IPPS TO ELECT NEW OFFICERS

The time has come to elect a new set of officers for the International Parasitic Plants Society. The term of service for officers is four years, and we are soon approaching the fourth anniversary of the inauguration of IPPS, which took place during the 7th International Parasitic Plant Symposium in Nantes, France. The new group of leaders will continue the work of advancing the Society, decide on all activities of the Society, and coordinate the next symposium and workshops. Elected positions are President, Vice President, Secretary, Treasurer, and two Members at Large.

Three members of the current Executive Committee volunteered as members of the Election Committee: Patrick Thalouarn, Gbèhounou Gualbert, and Jos Verkleij. Patrick Thalouarn, who is currently the Vice President of the IPPS agreed to serve as Chair of the Election Committee.

All members of the IPPS will receive a nomination form by email in early 2005. Then an electronic ballot will be sent to the members. Please begin thinking about who you would like to nominate and whether you would consider serving if nominated.

The IPPS extends its best wishes to all researchers of parasitic plants: let us hope that 2005 will be a fruitful year with breakthroughs in the understanding of key issues concerning the parasitic syndrome in plants, and with the introduction of new methods for an effective management of parasitic weeds.

Danny Joel
IPPS Secretary

ERRATA

We regret to note two errors in Haustorium 45 (partially corrected on the web-site version).

1. the date should of course have read August 2004 not 2005

2. the list of papers noted under the COST meeting in Nicosia, Cyprus (not Cypress!) was a repetition of those presented to the Rome meeting. The correct list of papers is included below.

Our apologies to those confused.

AFTER THE BOOK – PROGRESS IN PARASITIC PLANT RESEARCH SINCE KUIJT’S ‘BIOLOGY OF PARASITIC FLOWERING PLANTS’ - OVERVIEW OF A SYMPOSIUM JULY/AUGUST 2004

This symposium was held at Botany 2004 - the joint annual meeting of the American Bryological and Lichenological Society (ABLS), the American Fern Society (AFS), the American Society of Plant Taxonomists (ASPT), and the Botanical Society of America (BSA) held from July 31 to August 5 in Snowbird, Utah.

The symposium was presided over by Lytton Musselman and Daniel Nickrent and sponsored by the Tropical Botany and Systematics sections of BSA and Old Dominion University. It was dedicated to Job Kuijt’s seminal publication, The Biology of Parasitic Flowering Plants (1969), a volume that has indisputably influenced a generation (or two) of botanists. Current research was presented in twelve papers encompassing the ecology, systematics, and anatomy of parasitic plants. In addition to the symposium, five
presentations on parasitic plants were given in other paper sessions at the meeting. The following is a brief overview of all pertinent papers presented at Snowbird, with the senior author in each case indicated in brackets.

The opening presentation by Lytton Musselman discussed the impact of Kuijt’s book on plant sciences and reviewed progress of research since its publication. Musselman emphasized the disparity between research progress and the lack of positive change for the poorest world citizens suffering from parasitic plants.

Job Kuijt spoke kindly about the recognition of his efforts, the motivation for his book, and without approbation, the current emphasis on molecular systematics at the expense of descriptive work. David Lye introduced their joint paper giving information about the complex organization of Arceuthobium tissues in undifferentiated Psuedotsuga apical buds (Kuijt).

Symposium papers on Orobanchaceae included phylogenetic analyses that compared the generic relationships within the family using ITS sequence data (Wolfe); the Orobanchaceae as a model for the molecular evolution of a gene (PHYA) encoding for phytochrome (Bennett); the use of transgenic host plants engineered for hypersensitive response to parasitism by Orobanche (Westwood); and a helpful review of parasite-host interactions for root hemiparasites in a community assembly and ecophysiological framework by Malcolm Press. In the regular paper sessions, species relationships in Hyobanche complexes were resolved using ISSR markers and correlated with biogeographic patterns of morphology (Wolfe).

A convincing argument was made for the photosynthetic potential of Cuscuta using natural history observations and molecular data that included the sequences of entire chloroplast genomes of two Cuscuta species (McNeal). Dactylanthus taylorii (Balanophoraceae), a New Zealand endemic, faces a variety of conservation issues, primarily introduced rodents, while its intriguing basic biology is just beginning to be understood (Holzapfel). New information regarding the pollination biology of Hydnora was presented and a potential cryptic species was identified using ISSR markers (Maass).

Phylogenetic and biogeographic relationships within the Santalaceae were elucidated with sequence data from multiple gene regions (rDNA, rbcL, and matK), and strong support for several monophyletic clades were discussed (Nickrent). In the paper sessions evidence for the Australian origin of Santalum and the affiliations of Hawaiian and other Pacific island taxa are discussed using ITS sequence data (Harbaugh). An 80 million year biogeographic history of the Olacaceae was described using molecular, morphological, and fossil data (Malécot). Relationships within the Rafflesiales were discussed in light of horizontal gene transfer events, questioning the utility of mitochondrial sequences as phylogenetic markers (Blarer).

In the regular paper sessions of the symposium, the queen of the plant parasite world, Rafflesia, was placed in the Malpighiales using phylogenetic analyses of the mitochondrial gene matR (Barkman); a novel vector of horizontal gene transfer in angiosperms was presented with evidence for multiple origins of parasitism using three mitochondrial genes (Barkman); and the patterns of character divergence and convergence were shown in canopy dwelling Loranthaceae (Wilson).

The proceedings of this meeting will not be published but a list of relevant titles is included below and abstracts may be found on: http://www.2004.botanyconference.org/ or on http://www.science.siu.edu/parasitic-plants/Meetings/BotSoc2004.html

Jay F. Bolin
Old Dominion University
Norfolk VA 23529, USA
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Barkman, T.J. et al. - Mitochondrial DNA suggests 12 origins of parasitism in angiosperms and implicates parasitic plants as vectors of horizontal gene transfer.

Barkman, T.J. et al. - Phylogenetic analysis reveals the photosynthetic relatives of Rafflesia, the world’s largest flower.

Bennett, J. and Mathews, S. - Phytochrome evolution in Orobanchaceae.

Blarer, A. et al. - Rafflesiales – problems and advances in research.

Holzapfel, A.S. - Biology and Conservation of the New Zealand endemic parasitic plant Dactylanthus taylorii Hook f. (Balanophoraceae).

Kuijt, J and Lye, D. - The return of the isophasic filaments – the early Arceuthobium endophyte.

Maass, E. et al. - Hydnora - the ingenious genus.
Malécot, V. - Biogeography of Olacaceae - paleobotanical and phylogenetic congruence.
McNeal, J.R. et al. - Evidence for photosynthetic potential across the parasitic plant genus Cuscuta using complete plastid genome sequences.
Musselman, L.J. - Parasitic weeds in world agriculture—the best of times, the worst of times.
Nickrent, D. and Der, J. - Santalaceae: phylogeny, taxonomy, and biogeography.
Press, M.C. - Physiological traits of root hemiparasitic Orobanchaceae (ex-Scrophulariaceae): implications for community structure and function.
Sherman, T.D and Vaughn, K.C. - An ultrastructural overview of adaptations that make dodders (Cuscuta spp.) efficient parasites.
Westwood, J. - Molecular biology of parasitism in Orobanche.
Wilson, C.A. and Calvin, C.L. - Character divergences and convergences in canopy dwelling Loranthaceae.
Wolfe, A. et al. - Phylogeny and biogeography of Orobanchaceae.
Wolfe, A.D. and Arguedas, N. - Patterns of evolution in Hyobanche L. (Orobanchaceae), part II.

A MISTLETOE (SCURRULA PULVERULENTA) AND AN UNUSUAL HOST PLANT (ARAUJIA SERICIFERA)

Araujia sericifera (Asclepiadaceae), cruel plant, is a liana native to Brazil reported as naturalized in western Europe. I have seen its normally developed fruits and seeds only three times: about 1970 in the Hanbury Botanic Gardens (Italy), about 1990 in hedges of a motor-way not far from Milan (Italy) and last year in an orchard in the mountains of Riviera Ligure west of Genoa (Italy). In all three places the climate is Mediterranean with occasional frosts in winter and warm, dry summer. The mistletoe Scurrula pulverulenta was introduced about 1980 into Europe using fresh berries received from Shillong (Eastern India). It is said to be native in Kashmir and acclimatized in the Hanbury Gardens on Citrus hosts. I am studying a plant of S. pulverulenta derived from a seed I placed on the stem of A. sericifera. The hemiparasite was able to grow to a size of about 50 cm in spite of the very thin stem of the host (only 1.5 cm at 1 m above soil level) where it germinated. I expected a reduced growth, flowering and fruiting of the host-plant, but in September 2004 it was full of flowers in the upper part (about 4 m high) with about 15 nearly ripe fruits. There were several seedlings of A. sericifera climbing up in different parts of the orchard, thus confirming that the seeds of last year have germinated regularly and successfully. I will monitor both plants and eventually try the germination of another mistletoe on the host because that epiparasitism might lead to a better understanding of the relationship between host and parasite.

G. Grazeti.

PROMOTION OF GREEN MANURING TO COMBAT STRIGA IN TANZANIA

Continuous production of maize, sorghum or upland rice without using manure or fertilisers has led to a decline in soil fertility and a build up of Striga asiatica in many areas of Tanzania. Rice yields for example have fallen by between 30 and 70% over the past 20 years as Striga levels have increased. Farmers harvest little more than 300 kg ha\(^{-1}\) from severely infested fields. There is strong market demand for quality aromatic rice so farmers in affected areas, including Kyela district in the southern highlands and Matombo district in the Ulugulu mountains of Morogoro region, are keen to reverse the decline in yield. Farmer groups in Kyela participating in a project funded by the UK DFID Crop Protection Programme learned from on-farm trials with urea fertiliser that Striga is an indicator of low soil fertility. Prior to working with the project the farmers had little knowledge of Striga other than observing that it is found in fields where cereal crops grow poorly. Yields of rice were increased by 40% with an associated 60% reduction in Striga infestation when fertiliser was applied. However lack of cash at the beginning of the season and limited availability discourages farmers from buying inorganic fertilisers. Subsequently the project introduced the idea of a legume-rice rotation to farmers in two villages in Kyela to provide a low-cost locally sustainable alternative. Since October 2002 rotation of rice with the green manure ‘marejea’ (Crotalaria ochroleuca) or the pulse pigeon pea has been promoted by extension officers in Kyela and has also been introduced to communities in Matombo. Initially extension and research staff organised farmer field days at sites in the two villages where use of C. ochroleuca and an improved high yielding cultivar of pigeon pea were introduced, and arranged farmer exchange visits with farmers from other villages. The process of farmer evaluation of green manure, initiated by researchers, became farmer driven. By 2004 the
Rotations had been implemented at well over 100 sites and demand for seed has risen so that by 2005 both legumes will be in use across 16 villages. Promotion work is also being undertaken with village primary school teachers in both districts to spread knowledge of the cereal/legume rotations through agricultural science classes and school demonstration plots.

*C. ochroleuca* biomass contains approximately 3.5% N in shoots and 1.3% in root so with dry matter yields of 3 to 4 t ha$^{-1}$ significant levels of nutrient are available to subsequent crops. The green manure also acts to reduce the *Striga* seed bank because it produces germination stimulant in its root exudates: in laboratory tests, exudates from 10 day old seedlings stimulated 34% germination of *S. asiatica* compared to 57% stimulated by maize root exudates. Results from up-scaling the legume-rice rotations to farmer management are promising and increasing adoption is taking place. Rice yields on 15 farms in Kyela in 2003, where *C. ochroleuca* was grown the previous year, averaged 2408 kg ha$^{-1}$ compared 1042 kg ha$^{-1}$ under continuous rice, with associated reductions in *Striga* infestation. In 2004 farmer’s rice yields across sites in five villages were again on average more than 100% higher following *C. ochroleuca* or pigeon pea than on plots in continuous cereal production. An additional significant advantage of using *C. ochroleuca* is that it suppresses weeds. Most farmers do not find it necessary to weed the green manure itself and have weeded subsequent rice crops only once, compared to the two to three weeding needs in continuous rice, representing a considerable saving of labour. *C. ochroleuca*, provides a low cost, locally sustainable approach to soil fertility and hence *Striga* management. Growers can use farm-saved seed and are now passing on supplies to neighbours and selling seed to farmers in the wider community. One group in Kyela is setting up a shop to provide an outlet for the seed and to encourage greater adoption.

A.M. Mbwaga, Ilonga Agricultural Research Institute, Tanzania.
C. R. Riches, Natural Resources Institute, University of Greenwich, UK.

**STUDIES ON HYDNORA**

Among activities on parasitic plants in the Department of Biological Sciences at Old Dominion University, Norfolk, USA, Dr Kushan Tennakoon has joined Lytton Musselman from Sri Lanka for a sabbatical period to study the functional attributes of the genus *Hydnora*. This is a group of rare parasitic angiosperms growing on the roots of *Euphorbia* and *Acacia* species in southern Africa, some parts of the Arabian peninsula and Madagascar. Due to its furtive nature this genus is poorly studied and the new investigations include studies of the anatomy of *H. triceps* and *H. africana* and their haustorial structure, using light and electron microscopy, and of the factors governing the movement of assimilates from the hosts to the parasite.

**TAXONOMY OF BALANOPHORACEAE IN BRAZIL**

A study is in progress at the Botanical Gardens Research Institute in Rio de Janeiro on a revision of the taxonomy of the Balanophoraceae, including the genera *Langsdorffia*, *Ombrophytum*, *Lathrophytum*, *Scybalium*, *Lophophytum* and *Helosis* in Brazil. The scientists involved would welcome any assistance that readers of Haustorium can provide in the form of information on herbarium collections and duplicate herbarium specimens from other parts of the world, photographs, literature, etc. Any help or advice should please be passed to Dr Leandro Cardoso, Instituto de Pesquisas, Jardim Botânico do Rio de Janeiro, Rua Pacheco Leão, 915, Rio de Janeiro CEP 22460-030, Brazil.

email: leandrocardoso@msn.com
(With thanks to Jan Bartlett for translation.)

**BECA LAUNCHED IN NAIROBI**

The Biosciences Eastern and Central Africa (BECA) was officially launched in Nairobi, Kenya by the country’s Agriculture Minister Kipruto arap Kirwa. The Minister reiterated the country’s support for the use of science and technology to increase food production.

BECA consists of a network of institutional nodes and a hub, located at the International Livestock Research Institute, in Nairobi, Kenya. The hub provides a common biosciences research platform, research-related services, and capacity building and training linked to a network of laboratories, universities and other institutions throughout eastern and central Africa. Prof. James Ochanda, BECA Coordinator, said the facility offers a unique opportunity for African scientists to access state-of-the-art biosciences laboratory facilities and training.
to develop technological innovations to help relieve hunger in Africa.

Minister Kipruto arap Kirwa called for rapid adoption of new agricultural technologies to help in the fight against *Striga* weed and stem borer whose damage to maize is said to cost sub-Saharan Africa up to US $ 7 billion and US$ 90 million annually, respectively. He said Kenya would increase investment in agricultural research in general to meet the challenges of food requirements. He commended NEPAD for striving to harness science and technology for Africa’s sustainable development.

Following a NEPAD request, Canada pledged C$30 million of the Canada Fund for Africa to support the facility. The Fund has so far released C$4.5 million to support the planning and design phase of BECA.

For more information contact Daniel Otunge of the Kenya Biotechnology Information Center at dotunge@absafrica.org

(From Crop Biotech Update December 10, 2004)

**OBITUARY – ROBERT J. CARSKY**  
20 April 1955 – 6 November 2004

His colleagues at IITA and WARDA have reported with sadness that in the recent turmoil in Côte d’Ivoire, Bob Carsky was tragically killed when a bomb struck the French school in Bouaké where he was sheltering. Bob, an American citizen, had worked for IITA and more recently for WARDA over a period of 15 years as an agronomist, working closely with and for local farmers. His studies had included intensive field work on *Striga*. To quote a long-time colleague, Dr Christian Noble, ‘He constantly adapted his approach to work on solutions for those agricultural problems that haunted farmers most.’ He left a wife and three children in the US. He will be sorely missed.

**THE MAILING LIST**

The current circulation of Haustorium is approximately 360, about 220 by email and 140 by airmail. We are always seeking to reduce mailing costs (which are at present kindly borne by Old Dominion University) and any readers receiving this as hard copy who are prepared to receive by email are asked to contact Chris Parker accordingly. Those already receiving by email are asked to advise any change of address. Meanwhile, contact has been lost with the following:

- Dr Dana Berner in USA
- Dr Pavol Elias in Slovakia
- Dr Govind Khattri in Nepal
- Dr H.C. Lakshmi in Karnataka, India
- Mr Kadour Saffour in Morocco
- Dr A. Zemrag in Morocco
- Dr Sevda Atanasova, lately in The Netherlands
- Dr Awad Farah in Saudi Arabia (or Sudan?)
- Dr Are Rogler in Norway

If anyone can help us re-establish contact with any of these individuals it will be appreciated by all concerned.

**IUFRO WORLD CONGRESS**

The World Congress of the International Union of Forestry Research Organizations, to be held in Brisbane, Australia from August 8-13, 2005, will include a session on ‘Stem and shoot fungal pathogens and parasitic plants: the value of biological diversity’.

For any further detail contact Simon Shamoun sshamoun@nrcan.gc.ca

**COST 849 - PARASITIC PLANT MANAGEMENT IN SUSTAINABLE AGRICULTURE**

This programme, funded by European Union via European Science Foundation, has been able to arrange an increased number of meetings in 2004. Most recently there have been meetings in Wageningen, Bucharest, Naples and Cordoba. The programmes, abstracts and/or reports of these meetings are on the COST849 web-site (http://cost849.ba.cnr.it/) or will be added in due course. More details appear below, together with lists of paper presented and the corrected list of papers presented at the meeting in Nicosia in May.

**COST 849 MEETINGS**

Herbicide testing for control of broomrape held in Nicosia, Cyprus, 13-15 May, 2004. The corrected list of papers presented at this meeting is as follows:
Reuven Jacobsohn - Potential activities to be promoted on herbicide testing for broomrape control.
Diego Rubiales - *Orobanche* spp. problem in Europe. Perspectives for cooperative actions in the frame of COST 849.
Nicos Vouzounis - Broomrape problem and its chemical control in Cyprus.
Salvador Nadal - The status of broomrape and its control in Spain.
Joseph Hershenhorn - Control of *Orobanche aegyptiaca* in tomatoes using sulfosulfuron.
Maria Chrysayi-Tokousbalides - Broomrape problem in Greece. Strategies of control.

**Mechanisms of susceptibility and resistance in parasitic angiosperm-host symbioses: a comparative approach** held in Wageningen, The Netherlands, 13-15 October, 2004. Papers presented and discussed were:

John Yoder - Haustorial signalling and development: *Triphysaria* as a model.
Danny Joel - Structural development of haustoria in *Orobanche*.
Malcolm Press - Haustorial structure/function relations.
Radoslava Matusova - Biosynthesis of germination cues.
Sissy Lyra - Induction of *Orobanche* seed germination by stimulants.
Eliane Dumas-Gaudot - Plant-mycorrhizas interaction.
Hans Helder - Plant-nematode interactions.
René Geurts - Legume/rhizobia interactions.
Philippe Délavault - Early molecular responses of host and non host roots infected by *Orobanche* spp.
Ana Maria Maldonado - Proteomics as a high throughput global approach to understand parasitic angiosperm-host symbioses cues.
Patricia Letousey - Molecular events in resistant and susceptible sunflowers infested by *O. cumana*.
Sun Zhongkui - *Arabidopsis* as a model to study germination stimulant formation.
Patrick Thalouarn - Comparison of host root responses to *Orobanche* spp and other pathogens.
Alex Levine - The role of active oxygen species in *Orobanche* infection.
Julie Scholes - Host resistance in rice
Bob Vasey - Non-host resistance in *Arabidopsis*.
Maurizio Vurro - Natural compounds: tools to defend host plants from parasite aggression
Maria Pacureanu - Sunflower resistance.

**Use of natural compounds for parasitic plant management** held in Naples, Italy, 29-31 October, 2004. Papers presented and discussed were:

Anna Andolfi *et al.* - Plant and fungal bioactive metabolites as stimulants for germination of *Orobanche ramosa* seeds.
Anna Andolfi *et al.* - Fungal toxins in the control of the parasitic weed *Orobanche ramosa*.
Harro Bouwmeester *et al.* - Manipulation of germination stimulants for control.
Maria Chrysayi-Tokousbalides and Konstantinos Aliferis - Studying the mode of action of fungal phytotoxins.
E. Dor and J. Hershenhorn - Metabolite from *Inula viscosa* is toxic to dodder (*Cuscuta campestris*).
Stephen Duke and Jim Westwood - The potential for genetically engineering natural phytotoxins into crops for parasitic weed resistance.
Garifalia Economou *et al.* - Germination response of *Orobanche* populations to GR24 and to a new natural product.
J. Hershenhorn *et al.* - *Fusarium moniliforme* as a new pathogen of parasitic plant *Orobanche* sp.
Francisco Macías *et al.* - New chemical clues for sunflower-broomrape host-recognition.
Alice Nielsen and Jens Streibig - Root exudates from sorghum responsible for *Striga hermonthica* (Del.) Benth. germination.
A. Pérez-de-Luque *et al.* - Induction of systemic resistance in pea and faba bean to crenate broomrape (*Orobanche crenata*) by exogenous application of benzothiadiazole.
Peter Tóth and Ludovít Cagán - Possible role of secondary metabolites emitted by parasitic weeds in attraction of insects.
Maurizio Vurro and Angela Boari - Natural compounds: weapons against parasitic plant aggression.
Klaus Wegmann - Search for inhibitors of the exoenzymes of the *Orobanche* radicle.
Nadjia Zermane - Secondary metabolites of rhizobacteria and perspectives of their use for biocontrol of *Orobanche* spp.
Binne Zwanenburg - The quest for natural germination stimulants. A critical account on the structure and chemistry of compounds with claimed germinating activity.

**Breeding for *Orobanche* resistance in sunflower** held in Bucharest, Romania, 4-8 November, 2004. Papers presented and discussed were:

**Breeding methodologies:**
B. Pérez - Sources of broomrape resistance in sunflower.
Management of parasitic weeds held in Cordoba, Spain, 18-20 November, 2004. Papers presented and discussed were:

Robert Bulcke - Parasitic weeds - distribution and strategies of control in Belgium.
Henry Darmency – ditto in France.
Klaus Wegmann – ditto in Germany.
Pasquale Montemurro - ditto in Italy.
Nikos Vouzounis – ditto in Cyprus.
G. Economou - ditto in Greece.
Goran Malidza – ditto in Serbia.
Hanan Eizenberg – ditto in Israel.
Hanan Eizenberg - Modelling parasite development - a predictive tool for timing herbicide applications.
Svend Christiansen - How precision farming can be applied for parasitic weed management?
Yaacob Goldwasser - Management of Cuscuta campestris in tomato.
Alistair J. Murdoch - Linking laboratory and field studies of dormancy in parasitic plants: When is delayed planting an option for integrated control?
A. Pérez-de-Luque - Sowing date, chemical control and host resistance: effect on establishment and development of O. crenata in faba bean.
D. Rubiales - Integrated control of broomrape in pea.
C. García-Galindo - Natural products and allelopathy for parasitic weeds management.
Jesús Jorrín - Molecular approximation for the control of broomrape.
Rafael De Prado - Herbicide resistance – mechanisms and global overview.
Baruch Rubin - Risk of herbicide-resistance evolution in parasitic weeds.
Giovanni Dinelli - The use of molecular markers for the study of weed populations.
Goran Malidza - Control of broomrape in imidazolinone-tolerant sunflower hybrids.
Eleni Kotoula - Glyphosate for broomrape control in solanaceous crops.

Regional Project – assessment of Orobanche development model as a tool for Orobanche management:
Hanan Eizenberg - Introduction and overview.
Hanan Eizenberg - Practice of processing tomato cropping in Israel.
Falia Economou.- ditto in Greece.
Nikos Vouzounis.- ditto in Cyprus.
Pasquale Montemurro – ditto in Italy.
Hanan Eizenberg - Degree days- a predictive tool for Orobanche development in certain crops.

THESIS

Brenda J. Grewell (PhD, University of California, Davis, USA, September 2004)

Species diversity in Northern California salt marshes: functional significance of parasitic plant interactions.

I studied how parasitic plant interactions contribute to species coexistence in tidal wetlands of northern California. First, I address the effects of the native parasite Cuscuta salina on species interactions and
plant community structure. I showed that *Cuscuta* is restricted to nutrient poor areas with significant canopy gaps and high species diversity. I examined timing, level, and frequency of host infectivity and identified *Plantago maritima* as the primary host. I experimentally removed *Cuscuta* from the community and measured host fitness, rare plant fitness, and plant community response. *Cuscuta* reduction of host biomass and reproductive effort resulted in indirect positive effects on a rare hemiparasite, *Cordylanthus mollis*, and enhanced plant community diversity.

Then I present results demonstrating how parasitic plant – host interactions ameliorate physical stress conditions and generate environmental heterogeneity. Experimental bare plots, artificially shaded bare plots, and parasite removal plots across intertidal elevations were compared to controls with hemiparasites (*Cordylanthus mollis* and *Cordylanthus maritimus ssp. palustris*) at two coastal California sites representing a steep environmental stress gradient. Over three years, plant species richness was enhanced with parasites at both locations. Parasitic plants improve sediment salinity and redox potential, and parasite-generated habitat heterogeneity contributes to species coexistence.

Lastly, I present results of an experimental reintroduction of an endangered hemiparasite (*Cordylanthus mollis*) to a restoration site in the Suisun Marsh of the San Francisco Estuary, California. I tested disturbance management methods for enhancement of plant establishment and fitness. I identified critical life stages and used failure time survival analysis models for a demographic comparison of restoration and reference populations. I demonstrate that successful restoration requires a unique, productive host community to support the introduced parasite load. Disturbance-gap creation is a successful restoration technique that will enhance rare plant establishment and fitness, but benefits can be offset by exotic plant invasions. Applied conservation significance of the study points to a critical need for regional invasive plant control as the first step in restoration efforts.

Overall, my dissertation clarifies the functional role of parasitic plants within mid-Pacific Coast salt marshes of North America. Results demonstrate that preferential parasitism, spatial contingency of species interactions, and creation of habitat heterogeneity through parasitic amelioration of physiological stress conditions all play a role in supporting coexistence within the salt marsh community.

**CD-ROM**

CABI Crop Protection Compendium 2004 Edition. This latest edition has been comprehensively updated with the addition of over 300 new datasheets (now totalling 2100 pests, diseases, weeds and natural enemies), new search facilities, a new LUCID key to 425 weeds, and new library documents. Parasitic weed species having fully illustrated datasheets with distribution maps, host range, biology, ecology, control methods etc include *Alectra vogelii*, ten *Arceuthobium* spp., four *Cuscuta* spp., five *Orobanche* spp. and six *Striga* species.

The Compendium is available to individuals either as a one-off CD-ROM, or in the form of internet access (annually) for £70 (US$100) via CABI in UK (orders@cabi.org) or in USA (cabi-nao@cabi.org) or via the web-site (www.cabicompendium.org/cpc)

**GENERAL WEB SITES**

For individual web-site papers and reports see LITERATURE

For information on the International Parasitic Plant Society, past and current issues of Haustorium, etc. see: [http://www.ppws.vt.edu/IPPS/](http://www.ppws.vt.edu/IPPS/)

For past and current issues of Haustorium see also: [http://web.odu.edu/haustorium](http://web.odu.edu/haustorium)

For the ODU parasite site see: [http://www.odu.edu/webroot/instr/sci/plant.nsf/pages/parasitic_page](http://www.odu.edu/webroot/instr/sci/plant.nsf/pages/parasitic_page)

For Lytton Mussleman’s *Hydnora* site see: [http://www.odu.edu/webroot/instr/sci/plant.nsf/pages/lecturesandarticles](http://www.odu.edu/webroot/instr/sci/plant.nsf/pages/lecturesandarticles)

For Dan Nickrent’s ‘The Parasitic Plant Connection’ see: [http://www.science.siu.edu/parasitic-plants/index.html](http://www.science.siu.edu/parasitic-plants/index.html)

For The Mistletoe Center (including a comprehensive Annotated Bibliography on mistletoes) see: [http://www.rmrs.nau.edu/misteltoe/welcome.html](http://www.rmrs.nau.edu/misteltoe/welcome.html)
For information on activities and publications of the parasitic weed group at the University of Hohenheim see: http://www.uni-hohenheim.de/~www380/parasite/start.htm

For information on, and to subscribe to, PpDigest see:
http://omnisterra.com/mailman/listinfo/pp_omnisterra.com

For information on the EU COST 849 Project and reports of its meetings see:
http://cost849.ba.cnr.it/

For the Parasitic Plants Database, including ‘4000 entries giving an exhaustive nomenclatural synopsis of all parasitic plants’ the address is: http://www.omnisterra.com/bot/pp_home.cgi

For a description and other information about the Desmodium technique for Striga suppression, see:
http://www.push-pull.net

For information on EC-funded project ‘Improved Striga control in maize and sorghum (ISICMAS) see: http://www.plant.dlo.nl/projects/Striga/

LITERATURE
* indicates web-site reference only


Al-Eryan, M.A.S., Altahtawy, M.M.M., El-Sherief, H.K. and Abu-Shall, A.M.H. 2003. Phenological stages of the parasitic weeds Orobanche crenata Forsk. as a guide for collecting a parasitoid-free Phytomyza orobanchia Kalt. Egyptian Journal of Biological Pest Control 13:105-109. (In Egypt, the best time to collect P. orobanchia pupae free of the hymenopteran parasite Tetrastichus phytozymae was when spikes were still fleshy in April.)


Ángeles Castillolejo, M., Amiour, N., Dumas-Gaudot, E., Rubiales, D. and Jorrin, J.V. 2004. A proteomic approach to studying plant response to crenate broomrape (Orobanche crenata) in pea (Pisum sativum). Phytochemistry 65: 1817-1828. (Susceptible and resistant pea lines were compared by 2-D electrophoresis. Proteins showing pronounced qualitative or quantitative differences were identified, revealing parasite-induced changes in carbohydrate and nitrogen metabolism and defence proteins.)

Annapurna, D., Rathore, T.S. and Geeta Joshi 2004. Effect of container type and size on the growth and quality of seedlings of Indian sandalwood (Santalum album L.). Australian Forestry 67: 82-87. (Growth and development of S. album on Cajanus cajan was better in 600 ml ‘root trainers’ than in 1000ml plastic bags or plastic containers.)

Anon 2004. Biennial workshop of AICRIP-WC. Weed News 4(2): 1. (Noting that, in India, Striga in sugarcane, Orobanche in tomato, potato and eggplant, and Cuscuta in carrot and coffee are ‘creating major problems.’)

Bach, C.E. and Kelly, D. 2004. Effects of forest edges, fruit display size, and fruit colour on bird seed dispersal in a New Zealand mistletoe, Alepis flava. New Zealand Journal of Ecology 8: 93-103. (Birds prefer red fruit but orange fruit are also taken.)


Berg, S., Krause, K. and Krupinska, K. 2004. The rbcL genes of two Cuscuta species, C. gronovii and C. subinclusa, are transcribed by the nuclear-encoded plastid RNA polymerase (NEP). Planta 219: 541-546. (Describing the unusual situation in which a gene normally transcribed by plastid-encoded RNA polymerase is transcribed by nuclear-encoded RNA polymerase. Promoter regions of the genes appear to have been modified to be recognized by specific polymerases.)

Bisht, N.C., Burma, P.K. and Deepak Pental 2004. Development of 2,4-D-resistant transgenics in Indian oilseed mustard (Brassica juncea). Current Science 87: 367-370. (Suggesting the possibility for use of 2,4-D to control Orobanche spp.)

development of a marker that may be useful in breeding programs.)

Brand, J., Jones, P. and Donovan, O. 2004. Current growth rates and predicted yields of sandalwood (*Santalum spicatum*) grown in plantations in south-western Australia. Sandalwood Research Newsletter 19: 4-7. (Describing the successful commercial cultivation of *S. spicatum*, established by direct seeding next to 1-2 year old *Acacia acuminata* and reporting yields of timber and seed.)


Ciosek, M.T. 2002. (Station of *Orobanche coerulescens* Stephan ex Wild. in Bohukaly near Terespol (Podlaski Przelom Bugu).) (in Polish) Acta Scientiarum Polonorum – Biologia 1: 5-7. (Confirming the only know occurrence of *O. coerulescens* in Poland.)

CSIRO Entomology. 2004. Climex species report. In: CABI, 2004. CABI Crop Protection Compendium 2004 Edition (CDRom). (Sample reports on the use of the CLIMEX climate matching programme to predict potential spread of invasive species, include one on *Striga asiatica*, suggesting that large areas of Central and South America could be infested.)

Dadon, T., Nun, N.B. and Mayer, A.M. 2004. A factor from *Azospirillum brasilense* inhibits germination and radicle growth of *Orobanche aegyptiaca*. Israel Journal of Plant Sciences 52: 83-86. (A factor from *A. brasilense*, thought to be a small peptide, inhibited germination of *O. aegyptiaca* perhaps due to competition at the site of action of the germination stimulant. Similar effects were shown with certain synthetic peptides.)


Eizenberg, H., Colquhoun, J. and Mallory-Smith, C.A. 2004. The relationship between temperature and small broomrape (*Orobanche minor*) parasitism in red clover (*Trifolium pratense*). Weed Science 52: 735-741. (Providing a detailed plot of *O. minor* development against growing degree days (GDD) with the aim of optimising the timing of control measures, especially those involving herbicide applied before parasite emergence.)

Eizenberg, H., Goldwasser, Y., Golan, S., Plakhine, D. and Hershenhorn, J. 2004. Egyptian broomrape (*Orobanche aegyptiaca*) control in tomato with sulfonylurea herbicides - greenhouse studies. Weed Technology 18: 490-496. (Concluding that 3 post-emergence applications or one pre-planting plus 2 post-emergence applications of either rimsulfuron or MON 37500 could give excellent selective control of *O. aegyptiaca* in tomato. HOE 404 and SL-160 were less selective.)


Elzein, A., Kroschel, J. and Müller-Stöver, D. 2004. Optimization of storage conditions for adequate shelf-life of ‘Pesta’ formulation of *Fusarium oxysporum* ‘Foxy 2’, a potential mycoherbicide for *Striga*: effects of temperature, granule size and water activity. Biocontrol Science and Technology 14: 545-559. (Different sizes of ‘Pesta’ granules based on fresh and dried chlamydomspore-rich biomass, microconidia, or a mixture of mycelia and microconidia, were assessed for viability after
different periods under different temperatures and moisture contents. Low storage temperature was most important for good longevity.)

Emmett, T. 2004. Sandalwood growers network gains momentum. Sandalwood Research Newsletter 19: 7 (Describing the establishment and activities of a group of 60 members involved in cultivation of Santalum spicatum in Western Australia.)


roots in normal pea roots but were intensified at the junction between host root and the haustoria of Orobanche crenata.)


Jayasinghe C., Wijesundara, D.S.A., Tennakoon, K.U. and Marambe, B. 2004. Cuscuta species in the lowlands of Sri Lanka, their host range and host-parasite association. Tropical Agricultural Research. 16: 223-241. (Confirming at last that, as we believed, the common Cuscuta sp. of lowland Sri Lanka is indeed not C. chinensis but almost certainly ("similar to") C. campestris, with a wide range of hosts, the most favoured being Mikania 'cordata' (= M. micrantha') and Wedelia trilobata, but including rice, penetrated only via the mid-ribs. C. reflexa occurs in the highlands.)


Jiang Fan, Jeschke, W.D. and Hartung, W. 2004. Abscisic acid (ABA) flows from Hordeum vulgare to the hemiparasite Rhinanthus minor and the influence of infection on host and parasite abscisic acid relations. Journal of Experimental Botany 55: 2323-2329. (Describing detailed effects of N levels and host-parasite attachment on ABA levels – generally much higher in unattached R. minor than in un-parasitised barley. Even higher in attached R. minor but only slightly increased in parasitised barley. In spite of higher ABA levels, stomata remain open in attached parasite, whereas they are generally closed in unattached plants.)

Jiang Fan, Jeschke, W.D. and Hartung, W. 2004. Solute flows from Hordeum vulgare to the hemiparasite Rhinanthus minor and the influence of infection on host and parasite nutrient relations. Functional Plant Biology 31: 633-643. (R. minor attached to the host H. vulgare had 15-fold greater shoot weight but only 2-fold greater root weight than unattached plants. The host suffered 30-50% reduction in shoot growth mainly due to depleted N and P, but little reduction in roots. Many other detailed data on mineral levels in host and parasite.)

Kaya, Y., Demirci, M. and Evci, G. 2004. Sunflower (Helianthus annuus L.) breeding in Turkey for broomrape (Orobanche cernua Loeffl.) and herbicide resistance. Helia 27: 199-210. (Four lines of sunflower resistant to the F1 race of O. cernua showed varying response to new races but Pioneer hybrid P-4223 recorded high seed yields and showed resistance to broomrape in all locations in 2003.)

Kaya, Y., Evci, G., Pekcan, V. and Gucer, T. 2004. Determining new broomrape-infested areas, resistant lines and hybrids in Trakya Region of Turkey. Helia 27: 211-218. (Reporting an increase in infested areas from 3% in 1995 to 35% in 2002, and widespread development of new virulent races. Few varieties proved resistant to Orobanche cernua in more than one or two localities, but Pioneer hybrid PR-64-A95 showed resistance in all of 6 localities tested.)

Keith, A.M., Cameron, D.D. and Seel, W.E. 2004. Spatial interactions between the hemiparasitic angiosperm Rhinanthus minor and its host are species-specific. Functional Ecology 18: 435-442. (R. minor plants growing close to the vigorous host Festuca rubra was less vigorous than those further away but also caused more reduction of the host. These differences did not occur significantly with the less vigorous F. ovina.)

Kelly, D., Ladley, J.J. and Robertson, A.W. 2004. Is dispersal easier than pollination? Two tests in New Zealand Loranthaceae. New Zealand Journal of Botany: 89-103. (The mistletoes Peraxilla tetrapetala and Alepis flavida are both pollinated and dispersed by the bellbird (Anthornis melanura). Reproductive performance of only P. tetrapetala was reduced by limited pollination in some years.)

protein sequence and carbohydrate specificity of three lectin genes, MLI, MLII, and MLIII.)

Kutyna, I. and Wlodarczyk, E. 2004. (The occurrence of the mistletoe (Viscum album L.) in the selected areas of the city of Szczecin and in the areas adjacent to the Chemical Plant "Police" and the Power Station "Dolna Odra". (in Polish) Folia Universitatis Agriculturae Stetinensis, Agricultura 93: 197-206. (The main hosts for V. album were Populus nigra, Betula pendula and Robinia pseudoacacia.)

Kutyna, I. and Wlodarczyk, E. 2004. (The heavy metals, sulphur and fluoride content in mistletoe (Viscum album L.) within the area of Szczecin Region.) (in Polish) Folia Universitatis Agriculturae Stetinensis, Agricultura 93: 207-217. (Showing high levels of sulphur and fluoride near chemical plants, of fluoride and lead along roads, and of cobalt and copper in rural areas due to fertilizer and pesticide application.)

Lin LieChwen, Chiou WenFei and Chou ChengJen 2004. Phenylpropanoid glycosides from Orobanche caerulescens. Planta Medica 70: 53. (Phenylpropanoid glycosides from O. caerulescens in Taiwan included five known and two new compounds. All showed higher antioxidant activity than resveratrol from grape.)


Moss, S.R., Cussans, J.W., Perryman, S.A.M. and Hewitt, M.V. 2004. The Broadbalk long-term experiment at Rothamsted: what has it told us about weeds. Weed Science 52: 864-873. (Odontites vernus among the top 12 species on permanent wheat plots receiving no herbicide and no fertilizer over the past 150 years, but being much less common on plots receiving 96 kg/ha N fertilizer annually.)


Nadal, S., Moreno, M.T. and Cubero, J.I. 2004. Registration of ‘Retaca’ faba bean. Crop Science 44: 1865. (A new faba bean variety developed in Spain, susceptible to Orobanche crenata but tolerating relatively high doses of glyphosate.)
Nadler-Hassar, T., Goldshmidt, A., Rubin, B. and Wolf, S. 2004. Glyphosate inhibits the translocation of green fluorescent protein and sucrose from a transgenic tobacco host to *Cuscuta campestris* Yunk. Planta 219: 790-796. (Glyphosate applied to host plants caused a decrease in sucrose and green fluorescent protein translocation to *Cuscuta* within three days.)

*Neel, M.C. and Cummings, M.P. 2004. Section-level relationships of North American Agalinis (Orobanchaceae) based on DNA sequence analysis of three chloroplast gene regions. BMC Evolutionary Biology 4: http://www.biomedcentral.com/1471-2148/4/15 (Provides molecular systematic data to support the monophyly of Agalinis. Also reveals a single evolutionary reduction in chromosome number, from n = 14 to 13.)

Olakojo, S.A. 2004. Evaluation of some maize inbred lines for tolerance to *Striga lutea* (Lour) in Southern Guinea savanna ecology. Journal of Food, Agriculture & Environment 2:256-259. (Among 8 inbred lines tested in northern Nigeria, inbred lines 0107-17 and 0108-20 combined genes for both *Striga* tolerance and higher grain yield.)

Olakojo, S.A., Ogubode, B.A. Makinde, J.O. and Ogundiya, M.O. 2004. Performance of newly developed *Striga lutea* tolerant maize genotypes under artificial *Striga* infestation. Journal of Food, Agriculture & Environment 2: 260-264. (Maize lines Advance NCRE-STR, 9022-13 and ACr97STR syn Y showed resistance to *S. asiatica* and gave higher yields compared with the susceptible hybrid 8338-1 and the resistant 9022-13.)


Pérez-de-Luque, A., Sillero, J.C., Moral, A., Cubero, J.I. and Rubiales, D. 2004. Effect of sowing date and host resistance on the establishment and development of *Orobanche crenata* in faba bean and common vetch. Weed Research 44: 282-288. (Confirming reduced numbers of *O. crenata* emerged on partially resistant varieties of faba bean (Baraca) and vetch (A01) with early sowing, comparable with delayed sowing of susceptible varieties; but curiously lacking crop yield data.)


Plaza, L., Fernández, I., Juan, C., Pastor, J. and Pujadas, A. 2004. Micromorphological studies on seeds of *Orobanche* species from the Iberian Peninsula and the Balearic Islands, and their systematic significance. Annals of Botany 94: 167-178. (Presenting a key to 33 *Orobanche* spp. based mainly on ornamentation of the seed coat, detail of the periclinial walls allowing initial separation of 4 groups, further separation based on e.g. thickness of anticlinal walls, presence/absence of a trough, relative depth, etc.)

with endophytic systems of *Arceuthobium* spp.)

Shaw, D.C., Watson, D.M. and Mathiasen, R.L. 2004. Comparison of dwarf mistletoes (*Arceuthobium* spp., Visaceae) in the western United States with mistletoes (*Amyema* spp., Loranthaceae) in Australia - ecological analogs and reciprocal models for ecosystem management. Australian Journal of Botany 52: 481-498. (Reviewing and comparing the ecologies of the *Arceuthobium* spp. of N. America and the *Amyema* spp. of Australia and finding parallels in their ecological role in forests and woodlands, and their influence on stand- and forest-scale dynamics; e.g. both provide nesting resources for birds and mammals, and nutritional resources for a wider range of species and both interact with fire. Both are considered as pests but have the potential to serve as sensitive ecological indicators for their respective ecosystems.)

Slavov, S.A., van Onckelen, H., Batchvarova, R., Atanassov, A. and Prinsen, E. 2004. IAA production during germination of *Orobanchaceae* spp. seeds. Journal of Plant Physiology 161: 847-853. (Germination of *O. ramosa* and *O. cumana* seeds was accompanied by release of IAA within 24 hours, before 'germ tube' elongation. Free IAA within the seeds remained unchanged whether seeds germinated or not. ABA levels were not affected by germination.)


Peninsula.) (in Spanish) Anales del Jardín Botánico de Madrid 60: 387-393. (*O. flava* is reported on *Aconitum vulpinaria*. *O. flava* var. *flava* occurs in the Pyrenees and var. *albicans* in the Cantabrian Mountains.)


Puustinen, S., Koskela, T. and Mutikainen, P. 2004. Relatedness affects competitive performance of a parasitic plant (*Cuscuta europaea*) in multiple infections. Journal of Evolutionary Biology 17: 897-903. (When pairs of *C. europaea* plants infected the same *Urtica dioica*, relative size asymmetry between the competing parasites was significantly higher in the non-related infections compared to infections with siblings.)

Rank, C., Rasmussen, L.S., Jensen, S.R., Pierce, S., Press, M.C. and Scholes, J.D. 2004. Cytotoxic constituents of *Alectra* and *Striga* species. Weed Research 44: 265-270. (Identifying a range of iridoid glucosides and two glycosides in *Striga* and *Alectra* species with conceivable significance in the damaging effects of these parasites, and in variations in host tolerance.)


Tavoljanskiy, N.P., Tikhomirov, V.T., Chiryaev, P.V. and Yakutkin, V.I. 2004. Results of immunological estimation of the original and breeding material of sunflower from VIS. Helia 40: 219-225. (A wide range of material screened for resistance to fungal diseases and Orobanche cernua. ‘Almost all lines among the CMS (cytoplasmic male sterility) sources of the no-RET type remained free from broomrape.’)


Wilson, J.P., Hess, D.E., Hanna, W.W., Kumar, K.A. and Gupta, S.C. 2004. Pennisetum glaucum subsp. monodii accessions with Striga resistance in West Africa. Crop Protection 23: 865-870. (Out of 274 lines tested, 11 lines showed some consistent resistance to S. hermonthica and four (PS 202, PS 637, PS 639, and PS 727) were considered potentially useful. Among these PS202 also showed good downy mildew resistance.)

Yonli, D., Traoré, H., Hess, D.E., Abbasher, A.A. and Boussim, I.J. 2004. Effect of growth medium and method of application of Fusarium oxysporum on infestation of sorghum by Striga hermonthica in Burkina Faso. Biocontrol Science and Technology 14: 417-421. (Application of F. oxysporum isolate 4-3-B reduced numbers of S. hermonthica by 33 and 27% is successive years, and increased sorghum yield by up to 38%).