GOBIERNO DE CHILE
FUNDACIÓN PARA LA INNOVACIÓN AGRARIA

CONTENIDO DEL INFORME TÉCNICO

PROGRAMA DE FORMACIÓN PARA LA INNOVACIÓN AGRARIA

1. Antecedentes Generales de la Propuesta

Nombre **Simposio Internacional de Helechos**

Código **F01-1-PI-028**

Entidad Responsable Postulante Individual **Anja George**

Coordinador

Lugar de Formación (País, Región, Ciudad, Localidad) **Gran Bretaña, Universidad de Surrey**

Tipo o modalidad de Formación **Simposio**

Fecha de realización **22 al 26 de julio del 2001**

Participantes: *presentación de acuerdo al siguiente cuadro:*

Nombre	Institución/Empresa	Cargo/Actividad	Tipo Productor (si corresponde)
Anja George	Vivero Río Tijeral	Propietaria	viverista

Problema a Resolver: detallar brevemente el problema que se pretendía resolver con la participación en la actividad de formación, a nivel local, regional y/o nacional.

Con la participación en el Simposio se pretendió acceder a información sobre la conservación y reproducción de helechos nativos en otros países, como también conocer las realidades actuales de los diferentes países participantes.

Objetivos de la Propuesta

El objetivo general era:

- Conocer las realidades de la conservación y de la propagación de helechos nativos de otros países.

Los objetivos específicos eran:

- Conocer el estado de conservación de helechos en todo el mundo, incluyendo Chile, considerando los factores que amenazan realmente a los helechos en su hábitat natural.

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- Obtener información acerca de las acciones de conservación que se realizan en la propagación y creación de jardines botánicos.
- Reunir información acerca de la protección de la flora nativa de un país para evitar su explotación por naciones extranjeras.
- Contactar personas del ámbito de la investigación y de la producción de plantas para evaluar un posible trabajo en conjunto.
- Estudiar la posibilidad de construir una banca de esporas de las especies en peligro en Chile.
- Inscribirse como miembro de la British Pteridological Society.

2. Antecedentes Generales: describir si se lograron adquirir los conocimientos y/o experiencias en la actividad en la cual se participó (no más de 2 páginas).

Durante el Simposio se presentaron mas de 35 charlas cada una con duración de 25 minutos como máximo. Esto permitió adquirir una imagen general del tema pero no aprender un tema en especial, ya que por la cantidad de las exposiciones las presentaciones no fueron muy detalladas.
Hubieron presentaciones de países de todo el mundo, pero Sudamérica tuvo solo una charla presentada por un profesional de Brasil.
El punto más destacable fue la posibilidad de conocer las diferentes realidades en cuanto a trabajos relacionados con helechos. Existe un proyecto muy parecido al que se esta ejecutando en el Vivero Río Tijeral. Este proyecto se realiza en la Isla Mauritius cerca de la costa este de Africa. Una gran diferencia con respecto al proyecto que se ejecuta en el vivero Río Tijeral es que el financiamiento no es parcialmente privado. Una parte del proyecto lo financia el gobierno de Gran Bretaña y la otra parte Mauritius.
Como observación general se podría afirmar que los estudios sobre helechos de países subdesarrollados o en vía de desarrollo no son realizados por ellos mismos, sino por países de alto nivel tecnológico y de desarrollo. La mayoría de la investigación se realiza en Gran Bretaña, Alemania, Estados Unidos y Europa en general. Los profesionales estudian con mucho interés las especies de regiones tropicales. Esto se debe en primer lugar a la falta de fondos en los países subdesarrollados y también a la falta de interés. Por otro lado se está realizando algo de investigación a nivel local, pero los profesionales no cuentan con los recursos para participar en eventos como este simposio. Ya que la matricula equivale a un sueldo de un mes, como es el caso de la India.
Se presentó un póster acerca de una especie de Blechnum chilena pero el investigador es un profesional español
Uno de los aspectos mas destacables fue la posibilidad de contactar esas personas y de esa manera establecer un posible trabajo en conjunto. Se conversó con los especialistas españoles para ver la posibilidad de que ellos ayuden en el estudio de las esporas de las especies en estudio en el proyecto.
También se vio la posibilidad de ubicar un lugar para realizar pasantías y practicas en el extranjero.

3. **Itinerario Realizado**: presentación de acuerdo al siguiente cuadro:

Fecha	Actividad	Objetivo	Lugar
20.07.01	Viaje Osorno - Santiago		
21.07.01	Viaje Santiago - London		
23.07.01	Asistencia simposio	Conocer las amenazas internacionales para los helechos, analizando factores de riesgo.	Universidad de Surrey
24.07.01	Asistencia simposio	Conocer las respuestas a los problemas planteados el día anterior.	Universidad de Surrey
25.07.01	Excursión	Ver ejemplos de lugares en estado de conservación con especies que figuran en la lista roja.	Chobham, Thursley, Holmwood Common
26.07.01	Asistencia simposio	Analizar las acciones posibles para ayudar en la conservación de los helechos.	Universidad de Surrey

Se cambiaron los sitios de la excursión anteriormente planificados ya que el sector de Newforest estaba cerrado por el problema de la fiebre aftosa.

4. Resultados Obtenidos: descripción detallada de los conocimientos adquiridos. Explicar el grado de cumplimiento de los objetivos propuestos, de acuerdo a los resultados obtenidos. Incorporar en este punto fotografías relevantes que contribuyan a describir las actividades realizadas.

Se puede afirmar que se cumplieron la mayoría de los objetivos y en caso de que no fue así se contactaron personas para seguir trabajando en el tema.

Se vió que en muchos países el grado de destrucción de la flora nativa es mucho mas avanzado que en Chile, pero que por el otro lado se está haciendo mucho mas para estudiar las especies en peligro. En algunos casos las especies son representadas por pocos individuos. En Chile todavía tenemos el lujo de poder observar muchas especies en su hábitat natural, pero quedó muy en claro que al paso que va la destrucción de los bosques naturales es inminente la desaparición de especies endémicas de Chile. Aún se sabe muy poco de ellas como para asegurar una conservación exitosa.
Un punto clave en la conservación es la valorización de las cosas. Cuando una planta no tiene valor comercial es fácilmente eliminada, pero los coleccionistas de helechos en todo el mundo elevan el valor de las especies, ya que son capaz de pagar mucho dinero por una planta con el fin de completar una colección. Esto ayuda en la conservación pero no puede ser la única forma de hacerlo.
La mayor parte de la investigación se realiza en Universidades estatales con financiamiento estatal, sin la necesidad que la especie en estudio sea comercialmente interesante.
En todo el mundo existe el intercambio de esporas y material vegetal en general con fines de investigación. Si en Chile no queremos participar en este intercambio para no perder el

material genético debemos realizar las investigaciones nosotros. Falta hacer investigación seria continua y constante a nivel de académicos universitarios para llegar a obtener resultados interesantes.
En algunas especies su conservación solo es asegurada en jardines botánicos o a nivel de la jardinería particular y en los viveros. Este no es el caso de las especies del sur de Chile pero podría ser para los helechos de las islas de Juan Fernández, que causan mucho interés a nivel mundial pero que no son realmente estudiados aquí en Chile.
Para poder establecer una banca de esporas en Chile falta mucho camino por recorrer. Este es un tema de un alto nivel técnico y de un costo muy elevado. Se está realizando en un Jardín en Estados Unidos. Se conversó con la encargada del programa sobre la posibilidad de realizar una práctica de uno o dos meses en el Jardín.
Se hicieron contactos muy interesantes con personas que trabajan las mismas especies que nosotros en el proyecto:

1. Prof.Dr.F.Javier Amigo, Sonia Aguiar(España) — Blechnum sp.
2. Mr. John Burrows (Sud Africa) — Rumohra adiantiformis
3. Dr. Klaus Mehltreter, Monica Palacios (Mexico) — Lophosoria quadripinnata y Gleichenia
4. Prof. Paulo Windisch (Brasil) — Rumohra adiantiformis

5. Aplicabilidad: explicar la situación actual del rubro en Chile (región), compararla con la tendencias y perspectivas en el país (región) visitado y explicar la posible incorporación de los conocimientos adquiridos, en el corto, mediano o largo plazo, los procesos de adaptación necesarios, las zonas potenciales y los apoyos tanto técnicos como financieros necesarios para hacer posible su incorporación en nuestro país (región).

Es difícil relacionar los temas expuestos en el simposio con la aplicabilidad en nuestro país, ya que se trata principalmente de investigación científica a nivel de Universidades e Instituciones gubernamentales. Pero se podría intentar de reunir todas las personas que trabajan en la investigación y el cultivo de especies nativas chilenas, tanto de helechos como también de otras plantas, para desarrollar una estrategia en conjunto y presentarla al gobierno. Después de la transmisión del programa Tierra Adentro he recibido muchas llamadas telefónicas de personas interesadas en el tema, pero por falta de tiempo y de medios no me ha sido posible canalizar todas esas inquietudes y responder a toda las consultas. Sería interesante organizar un evento de esta índole para que las personas se puedan juntar e intercambiar opiniones y experiencias. Otra forma de avanzar en el área es buscando aliados internacionales que cuentan con los recursos para invertir en investigación y de esa manera concretar algunos proyectos con especies chilenas. (como ejemplo ver el proyecto realizado en Mauritius)

6. Contactos Establecidos: presentación de acuerdo al siguiente cuadro:

Ver lista completa de participantes en el anexo N°1

Institución/Empresa	Persona de Contacto	Cargo/Actividad	Fono/Fax	Dirección	E-mail
Universidad Santiago Compostella	Prof. Dr. Javier Amigo	Lab. De Botánica		E-15782 Santiago De Compostela	bvherbar @usc.es
Jardin Botánico de	Dr. Ana Ibars	Dir.Jardin Botánico		46008 Valencia	ana.ibars

Valencia		De Valencia			@uv.es
Inst. De Ecologia	MSc. Monica Palacios	Dpto. Ecol. Vegetal		Apartado Postal 63 Xalapa 91000 Veracruz,Mexico	Monica@ecologia.edu.mx
Cincinnati Zoo and Botanical Garden	Dr. Valerie Pence	Center for Research Of Endangered Wildlife		3400 Vine Street, Cincinnati USA	vcpence@aol.com

7. Detección de nuevas oportunidades y aspectos que quedan por abordar: señalar aquellas iniciativas detectadas en la actividad de formación, que significan un aporte para el rubro en el marco de los objetivos de la propuesta, como por ejemplo la posibilidad de realizar nuevos cursos, participar en ferias y establecer posibles contactos o convenios. Indicar además, en función de los resultados obtenidos, los aspectos y vacíos tecnológicos que aún quedan por abordar para la modernización del rubro.

- Se deberá incentivar el estudio de las especies endémicas chilenas en especial, sin considerar solo la factibilidad económica de una especie.
- Se deberá facilitar el acceso a información para personas interesadas en el rubro y en especies nativas en general.
- Las Universidades y los académicos que ahí trabajan deberán ser mas abiertos con la entrega de información a particulares y se deberán establecer trabajos en conjunto con instituciones de investigación, viveristas y personas interesadas.
- Los costos para poder asistir a un evento siguen siendo muy elevados. (En este caso aprox. $ 500.000. -), lo cual hace imposible que muchas personas participen en actividades internacionales.
- Es muy importante mantener un contacto constante con Instituciones y persones de todo el mundo y viajar para no perder el contacto y vivir en el aislamiento. Esto es importante sobre todo para el sur de Chile que esta bastante aislado, ya que la mayoría de las actividades se realizan en Santiago.

8. Resultados adicionales: capacidades adquiridas por el grupo o entidad responsable, como por ejemplo, formación de una organización, incorporación (compra) de alguna maquinaria, desarrollo de un proyecto, firma de un convenio, etc.

Ya que no se trataba de una actividad de capacitación no se puede hablar de conocimientos adquiridos, pero se pudo concretar una visita para fines de Noviembre de un pequeño grupo de productores de helechos de Gran Bretaña. Este viaje tiene como objetivo de conocer Chile en primer lugar y de ver la situación de los helechos nativos y probablemente buscar alguna especie interesante para el mercado europeo.

9. Material Recopilado: junto con el informe técnico se debe entregar un set de todo el material recopilado durante la actividad de formación (escrito y audiovisual) ordenado de acuerdo al cuadro que se presenta a continuación (deben señalarse aquí las fotografías incorporadas en el punto 4):

Tipo de Material	Nº Correlativo (si es necesario)	Caracterización (título)
Lista de participantes	1	Delegate list
Publicación	2	Review of the Darwin Fern Project
Paper	3	Aire de repartition et status de Trichomanes speciosum Willd. Au Luxembourg
Proyecto	4	A Case Study of the Sustainable Production of Tree Ferns in South-East Australia
Triptico	5	Maquique,Pesma or the Xaxim, and the Preservation of Tree-Ferns
Articulo	6	Der Gebrauch von Maquique und die Gefährdung der Baumfarne Mexikos
Poster	7	The Distribution of Theatened Pteridophytes in the Philippines
Abstracts Simposium	8	Abstracts
Resumen informativo	9	Field Excursionsto Chobham, Thursley and Holmwood Commons 25 th July 2001
Formulario Inscripcion	10	International Association of Pteridologists
Diptico	11	Science for Plant Conservatio – An International Conference for Botanic Gardens
Formulario de Inscripcion	12	British Pteridological Society
Certificado	13	Certificate of Attendance
Paper	14	Preparation of Action Plans
Abstract	15	A topic for discussion :Is fern conservation in the tropics possible?

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10. Aspectos Administrativos

10.1. Organización previa a la actividad de formación

a. Conformación del grupo

____ muy dificultosa ____ sin problemas ____ algunas dificultades

(Indicar los motivos en caso de dificultades)

b. Apoyo de la Entidad Responsable

____ bueno ____ regular ____ malo

(Justificar)

c. Información recibida durante la actividad de formación

____ amplia y detallada ____ aceptable ____ deficiente

d. Trámites de viaje (visa, pasajes, otros)

____ bueno ____ regular ____ malo

e. Recomendaciones (señalar aquellas recomendaciones que puedan aportar a mejorar los aspectos administrativos antes indicados)

10.2. Organización durante la actividad (indicar con cruces)

Ítem	Bueno	Regular	Malo
Recepción en país o región de destino	X		
Transporte aeropuerto/hotel y viceversa	X		
Reserva en hoteles	X		
Cumplimiento del programa y horarios	X		

En caso de existir un ítem Malo o Regular, señalar los problemas enfrentados durante el desarrollo de la actividad de formación, la forma como fueron abordados y las sugerencias que puedan aportar a mejorar los aspectos organizacionales de las actividades de formación a futuro.

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11. Conclusiones Finales

12. Conclusiones Individuales: anexar las conclusiones individuales de cada uno de los participantes de la actividad de formación, incluyendo el nivel de satisfacción de los objetivos personales (no más de 1 página y media por participante).

Para mi era muy provechoso participar en esta actividad, ya que permitió darme cuenta que estoy en la dirección correcta en cuanto al proyecto que coordino. Existen actividades muy parecidas en otras partes del mundo y las personas se han enfrentado al igual que nosotros a los problemas más diversos. Como por ejemplo esperar por meses la germinación de las esporas. Es muy importante contar con un titulo académico elevado pero finalmente la capacidad practica es la que lleva a obtener resultados. Creo que nosotros hemos estado trabajando con la tecnología mínima posible pero aun así hemos logrado resultados muy satisfactorios. El trabajo realizado en el Vivero Río Tijeral llama la atención a personas relacionados con helechos y existe mucho interés por parte de diferentes personas de conocer nuestra realidad.
Es importante mantenerse en contacto vía e-mail con las personas pero creo que es irreemplazable la participación en actividades internacionales para mostrar presencia e interés, renovar contactos y estar siempre familiarizado con los temas relacionadas al rubro.

Fecha: 28.08.2001

Nombre y Firma coordinador de la ejecución: Anja George

Anja George

AÑO 2001

An International Symposium 23-26 July 2001

fern flora worldwide
threats and responses

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REVIEW OF THE DARWIN MAURITIUS FERN PROJECT

by

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The National Parks and Conservation Service

Introduction

Mauritius is recognised as a biodiversity "hotspot" in the world. About seven hundred species of native plants exist out of which three hundred and eleven are endemic. The survival of most of these unique plants, including all the endemic fern species, is seriously threatened by habitat destruction. Today only 2% of our native forests still exists and even these are in various stages of degradation.

Following the Rio Summit in 1992 on the environment, the British government decided to fund specific conservation projects around the world under the Darwin Initiative for Species Survival Scheme.

This paper reviews the progress accomplished to date, and also describes the different techniques of fern propagation used.

Project justification

Ferns have received relatively little attention in terms of conservation initiatives and biodiversity studies in Mauritius. The aim of the project is to survey, monitor, propagate and restore the population of ferns in the wild. The propagation activity will also provide spores for research as well as make available plants to the public, thus resulting in less depletion of the natural ferns population.

Survey

Dr. Stuart Lindsay, a Senior Scientific Officer of the Royal Botanic Gardens of Edinburgh (RBGE), Scotland, as Project Manager, first visited the island in 1995 and carried out a comprehensive survey of the ferns and fern allies, with the staff of the National Parks and Conservation Service, the Mauritius Sugar Industry Research Institute (MSIRI) herbarium, the Mauritius Wildlife Foundation and local botanists.

Species which are known exclusively from cultivation were not surveyed. Investigations were also carried out at the MSIRI herbarium, the Kew Garden herbarium and the Paris herbarium, to identify several Mauritian fern species.

In the recent past, there were two hundred and fifty different species of fern in Mauritius. Approximately fifty of these have not been seen in the last thirty years suggesting that they are now probably extinct. Of the two hundred species existing today, at least seventeen are endemic to Mauritius, a further thirty are endemic to the Mascarene Islands and thirty three are found only in Madagascar and the Mascarene Islands.

The potentially new *Asplenium* species discovered in Mauritius at Yemen, and the new *Blechnum* species discovered at Tamarin Falls, are not new to science. The *Asplenium* proved to be a stunted montane form of *Asplenium aethiopicum*, a species already widely distributed (in a larger and lusher form) in the forests of Mauritius and is identical to montane forms of *A. aethiopicum* from Madagascar.

The *Blechnum* proved to be *Blechnum brasiliense*. This species has never been reported from any of the Mascarene Islands. It is a non-native and weedy species that has the potential to spread rapidly in forest margins.

The greatest threat is the invasion and destruction of their few remaining habitats by alien invasive species such as *Rubus alceifolius* ("piquant loulou"), *Ligustrum robustrum* var *walkerii* ("privet") and *Psidium cattleianum* ("goyave de Chine").

The second threat is the increasing number of "fern hunters" who harvest ferns from the forests in large quantities either for their own gardens or for selling. Indigenous fern collection from the wild is illegal in Mauritius, but many people still take the risk, and considerable losses are occurring.

Establishment of a fern house

A fern house was erected at Robinson road, Curepipe to raise a wide range of pteridophytes species both epiphytes and terrestrials. This location was selected as it offers the ideal conditions for the growth of ferns. The fern house comprises a laboratory for the propagation of ferns by spores, cuttings and bulbils. It is also equipped with a mist control unit. A wide range of growing media has been developed using local materials such as pine barks, coconut husks and sugarcane bagasse. A pasteuriser with eight heating elements was built for sterilising the growing media. Containers ranging from 8 cm to 18 cm in diametre for both epiphytes and terrestrials were used.

Training

Two members of staff, one Technical Officer and one Nurseryman, were trained in plant collection, management, propagation techniques, growing medium preparation, fertilizer supplementation and pests and diseases identification and their control. The training was undertaken at RBGE in 1997 under the supervision of experienced horticultural staff in tropical and subtropical ferns. It emphasized on techniques that were appropriate for the level of facilities available and sustainable in Mauritius.

A one-day workshop was also organised in Mauritius during the third visit of the Project Manager, Dr. S. Lindsay, in collaboration with the staff of the NPCS.

Fern propagation

Techniques for propagation used in the nursery at Curepipe are described below:-

Vegetative Propagation

(i) Cuttings

Any fern having a short creeping habit (e.g. *Dryopteris* spp. and *Bolbitis* spp.) can be propagated by cuttings. Clumps can simply be broken apart by hand or with a sharp knife or secateurs. This should be done when the plants are actively growing. It is the simplest but least productive method of propagation.

(ii) Rhizome cuttings

Part of plants with thick fleshy rhizomes can be removed from the plants, cut into sections at least 5 cm long and pinned down onto any free draining compost using loops of wire (**Fig. 1**). They are then placed in a warm humid place. The cuttings normally root and start growing in two to four months.

Fig. 1 *Rhizome cuttings of Phymatodes scolopendria on compost*

For plants with thin rhizomes (e.g. *Humata repens*) the same method is used but with 10 cm cuttings.

(iii) Bulbils

There are two methods of propagation from bulbils:-

(a) The frond with bulbils is layered directly in the soil or in a pot of compost (**Fig. 2**).

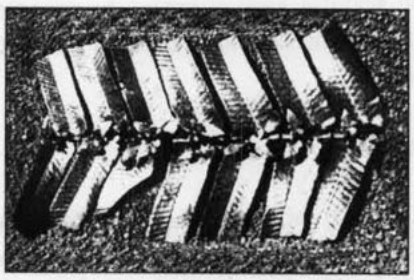

Fig 2. *The frond with bulbils of Diplazium proliferum on compost*

(b) The bulbils are removed from the frond and grown in trays of compost in a warm humid place.

For plants with less developed bulbils (e.g. *Asplenium viviparum*), the latter usually drop off the plants at an early stage and develop separately. The bulbils are simply brushed off the frond onto a tray of compost and placed in a warm and humid environment (**Fig. 3**).

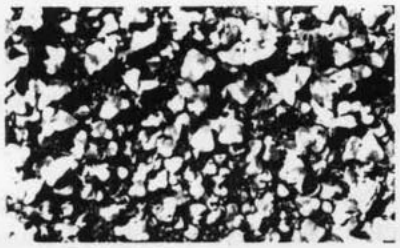

Fig. 3 *Bulbils of Asplenium viviparum*

The use of bulbils is a very quick and successful method of propagation and vigorous plants are produced within four months.

(iv) Auricles

Auricles (in the Marathiaceae family) found at the base of the stipe are removed and buried in compost. They develop shoots within two months. Auricles from younger plants tend to be more successful than from older plants.

(v) Aerial growth

Some species of Tassel fern (e.g. *Lycopodium* spp.) produce aerial growths near the tips of the fronds (**Fig. 4**). The aerial growths are put in a suitable compost, become established and eventually become separate plants.

Fig. 4 *Tips of the fronds of Lycopodium gnidioides*

Propagation from spores

Spore collection

The spores are collected just before the sporangia open. It is not easy to decide on the correct timing of spore collection and trial and error is necessary.

Once the fronds with mature sporangia have been collected, they are then placed between two sheets of paper and left in a warm place to dry out and dehisce (**Fig. 5**).

Fig. 5 *The spores dehisce and stick to the lower sheet of paper (seen as dark patches)*

Sowing

Although spores remain viable for many months if kept in a cool dry place, the sooner they are sown, the better the germination will be.

A mixture of two parts of finely ground pine barks and one part of sand is used as compost. This is put in clay or plastic pots. The compost and the pots are sterilised by using boiling water. The pots with compost are covered with cling film (until sowing) and allowed to cool. The spores are then sprinkled on clean white paper which are then gently tapped to remove the chaff. The minute spores remain stuck to the paper. The paper is then turned over the pot and flicked to sow the spores. The pots are finally wrapped again with cling film and placed in shaded places.

Photographs by Audiovisual Unit Agricultural Information Division

Germination takes place between ten days to five months and will be seen as a green film on the surface of the compost which will eventually develop into mature prothalli.

Patching - off

Once the sporophytes are big enough to handle, they are transferred to other pots and kept in a humid environment (**Fig. 6**). They are then gradually hardened off before being placed in the open.

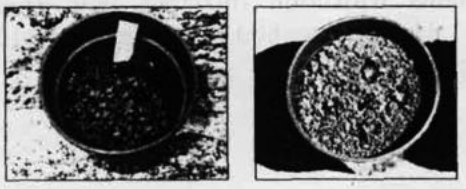

Fig. 6 *Transfer of sporophytes to individual pots*

Problem encountered

The main problem encountered with spore sowing is contamination from other spores of more vigorous weed ferns, mosses, fungi and algae. The best way of overcoming this is to have the sowing area completely separated from the growing area and keeping it as clean as possible.

Conclusion

To date, out of the two hundred and fifty pteridophytes, ninety species are in cultivation in the fern house for display to the public and students in order to inculcate the concept of conservation of endangered species. It is also providing spores for propagation and materials for researchers.

Ferns have a tremendous aesthetic appeal and are popular subjects for indoor cultivation. Hence extra plants will be made available to the public. This will help prevent people from collecting ferns in the wild.

To Anja.
With best wishes
Yves

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Aire de répartition et statut de *Trichomanes speciosum* Willd. (Hymenophyllaceae) au Luxembourg

par

Yves KRIPPEL [1])

Abstract: A description of the gametophyte of the filmy fern *Trichomanes speciosum* Willd. (Hymenophyllaceae), the history of its discovery, the present distribution and status in Luxembourg is given. The species is growing in Luxembourg as an 'independent gametophyte' with vegetative reproduction and dispersion by the way of gemmae. Currently, 100 sites in 69 kilometric squares are known. Most of the sites occur in the 'Petite Suisse' area, but the gametophyte of *T. speciosum* is largely present in the whole sandstone area as far as the valley of the river Alzette. The recent discoveries of the gametophyte on Devonian schist seem to indicate that the species may also be quite widespread in the Luxembourg Ardennes.

Keywords: Pteridophyta, Hymenophyllaccae, *Trichomanes*, gametophyte, distribution, Luxembourg.

1. Introduction

La Petite Suisse luxembourgeoise est connue bien au-delà des frontières du Grand-Duché pour la présence d'*Hymenophyllum tunbrigense* (L.) Smith au niveau de quelques gorges près de Berdorf. Or, depuis quelques années un deuxième représentant de la famille des Hymenophyllaceae est connu dans cette région. Ce fut en avril 1993, que Rasbach et al. (1993, 1995) ont découvert *Trichomanes speciosum* Willd. à l'intérieur du continent européen et plus précisément dans la Petite Suisse luxembourgeoise. Si la famille des Hymenophyllaceae est particulièrement bien représentée dans les régions tropicales et subtropicales, où elle compte 400 à 650 espèces, les représentants de cette famille sont beaucoup plus rares en dehors des tropiques. En Europe on n'en connaît que trois espèces, à savoir *H. tunbrigense* (L.) Smith, *H. wilsonii* Hook. et *T. speciosum* Willd. Chez ces espèces, comme dans la vie de toute fougère, on distingue habituellement deux stades différents, d'une part le sporophyte (la plante 'feuillée'), d'autre part le gamétophyte ou prothalle, qui en général n'a qu'une durée de vie limitée. Or, chez certaines familles, comme les Vittariaceae ou les Hymenophyllaceae, les prothalles peuvent exister, se maintenir et se multiplier de manière végétative avec dispersion par voie de gemmes, sans l'apparition de sporophytes (Farrar 1967, 1985). Aux Etats-Unis on rapporte des espèces qui ne sont représentées que par leur seul gamétophyte ou par celui-ci et des feuilles ne dépassant pas le stade juvénile (Raine et al. 1991, Farrar 1992, 1993).

Suite à la première observation de gamétophytes indépendants de *Trichomanes speciosum* pour l'Europe en 1989 dans les Iles Britanniques, on a constaté une grande

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différence dans la répartition du gamétophyte et du sporophyte (Rumsey et al. 1990, 1998, 1999, Rumsey & Sheffield 1996). En effet, le sporophyte de *T. speciosum* (fig. 1), très rare, est caractérisé par une distribution extrêmement océanique (Jalas & Suominen 1972, Page 1997) comme sur les côtes ouest en Irlande et en Grande-Bretagne, le long des côtes de Bretagne en France, au Pays Basque, le long de la côte cantabrique espagnole, ainsi qu'aux Açores, à Madère et aux îles Canaries. Une station isolée est actuellement connue dans les Alpes apuanes en Italie. Même si Rasbach et al. (1995, 1999) signalent de jeunes sporophytes dans les Vosges, ces plantules ne semblent pas se développer jusqu'au stade adulte dans nos régions. Au contraire du sporophyte, la génération gamétophytique et, notamment les gemmes sont nettement plus tolérantes envers la dessiccation et le gel (Farrar 1985), avec le résultat que le gamétophyte de certaines espèces, comme par exemple celui de *T. speciosum* dans nos régions, peut survivre et coloniser des sites où le sporophyte a disparu depuis longtemps. Le prothalle de *T. speciosum*, qui pousse généralement dans des fentes, des cavités d'érosion ou des grottes est donc bien représenté dans des régions à caractère nettement moins océanique et peut être trouvé à plus de 1.000 kilomètres de la population de sporophyte la plus proche (Rumsey et al. 1990, Vogel et al. 1993). Après sa découverte dans la Petite Suisse luxembourgeoise, le gamétophyte de *T. speciosum* a été trouvé à de nombreuses reprises sur le continent, entre autres dans les Vosges (Rasbach et al. 1993, 1995, 1999, Jérôme et al. 1994, Bizot 2000), en Saxe dans l'Elbsandsteingebirge (Vogel et al. 1993), en Rhénanie du Nord - Westphalie (Bennert et al. 1994), en Rhénanie-Palatinat (Rasbach et al 1993, Bujnoch & Kottke 1994, Bujnoch 1995, 1996, 2000, Kottke 1999) et en Bavière (Kirsch & Bennert 1996, Horn & Elsner 1997).

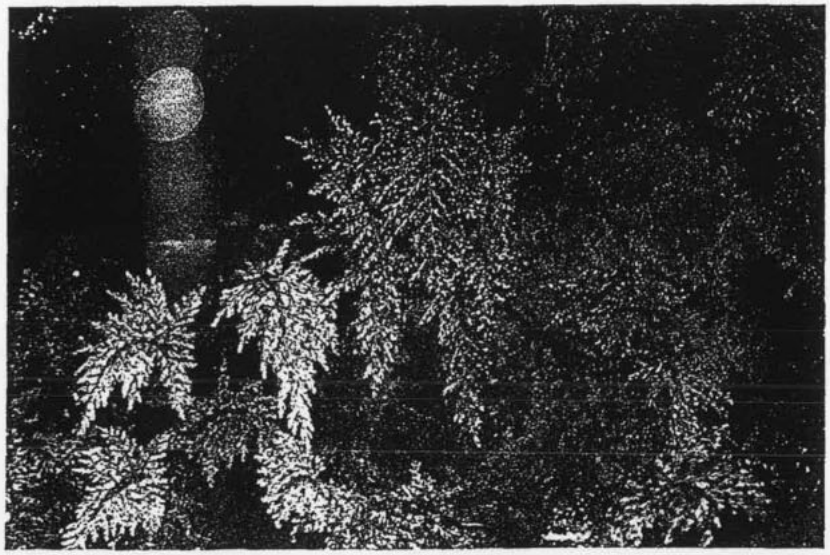

Fig. 1. Le sporophyte de *Trichomanes speciosum* dans une de ses rares stations en Grande-Bretagne (photo prise par l'auteur en avril 2000). Les frondes, finement disséquées, ont une taille de 20 à 45 cm et une forme grossièrement ovale à ovale-lancéolée.

Fig. 2. Le gamétophyte de *Trichomanes speciosum* recouvrant une partie du plafond d'une cavité d'érosion au niveau d'un affleurement de grès de Luxembourg, en milieu forestier, près de Schoos (photo prise par l'auteur en février 2000).

En ce qui concerne le Luxembourg, des prospections ponctuelles ont révélé quelques stations supplémentaires dans la Petite Suisse luxembourgeoise (Colling & Reichling 1996, Reichling 1997, Colling & Krippel 2001); toutefois, aucune recherche systématique n'avait jamais été effectuée jusqu'à ce jour. Comme *Trichomanes speciosum* et *Dicranum viride* représentent les deux seules espèces du règne végétal parmi les espèces de la liste de l'annexe II de la directive 'Habitats', présentes au Luxembourg, il semblait cependant intéressant de mieux connaître la distribution de *T. speciosum*. En 1999 et 2000, la région du grès de Luxembourg fut donc prospectée de manière systématique dans le but de rechercher le gamétophyte, de localiser les stations de l'espèce, d'évaluer si possible l'état et/ou la taille des populations et de définir les caractéristiques des stations.

2. Description du gamétophyte de *Trichomanes speciosum*

A l'œil nu, le gamétophyte de *Trichomanes speciosum* (fig. 2) se présente sous forme de flocons, coussinets ou tapis, constitués de filaments extrêmement fins. A l'état hydraté, sa couleur est d'un vert franc, presque fluorescent. En se déshydratant, la couleur passe au vert-bleu métallique. La consistance et l'aspect de ces flocons, coussinets ou tapis étant très caractéristiques, leur présences ne peuvent en principe échapper à un œil exercé. La structure du gamétophyte sous le microscope est assez spectaculaire. C'est d'ailleurs la méthode à 100% sûre de le distinguer de certaines algues vertes filamenteuses ou du protonéma de certaines mousses. Le gamétophyte de *T. speciosum* est constitué de filaments qui sont disposés à angle droit et formés

de cellules de ± 40-55 µm d'épaisseur et 150-300 µm de longueur (Rumsey & Jermy 1998). L'analyse microscopique montre également les nombreux chloroplastes (ce qui permet entre autres la distinction par rapport à une algue verte) ainsi que les cloisons transversales, de même que la présence de fins rhizoïdes, de gemmes et de gemmiphores (ce qui permet la distinction par rapport au protonéma de certaines mousses) (figs 4 & 5). Les principaux caractères sont déjà bien observables avec une bonne loupe (par exemple sous un grossissement de 20x), même sur le terrain.

Notons que la petite taille de ce gamétophyte et ses habitats peu accessibles ne facilitent pas sa découverte. Comme il pousse au plus profond de cavernes, cavités d'érosion et fentes rocheuses, il n'est en général observable dans son milieu naturel qu'à l'aide d'une torche électrique. L'espèce s'adapte cependant parfaitement à ces endroits confinés, d'autant plus que la faible luminosité empêche en grande partie le développement d'espèces concurrentes. Selon Rumsey & Sheffield (1996), le prothalle de *Trichomanes speciosum* occupe des microsites ne présentant, en moyenne, que 1% de la radiation photosynthétiquement utile par rapport à des mesures effectuées à l'extérieur. En l'absence de toute concurrence, le gamétophyte forme des colonies presque pures, mais celles-ci peuvent être entremêlées de bryophytes aux endroits plus exposés. La surface qu'occupent les colonies peut varier de quelques mm² à plusieurs dm²; leur épaisseur peut varier de ± 1 mm à ± 1 cm.

3. Matériel et méthodes

Le but de la recherche était de délimiter l'aire de répartition de *Trichomanes speciosum* au Luxembourg. Suite aux premières découvertes en Petite Suisse et vu l'abondance des stations trouvées sur substrat gréseux (grès liassique, grès bigarré, etc.) dans les pays voisins, il semblait évident de commencer les recherches intensives sur grès de Luxembourg en partant de la Petite Suisse. En plus des considérations géologiques et géomorphologiques, les différents feuillets des cartes topographiques au 1:20.000 (Administration du Cadastre et de la Topographie 1989) ont été étudiés afin de rechercher toute indication de falaises et rochers naturels. Sur cette base, les sites potentiellement favorables ont été visités de manière systématique. A l'aide d'une torche électrique, d'innombrables fissures et cavernes d'érosion ont été prospectées afin de déceler le gamétophyte de *T. speciosum*.

En 1999, les investigations se sont avant tout concentrées sur la Petite Suisse proprement dite, les 'Noumerlayen', les 'Mamerlayen', ainsi que les régions avoisinantes. En 2000, la zone d'étude a été élargie à toute la région gréseuse. Vu les découvertes du prothalle sur substrat non gréseux dans les régions voisines (Kottke 1999), des prospections sur Dévonien, bien que plutôt ponctuelles, ont également été entreprises. En cas de présence du gamétophyte, quelques détails liés à la station comme les caractéristiques de l'habitat, la surface couverte par la (ou les) colonie(s), etc., ont été notés et la station indiquée sur la carte topographique à l'échelle du 1:20.000. Notons que les 'anciennes' stations (Colling & Reichling 1996, Reichling comm. pers.) ont été en grande majorité revisitées afin de déterminer les coordonnées exactes et les caractéristiques des colonies. Les coordonnées des différentes stations furent saisies sur le terrain à l'aide d'un récepteur GPS du type Garmin III. La conversion en coordonnées Gauss-Luxembourg a été effectuée à l'aide du récepteur GPS en définissant une grille d'utilisateur (User Grid) avec les paramètres suivants: long. origin. E 006°10.000', scale 0.10000, false E 8000.0, false N -542239.0; ainsi qu'une date d'utilisateur (User Datum) avec les paramètres: Dx=-263 m, Dy=76 m, Dz=45 m, Da=-251 m, Df=-0.1419270 (comme défini par l'Administration du Cadastre et de la Topographie). Lorsque la détermination sur le terrain à l'aide d'une loupe 20x laissait des doutes, un prélèvement fut effectué en vue d'une vérification sous loupe binoculaire ou microscope. Pour quelques stations, des échantillons ont parallèlement été pris en vue d'une analyse d'ADN, par le Natural History Museum à Londres, afin de détecter une variation éventuelle entre les populations de *Trichomanes speciosum*.

4. Résultats

La prospection systématique des endroits potentiellement favorables à la croissance du gamétophyte a permis de recenser au Luxembourg jusqu'à fin mars 2001, au total 100 stations du gamétophyte de *Trichomanes speciosum*, dans 69 carrés kilométriques différents. On constate que le prothalle de cette Hymenophyllaceae est répandu dans la région du grès de Luxembourg de la Petite Suisse luxembourgeoise. Les stations sont particulièrement nombreuses sur le territoire des communes de Berdorf, Beaufort et Consdorf. Il est régulièrement présent dans des endroits favorables jusque dans la

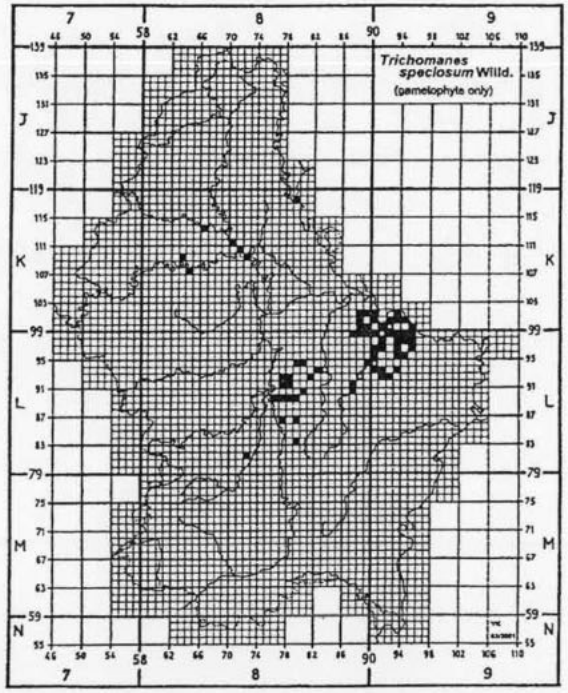

Fig. 3. Carte de répartition du gamétophyte de *Trichomanes speciosum* au Luxembourg, sur base des réseaux I.F.B.L. et Gauss-Luxembourg. Les carrés à point blanc représentent les carrés kilomètriques où des stations étaient déjà connues avant l'inventaire systématique. Situation à la date du 31/3/2001.

Fig. 4. Détails des filaments de gamétophyte de *Trichomanes speciosum*, montrant la ramification à angle droit, les rhizoïdes unicellulaires brunâtres et les cassures au niveau des cellules porteuses de gemmes; épaisseur du filament ± 42 µm (photo L. Reichling, 21/1/1997).

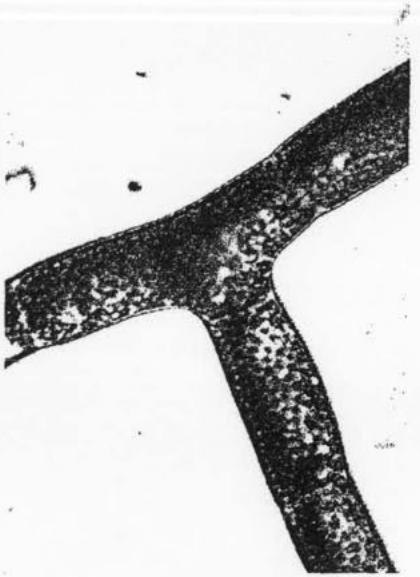

Fig. 5. Détail de filament de gamétophyte de *Trichomanes speciosum*, illustrant les parois cellulaires perpendiculaires et les nombreux chloroplastes; échantillon des Vosges, épaisseur du filament ± 42 µm (photo F. Sauber, Centre Universitaire Luxembourgeois, 18/12/1995).

vallée de l'Alzette. Notons cependant que, vu l'abondance des sites dans quelques carrés kilométriques au niveau de la région gréseuse de la Petite Suisse, un certain nombre de stations n'a pas été repris à titre isolé, même si on pouvait les considérer comme 'nouvelles stations' étant donné qu'on considère des populations comme étant distinctes si elles sont espacées de 10 mètres au minimum (Rasbach et al. 1995). Le nombre de stations vues est donc de loin supérieur au nombre de stations indiquées pour certains carrés kilométriques. Cette situation est notamment valable pour l'Aesbech et la Haupeschbaach. L'espèce est par contre fort rare dans les 'Noumerlayen' et même totalement absente dans d'autres régions, comme par exemple dans les 'Gorges du Loup' près d'Echternach, ou dans les 'Mamerlayen' près de Mersch. Jusqu'à présent une seule station a été trouvée à l'ouest de l'Alzette. La découverte de *T. speciosum* sur schiste dévonien n'était pas une surprise, car depuis 1994 une station découverte par R. Viane est connue en Belgique près de La Roche-en-Ardenne (Rasbach et al. 1995, Reichling 1997). Après que Kottke (comm. pers.) ait signalé pour la première fois le gamétophyte sur Dévonien en Ardenne luxembourgeoise, entre Kautenbach et Goebelsmühle, des recherches précises ont permis de recenser plusieurs stations dans une région assez vaste. Sur les schistes dévoniens, le gamétophyte ne rencontre toutefois que des conditions suboptimales

(Kirsch & Bennert 1996) et les populations sont en général assez petites. La carte de répartition (fig. 3) montre la distribution actuelle du gamétophyte de *T. speciosum* au Luxembourg.

Pour les différentes stations, la taille de la population a été évaluée. Notons qu'il ne s'agit que d'une estimation grossière, étant donné que la croissance de l'espèce au fond de fissures et fentes rendait, à de nombreuses reprises, l'appréciation assez difficile. La taille des populations n'est donc à considérer qu'à titre indicatif; elle donne cependant une bonne idée pour savoir s'il s'agit d'une petite, moyenne ou grande colonie (fig. 6). En général, la taille des populations est assez petite et dans 82% des cas elle ne dépasse pas le dm². La plus petite population s'est présentée sous forme de quelques filaments qui ne dépassaient pas au total 0,5 cm². La plus belle station a été trouvée sur le plafond d'une fissure au niveau d'un bloc rocheux à quelques mètres d'un cours d'eau, avec une taille approximative de 0,5 m² en surface continue.

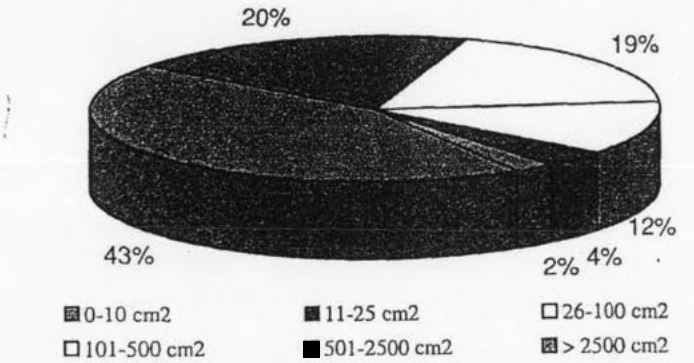

Fig. 6. Répartition des stations de *Trichomanes speciosum* au Luxembourg en fonction de la taille des coussinets ou tapis du prothalle.

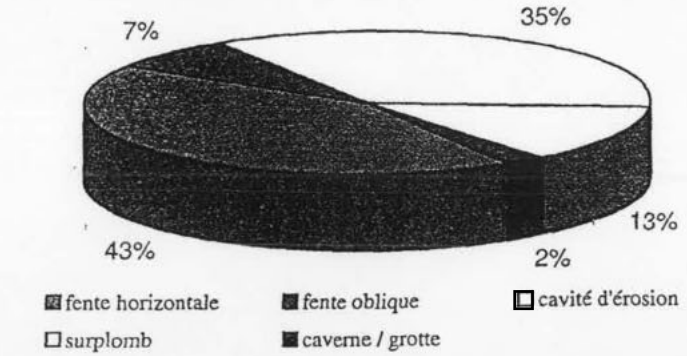

Fig. 7. Répartition des stations de *Trichomanes speciosum* au Luxembourg en fonction de l'habitat occupé par le prothalle.

En ce qui concerne l'habitat, nous avons constaté une nette préférence pour les fentes, en moindre mesure les cavités d'érosion (fig. 7). Les fentes et fissures d'érosion occupées par le gamétophyte étaient, sur grès de Luxembourg, presque toujours horizontales; des fentes faiblement obliques n'ont été observées qu'exceptionnellement. Sur Dévonien par contre, le gamétophyte occupe - vue la schistosité - exclusivement des fentes obliques, voire verticales. *Trichomanes speciosum* colonise soit le fond de la fissure - c'est généralement le cas des fissures peu profondes - soit le plafond de celles-ci, soit le fond et une partie du plafond. En ce qui concerne les cavités d'érosion, les flocons ou coussinets occupent généralement le plafond de la cavité. Quelques rares stations sont caractérisées par la croissance du gamétophyte au niveau de surplombs. Dans ce cas, il s'agissait quasi exclusivement de stations à proximité d'un cours d'eau et donc caractérisées par une humidité de l'air constamment élevée.

Les falaises, rochers et blocs abritant des stations de *Trichomanes speciosum* sont presque exclusivement situés en milieu forestier. Environ 20% des stations sont en plus localisées à proximité immédiate d'un cours d'eau. L'orientation des falaises et rochers ne semble à première vue pas avoir d'influence sur la présence ou non du gamétophyte, un fait déjà observé dans les pays voisins et notamment dans la région voisine allemande du côté de Bollendorf (Bujnoch & Kottke 1994). En ce qui concerne la hauteur par rapport au sol, les populations de *T. speciosum* ne semblent pas avoir une nette préférence. Nous avons trouvé le gamétophyte dans des fentes ou cavités situées à 10 cm du sol, aussi bien que dans des fentes ou sous des surplombs à 250 cm de celui-ci. Remarquons néanmoins que dans des zones moins propices, c'est-à-dire à humidité de l'atmosphère plus faible, il a tendance à occuper des fentes ou des cavités situées plus proches du sol et par conséquent moins exposées. Plus de la moitié des microsites de *T. speciosum* était située à moins de 1 m par rapport au sol. Notons que 'par rapport au sol' désigne ici la distance qui sépare la cavité du pied de la falaise ou du bloc rocheux; dans le cas de pentes, le fond du vallon peut être situé beaucoup plus bas.

Afin de détecter une variation éventuelle entre les populations de *Trichomanes speciosum*, des chercheurs du Natural History Museum à Londres utilisent depuis quelques années des techniques d'analyses génétiques. Ces techniques et notamment l'extraction de l'ADN et son amplification sont décrites par Rumsey et al. (1996). En utilisant une région non codante de l'ADN du chloroplaste, des variations de longueurs des différents fragments permettant de les séparer par électrophorèse sur des gels de polyacrylamide ont permis de distinguer deux génotypes, caractérisés respectivement comme variante 'nord' et variante 'sud' (Rumsey et al. 1996). Une adaptation de la technique, avec séquençage de ± 1000 paires de la région du trnL (UAA) intron et exon de l'ADN du chloroplaste, donc de la région coupée auparavant par des enzymes de restriction, permet d'obtenir plus d'informations et de déceler même des mutations ponctuelles (Rumsey comm. pers.). L'analyse de quelques échantillons luxembourgeois a montré une variation vers le milieu de la séquence, avec le remplacement d'une base G (guanine) par une base A (adénine) pour deux stations de la région de Berdorf; mutation qui semble être géographiquement très localisée. La localisation restreinte de ce génotype peut s'expliquer par l'absence actuelle de sporophytes dans nos régions, qui fait qu'une large dispersion par voie de spores est exclue.

5. Conclusions

Le gamétophyte de *Trichomanes speciosum* est donc relativement répandu sur grès de Luxembourg, avec une abondance de sites en Petite Suisse proprement dite et au niveau de la région Rollingen-Beringen-Angelsberg. L'absence ou la rareté de l'espèce dans d'autres régions semblent être liées à la nature de la roche, comme par exemple dans les 'Gorges du Loup' ou les 'Noumerlayen', étant donné que le grès de Luxembourg présente ici une plus grande teneur en calcaire; ou bien intervient le facteur humidité, comme par exemple au niveau du 'Grengewald', dans les 'Mamerlayen' et certaines parties des 'Noumerlayen', où le climat est nettement moins atlantique. Il semble par contre que le gamétophyte de *T. speciosum* soit bien représenté sur Dévonien. Malgré que la découverte de l'espèce en Ardenne luxembourgeoise soit encore relativement récente, sept stations sont déjà connues et la facilité de leur découverte laisse supposer que le gamétophyte soit relativement répandu dans cette région. La carte de répartition de *T. speciosum* n'est donc à considérer que comme provisoire, car des investigations complémentaires dans d'autres sites potentiellement favorables, notamment sur Dévonien, devraient en principe révéler des stations supplémentaires.

Le statut actuel de *Trichomanes speciosum* pour le Luxembourg est qualifié de 'rare' (R) (Colling & Reichling données non publiées). Malgré le grand nombre de sites actuellement connus, cette appréciation reste tout à fait justifiée, vu la spécificité de la niche écologique occupée et la petite taille des populations. Le gamétophyte de *T. speciosum* ne semble cependant pas être menacé dans un avenir immédiat, mais reste vulnérable. Etant donné le caractère discret et non attractif du gamétophyte, un danger par collecte semble peu probable. La présence ou le passage d'invertébrés et de petits mammifères au niveau des microsites ne semble pas non plus problématique, mais laisse même supposer une dispersion zoochore sur courte distance (Kottke 1999). Un changement du microclimat et des conditions de luminosité suite à la mise à nu des rochers par des coupes forestières ou des chablis pourrait cependant constituer une menace réelle.

Les analyses génétiques du matériel luxembourgeois et d'un nombre élevé d'échantillons provenant de toute l'aire européenne semblent indiquer que *Trichomanes speciosum* existe en Europe depuis fort longtemps et y a survécu à la dernière glaciation (Rumsey comm. pers.). Dans cet ordre d'idées, *T. speciosum*, tout comme *Hymenophyllum tunbrigense*, pourrait être considéré comme étant éventuellement un relique de l'aire tertiaire, hypothèse déjà émise par Vogel et al. (1993).

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A Case Study of the Sustainable Production of Tree Ferns in South-East Australia

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Abstract

Sustainable production or the term '*sustainability*' has become standard rhetoric in numerous government reports, discussion papers, management plans, research reports and reviews in Australia as well as internationally over the last decade. There appears to be a general consensus that all societies should be aiming for 'sustainable production'. The problem is to understand the meaning of, and ways to promote, sustainability. As Dahl (1995) contends, 'there are as many dimensions to sustainability as there are to human society'.

This paper explores the often-controversial journey of turning the rhetoric of sustainable production into the practice of sustainability. The research looked at a small horticultural business in the temperate rainforest of the Otway Ranges in Southeast Australia. It followed the development of the salvage tree fern business through to the establishment of a set of guidelines and principles on how to establish a self-sustaining, low-input, multifunctional, tree fern plantation.

The horticultural business has been broadly involved with all aspects of the tree fern industry, including micro-propagation, propagation, growing, wild harvesting, plantation establishment, exporting and conservation over the last twenty years. The research relates the experience of the horticultural aspects of cool-climate tree ferns and presents an overview of the development of the business. It also canvases broader issues of governance that can impact substantially upon the day to day operations of a horticultural business that aspires to a high level of sustainability.

Sustainable production or the term sustainability has become standard rhetoric throughout Australian society. There appears to be a general consensus that we should all aim for *sustainable production*. We argue that it is beneficial to adopt a pragmatic synthesis of the term sustainability that offers a comparable degree of clarity. Drawing upon Ikerd (1999) who has suggested that 'sustainable production requires finding a balance and harmony between the economic, ecological and social dimensions of the production system', this paper explores the often-controversial process of turning the rhetoric of sustainable production into a practice of sustainability.

Adding further clarity, Fresco and Kroonenberg (1992) surmise that if sustainability is defined as using land without disturbance of the ecosystem, there are few land-uses that could ever be deemed sustainable. They suggest acceptance of the view that ecosystems are not static but dynamic systems and that one goal for sustainable use is to employ the land in such a way as to ensure that, over time, no net quantitative or qualitative loss of natural resources occur. Dahl (1995) adopts a more anthropocentric view that,

> the sustainability we are seeking is that of human society. Society functions in a natural environment, uses resources and discharges wastes; society depends on and is intimately interrelated with natural systems.

Ikerd (1999) suggests that an uneconomical production system is also not sustainable as the landholder may not only lose the right to maintain the authority to use the resources but may also contemplate actions that may negatively impact upon the environment. It can be concluded that for a production system to be sustainable, it needs to achieve ecological sustainability, social sustainability and economic sustainability with each element finding a balance within the strategic objective of a broader notion of sustainability. In Australia, it is very common for stakeholders to refer to *ecological sustainable development*, rather than *environmental sustainable development* or just *sustainable development* as with the tendency in most other regions of the world. This could arguably be seen as narrowing the debate to focus primarily upon ecological factors at the expense of broader social interest that include the economic and social viability of stakeholders into the foreseeable future[1]. If one part of the sustainable production trilogy is preferenced over the other two parts then this can lead to disharmonious relations and failure of the strategic object of sustainability. Fortunately, there is a growing consensus that Australians must consider the so-called 'triple bottom line' (of economy, society and environment) when decisions are made about growth and development.

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[1] See Australian Productivity Commission (2000) 'Implementation of Ecological Sustainable Development by Commonwealth Departments and Agencies'.

Background for the case study: Evolution of the Tree Fern Industry in Victoria

The Parliament of Victoria[2], Environment and Natural Resources Committee inquiry into the Utilisation of Victorian Native Flora and Fauna (2000) identified four main 'phases of development' in the consumptive use of native flora and fauna, irrespective of the species involved:

1. Wild Harvest
2. Ranching/transitional
3. Basic cultivation or farming
4. 'High tech' or genetic engineering based

Through the 1980's, successful businesses utilising the native ground ferns of Victoria generally passed through the four phases of development. The case study looks at Mr. Fern Pty. Ltd., a business that has participated in all four phases, from wild harvest, evolving slowly to cultivation and propagation, and to micropropagating the more difficult to grow species. Very few native ground ferns are now wild harvested in Victoria, primarily because the quality and ease of production of cultivated ferns has stabilised the commodity chain. Practices have also been contoured by changing societal attitudes towards certain production practices, in particular those associated with native flora and fauna. In the 1970's, ground ferns available within Australia were grown in 'controlled environments' and were focused on the indoor market. The shift in the 1980's to growing the ground ferns in shadehouses with high levels of light produced a hardy garden fern suitable for planting directly into the suburban garden and was considered at the time to be very consumer friendly. There is now a considerable global market for both indoor and outdoor ferns, which originate from all parts of the world. The global market is not only consumer driven. Initiatives by small commercial growers are also a driving force of the global changes. However, they are largely operating within a legislative framework that is in many ways contradictory in the sense that legislation has emanated from different government organisations with different competing intentions[3].

In Australia, the wild harvest phase is still predominant for the mature tree fern specimens, however some parts of the industry (including Mr. Fern) are at the embryonic stage of the third phase, namely 'farming'. It would seem quite feasible for a similar transition with mature Australian tree ferns driven by the same ground swell of enlightened small commercial growers. The idea of tree fern plantations is just starting to catch the imagination of a growing number of traditional primary producers in the case study district, largely as a result of the plantation developments that have been demonstrated at Mr. Fern.

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[2] Victoria is one of Australia's six states, there are also two territories.

[3] While our case study is firmly set in Australia we would contend that there is a degree of universality in relation to the questions raised in this paper.

The case study: Mr. Fern Pty. Ltd.

Mr. Fern Pty. Ltd. is a small export orientated Tree Fern Nursery and Plantation situated on a thirty-three hectare property, located in the temperate rainforest region of the Otway Ranges in Victoria which is situated in South East Australia. The Otway Ranges is predominately public-owned land, with 72% set aside as national parks and conservation areas, and 28% classified as 'General Management Zones' where timber harvesting is permitted. [4]

In the early 1980's, income from traditional beef and potato production was supplemented with off-farm income by wholesaling tree ferns sourced from local primary producers and Tasmania[5] to metropolitan garden centres on a casual ad hoc basis. The decision was made to focus on supplying tree ferns due, in part, to fluctuating agricultural commodity prices. Some tree ferns were harvested from the Mr. Fern property and replanted during this period; this was the birth of the plantation concept albeit on a very small scale. In 1985, the focus of the business shifted more towards horticulture with the establishment of a production fern nursery on the property. The current business, Mr. Fern, was registered in 1987 and became a member of the Nursery Industry Association of Victoria and Nursery Industry Association of Australia. Training and practices were focused on traditional agriculture and horticulture throughout the 80's and 90's, which included courses on micropropagation and nursery production.

Qualitative feedback in the late 1980's from many sources including customers, nursery industry and government indicated that there was a general trend emerging; a desire for an eco-friendly product. Wild harvesting was being equated with a form of native resource exploitation associated with flora and fauna. The decision to offer only propagated ferns from 1990 onwards, appeared economically and ecologically feasible and coincided with an industry led 'go green' campaign. However, indications soon emerged that although many Australians rhetorically state that they would prefer 'green products', demand remained strong for wild harvested tree ferns. Due in part to financial and competitive pressures, the nursery resumed wild-harvesting four years later, this time conceiving a vision of a 'sustainable tree fern plantation' and formulating a long-term strategic business plan, that largely incorporated the directors philosophical goal, of sustainability.

Applications for funding and requests for assistance from numerous government and institutional organisations were, unfortunately, not successful for the tree fern farm, as the concept failed somehow to meet the criteria for grants or arouse sufficient academic interest. Exporting and some ad hoc planting of tree ferns on the property commenced in 1996. The Otway Agroforestry Network[6], a group of landholders in the Otway Region interested in combining commercial forestry and agriculture on their properties, assisted

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[4] Mr. Fern Pty. Ltd. does not harvest tree ferns from Public land in the Otway Ranges.

[5] The southern most state of Australia with extensive natural forest and the region from which germinated the most active and successful conservation society in Australia.

[6] See Australian Master TreeGrower, 1997

the directors in drawing up a site plan for the proposed tree fern plantation in December 1996. The plans were acted upon in 1997, self-funded by the business substantially from the returns on exporting tree ferns that occurred as a direct result of the business positioning itself within the global flow of commodities.

Throughout the 1990's, many different styles of farming were explored as the directors looked for ideas to incorporate in the fern farm/plantation concept including agroforestry[7], analogue forestry[8], community forestry, ecoforestry[9], organic farming[10], and integrated farm management systems[11]. New digital technologies particularly the Internet had a profound impact on the business, facilitating export courses, opening a library of accessible information and ideas from all over the world and removing the barriers of distance from far away markets. The business embraced both new electronic technologies as well as immersing itself within the emerging globalisation processes.

Significantly, the presence and comments of a professional environmental lobbyist in the district in 1997 became the next catalyst for a change of direction of the business, resulting in a substantial re-evaluation of the rapidly changing political environment. From 1998, the business became more politically active, writing submissions on inquiries into issues related to native flora and fauna and conservation, attending Senate hearings and questioning the directions of policy makers and writers. The desire was an informed debate based, at least partially, upon empirical evidence that emanated primarily from local and regional knowledges that also drew upon historical experiences.

In 2001, the property owners still believe the direction of the business would appear to be in line with the stated visions and objectives of many Australian policy makers. Primarily the objective has been to evolve towards the concepts within the notion of community forestry[12]. However, the question of why it is so difficult to farm 'outside the square' in the new millennium highlights the concerns and difficulties of exploring the definitions and parameters of sustainable production in any meaningful way.

From Traditional Practices to Sustainable Production

Following the efforts of the directors of Mr. Fern Pty. Ltd., supported by some very capable associates in conceiving a design to create the potentially sustainable fern farming/plantation system, a Site Report from the Otway Agroforestry Network (1996) offered the following observation of the concept at the initial planning stage:

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[7] See Rural Industries Research and Development Corporation (RIRDC) 2001
[8] See Senanayake and Jack (1998)
[9] See Drengson & Taylor, 1997
[10] See Canadian Organic Growers Inc, 1992
[11] See Trewavas (2001)
[12] Such as building a consensus among the multiple community stakeholders (bee-keepers, bush walkers, bird watchers, fern harvesters, logging both large and small, tourist operators etc) and the government. See Stephens,P.,2001

> As there are no tree fern plantations to draw on for experience, performance can only be guessed at. The project is complex and will consume a lot of labour and capital but will be valuable if successful and provide very useful experience. (Lawson, 1996).

Despite these concerns, in 1997, the directors removed the remaining beef cattle permanently from the property and the first ten-acre paddock was prepared for tree fern planting. This move by the directors could be seen as a *risky shift* into unknown territory based on Flora et al (1998) suggestion that 'risky shifts mean leaving the comfort zone and not returning to it'. In this case the risks of 'alternative farming' were considered, as much as that is possible, and minimised where possible. The economic risk was minimised in the short-term by exporting tree ferns predominately sourced off-site, in other words the business was required to maintain a cash flow throughout the changes. The ecological risk was deemed minimal. The CEO of the local shire questioned the wisdom of planting the farm to tree ferns and asked what would be the consequences if the plan failed. The directors pointed out that an abandoned tree fern farm would merely revert back to native forest at a more expedient rate than a cleared property. The social risk was the most complex to foresee. It was presumed that the quality of life would qualitatively increase with the directors pursuing a challenging goal in an area of expertise in concert with their philosophic intentions. As to whether the community would accept the concept and the reaction to significant change in a traditional farming community would only emerge in the fullness of time.

The different premises between past practices and perceived sustainable production were clearly in line with different, and somewhat combative, discourses. The past practices presumed there was an unlimited supply of tree ferns, growth was good and increased production through adoption of new technology was the way forward. The new discourse is based on the notion of a finite stock of resources that needs to be managed wisely and incorporates recognition of both economic and non-economic value of natural capital. It includes long-term plans and solutions, adoption of 'appropriate' technology and the mimicking of nature to increase resilience and diversity. In short, it includes sustainability.

Practical Steps to Sustainable Production

The tree fern plantation design attempted to emulate identifiable natural processes. Conditions at several locations such as natural tree fern groves, germination sites as well as selected areas devoid of ferns were carefully observed over a rather lengthy time, resulting in the compilation of significant and relevant knowledge that was subsequently transposed and to a degree adapted to the design of the plantation area. The goal was to create a microclimate suitable to grow a variety of tree ferns and also be conducive to

the self-germination of Dicksonia antarctica[13]. Permanent access was established to reduce soil disturbance in any future activities[14]. The design incorporated south facing banks, which are ideal in this region for ferns to germinate. In theory, a cycle of managed fern growing and utilisation could be created, with mature tree ferns selectively harvested from the growing beds and then replaced by removing the germinated ferns from the bank and transplanting them back into the growing beds. Myrtle beech *(Nothofagus cunninghamii)* trees were planted three metres apart[15], in order to create an overstory and create a natural 'shadecloth' to protect the ferns from the elements.

Each year, several different areas of the property were selected and planted using different methods adopted specifically for the particular microclimate present and potential microclimate deemed achievable. Variations included different methods of site preparation, size of tree ferns, spacing and combination of tree ferns from small-propagated plants to large, mature tree ferns.

With a 2000-mm rainfall, watering of newly planted ferns was only deemed to be required during the height of the dry period in summer[16] and confined to one planting area. Gravity-fed sprinklers were fed from a river adjacent to the main plantation and used to maintain humidity on days of drying winds.

There have been successes and failures. Last winter, approximately forty thousand small-propagated Dicksonia antarctica were planted on the property. The driest and hottest summer for fifty-two years followed and the losses were high in some plots. Since then, five inches of rain in five weeks has resulted in the surviving tree ferns flourishing. Replanting has commenced for 2001.

Threats to Sustainable Production of Tree Ferns

Discussions on the sustainable production of Dicksonia antarctica are not necessarily about choosing between wild harvesting and cultivation. There are pros and cons to both systems, as both may contravene the trilogy of sustainability. There is a presumption made that wild-harvesting or 'consumption' of tree ferns will reduce the quantity of tree ferns in the wild. While this can occur and unfortunately has occurred at some locations, it is not inevitable and in many cases depreciation of wild tree ferns has occurred because of 'other' activities, either social or commercial that under value the species. Tree ferns are a renewable resource and many of the tree ferns harvested for export in our particular district are in fact re-growth that occurs because of local knowledge and a local attachment to the ecology of the

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[13] Mr. Fern's most requested fern species.

[14] This can be a significant problem in this area especially with the high rainfall levels.

[15] A native tree that is listed by the DNRE Flora and Fauna Guarantee - Scientific Advisory Committee No. 453, 1997 (See page 20)

[16] Summer in this part of the Southern Hemisphere is from the beginning of December to the end of February. It is typically hot (occasionally 39c)

region. Basically, as long as the overstory is preserved, tree ferns will germinate more prolifically and of a higher quality after selective harvest, to replace what was taken. However, as Jenkins and Edwards (2000) soberly contend,

> when discussing the management and use of wild species, all decisions are based on imperfect knowledge and even a comprehensive understanding based on extensive information about a resource does not guarantee sustainability.

According to a compilation of local knowledge, the main perceived threats to a sustainable supply of Dicksonia antarctica in the case study district were the problems of changing land-use, the classification of tree ferns and prescriptive government regulations, rather than the wild harvesting practices of professional horticultural workers.

Changing Land-Use

Pressure from changing land-use was perceived to be from two different directions, industrial forestry and urbanisation. The Victorian State government accepted the 20/20 vision for forestry[17] in 1998, which established the goal of tripling the quantity of plantation trees in the state of Victoria by the year 2020 (DNRE, 1998)[18]. Many of the blue gum monocultures being established in the case study region are for the purpose of producing woodchips with harvesting scheduled on a ten-year rotation. It could be questioned whether tree ferns would grow as well in blue gum plantations over a ten-year period as they have in Radiata pine plantations with a thirty-year harvesting schedule.

Urbanisation was also deemed a threat to the sustainable production of tree ferns as the district adapted to cater for a shift in demographics from traditional family based monoculture farming to a recreational and leisure location for an expanding metropolis[19]. This has occurred in conjunction with a rapidly expanding tourism industry focused upon the tourist gaze[20] and the consumption of the 'natural wilderness'. This created a demand for 'lifestyle and weekend retreats' with increasing population levels and demand for land and the changing demographics of the local population.

It is argued that tree fern farming of varying intensity[21] as a component of a multifunctional farm is an appropriate course of action. It could produce a

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[17] Plantations 2020 Vision Implementation Committee 1997, "Plantations for Australia: 2020 Vision'.

[18] DNRE publication, The Private Forestry Council (Victoria) 1998, "Private Forestry in Victoria: Strategy towards 2020 (draft)".

[19] See Bernard Salt, 'The Big Shift' featured in the article 'Suburbia, apartmentia and beyond',in, The Sunday Age Forum, Broadsheet publication, 8th July, 2001, p.16.

[20] See Urry, 1990

[21] The intensity is really a decision for the individual enterprises. It will of course affect issues of sustainability however these difficulties are deemed as resolvable.

larger quantity of tree ferns more efficiently from a smaller area of land in a mode deemed more acceptable to the new *urbane* community members.

Classification

It is perceived that many of the difficulties in turning the rhetoric of sustainable development into practice arise not only from a confusion over what is meant by 'sustainable development' but also from the differing classification of tree ferns within different institutional structures and predominant discourses.

Tree ferns do not fit neatly into one category. Within Australia, wild-harvested tree ferns are sourced as a secondary product from agricultural and forestry commercial operations, marketed by the domestic nursery industry while regulated by a State government departmental division responsible for conservation and recreation. Under the predominant regulations, the Flora and Fauna Guarantee Act 1988, tree ferns are classified as 'wildflowers and other native flora (grasstrees and seeds)[22]. The local government regulations classify tree ferns, as native vegetation while the Federal Government department responsible for export permits is the 'Biodiversity Unit'. Harvesting of tree ferns is also governed by the timber industry's Code of Forest Practice for Timber Harvesting[23] and participation in a private timber training course [24] is required prior to employment in the tree fern industry.[25] State and Federal government regulations also distinguish between ground ferns and trunk species, both of which form part of the sustainable tree fern concept. A tree fern plantation, then, further complicates categorisation, introducing the concept of a fern agro-ecosystem mimicking nature, and attempting a degree of sustainability crosses a number of institutional and disciplinary boundaries.

By necessity, most systems and models are generally schematic overgeneralisations that assist regulators (and others) to manage the complexity of systems - whether they be social, economic or biological. The current approach of managing natural resources in Victoria tends to be by prescriptive regulations administered, with little flexibility by a large bureaucracy. Jenkins and Edwards (2000) use the term 'the blueprint approach' to describe this means of governance, whereby the broad plan is prescriptively laid out and stakeholders are required to conform. However, the tree fern farm is modelled on an adaptive management approach, described by Campbell et al. (1999) as design, act, monitor, reflect and revise. Difficulties arise when trying to adapt the realities of a dynamic system to the requirements of faraway decision-makers (ie governance at a distance). Even though it is recognised that diversity increases resilience, this principle is generally not

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[22] KPMG Consulting Pty Ltd, NCP Review of the FFG Act 1988 Report, 2000

[23] Department of Conservation and Natural Resources, 'CNR (1995) Proposed Code of Forest Practices for Timber Production. The CNR are now known as the Department of Natural Resources and Environment.

[24] Based on, Occupational Health and Safety Authority, 'Codes of Practice for Safety in Forest Operations (1990), Law Press, Melbourne

[25] For full details on statutory regulations See Environment and Natural Resources Committee, Utilisation of Victorian Native Flora and Fauna Inquiry Report, 2000, ch 7.

applied to natural resource management prescriptions, where one management regime is selected and then enforced. Operating outside the parameters of the blueprint can therefore become a very challenging exercise, particularly if the system is based on local knowledge as an increasing component of adaptive management, rather than a reductionist scientific knowledge.

There has been a succession of government inquiries over the last five years into the utilisation of native flora and fauna in Australia. Currently the Productivity Commission is researching the creation of markets that assist in the sustainable use and conservation of biodiversity[26]. Flora et al (1998) stress 'changes are taking place on the farm within a system, but without a system-wide change, innovation cannot be supported'. There are currently steps being taken by the three levels of regulators within Australia, to accommodate the innovation of a 'sustainable' tree fern production system in the 'blueprint', however this often occurs only after persistent lobbying.

Examples of significant barriers to sustainability:
The Dominant Industry

According to both the concept of the sustainability trilogy, and to the philosophy behind community forestry, what is required for the successful transition from traditional farming practices to sustainable farming practices is consistent partnerships. There is a strong imperative to bring 'others' along. This includes local and state government departments, members of local communities as well as the industries that have traditionally dominated particular areas. For example, the timber industry is a dominant natural resource user in the case study region. Over the last ten years, requests to harvest the niche product, tree ferns from clear-fell timber harvesting coupes on public land in the district have been refused - including requests to source tree ferns to replant as part of trials. According to the Environment and Natural Resources Committee report (2000)

> During a clear-fell operation, undergrowth, including tree ferns, are bulldozed to allow access to the trees. Once trees have been felled and removed, the bulldozed undergrowth is either left where it lies, for subsequent burning or is bulldozed into windrows and burnt. ...The current government policy not to permit the removal of tree ferns prior to clear-felling is based on the premise that if harvesting of tree ferns were permitted prior to logging, the combined operations would lead to a decreased survival rate of tree ferns in logging coupes.

The Victorian Minister for Conservation and Land Management explained in a letter to the local Progress Association[27] in 1999, that

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[26] Productivity Commission, 2001, 'Creating Markets for Biodiversity Resources and Services', Research Study, Current Project.

[27] The local Progress Association established approx. 35 years ago operates as an open forum in the community.

> the Department (DNRE) is seeking to maximise the retention of tree ferns on areas harvested for timber to provide the greatest opportunity for regeneration following harvesting.

The Progress Association replied that the best way to maximise the retention of tree ferns was to leave the trees and restrict clearfelling. However, where tree ferns where to be destroyed by timber harvesting, it was believed to be more prudent to utilise the tree fern than to destroy it. In a clear example of the de-valuing of natural resources the Department of Natural Resources and Environment (DNRE) explained that relocating and/or replanting the tree ferns was not considered environmentally or economically viable. According to the Co-ordinator of Flora Fauna and Fisheries, in the South West Region,

> The Department has conducted trials to assess the economic viability of tree fern harvesting prior to logging and has concluded the costs in management and supervision would outweigh the return therefore resulting in an uneconomically viable operation.

Our research and experience suggests that there are better ways to maximise the sustainability of this particular natural resource. Small and flexible horticultural enterprises such as Mr. Fern Pty. Ltd. are capable of maintaining and in many cases increasing re-growth rates in selected harvest areas.

Furthermore, there are also the serious implications of land tenure that were highlighted when the DNRE Forestry Division purchased land in our region from a private timber company in 1998. Permission had been granted the previous year from all levels of government for tree ferns to be selectively harvested and exported to satisfy global consumer demand. This meant it had therefore satisfied all the stated criteria, including public comments received as part of the export application. It was a six-month application process, with licenses granted on an annual basis. This required considerable pre-planning and co-ordination of dates to ensure all permits from the different tiers of government were valid at the same time, as the tree ferns were available for harvesting. However, the DNRE subsequently denied access to the tree ferns once they purchased the property. Although the land was purchased for the purpose of harvesting timber in a clearfelling operation, it was against the DNRE policy to permit the continuation of tree fern harvesting on the site.

The Federal Government had been satisfied that the tree ferns approved for harvesting 'would have no impact on the species concerned or the ecosystem in which they occur'[28] and had therefore issued a permit to export. The basis of the DNRE policy not to allow harvesting to continue simply due to change of tenure could be questioned. There appears to be little incentive to utilise all resources on public land as efficiently as possible and there was no consideration of the impact upon local enterprises in the area.

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[28] Director, Population Assessment Unit (1995)

One of the major concerns is that the sustainable production of tree ferns as a legitimate commercial activity is often subsumed by the dominant forestry industry whilst being subjected to legislation from a different quarter. How do you qualitatively compare the clearfelling operations of the timber industry with the selective harvesting practices within the tree fern industry. In this particular situation, the question can clearly be ask about the logic of simply dividing the ecosystem into two separate sections, on the one hand, timber is exclusively seen as part of the 'timber industry', and the remainder is referred to as simply a part of bio-diversity.

One example from our research that highlight the differing emphasis or focus from the stakeholders, is that the difficulties of regeneration of tree ferns[29] on DNRE clearfell logging sites is in stark contrast with trials at the tree fern plantation, where germination's of tree ferns were evident within twelve months of site development, from a bare paddock more exposed than many logging coupes. In our trials on regeneration/re-establishment of tree ferns, it could be concluded that current techniques and systems used in timber regeneration/re-establishment are different to that required for tree ferns. Regeneration systems therefore need to be designed for the species desired.

The following three examples demonstrate not only the complexity of integrating a new 'sustainable' production system with traditional un-sustainable monoculture systems but also the specialisation required when operating within niche markets and areas of horticultural production. The 'blueprint schema' would seem to fail to adequately account for the specifics involved with the sustainable production of tree ferns.

Weed Policy – RAGWORT

Ragwort (*Senecia jacobaea L.)* is classified as a Regionally Controlled Weed (Catchment and Land Protection Act 52/1994) in the case study district.[30] Landholders in the area have the legal responsibility for the control and suppression of proclaimed noxious weeds when they occur on their property. The Department of Natural Resources and Environment (DNRE) suitably consider ragwort control a 'priority' due to its potential to 'damage the region's environmental, economic and social values'. The DNRE has therefore implemented a 'compliance program' which involves inspections of properties and the issuing of compliance orders. The DNRE in this case are primarily an *enforcement arm* for the traditional farmers for whom ragwort was a significant problem because of the damage inflicted on cattle stock. The fact that there are very few cattle producers left in the area has not altered the approach to this particular plant. Within Mr. Fern's tree fern management plan the ragwort is merely a transitional weed, it is only an interim problem, that can be dealt with manually and is eventually overgrown by productive ferns.

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[29] Ough,K., Murphy,A.,(1996) *The effect of clearfell logging on tree-ferns in Victorian Wet Forest, Aust. For., Vol. 59, No. 4, 178-188.*

[30] See Department of Natural Resources and Environment, Landcare Notes: Pest Plant Identification Ragwort, 1995.

The following outline highlights some of the difficulties that can occur as 'sustainable' practices are introduced.

Visit 1

The directors were served a 'Notice of Intent to Enter' from the DNRE in March 2001, providing the opportunity to meet and discuss ragwort control options on-site. This coincided with the ragwort flowering season. There were no flowering plants found on the property by the inspector, however, he noted the property had a 'potential problem' as juvenile plants were present. The inspector stated 'what you do is up to you', and outlined a number of control options, grazing and heavily stocking the property, herbicides, pasture improvement or hiring a contractor to spray herbicides. After receiving additional Landcare[31] information in the mail and evaluating options, the directors selected to continue using the existing management strategy of pulling mature plants and slashing regularly in an environmentally friendly way.

Visit 2

A second 'Notice of intent to enter' from a regional Catchment Management Officer, was received in June, 2001. The directors explained the following two days were inconvenient, an animated phone discussion followed and the Officer threatened to bring the police with him to the property that day. The local school principal[32] was requested to intervene by the directors, reassured the officer the property owners were non-violent and negotiated a suitable time for an inspection.

Again, no flowering plants were found by the two inspectors, only emerging juvenile plants. However, they deemed there was still a 'potential problem' as it was 'not really controlled' as the ragwort was 'actively growing'. The purpose of the visit was to obtain a signature on a 'workplace agreement' stating the completion date of 'all reasonable steps to control Ragwort using a method capable of controlling all stages of growth of the said plant'. The workplace agreement was deemed necessary to allow the DNRE to monitor the property and check that all agreed actions were completed by the stated date. A Land Management Notice would be issued if the officer deemed non-compliance, requiring the negotiated work to be completed within two weeks or the DNRE would move to legal options, prosecution and a contractor sent to the property by the DNRE to spray herbicides at the directors cost. The directors verbally agreed to control the ragwort on the property, but would not sign the proforma work agreement. Primarily, because by signing the agreement they would be supporting the use of herbicides that would eliminate the opportunity for organic certification or Forest Stewardship Certification[33].

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[31] Landcare is an initiative to draw stakeholders together to improve the environment

[32] The most authoritative community member and also president of the Local Progress Association

[33] Forest Stewardship Certification is a utilisation certification scheme supported by the World Wide Fund for Nature.

The Second Opinion

A consultant was employed by the directors for a second opinion on whether there was a ragwort problem and management options available to the directors. He supported the director's strategy as the most pertinent and effective for the property. He was unable to source a chemical currently recommended to control ragwort that would not be detrimental to tree fern growing or recommended for spraying where tree ferns were present.

The directors are continuing to use the original management strategy, of pulling and slashing to control the weed 'ragwort' and await the DNRE response to their perceived 'obstructionism'.

Water

In 1998, the decision was made to irrigate the plantings in their first year on days of low humidity. The Chief Executive of Southern Rural Water[34] denied a request for a water license. He explained that 'Under the present guidelines the Minister has advised that no further (water) diversion licenses can be issued until Streamflow Management Plans have been developed for all streams and/or environmental assessment has been undertaken to determine the impacts of further diversions from any stream. So far the focus has been on priority streams. The Ford River a local waterway has not been identified as a priority stream.

In the past, if water was required it was simply a matter of notifying the local water inspector and paying the required fee. The directors pointed out that if the fern plantation was in an urban location in Southwest Victoria, water from this district would be available from a tap. It appeared unfair that the fern plantation was denied access to any water on the basis that the fern plantation, was situated near the water catchment for the surrounding urban areas. After establishing the fact that the quantity of water required was, in fact, less than the average household use, a license was eventually granted.

Surprisingly, the license form did not include 'gravity' as a legitimate form of moving water. Categories for moving water that were acceptable included mechanized systems, which allowed for accurate flow measurements. However, a system based on a simple gravity feed technology that would cut out once the water levels lowered created more of a problem. The system devised by the directors incorporated the use of different gauged mesh coverings for the water inlet. If a shorter watering time was required a finer gauge would be used, debris and leaves would block the inlet at a faster rate than coarser gauge mesh and hence the water time lessened. This became a very low-tech solution that was very clean as it did not require a petrol driven pump. Eventually the water services officer accepted this system as a satisfactory system after an actual inspection of the watering system. Annual permits are still issued and inspections are conducted each summer to ensure compliance.

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[34] Government owned water business

Myrtle beech *(Nothofagus cunninghamii)*

In July 1997, just after planting was completed, the Flora and Fauna Guarantee Scientific Advisory Committee released a preliminary recommendation to list human activity near Myrtle beech trees as a 'potentially threatening process. The effects of the ruling would be 'no human activity within 40 metres of a Myrtle beech tree.' This raised concerns as to whether the directors would be allowed to continue 'activity' in the fern paddock and removal of the Myrtle beech trees planted there, was contemplated. Telephone discussions with the DNRE Flora Research Senior Botanist at the Arthur Rylah Institute, reassured the directors that the listing of Myrtle beech trees should have no direct implications to operations on the property. The listing was to reduce the risk of the spread of myrtle wilt by industrial timber harvesting on public land. He wrote a reassuring letter encouraging the planting of rainforest species, whether for long-term hardwood production or aesthetics and advised on technical aspects of myrtle wilt. In his view, a plantation of managed Myrtle beech trees was a valuable genetic pool and resource for the future, and to contact him should the listing affect the plantation operations at any time. With reassurance, the Myrtle beech trees were allowed to stay. However, this illustrates how legislation within one sector impacts upon other resource uses and the requirement to harness support from all different areas of expertise to simply maintain the strategic objective of sustainability.

Conclusion

In conclusion, whilst we have only been able to sketch some of the trials and tribulations involved in moving from a rhetorical desire of sustainable practice to an actual practice we have demonstrated that it can to some degree occur. The decision to grow an unconventional crop (ferns) partly explains the difficulties experienced in dealing with state government officials. They were unable fully to comprehend the system of production that was being put in place, and had little knowledge or experience to provide in the management of the crop. Also obvious from this case study are the differences in views about what constitutes sustainability. Sustainability is obviously a contestable term/concept and its practice remains somewhat controversial. This paper highlights the need for state agencies to work closely with those growers who are trying to initiate 'triple bottom line' practices. Both growers and agencies have much to learn from each other.

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Which are the characteristics that a good substrate should meet?

Any substrate intended to be used for the correct cultivation, establishment and development of orchids, must meet the following characteristics:

- Must offer the plant a good support
- Good ventilation
- Good drainage
- Slow decomposition rate
- Inexpensive (monetary, biological)
- Easy to get

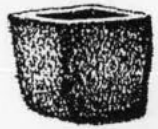
ALTERNATIVE SUBSTRATES

The following suggested alternative substrates (depending on species-specific requirements), meet the ideal characteristics mentioned above:

- Tree bark in small pieces
- Coconut (*Cocos nucifera*) fiber + moss
- Volcanic rock + charcoal + tree bark
- Root of a large grass (*Muhlenbergia macroura*) + moss
- Branches and trunks of certain trees growing in Veracruz como son:
  - "palo blanco" (*Meliosma alba*)
  - oaks (*Quercus* spp.)
  - fruit trees (peach, inga, apple, orange, etc.)
  - sweetgum (*Liquidambar macrophylla*)
- Volcanic rock + moss
- Polyestiren

Either in plastic, earthenware or polyestiren pots, or plastic or metal baskets or raks.

Professional or amateur orchidologists, housewives, nursery owners, peasants, salesmen, and garden enthusiasts in general interested in the preservation of endangered species (either orchids, bromeliads, ferns, etc.), are urged NOT contribute to eliminate the species of tree-ferns. PLEASE AVOID THE USE OF MAQUIQUE AT ALL COSTS!!!.



"MAQUIQUE", "PESMA" OR "XAXIM", AND THE PRESERVATION OF TREE-FERNS

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Do you know what "maquique" or "xaxim" are?

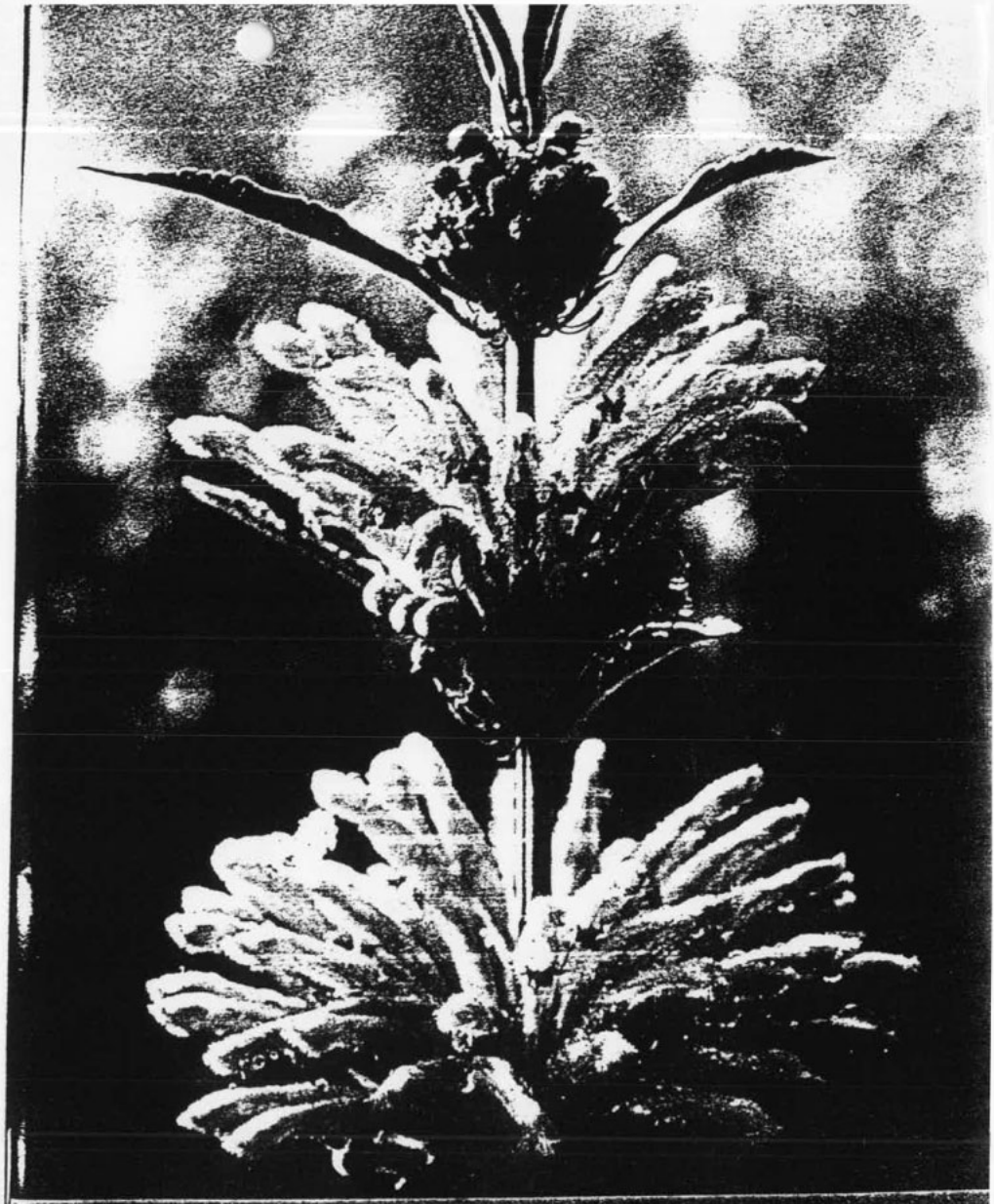
"Maquique", "maquiqui", "malque", "malquiqui", "pesma", "xaxim", "chachi", "parásita", "mexifern" or "raíz de helecho" is a structure formed by the adventicious roots of tree-ferns. This is a natural fiber with good drainage but maintains humidity for long periods of time, thus, it is used as the ideal substrate to plant orchids, bromeliads ("tenchos"), ferns, and other epiphytes.

Did you know that "maquique", "pesma" or "xaxim" is obtained from tree-ferns?

Indeed, "maquique" is obtained from the adventicious roots formed at the base of the leaf petiole of certain tree-ferns.

Do you know what a tree-fern is?

Ferns are a distinct plant group because instead of producing flowers and fruits, they present reproductive structures



DER PALMENGARTEN 63/2

PalmenGarten
Pflanzen. Leben. Kultur.

Der Gebrauch von Maquique und die Gefährdung der Baumfarne Mexikos

MÓNICA PALACIOS-RIOS & KLAUS MEHLTRETER

Abstract

„Maquique" is the material of adventitous roots, which surrounds and protects the trunk of some tree ferns. As a consequence of its use in commerce as a substrate for cultivation of epiphytes and as building material and because of the destruction of its natural habitat, most Mexican species are endangered. We conclude by discussing alternate materials for commercial use.

Resumen

„Maquique" es el material formado por las raíces adventicias de algunas especies de helechos arborescentes. Por su uso y su comercialización como sustrato para cultivar epífitas y por su uso como material de construcción y por el indiscriminado deterioro de su hábitat, muchas de las especies de México se encuentran amenazadas. Discutimos diversos sustratos alternativos.

Zusammenfassung

Als „Maquique" bezeichnet man in Mexiko das aus Adventivwurzeln gebildete Material, das den Stamm einiger Baumfarne umgibt. Wegen der Nutzung und des Handels als Kultursubstrat für Epiphyten, des Gebrauchs als Baumaterial und der Zerstörung der natürlichen Lebensräume sind die meisten Baumfarnarten Mexikos gefährdet. Verschiedene Alternativmaterialien werden vorgestellt.

1. Systematik

Baumfarne mit aufrechten, 6–15 m (maximal 25 m) hohen Stämmen und 2–3 m langen Blättern stammen besonders aus zwei pantropisch und in den warm-gemäßigten Regionen verbreiteten Familien der Pteridophyten: 1. den relativ altertümlichen Dicksoniaceae (6 Gattungen, ca. 40 Arten) mit zwei Gattungen *Dicksonia* L'HÉR. und *Cibotium* KAULF., die aufrechte Stämme mit einem Wurzelmantel bilden, und 2. den Cyatheaceae mit je nach Autor 1–6 Gattungen (*Alsophila* R. BR., *Cnemidaria* C. PRESL, *Cyathea* SM., *Nephelea* TRYON, *Sphaeropteris* BERNH., *Trichipteris* C. PRESL) und ca. 650 Arten. Beide Familien lassen sich leicht unterscheiden. Bei den Cyatheaceae stehen die Sori auf der Unterseite der Blattfläche; Stamm und Blattstiel besitzen echte Schuppen. Bei den Dicksoniaceae stehen die Sori am Blattrand, und echte Schuppen fehlen. Zwei weitere monotypische Familien Amerikas, die teils zu den Baumfarnen gerechnet werden, sind die Lophosoriaceae und Metaxyaceae, die wegen der fehlenden Bildung des Wurzelmantels nicht weiter betrachtet werden. Hochwüchsige Vertreter der Blechnaceae gehören nicht zu den echten Baumfarnen.

2. Morphologie

„Maquique", „Maquiqui", „Malquiqui", „Malque" oder „Parásita" nennt man in Mexiko (portugies./brasilian. „Xaxim"; venezol. „Raíz de helecho"), den von den Adventivwurzeln und teils auch den verfilzten Blattbasen gebildeten Mantel vieler (nicht aller!) Baumfarne. Die monopodial verzweigten Adventivwurzeln werden an der Basis der Blattstiele erzeugt und umschließen den bis zu 25 m hohen Stamm. Die Bildung dieses Wurzelmantels kompensiert funktionell das Fehlen des sekundären Dickenwachstums bei Farnen. Der Gesamtdurchmesser erreicht je nach Art 15–80 cm. Der Wurzelmantel kann das 2–5-fache des Stammdurchmessers ausmachen und verleiht auf diese Art dem nur schmalen, im Zentrum befindlichen Rhizomanteil erhöhte Festigkeit und Schutz (KRAMER et al. 1995). Außerdem dient er der Wasser- und Nährstoffaufnahme. Die Standfestigkeit der Arten ohne Wurzelmantel wird ausschließlich durch die Leitbündel umgebenden Sklerenchymplatten verursacht (LUKANSCY 1974).

3. Wachstum und Lebensalter

Das Wachstum vieler Baumfarne erfolgt sehr langsam. In den montanen Bergwäldern El Salvadors dauert die Entwicklung eines Blattes von *Alsophila salvinii* HOOK., welche keinen Wurzelmantel bildet, 3–4 Monate. Nachdem pro Jahr nur 3 Blätter in einem Stammabstand von ca. 2,5–3 cm entwickelt werden, und das Größenwachstum der Individuen einer Art nach einsetzender Stammbildung relativ konstant ist, läßt sich das Alter eines 2 m hohen Exemplares auf mindestens 24 Jahre hochrechnen (SEILER 1981). Für *Cyathea pubescens* METT. ex KUHN ermittelte TANNER (1983) in Jamaica eine ähnliche Wachstumsrate von 1 m in 15 Jahren. Dicksoniaceae wachsen nur 3–5 cm pro Jahr. Da über die Zeitdauer zwischen Keimung und einsetzendem Größenwachstum bei jungen Pflanzen nichts bekannt ist, läßt sich das genaue Alter nicht bestimmen. Arten von gestörten Sekundärstandorten Costa Ricas, wie *Cyathea trichiata* (MAXON) DOMIN haben eine größere Anzahl von Blättern und erreichen wesentlich höhere Wachstumsraten von 80–90 cm pro Jahr. *Cyathea delgadii* STERNB., welche sowohl im Unterholz von Primärwäldern als auch an Sekundärstandorten auftritt, beschleunigt ihr Wachstum an letzteren Standorten um das Dreifache (BITTNER & BRECKLE 1995). Je nach Wachstumsrate ändert sich auch die Lebensspanne. Schnellwüchsige Arten wie *Cyathea arborea* können 30–35 Jahre alt werden, langsamwüchsige wie *Alsophila bryophila* erreichen ein Alter von 130 Jahren (TRYON & TRYON 1982). Die Bildung von „Maquique", der kommerziell genutzt werden kann, dauert dementsprechend lange.

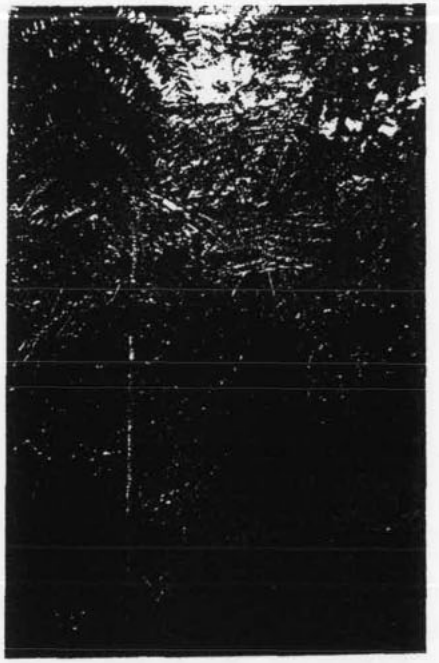


Abb. 1 (oben): Der Baumfarn *Alsophila firma*.

Abb. 2 (unten): Stamm von *Alsophila firma*.

4. Nutzung und Gefährdung

Maquique ist ein gutes Kultursubstrat für Orchideen, Bromelien, Farne und andere epiphytische Pflanzen, da die abgestorbenen Wurzelfasern die Feuchtigkeit für lange Zeit halten, über eine gut Drainage verfügen und sich nur langsam zersetzen. Viele der aus diesem Material angefertigten Kunsthandwerksgegenstände wie Skulpturen und Souvenirs sowie Blumentöpfe, die zum Verkauf angeboten werden, stammen von mächtigen, über 60 Jahre alten Exemplaren.

Tab. 1: Habitat und Verbreitung zur Maquiquegewinnung genutzter Arten. Alle 3 Arten führen in Mexiko auch den volkstümlichen Namen Maquique.

Art	Habitat	Höhenverbreitung in Mexiko	geographische Verbreitung	volkstümliche Namen in Mexiko
Dicksonia sellowiana	Gebirgswälder an gestörten Sekundärstandorten	1500–2300 m	Südmexiko, Mittelamerika, Kolumbien, Brasilien	Pesima, pesina
Alsophila firma	*Alnus*-, *Quercus*- und *Liquidambar*-Wälder	350–1700 m	Mexiko, Mittelamerika, Ecuador	Cola de mono, coyolillo, helecho, hidal, ocopetate
Sphaeropteris horrida	*Quercus*-Wälder, Kaffeeplantagen	100–1600 m	Mexiko, Guatemala, Honduras, Nicaragua	Cola de mono, rabo de chango, rabo de machín, rabo de mico

Die meisten der in Mexiko vorkommenden 18 Arten von Baumfarnen sind selten (s), vom Aussterben bedroht (b) oder geschützt (*) (DIARIO OFICIAL 1994, PALACIOS-RIOS 1992 a, b, 1994, 1997): *Alsophila firma* (BAKER) D. S. CONANT (*), *A. salvinii* HOOK. (s), *A. tryoniana* (GASTONY) D. S. CONANT; *Cibotium regale* VERSCHAFF. & LEM. (b), *C. schiedei* SCHLTDL. & CHAM. (b); *Cnemidaria apiculata* (HOOK. & BAKER) Stolze (s), *C. decurrens* (LIEBM.) R. M. TRYON (s); *Culcita coniifolia* (HOOK.) MAXON; *Cyathea bicrenata* LIEBM. (*), *C. costaricensis* (KLOTZSCH EX KUHN) DOMIN (b), *C. divergens* KUNZE (*), *C. fulva* (M. MARTENS & GALEOTTI) FÉE (*), *C. microdonta* (DESV.) DOMIN, *C. myosuroides* (LIEBM.) DOMIN, *C. schiedeana* (C. PRESL) DOMIN (s), *C. valdecrenata* DOMIN; *Dicksonia sellowiana* HOOK. (s); *Sphaeropteris horrida* (LIEBM.) R. M. TRYON (s).

Besonders drei Arten werden davon zur Gewinnung von „Maquique" genutzt (Tabelle 1). *Dicksonia sellowiana* ist die meistverwendete Art Südamerikas. Da es sich bei den abgeholzten Pflanzen ausschließlich um Exemplare von Wildstandorten handelt und sie über keine natürliche Regenerationsfähigkeit verfügen, sind alle Arten wegen des Raubbaus und der gleichzeitig fortschreitenden Zerstörung ihrer natürlichen Lebensräume stark im Rückgang. Eine Anzucht oder Wiederaufforstung in Kultur erfolgt nicht. Das Material wird sowohl auf lokalen Märkten (auch als Baumaterial) gehandelt als auch nach Europa und den USA exportiert. Die ersten Baumfarne sind 1975 in Anhang II der CITES aufgenommen worden. Seit 1995 stehen alle Arten der beiden Baumfarnfamilien unter Schutz (BUCHNER & DIETRICH 1996). Daher begann seit Jahren die Suche nach Alternativmaterialien.

5. Alternativmaterialien

Als Alternative für die Epiphytenkultur bietet sich „Coxim" (portugies.) an, das faserige Mesokarp der Kokosnüsse (PALACIOS-RIOS 1993). Dieses Material fällt bei der Kokosernte als Abfall an und wird in Brasilien seit Jahren als Ersatzprodukt verwendet. Es laugt nicht aus (d. h. es bleibt auch nach jahrelangem Gebrauch im sauren pH-Bereich zwischen 5 und 6), zersetzt sich unter tropischen Bedingungen in 4–8 Jahren und hat einen natürlichen Nährstoffgehalt von Kalium (1,39 %), Stickstoff (0,46 %) und Phosphor (0,26 %). Für die Orchideenkultur empfiehlt sich die Erhöhung des N-Gehalts und das vorherige, mehrere Tage lange Wässern des Materials, um den hohen Tanningehalt, der junge Wurzeln schädigen kann, zu reduzieren. Da es das doppelte des Eigengewichts an Wasser speichern kann und sich dabei das Volumen um 7% vergrößert, ist es nur in Mischung mit anderen Materialien zum Topfen geeignet. Zur Mischung können Vulkangestein, Moose, Styropor und Baumrinde verwendet werden. Letztere wird zum Beispiel von *Melia alba* („Cedro blanco"), *Liquidambar macrophylla*, *Quercus*- und *Citrus*-Arten gewonnen. Zum Aufbinden werden dickere Äste dieser Arten verwendet oder die gebündelten, verflochtenen Wurzeln von *Muhlenbergia macroura* („Raíz de zacatón") (PALACIOS-RIOS & FLORES 1992). Weitere Hinweise für die Orchideenkultur gibt die Homepage brasilianischer Orchideengärtner (http://delfina.simplenet.com).

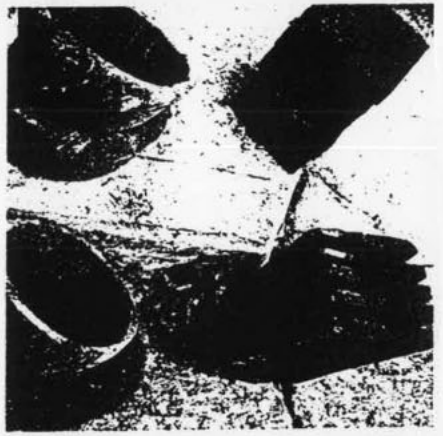


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Abb. 3 (oben): Ein Händler bietet Verarbeitungsprodukte des Stammes von *Alsophila firma* an.

Abb. 4 (Mitte): Gefäße aus dem Stamm von *Alsophila firma*.

Abb. 5 (unten): Baumfarn-Ente.

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Gärtnerisch-botanische Literatur

S. H. J. V. RAPANARIVO, J. J. LAVRANOS, A. J. M. LEEUWENBERG, W. ROOSLI

***Pachypodium* (Apocynaceae) – Taxonomy, Habitats, and Cultivation**

A. A. Balkema, Rotterdam, 1999, 120 S., 80 Farbfotos, 15 s/w Zeichnungen, 18 Verbreitungskarten; geb. ca. 90.– DM; ISBN 90-5410-485-6

Eine der populärsten Gattungen der „Anderen Sukkulenten" (d. h. der nicht zu den Kakteen gehörenden Sukkulenten) ist *Pachypodium*, deren bekannteste Arten, *P. lamerei* und *P. geayi*, als „Madagaskarpalmen" vor einigen Jahren Furore machten. Wie so oft ist der deutsche Name schlichtweg falsch – zwar sind die beiden Arten auf Madagaskar heimisch, sie gehören aber nicht im entferntesten zu den Palmen, sondern zu den Hundsgiftgewächsen (Apocynaceae) und damit in die Verwandtschaft unseres Immergrüns. Die letzte gründliche Überarbeitung der Gattung liegt knapp 20 Jahre zurück und unterschied 13 Arten. In der Zwischenzeit neu entdeckte Arten sowie die Abtrennung einiger bisher als Unterarten aufgefaßter Sippen hat die Zahl auf 23 (davon 18 auf Madagaskar und 5 in Afrika) anwachsen lassen und eine Neubearbeitung erforderlich gemacht. Diese wurde nun mit dem besprochenen Band vorgelegt, wobei RAPANARIVO und LEEUWENBERG die taxonomische Revision, der erstgenannte Autor ein Kapitel über die Lebensräume der Arten sowie ROOSLI einen Abschnitt mit detaillierten Kulturhinweisen zu den Arten Madagaskars beisteuerte. Daß es diesem Autor gelang, alle Arten Madagaskars aus Samen heranzuziehen und zur Blüte zu bringen, spricht für seine Kenntnisse und Fertigkeiten und empfiehlt seinen Beitrag sicherlich besser als viele Worte.

Alle Arten werden ausführlich beschrieben und mit guten Farbfotos illustriert, wobei die Standortaufnahmen aus den Trockengebieten Madagaskars und Afrikas den Leser immer neu in ihren Bann ziehen. Die Identifizierung wird durch einen ausführlichen Schlüssel leicht gemacht. Wissenschaftler und Liebhaber, die sich mit Sukkulenten auseinandersetzen, werden dieses Buch nicht nur brauchen, sondern auch ihre Freude daran haben.

STEFAN SCHNECKENBURGER

Gärtnerisch-botanische Literatur

H. P. LINDNER & H. KURZWEIL

Orchids of Southern Africa

A. A. Balkema, Rotterdam, 1999, 488 S., ca. 500 Farbfotos, 82 Strichzeichnungen, 458 Verbreitungskarten, geb. ca. 185.– DM; ISBN 90-5410-445-7

Floristisch ist das südliche Afrika eine der interessantesten Gebiete der Erde – mit etwa 24 500 Arten beherbergt die Region knapp 10 % der Pflanzenarten der ganzen Erde. Speziell die Kapregion, in der etwa 70 % der dort vorkommenden Arten endemisch sind, gilt als eines der sechs Florenreiche der Welt. Auch in der Orchideenflora spiegelt sich diese Sonderrolle wider – insgesamt 466 Arten in 52 Gattungen sind bisher vom südlichen Afrika bekannt, unter denen sich ausgesprochene Besonderheiten wie die Gattungen *Disa* oder *Bartholina* mit ihren teilweise spektakulären und bizarren Blüten finden. Insgesamt sind 8 Gattungen bzw. 302 Arten (65%) endemisch.

Das hervorragend gestaltete Buch beschreibt und verschlüsselt alle 466 Orchideenarten der Region; fast alle Arten sind durch prächtige Farbfotos illustriert. Jede Gattung ist durch eine detaillierte Strichzeichnung eines charakteristischen Vertreters zusätzlich repräsentiert. Verbreitungskarten, Hinweise zur Biologie, Bestäubung und Blütezeit werden gegeben; im einleitenden Teil findet sich eine ausführliche Darstellung der Geographie, Ökologie und Vegetationsverhältnisse der Region. Ausführlich wird über Bedrohung und Schutzmaßnahmen berichtet und Kapitel über den Nutzen und die Kultur runden die erschöpfende Darstellung ab. So erfährt man z. B. einiges über die wichtige Rolle, die manche Orchideen im lokalen Heilpflanzenhandel spielen.

Mit den „Orchids of Southern Africa" hat der Verlag seiner ähnlich gestalteten Reihe zu den Orchideenfloren von Belize (Zentralamerika) und Malawi (Afrika) einen großartigen Band hinzugefügt und einen Meilenstein gesetzt. Man kann ihn und seine Autoren hierzu nur beglückwünschen (und auf den nächsten Band gespannt sein). Dass der „LINDNER-KURZWEIL" ein Standardwerk zur südafrikanischen Orchidologie werden wird, braucht eigentlich nicht vorausgesagt zu werden – er ist es schon heute.

STEFAN SCHNECKENBURGER

Gärtnerisch-botanische Literatur

P. J. M. KNIPPELS

Growing Bulbs Indoors

A. A. Balkema, Rotterdam, 1999, 100 S., ca. 70 Farbfotos auf 16 Tafeln, zahlreiche Kulturtabellen und Zeichnungen, geb. ca. 50.– DM, ISBN 90-5410-467-8

Die „Fensterbankkultur" von Zwiebelpflanzen i. w. S. ist Thema dieses von kundiger, erfahrener Hand geschriebenen Buchs, das leider nur in englischer Sprache vorliegt. Aber dieses Thema beschäftigt so manchen Pflanzenfreund, so dass der Band aus unserem westlichen Nachbarland durchaus eine Vorstellung an dieser Stelle lohnt. Da hier die Betonung tatsächlich auf der „Fensterbankkultur" liegt, wird es sicher trotz der möglichen sprachlichen Probleme seine Interessenten und Nutzer in Deutschland finden. Auch die Auswahl der vorgestellten Arten ist an ihrer Erhältlichkeit orientiert – so werden überwiegend Sippen vorgestellt, die für den Liebhaber nicht in unerreichbarer Ferne liegen.

Das Spektrum der vorgestellten Gattungen – insgesamt sind es 51! – reicht von *Achimenes* und *Agapanthus* bis *Zantedeschia* und *Zephyranthes*. Die biologischen Grundinformationen wie Beschreibung, Artenanzahl und Verbreitung werden mitgeteilt sowie die kultivierten Arten vorgestellt. Neuartig und bisher einzigartig in diesem Zusammenhang sind die Kulturtabellen, in denen der Autor für jede Artengruppe die monatlichen Kulturmaßnahmen in einer kleinen Tabelle zusammenstellt. Hier finden sich Hinweise auf Ruhezeit, Blatt- und Blütenbildung sowie die hierdurch bedingten Pflegemaßnahmen – hier natürlich besonders die Zeit und Dosierung der Wassergaben bzw. des Trockenhaltens.

Übersichtskapitel über die Heimatgebiete der behandelten Zwiebelpflanzen sowie generelle Kulturhinweise und eine ausführliche Darstellung von Krankheiten und Schädlingen runden diesen überaus nützlichen und attraktiv bebilderten Band ab. Liebhaber werden von den Erfahrungen und Hinweisen des Autors reichen Nutzen ziehen und sich mit seiner Hilfe auch an die Kultur „neuer" Sippen wagen können. STEFAN SCHNECKENBURGER

The Distribution of Threatened Endemic Pteridophytes in the Philippines

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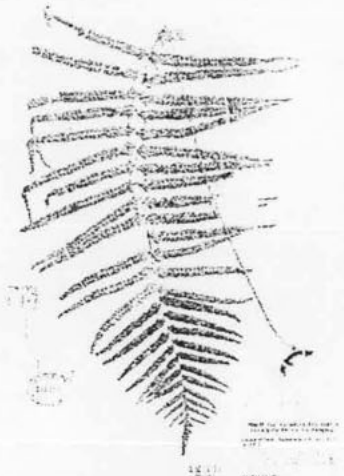
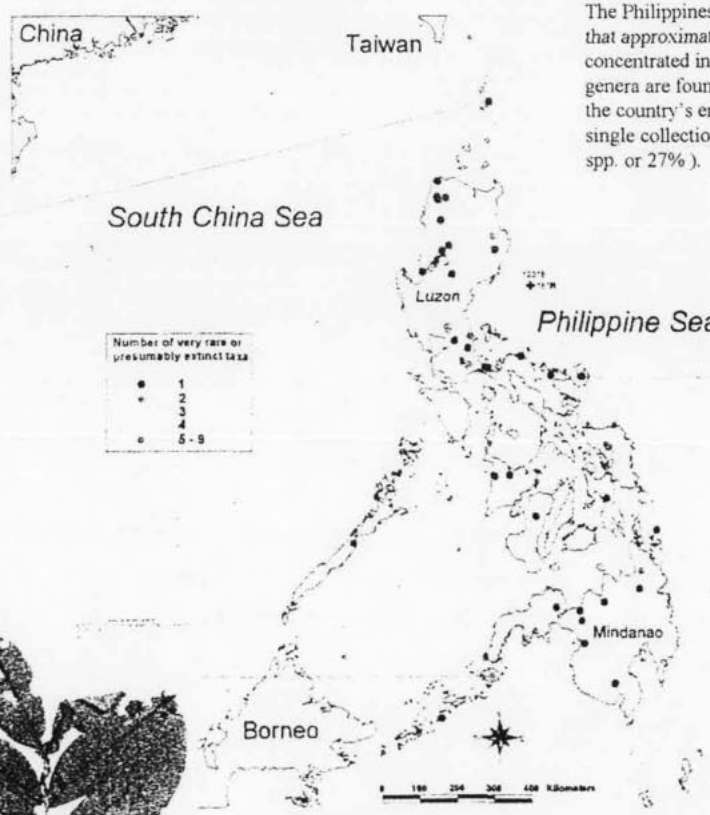


Gonitophlebium coadunatum Barcelona and M.G. Price (Polypodiaceae). A newly discovered species very rare and only known from 2 collections by the first author on Mt. Iraya, Batan Island in the Northern Philippines (background).

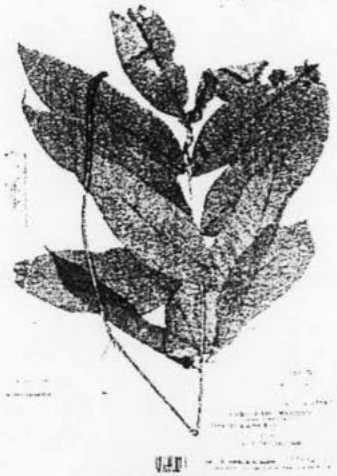


The Philippines is home to 1,100 species of pteridophytes in 142 genera and 39 families. This means that approximately 10% of the total described species of pteridophytes in the world today are concentrated in an area only about 0.06 % of the earth's land. Of these, 287 species (26%) and five genera are found only in the Philippines and nowhere else in the world. A significant percentage of the country's endemic pteridophyte taxa (29% or 82 species) are known only from types, i.e. from single collections, a bulk of which were collected from Luzon (37 spp. or 45%) and Mindanao (23 spp. or 27%).

Cyathea microchlamys Holtt
Known only from the type.

These taxa are either presumed **extinct** in the wild (or extinction is inevitable), or **recent discoveries**. Another eight percent (25 spp.) are known from only a few collections in the type localities (**very rare**), 15% (43 spp.) from adjacent localities, and 11% (32 spp.) from few disjunct localities – the last two categories are here considered **rare**.

The data for this study are extracted from a database of 15,200 records representing unique collection numbers of pteridophytes from the Philippines from the early 1800s to the late 1990s. These come from the collections of major Philippine, U.S., and some European herbaria. In addition, taxa mentioned in literature but without specimens that could be located at the time of this writing are also included. Taxonomic nomenclature was also updated accordingly. To produce the distribution map, coordinates were recorded or the collection localities were georeferenced, and these were plotted on the map using the computer Geographic Information System software ArcView / ArcInfo.



Tectaria suluensis Holtt
Known only from the type.

In a country where the population represents 1.25 % of that of the world, forest cover has been diminishing in an alarming rate. Current estimates of the remaining original forest cover in the Philippines put it below 10%. Large scale commercial logging, slash and burn agriculture, and indiscriminate urbanization have been the major threats to the country's pteridoflora. Current conservation status of these threatened taxa can only be confirmed by studying the more recent collections and actual visits to the collection localities to determine their presence and evaluate habitat integrity. Beyond intensive field studies, rallying for awareness of our environmental problems through outreach education, formulation and implementation of drastic measures by the Philippine government against illegal logging and urbanization, and possibly, in-situ and ex-situ conservation and reintroduction of populations in the wild, seem to be the only remaining options to save these plants from extinction.

Selaginella pricei Tan and Jermy
A recently discovered miniature plant, known from two collections in West Samar, named after Michael G. Price

Background: Mt. Iraya (1009 m), Batan I., Batanes Province, N. Luzon

16 July, 2001

Grateful acknowledgements to Michael G. Price, David Lellinger, Leonard L. Co, Greg McKee, R. James Hickey, Michael Vincent, Romualdo M. del Rosario, Benjie Francisco, John & Jodi Ferner, Peter Edwards, Eric & Maria Tepe, Teodoro Baldimoro, Asuncion Fajardo & family, Manuel & Christy Cordel, Leopoldo Villegas, Nel Loyola, Fedro Acevedo & family, Vicki Funk, Susan Hunter, Margie Knowles, Dan Nicolson, Rusty Russell, Warren L. Wagner, Josephine Camus, Marivene R. Manuel, Alfreen Paul, Batanes local and provincial government, the people of Batanes, ESRI, Lahara Coffee, The Field Museum, Miami University, The British Museum, RBG Kew, IUCN

British Pteridological Society
with
Species Survival Commission
Specialist Group for Pteridophytes

fern flora Worldwide threats and responses

An International Symposium
University of Surrey, Guildford, UK
23-26 July 2001

Abstracts

Presented Papers: pages 1-15
Posters: pages 16-27

NEW PHYTOLOGIST TRUST

ENGLISH NATURE

IUCN

SPECIES SURVIVAL COMMISSION

Presented Papers

Monday 23 July, 0930 h — Session 1: Setting the Scene

OPENING AND WELCOME

President of BPS: A. C. Wardlaw
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KEYNOTE ADDRESS: NEEDS, METHODS AND MEANS

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There is an increasing groundswell of attention being given to the conservation status of plants especially through the Convention on Biological Diversity. A developing global strategy recognizes fundamental objectives: integrated *in situ* and *ex situ* conservation, research on biology and decline, monitoring and information management, assessing the social benefits of plant diversity, and public awareness. Targets have been suggested for a number of key indicators. Do ferns and their allies need such a strategy? This question is addressed from several points of view, especially potential value as indicators of environmental health, as the descendents of ancient lineages of plants, extraordinarily wide distribution combined with habitat specificity, and their widespread cultural value and public recognition. Although perhaps better known taxonomically than many other plant groups, there are significant gaps in our knowledge of ferns, especially their biology, distribution and conservation status. A tendency to be concentrated in regions and habitats at risk and frequent local endemism especially on islands, means that a significant proportion of species may be at risk. The developing global strategy and the recently agreed Species Survival Commission conservation strategy for plants provide a robust framework for completion of an Action Plan for the conservation of pteridophytes, and development of guidelines for its implementation where most needed.

THE SSC PTERIDOPHYTE SPECIALIST GROUP: WHAT DO WE WANT TO ACHIEVE?

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The International Association of Pteridologists (IAP) was set up in 1981 and its Council formed a committee to consider fern conservation. Within two years the Species Survival Commission (IUCN) had decided to expand its Specialist Groups and set up a number of plant groups. The IAP 'Conservation Committee' was taken en bloc to become the first SG for Pteridophyta.

This symposium is the first the Pteridophyte SSC Group has convened and we welcomed the BPS' initiative to host and organise this symposium. The range of papers given can only be the tip of the iceberg but we hope we have shown the scope and value of basic research to conservation issues and action. Pteridophyte taxonomists who join or organise expeditions to collect research material often see first-hand potential threats to vegetation, habitats and individual populations. There is a need to share technical expertise as encouraged in the Convention on Biological Diversity but at the same time the number of experienced fern taxonomists to study the rapidly disappearing tropical flora is decreasing.

The varied mechanisms each State and Country sets up to manage its environment and protect and utilise, hopefully in a sustainable way, its biodiversity can also be complex, and the links between the science base, the community and the decision makers must be made for effective action. This brief introduction will outline some of the problems encountered by the Group and will suggest where discussions and exchange of ideas should concentrate, recognizing that much, if not most, of the success of this kind of meeting occurs informally.

THE IUCN/SSC RED LIST PROGRAMME: AN OVERVIEW

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The Species Survival Commission (SSC) of IUCN- the World Conservation Union, is the custodian and producer of the *IUCN Red List of Threatened Species*, which is widely recognized by both governments and NGOs as the world's most objective and authoritative listing of species that are globally at risk of extinction. For the last few years, the SSC has been developing the *IUCN Red List* into a global programme to monitor the extent and rate of biodiversity degradation. This has required considerable planning, because, until the mid-1990s, the *IUCN Red List* was essentially an *ad hoc* process with little overall purpose or co-ordination. Major changes have occurred or are underway to develop the IUCN Red List into one of the fundamental tools to support biodiversity assessments, and conservation priority setting. These changes provide a platform for major new developments. The SSC proposes to implement the new directions in Red Listing in close partnership with four other institutions: the Association for Biodiversity Information (ABI), BirdLife International, the Centre for Marine Conservation (CMC) and Conservation International (CI), especially its subsidiary the Centre for Applied Biodiversity Science (CABS).

PROTECTED AREAS, AND IUCN'S WORLD COMMISSION ON PROTECTED AREAS (WCPA) - HOW CAN THEY HELP IN THE CONSERVATION OF FERNS?

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There are more than 30,000 protected areas around the world, representing a global investment in in situ conservation of biodiversity. This paper will:

- introduce the World Commission on Protected Areas (WCPA is a part of IUCN) which leads IUCN's work in this field,
- review the history and current situation regarding protected areas, including the concept of protected area categories,
- identify the problems facing protected areas, and future trends and prospects,
- consider the role of protected areas in conservation, research and education for biodiversity, including through the Convention on Biological Diversity, and the World Heritage Convention,
- look at a few case studies of the part played by protected areas in conserving ferns,
- explore how the fern conservation community and protected areas people can co-operate, focusing on such topics as the need for information, the key position of the protected area manager, the role of research, and the scope for institutional co-operation (e.g. between SSC and WCPA),
- raise some questions for discussion at the conference.

ETHNOBOTANICAL STUDIES ON FERN AND FERN ALLIES OF INDIA

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India represents one of the twelve megadiversity areas of the world. The country is also endowed with all three levels of biodiversity, viz. species, habitats and genetic and hence has one of the richest and varied plant diversity. Of these the Pteridopyta constitute a very fascinating group with many species having edible, medicinal and ornamental value. They have been successfully employed in Ayurvedic, Unani and Homeopathic systems of medicine since the time of Charak and Shushrut.

Unil now, little attention has been paid to the ethnobotanical aspects of Indian pteridophytes. Hence this attempt that has been made to collect indigenous knowledge about the various uses of plants acquired by the tribal, aboriginal and local people of the different parts of India. The present communication deals with more than 200 species of ferns and fern allies of ethnobotanical importance with correct nomenclature, synonym, local name, habitat, distribution and local uses.

This study will highlight some interesting data in pteridophytic taxa which may be useful for the phytochemists and pharmacologists to determine their true therapeutic value.

NATURAL DISTURBANCE REGIMES AS MODELS IN PTERIDOPHYTE CONSERVATION MANAGEMENT

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The occurrence of soil-surface disturbance processes can be demonstrated to provide opportunities for sometimes spectacular episodes of renewed pteridophyte colonisation in many wild habitats. It is suggested that as a general principle in pteridophyte ecology, the occurrence of disturbance regimes at a variety of scales provide much-overlooked but often vital components of natural pteridophyte colonisation and regeneration, thereby promoting the long-term well-being of pteridophytes in many natural communities.

Such regimes illustrate important principles and provide particularly useful models of immense value to incorporate as components of pteridophyte conservation management strategies. Careful and sensitive experimentation and manipulation is advocated to develop field strategies for long-term maintenance of appropriately responsive pteridophyte species, and as tools for possible recapture of some scarce or even lost ones.

Monday 23 July, 1400 h — Session 2: Regional and Country Reviews

ASPECTS OF CONSERVATION ACTION IN A LARGE NATION: AT-RISK PTERIDOPHYTE CONSERVATION IN THE USA

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The United States flora has about 556 pteridophyte species, 425 on the continent and 131 in Hawaii. Of these, 122 species (22%) are at risk, including 32 rated G2 (critically imperiled). Hawaii, a group of isolated tropical Pacific islands, presents a distinct biogeographic situation (including a high percentage of endemic species), and will not considered here. The continental US has 71 endemic pteridophyte species of 425 total (16.7%). Within the continental US, Florida has over 32 pteridophyte species limited to that state. All but one endemic are neo-tropical species with range extensions north into Florida. Presumably, a large nation might relatively easily protect its endemic and at-risk species but, the US is comprised of 50 states and each has primary responsibility for conserving the at-risk biota within its borders. As a result, varied bureaucratic and scientific approaches, levels of financial support, and distinct political situations yield efforts among the states that vary in scope and effectiveness. Information about at-risk species continues to improve, in part as geographic information systems (GIS) technology is brought to bear. Access to steadily improving electronic databases in the various states is being enhanced by the Association for Biodiversity Information. Ongoing problems include: varied criteria for levels of legal protection, inadequate and sporadic financial support for enforcement of existing statutes, and insufficient numbers of adequately trained scientific personnel. The taxonomy, biogeography, and ecology of at-risk US pteridophytes and political, land use, and scientific issues affecting their conservation will be presented.

FERN CONSERVATION IN BRAZIL: THREATENED, VULNERABLE AND PROBABLY EXTINCT SPECIES

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Ferns and allied plants constitute an important group in the megadiverse flora of Brazil, with an estimate of ca. 1150 species, in its 8547403 square kilometers. The Southeastern region corresponds to one of Neotropical fern speciation and endemism centers, increasing the responsibility of the Brazilian authorities and scientific community as to the conservation of this diversity. Brazil also has some Atlantic islands, of which Trindade (ca. 1000 km from the coast) presents an interesting fern flora, but with serious conservation problems. The use of ferns by the original human populations did not constitute a threat to species or habitats. The rapid disappearance of forests for lumber and agricultural use started in colonial times and persists even at the present moment. All the Brazilian ecosystems present human interference to major or lesser degree. Intensive extraction in current days, especially of tree ferns for their fibrous layer of

adventitious roots on the caudex, as well as for decoration, is becoming a major concern. Data on these extraction activities and their consequences are presented, especially for *Dicksonia sellowiana* (C. Presl) Hook. The information on pteridophyte species conservation in Brazil is scarce, but the rapid destruction of special habitats permits to estimate the existence of a high number of threatened and endangered species. Some cases of probably extinct species can already be documented. The governmental action towards conservation is discussed, and a brief survey of the species conservation problems in each of the Brazilian regions is presented, with examples of species requiring immediate attention.

KEEP THE PLACES WHERE EVOLUTION IS WORKING!

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The diversity of ferns and allied plants is not high in the 'pampas', compared with other regions of the Neotropics in Argentina. The pteridophytes there grow only in the gallery forests along some rivers and in a few very old orthographic units. These latter emerge dispersed in the large plain, examples being Tandilia and Ventania in Buenos Aires, Los Viejos and Mahuidas in La Pampa and the Island of Martin Garcia in the estuary of the la Plata. This island arises as a rocky 'stake' in the so-called 'Sweet Sea', named by the Spanish conquerors of 500 years ago. These continental (4) and aquatic (1) 'islands', from analysis of their pteridophytic flora, are interpreted as intermediate shelters to explain the routes which have connected the three major floristic complexes in the South Cone of America, namely South-Brazilian, Andine and Southern-Antarctic units. In vulnerable sites in Ventania, an interesting hybridization, presumptively introgressive, of *Blechnum australe* subp *auriculatum* X *B. leavigatum* was found, showing a weak ecological barrier, the first taxon being more frequent and hardy than the second one. So, evolution is working there through the most common and simple type of speciation in ferns. Following back-crossing, the fertility of the achieved hybrid was very low, being not more than 11% in the F1. Obviously and as an example *in vivo*, like an observation in the laboratory, it must be kept carefully *in situ*, as a valuable teaching tool and as clear evidence that diversification is increasing stepwise.

BIOGEOGRAPHY, HUMAN GEOGRAPHY AND FERNS IN THE EASTERN CARIBBEAN

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Data on the distribution of pteridophyte species in the Eastern Caribbean were extracted from Proctor's 1977 (Lesser Antilles and Barbados) and 1989 (Puerto Rico and the Virgin Islands) floras. These data do not conform to the expected species-area relationship with both a poor fit and a high value of the 'slope' parameter. Other environmental factors that might control the observed distribution pattern were examined along with data on human population density and activity. A surprising trend of increased fern diversity with increased human population was detected. Possible explanations for this trend are evaluated.

THE BIODIVERSITY AND CONSERVATION OF THE FERNS AND FERN ALLIES OF NEW GUINEA

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The island of New Guinea supports one of the richest and most diverse, but the most poorly known tropical floras. It has in excess of 25,000 species of vascular plants (some estimates are lower), including over 2,000 species of ferns and fern allies. Thus the island supports some 12-15 percent of the total diversity of the pteridophytes, with many more species awaiting collection and description.

Conservation of this flora is of major international importance. Detailed studies of the flora and vegetation of both Papua (Irian Jaya) and Papua New Guinea have been made within the last ten years, and a comprehensive conservation strategy proposed. These proposals are reviewed in this paper. Some 30 percent of the total area of both Papua and Papua New Guinea was proposed for conservation in the two reviews (Johns 1994; Johns unpubl.). Endemism in the flora of New Guinea is very high with possibly 60 -70 percent

of all vascular plants being endemic. Several fern genera are endemic: these are discussed. A general review is made of the patterns of endemism in selected genera of ferns and fern allies. Distribution patterns of species within New Guinea are discussed but a more detailed understanding will require intensive field collections, particularly in Papua, although extensive areas in Papua New Guinea are also poorly known.

Conservation of the vegetation and flora of New Guinea is a major challenge for this millenium. Some of the threats to plant conservation are outlined and proposals made for a detailed study of this 'the last 'unknown tropical flora'.

HERBARIUM COLLECTIONS AS A RESOURCE FOR CONSERVATION PLANNING: AN EXAMPLE FROM THE PHILIPPINES

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A database of 15,500+ collection numbers of Philippine pteridophytes deposited in major U.S. and Philippine herbaria was evaluated to determine their current conservation status. The highest collection activities were between the years 1900 and 1910 and these drastically decreased in the 1930s until the present. More than half of the total collections were from Luzon and nearly one third were from Mindanao. Specimens collected after World War II are not well represented in U.S. herbaria. This, however, may not reflect the true collection activities in the country, but rather, of the slow incorporation into and distribution of these new collections to the different herbaria. Also, databasing of the more recent collections in major Philippine herbaria have just started. Processing of specimens should be the priority of herbaria in the Philippines so these new collections may be used in different floristic, revisionary, and conservation-related studies of pteridophytes. Analyses of the relative collection activities, the number of endemics known only from types, and the land areas of selected islands or regions (Leyte, Luzon, Mindanao, Mindoro, Negros, Palawan, Panay, Samar, and Sibuyan) show that all regions, except Luzon and Mindanao, have lower collection activities relative to their land areas. The ratio of single-collection endemics to the total collection numbers further suggests that all the regions, except Luzon and Panay, have high percentages of endemics known only from types. A more intensive studies in the field is needed in most areas in the Philippines to determine the real conservation status of these endemic taxa. Lastly, the number of publications of taxonomic-related studies on Philippine pteridophytes is low during the last half when compared to the first half of the century.

FERN CONSERVATION IN SOUTH TROPICAL AFRICA

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The region covered by this paper includes the countries of Angola, Botswana, Malawi, Mozambique, Zambia and Zimbabwe, which is a subtropical zone situated between the equatorial regions of the DRC and East Africa, down to South Africa in the south, and from the Atlantic Ocean in the west to the Indian Ocean in the east. The region has a reasonably well-explored fern flora by comparison to the more tropical regions of Central and West Africa. But as with much of Africa, burgeoning populations coupled with shattered economies and civil wars have resulted in extensive habitat destruction over much of the continent. Since ferns are so habitat-dependent, it is the conservation of habitat that is the over-riding priority in south tropical Africa. This paper gives a brief overview of the rare and endemic ferns of the region, the threats that they face, and the limited actions being taken to address these threats. Until recently no Red Data List existed for the region, a shortcoming now addressed by the compilation of the first RDL which lists all the rare, endemic and threatened pteridophytes of the *Flora Zambesiaca* countries. This is only the first small step in an effort to address the problems of education, conservation of natural habitats, and *ex-situ* conservation in a region where botanical conservation receives minimal support in the face of economic meltdown, starvation and political instability.

RARE FERN SPECIES OF RUSSIA AND REASONS FOR THEIR RARITY

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Nowadays about 160 fern species occur in Russia. The last edition of "The Red Book of the RSFSR" (1988) includes 10 fern species. In fact, the number of rare fern species in Russia is considerably larger: in the strict sense there are 34 rare species but the number may be expanded up to 40-45. What are the reasons for fern rarity? Four important reasons are: historic, ecologic, anthropogenic and biologic. The historic reasons involve a contraction and a breakup of areas in the Glacial epoch. Some species areas were reduced so much that at present in Russia they occur only within limited territories. Such species are met in the North Caucasus, the Altai and Far East. The ecologic reasons involve a narrow adaptation to the peculiar ecotypes and poor distribution of those ecotypes. The bulk of ecologically rare species in Russia are petrophilous and aquatic. The anthropogenic reasons are of importance only when forest felling, water-reservoir fouling, intensive tourist business, and deposit exploitation result in the destruction of ecosystems. In such case there may be a total destruction of some populations. But the main reason for the rarity of many fern species is the peculiarities of their biology. A necessary condition for a species to exist continuously in an ecosystem is the steady self-support of the population. The species, which have sporophytes propagating successfully by vegetative means, and also renew through the gametophyte phase, have the best chance for population well-being and continuous existence in coenosis. Such species, as a rule, are not rare and sometimes dominate in the herbal cover of the ecosystem. The species, which have sporophytes without effective vegetative reproduction, and need a combination of many favourable factors for producing gametophytes, are the most vulnerable and have least chance for continuous existence. Species with such biologic limitations are not able to form large populations and tend to be rare. The rarest are ancient species adapted to uncommon habitats, with both hampered spore and vegetative renewal, and inhabiting zones of intensive economic activity.

DISTRIBUTIONAL PATTERNS OF THE PTERIDOPHYTES WITH SPECIAL REFERENCE TO THOSE IN ENDANGERED HABITATS

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Many of the diverse structural adaptations shown by fern sporophytes are associated with their ecological role in particular habitats. In different habitats ferns have adapted to produce sometimes strikingly different sporophyte morphologies. The classification of habitats used here is of application to ferns worldwide, examples quoted are largely taken from the author's own experience in Taiwan and adjacent regions. The main types of habitats include forest floor, humid valleys, rocky slope, cliff, stream bank, alpine zone, mountain ridge, coastal area and. tree trunks, We must attempt to practice forestry to keep the mountains green for conservation especially for those in endangered habitats.

Tuesday 24 July 0900 h

Session 3: Relevance of Molecular Studies to Conservation

TAXON RARITY AND ENDEMISM VERSUS GLACIAL REFUGIA AND CENTRES OF GENETIC DIVERSITY - WHERE SHOULD WE PLACE CONSERVATION PRIORITIES FOR EUROPEAN PTERIDOPHYTES?

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[1]*Plant Molecular Biology Laboratory, Department of Botany, The Natural History Museum, London, UK*
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[2]*Department of Genetics, University of Cambridge, UK;* [3]*Royal Botanic Garden Edinburgh, UK*

Distribution patterns of plants are influenced by ecological, genetic and historic factors. The genus Asplenium and other European pteridopyhtes can supply interesting model studies to infer the processes that during the Pleistocene have shaped current species diversity and distribution patterns. When the distributions of different Asplenium taxa in Europe are examined, it is clear that the diploid taxa are restricted

predominantly around the Mediterranean Basin, but that the polyploid taxa occur mainly in the areas that had been affected by glaciation. By exploring the discontinuities in distribution patterns, substrate specificity, genetic diversity, ploidy levels and breeding systems we can determine centres of genetic diversity and long-term refugia in Europe, pin-point areas where polyploid taxa may have originated, and reconstruct colonisation patterns of plants in relation to Pleistocene glaciation cycles. The results of our studies have implications for the identification and assessment of priority species and priority areas for pteridophyte conservation in Europe.

THE IMPORTANCE OF RECENT POPULATION HISTORY FOR UNDERSTANDING GENETIC DIVERSITY IN NATURAL POPULATIONS OF ENDANGERED *DRYOPTERIS CRISTATA*

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The Crested Buckler-fern [*Dryopteris cristata* (L.) A. Gray] has become rare and endangered in south-western Central Europe. In Switzerland, at the southern border of the species, European distribution, 62% of all described populations were extinct due to habitat destruction, and only 14 populations remained in 1999. It was possible to reconstruct recent historical population sizes of most of the remnant Swiss populations for the past 120 years. Present-day genetic diversity of *D. cristata* was assessed by random amplified polymorphic DNA (RAPDs). Population genetic theory predicts stochastic losses of genetic diversity in small, fragmented populations, and genetic erosion will increase the risk of local extinction. In *D. cristata*, however, comparatively high genetic variation was found in some small populations. The lack of correlation between present-day genetic diversity and current population size is best explained by recent population histories. Severe historical bottlenecks resulted in a significant loss of about 40% of genetic variation in populations of this long-lived, allotetraploid fern. In contrast, distinct reductions of formerly large populations to small remnants did not substantially reduce genetic variation in the short-term. But we found evidence for genetic drift acting upon these small populations, which are thus prone to random losses of genetic diversity in the long-term. Although important for conservation biology, empirical research on random evolutionary processes during periods of small population size is scarce, because population history usually remains unknown. Understanding population history can substantially improve predictions on genetic diversity in remnant populations of threatened species and thereby help in choosing priority populations for conservation.

THE CRITICALLY ENDANGERED ENDEMIC FERN GENUS *DIELLIA* (ASPLENIACEAE) FROM HAWAII: ITS POPULATION STRUCTURE AND DISTRIBUTION

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Diellia Brack. (Aspleniaceae) represents one of three endemic fern genera restricted to the Hawaiian Islands, and is comprised of one hybrid and six species. The authors have evaluated the conservation status of all seven taxa according to current IUCN criteria (IUCN 2000) and find that besides the two taxa that are extinct -- *D. leucostegioides* (Baker) W. H. Wagner & *D. mannii* (D.C. Eaton) W.J. Rob. – the remaining five fall into the Critically Endangered category. Current phytogeographical distributions of all *Diellia* taxa are presented along with data on life-stage and size structure within 10 subpopulations of the five extant taxa: *Diellia erecta* Brack.; *D. falcata* Brack.; *D. pallida* W. H. Wagner; *D. unisora* W. H. Wagner; and the hybrid *D.* x *lauii* W. H. Wagner (*D. falcata* x *D. unisora*). The proportion of premature and reproductively mature sporophytes could be one possible variable for use of the population status of *Diellia* plants in short-term studies. In consideration of their rarity and unique phylogenetic significance, the remaining wild populations are suggested as priority candidates for future conservation efforts.

GENETIC DIVERSITY AND REPRODUCTIVE BIOLOGY OF *ARCHANGIOPTERIS SOMAI* HAYATA, A RARE FERN ENDEMIC TO TAIWAN

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Archangiopteris somai Hayata is a rare, endemic, and threatened fern in Taiwan. Only two populations are known: one in Wulai and one in Lienhwachi, in northern and central Taiwan respectively. Genetic variation and differentiation within and between populations of this fern were examined using isozymes, sequences of a noncoding spacer between the *rbc*L and *atp*B genes of the cpDNA, and sequences of the internal transcribed spacer between 18s and 23s of the nuclear ribosomal DNA. Low levels of genetic variation and differentiation were detected both within and between populations was very low. The mating system of *A. somai* is still unclear. However, given the low genetic variation among all individuals, even outcrossing would not generate high genetic diversity. Most spores reached maturity and were released in late winter or early spring. Released spores stored in distilled water at 4^0C remained viable longer than spores stored under other conditions. *A. somai* spores germinated on soil collected from their natural habitat, but not on agar or peat. It is possible the soil harbored symbiotic (or mutualistic) fungi that induced germination of *A. somai* spores.

Tuesday 24 July 1100 h

Session 4: Conservation in the UK: Policies and Practice

PLANT CONSERVATION IN GREAT BRITAIN: THE LEGISLATIVE AND POLICY FRAMEWORK

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Conservation within the Great Britain is underpinned by a series of legal provisions supported by the policies of both national and local government. Sites of Special Scientific Interest are legally protected sites within Great Britain where rare or threatened habitat or species populations types occur, such as *Sphagnum* mires or *Calluna* heathland, or for rare associations of species, such as Atlantic cryptogams, which can include *Hymenophyllum* spp, *Dryopteris aemula* and *Trichomanes speciosum*. The Unitied Kingdom is a signatory to the Convention on Biological Diversity and discharges its responsibilities through the policies within the Biodiversity Action Plan (BAP) where rare and declining species and habitats are given special attention to resore their areas or populations. Several fern species are listed on The UK BAP, including *Lycopodiella inundata*, *Trichomanes speciosum* and *Woodsia ilv*ensis. This talk will provide an overview of these approaches and review their achievements to date.

THE UK BIODIVERSITY ACTION PLAN (BAP) PROCESS IN ACTION: THE KILLARNEY FERN, *TRICHOMANES SPECIOSUM*, A CASE STUDY

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The UK Biodiversity Action Plan (BAP) process for rare and endangered organisms was launched in 1994 by the UK Government as a response to the Rio Convention on Biodiversity. Five pteridophytes were selected for priority conservation action as a result, including *Trichomanes speciosum* (the Killarney fern). The development of understanding and re-assessment of its conservation needs exemplify how scientific research can assist and should underpin the UK Biodiversity Action Plan (BAP) and similar conservation processes.

T. speciosum has long been thought of as one of Europe's most threatened and attractive plants. Accordingly it was among the first species to benefit from legislation at a Europe wide level, first under the Bern Convention and later the Habitats Directive, and at a UK national level appearing in the first tranche of

Biodiversity Action Plans in 1994. Largely as a result of its conservation status it has benefited from considerable grant aided research over the last 7 years and can now be considered among the most comprehensively researched ferns in the world. This research has led to a better understanding of all aspects of the species biology, which in turn supported proposed revisions to the Species Action Plan and refined BAP targets. *T. speciosum* exemplifies many BAP taxa; research is a basic necessity to inform conservation action but is often expensive, does not give quick-fix results and often throws up unexpected answers. Translocation may meet species targets but is contentious and requires long term monitoring to determine success. Habitat protection and improvement are ultimately necessary for long term success but are less easily delivered. The true resource implications must be considered and the need for basic research taken on board if the BAP process is to progress and deliver for the next century.

WOODSIA CONSERVATION IN THE UK

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This paper describes the implementation of part of the UK Species Action Plan for the rare British fern *Woodsia ilvensis*. Various conservation methods are discussed, but the main focus is in the practical issues involved in carrying out translocations as a means to restore populations of *W. ilvensis* at two sites in England and Scotland. Knowledge of both the chief cause of decline (collecting during the so called Victorian Fern Craze) and aspects of the reproductive biology of the fern, has assisted in deciding whether translocation is an appropriate course of action and has also helped in predicting the likelihood of success. Factors affecting many of the practical aspects of the translocation process are discussed including site choice, source of translocation material, time of translocation, microsite planting locations, post-planting maintenance, and monitoring methods. The problems and issues raised will hopefully help in guiding other fern-recovery programmes.

CONSERVATION ACTION ON *PILULARIA GLOBULIFERA* AND *LYCOPODIELLA INUNDATA* IN ENGLAND

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Pilularia globulifera and *Lycopodiella inundatum* are two endangered pteridophytes on the UK priority list and have had Biodiversity Action Plans prepared for them. This paper describes work carried out in England by a team of surveyors over the past four years to confirm present and check old sites to see if habitat conditions have changed irreversibly or are likely to change in the near future if not arrested. Records of past and present occurrences had been collected under the aupices of the Botanical Society of the British Isles (BSBI) and other voluntary naturalists and databased initially by the government funded Biological Records Centre (BRC) and now by the BSBI under the Threatened Plants Data Base (TPDB) project. Such data are integral to the project. The whole programme has be funded by English Nature, the government agency responsible for nature conservation in England, under their Recovery Programme, and managed by Plantlife, the leading NGO for plant conservation in the UK.

With *Pilularia*, sites for re-establishment have been considered and with *Lycopodiella*, actual tranplants have been made in lowland heaths in southern England. How this was tackled and the problems that arose will be described. [The sites will be visited on Wednesday 25 July].

Tuesday 24 July 1400 h

Session 5: *Ex Situ*: Ends and Means

HORTICULTURAL APPROACHES TO THE CONSERVATION OF BRITISH FERNS

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The geographic elements in the British fern flora (with number of species) are: Mediterranean-Atlantic (9), Atlantic (9), Sub-Atlantic (8), Continental (7), Arctic-Alpine (7), Northern-Continental (8) and Northern Montane (2). In addition, there are two species endemic to the British Isles, *Dryopteris submontana* and *Athyrium flexile* (also considered a variety of *A. distentifolium*). About 18 of the species are 'vulnerable' or 'threatened' in Britain, mainly by pressures from human activities. Five of the rare species are protected by law.

The diversity of underlying geographic affinities has not prevented the horticultural maintenance of 48 of the 52 native species of British fern in a suburban garden at the above address for several, in most cases many, years. In addition, the collection contains over 80 cultivars of British ferns. The garden is at 45 m above sea level and of 0.1 ha area. Special microhabitats, with high humidity and frost protection, were created for *Adiantum capillus-veneris*, *Anogramma leptophylla*, *Asplenium marinum*, *A. onopteris*, *Hymenophyllum tunbrigense*, *H. wilsoni* and *Trichomanes speciosum*. Bog and pond areas were constructed for *Azolla filiculoides*, *Dryopteris cristata*, *Pilularia globulifera*, *Thelypteris palustris* and *Osmunda regalis*. Appropriate sunny or shady locations were provided for the ferns of rocky habitats, heaths and woodlands (species of *Asplenium*, *Cryptogramma*, *Cystopteris*, *Dryopteris*, *Gymnocarpium*, *Polypodium*, *Polystichum*, and *Woodsia*). Two of the adder's tongue ferns, *Ophioglossum azoricum* and *O. vulgatum*, have been maintained in samples of original turf with angiosperms.

Although aesthetically it is desirable to conserve the whole habitat in which a fern species naturally occurs (e.g. as a 'Site of Special Scientific Interest'), there may be 'conservation-insurance' merit in garden collections such as the above. In particular, horticulture facilitates the observation, conservation, investigation, propagation and display of almost all the species of native British ferns, and has been done in a single location, without disturbance to numerous wild habitats. Similar collections are known to exist in other countries (e.g. Australia, New Zealand and the USA) except that the percentage of native fern species in a single location may not reach the 90% achieved here.

CRYOPRESERVATION AND *IN VITRO* METHODS FOR *EX SITU* CONSERVATION OF PTERIDOPHYTES

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Although in situ preservation must be the first choice for conservation, ex situ growth and germplasm storage can provide complimentary tools for conserving rare pteridophyte taxa. Spore banking can greatly increase the breadth of genetic diversity that can be maintained ex situ, and cryopreservation techniques have been successful with both chlorophyllous and nonchlorophyllous spores, increasing their potential longevity many-fold. In vitro collections of both gametophytes and sporophytes can also reduce the amount of space required to maintain these plants, and cryopreservation has been successfully applied to both types of tissues, demonstrating its potential for long-term, stable germplasm storage of vegetative tissues. In vitro collecting of pteridophytes has also demonstrated the usefulness of this method for collecting plant tissues from the field. Taken together, methods for cryopreservation and for in vitro growth provide a variety of flexible tools for enhancing the ability of conservation researchers to propagate and preserve pteridophyte germplasm ex situ.

EX SITU CONSERVATION OF GLOBALLY-ENDANGERED FERN SPECIES: THE CASE FOR AN INTERNATIONAL SPORE-STORAGE FACILITY

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While *in-situ* conservation with habitat restoration will always be the preferred option for long-term conservation, *ex-situ* conservation has a role to play in certain specific circumstances. When a population is declining rapidly, it can be used to preserve the remaining gene bank while habitat restoration is undertaken. It can be used to build up a population of plants for transplantation to the wild to augment a declining population or to re-introduce the species to an extinct site. Plants in cultivation can also be used for educational purposes, for research into the biology of the endangered species to provide a basis for improved conservation methods, and even as a source of commercially available plants to reduce the threat of collecting from the wild. The options for *ex-situ* conservation of endangered ferns are presented and the feasibility of developing an international spore storage facility discussed.

DOES ASULAM THREATEN NON-TARGET FERNS?

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Asulam is a herbicide widely used to control bracken fern (*Pteridium aquilinum*). Spraying bracken puts other species at risk of exposure to the herbicide, but there have been few rigorous studies on the sensitivity of non-target species. Helicopter and ground-based spray operations are likely to expand in the future, but the threat posed to non-target ferns is impossible to assess. The research reported extends recent experiments using laboratory exposure of fern gametophytes as a means to assess the sensitivity of non-target ferns. Young gametophytes of *Asplenium septentrionale, Athyrium filix-femina, Blechnum spicant, Cryptogramma crispa, Dryopteris filix-mas, Gymnocarpium dryopteris, Oreopteris limbosperma* and *Polystichum aculeatum* all proved more sensitive than those of *Pteridium* to asulam in the conditions tested. Gametophytic gemmae of *Trichomanes speciosum* and sporophytic bulbils of the clubmoss *Huperzia selago* were affected by the herbicide, but suffered less damage than young fern gametophytes. These findings are reviewed in the light of perceived risk to fern gametophytes and limited data pertaining to field and glasshouse exposure of fern sporophytes. Situations in which asulam spraying might threaten non-target ferns, and the response needed in such situations are examined.

SURVEY AND EVALUATION OF THE NATURAL RESOURCES OF *CIBOTIUM BAROMETZ* IN CHINA, WITH REFERENCE TO THE IMPLEMENTATION OF THE CITES CONVENTION

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Cibotium barometz (Dicksoniaceae) is well valued as a garden plant for its ornamental value, or for use as a medicinal herb. The whole family was listed in the CITES Appendix II as early as in 1975. More recently, April 2000, the inclusion of the whole family was revised but *C. barometz* is still kept in Appendix II.

C. barometz rhizome is a famous traditional Chinese herb medicine"Gouji" (Cibot Rhizome, Rhizoma Cibotii). The actions are believed to replenish the liver and kidney, strengthen the bones and muscles, expel wind-dampness and ease the joints. It is also used for deficiency of liver and kidney manifested as chronic rheumatism, backache, flaccidity and immovability of lower extremities and frequent enuresis. The hairs on the rhizome have long been used in China (and in Malaysia) as a styptic for bleeding wounds.

Recently in China, with the increase of trade of *C. barometz*, it became necessary to know the distribution of this natural resource, the quantity, and status of trade of *C. barometz* in China, to meet the implementation of the CITES convention. In China, *C. barometz* is mainly distributed in the South and Southwest, It is an acid-soil indicator species in tropical and subtropical areas. It is rather common on acid soil in hill and mountain areas, but not common in the limestone areas in Guangxi, Yunnan and Guizhou. It is estimated that each year there are about 3000 tons of "Gouji" sold for trade, and the large consumers are factories for producing pills of "Zhuangyao Bushen Wan", a kind of medicine helpful for the function of the kidney. These and other outlets have been investigated and will be discussed. The export quantity must be

confined strictly, taking into consideration many factors, and a quantity of no more than 140 tons per year for export is suggested. In the future, exporting of final products should be encouraged rather than raw materials. Consideration has also been given to growing *Cibotium* for commercial use and thereby using this species sustainably. Methods for propagation from spores and rhizhome buds will be discussed.

A CASE STUDY OF THE SUSTAINABLE PRODUCTION OF TREE FERNS IN SOUTH-EAST AUSTRALIA

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Sustainable production or the term "*sustainability*" has become standard rhetoric in numerous government reports, discussion papers, management plans, research reports and reviews in Australia as well as internationally over the last decade. There appears to be a general consensus that we should all be aiming for "sustainable production". Yet, as Dahl (1995) contends, "there are as many dimensions to sustainability as there are to human society."

This paper explores the often controversial journey of turning the rhetoric of sustainable production into the practice of sustainability. The research was done at a property in the temperate rainforest of the Otway Ranges in South East Australia. It followed the development of a salvage tree-fern business through to the establishment of a set of blueprints on how to establish a self-sustaining, low-input, multifunctional, tree fern plantation.

The horticultural business has been broadly involved with all aspects of the tree fern industry, including micro-propagation, propagation, growing, wild harvesting, plantation establishment, exporting and conservation over the last twenty years. The research relates the experience of the horticultural aspects of cool-climate tree ferns such as soil and fertiliser requirements and presents an overview of the different varieties of tree ferns grown at the nursery. It also canvases broader issues of governance that can impact substantially upon the day to day operations of a horticultural business .

CONSERVATION OF TREE FERNS *EX SITU*

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Tree ferns (*Cyatheaceae* and *Dicksoniaceae*) present at least seven special problems for *ex situ* conservation: 1) the large number of species, particularly of *Cyathea*; 2) the large size of individual plants, up to 20 m tall; 3) the long period of expert care needed, from spore culture to maturity, e.g. about 23 years for *Dicksonia antarctica*; 4) the numerous, mainly tropical or subtropical, nation-states where most of the species occur and from which the plants or their spores would have to be collected with appropriate permission; 5) the constraints on export and import of mature tree ferns imposed by CITES and by national regulations; 6) the expense of collecting, transporting and maintaining, on an extended time scale, such large plants; and 7) the possible need for ancillary angiosperms and special climatic conditions to recreate typical tree-fern habitats.

According to the *1997 IUCN Red List of Threatened Plants*, there are 623 species of *Cyatheaceae*, of which 202 (32.4%) are 'threatened'. Among these latter, 100 species are 'rare', a further 36 are 'imperilled', 10 are 'critically imperilled and one is 'probably extinct'. The corresponding figures for *Dicksoniaceae* are: 41 total species, with 4 (9.8%) 'threatened', three 'imperilled' and none in the other categories. *Ex situ* conservation of tree ferns occurs in ferneries in their native lands, e.g. Australia and New Zealand, but international collections inevitably are limited in species numbers by availability of authentic material and by glasshouse or garden space. A further consideration is the weed-potential of a few tree-fern species; e.g. the introduced Australian *Cyathea cooperi* has invaded forests in Hawaii and Madeira. Britain has a long tradition of importing tree ferns, e.g. *D. antarctica* since 1824, but climatic factors severely restrict the range of tree-fern species and the regions in the British Isles and Ireland where outdoor growth is possible, unless winter protection is provided. Tree ferns are widely appreciated as 'architectural' plants in gardens and conservatories, but the available species range is relatively small. Nevertheless, public popularity and tourism could provide the political and financial stimuli for establishing a small number of *International Tree-Fern Arboreta*. These could be out of doors in suitable tropical or subtropical locations, or in a large covered enclosure, such as the Eden Project in SouthWest England.

Thursday 26 July 0900 h

Session 6: Data-Basing for Conservation

DOCUMENTING THE CONSERVATION STATUS OF AUSTRALIAN FERNS AND FERN ALLIES

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Responsibility for management of native and introduced Australian flora and fauna lies with eight Australian states and territories; the Commonwealth is responsible for the biota of its parks, reserves and managed land areas. Over-riding Commonwealth legislation is invoked whenever "taxa of national significance" are involved: these are the national consensus of species considered to be endangered or vulnerable. There are over 460 species in 112 genera of Australian ferns and fern allies, representing c. 2.5% of the Australian vascular flora, and of these, 23 species in 11 genera are considered "nationally significant"; Australia is an arid continent and the greatest diversity of pteridophytes is confined to the moist regions of the eastern coast with almost three quarters of the species found in NE Queensland. Although the taxonomy of all Australian pteridophytes has been recently and comprehensively treated in the Flora of Australia (vol 48:1998), work continues on the documentation of their diversity, distribution and biology. Flora treatments are being migrated into an interactive on-line database using flexible XML technology; an interactive identification key to the species will be developed as part of this project. The recently funded Australia's Virtual Herbarium will place data from all 6 million specimens in Australian herbaria, including all the pteridophytes, on-line within 5 years using XML and GIS technologies. A three-year project has been funded to model distribution patterns of Australian pteridophytes using predictive spatial analysis tools. The national Species Profiles, Recovery and Threats (SPRAT) database documents known biology, occurrence and conservation status of all "species of national significance" and will be made available on-line to assist with environmental planning and decision-making.

AN APPROACH TO THE SPECIES DIVERSITY AND BIOGEOGRAPHY OF LATIN AMERICAN PTERIDOPHYTES FROM A DATABASE AND ITS CONTRIBUTION FOR CONSERVATIONAL PURPOSES

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The Flora Pteridológica Latinoamericana is not only an enormous data accumulation, including mainly herbarium specimens, and 12,500 bibliographic references. Since 1994 the continuous data input and actualization of data and the application itself made it dynamic. It runs in MSAccess® 2000 and occupies at the moment 12MB of disk space. Although there is still a lack of data, especially for regions like Bolivia, Brazil, and Colombia, the preliminary results consider more than 7,500 taxa (3,600 species, 3,400 synonyms, and over 450 infraspecies), 193 genera, and 34 families for Latin America. Interactive data analysis is possible using parametric queries, which can be valuable for ecological and conservational purposes. It can list species, endemisms and collections (numbers, sites, dates) for any Latin American region, and also compare the species composition between regions and report diversity hot spots for families, e.g. Hymenophyllaceae (Venezuela), and genera e.g. *Cheilanthes* (México). Besides it indicates species to be looked for, if they were not collected in a region for more than decades. Also it can reveal historical details, e.g. the genus *Polypodium* contained one time 579 species names, now only 153 are considered within this genus.

MEASURES OF BIODIVERSITY

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Measures of biodiversity are needed to determine the 'where'of in situ conservation action rather than the 'how', particularly in deciding which combinations of available areas could represent and help sustain the most biodiversity value for the future. This raises many questions, including:

What is biodiversity?
What is the value basis for measuring it?
What practical approaches are available for measuring this biodiversity value?
Identifying a fundamental currency of biodiversity value to people
Best estimates of biodiversity value (genes and characters)
Popular estimates of biodiversity value (species or higher taxa)
Relationship among estimates (surrogacy scale)

These questions will be discussed with respect to ferns on global and regional scales.

THE IUCN/SSC SPECIES INFORMATION SERVICE: A GLOBAL SPECIES INFORMATION RESOURCE

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The world's biodiversity is being lost at an alarming rate as human populations grow and impacts on natural resources become increasingly unsustainable. In response, a growing number of conservation initiatives are being implemented around the world at local, national and regional levels. The role of international treaties targeting conservation issues also continues to grow, along with the number of national governments choosing to implement them. These treaties require specific, current, and accurate information on the status of biodiversity. Lack of access to quality data and information hampers these efforts. With its network of more than 7000 expert volunteers, the SSC represents what is likely the world's most complete source of scientific and management expertise on species. However, this reservoir of knowledge is fragmented, and difficult to access and share across the network. The Species Information Service (SIS) through a centralised database is being developed to increase the sharing of data and information within the network, and to allow the application of existing and emerging analytical tools. This will enable the SSC to contribute significantly to the conservation and sustainable use of biodiversity.

The flagship SSC product - the *IUCN Red List of Threatened Species* - is a key to understanding the potential for loss of biodiversity worldwide. SIS is the information system to be used for the capture and management of data in the IUCN Red List. In addition, the SIS Red List Module will incorporate an innovative approach to the Red Listing process - the RAMAS® Red List software developed by Applied Biomathematics. This approach takes into consideration the degree of uncertainty that can be present in threatened species data, allows for flexible data entry (empowering specialists to use the most appropriate data available), collects these data in SIS, and automates the listing process.

Thursday 26 July 1100 h

Session 7: Conservation Assessment and Management

CONSERVATION OF FERNS ON MAURITIUS: A SMALL ISLAND WITH BIG PROBLEMS

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The small tropical island of Mauritius in the southwest Indian Ocean has a fascinating flora in which almost one-third of the 850 indigenous plant species are endemic. Most of these species are now restricted to tiny remnants of native forest, heath and scrub in areas that are unsuitable for agricultural or urban development. The largest remnant of native forest has recently been designated a National Park. This designation and its associated legislation should help to protect many of the island's terrestrial habitats from further deliberate destruction by man but the continued survival of many plant species within these protected habitats remains doubtful. There are a number of reasons for this, but one which is applicable to more species than any other is the massive and increasing competition from introduced invasive plant species. More than 450 alien plant species have already become naturalized on Mauritius and two of these in particular, Chinese guava and privet, form thickets so dense that indigenous plants cannot regenerate. Ferns appear to be particularly vulnerable; almost one-fifth and of the 250 taxa that have been recorded from Mauritius have not been seen in recent years. Despite this, there are still many interesting taxa among those that survive and at least 17 are endemic. In 1995, the Royal Botanic Garden Edinburgh (RBGE), in collaboration with the National Parks

and Conservation Service in Mauritius, launched a joint project to help improve the chances for survival of these and other endangered fern species. In addition to field surveys and taxonomic investigations, a large fern propagation unit was built near the Botanical Garden in Curepipe and scientific and horticultural staff from RBGE provided advice and training to local biologists on all issues relating to the design and implementation of a long-term pteridophyte conservation programme. The initial phase of this programme was funded by the UK Government through its Darwin Initiative for the Survival of Species Scheme. Darwin Initiative funding and RBGE's managerial responsibility for this programme ceased in 1998 but, three years on, ferns continue to feature prominently.

A CONSERVATION ASSESSMENT OF THE PTERIDOPHYTE FLORA OF THE PITCAIRN ISLANDS, SOUTH CENRTRAL PACIFIC OCEAN

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The pteridophyte flora of the Pitcairn Islands consists of 32 species, of which two are endemic. Extensive field surveys of the four islands in the group, carried out in 1991, 1992 & 1997, have allowed informed conservation assessments to be made of the flora. For Pitcairn Island itself, the distribution of pteridophytes has been mapped in detail. IUCN red data categories, which have been applied to the pteridophyte flora, show the flora to consist of 14 threatened taxa (including the two endemic species), 17 low risk taxa, and one taxon for which data is deficient to allow assessment. This paper discusses the taxa found on the island and the conservation measures necessary to ensure their continued survival.

THE CONSERVATION OF *ELAPHOGLOSSUM* ON ST HELENA

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The indigenous flora of St Helena is the most threatened in the world, with 41% classified as threatened according to the 1997 IUCN Red List of Threatened Plants (Walter and Gillet, 1998). The main threats to the flora, as with many oceanic islands, are; degraded and fragmented habitats, small and isolated populations, and competition with invasive exotic species. With limited resources available for conservation on St Helena it is essential that species, populations and individuals are targeted effectively based on an understanding of evolutionary relationships, population genetics, and ecology. In this study we have selected 4 fern taxa as a model group to investigate species relationships and population genetics. This has enabled us to infer evolutionary processes in this group of ferns and to make recommendations for conservation to the Agriculture and Natural Resources Department on St Helena.

Posters
(In alphabetical order of first author)

IDENTIFICATION AND DISTRIBUTION OF THE ENDANGERED FERN *BLECHNUM CORRALENSE* ESPINOSA

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Fourteen species in the genus *Blechnum* (Blechnaceae) have been reported from the Chilean flora. The south of the country and Juan Fernández Islands are particularly rich in endemics. *B. corralense*, known only from the Los Lagos Region, has been considered as endangered according to IUCN categories. From studies in the field and herbarium we conclude that it also occurs in La Araucanía and Aysén regions, and Argentina. Reports from Mocha Island (Bío-Bío Region) are probably erroneous. It is found usually near streams in forest or in shaded damp areas, from sea level up to 1300 m altitude. The variability of the characters traditionally used for separating *B. corralense* from its relatives is great. Leaf texture and indument, shape of the scales on the petiolar bases and spore size and color allow reliable identification.

COMPLEX STUDY OF PROTECTED FERNS OF ESTONIA TO DEFEND NATURAL POPULATIONS

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The indigenous flora of Estonia includes 22 species of ferns. Of these 10 belong to Red Data Book of Estonia (1998) and 7 species (*Asplenium ruta-muraria* L., A. *septentrionale* (L.) Hoffm., *A. trichomanes* L. ssp. *quadrivalens* D. E. Meyer, *Cystopteris sudetica* A. Br. et Milde, *Gymnocarpium robertianum* (Hoffm.) Newm., *Polystichum lonchitis* (L.) Roth, *Woodsia ilvensis* (L.) R. Br.) are protected according to their rarity and endangered status. The protected species and red-listed *Blechnum spicant* (L.) Roth were studied by the revision of distribution, gathering life history data and monitoring wild populations in 13 locations. Duration of the germination and different life cycle stages were determined. Data were gathered on population structure and dynamics. *W. ilvensis* has become extinct in two last known localities. Critically endangered *P. lonchitis* has currently been found in 2 locations, with 5 individuals altogether. The only isolated population of *A. septentrionale* is in stable state at present. The only population of *C. sudetica*, growing in patchy patterns in cliff forest, exhibits the tendency to expand. *A. ruta-muraria*, *A. trichomanes* ssp. *quadrivalens*, *G. robertianum* have restricted distribution on limestone areas and are endangered mainly by the destruction of natural habitats through human activities.

SOIL SPORE BANK OF *PHYLLITIS SAGITTATA* (DC.) GUINEA & HEYWOOD.

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Phyllitis sagittata has not been found in recent visits to localities in Valencia. It is considered that the scarce Valencian populations have very possibly disappeared as a consequence of human pressure and the alteration of their habitat. The viability of the spores present in the soil spore bank was studied to try to recuperate our lost population and so that we might reintroduce individuals from the nearest living sources. We have cultivated different samples from Benidoleig, the only well identified Valencian localities, and some from the Balearic Islands and Malaga, the nearest extant populations. Different soil samples were taken from the localities where this fern survives or has been cited. These samples were cultivated in sealed Petri dishes. Numerous gametophytes developed rapidly and after fertilisation, vigorous sporophytes were grown and have been conserved in the Valencia Botanical Garden. This work is the first step for future research on the Spanish populations of *Phyllitis sagittata*. The results give us a good approach to study the possibility of recovering the lost populations of this taxon.

THE DISTRIBUTION OF THREATENED ENDEMIC PTERIDOPHYTES IN THE PHILIPPINES

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The Philippines is home to 1,100+ species of pteridophytes in 142 genera and 39 families (my classification system). These data reveal that 10% of the total described species in the world today are concentrated in an area only approximately 0.06 % of the earth's land. Of these, 290 species (48%) are found only in the Philippines and nowhere else in the world. A significant percentage of the country's endemic pteridophytes (32.75% or 95 species) are known only from types, i.e. from single collections, 73% (69 species) of which were collected from Luzon (44 species) and Mindanao (25 species) alone. In a country where the population represents 1.25 % of that of the world's, forest cover has been diminishing in an alarming rate. Current estimates place the remaining original forest cover in the Philippines to be only less than 10%. Large scale commercial logging, slash and burn agriculture, and indiscriminate urbanization have been the major threats to the integrity of the country's biodiversity, particularly the pteridophytes. In addition to intensive field studies of this plant group, rallying for awareness to our environmental problems through outreach educational programs, and possibly, in situ conservation, seem to be the only remaining option to save these plants from extinction.

PTERIDOPHYTES OF THE STATE OF PERNAMBUCO, BRAZIL: RARE AND ENDANGERED SPECIES

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The State of Pernambuco in northeastern Brazil, with ca. 98938 km², presents a highly diversified flora in its 12 phytogeographic zones, where 302 species are currently known to occur. A considerable number of these species was collected in the remnants of the Atlantic Forest, which extended along the coast from South to Northeast Brazil, sometimes as an extremely narrow belt in the northern portions. Its destruction started with the exploitation of Brazil-wood, and was intensified enormously in the first agricultural cycles, with the use of the land for sugarcane plantations. Some very small remnants can be found, indicating that the past pteridoflora of the State was probably much richer than can be evaluated from the existing herbarium collections. Using the 36° 15' W meridian line as a reference, one can observe that 218 species grow only in the eastern half, 15 species only in the western, while 69 are common to both. The species in common occur only in small humid mountaintop forests (known as "matas serranas" or "brejos de altitude") which can be considered as highly endangered habitats. As to species conservation, one important aspect to consider is that 97 of them are known only from very small areas, representing squares of 0° 7' 15'' in a grid map of that State. Many of these localities have been altered or destroyed since the original collections were made. Data on the known pteridophyte richness of the different phytogeographic zones are presented together with information on the threatened and endangered species.

PROTECTED AREAS AND THE FERN FLORA OF SULAWESI, INDONESIA

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Sulawesi is the fourth largest island of Indonesia and lies across the equator between Borneo and the Moluccas. Six percent of the land area is protected by 18 (plus three proposed) Nature/Wildlife Reserves and six National Parks. Nineteen of these 24 protected areas were established for the conservation of birds or aquatic life. Indeed, in general more attention has been paid to the fauna, e.g. birds, mammals and coral reefs, than to the flora. Sulawesi has c.500 species of pteridophytes whose main habitats are amongst those found in the protected areas although not evenly distributed through them. However, the four main collecting trips by pteridologists during the C20th concentrated on montane areas so more information is needed for the lowland areas which are more vulnerable to human activity.

MARSILEA QUADRIFOLIA L. IN THE NATURAL PARK OF THE DELTA DEL EBRO (TARRAGONA, SPAIN). RECUPERATION AND CONSERVATION

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Marsilea quadrifolia L. in the Delta del Ebro is restricted to rice fields. Changes in the methods of rice cultivation and the use of weed-killers (herbicides) are the main cause of the extinction of this species. After the disappearance of *M. quadrifolia* from the Delta of the Ebro at the end of the 1970s, we developed a number of programmes for its recovery. The first step was to obtain material appropriate for reintroduction to this area. We resorted to the soil spore bank. The search for sporocarps in those areas where *M. quadrifolia* had been seen most recently was successful. Using these sporocarps, we initiated germination and grew the sporophytes in the Botanical Garden of Valencia University. The adult plants were acclimatised in the ecological demonstration gardens at the Visitor Centre of the Natural Park.

Plant introduction was made in three recovered parcels of old rice fields, located SW of the lagoon of "La Tancada". Recently some plants of this specie have been introduced in some old rice fields, which were restored for use as horse pastures in the Island of Buda.

A COMPARISON OF PTERIDOPHYTIC DIVERSITY OF VARIOUS RAINFORESTS IN MALAYSIA USING QUADRAT SAMPLING METHOD

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A study on the diversity of ferns and fern allies was carried out in various rainforests at different elevations and places in Malaysia (Malaya Peninsula and Sarawak) using quadrats of different sizes. The objectives are: 1) to compare the biodiversity of fern and fern allies in various rainforests at different elevations, and 2) to assess the effectiveness of quadrat sizes in capturing the species richness of rain forests in Malaysia.

The results show that the fern diversity is low per unit area when compared to the diversity pattern at high elevations where there are more number of taxa per unit area. As such, there is a need to conduct more quadrat samplings in the lowland rain forest than in montane forest if only to capture the total biodiversity in the lowland rain forests.

TRADE AND CONSERVATION OF TREE FERNS

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Significant trade in tree fern products takes place for horticultural, medicinal and ornamental purposes but is primarily in a limited number of species. All species of Dicksoniaceae and Cyantheaceae were originally listed in Appendix II of the *Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)*, which provides for regulation of international trade. However, by 2000, the practice of well regulated, apparently sustainable harvest, prompted a proposal for the de-listing of the majority of species. Monitoring trade impacts on certain species is still important, but constrained by the difficulties of identifying products to the species level. There is a need for research into methods of identification and for projects to develop and implement sustainable harvest plans for some heavily harvested species. Priorities include species from Indonesia and Guatemala, *Dicksonia antarctica* in Tasmania and various island endemics. Harvest from the wild continues, often in areas being deforested, but artificial propagation, retention of understorey islands in logging coupes, and annual quotas are very successful. Whilst there are problems associated with reliance on artificial propagation such as the possibility of disease introduction and loss of genetic diversity, more of an emphasis on the industry in cultivated specimens could greatly alleviate the threat to wild populations.

A NEW AND EFFECTIVE CYTOKININ FOR TISSUE CULTURE OF FERNS.

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Plant tissue culture has made amazing progress from the laboratory to the field. This is mainly because of its commercial application where in it is used to produce large number of plants of uniform quality all round the year. The early work of Morel (1960) on orchids and the development of Murashige and Skoog medium (1962) has stimulated the development and widespread use of tissue culture as a means of micropropagating plants of horticultural significance. However, the technique has not been widely successful when applied to pteridophytes as compared to its success in gymnosperms and angiosperms.

Plant growth regulators are an essential and important components of the tissue culture technique. Among the cytokinins and auxins conventionally used in other plants only a few are observed to induce *invitro* response in ferns. The cytokinin 2 iP [6-(γ,γ, dimethylallylamino) purine]was found to encourage somatic embryos in *Drynaria quercifolia, Acrostichum aureum* and *Cyathea nilgirensis.* This finding would help pteridologists interested in large scale micropropagation of ferns for conservation or commercial purposes.

AN EFFICIENT PROTOCOL FOR EXTRACTION AND PCR AMPLIFICATION OF DNA FROM TREE FERNS USING HERBARIUM SAMPLES.

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India has a rare and rich variety of ferns with a high rate of biodiversity. In comparison to the USA though only 1/3 in size, India possesses more than double the number of fern species (Kaur, 1991). Tree ferns are the rarest, most fascinating species of ferns, acclaimed worldwide for their gigantic foliage and antiquity. India has only 12 species of these tree ferns of which three are endemic to our country. Western Ghats, which is considered as one of the world's hot spots of biodiversity has three species of the tree fern *Cyathea crinata*, *Cyathea gigantea* and *Cyathea nilgirensis* (Manickam, 1995). Among the species endemic to Western Ghats, *Cyathea nilgirensis* is reported to be common, while *Cyathea gigantea* is rare and *Cyathea crinata* endangered. While studying biodiversity of a region it is important to study the habitat diversity, species diversity and genetic diversity. The molecular characterization of *Cyathea gigantea* and *Cyathea nilgirensis* was undertaken using RAPD technique as a stepping stone for studying the genetic diversity of these ferns in the region. Plant material from different location of the Western ghats were collected and brought to the lab as herbarium samples. DNA was extracted from these dried samples using a cetyltrimethyammonium (CTAB) extraction, a modified Porebski et al., (1997) method. The protocol of extraction has been standardized for *Cyathea gigantea* and *Cyathea nilgirensis* overcomming severe contamination problems caused by the polysaccharides and polyphenols.

For PCR amplification, RNAase treated DNA, further subjected to phenol-chloroform extraction was used. The basic procedure of PCR amplification was carried out as outlined by Williams et al., (1990) using random primers. Out of the 80 different primers tested 16 primers showed successful amplification for both the species tested.

The study has been successful in working out a protocol for DNA isolation and PCR amplification from herbaria samples of tree ferns. This method would be advantageous when samples have to be transported long distances from the forests to the laboratory because sample collection is simpler when compared to the laborious transportation of cryocans filled with liquid nitrogen.

THE USE OF ECOLOGICAL PROFILES IN SETTING TARGETS FOR PLANT CONSERVATION

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The term 'ecological profiling' is introduced to describe the process of reviewing data to develop an informed strategy for conservation and meaningful targets for monitoring. The process is based on synthesis of all available information from the literature, contact with other botanists and ecologists and field survey. The first stage is to initiate a comprehensive literature review and initiate contact with botanists throughout

the known range of the species; these two aspects are iterative and will continue throughout. All available data are compiled to provide a comprehensive review of the ecological requirements and conservation needs of the species. This review then provides a basis for setting monitoring targets against which to assess the viability of populations and to identify appropriate response to unfavourable conservation status of a population, meta-population or species.

To-date, an ecological profiles has been prepared for ephemoral aquatic species *Ranunculus tripartitus* in Wales and are being prepared for flowering plant species *Luronium natans*, *Senecio paludosus* and *Alisma gramineum*. The method has led to revision of the range of *R.tripartitus*, revision of search criteria, discovery of new populations, development of practical management guidelines and preparation of a detailed monitoring protocol both for individual sites and for various scales of population.

Application of the process to pteridophytes of similar wet habitats (*Pilularia globulifera, P. minuta, Marsilea badiae, M. quadrifolia, M. strigosa*, and *Isoetes* of the *velata* complex is being considered to aid conservation of these species in western Europe.

THE ONLY MIDDLE-EAST *ISOETES* MAY BE EXTINCT

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There is only one documented population of Isoetes in the Middle East, in the region of Jebel Al-Arab (historically known as Jebel Druze or Jebel Hauran) in southeastern Syria, an area undergoing massive destruction for commercial apple production. This has been determined as *Isoetes olympica* A. Braun, known only from the type locality, Jebel Al-Arab, and one other collection from Turkey in 1969. Mouterde reported two populations and one voucher of *I. olympica* in his Flore de Djebel Druze 1953 and distributed some duplicates. No further collections are known. I relocated a population in an intermittent wetland at an elevation of 1300 m near the village of Saleh in 1998. During the severe drought of 1999 no plants were found. In May 2000 I found an estimated one hundred plants at the margin of a dried depression, an intermittent wetland remaining after channelization of a winter stream. Plants were unremarkable in appearance with leaves up to 3 cm, submerged plants having longer leaves. Small black scales were present at the margin of the corm. Megaspores were just beginning to mature in early May. Because of the rarity of the plant, only a few leaves were available for molecular study, not yet done. Unlike most quillworts, the plants from Jebel Al-Arab have proven refractory to culture. Plants rapidly senesce when planted in soil. When grown as a submergent, growth is sluggish and the plants appear unhealthy. Growth-chamber studies are underway at Aleppo University. In a country where water is endangered and natural area protection is nascent, the future of this taxon is bleak despite its regional significance. In this case, plant rescue and culture may be the only hope for the survival of this denizen of Middle East wetlands

ASPLENIUM MAJORICUM LITARD ON THE SPANISH MAINLAND: VANISHING OR EXTENDING?

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The presence of *Asplenium majoricum* in the East of the Iberian Peninsula has been discussed over a long period. Some identification problems were due to the variability of morphological characters, and also cytological studies have resulted in some doubtful conclusions. Isozyme electrophoresis was used to assess the presence of this species in the mainland. As *Asplenium majoricum* is an allotetraploid, the study of some Balearic (Isle of Mallorca) populations of the tetraploid, and populations of its parents (*A. fontanum* and *A. petrarchae* subsp. *bivalens*) yield the existence of several species-specific isozymic markers. A survey was conducted along the coastal mountains of Valencia, Castellón and Alicante provinces. Plants for electrophoretic study were collected especially in those places where both parents were growing together, and in the localities where *A. majoricum* had been recorded by different authors. The cytology of the plants was also studied. The presence of *A. majoricum,* was confirmed (by cytological and electrophoretic data) in one locality only. The diploid hybrid *A.* × *protomajoricum* was found in some localities where both diploid parents were growing mixed in the same rock crevices. After these results we can conclude that, *Asplenium majoricum* is extremely rare in the mainland, but for the moment we can not state whether it was more

extended before and is disappearing, or on the contrary, it is being sporadically formed from *Asplenium x protomajoricum* fertilized gametophytes

CONSERVATION STATUS OF THE FERNS OF VERACRUZ, MÉXICO

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Based on the IUCN (1983, modified by the author), here I present the number of pteridophyte species for Veracruz under each conservation category. The conservation of pteridophytes in the state of Veracruz is mainly affected by the loss of natural habitats to agriculture or cattle raising; another important factor is the non-regulated collection of specimens in natural habitats by tradesmen and students. However, some endemic fern species for Veracruz are not necessarily threatened. Suggestions for their Conservation: Evaluation and documentation (data banks); Coordination among institutions; Emphasize the preservation of protected natural areas; Activities in Botanical Gardens (Education; Propagate and reproduce threatened species; Research); Control specimen collection by students; Control looting by tradesmen, and Ecoturism. The main worry, nonetheless, is not if species will eventually disappear, but the speed at which these extinctions are taking place. I appreciate the support of: Conacyt (1360-N9206/4102P-N9607/35123-V) and Conabio (W041).

THE TREE FERNS OF MEXICO: THEIR USE AND CONSERVATION STATUS

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The "maquique", "maquiqui", "malque", "malquiqui", "parásita", "pesma", "timber", "raíz de helecho" or "xaxim" is the material constituted of adventitious roots, which surrounds and protects the trunk of some tree ferns. As a consequence of its use and commerce as substrate for growing epiphytes (mainly orchids) and as building material, coupled with the destruction of their natural habitat, most of the Mexican species are endangered. The problem of the commerce and use of "maquique" is not exclusive of México, it is even worse in countries of tropical America and the South Pacific, mainly due to habitat destruction, collection and commerce of "maquique" for domestic trading and for export to first world countries. Several tree fern species in México have been reported as a source of "maquique": *Alsophila firma* (Baker) Conant, *Cyathea fulva* (Martens & Galeotti) Fée, *Dicksonia sellowiana* Hook., and *Sphaeropteris horrida* (Liebm.) Tryon. Here I discuss the use of alternative materials. I appreciate the support of: Conacyt (1360-N9206 / 4102P-N9607 / 35123-V) and Conabio (W041).

THE ENDANGERED PTERIDOPHYTES OF MÉXICO

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Thirty of the 1,050-1,100 Mexican species of Pteridophytes are currently protected and listed in the PROY-NOM-059-ECOL-2000 (Mexican norm). These species are distributed in the Aspleniaceae (3), Cyatheaceae (17), Dicksoniaceae (4), Isoëtaceae (1), Lycopodiaceae (1), Marattiaceae (2), Nephrolepidaceae (1), Polypodiaceae (2), Psilotaceae (1), Schizaeaceae (1), and Selaginellaceae (1). Sixteen of the latter are subject to special protection (Pr), eight are considered threatened (A), and six are considered endangered (P). In order to reconsider their conservation status, we accomplished a thorough taxonomic revision, prepared historical and current distribution maps, and an ecological-biogeographical analysis. At least in one of the cases the names were synonymous, and thus, only one species (*Alsophila firma*, sin. *Cyathea mexicana*). Furthermore, we were able to detect two groups of species, those (i) well collected and studied, like the Cyatheaceae, which are also widely distributed and threatened due to use of their parts or habitat destruction; and (ii) species that are badly documented (*Isoëtes bolanderi*), or hardly collected (*Schizaea elegans*), or have not been cited in recent years.

THE NATURAL HISTORY MUSEUM'S BOTANICAL COLLECTIONS - A CONSERVATION RESOURCE: THE RARE AND ENDANGERED BRITISH PLANTS DATABASE PROJECT

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The Natural History Museum's botanical collections number c.5½ million. To improve access to these specimens there is a drive to database them. However, prioritisation is essential in such a long-term project. The Rare & Endangered British Plants Database Project is one of these priorities. It will provide information on past and present distributions of endangered plants and supports the UK Biodiversity Action Plan by collating "accurate and accessible data" on the biodiversity contained in the NHM Herbarium (BM). Taxa of flowering plants, pteridophytes, bryophytes, lichens, charophytes and marine algae from Britain and Ireland that are given in Red Data Books or BAP lists, or which are considered Nationally Scarce, are being included. By eventually publishing a printed catalogue and making data available on the NHM web site we aim to publicise the wealth of information that exists in our herbarium, making it available to a wider audience and encouraging use of the collections themselves.

FERN DIVERSITY IN THE MBARACAYÚ FOREST, PARAGUAY

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The Atlantic Forest is one of the most biodiverse yet most threatened ecosystems in the world, being a centre of biological endemism for many taxa. Once covering a wide extent of Brazil, Paraguay and Argentina, today only 5-8% of this forest remains. It has been designated as one of the highest priority habitats for conservation on a global scale (Davis *et al.*, 1997).

Paraguay, with one of the highest rates of deforestation in Latin America, retains just 17% of its original Atlantic forest cover, all in the eastern part of the country, of which only 6% is effectively protected. The Mbaracayú Forest Nature Reserve (Reserva Natural del Bosque Mbaracayú), situated in the department of Canindeyú, holds more than half of the country's protected Atlantic forests. Between 1995 and 1998, with funding from the Darwin Initiative for the Survival of Species (UK Government), and in collaboration with the Paraguayan NGO Fundación Moisés Bertoni, a targeted inventory of plants and insects of the Mbaracayú Forest Reserve was made. Our preliminary checklist of the pteridophytes of Mbaracayú recorded 115 taxa in 22 families and 46 genera. Fifteen species in the list were new published records for Paraguay. A Spanish-language field guide to the Reserve's pteridophytes, *Helechos de Mbaracayú*, was published and is distributed through the NHM and the FMB. The high species richness of the Reserve has been attributed to the diversity of vegetation and soil types, creating a wide array of microhabitats. High diversity is also due to the location of the Reserve in an area of transition between the tropics and subtropics. The Reserve harbours several endemic subtropical genera and some tropical and *cerrado* species at the southern edges of their distributions.

EFFECT OF STORAGE METHOD ON SPORE GERMINATION IN FIVE THREATENED FERNS

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Spore germination of five threatened ferns (*Culcita macrocarpa*, *Dryopteris aemula*, *D. corleyi*, *D. guanchica* and *Woodwardia radicans*) was determined after one and six months storage in glass vials (dry technique) or sown on agar (wet technique) at 20°C, 5°C and –20°C. In all the species, technique and temperature affected significantly germination percentage, especially after six months storage. There was also significant interaction between both factors. In general, the highest germination percentage was found after wet storage at 20°C or 5°C. However, wet storage at –20°C killed the spores, with only low germination in *D. guanchica*. With regard to the dry technique, the highest germination was obtained after storage at 5°C and –20°C, and all the spores of *C. macrocarpa* died at 20°C. These results provide support to the view that spore storage at high moisture contents is an effective procedure for the long-term *ex situ* conservation.

ECOLOGICAL CHARACTERIZATION AND ENVIRONMENTAL THREATS FOR *CULCITA MACROCARPA* C. PRESL IN GALICIA (NW SPAIN)

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The macaronesian relict *Culcita macrocarpa* is located in the European continent in populations restricted to woody refugia, due mainly to the availability of moisture in those places, especially near to the coast. It is scattered widely in a discontinuous way along the Atlantic coast from Cádiz (South of Spain) to the Basque country.

Despite its existence in Galicia not being recognized until 1965, more than 10 locations are now known and are distributed by at least 5 different river basins. These Galician populations represent the absolute northern boundary of the world distribution of this species and some of them can be probably regarded as the largest population on the Iberian Peninsula.

Based on the qualitative and quantitative interest in these populations, we present a synthesis of their ecological characteristics (lithology, topographic aspects, bioclimatology and phytocoenosis). In addition, the detailed distribution is shown in 1 x 1 km UTM grid squares, some of which are reported for the first time. We also discuss the present and potential environmental risks that now threaten the existence of these populations.

CONSERVING A TROPICAL FERN IN EUROPE

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The Grammitidaceae are a predominantly tropical family of small, usually epiphytic ferns. Two species are recorded in Macaronesia: *Grammitis ebenina*, found elsewhere in St. Helena, but in Macaronesia known only as a single Azorean individual, perhaps also present early last century in the Canaries. The other, *Ceradenia jungermannioides*, a rare species of cloud forest in Central America and the Caribbean islands, detected, again as a single plant on the Azores, in 1972. A second locality for *Ceradenia* was discovered by Hansen in the 1980's and he suggested it may prove to be "not uncommon". Both provisionally had to be considered among the most critically endangered taxa in the Macaronesian flora. A survey of these taxa was therefore made in 1996 to establish their true extent and abundance, to clarify their ecology, and population biology to gain an insight into their conservation status and requirements. *Ceradenia* has now been found in four localities on Pico Island. The three extant populations, comprising just over 100 individuals, are restricted to extremely species rich fragments of tall mixed-evergreen "Laurisilva" where they almost entirely restricted to massive and often moribund *Erica azorica*, rarely occurring on *Juniperus brevifolia*, *Vaccineum cylindraceum* and *Euphorbia stygiana*. *G. ebenina* was not refound and may be extinct.
The continued survival of *Ceradenia* is dependent on the protection of suitable woodland. Areas not already protected as reserves should be notified, thereby giving protection to the exceptional range of threatened species eg. *Euphrasia grandiflora*, *Lactuca watsoniana*, etc. which co-exist.

CONSERVING THE FEN BUCKLER FERN (*DRYOPTERIS CRISTATA*) IN THE BRITISH ISLES

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Dryopteris cristata (L). A.Gray (Fen or Crested buckler-fern) is widely distributed in base-poor fens throughout the boreal regions of the northern hemisphere. Within the British Isles *D. cristata* has, in historical times, declined in range more markedly than any other of our native ferns. Much of this decline can be traced back to land use changes in the nineteenth century but sites have continued to be lost and the range had essentially contracted to the Broads of Norfolk by the time of the last intensive survey of this species' distribution and numbers, performed in 1977. Field surveys in 1997-8 of all known sites was combined with an investigation of the species genetic variability. Within the Broads few populations have been lost, population numbers in sites have generally increased and new populations have been found. Elsewhere only three small populations exist, two in Norfolk.

Genetically the species supports very low levels of variation within the British Isles but it has an inbreeding mating system and therefore has the potential to colonise new sites by a single spore. Suitable management is essential for the continuing survival of this fern. The situation reported here would indicate that habitat management by the Broads Authority and other concerned land-owners is proving effective.

DISTRIBUTION OF *DRYOPTERIS CARTHUSIANA* COMPLEX IN ESTONIA: FIRST LOOK

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The *Dryopteris carthusiana*-complex consists in Estonia of *D. expansa* (C.Presl)Fr.-Jk & Jermy, *D. carthusiana* (Vill.)H.P. Fuchs and *D. dilatata* (Hoffm.)A. Gray. On the basis of revised herbarium material a first outline of the distribution and habitats of *D. carthusiana*-complex species in Estonia was provided. *D. carthusiana* is common throughout the territory. *D. expansa* is distributed in scattered localities while *D. dilatata* is rare in Estonia and reaches the limit of its distribution. The present distribution of *D. dilatata* in Estonia includes 11 inspected populations and 7 localities that need final verification. Two populations in Jäneda and Varblasesaar are evidence that the total distribution of this species extends more towards the north northeast than was formerly believed.

PTERIDOGEOGRAPHIC ANALYSIS OF GRAN CANARIA AND ITS CONNECTION WITH THE REST OF THE ARCHIPELAGO AND MADEIRA

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The biogeography of 46 taxa from the pteridological flora of Gran Canaria has been examined, and its relation to the rest of the Canary archipelago and Madeira analysed.

After making a pteridological file, research has been done on the following types of analysis: floristic richness, species number/genre number, m/t (relation between species with monolete and trilete spores), index of similarity with nearby regions, ecological analysis, and chorological analysis. Finally, these data are applied to the ordering and hierarchical arrangement of OGUs. For this last process, matrices of Sokal distances have been elaborated, by using binary registers of absence/presence of taxa.

In the Canary archipelago and Madeira we distinguish four chorological units when comparing OGUs (islands) among them and suggest this may be a useful basis for a conservation strategy.

RARE THREATENED FERNS AND FERN-ALLIES FROM THE CANARY ISLANDS AND ACTIONS TO CONSERVE THEM

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For this study we have examined all the bibliographic and other records in the herbarium of the Canary Islands, of the 51 ferns and fern-allies taxa, with the exception of those that have escaped from gardens to the wild. The purpose of this work is to determine the state of conservation of each of the taxa, according to the criteria of LOBIN & ORMONDE (1996) for the conservation of the ferns and fern-allies in the Cape Verde Islands, although with slight modifications.

Our main conclusion is that there are 5 critically-endangered species: *Dryopteris aemula*, *Hymenophyllum tunbrigense*, *Cheilanthes tinaei*, *Ophioglossum azoricum* and *Ophioglossum polyphyllum*. Another species (*Hymenophyllum wilsonii*) is extinct. Also the taxon *Asplenium aethiopicum* ssp. *braithwaitii* is probably extinct, from the long period since its last sighting.

Reference: LOBIN,W.& ORMONDE, J. (1996): Lista Vermelha para os Pteridofitos (Pteridophyta).- *In* LEYENS, T. & LOBIN, W.(Eds.): *Primeira Lista Vermelha de Cabo Verde*.- Courier Forsch.-Inst.Senckenberg **193**: 37-42; Frankfurt am Main.

POPULATION SURVEY AND CONSERVATION OF TUNBRIDGE FILMY FERN (*HYMENOPHYLLUM TUNBRIGENSE*) IN THE GRAND DUCHY OF LUXEMBOURG

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This poster presents the results of two detailed surveys of the relict populations of Tunbridge Filmy-fern (*Hymenophyllum tunbrigense* (L) Sm.) in Luxembourg and the evolution of their health status between 1988 and 2000. The fern is located in deep and narrow fissures of Jurassic sandstone in the eastern part of the country where it was discovered in the early 19th century. Its survival in this continental 'island' is due to prevailing microclimatic conditions, which have been investigated in more detail in recent years. In the late 1980s, fears of a widespread decline of the species as a result of increased tourist pressures and rock-climbing activities prompted the introduction of special conservation measures by the Ministry of the Environment and the Forestry Commission.

CURRENT CONSERVATION STATUS OF THE ASPLENIUM SPECIES IN BRAZIL

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A recent revision of the species of the genus *Asplenium* L. in Brazil indicates that of the ca. 150 Neotropical species, 73 taxa (69 species, four varieties) can be found in Brazil. The genus is present in all the geographic regions. However, South and Southeastern Brazil, with one of the continental fern speciation and endemism centers, presents 58 taxa of which 19 are endemic to continental Brazil. Two species are from the Trindade Island, ca. 1000 km from the coast. Although some regions (especially in the States of Tocantins, Rio Grande do Norte and southern part of Pará) are underrepresented (or not at all) in the herbaria, the study was based on an extensive data base of ca. 6500 collections (excluding duplicates), ca. 5600 of them from Brazil. Applying the IUCN guidelines for evaluating the conservation status of the species within Brazil, a startling result was obtained. At least one third of the taxa present conservation problems. Two species are in risk of extinction (*Asplenium bradeanum* Handro, *A. cariocanum* Brade) and three are probably extinct (*A. beckeri* Brade, *A. schwakei* Christ and one species so far unknown to science). A discussion of the species and their habitats is presented, together with some suggestions as to their conservation.

EXPERIMENTAL TRANSLOCATION OF *GYMNOCARPIUM ROBERTIANUM* (HOFFM.) NEWMAN IN IRELAND

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Gymnocarpium robertianum has only been recorded from a single native site in Ireland, despite the apparent availability of suitable habitat. It occurs on limestone pavement on a low hill in County Mayo, and this site has in the past suffered damage due to bulldozing to extract limestone and improve pasture. This activity has now ceased, but the small population is seriously threatened. Cuttings were removed in 1995, and frond samples taken to provide spores for propagation. Cuttings were propagated at Trinity College Botanic Garden, and in October 1996 were translocated to a site in the Burren National Park, Co. Clare. Although the introduction site was not within the native range of the species, it had the advantage of being in a protected area. A total of 100 plants were introduced into suitable grykes in 10 X 10 m quadrats. Subsequent monitoring suggested successful establishment was low, possibly due to summer water deficit in this skeletal habitat; however, surviving plants have grown well and are mostly fertile.

THE USE OF *IN VITRO* TECHNIQUES FOR THE CONSERVATION OF *HYMENOPHYLLUM TUNBRIGENSE*

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The Tunbridge filmy-fern (*Hymenophyllum tunbrigense* (L.) Smith occurs on sandstone rocks in the ancient woodland within the Weald. High quality habitat has decreased over the last five decades due to a combination of woodland loss, collecting and public pressure. Over this period a decline of 27% in the number of sites and 72% in the number of surviving colonies found in the Southeast has been reported (Richardson *et al.*, 1995). *Ex-situ* work on this rare filmy fern has been instigated to support the declining populations and to provide material for future reintroduction.

To allow ex-situ support for local recovery programmes, protocols for the *in vitro* growth, multiplication and long-term cryogenic storage of *H. tunbrigense* have been developed. Green spores derived from fronds with mature sporangia were surface sterilised using a 2% sodium hypochlorite solution prior to culture on sucrose-free Knop's minimal medium (Knop, 1865) supported by filter paper rafts. Germinated spores produced gametophytic thalli, which grew optimally on ½ strength Murashige and Skoog (Murashige and Skoog, 1962) medium supplemented with $5gl^{-1}$ sucrose and solidified with $2.5gl^{-1}$ Gelrite. Techniques for the production and weaning of sporophytes are currently being investigated. This includes the use of native sandstone as a growth substrate on which gametophytic growth and subsequent sporophyte production can occur *in vitro* prior to weaning. Long-term storage of encapsulated gametophyte was achieved through cryopreservation using sucrose preculture and dehydration prior to cooling in liquid nitrogen.

THREATS TO THE FERN FLORA OF BRAZIL ILLUSTRATED BY THE GENUS *DORYOPTERIS* J.SM (PTERIDACEAE)

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Brazil has one of the richest floras in the world making it one of the highest ranked country in terms of plant biodiversity (GFW, Global Forest Watch). Endemism is very high, particularly in the Atlantic Forest, where most of the *Doryopteris* species grow. This is due to the size, climatic and edaphic diversity and the geomorphology of the country. There are few protected areas, currently only 6,1% (269399.5 km²) (UNEP World Conservation Monitoring Centre).

The accelerated process of the occupation of the land, with the accompanying human activities such as mineral extraction, wood, agricultural and irrational deforestation are causing severe adverse impact to the environment. As a consequence of habitat loss and fragmentation is that many species have become vulnerable and/or facing the possibility of extinction. Literature (Brade, 1935; Tryon, 1962) and herbarium

labels indicate that they once were more widely distributed. Today, the vast majority of *Doryopteris* species only occur within protected areas and are very rarely found elsewhere.

In developing countries, social problems such as poverty and landlessness are associated with loss and fragmentation of the ecosystems. Therefore the plan for conservation strategy should reflect this reality and able to deal with these issues. Inventories and a better understanding of the natural history of the plants are necessary to select key and ecologically important species from habitats that are most threatened. In Brazil, 27 species of the genus *Doryopteris* have been listed. Fifteen are national endemics; ten of which are endemic to the southeastern Brazil, the Atlantic Forest. This ecosystem is one of the most critically threatened. At present, there is not any appropriate assessment or protection status for most of the Brazilian ferns The only reference in literature is the endangered status of *Dicksonia sellowiana.*

Acknowledgement is made to The Royal Society (International Botanical Congress (Edinburgh) Fund) for supporting this work.

An International Symposium 23-26 July 2001

fern flora worldwide threats and responses

FIELD EXCURSIONS TO CHOBHAM, THURSLEY AND HOLMWOOD COMMONS 25TH JULY 2001

BACKGROUND

Marsh Clubmoss (*Lycopodiella inundata*) and Pillwort (*Pilularia globulifera*) have been identified as a priority species under the UK government's commitment to the Biodiversity Convention because of their threatened status in Britain and Europe. Both are associated with heathland, which is a habitat that is also a priority for conservation. The aim of these visits is to look at conservation action in progress for these species.

All three sites to be visited are ancient commons where communal rights of grazing have been established for several centuries. Because of this, they have escaped the agricultural improvements that have dominated the surrounding area (and much of lowland Britain) and remain as islands of semi-natural habitat. Commons now have a certain amount of legal protection and many are now managed for recreation and nature conservation.

However, a particular problem for commons in south-eastern England is that often the grazing rights have lapsed into disuse. This has resulted from an increase in the urban economy and widespread commuting to London and other towns and a corresponding decrease in the farming economy. Such farming that continues is largely based on arable crops. Also the numerous vehicles using roads across the commons results in a high risk of livestock being killed by road accidents. The result of this has been a decrease in open habitats such as heathland and an increase in scrub and woodland.

Attempts to fence off areas of common to allow grazing have often met with considerable resistance due to a belief that public open spaces should not be enclosed as well as concerns about dogs running freely with livestock around. About two years ago a public inquiry at Chobham Common turned down such an application for fencing. On some commons even the clearing of scrub and woodland is contentious. As a result other methods such as mowing and mechanical disturbance are needed to maintain heathland and open habitats suitable for Marsh Clubmoss and Pillwort.

The visits will also illustrate the partnership involved in the Biodiversity Action Plan process. The "lead partner" for both of these species is Plantlife, a plant conservation charity/membership organisation whose role is to identify the priorities for the conservation of the species and to co-ordinate between other organisations. The three sites to be visited are managed by a national government conservation agency

Marsh Clubmoss niche. The latter does not affect the sporophyte phase but seems to impede spore germination. At Chobham Common small areas of the peat surface have been skimmed with a spade and this has resulted in successful germination and an increase in the number of plants.

THURSLEY COMMON - MARSH CLUBMOSS
Warden: Mark Larther, English Nature

Marsh Clubmoss has been known at Thursley for over a century and seems always to have had its stronghold at its present location near the Moat Pond. From time to time it has appeared on other parts of the common, usually beside paths, but these seem to be much less persistent. Thursley Common was heavily used for training during the Second World War and the army has owned the Marsh Clubmoss area until very recently. In one part of the colony it seems to follow an old tank track through the heath. A notable associate at this site is Brown Beaked Sedge *Rhynchospora fusca* which is also threatened in Britain.

The vegetation is becoming quite thick in the vicinity of colonies and some strip trials are about to be undertaken to work out the best form of mechanical management. These will include mowing at different vegetation heights, driving a vehicle over the site at intervals and possibly scraping areas of the peat surface.

HOLMWOOD COMMON - PILLWORT
Warden: Rob Hewer, National Trust

Pillwort has occurred at Holmwood Common since the mid-nineteenth century but disappeared around 1985 due to re-profiling of part of the edge and to a decline in water quality. The latter is thought to be connected to heavy fish stocking for angling as well as duck-feeding. In 1999 the pond was temporarily drained down and much of the organic mud dredged out. A large number of fish were also removed. There was a considerable improvement in water quality and in 2000 the bottom of the pond had abundant Pillwort again. The site is now the best population in the South-East.

Nick Stewart
July 2001

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Science for Plant Conservation - An International Conference for Botanic Gardens

July 8-10, 2002
Trinity College, Dublin, Ireland

Science for Plant Conservation - An International Conference for Botanic Gardens

July 8-10, 2002

Trinity College, Dublin, Ireland

Botanic gardens throughout the world are actively involved in plant conservation at the local, regional, and international levels. Recently, Botanic Gardens Conservation International (BGCI) published an international agenda for botanic gardens which identifies the importance of conservation research at botanic gardens.

The goal of this conference is to bring together conservation scientists from the world's botanic gardens and academia to share methods and results (including: field, laboratory, horticultural, and analytical) that will advance plant conservation measurably. In order to develop best conservation science practice, Botanic Gardens need to work closely with other conservation scientists from universities, museums and other organisations. We hope that the conference will attract a wide range of participants to share their experiences and further the development of conservation science.

Sessions will include:

Causes of endangerment
Monitoring the situation
Population management
Recovery, reintroduction
Invasive species
Demography and population viability analysis
Conservation genetics
Restoration ecology
Seed biology
Propagation science
Sustainable utilisation
Genebanks
Pathology
Administration & Funding
Integrating practical conservation, research and political agenda

Oral papers and posters are invited. In addition to the three-day conference, pre- and post-conference field trips will be available.

Please join us for this timely and important conference, as we set the research agenda for plant conservation science at botanic gardens.

*****

Please reply with an expression of interest by September 28, 2001

*****

For further information or to express interest contact:
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Or visit our web site:
http://www.rbg.ca/cbcn/science/

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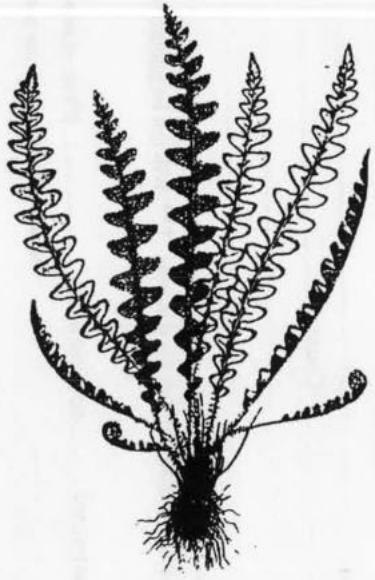
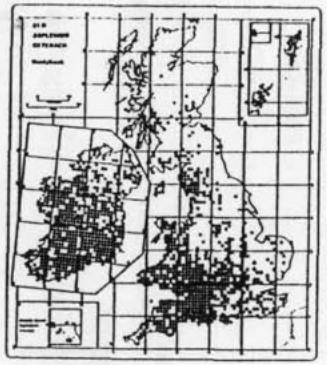


Taxonomy



Distribution

Cytology

BENEFITS OF MEMBERSHIP

PUBLICATIONS

All members receive the **BULLETIN**, which gives news about the Society and reports of its activities, and the **PTERIDOLOGIST**, which contains articles and book reviews of more general interest for the amateur enthusiast and grower of ferns and their varieties. The **FERN GAZETTE** is for those whose interests extend further to the botany of ferns, and contains scientific articles on ferns and allied plants world wide. Members not wishing to receive the *Fern Gazette* pay a reduced subscription.

MEETINGS

During the winter **INDOOR MEETINGS** are held, with talks, exhibits and informal discussions. In the summer there are **GARDEN VISITS** and **FIELD MEETINGS** (day, weekend and week) in fern-rich parts of the country and occasionally overseas, to see and study ferns in the field, to collect information on their status and need for conservation, and to enable those with little or no previous experience to become more familiar with species in their natural habitats. Academic meetings are held from time to time, ranging from short meetings of national interest to longer symposia attracting international attendance.

OTHER ACTIVITIES

A **SPORE EXCHANGE** receives a world-wide selection of fern spores from various sources and distributes them to members.

A **PLANT EXCHANGE SCHEME** offers the opportunity to obtain species and varieties of hardy and greenhouse ferns that are not readily available from commercial nurseries and enables good homes to be found for surplus plants.

A **READING CIRCLE** passes the *American Fern Journal* among interested members.

A **BOOKSALES SERVICE** gives members the opportunity to acquire old fern books not easily obtainable through normal sources, as well as new books hot off the press!

REGIONAL GROUPS give opportunities for informal meetings with other fern enthusiasts in your own area.

SPECIAL INTEREST GROUPS provide opportunities for members with similar interests to share ideas and experiences.

A variety of **MERCHANDISE** is available to members, including t-shirts, sweatshirts, ties, notelets and greetings cards.

PTERIDOLOGICAL · SOCIETY · BRITISH

THE SOCIETY FOR FERN ENTHUSIASTS

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THE BRITISH PTERIDOLOGICAL SOCIETY

The Society was founded in the Lake District in 1891 and soon became the focal point for fern enthusiasts throughout the British Isles. Today it continues to provide all kinds of information about ferns, by publishing regular journals, leaflets and books, and organising formal talks, informal discussions and outdoor meetings. The international membership includes those interested in gardening, natural history and botany, both amateur and professional. It is a friendly society run on a voluntary basis.

The AIMS of the Society are to promote the growing, study and conservation of FERNS and FERN ALLIES, both of wild species and cultivated varieties, and to encourage interest in their taxonomy, distribution and ecology through meetings, publications and grants.

The Society is affiliated to the Royal Horticultural Society and the National Council for the Conservation of Plants and Gardens, and supports recording and conservation activities with other botanical societies.

Web site: http://www.eBPS.org.uk

Patron: HRH The Prince of Wales

HOW TO JOIN

SUBSCRIPTION RATES 2001 (2002 rates in brackets)

Full Personal Members	£15.00 (£20)
Optional Members (not receiving the *Fern Gazette*)	£12.00 (£16)
Student Members (full-time students)	£ 9.00 (£10)
Family Members (spouse/partner; do not receive separate mailings)	£ 2.00
Subscribers (universities, libraries & other institutions, including agents acting on their behalf & trade agents)	£25.00 (£33)
Airmail postage	
For all journals	£4.00
For those not receiving the *Fern Gazette*	£2.50

Overseas remittances not made in sterling £5 extra to cover charges.

Credit card payment £2 extra to cover charges.

Subscriptions are due on 1st January annually in advance; journals will not be sent until payment has been received. Cheques should be made payable to 'The British Pteridological Society'. Standing order forms are available from the address below or via the BPS web site.

Applications for membership should be sent with payment to: Mr M.S. Porter,
Membership Secretary,
The British Pteridological Society,
5 West Avenue, Wigton,
Cumbria CA7 9LG England.

Data Protection Act 1998. For the purposes of exemption of the Society from registration, prospective members please note that all membership & subscription details are held on computer file. Members may, on request, see a copy of their own entry. A full membership list and updates are published regularly in the Society's *Bulletin*.

Please complete in BLOCK CAPITALS

*I/We wish to join the British Pteridological Society as a *Full/Optional/Student/Family member/Subscriber and enclose £..... in payment of my subscription for 1st January - 31st December ** 20.....

Surname ..... First name & Initials .....

Title (Dr/Miss/Mr/Mrs etc.).....

Family Member: Title ..... First name & Initials ..... Surname .....

Address .....

County/State ..... Postcode ..... Country .....

Tel. No. (home/work) ***.....

E-mail address .....

Signature ..... Date .....

* Delete where not applicable ** Members joining at any time during the year will receive all journals for that year *** Will not be published

CREDIT CARD PAYMENT

I authorise the British Pteridological Society to debit my Visa ..... / Mastercard ..... account by £ ..... (Please remember to add £2 extra to cover our costs)

Card number .... - .... - ....

Expiry date ..... / ..... Name as given on card .....

Signature of cardholder ..... Date .....

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An International Symposium 23-26 July 2001

fern flora worldwide
threats and responses

CERTIFICATE OF ATTENDANCE

This is to certify that Dipl.Ing. Gb FH Anja George has participated actively in the international symposium "Fern Flora Worldwide – Threats and Responses" convened at the University of Surrey, Guildford, UK, on 23 – 26 July 2001.

Signed –

R Graham Ackers
Symposium Chairman and Organiser.

BRITISH PTERIDOLOGICAL SOCIETY

NEW PHYTOLOGIST TRUST

ENGLISH NATURE

IAP

IUCN The World Conservation Union

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PREPARATION OF ACTION PLANS

These guidance points relate only to the specific contents of SSC Action Plans. They are intended to assist authors, compilers, and editors in the preparation of SSC Action Plans.

Aspects in this document adapted from that compiled by SSC staff will be discussed in the afternoon session 26 July The full unabridged version can be obtained from Alain Mauric [alain.mauric@ssc-uk.org

1. WHAT IS AN ACTION PLAN?

1.1 The Action Plan

An Action Plan is a tool for promoting conservation recommendations to target audiences who can act on them. It is a resource, giving all possible information needed to explain **why** species conservation action needs to be undertaken and **what** specific actions should be undertaken. It can be used as an aid to raise funds for the recommended actions. It is a means of communicating the conservation status of a taxonomic group, major problems associated with its viability and long-term survival, and the recommendations for its conservation in their order of priority.

Although Action Plans must be based on the best known scientific data and information, they should be written in a way that is both clear and appealing to the non-expert, avoiding scientific jargon as much as possible. An Action Plan should not extend to being an encyclopaedic overview or a detailed account of the life history of a species. **Its focus and coverage should be just sufficient to aid conservation action.**

1.3 The purpose of an Action Plan

SSC Action Plans are currently one of the most important communications tools used by the Commission. They stimulate communications within the Specialist Group which result in an increased number of partnerships between specialists and more informed conservationists worldwide. Their recommendations are used to influence players in the conservation sphere at local, national, regional, and global levels. Because sharing information about species with external audiences is not sufficient to ensure that conservation action will be taken, Action Plans make prioritised recommendations **specifically designed for** key players. It is hoped that these guidelines will make them even more effective communications tools for catalysing effective species conservation action. Some specific purposes of Action Plans are:

- **To serve the interests of the Specialist Group members**

First and foremost, the Action Plan serves the interests of SSC members. It is a compendium of their knowledge and expertise in one package, helping to guide future activities. The preparation of an Action Plan by the Specialist Group sets in motion the collection and synthesis of information on a species or set of species that may never have been put together and made available in print before, especially in a form that focuses on conservation of the species. The Action Plan also serves Specialist Group members by providing them with a complete overview of the rationale behind each recommendation in the Plan. Thus, members also acquire an authoritative resource to assist them in promoting their own recommendations, and clearly identifying where they may be able to provide technical advice during the implementation process.

- **To provide a baseline record against which to measure change**

As the Action Plan is a "snapshot in time", it serves as a baseline set of data and information against which to measure change and monitor progress, indicating where changes of emphasis or direction may

be needed to conserve the species. The potential also exists for these Action Plans to become living electronic documents, allowing them to be updated accordingly and thus record change.

- **To expand on the IUCN Red Lists of Threatened Species**

The Action Plan elaborates on the species information presented in the IUCN Red Lists of Threatened Species by describing the current threats to a species, what is currently being done to address these threats, what further actions need to be taken, by whom these actions should be taken, and their order of priority.

- **To provide scientifically-based recommendations for those who can promote and support species conservation**

Action Plans provide the rationale, information, and recommendations that need to be conveyed to audiences throughout the world, particularly those who could support SSC's work.

- **To provide a common framework and focus for a wide range of players**

By virtue of their contents, Action Plans become an authoritative resource to guide species conservation activities. They provide a common framework and focus for a range of players from decision-makers at the governmental level, to those who will implement the conservation recommendations on the ground. Scientists, resource managers, agency officials, funding organisations, and political leaders utilise them when deciding how to allocate available resources.

- **To provide a convenient and accessible conservation resource**

There are few resources available that provide species information in the framework of conservation action. Action Plans can provide additional guidance through references and a concise bibliography section. This is especially important to conservationists and researchers who work under isolated conditions.

- **To establish priorities in species conservation**

Action Plans identify gaps in species research and policy and give direction for future endeavours through prioritised conservation activities.

- **To aid fundraising**

Action Plans can be used as an aid to raise funds for the recommended actions. As part of a growing series of publications with a reputation for reliable, scientifically-based information and recommendations, they increasingly command attention and respect. They, particularly their executive summaries, can be a valuable and decisive resource for funders, as well as conservationists.

1.4 Who uses Action Plans?

The Action Plan is designed for any person or decision-making body that can promote or catalyse conservation action financially, technically, or logistically. Some examples are:

- SSC Specialist Group members, other SSC members and officers, IUCN members and programme personnel seeking to inform and influence those who can promote or catalyse action, including political leaders, international conventions, government officials. Action Plans are of particular use to CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora) Plant and Animal Committees and National Scientific and Management Authorities who make decisions on the conservation of species in international trade.
- Conservation professionals, including wildlife managers and park managers, and conservation organisations, as well as IUCN members who require accurate guides on how to implement species conservation.

- Fundraisers who approach donors including foundations, government departments, grant-giving bodies, the corporate sector, and other organisations.
- Those with a special interest in conserving the species, including the scientific community, taxonomists, ecologists, the zoo community, botanical gardens, traders, corporations, and any others.
- Funding bodies that want to have authoritative information and guides as to where they should put their resources.

2. Components of an Action Plan

The Action Plan should be a concise account that leads readers logically from an overview of the species' current status to the resulting recommended actions. The organisation of the Plan will depend on the taxa concerned and the approach that the compiler wishes to take. The following are the suggested components of the body an Action Plan in their logical order. Since these guidelines are designed in the format in which we should like you to submit the Action Plan manuscript, information on other components of Action Plans (cover, donor recognition page, title page, contents page, foreword, acknowledgements, references, appendices) is located where each component appears in the Action Plan.

2.1 Executive Summary

The Executive Summary is a single paged synopsis of the Action Plan intended to attract the attention of busy potential users. It is designed to be used for publicity purposes and to focus readers' attention on how the Plan relates to their responsibilities. If the Executive Summary does not indicate the type of problem being addressed, the countries in which it occurs, and the sorts of organisation responsible for recommended actions, we may lose an important reader. In terms of capturing the attention of readers and potential users, implementers, and donors, this is the most important part of the Action Plan.

Components of an Executive Summary

Uses of the single paged Executive Summary

- To draw in readers, especially those who may help promote and implement the Action Plan.
- To use as promotional material in displays, as handouts at meetings, or flyers. We have additional front covers of new Action Plans printed at the time of publication, with the Executive Summary on the reverse side, together with information on how to obtain copies of the full Action Plan.
- To send Executive Summaries out as stand-alone introductions to SSC Action Plans, not only in response to enquiries, but also as a means to promote these publications to audiences who may not receive the Plans as a matter of course. It is often appropriate to send a subset of summaries relating to a particular type of species, or species in a certain location, to relevant audiences.

2.2 Introduction

The Introduction can elaborate on the Executive Summary, and/or give some background information on how this Action Plan came to be compiled. A brief history of the Specialist Group's activities, or its Strategy could be included. Mention should be made as to whether this Action Plan is a first or subsequent edition, and if the latter, what changes have occurred since the publication of the last edition. The scope and structure of the Action Plan can be indicated here.

A brief discussion of the species and their importance could include references to their place in a nation's natural and cultural heritage, their potential in sustainable management programmes, their significance in biological research, as indicators of ecosystem health, and their aesthetic qualities. The value of the taxonomic group as a resource, or for its role in the ecosystem should be described where relevant to explain why the species should be conserved.

The introduction should explain the need for, and the rationale behind, the Action Plan, and how it fits within the broader context of biodiversity conservation.

Taxonomic and geographical limits should be defined and, where necessary, the reasons why some are included or excluded should be explained. This is particularly important if the title of an Action Plan implies that it covers a particular region. The role and importance of habitats should be discussed.

2.3 Conservation Strategy

The first section of the Action Plan should provide information setting the scene for the recommendations. Authors should consult with expert organisations, such as the IUCN Commissions on Environmental Law (CEL), Environmental, Economic, and Social Policy (CEESP), Education and Communication (CEC), the SSC Wildlife Trade Programme, and the IUCN Sustainable Use Initiative (SU), to ensure that topics relevant to their expertise are covered adequately. The SSC Wildlife Trade Programme for example, can provide information on the effects of trade on a species and can connect you to the TRAFFIC network for data on both the legal and illegal trade of a species. See Appendix 1 for contact information on these and other relevant IUCN programmes and partners.

In developing a Conservation Strategy, the authors should try to involve as many experts as possible, whether Specialist Group members or not. It is particularly useful to include those mentioned above, and regional experts who could potentially be involved in the implementation of conservation actions and who may be more inclined to pursue Action Plan recommendations if encouraged to assist in their development.

This section of the Plan should convey the following information about the species or group of species concerned:

- Importance to biological diversity
- Importance to humans and societies (culturally and economically)
- Types of existing and potential threats
- Types of existing conservation measures:
    - legislation (international, national, local)
    - *in situ* conservation (protecting the species in its native habitat)
    - *ex situ* conservation (for example, artificial propagation or conservation breeding in other locations)
- Potential as an indicator of ecosystem health
- Potential for sustainable management and conservation measures (e.g. ecotourism)

2.4 Taxonomic or Regional Accounts

As it is broadly argued that one of the prime reasons for preventing species extinction is the conservation of biological diversity, the Action Plan must illustrate the range of diversity in the species or group of species it covers by providing either Taxonomic or Regional Accounts.

For groups with few species, both Latin and common names can be included. Whenever possible, it is recommended that common names are listed in English and in the principle languages of the range countries of the species concerned. For species with several common names, only a small selection of the most widely used names should be given (see table 2.1).

In the plant Action Plans, however, common names are generally not used, unless in reference to specific uses of the plant in question. For consistency we ask that authors for plant taxa are not included in the text of the Plan, rather they should be present in taxonomic lists presented in tabular format. Author abbreviations should follow those in *Authors of Plant Names* (Brummitt, R.K. and Powell, C.E. (eds.) 1992. *Authors of Plant Names*. Royal Botanic Gardens, Kew. 732 pp.).

Taxonomic or Regional Accounts are vitally important because they help readers identify specifically what organisms they are reading about and they provide the factual justifications for the recommended actions that follow. In addition, each account should include as many of the topics listed in box 2.1 that may conservation planners for your species or group of species. For large groups of species, some of this information can be presented in tabular format. The specific Taxonomic or Regional Account might include sections on biological description, taxonomy, distribution, conservation threat, and existing conservation measures of the taxa concerned. Some of the suggested topics in Box 2.1 may be covered in the previous section in a more general format, or may be covered in both sections with cross-references made.

Box Checklist for topics to be covered in the Taxonomic or Regional Accounts

- ❑ The current listing of the species under the 2000 IUCN Red List Categories and Criteria. Where a category for any other species is proposed that differs from the current listings in the IUCN Red Lists of Threatened Animals and Plants, an explanation should be given for the difference.
- ❑ The current listing on a CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora) Appendix, if applicable (Consult the SSC Wildlife Trade Programme, see Appendix 1 for contact information)
- ❑ Biological data
  - distribution (mention whether in protected areas)
  - population estimates and trends
  - migratory patterns, if applicable
- ❑ Ecology, environment and habitat
  - in the context of conservation of biodiversity, a discussion of the relationship between the species and its ecosystem is important.
- ❑ Historical perspective
  - importance in culture; traditional uses
  - conservation measures taken in the past
- ❑ Present human use and influence
  - local, national, or international socio-economic and political factors
  - international trade demand/marketing (Consult TRAFFIC, see Appendix 1 for contact information)
  - human population/development trends
- ❑ Actual and potential threats
  - habitat degradation, loss, fragmentation
  - exploitation, direct and indirect
  - persecution
  - government changes of attitudes, policies, or support
  - other threats
- ❑ Current legal protection, and whether it is effective (Consult CEL, see Appendix 1 for contact information)
  - national
  - protected areas
- ❑ Current conservation measures
  - international treaties and conventions
  - traditional
  - specific projects being undertaken or completed
  - who is carrying them out
  - results so far

- expected results at termination
- costs (rough estimates to date if possible)
- constraints to their completion

❑ Captive breeding/artificial propagation

❑ Research activities

- on food habits, behaviour, reproduction and field ecology, migration and effects of pollution, pollination, population studies
- surveys

❑ Gaps in knowledge

2.5 Recommended Actions

By definition, this is the section that makes the Action Plan what it is, and is the most important part of the publication. It should be succinct, yet identify as clearly as possible the important details of **what** action is needed, **where** the action is necessary, and **who** should undertake the action. The recommendations are one of the most important aids to fulfilling SSC's mission:

> *to conserve biological diversity by developing and executing programs to study, save, restore and manage wisely species and their habitats.*

Authors should consult with expert organisations, such as the IUCN Commissions on Environmental

Points to take into account when formulating recommendations

To encourage the implementation of Recommended Actions, they should go beyond simply stating species **NEEDS**. They should suggest realistic **SOLUTIONS** attainable by specific **ACTIONS**. For example, where crop raiding is a problem, it is not sufficient to say that farmers should stop persecuting the species. Your recommendation may propose decoy feeding areas, compensation for loss of crops, or other constructive methods of solving the problem.

What? The recommendations should be designed to alleviate the problems discussed in the Taxonomic or Regional Accounts. Each recommendation should be based on a rationale for conserving the species, the threats to its survival, and actions needed to mitigate those threats.

Where? Most species conservation actions are authorised and carried out at the country level, although some are restricted to particular localities and others require trans-national cooperation to meet regional needs. You should indicate the geographical level to which your recommendations apply.

Who? SSC's influence extends to: international agencies; government ministries; government agencies; Non-Government Organisations (NGOs); park and protected area managers; local communities; specialists; IUCN members; the academic community. Decide which organisation, and which persons within those organisations, can promote the recommendation, or make decisions to allocate resources for its implementation, and who can implement the recommendation on the ground. The role of any international conventions may be relevant here. These people are your primary target audience(s), so the recommendations must make sense to them.

When? Actions should be categorised as short/medium/or long-term. Asking this question will help to prioritise the recommendations.

In what context? The relationship between species and the actions of people that affect their survival is influenced to a greater or lesser extent by human needs, and cultural and socio-economic factors. Any such factors that may affect the species covered by the recommendation you are formulating should be

mentioned earlier in general terms in the Introduction and discussed in more detail in this section as it relates to specific recommendations in the Action Plan.

Negative consequences? The possibility of unintended negative consequences of actions must be thought through and, if necessary, alternative solutions sought and proposed. Recommendations that fail to recognise possible short-term social problems will not be taken seriously by decision-makers. For example, a recommendation to close the paper mills so that a forest will stay intact to provide habitat for some little-appreciated species is unlikely to be heeded. The recommendation would have to concede that some realistic alternative forms of employment or income for those dependent on the paper mills would need to be found by some other agency. Thus the recommendation is pointing the way towards a solution that would involve wider expertise and community participation.

Calling on wider expertise? If, as is likely, the Specialist Group is not qualified to find solutions to overcome any negative consequences, the recommendation should specify that such problems need to be addressed by some other agency. If possible such agencies should be consulted or named, so that collaborative efforts may be initiated by Action Plan readers (see Appendix 1 for contact information).

How? All steps needed to achieve solutions should be specified. Ways to implement the solutions and monitor progress, with estimated time-scales, should be indicated. How feasible are they? Identifying specific objectives within the overall recommendation and the steps needed to meet them can be very helpful to implementers.

Timing? Consider the schedule for reaching target audiences. There may need to be a sequential approach, as support is built up from one target before approaching another. For example, is fundraising or government support needed before any other approach can be considered?

Motivation? Think about what will motivate your audiences to respond positively: to what extent do the recommendations fit in with their own priorities? Could they gain solutions to their own problems, benefits additional to their own programme outcomes, good public relations, or greater political and/or public support for their own programmes by assisting SSC with the recommendation?

Obstacles? Identify the realistic constraints of your primary audiences. Consider how SSC may be able to work in partnership with them to overcome those roadblocks, or attract funding for joint ventures.

IUCN? Consider how IUCN Regional and Countries Offices, Natural Biodiversity Conservation Groups, members of IUCN other Commissions, IUCN National Committees, or other IUCN programmes or partner organisations may be able to provide relevant information in formulating your recommendations. They may later be able to further the impact of your recommendations - by lending credibility and authority, supplying contact names, or other support (see Appendix 1 for contact information).

Costs? Make an estimate of costs, which may be included in the Action Plan, or be available on request. Indicate how accurate the estimates are, and in what currency and at what date they were made. Indicate whether funding is secure, or how much still needs to be allocated by responsible agencies, or raised from other sources. This information will serve as a resource in formulating funding proposals.

Prioritising? The recommendations should be prioritised through consensus according to: the urgency of the recommended action; the feasibility of success under existing constraints; and the readiness of the implementers to move ahead on the action. In general, priority should be given to actions that apply to known problems rather than on research to identify as yet unknown problems. Explain the criteria and system you are using to prioritise.

Evaluation?
Consider how progress on the recommendation could be evaluated to assess whether the results of actions are having the intended consequences for conservation of the species. Successes and lessons learned will be all the more valuable if they can be shared amongst other SSC members. Reports given to donors will reinforce their interest in seeing a recommendation through and supporting new ones.

The importance of communication in promoting action
To gain maximum support for your recommendations, it is essential that all players and stakeholders understand:

- why the action is needed
- what the potential benefits and costs are
- how the proposed action will affect their interests or life-styles, and
- what their role in ensuring the success of the action will be.

When formulating the Recommendations, think about how the Specialist Group or others will promote them. In the past, the failure of implementers to communicate their intentions to affected communities has led to serious resistance to conservation actions. Preventing this by encouraging two-way communication before, during, and after implementation will feed into a cycle of information-gathering, action, monitoring effects, and thus, further action. Reporting back will reinforce the interest of all players and supporters. Taking time at this stage to anticipate grass roots communication needs can help prevent misunderstanding and opposition later.

Most of the points above can help the Specialist Group to draw up a Communications Strategy to keep the process of promotion and implementation of the Action Plan moving. Communication links will also assist in monitoring and evaluating the impact of the Action Plan in realising its conservation objectives. SSC is keen to improve its monitoring and evaluation processes, particularly in relation to Action Plans. The Specialist Group should attempt to identify a set of targets to be achieved along the road to implementation. These targets can be changed into question form to become indicators of the success of the implementation of Action Plans. Some examples are:

- Have the intended audiences been receptive to the Action Plan?
- Has specific action been taken by those identified in the Action Plan?
- Has the action take led to the intended outcomes?

The achievement of each target should be assessed as to:

- whether or not the target was successfully reached
- what obstacles were encountered along the way
- how these obstacles were dealt with

This monitoring and evaluation process will assist the promotion of further action by identifying areas in which action still needs to be taken, as well as providing insight into how successful action was achieved and how to improve the Action Planning process.

Presenting the Recommendations in the Action Plan
SSC's recommendations should not be presented as an attempt to **dictate** to people or governments what they should do, or how they should do it. Recommendations should be presented to make clear that in a single document, SSC experts are providing information and proposals designed to **assist** those who have to make decisions about resource allocation, and those implementing species conservation.

After taking into account the points listed above, the conclusions should be distilled into clear and succinct recommended actions. The wider issues that have been discussed in the Action Plan can be referenced. You may wish to provide your contributing authors with a structure or framework within which to present their recommendations. This would ensure consistency and allow easy comparison between recommendations for the purposes of prioritising, targeting audiences, and determining what type of support is needed first - financial, political, or local for example.

Present each recommendation in a way that is meaningful to the people whom you wish to implement the action. To convince them or enhance their level of understanding of the issues, you may wish to provide some members of target audiences with information that is too lengthy or peripheral for inclusion in the Action Plan. In such cases, draw up separate notes for these audiences that can be put into a letter, or used in a presentation at a meeting with them.

Box Checklist for Action Plan Recommended Actions

- ❑ Have you consulted all relevant parties, e.g. implementers, stakeholders?
- ❑ Are specific problems noted earlier in the Plan being addressed?
- ❑ Is the location and geographical level of decision-making (local to global) identified?
- ❑ Are there measurable step by step objectives?
- ❑ Are implementers and stakeholders clearly identified?
- ❑ Do the proposed solutions take cultural and socio-economic issues into account?
- ❑ Are organisations and individuals with necessary expertise beyond that of SSC identified?
- ❑ Are co-operative processes suggested?
- ❑ Is a communications plan suggested?
- ❑ Is a monitoring system suggested?
- ❑ Is an evaluation system suggested?
- ❑ Is a reporting system suggested?
- ❑ Are the costs of the recommended actions estimated?

A topic for discussion (Document 2; Thursday 26 July, afternoon.

Is fern conservation in the tropics possible?

Alan Hamilton, Head, International Plants Conservation Unit and Co-ordinator of the People and Plants Programme, WWF-UK, E-mail

Conservation needs people of many skills. Experts in many botanical specialities have roles to play, including those concerned with ferns.

Fern specialists are scarce, especially in the tropics, where the majority of species are found. Many key tropical habitats for ferns and other forms of plant diversity are under threat. Conservation of the diversity of plant species in the tropics must, for now, be overwhelmingly a matter of retaining or restoring habitat. In practice, the 'integrated *in situ* / *ex situ*' approach, adopted by IUCN, must normally be heavily biased towards the former, given *inter alia* the poor current state of *ex situ* conservation facilities in most of the tropics, where there is a shortage of relevant specialists and facilities, and severe financial constraints. A large-scale species-by-species approach to plant conservation is realistic in only a few wealthy countries, in which, additionally, there is widespread cultural sensitivity towards rare or threatened species. These considerations underlay the concept (later implemented by WWF, IUCN, the Smithsonian Institution and many collaborators) to identify global Centres of Plant Diversity, so that the scarce resources available for conservation could be targeted at saving the most critical habitats.

The effective conservation of Centres of Plant Diversity depends, in part, on recognition of these centres by those involved in conservation planning, especially at national level, and adoption of appropriate management systems at the sites. Nearly all countries are parties to the Convention on Biodiversity and most have agencies or working groups responsible for recommending measures to achieve practical results. Taxonomic specialists, such as pteridologists, need to make recommendations for conservation to these policy-makers in appropriate (comprehensible) forms.

Strengthened management for conservation is often needed at Centres of Plant Diversity. Frequent proximate threats include conversion for agriculture and the unsustainable harvesting of plant resources (e.g. timber, fuelwood, craft materials, medicinal plants), often related to commercial pressure. Underlying causes of endangerment can include population growth, poverty (generating greater reliance on wild plant resources), political instability and structural adjustment programmes related to Third World debt.

The achievement of strengthened management at site level depends on finding an acceptable balance between conservation and use. Very few extensive tracts of land in the tropics, or the natural resources that they hold, are unused by local people. Attempts to totally exclude people from most protected areas will not only prove impossible but, most likely, eventually counter-productive. Divorcing people from their local natural worlds eliminates their interest in its long-term fate. Protected areas in the tropics tend to be very poorly resourced; park guards will be unable to prevent destructive exploitation without commitment to conservation by local citizens.

Achievement of a balance between conservation and the sustainable and equitable use of natural resources entails an understanding of local ecology, societies, cultures and economies, and the involvement of local people at all stages of planning, research, analysis and adoption of new management measures. Botanists should take a central role, because of the fundamental importance of plants (both wild and cultivated) to the lives of rural people in the tropics. Botanists can work with local plant specialists (e.g. farmers, craft experts and herbalists), drawing on their own skills and knowledge (such as knowledge of sampling techniques and access to the literature) and those of their partners.

Teams formed for conservation projects consisting of different types of narrow specialist (including perhaps botanists or even fern experts), each working in his/her own restricted field, may be severely limited in effectiveness, given the need for an holistic understanding which conforms to the realities of people's lives, including the ways that they interact with their environments. Since the people/plant relationship is so important to rural people in the tropics, it is perhaps especially incumbent on botanists who wish to be involved practically in conservation to widen their skills. Otherwise, their role

will likely be restricted to writing technical reports, with the hope that someone else will explore how their recommendations can be translated into action.

An understanding of rural societies is clearly important for practically conservation-orientated botanists, and similarly respectful sensitivity towards those of different cultures: hence the central need for ethnobotanists. Further, research by botanists and their local partners should be efficiently directed towards finding answers to real-life questions, which is why **applied ethnobotany** is so important. Exercises which merely document local uses of plants typically serve no conservation purpose. An action-research mode is recommended, involving a cycle of identifying critical issues (drawing on both wider conservation perspectives and key issues for local users of plant resources), careful research at requisite degrees of detail, joint analysis of results and the formulation of follow-up recommendations for action with the full involvement of local stakeholders. Depending on local circumstances, critical questions may include:

- Evaluations of the vulnerability of harvesting particular plants in protected areas (perhaps leading to new management systems of harvest and monitoring, designation of zones for different purposes or promotion of alternatives in support zones).
- Evaluations of trade in plant products (perhaps leading to potential interventions at different points along trading systems).
- Affirmation of local botanical cultures (perhaps leading to greater pride in local cultures, thus providing a firmer base for conservation.
- Identification of new sustainable economic possibilities involving plants at local level (perhaps leading to greater prosperity).
- Inventories and assessments of conservation status for species of both wider and more local interest (perhaps leading to improved planning).

Much greater capacity in applied ethnobotany is needed in all tropical countries at both national and local levels. Foreign botanists can play roles in building this capacity. Key areas include the training of professional applied ethnobotanists, institutional development (curricula and networks) and identification of more effective approaches and methods for tackling particular classes of problem. People and Plants is an initiative of WWF, UNESCO and the Royal Botanic Gardens, Kew, designed to serve this purpose. Action-research by trainees, supported by mentors, is carried out at a number of sites, mainly tropical Centres of Plant Diversity. Several networks and curricula have been strengthened or assisted in their formation. A range of publications, videos and a website carry information on case-studies, regional analyses, methods and available materials.

People and Plants is currently developing ideas for a Programme for Community-based Plant Conservation to launch in 2004. Our present thinking is to develop regional training centres at selected tropical Centres of Plant Diversity for the development of capacity in applied ethnobotany. Action-research will be aimed at local conservation priorities in the context of selected, internationally important, themes. Support for this new programme and ideas about its development will be most welcome from fern experts.

The People and Plants website can be visited at:
http://www.rbgkew.org.uk/peopleplants

I would appreciate information from those attending the symposium on:

- What are the numbers and geographical distribution of fern specialists?
- Why do people become interested in ferns?
- Are global centres of diversity for ferns similar to those for plants in general (as indicated by the Centres of Plant Diversity recognised by WWF, IUCN and the Smithsonian)?
- How do fern specialists translate their recommendations for conservation into practical action, whether in the tropics or elsewhere?