soil. Associated plants include *Celmisia densiflora* Hook.f., *C. ramulosa* Hook.f., *Hebe biggarii* Cockayne, *Helichrysum selago* (Hook.f.) Benth. & Hook.f. and *Raoulia buchananii* T.Kirk. The species has not been found in grassland or on unstable rocky outcrops or on screes (1).

CONSERVATION MEASURES TAKEN The numbers of herbivores in the area, chiefly Red Deer (*Cervus elaphus*) and Chamois (*Rupicapra rupicapra*), are declining under New Zealand Forest Service management. The natural range of this rare shrub has now been mapped in detail.

CONSERVATION MEASURES PROPOSED As recommended by Given:- "Periodic monitoring should continue and consideration be given to the eventual reservation of the head of Eyre Creek ... The valleys adjacent to Eyre Creek should be searched for possible extensions to the natural range of the species". Collecting should be discouraged (2).

BIOLOGY AND POTENTIAL VALUE A plant of outstanding horticultural merit which is already becoming known in gardens of New Zealand and the U.K., this is a very distinct species taxonomically, belonging to the subgenus *Lignosae*, and is unlikely to be confused with any other known species of *Celmisia*. The tight cushion habit is similar to that of *C. argentea* T.Kirk and *C. clavata* G.Simpson & J.S. Thompson, of subgenus *Celmisia* (1).

CULTIVATION The species is in cultivation. It can be propagated from cuttings or from seed. It may prove to be one of the easier species of *Celmisia* to grow in the rock garden.

DESCRIPTION Dwarf shrub with stout branchlets, forming a more or less hemispherical cushion up to 70 cm across. Leaves imbricating, with linear-oblong blades 1.5-2.5 cm long, the margin strongly recurved, glandular-hairy above, densely white-felted below. Flower-stalks up to 8 cm long with several linear bracts; involucral bracts straight, in several series; ray florets white, up to 2.5 cm long; disc florets yellow, narrowly funnel-shaped. Achene 4-5 x 0.8 mm, compressed, densely clad in long bifid hairs (1).

For an illustration see (1).

REFERENCES 1. Given, D.R. (1971). Two New Species of *Celmisia* Cass. (*Compositae-Astereae*). N.Z. Jl Bot. 9: 529-532.
2. Given, D.R. (1976). Threatened Plants of New Zealand. Mim. limited edition. Botany Division, DSIR, New Zealand.
3. Mark, A.F. & Adams, N.M. (1973). New Zealand Alpine Plants. Wellington.

This sheet has been compiled from the account in (2) of *Celmisia philocremna* by Dr D.R. Given, to whom the TPC is most grateful.

COMPOSITAE

STATUS Endangered; a species only known from a single population in the low hundreds, on an isolated rock surrounded by recent lava from an active volcano c. 1 km away; this erupted last in 1971 and volcanic cinders landed on the rock. Although neither the site nor the species are believed to be threatened by man in any way, the rock will almost certainly become deluged by lava at some stage and the species will become extinct in the wild.

DISTRIBUTION Canary Islands. The single locality is in the extreme south of La Palma, close to the Volcan de Teneguia. There are no records of a wider distribution on the island.

Out of 33 species of flowering plants endemic to La Palma, 8 are Endangered, 6 are Vulnerable and 10 are Rare.

HABITAT AND ECOLOGY It grows in rock crevices of Tertiary basalt in the coastal zone, facing the sea, at c. 300 m. The site is isolated, being surrounded by dry and desolate lava poor in plant species.

CONSERVATION MEASURES TAKEN None for the wild population. Many of the threatened Canarian endemics, including this one, are in cultivation under semi-natural conditions at the Jardín Botánico Viera y Clavijo on Gran Canaria. A seed bank for threatened Macaronesian and Iberian species has recently been set up at the Universidad Politécnica, Madrid.

CONSERVATION MEASURES PROPOSED The species should be made more widespread in cultivation.

BIOLOGY AND POTENTIAL VALUE It sets seed freely. The compact growth and long succession of pale mauve flowers from June to October should recommend it for horticulture.

CULTIVATION It is in cultivation and likely to be easily grown from seed.

DESCRIPTION Woody perennial with numerous stems 30-100 cm high. Lower leaves 10-15 cm long, glandular viscid, pinnately lobed or entire, the lobes lanceolate, obtuse, irregularly toothed. Flower-heads terminal on the branches, 25-45 mm across, with a broad ovoid involucre of olive green bracts each with a yellow grey, scaly, toothed appendage; florets pale mauve, densely crowded, tubular. Achenes 4 mm long, with white pappus which soon falls (1,2).

For illustrations see (1) and (2).

REFERENCES 1. Bramwell, D. & Z.I. (1974). Wild Flowers of the Canary Islands. Stanley Thornes, London. Pp. 28, 220, fig. 297.
2. Sventenius, E.R.S. (1946). Contribución al conocimiento de la Flora Canaria. Inst. Nac. Invest. Agron., Madrid, cuad. 79: 175-180.

The TPC is most grateful to Dr D. Bramwell, of the Jardín Botánico Viera y Clavijo, Gran Canaria, for help in producing this sheet.

COMPOSITAE

STATUS Rare; an Alpine endemic which is only known from a specialised habitat in a small region. Widder was originally of the opinion that although the plant is readily grazed by cattle, its rarity is due more to its requirement for light and intolerance of competition (2). However in (4) he gives photographs of one locality both in 1929 and 1954, the former showing a flowering of locally abundant *Doronicum*, the latter a greatly reduced population of dwarfed individuals. He estimated that the most important factor in this observed decline over 25 years was the increase in grazing by cattle (4). When the species was first discovered, several small populations in places easily accessible also declined as a result of collecting by gardeners and others; however the plant is now fully protected by law in the greater part of its range.

DISTRIBUTION Austria. It occurs on the Koralpe, a small area in the eastern central Alps, south west of Graz. A detailed discussion of the change in population size of rare and endemic species in the Koralpe, and of vegetation changes, is given by Widder in (4).

Out of 33 species and subspecies of flowering plants endemic to Austria, 7 are believed to be Rare and one Vulnerable.

HABITAT AND ECOLOGY "Stream-sides and other shady places, 1250-2000 m" (Flora Europaea). A locality described in detail by Widder is at 1700-1800 m, where a mountain stream runs down a steep slope through blocks of gneiss, the hard acid rock of which the Koralpe is principally composed. The rhizomes of the *Doronicum* grow between the wet rocks. On either side is scrub of *Alnus viridus* (Chaix) DC. although the site is above the forest limit, here depressed by heavy grazing (2).

CONSERVATION MEASURES TAKEN Under 'Verordnung der Landesregierung vom 28 November 1972, Zahl Ro-267/13/1972', it is fully protected in the Bundesland of Kärnten. Removal of any part of the plant or of the plant itself is forbidden. Koralpe is on the border of Kärnten and Steiermark; according to the dot map in (1) about a third of the sites for the species are in Steiermark where it does not appear to be protected by law. However, an effective nature reserve for this species in Steiermark, as proposed by Widder 20 years ago, is now being considered.

CONSERVATION MEASURES PROPOSED To ensure the long-term survival of this species, a nature reserve covering one or more of its localities is essential. The boundaries and location of such a reserve should take into account the other rare and local species occurring in the region.

BIOLOGY AND POTENTIAL VALUE With its yellow heads of flowers, *D. cataractarum* is a handsome Alpine plant and one of the floristic attractions of the area. Widder considers it to be a Tertiary relict element in the Alpine flora, together with other interesting relict species to be found in the Koralpe area such as *Saxifraga paradoxa* Sternb. and *Waldsteinia ternata* (Stephan) Fritsch. Both the *Saxifraga* and the *Doronicum* are clearly separated taxonomically from other European species in their genera. The nearest relatives of the *Doronicum* are Asiatic species such as *D. macrophyllum* Fischer (2).

DESCRIPTION Herbaceous perennial arising from a rhizome with tufts of silky hairs. Basal leaves more or less hairless, heart-shaped, 15-20 x 10-18 cm, on long stalks. Stems up to 130 cm high, carrying 4-10 flower-heads each 4-7 (-10) cm across; stem leaves smaller and narrower than the basal leaves, sharply toothed. Heads composed of ray and disc florets, the rays yellow and glandular-hairy on the outside; involucral bracts about half as long as the rays. Achenes of 2 kinds, those of the rays usually hairless, those of the disc more or less glandular-hairy.

For illustrations see (1) and (4).

REFERENCES

1. Hegi, G. (1938). Illustrierte Flora von Mittel-Europa 6(2). J.F. Lehmanns Verlag, Munich. Pp. 715-717.
2. Widder, F. (1925). Eine neue Pflanze der Ostalpen-*Doronicum* (Subsectio *Macrophylla*) *cataractarum* - und ihre Verwandten. Reprium nov. Spec. Regni veg. 22: 113-184.
3. Widder, F. (1939). Offene Fragen um Endemiten des Alpen-Ostrandes. Ber. dt. bot. Ges. 57: 139-147.
4. Widder, F. (1955). Veränderungen in der Pflanzendecke der Koralpe innerhalb eines Vierteljahrhunderts. Jahrb. Ver. Schutze Alpenpflanzen-Tiere 20: 77-88.

The TPC is most grateful to Dr H. Niklfeld of the Botanical Institute and Botanic Garden, University of Vienna, for help in producing this sheet.

COMPOSITAE

STATUS Rare. It is only known from two populations, one in the *locus classicus* where in 1977 hundreds of individuals were found, and a second, also of several hundred individuals, discovered in 1977-8 some 7 km away. The species is not believed to be under any immediate threat, but is at risk because of its low population size and very restricted distribution.

DISTRIBUTION Swaziland. The *locus classicus* is a mountain north east of Mbabane.

HABITAT AND ECOLOGY In rocky grassland, at c. 1400 m. The climate is near temperate with between 100 and 230 cm of rain annually, mostly in the summer. Frost occurs during the winter months.

CONSERVATION MEASURES TAKEN None.

CONSERVATION MEASURES PROPOSED It should be brought into cultivation. Seed should be gathered and sent in particular to the Botanical Research Institute in Pretoria, South Africa.

BIOLOGY AND POTENTIAL VALUE This species is an attractive shrub flowering in March to April and could be of value as a potential horticultural plant.

DESCRIPTION "Small shrub, densely branched, up to 60 cm high. Leaves opposite or alternate, very numerous, slender, up to 2 cm long, half-erect, usually three-lobed above middle but some shorter and undivided. Flower-heads numerous, shortly stalked in irregular more or less flat-topped inflorescences; involucral bracts in 3-5 rows, c. 5 mm long ... Ray-florets five, female, expanded part c. 3 mm long, white, three-toothed, hairless. Disc-florets bisexual, corolla tubular, five-lobed ... Pappus absent" (2).

REFERENCES 1. Compton, R.H. (1967). Plantae Novae Africanae. Jl S. Afr. Bot. 33: 300.
2. Compton, R.H. (1976). The Flora of Swaziland. Jl S. Afr. Bot., Suppl. Vol. 11: 641.

The material for this sheet was supplied by Mrs E.S. Kemp (of the Swaziland National Herbarium, Mbabane), to whom the TPC is most grateful.

COMPOSITAE

STATUS Rare. Several populations are known, in one of which it was recorded in 1920 as in great quantities (4). It has since become depleted at some sites. In most places, however, it is safe from the threat of fire and of grazing by its preference for a steep, more or less rocky habitat. Future disturbance could result from clearing of the vegetation in such areas, and from the introduction of weeds or taller shading plants that would be likely to reduce the vigour and abundance of the species.

DISTRIBUTION New Zealand; in the basin of the Waimakariri River, Canterbury, South Island, especially in the region of the Broken, Thomas and Poulter Rivers. Its precise distribution, however, is not known.

HABITAT AND ECOLOGY Recorded as growing on grassy slopes, cliffs and among scrub plants. It was described by Wall as "a strong climber ... (with) a lusty, thriving appearance, and the branches grow in great profusion and are most thickly massed together" (4). Associated species include *Coprosma propingua* Cunn., *Corokia cotoneaster* Raoul, *Discaria toumatou* Raoul and *Helichrysum filicaule* Hook.f.

CONSERVATION MEASURES TAKEN None.

CONSERVATION MEASURES PROPOSED As recommended by Given:- "Sites from which it has been recorded in the past should be revisited to determine the number and vigour of plants. Other likely spots should be searched. Provision of a reserve in the Waimakariri Valley between the Poulter and Broken River confluences should be considered not just for preservation of this species but also to preserve the distinctive scrub vegetation of the region" (3).

BIOLOGY AND POTENTIAL VALUE It is of interest as it differs from all other New Zealand species of *Helichrysum* by being a climber. Wall in (4) suggested that it had originated as a hybrid between *H. depressum* (Hook.f.) Benth. & Hook.f. and *H. filicaule*, but Allan in (1) notes that tests have shown the progeny comes true from seed.

CULTIVATION The species has been in cultivation at the Otari Plant Museum, Wellington.

DESCRIPTION Liane or climbing plant up to 8 m, with a stout woody base, sparingly branched below but with numerous, slender, flexible branches above. Juvenile and shade leaves spreading, up to 5 x 2 mm, ovate-oblong, white-tomentose below; leaves of ultimate branchlets imbricate, appressed, linear-lanceolate, c. 3 x 1 mm, also white-tomentose. Flower-heads terminal, very small, up to 9 mm long by 3.5 mm

across, each with 15-25 florets surrounded by a nearly cylindrical involucre of small bracts (1,2).

REFERENCES
1. Allan, H.H. (1961). Flora of New Zealand I. Government Printer, Wellington. Pp. 717-718, 721.
2. Cockayne, L. (1915). Some New Species of New Zealand Flowering-plants. Trans. N.Z. Inst. 47: 117.
3. Given, D.R. (1976-7). Threatened Plants of New Zealand. Mim. limited edition. Botany Division, DSIR, New Zealand.
4. Wall, A. (1920). *Helichrysum dimorphum* Cockayne - a Hybrid? Trans. N.Z. Inst. 52: 106-107.

This sheet has been compiled from the 1977 account in (3) of *Helichrysum dimorphum* by Dr D.R. Given, to whom the TPC is most grateful.

COMPOSITAE

STATUS Vulnerable. It occurs in approximately 10 localities, the majority of which contain fewer than 500 individuals. Although on the island of Malta the area of available habitat has decreased, no decline in its population has been observed. The ovaries are parasitized by a moth larva and very few young plants are found in the natural habitat. On the smaller island of Gozo, however, Zahra, and more recently Lanfranco, have found the plant to be surviving, but much rarer than in 1927 as described by Borg (6).

DISTRIBUTION Malta; on cliffs along the southern coasts of the islands of Malta and Gozo.

HABITAT AND ECOLOGY In crevices on vertical, maritime cliff-faces, in particular in the Coralline Limestones (Oligocene and Miocene). It is accompanied by other shrubs such as *Hypericum aegypticum* L., *Coronilla valentina* L., *Sedum sediforme* (Jacq.) Pau and *Senecio bicolor* (Willd.) Tod. ssp. *cineraria* (DC.) Chater.

CONSERVATION MEASURES TAKEN As it is only found in Malta and as a result of its striking appearance, it was adopted as the island's 'National Plant' in 1971, when it was also depicted on a set of postage stamps. Consequently it has become moderately widespread in cultivation on the island.

CONSERVATION MEASURES PROPOSED Careful consideration should be given as to how best the natural habitat can be conserved and a study made of the means to control its parasite.

BIOLOGY AND POTENTIAL VALUE It is the only species in the genus and is presumably a relict of pre-glacial periods. Its affinities lie with *Centaurea*. Its study in conjunction with related genera should held to increase the understanding of this group.

CULTIVATION It can be propagated by cuttings or from seeds.

DESCRIPTION Hairless evergreen shrub, typically up to c. 1 m high. Leaves somewhat succulent, spathulate, entire, 5-10 x 1.5-2 cm, mostly in rosettes. Flower-heads 2-3 cm across, terminal, on long ridged stems, each with an involucre of entire bracts; florets all tubular, purple. Achenes 6-8 mm, hairless, exceeded in length by a whitish pappus. (Syn. *Centaurea crassifolia* Bertol., *Centaurea spathulata* Zerapha, non Ten.)

For illustrations see (2), (3), (4), (5) and (6).

REFERENCES

1. Borg, J. (1927). Descriptive Flora of the Maltese Islands. Government Printing Office, Malta. Pp. 611-612. (as *Centaurea crassifolia*).
2. Fiori, A. & Paoletti, G. (1933). Iconographia Florae Italicae, 3rd Ed. San Casciano. p. 461.
3. Haslam, S.M., Sell, P.D. & Wolseley, P.A. (1977). A Flora of the Maltese Islands. Malta University Press, Msida. p. 344, pl. 48. (as *Centaurea crassifolia*).
4. Lanfranco, E. (1974). Wild Succulents in Malta. Kakti u Sukkulenti Ohra 17: 12-26.
5. Lanfranco, G.G. (1969, 1977). Field guide to the wild flowers of Malta. Malta. p. 46, pl. 38. (as *Centaurea spathulata*).
6. Zahra, R. (1975). A succulent from the Maltese Islands. Ashingtonia 2: 48-49, 58-59.

The material for this sheet was supplied by Mr E. Lanfranco, of the ICBP Malta, to whom the TPC is most grateful.

COMPOSITAE

STATUS Rare; a perennial herb with a restricted distribution, known only from a few localities in a single National Park. One of the major populations occurs at a look-out much visited by tourists for its magnificent views.

DISTRIBUTION Australia; known only from the Lamington National Park, McPherson Range, in the Moreton pastoral district, on the Queensland/New South Wales border not far inland.

HABITAT AND ECOLOGY It occurs in two different situations. It was first found on exposed faces of scarps on the upper slopes of the range at altitudes of c. 1100 m. The plants grow with their roots in soil and organic matter caught in the crevices. The vegetation up to the edge of the scarps and on associated back slopes is *Nothofagus* closed forest. More recently the plant has been found in a drier situation also in the Park and at an altitude of c. 1000 m, namely open Eucalyptus forests, relatively exposed and with a south westerly aspect. The soil is shallow and of basaltic origin. The climate is temperate with an average annual rainfall of approximately 1600 mm, half falling from December to March. The hottest month (January) has a mean temperature of 26° C. and the coldest month (July) a mean minimum of 8° C.

CONSERVATION MEASURES TAKEN The creation of the Lamington National Park (19,792 ha) has provided protection for all known populations of the plant.

CONSERVATION MEASURES PROPOSED None.

BIOLOGY AND POTENTIAL VALUE It is worthy of cultivation and a potential garden plant. Because of its very restricted range, it is also of some scientific interest.

CULTIVATION It is in cultivation in the Canberra Botanic Gardens, A.C.T.

DESCRIPTION Perennial herb with prostrate woody stems, bearing rosettes of ovate to obovate leaves up to 21 cm long. Upper surface of leaves sparsely tuberculate, lower surface lanate. From the rosettes emerge erect leafy flowering stems 20-50 cm high, with 1-10 flower-heads; stem leaves similar to the rosette leaves but clasping the stem at their base and the uppermost ones becoming linear. Flower-heads each with an involucre of bracts up to 2 cm long by 2.5 cm broad, c. 170 yellow disc florets and c. 30 yellow rays 2-3 cm long. Achenes straight or slightly curved, brown, 2.5-3.2 mm long by 0.8 mm broad (1).

For an illustration see (1).

REFERENCE 1. Henderson, R.J.F. (1969). *Podolepis monticola*, a new Species of *Compositae* from Queensland. Contr. Qd Herb. No. 2.

The material for this sheet was supplied by Mr D.E. Boyland (of the Queensland Herbarium, Brisbane), to whom the TPC is most grateful.

COMPOSITAE

STATUS Rare; one of a small group of endemic species from the Queen Charlotte Islands, related to more southern North American floristic elements (2).

DISTRIBUTION Canada; restricted to the mountainous regions of Graham Island and Moresby Island, Queen Charlotte Islands, British Columbia. For a map of its distribution see (2) and for an account of rare and threatened plants on the islands see (3).

HABITAT AND ECOLOGY It is best developed on open, rocky and boggy mountainous slopes along the west coast, being particularly common on the open heath and rock talus slopes of the Takakia Lake alpine region (2).

CONSERVATION MEASURES TAKEN The Vladimir J. Krajina Ecological Reserve situated on the west coast of Graham Island will afford a degree of protection to this endemic species (4).

CONSERVATION MEASURES PROPOSED None on record.

BIOLOGY AND POTENTIAL VALUE The existence of *Senecio newcombei* and of other endemic species, *Isopyrum savilei* Calder & R.L.Taylor, *Ligusticum calderi* Mathias & Constance, *Saxifraga taylori* Calder & Savile, has been advanced to support the presence of a refugia during the last glaciation in the Queen Charlotte Islands (2). Consequently the species is of considerable interest in studies of plant geography.

DESCRIPTION Small slender herbaceous perennial 10-20 cm or more tall, hairless or lightly soft-hairy especially in and near the axils of the lower leaves; stems arising singly from a thickened woody base. Leaves thin, mostly basal on relatively long stalks; blades broadly ovate to nearly kidney-shaped, conspicuously 3-7 lobed or toothed, cordate or truncate at the base, 1-2 cm long by 1-2.5 cm wide. Flower-heads single, terminal with 8-12 ray florets, the ligule up to 15 mm long, yellow to orange-yellow (1).

For a line drawing and colour photograph see (2).

REFERENCES 1. Barkley, T.M. (1962). A Revision of *Senecio aureus* Linn. and Allied Species. Trans. Kansas Acad. Sci. 65: 388-389.

2. Calder, J.A. & Taylor, R.L. (1968). Flora of the Queen Charlotte Islands. Part 1. Systematics of the vascular plants. Research Branch, Canada Department of Agriculture, Ottawa. Monograph 4(1). Pp. 543-546, 617.

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4. Krajina, V.J., Larkin, P.A., Foster, J.B. & Pearson, D.F. (1974). Ecological Reserves in British Columbia. Canadian Committee for the International Biological Programme. Conservation of Terrestrial Communities Subcommittee (CCIBP-CT). Region 1: British Columbia. Vancouver.

The material for this sheet was supplied by Dr R.V. Maher (of the Rare and Endangered Plants Project, National Museum of Natural Sciences, Ottawa), to whom the TPC is most grateful.

CRASSULACEAE

STATUS Vulnerable; an attractive succulent which has declined due to clearing of its habitat for agriculture, to grazing particularly by goats, and to over-collection for horticultural use. Although frequent in places, it only occurs in a few localities (1). In the 1920s Praeger found it to be locally abundant and saw several very large colonies (3), one of which could not be found in 1977, despite a careful search.

DISTRIBUTION Canary Islands; sporadically around the north coast of La Palma.

Out of 33 species of flowering plants endemic to La Palma, 8 are Endangered, 6 are Vulnerable and 10 are Rare.

HABITAT AND ECOLOGY On south-facing basalt cliffs and rocks at 120-800 m, associated with *Euphorbia canariensis* L. and *Kleinia neriifolia* Haw. This coastal vegetation is one of the most threatened vegetation types in the Canaries and is not covered by any reserves. The area where *A. nobile* occurs is also one of the local centres of diversity for the genus *Aeonium*; some degree of protection for the localities is therefore highly desirable.

CONSERVATION MEASURES TAKEN None for the wild populations. Many of the threatened Canarian endemics, including this one, are in cultivation under semi-natural conditions at the Jardín Botánico Viera y Clavijo on Gran Canaria. A seed bank for threatened Macaronesian and Iberian species has recently been set up at the Universidad Politécnica, Madrid.

CONSERVATION MEASURES PROPOSED Some of the localities should be protected either by an extension down towards the coast of the Taburiente National Park or by a local nature reserve, to cover both *A. nobile* and the other *Aeonium* species on La Palma, all of which grow in the area.

BIOLOGY AND POTENTIAL VALUE Seed is produced in abundance. The plant is very striking with its large, thick leaves and magnificent red flowers, and is of great horticultural value. The genus *Aeonium* is remarkably diverse in the Canaries, with at least 31 species on the islands. *A. nobile* is the only species in the genus with red flowers.

CULTIVATION It can be raised from seed but it is very slow-growing and takes a minimum of 4 years to flower. It must then be replaced by seedlings.

DESCRIPTION Robust succulent herb which dies after flowering (strictly monocarpic), with a stout unbranched stem up to 60 cm high and 5 cm

thick, bearing a rosette of yellowish, red-tinged, very large, thick, fleshy leaves c. 30 x 15 x 1 cm thick in the middle, broadly obovate to nearly orbicular. Flowering stem up to 30 cm above the rosette, much branched, flat-topped, up to 60 cm across with numerous, copper to blood red flowers, each 12 mm across and with parts in sevens to nines; petals lanceolate, c. 4 mm long. Fruit of several small, pale red or red-streaked carpels. Praeger observed wild hybrids between this species and *A. ciliatum* (Willd.) Webb & Berthel. (3).

For illustrations see (1) and (4).

REFERENCES
1. Bramwell, D. & Z.I. (1974). Wild Flowers of the Canary Islands. Stanley Thornes, London. Pp. 30 & 145, fig. 159, cover illustr.
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The TPC is most grateful to Dr D. Bramwell, of the Jardín Botánico Viera y Clavijo, Gran Canaria, for help in producing this sheet.

CRASSULACEAE

STATUS Rare; an island endemic of very limited distribution. One population occurs within a National Park. Further populations may exist undiscovered on crater walls.

DISTRIBUTION Canary Islands; in the centre and north west of La Palma. Records for its presence on Tenerife refer to another species in the genus.

Out of 33 species of flowering plants endemic to La Palma, 8 are Endangered, 6 are Vulnerable and 10 Rare.

HABITAT AND ECOLOGY In damp shady places in gullies on volcanic rocks, in pine and laurel woods, up to 1600 m (3). As with other *Aichryson* species, it appears to depend on the water flow through the gullies in which it grows. A reduction in stream flow, following the great extension of agriculture during the last century and the destruction of most of the laurel forests on the island, may have considerably reduced its range and distribution.

CONSERVATION MEASURES TAKEN One locality, La Cumbrecita, with a reasonably large population, occurs in the Taburiente National Park. Many of the threatened Canarian endemics, including this one, are in cultivation under semi-natural conditions at the Jardín Botánico Viera y Clavijo on Gran Canaria. A seed bank for threatened Macaronesian and Iberian species has recently been set up at the Universidad Politécnica, Madrid.

CONSERVATION MEASURES PROPOSED It would be desirable if additional populations could be included in protected areas.

BIOLOGY AND POTENTIAL VALUE Seed set appears to be adequate in the wild. *Aichryson bollei* is potentially an attractive horticultural plant. The genus is confined to the islands of the Azores, Canaries and Madeira.

CULTIVATION As with other species of *Aichryson*, it can be raised without difficulty from seed and is in cultivation. In particular it is being grown and bulked up at the Royal Botanic Gardens, Kew, and the University Botanic Garden, Cambridge, U.K.

DESCRIPTION Annual or biennial 20-50 cm high, densely glandular-hairy. Leaves up to 5 cm long, spathulate, villous with whitish hairs and with conspicuous black glands on the leaf margins. Flowers in a broad cyme, with parts in eights; petals broadly lanceolate, acute, pale yellow (3,5). It is easily distinguished from all other *Aichryson* species by the combination of pale yellow flowers and black-dotted leaf margins.

For illustrations see (3) and (4).

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The TPC is most grateful to Dr D. Bramwell, of the Jardín Botánico Viera y Clavijo, Gran Canaria, for help in producing this sheet.

Dudleya traskiae (Rose) Moran

Santa Barbara Island Live-forever

CRASSULACEAE

STATUS Vulnerable. In 1974 it was believed to be extinct, the last sighting having been in 1968 (8). In 1975, due to the reduction in the population of introduced hares, several regenerating plants were rediscovered on the island. A year later, a population of a few hundred individuals was found growing on a vertical cliff which offered protection from grazing by the hares (7).

DISTRIBUTION U.S.A. It is known only from Santa Barbara Island, a small island of 259 ha off the coast of California (4).

HABITAT AND ECOLOGY The majority of the plants are on sea-cliffs, at c. 100 m.

CONSERVATION MEASURES TAKEN The native vegetation of Santa Barbara Island has been adversely affected by farming and sheep grazing, and by the large population of the introduced European hare. With the creation of the Channel Islands National Monument in 1938, Santa Barbara Island was placed under the protection of the U.S. National Park Service, and these practices were stopped. The Park Service is now in the process of eradicating the hares (2).

The species has been determined to be 'Endangered' under the Endangered Species Act of 1973 (9). The Act directs that no federally-funded activity shall jeopardise the existence of species once officially determined as 'Endangered' or 'Threatened', as defined by the Act.

CONSERVATION MEASURES PROPOSED The recovery of this species will depend on the continued efforts by the National Park Service to eradicate the hares.

BIOLOGY AND POTENTIAL VALUE The morphology of the flower, intermediate between *Dudleya* proper and *Stylophyllum*, suggests that *D. traskiae* has arisen from a hybrid between these two genera (5).

CULTIVATION The species is in limited cultivation, but its success is not certain.

DESCRIPTION Succulent perennial herb with a short branched stem c. 1-2 cm thick forming clumps with 20-100 heads. Rosette leaves 25-35, close-set and more or less erect, strap-shaped to more or less oblanceolate, 4-15 cm long. Stem leaves deltoid-ovate, pointed. Flowers in a flat-topped cluster on a stem 20-30 cm high; petals bright yellow, becoming slightly red-veined, 8-10.5 mm long, curving outwards in the upper half (4,6).

For illustrations see (3), (4) and (5).

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The material for this sheet was supplied by the Endangered Flora Project of the Smithsonian Institution, Washington, D.C., to whom the TPC is most grateful.

CRUCIFERAE

STATUS Vulnerable; a Balkan endemic of restricted distribution which is said to have decreased considerably in its principal locality (Šugarje) because of vegetational succession. Lack of grazing as a possible cause for this is discussed below. According to Strgar (4), collecting has also been a factor in its decline.

DISTRIBUTION Yugoslavia. It was discovered at Šugarje in Velebit, Croatia, by Degen in 1907 (1). It was observed there and in the immediate area over many years by Horvat, who published detailed studies of the plant communities in which *Degenia* grows (2). Later a second locality, Bačić Kuk, was discovered near Solin, north of the Šugarje region. The information about both these localities is summarised by Kušan (3).

Out of 135 species of angiosperms believed to be endemic to Yugoslavia, at least one is Endangered, 5 are Vulnerable and 84 Rare. Many of these Rare species are montane plants with very restricted distributions, but not known at present to be under any immediate threat. *Degenia* is not a typical case, as detailed information on the variation of its population size and its ecology is available over more than 40 years. It is possible that because of changes in agricultural practice, several of the many Yugoslav species at present listed as Rare could be in similar situations to *Degenia* and may be declining.

HABITAT AND ECOLOGY On open, windswept scree slopes at 1200-1300 m where closed plant communities cannot effectively colonise, growing with other rare scree-plants, especially *Bunium alpinum* Waldst. & Kit. and *Iberis pruitii* Tineo (*I. carnosa* Waldst. & Kit.). Horvat observed over several years the partial colonisation of the scree by grasses, sedges and especially the dwarf shrub, *Arctostaphylos uva-ursi* (L.) Sprengel; both he and (later) Kušan thought the *Degenia* population was being reduced by this competition. Kušan (3) suggested for the Bačić Kuk locality that the disappearance of cattle grazing might be responsible; Mayer confirms that Velebit limestone areas were formerly heavily grazed (by cattle and, earlier, sheep), and are now no longer grazed. It seems likely that the original habitat of naturally open scree was much enlarged by excessive grazing in the 19th Century. Mayer however thinks that natural factors, especially the strong cold winter wind ('bora'), are sufficient to keep the scree unstable and the vegetation-cover open.

CONSERVATION MEASURES TAKEN None, to wild populations, but see Cultivation, below.

CONSERVATION MEASURES PROPOSED The present watch on the two separate localities should be accompanied by continued observations of the

population size, so that the careful recording begun by Horvat can be used for comparison.

BIOLOGY AND POTENTIAL VALUE It is the only species of the genus *Degenia*; it is related to *Alyssum*, but is considered by Degen and Hayek to be sufficiently distinct to be separated at the generic level. Degen in (1) reviews its taxonomic position. It is easily cultivated and could therefore find a place in the rock-garden.

CULTIVATION The species is in cultivation in the Botanic Garden, Ljubljana, where its performance has been carefully studied. Propagating material is made available to other institutions to relieve the collecting pressure on the wild populations (4). Individual plants are not long-lived, but new plants can easily be raised from seed, which is freely produced and of high viability. Details on its successful cultivation at Ljubljana are given in (4).

DESCRIPTION Tufted perennial herb with a silvery-grey appearance caused by the dense covering of stellate hairs. Leaves linear-lanceolate, in basal rosettes. Flowering stems up to 10 cm, each bearing a flat-topped panicle of several flowers; sepals 4, 7-8 mm long, the 2 inner ones slightly pouched at the base; petals yellow, 4, c. 15 mm long, with long claws. Fruit an ellipsoidal silicula, 10-14 x 7-8 mm, splitting into 2 valves to leave a broad septum or partition (latiseptate), and containing 2 seeds.

For illustrations see (3) and Q. Bull. alp. Gdn Soc. 42(4): 271 (1974) and 43(4): 304 (1975).

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This sheet, drafted by Dr S.M. Walters, is based upon information provided by Professor E. Mayer (of the Institute of Botany, University of Ljubljana), to whom the TPC is most grateful.

CRUCIFERAE

STATUS Rare. Most of the 9 localities known for this small Alpine plant are within the Swiss National Park where it is protected. However, its population is small, scattered within an area of only 30 sq. km, and so the species must be considered as Rare.

DISTRIBUTION Switzerland; in the Engadine chain of the Dolomite mountains, north west to north of the Pass dal Fuorn (Ofenpass) between Piz Nuna and Piz Tavrü, two of the local peaks. A dot map showing its exact distribution is given in (4). *Draba ladina* is considered to be the only species of flowering plant endemic to Switzerland.

HABITAT AND ECOLOGY It forms dense tussocks up to 8 cm across, in clefts of dolomitic rock between 2600 and 3040 m, more rarely occurring on limestone scree. It is a characteristic species of the high alpine plant community of *Androsace helvetica* (L.) All. and *Draba tomentosa* Clairv., with *Arabis pumila* Jacq., *Saxifraga oppositifolia* L. and the lichen *Squamaria crassa* (2,4).

CONSERVATION MEASURES TAKEN Most of the localities are in parts of the Swiss National Park (16,887 ha) where access is not normally permitted. This species and all other cushion-forming alpine plants were accorded legal protection in Canton Graubunden by the law of 17 March 1963.

CONSERVATION MEASURES PROPOSED None.

BIOLOGY AND POTENTIAL VALUE The origin of this species is interesting; it is clearly related very closely to the *D. alpina* complex of species, all the members of which have an Arctic distribution. However, in a paper discussing the possible origin of *Draba dolomitica*, a new species, Buttler considers that morphological and cytological evidence may point to a similar allopolyploid origin for *Draba ladina* from *D. tomentosa* Clairv. and *D. aizoides* L., both of which are widespread species on the mountains of central and southern Europe (3).

DESCRIPTION Small tufted perennial with a thin branching underground rhizome producing several dense basal rosettes of lanceolate leaves up to 8 mm long, 3-5 times as long as broad, often somewhat fleshy. On the lower surface and margins of the leaves are scattered stellate and numerous simple hairs. Flowering stem arising from the rosette, unbranched and leafless, up to 5 cm high, bearing a terminal cluster of 1-4 flowers; sepals 4, 2-3 mm long, hairless; petals 4, 3-5 mm long, pale yellow. Fruit a silicula 5-9 mm long, 2-3 times as long as broad, mostly with a few short hairs (5).

For a small illustration see (5).

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The material for this sheet was supplied by Professor E. Landolt (of the Geobotanisches Institut, ETH, Zürich), to whom the TPC is most grateful.

CRUCIFERAE

STATUS Endangered. In 1975, there were an estimated 500-700 mature plants, of which the majority were restricted to a 2-3 km stretch of river canyon and the remainder to some rocks c. 2 km away. This represents a major decline since 1973 when the population was estimated at 1050-1100. The causes are uncertain, but it is clear that the species is at risk from collectors and from more intensive land use (nearby land has been recently sold for housing). A hydro-electric scheme in the area if implemented would extinguish the species (1).

DISTRIBUTION Spain; on the Sierra de Alcaraz in the south west of Albacete Province. A map of its distribution is given in (3).

Within the *Cruciferae, Hutera* belongs to the tribe *Brassiceae* which has its maximum variability in the western Mediterranean with 24 genera endemic to the region. The tribe has a high proportion of rare and threatened species like *Hutera rupestris* which occupy small and scattered areas (2).

HABITAT AND ECOLOGY Limestone cliffs of mountainous river canyons 50-100 m deep, at an altitude of 1040-1120 m. It grows on rocks with *Sanguisorba ancistroides* (Desf.) Ces., *Sarcocapnos baetica* (Boiss. & Reuter) Nyman, *Bryonia cretica* L. ssp. *dioica* (Jacq.) Tutin and *Calepina irregularis* (Asso) Thell. It seems to be competing with a species of *Sisymbrium* occupying the same niche elsewhere. Beneath the cliffs, the vegetation is typically Mediterranean with the prickly Kermes Oak, *Quercus coccifera* L.

CONSERVATION MEASURES TAKEN Re-introduction experiments are being carried out by Drs E. Hernández-Bermejo and H. Sainz-Ollero.

CONSERVATION MEASURES PROPOSED Consideration should be given to the creation of a local nature reserve for this species.

BIOLOGY AND POTENTIAL VALUE The seeds were once used to make mustard. Gómez-Campo's studies on the clinal variation of *Hutera* and *Rhynchosinapis* suggest that this plant is not a relict species, but is a recent invader of calcareous cliffs and is derived from acid-living ancestors of the Sierra de Morena quartzites and schists (3).

CULTIVATION Viable seed is being stored and preserved in the seed-bank of the Universidad Politécnica, Madrid (2).

DESCRIPTION Biennial 60-100 cm high with erect branched stems bearing, mainly towards the base, lyre-shaped, pinnately lobed leaves 10-20 cm long, silvery-silky when young and with a toothed undulating margin. Flowers in flat-topped racemes which greatly elongate in the fruiting

stage and are up to c. 20 cm long. Sepals 4, green; petals 4, pale yellow with darker veins, spreading and wedge-shaped, abruptly narrowed at the base. Fruit a silicula divided into a stalk-like lower segment 2-6 mm long and an obovoid inflated upper segment 12-20 mm long, spongy on the inside and capped by a pointed beak; seeds black, spherical, 4-7 in each segment.

For illustrations see (1) and (5).

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This sheet is based upon information provided by Professor C. Gómez-Campo (of the Universidad Politécnica, Escuela Tecnica Superior de Ingenieros Agronomos, Madrid), to whom the TPC is most grateful.

Glade Cress (genus name)

CRUCIFERAE

STATUS Vulnerable. Although this is one of the most widespread species in the genus *Leavenworthia*, it is considered a threatened species due to the steady destruction of its cedar glade habitat. Many glades were flooded by the Percy Priest Lake near Nashville and the glades in the immediately surrounding area are being destroyed as new houses are built (4,5).

DISTRIBUTION U.S.A. It occurs in the Central Basin of Tennessee to southern Kentucky, with one station in northern Alabama (3,6,7). The known sites, however, are largely concentrated within 6 counties in central Tennessee, an area extending about 120 km in a north-south direction and about 70 km from east to west (6). In Kentucky, the species is restricted to only two small populations, each less than 10 sq. m in size (2).

HABITAT AND ECOLOGY The genus *Leavenworthia* is highly adapted to the conditions found in most cedar glades; all but one of the 11 taxa in the genus are restricted to this habitat (6). Cedar glades are characterised by exposed limestone surfaces or expanses of gravel often surrounded by trees. *L. torulosa* is found in parts of the glades where the soil is extremely shallow (1-5 cm deep). The moisture content of this soil closely follows the rainfall, especially during the summer (1).

It is a winter annual, i.e. although the seeds are dispersed in May, germination is delayed until the autumn when the soil moisture is higher. Germination depends on temperature; seeds are quiescent when exposed to high temperatures but germinate in the cooler temperatures of autumn. "These germination-regulating mechanisms can be interpreted as ecological adaptations to the seasonally-arid glade habitat" (1).

CONSERVATION MEASURES TAKEN None.

CONSERVATION MEASURES PROPOSED Cedar glades, which occur most frequently in the Central Basin of Tennessee, are of great scientific importance for their unique flora, which includes many endemics. Quarterman (4) lists 13 of these endemics as rare and endangered due to the steady destruction of their habitat. It is imperative that a few of these cedar glade communities be preserved.

BIOLOGY AND POTENTIAL VALUE The study of endemic cedar glade plants such as *Leavenworthia* can provide insights into the evolutionary process. For example, this genus has followed the long-term trend towards a progressively drier and warmer climate by shifting its flowering time towards an earlier part of the season when sufficient moisture is

available for growth. There is also a trend towards self-compatibility in the genus - an adaptation which compensates for the lack of insect pollinators in the dull, rainy days of early spring. *L. torulosa* is self-compatible; on cloudy days the flower remains closed and the anthers are guided into the stigma as the filaments elongate (6).

DESCRIPTION Small, hairless, winter-annual; early leaves usually entire, mature leaves lyrately pinnately lobed, rosette-forming, 3-8 cm long. Early and mid-season flowers on erect stems 3-8 cm long, but later flowers borne on lateral decumbent branches; petals spathulate, 6-10 mm long, white to light lavender, occasionally deep lavender or yellow, indented at the tip. Fruit a linear siliqua, 1.5-3 cm long (6).

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Duck River Bladderpod

CRUCIFERAE

STATUS Vulnerable. Although abundant in most of its localities, it is vulnerable due to its restricted habitat along the flood-plains of rivers and streams (3,4). The Tennessee Valley Authority has already begun construction on the Columbia Dam on the Duck River which, if carried out, would reduce the habitat of *Lesquerella densipila* as well as affecting a number of rare and endangered mussel, fish and snail species (1).

DISTRIBUTION U.S.A. It is found in scattered sites along a 50 km section of the Duck River, in middle Tennessee. There are a few other sites along the headwaters of the Harpeth River, and along the west fork of the Stones River, both also in Tennessee. All these sites lie within a 40 km radius. In addition, there are a very few disjunct sites in northern Alabama and near the Alabama line in Tennessee (4,5).

HABITAT AND ECOLOGY It is restricted to limestone soils of the Central Basin of Middle Tennessee and Alabama. It grows in open glades or along river and stream bottoms which are subjected to spring flooding each year (4).

CONSERVATION MEASURES TAKEN It was proposed as 'Endangered' by the U.S. Department of the Interior, Fish and Wildlife Service, on 16 June 1976. The Endangered Species Act of 1973 directs that no federally-funded activity shall jeopardise the existence of species once officially determined as 'Endangered' or 'Threatened', as defined by the Act.

CONSERVATION MEASURES PROPOSED Formal determination as an 'Endangered' species and hence protection under the Act. The feasibility of protecting a few sites should be investigated.

BIOLOGY AND POTENTIAL VALUE The study of the genus *Lesquerella* provides insights into the migration of plants and their subsequent genetic modification, as described in a popular article in (2). The genus reaches its greatest diversity in the American Southwest, and the Tennessee species represent an eastern migration from Texas (2). Out of 69 species of *Lesquerella* ranging from the arctic to southern Mexico (5), 21 taxa appear on the Smithsonian's list of endangered and threatened species of the United States (6).

In the wild *L. densipila* hybridises readily with *L. stonensis* Rollins (also a threatened species) where their ranges come together at the divide of the east and west forks of the Stones River (4).

CULTIVATION Cultivation of this species has probably never been attempted.

DESCRIPTION Annual 10-40 cm high, the stems and foliage hairy (hirsute and/or pubescent with simple or branched trichomes). Basal leaves stalked, pinnately lobed, 4-8 cm long; stem leaves stalkless, auriculate, broadly ovate to oblong, 1-3 cm long, dentate to lobed. Terminal bud often inactive, and the fertile stems arising laterally from the basal leaf clusters, bearing terminal racemes 10-20 cm long of flowers on stalks 1-2 cm; petals 4, 6-8 mm long, yellow, broadly obovate with no clear differentiation into blade and claw. Fruit a silicula 3-5 mm long, nearly spherical to slightly broader than long, with persistent style (4,5).

For an illustration of the fruits see (4).

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The material for this sheet was supplied by the Endangered Flora Project of the Smithsonian Institution, Washington, D.C., to whom the TPC is most grateful.

Lundy Cabbage

CRUCIFERAE

STATUS Rare; an island endemic most of whose population is restricted to about 0.5 km of cliff (4). It is at risk due to the presence of sheep, goats and deer on the island. However sheep do not appear to touch it although they graze widely on the slopes favoured by the plant. The spread of bracken, *Pteridium aquilinum* (L.) Kuhn, and possibly of the introduced *Rhododendron ponticum* L., may constitute a threat. Unfortunately the area where the species occurs is also the part of the island visited by numerous tourists, but most of the population is not easily reached. The island's vegetation and flora are conserved and the plant's existence carefully monitored.

DISTRIBUTION United Kingdom. It is confined to Lundy Island, off the coast of north Devon. Although the island is only about 4 sq. km in size, the species occurs in the south east corner with a few outlying stations up to several km away on the east coast (4).

HABITAT AND ECOLOGY A marked calcifuge growing on east and south-facing slopes and sea-cliffs of Devonian shales and sandstones but also on granite (4). It occurs in the lee of the island where it is protected from the Atlantic gales and favours sheltered spots, such as gullies, where it is damp in winter but hot and sunny in summer (4). It has also been reported as colonising waste ground (Dr R.C. Welch, pers. comm.).

CONSERVATION MEASURES TAKEN Lundy Island is owned by the National Trust and managed by the Landmark Trust. The Lundy Field Society have undertaken detailed studies of the species and monitor the populations from year to year. At present a Conservation Plan for the island is being drawn up.

CONSERVATION MEASURES PROPOSED None.

BIOLOGY AND POTENTIAL VALUE As a close relative of domestic Brassicas, it is important that this plant is preserved as part of the gene-pool available for breeding. Two beetles with very restricted distributions, *Psylliodes luridipennis* Kutschem and *Ceutorhynchus contractus* (Marsh.) var. *pallipes* Crotch, occur on this plant. The former is endemic to Lundy Island and the latter is only known in Britain from St. Kilda and Lundy.

DESCRIPTION Perennial herb with a slender tap-root, forming at first a rosette of stalked, hairy, pinnately lobed leaves 15-30 cm long, the segments coarsely toothed. Flowering stems stout and erect, rising to 1 m, woody below and branching above, covered with downward spreading hairs and bearing a few stem leaves, and flat-topped clusters (which soon lengthen) each of about 20 flowers. Sepals 4, erect, 8 mm long;

petals 4, yellow, 16 mm long. Fruit a linear siliqua, 6-8 cm long by 3-4 mm broad, on a spreading stalk and ending in a flattened beak; seeds spherical, purplish black, finely reticulate.

For illustrations see (2), (3) and (5).

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This sheet is based upon information provided by Dr F.H. Perring and Miss L. Farrell (of the Biological Records Centre, Institute of Terrestrial Ecology), to whom the TPC is most grateful. Help is also acknowledged from Mrs E. Hubbard of the Lundy Field Society.

CRUCIFERAE

STATUS Endangered. It has recently been rediscovered in two localities, after not having been seen for many years despite extensive searches. It was originally known from only two other localities, one of which is now a Square within Madrid; the other, which is about 15 sq. km in size, has been planted with pines. In the latter all recent records are for the extremely similar *S. officinale* (L.) Scop., the Hedge Mustard, with which this species has often been confused.

DISTRIBUTION Spain. The two earlier, now apparently extinct localities are in and near Madrid. The two recent ones are in the south west of the Province of Madrid and between Ontígola and Castillejo in Toledo (4).

HABITAT AND ECOLOGY A weedy species characteristic of disturbed or arable habitats, growing with other annual weeds. On one of the recent sites it was found as a weed in a field of cereal. Both sites are on more or less saline soils, the semi-natural vegetation characteristic of which would be scrub with *Quercus rotundifolia* Lam. as a common plant.

CONSERVATION MEASURES TAKEN None for the wild populations. A small amount of viable seed is stored in the seed bank of the Universidad Politécnica, Madrid.

CONSERVATION MEASURES PROPOSED None on record.

BIOLOGY AND POTENTIAL VALUE It is of interest as a potential medicinal plant.

DESCRIPTION Weedy annual or biennial, branching at the base, up to 90 cm high, with a rosette of pinnately lobed or coarsely toothed, narrowly oblong leaves from which emerge slender stems bearing long, lax racemes of up to 50 minute flowers, each with 4 pale yellow petals c. 1.5 mm long. Fruit a narrow siliqua 7-10 mm or more long, somewhat conical in shape, often slightly curved, tapering at the tip into the persistent style which is c. 1 mm long. (Syn. *Sisymbrium matritense* P.W.Ball & Heywood.)

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The TPC is most grateful to Professor C. Gómez-Campo (of the Universidad Politécnica, Escuela Tecnica Superior de Ingenieros Agronomos, Madrid), and to Dr E. Valdés-Bermejo (of the Instituto Botanico Cavanilles, Madrid), for help in producing this sheet.

Vella pseudocytisus L.

Shrubby Cress-rocket

CRUCIFERAE

STATUS Vulnerable; a small shrub only known from a few localities in two separate areas. The majority of the population occurs on a single farm. In parts of this locality the plant is abundant, in places even dominating the vegetation; in 1976 Gómez-Campo estimated there were 2000-3000 individuals over c. 3 sq. km of the site. It has virtually disappeared from the 3 other localities nearby due to destruction of the habitat. Collecting by botany students may have been a small contributory factor. In the other area from which is is known, only about 100 individuals were found in 1976, on 2 sites of 500 x 10-20 m, difficult of access for sheep and goats. In the past it was used for fuel, and in spite of its stiff hairs goats feed upon it.

DISTRIBUTION Spain. The main area is in Aranjuez Province south of Madrid; the other is in Teruel Province east of Madrid, where the species occurs as var. *badalii* (Pau) Heywood. It has been recorded from parts of south Spain, but a detailed search in 1976 failed to find it. Pasture-lands in this area have been reduced by about 85%-90% in the last 20 years since most of the land has been ploughed up and the hills planted with pines.

Within the *Cruciferae, Vella* belongs to the tribe *Brassiceae* which has its maximum variability in the western Mediterranean with 24 genera endemic to the region. The tribe has a high proportion of rare and threatened species like *Vella pseudocytisus* which occupy small and scattered areas (1).

HABITAT AND ECOLOGY The principal locality is the north-facing slope of a river terrace where it grows on soil derived from gypsum. The Teruel locality comprises two narrow strips of south-facing land along two parallel hills, where it grows on inclined rocks.

CONSERVATION MEASURES TAKEN The farm on which the majority of the population occurs is owned by the Patrimonio Nacional and is therefore conserved. It is not visited by the public. Viable seed of the species is being stored in the seed bank of the Universidad Politécnica, Madrid (1). Re-introduction experiments are being carried out by Drs E. Hernández-Bermejo and H. Sainz-Ollero, of the same institution.

CONSERVATION MEASURES PROPOSED Consideration should be given to the creation of a local nature reserve for this species.

BIOLOGY AND POTENTIAL VALUE It seems to have been cultivated more in the last century than today. Loudon writes that "it is a desirable shrub", due to its early and prolific flowering and that "on a mound of rockwork it would form a most ornamental bush" (3).

CULTIVATION It is easily propagated from cuttings of the young

wood and is in cultivation (3).

DESCRIPTION Small, much-branched, densely leafy shrub 60-70 cm or more high, the stems densely covered by very short, rigid hairs and by scattered longer hairs, and bearing stalkless, somewhat leathery, obovate leaves 1.5-2 cm long, with rough, bristly hairs on both sides. Flowers on short stalks (c. 2 mm), in long lax racemes up to 20 cm long, each flower with a tube of 4 sepals 6-8 mm long, from which protrude 4 yellow petals consisting of small rounded limbs 3-4 mm across on long thread-like claws about 10-12 mm long. Fruit a silicula divided into a lower, ellipsoidal section 3.5-4.5 mm long and an upper, more or less ovate beak, flat and blunt-tipped. Var. *badalii* (Pau) Heywood differs from the type variety by being hairless except on the leaf margins.

For illustrations see (5) and (6).

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This sheet is based upon information provided by Professor C. Gómez-Campo (of the Universidad Politécnica, Escuela Tecnica Superior de Ingenieros Agronomos, Madrid), to whom the TPC is most grateful.

Gamhen (local name); Cucumber Tree

CUCURBITACEAE

STATUS Vulnerable; an island endemic which was common in the past but is now greatly depleted because of exploitation of the tops for camel fodder and because of overgrazing by goats. In places regeneration is only possible under the protective cover of the common, succulent and densely bushy, endemic vine, *Cissus subaphylla* (Balf.f.) Planchon, which is one of the few plants left untouched by the goats.

DISTRIBUTION Socotra (an Island Territory of the People's Democratic Republic of Yemen, lying 225 km east of the Horn of Africa). It is widespread on the island, occurring in many of the limestone areas except in the east.

The flora of Socotra is critically threatened; out of 216 flowering plants endemic to Socotra and the neighbouring island of Abd al Kuri, 132 are believed to be rare or threatened, 85 of them in immediate danger of extinction (Endangered). This drastic situation is the result of grazing by excessive numbers of introduced livestock on an island flora which has presumably evolved partly in the absence of large mammals, unlike the flora of the African mainland.

HABITAT AND ECOLOGY It occurs mainly on rocky limestone slopes of scree and large boulders. It is most abundant on the slopes near the centre of the north coast where it grows within reach of the sea-spray. It is associated with the common endemic tree-Euphorbia, *E. arbuscula* Balf.f., and is usually surrounded by a wide range of small shrubs, perennials and annuals, many of which are endemic (3).

CONSERVATION MEASURES TAKEN None for the wild populations.

CONSERVATION MEASURES PROPOSED When selecting areas for reserves, care should be taken to include sites where *Dendrosicyos* occurs. Consideration should be given to regulating the exploitation of the tops as camel-fodder.

BIOLOGY AND POTENTIAL VALUE It is very much a botanical curiosity as it is the only arborescent member of the Cucumber family, the *Cucurbitaceae*. Its pollen is also distinctive and of interest. "The tree never attains any great height, but its soft, bare, and stout stems, surmounted by a tuft of a few slightly pendant branches, give it a weird and fantastic look possessed by only ... two other plants on the island", *Dorstenia gigas* Schweinf. of the *Moraceae* (also in the Red Data Book) and *Adenium obesum* (Forssk.) Roemer & J.A. Schultes subsp. *socotranum* (Vierh.) Lavranos of the *Apocynaceae* (1). These giant and obese succulents form perhaps the most unusual component of the strangely impressive and unique vegetation covering the limestone slopes of the island.

CULTIVATION Many specimens are now in cultivation in France, Germany, South Africa and the U.K.

DESCRIPTION Podagric or caudiciform succulent, i.e. a small tree (up to c. 7 m) with a bare, succulent and gout-like, tapering trunk (up to 1 m thick at the base and chalky white in colour). This stem bears a small spreading crown of a few, slightly pendent branches each of which ends in tufts of rounded to cordate leaves 4-8 cm long, spine-toothed on the margins. Flowers unisexual, mostly in clusters on irregular protuberances emerging from the stem; male flowers with a tubular calyx up to 2.5 cm long and 5 lanceolate, spreading corolla lobes. Female flowers smaller and narrower. Fruits soft, roughly hairy, 3 cm or more long, narrowly ovoid and attenuated at the apex.

For illustrations see (1), (2) and (3).

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This sheet is based upon information provided by Mr A. Radcliffe-Smith (of the Royal Botanic Gardens, Kew, U.K.), to whom the TPC is most grateful.

CUCURBITACEAE

STATUS Rare; confined to c. 25 km of island coast, where it occurs as scattered individuals. Its population is probably less than 1000 plants.

DISTRIBUTION Aldabra atoll, Indian Ocean. It is only known from the coast of South Island, between Trou Nenez and Cinq Cases (1).

Aldabra is one of a scattered group of slightly elevated islands whose surfaces are mostly 3.5-8 m above mean low-tide level. It is the largest of the group, covers about 97 sq. km of land and is the only one whose vegetation has not been disturbed in the past by strip-mining for phosphate rock or 'guano'. The terrestrial flora is exceptionally rich for a small coral island: 273 species and varieties of ferns and flowering plants are known, of which 178 are indigenous. 43 are believed to be endemic (1). Most of these are considered as Rare, or, in a few cases of critically low populations, as Endangered.

HABITAT AND ECOLOGY A component of the coastal vegetation, growing on dunes and limestone rock, either prostrate and mat-forming or scrambling over shrubs and trees of *Pandanus* (1,2).

CONSERVATION MEASURES TAKEN Its biological wealth has focused considerable attention on Aldabra in recent years. A threat that an airbase would be sited on the atoll was averted in 1967 (5) and, since then, detailed studies have been made of the biota of the group, the Royal Society (U.K.) establishing a Research Station on Aldabra itself in 1971. Many of the results of the research are given in (7), including a preliminary survey of the vegetation by Fosberg and an analysis of the origin and distribution of the flora by Renvoize, which is being followed up by the same authors (1) and by Wickens (8).

CONSERVATION MEASURES PROPOSED The Royal Society expects to hand over management and administration of its facilities on Aldabra in 1980 to an appropriate Seychelles organisation (3). It is hoped, and indeed essential for the future study and conservation of the island biota, that the facilities will be maintained.

BIOLOGY AND POTENTIAL VALUE "Aldabra is the last undisturbed elevated-limestone island in the Indian Ocean" (5) and, as emphasised above, of quite exceptional biological interest. It is significant in this connection that in a study of the pollen of *Peponium* species made by Page and Jeffrey, *P. sublitorale* has been found to have a "unique exine pattern" which confirms its suspected distinctness on morphological grounds (2).

DESCRIPTION Scrambling or trailing plant with stems 2 m or more long. Leaves broadly ovate, shallowly 3- to 5-lobed, 10-20 cm long, coarsely hairy. Male flowers clustered in short spikes up to 4 cm long; receptacle-tube 3 cm long, lobes linear, 5 mm long; petals yellow, obovate, 2 cm long. Female flowers smaller than the male. Fruit ellipsoid, up to 5.5 cm long or more; seeds ovate, flattened (1).

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The TPC is most grateful to Dr G.E. Wickens, of the Royal Botanic Gardens, Kew, U.K., for help in producing this sheet.

CYPERACEAE

STATUS Endangered; the Egyptian subspecies of papyrus which only occurs in small areas of fresh-water marsh around 3 soda-lakes. The habitat is decreasing in size and in danger of completely disappearing due to extraction of water from the Nile and changes in the irrigation pattern of the country. *Cyperus papyrus* was believed to have been extinct in Egypt for over 150 years (4) until Hadidi in 1968 discovered this new subspecies, an event of great botanical interest.

DISTRIBUTION Egypt; in the Wadi Natroun depression in the Western Desert, west of the southernmost part of the Nile Delta. The previous record was in 1820-21, from Damietta and the banks of Lake Manzala on the Mediterranean coast of the Nile Delta. There is palynological evidence that *Cyperus papyrus* was widespread in the northern part of the Nile Delta during Pharaonic and earlier times (3), but it is not certain whether or not this refers to ssp. *hadidii*.

HABITAT AND ECOLOGY Among reeds in fresh-water marsh around saline soda-lakes. It is confined to a few scattered sites where fresh-water emerges from underground sources fed by the Nile. It is associated with *Berula erecta* (Huds.) Coville, *Cyperus laevigatus* L., *Panicum repens* L., *Phragmites australis* (Cav.) Trin. ex Steudel, *Samolus valerandi* L., *Scirpus litoralis* Schrader, *Typha elephantina* Roxb. and *T. domingensis* Pers. (2).

In Pharaonic times it appears "that the Nile moved across its flood plain in a complicated network of river arms, islands, back-swamps and seasonally inundated alluvial basins. Back-swamps were low-lying depressions harbouring perennial waters that were dominated by marsh vegetation ... The locality of *Cyperus papyrus* in Wadi Natroun may represent a relic of a dried-up ancient back-swamp system" (2). These fresh-water areas were once extensive in the Western Desert, but are now rapidly shrinking and becoming saline. Their decrease has been mapped by Toussoun (5). They were associated with the ancient system of basin irrigation whereby cultivated land was systematically flooded every year. Since the completion of the Aswan High Dam, basin irrigation, used since Pharaonic times, has been completely replaced by perennial irrigation; combined with increased extraction of Nile water upstream, this has resulted in the drying-up of the numerous ponds and swamps that existed along the Nile and were the natural habitat of Papyrus and of Lotus, *Nymphaea lotus* L., a plant equally Endangered in Egypt and now known from only one locality in upper Egypt (2).

CONSERVATION MEASURES TAKEN None for the wild populations.

CONSERVATION MEASURES PROPOSED Protection for the remaining localities and maintenance of the water-table.

BIOLOGY AND POTENTIAL VALUE "*Cyperus papyrus* and *Nymphaea lotus* are among the most well-known plants of ancient Eygpt" (2). The papyrus is of great historical importance; it was used as a symbol of the Kingdom of Lower Egypt, whereas the *Nymphaea* represented Upper Egypt (4). Its numerous uses in Ancient Egypt, as food or medicine, for making mats, boats or sandals, in funeral garlands or formal bouquets, are described in detail in (4), as are its presence as a motif on columns, paintings and reliefs and, most important, its use as a writing material. Details of how to make the 'paper' are given in (4).

Cyperus papyrus as a species occurs in Madagascar, the Mascarenes and in the river basins of the Nile, Niger, Zaire and Zambezi in tropical Africa (1). The Egyptian subspecies is believed to represent the northern limit of the plant, since populations in Sicily and Israel are thought to have been derived from cultivated material (2,4).

CULTIVATION It is being grown with other subspecies of papyrus at the Papyrus Institute, Giza, Egypt, and being assessed for paper-making. For details of papyrus cultivation see (4).

DESCRIPTION Giant perennial sedge with stems indistinctly 3-angled to cylindrical in cross-section, 2-5 m tall, arising from short woody rhizomes and bearing at the apex a crown of gracefully arching branchlets (rays). Base of stem sheathed by ovate-lanceolate, pointed, brown or red-tinged scale leaves. Base of umbellate crown with 4-10 green linear bracts 5-15 cm long, subtending numerous slender rays 10-45 cm long; spikelets short, 6-8(-10) mm long, elliptic, nearly stalkless.

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This sheet is based upon information provided by Professor N. El-Hadidi (of the Department of Botany, Cairo University), to whom the TPC is most grateful.

Bois de Fer

DIPTEROCARPACEAE

STATUS Endangered. It is now known from about 5 localities (4) but the population is critically low. One estimate is of about 50 trees. It has been very extensively felled for its fine timber and for firewood with the result that it was becoming scarce by towards the end of the last century (1), and is now virtually extinct over most of its range. It occupied the zone cleared for cultivation of cinnamon and other crops. All the present localities are within the proposed Morne Seychellois National Park (4).

DISTRIBUTION Seychelles. It is endemic to Mahé and was formerly one of the dominants in the forest at the foot of the hills, ranging up to c. 400 m and possibly extending down to about 100 m in the now extinct lowland forest.

There are at least 72 flowering plants endemic to the Seychelles (not including Aldabra) and nearly all are believed to be threatened (4). They are mostly plants of the forest, which has been severely affected by fire and over-exploitation resulting in erosion, decrease of soil fertility and intensification of the adverse effects of drought. Large areas are covered by cinnamon coppice, the second most important crop on the islands and now the most abundant flowering plant.

HABITAT AND ECOLOGY Rain-forest on soils derived from granite. One group of the remaining trees is near what is probably the upper altitudinal limit of the species' former range; the surrounding vegetation is now secondary forest, regularly cut for cinnamon, which inhibits the formation of a forest canopy. Most of the surviving specimens appear to have regenerated from cut stumps but a few have only one stem. There are a few seedlings but no young trees. Numerous associates are listed in (4).

CONSERVATION MEASURES TAKEN None.

CONSERVATION MEASURES PROPOSED As mentioned above, all of the known population is within the proposed Morne Seychellois National Park. This area has been surveyed, but not yet gazetted. It is recommended that this important conservation area be declared. Also, the species should be propagated and grown in botanic gardens and tropical research institutes. Work is needed to determine the optimum conditions for establishing the tree, e.g. degree of shade, tolerance of competition and viability of the seed.

BIOLOGY AND POTENTIAL VALUE The timber is of good quality, comparable to that of the Dipterocarps of Malaya, and the species is thus a valuable part of the gene pool which should be available for breeding. (Dipterocarps are the dominant tall timber trees of primary lowland rain-forest

in south east Asia and a major source of timber.) When cut the bark of this species gives off a very fragrant resin which was once used as an incense (5) and is potentially valuable in the perfume industry. As an outlying member of the family, the species is of some importance in studies of plant geography and taxonomy.

CULTIVATION The Forestry Department in the Seychelles has been gathering seeds and germinating them with success. Some have been replanted in the wild. The species is also in cultivation at Aberdeen University, Scotland. Although it can be grown readily from seed, young trees often die after a promising start (4). Those that survive appear to be very slow-growing.

DESCRIPTION Tree 25-30 m high and c. 2 m in diameter at the base, with large leathery elliptic leaves 12-25 cm long, pointed at the tip. Flowers c. 1.5 cm across, in small racemes in the leaf axils, with 5 ovate blunt-tipped sepals, 5 spreading, slightly concave, obovate, yellow to white petals c. 7 mm long and a tight central boss of numerous short stamens. Fruits spherical, 3-4 cm across, each containing a single seed with 2 large fleshy cotyledons.

For illustrations see (4) and (5).

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The TPC is most grateful to Mr J. Procter and to the Conservation Officer, Ministry of Agriculture and Land Use, Republic of the Seychelles, for help in producing this sheet.

Rachman, Dirachma (local names)

DIRACHMACEAE

STATUS Endangered. In 1967 only 30 mature trees were found, with no seedlings or saplings to be seen. Despite a profusion of flowers, extremely little viable seed appeared to be set. Its decline is presumably due to overgrazing by goats and cattle, preventing regeneration.

DISTRIBUTION Socotra (an Island Territory of the People's Democratic Republic of Yemen, lying 225 km east of the Horn of Africa.) The single grove occurs where the granite of the Hajhir Mountains is juxtaposed with the limestone of the dissected plateau to the west. In the past *Dirachma* was more widespread on the island and in 1880 was "not uncommon on the slopes of the Hajhir" (1).

The flora of Socotra is critically threatened; out of 216 flowering plants endemic to Socotra and the neighbouring island of Abd al Kuri, 132 are believed to be rare or threatened, 85 of them in immediate danger of extinction (Endangered). This drastic situation is the result of grazing by excessive numbers of introduced livestock on an island flora which has presumably evolved partly in the absence of large mammals, unlike the flora of the African mainland.

HABITAT AND ECOLOGY In low open thicket among limestone boulders, on a steep slope at about 240 m, growing with *Buxus hildebrandtii* Baillon. The rainfall here is the highest on the island for that altitude and this is reflected in the thickets which are denser and richer in species than similar thickets elsewhere. This locality is the only known site for *Indigofera sokotrana* Vierh. (Endangered) and, 60 m higher up, for the small bulbous plant *Dipcadi guichardii* A.R.Smith (also Endangered). The largest concentration of the extraordinary caudiciform succulent *Dorstenia gigas* Schweinf. (Vulnerable), which is so prized by goats, occurs on nearby cliffs at the base of which is possibly the only site for *Clerodendron leucophloeum* Balf.f. (Vulnerable). This is one of the richest areas for plants on the island.

CONSERVATION MEASURES TAKEN None for the wild population.

CONSERVATION MEASURES PROPOSED It should be brought into cultivation as a matter of extreme urgency. Once established it may well prove easier to keep than previously expected. A reserve protected from grazing should be established to protect the *Dirachma* and the other threatened endemic plants growing nearby.

BIOLOGY AND POTENTIAL VALUE It is of great scientific importance as it is the only member of its family, the *Dirachmaceae;* its extinction would represent a major loss of diversity in the plant kingdom. All of the parts of the flower are in 8s with the stamens opposite the

petals (which are free) and a deeply lobed ovary with one ovule in each of 8 chambers, making up a unique and curious mixture of characters. It was originally placed in the family *Geraniaceae* by Balfour, but was moved to a family of its own in the order *Tiliales* by Hutchinson (3). However, its biochemistry is similar to that of *Geranium* (2) and the mode of dehiscence of the fruit is reminiscent of *Geranium* also. Its true relationships require further investigation and it is obviously of major interest to studies of plant taxonomy and evolution.

CULTIVATION It is easily propagated by cuttings, which were taken in 1967 and grew into small bushes in cultivation. Unfortunately they did not survive. Overwatering the young plants should be avoided.

DESCRIPTION Sweet-smelling shrub to small tree with rigid young shoots bearing elliptic toothed leaves 5-30 mm long, usually in clusters, and a mass of blossom appearing after the North East Monsoon. Individual flowers attractive and decorative, each with an epicalyx of 4 green bracteoles, 8 recurved lanceolate reddish sepals 8-10 mm long, and 8 white obovate petals forming a bowl about 2 cm across. Fruits more or less ovoid and beaked, consisting of 8 single-seeded valves and with dense white hair within.

For illustrations see (1) and (3).

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This sheet is based upon information provided by Mr. A. Radcliffe-Smith (of the Royal Botanic Gardens, Kew, U.K.), to whom the TPC is most grateful.

Venus' Flytrap

DROSERACEAE

STATUS Vulnerable. Many former localities are now covered by even-aged pine plantations where suppression of fire, with the resulting competition from other plants, and shading by the pines themselves, has destroyed the populations (2,3). A most severe threat to the habitat is the drainage that accompanies construction projects and agriculture. "A permanent significant drop in the water level spells the end of the flytrap population at a specific site" (2). In addition the plant continues to be illegally collected in large numbers from the wild, a process which is highly detrimental to the populations (2,3).

Folkerts (1977) could not locate those reputedly extensive populations in which the plant was reported as "weedy" and occurring "by the millions". Along with Jeffreys *et al.* (1971), he concludes that the plant's range has been diminished, although at least 100 stations still exist. There is, however, some tendency in the species to colonise disturbed areas such as roadsides and new pine plantations (2,3,4).

DISTRIBUTION U.S.A.; endemic to the coastal plain of North and South Carolina. The range extends south west for about 320 km, from Beaufort County, North Carolina, to Charleston County, South Carolina (5).

HABITAT AND ECOLOGY Wetland sites intermediate between the wet evergreen-shrub bogs (pocosins) and the dry sandy regions of the surrounding longleaf pine-wiregrass savannahs. In the more northern counties, where changes in micro-relief are abrupt, *Dionaea* occurs in well-defined zones around the edge of pocosins; in the southeastern part of its range, as near Wilmington, the ecotone between pocosin and savannah is far more extensive, and the plant therefore is spread over wider areas. It grows with a mixture of bog and savannah species, usually including other insectivorous plants such as *Drosera, Pinguicula* and *Sarracenia,* in varying abundance (5).

Fire plays an important role in maintaining the habitat. Most of the localities are burned fairly frequently, removing most of the low vegetation and reducing competition. Surface debris is also partially burned off, thus aiding decomposition. The soil is of medium to fine sand and contains some organic matter, either as humus or as peat, little mineral nutrients, and, due for the most part to the high water table, a high moisture content.

CONSERVATION MEASURES TAKEN It is protected by law in North Carolina, but this has not prevented its decline (3).

CONSERVATION MEASURES PROPOSED A survey of existing sites and populations preparatory to setting up some reserves. Plants for cultivation should be grown from seed rather than collected from the wild.

BIOLOGY AND POTENTIAL VALUE *Dionaea* is a monotypic insectivorous genus of scientific interest. It is widely offered for sale as a curiosity, forming part of many botanical collections. Insects are trapped by 2 hinged lobes of the leaf, which when the 'trigger' hairs are touched, rapidly close together. Details of the mechanism, which is still incompletely understood, are given in (6). Flowering begins about the last week in May and is usually over before the middle of June. New seedlings first appear at the end of July. Laboratory evidence indicates strict cross-pollination. In the field this is effected by various beetles, small flies and possibly spiders (5). Plants have been successfully translocated within the species' natural range (2). A transplanted colony in the New Jersey Pine Barrens has survived since 1948 (7).

CULTIVATION It is propagated readily from seed germinated under a bell-jar on moist sandy soil mixed with finely chopped sphagnum moss. It thrives when grown in a mixture of fine sand and black silt with some fibrous peat on the surface, in conditions of full sun and high humidity (1).

DESCRIPTION Perennial. Leaves 2-12 cm long, 4-8 in a spreading rosette; each consists of a flat expanded petiole ending in a blade of 2 identical semi-circular halves; midrib of the blade contractile, forming a hinged trap, with marginal bristles that interlock when the halves close. Flowers white, 4-10 in a terminal cluster (1). For illustrations see (1) and (6).

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The material for this sheet was supplied by the Endangered Flora Project of the Smithsonian Institution, Washington, D.C., to whom the TPC is most grateful.

EBENACEAE

STATUS Endangered. Only one individual of this potentially valuable tree is now known. The species is dioecious (i.e. the flowers are unisexual, with males and females on separate plants). The remaining tree is female; unless a male is found and measures taken to obtain seed, the species is clearly doomed to final extinction. Previously there was a male tree close by, but this died in 1954; the only tree now known is almost certainly over 100 years old and so is likely to be near the end of its life. It is close to a road and this could pose an additional threat.

This species was first known from a painting made in 1867, by Madame de Chazal-Moon. It was also found in 1925, 1934 and 1937 from 2 localities separate from the only locality known today, but the few trees concerned no longer survive, although of course there is the possibility that seedlings or small trees may remain undiscovered.

DISTRIBUTION Mauritius, Indian Ocean; the three localities are all in the south west of the island.

Out of 50 families revised so far for the Flore des Mascareignes, at least 25 angiosperm species endemic to Mauritius are Endangered or Extinct. Undoubtedly the pattern is similar for the c. 152 families still to be revised. Most of the island is under cultivation and the indigenous vegetation is irretrievably degraded with only small fragments surviving. Most of these are now threatened by illegal wood-cutting and invasion by vigorous introduced species. In several areas that appear at first sight to be original forest, these exotics have prevented regeneration of native plants for many years. The majority of the nature reserves established are being over-run by these species, spread in particular by alien animals such as pigs, Red-whiskered bulbuls *Otocompsa jocosa* and Malaysian monkeys *Macacus irus irus* (1).

HABITAT AND ECOLOGY The single tree occurs at c. 350 m in mid-altitude forest of indigenous species such as *Diospyros tessellaria* Poiret, *Foetidia mauritiana* Lam., *Hornea mauritiana* Baker, *Margaritaria* sp., *Phyllanthus casticum* Willemet and *Terminalia bentzoë* (L.) L.f. It grows just beside a road and is only a short distance from the edge of the forest.

CONSERVATION MEASURES TAKEN None. It is not in cultivation.

CONSERVATION MEASURES PROPOSED Great efforts should be made to search the known localities and other likely areas for a male or for any seedlings. Artificial pollination would presumably be needed to set seed which could then be used to build up a stock in cultivation.

The priority should then be to ensure the species is maintained safely in cultivation, preferably with other endangered species in a garden of native and endemic plants in Mauritius.

BIOLOGY AND POTENTIAL VALUE Although the species is not known to have been used as a source of timber, clearly because of its rarity, it has considerable potential as it is a relatively large and robust tree in comparison with most of the other species of *Diospyros* in the Mascarenes. Species of *Diospyros* have very hard woods and form the true ebonies of commerce. Out of 17 species in the genus that are endemic to Mauritius, Réunion or Rodrigues, at least 10 are Extinct or Endangered. Only one species, *D. tessellaria* Poiret, is considered as neither rare nor threatened, although it has been heavily exploited and was a very important source of timber in the past. Today many of the numerous individuals remaining are too small for commercial exploitation. *D. tessellaria* is a typical black ebony and produces one of the finest woods in the world. With a genus of such great economic importance, it is especially vital that the gene-pools of all its members are conserved so that they will be available for future use and breeding work.

DESCRIPTION Robust dioecious tree, with a grey-black, more or less smooth bark, the only known individual being c. 8 m high with a trunk c. 30 cm thick. Leaves oblong-elliptic, blunt tipped, 6-12 x c. 2.5 cm, leathery, dark green with lighter translucent veins. Flowers stalkless, mostly solitary in the leaf axils, the parts in 6 to 8s; calyx cup-shaped, 15-18 mm broad, corolla up to 3.5 cm across when expanded, with reflexed white lobes silky on the outside. Stamens numerous (c. 60 per male flower). Fruit spherical, 2-3 cm across, with the persistent, slightly winged, woody and enlarged calyx attached to the base.

A full description, illustration and scientific name for this recently recognised species will be given by Richardson in a forthcoming part of the Kew Bulletin. No published illustrations are known; the painting referred to above is lodged in the Mauritius Herbarium at MSIRI, Réduit, and will be published in the Flore des Mascareignes.

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This sheet is based upon information provided by Mr I.B.K. Richardson (formerly of the Flore des Mascareignes project, c/o The Royal Botanic Gardens, Kew, U.K.) to whom the TPC is most grateful. Acknowledgment is also made to a preliminary manuscript on the *Ebenaceae* in the Mascarenes by Dr R.E. Vaughan, formerly Curator of the Herbarium at the Mauritius Sugar Industry Research Institute (MSIRI). Dr Vaughan studied the plant in the field over some years in the early 1950s.

Madroño

ERICACEAE

STATUS Vulnerable; a very rare small tree which has drastically declined along with its habitat, the laurel forests of the Canaries, due to destruction for agriculture and due to coppicing of the trees for poles and firewood with resultant loss of species diversity. On one island (Tenerife) the laurel forests have been reduced by over 90% (1), the remaining areas mostly being of secondary forest and diminishing rapidly.

DISTRIBUTION Canary Islands. It is occasional on Tenerife (about 5 localities), frequent in the El Golfo region of Hierro, extinct or nearly so on La Palma (one locality recorded), on Gomera (2 localities recorded) (1) and on Gran Canaria (one station with 3 individuals).

HABITAT AND ECOLOGY In evergreen laurel forest and pine forest (*Pinus canariensis* C.Smith), on volcanic soils, at 600-1200 m, associated with *Visnea mocanera* L.f. The laurel forests are dominated by *Laurus azorica* (Seub.) Franco, *Apollonias barbujana* (Cav.) Bornm., *Ocotea foetens* (Aiton) Benth. and *Persea indica* (L.) Sprengel. They are the only moist forests on the islands and have a very important role both in erosion control and in condensing moisture from the clouds. They are of great interest since they contain a particularly high percentage of rare and endemic species, many of which are now becoming endangered by the felling and excessive coppicing of the forest. Such plants are believed to be relicts of a now virtually extinct flora which occupied southern Europe and north Africa in the Tertiary (1).

CONSERVATION MEASURES TAKEN None for the wild populations. The species is in cultivation and has been planted in groves of reconstructed laurel forest in the Jardín Botánico Viera y Clavijo on Gran Canaria. A seed bank for threatened Macaronesian and Iberian species has recently been set up at the Universidad Politécnica, Madrid.

CONSERVATION MEASURES PROPOSED Immediate steps should be taken to declare the major remaining habitats as local nature reserves.

BIOLOGY AND POTENTIAL VALUE Horticulturally it is an attractive small tree for warm temperate climates. The fruit is edible and similar to that of *A. unedo* L., which is moderately rich in Vitamin C (ascorbic acid 135-185 mg per 100 g). It is reputed to be the Golden Apple of the Hesperides.

DESCRIPTION Small tree up to 15 m high with brown bark peeling in flakes; leaves oblong-lanceolate, 8-15 cm long, finely serrate on the margin. Flowers in pendent to more or less erect panicles 10-15 cm long; calyx small, with rounded lobes; corolla bell-shaped,

5-8 mm long, white or greenish, often tinged with pink, contracted at the mouth. Berries 2-3 cm, warty and granular on the surface, yellow-orange when ripe.

For illustrations see (1), (2), (4) and (5).

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The TPC is most grateful to Dr D. Bramwell, of the Jardín Botánico Viera y Clavijo, Gran Canaria, for help in producing this sheet.

Sonoma Manzanita

ERICACEAE

STATUS Endangered. Since this plant was first discovered in 1928, the population at the *locus classicus* has suffered numerous setbacks. The roadside on which this population occurs, one of the last remnants of the Sonoma Barren, has been subjected to numerous experimental weed control programmes, involving spraying, scraping and coating with used oil. In 1932, the population was reported as scarcely numbering 100 individuals and all but 6 of these were confined to the banks of a single road for a distance of c. 150 m (1). In 1955 the plants were reported to be fairly plentiful, but in 1963, after continued pressure on the population, only two shrubs remained at the site. However, in 1967, the population appeared to be recovering and, in 1971, 19 mature individuals and 26 immature ones with seedlings were counted (5).

A second population, in the same general area, contained 10 mature and 3 young individuals in 1971. Plants from here have long been known and cultivated under the name *A. densiflora* 'James West'. A single additional disjunct plant brings the total number of individuals in the wild to 59 from which 4 were removed in 1971 for cultivation (5). The California Native Plant Society list this species as totally endangered and approaching extinction (4), but in view of the recovery noted above and the action detailed below, it is hoped that the species can soon be transferred to a less serious category.

DISTRIBUTION U.S.A.; restricted to some of the last remnants of Sonoma Barren (see Habitat and Ecology, below), near Santa Rosa in western Sonoma County, California. The two main populations occur along roadsides (5).

HABITAT AND ECOLOGY On the central, more acidic part of the Sonoma Barren. In its undisturbed state the soil is an acid sand, tawny or pale yellow in colour, the surface of which weathers tan to greyish white in summer, becoming naturally compacted when it is left undisturbed for a long time and baking brick hard in the sun. In winter the surface becomes a sticky colloidal mud. The dried surface crust very effectively prevents surface evaporation, a factor essential to the survival of this shallow-rooted species. When the sand is ploughed, however, it loses its capacity to retain water close beneath the surface (5).

Most of the area around Sebastopol, in the region of the *locus classicus*, has become cleared and converted to orchards and vineyards. In the process the flora of the Sonoma Barren in this area was all but obliterated. Some indication of this flora can be formed from those portions of the barren still remaining. In association with *A. densiflora*, and still found today in the remnants of the barren, was a Squaw lily, *Xerophyllum tenax* (Pursh) Nutt., and *Ceanothus foliosus* C.C.Parry var. *vineatus* McMinn. On the better drained soils at the margin

of the barren were taller shrubs such as California Coffeeberry, *Rhamnus californica* Eschsch., and *Ceanothus gloriosus* J.T.Howell var. *exaltatus* J.T.Howell (5).

CONSERVATION MEASURES TAKEN The *locus classicus* has been purchased by the California Native Plant Society (2). The species was proposed as 'Endangered' by the U.S. Department of the Interior, Fish and Wildlife Service, on 16 June 1976. The Endangered Species Act of 1973 directs that no federally funded activity shall jeopardise the existence of species once officially determined as 'Endangered' or 'Threatened', as defined by the Act.

CONSERVATION MEASURES PROPOSED Formal determination as an 'Endangered' species and hence protection under the Act.

BIOLOGY AND POTENTIAL VALUE It has been postulated that *A. densiflora* has been derived from *A. stanfordiana* C.C.Parry var. *repens* J.B.Roof. Like other dwarf species of *Arctostaphylos* adapted to adverse environments, it blooms and fruits heavily and reproduces freely. The seeds germinate in winter on the surface of the mud, and by summer the roots have penetrated the dry soil crust. As mentioned above, it has marked powers of recovery; possibly scraping the soil stimulated the germination of long-dormant seeds (5).

CULTIVATION Roots of young plants should be protected by a surface dressing of clean coarse gravel, as otherwise, in normal soil, the rootlets grow up to the surface and may be burned by the summer sun. It grows best in partial shade as although occurring in full sun in the wild it is often cooled by summer fog. Aluminium sulphate solution should be applied 3 or 4 times a year. The cultivar 'James West' is more stable in cultivation, thrives in hotter and more open garden situations and is less in need of acid treatments than the typical *A. densiflora*.

DESCRIPTION Woody evergreen shrub with spreading procumbent branches rooting freely, blackish. Leaves elliptic-suboblong, bright green, shining, 1.5-3 cm long. Inflorescence dense, short, many-flowered; calyx whitish, ciliate, c. 1 mm; corolla white or pink (rose-pink in 5), 4-5 mm long. Fruit flattened-globose, 5-6 mm across (3). For illustrations see (5).

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Georgia Plume

ERICACEAE

STATUS Endangered, due to destruction of the habitat by timber extraction and clearing for agriculture (3,7). However the main locality has recently been acquired for conservation (see below) and so it is hoped the Georgia Plume can soon be transferred to a less severe category.

DISTRIBUTION U.S.A.; confined to a few isolated stations in the Savannah River valley in eastern and south central Georgia. Formerly it was more widespread and abundant within its present range, and also occurred in South Carolina where it is now presumed extinct.

HABITAT AND ECOLOGY On low lying, moist but well-drained, acid soil, in mixed woods, associated with *Cyrilla racemiflora* L., *Stewartia malacodendron* L., *Magnolia virginiana* L., Azaleas and other *Ericaceae*. It also occurs on oak ridges, in *Pinus-Quercus* woods and in *Pinus australis* savannas (10).

CONSERVATION MEASURES TAKEN The Georgia Heritage Trust (Atlanta, Georgia), an agency of the Georgia Department of Natural Resources, has acquired the Phillips Tract (= Big Hammock Natural Area) in Tattnall County. This is a Pleistocene sand ridge of c. 300 ha on which grows the largest known population of the Georgia Plume (5). An additional tract of 29 ha, the Charles C. Harrold Nature Preserve, in Candler County, has been acquired by the Nature Conservancy (9).

CONSERVATION MEASURES PROPOSED None on record.

BIOLOGY AND POTENTIAL VALUE The seed set in the wild appears to be very low. The reasons for this are uncertain but it has been suggested that the plants are self-sterile and that each colony consists of only one clone. For a discussion of this hypothesis and for other ecological data see (10).

With its showy panicles of white flowers, it is potentially a beautiful garden shrub, if the difficulties in propagation can be overcome.

CULTIVATION The species is being propagated and distributed to various botanic gardens (3). It requires similar conditions to *Rhododendron* and other *Ericaceae*. Great difficulty has been experienced in raising it from seed or stem cuttings. Root cuttings laid horizontally 2 cm deep provide the best means of propagation. The juvenile shoots arising from the root cuttings root without much difficulty after hormone treatment, as described in detail in (3).

DESCRIPTION Deciduous tree up to 9 m high, or often a shrub to 3 m,

with grey bark. The ascending branches form a pyramidal head of chestnut-brown twigs which bear pointed, elliptic-oblong leaves 6-10 cm long on short stalks and numerous erect racemes 8-25 cm long, of fragrant white flowers, each on a slender stalk 10-15 mm long. Calyx very small, cup-shaped, 4-lobed; petals white, strap-shaped and recurving, 10-15 mm long; stamens 8. Capsule brown and spherical, 5-12 mm across with 4 valves, containing winged, disc-like seeds (10).

For illustrations see (1), (3), (6)-(8) and (10).

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ERICACEAE

STATUS Endangered. It is restricted to a small population confined to a seepage-marsh of less than one hectare in extent. It may be seriously threatened by fire. Only a few mature individuals survive, at the edges of a firebelt burnt through the colony. Other threats include the illegal taking of the flowers by picnickers and a possible future widening of the road which runs along the side of the colony. Invasive alien species such as *Acacia mearnsii* De Wild., *Hakea sericea* Schrader and *Pinus pinaster* Aiton have come into the area nearby.

DISTRIBUTION South Africa. The single locality is in the Fransch Hoek Mountains just east of Cape Town, Cape Province. A single record exists of a rather similar plant on a mountain peak several kilometres south, but with a corolla twice as large; this may prove to be a distinct but closely related species.

The Cape flora is one of the richest in locally endemic species of any flora. Confined to the tip of the African continent, its species have been unable to migrate southwards to follow the wetter conditions of the westerlies that probably gave a moister and cooler climate far inland during the Pleistocene (3). Hemmed in to the north by the Karoo, many of the species have come to occupy small ranges and are hence easily destroyed by quite local human activities.

HABITAT AND ECOLOGY In a marsh, at c. 300 m, the substrate probably having an acid reaction. The soil is a richly peaty white sand derived from Table Mountain Sandstone. The species is associated with tall, reed-like members of the *Restionaceae, Berzelia* spp. and *Leucadendron salicifolium* (Salisb.) I.Williams. The plants also grow in disturbed open ground, where they tend to be more sturdy in growth and more floriferous than in the marsh vegetation (1).

Cape plants are frequently well-adapted to surviving periodic fires; if, however, the seed-set had been poor in previous years, few seedlings would appear and the species would then become virtually extinct.

CONSERVATION MEASURES TAKEN Picking of the flowers is forbidden by the Provincial Nature Conservation Ordinance No. 19 of 1974. Invasive alien plants *(Acacia, Pinus* and *Hakea)* have been removed by the Department of Forestry. A fence has been erected around the marsh by the Divisional Council to discourage entry by flower-pickers and arrangements have been made to avoid re-burning the firebelt through the colony.

CONSERVATION MEASURES PROPOSED The present small population of adult plants needs to be protected until an effective stock of seedlings is confirmed in the burnt area. The effect of burning on the species

should be carefully monitored over a number of years, especially to show how fire might best be used to help the species regenenerate. Total protection from fire is not recommended, as through competition the number of individuals may be seriously reduced.

Invasive alien species should be removed on a regular basis. As a precaution against a major setback for the small remaining population, seeds should be collected and stored in a seed bank.

BIOLOGY AND POTENTIAL VALUE The bright, golden yellow flowers, densely crowded along the upper portions of the branches, are very attractive and suggest that the plant would be of horticultural value. The species has been described as "a most beautiful and showy heath" (1), and is one of the floristic attractions of the Cape flora, as are many species of *Erica* in Southern Africa.

CULTIVATION It is not known to be in cultivation although it is "well worth growing if wet conditions can be provided in a sandy peaty soil" (1). Seeds or cuttings should be tried, and once established, stocks should be grown for release to horticulture.

DESCRIPTION Small erect shrub up to 45 cm high with slender branches. Leaves in clusters of fours, linear, 3-4 mm long, the margin in-rolled and fringed with hairs. Flowers 1 or 2 on the tips of numerous short lateral branchlets crowded along 8-15 cm at the ends of the branches; sepals ovate, 3 mm; corolla golden-yellow, 6-7 mm long, funnel-shaped with 4 short, spreading or occasionally recurved lobes (1).

For an illustration see (1).

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The material for this sheet was supplied by the Rare and Endangered Plant Species Survey based at the University of Cape Town, to whom the TPC is most grateful.

ERICACEAE

STATUS Endangered. It is apparently restricted to an area of one hectare where a total of about 150 individuals are concentrated in a small patch of c. 100 sq. m. Searches for the species elsewhere have been unsuccessful; the plant is, however, difficult to find when not in flower so that further searches may reveal more populations. One threat to its survival is the isolation of the population as a result of intensive farming and road-works in the area. Farming practices nearby include the use of fire which could spread into the population and destroy the plants; if in such circumstances the fertile seed-load in the soil were small, the species would then become very close to extinction.

DISTRIBUTION South Africa. The surviving locality is near Caledon in south-western Cape Province. The species was formerly recorded from a second locality, also near Caledon, where it "was no doubt plentiful" when seen by Masson in 1796 (1), but is now extinct. The rich Cape flora has been reduced in area by about 60%, to patches of varying size that total about 18,000 sq. km, smaller than the Kruger National Park. Much of this reduction has been due to the spread of farmlands in the region. In the south-western Cape Province, 1459 species of plants are listed as rare or threatened.

HABITAT AND ECOLOGY The associated vegetation consists of Cape Macchia dominated by the proteaceous *Leucadendron teretifolium* (Andr.) I.Williams. The soil is a hard ferruginous gravel or sand with subsurface clay derived from shale. The altitude of the site is c. 200 m. Regeneration after fire is by seed. The population is surrounded by farmland, frequently burnt vegetation and roads; this may have caused an isolation from pollinators. Scarcely any seed was set in 1977. A possible return of pollinators in 1978 may have caused the abundant seed set, possibly associated with increasing maturity of an area of vegetation nearby that had not been burnt for several years.

CONSERVATION MEASURES TAKEN A fence has been put around the remaining population. 6000 seeds, representing a small part of the abundant crop in 1978, have been sown by the Provincial Department of Nature Conservation in a specially burnt strip nearby, in order to extend the population. Attempts are being made to bring the species into horticulture and 500 seeds have been put into storage in a seed bank.

CONSERVATION MEASURES PROPOSED The population should be enlarged by cultivation at the site, and adequate buffer-zones with fire-belts created to allow conservation action to proceed undisturbed. An attempt should be made to re-establish a population in the second, now extinct, locality. Observations should be made to show the essential habitat requirements of the pollinator, so that it may be conserved. The

species should be brought into horticulture on a wide scale to reduce the chances of damage to the wild population by flower-pickers.

BIOLOGY AND POTENTIAL VALUE The sticky corolla tube is a deterrent to bees and other insects that may bite into the side of the flower to reach the nectar without causing pollination. Flies of the families *Nemestrinidae* and *Tabanidae* may be the pollinators since they would be able to reach the nectar with their probosci down the long corolla tube, using the non-sticky lobes as a landing platform. *Erica jasmini-flora* is a very beautiful species with long slender flowers in clusters, resembling those of a jasmine, capable of flowering profusely in exposed hot and dry conditions in the austral summer months of December to February.

CULTIVATION The species can be grown from seed or from cuttings. Partly successful attempts at cultivation have been made at McGregor and at Caledon. Successful propagation is continuing at the National Botanic Gardens at Kirstenbosch.

DESCRIPTION Erect, sparsely branched shrub up to 60 cm high, with slender, closely leafy branches. Leaves needle-shaped, 3-10 mm long. Flowers in terminal clusters of 1-3, on stalks 8 mm long; sepals linear-oblong, 1-1.25 cm long; corolla a slender tube up to 3.2 cm long by 3 mm wide, white or pale rose veined red, with at the tip broadly stellate, white or striped, spreading lobes c. 1 cm long (1).

For illustrations see (1) and (2).

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The material for this sheet was supplied by the Rare and Endangered Plant Species Survey based at the University of Cape Town, to whom the TPC is most grateful.

ERICACEAE

STATUS Vulnerable; a dwarf shrub restricted to the volcanic peaks of two islands of the Lesser Antilles. Some of the localities on one (Guadeloupe) have recently been destroyed by the eruptions of La Soufrière in July - February 1977. After the eruption Sastre could only find two populations, totalling less than 10 individuals, in the area. On the other island (Martinique), the plant grows on a summit frequently visited by tourists and is uprooted by those who want to grow it for the attractive, red, bell-like flowers and small edible fruits. It is known locally as 'Myrtille des Hauts'.

DISTRIBUTION Guadeloupe, Martinique; it occurs in 3 mountainous localities in Guadeloupe and on Mt. Pelée on Martinique. It has never been found on Dominica, the island between Guadeloupe and Martinique (5).

HABITAT AND ECOLOGY On the volcanic peaks at 1100-1200 m, growing in *Sphagnum* associations with several species of *Lycopodiaceae* and *Bromeliaceae* (of the genera *Pitcairnia* and *Guzmania*). The humidity at this altitude is very high; the annual rainfall exceeds 5 m and the mountains are in cloud for about 300 days per year. The temperature only exceeds 20° C. during rare periods of sunshine. At night the temperature can drop below 10° C.

CONSERVATION MEASURES TAKEN All the populations are within the Parc Naturel Départemental of Guadeloupe and the Parc Naturel Régional of Martinique. This does not, however, afford protection against picking and uprooting of the plants.

CONSERVATION MEASURES PROPOSED Upgrading to Regional or National Parks, giving full protection not only to this species, but also to all the high altitude flora of the 2 islands.

BIOLOGY AND POTENTIAL VALUE It flowers and fruits through the year. There are two species of *Gaultheria* in the Lesser Antilles, *G. sphagnicola* and *G. domingensis* Urban from Hispaniola. The two species were united by Hersey and Vander Kloet (3), but observations by Sastre suggest that they are distinct taxa. The nomenclature of the group is very difficult and confused; according to Howard (4), the name *G. sphagnicola* is illegitimate and he has proposed the name of *G. swartzii* for this species. Its breeding biology is discussed in (3).

DESCRIPTION More or less erect, dwarf shrub 30-60 cm high, with grey to black bark and branchlets with reddish hairs. Leaves small, 10-25 x 5-15 mm, broadly ovate to rounded, finely toothed with each tooth ending in a short stiff bristle. Flowers in small, dense, terminal

clusters; calyx persistent with 5 narrowly triangular, pointed lobes, hairy; corolla c. 6-8 mm long, carmine-red, bell-shaped with 5 teeth covered by rigid hairs. Fruit spherical, edible, fleshy, containing black seeds. (Syn. *Epigaea cordifolia* Swartz, *Brossaea anastomosans* Griseb.) *G. domingensis* differs in characters of the hairs and in its glabrous calyx.

For an illustration see (2).

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The material for this sheet was supplied by Dr C. Sastre (of the Muséum National d'Histoire Naturelle, Paris), to whom the TPC is most grateful. Dr Sastre's original French version is in press, together with other sheets for the Lesser Antilles, as (7).

Bois de prune blanc (local name)

EUPHORBIACEAE

STATUS Endangered. On Mauritius it is known from 2 trees, one found in 1975 and one in 1976, after the species had been believed to be extinct on the island for over 120 years. The two trees are on different parts of the island. On Réunion about 12 individuals are still known to be surviving; one of the finest examples was felled in 1975 as it was overhanging a road. The greatest threat, however, is the felling of the remaining trees for their timber. The species is dioecious (i.e. male and female flowers on separate trees) and so doubly endangered, especially since the remaining individuals are scattered and therefore may be prevented from breeding.

DISTRIBUTION Mauritius and Réunion, Indian Ocean.

HABITAT AND ECOLOGY On Réunion, scattered in the low to mid-altitude forests, up to 800 m.

CONSERVATION MEASURES TAKEN An informal agreement has been made by the Réunion Forestry Service (ONF) not to cut any further individuals of the species in the Mare Longue Valley, Réunion. Efforts are being made to bring the species into cultivation on Réunion and reintroduce it into existing reserves.

CONSERVATION MEASURES PROPOSED As above; further measures are under consideration but not yet defined.

BIOLOGY AND POTENTIAL VALUE It is a medium-sized tree and is known to have been a source of good hard timber in the past (2). In addition to 'Bois de prune blanc' it is also known as 'corce blanc bâtard', with variations on this (2). Since only some of the indigenous tree species of the Mascarenes have local names, *Drypetes caustica* was presumably much more common in the past and probably of value to man. Its mustard oils make it of chemical interest. It was originally placed in the genus *Guya* of the *Flacourtiaceae*, but a report of its oils led to its correct placing in *Drypetes* (1).

DESCRIPTION Tree up to 20 m tall with pitted, pale greyish bark and dense, dark, dull green foliage; leaves elliptic or ovate-elliptic, 5-10 cm long, tapering towards the tip, on stalks 5-10 mm long. Flowers on short stalks, solitary or in clusters of 2-4 arising from persistent, more or less woody knots; petals absent; males with 3-5 lobed calyx, more or less circular or concave, c. 5 mm long, and numerous short stamens. Females apparently with similar calyx and 2 stigmas. Fruit spherical to ellipsoid, orange-yellowish with brown dots, hairy.

For an illustration see (2).

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This sheet is based on information provided by Mr M.J.E. Coode (of the Royal Botanic Gardens, Kew, U.K. and formerly of the Flore des Mascareignes project), to whom the TPC is most grateful. Help is also gratefully acknowledged from Dr Th. Cadet of L'Herbier de la Réunion, Université Française de l'Océan Indien.

EUPHORBIACEAE

STATUS Endangered; a very unusual succulent which was reduced to four clumps in one locality in 1967. The reasons for its decline are obscure: livestock do not touch it since it is highly poisonous. The island where it occurs is now too barren to support any goats permanently and those belonging to the 20 or so inhabitants have to be taken periodically to Socotra to graze. Presumably the island was less barren in the past as the species was much more abundant in the last century (see below).

DISTRIBUTION Abd al Kuri (an island 35 km long in the Socotran Archipelago which is an Island Territory of the People's Democratic Republic of Yemen, lying about 100 km east of the Horn of Africa). The single site is on the Qarat Saleh (or Jebel Hassala), the main backbone of the island. In the past the *Euphorbia* grew all over one side of this ridge from about 150 to 450 m (1).

Abd al Kuri is much more barren than Socotra and the majority of the island is semi-desert with little or no vegetation. The scanty flora resembles that of the Arabian or Somali mainland, and few of the Socotran endemics are represented. However, there are at least six species of flowering plants endemic to Abd al Kuri alone. Due to their extremely low population sizes, five of these are considered Endangered.

HABITAT AND ECOLOGY At about 230 m on granitic gravel slopes more or less bare of vegetation. However, in 1966, it was found by K.J. Virgo on limestone slopes at about 270 m.

CONSERVATION MEASURES TAKEN All succulent species of *Euphorbia* are included in Appendix 2 of the 1973 Convention on International Trade in Endangered Species of Wild Fauna and Flora.

CONSERVATION MEASURES PROPOSED None on record.

BIOLOGY AND POTENTIAL VALUE With its succulent stems lacking both leaves and thorns, described by Balfour as forming "a forest of green candles" (1), *E. abdelkuri* is a very strange and remarkable *Euphorbia*. It is believed to be the only species in the genus with a yellow sap. This is very poisonous. When stocks have become built up from the material at present in cultivation, it will surely become a species highly prized by growers of succulent plants.

CULTIVATION It is being grown at the Royal Botanic Gardens, Kew, U.K., and at other gardens, especially in California where there are reputed to be 5 different clones in cultivation. It appears to be very slow-growing. It can be propagated by removing the top of the stem and treating it as a cutting.

DESCRIPTION Leafless and thornless succulent, usually up to 2 m high, forming dense clumps of numerous, erect, unbranched stems, pale grey-green in colour, more or less cylindrical, being slightly constricted at intervals. Young shoots grey-pink, wrinkled at the surface. Cyathea turbinate, in contracted cymes borne towards the top of the stems. Fruits trigynous, dull green.

For illustrations see (1) and (2).

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This sheet is based upon information provided by Mr A. Radcliffe-Smith (of the Royal Botanic Gardens, Kew, U.K.), to whom the TPC is most grateful.

EUPHORBIACEAE

STATUS Endangered, if not already extinct. Although found in about 5 localities since 1913, only one bush at one of these localities (Duberin Pass) could be found in 1960, despite a thorough search of the neighbouring area (2). A single bush was later found at another of the localities (Bihendula) in 1973. The species had meanwhile also been found surviving at a third and most westerly locality (Amut Pass) in 1969, where according to C. Hemming it still occurred in quantity; however it is more than likely that during the drought of the 1970s these three stands were much reduced if they have not disappeared altogether. The situation is likely to be similar at the other two known localities, which have not been visited recently, and anywhere else it may occur, and the species is clearly in imminent danger of extinction if indeed it still survives. Its decline is due to overgrazing and the consequent environmental changes over the whole of the Horn of Africa. As a succulent shrub whose latex in its soft and fleshy branches is only mildly irritant, it has been readily eaten by livestock, mainly camels but also sheep and goats. During long, dry periods it is heavily exploited as a source of moisture in this arid region.

DISTRIBUTION Somalia; in the central northern part of the country, around the Golis Mountains. A dot map of 4 of the 5 localities is given in (2). The 1905 record for Malawi (then Nyasaland) cited in (3) has been shown to be in error (1).

HABITAT AND ECOLOGY Mostly on rocky hillsides, although one locality is a sandy alluvial plain.

CONSERVATION MEASURES TAKEN None for the wild populations. All succulent species of *Euphorbia* are included in Appendix 2 of the 1973 Convention on International Trade in Endangered Species of Wild Fauna and Flora.

CONSERVATION MEASURES PROPOSED None on record.

BIOLOGY AND POTENTIAL VALUE It has economic potential as a food plant for livestock in arid areas, and, as mentioned above, it could provide a useful source of moisture in dry periods. It has value as an ornamental with its comparatively large white bracts and would make a suitable hedge plant in coastal towns along the Somali coast. The only other species of *Euphorbia* in Somalia with showy white bracts is *E. leucochlamys* Chiov. which is only known from an extremely small area, but is more abundant there than *E. cameronii*.

CULTIVATION It has been brought into cultivation with material both

in Kenya and in the U.K. There is a single fertile plant at Olorgesailie (900 m) in Kenya, grown from material gathered by Bally at Bihendula.

DESCRIPTION Much-branched succulent unarmed hairless bush to 3 m high and 3.5 m across, branching from the base, with a dense conical crown. Branches cylindrical, 1.5-3 cm thick, with spirally arranged leaf scars. Leaves terminal, fleshy, obovate. Flowers small, with yellowish-green glands, occurring at the apex of the branches and branchlets, subtended by a whorl of 3-5 conspicuous white involucral bracts each up to 1.5 cm long and developed after the leaves have fallen. Capsule nearly spherical, obtusely 3-lobed, with 3 chambers, up to 15 mm long by 16 mm across (2).

For illustrations see (2).

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This sheet is based upon information provided by Dr P.R.O. Bally (of Nairobi) and Miss S. Carter (of the Royal Botanic Gardens, Kew, U.K.) to both of whom the TPC is most grateful.

EUPHORBIACEAE

STATUS Endangered; a spiny cactus-like spurge which only occurs in 3 small valleys. In 1924 it was found to be "enormously abundant" in 2 of them, forming "a continuous open shrubbery of millions of bushes on the eastern side" of one valley but surprisingly not occurring on the other side (7). However it has recently become very rare in these localities (1). The main reason for its decline is that it has been parasitised by a stem-boring beetle. It is also likely to have been depleted by collecting of the plants for horticulture.

DISTRIBUTION Canary Islands. It occurs near the coast in the lower parts of the valleys which lead southwards from the ridge of the Jandia Peninsula in the south west of Fuerteventura.

Out of 17 species of flowering plants endemic to Fuerteventura, 5 are Endangered, 3 are Vulnerable and 6 are Rare. Because of its low rainfall the island has a much more arid vegetation than that of the western Canaries, more resembling the vegetation of north Africa (7).

HABITAT AND ECOLOGY On sand and rock debris up to 150 m, originally forming extensive colonies. Jandia is a high volcanic ridge with steep slopes on either side dropping down to the coast. The region is very arid and the flora contains many interesting species such as the Endangered *Pulicaria burchardii* Hutch., which is only known from a small area of a few square metres with about 4 plants (1). On the summits occur a number of rare species such as *Argyranthemum winteri* (Svent.) Humphries and the blue-flowered *Echium handiense* Svent. (1), both of which are endemic to this area and Endangered.

CONSERVATION MEASURES TAKEN All succulent species of *Euphorbia* are included in Appendix 2 of the 1973 Convention on International Trade in Endangered Species of Wild Fauna and Flora. A survey of the conservation status of the flora of the Province of Las Palmas, which includes Fuerteventura, has been made by Kunkel, grant-aided by IUCN/WWF (6). Many of the threatened Canarian endemics are in cultivation under semi-natural conditions at the Jardín Botánico Viera y Clavijo on Gran Canaria. A seed bank for threatened Macaronesian and Iberian species has recently been set up at the Universidad Politécnica, Madrid.

CONSERVATION MEASURES PROPOSED The Jandia Peninsula should be considered for a nature reserve. Part of it is included in a recent account of Outstanding Landscapes (5). Spain should also ratify the 1973 Convention as a matter of urgency.

BIOLOGY AND POTENTIAL VALUE It is a local endemic of scientific interest, requiring further study. It is also a desirable succulent for horticulture.

CULTIVATION Seeds germinate readily but growth is slow, the plants attaining the size of a pea in the first season and taking 5 years to reach about 10 cm. Damage to plants on transplanting may be fatal.

DESCRIPTION Cactus-like succulent 50-100 cm high, often densely branched. The numerous and crowded, erect stems are cylindrical, 6-8 cm thick and fluted with 8-14 longitudinal ridges which bear at regular intervals pairs of straight spines 2-3 cm long and a tuft of spines at the apex. Flowers greenish to red, 3 mm long, borne singly or in pairs, each surrounded by 2 half-round, nearly black bracts. Capsule brown or red.

For illustrations see (1), (2), (3) and (4).

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The TPC is most grateful to Dr D. Bramwell, of the Jardín Botánico Viera y Clavijo, Gran Canaria, for help in producing this sheet.

EUPHORBIACEAE

STATUS Endangered. It was first discovered by Wakefield in 1880, found again in 1921 and again in 1948. In recent years it has entirely disappeared from its principal locality (Miritini) due to the destruction of the coastal forests surrounding Mombasa, although it survives in 2 nearby areas, both of which are threatened by ever-increasing land-use. It is also known from a few other localities further north, at one of which it was still surviving in 1976 and at another in 1971, but it is threatened in these areas by destruction of the surrounding forests for charcoal and for agriculture. In only one locality is the population believed to be over 100 trees and here it is becoming severely threatened.

DISTRIBUTION Kenya; scattered localities in coastal forest near and to the north of Mombasa, Coastal Province. A dot map of its distribution is given in (1).

HABITAT AND ECOLOGY On rocky coral outcrops of Jurassic limestone in dense scrub and forest. In one locality it was found by Mabberley growing with *Pandanus rabaiensis* Rendle, *Encephalartos hildebrandtii* A.Brown & Bouché, *Sansevieria* spp. and other succulents; the site had been burnt over several times and many of the other trees were already dead. These outcrops have a very interesting flora with a strong pachycaul element of cycads, aloes and pandans. An African Violet, *Saintpaulia rupicola* B.L.Burtt, which is also a rare species, is found in the vicinity.

CONSERVATION MEASURES TAKEN None for the wild populations. All succulent species of *Euphorbia* are included in Appendix 2 of the 1973 Convention on International Trade in Endangered Species of Wild Fauna and Flora.

CONSERVATION MEASURES PROPOSED At least one locality should be protected.

BIOLOGY AND POTENTIAL VALUE It is of interest in that it reproduces vegetatively by producing trailing lower branchlets which produce clusters of roots where they touch the soil, giving rise eventually to a dense stand of trees.

CULTIVATION It is in cultivation at the Royal Botanic Gardens, Kew, U.K., and in a few gardens in Kenya.

DESCRIPTION Tree with a palm-like growth, i.e. a slender erect trunk 7-15 m high with a small crown of slender but succulent, 3- to 4-angled branches, the angles toothed with each tooth surmounted by a pair of slender needle-like spines up to 1 cm long. Branches rarely more than 150 cm long, sparsely rebranched. Leaves terminal, minute, only on the young growth. Flowers very small, in terminal clusters. Fruits 3-lobed, with 3 chambers (1).

For a line drawing see (1).

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This sheet is based upon information provided by Dr P.R.O. Bally (of Nairobi, Kenya) and Miss S. Carter (of the Royal Botanic Gardens, Kew), to both of whom the TPC is most grateful. Help is also gratefully acknowedged from Dr D.J. Mabberley, University of Oxford, U.K.

EUPHORBIACEAE

STATUS Endangered. Grazing by cattle and goats and rooting by pigs were probably important factors in its decline, but the reason for the death of the remaining trees is obscure. In this dioecious species the population may be now too small for its survival (see Biology and Potential Value, below).

DISTRIBUTION Hawaiian Islands. It is very scarce in a few remote valleys on the Waianae Mts., Oahu; many of the trees were reported to be dying (3). It was probably widespread on the islands in former times. One tree, now dead, was seen on Molokai and the species was also found at Kapua, South Kona, Hawaii where it is possibly now extinct. A single tree was reported from Kauai (3).

The flora of the Hawaiian Islands is one of the most severely threatened floras in the world, in particular because of the intense pressures on land for development and the effects of introduced grazing animals. A remarkably high 97% of the flora is endemic to the islands. Initial estimates by Fosberg and Herbst indicate that at least 273 species, subspecies and varieties are Extinct and 800 Endangered (some of which are protected). The authors emphasise that these figures are premature and tentative (1).

HABITAT AND ECOLOGY In dry forest on rough lava flows on steeply sloping valley sides, the associates on Hawaii being *Antidesma* spp., *Pittosporum hosmeri* Rock, *Alphitonia, Colubrina oppositifolia* Brongn. and local endemics (2).

CONSERVATION MEASURES TAKEN None known.

CONSERVATION MEASURES PROPOSED Both sexes should be brought into cultivation, propagated vegetatively and when seed or plants are available, should be reinstated in the wild.

BIOLOGY AND POTENTIAL VALUE Male and female flowers are on separate trees and are probably insect-pollinated, but the reproductive biology needs study. There are probably so few trees surviving that the chance of fertilisation is small, a situation that must lead inevitably to extinction. The reason for the death of trees of various ages in the wild needs investigation. The timber is hard, close grained and heavy, with red sapwood and black heartwood; it should make a fine cabinet wood (2). The species is reputed to be the largest tree in the Hawaiian flora and huge dead trunks of it are occasionally found in the forest.

CULTIVATION Because of the size of the remaining trees it has been very difficult to collect seeds; in addition cuttings have proved very difficult to root.

DESCRIPTION Tree 10-30 m high with a trunk up to 1.6 m across, covered by grey brown bark, rough and scaly. Leaves ovate, 8-14 cm long, light green and glossy above, dull beneath. Male flowers crowded in small clusters at the nodes, individually 1.5 mm in diameter, greenish yellow with 5 minute sepals and 3-5 stamens; female flowers with rounded sepals 1 mm long and an ellipsoid ovary crowned by stalkless stigmas. Fruits berry-like, 6 mm across, spherical, reddish black, breaking into 3 segments each with 2 (or rarely 4) pale yellow seeds c. 2 mm long (2).

For an illustration see (2).

REFERENCES 1. Fosberg, F.R. & Herbst, D. (1975). Rare and Endangered Species of Hawaiian Vascular Plants. Allertonia 1(1).

2. Rock, J.F. (1913). The Indigenous Trees of the Hawaiian Islands. Honolulu. Pp. 245-246 & t. 92, 93. (Reprinted 1974 by Pacific Tropical Botanical Garden and Charles E. Tuttle Co., Rutland, Vermont.)

3. Sherff, E.E. (1939). Additional Studies of the Hawaiian *Euphorbiaceae*. Publs Field Mus. nat. Hist. Bot. 17: 562-563. (As *Drypetes phyllanthoides*.)

GENTIANACEAE

STATUS Vulnerable. Populations are threatened by farming activities and by the large scale exploitation of water resources in the region of the *locus classicus* (1,3). Until recently the species was probably present in most or all of the spring areas of the region; it is now restricted to a few localities in which remnants of vegetation and free-flowing water remain (3). Unconfined livestock, overgrazing and trampling have also contributed to its destruction. In California at least part of its population is endangered and declining (2).

DISTRIBUTION U.S.A.; known from several sites in the spring areas of northern and eastern Ash Meadows (1), southwestern Nye County, Nevada, and adjacent areas in Inyo County, California (3). In 1969 it was common in the *locus classicus* (1).

HABITAT AND ECOLOGY At altitudes of 670-720 m, in the Amargosa River drainage. In Ash Meadows it grows in wet *Distichlis* meadows close to springs and streams. On these sites it is often found with *Sisyrinchium funereum* E.P.Bicknell and *Grindelia fraxino-pratensis* Reveal & Beatley. In Ash Meadows and in California it also grows on alkaline clay soils of low uplands where some seepage is apparently available; on these drier sites it is often found with *Ivesia eremica* (Coville) Rydb., *Cordylanthus tecopensis* Munz & Roos, and *Cleomella brevipes* S.Watson (3).

CONSERVATION MEASURES TAKEN It was proposed as 'Endangered' by the U.S. Department of the Interior, Fish and Wildlife Service, on 16 June 1976. The Endangered Species Act of 1973 directs that no federally-funded activity shall jeopardise the existence of species once officially determined as 'Endangered' or 'Threatened', as defined by the Act.

CONSERVATION MEASURES PROPOSED Protection for as many of the existing sites as possible. Beatley in (1) recommends that certain privately owned but as yet unploughed parcels of land be preserved; the flora of these areas is critically endangered by farm operations and also by extreme overgrazing and trampling by free-ranging horses. Of the six plant species strictly endemic to Ash Meadows, five occur on a c. 20 ha tract within this area: one is *Centaurium namophilum;* the other four, all designated as Endangered by the Smithsonian, are *Grindelia fraxino-pratensis, Mentzelia leucophylla* T.S.Brandegee, *Ivesia eremica* and *Astragalus phoenix* Barneby (also in the Red Data Book).

BIOLOGY AND POTENTIAL VALUE Of all the North American species of *Centaurium,* it is most clearly related to *C. trichanthum* (Griseb.) B.L.Robinson (3). Flowering is from July to September, fruiting to October (3).

DESCRIPTION Erect hairless annual with yellowish to tannish green stems up to 45 cm high. Leaves opposite, linear to linear-lanceolate, up to 5 cm long by 5 mm wide, the blade rigid with an acute, sharp tip. Flowers in a panicle usually more than half the length of the plant; corolla with a slender greenish tube 7-8 mm long and 5, narrowly elliptic, spreading lobes 7-8 mm long, deep rose pink except for a broad whitish central band on the lower surface. Capsule 7-8 mm, narrowly fusiform (3).

For illustrations see (1) and (3).

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Old Father Live Forever

GERANIACEAE

STATUS Endangered. It was very rare in 1875 (4); several thriving plants were found in 1970 but nevertheless the population is drastically low (1). As an island endemic, its decline was caused by the introduction of goats in 1513 which formed herds nearly 2 km long within 75 years. They devastated the forests originally covering the island (4). In recent years the goats have been effectively controlled and few if any survive today (see Conservation Measures Taken, below).

DISTRIBUTION St. Helena, South Atlantic. It occurs in the south west of the island and was recorded from several localities in 1875 (4).

Out of about 30 endemic species of angiosperms known from St. Helena, 10 are Extinct and 15 Endangered. J.D. Hooker (quoted in 4) estimated that there must have been about 100 endemic species in this "wonderfully curious little flora" since the forests which orginally covered the island had been reduced to a few high-altitude areas on the central ridge when the island was first thoroughly explored botanically in 1805-1810. Most of these species will never be known.

HABITAT AND ECOLOGY It clings to more or less inaccessible, barren and exposed rocky cliffs at 150-300 m, overhanging the sea on the windward side of the island. This area of rocky desert and cliff has a rainfall of only 15-38 cm per year (1). Because of the plant's ability to retain vitality for months without either soil or water the St. Helenans named it 'Old Father Live Forever' (4).

CONSERVATION MEASURES TAKEN Since the 1950s the ranging feral goats have been progressively cleared from specified areas of the island, resulting in their virtual extermination. None were seen by Kerr in 1970, although it is possible that a few may still persist in the 'Barn' area. Their removal has "had a remarkable effect in allowing the regeneration of some species, in particular 'Scrubwood' *(Commidendron rugosum)* ... On the precipitous cliffs of the South West there has been a substantial increase in the vegetation, including some of the rarer endemic species, *Pelargonium cotyledonis, Frankenia portulacaefolia* and *Plantago robusta*" (1). Unfortunately this does not apply to the forest areas on the central ridge where the majority of the endemics occur.

A detailed survey (1) of the St. Helena endemic flora was made in 1970 by Kerr, under the auspices of the Royal Society and the International Biological Programme. Considerable success was achieved in alerting the islanders to the international importance of the endemic flora and to the threats to its existence.

CONSERVATION MEASURES PROPOSED Despite the plant's increase in recent years, it is felt that a small reserve in the south west of the island would be advisable to safeguard it in the long term.

BIOLOGY AND POTENTIAL VALUE The *Pelargonium* was described by Melliss (4) as the most curious member of the endemic flora which itself is of great interest.

CULTIVATION It is in cultivation locally and in botanic gardens in the U.K. Seeds from ripe fruits germinate freely and new plants can be raised in greenhouses in the U.K.

DESCRIPTION Perennial herb, for most of the year a thick and contorted, leafless and woody, brown stem 3-15 cm thick, up to 30 cm high, but producing in about May or June a loose rosette of wrinkled, more or less orbicular leaves 2-5 cm long on stalks up to c. 8 cm long; leaf blades minutely hairy above, paler and tomentose below, the stalk attached towards the centre of the underside (peltate). In the centre of the rosette is borne a slender scape 20 cm or more high, bearing loose compound umbels of flowers each with 5 white spreading obovate petals 10-14 mm. Fruits linear, ribbed, up to 2 cm long, emerging from the small cup of the persistent sepals.

For illustrations see (2) and (4).

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The TPC is most grateful to Mr N. Kerr, of Suffolk, England, and to Mr. R.O. Williams, Agricultural and Forestry Officer, St. Helena, for help in producing this sheet.

Interrupted Brome

GRAMINEAE

STATUS Extinct; a grass of arable fields which has not been seen in its last known station since 1972. Conservation action by the local Naturalists' Trust did not succeed in saving the species. It was previously more widespread; its decline was probably due to the use of improved seed-cleaning methods.

DISTRIBUTION United Kingdom. It was first discovered in 1849, in Cambridgeshire. Perring (4) records that its spread (or recognition) in Britain was fairly rapid, the species becoming widespread and locally abundant in scattered localities in south and central England. It seems to have reached its maximum extent in the first two decades of this century and has been recorded from c. 65 '10 km' squares, in 27 vice counties. Since about 1930 its decline has been dramatic and only 6 records have been traced during the last 25 years. The last known locality was in Cambridgeshire (4). The species has also been found in the Netherlands where it is regarded as an introduction (3,4).

HABITAT AND ECOLOGY "In fields of sainfoin (*Onobrychis viciifolia* Scop.), rye-grass (*Lolium* spp.), and clovers (*Trifolium* spp.), its seeds being distributed with the seeds of these fodder plants" (3). In Cambridgeshire at least, *Bromus commutatus* Schrader appears to have been a constant associate (4).

BIOLOGY AND POTENTIAL VALUE "It is a very distinct species, easily separated from all other species of *Bromus* by the split palea ... The arrangement of spikelets in small dense clusters of three gives the spike-like panicles the appearance of an ear of wheat, and provides another distinguishing characteristic" (3). Its origin is not certain; at first it was assumed that it had been introduced with imported seed (4). However it has not been matched with specimens from elsewhere (2) and it was given specific rank by Druce in 1895 (1), having been described originally by Hackel as a variety of *Bromus mollis* L.

In Europe 2 other species in the predominantly annual section *Bromus* of the genus are Extinct or on the verge of extinction. *Bromus bromoideus* (Lej.) Crépin was endemic to Belgium with an outlying station on the border with Luxembourg. It is now believed Extinct. The closely related *Bromus grossus* Desf. ex DC. has a similar but possibly wider distribution, occurring in some areas as a casual. It is not certain whether or not it is Extinct. Both species occurred in fields of spelt (*Triticum spelta* L.) (6). The possible origins and relationships of these species and of *B. interruptus* are discussed by Smith in (5).

DESCRIPTION Annual or sometimes biennial grass, 20-100 cm high, with erect, unbranched, loosely tufted or solitary culms with 2-4 nodes,

minutely hairy. Leaves green, the tubular sheath softly hairy below, the ligule membranous, toothed, 1-2 mm long, and the blade pointed, 6-20 cm x 2-6 mm, linear, also softly hairy. Panicles stiffly erect, dense, oblong, usually interrupted, 2-9 cm long by up to 2 cm wide, greyish-green. Spikelets in dense clusters, broadly ovate to broadly oblong, 10-15 mm long by 5-8 mm wide, with 5-11 florets. Lemma obovate, 7-9 mm long, palea shorter, split to the base (3).

For an illustration see (3).

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This sheet is based upon information provided by Dr F.H. Perring (of the Biological Records Centre, Institute of Terrestrial Ecology), to whom the TPC is most grateful. Help is also gratefully acknowledged from Dr T.A. Cope.

Perennial Teosinte

GRAMINEAE

STATUS Extinct in the wild but surviving in cultivation, from a single plant gathered in 1910. It has been propagated vegetatively by the U.S. Department of Agriculture and distributed to botanic gardens. De Wet and others have recently searched for it near the original locality and conclude it is now extinct in the wild, because of grazing (7).

DISTRIBUTION Mexico. It was known from only one locality, less than one sq. mile in extent, near Ciudad Guzmán in Jalisco (7), where it was seen in 1910 and 1921 (4).

HABITAT AND ECOLOGY No information.

BIOLOGY AND POTENTIAL VALUE It is of great interest and importance as one of the few wild relatives of maize, *Zea mays* L. ssp. *mays*, and is considered by some, e.g. Iltis in (6) and Reeves & Mangelsdorf in (8), as belonging to the genus *Zea*, a genus otherwise containing only cultivated maize, annual teosinte (*Z. mays* ssp. *mexicana* (Schrader) Iltis) and *Z. mays* ssp. *luxurians* (Durieu) Iltis, from Guatemala. *E. perennis* hybridises readily with both cultivated maize and annual teosinte; the characters of the progeny are described in (1), where hypotheses are also given for the origin of *E. perennis* as an autotetraploid.

The origin of cultivated maize is uncertain - for a general survey of this problem see (2) - but for at least three millenia annual teosinte has been growing at the edges of fields of cultivated maize in Mexico, where the two hybridise. Annual teosinte has provided a limited gene flow into the crop, giving it variability and heterotic vigour. This process is in danger of disappearing as annual teosinte is rapidly declining in the wild due to grazing and changes in agricultural techniques (9). Wilkes remarks, "Teosinte and the native races of maize in Mexico form a vital part of the genetic underpinnings of the world corn crop" (9).

Also cause for concern is that in recent years many of the variable and genetically diverse races of cultivated maize have been replaced by new and uniform cultivars based only on a very small fraction of the gene pool (3). The very uniformity of the modern crops greatly increases their vulnerability to pests and diseases, and so it is absolutely essential that both the wild relatives and the range of variation within the crop itself are preserved as the genetic base for future breeding.

CULTIVATION The plant is easy to propagate vegetatively (by division and at some times of the year by rooting at the nodes). It is self-fertile.

DESCRIPTION Perennial grass with strong scaly rhizomes and erect stems 1-2 m high; leaf blade linear or linear-lanceolate, up to 40 cm long by 3 cm wide, with a prominent white vein on the underside; ligule short, somewhat lacerate, 1-2 mm long. Terminal inflorescence of male florets only, consisting of 2-5 ascending or spreading racemes 6-12 cm long; spikelets in pairs, each 2-flowered, 8-9 mm long. Female inflorescences in the leaf axils, partly protruding from the sheaths, each wrapped in one or more sheathing bracts, consisting of a jointed axis 3-6 cm long by 4-5 mm thick into which the spikelets are sunk (4). (Syn. *Zea perennis* (A.S.Hitchc.) Reeves & Mangelsd.)

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GRAMINEAE

STATUS Presumed extinct. It was only known from the spray zone of a single waterfall and has become extinct there due to diversion of the water for a hydro-electric scheme and resultant desiccation of the habitat. Nevertheless, other waterfalls in the region with suitable spray zones should be searched for this species.

DISTRIBUTION India. The only known locality was the Gersoppa Falls of the Sharavati River, Jog, North Kanara, Karnataka.

HABITAT AND ECOLOGY It was presumably an annual and confined to the rocks in the spray zone of the waterfall, growing in the monsoon season (June-October), but dried up for a large part of the year and aestivating by seed.

BIOLOGY AND POTENTIAL VALUE It is a remarkable species of great scientific interest, and the only representative of the grass tribe *Hubbardieae* (2). "Nothing like the structure of the spikelet is to be found in any known genus of grasses" (1). A description of its unique characters and a discussion of its systematic position is given by Bor in (1).

It is also of interest as being adapted to its unusual habitat, especially through the extremely delicate texture of the leaves which "indicates that they could only exist in an atmosphere which is super-saturated, as the air in the neighbourhood of the falls certainly is" (1).

DESCRIPTION Trailing or pendulous annual grass with the slender stems rooting at the nodes and bearing translucent, pale green, exceedingly thin leaves 2-3 cm long. Leaves elliptic to oblong-elliptic, rough on the margin, attached to a short sheathing base without a ligule. Flowering panicles slender, numerous, arising from the nodes; spikelets ellipsoid, 2-3 mm long, with 2 glumes as long as the spikelet, oblong-acute and marked with (5-) 7 conspicuous longitudinal veins. Grain spindle-shaped, 1.25 mm long.

For illustrations see (1) and (2).

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GRAMINEAE

STATUS Endangered. This grass is known from the *locus classicus*, a shallow, intermittent lake about 500 m in diameter, where it was first discovered in 1958 (1,4).

The vernal pool habitat in which this species and several other rare and endangered species of the genus occur has been greatly depleted. Agriculture has claimed very large areas in the Central Valley of California and areas unprofitable for agriculture have been zoned for industrialisation (3). The California Native Plant Society has listed this species as totally endangered, with a declining population (5).

DISTRIBUTION U.S.A.; a single lake in Solano County, California. It occurs in only a few patches on the surface of the lake bed, in the deeper portions and on areas of cracked alkali, but not on the white smooth alkali pavement that is characteristic of much of the lake (1).

HABITAT AND ECOLOGY The predominant vegetation in the lake basin is *Frankenia grandifolia* Cham. & Schlecht., *Cressa truxillensis* H.B. & K., *Sida hederacea* (Douglas) Torrey, *Eryngium aristulatum* Jepson, with some patches of *Eleocharis palustris* (L.) Roemer & J.A.Schultes. The soil type is classified as the Lindsey clay loam series; organic matter is low and most areas of the lake contain alkali (1).

All species of *Orcuttia* are restricted to the larger vernal pools, being found in those ranging from 20 to 100 m or more in diameter or length. The best stands occur mostly in the absence of other vegetation and long periods of standing water are a necessity (1). Rainwater collects during winter and spring due to a dense claypan or hardpan lying at some depth below the surface. By late spring or early summer all but the largest pools have evaporated (1,3). These wetland areas are best developed in the rolling plains surrounding the Central Valley of California.

CONSERVATION MEASURES TAKEN It was proposed as 'Endangered' by the U.S. Department of the Interior, Fish and Wildlife Service, on 16 June 1976. The Endangered Species Act of 1973 directs that no federally funded activity shall jeopardise the existence of species once officially determined as 'Endangered' or 'Threatened', as defined by the Act.

CONSERVATION MEASURES PROPOSED Formal determination as an 'Endangered' species and hence protection under the Act.

Since vernal pools occur in a wide range of sizes and depths and on several different soil types, any vernal pool preserve system should contain pools representative of the entire range of types. Examples throughout the Central Valley, in every county, should be included, as well as in southern California, wherever they may still be found. A survey, using aerial photographs, should be conducted to determine areas of high priority for conservation efforts (3).

BIOLOGY AND POTENTIAL VALUE This species, as a plant endemic to vernal pools, is of considerable scientific value. *Orcuttia*, together with the monotypic genus *Neostapfia*, has no close relatives within the *Gramineae*, and probably represents a relict group. In the genus *Orcuttia*, certain characteristics such as viscidity, strong aroma and non-shattering inflorescences can be interpreted as adaptations to the vernal pool environment. The viscidity and strong aroma may prevent desiccation and predation by rodents and insects (1).

The florets are dispersed aquatically in the fall and winter (1,2). The fruits can endure and require a long period of immersion, even for as much as 6-7 months; thus during the years of very low rainfall, the seed deposited during the previous season (or seasons) fails to germinate (1,2).

DESCRIPTION Small, pilose, yellow-green, aromatic annual grass. Culms ascending, up to 12 cm high. Leaves sticky, 1-4 cm long, somewhat rigid, curved outwards. Inflorescence a solitary raceme 1.5-6 cm long, of 7-19 spirally arranged spikelets, each 7-13 mm long and 5-10 flowered (1).

For illustrations see (1).

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The material for this sheet was supplied by the Endangered Flora Project of the Smithsonian Institution, Washington, D.C., to whom the TPC is most grateful.

Bavarian Feathergrass

GRAMINEAE

STATUS Endangered. It is only known from one locality where it occurs as a few tufts on a rocky platform much visited by tourists for the magnificent view. This critically low population is hence at great risk, although all possible measures for its conservation have been taken.

DISTRIBUTION Federal Republic of Germany. The single locality is near Neuburg an der Donau in Bavaria and overlooks the River Danube. The first record of this grass dates back to 1848.

HABITAT AND ECOLOGY The plants grow at the upper edge of a prominent rocky ledge of Jurassic limestone in part of a narrow valley. On this exposed site, covered by steppe-like vegetation, it is associated with species such as the grass *Sesleria varia* (Jacq.) Wettst., the sedge *Carex humilis* Leysser, *Hippocrepis comosa* L. and *Inula hirta* L.

CONSERVATION MEASURES TAKEN The vegetation cover of the area in which it occurs is protected by legislation. A reserve has been effectively fenced to prevent further destruction of the vegetation and removal of the plants by tourists and collectors. Plants have been grown in cultivation from wild-collected seed and re-introduced into the wild in the original locality.

CONSERVATION MEASURES PROPOSED None.

BIOLOGY AND POTENTIAL VALUE It is of scientific interest as a connecting link between *Stipa pulcherrima* C.Koch and *S. dasyphylla* (Lindem.) Trautv. Regeneration by seed is possible in the natural, undisturbed habitat.

CULTIVATION It is relatively easy to grow from seed if normal care and precautions are taken.

DESCRIPTION Tufted perennial grass up to 70 cm high with grey-green, rather long leaves, the lower leaf-sheaths densely hairy, the upper ones hairless; ligule 1-3 mm long, obtuse or toothed, hairy; blades pointed, with many ribs, hairy above, scabrous or hairy beneath. Panicle contracted, with 6-9 spikelets; glumes subequal, 3-8 cm long, attenuated into a fine awn; lemma 23-25 mm long, on the back with 7 lines of hairs, and with an awn 33-41 cm long.

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The material for this sheet was supplied by Dr H. Scholz to whom the TPC is most grateful.

Eureka Dune Grass

GRAMINEAE

STATUS Vulnerable. It is restricted to a few sand dune sites in California and is rare in all localities (4,6). The *locus classicus*, the Eureka Dunes, is threatened by off-road-vehicles (ORVs) whose users are especially attracted to its steep slopes (9). In the pursuit of recreation, trail bikers, dune buggy riders and other ORV users cut across the dunes destroying the grass and its spreading rhizomes (9). These people have been described as reckless and extravagant, consuming entire landscapes to satisfy a pastime (3). Unless their activities are completely banned in these dune areas, it is likely that the grass will become extinct.

DISTRIBUTION U.S.A.; California. The largest population is on the slopes of the Eureka sand dunes, southern Eureka Valley, Inyo County, at c. 915-1065 m (4). The Eureka Dunes are an oblong ridge c. 5 km long, 2 km wide and 215 m high, situated in the Last Chance Mountains (1). In 1950 the species was reported to have been abundant on the north side of a large dune at the south end of the valley; it is now found nearly to the summit on the steep west face of the dunes (1). Another moderately large population, covering around 100 ha, is restricted to the small dunes at the mouth of Marble Canyon, Inyo Mountains (4) and individuals have been reported from a few dunes in Owen's Valley, Inyo County. To the south of Eureka Valley there is a small population on the shallow sand dunes of the Saline Range, west of the main dune.

HABITAT AND ECOLOGY It is a coarse grass that forms extensive masses of dense tussocks on sand dunes in creosote scrub, a plant community found in deserts between southern Owen's Valley, California, and Mexico; it is characterised by widely spaced shrubs 0.6-2.5 m tall, growing in well drained soils of slopes and valleys, usually below 1050 m (4,8).

CONSERVATION MEASURES TAKEN The ORVs are at present restricted from the dunes. In October 1976 the Bureau of Land Management (BLM) banned motor vehicles from the area, but allowed the dunes to remain open for any other public recreational use. This restriction is difficult to enforce, however, and vehicles still occasionally invade and abuse the area (9). *Swallenia alexandrae* has been determined to be 'Endangered' under the Endangered Species Act of 1973 (10). The Act directs that no federally-funded activity shall jeopardise the existence of species once officially determined as 'Endangered' or 'Threatened', as defined by the Act.

CONSERVATION MEASURES PROPOSED It has been suggested that the Eureka Dunes be established as a national monument. This would help ensure the protection of these unique dunes and the variety of rare endemics

they support (1). The BLM is currently considering designating the dunes as an 'outstanding natural area'. Such an assignment would provide better protection and would also encourage more scientific study (9).

BIOLOGY AND POTENTIAL VALUE It is the only species in the genus and thus of some scientific importance. Its spreading rhizomes bind the sand effectively, so helping to stabilise the slopes; its loss, in conjunction with the other vegetation, could lead to a drying out of the dunes (9). An important food source for some of the fauna, it also serves as a shelter for the endemic blue-green weevil, *Miloderes nelsoni* (9).

DESCRIPTION Stiff perennial grass, freely branched from a long branched, thick, scaly rhizome with woolly nodes. Flowering shoots erect or ascending, 25-35 cm high. Leaves conspicuously 2-ranked, with stiff, convolute blades 5-10 cm long by 3-5 mm wide, pungent at the tips; sheaths relatively short. Panicles narrow, simple, 5-10 cm long, the branches short appressed, bearing 1-3 broad spikelets each 1-1.5 cm long; lemma conspicuously hairy (2,4,8).

For illustrations see (1), (2), (8) and (9).

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Texas Wild Rice

GRAMINEAE

STATUS Vulnerable. The distribution and populations of this aquatic grass have been considerably reduced since it was described in 1933 (6). At that time it was abundant in the headwaters of the San Marcos River, in irrigation ditches and for c. 305 m behind the Spring Lake Dam (4). Today it is restricted to a 2.4 km stretch of headwaters, a heavily used area within the San Marcos city limits (10). Commercial plant collecting (1,4,5), floating debris, bottom ploughing, sewage and chemical pollution, swimming, boating and silting due to dams have all contributed to its rapid decline, either directly or by creating conditions that inhibit sexual reproduction (4,5). For the past 20 years, reproduction has been primarily vegetative, a method which appears unable to increase present populations (4,5). Although many of the damaging physical factors have recently been abated and the species has been declining at a slower rate, sexual reproduction has not yet been restored and existing clones, consisting of c. 18,000 individuals, have failed to increase to any appreciable extent (5).

DISTRIBUTION U.S.A. It is restricted to the upper reaches of the San Marcos River, Hays County, south central Texas (2,4).

HABITAT AND ECOLOGY Adapted to clear, relatively constant, cool, fast-flowing spring water, it forms large clumps which are firmly rooted in the gravel bottom of the river, both in the swiftest currents of the shallow areas near the middle of the river, and in water 2-3 m deep. In the upper 0.4 km of the river, it is associated with *Potamogeton, Vallisneria, Sagittaria* and *Hydrilla* (2-4,9,10).

CONSERVATION MEASURES TAKEN It has been determined to be 'Endangered' under the Endangered Species Act of 1973 (11). The Act directs that no federally-funded activity shall jeopardise the existence of species once officially determined as 'Endangered' or 'Threatened', as defined by the Act.

Emery has successfully germinated seeds obtained from wild plants in the San Marços River and has sexually reproducing stocks in cultivation (2,5).

CONSERVATION MEASURES PROPOSED Although nursery grown clones have become more available and river conditions have been generally improved, attempts to re-establish this grass in its natural habitat have often been unsuccessful due to the same reasons that originally caused its decline. The protection of the natural habitat should, indeed, be encouraged, but re-establishment work should also continue.

BIOLOGY AND POTENTIAL VALUE It is closely related to *Zizania aquatica* L. (1), Annual Wild Rice, whose seed is used in north America as a

source of food; it is also important and occasionally planted as shelter for waterfowl (7). *Z. texana* is reported to be palatable, nutritious and a potential horticultural crop.

CULTIVATION There are c. 500 individuals in cultivation at the Southwest Texas State University, San Marcos.

DESCRIPTION Coarse perennial aquatic grass. Culms long-decumbent and rooting at the nodes, 1-1.5 m or longer, the lower part with leaves often floating on the water, the upper part erect. Leaf blades elongate, flat, hairless, the lower ones 12-110 cm long forming underwater streamers, the uppermost blade aerial, 15-20 cm long. Panicle erect, 30-90 cm above the water, 20-30 cm long, the lower (male) branches ascending or somewhat spreading, the upper (female) appressed (3,6,7).

For illustrations see (1), (2), (7), (9) and (10).

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The material for this sheet was supplied by the Endangered Flora Project of the Smithsonian Institution, Washington, D.C., to whom the TPC is most grateful. Information is also gratefully acknowledged from Dr W.H.P. Emery, Southwest Texas State University, San Marcos, and E. Terrell.

GUNNERACEAE

STATUS Endangered. It is believed to survive in one, small, highly vulnerable coastal locality where it was found in 1976 to be confined to an area of 100 m by less than 2.5 m (5,7). The species may have been adversely affected by competition with weeds and grazing. It is believed extinct at a second site (Oreti River) where sand and gravel extraction, combined with invasion by lupin and clover, have overwhelmed the plant. The extant site is not protected and grazing pressure may continue, as the area is farmed at present. In the long-term, road-building and housing could be additional threats. Given, Kelly & Webb (5) conclude: "The survival of this species depends on rapid action."

DISTRIBUTION New Zealand. The extant locality is on the coast of Stewart Island, which lies across the Foveaux Strait south of South Island. The site where the species is believed to be extinct is on the mouth of the Oreti River, Southland, which is near the southern tip of South Island.

HABITAT AND ECOLOGY In coastal sand-dune hollows. It forms solitary rosettes or mats up to 1 m across on damp sandy sites in the transition zone between unstable sand-dunes, and scrub and bush, only occurring in the less vegetated parts of the zone (7). An account of the sand-dune vegetation of New Zealand is given in (3), describing the types of vegetation from grass-covered dunes to dune-forests, and mentioning the principal species found in them.

CONSERVATION MEASURES TAKEN At the Oreti River fences were erected to prevent damage by grazing animals, but were unsuccessful in saving the species. Attempts to transplant individuals to Invercargill City Reserve nearby and to find other localities have both failed.

CONSERVATION MEASURES PROPOSED As recommended by Given, Kelly & Webb:- "Reservation of the site must be seen as a necessity in preserving this species, and a management plan adopted which will help build up population size. Propagation and transplanting to another site should be done, selecting a site which is both secure and ecologically similar to the present natural one. Further populations should be searched for and cultivation encouraged although strict limitations should be made regarding removal of materials from the wild" (5).

BIOLOGY AND POTENTIAL VALUE The species is of considerable horticultural merit; it produces cushions of numerous small rosettes of slightly succulent leaves, arising from fleshy, spreading stolons. "The New Zealand species (of *Gunnera*), unlike those of South America and Hawaii, are all small herbs, *Gunnera hamiltonii* being the stoutest of them" (2).

CULTIVATION It is grown in some botanic gardens and is available from the horticultural trade. It is readily propagated from seed and layers, and Cockayne records that "it grows very rapidly in cultivation" (3). It is occasionally offered for sale in alpine garden catalogues.

DESCRIPTION Small herb forming compact cushions of overlapping leaf rosettes borne on stout branched stolons 3-5 mm in diameter, and up to c. 40 cm long, the internodes (between rosettes) c. 5 mm long. Leaves on stout flat stalks 2-5 cm long, slightly winged and widening at the base; leaf blade grey-green, slightly thickened, more or less hairless, toothed, triangular to broadly ovate, c. 2-3 cm long. From the rosette emerges an erect shoot up to c. 7 cm high, carrying crowded minute flowers. Fruit a red drupe c. 3 mm long (1).

For illustrations see (2) and (7).

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This sheet has been compiled from the 1977 revised account in (5) of *Gunnera hamiltonii* by Dr D.R. Given, G.C. Kelly and C.J. Webb, to whom the TPC is most grateful. Help from Dr D.R. Given of the Botany Division, DSIR, Christchurch is also gratefully acknowledged.

Golden Gladiolus

IRIDACEAE

STATUS Endangered. All known populations except one have been destroyed by changes in land-use (5). The species is rapidly moving to extinction: 50-70 plants in 1975 dwindled to 18 in 1977, confined to an area of 20 x 70 m. The site is being invaded by a dense infestation of alien woody species, *Acacia saligna* Wendl. from Australia and *Pinus pinaster* Aiton and *Pinus pinea* L. from the Mediterranean. Footpaths from a nearby town pass through the population which is bordered by two picnic places and a children's play area, and the flowering stems are picked for decorative purposes. Bulldozing for gravel above the site has probably modified the drainage which appears to be a critical habitat factor.

DISTRIBUTION South Africa. It was formerly known from several localities along a 5 km stretch of the west coast of Cape Peninsula, Cape Province.

The Cape flora is one of the richest in endemic species of any flora and one of the most threatened. It is now reduced to islands of vegetation over an area of c. 18,000 sq. km, but still contains c. 6000 species in the Fynbos vegetation alone. In south-western Cape Province, 1459 species are listed as rare and threatened, due to destruction of the habitat by man and invasive introduced woody plants, in particular *Pinus pinaster, Acacia, Hakea* and *Leptospermum* which are now estimated to infest 24% of the region.

HABITAT AND ECOLOGY It is recorded from moist flats and lower hill slopes. The remaining population is on a patch of poorly drained sandy soil underlain by gravel and clay. The area has copious subsurface moisture through the rainy season which is in winter.

CONSERVATION MEASURES TAKEN The Department of Mines has agreed to avoid quarrying for gravel and kaolin at the site. Seed has been put into refrigerated storage in the seed bank of the Royal Botanic Gardens, Kew, U.K. (5).

CONSERVATION MEASURES PROPOSED The Divisional Council of the Cape has been asked by Cape botanists to remove the infestations of Wattle and Pine around the population. Nature reserve status has been recommended for the area. It has been proposed that an alternative site under less pressure be found to which cultivated plants could be taken and established, as a habitat reserve, together with the other plants and insects with which the species is associated in the original ecosystem (5).

BIOLOGY AND POTENTIAL VALUE The bright and clear golden yellow flowers on slender, delicate stems are most attractive and have considerable potential for horticulture. They regularly set seed in the wild and

are probably pollinated by bees. Flowering time is during August and September (8).

CULTIVATION Several specialist bulb growers are cultivating the species with some success - for details see (2). Seed is sown at the end of the summer, thinly and shallowly in sand. The plants are frost-tender but need good ventilation. Mature plants require a very moist soil before and after flowering (8).

DESCRIPTION Slender herb with stems 15-85 cm tall, arising from an ovoid corm 2-2.5 cm across, flattened at the base. Leaves 3, erect, linear, very finely hairy, up to 45 cm long, sheathing the stem in the lower part. Spike with up to 6 flowers, subtended by bracts 1.4-1.8 cm long or less; perianth tube uniformly golden yellow, funnel-shaped, slightly curving, slender at the base, 1.8-2 cm long, with 6 elliptic lobes of similar length (6,8). The species is considered by some authorities, e.g. Lewis, Obermeyer & Barnard in (7), to belong to the genus *Homoglossum*, but in the more recent revision of that genus by de Vos (4), it is transferred back to *Gladiolus*.

For illustrations see (2), (3), (5) & (8).

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The material for this sheet was supplied by the Rare and Endangered Plant Species Survey based at the University of Cape Town, to whom the TPC is most grateful.

IRIDACEAE

STATUS Endangered. Only 4 small populations are known at present. The original populations never very large were drastically reduced by commercial exploitation and are currently under threat from rapid habitat destruction by afforestation and from the difficulties in restraining picking because of its exceptionally showy flowers.

DISTRIBUTION Israel; Eastern Upper Galilee. There are also records (4,6-8) for its presence in the extreme south east of Lebanon, south of the Litani River.

HABITAT AND ECOLOGY Dwarf shrub communities and rock outcroppings, at 700-1000 m. The rhizomes require a hot and dry dormancy period and the plants are sensitive to competition and shading. Grazing has up to now aided survival by reducing competition. Populations are invaded by *Quercus calliprinos* Webb and *Pinus halepensis* Miller (2).

CONSERVATION MEASURES TAKEN It is protected by the Nature Conservation laws of Israel.

CONSERVATION MEASURES PROPOSED To ensure the survival of the remaining populations, reserves should be declared, and active pollination and reseeding undertaken.

BIOLOGY AND POTENTIAL VALUE *Iris lortetii* is one of the largest-flowered and most attractive of the Irises. It is an isolated West Irano-Turanian endemic from a disjunct, small morphological group of Oncocyclus Irises (1,2). It was introduced to commerce shortly after its discovery and relatively large quantities of rhizomes are available from nursery-grown stock. Unfortunately, cultivated specimens rarely survive more than two seasons, causing a continuous demand for fresh material. Since there are no genetic barriers between members of section *Oncocyclus* of *Iris*, most of the material under cultivation is probably contaminated genetically (1). Pollination and seed dispersal are highly specialised: pollination is effected by large solitary bees of the genera *Bombus* and *Xylocopa*. Seed dispersal is by ants (2). The nearest relatives are *I. samariae* Dinsm. and *I. gatesii* Foster (1).

CULTIVATION The Oncocyclus Irises are reputedly very difficult to maintain in cultivation. However research in recent years, especially at the Van Tubergen Nurseries, Haarlem, The Netherlands, has developed successful techniques, and these are outlined by M.H. Hoog in (9). A key element is the storage of the rhizomes during late summer and autumn at c. 23° C., to imitate the hot, dry, Mediterranean summer of the natural habitat. During this time the rhizomes lose 30-60% of their weight (9).

DESCRIPTION Rhizomatous perennial with an erect flat fan of sword-shaped leaves 18-23 cm long and about 2 cm wide, sheathing the flower stem; stem about 75 cm carrying a solitary flower 10-16 cm in diameter and 10-20 cm in length; perianth segments (tepals) 6 in two dissimilar whorls of 3, the outer 3 (the 'falls') recurved, bearded in the centre, white, densely spotted with pink or grey-purple; inner 3 ('standards') erect, white, finely veined pink; style branches 3, bilobed and rather petal-like, arching over each of the falls to make a tube ('pollination tube').

For illustrations see (3), (4) and (6).

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IRIDACEAE

STATUS Endangered. Only a few hundred individuals of this narrowly endemic species are known in the wild (3). It has apparently been much uprooted by gardeners and amateur botanists (5).

DISTRIBUTION U.S.S.R.; on the slopes of a single mountain near Bakuriani in the Adzharo-Imeretinskiy Mountain Range, Georgia S.S.R.

HABITAT AND ECOLOGY Subalpine zone (1).

CONSERVATION MEASURES TAKEN None known for the wild population.

CONSERVATION MEASURES PROPOSED As recommended by the 'Red Book' of the U.S.S.R. (5), full protection should be afforded to this species.

BIOLOGY AND POTENTIAL VALUE It belongs to the *Reticulata* section of the genus. The early flowering habit and dwarf nature of the species in this section make them very popular for the rock-garden, bulb frame or cool greenhouse. *I. winogradowii* is one of two species in the section with yellow flowers. It is a most attractive species in flower and will undoubtedly become more commonly grown as stocks are available.

CULTIVATION It is becoming more widespread in cultivation and stocks are being built up. Bulbs from cultivated material of this species are offered for sale by Messrs. van Tubergen Ltd., of Haarlem, The Netherlands.

It needs much the same treatment as *I. reticulata*, with a hot dry period in summer. *I. winogradowii* appears to be no more difficult to grow than the other, more common species in the section which are very widely grown commercially for sale to gardeners.

DESCRIPTION Bulbous perennial herb up to 15 cm or more high when in flower; mature bulb more or less spherical, 2-3 cm across, with one or two smaller, more slender, daughter bulbs, covered with pale brown tunics which ultimately become very thin and in part reduced to a delicate network of fibres. Each bulb produces 2-4 erect, very narrow leaves quadrangular in cross-section, up to c. 40 cm long, the tip narrowed abruptly into a whitish point. Flowers golden yellow, 4-5 cm or more across, on a short scape; perianth tube erect; exterior segments (falls) more or less erect, with a sharply reflexed blade, spotted towards the centre; interior segments (standards) erect, much narrower than the falls and c. 4.5 cm high, unspotted. Capsule small, produced at ground level (4).

For illustrations see (4) and (5); there is also a black and white plate in Q. Bull. alp. Gdn Soc. 40(4): 285 (1972).

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IRIDACEAE

STATUS Endangered or Extinct in the wild. The granite hill on which it was first found in 1973 has been shown by repeated searches to be the only locality for the species. The hill has since been partly removed by quarrying and the remaining area of the population has been covered with dust and rubble from blasting. No individuals were found after a full search in 1977. The corms or seeds may still be alive but dormant below ground. Further quarrying will probably destroy the site altogether. The species has been brought into cultivation and can easily be grown on a variety of soils.

DISTRIBUTION South Africa. It is confined to a hill near Langebaan in south-western Cape Province.

The Cape flora is one of the richest in endemic species of any flora and one of the most threatened. It is now reduced to islands of vegetation over an area of c. 18,000 sq. km, but still contains c. 6000 species in the Fynbos vegetation alone. In south-western Cape Province, 1459 species are listed as rare and threatened, due to destruction of the habitat by man and invasive introduced woody plants, in particular *Pinus pinaster* Aiton from the Mediterranean and *Acacia, Hakea* and *Leptospermum* which are now estimated to infest 24% of the region.

HABITAT AND ECOLOGY It grows in fine-grained, rather hard and dry, sandy soil derived from granite, on a coastal hilltop at 70 m. The rainfall is low, 200-300 mm per annum, but may be supplemented by precipitation from coastal mists. The vegetation is a low, open, rather disturbed strand-veld with succulent shrubs, small woody perennials and annual grasses.

CONSERVATION MEASURES TAKEN In view of the likely total destruction of the natural habitat, efforts have concentrated on building up strong populations in cultivation (see below). A small amount of seed has been deposited in a refrigerated seed bank.

CONSERVATION MEASURES PROPOSED It has been suggested that the species be established as new populations in areas proposed for reserves within the region, on sites where the habitat is similar.

BIOLOGY AND POTENTIAL VALUE The species is allied to the 'peacock' group of Moraeas. It is easily distinguished from other species by the relatively large and attractive blue flowers with a remarkable black beard covering part of the outer perianth segments in the centre of the flower. The reasons for its extreme localisation are unknown, but it may not have been noticed in the surrounding areas which are now agricultural land. "Because of its beauty and relative ease of cultivation, it may become an established garden favourite" (1).

"Of a total of 54 species of *Moraea* in the southern African winter rainfall region, 2 are probably extinct, 3 more are in immediate danger, at least in the wild, although 2 of these are in cultivation, while a further 3 species can be regarded as severely reduced in range and endangered" (1). A number of others are highly localised. Details of these species are given by Goldblatt in (1).

CULTIVATION All growers report that it is easy to grow from seed on both sand and clay soils. The National Botanic Gardens at Kirstenbosch have found that it grows well in an established nursery population. It is being successfully grown by amateur and commercial bulb-growers in South Africa, California, France, New Zealand and Portugal.

DESCRIPTION Slender herb 15-20 cm high, with a corm c. 1 cm across. Leaf solitary, erect, linear, sheathing the stem at the base and usually exceeding it in height. Flowers c. 4-5 cm across, solitary, terminal; outer perianth segments blue violet, c. 2.3 cm long by 1.4-2 cm across at the widest point, slightly reflexed, bearded with black hairs towards the centre of the flower; inner perianth segments 1.5-2 cm long, very narrow, also reflexed, each with 2 short lateral lobes (1,2).

For illustrations see (1)-(4).

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The material for this sheet was supplied by the Rare and Endangered Plant Species Survey based at the University of Cape Town, to whom the TPC is most grateful.

Cumberland Rosemary

LABIATAE

STATUS Endangered. The small area in which it grows is becoming increasingly popular for recreational use. The vegetation of its habitat, sandy river banks, is extremely vulnerable to trampling and other disturbance. Heavy spring flooding is common and extreme erosion can result wherever the vegetation is so damaged. As the area becomes more heavily visited, this attractive lavender-flowered mint may become further endangered by wildflower collectors.

DISTRIBUTION U.S.A.; restricted, with the exception of a single disjunct population, to scattered colonies along two river systems in Tennessee and possibly Kentucky. It is found in deep river gorges along Clear Creek and Daddys Creek, two of the tributaries of the Obed River, in Morgan County. In addition, it occurs along the South Fork of the Cumberland River in Scott County. A population along the same river in McCreary County, Kentucky, is presumed submerged by the Wolf Creek Dam. Additional populations in Kentucky, however, may yet be located. The range also extends along the Clear Fork, which is a tributary of the South Fork in Morgan, Fentress and Scott Counties, Tennessee. A disjunct population has also been noted in White County, along the Caney Fork River about 80 km to the south west (3,4).

HABITAT AND ECOLOGY "On the sandy banks of rivers, on sandy islands and sand bars in the rivers and on sandy flood plains of streams along the escarpment of the Cumberland Plateau" (3). In at least one locality the plant is associated with shrubs such as Mountain Laurel, *Kalmia latifolia* L.; Ninebark, *Physocarpus opulifolius* (L.) Maxim.; Fringetree, *Chionanthus virginicus* L.; Witherod, *Viburnum cassinoides* L.; Southern Arrow-wood, *Viburnum dentatum* L.; and Farkleberry, *Vaccinium arboreum* Marshall.

CONSERVATION MEASURES TAKEN A portion of the Obed River System has been designated part of the Wild and Scenic River System. This authorisation encompasses all *Conradina* locations in Morgan County which lie along Clear and Daddys Creek. The Wild and Scenic River Act "preserves ... selected rivers or sections thereof in their free-flowing conditions" (Public Law 90-542). In addition, the South Fork of the Cumberland and its tributary, the Clear Fork River, are within the proposed Big South Fork National River and Recreation Area. The species was proposed as 'Endangered' by the U.S. Department of the Interior, Fish and Wildlife Service, on 16 June 1976. The Endangered Species Act of 1973 directs that no federally funded activity shall jeopardise the existence of species once officially determined as 'Endangered' or 'Threatened', as defined by the Act.

CONSERVATION MEASURES PROPOSED Since much of the river gorge is inaccessible except by canoe, the exact distribution of the species,

or even the amount of available habitat, is not fully known. Thus a survey should be conducted to determine the exact localities, the total number of populations and their sizes. Management plans and plans for the design or development of the Obed River and of the Big South Fork area should take into consideration the existence of this species with regard to trail construction, creation of canoe access points, and designation of camping areas.

BIOLOGY AND POTENTIAL VALUE Within the genus, *C. verticillata* is the only species from the Cumberland Plateau, the other 4 species being from the southern edge of the Coastal Plain. It is probably a relict of a more widespread ancestral type and is closest morphologically to *C. grandiflora* Small (3). As the Southeastern Coastal Plain gradually emerged and the area which is now the Cumberland Plateau was uplifted, the splitting of the ancestral stock into *C. verticillata* and *C. grandiflora* can be visualised (1,3). The lack of variability within populations and slight diversity between populations are other indications of its relict nature. It is not an aggressive species as shown by its inability to become established in similar habitats and its small populations. Vegetative propagation, however, may account for the persistence of the species in areas where it occurs (3).

CULTIVATION It is in cultivation at several botanic gardens and arboreta. It can be easily propagated from cuttings (2).

DESCRIPTION Aromatic evergreen subshrub, rarely more than 0.5 m high, diffusely branched from the base; older stems brown, cylindrical, younger twigs rufous, quadrangular. Leaves opposite, more or less revolute, virtually stalkless, conspicuously gland-dotted; those of the young growth linear to club-shaped, 14-33 mm long, those of the older growth shorter. Flowers in whorls of 1-3(-7) in the axils of the persistent bracts; calyx strongly 2-lipped, persistent, 7.5-9 mm long; corolla tube bent upwards, lavender to purple, with purple or wine-coloured dots, 2-lipped; upper lip erect; lower lip reflexed, spotted, c. 13-20 mm long (3).

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LABIATAE

STATUS Endangered, due to overgrazing by sheep. The flowers are destroyed and this prevents any regeneration by seed. Only about 40-50 plants were found to be surviving in 1966, with no seedlings. This is presumably the total world population for this species.

DISTRIBUTION Crete; restricted to the northern side of Mt. Svourichti in the Lévka Óri (White Mountains) at the west of the island.

Out of 155 species known to be endemic to Crete, 101 are believed to be rare or threatened. Fortunately 77 of these fall into the Rare category, reflecting their very localised distribution and, in many cases, their inaccessibility in the mountains, especially in crevices of vertical rock-faces protected from grazing. Much of the endemic flora is of horticultural merit and includes species of *Campanula, Colchicum, Crocus, Dianthus, Ebenus* (Giant Clover), *Helichrysum, Paeonia, Staehelina, Tulipa* and the monotypic genus *Petromarula* of the *Campanulaceae*.

HABITAT AND ECOLOGY Among calcareous rocks and scree at 2300 m on a north-facing slope.

CONSERVATION MEASURES TAKEN None.

CONSERVATION MEASURES PROPOSED Consideration should be given to controlling the number of sheep in the area. The species should be brought into cultivation and propagated in a botanic garden, and subsequently established in a protected area.

BIOLOGY AND POTENTIAL VALUE It is of considerable scientific interest as a member of a critical group relevant to studies of plant geography and taxonomy.

DESCRIPTION Perennial herb with several stems 10-20 cm high from a woody rootstock. Leaves arranged in opposite pairs up the stems, pale green, oblong to ovate, softly hairy, 12-15 mm long, with crenate margins. Flowers in whorled clusters (verticillasters) which are aggregated into a spike at the tip of the stem; calyx 7 mm long, covered with hoary grey hairs and ending in 5 pointed lobes; corolla white and unspotted, 12 mm long, 2-lipped with the upper lip hooded and the lower lip expanded and dentate.

REFERENCE Davis, P.H. (1952). Notes on the Summer Flora of the Aegean. Notes R. Bot. Gdn Edinb. 21(3): 136-137.

This sheet is based upon information provided by Dr W. Greuter (of the Conservatoire Botanique, Geneva), to whom the TPC is most grateful.

LACTORIDACEAE

STATUS Endangered. In 1954-5 Kunkel and Skottsberg were only able to find about 10 individuals from 5 localities (2), and in 1965 Solbrig's expedition saw only 3 individuals of flowering size. It was probably never a common plant and its decline is presumably due to the introduction of grazing animals. There are at present some 300 goats on the island and large numbers of sheep and cattle. However, the species appears now to be threatened principally by introduced plants of *Rubus*.

DISTRIBUTION Juan Fernández Islands, South Pacific Ocean; endemic to Isla Robinson Crusoe (formerly Más á Tierra), where in 1917 it was "confined to the wet fogswept forest belt ..., everywhere very scarce though not quite so rare as has been supposed" (4).

There are about 98 flowering plants and 17 ferns endemic to Juan Fernández and the majority are undoubtedly threatened, due to destruction of the forests by introduced sheep, cattle, horses, goats, rabbits, rats and the even more intractable problem of vigorous and invasive introduced plants such as *Aristotelia*, which is very common below 200 m, and *Rubus*, reported as an aggressive coloniser in the vegetation. The flora is of great interest for its most unusual evolutionary development, resulting in gigantism in many species, especially in the cabbage trees of the *Compositae* (3).

HABITAT AND ECOLOGY High altitude forest, only recorded from above 500 m; one locality was a deep gorge at 750-850 m where it was found among the palm *Juania australis* (Mart.) Drude (also in the Red Data Book), *Coprosma* sp., the bamboo *Chusquea fernandeziana* Phil., *Gunnera* spp. and several tree-Composites (2).

CONSERVATION MEASURES TAKEN The Parque Nacional Juan Fernández was declared in 1935, but introduced grazing animals are still continuing to degrade the vegetation and flora. It is planned to reduce the numbers of goats and eliminate the sheep and cattle on Isla Robinson Crusoe (G. Mann, pers. comm.).

CONSERVATION MEASURES PROPOSED Grazing animals should be eliminated from the island, or at least excluded from selected areas. The species should be brought into cultivation. The problem of how to remove the vigorous introduced plants should be urgently studied.

BIOLOGY AND POTENTIAL VALUE It is the only member of its family and is thus of great scientific importance. Hutchinson considers it a relict family and one that is "especially interesting because several of the floral characters savour of those of Monocotyledons ... (It) was classified in the *Piperaceae* by Bentham and Hooker, but it seems

and is highly vulnerable both to timber poaching and to squatters. The biological richness of the site is attested by the almost 50 new species of angiosperms that have been described from the locality, presumably all of them of a similar status to *P. theobromifolia*. Most are listed in (2). The almost 600 species per sq. km recorded from Río Palenque is one of the highest known plant diversities in the world (2).

CONSERVATION MEASURES TAKEN Only the fortuitous preservation provided by the Río Palenque Biological Station preserved this species long enough for it to be described in 1977.

CONSERVATION MEASURES PROPOSED Protection of the field station must

to be much nearer *Winteraceae*" (1).

DESCRIPTION Densely branched, rounded shrub usually less than 1 m high with one main stem but many branches, bearing small obovate leaves 8-20 mm long, covered with numerous minute pellucid dots. At the bases of the leaf-stalks are membranous stipules c. 2 mm long and in the leaf axils small clusters of 2 or 3 minute flowers each c. 3 mm across, either unisexual or bisexual (both on the same plant); each has 3 green spreading sepals, no petals, 6 stamens in 2 whorls and/or 3 spreading carpels, nearly free from one another and each tipped by a white stigma. Fruits of 3 beaked follicles, each containing 4-6 seeds.

For illustrations see (1) and (4).

REFERENCES
1. Hutchinson, J. (1969). Evolution and Phylogeny of Flowering Plants. Academic Press, London and New York. Pp. 12-13.
2. Kunkel, G. (1956). Über den Waldtypus der Robinson-Insel. Forschn Fortschr. 30(5): 129-137.
3. Kunkel, G. (1968). Robinson Crusoe's Island. Pacific Discovery 21(1): 1-8.
4. Skottsberg, C. (1920-1953). The Natural History of Juan Fernández & Easter Island 2. Almqvist & Wiksells

a single log of it. The vernacular name, 'Caoba', is the name usually used for mahogany in Latin America. As a fast-growing tree with established commercial value, it could be redeveloped into a valuable timber industry. As a congener of avocado, it is potentially important as a possible blight-resistant rootstock genetically compatible with the cultivated avocado, *P. americana* Miller. The California avocado industry has been anxiously searching for a *Persea* species with this combination of properties; *P. theobromifolia*, which falls into none of the established taxonomic groupings of *Persea*, has just the taxonomic divergence from *P. americana* to be a likely candidate. Moreover, with its opposite, glaucous, 3-veined leaves it is a strikingly unusual species of its genus and family, and may provide valuable clues to understanding the evolutionary diversification of the cultivated avocado and its relatives.

DESCRIPTION Large canopy tree 30-40 m tall. Leaves uniformly opposite, elliptic, obtuse at the base and apex, 10-22 x 4-12 cm, glaucous beneath with minute scales. Flowers grey-green, in panicles to 8 cm long in the leaf axils; sepals 3, c. 1 mm long; petals 3, c. 2.5 mm long, densely hairy on the inside. Fruit large, reddish brown, obovoid, 8.5-10 cm long by 5.5 cm wide, with a fleshy mesocarp and a single large seed c. 5 cm long (3).

For a line drawing see (3).

REFERENCES
1. Dodson, C.H. & Gentry, A.H. (1978). Flora of the Río Palenque Science Center. Selbyana 4: 368-369.
2. Gentry, A.H. (1977). Endangered plant species and habitats of Ecuador and Amazonian Peru. In Prance, G.T. & Elias, T.S. (eds), Extinction Is Forever. New York Botanical Garden. Pp. 136-149.
3. Gentry, A.H. (1977). New species of *Leguminosae, Lauraceae,* and *Monimiaceae*, and New Combinations in *Bignoniaceae* from Western Ecuador. Selbyana 2(1): 39-41.

The material for this sheet was supplied by Dr A.H. Gentry (of the Missouri Botanical Garden, St. Louis, U.S.A.), to whom the TPC is most grateful.

LEGUMINOSAE

STATUS Endangered; known only from three small populations, all of which are critically low. One consists of a few hundred plants spread over several hectares; it is on private property, in a farmer's paddock, and not protected in any way. The other two contain fewer than 30 individuals each, one being reduced to around 12 individuals in 1975 due to road-building activities. Although much seed is set annually, no seedlings have been observed during the past four years. The species is not in cultivation.

DISTRIBUTION Australia. The localities are in the Darling Range, south-west Western Australia. Although they are within 80 km of Perth, none were discovered until the 1960s. It is possible that sampling of habitats between the localities will reveal further populations.

HABITAT AND ECOLOGY Granite outcrops on hillsides, surrounded by open-forest (2) dominated by Jarrah, *Eucalyptus marginata* Smith, and Marri, *E. calophylla* R.Br. ex Lindl., or Open-woodland (2) dominated by York Gum, *E. loxophleba* Benth. The species often grows in rock crevices, which is an unusual habitat requirement for an *Acacia* and probably accounts for its rarity.

CONSERVATION MEASURES TAKEN The two smaller populations are in an area gazetted as a Camping Reserve and are therefore afforded some degree of protection. However, as mentioned above, over half of one of these populations was destroyed in 1975. Of the approximately 12 surviving plants, the one nearest the road is protected by metal stakes set in concrete.

CONSERVATION MEASURES PROPOSED Protection should be afforded to the larger population, which is particularly vulnerable, being on private property in an agricultural area, and consideration given and negotiations started for making the site into a reserve. Extreme care should be taken by the relevant authorities that the two smaller populations are not further depleted; attempts are currently being made to have this area included in a National Park. The species should, if possible, be brought into cultivation.

BIOLOGY AND POTENTIAL VALUE This is an extremely unusual and distinctive species in that it is completely devoid of foliage. It has no known close relatives and therefore is of considerable scientific interest in terms of evolution and plant geography. As with so many other *Acacia* species, very little is recorded of its biology. Its lack of foliage and unusual habitat make it likely that it has an interesting water-balance physiology.

is in the range of 125-200 mm and is extremely variable and unreliable. The mean maximum of the hottest month is about 37° C. with the mean maximum of the coldest month 5° C.

CONSERVATION MEASURES TAKEN None known for the wild populations.

CONSERVATION MEASURES PROPOSED As pointed out by Pedley in (5):- "There is a need for the species to be protected from further exploitation".

BIOLOGY AND POTENTIAL VALUE "The outstanding feature of this acacia is its ability to grow in tree form in one of the most severe desert climates of Australia" (3). In addition the wood is reported to be very hard, very dense and durable (2,3,4). A gouge is also of interest

With its divaricate, glaucous branches and its profuse, light golden flower-heads, it is potentially a beautiful garden plant assuming it can be grown in cultivation. In the wild it flowers from August to September and sets mature seeds between December and March.

DESCRIPTION Divaricately branched shrub to 2 m tall with spinescent hairless glaucous branches lacking normal foliage; phyllodes (leaf-like petioles) reduced to scales. Inflorescence of bright golden-yellow, globular flower-heads each 6-7 mm across when open, borne on hairless stalks c. 1 cm long. Pods narrowly oblong, 3-9 cm x 3-4 mm, flat but raised over the seeds, hairless and with a light bloom (pruinose). Seeds black, somewhat shiny, obloid, 4-4.5 x 2-2.5 mm, arranged longitudinally.

For an illustration see (1).

REFERENCES 1. Maslin, B.R. (1974). Studies in the genus *Acacia* 2. Miscellaneous new phyllodinous species. Nuytsia 1(4): 315-331.
2. Specht, R.L. *et al.* (eds) (1974). Conservation of Major Plant Communities in Australia and Papua New Guinea. Aust. J. Bot., Suppl. Ser. No. 7.

DESCRIPTION Tree up to c. 15 m high with a narrow, dense, dull green crown, usually with short horizontal branches and conifer-like, pendulous phyllodes. Bark rough, dark grey, fissured. Leaves reduced to leaf-like petioles (phyllodes) which are 4-sided, occasionally somewhat flattened, up to 40 cm but usually 8-12 cm long, about 1 mm wide, pungent and hairless. Flower-heads yellow, globular, c. 1 cm across on stalks in the leaf axils; calyx scarcely 1 mm long, divided almost to the base into 5 linear-lanceolate lobes; petals 5, hairless, 2.5 mm long, pointed. Pods firmly chartaceous, large and broad and flat, up to 18 cm long by 4 cm wide, brown but with a surface bloom (pruinose), somewhat thickened on the margin. Seeds flat, almost circular, c. 1 cm in diameter.

For an illustration see (4).

REFERENCES 1. Bentham, G. (1864). Flora Australiensis 2. London. p. 323.
2. Everist, S.L. (1969). Use of Fodder Trees and Shrubs. Division of Plant Industry Advisory Leaflet No. 1024, Queensland Department of Primary Industries.
3. Hall, N., Turnbull, J.W. & Brooker, M.I.H. (1975). Australian Acacias No. 3, Forestry & Timber Bureau, Canberra.
4. Lothian, N. (1968). *Acacia peuce*, the Pine or Birdsville Wattle. S. Aust. Nat. 43(2).
5. Pedley, L. (in press). A revision of *Acacia* in Queensland. Austrobaileya 1(2).

The material for this sheet was supplied by Mr D.E. Boyland (of the Queensland Herbarium, Brisbane), to whom the TPC is most grateful. Help from Mr B.R. Maslin of the Western Australian Herbarium, Perth, is also gratefully acknowledged.

LEGUMINOSAE

STATUS Endangered; known only from three small populations, all of which are critically low. One consists of a few hundred plants spread over several hectares; it is on private property, in a farmer's paddock, and not protected in any way. The other two contain fewer than 30 individuals each, one being reduced to around 12 individuals in 1975 due to road-building activities. Although much seed is set annually, no seedlings have been observed during the past four years. The species is not in cultivation.

DISTRIBUTION Australia. The localities are in the Darling Range, south-west Western Australia. Although they are within 80 km of Perth, none were discovered until the 1960s. It is possible that sampling of habitats between the localities will reveal further populations.

HABITAT AND ECOLOGY Granite outcrops on hillsides, surrounded by open-forest (2) dominated by Jarrah, *Eucalyptus marginata* Smith, and Marri, *E. calophylla* R.Br. ex Lindl., or Open-woodland (2) dominated by York Gum, *E. loxophleba* Benth. The species often grows in rock crevices, which is an unusual habitat requirement for an *Acacia* and probably accounts for its rarity.

CONSERVATION MEASURES TAKEN The two smaller populations are in an area gazetted as a Camping Reserve and are therefore afforded some degree of protection. However, as mentioned above, over half of one of these populations was destroyed in 1975. Of the approximately 12 surviving plants, the one nearest the road is protected by metal stakes set in concrete.

CONSERVATION MEASURES PROPOSED Protection should be afforded to the larger population, which is particularly vulnerable, being on private property in an agricultural area, and consideration given and negotiations started for making the site into a reserve. Extreme care should be taken by the relevant authorities that the two smaller populations are not further depleted; attempts are currently being made to have this area included in a National Park. The species should, if possible, be brought into cultivation.

BIOLOGY AND POTENTIAL VALUE This is an extremely unusual and distinctive species in that it is completely devoid of foliage. It has no known close relatives and therefore is of considerable scientific interest in terms of evolution and plant geography. As with so many other *Acacia* species, very little is recorded of its biology. Its lack of foliage and unusual habitat make it likely that it has an interesting water-balance physiology.

placed by Bentham (1) in the series *Continuae*, but modern work suggests it has no close relatives (5).

CULTIVATION A plant of *A. peuce* is growing in the Botanic Garden, Adelaide, and other individuals raised from seed have been planted in experimental plantations under the control of the Garden (4). Fresh seeds are reported to germinate rapidly, but storage may cause seed-coat dormancy. For details see (3).

With its divaricate, glaucous branches and its profuse, light golden flower-heads, it is potentially a beautiful garden plant assuming it can be grown in cultivation. In the wild it flowers from August to September and sets mature seeds between December and March.

DESCRIPTION Divaricately branched shrub to 2 m tall with spinescent hairless glaucous branches lacking normal foliage; phyllodes (leaf-like petioles) reduced to scales. Inflorescence of bright golden-yellow, globular flower-heads each 6-7 mm across when open, borne on hairless stalks c. 1 cm long. Pods narrowly oblong, 3-9 cm x 3-4 mm, flat but raised over the seeds, hairless and with a light bloom (pruinose). Seeds black, somewhat shiny, obloid, 4-4.5 x 2-2.5 mm,

DESCRIPTION Tree up to c. 15 m high with a narrow, dense, dull green crown, usually with short horizontal branches and conifer-like, pendulous phyllodes. Bark rough, dark grey, fissured. Leaves reduced to leaf-like petioles (phyllodes) which are 4-sided, occasionally somewhat flattened, up to 40 cm but usually 8-12 cm long, about 1 mm wide, pungent and hairless. Flower-heads yellow, globular, c. 1 cm across on stalks in the leaf axils; calyx scarcely 1 mm long, divided almost to the base into 5 linear-lanceolate lobes; petals 5, hairless, 2.5 mm long, pointed. Pods firmly chartaceous, large and broad and flat, up to 18 cm long by 4 cm wide, brown but with a surface bloom (pruinose), somewhat thickened on the margin. Seeds flat, almost circular, c. 1 cm in diameter.

For an illustration see (4).

REFERENCES
1. Bentham, G. (1864). Flora Australiensis 2. London. p. 323.
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3. Hall, N., Turnbull, J.W. & Brooker, M.I.H. (1975). Australian Acacias No. 3, Forestry & Timber Bureau, Canberra.
4. Lothian, N. (1968). *Acacia peuce*, the Pine or Birdsville Wattle. S. Aust. Nat. 43(2).
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Waddy, Waddy-Wood, Pine Wattle

LEGUMINOSAE

STATUS Vulnerable; a tree known from small scattered populations in a few localities, mostly on the fringes of the Simpson Desert. It grows in an arid environment and limited field experience indicates that regeneration is infrequent. The tree is extremely slow growing (4). "It occurs in a region where almost no other trees of suitable size are available and for that reason it has been widely used" (2). In the past the timber has been used for fence posts (2,3,4,5); the leaves are eaten by cattle (2).

DISTRIBUTION Central Australia. The major population occurs near Birdsville, on the South Australia/Queensland border, with scattered populations 300 km to the north, towards Boulia, Queensland, and 400 km to the west near Andado Station and Charlotte Waters, both in the Northern Territory. A map of its distribution is given in (3).

HABITAT AND ECOLOGY On flat to very gently undulating plains, growing in herbfield, associated either with short tussock grasses or with shrubby members of the *Chenopodiaceae*, of which *Bassia* spp., *Atriplex* spp. and *Maireana* spp. predominate, depending on seasonal conditions.

Soils in the area are shallow brown clay loams and clays, rarely with a loam or sandy loam surface. In places the surface is covered with ironstone pebbles. The climate is arid; the mean annual rainfall is in the range of 125-200 mm and is extremely variable and unreliable. The mean maximum of the hottest month is about 37° C. with the mean maximum of the coldest month 5° C.

CONSERVATION MEASURES TAKEN None known for the wild populations.

CONSERVATION MEASURES PROPOSED As pointed out by Pedley in (5):- "There is a need for the species to be protected from further exploitation".

BIOLOGY AND POTENTIAL VALUE "The outstanding feature of this acacia is its ability to grow in tree form in one of the most severe desert climates of Australia" (3). In addition the wood is reported to be very hard, very dense and durable (2,3,4). *A. peuce* is also of interest to studies of plant geography as it has an unusually fragmented distribution, as well as being isolated taxonomically. It was originally placed by Bentham (1) in the series *Continuae*, but modern work suggests it has no close relatives (5).

CULTIVATION A plant of *A. peuce* is growing in the Botanic Garden, Adelaide, and other individuals raised from seed have been planted in experimental plantations under the control of the Garden (4). Fresh seeds are reported to germinate rapidly, but storage may cause seed-coat dormancy. For details see (3).

DESCRIPTION Tree up to c. 15 m high with a narrow, dense, dull green crown, usually with short horizontal branches and conifer-like, pendulous phyllodes. Bark rough, dark grey, fissured. Leaves reduced to leaf-like petioles (phyllodes) which are 4-sided, occasionally somewhat flattened, up to 40 cm but usually 8-12 cm long, about 1 mm wide, pungent and hairless. Flower-heads yellow, globular, c. 1 cm across on stalks in the leaf axils; calyx scarcely 1 mm long, divided almost to the base into 5 linear-lanceolate lobes; petals 5, hairless, 2.5 mm long, pointed. Pods firmly chartaceous, large and broad and flat, up to 18 cm long by 4 cm wide, brown but with a surface bloom (pruinose), somewhat thickened on the margin. Seeds flat, almost circular, c. 1 cm in diameter.

For an illustration see (4).

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4. Lothian, N. (1968). *Acacia peuce*, the Pine or Birdsville Wattle. S. Aust. Nat. 43(2).
5. Pedley, L. (in press). A revision of *Acacia* in Queensland. Austrobaileya 1(2).

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LEGUMINOSAE

STATUS Vulnerable. In Bulgaria, where it is Rare, it is known from several sites within an area of c. 1500 ha, where grazing and changes in forestry practice are tentative threats. It is legally protected. It is considered as Vulnerable in the Crimea, the other part of its range.

DISTRIBUTION Bulgaria, U.S.S.R.; near Aytos north west of Burgas in the foothills of the eastern Stara Planina of south eastern Bulgaria. This population was described as *A. aitosensis* Ivanischvili in 1969. In the Crimea it occurs from Balaklava along the main range of hills to Koktebel and Feodosiya (2).

HABITAT AND ECOLOGY On hills between 90 and 550 m altitude. The vegetation is a degraded mixed oak forest of *Colutea arborescens* L., *Jasminum fruticans* L., *Paliurus spina-christi* Miller, *Phillyrea latifolia* L., *Quercus cerris* L., *Q. frainetto* Ten., *Q. pubescens* Willd., etc. In the grassland the principal species include *Agropyron brandzae* Pantu & Solac., *Chrysopogon gryllus* (L.) Trin., *Melica ciliata* L., and *Poa bulbosa* L. In the wild the species propagates well by seed and in one square metre plot about 100 seedlings have been counted.

The climate is transitional between sub-continental and coastal, the absolute minimum being -21° C. and maximum 42° C. The average annual temperature is 12° C.; the rainfall is c. 538 mm with a maximum in February and August to September.

CONSERVATION MEASURES TAKEN In Bulgaria it is protected by law, and part of the Bulgarian locality (near Aytos) is included in a town park.

CONSERVATION MEASURES PROPOSED None recorded.

BIOLOGY AND POTENTIAL VALUE It is of some interest to studies of taxonomy and plant geography, belonging as it does to a group of species in western Asia, centred on the Caucasus Region. It may also prove useful in protecting hills from erosion.

DESCRIPTION Low bush forming large hemispherical tussocks up to 50 cm high, with densely hairy, crowded, short branches bearing pinnate leaves 2-4 cm long, of 4-5(-6) pairs of softly hairy leaflets each 10-16 mm long by 2-3 mm wide, on spine-tipped axes which persist and harden after the leaflets fall off. Stipules lanceolate, membranous, up to 18 mm long. Flowers small, pea-like, in pairs in the axils of the leaves; corolla whitish-yellow or pink, the standard 14-18 mm.

For a line drawing see (4).

REFERENCES

1. Georgiev, A. (1967). Aitoskoto sgrabićé. Priroda, Sof. 6: 56-58.
2. Schischkin, B.K. (ed.) (1946). *Leguminosae: Astragalus.* In Komarov, V.L. (ed.), Flora URSS 12. Moscow. Pp. 351-352.
3. Stanev, S. (1975). Zvezdi gasnat v planinata: Razkazi za našite redki rastenija. Zemizdat, Bulgaria. Pp. 46-52. (in Bulgarian).
4. Valev, S. (1976). *Astragalus* in Jordanov, D. (ed.), Flora Reipublicae Popularis Bulgaricae 6. Sofia. p. 156, t. 22, f. 3. (as *A. aitosensis).*
5. Velcev, V. & Bondev, I. (1975). Verbreitung, Ökologisch-Biologische Besondersheiten und Phytozönotische charakterisierung des *Astragalus aitosensis* Ivanish. In In honour of Acad. D. Jordanov. Pp. 121-159.

The material for this sheet was supplied by Dr B. Kuzmanov (of the Institute of Botany, Bulgarian Academy of Sciences, Sofia), to whom the TPC is most grateful.

Beatley's Milkvetch

LEGUMINOSAE

STATUS Endangered. The greatest source of danger to this species is the destruction of habitat on the Nevada Test Site as a result of land clearing for roads or other types of construction. Off-road driving is another, although less serious, threat, especially to plants growing in the generally level 'flat rock' areas (3).

DISTRIBUTION U.S.A.; known only from Pahute Mesa, in the Nevada Test Site, Nye County, Nevada. It is restricted to two general areas, one about 5 km long and the other somewhat smaller, approximately 13 km apart (2,3). The vegetation of both areas is considered to be critically endangered since both are bisected by roads.

HABITAT AND ECOLOGY The species is found on open, flat areas characterised by very shallow volcanic soil with large expanses of exposed, flat, volcanic rocks. The sites in the larger of the two populations are among Pinyon-Juniper and shrubs of *Artemisia nova* A.Nelson. Herbaceous associates here are *Astragalus calycosus* Torrey, *Phacelia saxicola* A.Gray, *Eriogonum umbellatum* Torrey var. *dichrocephalum* Gand. and *Ipomopsis congesta* (Hook.) V.Grant. Shrubland of *Artemisia nova* is the dominant vegetation in the area of the second population (3).

CONSERVATION MEASURES TAKEN It was proposed as 'Endangered' by the U.S Department of the Interior, Fish and Wildlife Service, on 16 June 1976. The Endangered Species Act of 1973 directs that no federally funded activity shall jeopardise the existence of species once officially determined as 'Endangered' or 'Threatened', as defined by the Act.

CONSERVATION MEASURES PROPOSED Formal determination as an 'Endangered' species and hence protection under the Act. Rhoads & Williams suggest that barricades could be erected along the roadway at those locations where roads bisect or are parallel to a population, in order to ensure enforcement of the recent restrictions against off-road driving. Restricting the use of a certain road to essential travel only is also suggested (3).

BIOLOGY AND POTENTIAL VALUE Although animals as varied as Gambel's quail, chukar, rodents and pronghorn antelope have been reported to feed on some species of *Astragalus*, no grazing of *A. beatleyae* has been observed, even though all these animals are present in the area. Some members of the genus are known to accumulate toxic substances in the foliage and seed pods, and many species are poisonous to livestock (3).

DESCRIPTION Dwarf or diminutive, loosely cushion-shaped perennial herb of rapid growth and short duration. Stems several, prostrate to curved-ascending from the taproot, repeatedly and closely branching from the base. Leaves 1.5-3.5 cm long, with very slender, proportionately elongate stalks and (3-)5-9 loosely folded leaflets crowded towards the tips. Flowers pea-shaped, with blue-violet petals. Pod bladder-like, inflated, the valves thinly papery, pale green often minutely speckled purple (but not mottled), enclosing 4 pairs of seeds (1).

This species can be confused with *A. calycosus* Torrey which is common in the area but is not found on the same local sites. *A. calycosus* may be distinguished by a silver-grey, laterally compressed pod (2,3).

For illustrations see (2) and (3).

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2. Beatley, J.C. (1977). Endangered Plant Species of the Nevada Test Site, Ash Meadows, and Central-Southern Nevada. U.S. Energy Research and Development Administration Contract E(11-1)-2307. Pp. 8-13, fig. 7.
3. Rhoads, W.A. & Williams, M.P. (1977). Status of Endangered and Threatened Plant Species on Nevada Test Site - A Survey. Part I: Endangered Species. Pp. 19-26, fig. 3.

The material for this sheet was supplied by the Endangered Flora Project of the Smithsonian Institution, Washington, D.C., to whom the TPC is most grateful.

Ash Meadows Milk-Vetch

LEGUMINOSAE

STATUS Endangered; due to farming operations and trampling by horses on the open range (3). One area where it occurs has been reduced by half since 1969 (4). The species is not known in cultivation.

DISTRIBUTION U.S.A.; known only from a few scattered localities (principally 3 sites) in northern and eastern Ash Meadows, in the southern angle of Nye County, Nevada (3).

HABITAT AND ECOLOGY Ash Meadows is an extensive lowland plain near the northern edge of the Mojave Desert. In its northern and eastern part, where the *Astragalus* occurs, it is characterised by the presence of many surface springs, mostly of low salinity, and by a water table near the surface over much of the region. The soils tend to be alkaline clays (or clays and silts) of heavy texture, which, even after rain, usually appear to be dry. However, in contrast to the Mojave Desert, the spring and ground water permits a summer growth season; the plant communities that result are dominated by the shrubs *Atriplex confertifolia* (Torrey & Frémont) S.Watson and *Haplopappus acradenius* (Greene) Blake (2). The altitude of the localities is c. 685 m (1).

CONSERVATION MEASURES TAKEN It was proposed as 'Endangered' by the U.S. Department of the Interior, Fish and Wildlife Service, on 16 June 1976. The Endangered Species Act of 1973 directs that no federally-funded activity shall jeopardise the existence of species once officially determined as 'Endangered' or 'Threatened', as defined by the Act.

CONSERVATION MEASURES PROPOSED Protection for as many of the existing sites as possible. Beatley in (3) recommends that certain privately owned but as yet unploughed parcels of land be preserved; the flora of these areas is at present critically endangered by farm operations and also by extreme overgrazing and trampling by free-ranging horses. Of the six plant species strictly endemic to Ash Meadows, five occur on a c. 20 ha tract within this area: one is *Astragalus phoenix;* the other four, all designated as Endangered by the Smithsonian, are *Grindelia fraxino-pratensis* Reveal & Beatley, *Mentzelia leucophylla* T.S.Brandegee, *Ivesia eremica* (Coville) Rydb. and *Centaurium namophilum* Reveal, Broome & Beatley (also in the Red Data Book).

BIOLOGY AND POTENTIAL VALUE Probably derived from *A. newberryi* A.Gray (1).

DESCRIPTION Perennial, forming a "dense hemisphere or depressed mound of foliage that reaches a diameter of 40-50 cm and is composed of several score, perhaps over 100 rosettes of leaves" (1). Stems repeatedly branched, exceeding the leaves. Leaves 1.5-3.5 cm long, divided into 1-4 leaflets, with indumentum of relatively coarse,

spreading hairs. Flowers pea-shaped, single or in pairs, on permanently erect stalks to 5 mm, often scarcely exceeding the subtending stipules; petals pink-purple, the standard paler. Pod ovoid, pointed, up to 1.8 cm long by 1 cm across (1).

For black and white photographs see (1) and (3).

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The material for this sheet was supplied by the Endangered Flora Project of the Smithsonian Institution, Washington, D.C., to whom the TPC is most grateful.

LEGUMINOSAE

STATUS Rare or Endangered. Until recently it was believed extinct, since it had disappeared from its first known locality in 1902 and its second after 1961. Both were in Bulgaria. However, it has recently been discovered by Micevsky from a single locality in Yugoslavia, where its exact status is not yet known. Material from the first Bulgarian locality is in cultivation, and from this the species has been re-introduced into the original site which is now a public park surrounded by the town of Plovdiv.

This case illustrates a difficulty arising where taxa have been described in the 19th or early 20th Century from material gathered in the vicinity of large towns, which at that time were the only areas where botanical work was done. Such areas are now in almost every case profoundly modified either by urbanisation or by modern agriculture. Other more remote areas where the species could occur are less well known botanically.

DISTRIBUTION Bulgaria, Yugoslavia. The locality within Plovdiv is the hill of Dźendemtepe. The second Bulgarian locality (extinct) was near the village of Kulata in the valley of the River Struma in the south west of the country. The Yugoslav locality is in Macedonia.

HABITAT AND ECOLOGY At Dźendemtepe, it grows on a rocky slope with other rare Balkan species such as *Centaurea affinis* Frivald. and *Scabiosa triniifolia* Frivald. The hill is the first known locality (*locus classicus*) for both these species, discovered by Frivaldszky, as it is for *Astragalus physocalyx*.

CONSERVATION MEASURES TAKEN The species is legally protected in Bulgaria. Individuals from Dźendemtepe are grown successfully in the Botanical Garden of the Bulgarian Academy of Sciences, Sofia, and have recently been planted out in the original locality, now a public park within the town of Plovdiv. Individuals from the extinct Kulata locality are also grown in the Botanical Garden.

CONSERVATION MEASURES PROPOSED None on record.

BIOLOGY AND POTENTIAL VALUE It is of considerable importance as the only species in the monotypic section *Pogonotropis* Bunge of the genus *Astragalus*.

DESCRIPTION Tufted, mat-forming perennial with a branched stock. Leaves 15-20 cm long, pinnate with a terminal leaflet, consisting of 12-22 pairs of ovate to oblong-elliptic pointed leaflets 8-16 mm long, sparsely hairy. Flowers pea-like, 1-5 or more in compressed racemes; bracts ovate, 5-8 mm long; calyx 15-17 mm long when the

flower opens, up to 22 mm long and 15 mm wide, inflated in the fruit; corolla pale violet (incorrectly recorded as yellow), the standard 35-45 mm long. Pod 12-15 mm long by 4-6 mm wide, oblong to lanceolate, hairless.

For a line drawing see (3).

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The material for this sheet was supplied by Dr B. Kuzmanov (of the Institute of Botany, Bulgarian Academy of Sciences, Sofia), to whom the TPC is most grateful.

LEGUMINOSAE

STATUS Vulnerable; confined to the southern mountains of a small island (c. 10 x 2-3 km) and known from fewer than 10 sites. It may be susceptible to browsing by goats, but more information is needed to confirm this.

DISTRIBUTION Lord Howe Island, Pacific Ocean (31° 35'S., 159° 05'E.). It is restricted to the mountains of the island.

There are c. 75 species and subspecies of ferns and flowering plants endemic to Lord Howe Island, including 4 species of palms and 4 species of tree-ferns (5). Unlike most of the other subtropical and tropical islands with endemic species listed in the Red Data Book, nearly 70% of the original forest remains and this is reflected by the fact that none of the endemic plants are believed to be extinct. There are introduced goats and pigs on the island and their effects on the vegetation have been reviewed by Pickard (3). An airstrip has recently been built and the island will undoubtedly become subject to greater pressures from tourism in the future.

HABITAT AND ECOLOGY A range of vegetation types on the upper slopes and summits of Mounts Lidgbird and Gower. Most plants are at the foot or on terraces of the basalt cliffs. A few occur at lower altitudes in lowland rain-forest. The maximum altitude at which the species has been found is 600 m (6).

CONSERVATION MEASURES TAKEN An environmental survey of Lord Howe Island has been carried out and detailed recommendations made to conserve the remaining forests and promote wildlife tourism (4). The majority of the goats have been removed; in 1975 some 50 remained (3).

CONSERVATION MEASURES PROPOSED As recommended by Recher and Clark in (4):- Reservation of parts of the island and complete removal of the pigs and goats.

BIOLOGY AND POTENTIAL VALUE As mentioned above, the flora of Lord Howe Island is of great biological interest; the island's great physical beauty, in conjuction with an almost intact array of endemic biota, make it a key area for wildlife tourism. This species is of some additional interest, in that it belongs to a genus otherwise confined to New Zealand.

CULTIVATION The species is in cultivation.

DESCRIPTION Weeping, shrubby perennial up to 5 m, with finely ridged branchlets bearing leaves of 3-5 elliptic to obovate leaflets, indented at the tips, each c. 10-23 mm, on slender stalks. Leaves often replaced

by cladodes (leaf-like portions of stem). Flowers pea-shaped, in clusters on the stems, mostly occurring below the leaves, uncommon; calyx small, 2-3 mm; petals up to c. 8 mm long, pale cream, the standard more or less rounded. Fruit a short pod, rarely produced.

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The material for this sheet was supplied by Mr J. Pickard (of the National Herbarium, Sydney), to whom the TPC is most grateful. Help is also acknowledged from Mr P.S. Green (of the Royal Botanic Gardens, Kew, U.K.).

LEGUMINOSAE

STATUS Endangered. It is known from one population of under 100 trees, occurring within 0.5 km, and scattered individuals, making up a total of approximately a further 100 trees, over about 50 km of very arid, mountainous country. No regeneration has been observed during extensive field work in the area over the last few years; any young plants had clearly died from grazing or possibly from lack of rain. The goats also eat the leaves and pods of the mature trees. The Bedu by tradition do not cut the branches of the plant, but rather beat them to provide leaves for fodder, a practice that is not considered to be detrimental to the survival of the trees.

DISTRIBUTION Oman; confined to a few localities in the mountains between Muscat and Sūr.

HABITAT AND ECOLOGY On rocky limestone mountain slopes, less often on plateau tops. It only occurs between c. 900 m and 1800 m, being restricted to north-facing sites except at the extreme south of its range where it has been found on slopes facing west. The older trees tend to grow out from under sheltered rocks. Its most characteristic associates are species of *Olea*, *Reptonia* and *Acacia*.

CONSERVATION MEASURES TAKEN The largest population is in the Wadi Serin Nature Reserve, established in 1976 for the threatened Arabian Tahr (*Hemitragus jayakari*). Hunting of the Tahr is prohibited throughout the Sultanate. Within the reserve grazing by goats is still allowed. A detailed conservation survey of the region and of its ecology in relation to the Tahr was made during 1976 to 1978 by Munton for the Oman Government, grant-aided by IUCN/WWF.

CONSERVATION MEASURES PROPOSED As recommended by Munton:- Protection of parts of the reserve from grazing by goats and the creation of further reserves in the region. The species should also be brought into cultivation.

BIOLOGY AND POTENTIAL VALUE Before July 1945, the only member of the genus *Ceratonia* known was the Carob, *C. siliqua* L. In that month a new species, which has not yet received a name, was collected in former British Somaliland. Then, during the Oman Government Flora and Fauna Survey, in April 1975 the Omani species was discovered by Mandaville. This plant may or may not be distinct from the Somali one. It is known that the Bedu find the fruits and seeds palatable.

DESCRIPTION A rather untidily-branched tree up to 8 m. Bark dark grey, rough. Leaves pinnate, with up to 20 narrowly elliptic-oblong leaflets. Inflorescences spicate. Flowers dioecious. Male flowers: calyx small, green, petals 0, anthers reddish tinged. Female flowers:

ovaries grey-tomentose, stigmas reddish. Mature fruits dark reddish-purple, flattened, somewhat twisted, bullate (Radcliffe-Smith).

REFERENCE Mandaville, J.P., Jr. (1977). Plants. In The Scientific Results of the Oman Flora and Fauna Survey 1975. J. Oman Studies, Special Report. Pp. 229-267.

This sheet is based upon material supplied by Mr A. Radcliffe-Smith (of the Royal Botanic Gardens, Kew, U.K.) and Dr P. Munton, to both of whom the TPC is most grateful.

Cladrastis lutea (Michaux f.) C.Koch

American Yellowwood, Virgilia, Gopherwood

LEGUMINOSAE

STATUS Vulnerable; due to its rare occurrence and scattered distribution, its presence in areas subject to flooding by dams and exploitation of saplings for nursery stock (6,7). In the past forest managers have considered it as a 'weedy' timber species and have suggested its removal in management practice (6).

DISTRIBUTION U.S.A. It has a sporadic and disjunct distribution, occurring from southern Ohio and Indiana west through southern Illinois to southwestern Missouri, northern and central Arkansas and extreme eastern Oklahoma, south through central Tennessee to southern Alabama, and east to the mountains of eastern Tennessee, North Carolina and extreme northern Georgia (7).

HABITAT AND ECOLOGY It is found in two quite different habitats. In the western and southern part of its range, the Interior Highlands, it mainly occurs on the brink of cliffs, along cliff ledges, or sometimes toward the base of cliffs. The trees are small and the trunks fork at about the middle (5,7). The prevailing vegetation cover in the region is an oak-hickory forest (1). In the eastern part of its range, the Southern Appalachians, it grows in cove hardwood forests, forming a tall tree with an erect, flat crown and a trunk that forks fairly close to the ground (5,7). Such forests contain 25-30 tree species of which 6 to 8 may be dominants in varying proportions. These species are: sweet buckeye *(Aesculus octandra* Marshall), basswood *(Tilia heterophylla* Vent.), sugar maple *(Acer saccharum* Marshall), silverbell *(Halesia carolina* L. var. *monticola* Rehd.), tuliptree *(Liriodendron tulipifera* L.), beech *(Fagus* spp.), yellow birch *(Betula lutea* Michaux f.) and hemlock *(Tsuga canadensis* (L.) Carrière) (1).

CONSERVATION MEASURES TAKEN In the Great Smoky Mountains National Park it occurs in a number of localities, but for the most part it is uncommon and localised (8). It is extremely likely the species occurs in other reserves, such as in numerous State Parks. Many of the localities are within National Forest land adjacent to the Great Smoky Mountains National Park in North Carolina and south into Georgia; this does not, however, ensure the protection of the species or its habitat.

CONSERVATION MEASURES PROPOSED This tree should be protected wherever it occurs in the National Forests, particularly in those forests of western North Carolina and northern Georgia where it is most abundant.

BIOLOGY AND POTENTIAL VALUE It is a relict species dating from the Eocene Period; it is poorly competitive with more recent forest species and survives in climax forests mainly by vegetative reproduction. Its seed production is irregular and most populations indicate poor

seedling establishment (6). It is a most spectacular and attractive tree with its long pendulous, wisteria-like panicles of fragrant white flowers, opening in April to June, and its smooth beech-like bark. Heavy flowering occurs only every other year or so. It is occasionally planted as an ornamental and is hardy throughout the eastern United States and southern Canada (7). "The wood is hard, close-grained, and bright yellow, turning to light brown on exposure" (2). Because of its lightness and strength, it was used in the past for making gunstocks. The roots were used as a source of clear yellow dye. If the tree did not fork near the base into several thin stems, it would provide a superb cabinet wood (4).

CULTIVATION It is usually difficult to find in nurseries, and when available, is usually in limited quantities. The trees are slow-growing, flowering only after 10-20 years (7). They can be propagated by root cuttings, dug up in the autumn and kept in sand or moss, moderately moist and cool, until spring. If seed is sown in the spring, dormancy must first be broken by either scarification or stratification using any of the methods described in (2). Untreated seed can be planted in the autumn, mulched and protected with shade screens until spring.

DESCRIPTION Moderate-sized, broadly rounded, deciduous tree reaching c. 15 m when mature, with a short trunk forking into a few wider-spreading branches. Leaves alternate, pinnate, 25-40 cm long, with usually 7 leaflets per leaf. Flowers pea-like, white, in long, many-flowered, pendulous terminal panicles; upper petal (standard) yellow towards the base. Fruit a flattened pod up to 8 cm long, often slightly constricted laterally between the seeds (7). For illustrations see (4) & (7).

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The material for this sheet was supplied by the Endangered Flora Project of the Smithsonian Institution, Washington, D.C., to whom the TPC is most grateful.

Clianthus puniceus (G.Don) Solander ex Lindl.

New Zealand Parrot's-bill, Lobster Claw

LEGUMINOSAE

STATUS Endangered. Only 6 wild populations of this very spectacular plant are now known. The size of each is very low, in 3 cases being reduced to 2 individuals. The plant's decline is presumably due to heavy browsing, mainly by Australian opossum (*Trichosurus vulpecula*), but in addition introduced deer, pigs, goats and rats may have contributed. Collecting of seedlings may also have been a factor. Given, Atkinson & Esler (2) conclude: "Without urgent action, past and present disturbance will probably continue until all wild plants are destroyed".

DISTRIBUTION New Zealand; in 2 areas on North Island - around Lake Waikaremoana (East Coast), where there are 5 very small colonies, and a single population at Kaipara Harbour (Northland). Its past distribution is uncertain in view of the plantings by Maoris (see 3), but it was probably present in the wild on offshore islands and in some coastal areas. The range given in (1) is probably secondary and includes plantings.

HABITAT AND ECOLOGY The remaining plants occur in forest of *Metrosideros, Dacrydium* and *Beilschmiedia* at Lake Waikaremoana, and in coastal scrub at Kaipara Harbour. The original part played by the species in such communities is not clear although Esler suggests that the need for light is probably paramount. *Clianthus puniceus* appears to show a preference for thin soils on steep ground. Natural increase is poor with few seedlings and minimal vegetative increase except at one site where the plants are layering.

CONSERVATION MEASURES TAKEN The Lake Waikaremoana populations are within the Urewera National Park (199,523 ha).

CONSERVATION MEASURES PROPOSED As recommended by Given, Atkinson & Esler:- "Constant monitoring is imperative at all known sites and other sites should be searched for. Noxious animal control (chiefly Australian opossum) must be effective if the species is to survive in the wild. At Lake Waikaremoana, the species should be propagated from wild stock and seedlings planted back adjacent to parent plants to build up population size. Fencing may be necessary and possibly restrictions on access imposed, or tracks sited well away from known colonies. The public need to be educated to not take propagating material from wild stock; all such requests must be carefully refereed" (2).

BIOLOGY AND POTENTIAL VALUE *Clianthus puniceus* has long been regarded as an outstanding garden plant and is widely grown both in New Zealand and elsewhere. The names 'Parrot's Bill' and 'Lobster Claw' reflect the somewhat curious claw-like shape of the large, brilliant, red

flowers, which are borne in hanging racemes. A white form is also available in cultivation.

CULTIVATION It is widely cultivated in gardens and was formerly grown by Maoris (1). It is an easy plant to grow although it tends to be short-lived. It can be propagated by seed, cuttings or layers.

DESCRIPTION Softly woody shrub up to 2 m tall with spreading branches; branchlets more or less herbaceous, slightly silky-hairy, bearing pinnate leaves up to 15 cm long, with up to 15 pairs of nearly stalkless, linear-oblong leaflets each 1.5-2.5 cm long. Racemes pendulous, with up to 15 large scarlet pea-like flowers each up to 8 cm long. Calyx bell-shaped, 1.5-5 mm long; standard petal erect, bent back, ovate to lanceolate, c. 6 cm long; keel petal curved, pointed, claw-like, c. 6 cm or more long, twice as long as the wings. Pods up to 8 cm long, turgid, with numerous seeds (1).

For illustrations see (4) and (6).

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This sheet has been compiled from the account in (2) of *Clianthus puniceus* by Dr D.R. Given, I.A.E. Atkinson & A.E. Esler, to whom the TPC is most grateful.

Yeheb Nut

LEGUMINOSAE

STATUS Endangered. This bush which produces nuts valued as food has declined to dangerously low levels along with the general deterioration of the vegetation in the Horn of Africa, mainly due to overgrazing by rising populations of livestock. "The total absence of seedlings and of young plants suggested that regeneration had been inhibited for years" (4). Presumably this is due to nearly all the nuts being taken for human consumption and any seedlings that may come up being eaten by goats. "When the grass and herbaceous cover has gone, the mature plants too suffer considerable damage through the browsing goats which are fond of the Yeheb leaves" (4). In recent times great interest had been expressed in its potential as a source of food (see below).

DISTRIBUTION Ethiopia, Somalia. The wild populations are believed to be restricted to 3 areas in the arid region known as the Haud - near Bokh and near Gerlogubi in the Ogaden Province of Ethiopia and near Adawilif in Somalia. It was formerly abundant and locally dominant in a quadrilateral with corners at Damot and Gerlogubi (Ethiopia), Goffado (south Somalia) and Obbia (on the Somali coast) (4).

HABITAT AND ECOLOGY In open bush savanna on very poor red sandy soils with an annual rainfall of less than 250 mm, growing in scattered, isolated clumps surrounded by open tufted grassland. It is associated with occasional trees of *Acacia tortilis* (Forssk.) Hayne, and shrubs smaller than the Yeheb itself such as *Boswellia microphylla* Chiov., *Euphorbia longispina* Chiov., *Cassia truncata* Brenan, *Corchorus bricchettii* H.Weimarck and *Polygala obtusissima* Hochst. ex Chodat. An analysis of the soil is given in (4).

CONSERVATION MEASURES TAKEN None for the wild populations. It is, however, now in cultivation in Somalia and Kenya, and being evaluated as a crop plant. According to one unconfirmed report, the Somali Government intend to plant up to 500 sq. km with it.

CONSERVATION MEASURES PROPOSED When circumstances permit, it should be established in a National Park or equivalent reserve.

BIOLOGY AND POTENTIAL VALUE The seeds each weigh about 1.6 gm and contain about 41% starch, 12% sugar, 13% protein and 12% fat. They have a pleasant sweetish flavour. "They are eaten fresh, or boiled, occasionally roasted, when they taste somewhat like roasted chestnuts" (4). A full chemical analysis was made in 1977. The species is also known as a source of good dyes.

For regions with a low rainfall which can support only a nomadic

population, and where there is little or no agriculture, the introduction of the Yeheb Nut should be considered (4,6). Within its range it was once of considerable economic importance locally and has great potential as a source of food because the low rainfall in the area makes the cultivation of other crop legumes impossible. The Yeheb was described by Captain Cordeaux in 1907 as being the staple food of some of the inhabitants of the area (2). The seed could still become an important item in the local diet and also have considerable potential for export. Since the people in the area are primarily nomadic, a species such as *Cordeauxia* which does not require tending when planted has considerable advantages.

CULTIVATION It is being grown in Kenya, particularly near Voi and on the Galana River. There are a number of large bushes, all of which produce seed, and it is being planted on a crop scale. It is also being grown in Somalia. Seedlings were raised without difficulty under moist tropical conditions at Kew, but drier conditions are needed later. The seeds do not retain their vitality for long and should be sown without delay (2). It is a deep rooted species which requires deep sand; it almost certainly will not tolerate water-logging.

DESCRIPTION Bush reaching 2 m in height with many ascending, much-branched stems. Leaves pinnate, usually of 4 pairs of leathery, ovate leaflets each 15-25 mm long, olive-green above and paler below, dotted with numerous, scale-like, red glands which stain the hands when touched. Flowers bright yellow, about 25 mm across, in terminal clusters, each with 5 oblong gland-dotted sepals, 5 spoon-shaped petals 15 mm long, surrounding 10 free erect stamens. Pod compressed ovoid and curved into a horn, 4-6 cm long, with leathery walls enclosing 1 or 2 ovoid seeds (nuts) 35-50 mm long (1,4).

For illustrations see (4), (5), (6) and (7).

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A chemical analysis of the nuts, by P.R.O. Bally and J. Miège, is in press in the journal Economic Botany.

The TPC is most grateful to Dr P.R.O. Bally (of Nairobi, Kenya) and to Dr R.M. Polhill (of the Royal Botanic Gardens, Kew, U.K.), for help in producing this sheet.

LEGUMINOSAE

STATUS Rare. It is only known from about 17 localities in a mountainous area of about 300 sq. km, although in one of these, the Grigna, overlooking the south eastern arm of Lake Como, it is locally abundant both above and below the tree line (2). The populations are not believed to be in great danger, but are at risk from grazing by goats and collecting for botanical specimens.

DISTRIBUTION Swiss-Italian border area. It occurs in the south Alpi Bergamasche, west to the Lake Lugano and Lake Como region (3). The species belongs to a relatively large group of endemics which were able to survive the glaciations in this largely unglaciated southern part of the Alps; some of these are very restricted in distribution, e.g. *Saxifraga presolanensis* Engl.; others occur in more localities but are still confined to the region between Lake Como and Lake Garda, e.g. *Saxifraga vandellii* Sternb. and *Silene elisabetha* Jan.

HABITAT AND ECOLOGY On stony slopes of limestone (including dolomite) at 1000-1800 m. On the Grigna it occurs in the oak woods on the lower slopes, up into the *Erica* heath and in the alpine pastures of *Carex ferruginea* Scop. (2).

CONSERVATION MEASURES TAKEN None.

CONSERVATION MEASURES PROPOSED To ensure the well-being and long-term survival of this species, it is suggested that the declaration of a reserve to include one or more of the populations would be desirable.

BIOLOGY AND POTENTIAL VALUE It is of horticultural merit and has been used as a limestone rock-garden plant, where it grows well and carpets the rocks (2). It is one of the relict endemics of the region and was probably much more widely distributed before the last ice age (2).

DESCRIPTION Procumbent to erect shrub with rigid, angular stems 30-60 or rarely 100 cm long, the young twigs with appressed, villous hairs; leaves of 3 obovate-lanceolate leaflets 10-20 mm long, more or less hairless above but with short silky hairs below; flowers in clusters of 1-4, forming densely leafy terminal racemes, each on a sparsely hairy stalk c. 12 mm long; calyx of 2 lips, the upper with 2 small teeth; corolla pea-like, yellow, with a standard of 10-12 mm; pod linear to oblong, 25-35 x 6-7 mm, hairless (Flora Europaea).

For illustrations see (2) & (3).

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The material for this sheet was supplied by Professor E. Landolt (of the Geobotanisches Institut, ETH, Zürich), to whom the TPC is most grateful.

LEGUMINOSAE

STATUS Rare or Endangered; a very local species of restricted distribution which has been affected in the long term by climatic changes decreasing the area of forests, but more recently by forest clearing. The site at Mrima Hill in Kenya is at risk from mineral exploitation.

DISTRIBUTION Kenya, Tanzania. It is known from only 4 localities:-

1. On Mrima Hill in Kwale District, Kenya (where found in 1959 and 1960);
2. Between Msambweni and Lungalunga in Kwale District, Kenya (found there in 1964);
3. On the Rondo Plateau in Lindi District, Tanzania (found there in 1951 and 1952);
4. At Amani in Tanga in the eastern Usambara Mts., Tanzania (cultivated specimens found there in 1937).

The forest at Mrima Hill is a very good example of lowland evergreen forest, of a type probably once widespread in the coastal strip but now nearly all destroyed. The flora is of great interest, possessing as it does three distinct floristic elements and including "several of the apparently quite endemic Kenya coastal species" (6). "Each new collection from this region seems to turn up species not previously recorded from Kenya" (4).

The Rondo Plateau (c. 265 sq. km) is partly covered by what was "the finest *Chlorophora* forest in East Africa before it was cut over in the late forties and early fifties". Although part has been cleared and replanted with various exotics including teak and pine, a large part remains unchanged. "The Rondo is by far the best representative of a number of dissected plateaux carrying forest in the coastal plain of southern Tanzania" (5).

HABITAT AND ECOLOGY In lowland, evergreen, tropical forest, 120-900 m. The Kenya population is associated with a deposit of rare earth elements, but there is no evidence at present that this is a necessary association.

CONSERVATION MEASURES TAKEN Part of the Rondo Plateau (Tanzania) is a Central Government Forest Reserve (5).

CONSERVATION MEASURES PROPOSED The Mrima Hill Forest (Kenya) should be urgently considered as a possible National Park, as recommended by Lucas (4). Further protective measures should be considered for the Rondo plateau, as recommended by Polhill (5).

BIOLOGY AND POTENTIAL VALUE "The large and beautiful flowers of this

tree would make it a worthwhile introduction for ornament in other parts of the tropics" (2). As mentioned above, the vegetation of which it forms a part is of great scientific interest.

DESCRIPTION Large, round-topped forest tree up to 20 m high with whitish- or pinkish-grey bark. The branchlets, at first covered by short rusty hairs, bear papery, broadly ovate to subcordate leaves 8-17 cm long and large, magnolia-like flowers in short erect racemes. Flowers with 5 slender, long-pointed sepals 5-8 cm long, alternating with 5 obovate to elliptic petals 9-13 cm long, pure white except for a yellow splash on one, or white flushed creamy-pink; stamens 10. Pod large and flattened, up to c. 30 cm long by 6-7 cm wide, containing c. 6 purplish-brown seeds each 2-3 cm across and almost encircled by the narrow U-shaped scar of attachment (hilum) (2).

For an illustration see (2).

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Pico Paloma ('dove's beak')

LEGUMINOSAE

STATUS Almost certainly extinct in the wild. However, it survives in cultivation and is becoming widely grown in gardens. It was recorded in 1884 as "an exceedingly rare plant" (3) and collecting of the plants for horticulture was presumably the reason for the extinction of wild populations.

DISTRIBUTION Canary Islands. It was known from two localities on Tenerife, one near Orotava and the other on the south side of the island.

Out of 95 species of flowering plants endemic to Tenerife, 9 are Endangered, 18 are Vulnerable and 35 are Rare. The principal threats to the flora are destruction of the forests and pressure on land for agriculture and tourism.

HABITAT AND ECOLOGY On forest cliffs under *Pinus canariensis* C.Smith, at 700-1200 m.

BIOLOGY AND POTENTIAL VALUE It is a very attractive, pendulous cliff plant with strikingly beautiful, scarlet-red flowers, and is a valuable garden plant for growing in Mediterranean climates. Its breeding biology is under study: the flowers are one of the largest in the genus and this together with the bright colour, suggests an adaptation to pollination by birds. However, there are no extant pollinating birds in the island, though the plant is strongly self-incompatible.

CULTIVATION It can be propagated from seeds or cuttings and was formerly grown in hanging baskets. Because of its self-incompatibility, it has not been possible to obtain seed for storing in a seed bank.

DESCRIPTION Small much-branched shrub covered with short silvery hairs. Leaves stalkless, divided into 5-7 thread-like leaflets 10-18 mm long. Flowers brilliant scarlet to deep red, 30-35 mm long, clustered 1-4 together on short branchlets; calyx 10-14 mm, divided into 5 slender and irregular lobes; posterior petal (standard) narrowly lanceolate, sharply recurved over the calyx; lateral petals (wings) much broader and rather longer than the standard; keel longer than the wings, curved upwards and narrowed to a long point. Pod slender, irregularly twisting. (Syn. *Lotus peliorhynchus* Webb).

For illustrations see (1), (2), (3) and the cover of this book.

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The TPC is most grateful to Dr D. Bramwell, of the Jardín Botánico Viera y Clavijo, Gran Canaria, for help in producing this sheet.

Mimosa lanuginosa Glaziou ex Burkart

Snow Mimosa

LEGUMINOSAE

STATUS Vulnerable, possibly Endangered; restricted to one small district of Brazil. Some of the largest and best known populations are on land occupied by the Universidade de Brasília, where much of the vegetation has been cleared for development.

DISTRIBUTION Brazil; Brasília Distrito Federal.

HABITAT AND ECOLOGY In savannah (cerrado) woodland on acid, lateritic sand with summer rainfall, associated with *Caryocar brasiliense* St.-Hil., *Dimorphandra mollis* Benth., *Pterodon polygaliflorus* Benth., *Brosimum gaudichaudii* Trécul and other species.

CONSERVATION MEASURES TAKEN None known.

CONSERVATION MEASURES PROPOSED The possibility of declaring a reserve near Brasília should be considered. The species should be propagated in botanic gardens and distributed for horticulture.

BIOLOGY AND POTENTIAL VALUE Nothing is recorded of its biology, but seed set appears to be poor. The magenta pink of the flower-heads and snowy-white hairiness of the leaves and branches are both unusual features in the genus and together would make this species an attractive addition to tropical and subtropical gardens.

DESCRIPTION Sparingly branched, erect shrub 1-2 m high, completely covered by long, soft, woolly or shaggy, white hairs. Leaves nearly stalkless, pinnate, 10-35 mm long with 7-11 white, obliquely ovate leaflets, the margins fringed by longer hairs. Flower-heads spherical, 12-15 mm across, on stalks mostly 2-3 cm long, with numerous small flowers; calyx 4-toothed, tipped by tufts of white hairs; corolla narrowly tubular, 4-toothed, magenta pink, with 4 long and twisted, similarly coloured stamens protruding. Pods 10-15 mm long, covered by greyish hairs and containing 3-5 seeds.

For an illustration see (1).

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The TPC is most grateful to Professor H.S. Irwin of the New York Botanical Garden and Dr R.M. Harley of the Royal Botanic Gardens, Kew, for help in producing this sheet.

LEGUMINOSAE

STATUS Endangered; a large Micronesian tree reduced to a critically low population. It was discovered in about 1916 by Nelson, who described it as very scarce as far as he could ascertain (quoted in 4). Since then it has been found by four other botanists on the same island (Guam). In recent times it has been known from only four trees, two of which were discovered only in 1977. A further tree had been discovered earlier but was destroyed soon afterwards by a bulldozer. The surviving trees produce abundant seed, but the seedlings tend to be eaten by the Guam 'deer' (a species of Elk from South East Asia, whose introduction to Guam is suspected of having endangered several species on the island).

DISTRIBUTION Guam (U.S.A.), Rota (the U.S. Trust Territory) in the Marianas. In Guam two of the known trees occur at the northern end of the island (1) and the other two are in a ravine near the southern end; this unexpected distribution suggests that the species may have been more widespread on the island than thought hitherto. The species was recorded from Rota by Stone (5).

Guam is the largest and most southerly island of the Marianas. The flora includes about 68 species of ferns and angiosperms endemic to the archipelago (5). The much smaller island of Rota (c. 85 sq. km) lies to the north of Guam and is less well known botanically.

HABITAT AND ECOLOGY The two recently discovered trees in the south of Guam grow in ravine forest, on volcanic clay soil beside a small stream. In contrast the other two trees occur in forest on limestone. Much of the uplands of western Micronesia are formed by hard recrystallized coral limestones. "These areas are, or were covered by dense forest, rich in species composition, and interesting in environmental adaptations ... Except on Guam, any level land with enough soil for sugar cultivation was cleared and planted to cane by the Japanese. Some parts of Rota with almost no soil remain in forest. This forest contains several very rare or local tree species, endemic to the Marianas such as *Hernandia labyrinthica, Boerlagiodendron* sp., *Heritiera longipetiolata* (also in the Red Data Book) and *Serianthes nelsonii*. On Guam, destruction has been largely the result of use of the land for military installations and for unproductive week-end farming by local people. A few areas remain ... (&) several small areas have been designated as 'conservation areas' by the Guam Government" (2).

CONSERVATION MEASURES TAKEN The two trees in the north of Guam are on Federal Land.

CONSERVATION MEASURES PROPOSED Protection for the existing trees and possible re-introduction into conservation areas. Further search for the species in Rota.

BIOLOGY AND POTENTIAL VALUE It is both a handsome tree and capable of providing a good timber. Because of its rusty-brown foliage it stands out from the dense surrounding vegetation (5). Nelson (quoted in 4) described it as a "very large and beautiful tree". Although called 'hayun lago' (translated as 'foreign wood' or 'wood from the north') by the Guam people, it is certainly a native species since it has not been found elsewhere and since large trees have been found in the forest, remote from the villages (1).

CULTIVATION Seedlings from a roadside in Guam were transplanted into a garden in Agana, the principal town of the island; the species is also being grown in the Waimea Arboretum, Hawaii.

DESCRIPTION Large tree up to 20 m tall with a trunk up to 2 m across, the young growth with brown hairs. Leaves doubly pinnate, up to 23 cm long, with numerous small leaflets c. 5 x 2 mm, hairless above, glaucous and hairy below, the leaf axis with rusty coloured hairs. Inflorescence a stout, somewhat brown-hairy, sparsely branched panicle arising from the leaf axil, up to 5 cm (or in fruit 10 cm) long. Calyx more or less cylindrical, 7-10 mm long; corolla of 5 petals 15-23 mm long, recurved at the tips, from which protrude a curving mass of stamens about twice the length of the corolla. Pods c. 12 cm long, brownish hairy, slightly constricted between the hard brown shining seeds which are each c. 10 x 8 mm (1,5).

For an illustration see (3) or (5).

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Crusoe's Mayu-monte

LEGUMINOSAE

STATUS Vulnerable; an island species which has become depleted due to the introduction of goats and other grazing animals and the clearing of the lower slopes of the island for pasture. There are at present some 300 goats on the island and large numbers of sheep and cattle. The species was found to be "very rare" in 1954-5 (1); it was reported in 1978 as still surviving in a few places, but very few young plants have been seen. "Where the forest has been cleared, it has been replaced by secondary types of vegetation, the macal, formed by almost pure stands of *Aristotelia maqui*, and the weed-fields, formed by a mixture of indigenous and adventitious herbs and grasses, or lacking all native species" (3).

DISTRIBUTION Juan Fernández Islands, South Pacific Ocean; confined to Isla Robinson Crusoe (formerly Más á Tierra) and in 1917 "scattered through the lower montane forests ... extending from about 200 to above 450 m, always very local" (3).

There are about 98 flowering plants and 17 ferns endemic to Juan Fernández and the majority are undoubtedly threatened, due to the destruction of the forests by introduced sheep, cattle, horses, goats, rabbits, rats and the even more intractable problem of vigorous and invasive introduced plants such as *Aristotelia*, which is very common below 200 m, and *Rubus*, reported as an aggressive coloniser in the vegetation. The flora is of great interest for its most unusual evolutionary development, resulting in gigantism in many species, especially in the cabbage trees of the *Compositae* (2).

HABITAT AND ECOLOGY Evergreen forest mainly of *Nothomyrcia fernandeziana* (Hook. & Arn.) Kausel and *Drimys confertifolia* Phil.

CONSERVATION MEASURES TAKEN The Parque Nacional Juan Fernández was declared in 1935, but introduced grazing animals are still continuing to degrade the vegetation and flora. It is planned to reduce the numbers of goats and eliminate the sheep and cattle on Robinson Crusoe (G. Mann, pers. comm.).

CONSERVATION MEASURES PROPOSED Grazing animals should be eliminated from the island, or at least excluded from selected areas. The problem of how to remove the vigorous introduced plant species should be urgently studied.

BIOLOGY AND POTENTIAL VALUE The endemics of Juan Fernández are important to studies of plant geography and evolution (see under Distribution, above). This species is one of a group that is widespread in the Pacific, linking Juan Fernández with New Zealand, Easter Island, Hawaii and Chile.

CULTIVATION It has been grown in local nurseries with some success.

DESCRIPTION Small tree up to 10 m high with a hard, dark coloured wood and pinnate leaves 6-8 cm long of 8-12 pairs of elliptic leaflets, each 4-14 mm long, with scattered grey or rusty hairs above and slightly silky beneath. Flowers pea-shaped and golden yellow, c. 3 cm long. Mature pods up to 20 cm long, swollen round the irregularly spaced seeds.

Closely related and very similar to *S. masafuerana* (Phil.) Skottsb. (also in the Red Data Book), which is endemic to Isla Alejandro Selkirk, differing mainly in its longer pods.

For an illustration see (3) (dissections and leaves only).

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The TPC is most grateful to Mr G. Mann, of the Corporación Nacional Forestal, Chile, for help in producing this sheet.

Selkirk's Mayu-monte

LEGUMINOSAE

STATUS Endangered. It is known from a few localities on an island of 10 x 6 km and is threatened by feral goats, of which there are now about 4000 on the island, as well as cattle and rabbits and rats. It must have been seriously depleted by the extensive destruction of the forests in earlier centuries, probably when exploited for the sandalwood, now extinct. "Once destroyed, the forest does not come back; native ferns ... and ... introduced herbs and grasses rapidly invade the clearings, and tree seedlings may fall a victim to the innumerable goats" (3).

DISTRIBUTION Juan Fernández Islands, South Pacific Ocean; confined to Isla Alejandro Selkirk (formerly Más Afuera).

There are about 98 flowering plants and 17 ferns endemic to Juan Fernández and the majority are undoubtedly threatened, due to the destruction of the forests by introduced sheep, cattle, horses, goats, rabbits, rats and the even more intractable problem on Isla Robinson Crusoe of vigorous and invasive introduced plants such as *Aristotelia*, which is now very common below 200 m, and *Rubus*, reported as an aggressive coloniser in the vegetation. The flora is of great interest for its most unusual evolutionary development, resulting in gigantism in many species, especially in the cabbage trees of the *Compositae* (2).

HABITAT AND ECOLOGY In 1917 found in cliff forest on ledges on the walls of the deep canyons, "not common and often beyond reach", growing with *Coprosma pyrifolia* (Hook. & Arn.) Skottsb., *Myrceugenia schulzei* Johow, *Gunnera* and tree-Composites (3).

CONSERVATION MEASURES TAKEN The Parque Nacional Juan Fernández was declared in 1935, but introduced grazing animals are still continuing to degrade the vegetation and flora. It is planned to reduce the numbers of goats and eliminate the cattle on Isla Alejandro Selkirk (G. Mann, pers. comm.).

CONSERVATION MEASURES PROPOSED Grazing animals (as now planned) should be drastically reduced and if possible eliminated from the island.

BIOLOGY AND POTENTIAL VALUE The endemics of Juan Fernández are important to studies of plant geography and evolution (see under Distribution, above). This species is one of a group that is widespread in the Pacific, linking Juan Fernández with New Zealand, Easter Island, Hawaii and Chile.

DESCRIPTION Small tree only one to a few metres high with a prostrate-ascending trunk and slender flexuous branches bearing pinnate leaves 5-7 cm long of about 6-10 pairs of elliptic leaflets each 8-12 mm

long, white-hairy on the underside. Flowers pea-shaped and yellow, c. 3 cm long, and mature pods 8-11 cm long, swollen round the 3-7 irregularly shaped seeds which are ellipsoid or slightly compressed, 6-7 mm long and yellowish or chestnut brown.

Similar to the larger *S. fernandeziana* (Phil.) Skottsb., (also in the Red Data Book), which is endemic to Isla Robinson Crusoe, but differing in its shorter pods, the length of its hairs and other details.

For an illustration see (3) (dissections and leaves only).

REFERENCES

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3. Skottsberg, C. (1920-1953). The natural history of Juan Fernández and Easter Island 2. Almqvist & Wiksells Boktryckeri AB, Uppsala. Pp. 137-142, 840 and 921.

The TPC is most grateful to Mr G. Mann, of the Corporación Nacional Forestal, Chile, for help in producing this sheet.

Toromiro

LEGUMINOSAE

STATUS Probably Extinct. Skottsberg in 1917 found only one tree which was later seen by Chapin in 1935 (3). A few trees of it were found in the same locality in 1955-6, but had died by 1962 when unsuccessful searches were made for the species. The wood was used locally but the major reason for the plant's decline was destruction of the seedlings and disbarking of the trees by introduced sheep. It is not certain whether or not it is surviving in cultivation.

DISTRIBUTION Easter Island (Isla de Pascua, Rapa Nui), Pacific Ocean. The one surviving tree was on the slopes of the Rano Kao Crater at the south west tip of the island. The species must have been common in the past since the wood was used for making canoes, house frames, etc.

The flora of Easter Island is at present a small one, with about 30 indigenous angiosperms of which the *Sophora* and 3 grass species are endemic. The island is now covered mainly by grassland, despite a tropical climate, and there has been speculation as to how the original vegetation may have differed, bearing in mind the island's notable history (3). The *Sophora* was the only species of shrub or tree on the island in historic times, but there were undoubtedly other trees before the era of man.

HABITAT AND ECOLOGY When the *Sophora* was first discovered in 1774, it formed thickets on parts of the volcanic slopes of the island (1). "To judge from the famous wood-carvings of the islanders, the stem formerly attained a thickness of a couple of dm at least" (3).

BIOLOGY AND POTENTIAL VALUE The timber was valuable to the islanders (see above) as their only source of wood. The species is important to studies of plant geography and evolution as one of a group that is widespread in the Pacific.

CULTIVATION *Sophora* species are easily grown from seed. It is not certain whether or not *S. toromiro* is still in cultivation; it has been recorded in the past from botanic gardens.

DESCRIPTION Shrub or small tree up to 3 m high, with pale green pinnate leaves 4-5 cm long of 7-11 pairs of elliptic leaflets thinly covered by silky white hairs. Flowers pea-like, presumably yellow. Fruit a pale brown long-stalked pod up to 10 cm long, swollen around each of the 7 seeds and very narrow between them, with longitudinal flanges (wings) on the edges. Seeds small and yellow.

For an illustration see (3).

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Philip Island Glory Pea

LEGUMINOSAE

STATUS Extinct. A small island endemic which became extinct in the wild due to grazing by feral goats, pigs and rabbits. It was widely cultivated in the last century, but recent efforts to find it in gardens have been unsuccessful and it now seems unlikely to be surviving in cultivation.

DISTRIBUTION Philip Island, Pacific Ocean (29° 06'S., 167° 57'E.). Philip Island is an uninhabited precipitous island of volcanic origin about one square mile (c. 2.6 sq. km) in area (4), c. 10 km south of Norfolk Island. When discovered by Captain Cook in 1774, the island was believed to have carried scrub or dense forest in the valleys and at the lower altitudes (3,4). Shortly after the colonisation of Norfolk Island in 1788, goats and pigs were placed on Philip Island to provide a reserve of meat. By the 1830s vegetation was confined to the valleys and erosion had begun. At a later date rabbits were introduced. "Today the island is essentially a colourful desert", heavily eroded (4). 3 species are believed to be endemic, *Agropyron kingianum* (Endl.) Laing, which was last seen in 1912, the Endangered *Hibiscus insularis* Endl. (also in the Red Data Book) and the extinct *Streblorrhiza* (3).

HABITAT AND ECOLOGY Presumably in dense scrub on volcanic deposits.

BIOLOGY AND POTENTIAL VALUE The plant is of scientific interest as it is the only species in the genus. It belongs to the *Carmichaelieae*, a tribe restricted to New Zealand, Lord Howe Island and Philip Island. It was cultivated as a greenhouse climber in Europe in the early years of the 19th Century. Its attractions were at first overrated and this led to a decline in popularity, probably because it did not flower well when confined to pots. Given a free root run it was a beautiful and floriferous vine (2).

CULTIVATION It was said to strike from cuttings and flower well if protected from frost.

DESCRIPTION Perennial woody vine bearing shiny green pinnate leaves of 5-7 elliptic leaflets 3-4.5 cm long and a profusion of rose pink, pea-shaped blossoms. Individual flowers c. 25 mm long with the standard and upper part of the keel rose pink and the lower part of the keel pale green. Pods up to c. 8 cm long by 2 cm broad, containing about 6 dull green, red-spotted seeds, having the radicle twice folded.

For a fine colour plate see (2) (under the name *Clianthus carneus*).

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The TPC is most grateful to Mr P.S. Green, of the Royal Botanic Gardens, Kew, U.K., for help in producing this sheet.

LEGUMINOSAE

STATUS Presumed extinct; an island endemic only known from its original discovery in 1880 (1). It was seen in two places, but in 1967 intensive searches of these two localities failed to find it. Its demise, along with most of the vegetation of its habitat, has been due to overgrazing by goats and other introduced livestock.

DISTRIBUTION Socotra (an Island Territory of the People's Democratic Republic of Yemen, lying 225 km east of the Horn of Africa). It occurred towards the north coast on the plains of Qallansiya and Qadhub.

The flora of Socotra is critically threatened; out of 216 flowering plants endemic to Socotra and the neighbouring island of Abd al Kuri, 132 are believed to be rare and threatened, 85 of them in immediate danger of extinction (Endangered). This drastic situation is the result of grazing by excessive numbers of introduced livestock on an island flora which has presumably evolved partly in the absence of large mammals, unlike the flora of the African mainland.

HABITAT AND ECOLOGY In sandy places on the coastal plains. These are perhaps the most severely threatened of the habitats on Socotra, more so than the limestone slopes and the granite massif of the Hajhir Mountains. Overgrazing has had drastic effects on the vegetation and in 1967, large areas were found to be barren. Where plants occurred, they had become unnaturally stunted, forming either intricately-branched small cushions or reduced to short stumps of wood. Besides *Taverniera sericophylla*, ten other species endemic to the coastal plains of Socotra could not be found at all. Balfour in 1880 mentioned the prickly endemic *Lasiocorys spiculifolia* Balf.f. as "one of the plants which makes progress over many parts of the plains unpleasant" (1), yet in 1967 only one specimen of it was seen. The vegetation of arid zones is one of the most fragile ecosystems in the world and is very susceptible to permanent damage by overgrazing.

BIOLOGY AND POTENTIAL VALUE When squeezed the leaves emit a bright purple juice which Balfour mentions was used as a local dye (1).

DESCRIPTION Small shrub covered by silvery-silky hairs bearing soft, slightly thickened leaves consisting of 3 elliptic leaflets 15-25 mm long, the terminal one on a stalk of similar length, the lateral ones nearly stalkless but the whole leaf on a stalk of 1-2 cm. At the branch tips are borne short dense leafy racemes of 3-4 small pea-like flowers on short stalks; petals crimson-purple, the wings less than half as long as the keel, up to c. 8 mm long. According to Balfour the flowers are soon deciduous (1). Fruits not known.

For an illustration see (1).

REFERENCE 1. Balfour, I.B. (1888). Botany of Socotra. Trans. R. Soc. Edinb. 31: xxxix, 78-79, 244 & t. 19.

This sheet is based upon information provided by Mr A. Radcliffe-Smith (of the Royal Botanic Gardens, Kew, U.K.), to whom the TPC is most grateful.

Spiral Aloe or Kharetsa

LILIACEAE

STATUS Vulnerable. A rare species of great horticultural interest, which has been depleted by uprooting of the plants for sale to gardeners and nurserymen. A recent survey by Beverly (see below) found the species to be more widespread than hitherto believed, but with a population of only around 3500 individuals. These occur in about 50 localities, most of which are less than 1 ha in size. The species was found to be extinct in 12 known sites, and declining in several others.

DISTRIBUTION Lesotho. The localities are scattered throughout the country with a concentration in the Thaba Putsoa Range and Maseru area of the Drakensberg Mountains.

HABITAT AND ECOLOGY On steep basalt slopes with loose rock, at 2230-2720 m. It is found on predominantly north-facing slopes, but at the higher altitudes (2620-2720 m) on more easterly slopes. The roots are kept moist in summer by a continual flow of water. Associates are mostly low shrubs, e.g. *Chrysocoma tenuifolia* Bergius, *Passerina montana* Thoday, *Geigeria africana* Griess., *Artemisia afra* Jacq.; and grasses, e.g. *Cymbopogon plurinodis* Stapf ex Burtt Davy, *Themeda triandra* Forssk. and *Eragrostis curvula* (Schrader) Nees. The average annual rainfall in the area is around 1100 mm, over three quarters of which falls from September to March.

CONSERVATION MEASURES TAKEN A detailed study of the ecology and distribution of *Aloe polyphylla* has been made by Beverly (1) and presented to the Protection and Preservation Commission of Lesotho. During August 1976 to mid-1977, he visited the majority of known sites and recorded detailed information about the status and size of the populations in each. A nursery has been set up to bulk up stocks for commercial sale and so take the pressure off wild populations.

The species is legally protected in Lesotho and export is forbidden (2). It is included in Appendix 1 of the 1973 Convention on International Trade in Endangered Species of Wild Fauna and Flora.

CONSERVATION MEASURES PROPOSED As recommended by Beverly: (a) Effective enforcement of the legal protection of *Aloe polyphylla;* (b) protection in reserves for selected populations; (c) ratification by Lesotho of the Convention on International Trade in Endangered Species of Wild Fauna and Flora.

BIOLOGY AND POTENTIAL VALUE Pollination by the Malachite Sunbird *(Nectarina famosa famosa)* has been frequently observed, but insects may also help. A large amount of seed is produced, but only about half is viable and the species mainly seems to reproduce vegetatively; very few seedlings were seen in the wild. Suggested explanations

for this are given by Beverly (1), who discusses the possibility that the species may be declining partly due to biological reasons. This may possibly be also due to the effects of overgrazing on the surrounding vegetation, see (3). The species is unique for its very striking spiral arrangements of the leaves, for which it is highly coveted by horticulturists.

CULTIVATION Transplants from the wild, whether young or old, almost invariably die (3,9). The species is best grown from seed. Soil pH may be important; in the wild the pH was found to be 6.2-6.4 (4). For further details see (3), (4) and (5). The plant is in cultivation at the National Botanic Gardens, Pretoria, and in other botanic gardens.

DESCRIPTION Succulent perennial with a rounded rosette of 75-150, mostly erect leaves up to 80 cm across, arranged in 5 spiral rows, either clockwise or anti-clockwise. Individual leaves very fleshy, ovate-oblong, 20-30 cm long and 6-10 cm broad, nearly flat above and eccentrically keeled below, and with rather soft white teeth on the margin. Flowering shoot 50-60 cm high, branching from near the base, with flowers crowded on the branch tips. Flowers each with a narrow triangular bract 2-3 cm long and a cylindrical corolla 45-55 mm long, pale red to salmon-pink, rarely yellow. Capsules 3 cm long (6).

For illustrations see (2)-(9).

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This sheet is based upon the report on *Aloe polyphylla* in (1), by Mr A.C. Beverly (until July 1977 Associate Botanist at the Administrative and Research Centre of the Sehlabathebe National Park, Lesotho), to whom the TPC is most grateful.

LILIACEAE

STATUS Endangered. It is only known from the one locality where it was discovered in 1880, when only 2 plants of it were found. In 1967, it was seen to be still surviving but only in critically low numbers and severely threatened by large herds of goats.

DISTRIBUTION Socotra (an Island Territory of the People's Democratic Republic of Yemen, lying 225 km east of the Horn of Africa). It occurs in one place only, on a north-facing limestone escarpment in the north west of the island.

The flora of Socotra is critically threatened; out of 216 flowering plants endemic to Socotra and the neighbouring island of Abd al Kuri, 132 are believed to be rare or threatened, 85 of them in immediate danger of extinction (Endangered). This drastic situation is the result of grazing by excessive numbers of introduced livestock on an island flora which has presumably evolved partly in the absence of large mammals, unlike the flora of the African mainland.

HABITAT AND ECOLOGY On the rock face of lichen-covered cliffs at about 300 m. At this altitude it is at the base of the blanket of low cloud which commonly enshrouds these hills (3). Here the flora is very interesting as it differs considerably from that of all the other limestone slopes on Socotra. Out of 16 endemic species recorded from this area in 1880, 10 could not be found anywhere on the island in 1967. Examples of these possible extinctions are *Babiana socotrana* Hook.f., *Euphorbia obcordata* Balf.f. and *Helichrysum arachnoides* Balf.f. Of the remaining six, five are Endangered and in 1967 only single specimens of two of them, *Teucrium balfourii* Vierh. and *Xylocalyx aculeolatus* S.Carter, were seen. On the lower slopes is one of the four known trees of the Endangered Pomegranate-relative, *Punica protopunica* Balf.f. (also in the Red Data Book). This area is one of the more arid parts of Socotra and has suffered very badly from overgrazing.

CONSERVATION MEASURES TAKEN None for the wild population.

CONSERVATION MEASURES PROPOSED The escarpment should be declared a strict reserve and protected from grazing to save this and the other threatened endemic species occurring there.

BIOLOGY AND POTENTIAL VALUE This very attractive *Aloe* with bright red flowers and distinctive spotted leaves might be a possibility for horticulturists.

CULTIVATION It is in cultivation at the Royal Botanic Gardens, Kew.

DESCRIPTION Perennial branching from the base, with a pendent habit from cliff faces. Stems up to 40 cm long, bearing lanceolate recurved succulent leaves 5-7 cm long, sheathing the stem at the base and armed with rather firm deltoid whitish teeth 3-4 mm. The leaf surface is light green but with numerous whitish rounded spots on both surfaces. From the leaves emerges a scape carrying an unbranched, usually pendulous raceme 10-20 cm long of tubular flowers on short stalks (7-8 mm) with pointed membranous bracts 5 mm long; perianth scarlet, cylindrical, 23-25 mm by 5 mm in diameter near the base. Capsule dark green, oblong, 10 x 6 mm (3).

For illustrations see (2) and (3).

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This sheet is based upon information provided by Mr A. Radcliffe-Smith (of the Royal Botanic Gardens, Kew, U.K.), to whom the TPC is most grateful.

Cordyline kaspar W.R.B.Oliver

Three Kings Cabbage Tree

LILIACEAE

STATUS Rare; confined to a group of very small islands. In the past it greatly declined due to clearing of the vegetation by Maoris who inhabited the islands for two centuries or more up to about 1840. On the largest island, Great I., its decline was due also to grazing by goats which were introduced in 1889 to provide food for possible castaways (1), but may have existed there before. The goats on Great Island were killed in 1946 and the Cabbage Tree is clearly recovering well and regenerating from seed (2,5). Nevertheless because of its extremely small area of distribution (see below), it is considered as Rare.

DISTRIBUTION Three Kings Islands, New Zealand. It occurs on North-East Island (where c. 8 ha is suitable for scrub or forest), South-West Island (where c. 28 ha is suitable) and the largest island, Great Island, which is about 355 ha in size (3). In 1951 it was occasional on South-West Island (3) and by 1963 was becoming "widespread but only locally abundant" on Great Island (5). The Three Kings Islands lie 55 km north west of Cape Maria van Diemen, virtually the northernmost point of New Zealand.

There are 12 angiosperm species endemic to the Three Kings Islands of which *Tecomanthe speciosa* W.R.B.Oliver (also in the Red Data Book) and *Plectomirtha baylisiana* W.R.B.Oliver were reduced to single individuals in 1951. Of *Elingamita johnsonii* Baylis, there were only about 12 trees at that time (2,4). Both *Plectomirtha* and *Elingamita* are monotypic genera (i.e. with only one species in each).

HABITAT AND ECOLOGY In coastal forest on greywacke with *Leptospermum scoparium* J.R. & G. Forster, *L. ericoides* A.Rich., *Melicytus ramiflorus* J.R. & G. Forster and *Paratrophis smithii* Cheeseman. Baylis considers it was probably a subdominant in the original forests (1).

It is believed the islands were originally covered mostly by mixed coastal or semi-coastal forest which on all but West Island was virtually destroyed during the period of Maori occupation. On Great Island the goats prevented subsequent regeneration and the unpalatable *Leptospermum ericoides* has become the dominant tree, with few other species represented in the community. When goats were eliminated, only very small remnants of the original forest remained (1). On the smaller North-East and South-West Islands, *Meryta sinclairii* (Hook.f.) Seem. tends to form a persistent subclimax due to the scarcity of seed trees of the original climax species (3).

CONSERVATION MEASURES TAKEN In 1946, the New Zealand government eliminated the goats (393 individuals in all) from Great Island, bringing

to an end the long period of threats to the flora and modification to the plant cover. All the islands are uninhabited and rarely visited (1); they are now designated a Flora and Fauna Reserve.

CONSERVATION MEASURES PROPOSED None.

BIOLOGY AND POTENTIAL VALUE This Cabbage Tree flowers profusely and is an attractive small tree of horticultural value for planting in coastal districts.

CULTIVATION It is growing at Plant Diseases Division, DSIR, Auckland and numerous seedlings have been taken off this tree for horticultural use.

DESCRIPTION Small tree 5-7 m high, widely branched with large terminal tufts of sword-shaped leaves c. 60 cm long and up to 5-7 cm wide. Emerging from the dense clusters of leaves are much-branched flower panicles up to 80 cm or more long; flowers each with 6 narrow oblong petal-like segments, white on the margin, pale yellow at the centre and with three dark yellow ribs. Berries white, 3-lobed with 1-2 curved black shining seeds in each cell. It is closely related to *C. australis* Hook.f. of the New Zealand mainland (7).

For illustrations see (1) and (7).

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The TPC is most grateful to Dr D.R. Given of the Botany Division, DSIR, Christchurch, for help in producing this sheet.

N.B. This species was included under the AGAVACEAE (then listed as family 174/4) in the 1970/1971 edition of the Red Data Book.

Drago; Canarian Dragon Tree

LILIACEAE

STATUS Vulnerable in the wild, but quite common in cultivation. It is now restricted to small scattered populations, mostly on inaccessible cliffs. It has been heavily depleted by commercial exploitation for the 'Dragon's Blood' (see below under Biology and Potential Value) and has been destroyed or removed from all accessible sites; a small branched tree 2-3 m tall is worth c. U.S.$600 in the Canary Islands. The plants are slow to regenerate and although they set abundant seed, any seedlings that appear tend to be uprooted by collectors or eaten by domestic animals.

DISTRIBUTION Canary Islands, Cape Verde Islands, Madeira. In the Canaries it occurs on Gomera, Gran Canaria, La Palma and Tenerife; details of the populations on Gran Canaria are given in (6)-(8). In the Cape Verde Islands it occurs on Brava, Fogo, Santo Antão, São Nicolau, São Tiago ("probably extinct" according to 3) and São Vicente, where it was recorded in 1935 as on the way to extinction (4). Details of its occurrence on the islands in 1958-9, and previous decline, are given by Byström in (3). On Madeira only a single population of less than 5 individuals is known in the wild; it is extinct on the small neighbouring island of Porto Santo (3).

HABITAT AND ECOLOGY On stony volcanic cliffs from sea-level to 500 m. Trees may survive for centuries. "The famous tree at Orotava (Tenerife) which perished in a hurricane in 1867 was said by the explorer Alexander Von Humboldt to be over six-thousand years old" (2) though modern research suggests that the oldest trees may be only 3-4 centuries old at the most. Delightful accounts of the species are given in (1) and (5), and more recently by Lyons in (9).

CONSERVATION MEASURES TAKEN None for the wild populations.

CONSERVATION MEASURES PROPOSED Detailed local surveys are needed of existing sites, in particular to assess the numbers of remaining individuals in each, so that protection measures can be formulated. It is envisaged that local reserves will afford the best means of protection.

BIOLOGY AND POTENTIAL VALUE *Dracaena draco* is one of the floristic attractions of the islands of Macaronesia; it is widely cultivated as an architectural foliage plant in dry subtropical climates and in greenhouses in colder areas. If the trunk is cut, it yields a dark red gum resin known as 'Dragon's Blood', which was reputed to have medicinal properties and magical virtues. (Its potential medicinal value needs investigation by modern methods). A detailed historical review of the source and uses of Dragon's Blood is given by Lyons in (9). The berries are edible and have a flavour similar to that of cherries.

CULTIVATION It can be propagated from seed or with difficulty from stem cuttings, but may not flower until 30 or more years old. It is widespread in cultivation; particularly fine groves may be seen growing with other Canarian endemics under semi-natural conditions at the Jardín Botánico Viera y Clavijo on Gran Canaria.

DESCRIPTION Umbrella-shaped tree 5-10 m in height, taller in very old specimens, with a stout silvery-grey trunk, forking repeatedly after flowering, forming a broad and spreading head of branches. Leaves stiff and sword-shaped, 50-70 cm long, glaucous, reddish at the base, borne in dense rosettes at the ends of the branches. Inflorescence a dense terminal panicle; flowers each with 6 greenish-white perianth segments 8-10 mm long. Fruits spherical, up to 1.5 cm across, orange red (2,4,8). This species was included under the AGAVACEAE (then listed as family 174/4) in the 1970-1971 edition of the Red Data Book, Vol. 5.

For illustrations see (1), (2), (3), (5), (8) and (9).

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The TPC is most grateful to Dr D. Bramwell of the Jardín Botánico Viera y Clavijo, Gran Canaria, for help in producing this sheet. Help is also gratefully acknowledged from Dr J.J. Bos.

Ombet; The Nubian Dragon Tree

LILIACEAE

STATUS Vulnerable, possibly Endangered. It is declining rapidly because of exploitation. The trunks are cut for firewood and the fibrous leaves used for weaving mats and baskets. Overgrazing by domestic livestock and the recent droughts in the area have also been factors in its decline. The result has been a catastrophic effect on the vegetation, eliminating all plant life over vast areas formerly covered by *Dracaena* scrub.

DISTRIBUTION Djibouti, Ethiopia, Sudan; in Eritrea and on the Red Sea Hills, from Jebel Elba, at the boundary between Egypt and Sudan, to Djibouti. It possibly extends into Somalia along the north coast (5).

HABITAT AND ECOLOGY In scrub on arid hillsides of sandstone or on quartz outcrops, at altitudes of 750-1200 m, associated with the candelabra-shaped tree *Euphorbia abyssinica* J.F.Gmelin and *Acacia* spp. It was formerly subdominant on these hills, but virtually none of the vegetation illustrated in (6) still exists. Only scattered trees remain in immense areas of bare rock. It is possible the vegetation of these hills is beyond salvation.

CONSERVATION MEASURES TAKEN In the past protection was given to the area around the Erkowit oasis and plateau in the Red Sea Hills (Sudan). The drier part of this area was dominated by *D. ombet*. "Recently no control seems to be applied and thus the vegetation has changed tremendously. *D. ombet* has completely disappeared and on a visit to the area in 1961 only dead *Dracaena* trees were found. Recent reports tell of more deterioration of the vegetation" (3). "Within the Gebeit-Suakin road it disappeared from most of its localities on hill slopes whereas few mature trees were still in the gorges" (7).

CONSERVATION MEASURES PROPOSED An earlier edition (1971) of this sheet suggested that a National Park was needed on the Red Sea Hills. However it now seems too late for such a proposal to be worthwhile. Great efforts must now be made to bring the ombet into cultivation and maintain it safely in the botanic gardens of the world.

BIOLOGY AND POTENTIAL VALUE The ombet is one of the most distinctive plants of this area. The leaves are a good source of fibre.

DESCRIPTION Umbrella-shaped tree 3-4 m high with stout branches regularly forking after flowering and bearing at their tips dense clusters of thick, sword-shaped leaves 40-70 cm long, broadly ovate at the base. Flowers borne in large numbers on very short stalks in lax cylindrical racemes, forming a large panicle, each flower with 6 white or pale pink, narrowly oblong-linear perianth segments 6 mm long,

and 6 stamens slightly shorter, surrounding an oblong ovary with a simple style of equal length. Berries spherical, yellow when ripe. This species was included under the AGAVACEAE (then listed as family 174/4) in the 1970/1971 edition of the Red Data Book, Vol. 5.

For illustrations see (1), (2), (4), (6) and (8).

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The TPC is most grateful to Dr G. Wickens of the Royal Botanic Gardens, Kew, U.K., for help in producing this sheet.

White Fritillary

LILIACEAE

STATUS Endangered. The number of localities has been greatly reduced in recent years. The species is now restricted to a very few small populations. One site, in San Mateo County, includes a *Fritillaria* population of about 0.4 ha in extent; this area has been re-zoned for commercial and residential use. Even if the exact site in which the plant grows is not directly disturbed, this proposed construction would disrupt the natural drainage of the entire area, affecting the moisture balance critical to the fritillary's existence, put the plant under pressure from vandalism and disturb the ecology of its pollinator, *Apis mellifera*. At the second locality, also in San Mateo County, the species is threatened by impaction and erosion of the soil since the site is used as a practice area for fire trucks by the California State Forestry Department. Small populations are also found in San Benito County and in Marin County (3).

DISTRIBUTION U.S.A.; formerly in 9 counties from Sonoma County to Monterey County, in California.

HABITAT AND ECOLOGY In heavy soil, on open hills and fields in Northern Coastal Scrub, a plant community that occurs mostly below 150 m and is characterised by an annual rainfall of 65-200 cm, with much fog and wind (5). The two sites in San Mateo County are on serpentine soil. On the first mentioned site grow other species characteristic of serpentine: *Allium lacunosum* S.Watson, *A. serratum* S.Watson, *Lewisia rediviva* Pursh, *Linanthus ambiguus* (Rattan) Greene and *L. liniflorus* (Benth.) Greene. This area is also one of the few habitats of *Euphydras editha*, a checkerspot butterfly. Its larvae feed upon *Plantago erecta* Morris, which grows in the area (3).

CONSERVATION MEASURES TAKEN Various conservation groups and interested individuals have joined together and formed the Serpentine Protection League. This took place late in 1977, when the Redwood City Council voted to re-zone the first-mentioned site (in San Mateo County) for commercial and residential use. This site is one of the last remaining undisturbed serpentine sites on the San Francisco Peninsula. The League has filed suit against Redwood City on the grounds that an adequate Environmental Impact Report has not been prepared (3).

CONSERVATION MEASURES PROPOSED Protection for all 3 sites if possible and scheduling of the species as 'Endangered' under the U.S. Endangered Species Act.

BIOLOGY AND POTENTIAL VALUE *F. liliacea* is of scientific value as a plant adapted to serpentine areas and as very distinct from other members of the genus *Fritillaria*. There is significant variation between the serpentine and other populations. Although difficult

to grow, all Fritillary species are of interest to growers of bulbous plants for their delicate, recurved, bell-shaped flowers, which in this species are particularly attractive, being rather open and almost pure white, sweetly scented in some variants (4).

CULTIVATION It is occasionally grown in specialist collections, and offered for sale by nurserymen.

DESCRIPTION Perennial. Bulbs 15-20 mm thick, of a few round scales. Stem 10-35 cm high. Leaves just above ground level, alternate, ovate to linear, 5-10 cm long by 4-15 mm wide. Flowers pendent, 1-5 in a terminal raceme, each subtended by a single bract; perianth white with green striations, openly bell-shaped, of 6 distinct segments in 2 series each 12-25 mm long by 5-10 mm wide; segment gland or nectary narrow, green, rarely with purple dots. Capsule 12-15 mm long, stipitate, obtusely 3-angled (1,2,5).

For illustrations see (1), (6), (7) and Lily Yb., Lond., 1956: figs. 25 & 26 (1955).

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LILIACEAE

STATUS Vulnerable. Increasing agricultural activity and a new road alignment has disturbed the habitat of the species, reducing its numbers. One population was replaced in 1977 by a field of maize and others are on land due to be brought into cultivation; many of these have been transplanted to land within the proposed Malolotscha National Park. The total population of this species is greater than previously thought, now estimated at between 3000 and 4000 individuals.

DISTRIBUTION Swaziland. It is only known from a small area south of Forbes Reef, a short distance to the north of Mbabane. It was discovered there in 1951.

HABITAT AND ECOLOGY It grows at about 1400 m in well-drained, rocky grassland with a high water table. The dominant grass is *Themeda triandra* Forssk.; other associates include *Acalypha punctata* Meissner, *Berkheya setifera* DC., *Clutia monticola* S.Moore, *Helichrysum cephaloideum* DC., *Ipomoea crassipes* Hook., *Turbina oblongata* (E.Meyer ex Choisy) A.Meeuse and *Vigna vexillata* (L.) A.Rich.

The climate is temperate with between 100 and 230 cm of rain annually, mostly in the summer. Frost occurs during the winter months.

CONSERVATION MEASURES TAKEN Transplanting, as described above.

CONSERVATION MEASURES PROPOSED The site of one population, consisting of scattered groups over 4 ha, is shortly to be fenced by the Swaziland Trust Commission and will be declared a nature reserve.

BIOLOGY AND POTENTIAL VALUE It is potentially valuable as an horticultural plant.

CULTIVATION Seeds have been sent to the Botanical Research Institute and the Roodeplatt Horticultural Research Institute in Pretoria, South Africa.

DESCRIPTION Herbaceous perennial up to 1.8 m high, from a thick rhizome. Leaves 6-8 per stem, sword-shaped, at first erect, later reflexed, somewhat flaccid, 45-70 cm long by 1-2 cm broad, tapering towards a rather blunt apex. Flowering stem overtopping the leaves with several bracts below the very dense, more or less cylindrical inflorescence which is 7-15 cm long by 1.5-2 cm in diameter. Flowers slightly scented, short-stalked, eventually pendulous; perianth reddish brown to burnt umber, cylindrical, 8-9 mm long by 1.5 mm in diameter but wider at the mouth. Fruit ovoid, 3-parted, 5-6 mm long (1,2).

For an illustration see (2).

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The material for this sheet was supplied by Mrs E.S. Kemp (of the Swaziland National Herbarium, Mbabane), to whom the TPC is most grateful.

LILIACEAE

STATUS Rare; a very spectacular plant which is only known from several mountainous localities where collecting for horticulture, tourism and tourist development are tentative threats.

DISTRIBUTION Bulgaria, Greece. It occurs in the southern part of the central Rhodope mountains, in the border area, near the Bulgarian villages of Sivino, Rošanova koliba and Rožen, Smolyan District. Most of the population is confined to Bulgaria, but the species has recently been found in a single locality in Greece, close to the Bulgarian border.

HABITAT AND ECOLOGY At c. 1300 m in open alpine meadows of grasses such as *Festuca ovina* L., *Cynosurus cristatus* L. and *Molinia caerulea* (L.) Moench, with other species such as *Leucanthemum vulgare* Lam. The meadows are within the mixed conifer belt of *Picea abies* (L.) Karsten, *Abies alba* Miller and *Pinus sylvestris* L.

The climate is montane, with a strong sub-mediterranean influence. The winters are relatively mild with abundant snow, and the summers cool, with mean annual temperature of 8-10° C. The rainfall is about 830-1000 mm.

CONSERVATION MEASURES TAKEN The species is legally protected in Bulgaria.

CONSERVATION MEASURES PROPOSED One of the localities should be included in a protected area or reserve.

BIOLOGY AND POTENTIAL VALUE This lily is a most attractive species with large, beautiful yellow flowers. It is also of scientific interest and is related to Caucasian and Turkish species such as *L. monadelphum* M.Bieb. and *L. szovitsianum* Fischer & Avé-Lall.

CULTIVATION It is in cultivation at the Institute of Botany, Bulgarian Academy of Sciences, Sofia, at Beglika in west Rhodope, and in the Botanical Garden of the Higher Agricultural Institute in Plovdiv. It can be grown relatively easily; although seed is often set since the flowers tend to attract pollinators, it is usually propagated by division and from bulb scales.

DESCRIPTION Perennial with bulbs 3.5-4 cm across, of numerous, white or pale yellow scales, producing stems 80-100 cm high, which bear linear-oblong leaves 6-14 cm long, slightly silvery hairy on the veins beneath and on the margins. Flowers up to 5 in a terminal raceme (rarely borne singly), on recurved pedicels. Perianth segments 6, lanceolate, 8-12 cm long by 2-3 cm wide, recurved but not inrolled, bright lemon-yellow and spotless. Anthers red.

For illustrations see (1), (4) and (5).

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The material for this sheet was supplied by Dr B. Kuzmanov (of the Institute of Botany, Bulgarian Academy of Sciences, Sofia), to whom the TPC is most grateful.

Dehesa Beargrass, San Diego Nolina

LILIACEAE

STATUS Vulnerable. The *locus classicus* is in a developing residential area where local landowners are reported to be extremely reluctant to co-operate with any conservation efforts (2). Listed as endangered by the California Native Plant Society (4), the species is still vulnerable to collectors who find it has commercial value because of its attractive rhizome. It is believed to be declining (4); no young plants have been seen in the area and no recent reproduction at the second locality (2).

DISTRIBUTION U.S.A.; restricted to four localities in California (1,2,5). The *locus classicus* is distributed over two sections of land consisting of c. 50 ha in San Diego County (1). Small colonies are located on a west-facing slope along the south margins of two or three small gullies. In a 1972 survey, 10 colonies were noted, the largest consisting of 80 individuals, the smallest three, with an average of 15 per colony. Six of these had been disturbed and there was evidence that an entire eleventh colony had been removed. A total of 150 individuals was counted at that time (2). The second locality is south west of the *locus classicus*, on a hill between elevations of c. 670 and 700 m. In 1973 about 50 colonies were noted, distributed over the top of the hill and covering an area of c. 5 ha (5). One additional site, with a population of about 1000 individuals, has since been discovered close to the *locus classicus* (2).

HABITAT AND ECOLOGY Along dry slopes, on granitic outcrops and on coarse detrital edges of steep-sided gullies. It is also a component of Chaparral where it is associated with shrubs such as *Adenostoma fasciculatum* Hook. & Arn., *Arctostaphylos glandulosa* Eastw., *Helianthemum scoparium* Nutt., *Lotus scoparius* (Nutt.) Ottley, *Rhamnus crocea* Nutt., *Rhus laurina* Nutt., *Rhus ovata* S.Watson, *Salvia clevelandii* (A.Gray) Greene, *Tetracoccus dioicus* C.C.Parry, *Xylococcus bicolor* Nutt. and *Yucca whipplei* Torrey (1,3,5).

CONSERVATION MEASURES TAKEN The Cactus and Succulent Society of America has publicised the plight of this species and may have been instrumental in preventing it from being listed in dealers' catalogues. It was proposed as 'Endangered' by the U.S. Department of the Interior, Fish and Wildlife Service, on 16 June 1976. The Endangered Species Act of 1973 directs that no federally-funded activity shall jeopardise the existence of species once officially determined as 'Endangered' or 'Threatened', as defined by the Act.

CONSERVATION MEASURES PROPOSED The initial drive by the Society must be maintained; protection for the existing localities, possibly as nature reserves or as a State Park, is essential.

BIOLOGY AND POTENTIAL VALUE A species with no close relatives (1,2), it is valued as a commercial curiosity because of its unusual succulent rhizome. It rarely flowers and needs to be studied. It is possible that the branching rhizome is an adaptation to brush fires and to the dry chaparral. Under such conditions, vegetative propagation would be more successful than seed propagation (2).

CULTIVATION It is cultivated at the Huntingdon Desert Garden, San Marino, California, where it flowers annually (2).

DESCRIPTION Plant with a large subterranean rhizome 2-3.5 m long and many aerial rosettes of 10-20 or more, glaucous leaves 70-90 cm long by 8-15 mm wide, the margins scabrid with minute teeth of 2 sizes. Flowering stem 1.5-2 m tall, the flowers in an elongated compound panicle, the main branches subtended by long bracts 20-40 cm; perianth segments 3 mm long, puberulent at the swollen tips. Capsules 12-15 mm wide. Seeds yellowish, wrinkled, 5 mm long by 4 mm thick (1,3).

For illustrations see (1).

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The material for this sheet was supplied by the Endangered Flora Project of the Smithsonian Institution, Washington, D.C., to whom the TPC is most grateful.

LILIACEAE

STATUS Rare. Although locally abundant it is confined to several small offshore islands. Maoris inhabited the largest of the islands until the 1820s and pigs were introduced late in the eighteenth century. Vegetation clearing and pig rooting (on one island only) probably affected the forest vegetation until the pigs were killed in 1936, but would have had little effect on plants of the high bluffs (1,2,8).

DISTRIBUTION Poor Knights Islands and Hen & Chickens Islands, New Zealand. The majority of the population is on Poor Knights which consists of 4 high-cliffed, rhyolitic islands (Tawhiti, the largest, being c. 130 ha) and a number of stacks, all situated about 25 km east of the North Auckland mainland at Tutukaka (1). *Xeronema* also occurs on the higher parts of Taranga, the largest of the Hen & Chickens Islands, about 55 km south of the other group (2).

HABITAT AND ECOLOGY Oliver reports it to be extremely common on exposed rocky faces on the higher portions of the Poor Knights Islands, forming huge tussocks (7). It rarely occurs on flat ground where the soil is very poor and dry (5). Although typically a plant of open situations whose seedlings rarely thrive except in well-lit places, it has been found in the light shade of Pohutukawa (*Metrosideros excelsa* Solander ex Gaertn.) and Kanuka (*Leptospermum ericoides* A.Rich.) (1).

CONSERVATION MEASURES TAKEN In 1936 the New Zealand government eliminated the pigs from Tawhiti, one of the Poor Knights Islands. Both groups of islands are now Reserves for the Protection of Flora and Fauna; entry is permitted only by permit.

CONSERVATION MEASURES PROPOSED None.

BIOLOGY AND POTENTIAL VALUE The flowers yield abundant nectar and are adapted for pollination by birds. Both *X. callistemon* and the only other species (*X. moorei* Brongn. & Gris of New Caledonia) are very spectacular plants in flower with dense racemes of bright scarlet flowers which emerge from a mass of fanned leaves. It is cultivated in New Zealand gardens and is available from nurserymen.

CULTIVATION It can be propagated by seed or by dividing the rhizome.

DESCRIPTION Perennial herb with short rhizomes bearing fan-like groups of sword-shaped leaves up to 1 m by 4.5 cm wide, the margin indented just above the sheathing base. From the fan emerges a stout peduncle 60-120 cm high carrying a horizontal brush-like raceme of flowers 15-30 cm long with the slender threads of the stamens and styles standing vertical. Individual flowers with red, relatively small, narrow perianth segments 10-15 mm long and 6 prominent bright red slender stamens

20-25 mm long; ovary slightly 3-angled, at first pale, becoming glossy deep purplish red and bearing a single persistent style as long as the stamens. Fruit a dry capsule with numerous triangular black seeds (7).

Two varieties are recognised. In var. *callistemon* the floral bracts are short, scarious and reddish even in young inflorescences whereas in var. *bracteosa* L.B.Moore the floral bracts are leaf-like in texture, green at least until anthesis and longer than the pedicels (6).

For illustrations see (1), (4), (5) and (7).

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The TPC is most grateful to Dr D.R. Given of the Botany Division, DSIR, Christchurch, for help in producing this sheet.

LORANTHACEAE

STATUS Presumed Extinct. It was last seen in the wild in about 1954 and is not believed to be in cultivation. It was probably depleted by forest clearance associated with farming, milling and mining. Subsequently numbers were reduced through over-collecting. Any remaining plants would be vulnerable to damage by Australian opossums (*Trichosurus vulpecula*) although it is unlikely that they played a significant part in the demise of this species; mistletoes generally are susceptible to 'possum' damage. Some forest areas within and near the past range of the species are being currently managed for milling and pulping. Others are Department of Lands and Survey or New Zealand Forest Service reserves.

DISTRIBUTION New Zealand. It has been recorded from Waipoua and Kaipara (North Auckland), Great Barrier Island, Waiheke Island, Cape Colville Peninsula, Hunua and Maungakawa (South Auckland).

HABITAT AND ECOLOGY The species is recorded as parasitic on *Coprosma arborea* T.Kirk, *Melicope* sp. and *Myrsine australis* (A.Rich.) Allan. It was once plentiful near Thames (South Auckland), although elsewhere apparently rare and local.

BIOLOGY AND POTENTIAL VALUE It is the only species in the genus (*T. ralphii* (van Tieghem) van Tieghem having been reduced by Barlow (2) to synonymy under *T. adamsii*), so the genus itself must be regarded as Extinct. Barlow describes *Trilepidea* as a "primitive and relic monotypic genus" (2).

DESCRIPTION Stem-parasitic bushy shrub up to c. 1 m across, with opposite leaves on stout winged stalks; leaf blade thick, leathery, oblong to ovate or rhomboidal, 4-8 x 1.5-4 cm, the margins slightly recurved. Flowers in clusters of 2-4 in the leaf axils, each flower subtended by 3 small persistent bracts; corolla reddish, more or less tinged with yellowish-green, 3-4 cm long, narrowly tubular below, with 4 slender recurved lobes above. Fruits ellipsoid, red, c. 8-9 mm long (1,2,3).

For an illustration see (4).

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This sheet has been compiled from the account in (5) of *Trilepidea adamsii* by Dr D.R. Given & B.P.J. Molloy, to whom the TPC is most grateful.

LYTHRACEAE

STATUS Endangered. Only seven individuals of this tree are known, all from a single locality where it was found in 1975. The species had only been seen before when it was discovered in about 1800. Besides the grave danger of such a population being too small to maintain itself in the long term, the species is threatened by the invasion of exotics in its only locality (see below). The site is unprotected and although a considerable distance from the nearest village, accidental damage to the remaining trees is therefore always a possibility. Illegal woodcutting is less of a threat than elsewhere on the island, especially since the plant is neither known nor exploited locally. However, the area is a potential tourist site and this could pose further dangers in the future. An account of its rediscovery is given in (3).

DISTRIBUTION Mauritius, Indian Ocean; in the south of the island.

Out of 50 families revised so far for the Flore des Mascareignes, at least 25 angiosperm species endemic to Mauritius are Endangered or Extinct. Undoubtedly the pattern is similar for the c. 152 families still to be revised. Most of the island is under cultivation and the indigenous vegetation is irretrievably degraded, with only small fragments surviving. Most of these are now threatened by illegal woodcutting and invasion by vigorous introduced species. In several areas that appear at first sight to be original forest, these exotics have prevented regeneration of native plants for many years. The majority of the nature reserves established are being over-run by these species, spread in particular by alien animals such as pigs, Red-whiskered bulbuls *Otocompsa jocosa* and Malaysian monkeys *Macacus irus irus* (5).

HABITAT AND ECOLOGY The seven trees occur on a steep slope above a ledge at c. 530 m. The slope is thoroughly invaded by naturalised exotic species, notably *Ligustrum walkeri* Decaisne, *Psidium cattleianum* Sabine, *Rubus moluccanus* L. with occasional *Lantana camara* L. and *Litsea polyantha* Juss., but is on the edge of one of the largest areas of indigenous mixed forest surviving on the island. This area of forest differs to some extent from the more usual lower montane evergreen forest on Mauritius: the more common plants include *Nuxia verticillata* Lam. ('Bois maigre'), *Calophyllum* cf. *eputamen* P.F.Stevens ('Tatamaka') and the tree-fern *Cyathea excelsa* Swartz. Although the immediate habitat of *Tetrataxis* is very degraded with exotics, some of the trees of the species are younger than others and so presumably it has been able to reproduce in recent years. For further details of the habitat see (3).

CONSERVATION MEASURES TAKEN None for the wild population.

CONSERVATION MEASURES PROPOSED The priority should be to ensure that the species is maintained safely in cultivation, preferably with other endangered species in a garden of native and endemic plants in Mauritius. Conservation of its site and weeding out of the exotics may carry a risk of encouraging exploitation of the species, unless accompanied by an effective environmental education campaign among the local people.

BIOLOGY AND POTENTIAL VALUE It is of particular scientific interest as being the only species in its genus. It has no petals and this is an unusual feature in the *Lythraceae*. Koehne (4) considers it close to *Ginoria* from the West Indies and Central America.

CULTIVATION Attempts to bring it into cultivation have failed; the seedlings died soon after germination, the cause being uncertain.

DESCRIPTION Hairless tree up to 12 m high with dense foliage apparently in more or less flat sprays and grey, flaking bark. Leaves ovate to elliptic-ovate, c. 3-7 cm long, pointed at the tip, rather tough but not thick. Flowers in small clusters in the leaf axils on stalks 12-22 mm, greenish with 4 wings outside the receptacle which is topped by 4 triangular lobes; petals none. Fruit a smooth, more or less spherical capsule included in the receptacle, containing many small seeds (2).

For illustrations see (2), (3) and (4).

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This sheet is based upon information provided by Mr M.J.E. Coode (of the Royal Botanic Gardens, Kew, U.K., and formerly of the Flore des Mascareignes project), to whom the TPC is most grateful. Help is also gratefully acknowledged from Mr D.H. Lorence at the Missouri Botanical Garden, St. Louis, U.S.A.

Hau Kuahiwi (genus name)

MALVACEAE

STATUS Endangered; only one tree of this species was found in the wild and this died in 1930 (1-3). Fortunately the species had already been brought into cultivation, and from this stock it was re-introduced into the original locality, which is part of the Volcanoes National Park, Hawaii. By 1968 there were 10 healthy, mature trees with a number of seedlings. The reasons for its extreme rarity in recent times are not certain; probably it was heavily depleted by the lava flows in the Tertiary and only survived on one or a few isolated kipukas (islands of vegetation surrounded by lava). In modern times, cattle have destroyed much of the remaining habitat and disturbed the pollinators (see below), causing decline, and in some cases extinction, of both flora and fauna.

DISTRIBUTION Hawaii. The single tree was on "the eastern slope of Mauna Loa ..., a few miles from Kilauea Volcano ... within the area of the proposed National Park" (2). The genus is endemic to the islands of Hawaii, Kauai and Maui, and contains 5 species. *H. wilderianus* Rock (also in the Red Data Book) is Extinct, *H. bombycinus* C.N.Forbes is probably Extinct, and the remaining 3 species, *H. distans* L.E.Bishop & Herbst, *H. hualalaiensis* Rock and this species, are Endangered (4).

The flora of the Hawaiian Islands is one of the most severely threatened floras in the world, in particular because of the intense pressures on land for development and the effects of introduced grazing animals. A remarkably high 97% of the flora is endemic to the islands. Initial estimates by Fosberg and Herbst indicate that at least 273 species, subspecies and varieties are Extinct and 800 Endangered (some of which are protected). The authors emphasise that these figures are premature and tentative (4).

HABITAT AND ECOLOGY The original tree was, at c. 1200 m, "perched on the outer, south-eastern rim of a collapsed lava tube in such a position that cattle were reluctant to risk browsing on it" (3).

CONSERVATION MEASURES TAKEN See Status, above. Recently considerable success has been achieved in removing the feral goats from Volcanoes National Park, by means of fencing off relatively small areas at a time (5).

CONSERVATION MEASURES PROPOSED None on record.

BIOLOGY AND POTENTIAL VALUE The genus *Hibiscadelphus* is of considerable scientific interest as a possible example of closely linked evolution between plant and animal endemics. (For a detailed account of the genus and its biology see (3).) By failing to open completely, the corolla forms a tube which adapts the flower for pollination by birds,

presumably by members of the endemic, nectar-feeding *Drepaniidae*, the Hawaiian Honey-Creepers, whose bills apparently fit the curvature of the corolla. The Honey-Creepers have also suffered a catastrophic decline; out of 39 species and subspecies, 16 are Extinct and a further 14 listed in the Red Data Book (7,8).

CULTIVATION Contrary to reports in the literature, cuttings are very difficult to strike, but abundant seed is produced by cultivated trees and this germinates readily. It is in cultivation at the Waimea Arboretum, Hawaii, and elsewhere, but some of the material may be hybrid.

DESCRIPTION Tree c. 7 m high, with a much-branched, rounded crown and a smooth whitish bark. Leaves rounded cordate in outline, 9-15 cm wide, very bluntly lobed or pointed, and with a thin covering of stellate hairs. Flowers 5-7 cm long with at the base a ring of 5-7 stiff, spreading, almost thread-like bracts 2 cm long; calyx cup-shaped, yellowish-green, irregularly lobed; petals tightly rolled on one another forming a curving tube open only at the tip, deep magenta within and greyish-green on the outside, densely covered by stellate hairs. Capsule oblong, yellowish green, 4-5 cm long, containing kidney-shaped seeds covered by whitish-grey wool.

For illustrations see (1), (2), (3) and (6).

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Hau Kuahiwi (genus name)

MALVACEAE

STATUS Extinct, both in the wild and in cultivation. Only one individual of the species was known in the wild. It was discovered in 1910 and last seen in 1912 when it was "in a dying condition". G.P. Wilder raised one seedling but the stock has not survived (3). The reasons for its extreme rarity are not certain; probably it was heavily depleted by lava flows in the Tertiary and survived only on one or a few isolated kipukas (islands of vegetation surrounded by lava). In modern times, cattle have destroyed much of the remaining habitat and disturbed the pollinators (see below), causing decline, and in some cases extinction, of both flora and fauna.

DISTRIBUTION Hawaiian Islands. The one plant was on the southern slope of Mt. Haleakala on Maui (3). The genus is endemic to the islands of Hawaii, Kauai and Maui, and contains 5 species. *H. bombycinus* C.N.Forbes is probably extinct and the remaining three species, *H. distans* L.E.Bishop & Herbst, *H. giffardianus* Rock (also in the Red Data Book) and *H. hualalaiensis* Rock, are Endangered, being reduced to critically low populations (2).

The flora of the Hawaiian Islands is one of the most severely threatened floras in the world, in particular because of the intense pressures on land for development and the effects of introduced grazing animals. A remarkably high 97% of the flora is endemic to the islands. Initial estimates by Fosberg and Herbst indicate that at least 273 species, subspecies and varieties are Extinct and 800 Endangered (some of which are protected). The authors emphasise that these figures are premature and tentative (2).

HABITAT AND ECOLOGY Dry forest on kipukas.

BIOLOGY AND POTENTIAL VALUE The genus *Hibiscadelphus* is of considerable scientific interest as a possible example of closely linked evolution between plant and animal endemics. By failing to open completely, the corolla forms a tube which adapts the flower for pollination by birds, presumably by members of the endemic, nectar-feeding *Drepaniidae*, the Hawaiian Honey-Creepers, whose bills apparently fit the curvature of the corolla. The Honey-Creepers have also suffered a catastrophic decline; out of 39 species and subspecies, 16 are Extinct and a further 14 listed in the Red Data Book (4,5).

DESCRIPTION Tree c. 5 m high with palmately veined, rounded cordate leaves covered by minute stellate hairs on the underside. Flowers solitary, about 5-7 cm long, with at the base a ring of linear to spathulate, one-veined bracts 2 cm long; calyx cup-shaped, irregularly lobed; petals tightly rolled round each other to form a curving tube open only at the tip, yellowish within, greenish-yellow and densely

hairy on the outside. Capsule ovoid, 4 cm long, greenish-black and containing kidney-shaped seeds covered by whitish-grey wool (3).

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MALVACEAE

STATUS Endangered. A small island endemic which was found by Green to be reduced to 4 bushes in 1964, due to grazing by feral goats, pigs and rabbits. A survey of the island in late 1967 found the species to be still surviving. Due to the lack of vegetation the pigs and goats have long died out, but the rabbits are still believed to remain and probably prevent regeneration.

DISTRIBUTION Philip Island, Pacific Ocean (29° 06'S., 167° 57'E.), an uninhabited precipitous island of volcanic origin about one square mile (c. 2.6 sq.km) in area (4), c. 10 km south of Norfolk Island. When discovered by Captain Cook in 1774, the island was believed to have carried scrub or dense forest in the valleys and at the lower altitudes (3,4). Shortly after the colonisation of Norfolk Island in 1788, goats and pigs were placed on Philip Island to provide a reserve of meat. By the 1830s vegetation was confined to the valleys and erosion had begun. At a later date rabbits were introduced. "Today the island is essentially a colourful desert", heavily eroded (4). 3 species are believed to be endemic, *Agropyron kingianum* (Endl.) Laing which was last seen in 1912, *Streblorrhiza speciosa* Endl. which is now Extinct (also in the Red Data Book) and the *Hibiscus* (3).

HABITAT AND ECOLOGY The natural habitat was likely to have been scrub on volcanic deposits. When last seen the species was in a degenerate stand of *Celtis paniculata* (Endl.) Planchon ("Whitewood"), *Nestegis apetala* (Vahl) L.A.S.Johnson ("Ironwood") and *Lagunaria patersonia* (Andr.) Endl. ("White Oak"). Together with a few scattered trees of *Araucaria heterophylla* (Salisb.) Franco, the Norfolk Island Pine, this forms the principal vegetation remaining on the island (4).

CONSERVATION MEASURES TAKEN An environmental survey of Norfolk and Philip Islands (4) was made by Turner, Smithers and Hoogland in 1967 and proposals made for conservation.

CONSERVATION MEASURES PROPOSED As suggested by Turner, Smithers and Hoogland in (4):- Extermination of the rabbits and reservation of the island.

BIOLOGY AND POTENTIAL VALUE No information.

CULTIVATION A few plants are in cultivation on Norfolk Island and on the mainland of Australia. Seeds and cuttings were sent to the Honolulu Botanic Garden, Hawaii, in 1964 and plants raised. Seed set is reported to be good and germination easy.

DESCRIPTION Rounded, densely branched shrub 1-2.5 m high, with ovate crenate leaves 4-6 cm long. Flowers borne singly in the leaf axils, c. 8 cm across, each with 3-6 ovate bracts c. 10-13 mm long, a 5-lobed,

bell-shaped, felted calyx c. 22 mm long and 5 oblong, pale lemon-yellow, partly recurved petals c. 6 cm long, veined with purple; the whole flower becomes purplish with age. Fruit of 5 chambers, surrounded by the persistent calyx.

For an illustration see J. Arnold Arbor. 45: 486 (1964).

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The TPC is most grateful to Mr P.S. Green, of the Royal Botanic Gardens, Kew, U.K., for help in producing this sheet.

MALVACEAE

STATUS Rare. Only a single tree, surrounded by a few seedlings, was known of this Pacific island species when it was described in 1966 (3). Its decline was presumably due to grazing by feral horses and other domestic animals, associated with the destruction of the forests. However it has recently been found on a small neighbouring island where its population, though small, may be increasing since botanists who visited the island in the 1920s did not find it. It appears to be unpalatable to the feral sheep on the island and for this reason there have been proposals by residents from a nearby island to eliminate it in favour of species more suitable for grazing. The island is now a reserve, but the sheep still remain.

DISTRIBUTION Marquesas Islands, South Pacific. The single tree is above a bay on the north west of the island of Tahuata "where 37 years ago it was said to be found only in 2 or 3 localities" (3). The main population, now in an area of around 1 sq. km, is in the north west of the 1554 ha island of Mohotane. "There are rumours of it from Hiva Oa, but these are vague and not supported by specimens" (3); in recent years Schäfer could not find it there.

Out of about 80 species of angiosperms endemic to the Marquesas, at least 18 are believed to be Endangered or Extinct. On Tahuata the native forests had by 1975 been seriously reduced due to grazing from goats, cattle, pigs and horses. Mohotane is uninhabited and the central portion of the island is well forested with magnificent trees of *Pisonia*. However the northern 2-4 km, which had formerly been covered by xerophytic scrub, has been reduced by sheep to a barren waste of red, stony soil. As early as 1930, the sheep were beginning to do severe damage to the remaining forests (1).

HABITAT AND ECOLOGY The single Tahuatan tree is on "dry leeward slopes" at the edge of the woody vegetation (3). On Mohotane, the species occurs both within and outside the remaining dry forest, and ranges from near sea-level to 200 m. Outside the low forest it uniformly covers several hectares, with few other species being represented. Inside the forest, occurring in small ravines, it grows up to 10 m tall covering areas of about 50 sq. m, associated with the herbaceous *Cassia occidentalis* L. and producing abundant seedlings.

CONSERVATION MEASURES TAKEN In 1971 Mohotane was created a Nature Reserve, an account of which is given in (6). It is still overgrazed by feral sheep; following representations by botanists in 1974-5, the ban on hunting sheep was lifted, but apparently, since landing on the island is only permitted by permit, success in reducing the sheep population has been limited.

CONSERVATION MEASURES PROPOSED Further reduction or preferably elimination of the feral sheep on Mohotane.

BIOLOGY AND POTENTIAL VALUE It is of considerable scientific interest on account of its geographical isolation and in relation to the evolution of the cottons *(Gossypium)*, being ascribed to a genus of its own. Fosberg & Sachet write: "For the present, our inclination is to consider it as another of the several small, nearly extinct Malvaceous genera that mark the flora of the eastern fringes of Polynesia (e.g. *Kokia, Hibiscadelphus)*" (3). *Lebronnecia* fibre seems more persistent to sulphuric acid than that of *Gossypium* (B. de La Chapelle, unpublished observation).

CULTIVATION It is in cultivation at the Pacific Tropical Botanic Garden, Hawaii, and in Tahiti; it has been distributed to other gardens, such as the Royal Botanic Gardens, Kew, U.K.

DESCRIPTION Small tree or large shrub up to 10 m high, bearing on relatively long stalks, hairless, rounded cordate leaves up to 15 cm long (but usually less), somewhat pointed at the tip. Flowers 2-4 together in the leaf axils, on stalks up to 4 cm long; calyx cup-shaped, c. 1 cm long, tomentose externally, dotted with black glands, with an involucre of 3 minute bracts at the base; petals 5, ivory, turning yellowish, united at the base and forming a funnel 2-3 cm long, tomentose and black-dotted outside, smooth within. Inside is a rounded mass of stamens on a black column which encloses the single black style. Fruit a woody capsule 2-3 cm long, with 3 chambers each containing a single rounded black seed 8 mm across and covered with reddish brown hairs c. 1 cm long (3).

For illustrations see (5) and (6).

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This sheet is based upon information provided by Dr P.A. Schäfer (of the Institut de Botanique, Montpellier, France), to whom the TPC is most grateful.

San Clemente Island Bush-mallow

MALVACEAE

STATUS Endangered. It occurs in only two locations in the wild, each consisting of a group of not more than 10 individuals (2). The vegetation of San Clemente Island is at present being modified by the browsing of feral goats and the rooting of feral pigs. The island is administered by the U.S. Navy; at present its goat removal programme has been discontinued. Competition with introduced plants not native to the island also poses a threat to the survival of the species (7).

DISTRIBUTION U.S.A.; endemic to San Clemente Island (145 sq. km), off the coast of southern California.

HABITAT AND ECOLOGY On the rocky walls of deep canyons. In at least one locality it is associated with *Atriplex* and *Mirabilis* (5). The plant community is Coastal Sage Scrub, a community usually found on dry slopes of rock or gravel, mostly below 920 m and below the Chaparral. The plants here are half-shrubs, 30-150 cm high, forming a more open community than the Chaparral (4). On the island the community is now confined to canyon walls, but it seems probable that it may have formerly occupied large areas on the clay soils, before being grazed by feral animals (5).

CONSERVATION MEASURES TAKEN This species, along with the San Clemente Island endemics *Lotus scoparius* (Nutt.) Ottley ssp. *traskiae* (Abrams) Raven, *Delphinium kinkiense* Munz and *Castilleja grisea* Dunkle, have been determined to be 'Endangered' under the Endangered Species Act of 1973 (7). The Act directs that no federally funded activity shall jeopardise the existence of species once officially determined as 'Endangered' or 'Threatened', as defined by the Act.

CONSERVATION MEASURES PROPOSED The goat removal programme should be re-initiated. The Wildlife and Natural Resources Office of the U.S. Navy plans to make a detailed status survey of the four listed species. On the basis of that survey, formal recommendations to the U.S. Fish and Wildlife Service for Critical Habitat will be made (2). Critical Habitat is determined by the biological factors necessary to maintain the normal requirements for the survival of a species.

BIOLOGY AND POTENTIAL VALUE As one of 11 plant species endemic to San Clemente Island it is of scientific value. The island has never been connected to any other body of land; during the late Pleistocene, with the raising of the sea level, it was drastically reduced in size but not submerged. San Clemente Island and the Mexican island of Guadalupe, some 400 km south, have the most distinctive floras of all the Californian islands, and are examples of the world-wide destruction of island biota by human activities (5,6).

CULTIVATION The Wildlife and Natural Resources Office of the U.S. Navy is cultivating this species at its Native Plant Nursery on the island (2). The plant has also been grown since 1967 at San Diego State University and at Rancho Santa Ana Botanic Garden, Claremont, California.

DESCRIPTION "Rounded subshrub to 1 m tall, with numerous shaggy, stellate-tomentose branches; leaf-blades 3-5-lobed, deeply cordate at base, broadly ovate, 3-5 cm wide, greenish above, whiter and soft-stellate beneath" (4). Flowers numerous, nearly sessile, in interrupted spikes 10-20 cm, densely clustered in the uppermost leaf axils; calyx stellate-tomentose, 7-8 mm long, subtended by an involucre of slightly shorter, thread-like bracts; petals pink, c. 13 mm long, oblong-obovate. Fruit of several small dehiscent, single-seeded carpels each 2.5-3 mm high, stellate-tomentose on top (4).

For an illustration see (5).

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The material for this sheet was supplied by the Endangered Flora Project, of the Smithsonian Institution, Washington, D.C., to whom the TPC is most grateful. Information is also gratefully acknowledged from R.M. Beauchamp.

Bois méduse

MEDUSAGYNACEAE

STATUS Endangered. Since its discovery in 1903 it was not seen again until 1970, when it was rediscovered in a different locality; about 10 individuals are now known in this site. During 1974 a single individual was also rediscovered in the *locus classicus*. Both sites are in the proposed Morne Seychellois National Park.

DISTRIBUTION Seychelles; confined to Mahé. There are at least 72 flowering plants endemic to the Seychelles (not including Aldabra) and nearly all are believed to be threatened (6). They are mostly plants of the forest, which have been severely affected by fire and over-exploitation resulting in erosion, decrease of soil fertility and intensification of the adverse effects of drought. Large areas are covered by cinnamon coppice, the second most important crop on the islands and now the most abundant flowering plant.

HABITAT AND ECOLOGY Rocky inaccessible places at 220 m, growing in deep clefts between granite masses. The associates are listed in (6). The altitude at the *locus classicus* is c. 300-450 m.

CONSERVATION MEASURES TAKEN None.

CONSERVATION MEASURES PROPOSED The two sites are in areas proposed for Strict Nature Reserves, both of which, as mentioned above, lie within the proposed Morne Seychellois National Park. This area has been surveyed, but not yet gazetted. It is recommended that these conservation areas be declared. As opportunity permits, cultivated material of the species should be distributed among botanic gardens to help ensure its survival.

BIOLOGY AND POTENTIAL VALUE It is of great interest in taxonomic botany and in studies of plant geography as a species so distinct it is accorded a family of its own. The fruits, described below, are particularly interesting. It is possibly related to the *Theaceae*, but its true position in the plant kingdom is uncertain.

CULTIVATION It can be grown with some difficulty from seed; a single small specimen is being grown in the Sans Soucis Forestry Station in the Seychelles. It seems that wild seedlings rarely or never survive (6).

DESCRIPTION Shrub or small tree up to 10 m high with a dense umbrella-shaped crown of shining, leathery, elliptic leaves 4-9 cm long, in opposite pairs and red when senescent. Flowers in loose, slightly nodding panicles c. 3-5 cm long, scarcely exceeding the leaves; each flower with 5 small sepals, 5 spreading or recurved, white or pink-flushed petals 5 mm long and a ring of short stamens surrounding an

ovary which is crowned by about 20-25 short, spreading styles with swollen stigmas. Capsule barrel-shaped, 7 mm long, with persistent styles at the top and stamens at the bottom, longitudinally grooved and dividing into 20-25 segments spreading out from the top, resembling a small Medusa-like parasol, each segment to release two small winged seeds.

For illustrations see (2), (4) and (6).

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The TPC is most grateful to Mr J. Procter and to the Conservation Officer, Ministry of Agriculture and Land Use, Republic of the Seychelles, for help in producing this sheet.

MELASTOMATACEAE

STATUS Vulnerable; a dwarf shrub confined to high altitudes in Martinique. It is becoming depleted because the attractive flowers are picked in large bunches and plants uprooted, to an extent that the species is liable to become Endangered if protective measures are not taken. It is not possible to maintain the species in cultivation at lower altitudes and hence lessen the collecting pressure.

DISTRIBUTION Martinique. It occurs in 3 mountainous localities on the island, being locally abundant on some of the upper slopes of Mt Pelée.

HABITAT AND ECOLOGY On mountain summits at 900-1200 m, growing in *Sphagnum* associations with several species of *Lycopodiaceae* and *Bromeliaceae*. The humidity at this altitude is very high; the rainfall exceeds 5 m per year and the mountains are in cloud for about 300 days per year. The temperature only exceeds 20° C. during rare spells of sunshine. At night the temperature can drop below 10° C.

CONSERVATION MEASURES TAKEN The entire population occurs within the part of the uplands of Martinique that has been declared a Parc Naturel Régional. This does not, however, afford protection against picking and uprooting of the plants.

CONSERVATION MEASURES PROPOSED Upgrading to a National Park, giving full protection not only to this species, but also to all the high altitude flora of Martinique.

BIOLOGY AND POTENTIAL VALUE The species has very decorative, deep purple flowers, and is known locally as 'Thym sauvage'. It is closely related to *T. chironioides* (Griseb.) Cogn., an endemic of Dominica, to *T. ornata* (Swartz) Baillon from Montserrat, St. Kitts, Guadeloupe and possibly Dominica, and to *T. cistoides* (Griseb.) Cogn. from the Soufrière, St. Vincent.

DESCRIPTION Much twisted dwarf shrub with branches 15-40 cm, bearing small, sharply pointed, ovate to oval leaves 4-7 x 2-4 mm, rolled at the edges and with deeply impressed veins. Flowers in small clusters of 1-5, rarely more; calyx and flower stalk with pale-coloured bristles 1-2 mm; petals obovate, deep purple, c. 1-1.5 cm long. Fruit of 4 chambers. (Syn. *Hephestionia chamaecistus* Naudin, *Chaetogastra chamaecistus* Griseb.)

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The material for this sheet was supplied by Dr C. Sastre (of the Muséum National d'Histoire Naturelle, Paris), to whom the TPC is most grateful. Dr Sastre's original French version is in press, together with other sheets for the Lesser Antilles, as (4).

'Kartab' (local name)

MORACEAE

STATUS Vulnerable; a large tree-like succulent which has become greatly depleted because of overgrazing by introduced livestock. In 1967, it was mainly found in areas inaccessible to the goat, by which it is highly prized.

DISTRIBUTION Socotra (an Island Territory of the People's Democratic Republic of Yemen, lying 225 km east of the Horn of Africa). Although the *Dorstenia* is moderately widespread throughout the island, occurring both on granite and limestone formations, it is only known from a handful of localities (3). Its area of greatest density is on a sheer wall in north central Socotra, close to the only locality for several other threatened endemics, the most noteworthy of which is the Endangered tree, *Dirachma socotrana* Schweinf. (also in the Red Data Book).

The flora of Socotra is critically threatened; out of 216 flowering plants endemic to Socotra and the neighbouring island of Abd al Kuri, 132 are believed to be rare or threatened, 85 of them in immediate danger of extinction (Endangered). This drastic situation is the result of grazing by excessive numbers of introduced livestock on an island flora which has presumably evolved partly in the absence of large mammals, unlike the flora of the African mainland.

HABITAT AND ECOLOGY On rugged slopes, out of reach of the goats. Balfour in 1880-1 found it "in crevices and rocky places on the hills" (1). It is often associated with other succulents such as *Kleinia scottii* (Balf.f.) Chiov. and shrubs such as *Euphorbia oblanceolata* Balf.f. and *Hibiscus scottii* Balf.f. It tends to occur at higher altitudes than the Cucumber Tree, *Dendrosicyos socotranus* Balf.f. (also in the Red Data Book).

CONSERVATION MEASURES TAKEN None for the wild populations.

CONSERVATION MEASURES PROPOSED When selecting areas for reserves, care should be taken to include sites where *Dorstenia* occurs.

BIOLOGY AND POTENTIAL VALUE There are two other species of similar life form on Socotra - *Dendrosicyos socotranus* of the *Cucurbitaceae* (mentioned above) and *Adenium obesum* (Forssk.) Roemer & J.A.Schultes ssp. *socotranum* (Vierh.) Lavranos, of the *Apocynaceae* (1). These giant and obese succulents form perhaps the most unusual component of the weirdly impressive and unique vegetation covering the limestone slopes of the island..

CULTIVATION It is in cultivation at the Royal Botanic Gardens, Kew, U.K. For details of how to grow it see (3).

DESCRIPTION Podagric caudiciform succulent, i.e. a small tree (up to nearly 4 m) with a bare, succulent and gout-like, tapering trunk (up to 120 cm thick), branching only at the top. When cut the shoots emit a primrose yellow juice smelling of turpentine. Young branches also fleshy, flaking, bearing towards their tips clusters of oblanceolate leaves up to 16 cm long, and more or less flat orbicular flower-heads 5-20 mm across, solitary in the axils of the uppermost leaves. Each consists of numerous, tightly-packed, minute, unisexual flowers, surrounded by 6-10 unequal, rounded, brownish processes up to 3 mm long; male flowers spread over the receptacle, females sunken within it. Fruits ovoid, 2 mm across, pale green (3).

For illustrations see (1)-(3).

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This sheet is based upon information provided by Mr A. Radcliffe-Smith (of the Royal Botanic Gardens, Kew, U.K.), to whom the TPC is most grateful.

MYRSINACEAE

STATUS Endangered. Only three individuals of this small tree are known. Although they are not believed to be threatened at present by felling or habitat destruction, there were no signs of any regeneration in 1976 and the three trees were relatively far apart. All are close to a road and tourist viewpoint, development and enlargement of which in the future could pose a threat to the survival of this species; there is the additional danger of a breeding collapse due to drastically low population, or of accidental damage to the three trees.

DISTRIBUTION Réunion, Indian Ocean. It occurs in the Grande Montée area. There is also an old record for its presence on Mauritius but this is very doubtful (2). In contrast to Mauritius and Rodrigues, Réunion has a high mountain zone reaching 3069 m and here the flora has been less degraded than elsewhere on the Mascarene Islands. Nevertheless out of the 50 families revised so far for the Flore des Mascareignes, at least 24 angiosperm species endemic to the Mascarenes and occurring on Réunion are rare or threatened. Undoubtedly the pattern is similar for the c. 152 families still to be revised. The principal threats are clearance for agriculture and forestry, road-building, grazing by feral deer and in the more remote areas cutting of the remaining forests for timber and firewood, as well as intense pressure from the numerous vigorous introduced plants of which *Eugenia jambos* L., *Furcraea foetida* (L.) Haw., *Hedychium* spp., *Psidium cattleianum* Sabine and *Rubus moluccanus* L. are a very small selection.

HABITAT AND ECOLOGY On the edge of high altitude heath forest of *Philippia montana* Klotzsch to mossy *Gaertnera* forest, at c. 1700 m. The locality is relatively undisturbed at present, as is much of the upland forest, occurring as it does on very steep ground. In contrast large areas of mid-altitude forest have been replaced by plantations of *Cryptomeria japonica* (L.f.) D.Don and all the lowland forest has been destroyed except for a few small remnants now under threat from logging and invasion by vigorous introduced species. Such plants have replaced the indigenous vegetation in nearly all the lowlands, but it is uncertain to what extent they will be able to invade the existing undisturbed forest of higher altitudes, such as the area where *Badula crassa* occurs.

CONSERVATION MEASURES TAKEN A local initiative is reported to be underway to declare a small reserve for this species where grazing would be prohibited.

CONSERVATION MEASURES PROPOSED As above; further measures under consideration: the species is not yet in cultivation.

BIOLOGY AND POTENTIAL VALUE As a small tree with the leaves in cabbage-like clusters on the ends of thick branchlets, it is very different from most other species of *Badula* and is thus of special botanical interest. It may also be of horticultural value as a curiosity. Of the 12 species of *Badula* endemic to the Mascarenes, at least three are believed to be Extinct.

DESCRIPTION Very sparingly branched shrub or small tree with thick, soft and brittle, scarred twigs bearing in clusters at their tips shiny, elliptic to obovate leaves 7-12 cm long, thick, fleshy and hairless. Flowers in condensed panicles 3-6 cm long, borne among the leaves; calyx minute, 5- or 6-lobed; corolla c. 3-4 mm long, also 5- or 6-lobed, whitish or with a pink flush, often with minute orange dots. Fruit a spherical berry, c. 4 mm across but possibly more, shortly hairy, with thin flesh surrounding a hard stone (2).

No illustrations are known.

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This sheet is based upon information provided by Mr M.J.E. Coode (of the Royal Botanic Gardens, Kew, U.K., and formerly of the Flore des Mascareignes project), to whom the TPC is most grateful. Help is also gratefully acknowledged from Dr Th. Cadet of L'Herbier de la Réunion, Université Française de l'Océan Indien.

White Gum, Scrub Gum or Queensland Western White Gum

MYRTACEAE

STATUS Endangered in its native habitat, but widespread in cultivation. It occurs in an area suitable for cropping or pasture and much of the original forest or woodland has been cleared. The timber was used locally for fencing and general construction.

DISTRIBUTION Australia. It is found in a small belt about 30 to 50 km long and 10 to 15 km wide not far to the north of Chinchilla, in the Darling Downs pastoral district of southern Queensland.

HABITAT AND ECOLOGY It grows on and around the edges of flats in country of low topographic relief. It is associated with Brigalow (*Acacia harpophylla* F.Muell.) and Belah (*Casuarina cristata* Miq.) in woodland to open forest. Its altitudinal range is around 300-350 m (3).

The soils in the area are clays and clay loams, frequently gilgaid, of at least moderate fertility. The climate is warm temperate; the summers are hot with the mean maximum temperature of the hottest month about 32° C. whilst nights in winter are cool with the mean minimum of the coldest month about 5° C. The mean annual rainfall is 600-700 mm, with high variability.

CONSERVATION MEASURES TAKEN None known for the wild populations.

CONSERVATION MEASURES PROPOSED Submissions are being prepared in order to obtain a reserve to include this species growing in its natural habitat. Crown land suitable for this purpose is at present under special lease tenure.

BIOLOGY AND POTENTIAL VALUE This eucalypt is an attractive tree and has value as a cultivated plant. It is recommended as a species for shade, windbreaks and woodlots. Because of its very restricted range, it is also of scientific interest. It has a very straight trunk and "the timber is reported to be very strong, hard and durable ... The heartwood has a deep red colour ... There is little doubt that it is a tree which deserves to be better known than it is at present" (3).

CULTIVATION It is widely cultivated as an ornamental.

DESCRIPTION Tree up to 35 m high, with a stem up to 0.9 m in diameter and a smooth, white, peeling gum bark. Adult leaves alternate, stalked, narrow-lanceolate to oblong-lanceolate, 7.5-15 x 0.7-2.5 cm, a similar green on both sides, very firm in texture. Oil dots vary from sparsely scattered to numerous. Inflorescence usually 6-9 flowered, as umbels in the leaf axils; buds obovoid to club-shaped, 5 x 3 mm, with the bud cap (operculum) hemispherical. Fruit hemispherical to cup-shaped, 4-5 x 3-6 mm, on slender stalks, with 5-6 short valves (3).

For illustrations see (2) & (3).

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The material for this sheet was supplied by Mr D.E. Boyland (of the Queensland Herbarium, Brisbane), to whom the TPC is most grateful.

MYRTACEAE

STATUS Endangered. Only one individual of this species is known to exist, occurring in an area of extensive farming country. It now forms a mature shrub, having been found originally in 1937 by Steedman who noted "no other plants found, a keen search for other plants was made, none was discovered" (quoted in 2). It is not believed to be in cultivation.

DISTRIBUTION Australia; known from only one area near Piawaning, about 150 km slightly to the east of due north of Perth, Western Australia.

HABITAT AND ECOLOGY It grows in flat, sandy soil as an isolated shrub in a cleared field. It was originally associated with Mottlecah, *Eucalyptus macrocarpa* Hook. (2). The average annual rainfall in the area is 470-500 mm, mainly during the winter. There are frequent summer days over 37° C. and there are almost as many frosty days in winter.

CONSERVATION MEASURES TAKEN It is apparently protected by the owner of the land.

CONSERVATION MEASURES PROPOSED None on record.

BIOLOGY AND POTENTIAL VALUE It has been suggested that *E. carnabyi* is a natural hybrid between *E. drummondii* Benth. and *E. macrocarpa* Hook. (4), although this has not been proved. Large creamy flowers and powdery grey branchlets would make the plant an attractive ornamental, although it is now known in cultivation.

DESCRIPTION Spreading mallee shrub about 3 m high, but with a spread of 6-9 m. Leaves opposite to alternate, grey-green, elliptical to ovate-elliptical with a short point, 5-9 x 3.5 cm, with a flat stalk. Inflorescence 3-7 flowered; buds powdery grey, 22-25 x 12-18 mm, the bud cap (operculum) conical-hemispherical; stamens creamy yellow to white. Fruit a hemispherical capsule, broader than long, 15-20 x 20-25 mm, with projecting valves.

For illustrations see (2) and (3).

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4. Pryor, L.D. & Johnson, L.A.S. (1971). A Classification of the Eucalypts. Australian National University, Canberra. p. 63.

The material for this sheet was supplied by Dr G.M. Chippendale (of the Division of Forest Research, CSIRO, Canberra), to whom the TPC is most grateful.

Silver Gum

MYRTACEAE

STATUS Endangered; restricted to a small area in Victoria where there has been extensive clearing for farming. The species has not been subjected to browsing but is reduced to countable numbers of trees. There was some danger of the remaining virgin stands being lost in 1972, but this was overcome by the Forests Commission of Victoria.

DISTRIBUTION Australia; confined to the Acheron River valley in central eastern Victoria.

HABITAT AND ECOLOGY Gently sloping to flat sites near rivers or in slight depressions in wet sites which occasionally have surface water. The Silver Gum is often an understorey species to *Eucalyptus ovata* Labill. The average annual rainfall is 1140-1390 mm, with a winter maximum but no month averaging less than 63 mm. Summer temperatures are mild and the winter is cool with frequent frosts.

CONSERVATION MEASURES TAKEN None known to have been implemented.

CONSERVATION MEASURES PROPOSED Full protection should be given to the remaining stands. The Forests Commission of Victoria has been negotiating for a small area to be included in an adjoining State Forest.

BIOLOGY AND POTENTIAL VALUE This eucalypt is an attractive tree with possibilities as an ornamental in cold climates. It is markedly glaucous and the leaves are silvery and crenate. In cultivation on good land it can grow to a well-branched shady tree.

CULTIVATION It is in cultivation and is being grown for amenity purposes.

DESCRIPTION Tree 6-12 m, with persistent, hard, rough, fissured bark on the trunk, but smooth grey above. Juvenile leaves opposite, stalkless or short-stalked, broadly ovate, shining green above, silvery glaucous below, 2.5-3.8 x 1.3-1.7 cm and crenulate on the margin; adult leaves opposite, stalkless or nearly so, broadly ovate to cordate, also discolorous, 3.8-6.4 x 3.2-5.7 cm, and also crenulate. Inflorescence of 7-11 flowered umbels, stalked, with ovoid buds 5 x 2.5 mm, the bud cap (operculum) hemispherical but pointed at the tip. Fruit a small cup-shaped to truncate-ovoid capsule 4 x 4 mm.

For illustrations see (1), (2) and (3).

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The material for this sheet was supplied by Dr G.M. Chippendale (of the Division of Forest Research, CSIRO, Canberra), to whom the TPC is most grateful.

Plunkett Mallee

MYRTACEAE

STATUS Vulnerable; restricted to a few populations, some of which are in suburban areas where construction of roads and buildings is a threat to their survival.

DISTRIBUTION Australia. The species is endemic to Queensland and its major populations occur in the outer suburbs of Brisbane. Its range extends from the coastal areas 80 km north and south of Brisbane inland for over 300 km in a generally north-westerly direction, where isolated populations occur in the north of the Darling Downs pastoral district. Recent field trips have relocated individuals on the sandstone hills near Plunkett, which were the *locus classicus* where it was found in 1929.

HABITAT AND ECOLOGY This species grows mainly on low ridges with good surface drainage but also occurs on flats. Soils range from sandy podsols with impeded drainage through shallow stony soils to clay loams. On poorly drained lowland it is associated with *Banksia* and heath-like plants, or with *Eucalyptus conglomerata* Maiden & Blakely. On better drained soil it occurs as scattered individuals in open mixed forest. It is sometimes associated with *Eucalyptus fibrosa* F.Muell., *E. planchoniana* F.Muell. and *E. acmenioides* Schauer. Associated species in drier areas include *Eucalyptus maculata* Hook., *E. trachyphloia* F.Muell. and *Callitris endlicheri* (Parl.) F.M.Bailey. The average annual rainfall is 1100-1600 mm with a summer maximum. Summers are hot and winters mild.

CONSERVATION MEASURES TAKEN At least one small population is included in a State Forest at Beerwah, Queensland.

CONSERVATION MEASURES PROPOSED Consideration should be given to creating a nature reserve for this species.

BIOLOGY AND POTENTIAL VALUE The striking terminal inflorescence of creamy flowers makes this a useful ornamental shrub or small tree. *E. curtisii* is one of only two species in the subgenus *Gaubaea* of *Eucalyptus*, and as such is said to be of considerable isolation in the genus (4).

DESCRIPTION Mallee 2 m high or few-stemmed small tree to 12 m, with smooth grey or white bark. Adult leaves more or less leathery, dark green and shining above, paler beneath, lanceolate, 8-13 x 1.5-2.5 cm. Inflorescence 3-7 flowered, stalked, in more or less terminal, flat-topped panicles, with club-shaped buds 5-8 x 5-7 mm, the bud cap (operculum) hemispherical to more or less conical. Fruit an approximately bell-shaped capsule 7-10 x 6-8 mm.

For illustrations see (1), (2) and (3).

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The material for this sheet was supplied by Dr G.M. Chippendale (of the Division of Forest Research, CSIRO, Canberra), to whom the TPC is most grateful. Help is also gratefully acknowledged from Mr D.E. Boyland of the Queensland Herbarium, Brisbane.

Kamarooka Mallee

MYRTACEAE

STATUS Endangered. The species has a very limited occurrence in a small area of Victoria where much of the original vegetation has been cleared for farming, especially for wheat and sheep.

DISTRIBUTION Australia; sparsely scattered from north of Bendigo west north west to Charlton, latitude 36° 15' - 36° 45' S., in the central north of Victoria.

HABITAT AND ECOLOGY This eucalypt occurs in gently undulating, well-drained areas, growing in soils that include pisolitic laterite and red brown earths. The range of altitude is about 120-245 m. It is associated with the Bull Mallee, *Eucalyptus behriana* F.Muell. The area has occasional days in summer that are over 37° C. and occasional frosts in winter; the average annual rainfall is 385-525 mm, with a winter maximum.

CONSERVATION MEASURES TAKEN None known.

CONSERVATION MEASURES PROPOSED None on record.

BIOLOGY AND POTENTIAL VALUE Kamarooka Mallee has potential as a species for shelter planting on farms with dry, warm to hot climates.

DESCRIPTION Tree 6-9 m, either single-stemmed or with 2-3 stems arising from a common stock (the mallee habit); bark greyish to greyish-brown, subfibrous on the trunks but peeling in long narrow strips on the branches. Adult leaves slightly leathery, lanceolate, 7.6-12.7 cm x 1.3-2.0 cm, a similar green on both sides, stalked. Inflorescence 7-11 flowered in short terminal panicles; buds turbinate, 1-1.5 cm x 3-5 mm, with the bud cap (operculum) strongly ribbed, pyramidal, 4-7 mm long. Fruit a small pyriform capsule 6-8 x 5-6 mm, almost quadrangular in cross-section.

For illustrations see (1) and (2).

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The material for this sheet was supplied by Dr G.M. Chippendale (of the Division of Forest Research, CSIRO, Canberra), to whom the TPC is most grateful.

Rose Mallee

MYRTACEAE

STATUS Endangered; confined to a small area of south-western Western Australia where it mostly exists only in small zones between wheat fields and roads. There is a constant danger that the species will be further reduced as a result of re-positioning the roads in the area.

DISTRIBUTION Australia; recorded from Three Springs southward to near Bolgart, but is mostly restricted to small areas near Three Springs and near Gunyidi Siding, an area 200-300 km north of Perth, Western Australia.

HABITAT AND ECOLOGY This eucalypt grows in sandy soil in flat or slightly undulating areas, usually in small, almost pure communities, with some lower heath-like vegetation. In the southern part of its range it is associated with Mottlecah, *Eucalyptus macrocarpa* Hook. (2). The average annual rainfall in the area is 380-500 mm, mainly during the winter; frequent summer days over 37° C. and frequent winter frosts are the climatic extremes.

CONSERVATION MEASURES TAKEN None known for the wild populations.

CONSERVATION MEASURES PROPOSED Consideration should be given to creating a nature reserve for this species.

BIOLOGY AND POTENTIAL VALUE This most attractive red-flowering and silvery-leaved ornamental shrub with a straggling spreading habit may be used effectively in sloping gardens. It is reported to flower throughout the year (2).

CULTIVATION It has been cultivated in Australia and in California. "Seed should germinate in between one and two weeks, and plants may attain about 6 ft (2 m) in three years. Rose mallee prefers a dry, sunny position and is quite drought-resistant and moderately frost-resistant, perhaps needing protection in the young stages" (2).

DESCRIPTION Mallee shrub 2.5-3 m high, with smooth grey-brown bark and white-grey branchlets. Adult leaves orbicular-cordate, pointed, stalkless, thick, powdery grey, opposite, 6-8 x 6-8 cm. Inflorescence 1-3 flowered umbels with thick grey pedicels and peduncles; buds large, 3-5.5 x 2-4 cm, grey, with the bud cap (operculum) pointed, conical; flowers about 5-7.5 cm across, with numerous prominent stamens of red filaments and yellow anthers. Fruit a hemispherical, woody capsule 2-3 x 3.5-5.5 cm, containing dark brown, orbicular, winged seeds.

For illustrations see (1), (2), (3) & (4).

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The material for this sheet was supplied by Dr G.M. Chippendale (of the Division of Forest Research, CSIRO, Canberra), to whom the TPC is most grateful.

Steedman's Gum

MYRTACEAE

STATUS Extinct in the wild, but surviving in cultivation. It was endemic to a very small area of semi-arid southern Western Australia where there were attempts at farming in the late 1920s and 1930s. It has not been found since 1938, despite several careful searches in recent years. All of the scientific collections made were vague as to the exact area, giving only a district, but the area has been searched by competent field-workers. If by any chance it does survive in the wild, it would be Endangered.

DISTRIBUTION Australia; at or near Forrestania, an abandoned settlement, and between Forrestania and Hatters Hill. This area is small and is about 160 km south of the town of Southern Cross in Western Australia.

HABITAT AND ECOLOGY No notes on the habitat were made by the original workers, but the area in general has red sand and red sandy loam soils, is flat to slightly undulating and is covered by mallee or small tree heathland or semi-arid woodland. The rainfall is about 300 mm annually, predominantly in winter when there are frequent frosts. The summer is hot with an average of 12 days over 37° C.

BIOLOGY AND POTENTIAL VALUE This is a fast-growing species forming a small dense, rounded tree. It is resistant to drought and light frosts, and suitable for ornament, street planting, hedges and windbreaks.

CULTIVATION The species is in cultivation and is in several arboreta and Botanic Gardens, grown from seed apparently from the original collections.

DESCRIPTION Tree 8-12 m, with smooth, red brown bark and occasional strips of older bark adhering. Adult leaves narrowly elliptical or lanceolate, 6.5 x 1.2 cm. Inflorescence of 3-flowered umbels with angular pedicels and peduncles; buds 4-winged, 3.3 cm long, the bud cap (operculum) pyramidal. Stamens yellow, sometimes pink or red. Fruit a small, 4-winged, inverted pyramidal capsule 1-1.8 x 1-1.5 cm, containing brown, crescent-shaped seeds.

For illustrations see (1), (2) & (3).

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The material for this sheet was supplied by Dr G.M. Chippendale (of the Division of Forest Research, CSIRO, Canberra), to whom the TPC is most grateful.

OLEACEAE

STATUS Rare. The total known population is confined to a few small areas in a border area in the Balkans. Since vegetative spread and regeneration are very good, there seems to be no danger of a serious decline unless the regime of grazing and occasional burning of the hills alters radically. Although a species of great horticultural potential and at present little cultivated, collecting is unlikely to pose a major threat in the future, since cuttings and seeds rather than whole plants would be taken and since the species appears to be reasonably abundant in its localities.

DISTRIBUTION Albania, Yugoslavia; in the border area at 41° 40'-42° 45'N. and 19° 30'-20° 45'E., between and to the north of Shkodër and Skopje.

The Yugoslav populations occur in three separate areas;

1. Slopes of Mt. Gubavcu near Peć; the most visited, but the smallest population, discovered as late as 1917.
2. Hilly region between Peć and Dakovica; the detailed distribution here is not known, but the species is said to be locally abundant.
3 Mt. Koznika Prizren and to the west of the Dakovica road; a large series of populations, over c. 4 sq. km.

These populations are illustrated and described in detail by Mayer (5). Information on the Albanian populations is not recent. In 1928 they were surveyed by Markgraf who published a description and distribution map (4). There is no available evidence that these Albanian populations are threatened. In April the bushes are very conspicuous, since the large yellow flowers are produced abundantly before the leaves.

HABITAT AND ECOLOGY It grows almost exclusively on serpentine rocks, between 300 and 900 m. The restriction to serpentine is a remarkable feature, shared by a number of endemics in several European countries. Presumably the natural habitat of the *Forsythia* is as a member of the shrub community with open woodland dominated by sub-mediterranean species such as *Ostrya carpinifolia* Scop., *Fraxinus ornus* L. or more rarely, *Pinus nigra* Arnold. The woodland has, however, almost entirely disappeared because of grazing and fire, and it seems likely that the *Forsythia* has increased in the 'sibjak' communities which replace the woodland.

CONSERVATION MEASURES TAKEN None known.

CONSERVATION MEASURES PROPOSED None recorded.

BIOLOGY AND POTENTIAL VALUE It is the only European species of a very familiar genus of decorative shrubs much cultivated in gardens for their early flowering. *Forsythia europaea* itself is easy to grow, but is not seen in cultivation, except in botanic gardens or specialist collections. The commonest garden plants are *F. suspensa* (Thunb.) Vahl, a far eastern species, and cultivars and hybrids derived from it.

CULTIVATION It can be propagated from cuttings and also by seed. Most of its spread in the wild seems to be vegetative, but Markgraf records seedlings (4).

DESCRIPTION Deciduous shrub up to 2 m high, freely producing new shoots from suckers. The upright branches bear opposite, ovate to lanceolate leaves 4-7 cm long. Flowers 15-20 mm, appearing in March and April before the leaf buds unfold. Calyx 4-lobed, small; corolla bright yellow with a short tube and 4 narrow spreading lobes 12 x 4 mm; stamens 2. Fruit a smooth ovoid capsule 10-15 mm long.

For illustrations see (1), (3), (4) and (5).

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This sheet, drafted by Dr S.M. Walters, is based upon information provided by Professor E. Mayer (of the Institute of Botany, University of Ljubljana), to whom the TPC is most grateful.

OLEACEAE

STATUS Vulnerable; a small tree, closely related to the cultivated olive, with a disjunct distribution on the mountains of the Sahara and the Sahel. In the central Saharan localities (Algeria and Niger), the trees are reported as not regenerating, due presumably in part to the general deterioration of the vegetation in the region and subsequent lack of soil moisture. Even in 1933 Maire reported that the young branches of the trees were regularly cut by the Touareg for cattle fodder (2). The extent of grazing, browsing and cutting are likely to have greatly increased during the Sahel drought of the early 1970s.

In contrast, in the Sudanese localities the trees are in good condition. In one (Jebel Marra) Wickens found in 1953-5 a population of the order of 1000 trees; in the other, a small hill called Jebel Gurgei, Quézel in 1967 found the species to be frequent (4), though the area of available habitat is less than 5 sq. km.

DISTRIBUTION Algeria, Niger, Sudan; on the central Saharan mountains of Tassili N'Ajjer, Ahaggar (Algeria) and Aïr (Niger) and in west central Sudan, Darfur Province, on the Jebel Marra massif and an outlying hill, Jebel Gurgei, some 100 km to the north (8). There is also a record for the Atlas Mountains (Morocco), but it is uncertain whether it refers to this species (2,8). A dot map of the localities is given in (8).

HABITAT AND ECOLOGY Generally on stony ground under cliffs and near water-courses, 1000-3000 m. On Jebel Gurgei it occurs throughout the upper hill slopes, but not in the open grassland on the top of the hill (4). On Jebel Marra it is thinly scattered over the montane grassland at 2150-2950 m; Wickens distinguishes two communities in this zone: Upland Grassland dominated by *Andropogon distachyos* L. and the more species-rich and floriferous Upland Meadow of the moister, flatter areas; the *Olea* is thinly scattered with *Acacia albida* Delile through both these communities, occurring both as stunted, readily browsed, cushion shrubs (the juvenile phase) and as mature graceful trees that resemble a cultivated olive and are apparently not browsed. "The better grown specimens tend to border the perennial streams; ... at the higher altitudes it tends to concentrate in the deep gullies, often with *Ficus palmata*" Forssk. (8).

CONSERVATION MEASURES TAKEN None.

CONSERVATION MEASURES PROPOSED As recommended and detailed by UNDP/FAO, it is suggested that one or more areas on the western slopes of Jebel Marra, which include good stands of *Olea laperrinei*, be designated as nature reserves (7).

BIOLOGY AND POTENTIAL VALUE It is closely related to the cultivated olive, *Olea europaea* L. Near relatives of crop plants are a genetic resource of major importance as they can often be used to introduce factors such as disease and drought resistance into the cultivars.

"The trees are very slow growing and reach a height of 12 m or more, with a diameter of over 2 m. According to the estimates of Professor Quézel (1962), such trees would be from two to three thousand years old ... Some trees are regarded as sacred, a notable specimen being that at Toro Tonga." The wood is used for making throwing sticks (8).

DESCRIPTION Tree to 12 m; leaves linear-lanceolate, silvery on the underside, 3-6 cm x 4-6 mm, with a slender point at the apex (mucronate). Flowers very small, in lax clusters in the leaf axils, stalked; calyx shortly 4-lobed; corolla white, with 4 ovate lobes 3 mm long. Fruit like a very small olive, dark purple, ellipsoidal, tapering at the tip (1,2,6).

For illustrations see (8).

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This sheet is based upon information provided by Dr G.E. Wickens (of the Royal Botanic Gardens, Kew, U.K.), to whom the TPC is most grateful.

Antioch Dunes Evening Primrose

ONAGRACEAE

STATUS Endangered. Because of habitat destruction, this species is approaching extinction in the wild (3). It is confined to an area of sand dunes which has been drastically reduced in recent years. Most of the habitat has been lost to agriculture, industry and urbanisation, and the remainder, a small fraction of the plant's former range, has been claimed either for commerce or as a right-of-way for power lines (4). At present a population of several thousand individuals is known, on an area of c. 6 ha.

DISTRIBUTION U.S.A.; in the Antioch sand dunes east of Antioch, Contra Costa County, California. In their original state these dunes extended for c. 5 km parallel to the Sacramento-San Joaquin River and averaged about 400 m in width (c. 200 ha). By the early 1960s they were reduced to a strip of badly abused land only about 550 m long by 90 m wide, much of which was claimed for industrial use (4). These dunes, as the northern limit for many desert species and due to their long period of separation, carry a considerable number of endemic taxa.

HABITAT AND ECOLOGY Sunny, exposed, well drained areas of sand dunes, below 1050 m. The species requires the natural movement of the dunes which replenishes the sand with nutrients (4). It is pollinated by the bee *Sphecodogastra aberrans*; both the *Oenothera* and another Endangered endemic of the dunes, *Erysimum capitatum* (Douglas) Greene var. *angustatum* (Greene) G.B.Rossbach, are the exclusive hosts of several moths, beetles and bees. Although the Antioch Sand Dunes resemble coastal dunes, they are very different in the species they support; the flora includes *Aster chilensis* Nees var. *lentus* (Greene) Jepson, *Heterotheca grandiflora* Nutt., *Senecio douglasii* DC., *Lotus scoparius* (Nutt.) Ottley, *Lupinus albifrons* Benth. and *Eschscholzia californica* Cham., all of which are important in binding and stabilising the dune surface (4).

CONSERVATION MEASURES TAKEN It has been determined to be 'Endangered' under the Endangered Species Act of 1973 (6). A proposed definition of Critical Habitat for this species and for *Erysimum capitatum* var. *angustatum* was published on 8 February 1977 (6). Critical Habitat is determined by the biological factors necessary to maintain the normal requirements for the survival of a species. The designation of a Critical Habitat represents an official notification that the 'Endangered' and 'Threatened' species of that area be conserved and that no action be taken by federal agencies that would jeopardise their continued existence.

CONSERVATION MEASURES PROPOSED Protection under the Endangered Species Act. Land should be acquired to preserve the remaining habitat and

population. The East Bay Regional Parks Botanic Garden has suggested introducing seeds to isolated dune localities along the coast (4).

BIOLOGY AND POTENTIAL VALUE It is an attractive species, but is difficult to maintain in gardens. The "large flowers, soft-white and blushing with pink, are much enhanced by the backing of their crinkled gray leaves" (4). Although normally a perennial, it also behaves as a biennial in cultivation. Flowering is usually in the late afternoon or early evening, although it may occur in full sunshine on mild spring days. The flowering season lasts from March through to May, and again briefly in September. At the end of the season, the plant dies back leaving a cage-like network of dry hollow stems (4,5).

CULTIVATION It is in cultivation at the East Bay Regional Parks Botanic Garden, Berkeley, California; the beds are seeded with fresh sand at two year intervals with the aim of replacing the nutrients utilised by adult plants and ensuring the survival of the progeny.

DESCRIPTION Perennial herb with much branched stems 40-80 cm long. Leaves greyish, lanceolate in outline, pinnately toothed to lobed, 3-12 cm long. Flowers c. 7.5 cm in diameter, solitary in the upper leaf axils; buds long-pointed; sepals 4, 2-3 cm long, with spreading hairs; petals 4, white, 2-3 cm long. Capsule spreading to more or less reflexed, woody, 4-6 cm long by 2-3 mm thick at the base (1).

For illustrations see (4) and (5).

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The material for this sheet was supplied by the Endangered Flora Project of the Smithsonian Institution, Washington, D.C., to whom the TPC is most grateful. Information is also gratefully acknowledged from M.M. Bennett and P. Opler, U.S. Fish and Wildlife Service.

ORCHIDACEAE

STATUS Vulnerable, possibly Endangered. The only known extant population is seriously endangered by illegal cutting of firewood and by fire. Records for other localities are not recent (see below); in 1978 the species was searched for in the only known Malayan locality by J. and S. Dransfield, but without success; the habitat of steep ridge tops is, however, a particularly inaccessible one and it is possible that further populations may exist both on neighbouring ranges near the Malayan locality and elsewhere in the region.

DISTRIBUTION Indonesia, Malaysia. It has been recorded from Gunung Salak in West Java, where it has not been seen recently, and from G. Dorowati-Kukusan, Ngantang, East Java, where it is now confined to a very small area growing with the more widespread *C. pictus* (Blume) Kuntze. All records from the Malay Peninsula are incorrect except for one gathering by Carr in 1930 at Fraser's Hill; since then, it has not been found either at Fraser's Hill or elsewhere in Malaysia. It is possible that *C. sumatranus* (Schlechter) J.J.Smith, known from one gathering, may belong to this species.

HABITAT AND ECOLOGY Like most species of *Corybas* in Malesia, *C. fornicatus* is confined to a very precise microhabitat. It grows on sharply drained, mor humus banks on ridge tops in very humid montane forest, usually among mosses. On G. Dorowati it grows up to 2 m above the ground, among mosses that are epiphytic on tree trunks. This unusual habitat requirement, combining both sharp drainage and humid forest, is one reason for the natural rarity of *Corybas* species, many of which are known to be rare or threatened.

CONSERVATION MEASURES TAKEN Gunung Salak and G. Dorowati-Kukusan are designated as Protection Forest, but this has not in practice ensured protection from burning or from woodcutting. All species of *Orchidaceae* are included in Appendix 2 of the 1973 Convention on International Trade in Endangered Species of Wild Fauna and Flora.

CONSERVATION MEASURES PROPOSED A concerted effort should be made to refind this species on G. Salak along with *C. carinatus* (J.J.Smith) Schlechter and *C. vinosus* (J.J.Smith) Schlechter, also recorded from this locality and not seen recently. Further protective measures are highly desirable on both these mountains.

BIOLOGY AND POTENTIAL VALUE The genus *Corybas* comprises about 60 species stretching from the Himalayas, China and Taiwan, through the Malesian region, to the Pacific Islands, Australia, New Zealand and Macquarie Island. The genus has most remarkable and peculiar morphology, being strikingly different from other orchid genera. Plants consist of a single leaf of apparently annual duration, the plant

perennating as an underground tuber. Above the single leaf is found a single flower of bizarre appearance: one of the sepals is usually much enlarged and in the lower portion tends to clasp the lip to form a tube. The lip in the upper portion is usually expanded, and unlike most other orchids there are usually 2 well-developed 'spurs'. This jewel-like flower, just above the single leaf, is usually beautifully and variously coloured in shades of purple, pink and white. It is not known what is the pollinator. The capsule develops usually almost stalkless until just before it is ripe when it suddenly elongates in a manner very reminiscent of the capsules of liverworts.

DESCRIPTION Small ground orchid with a single leaf, ovate, nearly cordate at the base, bluish-green with paler veins, up to c. 4.5 x 2 cm. Single flower stalkless; lateral sepals and petals reduced to minute greenish threads; odd sepal c. 1.5 cm long, bright red; lip erect, recurved at the apex, enclosed by the sepal in the lower half to form a tube, which is hooded by the sepal tip. The lip itself has a gross swelling towards the base, along the midline, and 2 short conical white spurs; the limb of the lip eventually becomes expanded, with a toothed margin, white lined red.

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This sheet is based upon unpublished research and field work on the genus *Corybas* by J. & S. Dransfield, J.B. Comber of Tretes, Java, and Dr G. Smith, of Kuala Lumpur, to all of whom the TPC is most grateful.

Small White Lady's Slipper

ORCHIDACEAE

STATUS Vulnerable; an orchid that is generally rare throughout its range and threatened or endangered in particular areas. Although it occurs in 14 states of the U.S.A., it is listed as rare, endangered or threatened in nearly all those states that have a threatened plants programme. Even where it is relatively common its habitat is under threat, especially from drainage, agriculture (2), grazing and new construction (9). In other places it has been depleted by collectors: for example in the state of Illinois it was described as "not infrequent" before 1900, but indiscriminate collecting has now greatly reduced the populations, together with those of other Lady's Slipper orchids (8). Its decline in Canada to three populations, of c. 1000, 100 and 20 individuals, none of the sites of which are in conservation areas, has been detailed by Catling & Whiting (3), who declare the Small White to be "undoubtedly the rarest of the Lady's-slipper orchids in Ontario".

DISTRIBUTION Canada, U.S.A. It ranges in the northeastern quarter of the United States from New York west to North Dakota, south to northern New Jersey, Kentucky and Missouri (only one locality known in this state - see 10), and north into 3 localities in southwestern Ontario of adjacent Canada. For maps of its distribution see (1) and (2) (U.S.A. only) and (7).

HABITAT AND ECOLOGY Calcareous meadows and wet prairies, invading marl bogs and low wooded slopes bordering streams (1,2,8,10). It prefers full sun where it may be associated with *Carex, Cornus stolonifera* Michaux, *Larix laricina* (Duroi) Koch, *Potentilla fruticosa* L. and *Rhus vernix* L. In places it is accompanied by the Small Yellow Lady's Slipper, *C. calceolus* L. var. *parviflorum* (Salisb.) Fernald, and later in the year by the Prairie Fringed Orchid, *Platanthera leucophaea* (Nutt.) Lindl.. (7). It is the only species of *Cypripedium* that thrives on open prairies.

CONSERVATION MEASURES TAKEN It is protected by the Ontario Endangered Species Act (Statutes of Ontario, Chapter 52) and in several U.S. states by laws prohibiting the picking of orchids (6). All species of *Orchidaceae* are included in Appendix 2 of the 1973 Convention on International Trade in Endangered Species of Wild Fauna and Flora.

CONSERVATION MEASURES PROPOSED In the U.S. a survey should be made to determine the extent to which this species occurs in existing National Parks and reserves.

BIOLOGY AND POTENTIAL VALUE A small and dainty orchid of a famous genus that is a great floristic attraction. It has been described as "one of the most beautiful of all native plants" (2). It could

possibly have evolved from a member of the *C. calceolus* complex which became isolated in its habitat between advances of the glaciers during the ice ages.

CULTIVATION It is likely to be difficult to maintain in cultivation since it is reportedly more delicate and more easily injured by unfavourable environmental conditions and parasitic fungi than *C. calceolus* (4).

DESCRIPTION Terrestrial orchid usually 10-40 cm high. Leaves 3-5, elliptic-lanceolate, strongly ribbed, 8-16 cm long, erect and sheathing the stem. Flowers solitary; sepals 3, ovate-lanceolate, greenish suffused with brown and with brown veins, 2-2.5 cm long, the lower 2 united nearly to the apex. Lateral petals linear-lanceolate, undulate or twisted, 2.5-4 cm long, similar to the sepals in colour; lip a white obovoid pouch (the lady's slipper), sometimes finely veined with purple. At the centre of the flower is the prominent staminode, yellow spotted with purple, 1 cm (2,7).

For illustrations see (2), (3), (4), (5), (7), (8) and (10).

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The material for this sheet was supplied by Dr G.W. Argus (of the Rare and Endangered Plants Project, National Museum of Natural Sciences, Ottawa) and by the Endangered Flora Project (of the Smithsonian Institution, Washington, D.C.), to both of whom the TPC is most grateful.

Picotee Dendrobium

ORCHIDACEAE

STATUS Endangered, possibly Extinct. This species was recorded in the last century from two localities open to felling. In recent years Pradhan has searched for it, but found only a single individual, in 1970, and has not been successful in bringing the species into cultivation.

DISTRIBUTION India; the two recorded sites are in the adjoining states of West Bengal and Sikkim. The West Bengal locality is in the valley of the Tista River, presumably close to the Sikkim border.

HABITAT AND ECOLOGY An epiphyte reportedly found in riverine jungles, 600-1000 m. It flowers in June.

CONSERVATION MEASURES TAKEN On 8 July 1910 the Chogyal of Sikkim, under Forest Notification Memo. No. 375, banned the collection of orchids in Sikkim. All species of *Orchidaceae* are on Appendix 2 of the Convention on International Trade in Endangered Species of Wild Fauna and Flora. However, a major threat to this species is habitat destruction.

CONSERVATION MEASURES PROPOSED Consideration should be given to an immediate cessation of felling in the two localities. Further searches should be made to relocate the species and gather seed from which it can be bulked up and propagated in cultivation. Since many species of *Dendrobium* are self-sterile, it is particularly important to conserve as many individuals as possible to increase the chances of its survival in the wild.

BIOLOGY AND POTENTIAL VALUE It is unique in the genus in having golden yellow flowers edged purple red and thus could be of immense value in breeding picotee Dendrobiums. Members of the genus have also been found to contain alkaloids of potential value.

DESCRIPTION Orchid with very thin pseudobulbs 60-90 cm x 5-7 mm (described by King & Pantling in (1) as "thick as a goose-quill"), tapering at both ends. Leaves linear-lanceolate, 7.5-10 cm x 12-18 mm, the apex obscurely cleft. Flowers 1-5 in a short raceme on leafless pseudobulbs, each flower 2 cm long, not opening fully, golden yellow with purple to purple red margins; sepals ovate, blunt, the dorsal narrower; petals ovate-lanceolate, with small marginal hairs; lip 3-lobed, the side lobes oblong rounded, much smaller than the mid-lobe which is flat, hispid, ovate and spotted with red; that part of the lip between the side lobes is thickened, with 3 longitudinal ridges.

For illustrations see (2) and (3).

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The material for this sheet was supplied by Mr U.C. Pradhan of Kalimpong, India, to whom the TPC is most grateful. Help is also gratefully acknowledged from Dr P.J. Cribb.

Snow Orchid

ORCHIDACEAE

STATUS Vulnerable; known to be confined at present to a small area which hardly spans one kilometre. The site, being beside a road, is most vulnerable and subject to landslip hazard. A population on a wall of c. 10 x 10 m was wiped out by a landslip in 1976 and a concrete embankment was subsequently constructed. However, as Pradhan points out in (5), the fact that the species reproduces quickly and abundantly from seed in the wild, and that it is difficult to collect as the tubers are lodged in rock crevices, suggests that its survival may be assured if the habitat can be protected.

DISTRIBUTION India; in the Darjeeling District of West Bengal, north east Himalayas. It has also been recorded from Nepal and from Bhutan, both in the 19th Century, but it has not been found there since. For a distribution map of past and present localities see (4).

HABITAT AND ECOLOGY On sandstone walls in association with *Begonia* spp., *Colocasia* spp., *Globba* spp., mosses and liverworts. The rock faces are more or less perpendicular and during the monsoon are wet and dripping. The plant grows with its solitary leaf pointing downwards, as illustrated in (2)-(6). For further details of its ecology see (5).

CONSERVATION MEASURES TAKEN The locality is under the jurisdiction of the Mahanadi Wildlife Sanctuary. Export of the plant is restricted by the Government; all species of *Orchidaceae* are on Appendix 2 of the Convention on International Trade in Endangered Species of Wild Fauna and Flora.

CONSERVATION MEASURES PROPOSED Strict vigilance especially during road repairs and extension, and during the monsoon when landslips are frequent. The plant should be bulked up in cultivation and individuals transferred to similar, safer habitats in the region. Any further collecting of the wild plants should be strongly discouraged.

BIOLOGY AND POTENTIAL VALUE A fine species of great horticultural value. The flowers are pure white and very beautiful (2), resembling those of an *Impatiens*. The species is also of interest as being extremely typical of the tribe *Orchideae* with its structures well defined and easily recognisable. The genus contains only two species, *D. hirsuta* and the more widespread *D. pulchella* D.Don. The tubers may contain useful alkaloids.

CULTIVATION It is in cultivation; for details see (3).

DESCRIPTION Orchid with more or less spherical tuber 5-10 mm across, bearing a solitary, oblong-elliptic leaf 5-6.5 x 2.5-3 cm, stiffly hairy on both sides. Flowering stem 4-5 cm long, with 1 or 2 pure white flowers each 3.5-4 cm across; sepals ovate-oblong, much smaller than the petals which are orbicular to kidney-shaped; lip sub-orbicular, indented at the tip and clawed abruptly at the base; spur 4.5 cm long, protruding behind the flower, slender and curved.

For illustrations see (2)-(6).

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The material for this sheet was supplied by Mr U.C. Pradhan of Kalimpong, India, to whom the TPC is most grateful. Help is also gratefully acknowledged from Dr P.J. Cribb.

Diuris fastidiosa R.S.Rogers

Proud Diuris

ORCHIDACEAE

STATUS Extinct. It was first found, a single specimen, in 1923. "In 1925 there were five small, compact tufts growing in an area of about 10 square feet (c. 1 sq. m). During the season of 1926, specimens were again difficult to find, two only being seen. In 1927 the five original tufts were once again in evidence, but since that favoured season the species has not re-appeared. Though the locality has been diligently searched each season, no sign of any growth in connection with this orchid has been detected. Since then the habitat of this species - a railway enclosure - has been covered with gravel" (1).

DISTRIBUTION Australia. Discovered at Tottenham, near Melbourne, Victoria, this orchid was probably more widely distributed on the plains west of Melbourne before they were farmed and the natural sward replaced by introduced grasses and legumes.

HABITAT AND ECOLOGY Grassland on basalt. The species had small, grass-like leaves and so would be very difficult to find when not in flower. "The spring of 1925, and that of 1927, are well remembered for the remarkable growth of vegetation ... Wild flowers were very plentiful. It was under such conditions that *D. fastidiosa*, the 'Proud Diuris', was first seen, and, so it would appear, in such seasons only does it show itself." It was found growing with *D. pedunculata* R.Br. and *D. palustris* Lindl., both in flower at the same time (1).

BIOLOGY AND POTENTIAL VALUE A delightful little ground orchid with a distinctive, almost vertical lip to the yellow flower - hence the name *fastidiosa*. It is of some interest to plant geographers as a parallel development to *D. setacea* R.Br. from Western Australia.

DESCRIPTION Small terrestrial orchid with a tuft of usually 7 or 8, bristle-like leaves, slightly twisted and about half as long as the slender stem 5-20 cm high which bore a terminal raceme of 1-3 small flowers on relatively long, very slender stalks; dorsal sepal more or less oval, erect, yellow, c. 11 mm long, equalling the labellum (lip) in length; lateral sepals greenish, linear, c. 17 mm long; lateral petals c. 13 mm long, stalked, yellow; labellum vertical or nearly so, yellow with irregular brown blotches or markings, divided into 3 lobes, the laterals oblong, blunt, c. 6 mm long, the mid-lobe obtuse, spatula- to diamond-shaped, c. 11 mm long (1,2).

For an illustration see (1).

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ORCHIDACEAE

STATUS Vulnerable; an epiphytic orchid of very restricted distribution which is becoming threatened by picking of the attractive heads of flowers. The newly built road across the island where it occurs has opened up the habitat and although the species has been able to colonise the roadside, the plants have become much more accessible to collectors.

DISTRIBUTION Guadeloupe. It occurs in several high altitude localities on the island.

HABITAT AND ECOLOGY It is an epiphyte by preference, occurring in low stunted forests, exposed to high winds; but it is also sometimes terrestrial. In contrast, *E. patens* Swartz, with which it has often been confused, is usually terrestrial. The altitudinal range of *E. mutelianum* is 500-1000 m.

CONSERVATION MEASURES TAKEN The entire population occurs within the Parc Naturel Départemental on Guadeloupe, the centre of which is the volcanic massif of the Basse-Terre. This does not, however, afford protection against picking and uprooting of the plants. All species of *Orchidaceae* are included in Appendix 2 of the Convention on International Trade in Endangered Species of Wild Fauna and Flora.

CONSERVATION MEASURES PROPOSED Upgrading to a Regional or National Park, giving full protection not only to this species but to all the high altitude flora of Guadeloupe.

BIOLOGY AND POTENTIAL VALUE It flowers and fruits throughout the year. With its yellow flowers, the labellum (lip) often tinged violet, and its fragrance reminiscent of lily-of-the-valley and lilac, this Guadeloupian endemic has been described as a "jewel of the island". Garay & Sweet (3) list 14 species of orchids as endemic to the Lesser Antilles of which 6 are confined to Guadeloupe.

DESCRIPTION Erect herb to 40 cm high, without pseudobulbs; stems flattened, covered by foliar bracts. Leaves slightly leathery, stalkless, lanceolate, 8-14 x 1.5-3 cm. Inflorescence a terminal panicle, with 1-2 branches, more or less erect, but pendent at the top. Flowers rigid, yellow; sepals 3, similar, obovate, pointed, up to 15 mm long; lateral petals also obovate, obtuse, up to 13 mm long; lip deeply divided into 3 spreading lobes, the laterals more or less rounded but the middle one larger and indented at the tip (3).

Stehlé (6) has partially described this species under the name of *E. pallidiflorum* Hook. and *E. patens* under the name of *E. mutelianum*. *E. patens* is distinguished by the central lobe of the labellum ending in 2 lateral outgrowths. There is a discussion of the species complex in (3) and a species key in (2).

For illustrations see (1), (2) & (3).

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The material for this sheet was supplied by Dr C. Sastre (of the Museum National d'Histoire Naturelle, Paris), to whom the TPC is most grateful. Dr Sastre's original French version is in press, together with other sheets for the Lesser Antilles, as (5).

Small Whorled Pogonia

ORCHIDACEAE

STATUS Vulnerable or Endangered; one of the rarest orchids in eastern North America. Many of its populations have been destroyed and others are endangered. Its occurrence is very sporadic and colonies typically consist of very few individuals. The recent first report of its presence in Canada mentions only four individuals, in two colonies. It has been estimated that there are fewer than 10 sites extant in the U.S. (5). However, the species may actually be more frequent than has been believed; flowers are often ephemeral and scattered individuals can occur along with the more common *I. verticillata* (Muhl. ex Willd.) Raf. (2).

DISTRIBUTION Canada, U.S.A.; from Maine south to North Carolina, from southern Illinois and adjacent Missouri (one locality, not refound; see 10), southern Michigan (one very small, threatened locality, see 2 & 11), and Elgin County of southwestern Ontario (4). For distribution maps see (1), (4) and (7).

HABITAT AND ECOLOGY In dry, open, deciduous woods where it grows in deep leaf litter. It is variously associated with species of *Acer, Betula, Carya, Fagus* and *Tsuga,* with an understorey of *Medeola virginiana* L., *Maianthemum canadense* Desf., *Lonicera* and *Polygonatum.*

CONSERVATION MEASURES TAKEN Orchids are protected by law in a number of states in which the species occurs and in some states its habitat is also protected (4,6).

CONSERVATION MEASURES PROPOSED None on record.

BIOLOGY AND POTENTIAL VALUE No information. The significance of this species is its rarity throughout its entire range and the threats to its habitat. Some colonies of this plant have been known to lie dormant for as long as 10 or 20 years between periods of flowering (Wherry in 3).

DESCRIPTION Small terrestrial orchid with a pale green or purplish, glaucous stem 9-25 cm high, topped by a whorl of 5 or 6 drooping, dusty green leaves 2-8.5 cm long. Flowers 1 or 2 terminating the stem, yellowish green; sepals green, linear oblong, up to 2.5 cm long; petals pale green, oblanceolate, to 1.7 cm long by c. 4 mm wide, the lip almost white but with green veins and a hard protuberance extending from the base; wart-like projections stand erect on the middle veins (7,8).

For illustrations see (2), (3), (4), (7), (9) and (11).

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The material for this sheet was supplied by Dr G.W. Argus (of the Rare and Endangered Plants Project, National Museum of Natural History, Ottawa), to whom the TPC is most grateful. Help is also gratefully acknowledged from the Endangered Flora Project of the Smithsonian Institution, Washington, D.C.

ORCHIDACEAE

STATUS Vulnerable; a rarely found orchid which is largely confined to the middle altitudes of volcanic slopes, where large areas of the forest have been cleared for coffee plantations. It is also an easy and favourite target for orchid collectors, and is likely to become Endangered in the near future if protection is not forthcoming.

DISTRIBUTION El Salvador. It may also occur in Honduras and Guatemala, but there are no recent published records. The species of *Lycaste* with yellow or orange flowers are a very natural taxonomic group (5) and extremely difficult to identify from each other; thus some of the old records may be based on misidentifications.

HABITAT AND ECOLOGY An epiphyte of moist, mixed hardwood forests. It seems to prefer areas with average temperatures of 17-22° C. and annual rainfalls of c. 200 cm.

Like most epiphytes it adjusts rapidly if removed from the original host tree and attached to a new branch where it sends out fresh adhesive roots. Where forests are selectively thinned for planting coffee it may survive on the shade trees and may colonise old 'living fences' of shade trees used to separate property. Floristic diversity is typical of the Salvadorean hedgerow (1).

CONSERVATION MEASURES TAKEN None known for the wild populations. All species of *Orchidaceae* are included on Appendix 2 of the 1973 Convention on International Trade in Endangered Species of Wild Fauna and Flora.

CONSERVATION MEASURES PROPOSED Conservation of the Cerro Cacaguatique where it is frequently found. Full legal protection should be considered for all *Lycaste* species since one speçies cannot be distinguished from another in the group when they are not in flower.

BIOLOGY AND POTENTIAL VALUE In flower it produces the strong yet pleasantly sharp smell typical of the genus and generally indicative of pollination by *Euglossa* bees (4). Continued research suggests that such orchid species have profoundly directed the evolutionary processes of their pollinators and may actually provide the sexual pheromones needed to complete the life-cycle (2). The species flowers in March and the fruit probably takes up to a year to mature and dehisce. With its brightly coloured, yellow and orange flowers, it is a very handsome plant, worthy of future cultivation and a potential source for new hybrids.

CULTIVATION It flourishes in orchid collections at c. 2,000 m in El Salvador, but will also survive and flower when transplanted to

lower altitudes, provided care is taken to ensure the plants remain cool, moist and shaded.

DESCRIPTION Epiphyte with large, crowded, dark green, flattened pseudobulbs 5 x 10 cm, with fibrous veins and apical spines. Leaves lanceolate, pointed, 15-25 cm long, withering at the onset of flowering and not replaced until the fruiting stage. Each pseudobulb produces up to 10 solitary flowers, borne on shoots 8-10 cm long. Flower c. 5 cm across; sepals greenish-yellow, ovate-lanceolate, the dorsal one c. 28 x 13 mm and the 2 laterals c. 30 x 15 mm; petals orange, elliptic-lanceolate, c. 28 x 12 mm, the lip golden-yellow, 3-lobed, c. 25 mm, with orange spots and white hairs at the base on the inside; sides lobes erect, semi-elliptical, rounded at the apex, 6 mm. Ovary green, stalked, 15-18 mm (3,5).

For illustrations see (3) and (5).

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The material for this sheet was supplied by P. Bernhardt, Professor of Botany in El Salvador, to whom the TPC is most grateful.

ORCHIDACEAE

STATUS Vulnerable. Its decline throughout Central America is due to uncontrolled logging operations and the subsequent lack of re-afforestation. It is an epiphyte and only grows on cedars, which have been depleted both by large-scale logging and local cutting for firewood.

DISTRIBUTION Costa Rica, El Salvador, Guatemala, Mexico. It probably also occurs in Honduras and Nicaragua, but there is no information. In El Salvador three localities are known.

HABITAT AND ECOLOGY It is a succulent epiphyte of cool, moist forests with average temperatures of 18-23° C. and an annual rainfall of c. 200 cm. It only grows on native cedars (*Cupressus* spp.) (3); it does not form dense colonies of a single clone on host trees, nor is it ever found in close association with the mosses, ferns and bromeliads that grow together forming dense hummocks encrusting tree limbs. In contrast, it is usually found in groups of two or three on the trunk of a single tree. According to Ames & Correll (1), it occurs at altitudes up to 1460 m in Guatemala.

CONSERVATION MEASURES TAKEN None known for the wild populations. All species of *Orchidaceae* are included on Appendix 2 of the 1973 Convention on International Trade in Endangered Species of Wild Fauna and Flora.

CONSERVATION MEASURES PROPOSED Conservation of isolated stands of cedar where the species is found. In the long-term it will only survive if the re-afforestation and silvicultural legislation already enacted in Central American countries is effectively enforced.

BIOLOGY AND POTENTIAL VALUE The restriction to cedars is a remarkable feature and research is needed on the host specificity of such plants. The majority of species of *Notylia* are bee-pollinated (4), but the pollination biology of this species is still unknown. In flower it is a very beautiful plant with the charm of a miniature, and was described by Bateman as a "perfect gem" (2); it could prove of commercial value if it becomes popular among orchid enthusiasts, and could be important in future hybridisation attempts.

CULTIVATION Seeds have been sent for cultivation to the Orchid Sub-Committee of the Smithsonian Museum, Washington, D.C. No germination has been reported so far.

DESCRIPTION Small epiphyte 3.5-10 cm high, with pseudobulbs less than 1 cm long, covered by leaf sheaths. Leaves more or less lanceolate, rigid, fleshy, jointed, up to 5 cm long. Inflorescence a lateral,

usually pendulous, slender raceme of about 20 flowers which are each c. 15 mm in diameter and apparently scentless. Sepals drooping, light green, narrowly lanceolate, pointed, 9-15 x 1-2 mm; petals similar in shape but clear purple, spotted, 8-13 x 1.3-1.5 mm; lip white with purple spots, c. 7 mm long, narrow, arrow-shaped near the tip. Column c. 5 mm long, cylindrical, green. Fruit a spherical capsule, bright green when immature and dull green at dehiscence. The species rarely produces more than 2 fruits per inflorescence (1-3).

For illustrations see (1), (2) and (3).

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The material for this sheet was supplied by P. Bernhardt, Professor of Botany in El Salvador, to whom the TPC is most grateful.

ORCHIDACEAE

STATUS Endangered or Extinct in the wild, but surviving in cultivation. Causes for its decline and possible extinction are forest fires and excessive collecting (4,5). It has not been seen in the wild since 1972 when collecting was particularly severe, but it is likely that some rhizomes or seedlings may still remain.

DISTRIBUTION India; endemic to a single locality in Kerala State in the south of the country. It was reported by Colonel Drury in 1865 from the Travancore Hills and later in 1875 by Colonel Beddome from the Kalikad Hills. Recent gatherings, however, reported in (4) and (5), confirm that in recent times only the one locality is known.

HABITAT AND ECOLOGY In nearly full sunlight with, and sometimes epiphytic on, *Euphorbia* spp., growing with sedges and grasses. The roots are tightly packed and embedded in the hard limey soil. During the growing period of April to November, the grasses provide shade from intense overhead sun and after that wither to permit full exposure to less intense sun. The species is closely associated with another orchid, *Aërides maculosum* Lindl.

CONSERVATION MEASURES TAKEN None for the wild habitat. However, very recently, it has been banned from export by the Government of India. All species of *Orchidaceae* are on Appendix 2 of the Convention on International Trade in Endangered Species of Wild Fauna and Flora.

CONSERVATION MEASURES PROPOSED (a) To declare the locality as a protected reserve by the State and central Government; (b) To obtain seeds from all possible private and institutional collections and grow them artificially for replanting in the original and only known habitat. If it is rediscovered in the wild, no further collections should be made.

BIOLOGY AND POTENTIAL VALUE A very striking member of the genus *Paphiopedilum*, and widely admired in horticulture for its attractive flowers, appearing in the wild from March to April. It is the only *Paphiopedilum* species found in complete isolation near the southern tip of India, possibly due to the changes in ecology in the land masses of India after the Pleistocene era (3). It is also the only species in the genus with long creeping rhizomes. Being taxonomically very close to *P. villosum* (Lindl.) Pfitzer, it may have useful alkaloids and there are indications of its use in Ayurvedic medicines.

CULTIVATION It is well known in cultivation throughout the world, but only about 12 individuals are being grown in India itself.

DESCRIPTION Orchid with stout creeping rhizomes up to 1 m long, bearing 5-6 shoots; leaves strap-shaped, stiff, 20-30 x 3-5 cm, shiny and uniformly bright green. Flowers solitary, 7.5 cm across, yellowish green to rich yellow, striped with purple, on purplish stems 25-30 cm long; upper sepal broadly ovate, with a broad black median band and white hairs on the margin; lateral sepals fused to the apex, pointing downwards, yellow with brown streaks; lateral petals spreading to slightly drooping, with maroon median lines; lip shaped like a slipper, 3.5-4.5 cm long, bright yellow finely spotted reddish-purple.

For illustrations see (1)-(6).

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The material for this sheet was supplied by Mr U.C. Pradhan of Kalimpong, India, to whom the TPC is most grateful. Help is also gratefully acknowledged from Dr P.J. Cribb.

ORCHIDACEAE

STATUS Endangered. This very attractive orchid is only known from a few areas and is threatened by clearing of the forests for planting coffee on the mountain slopes where it grows.

DISTRIBUTION El Salvador, Guatemala. It is only known from one area in El Salvador. In Guatemala it is recorded from San Cristóbal and Huehuetenango (1). It probably also occurs in Honduras, but there is no information.

HABITAT AND ECOLOGY In El Salvador it is terrestrial or grows on rocks, occurring in the herb layer of cool moist forests, with average temperatures of 18-23° C. and annual rainfall of c. 200 cm. It is recorded in Guatemala as epiphytic as well as growing on rocks (1). It occurs at around 1700 m in El Salvador (2) and up to 1550 m in Guatemala (1).

CONSERVATION MEASURES TAKEN The only area where it has been found in El Salvador is now protected. All species of *Orchidaceae* are included on Appendix 2 of the 1973 Convention on International Trade in Endangered Species of Wild Fauna and Flora.

CONSERVATION MEASURES PROPOSED Similar measures to those in El Salvador should be taken in Guatemala.

BIOLOGY AND POTENTIAL VALUE *Sobralia* species are believed to be pollinated by bees. This species is of interest to studies of chemical taxonomy in that while the majority of Central American species of *Sobralia* are white- or purple-flowered, *S. xantholeuca* is yellow. By any criteria, it is a most handsome plant, with large yellow flowers, golden towards the centre.

CULTIVATION It is grown at the Royal Botanic Gardens, Kew, U.K.

DESCRIPTION Large orchid with hairless, leafy stems c. 150 cm long arising from a rhizome and covered by brown-speckled leaf-sheaths. Leaves dark green, lanceolate, spreading and drooping, c. 25 x 5 cm, narrowed into points at the tips. Flowers yellow, subtended by dark green, lanceolate bracts c. 11 cm long; sepals more or less lanceolate, c. 9.5 cm long, spreading and recurved; lateral petals similar, c. 10 cm long; lip c. 11.5 cm long, the lower half forming a tube around the column, tinged golden on the inside; lamina of lip spreading, with an undulating margin and indented up to 1.5 cm at the tip. Fruit dark green, over 2 cm long (1-3).

There is a magnificent colour plate of this species by Fitch in (3) and more recent illustrations in (2).

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The material for this sheet was supplied by P. Bernhardt, Professor of Botany in El Salvador, to whom the TPC is most grateful.

ORCHIDACEAE

STATUS Vulnerable. This orchid is only known from a few scattered localities (1,4). In one, the Atuanui State Forest, three separate populations are known; the largest, of more than 20 individuals (as judged by clumps of stems above ground), occupies an area of about 500 x 100 m on both sides of a small stream. However, the greater part of the plant's life cycle is spent underground (1) and so it could be more widespread and abundant.

It is likely to have declined due to clearing of the forests on the better soils for pasture and arable crops; most localities have a past history of kauri logging which probably has influenced the development of the Taraire trees to which it is restricted (see below). Other records are from unreserved forest remnants on farmland where it may be disturbed by farming practices. In addition, in the Atuanui State Forest there has been a decline in the number of flower-heads since about 1970, which may coincide with the summer droughts that have caused widespread branch death, and occasional tree death, of the Taraire (2).

DISTRIBUTION New Zealand; several sites towards the north of North Island, between 35° 30' and 37° S., but easily overlooked and distribution imperfectly known (2).

HABITAT AND ECOLOGY Exclusively deep forest humus in relatively dark and damp situations under mature trees of Taraire, *Beilschmiedia tarairi* (Cunn.) Benth.& Hook.f. ex T.Kirk of the *Lauraceae*. The soil is a highly fertile mull of the Puhoi clay type, a weakly leached, northern yellow brown earth (1,3). Both the orchid and the Taraire have mycorrhizal associations with the puffball *Lycoperdon perlatum* Pers., which has a wide distribution outside New Zealand. The Taraire is endemic to North Island but the orchid has not been found in many of its stations. The orchid appears to require both the tree and the fungus; Campbell (1) considers it parasitic on the fungus.

CONSERVATION MEASURES TAKEN One of the localities is within the Waipoua Forest Sanctuary which covers 10,122 ha and was established in 1952. Others are within the Centennial Park, Waitakere Ranges; Atuanui State Forest (Glorit) from where cattle have been excluded since the 1960s; and Kirk's Bush (Papakura) (2).

CONSERVATION MEASURES PROPOSED As recommended by Given and Beever:- Monitoring, especially with regard to drought conditions, which may have reduced the population at Atuanui. The species should be searched for in other areas where the Taraire occurs (2).

BIOLOGY AND POTENTIAL VALUE "The column is adapted for self-fertilisation, the wings almost enclosing the stigma. The concave labellum (lip), however, in conjunction with the dorsal (upper) sepal, forms a narrow tube which could be insect-attractive, so just what happens in nature is open to observation" (3). In the absence of chlorophyll, the plant must depend on absorption of food materials from the humus either directly or by intervention of the mycorrhiza. The relationship with the mycorrhizal fungus *Lycoperdon perlatum* has been studied by Campbell (1).

CULTIVATION It is unlikely to be successfully propagated away from its ecological microhabitat because of its unusual nutritional requirements (2).

DESCRIPTION The slender unbranched aerial stems c. 3-20 cm arise from an extensive underground system of brittle, fleshy, branching, whitish rhizomes c. 4 mm in diameter; stems with up to 7 ovate, pointed scale leaves c. 1 cm long, colourless and so producing a conspicuous banding effect in contrast to the dark stem and flower bases. At the top are 1-5 flowers, each c. 6 mm long, the lower portion brownish-pink, the upper white. Upper sepal hooded, 4.5 mm long, being slightly shorter than the lateral sepals and petals; lip oblong, translucent, with a dull yellow callus, 3 longitudinal pink streaks and a conspicuous central ridge (3,4).

Its taxonomic position is uncertain. Hatch in (3) erected a new subgenus to accommodate it (see also the discussion in 4). Recently it has been suggested that the species may be better placed in *Galeola* (2).

For illustrations see (3) and (4).

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This sheet has been compiled in part from the 1977 account in (2) of *Yoania australis* by Dr D.R. Given and R.E. Beever, to whom the TPC is most grateful.

PAEONIACEAE

STATUS Vulnerable. It has become depleted by grazing, mainly by goats, and is at risk from more intensive land use such as commercial developments for the tourist trade. Regeneration is seriously affected as the goats eat the developing fruits.

DISTRIBUTION Balearic Islands; probably now confined to the mountainous area in the north west of Mallorca. Formerly it was also on Menorca. References to its occurrence on Corsica are due to confusion with *P. russii* Biv.

Exactly the same situation applies to the endemic *Helleborus lividus* Aiton, which grows in association with the Paeony, but it is not nearly so widespread in cultivation. The Balearics have an endemic flora of 52 species and subspecies of flowering plants of which 21 are believed to be rare or threatened and one Extinct. They tend to be plants of the high mountains, often very rare but not necessarily under any threat, or plants of the lowland maquis communities, threatened by intensified land use and tourist developments. It is remarkable how many of the endemics are attractive garden plants.

HABITAT AND ECOLOGY On limestone screes and below limestone cliffs; also associated with *Smilax aspera* L. communities.

CONSERVATION MEASURES TAKEN None, to wild populations.

CONSERVATION MEASURES PROPOSED The Formentor Peninsula at the northern tip of Mallorca merits consideration for National Park status, to preserve this and other endemic species.

BIOLOGY AND POTENTIAL VALUE The flowers have a rose-like fragrance and are pollinated by bees and other insects. In Mallorca the roots are reputed to be useful in treating epilepsy. It is of great horticultural value as "one of the most delightful of all paeonies for the garden and ... the earliest to flower. The flowers are a beautiful shade of deep pink and the whole plant is charming with dark green leaves, purple underneath, set off by the red petioles and stem" (2).

CULTIVATION It is in cultivation and can be propagated by seed. As a garden plant it will thrive in a deep, rich soil and does well in partial shade under trees or shrubs, or against a wall (1,2).

DESCRIPTION Herbaceous perennial with the lower leaves up to 25 cm long, divided into 9 leaflets. Leaflets leathery, hairless, lanceolate to ovate, pointed, up to 10 cm long, dark green flushed with purple beneath. Flowering stems 30-45(-60) cm high, each ending in a large,

spreading to cup-shaped flower 6-10 cm across; petals deep rose pink, obovate, surrounding numerous golden yellow stamens. Fruit a group of 5-8 pink follicles c. 6 cm long, containing red to violet seeds.

For illustrations see (1), (2) and (3).

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This sheet is based upon information provided by Mrs L.F. Ferguson to whom the TPC is most grateful.

PALMAE

STATUS Endangered. The only known population, of the order of 1000 individuals or fewer, occurs in c. 2-4 ha of swamp woodland, and is at great risk from changes in the drainage pattern. Drainage itself, subjecting the trees to fire, or flooding (by filling in the narrow stream exit) are both likely to be a danger to the species. Its local name is 'Lenteri' (1,2).

DISTRIBUTION Sri Lanka; Kalutara District. Until 1969 it was only known from the original gathering in the 19th Century.

HABITAT AND ECOLOGY The single known population is in a low swamp-like woodland along a backwater. The surrounding slopes have recently been completely denuded of vegetation for agriculture. Silting at the bottom is of prime concern. The species is associated with a rattan and some *Pandanus* species, among the sapling-like understorey.

CONSERVATION MEASURES TAKEN None known.

CONSERVATION MEASURES PROPOSED Urgent consideration should be given to declaring a nature reserve in the area. Also important are further surveys of nearby forested areas to determine the full extent of its distribution.

BIOLOGY AND POTENTIAL VALUE The fruits are used as a substitute for those of *A. catechu* L. and chewed with betel-leaf and lime, with similar effect (2,5).

CULTIVATION All specimens seen by Read in botanic gardens that were labelled as *A. concinna* have been misidentified and are in fact *A. triandra* Roxb.

DESCRIPTION Solitary undergrowth palm with stem 2-4 m tall and 3-4 cm in diameter, and internodes 3-15 cm long. Crownshaft well developed, 35-45 cm long. Leaf 1-1.5 m long, with pinnae 30-50 cm long, 2.5-10.5 cm wide, the lowermost usually broadest with 1-6 main nerves. Inflorescence 10-17 cm long, enclosed within the crownshaft until the subtending leaf falls. The many flower-bearing branches are entirely enclosed in the prophyll until anthesis and are covered with small flowers, the females at the base, usually with 2 accompanying male flowers, and paired male flowers above; stamens 6. (The closely related and widespread *Areca triandra* has 3 stamens and is clustering.) Fruit c. 3 cm long, spindle-shaped, bright red, the endosperm deeply ruminate (2).

In the past this species has been confused with *A. triandra* as in (1) and (3).

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This sheet is based upon information provided by Dr R.W. Read (of the Smithsonian Institution, Washington, D.C.), to whom the TPC is most grateful. Help from Dr J. Dransfield, Secretary of the TPC Palm Group, is also gratefully acknowledged.

PALMAE

STATUS Endangered. It is at present only known from two forest localities where it occurs in very low numbers. Neither are protected and both are frequented by hunters and climbers whose activities could pose a threat to the palm's survival. When it was discovered by Moore in 1964, very few individuals were found.

DISTRIBUTION New Caledonia. The locality where it was discovered is the mountain pass of Parari, at c. 300 m. It was subsequently found by Schmid in the Valley of Palms in the drainage basin of the Nehoue river, c. 30 km to the west, at under 100 m. It is possible that other populations of the species may exist elsewhere in the region, especially in the neighbourhood of the Valley of Palms, which is still very little explored botanically.

The New Caledonian palm flora is of great scientific interest and has a very high degree of endemism. All the species and all but one of the 17 genera represented are confined to New Caledonia (including the Loyalty Islands). Of the 31 species, one is presumed Extinct, 4 are considered Endangered, 3 Vulnerable and 18 Rare. The high proportion of Rare species is reflected by the presence of many of the species in a botanical reserve rich in palms on Mont Panie.

HABITAT AND ECOLOGY In the Parari Pass it occurs in a narrow, more or less degraded strip of wet gallery forest bounded by frequently burnt *Melaleuca* savanna, growing with other palms, such as one species belonging to a new genus as yet undescribed and of which only one individual was found in this locality. The soils in the area are more or less leached and are formed from mica schists and glaucophanites. In the Valley of Palms, the species forms part of the gallery forest, occurring on clay soil rich in calcium.

CONSERVATION MEASURES TAKEN None.

CONSERVATION MEASURES PROPOSED Urgent consideration should be given to declaring a reserve to include the Parari Pass and part of the Panie-Iguambi Range.

BIOLOGY AND POTENTIAL VALUE The genus *Burretiokentia* consists of two species, both confined to the Grande Terre Region of New Caledonia. The other species, *B. veiellardii* (Brongn. & Gris) Pichi-Sermolli, is more abundant. *B. hapala* is the more elegant species of the two; it has a very handsome, bright green trunk marked with pale rings of the leaf scars, and is of considerable potential for horticulture.

DESCRIPTION Tree-palm to 12 m high with a solitary green stem and

a crown of c. 10 spreading pinnate leaves; leaflets c. 40 on each side, regularly arranged, narrowly elliptic in outline, dull green above, paler and densely brown-scaly beneath, up to 90 cm long by 5 cm wide. Inflorescences produced among the leaves, about twice as broad as long, with the triads of 2 male and one female flower nearly obscured by very dense brown woolly hairs. Fruit ovoid, 16 mm or more long, pointed at the apex. The principal difference between this species and the closely related *B. veiellardii* is the very woolly rather than the hairless inflorescence. Further differences are given by Moore in (1) from which the above description is taken.

For an illustration of the inflorescence and fruit see (1).

REFERENCE 1. Moore, H.E., Jr. (1969). New Palms from the Pacific, II. Principes 13(2): 67-69.

This sheet is based upon information provided by Dr M. Schmid, of Versailles, France, to whom the TPC is most grateful. Help is also gratefully acknowledged from Professor H.E. Moore, Jr., and Dr J. Dransfield, Secretary of the TPC Palm Group.

PALMAE

STATUS Endangered. It is now reduced to a few individuals, apparently on private land difficult of access. It could be eliminated by a local fire or by wood cutting. "In 1970 only about 20 plants of all sizes were seen. It was reported that a second grove nearby might have been destroyed by clearing for agriculture" (3). Its local names are 'Palma manaca', 'palmillo', or in English, the manac palm.

DISTRIBUTION Puerto Rico. The locality is east of San Sebastián in the north west of the island. It is possible that the species may also occur in the Dominican Republic but verification is needed, and even then it must be extremely rare there since only a single gathering of sterile material is known, from the Samana Peninsula.

HABITAT AND ECOLOGY Along a stream bed in moist limestone forest, at c. 300 m.

CONSERVATION MEASURES TAKEN Apparently all the plants of this species occur on property under a single ownership. According to Little *& al.* (3), the owner has "expressed an intent to protect the remaining trees".

CONSERVATION MEASURES PROPOSED None on record.

BIOLOGY AND POTENTIAL VALUE It resembles the coconut palm both in trunk and leaves but is smaller. It was formerly included under *Calyptrogyne occidentalis* (Swartz) Maza, then interpreted as occurring in Jamaica, Cuba and Hispaniola. However the Puerto Rican palm is now accepted as distinct but its history is uncertain. Possibly it may have been more widespread in the past (3).

In the wild there is considerable mortality of the seedlings during the first few years. Where one year several hundred seedlings may have germinated in a pile of debris along the bank of the stream, there will only be one or several remaining during the following year, and these may even disappear during subsequent years. Seed germination is rather good under natural conditions.

CULTIVATION "Young plants are growing in the botanical garden of the University of Puerto Rico at Lajas from seedlings collected in 1958" (3). Previous attempts at cultivation have for some reason not been successful with plants of this genus. Outside Puerto Rico, only one mature specimen of *Calyptronoma* is known in a botanic garden, in Jamaica, and may in fact be a natural occurrence.

DESCRIPTION Medium-sized solitary tree-palm with trunk to 10 m and leaf scars up to 10 cm apart; crown of 15-20 leaves with an ill-defined crownshaft composed of grey-green leaf sheaths. Leaf pinnate, to

8 m long, with very regular, close, somewhat pendulous leaflets. Inflorescence arising between the leaves, at maturity below the lowest leaves, enclosed in one large peduncular bract which is itself enclosed at the base in a prophyll; branches numerous, crowded at the tip of the penduncle, c. 30 cm long; flowers borne in triads, sunken in pits on the flowering branches, two male, one female. Fruit purple, rounded at both ends and with a smooth outer layer carrying the dry floral parts when falling (1,3).

For illustrations see (1) and (3).

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3. Little, E.L., Woodbury, R.O. & Wadsworth, F.H. (1974). Trees of Puerto Rico & the Virgin Islands, Second Volume. U.S.D.A. Agriculture Handbook No. 449. Washington, D.C. Pp. 70-71.

This sheet is based upon information provided by Dr R.W. Read (of the Smithsonian Institution, Washington, D.C.), to whom the TPC is most grateful. Help from Dr J. Dransfield, Secretary of the TPC Palm Group, is also gratefully acknowledged.

Fish-tail Palm (genus name)

PALMAE

STATUS Vulnerable; a very local species threatened mainly by destructive exploitation of its habitat, the lowland tropical rain-forest, but also to some extent by local people who remove the edible apex or "cabbage" as a vegetable and also obtain sago from the pith of the trunk, so killing the tree.

DISTRIBUTION Indonesia, Malaysia; widespread in the lowlands of Borneo, occurring in Kalimantan, Sabah and Sarawak, but very local and usually only seen as single specimens.

HABITAT AND ECOLOGY Lowland tropical rain-forest below 400 m; it seems to prefer disturbed sites at the foot of limestone hills.

CONSERVATION MEASURES TAKEN It is present in the Mulu National Park, Sarawak, but receives no direct protection there.

CONSERVATION MEASURES PROPOSED In establishing National Parks and reserves in Borneo, attention should be paid to including areas where this palm occurs. Removal of the "cabbage" or apex should be prohibited in such areas.

BIOLOGY AND POTENTIAL VALUE A very spectacular and impressive palm with gracefully hanging, doubly pinnate leaves; it is the largest species in the genus and the only solitary, giant *Caryota* that occurs in the lowlands of west Malesia. It would make an excellent avenue tree for cities in the lowland tropics and is a speedy grower (3).

CULTIVATION It is in cultivation at Bogor in Java and seed has been distributed to growers through the Palm Society Seed Bank.

DESCRIPTION Immense palm with a tapering trunk up to 20 m (or more) high, bulging towards the base, covered by a smooth bark ringed by leaf scars. The leaves are up to 8 m long, bipinnate, with axes stiffly horizontal but leaflets pendulous; leaflets 15-25 cm long, shaped like a fish-tail (narrowly ½-rhomboid), with a jagged upper edge. Inflorescence of long pendulous spikes up to 2 m long with flowers borne in threes, a central female and two lateral males each with numerous stamens. As in other members of the genus, when flowering begins, the first inflorescence is produced at the top of the stem and subsequent inflorescences are produced below the other (basipetal sequence). After flowering the stem dies (hepaxanthic) and as there are no suckers, the plant is monocarpic. Fruits small and fleshy, 3 cm across, containing two hard, hemispherical seeds surrounded by thin flesh, filled with needle crystals.

For illustrations see (3).

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This sheet is based on field work and taxonomic studies (3) of the genus *Caryota* by Dr J. Dransfield, to whom the TPC is most grateful.

PALMAE

STATUS Endangered. The total known wild population of this slender rattan is very unlikely to exceed 30 individuals, with male plants about equal in number to females. Each year the small fragment of forest where it grows appears to decrease due to fire, vandalism and cutting for firewood, despite its status as a Nature Reserve.

DISTRIBUTION Indonesia. The only known locality is near Pelabuanratu on the south coast of west Java. The species was previously recorded from 70 km inland to the north, on a limestone hill near Bogor, where it is now extinct. However it possibly awaits discovery elsewhere along the south coast of west Java.

HABITAT AND ECOLOGY In the undergrowth of coastal rain-forest, now almost destroyed and largely consisting of entanglements of shrubs and climbers. In one area of the reserve, it grows in closed forest, and this is assumed to be the natural habitat. Where previously recorded near Bogor, it grew in forest on an outcrop of coral limestone.

CONSERVATION MEASURES TAKEN The entire known population occurs within the 33 hectare Sukawayana Nature Reserve, although as described above, this does not afford adequate protection. The general aspect of the vegetation of the reserve is so disturbed as to give little hope of its successful survival in the future.

CONSERVATION MEASURES PROPOSED In order to maintain this species in the wild, even as a minimal population, the Sukawayana Nature Reserve will need to be much more effectively managed and total protection given to the remaining areas of forest within its boundaries.

BIOLOGY AND POTENTIAL VALUE As a cane this species is worthless, but as an ornamental it has considerable potential, combining as it does a slender habit with finely shaped and coloured leaflets. However the extraordinary type of inflorescence, the pollination biology of which has only partially been worked out, represents an extreme of rattan evolution, a study of which would be of considerable scientific value. The other 6 species of the genus have very similar inflorescences: however nowhere are they common and nowhere have been found such closely located male and female plants as in the population of *C. glaucescens*.

CULTIVATION It is easy to grow from seed, reaching flowering size in about 3 years at Kebun Raya, Bogor, and making an elegant plant. Until recently *C. glaucescens* was unknown in cultivation outside Bogor. Seed has now been distributed to other Botanic Gardens and to the Palm Society.

DESCRIPTION Delicate slender clustering rattan, with spiny climbing stems to about 6 m tall. Leaves 1.5 m long, ending in a barbed whip (cirrus) and bearing 5-8 fish-tail leaflets on each side of the leaf axis, rich dark green above, dense white indumentose below; young leaves flushed pink. Male and female flowers on separate plants. The entire inflorescence is enclosed in a single bract opening by a tiny apical pore, through which potential pollinators have to pass. After fertilisation ants often use the inflorescence as a nesting place and may give some protection to the developing fruit by their presence. Fruit oblong, c. 1 cm long by 5 mm wide, covered in reflexed overlapping brown scales; seed with a sweet fleshy seedcoat.

For illustrations see (2) and (3).

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This sheet is based upon field work and an unpublished taxonomic monograph of *Ceratolobus* by Dr J. Dransfield, to whom the TPC is most grateful.

PALMAE

STATUS Endangered. Only a critically low population is known. However, the species does appear to be regenerating. It was discovered first by Däniker in 1925, who considered it to be a species of *Microkentia* (= *Basselinia*) (1). It was described as a new species of the endemic genus *Cyphophoenix* by Moore in 1976 (2). Its local name is 'Nucele' (1) from which the specific epithet is taken and which is "explained by Dr MacKee (pers. comm.) as derived from *nu* (coconut) and *cele* (sling), the fruits having formerly been used as projectiles in hunting birds" (2).

DISTRIBUTION New Caledonia. It is only known from one locality on the central north east coast of Lifou, Loyalty Islands.

The New Caledonian palm flora is of great scientific interest and has a very high degree of endemism. All the species and all but one of the 17 genera represented are confined to New Caledonia (including the Loyalty Islands). Of the 31 species, one is presumed Extinct, 4 are considered Endangered, 3 Vulnerable and 18 Rare. The high proportion of Rare species reflects the presence of many of the species in a botanical reserve rich in palms on Mont Panie.

HABITAT AND ECOLOGY In wet forest on raised coral, at c. 60 m.

CONSERVATION MEASURES TAKEN None.

CONSERVATION MEASURES PROPOSED Consideration should be given to a small local nature reserve for this species.

BIOLOGY AND POTENTIAL VALUE The only other species in the genus, *Cyphophoenix elegans* (Brongn. & Gris) H.Wendl. ex Salomon, from the north eastern part of the Grande Terre region in New Caledonia, is also known from only a very small population, in this case threatened by forest fires, and so is Endangered. Thus *Cyphophoenix* must be considered as Endangered at generic level. The degree of generic endangerment in palms is particularly high in comparison with other plant groups.

The species seems to fruit abundantly and to regenerate well. It is apparently the only palm in New Caledonia that is adapted to coralline terrain, besides the coconut.

CULTIVATION "Seed of *C. nucele* has been introduced into cultivation in the United States where it may be expected to do well in southern Florida" (2).

DESCRIPTION Moderate-sized, solitary tree-palm to 12 m tall, with a prominently ringed, smooth trunk and a crown of about 8 pinnate

leaves. Leaflets c. 40 on each side, dark green and glossy above, light green but scaly beneath, c. 50-70 cm long by 2.5-3.5 cm wide. Inflorescence arising below the leaves, c. 50-62 cm long to 90 cm wide, stiffly branched; flowers borne in triads of 2 males and 1 female. Fruit ellipsoid and smooth when fresh, c. 2 cm long (2). The differences between this species and the closely related *C. elegans* are given by Moore in (2), from which the above description is taken.

For an illustration see (2).

REFERENCES 1. Däniker, A.U. (1932). Ergebnisse der Reise von Dr. A.U. Däniker nach Neu-Caledonien und den Loyalty-Inseln (1924/6). 4. Katalog der Pteridophyta und Embryophyta siphonogama. Vjschr. naturf. Ges. Zürich 77, Beibl. 19: 88.

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This sheet is based on information provided by Professor H.E. Moore, Jr., to whom the TPC is most grateful. Help from Dr J. Dransfield, Secretary of the TPC Palm Group, is also gratefully acknowledged.

PALMAE

STATUS Vulnerable; a very local species of scattered but wide distribution which only occurs in primary rain-forest and is threatened by destructive exploitation of the habitat for timber.

DISTRIBUTION Malaysia, Indonesia; "Common in East Johor, and locally abundant on ridge-tops in the north of Malaya ... and very local in West Sarawak" (1). In Indonesia it only occurs in one area within the Langkat Nature Reserve, Sumatra. The 3 other species in the genus are restricted to West Malaysia, each only occurring in a few areas of rain-forest. Though all occur in various Forest Reserves, all should be considered rare or threatened due to the small size of their populations. *J. perakensis* Dransfield is on 2 parallel mountain systems in Perak, *J. magnifica* Dransfield at Ulu Semenyih (Selangor), one valley near Ipoh in Perak and a few hills in north east Negri Sembilan, and *J. lanceolata* Dransfield at Ulu Semenyih where it grows with *J. magnifica* and 1.5 km away from *J. altifrons* (1).

HABITAT AND ECOLOGY In primary rain-forest on ridge-tops and hillsides on well-drained soils, mostly above 300 m. "It is never found in belukar (secondary regrowth) and it rarely survives any clear-felling of trees. It can, however, survive in selectively logged forest, but often sustains considerable damage from falling trees and scorching when exposed to direct sunlight" (1).

CONSERVATION MEASURES TAKEN In Malaysia it occurs in the Taman Negara National Park (Malaya) and in the Bako National Park (Sarawak). In Indonesia it occurs in the Langkat Nature Reserve (Sumatra), but in the part of the reserve that was being actively logged in 1971.

CONSERVATION MEASURES PROPOSED None on record.

BIOLOGY AND POTENTIAL VALUE A very spectacular undergrowth palm with immense undivided leaves rising gracefully from the base. The foliage is an excellent thatch for huts and shelters, and a single leaf makes a good umbrella; the young endosperm is said to be edible (1).

CULTIVATION Although many attempts have been made to introduce members of this genus into cultivation, very few have been successful; it is very difficult to obtain ripe seed and care of the seedlings is problematical.

DESCRIPTION Palm with a creeping underground stem which bears a tuft of about 20-30 very large, erect, diamond-shaped leaves up to 6 m high. The stalk, armed with short thorns, is 2.5 m long and the lamina up to 3.5 x 1.8 m, slightly lobed on the 2 upper edges and with prominent veins parallel to the 2 lower edges. Inflorescence borne in the leaf axils, at first erect becoming pendulous, surrounded towards the base

by 5-6 sheathing lanceolate spathes 10-20 cm long from which emerges the much branched panicle which is up to 100 cm long and divided into 20-100 branchlets, densely covered in small flowers; petals fleshy, white, up to 4 mm long. Fruit woody, c. 4 cm long, more or less spherical in outline but covered by numerous, more or less conical protuberances nearly 1 cm high (1).

For illustrations see (1) and (3).

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This sheet is based on field work and a taxonomic monograph (1) of the genus *Johannesteijsmannia* by Dr J. Dransfield, to whom the TPC is most grateful.

'Chonta'

PALMAE

STATUS Rare. The total population in 1965 was estimated by Solbrig and Moore (3) at between 500 and 1000 or more, mostly in areas that are not easily accessible. Despite legal protection they "saw evidence of occasional felling". In the past the species may have declined due to exploitation but also from habitat destruction by grazing animals. At present, however, the existing colonies do not appear to be threatened either by introduced plants or animals. It has recently been reported that there are at least 2000 adult plants and twice as many young palms on the island. Collecting of the wood and apex for sale as souvenirs to tourists is reported to be insignificant, due to effective control by park guards.

DISTRIBUTION Juan Fernández Islands, South Pacific Ocean. It is confined to Isla Robinson Crusoe (formerly Más á Tierra) where it occurs as scattered colonies on the hills from Puerto Frances to Puerto Ingles.

There are about 98 flowering plants and 17 ferns endemic to Juan Fernández and the majority are undoubtedly threatened, due to destruction of the forests by introduced sheep, cattle, horses, goats, rabbits, rats and in the lowlands the even more intractable problem of vigorous and invasive introduced plants such as *Aristotelia*, which is very common below 200 m, and *Rubus*, reported as an aggressive coloniser in the vegetation. The flora is of great interest for its most unusual evolutionary development, resulting in gigantism in many species, especially in the cabbage trees of the *Compositae* (2).

HABITAT AND ECOLOGY "On steep slopes and ridges in lower and upper montane forest above the zone of *Aristotelia* invasion, 200-800 m ..., most abundant in upper montane forest above 500 m ... in the upper reaches of the various quebradas ... A more detailed account is to be found in Skottsberg (4), where *Juania australis* is considered a tree of secondary importance but more or less common, and there it appears among many of the various associations detailed" (3).

CONSERVATION MEASURES TAKEN The species is protected by law and the Parque Nacional Juan Fernández was declared in 1935, but introduced grazing animals are still continuing to degrade the vegetation and flora. It is planned to reduce the number of goats and eliminate the sheep and cattle on Isla Robinson Crusoe (G. Mann, pers. comm.).

CONSERVATION MEASURES PROPOSED Grazing animals should be eliminated from the island, or at least excluded from selected areas. The palm should be more widely cultivated in botanic gardens.

BIOLOGY AND POTENTIAL VALUE "The 'heart', the apex with the undeveloped leaves, is edible ('col de palma') and the wood appreciated for making walking-sticks and for cabinet work" (4). As the only species in the genus, it is scientifically important; its position in the *Arecoideae* is discussed in detail by Moore (3).

CULTIVATION It is known to be in cultivation in a few gardens in Santiago, Chile, and in local nurseries. There has, apparently, been little success with transplanting individuals.

DESCRIPTION Straight-stemmed palm up to 15 m high, with a green trunk, smooth, polished and ringed with whitish to brown leaf scars, carrying a crown of about 18 pinnate leaves up to 1.3 m or more long, at first erect, then spreading, each of c. 80 linear pointed leaflets 20-30 cm x 4-25 mm. Flowers small, white and unisexual, the males and females on separate plants, borne on stiffly branched panicles up to 1 m long, emerging from 4 large bracts in the leaf axils. Fruits spherical, about 15-18 mm across, orange-red when mature (3).

For illustrations see (2), (3) and (4).

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The TPC is most grateful to Professor H.E. Moore, Jr., to Dr J. Dransfield, Secretary of the TPC Palm Group, and to Mr G. Mann, of the Corporación Nacional Forestal, Chile, for help in producing this sheet.

PALMAE

STATUS Rare. It is confined to 2 riverine localities. Robertson & Visagie (5) estimate the population size in one of them (Mtentu) to be in the order of 5000 individuals. Due to insect attack and exploitation of the fruits, reproduction appears to be almost entirely vegetative. In the other locality (Msikaba), the population is much smaller and estimated at probably no more than 200-300 trees, mainly concentrated in one grove (5).

DISTRIBUTION Transkei, South Africa. It occurs on the northern banks of the rivers Mtentu and Msikaba, Eastern Cape. On the Mtentu it occurs from the mouth to 4 km upstream with large groves from about 1 km upstream, but scattered individuals and small groups of individuals over most of the distance (5).

HABITAT AND ECOLOGY At all levels of the steep and rocky banks, from the level of the high water mark as illustrated in (5) to 100-150 m above. The banks are steep to vertical, with little soil.

The species mainly appears to be reproducing vegetatively, by suckers developing from axillary buds, especially from the rhizomatous sections of older stems. It is estimated that each mature tree produces about 200 seeds per year (5), but of these about 80% appear to be lost from insect attack. It is also reported that the seeds, which resemble miniature coconuts, are harvested: "Because of the hard nature of the fruit's endocarp (shell), the kernel is obtained by cracking the nut with two stones ... and the entire inflorescence is cut or broken down" (5). Only the inaccessible trees on rocky cliffs escape, but most of their seeds fall into the river rather than on to the bank.

CONSERVATION MEASURES TAKEN The species is protected under Section 10 (Protected Indigenous Plants) of the Transkei Nature Conservation Act No. 6 of 1973. The Mkambati Nature Reserve has been proclaimed for the species; Mkambati is the Pondo name for *Jubaeopsis*.

CONSERVATION MEASURES PROPOSED A large nursery for the palm's propagation is planned.

BIOLOGY AND POTENTIAL VALUE It is the only species in the genus *Jubaeopsis* and is of particular scientific interest "because of its apparently unspecialised nature among the cocosoid palms and its disjunct distribution. All other genera except *Cocos* itself and one species of *Elaeis* are now restricted to the Western Hemisphere" (3). Perhaps its closest relative is the threatened palm from Chile, *Jubaea chilensis* (Molina) Baillon. Robertson & Visagie (5) present possible hypotheses to explain its very restricted distribution.

CULTIVATION Detailed studies of germination *in vitro* were made by Robertson & Small; details of the optimum combinations of temperature, moisture and oxygen are given in (6). Germination of selected seed under climatic conditions close to those of the palm is reported to present no problems.

DESCRIPTION Moderate-sized palm with stems clustering by basal suckers, ultimately reaching 6 m tall. Leaves pinnate, to c. 2 m long, arching with numerous crowded stiff leaflets held in one plane. Inflorescence borne in the leaf axil with a long peduncle and spreading axes bearing male and female flowers. Fruit c. 2.5 cm in diameter, with a thin skin covering a hard stone, inside which lies the white endosperm. The seed germinates through one of the 3 'eyes' in the stone.

For illustrations see (4), (5), (7) and (9).

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The TPC is most grateful to the Secretary for Agriculture and Forestry, Transkei, for help in producing this sheet.

Central Australian Cabbage Palm

PALMAE

STATUS Rare; known only from an area of c. 60 sq. km in a National Park. The palm is found in a very specialised, moist habitat of which there are only a few examples in the arid region where it occurs. Latz estimated that its population consists of around 1500 individuals of reproductive age and slightly more immature ones; it appears to have increased to some extent over the last 50 years (3).

DISTRIBUTION Australia; along the Finke River and tributaries in the MacDonnell Range system, south of Alice Springs in the Northern Territory. A map of its distribution is given in (3) with estimates of the population sizes in individual sites.

HABITAT AND ECOLOGY The palm grows in moderately deep sand in watercourses in areas protected from severe erosion; it has a shallow, fibrous root-system and cannot survive scouring of the surrounding soil (3). The watercourses are irregularly flooded and have permanent water flowing through them, sometimes a metre or so below the surface. Regeneration usually takes place after flooding following rain, when there appears to be a massive germination of palm seeds, but a much lower survival rate. It has been estimated that some of the plants existing today may be 100-300 years old (3).

In contrast to the microhabitat, the climate is arid, the mean annual rainfall being c. 250 mm. The area is subject to drought and high temperatures during summer (25-35° C.) and occasional dry frosts during winter.

The effect of fire is reviewed in (3); it appears that many individuals can survive a fire and subsequent regeneration is quite rapid, but that effects could be more severe if large amounts of palm debris have built up before burning.

CONSERVATION MEASURES TAKEN Virtually all the palms occur within the Finke Gorge National Park (45,878 ha), established in 1967 (3). The best known locality, Palm Valley, contains c. 750 mature individuals as well as over 300 other plant species, about 10% of which are rare or of restricted distribution in Central Australia, an example being the cycad *Macrozamia macdonnellii* (F.Muell. ex Miq.) A.DC. (2,3).

CONSERVATION MEASURES PROPOSED The area adjacent to and north of the National Park is underlaid by the Palm Valley Natural Gas Field and care must be taken in any development programmes that the palms and their habitat are not damaged.

BIOLOGY AND POTENTIAL VALUE The species is of scientific interest because of its relict distribution; it is separated by c. 1000 km

from the nearest *Livistona* to the north (3). As a horticultural plant, it makes a fine specimen and should be more widely used in parks and similar areas, particularly in the arid zone.

CULTIVATION It has been grown in Miami, Florida, in the Adelaide Botanic Garden, and in Kebun Raya, Bogor, Java. Details of seed germination are given in (4).

DESCRIPTION Tree-palm to 25 m high with a bare, relatively slender trunk 20-30 cm in diameter, carrying a crown of fan leaves on heavily armed stalks c. 2 m; blade c. 1 m in radius, with numerous segments each divided deeply into 2 pendulous halves. Inflorescence a long panicle, the ultimate branches bearing clusters of sessile creamy white hermaphrodite flowers. Fruit spherical, 13-15 mm in diameter, with a shiny blackish surface.

For illustrations see (1), (3), (4) and (5).

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The material for this sheet was supplied by Mr J.R. Maconochie (of the Arid Zone Research Institute, Alice Springs), to whom the TPC is most grateful.

Coco de Mer, Double Coconut

PALMAE

STATUS Vulnerable. "This famous palm is protected both by law and by sentiment but the demand for nuts by tourists and others constitutes a threat to the species" (6). Recently, however, further measures have been taken to reduce over-exploitation of the nuts (see below). The species had declined mainly because of severe exploitation, but also because of fire, competition from introduced trees and shrubs, and to some extent clearing for cultivation. The trees in the Vallée de Mai, Fond Ferdinand and on Curieuse Island are protected.

DISTRIBUTION Seychelles. It is local and scattered on Praslin ('Isle of Palms', about 10 x 3-5 km) with dense stands in only two localities, but was formerly abundant and locally dominant; it is also on Curieuse Island (about 3 x 1 km) but extinct on the small Round Island.

HABITAT AND ECOLOGY Hill slopes and valleys from near sea-level to c. 300 m, presumably forming pure stands in the past. Vesey-FitzGerald points out in (1) that possibly the species could not survive if reduced to scattered individuals since other species can invade once the dense palm canopy is lost. A major factor may be pollination - the mechanism is not understood.

CONSERVATION MEASURES TAKEN To reduce poaching, the Government has recently become the sole distributor of the nuts, buying all of them and re-selling at a fixed price. Only nuts with a government issued tag may be exported. The most famous locality, the Vallée de Mai, is a reserve under the Wild Birds Protection (Nature Reserves) Regulations 1966.

CONSERVATION MEASURES PROPOSED It is recommended that the Government declare the proposed Praslin National Park, which has already been surveyed but not yet gazetted.

BIOLOGY AND POTENTIAL VALUE In the past many fables arose about the origin of the giant nuts. Their distinctive shape and immense size (they are the largest seeds in the plant kingdom) made them much-prized symbols of virility and suggested a supernatural origin until the tree itself was discovered in 1743.

As with most palms, the trees have many local uses. The 'cabbage' of young developing leaves was used in the past as a vegetable, the old leaves used for roofing, etc., the trunks for building materials and the young nuts for their edible, fleshy, white endosperm. The immature leaves (before they unfold) were used for making hats, vessels, baskets, brooms and even for filling pillows (3).

Lodoicea is of great interest to studies of plant geography and taxonomy for the most unusual size of its flowers and fruits. *L. maldivica* is the only species in the genus.

CULTIVATION It is in cultivation on Mahé, Silhouette, Félicité, La Digue and Frigate Islands, as well as in numerous botanic gardens. It is said to be easy to grow from seed, but germination has proved difficult in some cases. In the Seychelles the nuts (after they fall) are dehusked, stored for about six months and then sown by laying them on moist soil. The Department of Agriculture sells germinated nuts at a reduced price to interested growers.

DESCRIPTION Palm with a bare slender columnar trunk only c. 30 cm across, but up to 30 m high, with a crown of 12-20 pale yellow-green leaves, each 4-6 m long by 2-4 m wide on stalks 2-4(-10) m and folded like a fan when young, later opening into a broadly ovate blade with sub-pendulous folds or segments 4-10 cm broad. Male and female flowers appearing after 14-30 years and on different trees; male spikes spreading pendulous, more or less cylindrical, 1-2 m long and 6-10 cm across; female spikes stout, 1-2 m long, covered with large red-brown scales and bulging where the 5-13 large flowers are each inserted. Fruits more or less ovoid, somewhat flattened, 40-50 cm long, with a fibrous husk 1-2 cm thick covering the distinctive, black, usually 2-lobed nut which resembles two coconuts joined as Siamese twins, weighs 10-22 kg and remains on the tree for 5-8 years (1).

For illustrations see (1), (2), (3) and (4).

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PALMAE

STATUS Vulnerable; confined to 3 limestone hilltops, all within 40 km of Kuala Lumpur. It is threatened on one (Batu Caves) by quarrying and is at risk on one other (Bukit Takun) as a result of fires lit by climbers. Natural fires caused by lightning may also be a threat. Although 2 localities (Bukit Anak Takun and Bukit Takun) are protected, the total population is probably below 1,000 individuals.

DISTRIBUTION West Malaysia; confined to the tops of Batu Caves Hill, Bukit Takun and Bukit Anak Takun (Selangor State).

The Batu Caves themselves are a major tourist attraction, a centre for the Hindu religion and contain a rich, complex fauna. Wycherley mentions nearly 50 species of ferns and 30 rare plants growing at Batu Caves Hill, of which several of the latter do not occur elsewhere, e.g. *Hoya occlusa* Ridley (6). The rugged limestone hilltops of west Malaysia are relicts of an ancient calcareous mantle and have an extremely varied flora with numerous orchids; many of the species are local endemics and hence at great risk from habitat destruction.

HABITAT AND ECOLOGY "In the black humic soil of crevices in the limestone, sometimes in the open, sometimes under light forest shade" (4).

CONSERVATION MEASURES TAKEN The 2 hills of Bukit Anak Takun and Bukit Takun are within the Templer Park.

CONSERVATION MEASURES PROPOSED Quarrying at the Batu Caves should be controlled to ensure the palm's survival there. The Malayan Nature Society have proposed the Batu Caves be designated a National Nature Monument (3). Attempts should be made to prevent man-made fires on the hilltops within the Templer Park.

BIOLOGY AND POTENTIAL VALUE A Coryphoid palm which is of scientific interest for its mixed inflorescences (see below) and for its unusual distribution; its closest relatives occur on the Langkawi Islands near the Thai border in Kedah (*Maxburretia gracilis* (Burret) Dransfield, which is Rare), on a group of limestone hills in south Thailand (*M. furtadoana* Dransfield) and in the Himalayas, South China and the Mediterranean (*Trachycarpus* and *Chamaerops*) (1).

DESCRIPTION Small palm, stemless or with a short stem of c. 1 m covered by a fibrous mass of old leaf sheaths, bearing stiff fan leaves 50-60 cm long, roundish in outline on stalks of c. 1 m; leaflets sword-shaped, folded down the middle (induplicate), slightly smoky green on the underside, and 1-2 cm wide. Flowers minute, in erect panicles 50-65 cm high, of 2 kinds, one with bisexual flowers in

twice-branching, more or less straight spikes and the other with male flowers in thrice branching, zigzagging spikes. Fruits ellipsoid, 6 mm long and shiny black when ripe (4).

For illustrations see (2), (4) and (5).

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This sheet is based on field work by Dr J. Dransfield, to whom the TPC is most grateful.

'/Urgoun, Dalla'

PALMAE

STATUS Endangered. The population has been reduced to a critically low level by exploitation - the leaves are used for making mats - and by destruction of the natural habitat under irrigation schemes along the banks of the Nile.

DISTRIBUTION Egypt, Sudan. In Egypt it is known from 3 localities: an uninhabited oasis 220 km south west of Aswan where one tree and a few small seedlings were found in 1963, a similar site about 200 km west of Aswan where one tree was found in 1964 (3), and on the east side of the Nile in the south (1). In contrast it seems to have been widespread in Ancient Egypt (5). In the Sudan it is now known from only one locality about 200 km south east of Wadi Halfa (1); there are also unverified, pre-1910 records from a few other areas where it is doubtful whether it still survives.

HABITAT AND ECOLOGY River banks, wadis and oases, presumably forming groves in the past. At the oasis west of Aswan, the single tree was found "with a single dom palm (*Hyphaene thebaica* (L.) Mart.) and about 30 date palms (*Phoenix dactylifera* L.). Other associated plants were: *Juncus arabicus* (Asch. & Buch.) Adams, *Desmostachya bipinnata* (L.) Stapf and *Cressa cretica* L." (3). There are former reports of five individuals of *Medemia* growing in this locality.

CONSERVATION MEASURES TAKEN None for the wild populations.

CONSERVATION MEASURES PROPOSED Wherever possible, full protection should be given to the remaining plants.

BIOLOGY AND POTENTIAL VALUE Numerous pictures and fruits of *Medemia argun* have been found as offerings in Ancient Egyptian tombs; it was called "Mama enxanini". The fruits are barely edible and it is thought they were buried in the ground first, making them more palatable (3). In recent times the leaves have been used for making mats (5).

CULTIVATION It is in cultivation in Sudan.

DESCRIPTION (Including *M. albadiensis* H.Wendl.) Palm up to c. 10 m high with a bare unbranched trunk carrying a crown of fan-shaped leaves up to c. 1.35 m long, on equally long stalks. The leaflets are stiff, sword-shaped and 1-4 cm wide, the lateral ones being considerably shorter and narrower than the median ones. Male and female flowers on separate trees; male flowers small, with 3 spreading petals 3-4 mm long, subtended by felted bracts on dense spikes about 15-28 cm long and 1 cm thick. Female flowers c. 5 mm across, rounded, on stout stalks 1 cm long protruding from the "spike". Fruits ellipsoid, 2-5 cm long, with a shiny, brown-violet surface.

For illustrations see (2) and (3).

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PALMAE

STATUS Rare. It is only known from two localities; one (Kepahiang) lies in an area which has been designated at least as Protection Forest, but is being felled illegally for planting coffee. There is no information about the plant's status in the other locality.

DISTRIBUTION Indonesia; the 2 localities, both in Sumatra and 500 km apart, are Kepahiang, 50 km north east of Bengkula and on the main divide between the east & west coasts, and Gunung Talakmau, a volcano on the west of the divide and 70 km north north west of Bukittinggi. During extensive exploration of the palm flora of Sumatra, the species has not been found elsewhere.

HABITAT AND ECOLOGY It is locally abundant in the undergrowth of tropical rain-forest, occurring on hill-slopes and in valley bottoms, at c. 800 m. The area where it occurs is covered by extremely species-rich hill Dipterocarp forest; *Rafflesia arnoldii* R.Br. (also in the Red Data Book) and *Amorphophallus titanum* Becc. grow nearby.

CONSERVATION MEASURES TAKEN See above.

CONSERVATION MEASURES PROPOSED None on record.

BIOLOGY AND POTENTIAL VALUE No information.

CULTIVATION Seeds have been distributed to growers through the Palm Society Seed Bank.

DESCRIPTION Solitary squat unarmed palm with stout, stilt-rooted stem to 2 m high and 15 cm in diameter below the leaves, grey-brown and marked with close horizontal leaf-scars. Leaves 8-10 in crown, not abscissing neatly, spreading, to 3 m long; leaf-sheath to 50 cm long, dirty yellowish-green. Leaflets regular, 8-10 pairs, each up to 60 cm long by 8 cm broad. Inflorescence arising between the leaves, erect, 30-40 cm long, with 3-5 branches emerging from a single, dark brown or purplish, hard bract up to 25 cm long by 4 cm wide. Lower 2-4 inflorescence branchlets with male flowers only, the main axis with female flowers crowded at the base. Fruits crowded together to form a club-like mass on the end of the pendulous peduncle (1).

For illustrations see (1).

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This sheet is based upon field work by Dr J. Dransfield, to whom the TPC is most grateful.

Neoveitchia storckii (H.Wendl.) Becc.

"Vuleito" (local name)

PALMAE

STATUS Endangered. In 1972-3 this palm was reduced to a single population of 150-200 mature trees, occupying an area of less than 2 ha. On average each tree was surrounded by about 3½ seedlings under 1 m high. This final population has now been further reduced by additional felling and clearing of the habitat for banana cultivation (1). Its decline has been rapid; in 1971 specimens were seen over an area of about 12 sq. km. An additional threat to its survival is the voracious Rhinoceros beetle, *Oryctes rhinoceros*, which was introduced during the 1960s. It had badly damaged at least two trees of the palm in 1972-3.

DISTRIBUTION Fiji. The remaining locality is in the south east of Viti Levu where the species was formerly widely distributed along the banks of the Rewa River (1,5).

HABITAT AND ECOLOGY Now only in secondary forest. Although seed set appears to be good, the dense cover of lianes that were reported in 1971 is not conducive to regeneration.

CONSERVATION MEASURES TAKEN None for the wild population.

CONSERVATION MEASURES PROPOSED As recommended by Gorman & Siwatibau (1), the remaining stand should be protected from exploitation and from destruction of the habitat, as a matter of the greatest urgency. Further study of the effect of the rhinoceros beetle is needed and consideration given as to how it can be controlled. Further seed collections should be made.

BIOLOGY AND POTENTIAL VALUE *Neoveitchia storckii* is the only species in the genus and is of scientific interest as a most unusual relict of Arecoid palm evolution in the west Pacific. It would also be a handsome ornamental. The trunks make ideal poles for traditional Fijian houses and the unripe fruits were eaten when available (1,4).

CULTIVATION In 1972-3, four seedlings were transferred from the wild to the campus of the University of South Pacific, Suva, where they have successfully established themselves (1). A single specimen is in cultivation at the Fairchild Tropical Garden, Florida, U.S.A. Although there have been reports of erratic germination (1), it is likely that ripe seed will germinate easily without special treatments.

DESCRIPTION A solitary unarmed palm to 10 m tall with a smooth, greyish to pale brown trunk carrying a crown of c. 14 pinnate leaves 3.7-4.5 m long, with sheaths forming a well-defined crownshaft; pinnae numerous, regularly arranged along the rachis. Inflorescence axillary, appearing in bud among the leaf sheaths but not expanding until the subtending

leaf has fallen. Bracts 2, the outer much shorter than the horn-like, exserted inner one (c. 75 cm). Inflorescence shortly pedunculate with 2-3 orders of branching, about 70 cm long with eventually rather stiffly spreading rachillae. Lower portion of rachillae bearing triads of one female and 2 lateral male flowers, the upper portion bearing vertical pairs of male flowers; stamens 6 only. Fruit yellowish or reddish yellow, 47-50 mm long by 21-22 mm wide.

It was formerly confused with *Veitchia* but is abundantly distinct in the structure of the inflorescence, the arrangement of male flowers and the number of stamens.

There are photographs of the palm in its natural habitat (in 1964) in (3) and botanical illustrations in (2) and (5).

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This sheet is based on the detailed survey of Gorman and Siwatibau (1) and upon information obtained by Dr Melville on his visit to Fiji in 1971. Help from Dr J. Dransfield, Secretary of the TPC Palm Group, is also gratefully acknowledged.

'Enu, Vahane'

PALMAE

STATUS Endangered. The only known wild population in 1970 consisted of 30 individuals, of which 2 were mature, within an area of 0.5 ha. The species had presumably declined due to the destruction of the native forests from grazing by sheep and cattle. In 1970 Gillett found it was "reproducing very well, with the population slowly expanding. The feral pigs had not (by then) apparently discovered this food source". However, this population is close to an old house foundation and so could possibly be the remnant of cultivated plants (6). In 1978, there were unconfirmed reports of a further major population nearby.

DISTRIBUTION Marquesas Islands, South Pacific; on Nuku Hiva, the largest island of the archipelago. Besides the main locality near the centre of the island, Brown received local reports of a few trees at low altitudes in the north east, but this has not been confirmed (2). According to Father Delmas, there are also records for Hiva Oa and Tahuata (7). It occurs on Raivavaé (Austral Islands) where it was probably introduced (2). A recent and surprising discovery was its presence on the south coast of San Cristobal (Solomon Islands) where it had apparently grown from fruit washed up from the sea. Subsequently a grove of the palm was reported from the same coast, near a Mission Station and so probably introduced, and it seems likely that this was the source of the fruits washed ashore (4).

HABITAT AND ECOLOGY Under tropical rain-forest with *Inocarpus edulis* J.R. & G. Forster and *Hibiscus tiliaceus* L., on stony, gently sloping ground at c. 40 m altitude, about 0.5 km from a high waterfall (6).

CONSERVATION MEASURES TAKEN None known.

CONSERVATION MEASURES PROPOSED As recommended by Gillett in (5), a fence should be built around the remaining population and the area of remnant montane forest in which it occurs be designated a nature reserve. Re-introductions should also be considered. The palm also needs to be more widely cultivated especially in the tropics.

BIOLOGY AND POTENTIAL VALUE "In the Marquesas the immature endosperm was sometimes consumed as food, especially in times of famine ... Unlike that of the coconut, it becomes hard and inedible when mature. A water extract from the endosperm was used as medicine" (2).

Henry wrote of this species: "I have rarely seen a more beautiful palm. Some individuals 4-5 years of age, straight of stem, have the appearance of adult specimens of *Kentia;* the large, entire, pleated leaves, silvered below, give them a special quality" (quoted in 7). Because of its taxonomic and geographical isolation, *Pelagodoxa* is

of great interest to the palm evolutionist.

CULTIVATION It is in cultivation in several gardens and stocks for distribution are being built up, especially by the Botanical Garden of Papeari, Tahiti (8). To ensure germination, the seeds should be completely buried in the soil (8). The single tree at Bogor, Java, produces fertile fruits, but few seem to reach maturity due to the activities of fruit bats, rats and people.

DESCRIPTION Solitary palm with trunk to 8 m tall, sometimes stilt-rooted at the base. Crown without crownshaft, with about 10 broad, bright green leaves to 2 m long by 1 m broad, folded but not at first split into leaflets except very shallowly at the margins, later split by wind and rain into variously ribbed leaflets. The midrib is yellowish and lower leaf surface silvery-grey; leaf-stalks c. 20 cm long, covered in white felt-like indumentum. Inflorescences axillary, with many divaricate branches, bearing male and female flowers proximally and male flowers only distally, in both cases yellowish, on dull green axes. Fruit up to 15 cm in diameter, covered with corky warts. Seed rounded, with solid homogeneous endosperm surrounding a hollow centre.

Pelagodoxa mesocarpa Burret, described from a single fruit supposedly collected in New Caledonia by Cuming but thought by Burret possibly to have been gathered in the Philippines (3), may prove to be conspecific. It is almost certainly not native in New Caledonia as palm work there has been intensive and *Pelagodoxa* not yet found.

For illustrations see (1), (2), (6), (8) and Principes 2(3): cover & 95 (1958).

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Cretan Date Palm

PALMAE

STATUS Vulnerable; a many-stemmed Mediterranean palm known only from five coastal localities. In much the largest locality at Vai it is threatened by tourists, by people camping under the trees and by cars driven into the centre of the grove, all of which prevents regeneration. It is also at risk from drainage schemes. In the other four localities it only occurs in very small numbers; in one of these it was evidently declining in 1967 (3) and forming mere sparse low scrub; but in 1973 there was evidence of some regeneration.

DISTRIBUTION Crete. The main locality is near Vai on the north east tip of the island and is a major tourist attraction. Here the palms cover the bottom of a small valley for about 1 km, leading to a sandy and sheltered beach. Of the four other localities, three are scattered along the south coast; the other one, mentioned above, is on the north coast west of Iráklion. There are also occasional specimens elsewhere on the north coast. It is uncertain whether the species ever extended beyond Crete, but in the past it was presumably more widespread on the island; it is pictured on Roman coins minted in Ierápetra where it no longer occurs. Obviously the palm thickets existing today are the result of the degradation of natural groves which have been cut or burnt by man and have sprouted from the base (3).

Out of 155 species known to be endemic to Crete, 101 are believed to be rare or threatened. Fortunately 77 of these fall into the Rare category, reflecting their very localised distribution and, in many cases, their inaccessibility in the mountains, especially in crevices of vertical rock-faces protected from grazing. Much of the endemic flora is of horticultural merit and includes species of *Campanula, Colchicum, Crocus, Dianthus, Ebenus* (Giant Clover), *Helichrysum, Paeonia, Staehelina, Tulipa* and the monotypic genus *Petromarula* of the *Campanulaceae*.

HABITAT AND ECOLOGY Usually on sandy alluvial sites close to the sea. It is always associated with a high water-table and so any drainage of the area at Vai could result in the death of the palms. The same applies to any lowering of the water-table by pumping to provide fresh water for local enterprises.

The Cretan Date Palm produces more than one stem from the base and thus in the wild can regenerate vegetatively as well as from seed. At Vai the dry lower fronds have been cut away to reduce the risk of fire. This has tended to prevent regeneration both because of the damage to offshoots themselves and because of the constant movement of people between the trees which damages the seedlings. In the past the lower suckers around the main stems, with their spiny fronds, made much of the grove impenetrable. Fires lit by campers have also been

a problem at Vai, but these have now been prohibited.

CONSERVATION MEASURES TAKEN None.

CONSERVATION MEASURES PROPOSED At Vai a management study is needed to ascertain how the survival of the palm grove can be reconciled with the pressures from the tourism it attracts. One possibility is fencing off an inner sanctum as a strict reserve. The situation of the water table should be carefully studied. Consideration should be given to declaring one or more of the other sites as a strict reserve.

BIOLOGY AND POTENTIAL VALUE The Cretan Date Palm is undoubtedly the most unusual and striking member of the island's endemic flora. The spectacular grove at Vai is a major tourist attraction and has been used as a set for film-making. It is unique in Europe. The species has featured in botanical literature since the days of Theophrastus and is of considerable botanical importance as a close relative of the cultivated date palm, *Phoenix dactylifera* L. It could prove invaluable in the future for breeding new hybrid cultivars, e.g. with resistance to cold or to some pests and diseases.

CULTIVATION It is said to be easily grown from wild-collected seeds (3).

DESCRIPTION Palm up to c. 10 m high, each stem with several shorter side-shoots from the base, forming dense thickets or a mound with the dense foliage on the side-shoots hiding the main trunk. Each stem carries a dense head of slender, pinnate leaves 3-5 m long, at first erect, then horizontal and pendent. The middle and upper pinnae are mostly 20-50 cm long, each folded down the middle with a pungent tip; the lower pinnae, along the petiole, are transformed into hard spines. Male and female flowers on separate trees, both in large, much-branched panicles which in fruit are upright, enclosed by the leaf bases and have vivid yellow branches. Fruits ellipsoid, 14-16 mm long, inedible, scarcely fleshy and yellowish-brown. The main differences from the cultivated date palm are the upright fruit clusters and the small inedible fruits. For illustrations see (1), (2), (3) and (4).

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'Loulu' (genus name)

PALMAE

STATUS Extinct in the wild, surviving in cultivation but only as a single individual in Honolulu Botanical Garden's Foster Garden. Although the plant is apparently in good health, and surrounded by a low fence, it has not yet been possible for the staff of the garden to obtain seed due to the constant theft of the immature fruits. Clearly better protection is needed, and hand-pollination may also be necessary.

According to Hillebrand (4), one of the causes for its extinction in the wild was collecting of the plants for sale to amateur gardeners in Honolulu. Only a very small colony of the species in one locality was ever found.

DISTRIBUTION Hawaiian Islands; only known from Nuuanu Valley, close to Honolulu, Oahu. The last report of it in the wild was by Hillebrand in 1888 who wrote: "In Nuuanu, where until a recent time two clumps could be seen from the upper part of the valley, one was completely exterminated ... (and) the other owes its preservation to the absolute inaccessibility of the cliff on which it stands" (4). These plants do not now exist. Rock in the earlier part of this century explored this area very thoroughly but never found the species in the wild; he only knew the plant from 5 or 6 individuals in cultivation (2).

The flora of the Hawaiian Islands is one of the most severely threatened floras in the world, in particular because of the intense pressures on land for development and the effects of introduced grazing animals. A remarkably high 97% of the flora is endemic to the islands. Initial estimates by Fosberg and Herbst indicate that at least 273 species, subspecies and varieties are Extinct and 800 Endangered (some of which are protected). The authors emphasise that these figures are premature and tentative (3).

HABITAT AND ECOLOGY The locality was in an area of high rainfall and frequent mists. Steep, well-drained cliffs are typical of the valley.

BIOLOGY AND POTENTIAL VALUE The species is apparently easy to cultivate and very ornamental. Its chief attraction lies in its low stature and swollen trunk. Thus it is surprising that only one tree is known in cultivation, especially since Linden had sent seeds to Europe (1,2,4) and Rock knew it in cultivation in Honolulu (2).

The genus *Pritchardia* reaches its maximum development in the Hawaiian Islands (2). Fosberg and Herbst list 33 taxa of the genus in their list of rare and threatened Hawaiian plants, and of these 11 are known to be Endangered (3).

CULTIVATION See above.

DESCRIPTION Low, single-stemmed palm; the existing plant has a trunk c. 3 m tall, swollen near the base. Leaves fan-shaped, on long stalks (at least 1 m) which are woolly below, hairless above; leaf blade c. 1 m long, green on both sides, slightly lighter below, much divided to about half way (at the sides) or one third (centre), each division ending in 2 pendulous tips. Inflorescence emerging from an arching bract c. 1 m, with 2-3 major branches subtended by more or less silvery bracts. Fruits relatively large, 4-4.5 cm long and 3-3.5 cm wide, obovoid, rounded above.

For illustrations see (1) and (2).

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The material for this sheet was supplied by Mr K.R. Woolliams (of the Waimea Arboretum, Hawaii), to whom the TPC is most grateful.

'Loulu' (genus name)

PALMAE

STATUS Endangered; known only from a solitary plant, thought to be the same individual which was discovered by Rock in 1920 and on which he based his original description in (1). This lone tree has a marked, deep constriction on the trunk, about 1 m from the ground, but otherwise is in good condition.

The area in which it is growing is very isolated and the plant, therefore, is unlikely to be in immediate danger of being cut down. However, the area is heavily populated by feral goats. Although no seedlings exist, in 1975 there was an abundance of seed on the ground beneath the tree. Many of the seeds germinated in cultivation, indicating that given sufficient water and provided there was protection from grazing animals, natural regeneration might be possible. It appears that in the natural habitat the seeds are eaten by rats most years.

DISTRIBUTION Hawaiian Islands. The solitary tree is on the leeward side of Molokai. The species is not known from elsewhere in the Hawaiian Islands.

The flora of the Hawaiian Islands is one of the most severely threatened floras in the world, in particular because of the intense pressures on land for development and the effects of introduced grazing animals. A remarkably high 97% of the flora is endemic to the islands. Initial estimates by Fosberg and Herbst indicate that at least 273 species, subspecies and varieties are Extinct and 800 Endangered (some of which are protected). The authors emphasise that these figures are premature and tentative (2).

HABITAT AND ECOLOGY It is found in an area of scrub, near the base of a small, very dry valley, at c. 550 m. Beccari & Rock list its associates as *Diospyros ferrea* (Willd.) Bakh., *Dodonaea stenoptera* Hillebr., *Dodonaea viscosa* Jacq., *Pleomele aurea* (H.Mann) N.E.Brown, *Zanthoxylum maviense* Mann, and *Sida* (1). It is believed that this area was once considerably wetter, before the extensive removal of the natural forest on the hills above the site. Current rainfall is estimated to be about 37-62 cm per annum.

CONSERVATION MEASURES TAKEN To the remaining tree, none. There are long-term plans to re-introduce seedlings onto Molokai from cultivated material.

CONSERVATION MEASURES PROPOSED As irrigation is unlikely to be possible, the only conservation measure feasible would be to fence off the plant, thus ensuring it would not be destroyed by accident and giving protection from grazing to any seedlings which might arise.

BIOLOGY AND POTENTIAL VALUE It is a most attractive and distinctive palm, particularly because of the very small panicles which are covered by greyish-brown hairs; the undersides of the leaves are similarly covered. It would be a very suitable plant for landscaping purposes, especially in dry areas.

The genus *Pritchardia* reaches its maximum development in the Hawaiian Islands (1). Fosberg and Herbst list 33 taxa of the genus in their list of rare and threatened Hawaiian plants, and of these 11 are known to be Endangered (2).

CULTIVATION The species is being successfully grown at the Waimea Arboretum, Hawaii, from seeds gathered by the staff of the Arboretum in 1975. At that time seeds were widely distributed to botanical institutions around the world.

DESCRIPTION Palm with a solitary trunk to c. 3 m high and an overall height of c. 5 m. Leaves fan-shaped, deeply divided, relatively small for *Pritchardia*, the blade c. 85 cm long by 40 cm wide, and the petiole c. 85 cm long; leaf segments long, tapering and pendulous at the tips, with dense, grey to greyish-brown woolly hairs on the lower portion of the underside. Inflorescence short, covered by similar hairs, with much branched panicles 10-13 cm long arising from a large bract c. 50 cm long. Fruit more or less spherical, c. 22 mm long.

For illustrations see (1).

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The material for this sheet was supplied by Mr K.R. Woolliams (of the Waimea Arboretum, Hawaii), to whom the TPC is most grateful.

PALMAE

STATUS Endangered or possibly Extinct. It is only known from the original finding in 1926 when it was recorded as being extensively used for making wine (see below). This process, which kills the tree, may have exterminated the species.

DISTRIBUTION Dominican Republic. It was found on the Barahona peninsula in the extreme south. There are also reports of its occurrence on Isla Beata (to the south west of the peninsula), but these need confirmation. Floristic surveys are presently being carried out by Dr A. Liogier of Santo Domingo.

HABITAT AND ECOLOGY In extremely dry areas of quaternary limestone (1).

CONSERVATION MEASURES TAKEN None known.

CONSERVATION MEASURES PROPOSED A first priority would be a search of the Barahona peninsula to see if it still survives.

BIOLOGY AND POTENTIAL VALUE Read (2) believes that *P. ekmanii* is the 'wine palm' described by early explorers (e.g. Esquemeling in 1684). Such descriptions mention the palm's extraordinary shape; the lower half of the trunk is c. 20 cm across, but above about two thirds of its height it is very swollen, up to 80 cm across, and contains a very juicy, pleasant-tasting sap. They mention that after fermentation and settling this material produces a good clear wine. The fruits are recorded as being small, not unlike cherries, and with a good taste, but causing extreme pains in the throat (2).

"It would be highly prized as an ornamental" if available in cultivation (2). The genus *Pseudophoenix* is of considerable scientific interest, being the only representative of the Pseudophoenicoid group. Two of the 4 species, known from the Caribbean and Central America, are apparently very local. One of the reputedly more common species, *P. vinifera* (Mart.) Becc. from Haiti, is apparently suffering from land clearance and is rarely used today for wine-making.

DESCRIPTION Solitary palm 4-5 m tall, the base of the stem c. 20 cm in diameter, gradually enlarging above to produce a belly c. 80 cm across, then contracting suddenly to c. 15 cm below the crown. Leaves c. 1.5 m long, leaflets c. 95 on each side of the rachis arranged in groups in several planes, pale green above, white below. Inflorescence pendulous, to 80 cm long, with many branches; flowers on slender pedicels, c. 5 mm long (2). The extremely short stamen filaments and the relatively long pedicels immediately set this species apart from the other members of the genus (2).

For illustrations see (1) and (2).

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This sheet is based upon information provided by Dr R.W. Read (of the Smithsonian Institution, Washington, D.C.), to whom the TPC is most grateful. Help from Dr J. Dransfield, Secretary of the TPC Palm Group, is also gratefully acknowledged.

Needle-palm, Blue Palmetto

PALMAE

STATUS Vulnerable. It is uncommon over its restricted range and is frequently dug up and sold commercially in nurseries. As a result of its narrow habitat requirements and the vulnerability of its seed, the species only occasionally reproduces sexually (3,4). Small (4) believed it to be on the verge of extinction through natural causes.

DISTRIBUTION U.S.A.; confined to the southeastern Coastal Plain, where it occurs sporadically from central Florida to southern Georgia, west to southern Alabama and Mississippi (3,7). For a distribution map see (3).

HABITAT AND ECOLOGY Mainly in low sandy woods and swamps, particularly in river swamps (4). In Mississippi it occurs along the flood-plains of small streams or along the drainages of species-rich, wooded ravines (7). It is also found in the limestone fern grottoes of northern peninsular Florida, occurring on the top of the highest rock outcrops where the plants are much reduced in size (4).

It is not a vigorous or aggressive species. Because of its slow growth rate, it can occupy habitats with low light intensity, where it does not have to compete with faster growing plants for light, moisture and nutrients (3).

CONSERVATION MEASURES TAKEN It is found in several state parks such as Torreya State Park and Highlands Hammock.

CONSERVATION MEASURES PROPOSED A detailed survey should be made of its occurrence in state parks and other protected areas.

BIOLOGY AND POTENTIAL VALUE *Rhapidophyllum* is a monotypic genus of Coryphoid palm and is most closely related to *Trithrinax, Trachycarpus* and *Chamaerops*; all are regarded as being primitive, unspecialised palms on the basis of their flowers and fruits. *Rhapidophyllum* represents an isolated relict of palm evolution. The inflorescence, especially the female, is much condensed and bears dense clusters of flowers. As a result most of the fruits are caught in the mass of needles and leaf-stalks surrounding the inflorescence, and remain there until they decay or sprout; the resulting seedlings rarely survive. Reproduction is mostly vegetative by offshoots, which in time produce individual plants (3,4). There appears to be no effective long-range disperal mechanism to establish new populations in suitable habitats (3). For an account of its natural history see (3).

A weevil, probably a new species of *Notolomus* (Curculionidae), could prove to be the pollinator (3).

The palm can withstand relatively frequent frosts which makes it a valuable species for temperate gardens (see below).

CULTIVATION Although in the wild it is only found in partial shade, it can be grown in full sun if kept moist. Seeds germinate in 2 years. It is one of the hardiest palms, recorded as having withstood temperatures of -26° C. in Tennessee. It should, however, be grown in a protected spot, such as on a south-facing wall (1,6). It is in cultivation at the Fairchild Tropical Garden, Miami, and at the U.S. National Arboretum, according to the American Horticultural Society's Plant Service Data Center.

DESCRIPTION Low fan palm with short erect or creeping stems, producing suckers at the base. Stem covered by the persistent leaf sheaths which bear numerous, long, slender, needle-like spines woven together by coarse pliable fibres; leaf blades fan-like, about 50-70 cm in diameter, scurfy beneath. Inflorescence short and stout, 10-25 cm long, densely covered in unisexual flowers, or more rarely with hermaphrodite flowers; petals rounded; anthers c. 2 mm long, longer than the filaments. Fruit rounded, about 15-20 mm in diameter; tan or brown.

For illustrations see (2), (3) and (4).

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Florida Royal Palm

PALMAE

STATUS Endangered. In the wild it is restricted to four reproducing populations totalling only a few hundred trees, and a fifth locality containing a few juvenile individuals. Although these populations are in protected areas, they are threatened by fires resulting from the general lowering of the water table in the course of road building and the construction of drainage canals (3). It was once common in the region, but has been nearly exterminated by removal of young plants for transplanting as ornamentals (2). However, because it grows so readily from seed, wild plants are now less sought after than in the past.

DISTRIBUTION U.S.A. It is restricted to the Everglades and Big Cypress Swamp region of Florida, where, in Collier County, it is found in Collier Seminole State Park, in the Fakahatchee Strand State Preserve, and in the Corkscrew Swamp Sanctuary (juvenile individuals). Two additional populations occur in the Everglades National Park, in Dade County. A few isolated trees were seen in 1774 by Bartram 400 km to the north near De Land, Volusia County, where it is now extinct (2,3). This species or the related *R. regia* O.F.Cook of Cuba is one of the commonest cultivated palms.

HABITAT AND ECOLOGY Moist hammocks, and fresh or brackish swamps (3,9). Hammocks are dense forests with many species of trees, palms, shrubs, ferns and epiphytes, occurring on land slightly higher than the surrounding area. The characteristic vegetation of the Fakahatchee Strand is a swamp forest in the central part of which, where the water is deepest, is found the *Roystonea* with species of *Salix, Fraxinus* and *Annona*. Its past occurrence in central Florida may be due to the then much heavier forest cover which protected the more susceptible trees from occasional frost (3).

CONSERVATION MEASURES TAKEN All populations are in protected areas. The species was proposed as 'Endangered' by the U.S. Department of the Interior, Fish and Wildlife Service, on 16 June 1976. The Endangered Species Act of 1973 directs that no federally-funded activity shall jeopardise the existence of species once officially determined as 'Endangered' or 'Threatened', as defined by the Act.

CONSERVATION MEASURES PROPOSED None on record.

BIOLOGY AND POTENTIAL VALUE The Royal Palms (*Roystonea* spp.) are some of the most widely cultivated palms in the tropics. Unfortunately the taxonomic status of the Floridan and Cuban Royal Palms is not clear, so it is not possible to say how widespread the Floridan species is in cultivation. For an account of the genus see (1). In the West Indies the Royal Palms provide building material and pig food, and

have many other uses. *R. elata* is a stately and beautiful tree which can withstand severe storms (3). The seeds are scattered by birds.

CULTIVATION Transplanting from nurseries often results in root injuries and setbacks. Seedlings may be started in pots and planted in the second to third year. Under favourable conditions they may reach 6 m in 6 years from seed (3). Older specimens are half-hardy; they suffer minor damage when the temperature dips below freezing for a short period, but are consistently able to recover fully (10). The species is in cultivation at the Fairchild Tropical Garden, Miami, according to the American Horticultural Society's Plant Service Data Center.

DESCRIPTION Tree up to 30 m, likely to be taller than *R. regia*, but mostly straight, thickened usually towards the upper part with a shoulder at the top; crown-shaft bright green, 2-3 m high. Leaf massive with numerous crowded leaflets held in many planes giving the leaf a plumose appearance. Inflorescence massive. Fruit purple, rounded, c. 1.2 cm in diameter.

For illustrations see (1), (2), (5) and (6).

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The material for this sheet was supplied by the Endangered Flora Project of the Smithsonian Institution, Washington, D.C., to whom the TPC is most grateful. Help is also acknowledged from the TPC Palm Group, in particular Dr J. Dransfield and Dr R.W. Read, and from Dr D.F. Austin of the Florida Atlantic University, Boca Raton.

PALMAE

STATUS Vulnerable, probably Endangered. In the African localities it is clearly Endangered since its population has been reduced to critically low levels, and grazing by sheep and cattle prevents any regeneration. It forms the only straight timber in the area and its durable trunks are much sought after for building purposes.

DISTRIBUTION Djibouti, Somalia, South Yemen. In Somalia it is known from 3 north-eastern localities in one of which it has become extinct and in another reduced to about 25 trees; in the neighbouring Djibouti it was formerly recorded from 7 localities in the Goda Mountains (4) but is now existing in very low numbers - there were only 97 trees with no regeneration at the main locality in 1971 (5). Its status is uncertain in South Yemen but it is only recorded from one area in the Hadhramawt (1) and is likely to be threatened there. There are no past records of a wider distribution.

HABITAT AND ECOLOGY It grows by water, either in river valleys or by oases. In Djibouti it grows by a mere trickle of water; probably the Yemen locality is similar, being described as "sinter formations formed by a permanent, apparently saline, warm spring flowing from a chalk formation" (1). All the known localities are above 500 m. Details of the relict forests of the Goda Mountains (Djibouti) are given in (2) and proposals put for their conservation.

CONSERVATION MEASURES TAKEN A detailed plan was prepared by the Agricultural and Forestry Service of the Djibouti (then T.F.A.I.) Government to put a fence round the main locality in the Goda Mountains. The project was subsequently grant-aided by WWF but no news of progress have yet been received. The palm has been depicted on a postage stamp issued by Djibouti (then T.F.A.I.).

CONSERVATION MEASURES PROPOSED Wherever possible, full protection from grazing and cutting should be given to the remaining individuals of this palm.

BIOLOGY AND POTENTIAL VALUE It is one of the less specialised palms and is associated with a relict Mediterranean forest on nearby Mt. Daĭ; it is doubtless itself relictual. It is closely related to the Asiatic genus *Livistona* (6). As an avenue tree for the drier subtropics, it is of considerable ornamental potential.

CULTIVATION It was brought into cultivation by Bally and there are now seedlings in Kenya, in particular at Mr P. Greensmith's nursery at Langata, and at the Royal Botanic Gardens, Kew, U.K. It is being distributed to botanic gardens in southern Europe.

DESCRIPTION Solitary tree palm with grey-brown trunk to 15-20 m tall by 40 cm across. Crown with up to 40 fan leaves on leaf stalks c. 120 cm long, armed with recurved spines on the margin and yellow-green on the lower surface; blade c. 95 cm long, green on both sides. Inflorescence axillary and extending beyond the leaves to about 240 cm in all, bearing 8-9 branches which divide into many yellowish branchlets each bearing tiny, yellow hermaphrodite flowers. Ripe fruit rounded. The tree bears a remarkable resemblance to some species of the widely cultivated genus *Livistona*.

For illustrations see (3), (4) & (5).

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PAPAVERACEAE

STATUS Rare; an endemic restricted to a small, mountainous area in Scandinavia. The species is plentiful in at least one of the four known localities (5). None of the populations are believed to be threatened at present and there are no reports of any decline. The localities are not easily accessible and are some distance from tourist routes. Some sparse collecting has occurred, but has not greatly reduced the populations.

DISTRIBUTION Norway, Sweden; in the northernmost region, around the border. In Norway three localities are known in the Province of Troms; it was here that it was discovered by Laestadius in 1832 (although it was not described until 1931) (3). In Sweden it occurs in the Mt. Pältsa region in Torne Lappmark, where it is known from several sites (1). All the localities are within an area of c. 12 x 12 km.

HABITAT AND ECOLOGY In naturally open sites not influenced by man, within the middle alpine belt at 900-1300 m. It grows in relatively loose, moist, calcareous and schistose soil in sites that often face north (3). In Sweden it occurs with several species that are rare in Scandinavia, e.g. *Armeria scabra* Pallas, *Carex holostoma* Drejer, *C. nardina* Fries, *Sagina caespitosa* (J.L.M. Vahl) Lange and *Stellaria crassipes* Hultén (1).

CONSERVATION MEASURES TAKEN In Sweden the species is protected within the provincial jurisdiction by special regulations which prohibit removal or causing damage to the plant.

CONSERVATION MEASURES PROPOSED To ensure the well-being and long-term survival of this species, it is suggested that the declaration of a reserve to include one or more of the populations would be desirable. Since it is unlikely to be sought by collectors, legal protection is less of a priority.

BIOLOGY AND POTENTIAL VALUE The species is part of the complex *P. radicatum* group of *Scapiflora* poppies. The group has been thoroughly studied and the species have been of considerable importance in the discussion of per-glacial survival of ancient floras in Scandinavia during the Quaternary glaciations (4), and the evolution of isolated populations in refuges where they hibernated (2).

The species is self-fertile (2). The seeds have a low germination rate.

CULTIVATION The species is extremely difficult to cultivate, mainly because it is an extreme long-day plant. Attempts at cultivation have so far been unsuccessful (2).

DESCRIPTION Low-growing perennial with a dense basal rosette of pinnate leaves, with yellow indumentum; latex yellow. Leaflets broadly lanceolate, pointed, 3-5 per leaf. Flowers solitary, on more or less erect shoots c. 10 cm long, with spreading hairs; petals 4, yellow. Capsule 10-12 mm long, rather narrow with dense, much spreading, almost black hairs; stigmatic disc flat, with 5 broad stigma rays.

For illustrations of details of the plant see (3).

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Lord Howe Island Passionfruit

PASSIFLORACEAE

STATUS Endangered; an island endemic known from less than 10 gatherings (mostly without definite location) and at present from only two definite localities, in both of which the habitat is critically threatened. One of the known sites, towards the north east of the island, is threatened by grazing from cattle and possible future housing. The other is adjacent to a rough track used by cattle and feral pigs. Reconstruction of the road would destroy this population.

DISTRIBUTION Lord Howe Island, Pacific Ocean (31° 35'S., 159° 05'E.)

There are c. 75 species and subspecies of ferns and flowering plants endemic to Lord Howe Island, including 4 species of palms and 4 species of tree-ferns (6). Unlike most of the other subtropical and tropical islands with endemic species listed in the Red Data Book, nearly 70% of the original forest remains (3) and this is reflected by the fact that none of the endemic plants are believed to be extinct. There are introduced goats and pigs on the island and their effects on the vegetation have been reviewed by Pickard (4). An airstrip has recently been built and the island will undoubtedly become subject to greater pressures from tourism in the future.

HABITAT AND ECOLOGY The subspecies occurs as a low twiner in lowland rain-forest dominated by *Drypetes australasica* (J.Muell.) Pax & K.Hoffman ("Greybark") and *Cryptocarya triplinervis* R.Br. ("Blackbutt"), or by *Cleistocalyx fullageri* (C.Moore & F.Muell.) Merr. & Perry ("Scalybark") and *Linociera quadristaminea* (F.Muell.) Knobl. ("Blue Plum"), as described and mapped in (3).

CONSERVATION MEASURES TAKEN An environmental survey of Lord Howe Island has been carried out and detailed recommendations made to conserve the remaining forests and promote wildlife tourism (5). Although a reserve was recommended which would include both sites where this passionfruit occurs, it has not been declared and the area around one site is planned for future urban expansion.

CONSERVATION MEASURES PROPOSED As recommended by Recher and Clark in (5):- Reservation for the two localities and complete removal of the feral pigs. In addition grazing by cattle needs to be more strictly controlled and the plans for the urban expansion reconsidered in the light of the probable overall impact on a range of ecosystems.

BIOLOGY AND POTENTIAL VALUE The type subspecies occurs in Australia. The Lord Howe Island plant is little known and may well merit recognition as a separate species. The genus is of horticultural interest for its intricate and beautiful flowers.

CULTIVATION The subspecies was at one time in cultivation at the Royal Botanic Gardens, Kew, U.K., but has been lost.

DESCRIPTION Climber with axillary tendrils and hairless stems. Leaves also hairless, the blade c. 5-8 cm long by c. 5-8 cm broad with 3 pointed lobes, on a glandular stalk. Flowers hermaphrodite, single, creamy-yellow turning to pale salmon and red inside; corolla lobes 5, 2 cm long. Fruits not seen.

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The material for this sheet was supplied by Mr J. Pickard (of the National Herbarium, Sydney), to whom the TPC is most grateful. Help is also acknowledged from Mr P.S. Green (of the Royal Botanic Gardens, Kew, U.K.).

PITTOSPORACEAE

STATUS Endangered. This rare and interesting tree is only known from several populations, the average size of which is less than 12 trees. Disturbance of the forest in connection with early mining activity probably affected some of the populations and may be a future threat. Other populations were disturbed during road-building in the 1950s; this area has been developed for mining and the main access road to a hydro-electric dam passes through the site where the *Pittosporum* is probably most abundant.

As a famous rarity, it is also threatened by collectors. There seems to be a paucity of seedlings at many sites; no animal damage has been documented.

DISTRIBUTION New Zealand; several sites in the north west tip of South Island, in the region west and north west of Motueka. A detailed account of its occurrence in the early 1950s is given in (7).

HABITAT AND ECOLOGY Rocky forested creeks, among large granite boulders, on forest margins and in beech forest, at 600-1000 m. It appears to favour open habitats in the early stages of growth; J. & G. Patterson in (7) note its appearance on bulldozed clay banks along a stretch of road.

CONSERVATION MEASURES TAKEN Much of north west Nelson (the Tasman Mountains) is now included in a Forest Park; known populations of this species are assured of some degree of protection.

CONSERVATION MEASURES PROPOSED As recommended by Given:- Some populations (as detailed in 5) "could be best preserved in their present state by discouraging development of the area". For those disturbed by road-building: "Recording of the position of individuals and sites of maximum regeneration would provide information useful to engineers and others should road alignments be carried out or buildings, etc., erected" (5).

BIOLOGY AND POTENTIAL VALUE This is an attractive tree which is sweetly scented in flower.

CULTIVATION It is in cultivation, especially in New Zealand and the U.K. It is reported to be one of the hardiest of the pittosporums (2).

DESCRIPTION Small tree 4-6 m high with spreading branches; bark of stem and larger branches light grey, reddish purple on the younger wood. Leaves crowded towards the tips of the branchlets, the blade 5-10 cm long, elliptic to elliptic-oblong, rigidly leathery, coarsely

serrate. Flowers numerous, white, fragrant, arranged in dense terminal umbels with conspicuous bracts that fall early; both bracts and pedicels more or less silky-tomentose; sepals narrowly linear, to 1 cm long; petals white, linear-oblong, 2 cm or more long. Capsules aggregated, c. 1 cm long, elliptic-oblong, with numerous seeds immersed in pulp (1-4).

For an illustration see (6).

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This sheet has been compiled from the 1977 account in (5) of *Pittosporum dallii* by Dr D.R. Given, to whom the TPC is most grateful.

PLUMBAGINACEAE

STATUS Rare. It is endemic to the active sand dunes in a 200 sq. km area which is being considered for conservation. It occurs as two disjunct populations 90 km apart.

DISTRIBUTION Canada; known only from within 20 km of the south shore of Lake Athabasca in northwestern Saskatchewan.

The Athabasca sand dunes are remote from civilisation and can be reached only by aircraft or boat. There is, however, a winter road from Uranium City to the uranium mine at Cluff Lake that skirts the western edge of the area. As mining development expands in northern Saskatchewan, the likelihood of threats from human disturbance will increase. Other endemics confined to the Athabasca sand dunes are *Achillea lanulosa* Nutt. ssp. *megacephala* (Raup) Argus, *Deschampsia mackenzieana* Raup, *Salix brachycarpa* Nutt. var. *psammophila* Raup, *S. turnorii* Raup, *S. tyrrellii* Raup, *Stellaria arenicola* Raup and *Tanacetum huronense* Nutt. var. *floccosum* Raup.

HABITAT AND ECOLOGY It occurs as scattered individuals on gravel pavements within active sand dunes. These pavements are heavily sand-blasted and covered with stones. The species does not occur elsewhere in the sand dune habitat. It is associated with *Arabis arenicola* (Richardson) Gelert, *Artemisia campestris* L. ssp. *borealis* (Pallas) Hall & Clements, *Carex*, endemic *Salix* species (including *S. silicicola* Raup, also in the Red Data Book), *Silene acaulis* L. and *Tanacetum huronense* var. *floccosum*.

CONSERVATION MEASURES TAKEN None.

CONSERVATION MEASURES PROPOSED The sand dune region is being considered for park status by Parks Canada and the Saskatchewan Department of Tourism and Renewable Resources, but no final action has been taken (3).

BIOLOGY AND POTENTIAL VALUE This unique taxon, which is related to a circumpolar, predominantly coastal species, occurs about 850 km from the nearest coast. It probably evolved in postglacial times and it is of evolutionary significance. Similarly, local mainland taxa are described in Europe.

DESCRIPTION Perennial herb with a branched woody stock and many basal rosettes of flat linear leaves 2-6 cm long, up to 3.5 mm wide. Flowering stems erect, 10-18 cm long, each bearing a dense, nearly spherical head c. 2 cm across of numerous small flowers, surrounded by scarious bracts forming an involucre below which is a membranous sheath around the top of the stem, 1.8-2.2 cm long; outer bracts ovate-oblong,

acute; inner bracts obtuse, larger. The differences between this plant and other subspecies of *A. maritima* are given by Lawrence in (1). (Syn. *Statice interior* Raup, *Armeria maritima* (Miller) Willd. var. *interior* (Raup) Lawrence.)

For an illustration see (2).

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The material for this sheet was supplied by Dr G.W. Argus (of the Rare and Endangered Plants Project, National Museum of Natural Sciences, Ottawa), to whom the TPC is most grateful.

PLUMBAGINACEAE

STATUS Endangered; a giant Sea Lavender which is exceedingly rare and severely threatened, partly by grazing and partly by collecting for horticulture. It was believed extinct for many years (5,6), but is now known to survive in very small numbers in a single locality, which is inaccessible to goats. The population is reproducing and seedlings are becoming abundant.

DISTRIBUTION Canary Islands. The single locality is on the north coast of Tenerife. The species has also been recorded from two basalt islets off the coast near Orotava, but according to Perez in 1904, it had been extinct there "for many years ... owing to the goats having been placed to graze on these islets" (5).

Out of 95 species of flowering plants endemic to Tenerife, 9 are Endangered, 18 are Vulnerable and 35 are Rare. The principal threats to the flora are destruction of the forests and pressure on land for agriculture and tourism.

HABITAT AND ECOLOGY On rocky slopes and cliffs near the sea. The vegetation of such habitats includes a particularly large number of endemic species. One area of a few square kilometres in the Teno region in the north west of the island contains over 300 species of flowering plants, including on an ancient basalt cliff the Endangered and closely related *Limonium fruticans* (Webb) Kuntze and the endemic Composites, *Centaurea canariensis* Willd., *Tolpis crassiuscula* Svent., *Vieraea laevigata* Webb & Berthel. and *Argyranthemum coronopifolium* (Willd.) Webb ex Schultz Bip. All are rare plants and have their largest populations on this cliff (2).

CONSERVATION MEASURES TAKEN Many of the threatened Canarian endemics, including this one, are in cultivation at the Jardín Botánico Viera y Clavijo on Gran Canaria. A seed bank for threatened Macaronesian and Iberian species has recently been set up at the Universidad Politécnica, Madrid.

CONSERVATION MEASURES PROPOSED None on record.

BIOLOGY AND POTENTIAL VALUE It is a magnificent plant when in flower and much prized by gardeners.

There are believed to be 16 species of *Limonium* endemic to the Canaries. Several are very rare and of the 5 confined to Tenerife, at least two others, *L. fruticans* and *L. spectabile* (Svent.) Kunkel & Sunding, are Endangered (4). The group is one of the floristic attractions of the Canary Islands and is of considerable interest to students of plant geography.

CULTIVATION It is commonly grown in cultivation and strikes readily from cuttings. It tends to hybridise with other *Limonium* species (5). It is not frost-hardy.

DESCRIPTION Shrub up to 180 cm high, with a smooth, cylindrical, woody stem sparingly branched at the top, bearing clusters of glaucous, ovate to elliptic leaves 10-25 cm long on lengthy stalks which widen at the base. The large terminal inflorescence is 20-100 cm across, dense and much-branched; flowers in small clusters surrounded by papery-edged, brownish bracts, on short branchlets up to 4 cm long, winged on both sides with pointed lobes at the top; calyx papery, blue mauve, funnel-shaped, 8-10 mm across at the top, persisting after the slightly smaller, nearly white corolla has shrivelled. Capsule small, enclosing a single seed. (Syn. *Statice arborea* Willd.) This species was listed as *Limonium arboreum* in the 1970-1971 edition of the Red Data Book, Vol. 5; included under this name was also *L. fruticans*, which is now recognised as a distinct species.

For illustrations see (2) and (3).

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The TPC is most grateful to Dr D. Bramwell, of the Jardín Botánico Viera y Clavijo, Gran Canaria, for help in producing this sheet.

PLUMBAGINACEAE

STATUS Endangered; an endemic of maritime cliffs with a very restricted distribution. The locality where Henslow first discovered this plant in 1832 has been completely destroyed by quarrying for building stone (2). In April 1977 the total population of the species was estimated at between 1100 and 1600 individuals, occurring in four neighbouring colonies. One of these sites is threatened by people walking close to the cliff edge, and the rocks on which the plants occur will probably crumble away in due course. In two of the other sites, which contain c. 85% of the total population, the species does not appear to be declining; however, one of these sites is close to an active quarry and in the other the plants grow on a wall of the quarry itself.

DISTRIBUTION United Kingdom. It is confined to a stretch of about 1200 m on the cliffs of the Isle of Portland, Dorset. It is not certain whether or not a plant found in Co. Clare, Ireland, in 1952 belongs to this species.

HABITAT AND ECOLOGY It is restricted to crumbling oolitic limestone (Portland Stone) cliffs and quarry faces. It is associated with *Armeria maritima* (Miller) Willd., *Beta vulgaris* L. ssp. *maritima* (L.) Arcang., *Cerastium diffusum* Pers., *Crithmum maritimum* L., *Daucus carota* L., *Festuca rubra* L., *Inula crithmoides* L., *Plantago coronopus* L., *Puccinellia maritima* (Huds.) Parl. and *Sagina maritima* Don.

CONSERVATION MEASURES TAKEN A detailed survey of the localities and surrounding area has been made by Clafton, Cooke, Hutton and Sell. All the sites are within the area of Portland coast designated as a Site of Special Scientific Interest.

CONSERVATION MEASURES PROPOSED A local nature reserve is needed covering the two major and least threatened sites to protect them from further quarrying.

BIOLOGY AND POTENTIAL VALUE It is an elegant small sea-lavender suitable for growing in rock-gardens.

CULTIVATION It has been brought into cultivation and is in the University Botanic Garden, Cambridge.

DESCRIPTION Perennial herb with a woody stock and rosettes of narrowly obovate-spathulate, blunt, rigid leaves 2-4 cm long. Flowering stems more or less rough-surfaced, 5-20 cm high, bearing short, dense, arching or recurved, somewhat horizontal spikes about 1-2 cm long, consisting of 2 closely crowded rows of spikelets. Each spikelet has 3 small,

scale-like bracts 3-5 mm long and 1-3 flowers; calyx funnel-shaped, with 5 conspicuous, papery white lobes; corolla violet blue, 6 mm across, with a very short tube and 5 spreading lobes.

For illustrations see (2).

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The material for this sheet was supplied by Dr F.H. Perring (of the Biological Records Centre, Institute of Terrestrial Ecology), to whom the TPC is most grateful. The sheet is based upon a detailed survey of the field populations by F. Clafton, A.S. Cooke, P. Hutton and P.D. Sell, in April 1977.

Wild Rhubarb

POLYGONACEAE

STATUS Rare; a plant of great economic and historical importance which occurs in a few mountain localities in Bulgaria where "apparently ... it has been depleted by uprooting of the plants to make a liqueur" (4). "A most astonishing discovery has been its occurrence" in one locality in Norway "where ... it may become extinct in the near future by diversion of water" (4). In 1944 Nordhagen visited the site, which was already known to the local inhabitants, and saw from below about 12 large individuals. In 1968 a few more were found on the eastern end of the same mountain (3).

DISTRIBUTION Bulgaria, Norway. Stojanov, having visited the Bulgarian area in 1923, knew 4 localities and had indications of 2 others, all at 1800-2100 m in the western part of the Rila Mountains, south of Sofia. On this occasion it was brought into cultivation by Kellerer (5).

The Norwegian locality is on Mt. Onstadberg in the Aurland region 120 km north west of Bergen (3), where "its occurrence ... seems due to its survival in a special micro-climate, the disjunct distribution (being due to) extinction during climatic change" (4).

HABITAT AND ECOLOGY Stojanov (5) describes one of the Bulgarian localities: under overhanging rocks on north east facing cliff terraces he found 20 individuals, associated with low growing species such as *Pinguicula vulgaris* L., *Soldanella hungarica* Simonkai and *Swertia perennis* L., which clearly could not tolerate a closed herb community. From this locality Kellerer raised young plants in cultivation and as an experiment planted them out along the bank of the Sara-Gjol River; at first they grew well but later were eliminated by competition from the tall growing herbs, e.g. *Heracleum verticillatum* Pančič. From this Stojanov concludes that *Rheum rhaponticum* requires damp places and low competition, being a relict species with little competitive power (5).

The Norwegian locality, described in great detail by Nordhagen (3), is a steep, north facing, broken cliff at c. 480 m, with sparse vegetation cover, analysed in detail in (3). The *Rheum* is associated with a number of low growing species that are mostly common in damp parts of the Norwegian mountains.

CONSERVATION MEASURES TAKEN It is legally protected in Bulgaria.

CONSERVATION MEASURES PROPOSED None recorded.

BIOLOGY AND POTENTIAL VALUE It is one of the parents of the cultivated rhubarb, *R. X cultorum*. "Some time before 1608 an Italian medical

man, Francisco Crasso at Ragusa (now Dubrovnik) obtained roots of a species growing in the Rhodope mountains of Thrace (now Rila, Bulgaria) which he recognised as being like the *rha ponticum* of the Ancients. He sent this plant to Prospero Alpino (1553-1617) at the medically celebrated Venetian University of Padua. Alpino grew it successfully, distributed seeds to botanic gardens and published a work De Rhapontico Disputatio (1612) giving a detailed account of this remarkable discovery. In 1753 Linnaeus named it *Rheum rhaponticum*" (4). It was first cultivated as a medicinal plant but was later used for culinary purposes. During the 18th Century other *Rheum* species were brought into cultivation which have produced through hybridisation and selection the culinary rhubarbs, *R. X cultorum*. Meanwhile *R. rhaponticum* itself has almost disappeared from cultivation, its place being taken by a hybrid descendant (4).

CULTIVATION It is in cultivation.

DESCRIPTION Robust perennial herb with a woody rhizome and large, hairless, palmately-veined leaves, ovate to rounded but heart-shaped at the base, up to 50 cm wide, borne on long thick stalks (the rhubarb). Flowering stems up to 2 m high bearing several stem leaves and a diffuse panicle of small yellowish flowers; perianth segments 6. Fruit a small hard nut with 3 membranous wings. Nordhagen has carefully compared the Norwegian and Bulgarian material and finds no significant difference; both have 2n=22 (3).

For illustrations see (3) & (5).

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POLYGONACEAE

STATUS Endangered. It was described in 1941 from specimens gathered at the beginning of the century (1), and has always been known as a rare endemic of the coastal belt of Israel. At present only two populations are known, one of which is within a nature reserve. In 1977, only around 30 individuals were seen. The vegetation and flora of the Israeli coast has particularly suffered from urbanisation and development for recreation during the last 30 years and the belt of sandy soils east of the coast, in which this species grows, is in danger of being totally destroyed.

DISTRIBUTION Israel. The remaining localities are 8 km apart, near the coast north of Tel Aviv. A few scattered plants may remain elsewhere on the Mediterranean coast between Gaza and c. 40 km south of Haifa.

HABITAT AND ECOLOGY On sandy soils east of the sea coast. The plant association of these soils is of *Desmostachya bipinnata* (L.) Stapf and *Centaurea procurrens* Sieber with a dense cover of annuals such as *Crepis aculeata* (DC.) Boiss., *Aegilops longissima* Schweinf. & Muschler, *Trifolium dichroanthum* Boiss., *Trigonella cylindracea* Desvaux, *Nigella arvensis* L., etc. Scattered plants of *Retama raetam* (Forssk.) Webb and *Artemisia monosperma* Delile are also common.

CONSERVATION MEASURES TAKEN One remaining population is protected, in the Udim Nature Reserve. However, the reserve is suffering from speeded up growth of perennials (especially *Retama)* which is causing a decrease in the number of annuals. Remedial measures have not yet been successful.

CONSERVATION MEASURES PROPOSED None on record.

BIOLOGY AND POTENTIAL VALUE It flowers in March to April. Some other species of the genus are used as pot herbs and are known in folk-medicine (3).

DESCRIPTION Dioecious glabrous annual with simple erect stems 10-45(-75) cm high. Leaves up to 9 x 3.5(-4) cm, the basal ones stalked, oblong-obovate, more or less rounded at the tip; stem leaves stalkless, ovate-oblong, abruptly pointed at the apex, with 2 back-pointing lobes at the base; uppermost leaves narrower. Inflorescences terminal, dense, elongated, cylindrical with 3-4 stalked flowers in each axil; male flowers 3-4 mm across; female flowers c. 2 mm. Fruit a spindle-shaped, black-brown, shining achene 2-3 mm long, enclosed within the inner perianth segments which form a membranous, leathery, aeroplane-like structure up to 7 mm long consisting of 3 toothed, wing-like lateral lobes and a smaller triangular pointed lobe at the apex (3).

For illustrations see (1) and (3).

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The material for this sheet was supplied by Dr A. Dafni and Professor C.C. Heyn (of the Department of Botany, Hebrew University of Jerusalem), to whom the TPC is most grateful.

Felton's Flower

PORTULACACEAE

STATUS Extinct in the wild but surviving in cultivation near the original locality. The causes for its demise are overgrazing by sheep, to which it is very susceptible because of its annual habit, and the increase of introduced pasture grasses and associated weeds. There are no reports of specimens in the wild since around 1910. The flowers were originally described as varying from white to magenta (3); all the population is now of the magenta form with the exception of a few, recently found individuals with white flowers (see below).

DISTRIBUTION Falkland Islands, South Atlantic. It is now confined to the gardens of the settlement area of West Point Island, but was formerly reported as common in the north west corner of the West Falklands (3). The white form, hitherto believed extinct, was surprisingly found in 1976, growing as a weed in the vegetable garden on West Point.

There are 12 angiosperm species believed to be endemic to the Falkland Islands. In addition to *Calandrinia feltonii*, three of these are Rare and one is Endangered (*Arabis macloviana* (Urv.) Hook.f. which is now very scarce, also as a result of overgrazing by sheep).

HABITAT AND ECOLOGY Dry areas at the base of 'stone runs' (a local phenomenon where the large, sharp-edged rocks are arranged in a formation not unlike the dry bed of a stream or river). In such situations the soil is dry, warm and porous (1). It also occurred on the north sides of ridges covered by the small shrub *Empetrum rubrum* Vahl ex Willd.

CONSERVATION MEASURES TAKEN The remaining population is protected from sheep and grazing animals in the West Point settlement gardens. In the past attempts were made to re-introduce the species into the wild, but with no lasting success. However, efforts are now being made to distribute seed and transplant specimens into areas fenced off from sheep. A small colony has been established at Carcass Island, near West Point. Seed has also been sent to the Royal Botanic Gardens, Kew, U.K., and will be distributed to other establishments.

CONSERVATION MEASURES PROPOSED The re-introduction work should be continued and supported. Nevertheless it is important that the plant should also be more widely cultivated.

BIOLOGY AND POTENTIAL VALUE It makes a very attractive garden plant particularly on warm, sunny days when the plants are covered in small bright magenta flowers (1). It is also of botanical interest as its nearest relatives occur north of latitude 35° S., whereas other endemics from the Falkland Islands have affinities to the nearby South American mainland flora, at about latitude 50° S.

CULTIVATION It thrives in poor, dry soil with a sunny aspect, but is intolerant of competition from weeds. In the Falkland Islands the seeds usually germinate in late summer and the plant overwinters as a small seedling, often with only the cotyledon leaves extended (1).

DESCRIPTION Annual herb with many prostrate lax stems up to 30 cm or more long, bearing alternate, nearly hairless, linear-spathulate leaves 1-3 cm long, slightly fleshy, narrowing at the base into a winged stalk. Flowers in leafy racemes from the axils of the upper leaves, each flower with 2 small sepals joined together at the base and 5 spreading magenta petals 8-11 mm long. Capsule 8-10 mm long, equalling or shorter than the sepals.

For an illustration see (1).

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The material for this sheet was supplied by Mrs M. Davidson (of West Point Island), to whom the TPC is most grateful.

PRIMULACEAE

STATUS Rare. This attractive small alpine plant only occurs in a few localities in a mountainous area of about 150 sq. km. It is protected by law in some of its range, but must be considered as Rare because of its low population, part of which may be at risk from collectors. Nevertheless most of the localities are in areas little visited by tourists, so that the risk would only arise if and when tourism was developed in one of these areas.

DISTRIBUTION Italy, Switzerland. It occurs on the mountains on both sides of the north of Lake Como. Records from the Graian Alps (2) probably refer to unusual growth forms of *A. alpina* (L.) Lam. The verified distribution of *A. brevis* is thus in the siliceous region of the north west Bergamasche Alps and the adjoining chains of mountains to the west; the latter, however, were significantly more glaciated than the southern Bergamasche Alps, which are formed of limestone and have more endemics.

HABITAT AND ECOLOGY It grows in stabilised scree and rock-crevices of stony lime-free soil, between 1950 and 2600 m. Sunny exposed sites, mostly free from snow in winter, are favoured.

CONSERVATION MEASURES TAKEN Under the 'Ordonnance d'exécution de la loi fédérale sur la protection de la nature et du paysage' (27 December 1966), picking and uprooting as well as transport, selling and purchasing of all *Androsace* species are prohibited throughout Switzerland.

CONSERVATION MEASURES PROPOSED Measures similar to those in Switzerland should be enacted in Italy.

BIOLOGY AND POTENTIAL VALUE All species of *Androsace*, especially the dwarf cushion species which are particularly decorative in flower, have a special attraction for collectors and alpine gardeners. This species is close to *A. alpina* which differs mainly in its habit and leaves as well as in its ecology, preferring sheltered spots covered by snow in winter.

DESCRIPTION Very small perennial forming a densely tufted, flat cushion, with small spathulate leaves 3-5(-6) mm, sheathing the stem at the base and forming dense rosettes. Flowers on delicate protruding stalks 4-23 mm long; corolla 5-7 mm across, with a short tube constricted at the mouth, and lobes slightly notched at the tip, pink with a yellow throat. Fruit a small five-parted capsule.

For a small line drawing see (2).

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The material for this sheet was supplied by Professor E. Landolt (of the Geobotanisches Institut, ETH, Zürich), to whom the TPC is most grateful.

PRIMULACEAE

STATUS Rare. It is confined to high-altitude limestone cliffs, along c. 300 km of mountain range. It tends to occur in low numbers; for example in the principal locality of a *Ceratonia* sp. nov. (also in the Red Data Book), only 10-20 individuals of *D. mira* were found and, following detailed exploration by Munton of the mountain range where it occurs, this may be considered as a typical population. It is not eaten by goats, presumably because most of the plants are inaccessible to them; the only possible threat would be collecting of the plants for horticulture. It is said, however, to be eaten by the Arabian Tahr and is known locally as 'Shajarat al-Wa'al (Tahr Bush).

DISTRIBUTION Oman; locally distributed on the north slopes of Jabal Akhdar and J. Aswad, the latter being the small part of the mountain range between Muscat and Sūr, which lies south west of the town of Kuryaat. The species may also occur on the north of the Jabal Beni Jābir, due west of the village of Bimmah.

HABITAT AND ECOLOGY Above 1200 m on steep to vertical and overhanging, north faces of limestone rock, often growing in sheltered spots that are moist from dripping water during part of the year. No other species are associated with it.

CONSERVATION MEASURES TAKEN Some populations are in the Wadi Serin Nature Reserve, established in 1976 for the threatened Arabian Tahr *(Hemitragus jayakari)*. A detailed conservation survey of the region and of its ecology in relation to the Tahr was made during 1976 to 1978 by Munton for the Oman Government, grant-aided by IUCN/WWF.

CONSERVATION MEASURES PROPOSED None required, other than discouraging collecting now that it is in cultivation.

BIOLOGY AND POTENTIAL VALUE With its delicate yellow flowers this species is one of the floristic attractions of the region. Although difficult to grow, all *Dionysia* species are of interest to specialist growers of alpine plants. This species is also of scientific interest and has been described as the most primitive in the genus coming close to the *Floribundae* section of *Primula* (1,5). It was originally placed in *Primula*, after it was discovered by Aucher-Eloy in 1838, but was recently transferred to *Dionysia* by Wendelbo (4). It is of distributional interest being the only species of *Dionysia* to be found south of the Persian Gulf, the centre of the genus being Afghanistan and Iran. "The majority of *(Dionysia)* species appear to be restricted to very small areas, in several instances to a single mountain or locality" (1).

CULTIVATION It is being grown at the Royal Botanic Gardens, Kew, U.K.,

where it appears to flower throughout the year and has been propagated successfully from leaf cuttings. It is proving easier to grow than was expected. General details on *Dionysia* cultivation are given in (1).

DESCRIPTION Subshrub with long slender branches. Leaves mainly clustered in the lower portion, oblong-lanceolate to oblanceolate, 2.5-7.5 cm long, crenate to sharply serrate on the margin, covered by white, powdery farina on the lower surface. Inflorescence on erect stems up to 30 cm high, of 3-12 whorls each with 5-7 stalked flowers subtended by lanceolate or linear bracts; calyx narrowly bell-shaped, deeply lobed, c. 11 mm long; corolla yellow, with a slender tube 15-17 mm long and 5 spreading, oval-obovate lobes (1,5).

For illustrations see (1) and (2).

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This sheet is based upon material supplied by Dr P. Munton to whom the TPC is most grateful.

Primula di Capo Palinuro

PRIMULACEAE

STATUS Rare. Although it is confined to a relatively small length of Mediterranean coast, it mostly grows on vertical rocks near the sea and is thus at present apparently safe from tourist development. Nevertheless threats may well arise in future from the increasing recreational use of the coast for tourism.

DISTRIBUTION Italy. It is confined to scattered localities on the Tyrrhenian coast of Campania, Lucania and Calábria between Cape Palinuro and Cape Scalea. Most of the localities are in the vicinity of Cape Palinuro. There is a dot map of its exact distribution in (7). Some of the early records given in (8) are believed to be erroneous.

HABITAT AND ECOLOGY On vertical, north, north west and west-facing rocks of sandstone and limestone, always near the sea. Associated species include *Asplenium trichomanes* L., *Dianthus rupicola* Biv., *Iberis semperflorens* L., *Prasium majus* L., *Reichardia picroides* (L.) Roth and *Sedum dasyphyllum* L. The plant tends to grow on the vertical sections, whereas the larger shrubs such as *Lonicera implexa* Aiton and grasses such as *Brachypodium* grow on the ledges. Pizzolongo, who gives a detailed account of its ecology in (5) from which the above is taken, to some extent distinguishes different communities on the sandstone and on the limestone; thus he suggests that the open nature of the habitat, partly caused by landslips of the soft sandstone, is important for the survival of *Primula palinuri* which does not flower when shaded by other plants.

CONSERVATION MEASURES TAKEN Some small measure of land protection under laws concerning building (Vincolo idrogeologico) is in force on Cape Palinuro.

CONSERVATION MEASURES PROPOSED *Primula palinuri* is included in a list of species from Campania for which complete legal protection is recommended. The Nature Conservation Working Group of the Italian Botanical Society has proposed full protection for c. 175 ha of the Palinuro Promontory as a "Vincolo paesaggistico" and acquisition by the Azienda di Stato per le Foreste Demaniali (ASFD) (1).

BIOLOGY AND POTENTIAL VALUE It is presumably pollinated by the larger bees and by *Lepidoptera* (Butterflies and Moths) as are its relatives. Individuals have either long or short styles which ensures cross-pollination between them (heterostyly). It is a beautiful and fragrant species for the garden and the fragrance "together with the bright yellow corollas, almost pure white, mealy calyces, pedicel, and involucre, and the season of its blossoming (March) render it a most desirable acquisition" (2).

CULTIVATION It is in cultivation and can be raised easily from seed.

It is said to be vigorous and to increase rapidly, spreading by underground rhizomes (3). In warm and dry climates some shade is needed.

DESCRIPTION Rhizomatous perennial, with a rosette of leaves raised on a stout stem up to 7 cm high, scarred with old leaf bases. Leaves more or less obovate, about 4-16 cm long, pale green and toothed in the upper half. From the rosette emerges a leafless stem 8-20 cm high carrying an umbel of about 5-25 sweet-scented, nodding, yellow flowers. Calyx 5-8 mm long, cup-shaped, split into 5 triangular lobes and densely covered with a white, mealy deposit (as are the flower stalks and bracts) From it emerges the intense golden yellow, funnel-shaped corolla consisting of a slender tube about 12-15 mm long with a deep yellow ring inside and 5 rounded lobes at the tip. Capsule brown, more or less pear-shaped, 5-7 mm long, enclosed in the calyx.

For illustrations see (2) and (9).

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The TPC is most grateful to the Floristic Working Group of the Italian Botanical Society and in particular their Co-ordinator, Professor S. Filipello of the Institute of Botany, University of Pavia, and to Dr M. Ricciardi of the Agronomic Faculty of Portici, Naples, for help in producing this sheet.

PROTEACEAE

STATUS Endangered. This small shrub survives in two populations on the floor of a fertile mountain valley that is intensively used for vineyards, orchards and forestry plantations. One population is scattered through several square kilometres, the other occupies 2-3 ha. In both cases the species is threatened by planted trees of *Pinus pinaster* Aiton, an introduction from Europe that excludes almost all indigenous vegetation. Although the species has so far been able to survive under the pines, it is doubtful whether it could propagate itself by seed through the thick mat of pine needles. The trailing branches can, however, root at the nodes. It is likely that the populations will become progressively more depleted when the plantations are felled and replaced by fast-growing young trees.

DISTRIBUTION South Africa. The two populations are in the Fransch Hoek valley just east of Cape Town, south-western Cape Province. Until these sites had been discovered in 1976 by the Rare and Endangered Plant Species Survey based at the University of Cape Town, the species had not been seen for over 40 years. It had been exterminated at its previously known localities in the Fransch Hoek valley by residential and agricultural land-uses, and was thought to be extinct (1). Many other species in the highly species-rich Cape flora are similarly localised and prone to endangerment from quite local pressures.

HABITAT AND ECOLOGY It prefers sandy flats and nearby slopes at the bottom of a valley receiving an annual rainfall, mostly in winter, of about 100 cm. The altitude is 150-300 m. In several places the species tolerates a high water-table. It has so far been able to survive under dense plantations of *Pinus pinaster* where all other indigenous vegetation has disappeared. The former vegetation of the sites is unknown, but was probably a mixed plant community with reed-like *Restionaceae* and dispersed tall *Proteaceae*.

CONSERVATION MEASURES TAKEN The Department of Forestry, which owns the sites, has been alerted to the endangered status of the species.

CONSERVATION MEASURES PROPOSED Significant portions of both remaining populations should have the pine trees removed with care so as not to damage the plants. Invasive woody weeds from surrounding areas should be controlled so that the former plant communities can regenerate from seed laid down before the pines were planted. Observations should be made to ensure that adequate seed-set takes place and that the species can survive fire.

BIOLOGY AND POTENTIAL VALUE Nothing is known about the biology of the species. The masses of pink flowers, which turn white towards the end of the flowering time, make this low spreading shrub potentially a fine ground-cover plant.

CULTIVATION New plants form naturally by roots appearing at the nodes of prostrate branches lying on the soil. The species could also be readily propagated from cuttings and rootstocks.

DESCRIPTION Prostrate shrub with procumbent trailing branches forming a dense mat 15 cm high, up to 1 m across. Stems hairless, flushed red, with ascending, needle-like leaves 1-2.5 cm long. Flower-heads terminal, over-topped by the leaves, pink, 1-1.5 cm across, with 15-20 florets. Outer bracts lanceolate, 5-7 mm long, hairless on the outer surface; floral bracts linear to awl-shaped, 6-7 mm long (1).

For an illustration see (1).

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The material for this sheet was supplied by the Rare and Endangered Plant Species Survey based at the University of Cape Town, to whom the TPC is most grateful. Help is also gratefully acknowledged from Dr J.P. Rourke of the Kirstenbosch Botanic Garden.

PROTEACEAE

STATUS Endangered; reduced to four populations in an area of 30 sq. km, three of which consist of a few individuals each and may soon disappear. The fourth is a mature stand 2.5 m high, covering c. 4 ha, mostly surrounded, like the other populations, by ploughed land and invasive thickets of *Acacia saligna* (Labill.) Wendl. Most of this population is on private land. Outliers consisting of a few plants from the main population are present on an adjacent Provincial Nature Reserve, established in 1972 for the endangered Geometric Tortoise *Testudo geometrica*. It is doubtful whether these outliers would carry sufficient genetic diversity to perpetuate the species which is dioecious (i.e. with male and female flowers on separate plants), so that small populations are particularly vulnerable to a lack of pollinators.

DISTRIBUTION South Africa. Confined to four of the relict patches of natural vegetation in the intensively cultivated farmland between Cape Town and Paarl, south-western Cape Province. Herbarium records show that the species was formerly relatively frequent over an area of c. 300 sq. km "where the divisions of Bellville, Paarl, Malmesbury and Stellenbosch adjoin each other" (1), and that it has been depleted by the destruction of its habitat for agriculture.

HABITAT AND ECOLOGY The associated vegetation is Cape Coastal Macchia with low stands of *Restionaceae*, on soils of coarse sandy loam, at 100 m altitude. The area is seasonally wet in winter; heath-like sclerophyllous vegetation occurs on the better-drained, surrounding land.

The conversion of natural vegetation into agricultural land has led to many of its associated species becoming rare and endangered, examples of which are *Cliffortia acockii* Weimark, *Restio duthieae* Pillans, *Tritoniopsis elongata* (L.Bolus) G.J.Lewis and *Watsonia strictiflora* Ker-Gawl.

CONSERVATION MEASURES TAKEN It is protected under Provincial Nature Conservation Ordinance No. 19 of 1974. The present owner of the land carrying the large population next to the Geometric Tortoise Reserve has a co-operative attitude towards management of the area and follows advice from the Provincial Department of Nature and Environmental Conservation.

CONSERVATION MEASURES PROPOSED Full conservation management needs to be applied to the site carrying the largest population, just as it is in the adjoining Geometric Tortoise Reserve. Nearby invading thickets of *Acacia saligna* should be carefully removed and a buffer zone established to reduce the impact of pressures from surrounding land-uses.

BIOLOGY AND POTENTIAL VALUE As a tall slender shrub with silvery leaves, it is a potential horticultural species. In the wild, "it flowers in September and October and is apparently pollinated by insects. Fruits ripen in February. Relatively few seeds are produced and these soon fall to the ground. Regeneration from seed may take place after fires" (1).

CULTIVATION Seed would probably be the most suitable means of propagation. Experience at Kirstenbosch Botanic Garden suggests that it is short-lived in cultivation, surviving for only 6-8 years.

DESCRIPTION Erect slender shrub up to 2 m tall, developing from a single stem. Leaves silvery-silky, narrowly oblanceolate, narrowing evenly to the base, up to 2.5 cm long by 4.5 mm broad, smaller on male plants. Flower-heads small, borne among the leaves at the ends of the branches. Male flower-heads hemispherical, 7 mm long, 11 mm in diameter, with c. 6 linear basal bracts 3-4 mm long and minute floral bracts. Female flower-heads similar but smaller (8 mm across) with up to 12 florets towards the apex; basal bracts c. 10, 5 mm long (1).

There is an unpublished drawing by Guthrie of her 121, labelled as *L. cinereum* R.Br., at the Bolus Herbarium, University of Cape Town.

REFERENCE 1. Williams, I.J.M. (1972). A revision of the genus *Leucadendron (Proteaceae)*. Contr. Bolus Herb. No. 3: 137-140, fig. 14 & 15.

The material for this sheet was supplied by the Rare and Endangered Plant Species Survey based at the University of Cape Town, to whom the TPC is most grateful. Help is also gratefully acknowledged from Dr J.P. Rourke of Kirstenbosch Botanic Garden.

Marsh Rose

PROTEACEAE

STATUS Vulnerable. Although rescue measures have increased the size of populations over the last 10 years, the species is still partly under threat. In 1968, an estimated 90 plants remained and the species was in imminent danger of extinction (6), partly due to picking of the beautiful flower-heads. With stimulation of dormant seed by burning the vegetation, and the discovery after intensive searching of other small colonies, the total in 1977 was estimated to be slightly more than 1940 plants. The populations are now carefully protected. Present threats are poor pollination and seed set; damage by the fungi *Phytophthora cinnamomi* and *Pythium* sp. which may have been brought to some populations on footwear and equipment (7); and injury by the indigenous Saunders's Vlei Rat *(Otomys saundersi,* Muridae). Although fire has proved vital in restoring the populations, the species could be severely endangered by accidental fires coming too soon after the controlled burns to allow enough seed to be set. A large dam and pipelines are to be constructed near the main populations, increasing the threat of interference by factors such as infestation by easily-spread invasive Australian Wattles and Hakeas, and direct damage by man.

DISTRIBUTION South Africa. It exists as 9 populations and a few minor groups of plants in the Kogelberg Mountains in south-western Cape Province, and also in an outlying population near Hermanus 25 km to the east.

HABITAT AND ECOLOGY It grows mostly on steep south-facing slopes at 500-850 m, generally but not always receiving moisture from mists during the otherwise dry summers. The soils are sandy and very acid, with a high peat content and continually percolating subsurface water.

CONSERVATION MEASURES TAKEN The State Forestry Department and the Botanical Research Institute have co-operated in an intensive study, rescue and management operation in the Kogelberg Mountains, which have been declared a Nature Reserve with strictly controlled access. Visits to the localities have been further limited since the discovery of fungus attacks. Steps were taken to reduce the number of Saunders's Vlei Rat. The Hermanus population is in a 20 ha reserve of the Cape Provincial Department of Nature and Environmental Conservation, whose staff have been studying the biology and cultivation of the species (6,7); seed has been sown on suitable sites in two adjoining nature reserves and this is beginning to germinate. Management details for the Kogelberg reserve are given in (2) and for the Hermanus reserve in (6). The plant is fully protected by law, consolidated by Ordinance No. 19 of 1974 (Chapter VII, Schedule 3) (7).

CONSERVATION MEASURES PROPOSED Strict attention must be given to avoiding infestation by Australian *Acacia* and *Hakea* and other pressures, when the large dam is built near the main populations of the species in the Kogelberg Mountains. Studies need to be made of how to ensure effective pollination in the wild and therefore effective seed set, as well as of the use of controlled burning at extended intervals to ensure regeneration.

BIOLOGY AND POTENTAL VALUE It has been described as "the loveliest of all the proteas" (6). The shining, rose-like red bracts of the flower-heads are extremely decorative and early drew the destructive attentions of flower-pickers for Cape Town markets (2). *Orothamnus* is a monotypic genus and is of scientific value (6). Flowering occurs throughout the year but chiefly from March to November. Germination can take place from seed which has been in the soil for as long as 19 years.

CULTIVATION It is in cultivation, but in view of the longevity of its seeds, storage in a seed bank is also desirable. Shoots can be successfully grafted on to *Leucospermum conocarpodendron* (L.) Buek, a common and widespread member of the *Proteaceae*. Details of propagation from cuttings are given in (7). Branching in plants grown at the Cape can be induced by removing the apical bud in February or June.

DESCRIPTION Single-stemmed or sparingly branched shrub 1-4 m tall. Leaves crowded, 3-6 cm long, elliptic, leathery, hairy especially along the margins. Flower-heads nodding, 1-3 at the branch tips, 5-7 cm long, with rose-red, hairy and shining bracts 4-6 cm long, enclosing the lemon-yellow flowers. Fruit oblong, c. 6 mm (4,5).

For illustrations see (2), (3) & (5)-(7).

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PROTEACEAE

STATUS Endangered. It has become severely depleted and is now reduced to three small relict populations, each with less than 200 plants and of about 2-20 hectares in extent. All three are in immediate danger from the spread of housing and the destruction of their habitat by invasive *Acacia saligna* (Labill.) Wendl., *A. pycnantha* Benth. and *A. cyclops* Cunn., introduced from Australia for sand-binding and tannin production. Both the invasion by these species and the destruction of natural vegetation have been aided by over-frequent fires.

DISTRIBUTION South Africa. It occurs in three places on the flats linking the Cape Peninsula to the mainland. It was formerly widespread on this sandy plain but has been depleted by urban growth and the spread of invasive Acacias. The Cape Province, excluding the eastern section, has 1459 species listed as rare or threatened; many of these lie at lower altitudes where the pressures of agriculture, forestry, urban expansion and invasive plants have been heaviest. Large numbers of very local endemics exist in the mountains, where fires and the introduction of *Pinus pinaster* Aiton from the Mediterranean and *Acacia, Hakea* and *Leptospermum* from Australia give great cause for concern.

HABITAT AND ECOLOGY The associated vegetation consists of Cape Coastal Macchia growing on deep white sands in areas with an annual rainfall of about 600 mm. The rain falls mostly in winter and flowering takes place in the austral spring months of September and October. Regeneration after fire is by seed.

CONSERVATION MEASURES TAKEN It is protected under Provincial Nature Conservation Ordinance No. 19 of 1974.

CONSERVATION MEASURES PROPOSED The three sites together with buffer zones should be fenced off and protected. The invasive Acacias should be carefully removed periodically as new seedlings appear; there is evidence to suggest that some of their seed may remain viable for up to 160 years. Observations should be made to ensure that seed set of *Serruria* is adequate for surviving the fires that should be planned at extended intervals for renewing all elements in the ecosystem.

BIOLOGY AND POTENTIAL VALUE Due to its extreme rarity the biology of the species in unknown. One of the populations appears to be a more robust form once recognised as var. *congesta* Hutch. Present evidence suggests that it might not be possible to uphold this as a separate variety. The species has small pink and white flowers and a delicate growth-form that make it attractive for horticulture.

CULTIVATION Plants were recently brought into cultivation at the Kirstenbosch Botanic Garden.

DESCRIPTION Small erect spreading shrub up to 60 cm high with slender, usually trifoliate leaves 1-3 cm long, the segments linear and sharply pointed. Flower-heads solitary, terminal, 10-14 mm long, with numerous flowers; outer bracts 6-8 mm long, narrowly lanceolate, pointed, with long hairs; floral bracts 5-9 mm long, similar (2).

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PROTEACEAE

STATUS Endangered. It is restricted to 2 isolated patches of natural vegetation. At one site there are nearly 3000 individuals, in 25 ha, but at the other, on 35 ha, the population is smaller since the vegetation has been badly overgrazed and trampled. Both sites are relicts from an area of natural vegetation that covered c. 1000 ha in 1955, the reduction being caused by extension of farmlands. The remaining two populations could be destroyed by ploughing at any time, so that the survival of the species depends on the co-operation and goodwill of the owners of the land. Both sites are partly surrounded by ploughed and brush-cut land, and are bordered along one side by a dense infestation of *Acacia saligna* (Labill.) Wendl. Aided by uncontrolled fires, this invasive species could spread and destroy the remaining habitats.

DISTRIBUTION South Africa. Numerous past records show it was restricted to the lowlands north of Wellington in south-western Cape Province, where it was last seen in the 1850s. It had not been found for nearly 100 years and was feared to be extinct until the present populations were found in 1976, north-west of Wellington, during an intensive survey of endangered species.

The Cape flora is one of the richest in endemic species of any flora and one of the most threatened. It is now reduced to islands of vegetation over an area of c. 18,000 sq. km, but still contains c. 6000 species in the Fynbos vegetation alone. In south-western Cape Province, 1459 species are listed as rare and threatened, due to destruction of the habitat by man and invasive introduced woody plants, in particular *Pinus pinaster* Aiton from the Mediterranean and *Acacia, Hakea* and *Leptospermum* which are now estimated to infest 24% of the region.

HABITAT AND ECOLOGY It grows at c. 100 m in Cape Coastal Macchia, on deep, white, sandy soils. It is found in dry places dominated by *Phylica stipularis* L. and *Thamnochortus* spp., extending to wetter seepage zones with *Berzelia abrotanoides* Brongn. The rainfall in the area is 400-500 mm per annum, mostly in winter. It regenerates from seed after fire.

CONSERVATION MEASURES TAKEN None.

CONSERVATION MEASURES PROPOSED Both populations should be fenced and observations made to confirm that seed set is adequate to survive uncontrolled fires. Block-burning should be carried out on a planned basis to ensure the survival of all elements in the ecosystem. Invasive *Acacia saligna* should be removed, and buffer zones established to absorb impacts such as fresh encroachments or damage to pollinators by insecticides.

BIOLOGY AND POTENTIAL VALUE It is an attractive member of the genus *Serruria*, many species of which have been heavily depleted on the coastal plains of south-western Cape Province. In the wild it flowers from September to November.

DESCRIPTION Small delicate shrub with erect stems up to 50 cm high. Leaves 1-2 cm long, bipinnately divided in the upper half into thread-like, pointed segments. Flower-heads mainly in dense clusters at the top of the stems, each many-flowered and rich salmon-pink in colour. Floral bracts 6-8 mm long, narrowly ovate, pointed, hairy in the lower part (1).

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The material for this sheet was supplied by the Rare and Endangered Plant Species Survey based at the University of Cape Town, to whom the TPC is most grateful.

Rihane, Dihane (local names)

PUNICACEAE

STATUS Endangered due to excessive grazing by goats and cattle. In 1967 only four ancient, widely separated trees were seen, with no regeneration. It is clear that this species has been declining fast and when the four trees die, it will probably become extinct in the wild.

DISTRIBUTION Socotra (an Island Territory of the People's Democratic Republic of Yemen, lying 225 km east of the Horn of Africa). In 1880, the *Punica* was found to be a common tree on the higher parts of the granitic Hajhir mountains, growing in abundance over the limestone plateau sloping southwards from the Hajhir peaks (1). More recently, in 1953, it was recorded as a main constituent of the thickets on the limestone slopes in the north east of the island (2).

The flora of Socotra is critically threatened; out of 216 flowering plants endemic to Socotra and the neighbouring island of Abd al Kuri, 132 are believed to be rare or threatened, 85 of them are in immediate danger of extinction (Endangered). This drastic situation is the result of grazing by excessive numbers of introduced livestock on an island flora which has presumably evolved partly in the absence of large mammals, unlike the flora of the African mainland.

HABITAT AND ECOLOGY The four remaining trees were found only on limestone slopes or on open and exposed areas of limestone plateau with scrub of *Croton socotranus* Balf.f.

CONSERVATION MEASURES TAKEN None for the wild trees.

CONSERVATION MEASURES PROPOSED One or more reserves protected from grazing should be established to save this and other threatened endemics of Socotra.

BIOLOGY AND POTENTIAL VALUE It is closely related to the cultivated pomegranate *P. granatum* L., but has a single row of carpels in the fruit. Near relatives of crop plants are a genetic resource of major importance as they can often be used to introduce factors such as disease resistance into the cultivars. The fruits are relished by the local Bedu.

CULTIVATION It is now in cultivation at the Royal Botanic Gardens, Kew, U.K. Stock is being increased and plants are being sent to other botanic gardens. Cuttings root fairly easily when treated with hormone. Very little fibrous root seems to be formed and so damage to the roots during transplanting has to be avoided.

DESCRIPTION Tree up to 5 m high with elliptic to rounded leaves

2-8 cm, slightly leathery and often with a small indentation at the tip, arranged in clusters or in opposite pairs up the stem; flowers in small axillary clusters, each with a tubular calyx, the tip 5- to 7-lobed, a bright red corolla spreading above the calyx tube and many stamens; fruits reddish and nearly spherical, about 25 mm across and of 5-7 chambers containing fleshy-coated seeds.

"In general habit it is not unlike the pomegranate, but its leaves are larger and coarser ... The flowers are somewhat smaller, and their turbinate (top-shaped) base is more angular. The fruit is much less in size" (1).

For an illustration see (1).

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This sheet is based upon information provided by Mr A. Radcliffe-Smith (of the Royal Botanic Gardens, Kew, U.K.), to whom the TPC is most grateful.

RAFFLESIACEAE

STATUS Vulnerable, possibly Endangered; a most spectacular plant under threat partly from destruction and disturbance of its rain-forest habitat and partly from the attention it attracts: it is prey to being collected for medicine and for novelty, and many field botanists have been unable to resist collecting the spectacular flower, even from areas where it has been collected before. As a parasite, its status is particularly hazardous being dependent on the distribution of, and its interactions with, the host liane; it is believed to be declining in several and extinct in one of the nature reserves created for it. Kuijt remarks: "*Rafflesia*, especially *R. arnoldii*, is the prima donna, not just of its family but of all parasitic plants ... It is safe to predict that botanists will continue to make pilgrimages into the jungles of Sumatra to gaze upon this extraordinary creation of the plant kingdom" (5).

DISTRIBUTION Indonesia; Sumatra. Since the taxonomy of the genus is difficult and little understood, it is not known which of the *Rafflesia* localities in Sumatra contain this species; this includes the most famous and accessible *Rafflesia* population at Batang Palupuh; records for Aceh, including the Gunung Leuser Reserve, apparently refer to another species, possibly *R. hasseltii* Sur.

R. arnoldii was discovered by Dr Joseph Arnold and Sir Thomas Stamford Raffles in 1818; Arnold died shortly afterwards and is commemorated in the species name.

HABITAT AND ECOLOGY Parasitic on species of the climbing Vitaceous genus *Tetrastigma*, it is found in Hill Mixed Dipterocarp Forest on moist valley bottoms or on steep but moist slopes, generally between 500 and 1000 m. There is some suggestion that the host may prefer old clearings such as may be formed by fallen trees, landslips or possibly even old ladangs (units of shifting cultivation). The related *Rhizanthes lowii* (Becc.) Harms can sometimes be found growing nearby and the remarkable giant Aroid *Amorphophallus titanum* Becc. is also frequent in this habitat.

CONSERVATION MEASURES TAKEN It is believed to occur in the following reserves: Sungai Jernih, Batang Palupuh (or a related species, see above), Rafflesia Bengkulu, Rafflesia Despetah I/II and Cawang I/II.

CONSERVATION MEASURES PROPOSED An extended, intensive field study of its distribution and natural history, in particular to gather information on the morphology, phenology and interactions with the host, so as to find out how best this and other *Rafflesia* species can be conserved, both within and outside existing reserves. Such a study

would be of great value in ascertaining how conservation of individual tropical plant species may be fitted into programmes of ecosystem conservation. *Rafflesia* is bound to attract public attention and in this way could be of immense educational potential for conservation. A formal outline for this most important project was submitted to IUCN/WWF in 1976 and is awaiting funding.

BIOLOGY AND POTENTIAL VALUE Remarkably little is known of its biology; even its life cycle has still not been elucidated in detail. It is apparently dioecious. The flowers smell of tainted beef and attract large numbers of flies (1). Few flowers seem to develop into fruits. The seeds are very small but the mode of transport from fruit to host and infestation of the host through the bark is unknown. It has been suggested that the seed may only be able to penetrate the host when the bark has been damaged and that trampling by large mammals such as elephant, tapir and rhinoceros may be responsible.

Not only is *Rafflesia arnoldii* the largest flower in the world but it is morphologically quite extraordinary; the plant in the vegetative state consists of thread-like structures within the host tissue, reminiscent of a parasitic fungus. Apparently flowers build up by development within this conglomeration of threads, before bursting through the bark of the host, which is stimulated to produce a cup-like swelling on which the flower is borne, usually at ground level but rarely up to 2 m above the ground. "The performance and dimensions (of the resulting flower) ... are so spectacular that the onlooker cannot fail to be impressed" (5).

DESCRIPTION Parasitic flowering plant, the vegetative parts reduced to colourless threads. Open flowers up to 1 m or more in diameter, the base surrounded by scales; flowers basin-shaped, surrounded by 5 rounded, imbricate, extremely fleshy perianth lobes, dull liver-brown with paler wart-like spots, each lobe with a large diaphram near its base on the inside.

For illustrations see (1), (5) and (6).

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The material for this sheet was supplied by Dr J. Dransfield to whom the TPC is most grateful.

Northern Wild Monkshood

RANUNCULACEAE

STATUS Vulnerable; considered as threatened throughout its range primarily due to the potential destruction of its habitat. The proposed construction of the La Farge Dam could destroy 25% of its population in Wisconsin during flood conditions; at best, 3 of the 9 known sites in that state would be submerged at normal water levels if the dam were completed (6,7). The one extant colony in New York is close to a road and so readily accessible to collectors; in addition it would be threatened by any future road widening. In Ohio, construction surrounding an urban park threatens the only colony in the state, and in Iowa, one colony, situated on farmland, is threatened by grazing (7). This Monkshood is very local and as such especially vulnerable (4,7). Formerly found in 27 localities, now only 14 remain and only 4 of these are in protected areas (7).

DISTRIBUTION U.S.A. The species occurs north of the glacial boundary in New York, in eastern Ohio, in northeastern Iowa (4) and in or near the Driftless Area of southwestern Wisconsin. The vast Driftless Area is one that has never been covered by glacial ice, although all surrounding lands have been glaciated at different times (1). The disjunct distribution of this species is probably due to the loss of connecting localities from ice movements (7).

The following populations are known: in New York, one colony, in 1975 of only 150 individuals, along a c. 4 km sandstone cliff ledge in Ulster County; in Ohio, one of c. 480 individuals in Summit County, near Stow; in Iowa, one of at least 50 in Allamakee County, one of c. 50 in Clayton County, and one of at least 700 in Jackson County; and in Wisconsin, one in Richland County with only 20 individuals in 1974, populations of 100-150 (Parfrey's Glen) and c. 70 (Lodde's Mill Bluff) in Sauk County, and c. 1365 individuals at 6 localities in the Kickapoo valley, Vernon County (5,7).

HABITAT AND ECOLOGY Generally confined to species-rich woods (4) and moist soil pockets at the bottom of shaded cliffs or steep talus slopes. In Wisconsin, Ohio and New York the cliffs are usually sandstone; in Iowa they are sometimes limestone. The exposure is usually north or east and the plants are therefore shaded most of the day (7). Additional shading, important in preventing excessive evaporation from the cliffs, is provided by surrounding vegetation. Not usually a species of many associates, it may be found in the Kickapoo Valley with nettle, *Laportea canadensis* (L.) Wedd.; clearweed, *Pilea pumila* (L.) A.Gray; bulblet fern, *Cystopteris bulbifera* (L.) Bernh.; and moschatel, *Adoxa moschatellina* L.

CONSERVATION MEASURES TAKEN In Wisconsin, it is protected in 3 of the 4 sites not threatened by the completion of the Dam. One is in

Parfrey's Glen (8) and one in Lodde's Mill Bluff, both scientific research areas; the other is in Wildcat Mountain State Park, Vernon County (6,7). The one site in Clayton County, Iowa, is in Bixby State Park and is also protected. In all, c. 475 individuals are covered in these areas (7). *Aconitum noveboracense* has been determined to be 'Threatened' under the Endangered Species Act of 1973 (7). The Act directs that no federally funded activity shall jeopardise the existence of species once officially determined as 'Endangered' or 'Threatened', as defined by the Act.

CONSERVATION MEASURES PROPOSED Although federally protected, the creation of more state conservation programmes would help ensure the survival of this species.

BIOLOGY AND POTENTIAL VALUE The blue flowers, appearing from June to November in different parts of its range, are showy and attractive.

DESCRIPTION Erect perennial herb, reclining or climbing, 30-250 cm, with tubers 1-8 cm long and up to 1.5 cm thick. Leaves hairless, kidney-shaped to ovate in outline, (5-) 7-lobed, the lobes very narrow and themselves deeply lobed or toothed, the lowest leaves 4-10 cm wide, the stem leaves smaller. Flowers in a terminal raceme or open panicle of lateral racemes, the stalks and inflorescence axis short-hairy. Sepals 5, petal-like, blue, the upper one (helmet) hooded and longer than the others (2,3,4).

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The material for this sheet was supplied by the Endangered Flora Project of the Smithsonian Institution, Washington, D.C., to whom the TPC is most grateful.

RANUNCULACEAE

STATUS Endangered, possibly Extinct. It is known from only one island locality and has been severely damaged by goats. When discovered in 1917, the flowers had been bitten off and are still apparently unknown to man; "not one intact specimen was seen and most of them were badly damaged, so that the existence of the species seems to be seriously threatened" (3); there appear to be no records of any finds other than its discovery in 1917. There are at present about 4000 feral goats, as well as cattle, rabbits and rats, on the island, which is only about 10 x 6 km.

DISTRIBUTION Juan Fernández Islands, South Pacific Ocean; confined to one locality north of the Casas Gorge on Isla Alejandro Selkirk (formerly Más Afuera) (3).

There are about 98 flowering plants and 17 ferns endemic to Juan Fernández and the majority are undoubtedly threatened, due to destruction of the forests by introduced sheep, cattle, horses, goats, rabbits, rats and the even more intractable problem on Isla Robinson Crusoe of vigorous and invasive introduced plants such as *Aristotelia*, which is now very common below 200 m, and *Rubus*, reported as an aggressive coloniser in the vegetation. The flora is of great interest for its most unusual evolutionary development, resulting in gigantism in many species, especially in the cabbage trees of the *Compositae* (2).

HABITAT AND ECOLOGY Precipice of igneous rock, at 1200-1300 m, growing beside a goat track (3).

CONSERVATION MEASURES TAKEN The Parque Nacional Juan Fernández was declared in 1935, but introduced grazing animals are still continuing to degrade the vegetation and flora. It is planned to reduce the numbers of goats and eliminate the cattle on Isla Alejandro Selkirk (G. Mann, pers. comm.).

CONSERVATION MEASURES PROPOSED In addition to drastic reduction and if possible removal of the cattle and goats, further investigation of the plant's local distribution is urgently needed, so that any remaining individuals can be adequately protected.

BIOLOGY AND POTENTIAL VALUE The endemics of Juan Fernández are important to studies of plant geography and evolution (see under Distribution, above); this species is related to *R. lyallii* Hook.f., *R. haastii* Hook.f. of New Zealand and *R. hawaiensis* A.Gray (3).

DESCRIPTION Erect shaggy herb with stems up to 75 cm high and a short rhizome which has a rosette of hairy, rounded cordate leaves 9-23 cm across, deeply cut into 3-5 toothed lobes and borne on long, shaggy

stalks up to 20 cm long. Flowers unknown, but fruits hard and one-seeded, flattened and triangular, 6-7 mm long, several attached to each of the slightly hairy flower receptacles.

For an illustration see (3).

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The TPC is most grateful to Mr G. Mann, of the Corporación Nacional Forestal, Chile, for help in producing this sheet.

RANUNCULACEAE

STATUS Vulnerable; confined to one locality, now a fenced reserve. Accordingly its numbers have risen from only 32 individuals in 1948 to several hundred plants in 1972. Its decline before the reserve was declared was primarily due to grazing by sheep and rabbits, but also to indiscriminate collecting. Lime quarrying on adjacent land may also have destroyed some individuals. The site was on a mustering route and hence the influx of weeds, in particular species of *Poa*, *Hieracium* and *Chrysanthemum*, is a problem. The present fence surrounding the site is not hare-proof and hares have probably damaged some plants. Despite access restrictions, the scree habitat is sporadically disturbed by visitors and occasionally by stock. An additional threat is the proposed use of adjacent land for an alpine village. Nevertheless, as Kelly remarks, "the perpetuation of the *Ranunculus* is a small but significant triumph in conservation", especially in view of the myriad threats described above and the critical status of the plant in the 1940s (6).

DISTRIBUTION New Zealand. The single locality is in Malvern County, Canterbury, South Island.

HABITAT AND ECOLOGY The locality is a small basin at c. 600 m, surrounded by limestone cliffs and tors. The plant grows on slight to moderate slopes of semi-stable limestone debris, virtually bare of other vegetation. It apparently reproduces well in the absence of disturbance or competition.

The locality is described in great detail in (3) & (8) and many species are listed for the surrounding area; Burrows in (3) stresses the botanical importance of the locality, especially since 3 other plants are endemic there - *Wahlenbergia brockiei* J.A.Hay, *Myosotis colensoi* (T.Kirk) J.F.Macbride and *Myosotis traversei* Hook.f. var. *cinerascens* (Petrie) L.B.Moore.

CONSERVATION MEASURES TAKEN The locality was declared a Flora and Fauna Reserve in 1954 by the New Zealand Department of Lands and Survey. The area was fenced to keep out grazing animals and public access is restricted. There are periodic checks of the fences and monitoring of the plant population. The reserve has been periodically weeded, the plants divided and seed scattered to help regeneration. The reserve is fully described in (6) where details of its history and management are to be found.

CONSERVATION MEASURES PROPOSED As recommended by Given and Burrows:- Continuation of the present management, including weeding and monitoring. "Requests for specimens and seed must be strictly refereed. Should

a village be established nearby, pressure on and use of the reserve will increase and consideration should be given to (a) a buffer zone, (b) putting in boardwalks for access, (c) limiting the size of groups allowed in the reserve, (d) planting in the scree outside the reserve" (5).

BIOLOGY AND POTENTIAL VALUE Although the plant is extremely local in its distribution, it is a well known alpine buttercup of outstanding appearance. Subspecies *crithmifolius* occurs on nearby mountains, but is restricted to greywacke screes.

DESCRIPTION Small fleshy perennial herb 5-10 cm high with a short stout rhizome. Leaves in a spreading basal rosette, greyish-brown, 5-10 cm long, typically with 3 overlapping lobes and the margins sharply or finely toothed. Flowers bright yellow, 3-5 cm across, solitary on short stems 1-2 cm; sepals 5, linear-oblong; petals 5-6, rarely more, slender, nearly twice as long as the sepals. Achenes 12-20, rounded, 3 mm across, forming a small spherical head 8-15 mm across which is pushed downwards into the soil by the elongating stalk. (Syn. *R. paucifolius* T.Kirk) (4).

For illustrations see (2), (4) and (8).

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This sheet has been compiled from the account in (5) of *Ranunculus crithmifolius* ssp. *paucifolius* by Dr D.R. Given & C.J. Burrows, to whom the TPC is most grateful.

RANUNCULACEAE

STATUS Vulnerable. Although it occurs in several national parks, it is heavily grazed by introduced herbivores, in particular Chamois (*Rupicapra rupicapra*) and possibly Himalayan tahr (*Hemitragus jemlahicus*), which are both frequent in Mount Cook and Westland National Parks. In recent years Wilson (3) could not find it at one locality where Wall found it to be common in 1925 and Fisher had noted it as rare in 1951. Populations are numerous, but generally consist of only about 10-50 individuals. The largest is believed to be where the species provides a discontinuous cover over c. 0.5 ha. Collecting of plants and seed for horticulture could be an additional threat in the future.

DISTRIBUTION New Zealand; higher ranges of the central region of the Southern Alps, adjacent to the main divide from Mount Hunt south to the Sealy Range, west to north west of Christchurch. It occurs over about 160 km (2). In the past it was presumably more widespread within this area.

HABITAT AND ECOLOGY With only rare exceptions this species is restricted to morainic or rubble sites. It is most frequent on exposed patches of loose stones, less often growing on firmer rock or rooted in crevices. It rarely occurs on ridge crests. Although it occurs from c. 1200 to 2100 m (4), it is almost invariably found in places where the roots are saturated with abundant icy melt-water from adjacent fields of snow and semi-permanent ice. It is reported as seeding abundantly in the wild.

CONSERVATION MEASURES TAKEN It occurs in the National Parks of Westland (91,804 ha), Mount Cook (70,002 ha) and Arthur's Pass (98,371 ha). Elsewhere it grows on Forest Service lands and unoccupied Crown lands.

CONSERVATION MEASURES PROPOSED As recommended by Given & Wilson:- "Monitoring of known sites is essential, particularly where there are moderate numbers of plants ... Further exploration for new sites should be encouraged and data on browsing by noxious animals must be sought" (3).

BIOLOGY AND POTENTIAL VALUE An attractive species with large leaves and buttercup flowers, this *Ranunculus* has considerable potential for horticulture; it was originally described by Hooker as "a noble plant" (4).

CULTIVATION It is in cultivation.

DESCRIPTION Very stout hairless tufted herb up to 60 cm tall with the stem c. 2.5 cm thick at the base. Leaves all basal, on stout stalks up to 16 x 3 cm; leaf blades 6-18 cm long, broadly oblong to rounded,

coarsely or doubly crenate. Flowers on stout branching scapes up to 15 cm high, with 1-4 oblong bracts up to c. 5 cm long. Flowers 2-5 cm across, with 5 sepals c. 1 cm long, 5-6(-9) golden yellow petals c. 1.5 cm long. Fruiting heads with numerous achenes c. 2 mm long (1).

For an illustration see (2).

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This sheet has been compiled from the account in (3) of *Ranunculus godleyanus* by Dr D.R. Given & H.W. Wilson, to whom the TPC is most grateful.

RESTIONACEAE

STATUS Endangered; known from four populations in patches of natural vegetation remaining after urban and agricultural development. Two are in areas designated for the construction of new towns. In each population the area covered is less than about two hectares and the scattered clumps of individuals together make up several hundred plants at each site. The extension of farmlands and urban development could bring this species to extinction within a few years. All four populations are partially infested with *Acacia saligna* (Labill.) Wendl.

DISTRIBUTION South Africa. The localities extend from the northern suburbs of Cape Town through heavily farmed areas to near Mamre, a distance of 45 km. A full search for other populations in relict vegetation patches in this area has proved unsuccessful. The localities lie in the major wheat-growing belt of South Africa.

The Cape flora is one of the richest in endemic species of any flora and one of the most threatened. It is now reduced to islands of vegetation over an area of c. 18,000 sq. km, but still contains c. 6000 species in the Fynbos vegetation alone. In south-western Cape Province, 1459 species are listed as rare and threatened due to destruction of the habitat by man and invasive introduced woody plants, in particular *Pinus pinaster* Aiton from the Mediterranean and *Acacia, Hakea* and *Leptospermum* which are now estimated to infest 24% of the region.

HABITAT AND ECOLOGY The associated vegetation consists of reed-like members of the *Restionaceae* 0.7-1 m tall with *Proteaceae* and members of the endemic Cape family *Bruniaceae*. It grows on poorly drained, nearly level sands overlying clays that allow a build up of water at the surface during the rainy winter months. Further details of the habitat are given in (1).

The annual rainfall is 450-550 mm and the altitude 100-300 m. *Restio acockii* Pillans, another highly endangered species that had also been presumed extinct and is in the Red Data Book, grows in close proximity to *Chondropetalum acockii*.

CONSERVATION MEASURES TAKEN None for the wild populations.

CONSERVATION MEASURES PROPOSED One population grows in a small part of a large unploughed, privately owned field of several hundred hectares, together with 21 other species that are in various degrees of endangerment. The area should if possible be purchased and brought under conservation management, with fire control to reduce the rate of spread of *Acacia saligna* from seed, all plants of which should be removed as soon as they appear. This must be done on a regular basis as this invasive species lays down up to 14,000 seeds per square metre

(S.J.Milton, pers. comm.), some of which are viable for up to about 160 years. A belt of *Acacia saligna* lies less than 100 m from the population at this site and should be removed. An effort should be made to conserve at least one of the other populations, all of which are also heavily threatened by growth of *Acacia saligna*.

BIOLOGY AND POTENTIAL VALUE Within their restricted areas the populations appear to be vigorous. Flowers appear in April to May and fruits in August to September. The plants have very attractive dark brown flower-heads which contrast with the lighter coloured stems and bracts, making them potentially valuable for decorative purposes and for the dried-flower industry.

CULTIVATION In 1975 several individuals were removed from one site for growing and propagating at the National Botanic Gardens, Kirstenbosch.

DESCRIPTION Reed growing in clumps with creeping rhizomes and very slender erect unbranched stems c. 70 cm high. Male inflorescence a crowded panicle 5-10 cm long, with small, light coloured bracts; spikelets c. 3 mm, compact, about 6-flowered, chestnut-brown. Female inflorescence similar, but smaller (2).

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The material for this sheet was supplied by the Rare and Endangered Plant Species Survey based at the University of Cape Town, to whom the TPC is most grateful.

RESTIONACEAE

STATUS Endangered. This species was thought to be extinct for over forty years. A recent programme of careful searches in likely areas away from its only known locality (where it had been exterminated) revealed a small, highly endangered population in an isolated patch of wild vegetation, in the wheatlands lying 45 km to the north. The population consisted then of several thousand clumped individuals in an area of about 6 ha. However, a recent hot summer fire has destroyed most of this population. The previous fire had taken place about six years before; it is believed that at least several years must elapse before the seed store in the soil can be adequately renewed. The rhizomes normally survive less intense fires and rapidly regenerate.

Thickets of invasive introduced *Acacia saligna* (Labill.) Wendl. lie within 100 m of the population and could spread and destroy the habitat in 15-20 years. Land had been ploughed in strips up to the edge of the population and ploughing has started at another place nearby, although crop production at the site would at present be hindered by marshy conditions. Ploughing of the site itself would clearly make the species extinct. In addition, a new town is zoned for construction about 1500 m away; this could bring further pressures such as drainage of the marshy soil and increased accidental fires, together with land-uses destructive to the vegetation.

DISTRIBUTION South Africa. The locality is on the heavily farmed plains about 50 km north of Cape Town. The vegetation in a former locality nearer Cape Town has been replaced by suburban housing. The *Restionaceae* are a major element in Cape flora, which is one of the richest in endemic species of any flora and one of the most endangered. It is now reduced to islands of vegetation with a combined area of c. 18,000 sq. km, but still contains about c. 6000 species in the Cape Macchia alone. In an area of the Cape Province excluding the eastern section, 1459 species of plants are listed as rare and threatened, due to the destruction of habitats by man and invasive woody plants, imported for practical uses from other countries.

HABITAT AND ECOLOGY It appears to be restricted to low-lying marshy areas on sandy flats with a clay subsoil that impedes drainage and causes a build-up of surface moisture during the rainy winter months. During the dry summer, the soil remains moist at the surface. The plant grows in restionaceous reed vegetation often associated with *Restio micans* Nees, *R. quinquefarius* Nees, *Elegia parviflora* Kunth, *E. prominens* Pillans and *Diosma dichotoma* Bergius. Also in the locality are *Chondropetalum acockii* Pillans, another Endangered species (also in the Red Data Book) and twenty other taxa under threat, all in an area of about 750 ha. The site is surrounded by farmland, by extensive areas infested with *Acacia saligna*, and a new urban and industrial centre is situated nearby.

CONSERVATION MEASURES TAKEN Protected under Nature Conservation Ordinance No. 19 of 1974.

CONSERVATION MEASURES PROPOSED The area containing the 22 Endangered plants should if possible be purchased and brought under conservation management, with fire control to reduce the rate of spread of the *Acacia saligna* from seed, all plants of which should be removed as soon as they appear. The local town zoning of the area should be altered to that of a nature reserve. Buffer zones need to be established on adjoining lands. Seeds should be collected for storage in a seed bank.

BIOLOGY AND POTENTIAL VALUE Unknown at present. The species is so rare that it has not been studied for its potential value.

CULTIVATION It is not known in cultivation at present. It could probably be propagated by seed or by cuttings.

DESCRIPTION Erect reed with numerous, very slender stems c. 1 m high, simple or sparingly branched. Male inflorescence 1.5-2 cm long by c. 2 mm wide, cylindric, pointed at both ends, with pale brown bracts; female inflorescence similar (1). The very compressed stems distinguish this species from others with similar spikelets or flowers.

REFERENCE 1. Pillans, N.S. (1942). New Species of South African *Restionaceae*. Trans. R. Soc. S. Afr. 29: 339-340.

The material for this sheet was supplied by the Rare and Endangered Plant Species Survey based at the University of Cape Town, to whom the TPC is most grateful.

Graves's Beach Plum

ROSACEAE

STATUS Endangered. It has been found only at the *locus classicus* where the single stand of 10 x 10 m probably represents one individual (1). The plant is in a moderately disturbed area crossed by footpaths and adjacent to a beach heavily used for urban recreation.

DISTRIBUTION U.S.A. The only known locality is on the north side of Long Island Sound, near Groton in New London County, Connecticut.

HABITAT AND ECOLOGY It is restricted to coastal shrub thickets on well-drained gravelly sands, in association with *Corylus americana* Walter, *Lonicera japonica* Thunb., *Prunus* and *Rubus allegheniensis* T.C.Porter.

CONSERVATION MEASURES TAKEN In 1975 a snow fence was erected enclosing the entire stand as well as a large buffer zone around the perimeter, but the fence has subsequently been damaged (1). *Prunus gravesii* was proposed as 'Endangered' by the U.S. Department of the Interior, Fish and Wildlife Service, on 16 June 1976. The Endangered Species Act of 1973 directs that no federally-funded activity shall jeopardise the existence of species once officially determined as 'Endangered' or 'Threatened', as defined by the Act.

CONSERVATION MEASURES PROPOSED Further management recommendations must await additional information on its ecological requirements. The species should, however, be made more widespread in gardens, using the stocks already in cultivation.

BIOLOGY AND POTENTIAL VALUE It may be of hybrid origin involving *Prunus maritima* as one parent (2). Investigations, including germination studies and morphological analyses, are continuing (1). It flowers in late May to early June and fruits in early September (4).

CULTIVATION It is in cultivation at the Morton Arboretum and Arnold Arboretum, according to the American Horticultural Society's Plant Service Data Center.

DESCRIPTION Unarmed shrub up to 2 m; stems erect or ascending, much branched with a dark rough bark. Leaves 2-4 cm, more or less orbicular, sparsely hairy, sharply serrate on the margin. Flowers white, 1-3 cm across, solitary or 2-3 together scattered on the twigs, appearing before or with the leaves; calyx bell-shaped, the lobes oblong, as long as the tube; petals orbicular, c. 5 mm in diameter, abruptly narrowed at the base. Fruit a fleshy globose drupe 10-15 mm across, purplish-black, glaucous, with a broadly oval stone (3,4).

For an illustration see (3).

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The material for this sheet was supplied by the Endangered Flora Project of the Smithsonian Institution, Washington, D.C., to whom the TPC is most grateful. Information is also gratefully acknowledged from T. Bampton.

RUTACEAE

STATUS Endangered; a shrub known from a few scattered populations. It occurs in moist Eucalyptus forest which is suitable for development so much of its habitat has been destroyed. It was discovered by James Keys in 1909, but was not seen again in the wild until 1971 when it was found in the same area by Dr A. Harrold (2).

DISTRIBUTION Australia; known from the Lake Cootharaba region in the Wide Bay pastoral district of south eastern Queensland, 150 km north of Brisbane.

HABITAT AND ECOLOGY Lowland areas of Eucalyptus forest, dominated mainly by *Eucalyptus gummifera* (Gaertn.) Hochr. and *E. acmenioides* Schauer, with a dense understorey of mixed trees and shrubs. The soils in the area are sandy and rich in humus, with the water table only 60-90 cm below the surface. The climate is subtropical, with an average annual rainfall of 1600 mm.

CONSERVATION MEASURES TAKEN A small population has been located in the Cooloola National Park (23,030 ha, declared in December 1975). Attempts to grow the plant from seed and cuttings have been largely unsuccessful, but seedling transplants have been successful in suitable environments.

CONSERVATION MEASURES PROPOSED None on record.

BIOLOGY AND POTENTIAL VALUE It is of scientific interest because of its very restricted range although there is abundant habitat nearby that appears suitable. It would make an excellent garden plant under suitable conditions.

DESCRIPTION Shrub up to 2 m high with an open branching habit. Leaves opposite, simple to pinnate with 3-9 leaflets; simple leaves lanceolate, up to 3 x 0.8 cm, dark green above, paler beneath, hairless, the margins recurved; leaflets of pinnate leaves lanceolate, the terminal leaflet twice the size of the lateral leaflets. Inflorescence 2-6 flowered, as umbels in the leaf axils; sepals 4, pointed, up to 2.5 x 1.2 mm; petals 4, obovate with a pointed tip, c. 6-8 mm long, deep rose pink fading with age. Stamens 8, the filaments deep rose pink fringed with long white silky hairs on each side of the lower portion. Fruit of 4 smooth, olive-green carpels, spreading when mature and each containing one smooth, dull black seed 3 x 4 mm (2).

For an illustration see (2).

REFERENCES 1. Domin, K. (1926). Beiträge zur Flora und Pflanzengeographie Australiens. Biblthca bot. Heft 89(3): 284-285 (838-839).
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The material for this sheet was supplied by Mr D.E. Boyland (of the Queensland Herbarium, Brisbane), to whom the TPC is most grateful.

Tedera Salvaje

RUTACEAE

STATUS Vulnerable; an island endemic of great chemical interest which is known from about 6 localities, in all of which it occurs as low populations of around 100-150 individuals. None are protected. It has declined as a result of clearing of vegetation for agriculture and to some extent through grazing.

DISTRIBUTION Canary Islands; Tenerife. Records for its presence on La Palma refer to a closely related, undescribed species of the genus.

Out of 95 species of flowering plants endemic to Tenerife, 9 are Endangered, 18 are Vulnerable and 35 are Rare. The principal threats to the flora are destruction of the forests and pressure on land for agriculture and tourism.

HABITAT AND ECOLOGY On dry stony hillsides on volcanic deposits at about 150-600 m, in the lower zone of dry scrub, associated with species of *Aeonium, Argyranthemum* and *Rumex*. It now only occurs on the steeper slopes, since on the flatter areas little vegetation of the coastal zone remains.

CONSERVATION MEASURES TAKEN None for the wild populations. Many of the threatened Canarian endemics, including this one, are in cultivation under semi-natural conditions at the Jardín Botánico Viera y Clavijo on Gran Canaria. A seed bank for threatened Macaronesian and Iberian species has recently been set up at the Universidad Politécnica, Madrid.

CONSERVATION MEASURES PROPOSED Local nature reserves should be considered for as many of the remaining populations as possible.

BIOLOGY AND POTENTIAL VALUE Seed set appears to be adequate in the wild. The flowers are handsome and may have horticultural value. Leaves and fruits are liberally supplied with oil glands giving a balsamic and terebinthine odour, which differs considerably from that of the common and widespread rue, *Ruta graveolens* L. Its chemistry is of great interest and has been investigated in detail by González and Luis who have produced a list of the chemicals it contains (2).

DESCRIPTION Shrub up to 1.5(-2) m tall with light green, pinnate leaves; leaflets linear to rhomboidal, 2-4 cm long, gland-dotted and with crenate margins. Flowers in panicles at the branch tips, each with 4 or 5 buttercup yellow, obovate, flat petals. Fruit nearly spherical, slightly 4-lobed, orange brown, c. 5 mm across.

For illustrations see (1) and (3).

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The TPC is most grateful to Dr D. Bramwell, of the Jardín Botánico Viera y Clavijo, Gran Canaria, for help in producing this sheet.

RUTACEAE

STATUS Endangered. It is only known to survive in part of a 15.5 ha area of forest protected as a nature reserve. Eight mature trees over 4 m tall have been found and marked. There are a small number of seedlings up to 20 cm high near the parent trees, but they are very sensitive to sun-scorch and apparently very few survive the dry season. The species was first found in this locality in 1967, when Kirrika made a systematic study of the flora of the reserve. The species is extinct at its only other known locality, where in about 1928 it was first discovered; the forest in the area was cleared in the 1940s.

The vernacular name of the species in Mũnderendu-Ĩtũ. Mũnderendu is the Kikuyu name for several species of *Teclea* and *Vepris*. The suffix 'Ĩtũ' distinguishes *Vepris glandulosa* from *Teclea simplicifolia* (Engl.) Verdoorn, which grows in the same locality and closely resembles it in general appearance and habit. However the vernacular distinction appears to be little used nowadays.

DISTRIBUTION Kenya. It survives in the Muguga Forest, north west of Nairobi. The *locus classicus*, where it is now extinct, is the GĨchuĨro Forest, near Kikuyu.

HABITAT AND ECOLOGY The tree is one among numerous species of small, evergreen, understorey trees occurring in the semi-deciduous forests of central Kenya. This type of forest occurs in scattered patches at 1550 to 2150 m, between the lower edge of the montane conifer forest and the grass and open woodlands found at lower altitudes (4). These forests were once abundant near Nairobi, but many have now been cleared for settlement. In the Muguga area, the main canopy species are *Calodendrum capense* (L.f.) Thunb., *Croton megalocarpus* Hutch., *Olea africana* Miller and *Warburgia ugandensis* Sprague. *Juniperus procera* Endl. was common formerly, but has now mostly been felled.

V. glandulosa occurs in dense shade in the wet season, but is more exposed in dry weather when the *Calodendrum* and *Croton* of the canopy are leafless. The altitude of the locality is 2100 m.

CONSERVATION MEASURES TAKEN The locality is part of the 15.5 ha nature reserve on the estate of the East African Agriculture and Forestry Research Organisation.

CONSERVATION MEASURES PROPOSED None on record.

BIOLOGY AND POTENTIAL VALUE The tree is now too rare to have any economic value. In the past it was presumably utilised together with *Teclea simplicifolia* for walking sticks and for shafts of spears,

bows and arrows. The wood, as judged from a small branch sample, is similar to that of *Teclea* and would also be suitable for small turned handles.

CULTIVATION Seeds were gathered in 1973 (EAAFRO Seed Batch No. 2412) from which 140 seedlings were raised. They are slow-growing and very liable to sun-scorch. It is proposed to establish a plot of the species in the Muguga arboretum.

DESCRIPTION Unarmed evergreen tree up to 6 m tall with smooth grey bark. Leaves opposite, each of 3 leaflets, the central one oblong-lanceolate, to 12 cm long; leaf stalk c. 2.5 cm long, deeply channelled above. Flowers small, in axillary and terminal, densely tomentose panicles to 10 cm long; calyx small, 4-toothed; petals 4, c. 2.5 mm long. Fruit compressed, elliptic, 2- or rarely 3-lobed, 1 cm long, with a smooth reddish gland-dotted skin and pulpy flesh within. Seeds slightly compressed, ellipsoid, 5 mm long. In general appearance the plant resembles *Teclea simplicifolia*, but is distinguished by the trifoliate leaves. (Syn. *Tecleopsis glandulosa* Hoyle & Leakey.)

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This data sheet is based on one compiled for the International Union of Forestry Research Organisations (IUFRO) by W.G. Dyson, under the name *Tecleopsis glandulosa*. The TPC is most grateful for their help.

RUTACEAE

STATUS Endangered. Only two individuals of this tree are known in the wild. Both were seen in 1973, but no seedlings were found, probably because of the grazing by goats and cattle, which is presumably one of the reasons for its decline. Both trees are highly likely to be cut down for firewood. Flowering has never been observed. The species may possibly exist elsewhere on the island, but this is unlikely since the great majority of the original vegetation has been destroyed and the small remaining areas have been explored botanically. The species was apparently as rare when it was discovered by I.B. Balfour in 1874 as it is today (1,2).

DISTRIBUTION Rodrigues, Indian Ocean. The two trees occur in the south west of the island.

Out of 34 angiosperm species recorded by Balfour (1,2) as endemic to Rodrigues, all but two are Extinct or Endangered. Early descriptions of the island suggest that it was covered with low woodland, possibly of a savannah type. This has been cleared for cultivation, cut for firewood, grazed by goats and cattle, and ravaged by fire for over 200 years; as early as 1874 "fully half of the island was entirely bare of vegetation, save for a few social weeds which occupied the place of the destroyed, indigenous plants" (2). Cadet (3) lists 119 species of introduced weeds which have become established (and troublesome in many cases) since 1874. These vigorous plants are now threatening the small remnants of the original vegetation surviving in a few areas on hilltops and in the upper reaches of some valleys.

HABITAT AND ECOLOGY The two individuals grow beside a stream among a small group of indigenous trees such as *Gastonia* sp., *Elaeodendron orientale* Jacq. and the Endangered endemic, *Clerodendron laciniatum* Balf.f. It was presumably a component of the dry tropical woodland which was the principal vegetation type of the island, but, as described above, is now virtually extinct as a community. Both trees of *Zanthoxylum paniculatum* were producing abundant seed in 1973.

CONSERVATION MEASURES TAKEN According to Balfour (2), cutting of the forest was forbidden by law as long ago as 1874. Although these regulations are still valid, they have never been effectively enforced.

CONSERVATION MEASURES PROPOSED The only way to save this species in the wild is to give formal protection to the remaining colony and by continual weeding of exotics, maintaining its indigenous composition. The species should be maintained safely in cultivation, preferably with other endangered species from Mauritius and Rodrigues in a garden of native and endemic plants, situated on one of the islands.

BIOLOGY AND POTENTIAL VALUE The wood is white, fine-grained and very hard (2). Thus the species may have potential as a timber tree, but probably it never becomes very tall. The few specimens found by Balfour in 1874 were c. 7 m high, those surviving today c. 9 m. The species is of interest to studies of anatomy and life form since the juvenile leaves are markedly different from the mature ones. It is also interesting as an island representative of a large and widespread genus. It is a decorative plant with very shiny leaves in the juvenile phase.

CULTIVATION There are two young plants of the species in the Royal Botanic Gardens, Kew, U.K., and the species may also be in cultivation in Mauritius with the Mauritian Forestry Service.

DESCRIPTION Deciduous, aromatic tree with smooth, dark grey bark, stout thorny branchlets bearing clusters of pinnate leaves at the ends of the twigs and gummy-resinous apical buds. Juvenile leaves very spiny, with many pairs of very small, more or less oblong to ovate leaflets, asymmetrical and rounded to somewhat cordate at the base, the stalks and the underneath of the midrib armed with small brown ascending prickles; mature leaves 15-20 cm long, the leaflets in 5-9 pairs, similar in shape to the juveniles but much larger (4-8 cm long). Flowers unknown but the other species of *Zanthoxylum* in the Mascarenes is dioecious (i.e. male and female flowers on separate individuals). Fruit more or less spherical to broadly ovoid, 7-9 mm long, warty on the surface, containing a few very shiny black seeds in each chamber (4).

No illustrations are known.

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This sheet is based on information provided by Mr M.J.E. Coode (of the Royal Botanic Gardens, Kew, U.K. and formerly of the Flore des Mascareignes project), to whom the TPC is most grateful.

SALICACEAE

STATUS Rare; a willow confined to the active sand dunes in a 200 sq. km area which is being considered for conservation. It occurs as widely scattered individuals in two disjunct populations 90 km apart; its population size has not been determined.

DISTRIBUTION Canada; known definitely only from within 20 km of the south shore of Lake Athabasca in northwestern Saskatchewan. There is a possible population to the north east at Pelly Lake, Northwest Territories, which has not been confirmed. For a distribution map see (3).

The Athabasca sand dunes are remote from civilisation and can be reached only by aircraft or boat. There is, however, a winter road from Uranium City to the uranium mine at Cluff Lake that skirts the western edge of the area. As mining development expands in northern Saskatchewan, the likelihood of threats from human disturbance will increase. Other endemics confined to the Athabasca sand dunes are *Achillea lanulosa* Nutt. ssp. *megacephala* (Raup) Argus, *Deschampsia mackenzieana* Raup, *Salix brachycarpa* Nutt. var. *psammophila* Raup, *S. turnorii* Raup, *S. tyrrellii* Raup, *Stellaria arenicola* Raup and *Tanacetum huronense* Nutt. var. *floccosum* Raup.

HABITAT AND ECOLOGY A dune-forming species which occurs as occasional shrubs up to 3 m tall on active sand dunes. It also occurs as a rare shrub on gravel pavements where it rarely exceeds 1 m. Seedlings become established in wet dune slacks and on the gravel pavements. On the dunes it is associated with grasses such as species of *Bromus, Calamagrostis, Elymus* and *Festuca,* and trees and shrubs such as *Betula papyrifera* Marshall and *Empetrum nigrum* L., together with the endemics listed above. On the gravel pavements it grows with other endemic *Salix* spp., *Carex* and cushion plants such as *Silene acaulis* L. and *Armeria maritima* (Miller) Willd. ssp. *interior* (Raup) Porsild (also in the Red Data Book).

CONSERVATION MEASURES TAKEN None.

CONSERVATION MEASURES PROPOSED The sand dune region is being considered for park status by Parks Canada and the Saskatchewan Department of Tourism and Renewable Resources, but no final action has been taken (4).

BIOLOGY AND POTENTIAL VALUE It is related to the arctic species *Salix alaxensis* (Anderss.) Coville, from which it probably evolved in postglacial times. As one of the few endemic taxa in northwestern Canada, it is of evolutionary importance. In addition, it was described by Raup as "one of the most attractive willows of the Mackenzie basin, ...

conspicuous against the dark green of the conifers by its nearly white leaves and twigs" (2).

DESCRIPTION Erect shrub with spreading branches and reddish-brown bark, up to 3 m tall, twigs densely white-tomentose. Leaves 3-6 cm long, broadly elliptic, entire and clothed on both sides with a dense white tomentum. Catkins sessile, 2-7 cm long, c. 1 cm thick, densely flowered. Capsule tomentose, 6 mm long, bracts black and clothed with long hairs (3). (Syn. *S. alaxensis* (Anderss.) Coville var. *silicicola* (Raup) Boivin.)

For an illustration see (2).

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The material for this sheet was supplied by Dr G.W. Argus (of the Rare and Endangered Plants Project, National Museum of Natural Sciences, Ottawa), to whom the TPC is most grateful.

Juan Fernández Sandalwood, 'Sándalo'

SANTALACEAE

STATUS Extinct. The last tree, an old specimen 9 m high, was seen alive by Skottsberg in 1908 but was dead when he revisited the locality in 1916. The species was said to be abundant in 1624, but because of exploitation for its sweet-scented and valuable wood, which was shipped to Peru, it had become very rare by 1740. Feral goats may also have played a part in its extinction by grazing off the young seedlings, so preventing regeneration (4).

DISTRIBUTION Juan Fernández Islands, South Pacific Ocean. It was confined to the forest covering part of the Isla Robinson Crusoe (formerly Más á Tierra). Sandalwood fossils have been found on the neighbouring Isla Alejandro Selkirk, but it is uncertain whether they belong to this species (5).

There are about 98 flowering plants and 17 ferns endemic to Juan Fernández and the majority are undoubtedly threatened, due to destruction of the forests by introduced sheep, cattle, horses, goats, rabbits, rats and the even more intractable problem of vigorous and invasive introduced plants such as *Aristotelia*, which is very common below 200 m, and *Rubus*, reported as an aggressive coloniser in the vegetation. The flora is of great interest for its unusual evolutionary development, resulting in gigantism in many species, especially in the cabbage trees of the *Compositae* (2).

HABITAT AND ECOLOGY Forest; the last tree grew in a gorge among *Nothomyrcia fernandeziana* (Hook. & Arn.) Kausel, *Fagara mayu* (Bert.) Engl., *Drimys confertifolia* Phil. and *Coprosma pyrifolia* (Hook. & Arn.) Skottsb. (4).

BIOLOGY AND POTENTIAL VALUE As with all *Santalum* species the wood was of great value because of its beautiful red colour and its powerful, long-lasting, aromatic scent; it was reported to have been used for making 'cosas curiosas', presumably small pictures of saints, boxes for relics, prayer beads, etc. (4).

DESCRIPTION Small, semi-parasitic tree probably less than or about 10 m high, with a dark, brownish-grey, flaky bark which splits into rectangular pieces; young branches bearing opposite pairs of shining, dark green, slightly fleshy, oblong leaves mostly 4.5-8.5 cm long, either pointed or indented at the tip, and terminal pyramidal panicles of minute whitish fleshy flowers 4-5 mm across, the parts in fours; perianth segments broadly triangular, densely hairy on the upper surface (1).

For an illustration of the last tree see (4).

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The TPC is most grateful to Mr G. Mann, of the Corporación Nacional Forestal, Chile, for help in producing this sheet.

Canebrake Pitcher Plant

SARRACENIACEAE

STATUS Vulnerable. This insectivorous plant is extremely rare and occurs only in very small localised colonies which range from single clumps to one group of about 100 individuals in an area of c. 7 x 15 m (1). In 1976, fewer than 500 individuals were counted at the 6 known sites. It is a botanical curiosity and much desired by plant collectors who remove it for hobby trading or commercial sale. In 1975, Alabama newspaper advertisements for specimens resulted in plundering of one site.

In addition to the threats posed by collectors, the subspecies is declining due to shading by introduced plants such as honeysuckle (1) and from spraying of herbicides along a railroad right-of-way (1,3). Agriculture, drainage, road-building and the absence of bog-burning in recent years have also contributed to its decline. It is not at present legally protected, but due to the threats described above, managed protection of the sites will certainly be needed to ensure the survival of the remaining individuals (2).

DISTRIBUTION U.S.A.; restricted to central Alabama, occurring along the Fall Line Sand Hills of Elmore, Chilton and Autauga Counties (1,3,6).

HABITAT AND ECOLOGY All species of *Sarracenia* are hydrophytes and require water-logged soils to survive (5). "*S. alabamensis* occurs in somewhat sandy-gravelly bogs, usually on sloping ground, or in damp peaty or mucky soil around small spring-heads and tiny rills. It is not usually a plant of sphagnum beds although species of *Sphagnum* may occur in isolated patches nearby ... (It) grows most often in open stands of *Magnolia virginiana*, *Arundinaria tecta*, and *Alnus*, in the 'Canebrakes' of the region, or in open boggy swales" (1), canebrakes being those areas where the giant cane *Arundinaria gigantea* (Walter) Muehl. has grown into dense colonies due to lack of bog burning. Although tolerant of some shade, this subspecies requires a habitat kept open by the fires that normally check the growth of grass, shrubs and trees in the area, or, alternatively, by moderate levels of grazing (1,2).

CONSERVATION MEASURES TAKEN It was proposed as 'Endangered' by the U.S. Department of the Interior, Fish and Wildlife Service, on 16 June 1976. The Endangered Species Act of 1973 directs that no federally funded activity shall jeopardise the existence of species once officially determined as 'Endangered' or 'Threatened', as defined by the Act.

CONSERVATION MEASURES PROPOSED Formal determination as an 'Endangered' species and hence protection under the Act.

BIOLOGY AND POTENTIAL VALUE A controversial taxon, *Sarracenia alabamensis* ssp. *alabamensis* is believed by some authorities to be a shade variant of *S. rubra* Walter, a species known to hybridise easily and display considerable variation (4). The subspecies differs from all other trumpet-leaved species of *Sarracenia* in that it produces "pitchers which differ significantly in size and form with the season", as described and illustrated in (1). It is an insectivorous species which attracts insects to the mouth of the pitchers by nectar secreting glands. Once past the mouth, downward-pointing hairs along the lip prevent the escape of the prey which eventually slides down the smooth, deep throat of the pitcher to be decomposed by digestive enzymes and bacteria at the base (5).

CULTIVATION This plant has been cultivated for scientific study (1,2,4).

DESCRIPTION Perennial with a much branched rhizome producing a cluster of leaves developed into hooded pitchers towards the apex. Spring leaves recurved, 17-50 cm long, gradually tapering from a narrow base to a relatively broad mouth 0.7-3 cm wide, clear to yellow green, often suffused strawberry red in the upper third when young, and strongly maroon-veined only on the inside. Summer leaves erect, larger (up to 72 cm high), pubescent, soft and thin textured, distinctly yellowish-green, with large, undulate, conspicuously reflexed hoods; rim of pitcher loosely rolled, bright yellow green. The plant also intermittently produces additional small decumbent foliar organs, termed phyllodia, usually after the spring and before the summer leaves. Flowering stems numerous, 27-57 cm tall; petals variably maroon. Ripe capsules small, 6-10 mm wide (1,2). For illustrations see (1), (2), (4) and (5).

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The material for this sheet was supplied by the Endangered Flora Project of the Smithsonian Institution, Washington, D.C., to whom the TPC is most grateful. Information is also gratefully acknowledged from F. Case and T.C. Gibson.

SAXIFRAGACEAE

STATUS Rare; a species only known from two mountain localities and at some risk in one of them from visitors who use the area as a picnic spot. A road has now been built to this site, which is a tourist attraction, but the plant is still reported to be abundant (3).

DISTRIBUTION Spain; in two localities, 25 km apart, in the mountains north of Malaga (5).

HABITAT AND ECOLOGY In the original site it grows "on vertical rock-faces, mainly in horizontal fissures overhung by a narrow ledge, but also to some extent in vertical fissures freely exposed to the sun" at about 1000-1100 m. It receives little rain in summer, but is often shrouded in cloud or fog. The rock formation consists of "a confused jumble of limestone rocks, with scattered boulders, table-like slabs and narrow ravines flanked by low cliffs ..., produced by weathering not by earth-movements". These unusual rocks are the tourist attraction. The habitat in the other locality is similar (5).

CONSERVATION MEASURES TAKEN None for the wild populations.

CONSERVATION MEASURES PROPOSED None on record.

BIOLOGY AND POTENTIAL VALUE A large number of Saxifrages are prized by alpine garden enthusiasts but this one is very different from the rosette species and hybrids commonly grown. When not in flower it looks more like a small fern or *Erodium* than a Saxifrage. Nevertheless it is both curious and beautiful; the white flowers borne in profusion are as large as those in any other species of the genus. Botanically it is interesting as "apart from 2 closely related species (*S. boissieri* Engl. & *S. gemmulosa* Boiss.) ... it is unique in the genus in possessing virtually compound leaves ... Other striking features of the plant include the persistent woody stems ... and the conspicuous bulbils or dormant buds in the axils of very broad leaf-bases." According to Webb, it seems to be a relict, stranded in or near Quaternary refugia, of a Tertiary population ancestral to the sections *Saxifraga* and *Dactyloides* of the genus (5).

CULTIVATION It is grown in several botanic gardens and occasionally in private collections. It should be protected from damp in winter and kept reasonably dry in summer (4). It is easily propagated by cuttings or by seed, although artificial pollination may be necessary (5).

DESCRIPTION Small loosely tufted perennial, rather densely covered by soft hairs, and with a rosette of fern-like, bright green leaves, velvety above and shiny beneath, mostly 2.5-8 cm long and twice cut

into a few lobed or toothed segments. In the axils of the lower leaves are numerous bulbil-like buds which expand in autumn to produce new shoots. Stems almost woody, prostrate or ascending, up to 20 cm long, bearing relatively large bell- to funnel-shaped flowers each with 4 or 5 small oblong sepals 4-5.5 mm long and 4 or 5 petals, white but with conspicuous green veins, 15-20 mm long. Capsule more or less spherical, c. 8 mm across (5).

There are fine colour plates of this species in (1) and (5), a black and white photograph in (2), and a line drawing in (3).

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The TPC is most grateful to Professor D.A. Webb of Trinity College, Dublin, and to Mr B.E. Smythies for help in producing this sheet.

SAXIFRAGACEAE

STATUS Vulnerable; a very desirable and spectacular alpine plant which has diminished in the wild partly due to natural causes but partly due to collectors. It grows almost exclusively on vertical rock-faces where many of the specimens are inaccessible except to a skilled climber with ropes. However, it is occasionally found in the talus at the base of a cliff. It is particularly vulnerable because very slow-growing, taking at least 10-12 years to flower, and because of its strictly monocarpic habit (i.e. it dies after flowering and has no means of vegetative reproduction).

It is extremely difficult to maintain in cultivation, and hence has a prestige value. Flowering is particularly difficult, as the plants rarely survive long enough, and propagation is impossible other than by seed. Thus, unlike most of the other species in the Red Data Book, it seems that horticulture will not help ensure its survival, but will tend to hasten its extinction.

DISTRIBUTION France, Italy, in the border area; it occurs at the southern end of the Alpes Maritimes, mainly around the Mt. Clapier massif, but extending locally north west to beyond Mt. Ténibres, over a distance of about 45 km. It is believed extinct in a number of the localities cited by Burnat (1,2).

HABITAT AND ECOLOGY Around 2000-2500 m, on siliceous vertical rocks, usually of granite or gneiss, facing north or north west. No other species are associated with it. Although it is usually found in tens, a few colonies may exceed 100 plants.

CONSERVATION MEASURES TAKEN It is given total legal protection in the Province of Cuneo, Piedmont, to which the entire Italian population of the plant is confined, by a decree of the President of the Regional Council dated 2 July 1975. Removal of seeds and flowers is forbidden.

CONSERVATION MEASURES PROPOSED It would be advantageous if horticultural societies discouraged their members from growing and exhibiting this species.

BIOLOGY AND POTENTIAL VALUE It is a very remarkable and spectacular relict species, forming beautifully arranged, tight rosettes of leaves and eventually a relatively large, curving inflorescence. It is taxonomically isolated within the genus *Saxifraga* and has a number of unusual botanical features. For instance multiplication of the floral parts occurs, a feature very rare in the genus. Many flowers have 3 carpels instead of 2 and the terminal one often has 5. Similarly there can be up to 9 sepals and petals and 15 stamens. Although in general habit it is close to the 'encrusted saxifrages' (sect. *Euaizonia)*, the leaf

lacks the marginal glands and consequently there is no calcareous encrustation. This species may well be important in unravelling the evolution of the genus.

DESCRIPTION Slow-growing, long-lived perennial consisting of a dense, more or less flat rosette of very numerous, leathery, dull green, narrowly spathulate leaves 30-60 x 4-7 mm in mature plants, but considerably shorter in young ones, sharply pointed at the tip (mucronate). The dead leaves persist so that the rosette eventually forms a low cylinder. From the rosette emerges the long, narrow, glandular-hairy, dense panicle of flowers, each with 5(-9) flesh-coloured petals 5-7 mm long and 2, 3 or 5 carpels. Capsule spherical, 4-6 mm long.

There is a photograph of a fine rosette in (3) and a magnificent colour plate by Fitch in (5).

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The TPC is most grateful to Professor D.A. Webb of Trinity College, Dublin, and to Professor S. Filipello of the Institute of Botany, University of Pavia, for help in preparing this sheet.

SCROPHULARIACEAE

STATUS Rare; a species only known from two maritime localities, in both of which it is scarce. The original locality, Bulbjerg, is a limestone headland within a nature reserve (1). There is unrestricted public access, with a car park, and tourist pressure on the short turf in which it grows may increasingly threaten the plant's survival. Its presence at the second locality, 20 km to the east, has not been recently confirmed and the site is not protected.

DISTRIBUTION Denmark. The two localities are on the north west Jutland coast. "Records from elsewhere in Denmark are erroneous" (Flora Europaea). *E. dunensis* is believed to be the only species of flowering plant endemic to Denmark, as is *Euphrasia atropurpurea* (Rostrup) Ostenf. to the Faeroes.

HABITAT AND ECOLOGY Calcareous maritime grassland; at Bulbjerg it mainly grows in the short, somewhat eroded turf near the edge of the sea-cliff. It is associated with *Plantago media* L. and dwarf variants of *Plantago maritima* L. & *Hypochoeris maculata* L. Presumably slow erosion of the relatively hard limestone provides open habitats in the short turf. Localities of this type in northern Europe tend to be characterised by the presence of rare and endemic species. At the other locality it is believed to occur in dune-slacks, a particularly vulnerable habitat that is tending to come under threat in much of the North Sea littoral.

CONSERVATION MEASURES TAKEN The nature reserve of Bulbjerg and Lildstrand covers c. 1200 ha of coastal cliff-top grassland, coastal heath and a small lake (1). The reserve is mainly of geological and physiographic interest, as well as being a site of scenic beauty. Bulbjerg itself is a cliff c. 40 m high and is illustrated in (1).

CONSERVATION MEASURES PROPOSED In the absence of detailed information on its population size at Bulbjerg and particularly on possible changes since 1935 (when the species was described), it is difficult to recommend stronger conservation measures. Both Hansen and Walters, however, suspect that damage to the short, open turf caused by increasingly heavy public pressure might be reducing the suitable habitat, and so it is suggested that the population should be monitored over the next few years.

BIOLOGY AND POTENTIAL VALUE *Euphrasia dunensis* is one of several very local species of the genus; the origin of such taxa may be correlated with their semi-parasitic habit and tendency to self-pollination.

DESCRIPTION Annual semi-parasitic herb with a stem up to c. 12 cm & 0-3 pairs of short erect branches. Stem internodes up to 1½ (-3) times as long as the subtending leaves, the first flower arising at node no. (5-) 6-9. Leaves more or less ovate, up to 11 mm long with up to 5 pairs of teeth, densely grey-hairy, the hairs mainly without glands but with an admixture of short or long, gland-tipped hairs. Calyx more or less tubular, 4-lobed; corolla 6-7 mm long, white with violet lines, 2-lipped, the upper lip helmet-shaped, the lower flat and 3-lobed. Capsule 4-5.5 (-6.5) mm long, about as long as the calyx and twice as long as broad or rather more, oblong or elliptic-oblong (Yeo).

Taxonomically, the species is closely related to *E. ostenfeldii* (Pugsley) Yeo (*E. curta* auct.), a widespread but local species of north west Europe, often growing by the sea. Other species of this group are endemic to north Scotland, where they occur in similar habitats of coastal grassland.

For a line drawing of the flower see (2).

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The TPC is most grateful to Mr A. Hansen of the Botanical Museum, Copenhagen, and to Dr P.F. Yeo of the University Botanic Garden, Cambridge, U.K., for help in producing this sheet.

SCROPHULARIACEAE

STATUS Endangered; confined to a few maritime sites within an area of about 20 sq. km. It has presumably always been rare because of its very restricted coastal habitat (see below); it is now critically threatened by loss of that habitat through development. It also occurs in a few cultivated areas but here it is threatened by agricultural activity, in particular control of weeds. In recent times, Yannitsaros has found 4 localities, with only 2-6 individuals in 3 of them and around 100 in the fourth one. He failed to find the plant either in the *locus classicus* or in the other localities where it had been seen by Goulimis, who originally discovered it in 1955; these sites are now on cultivated land, where the species is less likely to survive (6).

DISTRIBUTION Greece; recorded from 6 localities on the Maléa Peninsula at the south eastern tip of the Pelopónnisos, occurring in the Gulf of Neápolis and on the neighbouring island of Elafónisos (6). Maps of its distribution are given in (1) and (6).

HABITAT AND ECOLOGY Sandy beaches or cultivated and uncultivated sandy areas near the sea (6). It is poorly competitive with other species and is more or less restricted to flat, open sites, and never occurs on the sand dunes (1); this habitat is not only rare but also more or less unstable (6). In the principal locality the *Linaria* grows with *Anthemis tomentosa* L. ssp. *tomentosa*, *Elymus farctus* (Viv.) Runemark, *Polygonum maritimum* L. and species of *Medicago*, *Silene* and *Trifolium* (1). The annual rainfall on Elafónisos is 600-800 mm and in the Gulf of Neápolis 400-600 mm (1).

CONSERVATION MEASURES TAKEN None for the wild populations.

CONSERVATION MEASURES PROPOSED As suggested by Yannitsaros in (6): immediate measures should be taken for the protection of certain sandy coastal areas where the species occurs. Consideration could be given to prohibiting its collection or its eradication as a weed. It should be bulked up in cultivation, distributed to botanic gardens, and seed deposited in a seed bank.

BIOLOGY AND POTENTIAL VALUE It belongs to the subgenus *Linariastrum* Chav. Its affinities are discussed in (1). Its cytology is of some interest because the species has been shown to be tetraploid (2n=24; some individuals have 2n=26); polyploidy is a rare phenomenon in *Linaria* and very rare in the subgenus *Linariastrum* (1,6).

"The reproductive capacity of *L. hellenica* is rather great, as well as the vegetative one. It appears that the critical stage for this species is the seedling-stage because the seedlings are very small

and are influenced by any change in the environment". Combined with the instability of the habitat itself, "the establishment of *Linaria hellenica* ... is therefore somewhat difficult and the populations are very small" (6).

CULTIVATION It is being grown at the University of Athens (1,6).

DESCRIPTION Annual with slender, erect or arching, branched stems to 60 cm. Leaves linear to linear-oblong, succulent, obtuse, 5-45 x 1-2.5 mm. Inflorescence a terminal raceme of 5-20 flowers on erect stalks up to 15 mm long; calyx 4.5-5 mm, with oblong, subequal lobes; corolla yellow, 13-16 mm, 2-lipped, the upper lip 2-lobed, the lower 3-lobed; corolla tube cylindrical, with a basal spur 6-7 mm long. Capsule more or less globose, c. 5 mm. Seeds reniform, strongly rugose, black.

For an illustration see (6).

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This sheet has been compiled from the account in (6) of *Linaria hellenica* by Dr A. Yannitsaros, of the University of Athens, to whom the TPC is most grateful.

Furbish's Lousewort

SCROPHULARIACEAE

STATUS Endangered. The Dickey-Lincoln hydro-electric project, proposed by the Army Corps of Engineers, would flood 13 of the 18 known colonies of this plant existing in the U.S. and some 350 of over 500 counted individuals. The colonies that lie below the impoundment area are on private land and are subject to disturbance and destruction (5). In addition 3 stations consisting of 364 individuals have been located in New Brunswick, Canada, some 130 km down river from the proposed dam site. No information is available on the status of these populations.

This species was rare and restricted to intermittent colonies along the St. John River even at the time of Watson's original description. In the decades that followed, the number of populations was gradually reduced by a combination of human activity and the natural cycles of destruction and recolonisation of the river bank vegetation (5). The last known gatherings had been made in 1946 in Maine and in 1943 in Canada, and thereafter it was believed to be probably extinct until it was refound in 1976 by C.A. Richards, Professor of Botany of the University of Maine (4).

DISTRIBUTION Canada, U.S.A.; in the latter confined to a 200 km stretch of the St. John River, Maine, the range extending for another 32 km along the river into the Province of New Brunswick, Canada.

HABITAT AND ECOLOGY Restricted to river banks between the high water erosion level and the edge of the forest. Here it is found in thickets of alder (*Alnus crispa* (Aiton) Pursh, *A. rugosa* (Duroi) Sprengel) with shrubs of *Cornus stolonifera* Michaux, *Salix coactilis* Fernald, *Salix glaucophylloides* Fernald and *Spiraea latifolia* (Aiton) Borkh. Herbaceous associates include *Campanula rotundifolia* L., *Epilobium angustifolium* L., *Silene vulgaris* (Moench) Garcke, *Thalictrum dasycarpum* Fischer & Avé-Lall. and *Vicia cracca* L. Alder, the dominating associate, is a rapidly growing shrub which, even when killed back by winter winds and spring ice packs, quickly recovers and soon shades the habitat with dense foliage. As a result, only a small number of *Pedicularis* plants become robust enough to flower (5).

CONSERVATION MEASURES TAKEN It has been determined to be 'Endangered' under the Endangered Species Act of 1973 (9). This determination will now require the Corps of Engineers or any other federal agency to ensure that actions it authorises, funds or carries out do not further jeopardise the survival of this 'Endangered' species.

CONSERVATION MEASURES PROPOSED The U.S. Department of the Interior should take immediate steps to determine the 'Critical Habitat' for this species. The Dickey-Lincoln hydro-electric project in Maine, consisting of a dam c. 5 km long and c. 300 m high to be built in the small town of Dickey, and a smaller control dam to be constructed

downstream at Lincoln School, has received considerable criticism from conservationists. The headwaters of the St. John, it is argued, represent one of the largest free-flowing, wild rivers in the Northeast. In addition, it is argued that the benefits provided by the project would not outweigh the loss of natural resources, such as timber, hunting terrain and trout streams (1,4,6). It has also been suggested that mature individuals and seedlings be transplanted into habitats not now occupied by the species.

BIOLOGY AND POTENTIAL VALUE It is of considerable scientific interest as the most narrowly endemic of over 500 species of *Pedicularis* known. Although some members of the *Scrophulariaceae* are partial or total parasites on the roots of other plants, no parasitic connection was found with 11 uprooted mature plants of *Pedicularis furbishiae* (later successfully replanted in the original colony) (5). A single species of bumble bee (*Bombus vagans* Smith) has been found to be the sole pollinator. No vegetative propagation has been found in wild populations; it is apparent the species reproduces solely by seed, an adequate amount of which is produced.

DESCRIPTION Perennial herb 40-90 cm high. Leaves stalked, lanceolate, pinnately divided into short oblong sections, silvery on the margin. Flowers in a dense terminal raceme, subtended by ovate, toothed bracts; calyx 5-lobed, the lobes rather unequal; corolla greenish-yellow, 2-lipped, the upper lip straight and beakless, forked at the apex, the lower lip erect, 3-lobed. Capsule broadly ovoid, barely exceeding calyx (3). For illustrations see (2), (4), (5) and (8).

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SELAGINACEAE

STATUS Endangered. Two small populations of this local endemic species have been found. Although the island on which they occur has been well explored botanically, the species was not discovered until 1972 when it was found on a steep wooded cliff difficult of access. It is likely that more plants of it will be found in the future, but the area of available cliff habitat is small. The specific name *ascanii* was given in recognition of the contribution made to conserving the flora of the Canary Islands by the Asociación Canaria para Defensa de la Naturaleza (ASCAN) (2).

DISTRIBUTION Canary Islands. It is confined to the Tamadaba Massif in the north west of Gran Canaria (2).

Out of 56 species of flowering plants endemic to Gran Canaria, 2 are believed Extinct, 8 are Endangered, 9 are Vulnerable and 21 are Rare.

HABITAT AND ECOLOGY On broad ledges on steep basaltic cliffs at 950-1200 m (2), under woodland of *Pinus canariensis* C.Smith. The following plants grow nearby: *Bystropogon plumosus* (L.f.) L'Hérit., *Cistus symphytifolius* Lam., *C. monspeliensis* L., *Erica arborea* L., *Greenovia aurea* (C.Smith) Webb & Berthel., *Ilex canariensis* Poiret, *Micromeria benthamii* Webb & Berthel., *M. lanata* (C.Smith) Benth., *M. pineolens* Svent., *Phillyrea angustifolia* L., *Sonchus acaulis* Dum. Cours. and *S. platylepis* Webb & Berthel. (2).

Several interesting and rare endemic species are found on these western cliffs where the Tamadaba Massif drops steeply down to the coast. They include the palm-like *Dendriopoterium menendezii* Svent., the yellow Composite *Sventenia bupleuroides* Font Quer and an almost arborescent *Centaurea,* the pink-flowered *C. arbutifolia* Svent. The last two are Endangered, being confined to these cliffs and the neighbouring area (1).

CONSERVATION MEASURES TAKEN The site belongs to the state and is being considered for a nature reserve.

A survey of the conservation status of the flora of the Province of Las Palmas, which includes Gran Canaria, has been made by Kunkel, grant-aided by IUCN/WWF (3). Many of the threatened Canarian endemics, including this one, are in cultivation under semi-natural conditions at the Jardín Botánico Viera y Clavijo on Gran Canaria. A seed bank for threatened Macaronesian and Iberian species has recently been set up at the Universidad Politécnica, Madrid.

CONSERVATION MEASURES PROPOSED It is hoped that the declaration of

a nature reserve covering the site will soon be forthcoming.

BIOLOGY AND POTENTIAL VALUE The species is of potential ornamental value.

CULTIVATION It is being bulked up in cultivation and can be propagated from seed and from cuttings.

DESCRIPTION Small procumbent shrublet with a woody stock and slender stems 20-30(-40) cm long, bearing more or less lanceolate, somewhat fleshy, slightly glossy leaves 5-7 cm long by c. 1.5 cm wide. Inflorescence dense, compact and terminal, consisting of 4-6 nearly spherical flower-heads 1.5-2 cm across on stalks 2-3 cm long; bracts scale-like, narrowly triangular; flowers numerous, milky-white with bluish-purple tips. Fruits unknown (2).

For illustrations see (1) and (2).

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The TPC is most grateful to Dr D. Bramwell, of the Jardín Botánico Viera y Clavijo, Gran Canaria, for help in producing this sheet.

SIMAROUBACEAE

STATUS Rare. It was originally known from about ten trees in one locality, but recently over 140 further trees of the species have been found, occurring in a total of 9 localities; no immediate threats are known, but six of the sites have under 10 trees in each.

DISTRIBUTION Hong Kong. The original group of 10 trees are scattered on a rocky headland c. 2 km long at the south eastern extremity of Hong Kong Island. However the larger part of the population (four localities) is in the New Territories of Hong Kong.

HABITAT AND ECOLOGY In sheltered ravines, growing in woodland or as an emergent in thick scrub in association with *Pinus massoniana* Lambert, *Reevesia thyrsoidea* Lindl., *Sapium discolor* Muell. Arg., and *Schefflera actophylla* (Lour.) Harms, at altitudes of up to c. 400 m. In one area young trees have been seen growing in roadside cuttings, the seeds having been presumably washed down from higher up the slopes.

CONSERVATION MEASURES TAKEN One site is within a Country Park with protection and management services. Consideration is being given by the Hong Kong authorities to designate another site as a Special Area where the trees will be protected. Consideration is also being given to including the tree in the Protected Species List when the local Countryside and Forest Ordinance is revised.

CONSERVATION MEASURES PROPOSED As suggested by Nooteboom in (1): a nature reserve or equivalent protected area would be highly desirable for this species.

BIOLOGY AND POTENTIAL VALUE It is of scientific interest as being a narrow endemic in a genus otherwise comprising 4 much more widespread but relatively rare species. It is of possible horticultural value as an amenity tree and for breeding with other species for timber or amenity trees.

CULTIVATION Seedlings have been raised from seeds collected in the wild and have been planted in public gardens in Hong Kong.

DESCRIPTION Small tree c. 10 m high with a single trunk tapering sharply upwards and bearing a terminal crown of leaves giving a palm-like appearance. Leaves compound pinnate, c. 40 cm long with 6-13 pairs of ovate-lanceolate leaflets. The species is dioecious, (i.e. flowers unisexual, the males and females on separate individuals). Flowers small, cream-coloured, in large pyramidal panicles 20-40 cm long and c. 20 cm wide at the base. Petals more or less oblong, 2-3 mm long. Fruit (samara) flattened and wing-like, 3-5 cm long, oblong with the seed slightly above the middle (1).

For a drawing of the fruit and of the seedlings see (1).

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This sheet is based on information provided by the Director of Urban Services and Director of Agriculture and Fisheries, Hong Kong Government, to whom the TPC is most grateful.

STERCULIACEAE

STATUS Endangered. On the larger island where it occurs (Guam), the population of this small tree is critically low. Its status on the other small islands from which it has been recorded is uncertain. The local name of this tree is Ufa-Halomtano.

DISTRIBUTION Guam (U.S.A.) and several other islands of the Marianas (U.S. Trust Territory). It was originally described in 1932 from the island of Tinian (2,3), but it is not known whether it still survives there (5). According to Stone (6), it is also known from Saipan and Rota.

Guam is the largest and most southerly island of the Marianas. The flora includes about 68 species of ferns and angiosperms endemic to the archipelago (6). The much smaller islands of Rota (c. 85 sq. km), Saipan (c. 130 sq. km) and Tinian (c. 110 sq. km) lie immediately to the north of Guam.

HABITAT AND ECOLOGY It is restricted to limestone cliffs and plateaux. It is often stunted by wind and the trunk is often rooted at the base of a deep crevice, producing at the top numerous, gnarled, twisted branches (6). On Guam, the small grove of this species occurs with a single tree of *Tabernaemontana rotensis* (Kanehira) Fosberg, the only tree of Guam of this rare species from Rota (5,6). On Tinian it was found at c. 100 m, in primary forests (3).

"In general, the forests on steep limestone slopes and cliffs have been less subject to destructive human activities than most of the other types (of forest) in western Micronesia and in many places are still quite intact. Effective protection of them will preserve a large number of local endemic species" (1).

CONSERVATION MEASURES TAKEN Most of the known trees of the species occur on military land or in Government of Guam conservation areas, and are thus protected. Any occurring outside these areas but not yet discovered would presumably be on rugged terrain that is less likely to be developed.

CONSERVATION MEASURES PROPOSED Protection for the remaining trees and possible re-introduction into conservation areas.

BIOLOGY AND POTENTIAL VALUE Its timber "is much esteemed for building purposes" (3). Stone considers this tree as an example of speciation of an inland endemic from a littoral or riverine species (in this case *H. littoralis* Dryander, a widespread tree of this habitat in the Pacific). He suggests that the abrupt changes in sea-level on Guam could have enabled floating fruits or seeds of species such as

H. littoralis to be dispersed to the interior and so to a different habitat (6).

CULTIVATION Seed was gathered by Moore in 1976 and it is now in cultivation both in Guam and in the Waimea Arboretum, Hawaii.

DESCRIPTION Stout, short tree (but up to 15 m high according to Kanehira), the trunk often twisted, bearing ovate, ovate-oblong or elliptic leaves mostly 15-30 cm long on stalks usually 4-6 cm long. The underside of the leaf is densely covered with silvery scales. Flowers unisexual, in short open panicles arising from the leaf axils. Calyx of 4-6 segments; petals none. Fruit pod-like, more or less rounded, but with a keel c. 5 mm long (3,6).

For an illustration see (4) or (6).

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This sheet is based on information provided by Dr F.R. Fosberg (of the Smithsonian Institution, Washington) to whom the TPC is most grateful. Help is also acknowledged from Mr P.H. Moore of Agana, Guam.

St. Helena Redwood

STERCULIACEAE

STATUS Endangered. A very beautiful small tree which was reduced in 1956 to only one specimen in the wild and a few in gardens locally. Its decline has been due to grazing by goats, introduced in the 16th century, and possibly other feral animals. The timber may also have been exploited in the past.

DISTRIBUTION St. Helena, South Atlantic.

Of about 30 endemic species of angiosperms known from St. Helena, 10 are Extinct and 15 Endangered. J.D. Hooker (quoted in 4) estimated that there must have been over 100 endemic species in this "wonderfully curious little flora" since the forests which originally covered the island had been reduced to a few high-altitude areas on the central ridge when the island was first thoroughly explored botanically in 1805-1810. Most of these species will never be known.

HABITAT AND ECOLOGY Although the few surviving specimens recorded in 1875 occurred near the top of the central ridge at about 760 m (4), the single specimen surviving in this century is recorded from the middle zone of the island, at 300-450 m. "Over the centuries this area has been deforested, turned into pasture, replanted woodland or 'estates' so that only vestiges of the native vegetation remains" (3). The species may have been associated with the now extinct *T. melanoxylon* (Aiton f.) Benth., the St. Helena Ebony, which was once said to be one of the commonest trees on the island, occurring mainly near the coasts at 300-600 m (4). The ebony's decline was hastened because the bark was used for tanning and the wood for burning lime (although it would have been more suitable for cabinet-making and carving).

CONSERVATION MEASURES TAKEN A detailed survey (3) of the St. Helena endemic flora was made in 1970 by Kerr, under the auspices of the Royal Society and the International Biological Programme. Considerable success was achieved in alerting the islanders to the international importance of the endemic flora and to the threats to its existence.

CONSERVATION MEASURES PROPOSED Efforts should be made to popularise this species as an ornamental for the subtropics.

BIOLOGY AND POTENTIAL VALUE The two endemic *Trochetia* species are of great interest to studies of plant geography since the genus is confined to St. Helena in the South Atlantic and to Madagascar and Mauritius in the Indian Ocean. The timber of *T. erythroxylon* is hard and reddish brown; as with the extinct *T. melanoxylon*, the bark was used for tanning (4). The species is of horticultural potential for tropical and subtropical countries on account of its beautiful flowers and handsome foliage.

CULTIVATION It is readily propagated from seeds which are freely produced and remain viable for several years. Propagation by cuttings appears to be difficult since the wood of *Trochetia* spp. is very hard and the growth of the young shoots hairy. Semi-ripe or hardwood cuttings are probably best, with as little water as possible. It is in cultivation at the University Botanic Garden, Cambridge, and elsewhere.

DESCRIPTION Small tree with pale green ovate leaves 7-15 cm long, tapering to a fine point and cordate at the base, smooth above and grey-felted with stellate hairs below. Flowers generally in pairs on a stalk 5-7 cm long; sepals slender, grey-felted, tapering, half as long as the petals which are neatly folded to form a narrowly fluted bell c. 5 cm long, at first pure white and gradually changing to pink and finally red. Fruit an ovoid capsule 1-1.5 cm long, densely covered with grey hairs and breaking into 5 valves. Seeds angular, black speckled with grey, 3 mm long.

There are fine colour plates in (4) of both *Trochetia* species.

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The TPC is most grateful to Mr N. Kerr, of Suffolk, England, and to Mr R.O. Williams, Agricultural and Forestry Officer, St. Helena, for help in producing this sheet.

THEACEAE

STATUS Endangered; only a single tree was known when the species was discovered in 1903; this tree was cut and the species believed to be extinct until rediscovered in the same locality in 1965; a second group of 58 trees with many seedlings has also been known from the adjacent mainland since 1967.

DISTRIBUTION Hong Kong. The original locality is on the south side of Mt. Parker, Hong Kong Island. The second group of trees are near Mau Ping in the New Territories.

HABITAT AND ECOLOGY The Mt. Parker site is along a mountain stream in dense woods at c. 300 m, where the *Camellia* grows in association with *Litsea* spp., *Machilus* spp. and *Phoenix hanceana* Naud. The Mau Ping site is also in dense woods, at c. 200 m, with *Asplenium nidus* L., *Cratoxylum ligustrinum* (Spach) Blume, *Melodinus suaveolens* Champ., *Sapium discolor* Muell. Arg., *Schima superba* Gardner & Champ. and *Viburnum odoratissimum* Ker.

CONSERVATION MEASURES TAKEN It is protected under the Countryside and Forests Ordinance: it is an offence to possess or sell any portion of the species except from individuals grown in gardens or imported to Hong Kong.

CONSERVATION MEASURES PROPOSED A nature reserve or similar protected area would be highly desirable for this species.

BIOLOGY AND POTENTIAL VALUE The plant flowers from November to December, and the fruits ripen in December. The large white flowers combined with the deep green leaves and red bark make it a valuable species for horticulture.

CULTIVATION It is in cultivation and can be propagated from seed or cuttings. Seeds should be sown soon after collecting.

DESCRIPTION Small tree 5-7 m high, with the bark of the trunk brick red, but of the young branches greyish and smooth. Leaves obovate-elliptic, abruptly tapering at the apex, dark green and leathery, with the margins obscurely toothed. Flowers terminal on the branchlets, 7.5-10 cm across, with an involucre c. 2 cm high of similar bracteoles and sepals, surrounding 6-8 obovate or oblanceolate, white, spreading petals 4-4.5 cm long, united at the base with the numerous yellow stamens (1). Fruit a brown spherical capsule 7-10 cm across with the wall 1-2 cm thick and enclosing several large brown seeds.

For an illustration see (1).

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This sheet is based on information provided by the Director of Urban Services and Director of Agriculture and Fisheries, Hong Kong Government, to whom the TPC is most grateful.

THEACEAE

STATUS Endangered; until recently this very attractive species was only known from a single individual, a small tree about 3 m high discovered in a wooded ravine by Lau in 1955. At the time no other individuals of the species were found within about 100 m. However, in 1972 a group of 18 trees with several seedlings was discovered in another ravine nearly 1 km away, and in 1973 another individual with several seedlings was discovered about 2-3 km away from the original locality. Since the known trees are on the edge of an extensive and more or less impenetrable area of dense trees and shrubs, it has been suggested that it is likely further undiscovered individuals of the species may still exist (Walden, pers. comm.).

DISTRIBUTION Hong Kong; in the water catchment of the Shing Mun Reservoir.

HABITAT AND ECOLOGY On sloping river banks in wooded ravines. The original tree is in partial shade on the edge of a stream bed, at c. 600 m, growing with *Ilex rotunda* Thunb., *Caesalpinia* spp., *Adina* spp. and tall grasses (2). It appears that the individual stems are not coppice shoots as originally thought, as almost all the individuals are multi-stemmed trees and no stump can be recognised.

CONSERVATION MEASURES TAKEN All the trees are located within an area designated as a Site of Special Scientific Interest, where development proposals would be carefully considered. The species is protected under the Countryside and Forests Ordinance: it is an offence to possess or sell any portion of the species except from individuals grown in gardens or imported into Hong Kong.

CONSERVATION MEASURES PROPOSED None on record.

BIOLOGY AND POTENTIAL VALUE The very large white flowers with their mass of golden stamens set against dark green, lustrous leaves make it an attractive horticultural plant with considerable value in the breeding of new cultivars. It has already been widely used for hybridising e.g. with *C. japonica* L., *C. reticulata* Lindl. and *C. saluenensis* Stapf, but also with *Franklinia alatamaha* Marshall (also in the Red Data Book) and *Tutcheria virgata* (Koidz.) Nakai, tending to give to its offspring the characters of its handsome foliage, large undulate petals and late flowering. It is of botanical interest as it is not closely related to any of its congeners (5); the decorative white flowers are particularly large compared with other species in the genus. It usually flowers in October and seeds are ripe by November.

CULTIVATION Propagating material has been widely distributed by the Hong Kong Botanic Gardens (5) so that it is becoming well established

in cultivation in the temperate zone. It can be propagated by cuttings or by grafting on to *C. japonica* (5). Seeds should be sown soon after collecting. It is not frost-hardy.

DESCRIPTION Small tree with dark green, shining, oblong-elliptic leaves 8-11 cm long with slender tips, the margins finely serrate and the veins impressed in the upper surface. Flowers bowl-shaped, 11-14 cm across, with a persistent cup-shaped involucre 4-5 cm wide of about 12 bracteoles and sepals, surrounding 8 large, broadly obovate, overlapping white petals, notched at the tips, enclosing a central boss of numerous stamens c. 2-2.5 cm long with golden anthers 3 mm long. Fruit a woody capsule 4-5 cm across dividing into 5 segments, with dull brown, nearly spherical seeds each c. 13 mm across (5).

For illustrations see (1), (3), (4), (5), (6) and (7).

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The TPC is most grateful to the Director of Agriculture and Fisheries, Hong Kong Government, and to Mrs B.M. Walden for help in preparing this sheet.

Franklinia

THEACEAE

STATUS Extinct in the wild, but rather widespread in cultivation. The reasons for its decline are not certain but over-collecting by nurserymen was probably a factor. Possibly the Franklinia only existed as one population when it was discovered in 1765 by John and William Bartram. It was seen again in 1790 by Moses Marshall and was last seen in its original habitat on 1 June 1803 by John Lyon, who found only 6 or 8 fully grown trees (1-8).

DISTRIBUTION U.S.A.; formerly along the Altamaha River in McIntosh County, Georgia, where it was said to be confined to an area of 1-2 ha (8).

HABITAT AND ECOLOGY It grew in 'sand-hill bog' or 'branch-swamp' on non-alluvial, acid soil at the head of a sand-hill branch. Its associates probably included trees such as *Pinus serotina* Michaux f., *Magnolia virginiana* L. and *Liriodendron* (8).

CONSERVATION MEASURES TAKEN None.

CONSERVATION MEASURES PROPOSED The possibility of re-introducing it in a suitably sited reserve in or near its former locality could be considered.

BIOLOGY AND POTENTIAL VALUE "It is a flowering tree, of the first order for beauty and fragrance of blossoms" (Bartram, quoted in 2). It is indeed a most desirable and attractive species for the garden, with the large, creamy-white flowers appearing from April onwards, the date depending on latitude. *F. alatamaha* is the only species in the genus, which commemorates Dr Benjamin Franklin. It is self-sterile.

CULTIVATION It is widespread in cultivation, both in the Old and New Worlds. The United States National Arboretum (of the U.S. Department of Agriculture, Washington, D.C.) has been distributing seedlings to arboreta and botanic gardens around the world. It is easily raised from seed and requires an acid soil.

DESCRIPTION Deciduous, Camellia-like shrub or small tree up to c. 10 m high with a smooth bark. Leaves oblanceolate to obovate, 6-20 cm long, slightly serrate, downy below. Flowers large and spreading, about 6-12 cm across, with a fragrance like orange blossom and borne on very short stalks towards the end of the branches; sepals more or less rounded, c. 1 cm long, softly hairy; petals obovate, slightly concave, forming a creamy white bowl or saucer, with a tuft of numerous, gold-coloured stamens in the centre. Capsule spherical, woody, c. 1-2 cm across, of 5 chambers, each opening by a slit at the top and bottom

to release the seeds.

For illustrations see (1), (3) and (8).

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The TPC is most grateful to the Endangered Flora Project of the Smithsonian Institution, Washington, D.C., for help in producing this sheet.

THEACEAE

STATUS Endangered. The population apparently consists of three trees, confined to a mountain summit on the border of Panama and Colombia, where it was discovered in 1976. All the trees on one side of the summit are dead or dying, apparently from natural causes, and most of the living trees have sparse canopies and many dead branches. It seems likely that the whole montane thicket in which it grows is unstable and undergoing natural elimination. Although it is acutely threatened, it is "one of the very few endangered species to whose demise man has not contributed" (2). It is not in cultivation.

DISTRIBUTION Colombia, Panama; on the summit of Pico Tacarcuna, the highest point of the Serranía del Darién.

HABITAT AND ECOLOGY Pico Tacarcuna has a unique relict vegetation, described by Gentry in (1). The flat summit at c. 1900 m is covered by open montane thicket very different from the elfin forest of other exposed parts of the massif above 1400 m. *Freziera forerorum* is one of only five tree species which grow on the extreme summit, but unlike the other four, it does not occur lower down the mountain. It is unlikely to be found on other unexplored mountains of eastern Panama since Cerro Tacarcuna is much higher than any other summit in the 600 km lowland gap between the Andes and western Panama, and since the peaks of the other eastern Panamanian mountains are covered with elfin forest rather than the peculiar open montane thicket of Pico Tacarcuna.

CONSERVATION MEASURES TAKEN None.

CONSERVATION MEASURES PROPOSED It is likely that only an early return of Pleistocene climatic fluctuations would save this species in the wild.

BIOLOGY AND POTENTIAL VALUE "This is a truly remarkable plant which may have the most asymmetric leaf base of any angiosperm", with the possible exception of a few members of the *Piperaceae* (2).

DESCRIPTION Slender tree 8 m tall with strongly angled branches. Leaves stalkless, oblanceolate, leathery, 8-18 x 1.8-5.2 cm, pointed at the apex, strikingly asymmetric at the base, the blade on one side attenuate and ending 5-10 mm from the leaf base, on the other side cordate, with an accentuated basal lobe, toothed on the margin. Flowers in clusters of 1 to 3 in the leaf axils or below the leaves, on stalks 3-4 mm long; calyx lobes imbricate, nearly rounded, c. 4 mm long; petals and stamens unknown. Immature fruit small, more or less spherical, 3-4 mm across, with numerous tiny kidney-shaped seeds (2).

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The material for this sheet was supplied by Dr A.H. Gentry (of the Missouri Botanical Garden, St. Louis, U.S.A.), to whom the TPC is most grateful.

THYMELAEACEAE

STATUS Rare; a small mountain shrub of very limited distribution. It is at risk from local people picking branches of the attractive, deliciously fragrant flowers, and is also beginning to be threatened by removal of the plants for rock-gardens. However, only 2 localities are easily accessible, so that in most places there is little danger from collectors.

DISTRIBUTION Czechoslovakia. It is confined to the limestone highlands in the centre of the West Carpathians. Ten localities are known in an area of about 15 x 14 km (3). It very probably survived at least the last glacial period *in situ*.

D. arbuscula is perhaps the best known and most interesting of the West Carpathian endemics that have very small areas of distribution. Other relict endemics of the flora include *Campanula xylocarpa* Kovanda (Rare), *Delphinium oxysepalum* Borbás & Pax, *Saxifraga wahlenbergii* Ball (Rare), *Dianthus nitidus* Waldst. & Kit. and *Koeleria tristis* Domin. The first three grow with *D. arbuscula* in some of its localities.

HABITAT AND ECOLOGY On steep rocks or rocky slopes of Triassic limestone at 750-1300 m, often in crevices. In spite of its relict nature and limited distribution it occurs in various plant communities. On north and west-facing slopes it usually grows in calcareous grassland (with species such as *Campanula carpatica* Jacq., *C. cochlearifolia* Lam., *Cortusa matthioli* L., *Primula auricula* L., and *Saxifraga paniculata* Miller) or in margins of *Calamagrostis* grassland with occasional trees of larch, *Larix decidua* Miller, and Scots Pine, *Pinus sylvestris* L. In its highest localities it grows with montane species such as *Draba aizoides* L., *Dryas octopetala* L. and *Soldanella carpatica* Vierh. It occurs rarely on south-facing rocks with species adapted to hot, dry conditions such as *Alyssum saxatile* L.

CONSERVATION MEASURES TAKEN It is protected by law and several of the localities have been declared as nature reserves.

CONSERVATION MEASURES PROPOSED None on record.

BIOLOGY AND POTENTIAL VALUE The fruits which are sparingly produced ripen very quickly (in 3 weeks) and immediately fall off. The biology of their dispersal is not well understood and various opinions have been expressed (2,3). In the wild the plant seems to spread by rooting of the branches. The populations appear to consist mainly of old plants; stems with a diameter of 35 mm have been shown to be at least 85 years old. This delightful dwarf shrub should be more widely grown in rock-gardens for its dwarf habit, its evergreen leaves and its conspicuous, sweet-smelling, rose-pink flowers; its reputation as being difficult

to cultivate seems to be undeserved (1).

CULTIVATION It is in cultivation and can be propagated vegetatively, but seeds germinate well.

DESCRIPTION Dwarf evergreen shrub up to 30(-50) cm high, with decumbent or ascending, coral-red branches, bearing mainly at their tips crowded, leathery, linear to oblong leaves c. 2 cm long, deeply channelled above, rolled back at the margin. The fragrant flowers are borne in clusters of 4-10 with membranous bracts at the ends of the branches; corolla rose pink, with a narrow tube 12-20 mm long, bearing 4 spreading lobes 5-7 mm. Fruits greyish, finely woolly. The hairiness of the plant, the shape of the leaf and the size and colour of the flower vary, see (1) and (2). The species is closely related to *D. petraea* Leybold, an endemic of the Italian Alps, and *D. striata* Tratt, a wider Alpine endemic.

For illustrations see (1), (2) and (4).

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The material for this sheet was supplied by Dr J. Holub (of the Botanical Institute, Czechoslovak Academy of Science, Průhonice near Prague), to whom the TPC is most grateful. Help is also gratefully acknowledged from Dr O. Svobodová, Director of the State Institute for Protection of Relics and Conservation of Nature, Prague.

THYMELAEACEAE

STATUS Endangered. All or nearly all the population is restricted to a small inshore island of about 70 ha and is at great risk. The adjacent coastline has been highly developed in recent years and is a major tourist attraction.

DISTRIBUTION Balearic Islands. It grows in some abundance on Isla Colom off Menorca. It has also been recorded from a few coastal localities on Menorca itself, but it has not been seen there recently, despite extensive searches by Money-Coutts, Lesouëf and others, and the localities from which it was recorded have been greatly affected by tourist developments (2).

The Balearics have an endemic flora of 52 species and subspecies of flowering plants, of which 21 are believed to be rare or threatened and one Extinct. These tend to be plants of the high mountains, often very rare but not necessarily under any threat, or plants of the lowland maquis communities, threatened by intensified land use and tourist developments. It is remarkable how many of the endemics are attractive garden plants.

HABITAT AND ECOLOGY Isla Colom is "stony and bare, swept by salt spray in winter and baked dry in summer". The species grows in dry, rocky ground and is abundant on much of the island among windswept shrubs of *Pistacia lentiscus* L., *Cistus* and *Erica* (2).

CONSERVATION MEASURES TAKEN None, to the wild population.

CONSERVATION MEASURES PROPOSED Care should be taken that Isla Colom remains undisturbed and that no developments take place that would threaten the survival of *Daphne rodriguezii*.

BIOLOGY AND POTENTIAL VALUE *Daphne* species make good garden plants and this species would be suitable for the rockery or alpine garden.

CULTIVATION It is being grown at the Hortus Balearicus Nursery, Mallorca, and is being distributed to other gardens. "(It) seems to be thriving in the company of a clump of *D. collina* ... and *D. jasminea*", so is presumably not difficult to grow (2).

DESCRIPTION Small dense evergreen dwarf shrub up to 60 cm high, with numerous short lateral branches and more or less smooth greyish bark. Leaves alternate, oblong-oblanceolate, 1-2 cm long, dark green above, lighter below with short fine hairs protruding from the margins. Flowers small and slightly fragrant, in clusters of 1 to 5; corolla 4-lobed, white, with a tube 5-8 mm long and 4 spreading creamy-white lobes 3-5 mm long; bud and tube tinged green or occasionally purple. Fruit

a small greenish-brown drupe.

For an illustration see (1).

REFERENCES 1. Brickell, C.D. & Mathew, B. (1976). *Daphne*, The Genus in the Wild and in Cultivation. Alpine Garden Society, Woking, U.K. Pp. 170-171, frontispiece.

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The type description by J. Texidor y Cos in Apuntes para la Flora de España: 64 (1869) has not been seen.

This sheet is based upon information provided by Mrs L.F. Ferguson to whom the TPC is most grateful.

ULMACEAE

STATUS Endangered; it has become under threat throughout its range as it is constantly lopped by an increasing population for fodder which is fed to cattle, sheep and goats. This kills the trees prematurely and prevents them from reproducing, as the resulting young shoots do not flower for a number of years. On a visit to Kashmir, Himachal Pradesh and Uttar Pradesh in 1960 to study the elms, Heybroek found only 3 flowering trees of this species besides those in the Dachigam Game Reserve, Kashmir, and those on a few inaccessible cliffs. In the past, local people planted specimens in the villages to give a sustained yield of fodder, which was dried and kept for use in the winter. However new types of fodder are mostly replacing elm (2). Local names for this species are 'brare, himri, imroi, mair, marai'.

DISTRIBUTION Afghanistan, India, Nepal, Pakistan. It was formerly frequent but is now scattered from central Nuristan along the Himalayas through Kashmir and into Nepal, reaching 82° 55' E. Subsp. *xanthoderma* occupies the western part and subsp. *wallichiana* the eastern; var. *tomentosa* of the latter is known from only one valley (3).

HABITAT AND ECOLOGY In temperate oak or mixed conifer or *Cedrus deodara* forest, usually in moist situations. It tends to occur in mixed stands with many other deciduous species, often growing near streams. It is found in an altitudinal zone of about 800 m reaching a maximum altitude of 2300-2800 m (3).

CONSERVATION MEASURES TAKEN There is a regenerating colony of subsp. *xanthoderma* in the Dachigam Game Reserve, near Srinagar, Kashmir. A small collection of clones of the 2 subspecies is being maintained at the Forest Research Station, Wageningen, Netherlands.

CONSERVATION MEASURES PROPOSED As recommended by IUFRO: in establishing new game and forest reserves in the Himalayas, attention should be paid to including areas where it occurs. Small stands of it should be planted near the foresters' and wardens' homes, where the trees can be protected from lopping and so can be used to provide seed for forestry use. Groups should consist of at least ten seedlings (clones) of local origin, to provide sufficient cross-pollination.

BIOLOGY AND POTENTIAL VALUE It produces a good quality timber, with many uses (1,4). According to Gamble (1) it "deserves to be much better known ... as a furniture wood". A full description of the wood is given in (4). The fibrous bark was used for making ropes and sandals, and, as mentioned above, the foliage is a favourite fodder for cattle.

The tree has some resistance to Dutch Elm Disease and is being used in breeding programmes to provide resistant forms for amenity planting.

CULTIVATION The seeds do not retain their vitality for long and should be sown immediately; they germinate within a few days. Various methods of vegetative propagation are effective, such as grafting, layering and rooting cuttings under mist in summer.

DESCRIPTION Deciduous tree up to 30 m high with a spreading crown, bearing elliptic leaves 6-15 cm long, doubly serrate on the margin and abruptly tapering into a pointed apex. The minute red flowers are borne in small rounded clusters of 15-30, each cluster on an axis 7-12 mm long, appearing on the bare twigs in spring. Fruit (samara) flat, round and papery, 10-13 mm across, with a central seed (3).

Subsp. *wallichiana* has more or less roughly hairy leaves and fruits that are sparingly hairy over the seed. Its var. *tomentosa* Melville & Heybroek has densely softly hairy leaves and branchlets, and uniformly hairy fruits. Subsp. *xanthoderma* Melville & Heybroek has smooth yellowish branchlets and hairless fruits (3).

For illustrations see (2), (3) and (5).

REFERENCES
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This sheet has been produced from a data sheet compiled for the International Union of Forestry Research Organisations (IUFRO) by Dr H.M. Heybroek. The TPC is most grateful for their help.

UMBELLIFERAE

STATUS Endangered. It is only known from a critically low population. Only 4 or 5 individuals were found in flower in 1971, and there were no flowers when the species was first discovered in 1966, nor any signs of the remains of inflorescences from previous years. The species is particularly susceptible because of its reproductive biology: it is monocarpic (i.e. it dies after flowering), but it passes through a long sterile period first. If the population drops below a certain level, the chance of cross-pollination is so heavily reduced that in the long term extinction becomes almost inevitable. This point may already have been reached, although it is unlikely that the population was much larger in the recent past. Fortunately the locality is inaccessible, probably even to goats, but there is a lack of detailed field information.

DISTRIBUTION Crete. At present it is only known from one locality in the Lévka Óri (White Mountains) (Khaniá Province) above the Plain of Omalos, occurring close to the boundary of the Samarias Ravines National Park.

Out of 155 species known to be endemic to Crete, 101 are believed to be rare or threatened. Fortunately 77 of these fall into the Rare category, reflecting their very localised distribution and, in many cases, their inaccessibility in the mountains, especially in crevices of vertical rock-faces protected from grazing. Much of the endemic flora is of horticultural merit and includes species of *Campanula, Colchicum, Crocus, Dianthus, Ebenus* (Giant Clover), *Helichrysum, Paeonia, Staehelina, Tulipa* and the monotypic genus *Petromarula* of the *Campanulaceae*.

HABITAT AND ECOLOGY In crevices of a single vertical rock-face in an extensive cliff system of thin-bedded, easily disintegrating, metamorphic, calcareous rock ('Plattenkalk'). It grows at 1450 m with *Dianthus juniperinus* Smith, *Odontites linkii* Boiss. subsp. *cretica* (Boiss.) Greuter, *Scabiosa albocincta* Greuter, *Crepis auriculifolia* Sprengel, *Diosphaera jacquinii* (Sieber) Buser and *Onobrychis sphaciotica* Greuter.

CONSERVATION MEASURES TAKEN None.

CONSERVATION MEASURES PROPOSED A detailed search should be made of the surrounding area to see if it occurs elsewhere and a study made as to whether additional protection of the locality is necessary. It should be brought into cultivation as a matter of urgency so that it could be re-established in its original locality if it dies out in the wild.

BIOLOGY AND POTENTIAL VALUE It is of scientific interest as being taxonomically isolated and possibly the only species in the genus *Bupleurum*

with this life-cycle and growth-habit.

DESCRIPTION Monocarpic perennial with a tap root. Sterile plants are up to 12 years old and consist of a single stout unbranched woody stem 1 cm or more thick and about 12 cm long, carrying a tight rosette of 15-30 oblanceolate leaves up to 25 cm long.

Fertile stems are up to 1 m high, arising from the previous year's rosettes, bearing a loose, freely-branched panicle of umbels each with 4-6 rays; bracts and bracteoles 5-9 nerved, herbaceous, c. 3 mm long, obtuse or blunt, ligulate or spathulate; petals yellow; ovaries pruinose (with a waxy secretion or bloom on the surface), smooth. Ripe fruits unknown.

REFERENCE Greuter, W. (1967). Beiträge zur Flora der Südägäis 9. Drei neuentdeckte, unvollständig bekannte kretische Reliktarten. Bauhinia 3: 250-253.

This sheet is based upon information provided by Dr W. Greuter (of the Conservatoire Botanique, Geneva), to whom the TPC is most grateful.

UMBELLIFERAE

STATUS Vulnerable. It was first discovered on Mallorca in 1962, but not seen again for 7 years, despite extensive searches by several botanists. It was re-discovered in 1969, growing "in profusion" in one, almost inaccessible locality on the coast. "(It) may well be more widespread on shaded, precipitous maritime cliffs on the north west of the island; but attempts to study the cliff faces from land were abortive and approach from the sea seems to be the only practical way of investigating these areas successfully" (2). It is apparently restricted to areas inaccessible to goats.

DISTRIBUTION Balearic Islands. It is confined to one or possibly more localities on the coastal cliffs of Mallorca.

The Balearics have an endemic flora of 52 species and subspecies of flowering plants of which 21 are believed to be rare or threatened and one Extinct. These tend to be plants of the high mountains, often very rare but not necessarily under any threat, or plants of the lowland maquis communities, threatened by intensified land use and tourist developments. It is remarkable how many of the endemics are attractive garden plants.

HABITAT AND ECOLOGY On steep, damp limestone cliffs by the sea, facing north and permanently in shade. It forms dense communities on the upper slopes and on eroded ground, generally growing on its own and not persisting with other species. It spreads to form small mats by means of short stolons.

CONSERVATION MEASURES TAKEN None for the wild population.

CONSERVATION MEASURES PROPOSED To preserve the vegetation of the cliff-slopes and to ensure the long-term survival of this species, a coastal reserve is desirable.

BIOLOGY AND POTENTIAL VALUE It is of great interest to studies of plant geography and taxonomy. It is one of a small number of plants from the Balearics with their closest relatives in Australia, New Zealand or Chile, a startling phenomena first noticed by Knoche (3). Such species are now thought to be probably Cretaceous relicts preserved by isolation. It is the only species in the genus and is probably most closely related to *Schizellema* and *Hydrocotyle* of New Zealand and South America, but its relationships are still obscure. It is remarkable among the *Umbelliferae* for its mericarps (fruit lobes) suspended almost free from the flower-stalk and for its well-developed stipules (1).

CULTIVATION It is grown in several gardens, including the Plant Science Botanic Gardens, University of Reading, and the Royal Botanic Gardens, Kew, U.K. It can be propagated from seed or from lateral shoots which root readily at the nodes.

DESCRIPTION Small, delicate, hairless, tufted perennial herb, 2.5-4 cm high, forming mats of rosettes of long-stalked leaves, each with 3 or 5 diminutive, ovate or oblong-ovate leaflets 1.5-5 mm long. Stems with a whorl of 2-4 leaves, each 5-10 mm long and of 3 leaflets, with papery white stipules. From the leaf axils arise simple umbels of 1-8 minute white flowers, the petals 0.3 mm long. Mericarps laterally flattened, truncate and hanging like a pair of minute saddle-bags from the top of the stalk (1).

For an illustration see (1).

REFERENCES 1. Constance, L. & Cannon, J.F.M. (1967). *Naufraga* - a New Genus of *Umbelliferae* from Mallorca. Feddes Reprium 74(1-2): 1-4.
2. Ferguson, L.F. (1971). *Naufraga balearica* Constance & Cannon - Refound. Watsonia 8(3): 294-295.
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This sheet is based upon information provided by Mrs L.F. Ferguson to whom the TPC is most grateful.

VIOLACEAE

STATUS Vulnerable; known from only two populations on the chalk of the Seine Valley where it is threatened in part by urbanisation and the increasing recreational use of its remaining habitat. Collectors may also be a threat.

DISTRIBUTION France; in the Seine Valley near Rouen.

Out of 73 species of flowering plants endemic to France, 7 are Endangered, 10 are Vulnerable and 23 are Rare. Three are Extinct (*Myosotis ruscinonensis* Rouy, also in the Red Data Book, *Minuartia olonensis* (Bonnier) P.Fourn. and *Viola cryana* Gillot). One (*Artemisia insipida* Vill.) is possibly extinct.

HABITAT AND ECOLOGY On steep, unstable chalk slopes, generally exposed to the west or south, sometimes on vertical rocks. This is an unusual habitat, caused here by the exceptional hardness of the chalk. The *Viola* was first discovered on the stony sides of the main road to Rouen and there is some evidence that in one or two places it has shown some power of colonising bare chalk slopes when new roads are being constructed. However, such artificial slopes are an ecologically temporary habitat, as it can be assumed that they will eventually carry a closed grassland or scrub flora in which the *Viola*, a plant of open chalk scree, could not survive.

CONSERVATION MEASURES TAKEN None known.

CONSERVATION MEASURES PROPOSED None on record.

BIOLOGY AND POTENTIAL VALUE It is a very attractive small plant for rock-gardens and is also of ecological interest. It is similar to *Viola cryana* Gillot which occurred on chalk slopes in north central France but is now extinct. Its exact taxonomic status is still apparently uncertain; its close affinities are not evident and it deserves further investigation. It apparently hybridises with *V. tricolor* L.

CULTIVATION It is easy to grow and spreads by runners, although propagation from seed is said to be difficult. A west or south-west, well-drained slope is reputed to be best; very dry, hot slopes should be avoided as should excessive humidity or deep shade. Details of cultivation are given in (3).

DESCRIPTION Tangled hairy perennial herb with stems up to 25 cm and leaves 1-3 cm long on stalks of similar length, the lower leaves rounded to cordate and upper more or less ovate, usually with a crenate margin. In the axils are conspicuous stipules mostly about 1-2 cm long and

palmately lobed. Flowers c. 2 cm, violet or yellowish, with 5 petals, the lower of which exceeds the others and has a sac-like spur c. 4 mm long projecting behind the flower. Fruit a capsule splitting into 3 segments when ripe. (Syn. *V. rothomagensis* auct.)

For illustrations see (1) and (3).

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4. Rouy, G. & Foucaud, J. (1896). Flore de France, Vol. 3. p. 52. (as *V. rothomagensis*).

The TPC is most grateful to Dr J. Raynal, of the Muséum National d'Histoire Naturelle, Paris, for help in producing this sheet.

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