Nomination of Colin Bower for the R.D. Fitzgerald Trophy

By the Australasian Native Orchid Society (Illawarra) Inc.

Dr. Colin (Col) Charles Bower was born in Fairfield, in the western suburbs of Sydney on 29th August 1948 when it was still semi-rural, the eldest of three children, the son of Charles and Joan Bower.

The young Colin showed enough aptitude at primary school in Fairfield to be admitted to an "opportunity class" at Berala Public School. There was an emphasis at Berala on biology and Miss Wilkes, a knowledgeable and inspirational teacher, sparked Colin's interest in natural history, opening up a whole new world through bush excursions.

Charles Bower had a strong belief in the value of sport in child development and harboured ambitions of sporting glory for his offspring. Consequently Colin, his sister Marilyn and brother Stephen trained at swimming twice a day, five days a week and raced in swimming carnivals on the weekends. Marilyn came closest to immortalising the Bower name is swimming, just missing out more than once on selection in the national team. Colin couldn't compete with the bigger and stronger lads but nevertheless benefitted from the exercise and physical development. Swimming ultimately gave way to more academic pursuits in his final year at Fairfield Boys High School.

Colin entered Sydney University in 1966 and emerged in 1975 with a PhD in Zoology. During this time he developed a strong interest in bird watching, spending a lot of time in the bush with other like-minded students. He also remembers seeing his first native orchid, the large Flying Duck orchid, *Caleana major,* on a first year biology excursion. Also at university, Colin became involved with the environment group, Ecology Action, which played a major role in opposing the Eden woodchip scheme. He conducted independent research on the effects of forest clear-felling on birds and subsequently gave evidence to a Senate Inquiry.

Dr. Bower joined the NSW Department of Agriculture as a research entomologist in late 1975 at the Bathurst Agricultural Research Station, before being transferred to the Orange Agricultural Institute in 1980. He worked for 17 years on the development of integrated pest management in New South Wales deciduous fruit orchards with the primary aim of reducing dependence on synthetic chemicals for pest control, with some success. In 1992 he was promoted to the role of Program Leader of Horticultural Product Systems and later of Extensive Horticulture (1992-2002) in NSW Agriculture. In this role he led the adoption of quality management training for departmental horticultural staff and assistance to NSW horticultural industries to adopt quality assurance systems.

In 2003, Dr. Bower left the public service to become an environmental consultant and he now works full-time undertaking flora surveys for environmental assessment of development projects. He is a member of the Ecological Consultants Association of NSW, an Honorary Associate of the Australian National Herbarium and a member of the Australian Entomological Society.

After moving to Bathurst, Dr. Bower joined the Central West Bushwalking Club and Bathurst Field Naturalist and Conservation Society, participated in the first Australian Bird Atlas program and helped found the Central West Branch of the National Parks Association of NSW (NPA), serving as the foundation Secretary and later President. Conservation activities continued with articles in the National Parks Journal and participation in the NPA State Council. In Orange, he joined the Orange Camera Club, developed his photographic skills and for several years exhibited in national photographic competitions.

It was on an NPA camping trip to Newnes in the late 1970's that Dr. Bower's interest in native orchids began in earnest after a colleague pointed out on a walk that he was about to step on some orchid flowers. He went home and looked them up in Cady and Rotherham's wonderful little book, *Australian Native Orchids in Colour,* which he happened to have, but hadn't really studied until then. He was then hooked! His whole focus from that point on through the 1980's switched to finding orchids and photographing them. This led to a long association with many

orchidologists, both professional and amateur. Like a few others, Dr. Bower developed a large collection of images, gathered all the literature and began to write a book. This enterprise ended with a house fire in 1990 which destroyed all the colour slides.

Not wanting to repeat all that work, Dr. Bower decided it was time to head in a new direction. Fortunately, in 1988 he went to a talk by Rod Peakall who had just finished his PhD on orchid pollination and population genetics. This began a long friendship and inspired Dr. Bower to start investigating, in his spare time, the pollination biology of Australian native terrestrial orchids and especially the sexually deceptive members of the subtribes Drakaeinae and Caladeniinae in eastern Australia. This work has now continued for nearly 20 years and has been extremely fruitful both personally and scientifically. It has allowed him to combine his entomological skills with his interest in orchids. It has resulted in the development of novel field bioassay techniques, the application of experimental scientific methods to the study of associations between Australian orchids and their pollinators, the discovery of new cryptic orchid species and new species of wasps. He has reported his discoveries in eight scientific papers published in refereed international scientific journals and seven articles published in *The Orchadian.* These publications have earned Dr. Bower an international scientific reputation as an innovative and productive pollination biologist and an expert of the pollination biology of Australian orchids. This reputation led the European and North American editors of the encyclopaedic series *Genera Orchidacerearum* to invite Dr. Bower to provide the pollination accounts for all genera of the tribe Diurideae published in volume 2 of that series. Perhaps most importantly, his research on orchid pollination has been seminal in providing crucial background knowledge underpinning a series of ground-breaking studies by Professors Rod Peakall, Florian Schiestl and their colleagues, on the biochemistry of pheromones produced by sexually deceptive orchids and their pollinators.

Dr. Bower is highly regarded by those who know him. My initial contact with Dr. Bower was shortly following the formation of the *Prasophyllum affine* Recovery team in 2001, when an expert Entomologist was required to conduct an in-depth study into the pollination dynamics of *P. affine* and Dr. Bower was the person suggested by the scientific authority on the team, Mr. David L. Jones. Expressions of interest were requested from various qualified persons but Dr. Bower was chosen due to his knowledge and interest in native orchids and their pollinators. The study required three continuous weeks in the field across three sites and resulted in a very detailed 65 page document (Feb 2002), which is the most comprehensive work on the pollinators of *P. affine.* Two subsequent papers were also completed into specific areas of pollinator requirements. These related to *Distribution and Movements* (May 2004) and *Nectar Resources* (April 2005). All three reports contributed greatly to the eventual decision to excise 53 hectares of *P. affine* and pollinator habitat from the planned Regional Shopping Centre at Vincentia, which ultimately ensure the protection of 300 individuals of *P. affine*, a population of *Cryptostylis hunteriana* and 25% of the known population of the rare *Calochilus pulchellus.*

His knowledge of pollination of native orchids is unsurpassed and Dr. Bower is highly regarded by his peers. A perusal of the papers he written (reference list attached) is testament to his overall plant knowledge and his conservation ethic. Dr. Lachlan Copeland has high praise for the conscientiousness and thoroughness of the work of Dr. Bower and his collaboration with others well qualified in orchidaceous matters, such as Dr. Mark Clements and Jeff Jeanes, indicates he has the ability and willingness to work with a range of people for the long-term benefit of those concerned with orchid conservation and pollination.

Letters of support from a number of eminent Australian and international biologists are attached to this nomination. With Colin Bower's excellence in Australian Orchids, ANOS Illawarra wish to nominate him for the R. D. Fitzgerald trophy.

Alan W Stephenson
President ANOS Illawarra
National Conservation Officer
Australasian Native Orchid Society

Supporting Documentation for the Nomination of Colin Bower for the R.D. Fitzgerald Trophy

Committee R.D. Fitzgerald Trophy May 21, 2010
Australian Native Orchid Society

Dear Colleagues:

Please accept this letter as a formal and enthusiastic endorsement of Colin Bower for the R.D. Fitzgerald Trophy in 2010. To be honest, I did not know of the existence of this trophy until informed by Dr. Peter Weston a few weeks ago. In my professional opinion, Colin Bower makes a logical and happy match for this award for two outstanding reasons.

First, let's remember that Fitzgerald carried out seminal research and field observations on self-pollination in the native orchids of Australia. He also commented on the low conversion rate of flowers into fruits in at least one *Dendrobium* sp. Dr. Bower's work from 1992 until the present day is not only in concert with Fitzgerald's pioneer studies it expands and develops the role of insects as agents of cross-pollination in your terrestrial species. Bower has made considerable progress in less than 20 years of fieldwork. Fortunately, the Missouri Botanical Garden subscribes to *The Orchadian* and the *Australian Journal of Botany*. I own a copy of *Genera Orchidacearum* Volume 2 so it has been easy to follow Dr. Bower's progress whether he publishes his research alone or with Drs. Brown, Peakall. Mant and Weston. While I acknowledge the sheer importance of Dr. Bower's long-term work on the pollination of orchids by male wasps please note thaI I am most interested in his past studies on hybridization in *Diuris* and *Chiloglottis*. This topic does not get all the attention it deserves in Australian Orchidology despite the fact what we are going through a much-extended period in which large species are being chopped up into little ones. First generation (F1) hybrids and species with past histories of recombination must be identified and tracked if Australian treatments of orchid diversity are to remain relevant.

Second, let's also remember that Fitzgerald was not trained as a botanist. Dr. Bower's highest degree is in Zoology. One of the most exciting features of life in Australia is that people often enjoy double careers and it's their second career that makes the most positive impact on society. I've discussed this quality of careers with North American colleagues and we agree that what happens in Australia has no modern parallel in America or Canada. After all, we've forgotten what Fitzgerald did to better Australian railroads but his completed orchid publications live on. Likewise, the late Sophie Ducker is remembered for her contributions to studies on algae of the southern hemisphere and her books on the history of Botany. We don't have much to say about her job running

student laboratories at the U. of Melbourne (although she did it for over a quarter of a century). The late, William W. Delaney is acknowledged for his work as a wildlife painter/illustrator compared to his professional employment as an architect. A dear friend of mine is about to receive an Australian Medal of Honor in June 2010 and I can assure you that it wasn't for her work at the ABC archives. I could go on and on but we really should consider ourselves lucky that Dr. Bower is making such accomplishments in our field while he is relatively young and fit instead of waiting for time allotted in retirement. Consequently, I argue there are few applicants as appropriate for this trophy as Colin Bower.

Sincerely,

Peter Bernhardt
Professor Biology
Research Assoc. The Missouri Botanical Garden, Royal Botanic Gardens (Sydney)

Professor Stephen D. Hopper FLS, Director

Kew

PLANTS PEOPLE
POSSIBILITIES

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Mr Alan Stephenson
President,
Australasian Native Orchid Society
Illawarra Group

21 May 2010

Dear Mr Stephenson

I have no hesitation in supporting a nomination of Dr Colin Bower for the R D Fitzgerald Trophy. Colin's work on orchid pollination, undertaken primarily in his own time over more than two decades, is recognised nationally and internationally as meticulous, and ground-breaking. He has been consistently rigorous in testing hypotheses about pollinator specificity in Australian orchids using bait flowers in the field. The insights gained and papers published are world class. The findings have helped significantly in unravelling the taxonomy and phylogeny of species complexes of orchids and of wasps involved especially in pollination through sexual deception. There are also major learnings relevant to conservation strategies.

Best wishes.

Yours sincerely

Steve Hopper

Professor Stephen D Hopper, FLS
Director

Professor Rod Peakall
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THE AUSTRALIAN NATIONAL UNIVERSITY

Dr Peter Weston
Senior Principal Research Scientist
National Herbarium of New South Wales
Botanic Gardens Trust, Mrs Macquaries Road
Sydney NSW 2000 Australia

Re-Nomination of Dr Colin Bower for the R.D. Fitzgerald Trophy

Dear Peter

I am delighted to write this letter of support for the nomination of Dr Colin Bower for the R.D. Fitzgerald Trophy. I understand that this award is presented 'from time to time by the Ira Butler Trophy Committee for major contributions to the advancement, conservation or propagation of Australian orchid species'.

Col is an exceptional entomologist and botanist who has combined these skills with his love and fascination of Australian terrestrial orchids. His superb photography further enables him to freely share his enthusiasm for orchids with the public in popular articles and presentations.

Over many years, Col has devoted hundreds of hours of his spare time each season to the study of the pollination of Australia orchids, with a special emphasis on the sexually deceptive orchids that exhibit extraordinary diversity in Australia. During this work he has documented with extreme care the relationships between orchids and their specific pollinators. Consequently, he has undoubtedly uncovered the pollinator of more orchids than anyone else in the history of Australia orchidology. Along the way he has discovered many new species of pollinators as well as some new species of orchids.

Col's research has gone well beyond the mere discovery of the species involved in the partnership between orchid and pollinators. He has also experimentally evaluated the degree of pollinator specificity and explored the likely evolutionary processes involved in orchid speciation. The high calibre nature of this research is evident by his multiple scientific papers in the *Australian Journal of Botany*. He is also a co-author on additional papers published in high profile international scientific journals.

From a more personal perspective, I am indebted to Col for his ground breaking field-based studies that have underpinned my own multidisciplinary research program on the evolution and conservation of Australian terrestrial orchids. My international research program in this field would certainly not have been possible without the background knowledge discovered by Col. It is also remains a great privilege to have Col as an ongoing collaborator and co-author. I look forward to many more years of interaction in this capacity.

In conclusion, I support in the strongest possible way this nomination of Col for the R.D. Fitzgerald Trophy.

Yours sincerely,

Rod Peakall (30-4-2010)

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Dr. Florian Schiestl
Professor

Mr Alan Stephenson, President,
Australasian Native Orchid Society,
Illawarra Group

Zürich, 28. 4. 2010

Dear Mr Stepenson,

I strongly support the nomination of Dr Colin Bower for the R.D. Fitzgerald Trophy. Dr Bowers' contributions to our understanding of the pollination systems of Australian native orchids, and their consequences for conservation clearly classify him for this prestigious prize. Dr Bower has, for many years and besides his job as an agricultural researcher, investigated the pollination system of Australian orchids. This research was difficult and time intensive, it required a lot of travel to remote areas. His research was clearly a pioneer endeavour, since very little was known about pollinator identity and specificity in most Australian orchids before he started his work. Through many years of research, and several publications with strong impact, he has established that orchids of many genera, especially the species with the peculiar pollination mechanism of "sexual deception", are highly specialised in their pollinator attraction. He has also established, besides the finding of high specificity, the presence of so-called "minor responders", basically a pool of related insects with the potential of being recruited as pollinators by the plant, either through evolutionary diversification, or adaptation to new pollinators in the face of environmental change. Through his insights in the pollination biology, and a keen observers' eye, he has foreseen and suggested many taxonomic revisions, that later proved correct through detailed molecular and chemical analyses. Besides of high interest to basic research, Dr Bowers' findings also have strong implications for orchid conservation. First of all, they tell us that long term protection of the orchids can only work in connection with the protection of the pollinator insects, since many orchids are dependent on sometimes a single pollinator species for sexual reproduction. Secondly, we learn that despite this strong dependence, there is also an adaptive flexibility through the so-called minor responders, which the plant may adapt to in case their major pollinator disappears. Besides their direct impact, Dr Bowers' findings have also stimulated and enabled more research on the chemical ecology, evolutionary dynamics, and systematics of many groups of Australian native orchids. His type of research, being very time intensive, is simply not doable for most professional researchers with other academic commitments. Therefore, it is ex-

tremely valuable, though rare, to have such committed and skilled people like Dr Bower engaged in the difficult endeavour of orchid pollination research. There is no doubt that his finding will continue to inspire new research and deepen our knowledge on the evolution and ecology of these fascinating plants, and thus allowing us to implement effective protection measures. I sincerely hope that the R.D. Fitzgerald Trophy can be awarded to Dr Colin Bower.

With kind regards,

Prof. Florian Schiestl

CURRICULUM VITAE

Name Colin Charles Bower

Age 61 years **Date of birth** 29 August 1948

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Current employment Consultant Botanist / Entomologist
FloraSearch, PO Box 300, Orange, NSW 2800

Qualifications B.Sc. (Hons) (Zoology), University of Sydney (1969)
Ph.D. (Zoology), University of Sydney (1975)

Professional history

1975-1992	Employed as a research entomologist by NSW Agriculture at:
1975	Biological and Chemical Research Institute, Rydalmere
1975-1980	Agricultural Research Station, Bathurst
1980-1992	Agricultural Research and Veterinary Centre, Orange
1992- Apr. 2003	Program Leader, Horticulture, NSW Agriculture, Head Office, Orange
Apr. 2003 - present	Full time consultant (economic entomology, flora and fauna surveys, pollination biology, scientific reviews)

Research history:

Undergraduate

1969 Honours thesis on the anatomy and physiology of colour patterns in the mouth breeding cichlid, *Tilapia mossambica.*

Postgraduate

1970-1974 Ph.D. thesis on the behaviour and ecology of the larvae of the Queensland fruitfly, *Dacus tryoni* Froggatt.

Current society memberships:

- Ecological Consultants Association of New South Wales
- Associate of the Australian National Herbarium Canberra
- Australian Entomological Society
- Entomological Society of New South Wales
- Friends of the Royal Botanic Gardens Sydney
- Australasian Native Orchid Society
- Orange Field Naturalist and Conservation Society

Professional Committee:

1998-present Member of Research Committee of the Australian Orchid Foundation.

Licences:

- Scientific Licence No. S11329, NSW National Parks and Wildlife Service

Insurances:

- Public Liability - $20m
- Professional Indemnity - $10m

Economic entomology research – Projects led

1975-1978	Ecology and control of apple root weevil, *Perperus* sp.
1975-1977	Investigation of the insect growth regulator Dimilin for control of codling moth, *Cydia pomonella,* and its effects on the natural enemies of pest mites
1977-1992	Integrated control of twospotted mite, *Tetranychus urticae,* and European red mite, *Panonychus ulmi*, by the introduced predatory mites, *Typhlodromus occidentalis* and *T.pyri*. (This work had major benefits for the NSW apple industry and has involved many separate investigations.)
1982-1984	Phenology and control of San Jose Scale, *Quadraspidiotus perniciosus*.
1985-1992	Damage relationships, biology and economics of apple dimpling bug, *Campylomma liebknechti* on apples.
1987-1992	Control of European earwig, *Forficula auricularia*, in stone fruit trees at Young.

Flora surveys and entomological studies – major contract studies as a consultant entomologist / botanist:

1986	Junction Reefs Gold Mine proposal. Flora and fauna survey for Environmental Impact Statement (EIS). R.W. Corkery and Co. Pty. Ltd.
1987	Browns Creek Gold Mine proposal. Flora and fauna survey for EIS. R.W. Corkery and Co. Pty. Ltd.
1990	Prepared Statements of Significance for ten nature conservation areas. Australian Heritage Commission.
1995	Cadia Gold Mine proposal. Flora surveys for EIS with R. W. Medd and Orange Field Naturalist and Conservation Society. AGC Woodward-Clyde Pty. Limited
1996	Remnant vegetation survey and regeneration plan for the Lidster-Cargo-Cudal area west of Orange, NSW with J. Kenna and L. Kingham. Cudal and Lidster Landcare Groups.
1997	Flora survey of the Ophir Reserve, Orange with R.W. Medd and J.I. Kenna for Cabonne Shire Council. R.W. Corkery and Co. Pty. Limited.
1997	Member of expert panel to assess the potential long term environmental impact of a proposed gold mine on the shore of Lake Cowal in Central Western NSW. Resource Strategies Pty. Ltd.
1998	Lake Cowal Gold Mine EIS. Threatened species assessment (Eight Part Tests of Significance). Resource Strategies Pty. Ltd.
1998	Lake Cowal Gold Mine EIS. Targeted searches for the threatened plant species, *Lepidium hyssopifolium* and *Pilularia novae-hollandiae*. Resource Strategies Pty. Ltd.
1998	Survey of bushland remnants on the NSW Central Tablelands for populations of a rare undescribed greenhood orchid related to *Pterostylis longifolia*. Cadia Mines Pty. Limited
1998	Cadia-Ridgeway Gold Mine proposal. Flora survey, vegetation community mapping and targeted searches for threatened species with R.W. Medd and J.I. Kenna. Resource Strategies Pty. Ltd.
2000	Syerston Nickel-Cobalt Mine proposal, Fifield, NSW. Flora survey and targeted searches for threatened species on mine site and service corridors for EIS, with J.I. Kenna. Resource Strategies Pty. Ltd.

2001	Study of the pollination of the endangered Jervis Bay Leek Orchid, *Prasophyllum affine*, in order to develop a conservation strategy for this species compatible with a major shopping centre and residential development at Vincentia. NSW National Parks and Wildlife Service.
2001/02	Ginkgo Mineral Sand Mine proposal, Pooncarie, NSW. Flora survey of service corridors and targeted searches for threatened species for EIS. Resource Strategies Pty. Ltd.
2002	Cadia Gold Mine, Cadia, NSW. Establishment of permanent flora monitoring sites in the Wire Gully vegetation enhancement area. Resource Strategies Pty. Ltd.
2002	Ridgeway Gold Mine, Cadia, NSW. Flora survey, vegetation community mapping and targeted searches for threatened plant species on the 'Southern Remnant'. Resource Strategies Pty. Ltd.
2002	Wambo Coal Mine Expansion Proposal, Warkworth, NSW. Flora survey, vegetation community mapping, targeted searches for threatened species for EIS, assessment of disturbance. Resource Strategies Pty. Ltd.
2003	Timbarra Gold Mine, Tenterfield, NSW. Assessment of ground cover of individual plant species by vegetation layer and assessment of plant health on long term monitoring plots. Resource Strategies Pty. Ltd.
Spring 2003	Continue study of the pollination of the endangered Jervis Bay Leek Orchid, *Prasophyllum affine*. Environmental Resources Management Australia.
2003/2004	Country Energy, Temora to Lake Cowal, NSW. Targeted searches for threatened plant species on the Electricity Transmission Line route. Resource Strategies Pty. Ltd.
2003/2004	Hydro Aluminium, Kurri Kurri, NSW. Flora survey, vegetation community mapping, plant species listing, targeted searches for threatened plant species, assessment of disturbance, recommendations for conservation and enhancement of the aluminium smelter's native vegetation buffer zone. Resource Strategies Pty. Ltd.
2004	Cadia Gold Mine, Cadia, NSW. Flora survey of proposed extension area for waste rock dump. Resource Strategies Pty. Ltd.
2004	Proposed Cadia East Gold Mine, Cadia, NSW. Flora survey, vegetation community mapping, plant species listing, targeted searches for threatened plant species. Resource Strategies Pty. Ltd.
2004	Warkworth Coal Mine, Singleton, NSW. Map all occurrences of the Warkworth Sands Endangered Ecological Community on land owned by the Warkworth and Wambo Coal Mines. Resource Strategies Pty. Ltd.
Spring 2004	Continue study of the pollination of the endangered Jervis Bay Leek Orchid. Environmental Resources Management Australia.
2004	Proposed Orange City Council residential subdivision, Ploughmans Creek, Orange, NSW. Flora survey, flora species listing, vegetation mapping, assessment of vegetation condition. Geolyse Pty. Ltd.
2004	Jenolan Caves, NSW. Weed survey of resort environs with recommendations for improved weed management. Jenolan Caves Resort Pty. Ltd.
2004/2005	Review Biosecurity Australia's 2004 draft Import Risk Assessment for the proposed importation of apples from New Zealand. Apple and Pear Australia Limited.
2004/2005	Proposed Wilpinjong Coal Mine, Wollar, NSW. Flora survey, vegetation community mapping, plant species listing, targeted searches for threatened plant species. Resource Strategies Pty. Ltd.

2005	Black Rock Ridge, Cargo, NSW. Flora survey, vegetation community mapping, plant species listing, targeted searches for threatened plant species. Assess value of area as an offset for proposed Cadia East Gold Mine. Resource Strategies Pty. Ltd.
2005	South Mullion Range, Orange, NSW. Flora survey, vegetation community mapping, plant species listing, targeted searches for threatened plant species. Community Biodiversity Survey, National Parks Association of NSW.
2005	Crown Lands, Ulan, NSW. Flora survey, vegetation community mapping, plant species listing, targeted searches for threatened plant species. Community Biodiversity Survey, National Parks Association of NSW.
2005	Hydro Aluminium Smelter, Kurri Kurri. Pre-control burn baseline vegetation survey. Resource Strategies Pty. Ltd.
2005	Duralie Coal Mine expansion, Stroud, NSW. Targeted searches for threatened species and communities; threatened community mapping. Resource Strategies Pty. Ltd.
2005	Orchid pollination workshop, Castlemaine, Vic. Prepare and run two hour workshop on pollination of threatened orchid species. Department of Sustainability and Environment.
2006	Review the entomological aspects of the 2005 draft of Biosecurity Australia's Import Risk Assessment for the Importation of New Zealand apples into Australia. Apple and Pear Australia Limited.
2006	Ulan to Wilpinjong Electricity Transmission Line. Targeted searches for threatened flora species, populations and communities. Wilpinjong Coal Pty. Ltd.
2006	Contribute to the development of the Property Management Plan for the Hydro Aluminium Smelter, Kurri Kurri, particularly the flora monitoring, fire management, weed control and rehabilitation aspects. Resource Strategies Pty. Ltd. and Hydro Aluminium Kurri Kurri Pty. Ltd.
2006	Snapper Mineral Sands Project, Pooncarie, NSW. Baseline flora survey, threatened flora searches, vegetation community mapping. Bemax Resources N/L.
2006	Warkworth Coal Mine. Map former occurrences of the Warkworth Sands Woodland Endangered Ecological Community in the Warkworth area as potential offset and rehabilitation sites for the Warkworth Coal Mine expansion. Coal and Allied Pty. Ltd.
2006	Community Biodiversity Survey. Flora Team Leader for survey of remnant woodlands in the Parkes area, NSW. National Parks Association of NSW.
2006	Molong Electricity Substation. Preliminary flora survey: community identification, plant species list, threatened species search. TransGrid.
2006	Collection and identification of pollinators of eleven threatened orchid (*Caladenia*) species in South West Victoria. Determination of pollinator distribution and abundance. Department of Sustainability and the Environment, Victoria.
2006	Buffer zone of the Hydro Aluminium Smelter, Kurri Kurri. Monitor effects of planned autumn 2006 hazard reduction burn on five permanent quadrat sites and 14 species of tagged plants in spring 2006. Hydro Aluminium Kurri Kurri Pty Ltd.
2006	Buffer zone of the Hydro Aluminium Smelter, Kurri Kurri. Establish and perform baseline measurements on 28 long term flora quadrats as part of the approved Property Management Plan. Hydro Aluminium Kurri Kurri Pty Ltd.
2006	The Salt Lakes, SW of Pooncarie, NSW. Map vegetation communities and list plant species present along seven transects across The Salt Lakes on Kelleen Station. Bemax Resources N/L.

2006	Orchid Reintroduction Workshop, Melbourne, Vic. Present results of pollinator research on eleven threatened *Caladenia* species in South West Victoria with implications for potential reintroductions. Department of Sustainability and the Environment, Vic.
2007	Review Australian Pome Fruit Improvement Program (APFIP) in collaboration with another consultant. APFIP and Horticulture Australia Limited.
2007	Flora survey of proposed rural subdivision at Little Hartley, NSW.
2007	Survey habitat value of proposed offset for the Snapper Mineral Sands Mine using the NSW Department of Environment and Climate Change 'Biometric' tool. Bemax Resources N/L
2007	Second measurements of tagged plants and permanent quadrats in a long term monitoring study of the effects of a control burn on threatened flora and communities in the buffer zone of an aluminium smelter in the lower Hunter Valley, NSW. Hydro Aluminium Kurri Kurri.
2007	Inspections for the presence of significant flora on proposed water pipeline routes from the Icely Road Quarry and Gosling Creek Reservoir, Orange, to the Orange to Cadiangullong Dam water pipeline. Cadia Valley Operations Pty. Ltd.
2007	Flora and fauna survey, threatened species searches and impact assessment of proposed Dentistry School, Charles Sturt University, Orange Campus. Charles Sturt University.
2007	Mapping of vegetation communities on farming lands owned by Cadia Valley Operations, Cadia. Cadia Valley Operations Pty. Ltd.
2007	Survey and mapping of vegetation communities and threatened species searches on the Cadia to Blayney concentrate slurry pipeline. Cadia Valley Operations Pty. Ltd.
2007	Survey and mapping of vegetation communities and impact assessment on route of proposed borefield pipeline on Escort Way. Parkes Shire Council.
2007	Flora survey, vegetation community mapping, threatened species searches and impact assessment for proposed vegetation clearance below 33Kv power line through Turon National Park, Capertee. TransGrid.
2007	Flora and fauna survey and assessment for proposed Orange Private Hospital, Forest Road, Orange. Forest Road Syndicate Pty. Ltd.
2007	Second season of pollinator collection and identification project on threatened orchid (*Caladenia*) species in Victoria. Determination of pollinator distribution and abundance. Department of Sustainability and the Environment, Victoria.
2007	Expert review of survey methodology and impact assessment of a threatened orchid species in a disputed Environmental Assessment for a housing subdivision at Dolphin Point on the NSW South Coast. NSW Department of Planning.
2007	Tagging and baseline measurement of 100 plants of each of three threatened species for long term monitoring under the Property Management Plan for the buffer zone of an aluminium smelter in the lower Hunter Valley. Hydro Aluminium Kurri Kurri.
2008	Baseline flora survey of section of Wentworth Swamp on 'Wangara' property, Kurri Kurri, NSW. Hydro Aluminium Kurri Kurri.
2008	Flora survey, targeted searches for threatened flora and vegetation mapping on the Woronora Plateau and Cumberland Plain for Illawarra Coal Bulli Seam Operations Environmental Assessment. A large ongoing project. BHP Billiton.
2008	Assessment of swamp condition and plant health in 27 Woronora Plateau upland swamps, including swamps over previous longwall mined areas and unmined areas. Helensburgh Coal.

2008	Flora survey and assessment for expansion of the E42 pit at the Lake Cowal Gold Mine. Barrick Australia Limited.
2008	Flora survey of powerline easement, Premer, NSW. Country Energy.
2008	Desktop review of flora and fauna issues for State Significant Site development on the Orange Agricultural Research, Forest Road, Orange. NSW Department of Primary Industries.
2008	Pre-disturbance inspection for threatened flora species of six proposed surface drill sites for groundwater monitoring bores with recommendations for relocation to avoid occurrences of the Prickly Bush-pea. Helensburgh Coal.
2008	Flora survey of the 'Southern Remnant' bushland area, Lake Cowal Gold Mine. Barrick Australia Limited.
2008	Targeted searches for threatened flora species and communities on proposed upgrade of culverts on Gradgery Lane, Macquarie Marshes, NSW. Warren Shire Council.
2008	Pre-clearance survey for threatened flora species and communities in the 'Southern Remnant', Cadia Valley, for expansion of a waste rock emplacement for the Cadia Gold Mine. Cadia Valley Operations.
2008	Participate in development of the Environmental Assessment for the Metropolitan Coal Project. Helensburgh Coal.
2008	Flora survey for Review of Environmental Factors at 'Big Cadia' ore deposit, Cadia, NSW. Cadia Valley Operations.
2008	Flora and fauna survey and assessment of site for student residential complex. Charles Sturt University, Orange.
2008	Flora survey and assessment of proposed stormwater harvesting project on Blackmans Swamp Creek. Orange City Council.
2008	Third season of pollinator studies on threatened Caladenia orchid species in Victoria. Department of Sustainability and the Environment, Vic.
2008	Ongoing monitoring of vegetation recovery (flora quadrats and tagged plant measurements) following hazard reduction burning in autumn 2006 of Blocks X and Y in the buffer zone of the Hydro Aluminium smelter, Kurri Kurri.
2008	Pre-burn baseline flora survey (flora quadrats and measurement of tagged plants of 3 threatened species) in blocks R and U in the buffer zone of the Hydro Aluminium smelter, Kurri Kurri, for a proposed hazard reduction burn in autumn 2009.
2008	Baseline flora survey and establishment of permanent monitoring quadrats for proposed vegetation offset for the Ginkgo and Snapper Mineral Sands Mines, Pooncarie, NSW. Bemax Minerals.

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