

**Wheeler Creek Valley
Biodiversity Survey 2001
V1.1 (C) released July, 2002**

**Conducted by the
National Parks Association of NSW Inc**

Message from the Sydney Branch President of the National Parks Association of NSW Inc

Peter Caldwell

The preservation of all species both flora and fauna or the conservation of biodiversity is vital to the continuing health of our world. It is the responsibility of Governments global, national, state and local. However achieving this conservation so often depends on community groups and individuals having the knowledge and experience of the natural environment. Undertaking biodiversity surveys greatly adds to this knowledge and hence is a very important step towards the conservation of biodiversity.

The *Community Biodiversity Survey Manual*, initiated by the National Parks Association of NSW and now in its second edition, represents a partnership between NPA and the NSW National Parks and Wildlife Service. It has been widely sought throughout Australia and even internationally. It provides the opportunity for many to become involved in learning about our natural environment and building the capacity of the community to generate reliable data on the flora and fauna present or now absent in an area.

The two phase biodiversity survey of the Wheeler Creek catchment carried out by the Sydney Branch of NPA in March and September 2001 provides valuable data about the natural environment of this area, which we hope will enable Local Government and State Government agencies to better plan and manage this area to preserve and enhance its biodiversity for this and future generations.

Whilst the Branch is very grateful to the many volunteers that gave their time and expertise to enable the survey to happen I must particularly thank Judith Bennett who has been the Project Manager for this area for two busy years, and through her initiative this survey took place, and to Anne Reeves who undertook the overall management of the survey.

Peter Caldwell,
President, Sydney Branch NPA
May 2002

Abbreviations used in this document include:-

AMBS Australian Museum Business Services
CVA Conservation Volunteers Australia
DLWC Department of Land and Water Conservation
MLALC Metropolitan Local Aboriginal Land Council
NAL Natural Areas Ltd
NPA National Parks Association of NSW Inc
NPWS National Parks and Wildlife Service
RCE Riparian Channel and Environmental Inventory
RFS Rural Fire Service

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NOTE: The CD accompanying this report contains an Excel Spreadsheet with more detailed information concerning the vegetation.
It also contains two other Biodiversity Surveys undertaken by NPA elsewhere in NSW.

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1. The National Parks and Wildlife Service, under area manager Alan Ginns, lent trapping equipment and provided a ranger to accompany and instruct the field workers in both the March and the September surveys.
2. Warringah Council, with the leadership of Mayor Peter Moxham, provided detailed maps and other practical assistance such as recycling rubbish from the base camp at Beacon Hill Scout Hall.
3. The Department of Land and Water Conservation provided maps and equipment and permission to survey their land
4. Beacon Hill Rural Fire Service, under the leadership of Peter Lyons, allowed us to shelter in their building and use it as a base during the March survey
5. Rural Fire Service provided detailed vegetation maps
6. Metropolitan Local Aboriginal Lands Council, through representative Allen Madden has provided valued support and attended planning meetings
7. The Royal Botanical Gardens, the Australian Museum, Rebecca Harris, Nick Skelton, Cr Phil Colman and Barbara Triggs for providing follow-up identification of flora and fauna specimens.
8. The Sydney Fungus Study Group undertook a field study visit in May.
9. Warringah Library staff, in particular Tina Graham of the Local Studies Unit.

At this time the Department of Land and Water Conservation is evaluating the area to determine whether or not to rezone it for "Public recreation and environmental protection".

There is an ad hoc committee which has met several times to discuss the future of the Wheeler Creek Valley and will continue to meet while the assessment process of this area is in progress. The committee of people interested in the future of the valley includes: -

NPA	Peter Caldwell	Anne Reeves	Andrew Cox
	Tim Bidder	John Macris	Mary Johnsen
DLWC	Tim Wilkinson	Martin Sewell	
MLALC	Allen Madden		
Aboriginal Heritage Officer	David Watts		
NPWS	Alan Ginns	Amelia Hurren	Tegan Burton
Warringah Council	Mark Walters	Adam Byrne	
Natural Areas Ltd	Maria Manning	John Clarke	Jim Somerville
Local Citizens	Michael Paine	Frank Gleason	Diane Cunningham
	Peter Beeh	David Paine	

This document has been assembled by Judith Bennett from the reports submitted by Andrew Lo, Robyn Tuft, Ray Mjadwesch, Nick Skelton, Noel Ryan, Anne Reeves, John Macris, Andrew Hunt, Melinda Elith, Mary Johnsen, Alex Tucker. The data was entered by Carmen Bennett in March and Judith Bennett in September from the handwritten fieldwork papers. Proofreaders include Nick Skelton, Mary Johnsen and Dr. Frank Gleason.

Volunteer scientific people and field workers:

Sydney Branch acknowledges with thanks the enormous support and enthusiasm of many people, volunteers and organisations, that have made the work possible. This includes all survey participants who have given so freely of their time and expertise and local people who have reported their sightings.

NPA would like to thank the following specialists who volunteered their time and expertise as leaders for this survey:-

Anne Reeves, B.Sc (Zool) Hons, University College London, OAM (Order of Australia Medal), zoologist, co-ordinated the survey

Ray Mjadwesch, B.A. App Sci - Env Tech (1994), Environmental Consultant, from Bathurst, whose generous offer of help made this survey possible, provided the traps and trapping licence and instructed the teams in methods.

Nick Skelton, B.Sc (Hons), M. App.Sc, Environmental Scientist, planned the first survey locations together with Ray and led the second survey.

Tegan Burton, from NPWS, led mammal trapping in March.

Karen Hudson, from NPWS, led mammal trapping in September.

NPA appreciates the volunteer field work performed in March by:-

Cheryl Bate	Frank Gleason	Coleen Lustig	Anne Reeves
Jeff Bembrick	Donald Glover	Marita Macrae	Martyn Robinson
Carmen Bennett	Judith Glover	John Macris	Tyson Russell
Judith Bennett	Henry Gold	Elizabeth Makris	Noel Ryan
Timothy Bidder	Paul Greenfield	Richard Mason	Debbie Saunders
Elizabeth Brennan	Mark Grumley	Pamela Mawbey	Janine Singleton
Peter Caldwell	Conny Harris	Belinda McNeill	Nick Skelton
Phil Colman	Max Harris	Shannon McNeil	James Smallhorn
Sarah Cornielsson	Effie Howe	Richard Meares	Heather Stolle
Richard Daniel	Michael Howe	Ray Mjadwesch	Diane Tracy
Donnah Day	Shirley Jensen	Elizabeth Moore	Alex Tucker
Steve Dimitriadis	Mary Johnsen	Pip Moore	Robyn Tuft
Melinda Elith	Jennifer Kitto	Denise Paine	Mervyn Vessey
Diane Eva	Andrew Lo	Michael Paine	Helen Ward
Ute Foster	Richard Llewellyn	Robin Plumb	Meron Wilson

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Cheryl	Bate	Frank	Gleason	Pamela	Mawbey
Judith	Bennett	Eddie	Goodall	Ian	Moran
Kate	Bestwick	George	Hangay	Rod	Napier
Timothy	Bidder	Peta	Hansen	Christine	Newman
Peter	Caldwell	Conny	Harris	Robyn	Plumb
D.J.	Cavanagh	Max	Harris	Anne	Reeves
Ben	Chandler	Karen	Hudson	Martyn	Robinson
Justin	Collins	Mary	Johnsen	Noel	Ryan
Phil	Colman	Cliff	Kelsall	Nick	Skelton
Emily	Cracknell	Paul	Kelton	Courtney	Smithers
Charles	Cullen	Andrew	Lo	Alex	Tucker
Claire	Cullen	Marita	McRae	Robyn	Tuft
Madhava	D'Costa	John	Macris	Inga	Van Dyk
Melinda	Elith	Lisa	Madden	James	Walker

Qualifications and contributions of participants included:-

Cheryl Bate, BSc (Hons) from Univ of Witwatersrand, Johannesburg

- Bush Regeneration certificates, Ryde TAFE

- Co-ordinator for Sydney North and Sydney West Noxious Weeds Committees

- Supervisor with National Trust for the Barrenjoey Headland bush regeneration contract team

Jeff Bembrick, Senior Environmental Auditor (QSA, Register of Certified Auditors)

1998 - Soil and Water Management for Urban Development UWS - Certificate

1995 - Business Management Certificate Australian Institute of Management

1993 - Master of Environmental Studies - University of NSW 1974 - Bachelor of Science (Geology) - University of NSW, Wollongong

Also undertake local community roles as follows:

Volunteer coordinator - Undercliff Reserve bush regenerators (Warringah

FOB) Stony Range Flora Reserve Advisory Committee member and Volunteer

Judith Bennett, Diploma in teaching (Infants and Primary School)

Tim Bidder, Horticulture training and land management experience

Elizabeth Brennan, 3rd year of Bachelor of Science degree in Environmental Biology

Peter Caldwell, B.A (Cantab- engineering), M.I.E Aust (Member of Institution of Engineers Australia), CP Eng (Chartered Professional Engineer), Dip Env Stud (Diploma of Environmental Studies, Macquarie Univ), MSAE USA, MSAE_A (Member of Society of Automotive Engineers USA & Aust)

Cr Phillip Colman, biologist, led the invertebrate studies

Bruce Cox, member of the "Cumberland Bird Observers Club" and the "N.S.W. Atlassers", supplied a bird list for the area.

Emily Cracknell led the soil survey.

Charles Cullen, forester, led vegetation surveys in September.

Richard Daniel, BSc, geocologist

Donnah Day, Advanced Diploma of Land Management from Orange Agricultural College (a campus of the University of Sydney), a Bachelors degree in Environmental Science submajoring in molecular biology from UTS, Sydney, Honours from the School of Immunology and Microbiology at UNSW

Melinda Elith, 3rd year of Bachelor of Science degree in Environmental Biology

Ute Foster, B. A. (Hons.) with majors in French & German, Diploma of Education Diploma of Information Management - Librarianship

Dr Frank Gleason, B.S. Trinity College, Ph.D University of California, Berkeley, microbiologist, provided valuable local and scientific knowledge.

Judith and Donald Glover, BSc (Tech), Grad. Dip. Sc., led the fungal study team.

Paul Greenfield, B.Sc (Hons) in Computer Science (University of Sydney)

M.Sc (Research) in Computer Science (University of Sydney), Senior Research Engineer with CSIRO Mathematical and Information Sciences

Mark Grumley, Richard Llewellyn and James Walker found the reptiles.

Conny Harris led vegetation surveys in March and Seoptember

Rebecca Harris identified ants and spiders.

Mary Johnsen, B.Sc, Master of Environmental Management.

Effie and Michael Howe performed fish surveys.

Jennifer Kitto, Diploma in Environmental Management, Certificate 2 in Land Conservation and Restoration, currently doing Cert. 3 in Parks and Gardens.

Andrew Lo, B.A. (Hon) University of Melbourne. M.A. (Hon) UNSW. Environmental Economist, Secretary of the Australia New Guinea Fish Association NSW led the studies of aquatic life .

Marita Macrae, B.A. Dip Ed (Infants and Primary), Advanced Horticulture Certificate, Bush Regeneration Certificate

John Macris, B.Sc, provided geological information

Marita Macrae led vegetation surveys in March and identified plants in September.

Pamela Mawbey, B.A. in English and Psychology from Sydney Uni, member of the Society for Growing Australian Plants. High school teacher, journalist.

Belinda McNeill, B. Horticultural Science, M. Environmental Studies, Certificate Bushland Regeneration Level 2

Shannon McNeill, Grad.Dip.Tropical Environmental Management, bushregen student

Dr Richard Mason led birdwatching teams.

Richard Meares led vegetation surveys in March.

Ray Mjadwesch, B.A. App Sci - Env Tech (1994)

Christine Newman led vegetation surveys in March and September

Denise Paine, Denise Paine is a teacher at Cromer Primary School near Wheeler reek Valley. She has organised many environmental projects at the school including Streamwatch, Dee Why Wetlands restoration, and stormwater management and native gardens within the school grounds winning an Environment Encouragement Award for Schools from Warringah Council

Michael Paine is a professional engineer who specialises in automotive safety. He is a committee member of the Red Hill Preservation Society. He is also a member of Warringah Council's LEP Community Advisory Committee. That committee assisted in the preparation of the innovative new Local Environment Plan to control development.

Robin Plumb, Cert teaching 1958, Diploma of Special Education,1968, BA majoring in Psychology, also first year uni Botany and Zoology, Bushcare Course

Anne Reeves, B.Sc (Zool) Hons, University College London, OAM (Order of Australia Medal)

Noel Ryan, Master of Environmental Management and Development, National Centre for Development Studies, Australian National University,1996, Bushland Restoration Certificate II, NSW TAFE, Ryde, 2000, led birdwatching teams in March and September.

Debbie Saunders, B.Sc (Hons Zoology), identified mammals in March

Janine Singleton, bushregenerator, led vegetation surveys in March.

Dr. Courtney Smithers, Ph.D, former curator of the Australian Museum

Heather Stolle, bushregenerator, led vegetation surveys in March.

Diane Tracy, B.Sc.,Masters of Tropical Environmental Management, bushregen student

Dr Robyn Tuft, Ph.D. who tested for macroinvertebrates, provided data sheets and reports and assisted **Melinda Elith, Cliff Kelsall, Ian Moran and Mary Johnsen** when they were conducting water quality tests.

Inga Van Dyk, bushregenerator, helped identify plants in September.

Helen Ward, Associate Diploma in Park Management (Ryde TAFE), Bush Regeneration Certificate 2 (Ryde TAFE), Bush Regeneration Certificate 4.

Currently working as a Bush Regenerator and Bushcare Supervisor

Meron Wilson led vegetation surveys in March.

Dr. Alec Wood, Visiting Fellow, School of Biological Sciences, University of NSW, identified fungi.



Cliff Kelsall and Ian Moran

The September Survey was greatly assisted by the Green Reserve team. Cliff Kelsall conducted water quality tests and assisted with the mammal survey. Ian Moran, a qualified chef, organised the catering and cooked the meals. This team began working with NPA seeking environmental protection for the Wheeler Creek Valley in May 2001. Both men are studying bushregeneration at TAFE and work on bushregeneration projects within the Wheeler Creek valley.

Biodiversity Survey Reports are lodged on our website (wwildlife.com).

Introduction

By Anne Reeves

Wheeler Creek Valley forms part of the southern catchment of Narrabeen Lake; it abuts Red Hill, Oxford Falls, Cromer Heights and Cromer. Its vegetation of predominately Sydney Sandstone Heath forms the southern-most extent of continuous bushland that reaches north to Garigal and Ku-ring-gai Chase National Parks (intercepted by Oxford Falls Road and Mona Vale Road). See Appendix 1 for locality and site details.

The greatest value of the area is in its ability to sustain ecosystems and biodiversity and the biodiversity survey participants are concerned that the integrity of the area may be at risk from inappropriate management or adverse urban development. The aim of the study is to establish the condition of the ecosystems and to investigate whether threatened species are present.

This study included terrestrial and aquatic communities within the Wheeler Creek catchment area and other lands to the north owned by variously Warringah Council, the Crown, Metropolitan Aboriginal Lands Council and DLWC.

The survey was coordinated by Raymond Mjadwesch from 22-26 March 2001, and Nick Skelton from 14-17th September 2001, and utilised volunteers (approximately 55) recruited by the NPA for the on ground work, under the guidance of specialists including Andrew Lo, Phillip Colman, Noel Ryan, Deb Saunders, Frank Gleason, Cheryl Bate, Effie Howe, Marita Macrae, Meron Wilson, Robyn Tuft, Martyn Robinson, Richard Meares, Heather Stolle, Conny Harris, Christine Newman, Mark Grumley, Richard Llewellyn and James Walker.

Overview

By Judith Bennett

The Sydney Branch of the National Parks Association of NSW Inc (NPA) conducted this survey in order to establish the biodiversity values of the Wheeler Creek Valley and the nearby bushland areas that link through to National Parks. The study includes comments on the landform, indigenous and European occupation, current uses and impacts in addition to the descriptions of flora and fauna found during the surveys in March and September 2001.

The geographical area is dominated by Sydney Sandstone Heath and is the southern-most extent of continuous vegetation that reaches north to Garigal and Ku-ring-gai Chase National Parks (although separated from these by Oxford Falls Road and Mona Vale Road). See Appendix 1 for locality and site details.

Increasing pressure from urban development coupled with rising land values means that unless this bushland link to the National Parks is formally protected it will become very difficult in the future to prevent encroachments into the area that would destroy its environmental values.

The area is owned by a number of agencies and organisations - Warringah Council, Metropolitan Aboriginal Lands Council, Department of Land and Water Conservation, Natural Areas Ltd and various private land owners.

All participants in this project were volunteers except that NPWS provided rangers Tegan Burton in March and Karen Hudson in September to assist with mammal trapping and identification. Flora and fauna specimens collected during the survey that could not be identified at the time, were sent to the Australian Museum, the Royal Botanic Gardens or an appropriate specialist.

Based on the findings of the survey, NPA has made recommendations concerning the area and its flora and fauna because it is a relatively undisturbed part of the southern catchment of Narrabeen Lake and contains an array of ecosystems that make it a valuable study area for educational institutions. The Wheeler Creek Valley is important habitat for several threatened species and needs to be permanently protected from urban development or intense recreational use.

Methods

By Anne Reeves and Ray Mjadwesch

Using vegetation maps from an ongoing Non-Urban Lands Study different vegetative communities were identified, and locations for quadrats within these communities were marked for survey (selection based on aspect and landform – soil maps not available).

Initially 12 sites were selected within the Wheeler Creek catchment area for optimal survey coverage, and a further 5 sites to the north of Wheeler Creek Valley. (Time constraints did not allow survey of all sites). See Appendix 1 for site locations. In

September, vegetation was mapped for one more site within the Valley, one just to the west and one to the north with an additional mapping of vegetation along the edges of a track to the north.

Data collection techniques included:

- Vegetation: 20x20m quadrats, opportunistic records
- Vertebrates: diurnal bird census, scat collection, habitat search (creeks, vegetation, under rocks and fallen timber), spotlighting, anabat sonar recording and nocturnal call playback, hair tubes (8) and trapping (see Appendix 1 for location details of 5 pits, (and 50m drift-fence), 10 small Elliots and 12 cage traps)
- Invertebrates: net, malaise trap, small wet pits, sweeping and beating vegetation, habitat search (leaf litter, foliage and under bark, under fallen timber and rocks, streams / pools).

At a group meeting prior to the survey, everyone was made familiar with the data collection techniques and was then split into groups to take samples from the identified quadrat sites. Each group was multi-disciplinary (birds, invertebrates, plants). Specialists (fish, reptile, swamp, frog) spent time with different groups and also took small groups of participants for targeted searches.

The reports were collated mostly from these teams of people who conducted the fieldwork during the weekends of March 24-26th and September 14-17th. Certain observations and verifications were completed in the weeks following those dates.

Where verification of identification was considered necessary, it was carried out by the following agencies:-

Scats and hairs from hair tubes by Barbara Triggs,
Invertebrates by the Australian Museum,
Plant specimens by the Royal Botanical Gardens
Fungi by the Sydney Fungal Studies Group
Bird identifications checked by Bruce Cox

Local citizens have contributed their observations and experiences and include sightings of Red-crowned Toadlets, Giant Burrowing Frogs and Powerful Owls.

Permission of owners and occupiers was obtained for entry and data collections.

Conclusions recorded in the Biodiversity Survey

Geology

This portion of the Hornsby Plateau contains upland sites - remnant plateau tops of generally low relief; headwater valleys with dish shaped profiles; major valley sides - the dominant landform - featuring low cliff lines and intervening linear to concave-convex hillslopes; and valley bottoms, which feature either a bedrock dominated stream channel, or a valley fill of deposited sediments.

On the Hornsby Plateau, the ecological significance of podzol (i.e. iron pan layer under leached white sand) soils is the distinct differences in plant associations that occur in otherwise uniform settings, according to the presence or absence of a podzol. Species such as Christmas Bush (*Ceratopetalum gummiferum*) and Grass trees (*Xanthorrhoea arborea*) are two examples of species that favour podzol soils, while Scribbly Gum (*Eucalyptus haemastoma*) may grow in proximity to but rarely if ever on podzol soils (Buchanan and Humphreys, 1980).

History

Wheeler Creek Valley is a natural amphitheatre, and the surrounding area includes an array of multi-coloured clays, rock engravings and large areas of flat rock like those that were commonly used elsewhere for dances. The Manly Daily reported that in the 1972 archeologists were objecting to urban development in this area because this valley was special to the Aboriginal people as a meeting place and for ceremonies. Narrabeen Lake, Dee Why Lagoon and Long Reef supplied plenty of food for the people who lived in this region.

During the 19th and 20th Centuries, European settlers established quarries, poultry farms and market gardens.

During the second half of the 20th Century, with increased road and ferry transport, Warringah areas became suburbs of Sydney. The land values rose rapidly. The terrain is uneven which provides many opportunities for highly desirable picturesque views. This has led to ridgeline developments to maximise the return on investments for developers but the impact on the natural environment is most unfortunate.

There are many species which need access to the ridgelines during their lifespan. Erosion, pollution and weeds impact the bush in the gullies below developments. Bushfires travel quickly up steep slopes and, in order to protect their housing, residents demand wide open buffer areas and hazard reduction burns more frequently than would be advisable for ecological reasons.

Retirement Villages, permitted on rural land under a SEPP5 provision of the State Government, are financially rewarding for developers who have already built two retirement complexes bordering on Wheeler Creek Valley and made several attempts to gain approval for other similar projects along the Red Hill side of the Valley.

Residents of Warringah value the bushland setting in which they live and are also concerned about the future of Narrabeen Lake. Therefore in the 21st Century there is

pressure on Warringah Council to uphold their Local Environment Plan and protect Wheeler Creek Valley from any further urban developments. This biodiversity survey documents the array and quality of species within the valley including some that are currently listed as endangered or rare.

Management Challenges

Considerable erosion was evident - mainly due to braided tracks that give access to powered vehicles, including 4-wheel drive vehicles and trailbikes. This situation was exacerbated in December 2001 by the renewed bulldozing of service tracks to the power lines. Warringah Council took action and demanded that the bulldozed track be kept to a minimum width. Horses and mountain bikes are also causing erosion.

Weeds have encroached where disturbance to the soil has taken place - for example, in the bulldozed areas of Numeve land and the land around Maybrook Manors. There are weed plumes behind houses and along drainage lines. These weed plumes are being reduced by the efforts of the Green Reserve team members who are also removing weeds around three sides of the Willandra Bungalows development in Little Willandra Road.

Warringah Council have taken action on notified noxious weed problems - the pampas grass has been removed from the Numeve land, blackberry and lantana have been poisoned on Maybrook Manors land and ludwigia has been removed from the creek as it flows through Willandra Bungalows. Continued monitoring will be necessary to ensure that weeds do not become reestablished.

Soils

The examination near the hanging swamp found that the rock shelf divides the wetland into a "permanent" hanging swamp and the lower section, which has surface water only after a large storm event. This storm event brings down a layer of sand, which covers the accumulated loam derived from vegetation decomposition over a long dry period.

Below the houses in Maybrook Avenue, weeds are growing where the soil and rocks appear to have been pushed there in the creation of the road and some flat areas for building.

Water Quality

The lowest site W4 (Wheeler Creek at Little Willandra Rd) shows the least favourable conditions for macroinvertebrates, with the lowest biotic index (measure of water quality based on the abundance of macroinvertebrate indicator animals) and dominant animals known to be tolerant of poor water quality. The riparian weeds and instream plants (macrophytes) also indicated nutrient enrichment and eutrophication of the stream.

The site W3 below 'The Manors' showed a diverse invertebrate fauna, including some sensitive animals such as mayfly nymphs. The biotic index was higher than site W4 but substantially lower than the site W2 immediately upstream of 'The Manors'. Eastern froglets were heard and a swamp wallaby and a family of ducks observed. The riparian and instream environments of the two sites near 'The Manors' were similar, although the lower site W3 recorded a lower RCE, due to riparian weed invasion, vegetation breaks and eroding banks.

Above 'The Manors' the stream W2 had a high biotic index and a dominance of sensitive mayfly and caddisfly nymphs. The eastern froglet was again heard. Algae and macrophytes were very low. The RCE for this site indicated a good stream condition.

The uppermost site W1 was in an incised section of stream which provided little habitat for invertebrates and evidence of scouring from periodic high volume of water flow. The steepness of the stream would have encouraged erosion. These characteristics probably explain the lower SIGNAL index, diversity and RCE score shown by this site W1 as compared to the second site W2. The fauna was predominately mayflies and algal response was low.

Wheeler Creek provides a graphic example of the impact of urban development where observers can readily detect good water quality in the upper reaches and a low biotic index by the time the creek reaches Little Willandra Road. The quality of the upper stream is assisted by the thick vegetation including *Hakea teretifolia* around some small tributaries (that are not even marked on maps).

Fauna

Birds

There are 89 bird species that can be seen in the area. Superficially Red Hill looks like any of the other heath and woodland covered part of Sydney's Northern Beaches, yet it attracts several unusual bird species, either rare or not seen at all in nearby similar environments. Birds such as Pheasant Coucal, Painted Button-quail, Rock Warbler, Brush Bronzewing, Bar-shouldered Dove and Tawny-crowned Honeyeater can all be seen at Red Hill. No other area on the Northern Beaches are known to support all of these species! Most do not support any!

The Valley is habitat for a pair of Powerful Owls that were photographed in May and June 2002 and whose chick was seen last season. Their pellets and scats were collected and photographed.

Frogs

Good habitat for red-crowned toadlets and giant burrowing frogs was documented. Burrows were in use by either big yabbies or giant burrowing frogs. Two species of frogs were sighted.

Mammals

39 cage and 39 Elliot traps were set out each night in September. There were 20 mammals in the traps on 15th, 23 on 16th, 39 on 17th Sept) - bushrats, long-nosed bandicoots and antechinus.

Swamp wallabies and echidnas were recorded. Brushtail, ringtail and glider possums were noted. In total eleven species of mammals were recorded.

Reptiles

Thirteen snakes, skinks and lizards were recorded. The endangered Heath Monitor was captured and released near its burrow on the ridgeline and seen in two locations in the valley.

Conclusion:

Wheeler Valley and nearby bushland is supporting a wide variety of fauna some species of which are rare, vulnerable or endangered.

Flora

There are unusual fungi, orchids and other species of plants growing in and near Wheeler Creek Valley that are in need of protection and further study.

There is a variety of vegetation communities resulting from the differences in groundwater, slope, soil types and creek activity.

Recovery after bushfire is made possible by control of the frequency of fire, the presence of swamps and rainforest areas, and the existing bushland links through to Garigal National Park.

Summary of Conclusions:

The survey area revealed high quality bushland in the Wheeler Creek catchment with signs of some degradation further down the valley from stormwater run-off, weed plumes and other processes associated with urban development. Recreational use of motor vehicles, trailbikes, mountain bikes and horses is causing erosion and degradation in some areas. There is need for a management plan for the area.

Data collected from the survey sites was evidence of significant biodiversity and stable ecosystems that support several endangered, vulnerable and rare flora and fauna species. The area is relatively easy to access and there are many other valuable study projects that could be undertaken by students at various levels.

Overall this picturesque area with its extensive views, Aboriginal heritage, threatened species and bushland that is connected to existing National Parks has high environmental value and needs to be protected for future generations to appreciate.

Recommendations for Wheeler Creek Valley

Conclusions:

The survey findings confirm that:

- 1 There are Aboriginal carvings which are listed in a number of publications and are important to Aboriginal heritage, history and culture. These need better protection.
- 2 The area is naturally visually pleasing with large trees and rocky outcrops and from the ridges there are views to the ocean, the lagoons, the undulating bushland and the distant city.
- 3 The upper Wheeler Creek catchment remains in a remarkably pristine condition and there are very few man-made structures on the ridgelines - only the ones in Cromer Heights in the North East of the catchment. The urban dwellings along Maybrook Avenue and Jersey Place in the North East are the only ones in the catchment until the creek gets down to Willandra Bungalows.
- 4 The creek, as it spills over rocks in the steeper part of the valley, is picturesque.
- 5 The area retains significant biodiversity, mature and complex ecosystems, diversity of plant communities and appealing natural features of considerable local and possibly wider importance.
- 6 Wheeler Creek Valley is part of the catchment for Narrabeen Lagoon.

There have been a few threats operating in the catchment such as:-

- a blockage in the creek, which was removed before the September survey but it is still not clear whether the *Galaxias maculata* fish have returned to the creek.
- stormwater runoff into the creek affecting water quality
- removal of natural vegetation, e.g. around Maybrook Manors
- loss of habitat
- high fire frequency and risk of hazard reduction burns before ecologically wise
- erosion caused by 4WD vehicles, trailbikes, horses and clearing (Numeve land)
- continuing erosion caused by the Willandra Bungalows development
- alteration of the creek banks by the Willandra Bungalows development
- piping of the creek tributary (that comes from behind the Fire Station - our Quadrat 21) under the Willandra Bungalows development a blockage of which caused flooding in the development in February 2002. Cromer residents are convinced that fast flow after storms from this pipe causes erosion of the banks of Wheeler Creek including those on the other side of Little Willandra Rd.
- soil disturbance in the hanging swamp area from vehicles and trailbikes
- power lines that require truck access for servicing.
- weeds
- predation by *Gambusia holbrooki*, foxes, cats and dogs

With appropriate management regarding future use and development and with links through to substantial bushland areas to the north, the natural and heritage values of the Wheeler Creek valley can substantially be retained as an important community asset into the future.

Recommendations:

There is evidence of several endangered species of flora and fauna in and near this valley. Several were positively identified during the surveys. The precautionary principle needs to be applied here.

The valley is compact enough to be useful for study groups of all levels of education to pursue a range of opportunities for scientific investigations of natural systems and graphic examples of the impact of 20th Century environmental management practices, including resource extraction, farming, building, gardening and recreation.

We recommend taking no action that would cause further removal of or damage any of the habitats until more study has been undertaken and :-

- 1 That the Council ensure appropriate environmental protection designation to the area within its regional and local planning schemes, modifying the Local Environment Plan to identify Wheeler Creek Valley as a specific area with its own definition of desired character.
- 2 That Council actively work towards an environmental protection rating for the valley.
- 3 That the Council initiates consultation with MLALC about protecting Aboriginal engravings from vandalism.
- 4 That the Council ensure that any approved and current developments conform to existing requirements under the laws of NSW.

- 5 That the Council enforce non-urban land requirements on private landholdings in the valley.
- 6 That the Council encourages universities, schools and other organisations to undertake scientific research in the valley.
- 7 That the Council encourages study groups to document the collection of interdependent ecosystems in the valley together with the Aboriginal heritage sites in their research programs and publish their findings.
- 8 That no change in management or transfer of Crown Lands to other parties is made that would pre-empt or diminish retention of the natural values and Aboriginal significance of the area.
- 9 That an action plan or management plan be prepared for the Wheeler Creek valley aimed at retaining and enhancing its natural values and Aboriginal significance taking into account the findings of this survey.
- 10 That the Council prohibit activities which result in the addition of silt to the Narrabeen Lagoon catchment area downstream from Wheeler Creek.
- 11 That the Council restrict the use of motorised vehicles in Wheeler Creek Valley and adjacent ridge tops.
- 12 That the Council adopt a program to replant native species in areas burned by bushfires and denuded by human activities and endemic native species which formerly grew there.
- 13 That the waterfalls in Wheeler Creek be examined for listing for their heritage values particularly the one where there is an old rock wall around the pool.

There are also other recommendations within this document, e.g. these from the Aboriginal heritage section.....

1. A detailed study of the Aboriginal heritage of this and nearby areas by Aboriginal consultants is advised.
2. The road reserves in the valley need to be rezoned.
3. The whole valley needs environmental protection.
4. The roads that facilitate trailbikes or 4WD vehicles need to be blocked off with signs erected to educate people that trailbikes and 4WD vehicles are not permitted.
5. The Warringah LEP needs to ensure the preservation of the remaining bushland of Warringah and particularly exclude any new buildings that would be visible from vantage points on Narrabeen Lake or within Aboriginal land.
6. The tradition of this being a teaching place - a place where people contemplate their responsibilities towards the land we inhabit, needs to be incorporated into the management of this area through the 21st Century in ways that enrich all people whether or not they are of Aboriginal descent.

Landform

By John Macris

Landscapes of the Southern Hornsby Plateau
compiled by R.J. Daniel, BSc and J.L. Macris, Bsc (pending)

Geology

The areas within this study mainly feature a bedrock of Hawkesbury Sandstone. In its unweathered state, this rock is dominantly off-white coloured, consisting of medium-fine grain quartz sand particles, bound by a matrix of argillaceous cement (Humphreys, 1976).

Commonly observed sub-forms are:

- a) Sheet facies, identifiable by cross bedding sedimentary forms, up to 5 metres thick. This facies is the most resistant to weathering (Conaghan and Jones, 1975).
- b) Massive facies, with no obvious sedimentary layering within the unit and a fairly uniform sand grain-size. This is lighter in colour and more easily weathered (Conaghan and Jones, 1975).
- c) Thin lenses of shale or siltstone, which occur as occasional interbeds with facies types a) and b) (Conaghan and Jones, 1975).

The regional dip of the Hawkesbury Sandstone is less than 0.5deg towards the east and south (Humphreys 1976).

A further important characteristic of the sandstone is its linear joint structures - breaks in the body of rock which may form along planes of weakness either inherited from the original sedimentary materials or resulting from the process of lithification. These joints may be orientated laterally, vertically or at some intermediate angle. Joints which penetrate some metres to tens of metres through the sandstone strata are particularly important in the long term processes of mechanical weathering and drainage development described in the following sections.

Some minor occurrences of basaltic igneous rock have been identified in the Middle Creek catchment in the form of small dyke features. This rock, in stark contrast to the Hawkesbury sedimentary unit, contains no quartz mineral and weathers readily at the outcropping surface to yield clay materials.

Drainage and Landform evolution

The present day plateau surfaces share a fairly uniform elevation. Although subject to some down-wearing erosion over the millennia, these upland areas indicate an approximation of the former topographic surface at the time of tectonic uplift in the mid Tertiary (Jones and Veevers, 1982). The main agent of landform evolution since then has been incision and headcut valley extension along watercourses (Nott *et al*, 1996).

Structural controls on this drainage development have been significant for most Sydney Basin sandstone landscapes. Studies of the drainage networks of the Hornsby Plateau (see Humphreys, 1976, p17-19 for summary) have reported a generally close association between the orientation of major joints in the sandstone (clearly visible from aerial photography) and the dominant direction of major valleys and escarpments.

The major process-form relationship over the geological timescale therefore, has been gradual dissection of a former widespread plateau surface by the erosive action of water, with preferential erosion, and hence valley formation and expansion along the axes of the major sandstone joints.

The horizontal strata of different weathering potential - the bedded and massive sandstones and lenses of shale and siltstone - favour the gradual development of a 'stepped' hillslope, with sections of low angle sandstone bench on the sheet facies terminating at small bands of cliff line. The highly weatherable shale lenses promote undercutting of the overlying strata. Larger bodies of more erodible rock (the massive facies) will favour a more linear to concave slope between the stepped sections.

The regional dip of the bedrock, although minor, appears to have contributed to asymmetric valley profiles in some catchments of the Hornsby Plateau. This is believed to be largely due to the consequent differences in mass strength of the eroding valley slopes, where the truncated bedrock face dips towards the slope (more erodible) or away from it (less erodible) (Humphreys, 1976).

Some further complicating factors important in the evolution of valley slopes are the presence of basalt dykes, which as sites of preferential erosion, have generally steeper linear slopes in their vicinity than occur on the adjacent sedimentary bedrock.

Prior to the current sea level high-stand of the past 6000 years, the valleys of the Hornsby Plateau extended further seaward, with slope evolution progressing along the lines described above. Substantial parts of the lower valley systems have subsequently been drowned to form bays and estuaries. Narrabeen Lagoon has further evolved from a coastal embayment to estuarine lagoon, after enclosure by a sand barrier.

The mean lake height has formed the adjusted base limit to erosion and transport by rivers and mass movement. Some creek valleys, for short distances upstream of Narrabeen Lagoon, have also accumulated bodies sediment across their floors, thus changing the overall valley profile.

From this range of influencing factors, the present valley profiles encountered are either:

- a) Dish shaped, which is a common form in upland, low order streams;
- b) 'V' shaped, which is common to higher order streams and indicates incision and valley expansion over millions to a few tens of millions of years (Nott *et al*, 1996); or
- c) Trough shaped, which have evolved from 'V' shaped valleys over a few thousand years by infilling of sediment on the valley base (Humphreys, 1976).

In summary, this portion of the Hornsby Plateau contains upland sites - remnant plateau tops of generally low relief; headwater valleys with dish shaped profiles; major valley sides - the dominant landform - featuring low cliff lines and intervening linear to concave-convex hillslopes; and valley bottoms, which feature either a bedrock dominated stream channel, or a valley fill of deposited sediments.

Surface processes and the resulting Soil Province and Types within Land Units

Superimposed on the major geological time-scale landforming factors described in the previous section, are surface and near-surface processes operating on shorter time-scales of years to thousands of years, which have yielded the soil products of the various land units.

- a) Laterisation - Where weathering occurs along the boundary of sandy and shale units, iron minerals from the bedrock often enter solution and, by subsequently concentrating in other sediment layers, lead to the formation of iron-cemented bands and pebbles known as Laterites (Hunt *et al*, 1977). These have been recorded in the Red Hill area.
- b) Fire - Bushfires have been shown to cause rapid episodic breakdown of sandstone outcrops into cobbles, gravels and smaller particles, through heat expansion of liquids within the rock pores (Adamson *et al*, 1983). Given the long term role of fire in the Sydney basin sclerophyll forests, this process may even have been of significance in contributing to slope profile variations between sites with fire-prone versus fire-sheltered aspects.
- c) Near surface bedrock alteration - Weathering of Hawkesbury Sandstone at depth produces a saprolite (bedrock modified in its original location) rich in quartz sand but also including a

significant clay component (Paton *et al*, 1995). The end-product subsoil is mineralogically similar to the bedrock from which it derives, and provides most of the materials which through surface processes lead to topsoil formation.

d) Bioturbation - Studies have been undertaken in the Middle Creek catchment (Humphreys and Mitchell, 1983) and elsewhere in the Sydney Basin, of the transporting effects of soil mesofauna such as earthworms, ants and termites. Through regular activities of burrowing, overturning and mounding at the surface, these fauna produce a well sorted topsoil which overlies saprolite and bedrock on most parts of the plateau and hillslopes. This uppermost soil horizon is best termed the 'biomantle' (Johnson, 1990) due to its association with biotic processes. The rates of bioturbation generally exceed all other non-catastrophic movement of sediment on these hillslopes (Humphreys and Mitchell, 1983).

e) rainwash - Sediment exposed at the land surface by bioturbation, or following fires, is susceptible to downslope movement during runoff. This phenomenon, termed rainwash, has also been quantitatively studied in the Middle Creek catchment (Mitchell and Humphreys, 1987, Koop, 2000). On well vegetated slopes, patterns of micro-relief related to forest litter accumulations (litter dams) and root clusters of numerous plant species, act to buffer against mass sheet erosion, favouring incremental downslope movement of biomantle material (Mitchell and Humphreys, 1987).

The smallest particle sizes - clays and fine silts - are less easily retained and are readily transported in suspension during rainwash, allowing their rapid export from the slope. This winnowing of clays and silts acts to progressively leave a coarser textured biomantle, and gives rise to duplex soils on the hillslopes of this area, featuring a coarse textured upper horizon (the clay depleted biomantle) overlying a more clay rich soil, formed by direct alteration of bedrock (the saprolite) (Paton *et al*, 1995).

f) Alluviation - Valley fills have been described above for the main watercourses upstream of Narrabeen Lagoon, arising from termination of stream transport at the elevation of the lake. Much of the clay and silt material removed by rainwash from the catchment is deposited from suspension in the lagoon and as a component of the alluvial valley fills.

Localised accumulations of deep (1-7 m) sediment bodies are also quite common on the valley floors and foot slopes at higher elevations in the sub-catchments of Narrabeen Lagoon. The term hanging swamp is often applied to those deposits within watercourses or in a waterlogged position perched on rock shelves (Buchanan, 1980). These features form where the bedrock structure or in-stream vegetation prompts organic and inorganic detritus to pond and settle out as laminar sediments (Young, 1986).

Other deep deposits of sand occur in footslope settings adjacent to watercourses, where an upslope source area such as a bench, cliff and colluvial slope sequence occur. One such deposit in the Middle Creek catchment has been shown by dating to have commenced accumulating prior to 10,000 years before present (Field and Humphreys, 2000). A distinctive soil-vegetation relationship has been documented on such sand bodies and this process is described in the following point.

g) Podzolisation - The deep, porous sand bodies provide relatively acid and infertile soil conditions for vegetation. Plant species adapted to these harsh growing conditions tend to produce organic acids in their foliage known as simple polyphenols (Blaser, 1994). The ongoing downward percolation of these polyphenols mobilises iron from the upper soil horizon, which redeposits at depth as the acid is gradually neutralised (Blaser, 1994). The concentration of iron often forms a cemented or 'pan' layer within the sand, while the upper profile is typically bleached white due to iron removal. These profiles are termed Podzols (Buchanan and Humphreys, 1980).

On the Hornsby Plateau, the ecological significance of Podzol soils is the distinct differences in plant associations that occur in otherwise uniform settings, according to the presence or absence of a podzol. Species such as Christmas Bush (*Ceratopetalum gummiferum*) and Grass trees (*Xanthorrhoea arborea*) are two examples of species that favour podzol soils, while Scribbly Gum (*Eucalyptus haemastoma*) may grow in proximity to but rarely if ever on podzol soils (Buchanan and Humphreys, 1980). Tree and shrub species are also observed to grow generally taller on the podzol soil than in the immediate surrounding area (Buchanan and Humphreys). The following soil provinces and types, based on the work of Humphreys (1976) and other cited research, are outlined according to land units and the relative importance of the various process factors outlined above:

- a) Residual - At the plateau tops, soils form dominantly by *in situ* processes of bedrock alteration and bioturbation, yielding yellow earths or gradational soils. Laterite formation has also been prevalent on some plateau areas.
- b) Transportational - On valley slopes, the biomantle is mobile over an *in situ* layer of saprolite, or directly over bedrock due to rainwash processes. This process also removes clay and fine silt in suspension. The resulting soils commonly have a distinct texture contrast and have been termed yellow podsolics or duplex soils.
- c) Depositional - On or near valley bottoms, the weathered materials from upslope and/or upstream aggrade to form either swamp deposits, deep sands or lake muds and deltas. Soil types are typically alluvial soils or podzols.

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Aboriginal Heritage in and near Wheeler Creek Valley

by Judith Bennett

Proofread by Dennis Foley, lecturer at the University of Queensland.

Living heritage

Aboriginal people had permanent homes until recently on the shore of Narrabeen Lake where the NSW Academy of Sport now stands. Older local people remember them living their traditional lifestyles near here through until 40 or 50 years ago (into the 1960s). Dennis Foley, a descendent of these people, mentions this fact also on page 57 of his book entitled "*Repossession of our Spirit*" published by Goanna Print in 2000. He tells how the Academy of Sport was built on the bulldozed remains of their campsite after the sandmining of Narrabeen Lake ceased. (2)

Dennis has expressed his stories powerfully in ways that enable the reader to envisage many aspects of the life people lived here. The Aboriginal heritage of Wheeler Creek Valley and other areas in the Narrabeen catchment have been brought to life in his writing. More importantly, he has drawn our attention to the fact that in Australia there are still people with this heritage and these memories alive and well today but not living in the area. He has mentioned some of the relationships the local people had with other Aboriginal groups both near and far. I feel privileged to have met Dennis Foley briefly at the launch of his book and he has generously offered further information that specifically relates to the Wheeler Creek Valley, e.g.

"There was once a trail that led to the Oxford Falls, this was a men's site. Remember the old Pig Farm there? - that was right on top of a sacred area. The other trail from Wheeler Creek went down the side of South Creek, this met up with the main trail that went straight up to the Bora Rings at Duffy's Forest (refer the thesis of Dr. Annie Ross, I think it was her Honours, Sydney Uni around 1974) and the women's sites there and at Terrey Hills.

This track continued to Coal and Candle and across to the canoe spot (Whale engravings) to go north, and from Duffy's Forest another trail led both east and west to other major sites. Wheeler Creek and Duffy's Forest and Terrey Hills are all Bandicoot land. This is women's business. We are matriarchal and some would say that it is all Bandicoot, look for the funny 'V' shape carvings that are lateral. This is the sign of the Bandicoot head." - email from Dennis Foley, July, 2002.

Interactions with other tribal groups

Another additional story that Dennis has supplied concerns the Treaty Rock. On July 14th, 2002, he wrote

"OK, the land of Wheeler Creek

to the north western corner there should be a rock, that is raised - it holds the carving of a small wallaby, the short-tail of which depicts the Gai-mariagal clans and a superimposed kangaroo, the big tail, that represents the Wonnarua clans of the upper Hunter River. These include people of Singleton and right up to Scone. They lived in our land in a time of great drought. This is Treaty Rock.

On the northern side of the valley there once were tubes of bark with bone fragments, I cannot tell you where exactly - I would have to visit. There were also old stunted hollow trees where the bones were placed. There was burial land and sorry business

practices there. It must be preserved. If not then it is another step towards my people's extirpation." - email from Dennis Foley, July, 2002

In his book "*Repossessing of our Spirit*", on Page 21, Dennis tells of burial practices - where after allowing the person's spirit to depart, the body would be cremated. The ashes were used by close family members to coat them in their sorrow. The remaining bones were placed in freshly cut bark which, after being smoked, would form a cylinder. This cylinder was then plugged with clay and painted red with ochre before being carefully placed in a hollow tree, a cave or a high rock crevice.

The presence of clays and coloured ochres (see the story below of the visit by Lisa Madden in September, 2001, for pictures of these colours.) in Wheeler Creek Valley so close to the carvings is an important clue that these carvings were an integral part of regular Aboriginal cultural use. White clay was particularly important for ceremonial use.

Dennis Foley mentions that there was a good supply of white clay in the area and people living beside Narrabeen Lake packed this clay into abalone shell containers of a uniform size for **regular trading with other Aboriginal peoples** from areas where white clay was scarce. (2)

Remaining visible heritage

There are many known and listed Aboriginal heritage sites in and near the area. One of these has a fence around it. The fence was built after Mackellar County Council installed a power pole on this rock in 1975 with steel stuncheons drilled in amongst the carvings. Because of public outrage, the electricity authority was made to remove the pole and NPWS installed the fence to keep the trailbikes (that were using the power line access road) from riding onto the carvings. (See Appendix 11 for full texts of references concerning this event.)

When I asked Dennis Foley about this he wrote

"The electricity authority used a D9 dozer to destroy one of our most important fertility images, and they did not even put a post there. They drove in circles till they crushed the rock, and they did the same on Uncle Colin Gale's land."

Many people visit the carvings in Wheeler Creek Valley and, in the past, some people have desecrated parts of it by carving their initials, scratching in extra animals or scraping around the lines of the engravings. On comparing the drawings made in 1899 with the site in 2002, it becomes clear that bushes are encroaching and covering parts of the engravings.

A discussion of this particular carving is found in "*A Field Guide to Aboriginal Rock Engravings*" (1), although the authors incorrectly refer to the site as being in Wheeler Heights. It is actually at the headwaters of Wheeler Creek. Cromer Heights is the nearest suburb. These authors state that the carvings include a stingray, skates, bream, dolphin, seal and various clubs, spearthrowers and bullroarers around the fish. They mention that these items are men's sacred objects but then state that because cult heroes are not depicted "it is not thought that this area was of great ceremonial importance". (1)

Dennis Foley states ...

To the anthropologist I say "You are ignorant!". The dolphin, the ray, the bream they ARE a link in an ontology and epistemology that is as old as time (and I might

add a scientific knowledge that is far richer than that of the gravediggers of Sydney University). The anthropologist is comparing apples with potatoes - two distinctly different things. The engravings do not need 'cult' figures, that is a different story, from a different place.

To better explain, in Westminster Law, the law is made in the courts under common law or in parliament under statute law. When you walk out of the court room and/or parliament are not these same laws applicable?

It is the same in Aboriginal concepts, we do not need to have 'mega cult figures' to ordain each and every site. Different figures mean different things, but the importance of law still is evident outside of our "parliament" or "court room". I hope this helps to explain." - email from Dennis Foley, 19th July, 2002.

Interpretation by visiting authorities

At the biodiversity survey in 2001, Robin Plumb of NPA told me that Barbara Hastings used to lead NPA bushwalks in Wheeler Creek Valley to encourage people to respect the Aboriginal importance of the land.

On July 14th 2002 I emailed Dennis Foley saying.....

I have an intriguing story. I wonder if you know anything of it. It is tantalising.... but I cannot use it because I cannot verify it. Here it is. My friend, Robin Plumb of NPA, says she can remember that some 30 or 40 years ago, an elderly Aboriginal man from the Northern Territory came to Wheeler Creek Valley and went into a sort of trance. He then said that in the valley there was a rock about the height of a man's waist on which was carved an arrow pointing East. He said this rock was the centre piece for important ceremonies or gatherings in the past.

Dennis replied

Re the man, there have been two, the first his name is gone, that was in the early 1960's. He was Yolongu, from the Territory. He was a law man and he talked to our old ones and gave us knowledge, he spoke of many sites and his existence is true. Perhaps his story of the canoe carving was the most important.

The second man is also Yolongu, his name when living was Wandjuk Marika, that was late 70's and early 80's. He gave us our skin name. He was strong like his uncle. He also read our land and taught us of our people.

The rock he talks of points to our 'other' land; to the east and the land of the Gidjingal, I speak of it in the book. This is the land now under water where we were created. It is where the sun was created. It holds great significance in women's business. You need to realise that our people are warriors, we had to fight for this land when the sea rose, we fought people from over the range, from the south and the people from what is now called the Cumberland Plain.

Look at a topographic map and you will see that the Cumberland Plain resembles a foetus - now you can start to understand the significance of Sydney. The male Phallus is near Blacktown (or was before it was mined for blue metal) and the woman's birthing canal is on the edge of the Hawkesbury water table, right near Hornsby

Station, also a blue metal quarry. The Blue Mountains are mother's spine and the water is of her birthing sack." - email from Dennis Foley.

Coincidentally, on 15th July 2002, Jim Casimir of Warringah Council phoned and gave me the name of Yvonne Witton in Cromer Heights because she has been clearing weeds from the bushland behind her house and wants to set up a bushregeneration group in conjunction with the work the Green Reserves are doing behind the houses in Maybrook Ave. When I phoned Yvonne and happened to talk about the Aboriginal heritage of Wheeler Creek Valley, she told me she had papers from the 1970s concerning this. She remembered visiting the ceremonial rock in the amphitheatre with Barbara Hastings in 1976. The papers she had kept for 26 years gave us verification also of the visit from the Aboriginal specialist in 1976. It is copies of these papers that are now in Appendix 11 of this document. (On 19th July, Karen Petley confirmed that one of these papers is a copy of what is in the NPA archives having been published in the June-July, 1976, NPA Journal.)

Stanbury and Clegg state that because "cult heroes are not depicted it is not thought that this area was of great ceremonial importance".(1) See Appendix 12 for comments on this.

However, as reported in The Sydney Morning Herald on January 27th, 1976, when Mr Jackson Jacobs (who lectured on Aboriginal art and culture at the Australian Museum) saw the carvings of the Wheeler Creek Valley he said "This is a very powerful place. It was a sub-initiation site where the magic men congregated." (6) He was referring to carvings on both the North and the South sides of the valley, the men's sacred cave and to the amphitheatre between them in which a particularly important rock stands.

"Mr Jacobs located a very unusual rock and traced out a great semi-circle from it and suggested it could have been a corroboree ground. Campbell, in 1899, had commented on how the area formed a natural amphitheatre. Another short walk and Mr Jacobs located a heap of shells or midden." see Appendix 11.

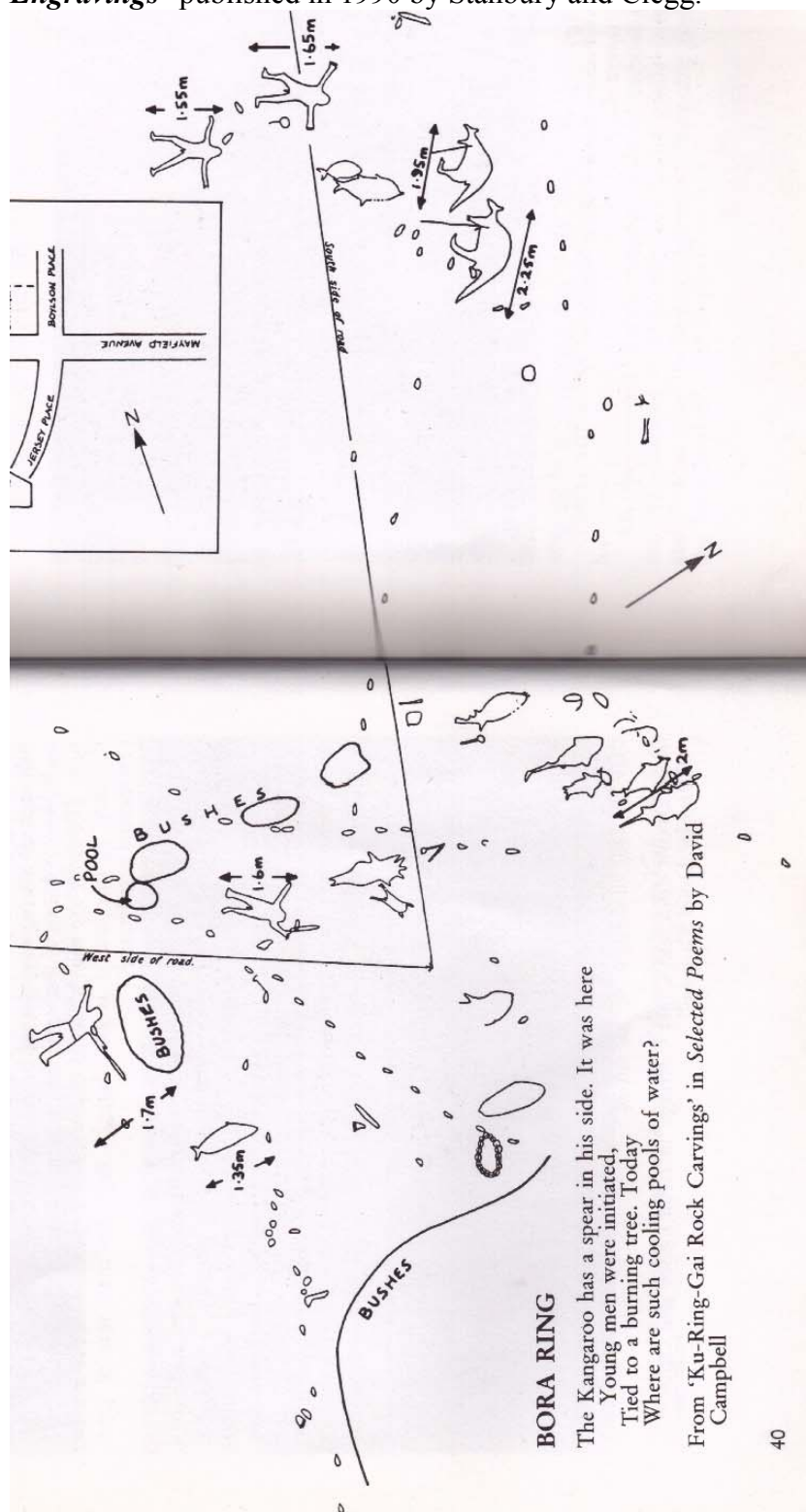
He went on to explain (as much as he could to uninitiated people) ...

that there were many great stories involved with the carvings but not for the uninitiated. The site was a sacred site that linked back to early times when the great rainbow serpent roamed Australia giving the tribes their land. In each area a special site was set aside where the law would be taught and kept. This was such a site and the Wallaby people had been charged with keeping it. The kangaroo and fish with spears in them did not mean this is how an aborigine kills animals but were related to the breaking of the laws and how the kangaroos and fish would vanish from the area if the laws were not obeyed. One of the large figures carried a woomerah and another a magic axe. If an individual broke the law they would see that he died. They would not have to see the individual - so powerful were the magical forces associated with the site.

In 1899, Mr W.D. Campbell, a surveyor for the then Department of Mines and Agriculture, described these carvings as "altogether one of the finest groups the writer has ever come across." (7)

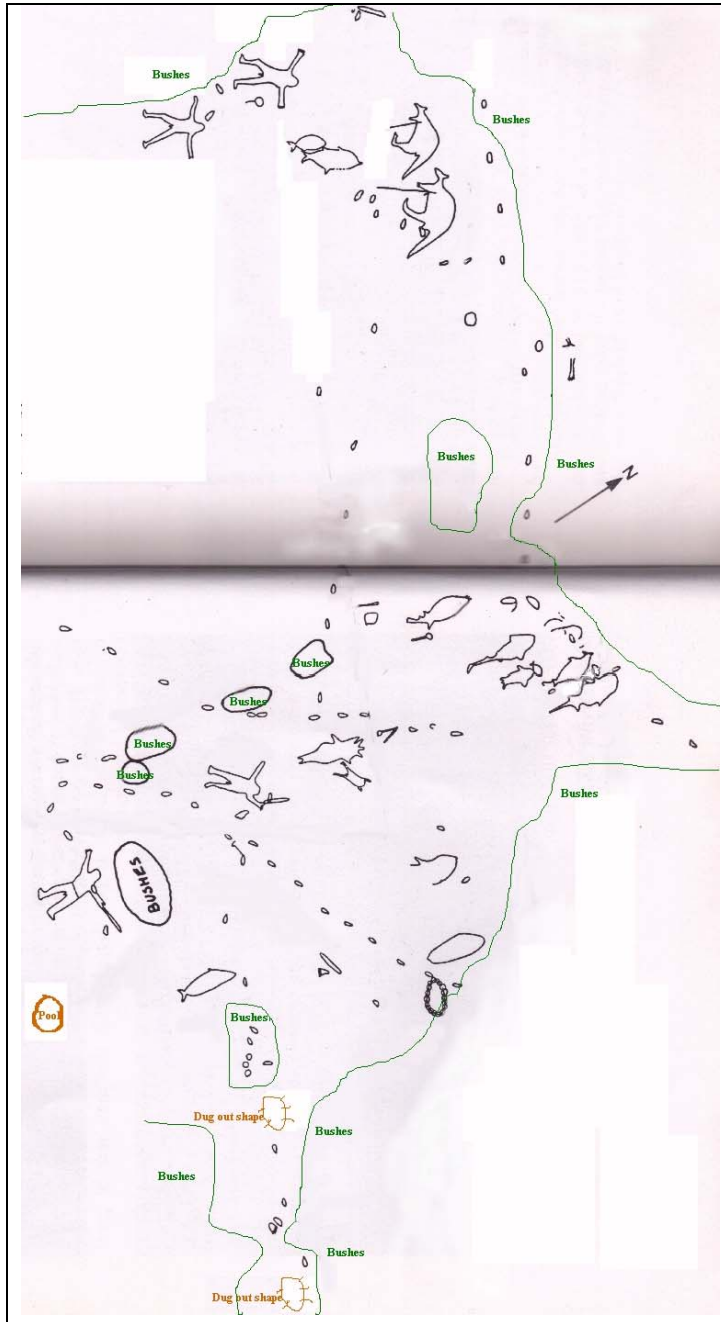
It is astonishing that the surveyors, even though acknowledging their quality, drew the road going right through the carvings and this remains marked as a road reserve to this day (2002).

Here is how the site layout was depicted in "*A Field Guide to Aboriginal Rock Engravings*" published in 1990 by Stanbury and Clegg.



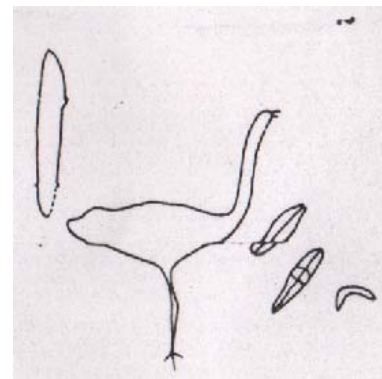
(It is the same diagram as was published for the GEOL SURVEY, N.S.W. ETHNOL. No 1. Plate 10 entitled "Head of Wheeler Creek - Parish of Manly Cove. North Side.)

Here is how the bushes have encroached in the over the years....

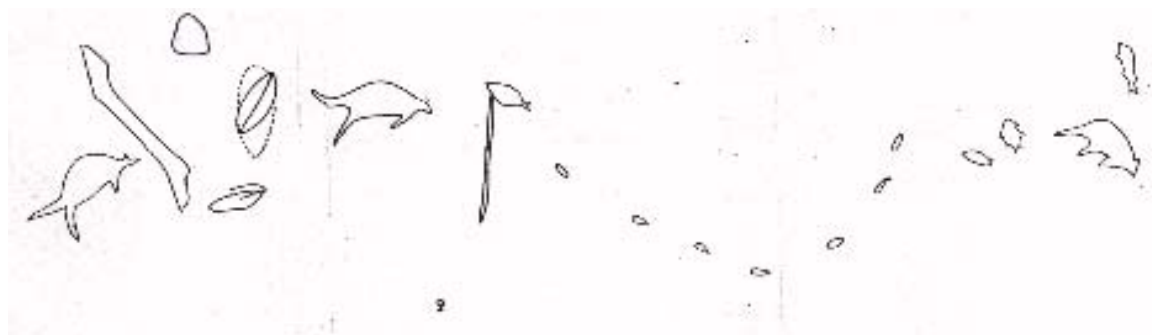


This drawing was scanned from the 1899 Campbell diagram in Stanbury and Clegg's book and modified in an attempt to show differences that have occurred since then. I have erased the offending road reserve markings. Green lines mark bushes. Brown lines are items not mentioned in the 1899 version. Either they have been added since then, or the authors in 1899 did not regard them as significant. Judging from the position of the power pole in the photo from the Sydney Morning Herald of 1976, I would guess that the strange round hole marked "pool" in brown at the left of the picture is where the electricity authority dug out the powerpole. Crinea frogs breed in there now.

Yvonne Witton's 30yr old papers included copies of the 1899 drawings by W.D. Campbell in which there were two inserts - not reproduced in the Stanbury and Clegg book



Emu carving from 1899 drawing



These carvings were depicted in an insert on the 1899 drawing with no indication of their size, location or orientation with respect to due North.

Transmitting the culture and law

Dennis Foley, in his book "*Repossession of our Spirit*" describes how male initiates travelled from Narrabeen Lake up the steep cliffs to Oxford Falls to the men's area for initiation ceremonies (where later a pig and poultry farm operated and where now there is Oxford Falls Grammar School). (2)

In their book, "*A Field Guide to Aboriginal Rock Engravings*" Stanbury and Clegg describe the use of mundoes (carved footprints) or pits (P.129) in men's initiation ceremonies where the initiate was blindfolded then led around the tracks, being shown one important picture or carving after another. The book records 11 mundoes for the carving but that seems to be a small number compared to the diagram. (1) and to the number of markings that look like mundoes that can still be seen in 2002 on the rock. I also suspect that bushes and encroaching earth obscure other parts of the original carvings in this area.

Stanberry and Clegg, in "*A Field Guide to Aboriginal Rock Engravings*", when discussing Totemism state that **"Any engraving, for example, one which looks like a kangaroo, could be a picture of a kangaroo, a picture of a person or clan which had a kangaroo totem or a mythic being... As religion is all pervasive and closely related to the land, all pictures are probably sacred and belong to places If you are near an engraving you are almost certainly on sacred land.... Engravings are the physical manifestations of songs which were expressed in dance, pictures and rituals, as well as by singing."**

Engravings, dances and songs contained quite a degree of esoteric information and were designed to be understood at various levels - intentionally simple for the uninitiated.

(For me, personally, seeing ocean fish depicted at the headwaters of Wheeler Creek Valley reminded me of how we, in our schools, teach children to paint yellow fish above drains as a public education measure - reminding people to take care because the drain leads to the ocean. It is fascinating to note that Mr Jackson Jacobs indicated that this was a teaching place - where Aboriginal law was transmitted.)

Stanbury and Clegg conclude that **"A visit to an Aboriginal rock engraving site is an excursion into prehistory. The engravings were made by people who had no writing but a thorough understanding of the way their community was a part of the landscape and the environment. Information was passed to the next generation by speech, and reinforced by ceremony and representational art."**

Dennis Foley, in his book "*Repossession of our spirit*" (- page 44) tells a story from Narrabeen Beach of how a greedy man caught more fish than he needed, and was punished, banished, told lies and then was turned into a brown snake. (2)

He points out that stories like this taught lessons about caring for the environment such as **"to take only what food is necessary, never to waste, to respect the elders in a school of fish, and never to let greed dominate our values. Perhaps the most important lesson is that one should never lie."** - (2)

Other important nearby sites

There are caves, (at least one containing hand paintings) and many rock carvings nearby. (3) Local residents fought (but lost) battles to prevent urban development of Red Hill for this reason as well as for the protection of the natural environment. (3) Little or no

protection is afforded to most of the Aboriginal sites and some rock engravings are suffering serious damage, most notably sites near tracks and one where bulldozing destroyed the rock surface. Vegetation appears to be invading some of the engraved rock platforms.

There are stone arrangements in the area that is now registered as Aboriginal land. (5)

The land managed by the Metropolitan Local Aboriginal Land Council extends from just past the carvings depicted above around to the NSW Academy of Sport (which was the area of permanent dwelling until the 1960s). When walking on this land it is still possible to stand on outcrops of rock and have views of bushland with no buildings visible. If there are no human noises (such as trail bikes) then I find that there seems to be a revitalising presence - a sense of continuity - an inkling of what the place meant years ago perceptible even to those of us without blood line Aboriginal connection.

There are many discussions about the origin of the name of Narrabeen Lake. Some record that Aboriginal people called it Narrabang - a reference to black swans on the lake. There are also records of it being called Narrabin, in honour of a young girl from old Yowal's clan who did good dispatch work - including running to get help when her people were about to attack some Europeans. In some early records it was spelt Narrabine. (4)

Recommendations:

A detailed study of the Aboriginal heritage of this and nearby areas by Aboriginal consultants is advised.

The road reserves in the valley need to be rezoned.

The whole valley needs environmental protection.

The roads that facilitate trailbikes or 4WD vehicles need to be blocked off with signs erected to educate people that trailbikes and 4WD vehicles are not permitted.

The Warringah LEP needs to ensure the preservation of the remaining bushland of Warringah and particularly exclude any new buildings that would be visible from vantage points on Narrabeen Lake or within Aboriginal land.

The tradition of this being a teaching place - a place where people contemplate their responsibilities towards the land we inhabit, needs to be incorporated into the management of this area through the 21st Century in ways that enrich all people whether or not they are of Aboriginal descent.

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6. The Sydney Morning Herald, Tuesday, Jan 27, 1976
7. Campbell, W.D. 1899 "Aboriginal carvings of Port Jackson and Broken Bay", memoirs of the Geological Survey of NSW Ethnographical Series, No 1, Sydney.
8. From an article entitled "Place of the Wallaby" by Joy Lee, NPA Journal June/July 1976 - see Appendix 11 for full script

Aboriginal Speech

By Lisa Madden

During the September survey several Aboriginal students who are studying Aboriginal heritage management joined us in the survey. One of them, Lisa Madden, gave the following speech during the closing barbecue when politicians and Warringah councillors attended.

Hi. I'm Lisa Madden. I am a descendent of the Eora nation. Within the Eora nation there were 29 clans whose land was bounded by the Hawkesbury, the Nepean and the Georges Rivers. I would like to acknowledge and for all of us to pay our respects to the Ku-ring-gai clan.

Where we are here this evening and the Wheeler Creek Valley we have researched is the land of the Ku-ring-gai clan. There are 6000 Aboriginal heritage sites in Sydney registered with the Metropolitan Local Aboriginal Land Council. Sydney has the highest number of Aboriginal sites of any city in the world - these are precious and need protecting, but the task of doing this is enormous.



Lisa is making a collection of clay and coloured ochre suitable for painting.

This morning, I was moved by what I saw at the top of Wheeler Creek. On our way, heading up to the engravings I could sense that the colours were right there. I had this picture in my mind that people used these colours to get art painting ready on their way to the engraving site.

These colours were clay mixed with sandstone giving a variety of shades. My ancestors used these colours to get ready for festivals and there are plenty around Wheeler Creek!



Colours of clay and kaolin near Aboriginal carvings



Kangaroo carving

This particular heritage site has an array of engravings. I saw engravings of a child, two or three men, fish, sharks, stingrays and a kangaroo. This particular engraving is very special as it tells a story that these people had the best of both worlds. They had a variety of foods from sea foods to bush foods. There were also cleaning areas where they would have cleaned fish, sharpened spears and there were footprints walking through.

Across the valley, I could sense that there were camp sites. This is a meeting ground. This valley may well have been a place to meet, to eat, to gather and maybe move further along for dancing and story telling.

I really enjoyed the native flowers and my experiences at Wheeler Creek.
Thank you to all the volunteers that came together this weekend to do this survey.



Volunteers at the survey

Land Ownership in the study area

by Judith Bennett

The area around Wheeler Creek is held under a range of ownerships. These include Crown Land held under the Department of Lands and Conservation, areas vested in other state government departments for public and recreational purposes, Local Government lands, Metropolitan Aboriginal Land Council holdings, and a range of private tenures including land in Cromer Heights owned by Cromer Golf Course, land developed for aged care and private housing and some as yet undeveloped land. There is one portion of land held for nature conservation purposes.

On the map in Appendix 1, there is an area to the North marked as "Recreation Reserve". From this point and along to the west of Cromer Heights is mostly Metropolitan Local Aboriginal Land Council land. We had the permission of the MLALC to survey areas on their land adjacent to Wheeler Creek Valley. Quadrats 8, 11 and 16 were in that area. Some night spotlighting was done with the permission of the owners in a property at the end of Northcott Ave, Cromer Heights.

On the Southern slope of Wheeler Creek Valley near Lady Penrhyn Drive in Red Hill is a collection of privately-owned parcels of non-urban land. These parcels of land are on the bushland side of Lady Penrhyn Drive which means that the road is serving as a firebreak. Some of the landowners of the non-urban land are hoping to build on their land but, as this survey will show, great care needs to be taken and more detailed surveys undertaken, as this land is potentially environmentally sensitive and important for a number of reasons discussed elsewhere in this report. It is likely to be critical habitat for more than one endangered species. Any buildings, particularly if for elderly or disabled people, on this land would require extensive clearing for firebreaks in this environmentally sensitive area.

History of Wheeler Creek Area

By Judith Bennett

Aboriginal lifestyle

For thousands of years, Aboriginal people found plenty of food in Dee Why Lagoon, Long Reef and Narrabeen Lake to support the people living in the area. The carvings in Wheeler Creek Valley depict ocean creatures as well as land based ones. Wheeler Creek Valley was a meeting place and a place for transmitting the law for members of the Aboriginal community. A special rock commemorates the times (thousands of years ago) when their ancestors lived several kilometers East of the current coastline on lands which are now under the sea. Aboriginal people continued to live on the shore of Narrabeen Lake until the 1960s. (1)

European land grants

In the 1830s, early land grants in Cromer and Narrabeen were given by the Crown to James Wheeler, Rev J.J. Terry and David Meares. (3)

In 1836, James Wheeler built a rough hewn bush timber home on the shores of Narrabeen Lagoon where he owned 230 acres and in 1839 he built the "Homestead". When he died in 1890 he was buried on his estate overlooking Narrabeen Lagoon. His descendents still live on the estate. (6)

Transport to the area from Sydney

In 1850 Peter Ellery started a punt at the Spit which was replaced by a wooden bridge in 1924. In 1854 the Manly Ferry operation began. In 1910 there was a tram line built from the spit to Brookvale which was extended to Collaroy in 1912. At this time Narrabeen was a coal refueling wharf for coastal steamers. The tram was replaced by buses in 1936. (6)

Prior to 1883 the little building which became the first Cromer Community Centre was the old Newport post office. (2)

Surveys

In 1885 Wheeler Creek and Wheeler Trig Station were named after James Wheeler senior. Surveyor G.H. Knibbs traversed South, Middle, Wheeler, Snake and French's Creeks and named them on a survey map. (6)

Notes on a map in 1887 indicate that the land in the Cromer area was used for poultry and vegetable farms, bee keeping and grazing.

A Land Auction was held on 1st November, 1888. Some of the streets in Cromer are named after the purchasers of land from this Crown Land auction.

European surveyors examined the areas inland from Narrabeen and were followed by settlers. Early landowners included:-

Lot 806 H.H. Cormack

Lot 809 J. Davison

Lot 810 S. Carathas

Lot 811-816 John Davison

Lot 817 H. Hall and J.W. Dawson

Lot 821 William Henry McIntosh

Lot 908-917 R. Amos

Lot 918 Fleming

Lot 919 Little

Lot 929-931 McIntosh

Lot 2559 CP5842 A.D. May

In the 19th and early 20th Centuries, settlers were interested in the commercially viable resources of the area. They established a quarry on Red Hill (named for the iron-rich shale which is coloured red) and a market garden on the small 100year flood plain of Wheeler Creek west of Little Willandra Road. In nearby areas poultry farms and market gardens predominated. (6)

Industries

In 1889 the Brick Pit was opened in Brookvale requiring quarrying operations in Beacon Hill. (6)

In 1930 Water from Pymble Reservoir was pumped to a newly constructed reservoir on Rocky Hill, Beacon Hill to augment the Manly Dam Storage Reservoir. (6)

In 1932 St Matthew's Farm nearby was set up by Rev Ebbs of St Matthew's church in Manly as a training farm for unemployed youth from 1932 - 1940. (4)

By 1954 there were 14 mine and quarry firms in Warringah employing 76 people with 12 industries producing bricks, pottery and glass and employing 196. In this year there were 706 people in rural pursuits (mostly mixed farming, but also grazing and dairying). (6)

In 1954 the Oxford Falls and Dee Why areas were mostly poultry farms but also some pig farms and market gardens. (6)

In 1956 - brick shales, kaolin, foundry loams and building stone were needed for the building industry and there were several quarries including one on Red Hill next to Wheeler Creek valley. (6)

In 1957 - electricity substation built at Beacon Hill.

During the second half of the 20th Century, with increased road and ferry transport, Warringah areas became suburbs of Sydney. Because of the beaches and bushland, land values rose sharply and there have been increasing demands to convert bushland into suburban developments. Recently, Warringah Council, knowing that the residents place a high value on natural bushland, has created a Local Environment Plan lodged 2000, required by State Government Planning Policies, designed to protect the remaining bush areas.

Housing and residential developments

Streets in Cromer Heights are named after winners of Victoria Crosses except for Maybrook Ave which is named after A.D. May - the first owner of the land now occupied by Maybrook Manors. (4)

In 1956 there was a premature and unsatisfactory Planning Scheme written for Warringah Shire Council which did not envisage needs for schools at Beacon Hill or Cromer and which proposed new housing subdivisions in impossible locations having no regard to road access and no provision for parks, schools or children's playgrounds in Dee Why West. (It recommended that a hospital site be purchased in French's Forest or Belrose.) (6)

In 1959 an old Army hut from North Head was transported to Cromer for the Uniting Church in Carrington Ave. (4)

Early in the 1960s Mr Maurice Boylston built the first brick home in Cromer Heights and paid 1500 pounds to bring electricity to Cromer Heights. His mother was the daughter of Maurice Corkery who lived in Cromer from 1896 - 1897. (4)

By 1970, the quarry on Red Hill was no longer in use - the area had been scraped bare by the quarry and for that reason, the site was chosen by the ABC for filming of a movie called "Over There" - about World War II. See Appendix 10 for information and photographs.

In 1972 shops were built in Truman Ave, Cromer Heights.
A memorial to Peter Badcoe, V.C. was established in Badcoe Rd, Cromer. (4)

In 1981 the new Cromer Community Centre was opened. (4)

In 1990 the first stage of Maybrook Manors was built. (4)

In 1997 Willandra Bungalows construction began on land straddling Wheeler Creek that was formerly market garden and nursery and next door to Natural Areas Ltd land.

By the end of the 20th Century, land values in the area were high. The terrain is uneven which provides many opportunities for highly desirable picturesque views. This has led to ridgeline developments to maximise the return on investments for developers but the impact on the natural environment is most unfortunate. There are species such as butterflies, heath monitors and red-crowned toadlets which need access to ridgeline areas during their lifespan. Erosion, pollution and weeds impact the bush in the gullies below developments. Bushfires travel quickly up steep slopes and in order to protect their housing, residents demand hazard reduction burns more frequently than would be advisable for ecological reasons and construction of firebreaks behind their properties that result in extra clearing of wildlife habitat.

The aftermath of the 2nd World War has created a population age shift with sharply increasing numbers of people reaching retirement age. Legislation put in place by the State Government to force Councils in NSW to provide retirement housing has been mis-used to justify medium density housing developments in bushland areas designated as rural where housing was not intended to be closer than 1 house per 2 hectares. Developers have already built two retirement complexes bordering on Wheeler Creek Valley (Maybrook Manors and Willandra Bungalows) and made several attempts to gain approval for other similar projects along the Red Hill side of the Valley. The land values, combined with a perceived shortage of retirement housing have led to a situation where each unit within the development sells for more than suburban family homes nearby.

Nature conservation, objections to development and respect for history

Since 1961, NPA has been urging the Council and Government authorities to preserve this bushland area of Sydney.

In 1971 Lot 821 was purchased from Dorothy Phillips by Natural Areas Ltd changing the former nudist colony usage to an area preserved as natural bushland. The land has access via Maybrook Ave, Cromer Heights and also via Kirrang Ave off Little Willandra Rd. (8) Many efforts have been made since then to remove all traces of the bamboo Dorothy Phillips planted as a screen. In 2002, the Green Reserve team is digging the bamboo roots out one by one.

In 1976, after the Mackellar County Council had desecrated sacred carvings, conservationists called for a ban on residential development in Wheeler Creek Valley because of its importance to Aboriginal people. (6)

In 1981 on 3rd Sept Warringah Council urged the State Government to rezone land in Cromer so that a \$5m retirement village could proceed. On the 17th Sept a deputation of residents to the Minister for Planning and Environment, Mr Bedford, to object to retirement village. (5) On the 21st March in 1987 two new public housing estates proposed in Maybrook Ave and Northcott Rd were opposed by local residents. (4)

In 1988 Phil Shaw, Vice-President of Bird Protection League, operated a hospice for birds in Blighs Rd, Cromer Heights. (4)

In 1991 Michael Guider wanted a full survey of Aboriginal carvings in Wheeler Creek area. There was more than one Manly Daily article such as the one on Page 2 of 8/3/91 by Marj Belessis that pictured Michael Guider beside Aboriginal sites. (5) This man is now in jail accused of crimes committed in Manly and elsewhere. In this year there were three flora surveys in the area, which recorded no rare or endangered species. (Note: There was no Threatened Species Conservation Act at that time.)

In 1992 Warringah Council sought environmental protection rating for the Wheeler Creek area. (6) In 1993 a museum was proposed by the Metropolitan Local Aboriginal Land Council but no details were mentioned in the newspaper about its proposed location. (5)

In 1994 bushfires (lit at night to back burn before encroaching bushfires) burned out of control through Wheeler Creek Valley and surrounding bushland. (7)

In December 2000, Warringah Councillors voted unanimously to seek an environmental protection rating for the Wheeler Creek Valley and to ascertain the intentions of landholders in the valley including Natural Areas Ltd. (8)

In 2001 Green Reserve team - Cliff Kelsall and Ian Moran began work on a program - approved by Warringah Council and supervised by Judith Bennett of NPA - clearing weed from Natural Areas Ltd land, the Kirrang St road reserve and the banks of Wheeler Creek west of Little Willandra Rd. Native plants donated by the Society for Growing Australian Plants and by Warringah Council have been established by the team along the banks of the creek and one of its tributaries. The Green Reserve team also monitors activities within Wheeler Creek Valley bushland. (7)

During the year 2001 the Land and Environment Court upheld the decision by Warringah Council to refuse a development for a retirement village on Lady Penrhyn Drive Red Hill on rather steeply sloping land. (7)

In December 2001 - storms, wind and lightening strikes caused many trees to fall in the valley but there were no fires. The Electricity Authority, which has power lines running through the valley, built a wide track to be bulldozed through the area to allow service trucks to get through. The bulldozed tracks go down from the main track to each of the power poles which are built along a cliff top. This is causing erosion and carries the risk of weed infestation. Warringah Council intervened during the process and instructed the contractor to make the remainder of the track the minimum necessary width, and there have been straw bales put in place which are not proving to be very successful in controlling the erosion and in which weeds are growing (observed 22/7/2002). (7)

Although this track is useful for servicing power lines, for educational excursions and for access in the event of bushfire, Warringah Council needs to insist that the energy company either reticulate the power through built areas and remove the power lines from the valley or form the tracks in accordance with soil conservation guidelines e.g. using table and mitre drains and rollovers to disperse flows and minimise erosion. Horses, bikes and 4-wheel drive vehicles are now coming through on this track and exacerbating the erosion problems and the threat of weeds. (7)

In January 2002 - the Minister for the Environment, Mr Bob Debus, announced the publication of a "Planning for Bushfire Protection" document which contains recommendations for future developments near bushfire prone areas. (7)

In February 2002 - the retirement village development plans for the Catholic Church lands on the Red Hill side of the valley were to have been the subject of a Land and Environment Court case but the case was withdrawn because of the implications of the proposed new regulations regarding developments in bushfire-prone areas. (7)

In 2002 Community working bees began that involved the residents of Willandra Bungalows in clearing weed from Wheeler Creek and from Natural Areas Ltd land working together with the Green Reserve team and representatives from Warringah Council. (7)

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8. From the files and records of Natural Areas Ltd.

Management Challenges at Wheeler Creek

Human Impacts

By Anne Reeves

A number of tracks, many widened to road width, exist parallel or near the ridgelines, with some smaller tracks crossing down to the creek line. These were built to service power lines and provide access in case of bush fires. The area is used for informal recreation with some of the track activities leading to considerable erosion, currently exacerbated by increasing pressure from mountain bike riders to build new tracks and to mold tracks to suit speed riding or jumps rather than to reduce erosion. Silt released by erosion has been carried downstream.

Off road vehicle activity, especially around some of the heath and hanging swamp areas, has caused serious impact to the vegetation and natural water run-off.

Dog walking off lead possibly contribute to loss of small fauna (e.g. lizards) in the more open areas whilst dog and horse droppings introduce nutrients and seeds.

Some of the surrounding development seriously affected the lower parts of Wheeler Creek, as is evident in the section below Maybrook Avenue and off Jersey Road.

Housing developments off Little Willandra Road adjacent to Natural Areas Ltd have significantly impacted on the natural creek line. Barriers that prevent the natural native fish migration essential to maintain life cycle and breeding, loss of riparian vegetation, and possible re-alignment of the creek have occurred. Siting and layout of some of these developments do not appear to have been given adequate attention to bushfire risk.

Over the last 30 years, man-made litter (such as plastic bags, drink cans, etc) has been washing down the storm water lines in the bush and down to the creek. This litter load, together with the nutrients from suburban gardens have caused weed plumes down the drain lines.

Erosion:

By John Macris

A survey of the conditions at a number of the disturbed sites identified from air photos commissioned by Warringah Council was undertaken on foot.

These were principally in the catchment adjacent to Wheeler Creek (draining towards Middle Creek) and occur within the bushland linked to Garigal National Park.

Uniformly, disturbance is concentrated around parts of the vehicle trail network, reflecting a pattern of recreational usage by motor vehicles, mountain bikes, horses, joggers and walkers.

Three site examples from different land units within this area are briefly described, as an indicator of the different degree and type of human impacts, relative to slope and soil characteristics.

Site A. broad ridge top,

0.4 km north of the western end of Cromer Road, Cromer Heights.

At the intersection of two trails, around 300 square metres are devoid of vegetation, exposing sandy topsoils and in local sections, the underlying sandy clay subsoils. The entire

surface shows evidence of being regularly driven over, and accordingly no vegetation recovery has taken place.

Soil loss in total from the site has been of low orders, because of the subdued topography of the expansive sandstone plateau near the upland margins of the catchment. Hence the recovery prospects for this site would be high if containment of vehicles and pedestrians to the original road alignment could be achieved.

Enclosure and brush mulching would be desirable.

Site B. gently sloping section of trail, passing within 10 m of a ridgetop house at the western end of Northcote Road, Cromer Heights.

A braided trail has 'evolved' along much of this slope as a consequence of knick-point gully erosion along the original trail alignment. Average gully depth exceeds 1.5 metres, and some entrenchment is continuous for up to 50 metre sections. Exposure of subsoils is common along these entrenched sections.

The slightly steeper topography in comparison to site A (slopes of 5-10 degrees through this area) have contributed to much more serious surface erosion.

These deep gullies would be likely to require at least annual placement of sediment trapping structures to disperse or divert flows and brush mulching to rehabilitate, over a time span of some years. Vehicle exclusion would greatly aid efforts in curtailing and diminishing the erosive potential of runoff, by allowing the remaining unincised surfaces to revegetate and recover their natural level of physical resistance to shear forces.

Site C. hairpin bend of management trail 1.5 km south east of Oxford Falls.

On the steep valley slopes (up to ~ 30 degrees) examples like this area are fairly common. Around 100 square metres is void of vegetation due to the erosion of the shallow mantle of sandy soil, which would normally occur in mosaics over the benches of Hawkesbury sandstone, amid rock outcrops.

Surface degradation appears to have been most pronounced at the base of sandstone benches, with erosion of up to 0.8 m indicated. The net total effect of deep erosion of these prior colluvial aggradation zones, and loss of the shallow soils on bench surfaces, is a large denuded area, and a management trail of extremely poor condition.

Natural or assisted revegetation would seem feasible, but its effectiveness pivots on controlling the erosion hazard presented by the regular passage of motor vehicles, trailbikes, mountain bikes, horse riders, joggers and walkers.

Conclusion:

In summary, much of this network of management trails is of greatly reduced utility due to the condition that it has fallen into through recreational use followed by periodic erosion of the disturbed surfaces by storm runoff.

The degraded sites on low relief plateau tops (as per site A) are classed as recoverable pending usage change and encouragement of natural revegetation.

Areas with deep texture contrast soils and sufficient slope to experience rapid saturation surface wash during storms, are prone to deep gully excavation, as at site B. Rehabilitation requires considerable assistance and recurring attention. The steeper slopes, with highly variable soil depths have experienced not insignificant erosion, but are less prone to gully incision than the areas of uniformly deeper soil mantles further upslope.

Hence degradation could be arrested by appropriate control on vehicle passage and assisted revegetation.

Weeds

Collated by Judith Bennett from opportunistic sightings of the participants

List of common invasive weeds with locations

ACACIA SALIGNA - On land next to Maybrook Manors, in Quadrats 6 and 21

PAMPAS GRASS - 1 x Sport & Rec at dam on Western end. Some behind houses in Maybrook Ave

WHISKY GRASS - on ridge top, small patch behind Sport & Rec Centre dam at Eastern end. At carpark at dam at Sport & Rec Centre. In Quadrat 21

CROFTON WEED - at end of water course at Sport & Rec dam. Behind houses along Maybrook Ave to Maybrook Manor.

LANTANA - at end of water course at Sport & Rec dam. Behind houses along Maybrook Ave to Maybrook Manor.

WILD TOBACCO - three locations on the North side of the creek.

FISHBONE FERN - along Maybrook Street to Maybrook Manor.

PRIVET - North side of creek behind houses.

TURKEY RHUBARB - North side of creek behind houses.

BAMBOO - Near Quadrat 12 behind houses in Willandra Bungalows

STINKING ROGER - Behind houses in Willandra Bungalows

FLEABANE - North side of creek behind houses Behind houses in Willandra Bungalows

LUDWIGIA - in Wheeler Creek near Willandra Bungalows and West of the bridge

BLACKBERRY - in Kirrang St road reserve. On Maybrook Manors land.

CORAL TREES - in Kirrang St road reserve and on creek bank of Natural Areas Ltd land.

NOTE: some of these weed problems have been treated since the collection of this data. e.g. Maybrook Manors have treated their blackberry. The Green Reserve team together with Warringah Council and Willandra Bungalows have removed Ludwigia from the Creek west of the Little Willandra Rd bridge. The creek needs frequent surveying and treatment if necessary to ensure that the Ludwigia does not become re-established.

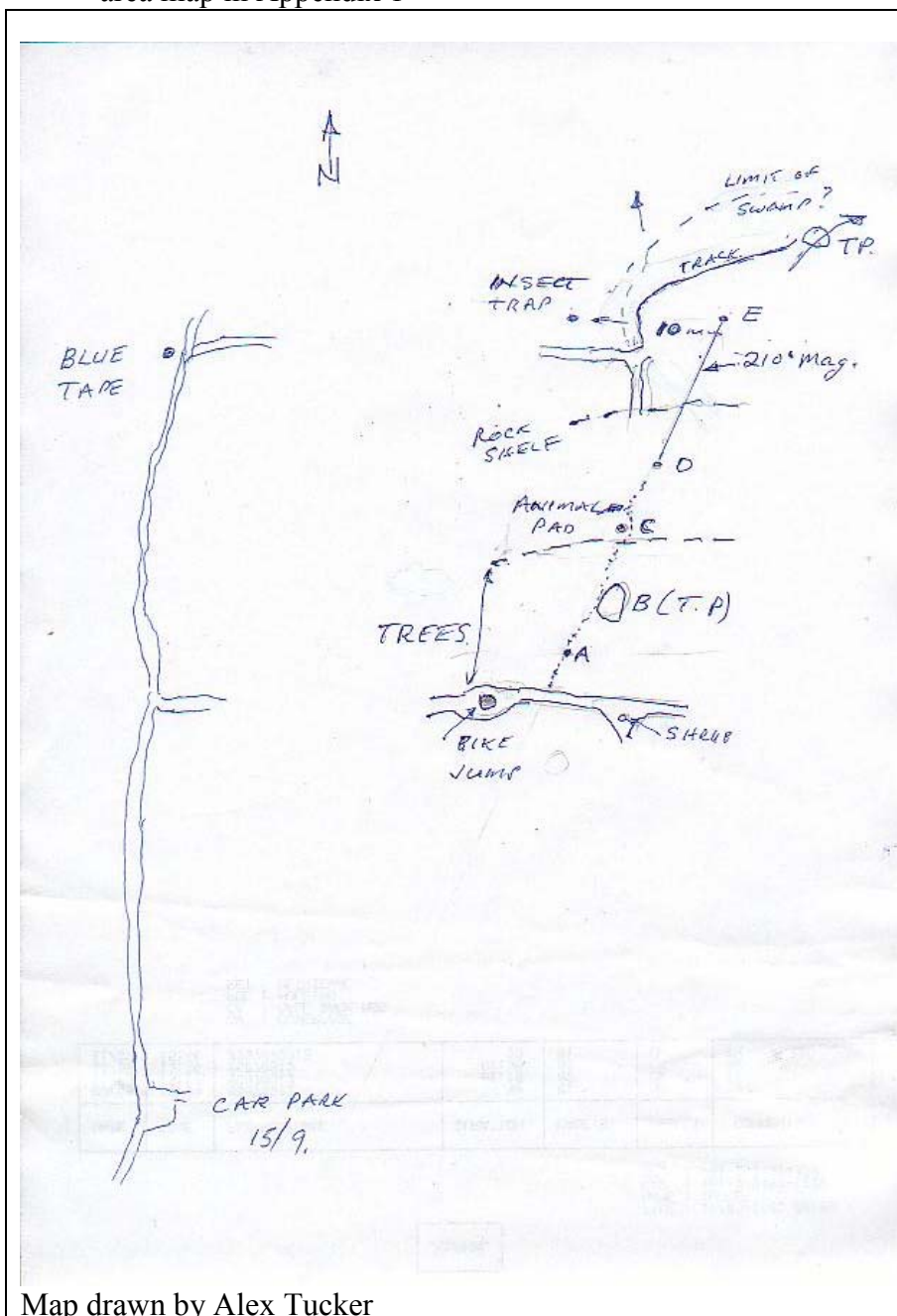
Soil Sampling

by John Macris and Alex Tucker

To compliment the flora and habitat information collected on the biodiversity survey, an examination of changes in soil characteristics was undertaken on a north-east facing valley slope in the Wheeler Creek head waters. Topographic and vegetation changes were used as reference points for soil testing. For convenience and to minimise disturbance, soil profiles were excavated using a hand-turned auger.

Observations:


Sites referred to are depicted on the sketch map below. Location marked as "SS" no the area map in Appendix 1



There was no surface water at any test site. At site D, approximately the upper 50-70 cm of soil was saturated immediately below surface and was too fluid to be extracted by the auger. This material was an organic-stained coarse sand, waterlogged under present conditions. Below this depth the soil changes sharply to a heavy clay, essentially void of any organic colouration and defining the limits to subsurface saturation.

Logically, this clay would be a product of *in situ* weathering; that is, breakdown of clay rich strata in the Hawkesbury sandstone bedrock. This can be assumed because of the local topographic relief, with slopes of 8-15 degrees. On such gradients, suspended clay sized particles transported by runoff would rarely, if ever, settle out and deposit (see experimental work of Mitchell and Humphreys, 1987).

Map drawn by Alex Tucker

<p>There is a rock shelf at E 338178 N 6265348 which diverts surface water into wheel ruts and apparently forces sub surface water down.</p> <p>Below the shelf ,the sedges persist and beyond site E there is a ridge of <i>Hakea teretifolia</i> and <i>Banksia ericifolia</i>. No surface water was noted, but the soil is spongy and close to saturation. The limit of wet lands is assumed to be where there is an incised creek bed</p> <p>The western arrow on the map is the creeklet taking the surface flow from the wheel tracks.</p> <p>Approaching the scarp, one dry creek channel was seen but there may be others hidden by the shrub layer. The eastern arrow shows the larger creek probably taking the sub surface flow.</p> <p>Site B, on the more gentle plateau slopes above the scarp, is believed to be a prospector's test pit, dug by hand and subsequently eroded into a 2 metre square cavity. There is a further test pit in the eastern creek where the sand appears to have been dug out by a small front end loader but might have been dug by hand, exposing in a creek bank about 1 metre of whitish sand under minimal organic soil. No waterlogging was encountered in the soils of the plateau.</p>	<p>Test Locations</p> <p>Easting Northing</p> <p>A 338137 6265257</p> <p>B 338140 6265285</p> <p>C 338157 6265312</p> <p>D 338167 6265338</p> <p>E 338193 6265362</p>  <p>Edge of rock shelf E 338178 N 6265348 The area above the rock shelf is possibly a permanent wetland and contains swamp vegetation.</p>
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Observaions concerning the surrounding area

The area to the south and south west of the swamp (marked "carpark" and "bike jump" in the map) was once a quarry on Red Hill so called because of the red laterite layer being



quarried. The gravel was often used for road base because the high iron content made it hardwearing.

Vegetation is low growing in the hanging swamp. The trees are along the ridge line above the hanging swamp.

Soil Landscape Analysis

Between the lower and upper constraints of the rock shelf and plateau margin respectively, is a landform complex of moist shrubland and valley-side swamp (using the terminology of Buchanan, 1980, from the Lambert Peninsula). The grey clay layer encountered below the waterlogged sands has been reported in association with moist shrublands by Lambert (1980) in a limited number of settings on the Hornsby Plateau. This type of geology-dependant upland swamp appears to be limited in distribution however, with contrasting stratigraphic characteristics reported for swamps of the Woronora Plateau (Young, 1986) and Blue Mountains (Holland, 1974).

In the present setting, the clay-rich parent material is required to lead to the notable waterlogging and groundwater sapping conditions that support these hillslope wetlands. Additionally, Buchanan (1980) found topographic limits to their formation; In very incised Vee shaped valleys, gorges and steep plateau margins, conditions do not favour development of hanging swamps (collectively referring to valley-side swamps and moist shrublands).

Hence, the hanging swamp landforms (and dependent ecosystems) should be considered far from ubiquitous in the Sydney Basin context. Indeed, the bias towards steeper Hawkesbury sandstone landscapes in the reserve system of the Sydney region (Latham, 1999) generally, and northern beaches/Broken Bay vicinity specifically, renders such wetlands considerably less well recorded, recognized and protected than those of the coast and estuaries.

To redress this in part, among the management and broad scale recommendations of this report will be a proposal for State Environmental Planning Policy (SEPP) 14 to be amended to recognize and list the types of wetlands described in this catchment.

References

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Holland, W.N. (1974) Origin and Development of Hanging Valleys in the Blue Mountains, New South Wales. Unpublished PHD Thesis, University of Sydney.

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Water Testing of Wheeler Creek

Water testing in March

By Melinda Elith

Water testing was carried out over two days (8/4/01-9/4/01) at both sites 10 and 12, in Wheeler Creek. Wheeler creek is an upper catchment creek that feeds ultimately into Narrabeen Lagoon.

The biological consequences of chemical variation within freshwaters appear not to be very significant when conditions are reasonably close to the average. However, when one encounters the extremes, due to natural causes or human influence, chemical variation from place to place can be of some biological significance.

The five main parameters tested in Wheeler creek were

- Conductivity (using a conductivity meter)
- Dissolved Oxygen (using a DO meter)
- pH (using pH strips)
- Temperature (tested on both the conductivity meter and the DO meter)
- Water clarity (using a tube for water absorption).

Conductivity is a measure of electrical conductance of water, and an appropriate predictor of total dissolved ions. Distilled water has a very high resistance to electron flow (normally <5 μmhos) and the presence of ions in the water reduces that resistance. Polluted streams normally have a conductivity reading of 1000 μmhos or more. So in the case of the two sites tested here, they have average conductivity readings, but it was shown that site 10 (Table two) had lower conductivity reading showing that there were fewer dissolved ions in the water.

Differences in conductivity result mainly from the concentration of the charged ions in solution, and to a lesser degree from ionic composition and temperature.

pH is a measure of the concentration of hydrogen ions, hence the strength and amount of acid present. A value of 7 is neutral, and because the scale is logarithmic to the base 10, a decline of one pH unit represents a tenfold increase in Hydrogen ion concentration.

Freshwaters can vary widely in acidity and alkalinity due to natural causes as well as anthropogenic inputs. Extreme pH values, generally below 5 or above 9, are harmful to most organisms, and so the buffering capacity of water is critical to the maintenance of life. Neither of the two sites examined in this study experienced extreme pH levels, so the quality of the water with respect to the pH level is acceptable.

In natural waters, carbonic acid is the main source of hydrogen ions, resulting in a pH of 5.7. It is also known that where decaying plant matter is abundant, humic acids create a lowering of the pH level. This may be why the pH level of site 10 had a slightly lower pH level than site 12 (Tables one and two) - because of the amount of leaf litter in the water.

Notes from reviewer, Dr Frank Gleason,

1: When carbon dioxide dissolves in water it becomes carbonic acid. The sources of carbon dioxide are the air and respiration of living organisms in soil and water.

2: Leaching of chemicals from minerals in the soil also affects pH.

Temperature affects the growth and respiration of individual organisms and the productivity of ecosystems through its many influences upon metabolic processes. Organisms generally perform best within a range of possible temperatures that corresponds to their physiological capacity, but some tolerate a wider temperature range than others.

Diurnal temperature fluctuations are common in small streams, especially if unshaded, due to diurnal changes in air temperature and absorption of solar radiation during the day. So it may be useful if ongoing studies are done, to have water temperature measured at night to compare to the daylight results.

Temperature is known to play an important part in influencing both the availability and the demand for oxygen from individual organisms. Temperature only varied slightly between the two sites (Tables one and two) and should have had no great influence over the biota.

Notes from reviewer, Dr Frank Gleason:

1. The solubility of oxygen in water is a function of temperature.
2. Water clarity affects photosynthetic rates.

Oxygen is one of the dissolved gases that are considered of particular interest when testing the water quality of a water body. Exchange with the atmosphere maintains the concentrations of both at close to the equilibrium determined by temperature and atmospheric partial pressure, especially in streams that are small and turbulent. Photosynthetic activity in highly productive settings, usually involving filamentous algae or macrophytes, can elevate oxygen to super-saturated levels and result in strong fluctuations between day and night. Respiration has the opposite effect, reducing oxygen and elevating carbon dioxide. Site 10 was seen to have slightly lower dissolved oxygen readings than site 12 (Table one and two). One of the reasons why this may have occurred was due to the greater amount of algae at site 12.

So simple water tests have been conducted and we are still no closer to the reason why many macro-invertebrate species are found at site 10, along with the yabbies in high numbers, and why there are little to no presence of macro-invertebrates at site 12. More specific water testing should be carried out over a longer period testing at regular time intervals, also looking at before and after rain events, to gain more knowledge about the water quality. Only through these more specific tests can a conclusion be made to whether water quality is the underlying factor affecting the biota at both sites and all along Wheeler Creek.

References.

Allan, J.D. (1995) *Stream Ecology- structure and function of running waters*. Chapman and Hall.

Comment concerning water testing

The above report is a satisfactory description of water quality at the two sites for the parameters that were measured. It should be borne in mind though that the parameters used represent a small subset of water quality variables which may impact aquatic ecosystems and the samples were taken over a short time span.

Aquatic animals can be influenced by a number of variables, for example:

- * **Short pulses of a pollutant (natural or artificial)**
- * **High flow water causing animals to be washed downstream**
- * **Lack of habitat (eg macrophytes, wood, rocks, detritus)**
- * **Predator prey imbalances**
- * **Removal of yabbies (crayfish) by humans or foxes**
- * **Introduction or removal of species from the area**

Any of these factors could explain the paucity of fauna at Quadrat 12. To identify the major factors in aquatic community structure would require quantifying habitat, flow patterns as well as a comprehensive study of macroinvertebrates. A more detailed sampling program may identify pollutants if there is a continual presence of the pollutant but short pulse events would be difficult to identify.

Dr Robyn Tuft
Robyn Tuft & Associates (Water Quality Consultants)

Note from reviewer, Dr Frank Gleason:
A large number of physical and biological factors need to be analysed.

Water Testing in September

Written by Mary Johnsen and Cliff Kelsall
Verified by Robyn Tuft

As part of the biodiversity survey from 14th to 16th Sept, it was decided to carry out water tests during the week preceding to avoid variability caused by the disturbance of the area by the volunteers working around the creek precincts.

Streamwatch was contacted for support and Chris Gow offered to train the Green Reservists, Cliff Kelsall and Ian Moran and also Mary Johnsen in the use of Streamwatch equipment. Thereafter he lent his demonstration kit for our use during the survey. In addition Oz Green was approached in order to be able to carry out coliform tests, and Sue Lennox kindly offered the use of their sterilizing equipment and mini-lab which is conveniently situated in Dee Why.

It is stressed at this point that the testing program undertaken was intended only as a preliminary picture. The time and resources available were not sufficient to carry out sampling in triplicate or even in duplicate to provide statistical rigidity. Part of the value of the work was intended as training in water testing procedures for volunteers with an interest in same and to provide some baseline data for future studies.

Samples were collected from six selected sites of the creek from the headwaters down to below Willandra Bungalows on Tuesday 11th Sept. Because light rain fell on the night of 11th, it was decided to sample again on Wednesday 12th to give a comparison after rain. These results show an understandable increase in coliform numbers at all sites after the rain; and a significant increase at the stormwater site 3. However there is no underlying adverse interpretation to these figures on their own. The other simple and standard parameters tested were Temperature, Turbidity, pH, Dissolved Oxygen, and Total Dissolved Solids. There was nothing alarming about any of these figures excepting that all figures for dissolved oxygen appeared strangely unreal (low); it is possible that since we were using a demonstration kit at this time with maybe not current reagents that this delivered false results. Therefore they should be retested at a later date – they are presented only for some comparison between sites.

As an adjunct to the above chemical tests, sampling was also carried out for macroinvertebrates on 15th Sept (Robyn Tuft and Mary Johnsen) at three of the sites, the head-waters, below The Manors and the lowest site. Measurements for Temperature, Dissolved Oxygen, pH, Turbidity, Redox Potential and Conductivity were taken by a calibrated multiprobe (Yeo Kal) prior to disturbing the site.

These probe measurements were in general agreement with the previous readings for Ph and turbidity but were substantially higher for dissolved oxygen. Cooler temperatures were also evident on the 15th. The dissolved oxygen saturation levels indicated that there is sufficient oxygen for sustaining fish at sites 1 and 3. As the lowest site was sampled in the afternoon, when algae would have been adding oxygen to the water, it is not known whether early morning dissolved oxygen concentrations are low. The redox values indicated that at the site below The Manors there is groundwater influences (negative value), however this may be a natural occurrence and is not a cause for concern.

When the above counts of macroinvertebrates are completed and correlated with the physical and chemical parameters, it is hoped to design a more informative and reliable water testing program.

See Appendix 2 for Water Sampling Test results.

Aquatic Invertebrates

March aquatic invertebrates

By Dr Robyn Tuft

WHEELER CREEK QUADRAT 1

This Quadrat was located in the headwaters of Wheeler Creek amongst a wet heathland vegetation. There were small channels braiding through the vegetation. Net sweeps of these channels were taken on 25th March, 2001 and enabled a composite sample to be taken of aquatic invertebrates.

Animals were identified to species where possible. The analysis revealed a total of 17 taxa. This included 2 families of beetles, 2 fly larval families, 3 families of bugs, 3 dragonfly families, a caddisfly family and a mayfly family. On a grading system of 1 to 10 in increasing sensitivity, five out of twelve families were relatively sensitive to pollutants (with grades of between 7 and 10).



Robyn Tuft explaining the methods to the field workers.

The SIGNAL index was calculated to provide an index of ecological health. The SIGNAL takes into account the sensitivity (on a scale of 1 to 10) and abundance of each family (on a 4 point scale).

$\text{SIGNAL} = \frac{\text{Sum (grade} \times \text{abundance)}}{\text{sum of abundances}}$. The sample from Site 1 gave a SIGNAL of 4.5, placing the site in 'poor' category. It should be remembered however, that the habitat for macroinvertebrates was very limited and this may be the major factor in shaping the community structure. Being so high up in the catchment, water permanence may be a problem for many aquatic invertebrates - we did not find a deep or permanent pool

Dr Robyn Tuft

Invertebrates collected during the Biodiversity Survey included a collection of :-

Spiders	Preying Mantids
Ants	Bugs
Cockroaches	Dragonflies
Grasshoppers	Beetles
Millipedes	Aquatic invertebrates
	Froglets and tadpoles at carvings site.

Invertebrates in the stream near QUADRAT 10 in March

Spotlights were used at night to check for invertebrates in the creek. Crayfish, a water scorpion, mayfly larvae and a pond skater were seen.



Andrew and Nick spotlighting at the creek.

Opportunistic sightings in March included:

Damsel fly	Dragonfly
Mayfly nymph	Water scorpion
Caddisfly larvae	Red-triangled slug
Beetles	Water spider

September Aquatic Invertebrates

By Dr Robin Tuft

Introduction

Sampling for aquatic invertebrates was undertaken at four sites on Wheeler Creek, Cromer, as part of the Spring Biodiversity Survey. Macroinvertebrates and algae were used as both indicators of biodiversity but also reflect the prevailing water quality of the stream.

The site locations were:

Site W1	Headwaters of Wheeler Creek
Site W2	50m upstream of 'The Manors'
Site W3	50m downstream of drainage from 'The Manors'
Site W4	Immediately upstream of Little Willandra Road bridge

Macroinvertebrates

Macroinvertebrate diversity and abundance was determined, together with calculation of the biotic indicators SIGNAL. The stream was sampled for macroinvertebrates using a fine net and hand picking from rocks. One of each type was then preserved and transported to the laboratory for analysis. Animals were identified to genus level where possible, using a dissecting microscope. Animals were collected and in accordance with SIGNAL-HU97B (Chessman et al, 1997).

The SIGNAL index (Chessman et al, 1997) is a measure of water quality based on the abundance of macroinvertebrate indicator animals. Animals are identified to family level classification, with each family assigned a grade between 1 and 10 depending on the tolerance to common pollutants (higher values represent more sensitive organisms and a higher water quality). This provides a comprehensive ecological and water quality indicator that takes into account the number and abundance of pollutant sensitive animals.

SIGNAL indices are classified into 5 levels:

- less than 4 = severely impaired = very poor water quality
- 4-5 = moderately impaired = poor water quality
- 5-6 = mildly impaired = fair water quality
- 6-7 = unimpaired = good water quality
- 7 = unimpaired & rich in sensitive taxa = excellent water quality

Algae and Aquatic Plants

The relative abundance of algae and macrophytes was used to assess the degree of eutrophication. Changes in algal populations can also be used to qualify potential impacts. In addition, the degree of weed infestation of the riparian zone may reflect elevated nutrient levels. Samples of attached algae (periphyton) were collected from a variety of habitats. Percent coverage of periphyton was also recorded. Macrophyte species and abundance were recorded on the stream observation sheets.

Observations

Stream geomorphology and habitat were assessed using the RCE protocol (Peterson, 1992). Any sightings or signs of vertebrates within the stream environment (eg fish and frogs) were also recorded on the stream observation sheets.

Results

SIGNAL INDEX SUMMARY

Wheeler Creek, Cromer headwaters	14 Sep 2001	5.1
Wheeler Creek above Manors	14 Sep 2001	6.2
Wheeler Creek below Manors	14 Sep 2001	5.1
Wheeler Creek at Little Willandra Rd	14 Sep 2001	4.7

The biological results, full species and abundance lists are provided in Appendix 2.

The lowest site (Wheeler Creek at Little Willandra Rd) shows the greatest impairment for macroinvertebrates, with the lowest biotic index and dominant animals known to be tolerant of poor water quality. The riparian weeds and instream plants (macrophytes) also indicated nutrient enrichment of the stream. The RCE score at this site was indicative of a very poor stream geomorphology (not helped by the creation of an artificial channel. There was little natural habitat for aquatic fauna. The presence of *Gambusia* at this location is of concern as these fish attack native fish and tadpoles. Algae were present as filamentous clumps or diatomaceous silts.

The site below 'The Manors' showed a diverse invertebrate fauna, including some sensitive animals such as mayfly nymphs. The biotic index was higher than site 4 but substantially lower than the site immediately upstream of 'The Manors'. Eastern froglets were heard and a swamp wallaby and a family of ducks observed. The riparian and instream environments of the two sites near 'The Manors' was similar, although the lower site recorded a lower RCE, due to riparian weed invasion, vegetation breaks and eroding banks. Attached filamentous algae were obvious (covering approximately 50% of rock surfaces).

Above 'The Manors' the stream had a high biotic index and a dominance of sensitive mayfly and caddisfly nymphs. The eastern froglet was again heard. Algae and macrophytes were very low. The RCE for this site indicated a good stream condition.

The uppermost site was in an incised section of stream which provided little habitat for invertebrates and evidence of scouring from high flows. The steepness of the stream would have encouraged erosion. These characteristics probably explain the lower SIGNAL index and diversity and RCE score shown by this site as compared to the second site. Nevertheless, the fauna was dominated by mayflies and algal response was low.

References

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- Peterson RC Jun. (1992) *The RCE: a riparian channel and environmental inventory for small streams in the agricultural landscape*. Freshwater Biology 27: 295-306

Aquatic Life

By Andrew Lo

March Aquatic Life survey

INTRODUCTION:



Andrew Lo

Photo:J.Bennett

WATER BODIES

Wheeler Creek is a feeder creek of South Creek which drains into Narrabeen Lake. The two creeks are typical coastal streams in the Sydney region. Unmodified by humans, these coastal streams would possess the following characteristics: high initial gradients, high annual discharges, erratic flows, variable turbidity, large seasonal and short-term fluctuations of many physical and chemical water characteristics.

The streams usually consist of a series of pools, inter-connected by races, rapids, and waterfalls. The stream bed substrate is Hawksbury sandstone, and in-stream vegetation is often sparse or non-existent.

In pristine condition, dissolved oxygen levels approach saturation for most of the year (i.e. 7.5 to 11.5mg oxygen/litre). Temperature ranges are wide, 7 - 27 degrees C.

The catchment of Wheeler Creek is heavily timbered, shading the watercourse which consequently collects and carries tremendous amounts of organic matter.

As the streams move onto the coastal estuaries, the gradient decreases as does the rate of flow. The width and depth of the waterway increase and the water eventually becomes brackish. The physiochemical composition of the water changes and turbidity often rises.

Changes to coastal streams resulting from human activities are threefold: physical, chemical and biotic.

Physical changes: road and residential constructions, dams, bush clearance, result in altered flow patterns, temperature regimes.

Chemical changes: run-offs from human habitations consisting of fertilizers, pesticides, herbicides, hydrocarbons. Also sewage effluent.

Biotic changes: associated with introduced aquatic fauna and flora.

AQUATIC FAUNA

Aquatic fauna are sensitive bio-indicators of altered state of the eco-systems resulting from human habitations.

The presence or absence of fish species that normally inhabit pristine coastal streams will reveal the status quo of the ecosystem in question.

Water quality tests will provide answers to why endemic aquatic fauna are present or absent.

The following is a list of freshwater aquatic fauna that normally inhabit coastal streams in the Sydney region:

Eels (*Anguilla australis*, short-finned eel; *Anguilla reinhardtii*, long-finned eel).

Gudgeons (*Gobiomorphus australis*, striped gudgeon; *G. coxii*, Cox's gudgeon, *Philypnodon grandiceps*, big-headed gudgeon; *Hypseleotris compressa*, empire gudgeon).

Galaxias (*Galaxias maculatus*, jollytail).



Striped Gudgeon

- *Gobiomorphus australis*



Empire Gudgeon

- *Hypseleotris compressa*



Jollytail - *Galaxias maculatus*

Pictures supplied by Andrew Lo

The following species are found in the estuaries:

Pacific blue eyes (*Pseudomugil signifer*)

Glass fish (*Ambassis agassiz*, Chanda perch

Gobies (*Pseudogobius olorum*, blue-spotted goby)

Mulletts.

Apart from fish fauna, two species of freshwater crayfish are also found in coastal streams in the Sydney region:

Euastacus spinifer (Sydney/ Blue Mountain crayfish)

Euastacus australasiansis (Australian crayfish).

SURVEY OF QUADRAT 10

Site 10 is situated at the headwaters of Wheeler Creek. This section of the Hawkesbury sandstone bedrock creek is ephemeral. A series of shallow pools, inter-connected by races and riffles are partly fed by ground water, but are likely to dry up in drought periods. No fish were sighted in this section of the creek, but the crayfish *Euastacus australasiansis*, both juveniles and adults were relatively abundant. This species of crayfish live in burrows that lead down to the water table and can therefore live through dry periods.



Euastacus australasiansis



Euastacus australasiansis

A macroinvertebrate assessment showed the water quality to be satisfactory. In this section of the creek, below a 2 to 3 metres tall waterfall, there is a shallow pool where a single adult short fin eel was sighted. Here, the creek runs up against an embankment and disappears underground.

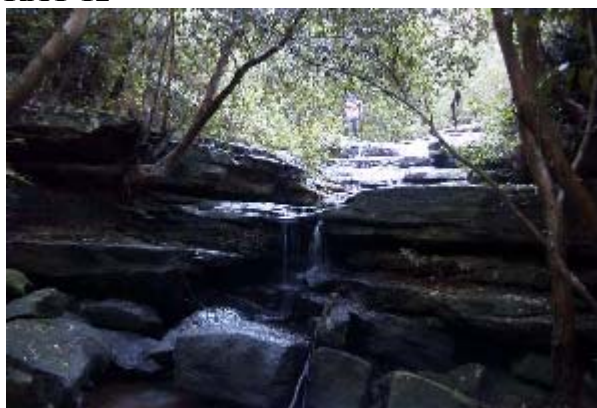
Where the creek re-emerges, there is a drainage pipe and the riparian zone is heavily weed invested. Siltation of the creek bed was also apparent.

Apart from short-finned eels, there was no sign of aquatic fauna in this section of the creek.



Andrew Lo and Nick Skelton studying invertebrates
near Quadrat 10 in Wheeler Creek

SURVEY OF QUADRAT 12



In this section of Wheeler Creek, a series of waterfalls and cascades empty into a pool with large boulders. Riparian vegetation is dense. This part of the creek is heavily polluted by residential run offs from the north-eastern bank. Under normal circumstances, this section of the creek would be an ideal habitat of the crayfish species *Euastacus spinifer* as well as *Euastacus australasiensis*. In contrast to quadrat 10, no crayfish was sighted. The boulders in the pool are silted over and macroinvertebrates are scarce or absent. The creek levels out further down and siltation resulting from vegetation clearance in adjacent construction site is apparent.



In this section of the creek, three species of native fish were sighted in shallow pools: *Galaxias maculatus*, *Gobiomorphus australis* and *Hypseliotris compressa*. An introduced species, *Gambusia holbrooki* were also present in the pools. The *G. maculatus* were all adults to 125mm. No juvenile of the species was sighted. This could only mean that access to Narrabeen Lake was blocked, as *G. maculatus* normally spawn in late autumn down stream and the juveniles access the Lake and return upstream after approximately six months. On inspection, residential construction downstream has not only modified the water course, but the creek is obstructed as well. The creek below the construction zone is also heavily weed infested.

The survey shows that Wheeler Creek has undergone physical, chemical as well as biotic modifications.

September Aquatic Life survey

by Pamela Mawbey, verified by Andrew Lo

Survey in Quadrat 12

We observed the section of Wheeler Creek just before it passes under Little Willandra Rd to join South Creek. No fish were sighted. The developer had removed an obstruction, which blocked the Creek last March. Earlier in the day *Gambusia holbrooki* were found in the lower section. The section of Wheeler Creek that ran adjacent to the Willandra Bungalows had been reduced to the size of a small drain.

Higher up the creek just beyond the Willandra Bungalows development were lots of fallen branches and parts of tree trunks possibly blocking the creek in one spot. We sighted a Water Spider. The creek bed and the sandstone bedrock of this section of the creek was heavily silted over. This would impact adversely on the micro-fauna and disrupt the food chain of the aquatic fauna. The flow rate of the creek had been altered. The adult jollytails (*Galaxias maculatus*) sighted in the same section of the creek in March were not apparent. Further upstream in the pool near Quadrat #12 we sighted 2 adult Striped Gudgeon (*Gobiomorphus australis*) approx. 12.5cm long.

In a pool further upstream - a Striped Gudgeon about 1 year old and 6cm long was sighted with about 12 juveniles. I also sighted a shortfinned eel (*Anguilla australis*) approx. 60cm long and 3cm in diameter.

Fish found in Wheeler Creek in September

Observed on 15/9/01 in Quadrat 12 Location : E 339333 N 6265475

Striped Gudgeon	2 adult approx 12.5cm
Striped Gudgeon	1yr old approx 6cm with 12 babies
Short-finned eel	Approx 60cm long x 3cm diameter
<i>Gambusia holbrooki</i>	Feral

Note: No evidence of Jollytail - *Galaxias maculatus* was found in September 2001.

Further investigation of this matter will need to be undertaken now that the obstruction in the creek has been removed. It is not known yet whether this Jollytail - *Galaxias maculatus* - species of fish will recover from the disturbance to the creek caused by the construction of Willandra Bungalows that prevented the Jollytail - *Galaxias maculatus* from travelling downstream to breed or upstream to this habitat.

References:

G.Allen, <i>Freshwater Fishes of Australia</i> , Tropical Fish Hobbyist Publications, Neptune City, NJ, USA, 1989	Merrick and Schmida, <i>Australian Freshwater Fishes</i> Merrick and Schmida, Sydney NSW 1984
R.M. McDowell, <i>Freshwater Fishes of South-eastern Australia</i> Reed, Sydney, NSW, 1996	Smith A.K. and Pollard DA (eds) N.S.W Fisheries: <i>Policy and Guidelines, Aquatic Habitat Management and Fish Conservation</i> NSW Fisheries, Office of Conservation, Sydney 1998.

(Andrew Lo lectures in environmental economics at the UNSW and is Secretary. of the Australia New Guinea Fish Association NSW)

Birds

See Appendix 3 for all bird data

Bird Survey in March 2001

By Noel Ryan

Central point : E338850 N6265800 - accuracy 1km

Each of the teams that installed and inspected mammal traps and conducted the vegetation quadrats also included at least one bird observer. Usually two for each team. The observations of birds from all bird observers were combined into one list. Call playback was used to test for nocturnal birds.



Noel Ryan demonstrating bird flight to Cr Phil Colman.

Photo: J.Bennett

The bird list obtained during the survey consists of observations from widely dispersed locations within the study area. Records of locations for individual sightings were not kept for most sightings.

Observation were obtained visually or by calls. Call records were only recorded from people who were experienced in identifying calls.

I also have a record for Brush Bronzewing.

Brush Bronzewing, female, 5.55pm 11 October 1999. On the track that leads from the quarry (Red Hill) to the fenced off engravings. It was on the rise up toward Red Hill about half way between Red Hill quarry and the power lines.

Additional observation - Pheasant Coucal, one individual, in Allocasuarina distyla thicket.
2 June 2001, 10.45 am

Powerful Owls

Comments by Judith Bennett

The manager of the Maybrook Manors retirement complex has reported where powerful owls were known to have roosted until recently. Local residents report having seen them at that end of the creek near Maybrook Manors. Residents of Jersey Place often hear their calls at night.

Roger Lembit, when doing a vegetation survey in Natural Areas Ltd land reported seeing a roosting site that could well be used by powerful owls.

People living in Kirrang St, Cromer, have reported being swooped by enormous owls with "feet as big as men's hands" when walking near the first waterfall on Natural Areas Ltd land in the very late afternoon in Winter, 2000.

May 8th 2002 Two Powerful Owls were seen and photographed near Quadrat 12. Their droppings and pellets were photographed on a rock beside the creek.

Observations of birds in the area during the last 12 years

By Bruce Cox.

Wheeler Creek Grid. 33° 44' 10"s 151° 15' 29"e

Red Hill....An Enigma!

Why do birds find one area more attractive than another with apparently identical vegetation and other resources birds need for their wellbeing? And why is this the case with Red Hill? At least superficially Red Hill looks like any of the other heath and woodland covered part of Sydney's Northern Beaches, yet attracts several unusual species, either rare or not recorded having been seen at all in nearby similar environments. Birds such as Pheasant Coucal, Painted Button-quail, Rock Warbler, Brush Bronzewing, Bar-shouldered Dove and Tawny-crowned Honeyeater can all be seen at Red Hill. No other area on the Northern Beaches is known to produce all of these species!

The recently conducted Biodiversity Study in the Wheeler Creek catchment may supply the answer to the above question, some particular characteristic unique to Red Hill that is not obvious at a cursory inspection.

My bird watching experience of Red Hill began in June 1988 and I have been back there many times over the years, its bird diversity constantly amazes me and every now and then I still see something new.

Over the years I have seen 74 bird species there, some migrants stopping over on their travels, some vagrants from some other habitat but many residents in this unique area.

Bruce Cox,
Member of the "Cumberland Bird Observers Club" and the "N.S.W. Atlassers"

Bird survey in September

Noel Ryan led teams of people to observe birds early mornings, during the day and in the late afternoon.

Karen Hudson, the NPWS ranger took a team out at night to amplify bird calls through the valley hoping to hear responses from owls and other nocturnal birds.

57 species of birds were recorded.

Bird data lists are found in Appendix 3

Frogs in Wheeler Creek Valley

By Andrew Hunt
Dee Why

Having known the Red Hill area when I used to be taken on bushwalks there during the late 1960s and early 1970s, I recall seeing large black tadpoles in a small swampy area at the front of a sandstone cliff facing the East.

Since then I had not been back until 1995 when, being a member of the Beacon Hill Rural Fire Service, I wanted to see the amount of bush that had been burnt behind and to the left of the Fire Station.



As I have an interest in animals especially frogs, I wanted and hoped to see some. Currently, my main interest is in fighting bush fires, nevertheless I also have an interest in a wide range of environmental issues, from recycling to bush regeneration.

During the early 90s, I joined the Frog and Tadpole Study Group based at the Australian Museum but have since had to finish my membership due to other commitments, but still retain an interest in frogs and other amphibians and reptiles.

Anyway, I bought a couple of books on frogs, lizards and snakes for identification purposes that I use whenever I get the chance to go bushwalking.

During the first year after the 1994 bushfires, I was able to get a good idea of where the Wheeler Creek tributaries flowed from and one particular afternoon, I came across a number of large black tadpoles lying on the bottom of a drying out small pool. As it had not rained for a while, parts of the creek were drying out.

I decided to save these tadpoles, so I quickly went home and collected a small handheld net and a plastic bucket. I collected some water from a deeper part of the creek and put the water into the depression for the tadpoles. I carefully collected them into the bucket and put them into the deeper pond.

After that, I continued to walk along the track and camp upon more large tadpoles in the swampy area but they didn't need rescuing.

I identified the tadpoles from my book. They were Giant Burrowing Frog tadpoles and so I rang the National Parks and Wildlife Service at Hurstville. They sent me out a number of fauna cards to fill in if I found more animals.



Red-crowned
Toadlet

There were two ladies who have an interest in Giant Burrowing Frogs and Red Crowned Toadlets, so when I came across a number of Red-crowned Toadlet tadpoles in the same creek as the Giant Burrowing Frogs, I called them. The Red-crowned Toadlet tadpoles were found in 1997/8 as I recall.

Since then I have seen in the same area, a dead monitor lizard, sulphur-crested cockatoos, red-winged black cockatoos, a feral cat, a diamond python, yabbies, Common Eastern Froglets, fairy wrens, Eastern water dragons, blue-tongued lizards, numerous other birds, brushtail and ringtail possums, Eastern water skinks. I try to record what I see and where I see them.

In summary, I believe that the remaining bush in the Red Hill area should be either included in the Garigal National Park or secured as a permanent Bush Reserve. This is particularly important when considering the endangered species such as Red-crowned Toadlets and Giant Burrowing Frogs that live in this area.

Written by Andrew Hunt, 15/5/01

Frog survey in March

By Judith Bennett

During the March 2001 survey, members of the NPA survey teams found many tadpoles of the Common Eastern Froglet, *Crinia signifera* and also *Litoria phyllochroa*.

***Crinia signifera* (tadpoles)**

***Littora phyllochroa* (Leaf Green Tree Frog) x 1**

The Australian Museum Business Services (AMBS) 1996 brief survey identified several locations of suitable habitat for *Pseudophyrne australis* (Red-crowned toadlet) in vicinity of proposed Wheeler Creek sewerage scheme. This study indicated Giant *Heleioporous australis* (Burrowing Frog) may also be present in the area below the houses in Maybrook Ave.

Frog Survey in September

By Judith Bennett, verified by Martyn Robinson

15th September, 2001

Method:

We went for a walk looking for suitable frog habitats, looked for tadpoles and listened for frog calls. We saw many *Crinia signifera* (Eastern Brown Froglet) tadpoles and adult frogs and heard them calling.

Martyn Robinson described the type of habitat required for survival of the threatened species of Red-Crowned Toadlets and Giant Burrowing Frogs :-

Red-Crowned Toadlet - *Pseudophryne australis*

We looked for the following:-

- * relationship of terrain to the uppermost escarpment,
- * drainage lines taking water off the escarpment
- * buildup of moist leaf litter,
- * it had rained often in preceding weeks so we looked for permanent puddles with detritus and algae in them,
- * patches of clay that would hold water in the puddles,
- * logs lying on the ground and overhanging rocks with sandy soil underneath,
- * semi-permanent streams that have high amounts of leaf litter located near the sandstone ridges and characterised by shallow pooling in the channels after rain

Giant Burrowing Frog – *Heleioporus australiacus*

We looked for :-

- streams of very good water quality through sandstone
- clay banks of semi-permanent streams where there were large crayfish holes

Results:

South of Wheeler Creek

Quadrat #21 E 339108 N 6265129

At the uppermost reaches of the Wheeler Creek tributary that runs down to Willandra Bungalows, we found a large clay area where vegetation was mapped under the heading "Quadrat #21" in September, 2001. There were natural drainage lines nearby with piles of moist leaf litter suitable for Red-Crowned Toadlets.

There was water in Quadrat #21 that Martyn said was suitable also habitat for Red Crowned Toadlets. The water temperature was higher in this area than in the nearby drainage lines but not too high for tadpole development. *Crinia signifera* tadpoles and frogs were in the water and the higher temperature would lead to tadpoles developing more quickly into frogs. The area was not far below the ridgeline. This particular ridgeline has been modified by quarrying activities in the past, but the terrain is still suitable for frogs including Red-Crowned Toadlets.

The banks of the nearby drainage lines were mostly clay and had large holes that could have been used by Giant Burrowing Frogs. Some of the holes appeared disused but others appeared to be in use by either crayfish or frogs.

The path between Quadrat #21 and Quadrat #7

We walked along the "Logger's Track" and noted the three tributaries which crossed the track. Each of these tributaries had collections of damp leaf litter within sight of the Logger's Track. We did not inspect very far up or down these tributaries.

Quadrat #7 E338469 N 6265474

West of the Logger's Track (at the point where the Logger's Track turns and heads South) we found a tributary to Wheeler's Creek that has large pools with relatively slow moving water. The bottom of the pools is sandy and the banks are clay with large holes made either by crayfish or Giant Burrowing Frogs. These holes appear to be in current use.

There was plenty of damp leaf litter nearby.

This would appear to be terrain suitable for both Giant Burrowing Frogs and Red-Crowned Toadlets.

North of Wheeler Creek

The study completed by AMBS for Sydney Water nominated land to the North of Wheeler Creek (below the escarpment on which Maybrook Avenue is built) near Quadrat 12 as suitable habitat for Red-Crowned Toadlets. The western part of this land belongs to Warringah Council and the eastern part to Natural Areas Ltd.

Conclusion:

Wheeler Creek Valley contains many drainage lines from escarpments to the creek. The drainage lines merge into tributaries to Wheeler Creek. Most of these drainage lines and tributaries have areas where leaf litter collects and remains damp.

On the South side of the creek, there is currently no urban development polluting the runoff into the drainage lines.

The banks of several of the tributaries are made of clay in which large crayfish and/or Giant Burrowing Frogs are currently burrowing.

Red-Crowned Toadlets and Giant Burrowing Frogs have been recorded in this valley recently and, although not seen in our survey, there has been no significant change to the terrain so there is no reason to assume these frogs have disappeared.

The terrain matches their preferred habitat and ridgeline development is known to be a threatening process for these species.

Therefore, preserving this valley including the ridgeline is recommended.

Mammals in the Wheeler Creek area

by Judith Bennett

See Appendix 4 for lists of mammals identified in traps, by scats, and by hair funnels.

March Mammal Survey

Methods:

The Pitfall trap was stretched from E 338213 N 6265777 to E 338247 N 6265743
Mammal traps were set on Friday night - a pitfall trap, several cage traps and 10 Elliott traps using peanut butter, honey and rolled oats as bait. Hair tubes were set up. The hair tubes were left in location for about a week.

The mammal traps were checked at sunrise each morning, with animals being released immediately after identification and traps being set again in the late afternoons.

Bandicoot diggings were noted.

Various scats were collected and sent away for examination to see what the foxes and dogs had been eating.



Bushrat

Scratchings on trees at:-

7/4/01 5:05 E 339094 N 6264989

7/4/01 5:24 E 338916 N 6265410

were observed and estimated to be from gliders. Further investigation would be most interesting to verify which gliders are present.

The anabat recorder was used one night but no bats were identified.

Some possums were seen by spotlight at night.

Bushrats, *Rattus fuscipes assimilis*, and a long-nosed bandicoot, *Perameles nasuta*, were found in the traps and an antechinus, *Antechinus stuartii stuartii*, was found in an Elliot Trap.

Hair tubes were placed on 23rd March, 2001 and lifted on 7th April with the tapes being sent to Barbara Triggs for analysis.

September Mammal Survey

Traps were set each evening from 14th September to 16th September, 2001 and animals were released the following mornings before sunrise. There were many bushrats, long-nosed bandicoots and antechinus.

Many of the animals were pregnant or carrying young.

The night time spotlighting, scats and some tracks revealed the presence of other mammals such as possums and wallabies. There was evidence of feral dogs and foxes.

Scats that were collected were sent to Barbara Triggs for analysis. Hair funnels were set adjacent to each cage trap with the wafers being sent to Barbara for analysis.

See Appendix 4 for lists of mammals identified in traps, by scats, and by hair funnels.

Reptiles

by Judith Bennett

March Reptile Survey

Central point : E338850 N6265800 - accuracy 1km



Mark Grumley and Richard Llewellyn, herpetologists, joined the survey for the afternoon of March 24th. Mark and Richard joined one of the survey teams and made observations. When they saw a monitor run down a hole rather than up a tree, they were sure it would be a Heath Monitor so they waited for two hours near the overhanging rock at the entrance to its burrow.

Reptile sightings were by Mark and Richard but also as opportunistic sightings when groups were working in their quadrats.

Reptiles observed included :-

Coppertail	<i>Ctenotus treniolatus</i>
Cunningham's skinks	<i>Egenia cunninghami</i>
Delicate garden skink	<i>Lampropholis delicata</i>
Garden skinks	
Golden crowned skink	<i>Cocophis squamutosis</i>
Heath Monitor	<i>Varanus rosenbergi</i>
Leaf-tailed gecko	<i>Phyllunus platunus</i>
Lesueur's gecko	<i>Oedura lesueurii</i>
Nocturnal Golden-crowned snake	
Snake-eyed/fence skink	<i>Cryptoblephonus vingatus</i>
Thick tailed gecko	<i>Underwoodicovers milii</i>
Water dragon	<i>Physignathus leseurii</i>

Recently reported by Andrew Hunt of the Rural Fire Service, a python probably a diamond python near Maybrook Manors beside Wheeler Creek.

NOTE:

The Heath Monitor, *Varanus rosenbergi*, is an endangered species, with the Sydney population being an outlying northern component of its more south coast distribution.

September Reptile Survey

James Walker, Greg Narker, Noel Ryan, Melinda Elith, D.J. Cavanagh, Madhara D'Costa

Rocky sites on sandstone ridge at end of Northcott St

Observed on 16/09/01

Scientific Name	Common Name	No.	Location
Ctenotus taeniolatus/adult		2	Under rock on soil
Ramphotyphlops/adult		1	Under rock on soil
Oedura lesueurii/9 adults	Lesueur's velvet gecko	2	Under rock on rock
Lamphropholis delicata	Delicate garden skink	3	2 under rock, 1 on rock
Lomphropholis guichenoti	Common garden skink	3	Under rock
Ramphotyphlops/juvenile	Blind snake	1	Under rock on soil

Opportunistic sightings

Date	E	N		Common Name	Observer
15/9/01	339280	6265240	Reptile	Blue tongue lizard	By Noel Ryan
23/9/01	339279	6265318	Reptile	Large green lizard	By Cliff Kelsall
16/9/01	339282	6265252	Reptile	Water Dragon	By Noel Ryan
16/9/01	339282	6265252	Reptile	Delicate Skink	By Noel Ryan
15/9/01	338362	6265734	Reptile	Blue tongue lizard	By Charles Cullen
15/9/01	339108	6265129	Geckonidae Phylurus platurus	Leaf tailed gecko	7:30pm 3 adults By James Walker

Martyn Robinson, whilst researching birds in the valley on October 6th, near Quadrat #21 E 339108 N 6265129, observed the following:-

Varanus rosenbergii - heath monitor - (threatened species)

This observation verifies reports from nearby residents of having seen this endangered reptile in different locations within the Wheeler Creek valley during the Spring of 2001 and supports the claim that the valley is part of the habitat regularly used by this reptile which has its burrow on the escarpment.

Diamond pythons have been seen during Spring by the Green Reserve team, residents of Jersey Place (where an NPWS snake handler caught the snake on a roof and brought it down to the bush), Maybrook Ave and Willandra Bungalows. From the Willandra Bungalows, a diamond python is often observed in the Kirrang St road reserve. A green tree snake was seen in a tree in Jersey Place in Spring.

Invertebrates on land

by Judith Bennett

March Survey

Collection methods included erecting a malaise trap and burying containers containing water and a drop of detergent. The detergent broke the surface tension so that invertebrates landed in the water. The Malaise Trap set at: 23/3/01 E 338123 N 6265698

Lists of invertebrates identified from survey are recorded in Appendix 6

Conclusion:

The invertebrate specimens noted by pitfall and opportunistic collecting in March indicated the presence of commonly expected species for March in this type of area.



Setting up the malaise trap.



Cr Phil Colman testing the malaise trap in the hall.



Hunting through leaf litter

Photo by Henry Gold

People hunted through the leaf litter, looked under rocks and bark, and collected invertebrates from near flowers.



Using a net to collect invertebrates

Photo by Henry Gold

Sweeping and beating of invertebrates

Some people put a sheet on the ground and beat the tree above to cause invertebrates to fall on it - other people followed the same method but used an upturned umbrella as the collection device.



Ray Mjadwesch

Photo by Henry Gold

Opportunistic sightings of invertebrates

People were asked to keep their eyes open all the time and take note of invertebrates around them.

There were plenty of sightings of ticks! - many were brought back to the hall inadvertently and removed from the skin. One or two may have been collected in containers but mostly people were in a hurry to remove them and not really concentrating on scientific investigation.



Golden Orb Spider with remains of previous feasts still in her web. The small black dot near her back leg is one of the males.



Setting up the pitfall trap.

The pitfall traps were aimed at small mammals or lizards that ran along the ground but none of these fell in. Some invertebrates fell into pits that were buried along the pitfall trap line.



Ray looking in a pitfall trap
- there was a beetle in there.

September Survey

Small traps (plastic containers with liquid and a lid) were placed with the opening at ground level under leaf litter in the following locations over a week before the survey began and lifted during the survey. The ants were selected out from other invertebrates and identified.

Opportunistic sightings of invertebrates

15/09/01	E339333	N6265475	Water Spider	
15/09/01	E338319	N6265699	Stick Insect	8pm Spotlighting
15/09/01	E338319	N6265699	Cockroach with egg	8pm Spotlighting
15/09/01	E338483	N6265490	Mayfly Lavae	Frog walk near Site #7
16/09/01			Sack spider	West of Northcott St
16/09/01			Black banded bee on <i>Grevillea sericea</i>	Above Narrabeen Lake
16/09/01			Red rumped bee on <i>Leptospermum trinervium</i>	Above Narrabeen Lake

Martyn Robinson, whilst researching birds in the valley on October 6th, near Quadrat #21 E 339108 N 6265129, observed the following:-

Bees and flies

Zylocopa aeratus - 3 bottle-green carpenter bees with yellow faces - in *Pultanea* flowers. These bees like to nest in *Xanthorrhoea* stalks but will use dead, rotting *Banksia serrata* trunks instead.

A very small bee - 1cm in total length - on *Pultanea* - went right inside the flower.

Trichocolletes - Black and white striped, fast flying, hairy bee - on *Kunzea*

Tachinidae flies

Ant species

Lists of ants and spiders identified from the two surveys are recorded in Appendix 6

Butterflies

by Dr. Courtney Smithers

See Appendix 6 for the full text from Dr. Courtney Smithers together with butterfly species list Wheeler Creek Valley and also from nearby Ku-ring-gai Chase.

I visited the Wheeler Creek Valley site twice in Spring 2001, once with John Peters, who is very knowledgeable about butterflies but it would take a proper long-term survey to establish a definitive list of butterflies that visit the area. In fact, we saw fewer than a dozen species, a surprisingly small number. One point to note is that in the 2001/2002 season butterfly populations seem to have been, in general, exceptionally low. There is no doubt that the local environment at Beacon Hill would support a fauna very similar to that of Ku-ring-gai Chase, of which a species list was published by Tony Rose (1968).

We noticed a hilltopping site near the trig. station.

See appendix 6 for a description of the hilltopping behaviour of butterflies.

Fungi

by Don Glover

Sydney Fungal Study Group - May 12th Field Trip



A preliminary survey of the area took place during the weekend of the March Biodiversity Survey by Judith and Don Glover of the Sydney Fungal Study Group. This was followed by a field trip on May 12th by the group who identified a range of fungi and took some unusual or unknown specimens away for further study.

The main area studied on May 12th was close to Quadrat 12, whilst some members of the group looked in areas close to Quadrats 4 and 6.

Some fungus from the survey included:



The survey was conducted along the creek and extended into the upper slopes of the area particularly the moist, and in some cases wet areas, of the 'hanging swamps' although the drier ridge tops were also included in the survey area.

You will notice that some specimens were not identified completely as unfortunately not all specimens found were of a condition that allowed identification to species level, while for some an insufficient number of specimens were available at the time and for others more research needs to be carried out.



15 people took part collecting for 2 hours, after which the collection was arranged on a table for all to view.

Listed on the attached are the fungal species observed; their numbers and range suggests that the area has a reasonably extensive and diverse fungal population.

Donald Gover, BSc (Tech), Grad. Dip. Sc.
Dr. Alec Wood, Visiting Fellow, School of Biological Sciences,
University of New South Wales

Fungus data is found in Appendix 7

Vegetation

By Nick Skelton, Judith Bennett and Emma Gorrod

The study area

As indicated on the map provided, the study area is within the catchment of Narrabeen Lagoon. There are houses (in Maybrook Ave and Jersey Place) on one part of the northern edge of the valley, but the other ridgelines are free of urban development. As the area is a spur of bushland that is linked to Garigal National Park, it provides a valuable buffer area to prevent degradation of Garigal National Park.

Wheeler Creek Valley has a number of vegetation types within it, associated with variations in topographic and soil profiles. These vegetation types have been mapped (by Smith & Smith 1997 "*Interim report of Natural Area Survey of Warringah's Bushland*") based on aerial photographs of canopy trees. One of the primary aims of this investigation was to determine the accuracy and adequacy of these maps by ground truthing vegetation structure. The diversity of plant species within Wheeler Creek has not been previously investigated. As the valley is relatively free of disturbance, it is important that the occurrence, distribution and abundance of species is recorded. Such information will facilitate the development and implementation of appropriate management plans.

Within the study area there are a number of potential threats to the vegetation:

- Stormwater runoff from yards can bring weeds and nutrients into the bushland.
- Stormwater can cause erosion of streambanks, thereby disturbing soil profiles.
- Sewer pipes have been installed along the north side of the valley. If these malfunction or overflow, nutrient loads arrive in the bush or the creek.
- Horses are regularly ridden through the valley. Their hooves may cause erosion of tracks, and their droppings deposit grass seed and nutrients that are detrimental to native vegetation.
- Dogs and foxes eat bandicoots. Dog droppings add nutrients. Rabbits eat grass and cause erosion.
- There are dumped cars in the valley, which contain broken glass and oil, both of which are a potential fire risk. They also leach heavy metals which could potentially contaminate the water table. But, they may be useful habitat for wildlife.
- Trailbike riders regularly use the tracks and 'obstacle courses' in this valley. Their tyres contribute to erosion and can kill plant seedlings.
- Mountain bike riders also use the tracks - the resultant erosion is not as severe as that caused by trail bikes. However, the mountain bike riders are wanting to remove vegetation and extend the network of formed bike tracks. Tracks facilitate the movement of foxes, dogs, people and weeds through the bush.
- Fire access trails are a potential source of weeds and erosion. They need to have a gate to keep 4WD and other vehicles out.

The study method

In order to document the diversity of plant species, populations and communities within Wheeler Creek, vegetation surveys were conducted using quadrats. Eleven quadrats of 400m² were studied in the Autumn of 2001. A further 3 areas were surveyed in September. These quadrats were specifically chosen to represent the different vegetation types in the area. All surveys were conducted by volunteers, many of whom were experienced bush regenerators.

Within each quadrat, the following nested quadrat method was used:

1. Select a starting point, mark this with a peg, then measure out a 20m x 20m quadrat to the North and East of the marker.
2. Within the marked quadrat, record firstly each plant within the first 1m x 1m square.
3. Using the peg as the reference point, record each plant found within a 2m x 2m square that was not already recorded in the 1m x 1m square.
4. Repeat for 5m x 5m, 10m x 10m then 20m x 20m squares.
5. Record approximate abundances of each of the species in terms of the number of plants and the area they cover.
6. Record any opportunistic sightings of plants that could be seen outside the 20m x 20m quadrat when standing within the quadrat.
7. Record opportunistic sightings of birds, reptiles, invertebrates and mammals where possible.

Any specimens that could not be identified on site were taken off site, and examined within a few days. In cases of uncertainty the plant specimens were pressed and sent to the Royal Botanic Gardens for verification or more detailed information.

In order gauge the value of the vegetation in Wheeler Creek, comparisons were made with the vegetation in adjacent land on the western slopes. This land belongs to the Metropolitan Local Aboriginal Land Council.

Findings

Vegetation Communities

Seven vegetation types were identified in this study, including open forest, woodland, heath, wet heath, and ephemeral swamp.

Of particular significance is the presence of two threatened ecological communities: Cabbage Tree Palm Forest (quadrat 12) and Duffy's Forest (site 22).

- Duffy's Forest

Duffy's Forest vegetation community is characterised by an Open Forest structure, with trees spaced so the crowns only just touch and a fairly thick layer of shrubs. There are

also other fungi and animals that are specifically associated with this community. It is found on lateritic soils on ridge tops.

There are two existing publications that describe Duffy's Forest and facilitate determination of the vegetation on this site: Smith & Smith (2000) and the Threatened Species Conservation Act 1995. The 2002 preliminary determination of Duffy's Forest as an endangered ecological community lists 73 species that characterise Duffy's Forest Ecological Community. Of these 36 species (or 49%) occur on the site in question. Smith & Smith (2000) list species that constitute positive and negative diagnostic species for Duffy's Forest. There are 20 positive diagnostic species, including various trees such as *Eucalyptus globoidea*, various shrubs including *Hakea sericea* and various herbs and grasses. Similarly, there are 20 negative diagnostic species. Presence of these species (both positive and negative diagnostic species) on the site in question is then used to calculate the Duffy's Forest Index (DFI).

$$DFI = \frac{100(x + (20 - y))}{40}$$

Where x = number of positive diagnostic Duffy's Forest species recorded
and y = number of negative diagnostic Duffy's Forest species recorded

The value of the index ranges from 100 when all positive diagnostic species are present and all negative diagnostic species are absent, and 0 when the reverse is true. In the vegetation at site 22 in Wheeler Creek, 1 positive diagnostic species were present, and 2 negative diagnostic species were present. This yields a DFI of 47.5.

As the species listed in these two documents are characteristic species only, and at any one time not all species will necessarily be present, the implication is that the threatened ecological community of Duffy's Forest definitely occurs in Wheeler Creek.

In some cases, the results of the quadrat surveys conflicted with the existing vegetation map of the area. Specifically, the species composition of a particular vegetation type (for example 'woodland') varied considerably.

Species diversity

The database of vegetation for all the quadrats contains in excess of 300 identified plant species. No recorded plant occurred in every quadrat.

The most common species (occurring in 8 or 9 quadrats) in Wheeler Creek are:

Actinotis minor *Platysace linearifolia*
Allocasuarina distyla
Banksia ericifolia
Dillwynia retorta
Hakea teretifolia

Threatened species

Several threatened species (as listed in the National Parks and Wildlife Service publication “Saving our Threatened native animals and plants - Recovery planning in action 1999 - 2000”) were located within Wheeler Creek Valley. Unfortunately a targeted search for orchid species was not conducted, due to time constraints. There have been reports of rare orchids occurring in the valley.

Table . Threatened and locally significant species observed in Wheeler Creek Valley.

Species	Status	Location
<i>Banksia Robur</i>	Threatened	Incidental
<i>Eucalyptus camfieldii</i>	Threatened	Quadrat 11
<i>Persoonia hirsuta</i>	Threatened	Incidental
<i>Pimelia curviflora</i> var. <i>curviflora</i>	Threatened	Quadrat 11
<i>Leptospermum neesii</i>	Locally significant	Incidental?
<i>Syzygium oleosum</i>		Incidental
<i>Tetradlea glandulosa</i>	Threatened	Quadrat 11

Weed species

The Wheeler Valley catchment has very little urban runoff to bring weed into the bushland. The disturbed soil caused by bulldozers (in the Numeve property, along the road leading to it, and on either side of Maybrook Manors) contains many weeds. The pampas grass identified in March 2001 has been cleared.

There is also some evidence of weed establishment on the Cromer Heights side of the valley, thought to be associated with stormwater runoff from backyards.

The undisturbed areas, however, contain very few recorded weeds.

Discussion

Significance of vegetation communities

- Duffy's Forest

The Threatened Species Conservation Act, 1995, lists species, populations and communities that are likely to become extinct in nature unless the circumstances and factors threatening its survival cease to operate. One such vegetation community that occurs in the Duffy's Forest / Terrey Hills / Ingleside / Belrose areas is called Duffy's Forest. It is estimated that only 15% of the original area of the community currently exists in a number of remnants. Numerous fungi and animals are specifically associated with this community. The maximum penalty for harming threatened species or vegetation without permission is \$220,000 and / or 2 years in jail.

Threats to the survival of the Duffy's Forest Vegetation Community include: land clearing, habitat degradation by rubbish dumping and access by people, trail bikes, mountain bikes and

other vehicles, weed invasion facilitated by urban runoff, an inappropriate fire regime, and unauthorised horse riding activities in the area.

Significance of species diversity

The presence of at least 7 threatened and significant plant species in Wheeler Creek emphasizes the value of this Valley. It is imperative that the habitats of these species are maintained and not degraded. All threats should be identified and ameliorated.

The peripheral weed encroachment problems are likely to be manageable if the stormwater from Cromer Heights is redirected away from the bushland. This is one of the aims stated in the Warringah Council draft Environmental Strategy. The relatively low abundances and limited distributions of weeds throughout Wheeler Creek is significant in itself: it is important to ensure that weeds are not allowed to penetrate the healthy bushland and affect the threatened vegetation communities and species that occur here.

More investigation is needed of the *Syzygium oleasium* and the *Persoonia hirsuta* which were opportunistic sightings.

Vegetation as habitat for fauna

- The *Ceratopetalum apetalum* (Coachwood) vegetation that occurs next to the creek (quadrat 12) is suitable habitat for Powerful Owls. There is considerable anecdotal evidence that a Powerful Owl population inhabits this area - and additional evidence of a roosting site, scats (found in May 2002), sightings and frequent calls.
- *Banksia ericifolia*, which is one of the dominant plant species throughout the area, is a major winter food source for Honeyeaters and other fauna.
- The creek, surrounding landform and vegetation are consistent with terrain required for Red-crowned toadlets, which are a threatened species.
- Many other animal species have been recorded in the area, including Bandicoots that assist in the regeneration of bushland through their activities in the soil. Refer to other sections of this Biodiversity Survey for specific information regarding fauna in Wheeler Creek valley.

Relevance of findings to bushfire management

In 9 of the survey areas *Banksia ericifolia* was present, and in many was a dominant species. Unlike other native species, *B. ericifolia* is killed by fire and must regenerate from seed. It can be eliminated from a site if fires occur at too frequent intervals that do not allow the regenerating plants enough time to replenish the soil seedbank. Fires at less than 10 years can be expected to have an adverse effect on populations of *B. ericifolia* and other fire sensitive species¹. The last bushfire, in 1994, affected the entire valley. Thus the presence of this species indicates that there was a sufficient seedbank stored in the soil prior to 1994.

The vegetation in the study area is in good condition, and has regenerated well from the 1994 fire. Future fire management plans need to consider the requirements of *Banksia ericifolia* and

¹ Information from the management plan for Golden Grove and Red Hill Parks, adjacent to this area.

other fire sensitive species (for example *Ceratopetalum apetalum*), and the threatened species present.

Conclusions

The presence of a substantial number of threatened species is important and highlights the value of Wheeler Creek valley. These species must be protected under federal legislation (the Threatened Species Conservation Act, 1995). Therefore, caution is needed when any activity in Wheeler Creek valley is undertaken that may affect them. Further research should be conducted into the populations of these species, and it is strongly recommended that recovery plans be constructed in consultation with the National Parks and Wildlife Service.

The relative absence of weed species within Wheeler Creek valley increases the value of the area immeasurably. Despite the threats to the vegetation, it appears that the vegetation is presently resilient enough to resist the encroachment of weed species.

The variety of plants in different quadrats indicates a fascinating series of ecosystems, the like of which is not found in other areas of Sydney. Vigilance is needed to protect this catchment from detrimental urban development. It would be far more difficult to attempt to repair damage later than to prevent it whilst the bushland is still in good condition.

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Sincere thanks to all those who contributed to this library of reference material during the survey.

Appendix 1 - Locality Map



Source: topographic mapsheet Mona Vale 9130 - 1S

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BATHURST NSW 2795

Key:

- P** Pitfalls
- C** Cage traps
- E** Elliotts
- X** Vegetation quadrats

The locations are listed here as determined by GPS readings (AMG) for the South-west corner of each quadrat, expressed in Eastings and Northings.

1. Swamp. Aspect NE.
E 338 184 N 6265 400
2. Swamp. Aspect W.
Insufficient time
3. Swamp. Aspect N.
Insufficient time
4. Sydney Sandstone Heath. Aspect N.
E 338 617 N 6265 021
5. Swamp. Aspect S.
Insufficient time
6. Riparian. Aspect S.
E 338 804 N 6265 597
7. Riparian. Aspect N.
E 338483 & N 6265490
8. Sydney Sandstone Heath. Aspect N.
Insufficient time
9. Riparian. Gully. Upper catchment. Aspect E.
Insufficient time
10. Riparian. Gully. Upper catchment Aspect E
E 338213 & N 6265777
11. Sydney Sandstone Heath. Aspect W.
E 338390 & N 6266600
12. Community without identification on veg. map key
Riparian. Gully. Lower catchment
E 339333 & N 6265475
13. Sydney Sandstone Heath. Aspect S & E.
E 339550 & N 6265502
14. Bloodwood / Scribbly gum / heath. Aspect N & W.
E 339100 & N 6265000
15. Bloodwood / Scribbly gum / heath. Aspect S.
Insufficient time
16. Sydney Sandstone Heath. Aspect S.
E 338 369 N 6266 019
17. Sydney Sandstone Heath Aspect S.
E 338474 & N 6265835
21. Sydney Sandstone Heath Aspect N & E
E 339108 & N 6265129
22. Sydney Sandstone Heath Aspect N & W

23. Sydney Sandstone Heath Aspect N
E 338054 & N 6266523
Track which transects approximately E 339000 & N 6266500

Another community was identified as interesting between sites 14 & 12 / 13. This will be referred to as the Lilly-pilly site although it is possible that the trees in this area are *Syzygium Oleosum* rather than *Acmena smithii* - the area needs more study.

Appendix 2 Water Test Results

ROBYN TUFT & ASSOCIATES

Periphyton Sampling Results

14 Sep 2001

Key to abundance scores:

1 = Few 2 = Occasional 3 = Common 4 = Abundant 5 = Extremely Abundant

<p>Wheeler Creek, Cromer headwaters Total Number of Taxa: 3</p> <table border="1"> <thead> <tr> <th>Genus</th> <th>Abundance</th> </tr> </thead> <tbody> <tr> <td>Mougeotia</td> <td>4</td> </tr> <tr> <td>Navicula</td> <td>1</td> </tr> <tr> <td>Pinnularia</td> <td>1</td> </tr> </tbody> </table>	Genus	Abundance	Mougeotia	4	Navicula	1	Pinnularia	1	<p>Wheeler Creek above Manors Total Number of Taxa: 8</p> <table border="1"> <thead> <tr> <th>Genus</th> <th>Abundance</th> </tr> </thead> <tbody> <tr> <td>Mougeotia</td> <td>4</td> </tr> <tr> <td>Pennate Group</td> <td>3</td> </tr> <tr> <td>Meridion</td> <td>3</td> </tr> <tr> <td>Zygnema</td> <td>2</td> </tr> <tr> <td>Cylindrocapsa</td> <td>2</td> </tr> <tr> <td>Cryptomonas</td> <td>2</td> </tr> <tr> <td>Pinnularia</td> <td>1</td> </tr> <tr> <td>Chlamydomonas</td> <td>1</td> </tr> </tbody> </table>	Genus	Abundance	Mougeotia	4	Pennate Group	3	Meridion	3	Zygnema	2	Cylindrocapsa	2	Cryptomonas	2	Pinnularia	1	Chlamydomonas	1		
Genus	Abundance																												
Mougeotia	4																												
Navicula	1																												
Pinnularia	1																												
Genus	Abundance																												
Mougeotia	4																												
Pennate Group	3																												
Meridion	3																												
Zygnema	2																												
Cylindrocapsa	2																												
Cryptomonas	2																												
Pinnularia	1																												
Chlamydomonas	1																												
<p>Wheeler Creek below Manors Total Number of Taxa: 8</p> <table border="1"> <thead> <tr> <th>Genus</th> <th>Abundance</th> </tr> </thead> <tbody> <tr> <td>Uronema</td> <td>4</td> </tr> <tr> <td>Mougeotia</td> <td>3</td> </tr> <tr> <td>Pennate Group</td> <td>3</td> </tr> <tr> <td>Cylindrocapsa</td> <td>2</td> </tr> <tr> <td>Cosmarium</td> <td>2</td> </tr> <tr> <td>Cryptomonas</td> <td>2</td> </tr> <tr> <td>Pinnularia</td> <td>1</td> </tr> <tr> <td>Oscillatoria</td> <td>1</td> </tr> </tbody> </table>	Genus	Abundance	Uronema	4	Mougeotia	3	Pennate Group	3	Cylindrocapsa	2	Cosmarium	2	Cryptomonas	2	Pinnularia	1	Oscillatoria	1	<p>Wheeler Creek at Little Willandra Rd Total Number of Taxa: 4</p> <table border="1"> <thead> <tr> <th>Genus</th> <th>Abundance</th> </tr> </thead> <tbody> <tr> <td>Mougeotia</td> <td>4</td> </tr> <tr> <td>Pennate Group</td> <td>4</td> </tr> <tr> <td>Tribonema</td> <td>3</td> </tr> <tr> <td>Euglena</td> <td>1</td> </tr> </tbody> </table>	Genus	Abundance	Mougeotia	4	Pennate Group	4	Tribonema	3	Euglena	1
Genus	Abundance																												
Uronema	4																												
Mougeotia	3																												
Pennate Group	3																												
Cylindrocapsa	2																												
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Pennate Group	4																												
Tribonema	3																												
Euglena	1																												

Macroinvertebrate Sampling Results

Wheeler Creek, Cromer headwaters 14 Sep 2001

Taxon ID	Abundance	Number of Taxa	Score
Ceratopogonidae	1	1	6
Chironomidae	2	4	2
Culicidae	2	1	4
Ecnomidae	1	1	4
Gripopterygidae	1	1	7
Hydracarina	1	1	5
Leptophlebiidae	3	3	30
Lumbriculidae	1	1	1
Megapodagrionidae	1	1	7
Tipulidae	2	1	10

Wheeler Creek above Manors 14 Sep 2001

Taxon ID	Total Number of Taxa 16		Score
	Abundance	Number of Taxa	
Calamoceratidae	1	1	8
Chironomidae	2	3	2
Culicidae	2	1	4
Gripopterygidae	1	1	7
Hydropsychidae	1	1	5
Leptoceridae	2	2	14
Leptophlebiidae	4	3	40
Megapodagrionidae	1	1	7
Notonectidae	1	1	4
Parastacidae	1	1	7
Scirtidae	1	1	7

Wheeler Creek below Manors` 14 Sep 2001

Taxon ID	Total Number of Taxa 23		Score
	Abundance	Number of Taxa	
Calamoceratidae	1	1	8
Ceratopogonidae	1	1	6
Chironomidae	3	5	3
Copepoda	3	1	0
Corydalidae	1	1	4
Culicidae	2	1	4
Dugesidae	1	1	3
Dytiscidae	2	1	10
Gerridae	2	1	10
Gomphidae	1	1	7
Hemicorduliidae	2	1	14
Hydracarina	2	1	10
Hydrophilidae	1	1	5
Leptoceridae	1	1	7
Leptophlebiidae	2	1	20
Megapodagrionidae	1	1	7
Parastacidae	1	1	7
Psephenidae	1	1	5
Veliidae	2	1	8

Wheeler Creek at Little Willandra Rd 14 Sep 2001

Taxon ID	Total Number of Taxa 24		Score
	Abundance	Number of Taxa	
Aeschnidae	1	1	6
Chironomidae	2	5	2
Copepoda	4	1	0
Corixidae	2	2	10
Dugesidae	2	2	6
Dytiscidae	3	2	15
Gerridae	2	1	10
Gomphidae	1	1	7
Gripopterygidae	1	1	7
Hemicorduliidae	2	1	14
Hydracarina	2	1	10
Leptophlebiidae	1	1	10
Lumbriculidae	1	1	1
Naididae	1	1	1
Notonectidae	1	1	4
Poeciliidae	2	1	0
Tipulidae	1	1	5

Macroinvertebrate Sampling Results
By Robyn Tuft
Summary of Taxa

Phylum	Class	Sub Class	Order	Family	Grade	Common Name
Annelida	Oligochaeta			Lumbriculidae	1	segmented worm
Annelida	Oligochaeta			Naididae	1	segmented worm
Arthropoda	Arachnida		Acariformes		5	mite
Arthropoda	Crustacea	Copepoda				copepod
Arthropoda	Crustacea	Malacostraca	Decapoda	Parastacidae	7	yabbie
Arthropoda	Insecta		Coleoptera	Dytiscidae	5	beetle
Arthropoda	Insecta		Coleoptera	Hydrophilidae	5	beetle
Arthropoda	Insecta		Coleoptera	Psephenidae	5	beetle
Arthropoda	Insecta		Coleoptera	Scirtidae	7	beetle
Arthropoda	Insecta		Diptera	Ceratopogonidae	6	biting midge larva
Arthropoda	Insecta		Diptera	Chironomidae	1	gnat/midge larva
Arthropoda	Insecta		Diptera	Culicidae	2	mosquito larva
Arthropoda	Insecta		Diptera	Tipulidae	5	crane-fly ;arva
Arthropoda	Insecta		Ephemeroptera	Leptophlebiidae	10	mayfly nymph
Arthropoda	Insecta		Hemiptera	Corixidae	5	lesser water strider
Arthropoda	Insecta		Hemiptera	Gerridae	5	water strider
Arthropoda	Insecta		Hemiptera	Notonectidae	4	water boatmen
Arthropoda	Insecta		Hemiptera	Veliidae	4	but
Arthropoda	Insecta		Megaloptera	Corydalidae	4	dobson fly
Arthropoda	Insecta		Odonata	Aeschnidae	6	dragonfly nymph
Arthropoda	Insecta		Odonata	Gomphidae	7	dragonfly
Arthropoda	Insecta		Odonata	Hemicorduliidae	7	dragonfly (formerly
Arthropoda	Insecta		Odonata	Megapodagrionid	7	damselfly nymph
Arthropoda	Insecta		Plecoptera	Gripopterygidae	7	stonefly nymph
Arthropoda	Insecta		Trichoptera	Calamoceratidae	8	caddis fly nymph
Arthropoda	Insecta		Trichoptera	Ecnomidae	4	caddis fly nymph
Arthropoda	Insecta		Trichoptera	Hydropsychidae	5	caddis fly nymph
Arthropoda	Insecta		Trichoptera	Leptoceridae	7	caddis fly nymph
Chordata	Osteichthyes			Poeciliidae		mosquito fish
Platyhelminthes	Turbellaria		Tricladida	Dugosidae	3	flatworm

Biological Results

Robyn Tuft and Associates.

TABLE 1 BIOLOGICAL RESULTS

Parameter		Wheeler Creek Headwaters	Wheeler Creek Upstream The Manors	Wheeler Creek Downstream The Manors	Wheeler Creek at Little Willandra Road
Macroinvertebrates	SIGNAL Index	5.1 moderately impaired	6.2 mildly impaired	5.1 moderately impaired	4.7 moderately impaired
	Number of Taxa	15	16	23	24
	Dominant Organisms	Leptophlebiidae (mayflies) Chironomidae (midge larvae)	Leptophlebiidae (mayflies) Chironomidae (midge larvae) Leptoceridae (caddisfly nymphs)	Chironomidae (midge larvae) Dytiscidae (beetles) Hemicordulidae (dragonfly nymphs) Leptophlebiidae (mayfly nymphs)	Dytiscidae (beetles) Chironomidae (midge larvae) Gerridae (water skaters) Hemicordulidae (dragonfly nymphs) Dugesidae (flatworms)
Vertebrates			<i>Crinea signifera</i> (Eastern froglet)	<i>Crinea signifera</i> (Eastern froglet) Ducks, Swamp Wallaby	<i>Gambusia holbrooki</i> (mosquito fish) Eastern Water Dragon
Periphyton	% Cover	2-25%	2-25%	50%	25-50%
	Dominant Types	<i>Mougeotia</i>	<i>Mougeotia</i> Diatoms	<i>Uronema</i> (filamentous) <i>Mougeotia</i> (filamentous) Diatoms	<i>Mougeotia</i> Diatoms <i>Euglena</i>
Macrophytes	% cover	<2%	<2%	<2%	2-25%
	Dominant types	-	-	-	<i>Hydrocotyl</i> <i>Callitriche</i>
Riparian Vegetation		<i>Callicoma</i> <i>Angophora costata</i> <i>Eucalyptus</i> sp	<i>Gleicheina</i> <i>Callicoma</i> <i>Eucalyptus</i> sp	<i>Gleicheina</i> <i>Callicoma</i> <i>Eucalyptus</i> sp	Crofton Weed Lantana Fish bone fern
RCE		42 (good)	46 (good)	35 (fair)	18 (very poor)

March/April Water Test Results

By Melinda Elith

Middle Reach (Site 12)		
Water Variables	8/04/01 10:12am	9/04/01 10:29am
Conductivity (µmhos)	233	232
Dissolved Oxygen (mg/L)	7.1	6.0
pH	6	6.5
Temperature (°C)	17.9	18.9
Light absorption (log scale 0-1000)	Off the scale = clear water	Off the scale = clear water

Table one- the results from water tests conducted at Site 10 in Wheeler creek.

Site conditions for the site on the two days sampling was carried out are as follows:
8/04/01- 96% cloud cover, overcast, 60% humidity, large algae content in water, overhang of vegetation approx. 10% on left bank, water depth ranges from 10-50cm, slight flow in the pool.

9/04/01- 0% cloud cover, sunny, humidity <10%, large algae content in the water, overhang of vegetation approx. 10% on left bank, water depth ranges from 10-50cm, slight flow in the pool.

Upper Reach (Site 10)		
Water Variables	8/04/01 11:00am	9/04/01 11:11am
Conductivity (µmhos)	210	195
Dissolved Oxygen (mg/L)	6.6	5.7
pH	5.5	6
Temperature (°C)	20.2	20
Light absorption (log scale 0-1000)	Off the scale = clear water	Off the scale = clear water

Table two- the results from water tests conducted at site 12 in Wheeler creek.

Site conditions for the site on the two days sampling was carried out are as follows:
8/04/01- 100% cloud cover, overcast, 60% humidity, leaf litter covering 75% of the substrate, overhang of vegetation 15-25%, water depth 5-40cm, no flow in the pool.

9/04/01- 25% cloud cover, sunny, humidity <20%, leaf litter covering 75% of the substrate, overhang of vegetation 15-25%, water depth 5-40cm, no flow in the pool, many dead mayflies present.

September Water Testing Results

By Mary Johnsen and Cliff Kelsall

Weather on 11th Sept was fine and mild

11 th Sept 01	Site 1 10.30am	Site 2 11.00 am	Site 3	Site 4 11.30 am	Site 5 11.45 am	Site 6 12.15 pm
Location	Headwaters	Opposite Maybrook Manor. Pool below small fall	Below the stormwater pipe	Pool above Willandra. Quad 12.	Opposite Willandra	Below Willandra, above bridge.
Water Flow	Subtle flow in narrow trickle	Slow flow in larger pool		Water entering quiet pool	Still water- +++ organic matter	Gentle flow, silty bottom, brown organic matter.
Temperature °Centigrade	13	14		12.5	13	13
Turbidity ppm	<10	<10		<10	<10	<10
Dissolved Oxygen mg/ml						
Coliforms/100ml	30	No Growth		No Growth	10	No Growth
Total Dissolved Solids ppm	70	110		120	130	140
pH						

Weather on 12th Sept was overcast following overnight rain

12 th Sept 01	Site 1 11.30 am	Site 2 12.00 noon	Site 3 12.20 pm	Site 6 1.30 pm
Location	Headwaters	Opposite Maybrook Manor. Pool below small fall	Below the stormwater pipe	Below Willandra, above bridge.
Water Flow	Gentler flow in pool	Slow flow in larger pool	Still water	Highly turbid water discharge developer's pipe
Temperature °Centigrade	16	18	17.5	18
Turbidity ppm	<10	<10	<10	100
Dissolved Oxygen mg/ml % Saturation	3.8 38%	6.1 76%	4.8 49%	3.4 36%
Coliforms/100ml	190	10	1,170	390
Total Dissolved Solids ppm	70	110	220	120
pH	5	6	7	6

15 th Sept 01	Site 1 3.00 pm	Site 1a 10.30 am	Site 3 9.00 am	Site 6 4.00 pm
Location	Headwaters	Above Maybrook Manor.	In-stream Below the stormwater pipe	Below Willandra, above bridge.
Water Flow	Low	Low	Low	Low
Temperature °Centigrade	13.9	13.4	13.1	16.2
pH	5.7	5.3	6.2	6.5
Dissolved Oxygen mg/ml % Saturation	10.0 95%	9.9 96%	9.0 85%	9.0 95%
Redox mvolts	66	71	-60	49
Turbidity NTU	<10	<10	<10	<10

Appendix 3 Birds

Powerful Owls - seen at Wheeler Creek on 8th May, 2002

NPA Biodiversity Study Quadrat 12 E 339333 N 6265475

Brett Morrissey, Chris Batty, Lisa Stott and Sue Stevens of Total Earth Care were sent to the Wheeler Creek to remove Ludwigia. Chris Batty went up the creek looking for Ludwigia and found powerful owl scats.

Judith Bennett, Cliff Kelsall, Ian Moran and Joanne Tort followed the Total Earth Care team back to where Chris had seen the scats.

We photographed these and then Joanne spotted the two owls up in a high Allocasuarina tree.



Ringtail possum claw and bones.



Owl droppings which contain small bits of ringtail possum bones.



Pellet that an owl regurgitated which contains fur, claws and bones of possums.



Brett Morrissey of Total Earth Care with owl scats.



Powerful owls asleep in the Allocasuarina tree.



Terrain where scats were found beneath and amongst the leaves of a Coachwood tree that overhung the creek.

Birds seen or heard during the March 2001 Biodiversity Survey:-

Key to Identification method - c = call, v = visual. Q1-17 identify the Quadrat where the bird was heard or seen.

Common Name	Scientific Name	Method	Q 01	Q 04	Q 10	Q 12	Q 17	Opp
Australian Magpie.		c,v			1	1		
Australian Raven.		c,v		1		1	2	
Bar-shouldered Dove.	<i>Geopilia humeralis</i>	c,v			1			1
Black-faced Cuckoo-shrike.		c, v			1			
Brown Quail. *	<i>Coturnix pectoralis</i>	v		1				1
Brown Thornbill.		v						1
Buff-banded Rail	<i>Gallirallus philippensis</i>	v						
Crested Pigeon		v						1
Double-barred Finch.		v						1
Dusky Woodswallow.		v						1
Eastern Rosella.		v						1
Eastern Spinebill.		c,v			1	1	1	
Eastern Whipbird.		c, v M+F	1	1	2	6	2	1
Eastern Yellow Robin.		c						1
Fan-tailed Cuckoo.	<i>Cacomantis flabelliformis</i>	c, v		1	1		1	1
Golden Whistler.	<i>Pachycephala pectoralis</i>	v + spotlight						1
Grey Butcherbird.		v						1
Grey Fantail.		v						1
Grey Shrike-Thrush.		c,v					1	
King Parrot		v						1
Laughing Kookaburra.		c, v						1
Little Wattlebird.	<i>Anthochaera chrysoptera</i>	c, v	1	1	2		2	1
Masked Lapwing *		c						1
New Holland Honeyeater	<i>Phylidonyris novaehollandiae</i>	c,v		1	4	1	6	1
Noisy Miner.		c						1
Pacific Black Duck.		v						1
Peaceful Dove	<i>Geopelia striata</i>	v						1
Pied Currawong.		v		1			2	
Rainbow Lorikeet.		c,v				2		
Red Wattlebird.		v		1	3			
Red-browed Finch (Firetail)		v		1				
Rufus Whistler.		v						1
Spotless Crane		v	1					
Spotted Pardalote. *		c, v				1		
Spotted Turtle-Dove.		c,v			2		1	
Sulphur-crested Cockatoo.		c, v				1		
Variiegated Fairy-wren *		v						1
Welcome Swallow.		c,v	1	1	1		4	1
Whistling Kite		v						1
White-browed Scrubwren *	<i>Sericornis frontalis</i>	c,v			2	1		1
White-cheeked Honeyeater.		v	1	1				
White-eared Honeyeater.		v						1
White-throated tree-creeper		c				1		
Wood Duck		v						1
Yellow-faced Honeyeater.		c						1

* denotes ground nester or birds threatened by dogs

74 birds recorded by Bruce Cox

* = Ground nester, particularly subject to disturbance by dogs.

V = vagrant to this location.

Ms. = summer migrant to Sydney region.

Mw. = winter migrant to Sydney region.

R = resident in this location.

B = believed a breeding species at this location.

[most birds shown as resident would be !]

N = nomadic at this location.

I = introduced species.

E = escapee. [not used in this document !]

Status.

A = abundant at this location..

C = common at this location.

U = uncommon at this location.

S = seen only once at this location.

X = Seen or heard by me
in the Wheeler Creek catchment.

SPECIES	STATUS.	COMMENTS.	X
Australian Magpie.	C,R.		x
Australian Raven.	C,R.	Probably breeds in surrounding gullies.	x
Australian White Ibis.	V,S.	Overflying.	
Bar-shouldered Dove.	C,R,B.	Small colony of about 10 birds. Uncommon in the Sydney region.	x
Black-faced Cuckoo-shrike.	U,R.		x
Brown Goshawk.	U.	Seen three times, sub adult plumage.	x
Brown Quail.	* C,R,B.	Up to 16 birds seen on a single visit. Young runners seen !	x
Brown Thornbill.	U.		x
		Seen or heard most visits, uncommon in Sydney region.	
Brush Bronzewing.	U,R.	Seen elsewhere on northern beaches!	x
Channel-billed Cuckoo.	V,Ms,S.	Overflying.	x
Chestnut-rumped Heathwren.*	U,R,B.	This species is seen less frequently than in previous years.	x
Common Bronzewing.	V.	Seen twice, common west of Sydney.	x
Common Koel.	U,Ms.	Generally heard rather than seen, apparently from wetter gullies ?.	x
Common Myna.	C,R,B,I.	Seen in urban areas bordering Red Hill..	x
Common Starling.	U,I.		
Crimson Rosella.	U,N.		x
		Flocks of up to 10 birds seen.	
Double-barred Finch.	C,R,B.	Only 2 known locations on the northern beaches.	x
		Generally seen around the saddle, not always present.	
Dusky Woodswallow.	U,N.	Probable seasonal migration ?	x
Eastern Rosella.	U,R.	Appears to be a resident pair !	x
Eastern Spinebill.	U.		x
Eastern Whipbird.	C,R,B.		x
Eastern Yellow Robin.	C,R,B.		x
European Goldfinch.	U,I.	Seen on 3 occasions, believed nomadic in coastal heaths.	x
Fan-tailed Cuckoo.	U.		x
Fork-tailed Swift.	Ms.	Single bird seen once overflying with White-throated Needletails..	
		Only seen once at the saddle, common in western part of the county.	x
Fuscous Honeyeater.	S.		
Galah.	U.	Pair resident at Pipeclay Point [Narrabeen Lagoon]	
Golden Whistler.	C,R,B.		x
Grey Butcherbird.	U,R.		x
Grey Fantail.	C,R,B.		x
Grey Shrike-Thrush.	C,R,B.		x
Latham's Snipe.	Ms,V,S.	Flushed in hanging swamp.	x
Laughing Kookaburra.	C,R.		x
Leaden Flycatcher.	Ms,S.	Probably on migration ? not usual in this habitat.	x
Lewin's Honeyeater.	S.	Not usually seen in heath habitat. Probably resident in lower, wetter valleys.	

		Also seen by others. 2 on west track and 1 in hanging swamp.	
Lewin's Rail.	* U.	Known to inhabit wet heath !	x
Little Wattlebird.	A,R,B.		x
Magpie-lark.	U.	Unusual in heath habitat.	x
Masked Lapwing.	* V,B, S.	Found nest with eggs on south site prepared for playing oval.	
New Holland Honeyeater.	A,R,B.		x
Noisy Friarbird.	N.	Uncertain of status, possibly only seen once. Visits flowering trees.	
Noisy Miner.	S.	Resident in lower gullies.	x
Pacific Black Duck.	V,S.	Flushed from beside the track. Not their usual habitat ! Seen twice, also platelets seen !	
Painted Button-quail.	* U.	Very uncommon in northern beaches area..	x
Peregrine Falcon.	U.	Seen twice, possibly Narrabeen Lagoon pair or offspring ? A large, terrestrial, non parasitic cuckoo.	
Pheasant Coucal.	* U,R.	Fairly rare in the Sydney region.	x
Pied Currawong.	U,R.	Probably breeds in surrounding gullies.	x
Rainbow Lorikeet.	C,N.	Probably visits when food elsewhere is in short supply.	x
Red Wattlebird.	C.	Not always present, visits flowering trees.	
Red-browed Finch.	C,R,B.		x
Red-wiskered Bulbul.	C,I,R.		x
Rock Dove.	I.	Seen overflying.	
Rockwarbler.	* U,R,B.	Up to 5 seen together, breeds at the saddle.	x
Rufus Fantail.	Ms.	Seen twice. Probably on migration ? not it's usual habitat.	x
Rufus Whistler.	U,Ms.		x
Silvereye.	C.		
Spangled Drongo.	Mw,S.	Common winter migrant to the Sydney area. Not often in heath.	
Spotted Pardalote.	* C,N.	Locally nomadic, probably resident in lower, wetter gullies.	x
Spotted Turtle-Dove.	C,R,I.		x
Sulphur-crested Cockatoo.	C,R.	Generally seen on the western flank towards Oxford Falls..	x
Superb Fairy-wren.	* C,B,R.		x
		Overflying Wheeler Creek.	
Swamp Harrier.	S.	Seen at only 2 locations on the northern beaches. Very uncommon. in the northern beaches region.	x
Tawny-crowned Honeyeater.	U,N.	Only seen at 2 locations.	x
Variagated Fairy-wren.	* C,B,R.		x
Welcome Swallow.	C,R.	Some winter migration out of the Sydney area.	x
White-bellied Sea-Eagle.	S,V.	seen overflying.	
White-browed Scrubwren.	* C,R,B.		x
White-cheeked Honeyeater.	U.	Not usual in heath, more common in taller timber.	x
White-eared Honeyeater.	C,R,B.		x
White-naped Honeyeater.	U,N.	Visits flowering trees and shrubs.	x
White-throated needletail.	U,Ms.	seen overflying on several occasions.	x
Willy Wagtail.	U,R.		
Yellow-faced Honeyeater.	C,N,Ms.	Not always present.	x
Yellow-tailed Black-Cockatoo.	U,N,S.	Seen once overflying the saddle. Could visit seeding Wattle.	x

Birds in September

		15/9/01 6:20am	15/9/01 4:30pm	15/9/01 8pm	16/9/01 6:30am	16/9/01 2:30pm	16/9/01 4:30pm
	v = visual					Willandra Village	North Cromer Heights
	c = call					Calm, dry	Calm, dry
	*** = listed March but not Sept.					Noel Ryan, Melinda Elith, D.J. Cavanagh, Madhava D'Costa	Noel Ryan, Melinda Elith, D.J. Cavanagh, Madhava D'Costa
Australian Magpie.	v, c				Flying		3 flying
Australian Raven.	v, c		v		call		4 flying
Bar-shouldered Dove.	c, v	call, v					
Black-faced Cuckoo-shrike.	c	call					
Boobook Owl	c			v			
Brown Quail.	***						
Brown Thornbill.	v, c	call			call		
Cormorant	v						flying around lake
Crested Pigeon	***						
Crimson Rosella	v	v					
Double-barred Finch.	v	v					
Dusky Woodswallow.	***						
Eastern Rosella.	***						
Eastern Spinebill.	v, c				Flying	1	
Eastern Whipbird.	c	call			call	1 male, 1 female	2 males 1 fem
Eastern Yellow Robin.	c	call			call	1	
Fan-tailed Cuckoo.	c	call			call	1	
Golden Whistler.	***						
Grey Butcherbird.	***						
Grey Fantail.	v, c	call			Flying		
Grey Shrike-Thrush.	c	v			call		beautiful call
King Parrot	c				call	1	
Koel Cuckoo	v						In dev area
Laughing Kookaburra.	v, c				call	1 flying, 1 in tree	
Little Wattlebird.	v, c	v				1	
Masked Lapwing.	***						
New Holland Honeyeater.	c						flying
Noisy Friarbird	v		v				
Noisy Miner.	c	call			call		
Olive-backed Oriole	v,c				c, v		
Pacific Black Duck.	v					3 flying	on the lake
Pheasant Coucal	c	call			call		
Pied Currawong.	v, c	v			call	2 flying, 1 in tree	1 flying, 2 in tree
Rainbow Lorikeet.	v, c				call	1 flying, 1 calling	
Red Wattlebird.	***						
Red-browed Finch (Firetail)	v	v				2	in small shrub
Red Whiskered Bulbul	v					10 in trees	
Rufus Whistler.	***						
Shining Bronze Cuckoo	c	call			call		
Silver eye	v, c	call				7 in trees	
Spotless Crane	***						
Spotted Drongo	v	v					
Spotted Pardalote.	c	call			call		
Spotted Turtle-Dove.	v,c				call	2 in tree	
Sulphur-crested Cockatoo.	v, c	call	v	Roosting	call	3 flying, 2 calling	
Tawny Frogmouth	v, c		v	Roosting	call		

Tree Martin	v	v					
Turtle Dove	v						v in tree
Variegated Fairy-wren.	v		v		visual	1 male, 1 female	
Welcome Swallow.	v						in and out of water
Whistling Kite	***						
White-browed Scrubwren.	v		v			2 within 10m	3 in medium tree
White-cheeked Honeyeater.	***						
White-eared Honeyeater.	v						v in trees
White-throated Treecreeper	***						
Wood Duck	***						
Yellow-faced Honeyeater	***						
Yellow-tailed black cockatoo with chick	v						

Appendix 4 - Mammals

Hair tube analysis for March is as follows:

Location	GPS readings	Definite	Probable
H1	E 338267 N 6265851	<i>Perameles nasuta</i>	
H2	E 338303 N 6265876	(one macropod hair)	<i>Wallabia bicolor</i>
H3	E 338322 N 6265894	<i>Wallabia bicolor</i>	
H4	E 338356 N 6265903	(few rodent hairs)	<i>Rattus sp</i>
H5	E 338395 N 6265917	(one bandicoot hair) (few rodent hairs)	<i>Perameles nasuta</i> <i>Rattus sp</i>
H6 and H7	E 338517 N 6265909 E 338474 N 6265913	No data	

Scat Analysis for March

Scat materials were sent for identification. This analysis reveals what the animals had been eating, which in turn positively identifies some of the mammals from the area particularly the analysis of fox scats. There were 22 scats analysed with these results:-

Number	Scat	Definite	Probable
1	fox	(few bandicoot hairs)	<i>Perameles nasuta</i>
2	fox	<i>Oryctolagus cuniculus</i>	Rabbit
3	fox	<i>Pseudocheirus peregrinus</i>	Ringtail Possum
4	water-rat	<i>Hydromys chrysogaster</i> (grooming)	
5	cat	<i>Trichosurus sp</i> <i>Felis catus</i> (grooming)	Brushtail Possum
6	fox	<i>Rattus rattus</i>	Rat
7	fox	<i>Oryctolagus cuniculus</i>	Rabbit
8	fox	<i>Felis catus</i> (prey)	Cat
9	macropod	(No hairs - plant material)	<i>Wallabia bicolor</i>
10	fox	<i>Pseudocheirus peregrinus</i>	Ringtail Possum
11	fox	<i>Rattus rattus</i>	Rat
12	fox	<i>Oryctolagus cuniculus</i>	Rabbit
13	dog	<i>Perameles nasuta</i> <i>Rattus rattus</i> <i>Canis familiaris</i> (grooming)	Long-nosed Bandicoot Rat Dog
14	fox	(few bandicoot hairs)	<i>Perameles nasuta</i>
15	fox	------(feathers)	
16	fox	------(insect material)	
17	dog	<i>Trichosurus sp</i> <i>Canis familiaris</i> (grooming)	Brushtail Possum Dog
18	fox	<i>Oryctolagus cuniculus</i>	Rabbit
19	fox	<i>Pseudocheirus peregrinus</i> <i>Vulpes vulpes</i> (grooming)	Ringtail Possum Fox
20	? dog	------(feathers, bird bones)	
21	fox	<i>R. rattus</i> (few bandicoot hairs)	<i>Perameles nasuta</i>
22	dog	<i>Canis familiaris</i> (grooming) (and insect material)	

Mammal list for March

Common Name	Latin name	Identification method
Brown Antechinus	<i>Antechinus stuartii stuartii</i>	Elliot traps
Long-nosed Bandicoot	<i>Perameles nasuta</i>	Trap, hair tube, scat and diggings
Ringtail Possum	<i>Pseudocheirus peregrinus</i>	Fox scat, seen when spotlighting
Brushtail Possum	<i>Trichosurus vulpecula</i>	Fox scat, seen in Euc. in suburb, several seen when spotlighting
Grey-headed Fruit-bat	<i>Pteropus poliocephalus</i>	Spotlight sighting, sounds, seen flying
White-striped Mastiff Bat	<i>Tadarida australis</i>	Squeaks heard at night
Southern Bush Rat	<i>Rattus fuscipes assimilis</i>	6 caught in traps over 3 nights
Swamp Wallaby	<i>Wallabia bicolor</i>	Scat, hair tube, local residents' sightings, sound of jumping in evening, scats, hair
Gliders		Scratchings in trees
Dogs	<i>Canis familiaris</i>	(grooming hairs in scat), seen with humans
Water rat	<i>Hydromys chrysogaster</i>	(grooming hairs in scat)
Rabbit	<i>Oryctolagus cuniculus</i>	Fox scat
Horse	<i>Equus caballus</i>	Droppings, hoof prints, 1 pony with rider
Fox	<i>Vulpes vulpes</i>	Scats, smell
Cat	<i>Felis catus</i>	(grooming hairs in scat)
Humans	<i>Homo sapiens sapiens</i>	Footprints, sightings, bike tracks seen riding horses and mountain bikes, walking and jogging

Mammals observed in traps in September

			Cage 15/9	Elliot 15/9	Cage 16/9	Elliot 16/9	Cage 17/9	Elliot 17/9
Bait used			Peanut butter, honey, rolled oats, sardines	Peanut butter, honey, rolled oats	Peanut butter, honey, rolled oats, sardines	Peanut butter, honey, rolled oats	Peanut butter, honey, rolled oats, sardines	Peanut butter, honey, rolled oats
			No rain	No rain	No rain	No rain	No rain	No rain
							Cloud 80%	Cloud 80%
							Moderate wind	Moderate wind
Track near Maybrook Manors								
A1	338565	6265560		Bush rat		Bush rat - escaped		
A2	338567	6265573				Bush rat	Bush rat	Bush rat
A3	338555	6265613		Antechinus-F-breeding	Bush rat		Bush rat	Bush rat
A4	338552	6265624			Bush rat			
A5	338549	6265639	Bush rat	Bush rat				Antechinus - pregnant
A6	338554	6265650					Bush rat	Antechinus - breeding
A7	338553	6265664	Long-nosed Bandicoot					
A8	338553	6265695		Bush rat		Bush rat	Bush rat	
A9	338557	6265714			Long-nosed Bandicoot	Bush rat	Bush rat	Bush rat
Near Dumped Car west of Line A								
B1	338357	6265730			Long-nosed Bandicoot		Bush rat	
B2	338362	6265734		Antechinus-F-8 babies				
B3	338369	6265745		Bush rat			Bush rat	Big bush rat
B4	338365	6265751	Long-nosed Bandicoot - F - baby in pouch				Long-nosed Bandicoot - F - breeding	
B5	338350	6265727			Bush rat			Bush rat
B6	338343	6265711						Antechinus - 8 babies
B7	338319	6265699						
B8	338322	6265693					Long-nosed Bandicoot - Male	
B9	338314	6265689	Bush rat		Bush rat			
B10	338300	6265684	Bush rat		Bush rat		Bush rat	Bush rat

Hanging Swamp								
C1	338228	6265380			Bush rat			
C2	338201	6265408					Bush rat	
C3	338176	6265405					Bush rat	
C4	338167	6265417						
C5	338159	6265445			Bush rat		Bush rat	Bush rat
C6	338128	6265441			Bush rat		Bush rat	
C7	338105	6265467			Bush rat		Bush rat	Bush rat
C8	338098	6265478				Bush rat	Bush rat	Bush rat
C9	338155	6265527					Bush rat	
C10	338157	6265544		Bush rat				
Natural Areas Ltd								
D1	339378	6265143						
D2	339339	6265161		Bush rat		Bush rat		
D3	339272	6265188				Bush rat	Bush rat	
D4	339282	6265200	Bush rat	Bush rat			Long-nosed Bandicoot - Female	
D5	339282	6265252	Bush rat			Bush rat	Bush rat	
D6	339280	6265240					Bush rat	
D7	339276	6265262		Bush rat	Bush rat		Bush rat	
D8	339277	6265284		Bush rat	Bush rat		Bush rat	Bush rat
D9	339279	6265318		Bush rat	Bush rat	Bush rat	Bush rat	
D10	339287	6265311		Bush rat			Bush rat	Bush rat

Hair Funnel Analysis for September

By Barbara Triggs,

Site	Easting	Northing	Definite	Probable
A1	338565	6265560	Rattus fuscipes	
A2	338567	6265573	Rattus fuscipes, Permales nasuta	
A3	338555	6265613	Antechinus stuartii	
A4	338552	6265624	Rattus fuscipes, Antechinus stuartii	
A5	338549	6265639	Rattus fuscipes, Permales nasuta	
A6	338554	6265650	Permales nasuta, Antechinus stuartii	
A7	338553	6265664	Rattus fuscipes, Antechinus stuartii	
A8	338553	6265695	Antechinus stuartii, Wallabia bicolor	
A9	338557	6265714	Rattus fuscipes	
B1	338357	6265730	Permales nasuta	
B2	338362	6265734	Permales nasuta	
B3	338369	6265745	Permales nasuta, Rattus sp.	Rattus fuscipes
B4	338365	6265751	Permales nasuta	
B5	338350	6265727	Permales nasuta	
B6	338343	6265711	Antechinus stuartii, Rattus sp,(few hairs)	
B7	338319	6265699	Rattus fuscipes, Permales nasuta	
B8	338322	6265693	Rattus fuscipes, Permales nasuta	
B9	338314	6265689	Rattus fuscipes	
B10	338300	6265684	Rattus fuscipes, Permales nasuta	
C1	338228	6265380	Rattus fuscipes	
C2	338201	6265408	Permales nasuta	
C3	338176	6265405	Rattus fuscipes	
C4	338167	6265417	Permales nasuta	

C5	338159	6265445	Rattus fuscipes	
C6	338128	6265441	Rattus fuscipes	
C7	338105	6265467	Rattus fuscipes	
C8	338098	6265478	Rattus fuscipes, Antechinus stuartii	
C9	338155	6265527	Rattus fuscipes, Antechinus stuartii	
C10	338157	6265544	Rattus fuscipes, Antechinus stuartii	
D1	339378	6265143	Rattus fuscipes	
D2	339339	6265161	Permales nasuta , Rattus sp.(few hairs)	
D3	339272	6265188	Rattus fuscipes, Permales nasuta	
D4	339282	6265200	Permales nasuta	
D5	339282	6265252	Rattus fuscipes, Trichosurus sp.	Trichosurus vulpecula
D6	339280	6265240	Rattus fuscipes	
D7	339276	6265262	Rattus sp.	Rattus fuscipes
D8	339277	6265284	Rattus fuscipes	
D9	339279	6265318	Rattus fuscipes	
D10	339287	6265311		

Opportunistic sightings of mammals

Date	Easting	Northin g	Time	Species	Notes	
15/9/01	338319	6265699	7:30 AM	Ringtail Possum	Observed running out of its drey	By Max Harris
16/09/01	339045	6166523	12:00noon	Wallaby scats		

Observed during Spotlighting - along the Loggers trail behind the firestation

Date	Easting	Northing	Time	Species	Notes
15/9/01	338319	6265699	8:00 PM	Ringtail Possum	Two seen
15/9/01	338319	6265699	8:00 PM	Long-nosed bandicoot	

Martyn Robinson, whilst researching birds in the valley on October 6th, near Quadrat #21 E 339108 N 6265129, observed the following:-

Swamp wallaby tracks

Dog and fox tracks

Strong smell where fox has been spraying

Scat Analysis for September

By Barbara Triggs

Scats collected by volunteers during the survey were sent to Barbara for analysis.

Date	Location	Scat	Definite	Probable
15.9.11-16.9.11	Area B5	bandicoot	(fins grooming hair, insect material, soil)	Perameles nasuta
15.9.11-16.9.11	Track to Carvings B2	?possum	(no hairs found)	Trichosurus sp.
15.9.11-16.9.11	Area C2 on rock	macropod	Wallabia bicolor	
15.9.11	Area C2/D3 on track	fox	(few bandicoot hairs)	Perameles nasuta
15.9.11	Area C3/C2 on track	macropod	Macropus sp	Macropus rufogriseus
14.9.11	Trapline D2	macropod	Macropus sp	Macropus rufogriseus
15.9.11-16.9.11	Creek area on "Grizzly's Track"	hair	Pseudocheirus peregrinus	
15.9.11-16.9.11	Saddle area	fox	Oryctolagus cuniculus, Vulpes vulpes (grooming)	
15.9.11-16.9.11	Saddle	? fox	Rattus rattus	
15.9.11-16.9.11	Saddle	?dog	Wallabia bicolor	
15.9.11-16.9.11	Duffy's Forest area	1. macropod 2. hair	1. Wallabia bicolor 2. Pseudocheirus peregrinus	
14.9.11	Upper Wheeler Creek	macropod	Macropus rufogriseus	
15.9.11-16.9.11	"no specific location"	dog	Rattus sp	Rattus fuscipes
15.9.11-16.9.11	Saddle	fox	Oryctolagus cuniculus	
14.9.11	Trapline B near creek	macropod	Macropus sp	Macropus rufogriseus
15.9.11	Near Trap C*	hair	Pseudocheirus peregrinus	

Appendix 5 - Fauna Reports from residents

Brett Butler - Powerful Owl, bandicoots

Tracey Vause - Powerful Owls

Christopher and Christine Bidder - observations during 1999-2001

Birds

An Emu and 6 Chicks

Sulfur-Crested Cockatoos

Galahs

Red Tailed Black Cockatoos

Yellow Tailed Black Cockatoos

Rainbow Lorikeets

Kookaburras

Quails

Crimson Rosellas

Mammals

Ringail possum

An Echidna

A Swamp Wallaby

Bats

Bandicoots

Feral Foxes

Reptiles

Frill-Neck Lizard

Goannas

Geckos

Red-Bellied Black Snake

Brown Snake

Black snake

Tiger Snake

Green Tree Snakes

Diamond Pythons

Death Adder

Summary of mammal species from both surveys

Brown Antechinus	<i>Antechinus stuartii stuartii</i>		
Long-nosed Bandicoot	<i>Perameles nasuta</i>		
Ringtail Possum	<i>Pseudocheirus peregrinus</i>		
Brushtail Possum	<i>Trichosurus vulpecula</i>		
Grey-headed Fruit-bat	<i>Pteropus poliocephalus</i>		
White-striped Mastiff Bat	<i>Tadarida australis</i>		
Southern Bush Rat	<i>Rattus fuscipes assimilis</i>		
Swamp Wallaby	<i>Wallabia bicolor</i>		
Gliders			
Dogs	<i>Canis familiaris</i>		
Water rat	<i>Hydromys chrysogaster</i>		
Rabbit	<i>Oryctolagus cuniculus</i>		
Horse	<i>Equus caballus</i>		
Fox	<i>Vulpes vulpes</i>		
Cat	<i>Felis catus</i>		
Humans	<i>Homo sapiens sapiens</i>		

Appendix 6 - Invertebrates on land

March survey - ants

by Phil Colman

Dolichoderinae:

Doleromyrma darwiniaens
Indomyrmex sp (bickneli group)

Formicinae:

Camponotus consobrinus
Camponotus intrepidus
Camponotus nigriceps
Paratrachina minutula
Paratrechina sp
Polyrhachis ammon
Polyrhachis iase
Stigmacros sp (AMSA-11)
Stigmacros sp (AMBA-23)

Myrmicinae:

Adlerzia froggetti
Crematogaster sp
Mayriella abstinens
Meranopius sp
Monomorium sydneyanase
Pheidoia sp a
Pheidoia sp b

Pnerinae:

Rhytidoponera metallica (green-headed ant)
Pechycondyle australis

Myrmeclinae: (Bull Ants)

Myrmecia gulose
Myrmecia simillima
Myrmecia nigrocinota (jumping ant)
Myrmecia piliventris

Notes: Nothing exceptional here. The presence of R metallica indicates some disturbance - it's common in open exposed sites such as parks and gardens.

Insect traps were set on 23rd March at the following locations:

A01	E 338135	N 6265728	A08	E 338137	N 6265712
A02	E 338142	N 6265731	A09	E 338119	N 6265719
A03	E 338132	N 6265725	A10	E 338156	N 6265717
A04	E 338133	N 6265718	A11	E 338171	N 6265712
A05	E 338127	N 6265718	A12	E 338122	N 6265697
A06	E 338124	N 6265712	A13	E 338144	N 6265720
A07	E 338130	N 6265707			

Opportunistic sightings by Ray Mjadwesch in March

Name	Class	Order	Family
Earthworm	OLIGOCHAETA	HAPLOTAXIDA	
Wolf Spider	ARACHNIDA	ARANEAE	LYCOSIDAE
Crab Spider	ARACHNIDA	ARANEAE	GNAPHOSIDAE <i>Hemicloea ssp</i>
Golden-orb Weaver	ARACHNIDA	ARANEAE	ARGIOPIDAE <i>Nephila ssp</i>
Landhopper	MALACOSTRACA	AMPHIPODA	
Centipede (large common)	CHILOPODA	SCOLOPENDRIDA	
Centipede (v. fast, slenderer)	CHILOPODA	SCOLOPENDRIDA	
Earwig (skinny black)	INSECTA	DERMAPTERA	
Katydid (tree crickets)	INSECTA	ORTHOPTERA	TETTIGONIIDAE
Mosquito	INSECTA	DIPTERA	CULICIDAE

Tiger moth	INSECTA	LEPIDOPTERA	AMATIDAE <i>Amata ssp</i>
Skipper	INSECTA	LEPIDOPTERA	HESPERIIDAE (sp unknown)
White Butterfly	INSECTA	LEPIDOPTERA	PIERIDAE (sp unknown)
Varied Sword-grass Brown	INSECTA	LEPIDOPTERA	NYMPHALIDAE <i>Tisiphone abeona abeona</i>
Grey Ringlet	INSECTA	LEPIDOPTERA	NYMPHALIDAE <i>Hypocysta pseudirius</i>
Common Brown	INSECTA	LEPIDOPTERA	NYMPHALIDAE <i>Heteronympha merope merope</i>
Meadow Argus	INSECTA	LEPIDOPTERA	NYMPHALIDAE <i>Junonia villida calybe</i>
Common Blue	INSECTA	LEPIDOPTERA	LYCAENIDAE <i>Zizina labradus labradus</i>
Processionary caterpillars	INSECTA	LEPIDOPTERA	NOTODONTIDAE <i>Teara ssp.</i>
Sugar Ant	INSECTA	HERMIPTERA	FORMICIDAE <i>Camponotus consobrinus</i>
European Honey Bee	INSECTA	HERMIPTERA	APIDAE <i>Apis mellifera</i>

Ant Species for September, 2001

Small traps (shallow plastic containers with a lid and containing ethelene glycol liquid) were placed with the opening at ground level under leaf litter in the following locations over a week before the survey began and lifted during the survey. The ants were selected out from other invertebrates and identified.

Heathland on Numeve property	Tall Trees - beside trail from Beacon Hill to Carvings	Hanging Swamp area
1 337980 6265777	1 338187 6265812	1 338151 6265437
2 337968 6265787	2 338187 6265817	2 338151 6265437
3 337957 6265795	3 338187 6265822	3 338151 6265437
4 337945 6265792	4 338187 6265827	4 338151 6265437
5 337934 6265788	5 338187 6265832	5 338151 6265437
6 337938 6265797	6 338163 6265802	6 338171 6265377
7 337944 6265798	7 338155 6265805	7 338171 6265377
8 337950 6265797	8 338140 6265795	8 338171 6265377
9 337947 6265798	9 338142 6265795	9 338174 6265352
10 337957 6265795		
	Dolichoderinae: <i>Iridomyrmex sp</i> <i>(bicknelli group)</i> <i>Techniomyrmex sp</i> Formicinae: <i>Paratrechina sp</i> <i>Proiasius sp</i> <i>Stigmacros sp</i> <i>(AMSA-11)</i> Myrmicinae: <i>Crematogaster sp</i> <i>Monomorium sydneyanase</i> <i>Pheidoie sp</i> Ponerinae: <i>Rhytidoponera enigmatica</i>	Dolichoderinae: <i>Iridomyrmex sp</i> <i>(bicknelli group)</i> <i>Irodomyrmex sp</i> Formicinae: <i>Paratrechina sp</i> <i>Proiasius sp</i> Myrmicinae: <i>Pheidoie sp</i> Ponerinae: <i>Rhytidoponera metallica</i>

Note: This site seems to be undisturbed. *R enigmatica* is a local endemic.

Overall, there were rather fewer invertebrates in the traps than were expected. Possibly weather conditions had influenced this.

Spiders found in the area

Amaurobiodea			1F, 1J
Areneidae	Argiope keyseningii		1F
Areneidae	Naphia sp.		1F
Areneidae	Eriophora sp.	Garden Orb Weaver	1M
Clubionidae	Cheiracanthium sp		1M, 1J
Ctenidae? (Pisauridae) sp. 1			1F
	If this was caught near water, it is probably a Water Spider (Pisauridae)		
Ctenidae	sp 2		1M
Idiopidae		Trapdoor spider	2M
Lycosidae		Wolf Spiders	2M, 2J
Salticidae		Jumping Spiders	1M, 4J
Tetragnathidae	Deliochus sp	Leaf Curlers	1F
Tetragnathidae	Melinae		1F
Tetragnathidae	Tetragnatha sp		1M, 1F
Theridllidae			1F
Toxopidae			1M
Zodarikiee	Storana sp. ?		2M, 4J

Juveniles:

Areneicae	2J
Gnaphosidae	2J
Mygaomorph	1J
Oxyopidae	2J
Thariciidae	1J
Thomisidae	7J

Other orders/classes:

Collamboia	Springtail
Hymenoptera	Ants
Diptera	Flies
Acarina	Mites
Opilionicia	Harvestman

Butterflies

By Dr. Courtney Smithers

I visited the Wheeler Creek Valley site twice in Spring 2001, once with John Peters, who is very knowledgeable about butterflies but it would take a proper long-term survey to establish a definitive list of butterflies that visit the area. In fact, we saw fewer than a dozen species, a surprisingly small number. One point to note is that in the 2001/2002 season butterfly populations seem to have been, in general, exceptionally low.

I did not see any species which could in any way be considered to be "endangered" but, of course, alteration of any appropriate habitat would result in reduction or loss of locally bred populations, depending on the extent and nature of the alteration. There is no doubt that the local environment at Beacon Hill would support a fauna very similar to that of Ku-ring-gai Chase, of which a species list was published by Tony Rose (1968). To produce such a list for the Beacon Hill area would need observations over several years.

The area does include a low hill (that on which the trig. site is located) which is certainly being used as a "hilltopping" site by butterflies and which could be of significance to the breeding population of some species. It is important to understand the nature of "hilltopping" and the circumstances under which it is important to the continuance of a breeding population in those species which are habitual "hilltoppers". I thought it might be useful to set out here some idea of current thoughts on hilltopping for future reference. It is important for conservationists to understand how "hilltopping" works so that they don't make assumptions about its importance but can make a reasoned assessment of its value in each case.

Hilltopping is a complex phenomenon and one of which, unfortunately, little systematic study has been made in Australia. It is, however, a worldwide phenomenon and there is no reason to believe that it is different or less important here than elsewhere.

The nature and importance of "hilltopping" in butterflies

Many species of insects have the habit of seasonally gathering at restricted sites usually situated, but not always, on hilltops, tops of ridges or other prominent features of the landscape. The habit is best known and best studied in butterflies and is referred to as "hilltopping", irrespective of whether the site is actually on a hill or not. The nature and area of the sites chosen vary and a site may be as small as a few square metres or may cover several hectares, according to requirements of the species using the site and the nature of the site itself. In a few exceptional cases a single treetop may be significant. The same sites are used year after year whilst apparently similar nearby sites may never be used. Males removed from a site and released some way away will often return to the same site. Species differ in their time of occupation of a site and most sites are used by several species of butterflies at any one time. The sites do not necessarily have to provide nectar food sources for the butterflies nor need they provide food plants suitable for the next generation of caterpillars. The reasons for choice of a particular site are not clear in most cases but most are obviously higher, if not greatly so, than the surrounding country, although this is not always the case.

Changes to the physical and botanical features of a site are very likely to result in abandonment of the site. The factors which determine whether a site is used or not may be quite subtle so that the changes causing the butterflies to abandon it can be quite small.

Specimens found at the site are usually males, which frequently take flights over the area. These flights often follow a more or less set pattern for an individual butterfly and may include the same "resting" points along the way. These "patrolling" males tend to chase other males which enter their "territory" but they investigate any female which enters the area. Males of hilltopping species are usually very uncommon in areas other than the hilltop and may be difficult to find in any other location. Most of the females which fly to the hilltop are virgin females that soon mate with one of the males. After mating the females lose interest in the hilltop and leave the site to seek out plants which are suitable as food sources for their young (caterpillars), ensuring provision of food for the next generation. These plants may be some distance away, sometimes several kilometres, from the hilltopping site. This behaviour accounts for the unequal numbers of the sexes at hilltopping sites; in contrast to the males, females can sometimes be hard to find at the sites, especially in the case of uncommon species, because they are there for such a short time and can easily be missed.

The phenomenon of hilltopping is a very complex behavioural device which is designed to ensure the meeting of the sexes, especially important in the case of species which normally have small populations. In males it involves complex responses to the environment to determine which are suitable aggregation sites. In females, it involves visual responses to the presence of males and specific types of behaviour which change prior to and after mating. Such a mechanism is particularly important to species in which the population is sparse and operates by producing aggregations of males from a wide area which can be visited by females for mating. The females recognise the same sites as being likely to be frequented by males and it is clearly easier for a female to find such a site than it is to find a male in a wide area through which is dispersed a low male population. Small changes in the appearance of a site can result in males not using the site and females not recognising it as a suitable site at which to find males. This bringing-together of specimens from a wide area helps to ensure a mixture of genetic materials in sparse populations which are somewhat isolated.

Even though they are sometimes quite small, hilltopping sites are extremely important in the reproductive cycle of the species that use them because they effectively provide the mating area, for a widely dispersed population which extends well beyond the confines of the site. Their importance to successful reproduction is out of all proportion to their extent; a small area can be vital to survival of a species over a large area. In general, it is those species of hilltoppers which have low populations or are not long-distance fliers which are most in need of continuously available hilltops.

Past losses of hilltopping sites has certainly reduced the distribution of some species in the Sydney region.

Butterflies observed in March by Ray Mjadwesch

White Butterfly	Class INSECTA Order LEPIDOPTERA Family PIERIDAE (sp unknown)
Varied Sword-grass Brown	Class INSECTA Order LEPIDOPTERA Family NYMPHALIDAE <i>Tisiphone abeona abeona</i>
Grey Ringlet	Class INSECTA Order LEPIDOPTERA Family NYMPHALIDAE <i>Hypocysta pseudirius</i>
Common Brown	Class INSECTA Order LEPIDOPTERA Family NYMPHALIDAE <i>Heteronympha merope merope</i>
Meadow Argus	Class INSECTA Order LEPIDOPTERA Family NYMPHALIDAE <i>Junonia villida calybe</i>
Common Blue	Class INSECTA Order LEPIDOPTERA Family LYCAENIDAE <i>Zizina labradus labradus</i>
Processionary caterpillars	Class INSECTA Order LEPIDOPTERA Family NOTODONTIDAE <i>Teara ssp.</i>

Butterflies observed near Wheeler Creek Valley during October-November, 2001 by Dr. Courtney Smithers

Species	Months normally observed
<i>Mesodina halyzia halyzia</i> (Hew.) 'Halyzia Skipper'	November, January, March
<i>Graphium sarpedon choredon</i> (Feld.) 'Blue Triangle'	October to April
<i>Delias nigrina</i> (Fab.) 'Common Jezabel'	June to November
<i>Tisiphone abeona abeona</i> (Don.) 'Swordgrass Brown'	September to April
<i>Vanessa itea</i> (Fab.) 'Australian Admiral'	September to December
<i>Precis villida calybe</i> (Godt.) 'Meadow Argus'	March to November
<i>Neolucia agricola agricola</i> (Westw.) 'Fringed Blue'	September to November
<i>Erina hyacinthia hyacinthia</i> (Semper.) 'Common Dusky Blue'	August to March
<i>Holchila absimilis</i> (Feld.) 'Pencilled Blue'	December

plus one undetermined "skipper" which we failed to catch.

List of Butterflies observed in Ku-ring-gai Chase National Park, NSW by A.B. Rose in 1968

reproduced from "PROC. ROY. ZOOL.SOC.N.S.WALES 1968-69 (1970)"

Introduction

This list of eighty species would be far from complete owing to sporadic occurrences of many species of Lepidoptera and a thorough search of the area has not been undertaken. The months of the year species have been observed would no doubt be broadened by further observations.

Many are very local e.g. *H. mirifica*, females did not leave a certain gully, tagged specimens being recaptured within 150 yards of release, up to four weeks after. Yet none were observed elsewhere and none at all in 1969.

H. merope merope were common and widespread. Tagging made it apparent that they did not move far, specimens being caught within 100 yards of release up to four weeks after. In one small area, 31 were tagged from 1st November, 1968 to 23rd November 1968. On 28th November 1968, a bush fire swept through and not one was recaptured even though it was unburnt within 200 yards. In fact only one untagged specimen was seen in that burnt area, the rest of the summer.

The specimens of *Delias argenthona argenthona* have been observed in very fresh condition indicating the species is breeding locally.

Only one specimen of *Hesperilla crypsargyra crypsargyra* has been recorded; this being only the second specimen recorded from near the coast, the first being recorded at Berowra by the late Leslie Mosse-Robinson.

LEPIDOPTERA

HESPERIOIDEA

HESPERIIDAE-PYRGINAE	MONTHS OBSERVED
<i>Netrocoryne repanda repanda</i> Feld. 'Eastern Flat'	February
H.- TRAPEZITINAE	
<i>Trapezites symmokus symmokus</i> (Hübner) 'Symmokus Skipper'	February, March
<i>Trapezites eliena eliena</i> (Hew.) 'Eliena Skipper'	September to April
<i>Trapezites iacchoides</i> Waterh. 'Iacchoides Skipper'	September
<i>Trapezites maheta praxedes</i> (Plötz) 'Maheta Skipper'	October, March, April
<i>Trapezites phigalioides</i> Waterh. 'Phigalioides Skipper'	October
<i>Trapezites phigalia phigalia</i> (Hew.) 'Phigalia Skipper'	September to November
<i>Trapezites petalia</i> (Hew.) 'Common White-spot Skipper'	October
<i>Dispar compacta</i> (Butl.) 'Dispar Skipper'	February, March
<i>Toxidia peroni</i> (Latr.) 'Large Dingy Skipper'	September to April
<i>Toxidia parvula</i> (Plötz) 'Parvula Skipper'	November, April
<i>Toxidia doubledayi</i> (Feld.) 'Doubleday's Skipper'	October, November, January
<i>Hesperilla masteri</i> Waterh. 'Master's Skipper'	February, March
<i>Hesperilla ornata ornata</i> (Leach) 'Spotted Skipper'	February, October
<i>Hesperilla picta</i> (Leach) 'Painted Skipper'	December, January
<i>Hesperilla crypsargyra crypsargyra</i> (Mevr.) 'Silvered Skipper'	October
<i>Signera flammeata</i> (Butl.) 'Bright-Shield Skipper'	February, March
<i>Motasingha dirphia dilata</i> Waterh. 'Dirphia Skipper'	October, November
<i>Mesodina halyzia halyzia</i> (Hew.) 'Halyzia Skipper'	November, January, March
H.HESPERIINAE	
<i>Ocybadistes flavovittata flavittata</i> (Latr.) 'Common Dart'	October
<i>Ocybadistes walkeri sothis</i> Waterh. 'Yellow-banded Dart'	Sept-Dec, March, April
<i>Ocybadistes hypomeloma hypomeloma</i> (Low) 'Pale Orange Dart'	November, February
<i>Suniana lascivia lascivia</i> (Rosen.) 'Dingy Dart'	November
<i>Telicota colon argeus</i> (Plötz) 'Pale Darter'	December
<i>Telicota ancilla ancilla</i> (H.-Sch) 'Greenish Darter'	Nov - Dec, February
<i>Cephrenes augliades sperthias</i> (Feld.) 'Orange Palm-Dart'	March
PAPILIONOIDEA	
PAPILIONIDAE-LEPTOCIRCINI	
<i>Graphium macleayanus macleayanus</i> (Leach) McLeay's Swallowtail'	March
<i>Graphium sarpedon choredon</i> (Feld.) 'Blue Triangle'	October to April
P-PAPILIONII	
<i>Papilia anactus</i> Macl 'Dingy Swallowtail'	November to March
<i>Papilia aegeus aegeus</i> Don. 'Orchard Butterfly'	October to March
<i>Papilia demoleus sthenelus</i> Macl. 'Chequered Swallowtail'	February
PIERIDAE-COLIADINAE	
<i>Eurema smilax</i> (Don.) 'Small Grass Yellow'	November
P-PIERINAE	
<i>Delias argenthona argenthona</i> (Fab.) 'Northern Jezabel'	November
<i>Delias nysa nysa</i> (Fab.) 'Nysa Jezabel'	September, February
<i>Delias aganippe</i> (Don.) 'Wood White'	October
<i>Delias harpalyce</i> (Don.) 'Imperial White'	September to April
<i>Delias nigrina</i> (Fab.) 'Common Jezabel'	June to November
<i>Anaphaeis java teutonia</i> (Fab.) 'Caper White'	Oct-Dec, March, April
<i>Pieris rapae</i> (L.) 'Cabbage White'	All year round
NYMPHALIDAE-DANAINAE	
<i>Danaus plexippus</i> (L.) 'Wanderer'	July to April

<i>Danaus chrysippus petilla</i> (Stoll.) 'Lesser Wanderer' N-SATYRINAE	March
<i>Ypthinia arctous arctous</i> (Fab.) 'Dingy Ring'	October to April
<i>Hypocysta euphemia</i> Westw. 'Rock Ringlet'	August to April
<i>Hypocysta metirius</i> Butl. 'Common Brown Ringlet'	September to May
<i>Hypocysta pseudirius</i> Butl. 'Dingy Ringlet'	September to April
<i>Hypocysta aiante adiante</i> (Hüb.) 'Orange Ringlet'	September to May
<i>Heteronympha merope merope</i> (Fab.) 'Common Brown'	September to May
<i>Heteronympha mirifica</i> Butl. 'Wonder Brown'	January to March
<i>Heteronympha bankii bankii</i> (Leach) 'Bank's Brown'	March, April
<i>Argynnina hobartia cyrila</i> W. & L. 'Cyril's Brown'	August, September
<i>Geitoneura acantha acantha</i> (Don.) 'Eastern Ringed Xenica'	November to April
<i>Tisiphone abeona abeona</i> (Don.) 'Swordgrass Brown'	September to April
N.-CHARAXINAE	
<i>Polyura pyrrhus sempronius</i> (Fab.) 'Tailed Emporer'	November to April
N.-NYMPHALINAE	
<i>Vanessa kershawi</i> (McCoy) 'Australian Painted Lady'	September to March
<i>Vanessa itea</i> (Fab.) 'Australian Admiral'	September to December
<i>Precis villida calybe</i> (Godt.) 'Meadow Argus'	March to November
N.-ACRAEINAE	
<i>Acraea andromacha andromacha</i> (Fab.) 'Glass-wing'	February
LYCAENIDAE-LYCAENINAE	
<i>Ogyris genoveva gela</i> Waterh. 'Genoveva Azure'	Sept, Oct, Jan-March
<i>Ogyris abrota</i> Westw. 'Dark Purple Azure'	Sept, Oct, March
<i>Ogyris ianthis</i> Waterh. 'Sydney Azure'	November to April
<i>Hypochrysops delicia delicia</i> Hew. 'Blue Jewel'	November
<i>Hypochrysops ignita ignita</i> (Leach) 'Fiery Jewel'	October
<i>Hypochrysops byzos byzos</i> (Boisd.) 'Yellow Spot Jewel'	October, November
<i>Pseudodipsas brisbanensis brisbanensis</i> Misk. 'Large Ant Blue'	October to April
<i>Pseudodipsas cuprea</i> Sands. 'Copper Ant Blue'	December
<i>Paralucia aenea aenea</i> (Misk.) 'Dull Copper'	November to March
<i>Paralucia aurifer</i> (Blanch.) 'Bright Copper'	October, November
<i>Nacaduba biocellata biocellata</i> (Feld.) 'Double-spotted Lineblue'	September, April
<i>Theclinesthes miskini</i> (Luc.) 'Miskin's Blue'	February, March
<i>Lampides boeticus</i> (L.) 'Pea Blue'	September to November
<i>Lucia limbaria</i> Swains. 'Small Copper'	December
<i>Neolucia agricola agricola</i> (Westw.) 'Fringed Blue'	September to November
<i>Neolucia serpentata serpentata</i> (H.-Sch) 'Chequered Blue'	November to April
<i>Zizeeria otis labradus</i> (Godt.) 'Common Grass-blue'	August to April
<i>Erina acosta</i> (Cox) 'Blotched Blue'	August to May
<i>Erina hyacinthia hyacinthia</i> (Semper.) 'Common Dusky Blue'	August to March
<i>Holchila consimillis</i> (Waterh.) 'Consimilis Blue'	December to February
<i>Holchila absimilis</i> (Feld.) 'Pencilled Blue'	December
<i>Cyprotides cyprotus cyprotus</i> (Oll.) 'Cyprotus Blue'	September to December
<i>Candalides zanthospilos</i> (Hüb.) 'Yellow-Spot Blue'	Sept, October, January

Acknowledgements by A.B.Rose:

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Thanks are due to the Australian Museum entomologists for allowing me to check species with their collection and for altering generic and specific names that have been changed since 1964, the year "Australian Butterflies" by I.F.B. Common was published for that has been my reference book.

Appendix 7 - Fungi

SYDNEY FUNGAL STUDIES GROUP INC.

FUNGAL SURVEY at Wheeler Creek on the 12, MAY 2001

<p>Species observed:</p> <p>Division Myxomycota Class Myxomycetes "Slime mould"</p> <p>Division Eumycota Subdivision Ascomycotina Class Pyrenomycetes Order Sphaeriales <i>Diatrype (?) stigma</i></p> <p>Subdivision Basidiomycotina Class Heterobasidiomycetes Order Auriculariales <i>Auricularia polytricha</i></p> <p>Class Homobasidiomycetes Order Aphyllophorales <i>Cantharellus sp. (1 or 2 spp.)</i> "Clavaria" (Coralloid, pale yellow) "Corticiaceae" (6,7 spp.) <i>Fomitopsis ochroleuca</i> <i>Hexagonia (?tenuis)</i> <i>Hydnum repandum</i> <i>Microporus sp. (2,3 spp.)</i> <i>Phellinus (?ferruginosus)</i> <i>Pycnoporus coccineus</i> <i>Trameies versicolor</i></p> <p>Order Agaricales <i>Agaricus sp.</i> <i>Amanita sp. (2 spp.)</i> <i>Armillaria sp</i> "Bolete" <i>Collybia sp.</i> <i>Collybia (?sp.)</i> <i>Cortinarius australiensis</i> <i>Cortinarius rotundisporus</i> <i>Cortinarius sp. (9 spp.)</i> <i>sp.1 (cap, stem & gills blood red)</i> <i>sp.2 (cap conical, rusty brown)</i> <i>sp.3-9 (no details recorded)</i> <i>Crepidotus sp. (cap undulate, bright orange, white towards point of attachment; stem lacking; gills bright orange)</i> <i>Cystolepiota sp.</i> <i>Dictyopanus rhipidium</i></p>	<p>Order Agaricales (cont.) <i>Entoloma sp. (2 spp.)</i> <i>sp.1 (cap deep blue/blue grey)</i> <i>sp.2 (cap brown)</i> <i>Galerina sp. (? vittiformis)</i> <i>Gymnopilus mullaunius</i> <i>Gymnopilus eucalyptorum</i> <i>Hypholomo fasciculare</i> <i>Inocybe sp.</i> <i>Laccaria sp.</i> <i>Lactarius eucalypti</i> <i>Lepiota sp. (3 spp.)</i> <i>Marasmiellus (? sp.)</i> <i>Marasmius elegans</i> <i>Marasmius aff. elegans</i> <i>(similar to m.elegans, but small and slender.)</i> <i>Marasmius (? sp.)</i> <i>Melanoleuca (?sp.)</i> <i>Mycena sp. (7 spp.)</i> <i>Neoclitocybe sp.</i> <i>Omphalotus nidiformis</i> <i>Psathyrella sp.</i> <i>Psilocybe sp.</i> <i>Rickenella fibula</i> <i>Russula sp. (3 spp.)</i> <i>sp.1 (cap red; stem pink.)</i> <i>sp.2 (cap greyish/purple; stem white)</i> <i>sp.3 (cap purplish, stem purple tinge)</i> <i>Tricholomopsis rutilans</i> <i>Trogia sp.</i></p> <p>Class Gasteromycetes Lycoperdales <i>Geastrum sp.</i> <i>Lycoperdom sp.</i></p> <p>Order Sclerodermatales <i>Scleroderma sp.</i></p>
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Appendix 8 - Vegetation

Vegetation in Quadrat 1

Date: 25-03-2001 Aspect: North-facing Upper Slope Hawkesbury Sandstone
AMGs E 338184 N 6265400 Soil: clay loam Texture: Smooth
Colour: Brown Physiography: water logged Lithology: Thin sand, low in organic matter
Disturbance: Fire in 1994
Structural Formation Class: __ Wet Heath
Opportunistics: Banksia robur Problem: Pampas grass

People surveying in this Quadrat included: Ray Mjadwesch, Heather Stolle, Richard Meares, Donnah Day, Steve Dimitriadis, Tim Bidder, Frank Gleason (microbiologist), Anne Reeves (zoologist) and Robyn Tuft (water consultant)

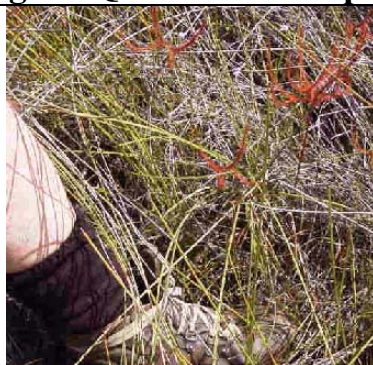
Vegetation list for Quadrat 1

Baeckea imbricata	Persoonia laurina
Banksia oblongifolia X robur	Philothea salsolifolia
Bauera rubioides	Ptilothrix deusta
Baumea rubiginosa	Restio complanatus
Blandfordia nobilis	Restio complanatus
Caustis pentandra	Restio fastigiatus now called Saropsis fastigiata
Dillwynia sp	Saliginella uliginosa
Drosera spatulata	Saropsis fastigiata
Epacris obtusifolia	Schoenus paludosus
Epacris sp	Sprengelia incarnata
Gleichenia microphylla	Thysanotus juncifolius
Gymnoschoenus spheracephalus	Xanthorrhoea minor
Leptocarpus tenax	Xyris operculata
Leptospermum squarrosum	
Micrantheum ericoides	

Opportunistic sightings in Quadrat 1 in September



Drosera binata
Forked Sundew
growing in a boggy part of
the swamp



Drosera binata
Forked Sundew
showing the size relative to a
man's foot



Banksia robur
Swamp Banksia
grows amongst the rushes.

Vegetation in Quadrat 4

Date: 25-03-2001 Aspect: North-facing Upper Slope Hawkesbury Sandstone
AMGs E 338617 N 6265021 Soil: very sandy Texture: Sandy loam
Colour: Light brown Physiography: well drained Depth: shallow
Lithology: Thin sand, low in organic matter

Disturbance: Fire in 1994

Dominant species: *Banksia ericifolia*, *Allocasuarina distyla*

Structural Formation Class: __ Closed Heath

Opportunistics: Welcome swallow Damsel fly

Vegetation List for Quadrat 4:

Key

1, 2, 5, 10, 20 indicate the plant was first seen in the 1mx1m square or 2mx2m, etc

<i>Angophora hispida</i>	1	<i>Anisopogon avenaceus</i>	5
<i>Bauera rubioides</i>	1	<i>Bossiaea scolopendria</i>	5
<i>Baumea rubiginosa</i>	1	<i>Lambertia formosa</i>	5
<i>Blandfordia nobilis</i>	1	<i>Lomandra</i> sp	5
<i>Cyathochaeta diandra</i>	1	<i>Burchardia umbellata</i>	10
<i>Epacris microphylla</i> var. <i>microphylla</i>	1	<i>Hakea dactyloides</i>	10
<i>Epacris pulchella</i>	1	<i>Kunzea capitata</i>	10
<i>Grevillea speciosa</i>	1	<i>Lindsaea linearis</i>	10
<i>Leptocarpus tenax</i>	1	<i>Lomandra glauca</i>	10
<i>Leptospermum juniperum</i>	1	<i>Pimelea linifolia</i> subsp. <i>linifolia</i>	10
<i>Micromyrtus ciliata</i>	1	<i>Xyris gracilis</i> ssp. <i>gracilis/laxa</i>	10
<i>Saliginella uliginosa</i>	1		
<i>Actinotus minor</i>	2		
<i>Banksia oblongifolia</i>	2		
<i>Bossiaea heterophylla</i>	2		
<i>Caustis pentandra</i>	2		
<i>Darwinia fascicularis</i> ssp. <i>fascicularis</i>	2		
<i>Eleocharis reticularis</i>	2		
<i>Epacris obtusifolia</i>	2	<i>Conospermum ericifolium</i>	20
<i>Hemigenia purpurea</i>	2	<i>Cryptandra ericiodes</i>	20
<i>Hibbertia</i> sp	2	<i>Dampiera stricta</i>	20
<i>Leptospermum laterale</i>	2	<i>Dillwynia parvifolia</i>	20
<i>Leucopogon microphyllus</i> var. <i>microphyllus</i>	2	<i>Eucalyptus multicaulis</i>	20
<i>Mirbelia speciosa</i>	2	<i>Gleichenia microphylla</i>	20
<i>Restio</i> sp	2	<i>Ptilothrix deustum</i>	20
<i>Saropsis fastigiata</i>	2	<i>Schoenus imberbis</i>	Opport
<i>Xanthorrhoea</i> sp	2		
<i>Xanthosia</i> sp	2		

Vegetation in Quadrat 6

Date: 24-03-2001 Aspect: South facing Slope: 30-35% Mid Slope Hawkesbury Sandstone

AMGs E 338804 N 6265597 Soil: very sandy, moist

Texture: Loamy sand Colour: Dark grey brown Physiography: well drained

Depth: shallow Lithology: Sandy loam

Location: Off Fire Trail near Maybrook Ave

Disturbance: Fire in 1994 - used the internodes of *Banksia ericifolia*

Stratum	Height (m)	% Cover	Dominant species
Tree canopy	8m	6-20%	<i>Angophora costata</i> , <i>Eucalyptus sieberi</i>
Shrub canopy	2.5m	76-100%	<i>Banksia ericifolia</i> , <i>Acacia terminalis</i>
Ground cover	10cm	<5%	

Structural Formation Class: __ Dense shrub layer regeneration from 1994 fire

Opportunistics: Honey bee, Sawgrass, brown butterfly, Butterflies

Termite nest in tree Kookaburra hole in termite nest Flock of crows

Currawong Eastern Spinebill Whipbird Spotted Pardolote

Vegetation list for Quadrat 06

Section 1x1m

<i>Banksia ericifolia</i> var. <i>ericifolia</i>	1	<i>Lepidosperma flexuosum</i>	1
<i>Bauera rubioides</i>		<i>Leptocarpus tenax</i>	3
<i>Baumea rubiginosa</i>	3	<i>Lomandra obliqua</i>	1
<i>Blandfordia nobilis</i>	5	<i>Pultenaea</i> sp.	
<i>Entolasia stricta</i>	1	<i>Xanthosia tridentata</i>	2
<i>Hakea gibbosa</i>	1		

Section 2x2m

<i>Acacia suaveolens</i>	4	<i>Gahnia sieberiana</i>	1
<i>Bossiaea heterophylla</i>		<i>Hakea teretifolia</i>	1

Section 5x5m

<i>Acacia ulicifolia</i>	3	<i>Grevillea sericea</i>	2
<i>Actinotus minor</i>	1	<i>Leptospermum trinervium</i>	1
<i>Allocasuarina distyla</i>	2	<i>Leucopogon amplexicaulis</i>	1
<i>Boronia floribunda</i>	1	<i>Leucopogon microphyllus</i> var. <i>microphyllus</i>	2
<i>Boronia ledifolia</i>	1	<i>Pterostylis erecta</i>	1
<i>Caustis pentandra</i>	2	<i>Woolisia pungens</i>	
<i>Eucalyptus sieberi</i>	1	<i>Zieria pilosa</i>	1

Section 10x10m

<i>Acacia saligna</i>	1	<i>Gompholobium grandiflorum</i>	
<i>Angophora costata</i>		<i>Lepyrodia muelleri</i>	1
<i>Banksia serrata</i>	1	<i>Leucopogon</i> sp.	
<i>Cassytha pubescens</i>	1	<i>Pultenaea elliptica</i>	2
<i>Ceratopetalum gummiferum</i>		<i>Pultenaea rosmarinifolia</i>	
<i>Dillwynia retorta</i>		<i>Smilax glycyphylla</i>	2
<i>Entolasia marginata</i>	2	<i>Stylidium productum</i>	1
<i>Epacris pulchella</i>	1	<i>Xanthorrhoea media</i>	1
<i>Gahnia radula</i> (or filum - inadequate sample)	3		

Section 20x20m

<i>Anisopogon avenaceus</i>		<i>Lepidosperma filiforme</i>	
<i>Callicoma serratifolia</i>	1	<i>Lepidosperma neesii</i>	
<i>Caustis flexuosa</i>	1	<i>Lepidosperma</i> sp.	1
<i>Corymbia gummifera</i>	1	<i>Lepyrodia anarthria</i>	1
<i>Crowea saligna</i>	1	<i>Leucopogon esquamatus</i>	

Cryptostylis sp	1	Lomandra longifolia	
Cyathea cooperi	1	Lomatia silaifolia	
Dillwynia floribunda		Opercularia aspera	
Eleocharis reticularis		Patersonia glabrata	1
Epacris obtusifolia		Petrophile pulchella	1
Gleichenia rupestris	3	Podocarpus spinulosus	1
Gompholobium sp		Prostanthera linearis	
Hakea dactyloides	1	Pultenaea daphnoides	1
Hakea sericea	1	Pultenaea stipularis	1
Hibbertia cistiflora		Restio fastigiatus now called Saropsis fastigiata	
Hibbertia linearis	1	Styphelia tubiflora	
Hibbertia sp		Thysanotus juncifolius	
Isopogon anethifolius	1	Xanthorrhoea sp	
Lambertia formosa	1		

Vegetation in Quadrat 7

Date: 25-03-2001 Meron Wilson Aspect: Northeast facing Slope: 5% Mid Slope
Hawkesbury Sandstone AMGs E 338483 N 6265491 Soil: very sandy, moist
Texture: Loamy sand Colour: Brown Physiography: well drained
Depth: shallow Lithology: Sandy loam Location: 2metres off Loggers track
Disturbance: Fire in 1994 - Many fallen shrub limbs decomposing

Stratum	Height (m)	% Cover	Dominant species
Tree canopy	15m	<5%	Angophora costata
Shrub canopy	2.5 - 3m	76-100%	Allocasuarina, Banksia ericifolia
Ground cover	30cm	6-20%	Xanthosia tridentata

Structural Formation Class: __ Dense shrub layer regeneration from 1994 fire
Comments: Very dense understory

Vegetation list for Quadrat 07

Section 1X1m

Acacia suaveolens	Phebalium squamulosum subsp. argenteum
Actinotus minor	Xanthorrhoea arboreum
Baumea rubiginosa	Xanthosia tridentata
Leptospermum trinervium	

Section 2x2m

Anisopogon avenaceus	Epacris pulchella
Blandfordia nobilis	Leucopogon microphyllus var. microphyllus
Caustis flexuosa	Leucopogon parvifolia
Entolasia stricta	

Section 5X5m

Acacia linifolia	Hakea gibbosa
Banksia ericifolia var. ericifolia	Hibbertia aspera
Bossiaea heterophylla	Lasiopetalum ferrugineum
Cassytha glabella	Lepidosperma laterale
Caustis pentandra	Persoonia laurina
Dillwynia retorta	Pultenaea elliptica
Dillwynia sp	Saliginella uliginosa
Gahnia erythrocarpa	Smilax glycyphylla

Section 10x10m

Angophora sp	Opercularia aspera
Gahnia radula (or filum - inadequate sample)	Schoenus imberbis

Section 20x20m

Bauera rubioides	Leucopogon amplexicaulis
Corymbia gummifera	Leucopogon sp.
Crowea saligna	Petrophile pulchella
Darwinia fascicularis ssp. fascicularis	Pimelea linifolia subsp. linifolia
Dianella caerulea var. caerulea/producta	Podocarpus spinulosus
Entolasia marginata	Pultenaea stipularis
Eriostemon australasius	Restio fastigiatus now called Saropsis fastigiata
Hakea dactyloides	Styphelia tubiflora
Hibbertia linearis	Tetralochea ericifolia
Kunzea ambigua	Xanthorrhoea media
Lepidosperma urophorum	

Vegetation in Quadrat 10

Date: 25-03-2001 Meron Wilson Aspect: East facing Slope: 30% Upper Slope
Hawkesbury Sandstone AMGs E 338213 N 6265777 Soil: sand Texture: Loamy sand
Colour: Sandy Physiography: well drained
Depth: shallow Lithology: Sandy loam
Location: Off service track for powerlines
Disturbance: Fire in 1994 - Fire scars on 2m high *Callicoma* and *Banksias*

Stratum	Height (m)	% Cover	Dominant species
Tree canopy	2m	100%	<i>Banksia ericifolia</i> , <i>Allocasuarina distyla</i>
Shrub canopy			
Ground cover			

Vegetation list for Quadrat 10

Key

1, 2, 5, 10, 20 indicate the plant was first seen in the 1mx1m square or 2mx2m, etc
Abundance = for some species an estimate of abundance is registered as a percentage.

Section 1x1m

<i>Acacia suaveolens</i>		<i>Crowea exalata</i>	
<i>Allocasuarina distyla</i>		<i>Epacris</i> sp	
<i>Angophora hispida</i>		<i>Gleichenia microphylla</i>	
<i>Asplenium flabellifolium</i>		<i>Leptocarpus tenax</i>	5-25%
<i>Banksia marginata</i>		<i>Leucopogon microphyllus</i> var. <i>microphyllus</i>	
<i>Baumea rubiginosa</i>	25-50%	<i>Lomandra longifolia</i>	
<i>Blandfordia nobilis</i>	75%	<i>Saliginella uliginosa</i>	5-25%
<i>Caustis pentandra</i>	5-25%	<i>Xanthorrhoea</i> sp	

Section 2X2m

<i>Darwinia fascicularis</i> ssp. <i>fascicularis</i>	5-25%	<i>Hakea</i>	
<i>propinqua</i>			
<i>Epacris obtusifolia</i>			

Section 5x5m

<i>Angophora costata</i>	<i>Xanthosia tridentata</i>
<i>Bauera capita</i>	<i>Zieria laevigata</i>

Section 10x10m

<i>Baekkea imbricata</i>	<i>Gleichenia dicarpa</i>
<i>Bossiaea heterophylla</i>	<i>Monotoca</i> sp
<i>Callicoma serratifolia</i>	

Section 20x20m

<i>Acacia</i> sp	<i>Hibbertia linearis</i>
<i>Banksia ericifolia</i> var. <i>ericifolia</i>	<i>Kunzea capitata</i>
<i>Bauera rubioides</i>	<i>Lambertia formosa</i>
<i>Dillwynia floribunda</i>	<i>Leptospermum squarrosum</i>
<i>Dillwynia floribunda</i> var. <i>floribunda/teretifolia</i>	<i>Lepyrodia scariosa</i>
<i>Entolasia stricta</i>	<i>Phebalium squamulosum</i> subsp. <i>argenteum</i>
<i>Epacris pulchella</i>	<i>Restio</i> sp
<i>Eriostemon australasius</i>	Rutaceae
<i>Grevillea buxifolia</i> ssp. <i>buxifolia</i>	<i>Smilax glycyphylla</i>
<i>Grevillea sericea</i>	<i>Styphelia tubiflora</i>
<i>Hemigenia purpurea</i>	<i>Zieria pilosa</i>

Vegetation in Quadrat 11

Date: 24-03-2001 Conny Harris Nick Skelton Aspect: Northerly Slope: Nil
Upper Slope Hawkesbury Sandstone AMGs E 338390 N 6266600 Soil: sand
Texture: Very fine Colour: Light brown/ White Physiography: moist
Depth: shallow Lithology: Sandy
Location: In Aboriginal land
Disturbance: Fire in 1994

Stratum	Height (m)	% Cover	Dominant species
Tree canopy	3.5m		Eucalyptus camfieldia, Banksia ericifolia
Shrub canopy	1.5m		
Ground cover	30cm		

Vegetation list for Quadrat 11

Abundance = for some species an estimate of abundance is registered as a percentage

Section 1x1m

Banksia ericifolia var. ericifolia	0-5 %	Hovea linearis	
Blandfordia nobilis	5-25 %	Marsdenia suaveolens	
Conospermum longifolium ssp. Longifolium	0-5 %		Pimelea
curviflora var. curviflora			
Crowea saligna	5-25 %	Saliginella uliginosa	
Epacris sp		Xanthorrhoea media	5-25 %
Eucalyptus gumnifera	0-5 %	Xyris operculata	

Section 2x2m

Banksia marginata	0-5 %	Hakea gibbosa	
Banksia oblongifolia X robur	5-25 %	Hypolaena fastigiata	
Boronia pinnata		Lepidosperma laterale	
Bossiaea heterophylla		Lomandra glauca	
Caustis pentandra		Schoenus paludosus	
Cryptostylis subulata		Tetratheca glandulosa	
Eucalyptus camfieldii	5-25 %		

Section 5x5m

Actinotus minor		Micromyrtus ciliata	
Bauera rubioides		Monotoca scoparia	
Dillwynia sp		Olax stricta	
Gompholobium glabratum		Opercularia aspera	
Gompholobium grandiflorum		Patersonia sericea	
Hemigenia purpurea		Tetratheca ericifolia	

Section 10x10m

Baumea rubiginosa		Lambertia formosa	
Cassytha glabella		Persoonia laurina	
Eriostemon buxifolius		Telopea speciosissima	
Hibbertia empetrifolia			

Section 20x20m

Anisopogon avenaceus		Hibbertia sp	
Banksia robur x oblongifolia		Pultenaea elliptica	
Cryptostylis erecta		Xanthorrhoea arboreum	
Eucalyptus punctata	0-5 %		

Vegetation in Quadrat 12

Date: 25-03-2001 Meron Wilson Aspect: East Slope: South Bank 60deg
North Bank 30deg Middle catchment Hawkesbury Sandstone
AMGs E 339333 N 6265475 Soil: sandy + organic matter
Texture: Very fine Colour: Brown yellow + black Physiography: well drained
Depth: shallow Lithology: Sandy Location: Straddles Wheeler Creek dense undergrowth
Disturbance: Fire in 1994
Other comments:
Pollution coming from urban development. More disturbance and siltation further downstream.

Stratum	Height (m)	% Cover	Dominant species
Tree canopy	10-20m	>50%	Allocasuarina, Callicoma
Shrub canopy	1.5m-2m	>75%	Astrotriche, Bracken, Umbrella fern
Ground cover	10cm	<5%	Tiny ferns

Opportunistic sightings: spiny crayfish, Crinia signifera tadpole, striped gudgeon
Gambusia male (Introduced mosquito fish), Water dragon (15cm), Bandicoot diggings
Garden skinks (5cm)

Vegetation list for Quadrat 12

Key

1, 2, 5, 10, 20 indicate the plant was first seen in the 1mx1m square or 2mx2m, etc.

1x1

Allocasuarina torulosa	Calochlaena dubia
Astrotricha floccosa	Hibbertia dentata

2x2

Clematis aristata	Endiandra sieberi
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5x5

* Oxalis sp	Leptospermum trinervium	Platysace linearifolia
Callicoma serratifolia	Microlaena stipoides	Schelhammera undulata
Cryptostylis reniformis	Omalanthus populifolius	Tristaniopsis laurina
Gymnostachys anceps	Oplismenus aemulus	
Lepidosperma sp.	Pandorea pandoreana	

10x10

* Conyza bonariensis	? * Cress sp	Pittosporum undulatum
* Ehretia sp	Eustrephus latifolius	Platylobium formosum
* Lonicera japonica	Gonocarpus teucrioides	Sticherus flabellatus
* Watsonia sp	Persoonia levis	Stylidium productum

20x20

* Ageratina sp	Banksia serrata	Isopogon sp
* Erythrina x skyesii	Breynia oblongifolia	Parsonia straminea
* Hydrangea sp	Cassytha sp	Pittosporum revolutum
* Ranunculus sp	Ceratopetalum apetalum	Rubus parvifolius
? * Pigeon grass	Cyathea cooperi	Scaevola ramosissima
? Haloragodendron sp	Entolasia stricta	Stephania japonica
Acacia suaveolens	Gahnia radula (or filum - inadequate sample)	Synoum glandulosum
Angophora costata	Hibbertia linearis	
Baeckea imbricata	Isolepsis sp	

Vegetation in Quadrat 13

Date: 07-04-2001 Marita Macrae

Aspect: South Slope: South facing slope 30deg Mid slope Hawkesbury Sandstone

AMGs E 339550 N 6265502 Soil: sandy + organic matter Texture: Very fine

Colour: Brown yellow + black Physiography: well drained

Depth: shallow Lithology: Sandy

Location: Eastern end of Maybrook Ave

Rocky outcrops

Disturbance: Fire in 1994 Other comments: Last fire 1994 - oral history from residents.

Stratum	Height (m)	% Cover	Dominant species
Tree canopy	10-20m	5%	Eucalyptus umbria, Angophora costata
Shrub canopy	1.5m-2m	>75%	Acacia terminalus, Allocasuarina distyla
Ground cover	10cm	<5%	Lomandra longifolia, Gahnia sp

Comments:

Although the street and back fences of houses were close by, there were no obvious weeds in the survey quadrat and few nearby except for areas close to the houses and street.

Broken glass, beer bottles, a discarded bong and a few bits of plastic indicate that humans regularly use this bit of bushland for out-of-sight recreational purposes.

Vegetation list for Quadrat 13

Section 1x1m

Acacia suaveolens	Angophora costata	Billardiera scandens
Acacia terminalis	Anisopogon avenaceus	Bossiaea heterophylla
Acacia ulicifolia	Baeckea imbricata	Caustis sp
Actinotus minor gummiferum	Banksia ericifolia var. ericifolia	Ceratopetalum
Allocasuarina distyla	Banksia serrata	Comesperma ericinum

Section 2x2m

Banksia oblongifolia X robur	Dianella caerulea var. caerulea/producta	Dillwynia retorta
Crocea saligna	Dodonea triquetra	
Cryptostylis sp	Eleocharis reticularis	

Section 5x5m

Bauera rubioides	Eucalyptus umbra
Baumea rubiginosa	Gahnia radula (or filum - inadequate sample)
Blandfordia nobilis	Gonocarpus teucroides
Caustis pentandra	Grevillea buxifolia ssp. buxifolia
Epacris pulchella	Hakea dactyloides

Section 10x10m

Hakea sericea	Hibbertia linearis
Hakea teretifolia	Isopogon sp
Hibbertia empetrifolia	Kunzea ambigua
Hibbertia fasciculata	

Section 20x20m

Dillwynia sp	Lepyrodia anarthria	Lomatia silaifolia
Persoonia levis	Podocarpus spinulosus	Styphelia longifolia
Drosera spatulata	Lepyrodia scariosa	Marsdenia suaveolens
Persoonia pinifolia	Pultenaea stipularis	Woolfsia pungens
Epacris obtusifolia	Lepyrodia sp	Mitrasacme polymorpha
Petrophile pulchella	Scaevola ramosissima	Xanthorrhoea arboreum
Lepidosperma sp.	Lomandra longifolia	Notolea longifolia
Phebalium dentatum	Smilax glycyphylla	Xanthosia pilosa
Leptospermum trinervium	Lomandra obliqua	Opercularia aspera
Platysace linearifolia	Stylidium productum	Ziera pilosa
Persoonia lanceolata		

Vegetation in Quadrat 14

Date: 25-03-2001 Jeff Bembrick Aspect: Northerly Slope: 1/6 to 1/4 Mid slope

Hawkesbury Sandstone AMGs E 339100 N 6265000 Soil: sandy loam

Texture: Sandy Colour: Dark brown Physiography: well drained

Depth: shallow Lithology: Sandy

Location: Pink tape, 5-10m East of disused fire trail and 5-10m from large bloodwood -

Bloodwood location is E339094 S6264989

Disturbance: Fire in 1994

Stratum	Height (m)	% Cover	Dominant species
Tree canopy	10m	15%	Eucalyptus gummifera
Shrub canopy	2m	75%	Acacia terminalis and variety of others
Ground cover	30cm	10%	Lomandra

Comments: Old rusty cars dumped along the track

Quarry area about 100-200m to west

The team included:

Christine Newman, Paul Greenfield, Conny Harris, Noel Ryan, Jeff Bembrick, Alex Tucker

Vegetation list for Quadrat 14

Section 1x1m

Acacia suaveolens	Dillwynia sp	Leptospermum trinervium
Actinotus minor	Entolasia stricta	Phyllanthus hirtellus
Comesperma ericinum	Eriostemon australasius	Saliginella uliginosa
Dampiera stricta	Lepidosperma laterale	

Section 2x2m

? * Reed rush	Billardiera scandens	Olx stricta	Ziera pilosa
Acacia ulicifolia	Bossiaea heterophylla	Smilax glycyphylla	

Section 5x5m

Allocasuarina distyla	Cassytha pubescens	Lomandra glauca
Angophora hispida	Eucalyptus haemastoma	Woolisia pungens
Banksia oblongifolia	Hibbertia sp	Xanthosia tridentata
Blandfordia nobilis	Lasiopetalum ferrugineum	
Cassytha globula	Leucopogon microphyllus var. microphyllus	

Section 10x10m

Angophora costata	Crowea sp	Micromyrtus ciliata
Bauera rubioides	Cryptostylis subulata	Persoonia laurina
Baumea rubiginosa	Eucalyptus gumnifera	Pultenaea elliptica
Bossiaea scolopendria	Grevillea sericea	Schoenus imberbis
Crowea saligna	Lepidosperma sp.	

Section 20x20m

Anisopogon avenaceus	Eucalyptus scias	Persoonia levis
Boronia ledifolia	Gonocarpus teucroides	Pultenaea stipularis
Darwinia fascicularis	Hakea dactyloides	Restio sp
ssp. fascicularis	Lambertia formosa	Tetratheca ericifolia
Stylidium productum	Leptospermum arachnoides	Xanthosia pilosa
Dillwynia retorta	Patersonia sericea	

Vegetation in Quadrat 16

Date: 24-03-2001 Helen Ward Aspect: South Slope: 1 in 6 Upper slope
Hawkesbury Sandstone AMGs E 338369 N 6266019 Soil: sand
Texture: Fine sand Colour: Light brown Physiography: well drained
Depth: shallow Lithology: Sandy
Landform Pattern: Hilly
Disturbance: Fire in 1994

Stratum	Height (m)	% Cover	Dominant species
Tree canopy	6-8m	15%	Eucalyptus gummifera, Eucalyptus haemastoma
Shrub canopy	2m	80%	Hakea spp
Ground cover	1cm	30-40%	Lepidosperma, platysace linifolia

Comments: Open woodland

Vegetation list for Quadrat 16

Section 1x1m

Actinotus minor	Lepyrodia scariosa
Asperulea sp	Lomandra obliqua
Baeckea imbricata	Persoonia pinifolia
Entolasia stricta	Petrophile pulchella
Hibbertia linearis	Pultenaea sp.
Juncus sp	

Section 2x2m

Boronia sp	Leucopogon microphyllus var. microphyllus
Cassyltha sp	Phebalium squamulosum subsp. argenteum
Eleocarpus reticularis	Saliginella uliginosa
Leptocarpus tenax	Xanthosia tridentata

Section 5x5m

Bauera rubioides	Eucalyptus haemastoma
Blandfordia nobilis	Hemigenia purpurea
Bossiaea heterophylla	Lambertia formosa
Caustis pentandra	Smilax glycyphylla

Section 10x10m

Acacia ulicifolia	Corymbia gummifera
Allocasuarina distyla	Grevillea speciosa
Banksia oblongifolia	Isopogon anethifolius

Section 20x20m

Crocea saligna	Hibbertia sp
Dillwynia sp	Xanthorrhoea arboreum
Eriostemon australasius	Xanthorrhoea sp
Hakea dactyloides	Ziera pilosa

Opportunistic sightings

Ceratopetalum gummiferum	Dianella caerulea var. caerulea/producta
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Vegetation in Quadrat 17

Date: 24-03-2001 Richard Meares Aspect: South facing slope Slope: 1 in 6

Upper slope Hawkesbury Sandstone AMGs E 338474 N 6265835

Soil: Thin sand low in organic matter Texture: Fine sand

Colour: Light brown Physiography: damp Depth: skeletal Lithology: Sandy

Location: North side of powerline service track Rocky outcrops

Disturbance: Fire in 1994

Stratum	Height (m)	% Cover	Dominant species
Tree canopy	3m	<5%	Eucalypts, (mallee form)
Shrub canopy	1.5m	>75%	Allocasuarina distyla, Banksia ericifolia
Ground cover	30cm	<5%	Sedges

Comments: Low uniform heath on upper slope, low-moderate diversity

Vegetation list for Quadrat 17

Section 1x1m

Actinotus minor	Hibbertia sp
Bauera rubioides	Leptospermum juniperum
Baumea rubiginosa	Leucopogon microphyllus var. microphyllus
Blandfordia nobilis	Restio sp
Darwinia fascicularis ssp. fascicularis	Saliginella uliginosa
Grevillea speciosa	

Section 2x2m

Epacris microphylla var. microphylla	Lepidosperma laterale
Hakea dactyloides	Phebalium squamulosum subsp. argenteum

Section 5x5m

Boronia ledifolia	Kunzea capitata
Caustis pentandra	Mirbelia speciosa
Cryptandra ericiodes	Ptilothrix deustum
Dillwynia retorta	Saropsis fastigiata
Grevillea sericea	Zieria laevigata
Isopogon anethifolius	

Section 10x10m

? Moss sp	Drosera peltata
Angophora hispida	Epacris sp
Baekkea brevifolia	Hemigenia purpurea
Banksia oblongifolia	Leptocarpus tenax
Bossiaea heterophylla	Xanthorrhoea sp
Bossiaea scolopendria	

Section 20x20m

Acacia suaveolens	Hibbertia serpyllifolia
Anisopogon avenaceus	Lepyrodia muelleri
Baekkea diosmifolia	Notolea longifolia
Eucalyptus stricta	Opercularia aspera
Gleichenia microphylla	Thysanotus juncifolius
Hakea gibbosa	Epacris obtusifolia
Hibbertia riparia	

Vegetation in Quadrat 21

Location: Off Loggers track behind Fire Station

E 339108 N 6265129 Waterlogged Ephemeral swamp

1x1

Baeckea imbricata	Grevillea sericea
Banksia ericifolia	Grevillea sericea (dark pink Collaroy form)
var. ericifolia	Hakea teretifolia
Drosera spatulata	Leptospermum squarrosum

2x2

Allocasuarina distyla	Epacris longiflora	Lepyrodia scariosa
Bauera rubioides	Epacris microphylla var. microphylla	Persoonia lanceolata

5x5

Acacia terminalis	Caustis flexuosa	Gleichenia dicarpa
Angophora costata	Choretrum candollei	Hibbertia linearis
Banksia serrata	Dillwynia floribunda var. floribunda/teretifolia	Persoonia pinifolia
Bossiaea scolopendria	Eucalyptus gumnifera	Petrophile pulchella
Callicoma serratifolia	Gahnia erythrocarpa	

10x10

Acacia linifolia	Grevillea buxifolia ssp. buxifolia	Ricinocarpus pinifolius
Acacia suaveolens	Leptospermum trinervium	Tetralochea ericifolia
Actinotus minor	Leucopogon microphyllus var. microphyllus	Xanthosia sp
Dampiera stricta	Persoonia levis	Zieria laevigata
Gonocarpus teucroides	Pultenaea rosmarinifolia	

20x20

Boronia ledifolia	Histiopteris incisa	Platysace linearifolia
Bracken	Lepidosperma sp.	Restio fastigiatus
Caustis pentandra	Leptomeria acida	Schoenus melanostachys
Eriostemon australasius	Lomandra longifolia	Xyris gracilis ssp.
gracilis/laxa		
Eucalyptus scias		

Weeds

* Acacia saligna

* Whiskey Grass

Vegetation in Quadrat 22

Location: Red Hill Duffy's Forest. Left of quarry area. Top of ridge to powerlines/cave

Aspect : N/NE

Tree Canopy Height: 10-15m Cover: 20%

Dominant: Eucalyptus capitellata, Eucalyptus sieberi, Eucalyptus gummifera

Shrub Canopy Height: 5m Cover: 5%

Dominant: Banksia ericifolia, Leptospermum sp, Eucalyptus haemastoma, Banksia serrata

Shrub Canopy Height: 1.5-2m Cover: 50%

Dominant: Grevillea buxifolia, Pultanaeae linifolia, Boronia pinnata

Shrub Canopy Height: 0-0.5m Cover: 5%

Dominant Species: Grass species, irises, lomandras/xanthorea

Vegetation list for Quadrat 22

1x1

Boronia ledifolia	Duffy's Forest	Patersonia sericea
Platysace linearifolia	Entolasia marginata	Phyllanthus hirtellus
Acacia myrtifolia	Eucalyptus haemastoma	Pultenaea elliptica
Asplenium flabellifolium	Hemigenia purpurea	Pultenaea linophylla
Boronia pinnata	Lasiopetalum ferrugineum	Xanthorrhoea media
Cassytha glabella	Lomandra glauca	
Daviesia alata	Micrantheum ericoides	

2x2

Grevillea buxifolia ssp. buxifolia	Grevillea speciosa
Leptospermum trinervium	Lepidosperma laterale

5x5

Actinotus minor	Epacris longiflora	Lambertia formosa
Acacia longifolia	Eucalyptus capitulata	Lomatia silaifolia
Bossiaea heterophylla	Eucalyptus oblonga	Patersonia sp
Conospermum longifolium	Hibbertia aspera	Persoonia lanceolata
ssp. Longifolium		Persoonia pinifolia

10x10

Banksia serrata	Dianella caerulea var. caerulea/producta
Banksia spinulosa var. spinulosa	Dillwynia retorta
Cassytha pubescens	Hakea linearis
Eucalyptus gummifera	Hakea teretifolia
Dampiera stricta	Hakea dactyloides
Poranthera corymbosa	

20x20

Angophora hispida	Lasiopetalum ferrugineum	Patersonia glabrata
Banksia ericifolia var. ericifolia	var ferrugineum	Telopea speciosissima
Banksia marginata	Monotoca scoparia	Xanthorrhoea arboreum
	Olax stricta	

Vegetation in Quadrat 23

Location: Sport & Rec Laterite ridge top

AMGs: E 339045 N 6266523

Physiography: Upper slope

Stratum, tree canopy, height: 6m Cover: 20%

Dominant Species: Eucalyptus gummifera, Eucalyptus haemastoma, Banksia serrata

Stratum, shrub canopy, height: 2m Cover: 85%

Dominant Species: Allocasuarina distylla, Banksia ericifolia, Leptospermum trinervium

Stratum, shrub canopy, height: 50cm Cover: 40%

Dominant Species: Lepirodia scariosa, Epacris microphyllis, Lepidosperma laterale

Vegetation List for Quadrat 23

1x1

Actinotus minor	Grevillea sericea	Lomandra obliqua
Angophora crassifolia	Grevillea sericea (dark pink Collaroy form)	Micranthemum ericoides
Banksia ericifolia var. ericifolia	Hakea bakerana	Patersonia sericea
Cyathochaeta diandra	Hemigenia purpurea	Phebalium squamulosum
Dillwynia retorta	Lepyrodia scariosa	Philotheca salsolifolia
Epacris obtusifolia	Lomandra brevis	Platysace linearifolia

2x2

Cryptostylis subulata	Epacris microphylla var. microphylla	Pultenaea elliptica
Darwinia fascicularis ssp. fascicularis	Leptospermum trinervium	Stylidium lineare
	Monotoca elliptica	

5x5

??Xantheria sp	Goodenia bellidifolia	Patersonia fragilis
Allocasuarina distyla	Grevillea buxifolia ssp. buxifolia	Persoonia levis
Boronia ledifolia	Hakea teretifolia	Phyllota phyllicoides
Bossiaea scolopendria	Lepidosperma laterale	Tetratheca glandulosa
Eucalyptus gumnifera	Leucopogon microphyllus var. microphyllus	? Moss sp

10x10

Dampiera stricta	Xanthosia tridentata
Eucalyptus haemastoma	Zieria laevigata
Tetratheca ericifolia	

20x20

Acacia suaveolens	Caustis pentandra	Lepidosperma filiforme
Acacia terminalis	Epacris longiflora	Leptospermum squarrosum
Banksia oblongifolia	Eucalyptus camfieldii	Mirbelia speciosa
Banksia serrata	Hakea dactyloides	Petrophile pulchella
Bauera rubioides	Hibbertia aspera	Styphelia tubiflora
Boronia floribunda	Hibbertia riparia	
Cassytha pubescens	Kunzea capitata	

Vegetation noted during a walk

Walking from Sport and Recreation Camp south.

Up the track

Angophora crassifolia
Dodonea minuta
Dodonea pinnata
Eucalyptus sp
Lomandra brevis

On the ridgeline.

Callitris muelleri
Eriostemon buxifolius ssp obovatus
Grevillea sericea (dark pink Collaroy form)
Phebalium squamulosum ssp squamulosum
Xanthosia pilosa
Zieria laevigata

Up the hill South west.

Dodonea sp (with black fruit?)
Kunzea capitata
Philothea salsolifolia

Further west along the ridgetop

Ampera xiphoclada ssp papalata
Eucalyptus camfieldii
Olax stricta
Putenga stipularis?

**Vegetation identified for NPA by the Royal Botanical Gardens
based on specimens collected during
the March Biodiversity Survey of Wheeler Creek Valley**

Acacia ulicifolia	Lepyrodia sp
Actinotus minor	Leucopogon esquamatus
Angophora costata	Lomandra longifolia
Angophora sp	Lomatia silaifolia
Anisopogon avenaceus	Marsdenia suaveolens
Baeckea diosmifolia	Monotoca scoparia
Baeckea imbricata	Opercularia aspera
Banksia ericifolia var. ericifolia	Patersonia sericea
Bauera rubioides	Persoonia laurina
Boronia ledifolia	Phebalium dentatum
Caustis pentandra	Phebalium squamulosum
Ceratopetalum gummiferum	Podocarpus spinulosus
Comesperma ericinum	Prostanthera linearis
Cryptostylis sp	Pultenaea elliptica
Dillwynia floribunda	Pultenaea rosmarinifolia
Dillwynia retorta	Restio fastigiatus (Saropsis fastigiata)
Dillwynia sp	Rutaceae
Drosera spatulata	Saliginella uliginosa
Eleocharis reticularis	Scaevola ramosissima
Epacris pulchella	Smilax glycyphylla
Eriostemon australasius	Styphelia tubiflora
Gleichenia microphylla	Tetratheca sp
Gleichenia rupestris	Thysanotus juncifolius
Gompholobium grandiflorum	Tricoryne sp
Gompholobium sp	Woolisia pungens
Grevillea buxifolia ssp. buxifolia	Xanthorrhoea arboreum
Grevillea speciosa	Xanthorrhoea sp
Hemigenia purpurea	Xanthosia tridentata
Hibbertia cistiflora	Zieria laevigata
Hibbertia riparia	
Hibbertia sp	
Kunzea capitata	
Lepidosperma filiforme	
Lepidosperma neesii	
Leptocarpus tenax	
Leptospermum squarrosum	
Lepyrodia muelleri	

Appendix 9 - report by Australian Museum

Australian Museum Study of part of Wheeler Creek Valley

The Museum Study was entitled: *Flora and Fauna Investigation Wheeler Ck Sewerage Scheme*, Australian Museum Business Services July 1996 for Sydney Water - see summary below for evaluation of plan to provide reticulated sewerage to approximately 40 properties in Maybrook Avenue and Jersey Place, Cromer Heights. The development includes the construction of a full gravity sewer scheme - approximately 500 m of sewer lines and 250 m of a borehole line.

Summary:

This report summarises the findings of a flora and fauna evaluation conducted during May and June 1996. The evaluation was based upon a field survey for flora, general ecological inspection of the site, targeted searches for Red Crowned Toadlet and Giant Burrowing Frog habitats, database searches and a literature review.

The vegetation on the study area strongly reflects the landform, geology and site history. Most of the site consists of an escarpment of Hawkesbury Sandstone and the slope below the escarpment down to Little Willandra Rd.

The vegetation covering the study area was originally (ie prior to severe fires in January 1994) Closed Shrubland and Woodland dominated by native plants typical of the Hawkesbury Sandstone. The four main types of vegetation at the site are: Forest-Gully (*Eucalyptus piperita*), Open Woodland-Cliff-scarp (*Angophora costata*, *Banksia serrata*), Woodland-Ridge-top (*Eucalyptus gummifera*, *Angophora costata*) and the Shrubland Riparian (*Tristaniopsis laurina*). Each of these vegetation types contain a distinct community of plant species and a characteristic vegetative structure.

This vegetation is of interest because it has a relatively high diversity of native plants and few introduced species (including weeds) and because it represents the Hawkesbury sandstone vegetation that has been cleared in many other parts of Sydney. The diversity of plants on the site is high with 124 native plant species being recorded during the field survey. No significant species were found at the site during this survey. The significant species Black-eyed Susan (*Tetratheca glandulosa*) may occur at the site, but was not found during site inspection, due to its cryptic nature and the season of the survey. An eight point test, defined in Section 5A of the Environmental Planning and Assessment Act (1979) was amended by the Threatened Species Conservation Act (1995) was applied to Black-eyed Susan (*Tetratheca glandulosa*) for this site, and it was determined that the development will not cause significant impact to a local population of the species.

Fauna habitat analysis of the site revealed that the following fauna habitat attributes were present on the site:

- * good foraging habitat for many bird species, particularly insectivorous birds,
- * habitat value for reptiles and other species requiring rocks, rock crevices and/or overhangs, and
- * good habitat for medium-sized hollow dependent fauna, such as bats and arboreal mammals.

At least seven threatened fauna species have potential habitat on the site. An eight point test of significance was completed for each species with none in the opinion of AMBS requiring a Species Impact Statement. Although the proposed development is not likely to significantly affect threatened fauna habitat, disturbance of the site is likely to result in some ecological damage to the other fauna and flora and potential damage to Wheeler Creek.

Measures that could help to mitigate or ameliorate potential impacts include:

- * Retention of as many mature trees as possible,
- * Conduct construction works during winter months,
- * Revegetation with native plant species (preferably from local seed stocks) to prevent weed invasion,
- * Prevent discharge of sediment and pollutants to water courses,
- * Storing and replacing topsoil,
- * Preventing soil compaction,
- * Avoidance of removal of the riparian community, and
- * Prevention of weed invasion after disturbance.

Access during the construction phase of the project should also be restricted to each end of the site, to avoid disturbance to the rest of the remnant bushland.

Appendix 10 - pictures from 1972

ABC film crew on Redhill

This image was scanned from the ABC "Radio Active magazine published in 1972.

<p style="text-align: center;">JULY, 1972 RADIO ACTIVE</p> <h1 style="text-align: center;">The Battle</h1> <p>A FULL scale battle was staged in Sydney for the new national TV drama series <i>Over There</i>, which uses events of World War II.</p> <p>On open land near Beacon Hill, Sydney, trenches were dug and bulldozers used to get the site ready — this part of the operation being supervised by Designer Roger Ford.</p> <p>ABC men made camouflaged underground cisterns, which were the underground caverns the Arab people used to store water, which the Italians pumped out in order to use the caverns as hiding places.</p> <p>The battle re-enacted was the first battle in which Australian troops were involved in World War II. It was the Battle of Bardia, which was about 70 miles from Tobruk, in the Middle East. During the three-day battle the Australian troops took 47,500 Italian prisoners.</p> <p>Six men worked for three days to prepare the battlefield and army encampment of underground dug-outs.</p> <p>Director of the episode Frank Arnold obtained an Italian anti-tank gun from the Australian War Memorial in Canberra, and also a Bren gun which the ABC Special Effects section modified to fire on gas instead of bullets, producing a flame each time it fired.</p> <p>About 200 lb. of explosives were used, and Special Effects made a thick leather vest with detonators for a stuntman who had to look as though explosions were taking place on his chest.</p> <p>The actual battle began at dawn on January 3, 1941, and the men went into it under smoke as a camouflage.</p> <p>One hundred and twenty-six people were on location. Three cameras were used to avoid problems with continuity of backgrounds, which showed special effects, fires, explosions and smoke.</p> <p>Sixty-five Citizens Military Servicemen and five actors were on camera.</p> <p>"It rained almost the whole week we were making the sequence," said Frank Arnold, "this made it very difficult with the men walking through mud on what was supposed to be a clear day in the desert. But it helped in one way, because the dull light made it look like dawn."</p> <p><i>Over There</i> will begin in most States this month, and in the 13-part series episodes are set in England, the Middle East and North Africa.</p> <p>The Middle East training camp which was built at Brookvale Plateau included parade ground, cook-house, battalion headquarters, orderly rooms, transport depot, mess marquees, hospital tent and ablutions section. The Salisbury Plain training camp was built at HMAS Nirimba, near Sydney.</p> <p><i>Over There</i> has a cast of more than 90 actors, was made with the co-operation of the Australian Armed Forces, and includes historic newsreel footage supplied by the Australian War Memorial.</p> <p>Its Executive Producer is Eric Tayler, and the other Directors are Howard Rubie, Julian Pringle and John Croyston.</p>	<p>Noel Ryan (see the reports on birds) lived in the area as a child in the 1960s and 1970s and can remember going up to the old quarry with his friends to watch the movie being made by the ABC.</p> <p>At one stage, the crew created a dummy to be blown up. They filled the dummy with old film scripts and other scraps of paper but unexpectedly, when the explosion happened, the bits of paper blew about in all directions - rather spoiling the effect that had been intended.</p> <p>The watching children, however, thoroughly enjoyed the show and the delight is still remembered thirty years later as is the sound of the loud explosions.</p>
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Shot taken during filming.



Filming "The Battle of Bardia"



Shot taken during filming.



Artransa Park Film Studios.
Jack Peacock, Charlie, John East



David and Les
(Les supplied these photos)



Director Frank Arnold (left) and Series Editor John Martin with a scale model of the area.

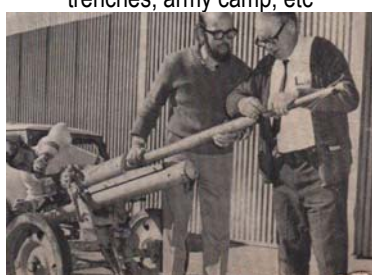
Marked out are the areas of shooting, trenches, army camp, etc



Preparing the site of the Italian underground cisterns (from Left) Jim Channell, Staging Assistant, Roger Ford, Designer, Jim Vernon, Staging Assistant, Ken Richardson, Senior Staging Assistant



John Coles, director with Assistant Cameraman



Les Conley, Senior Special Effects Officer, wires a charge for the Italian Anti-Tank gun: Brian Olsen, Propmaker (centre) helps him and Peter Firminger, Propmaker, pulls the firing wires down the barrel of the gun to make ready for firing.



ABC crew filming the battle. From left (in foreground of picture): Lloyd Spiels, Lighting Cameraman, Brent Collins, Key Grip, pushing the "star" dolly, and Kinsey McDonald, Sound Assistant with the boom microphone.



A shot is checked of "gas" Bren gun operating with camera shooting along "sights". From left: Kinsey McDonald, Sound Assistant, "Chicka" McDonald, Electrician, Frank Arnold, Director, Ivor Moffatt and Phillip Murray, both Camera Operators.

Sincere thanks to Les Conley for allowing NPA to scan in these images from his collection of photographs and his copy of the ABC "**Radio Active**" magazine.

Appendix 11 - cuttings referring to Aboriginal heritage

These papers have been kept by Yvonne Witton of Cromer Heights for 26 years. The first is an article from the June/July 1976 NPA Journal.

Place of the Wallaby People

by Joy Lee



Engraving suggested as "the spirit with the sacred axe" poised to deal a deadly blow to any man passing who failed to offer the finest cut of his captured prey.

In 1899 W.D. Campbell recorded a group of Aboriginal rock carvings on a single large surface of rock between Wheeler and Middle Creeks, above what is now known as Cromer. He described the carvings as altogether one of the finest groups the writer has come across. He recorded a second set of carvings on the other side of the gully and one was described as a strange looking figure ten feet long, well cut, resembling the leg of a man.

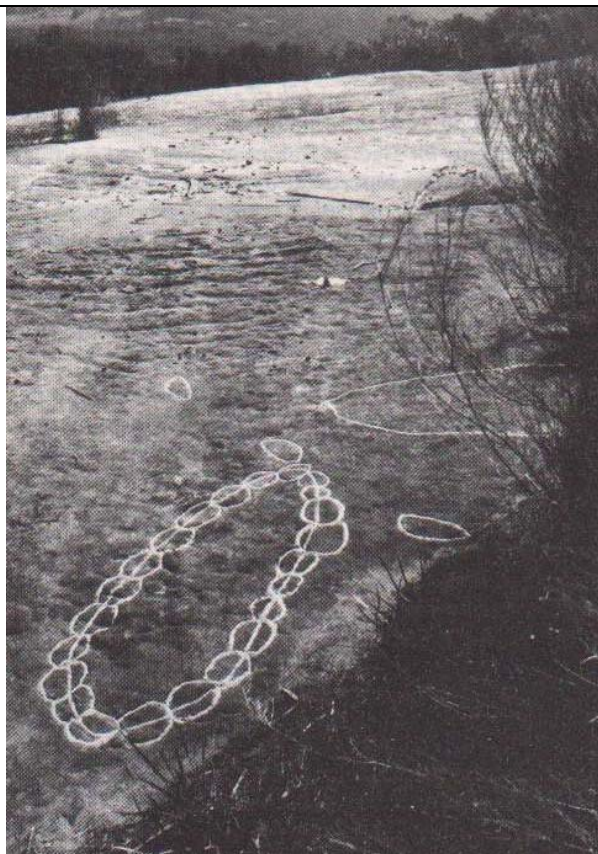
In December 1975 Mackellar County Council constructed a powerline through the area, one pole being placed beside the most important group of carvings with two steel stanchions being driven into the rock. A service road, bulldozed through the valley buried five carvings in the second group including the strange ten foot figure. The road not only desecrated the carvings but opened up the area to hundreds of trail bike users.

A local resident, Mr George Robinson, disturbed by the burial of the carvings reported it to the National Parks and Wildlife Service who are charged with the responsibility of protecting aboriginal relics. The Service arranged a site visit with council officials and it was agreed that work should stop near the site and that council should carry out restoration works. The problem remains that the damage has been done and the area totally changed by the road.

In January, Mr Jackson Jacobs, an aboriginal elder from Mornington Island, who lectures on aboriginal culture and who has spent a great deal of time visiting aborigines in Northern Australia collecting information on his people and their traditions, was in Sydney. Mr Jacobs was shown a drawing of the site and asked to interpret the strange carving. He answered without hesitation *sacred cave*. There was nothing on the drawing to indicate the presence of a small underground cave just below where the road has covered the carvings.



The "centre stone" of the corroboree ground. Holes have been drilled in its base.



A large expanse of rock on which about 120 engravings have been made. The engraving in the foreground is suggested as an "offering place" where the passing hunter was required to lave part of his catch.

He also said the carvings showed that this was a site that linked two places and that many aborigines would have passed through. The land lies between Narrabeen Lagoon and Dee Why Lagoon. He pointed out that another of the buried carvings is a marking sign that, according to aboriginal traditions, should never be moved.

Mr Jacobs said there were many great stories involved with the carvings but because I was a woman I could only be told the explanations given to the uninitiated. The site was a sacred site that linked back to early times when the great rainbow serpent roamed Australia giving the tribes their land. In each area a special site was set aside where the law would be taught and kept. This was such a site and the Wallaby people had been charged with keeping it. He pointed out that the kangaroo and fish with spears in them did not mean this is how an aborigine kills animals but were related to the breaking of the laws and how the kangaroos and fish would vanish from the area if the laws were not obeyed.

Mr Jacobs pointed out that one of the large figures carried a woomerah, the other a magic axe and if an individual broke the law they would see that he died. They would not have to see the individual - so powerful were the magical forces associated with the site.

Mr Jacobs was taken to visit the site and became even more excited as many things had not been shown on the drawing, being regarded as natural erosion or the result of natural forces. Mr Jacobs said the small rock pools and ridges in the rock were very important to the aborigines.

Mr Jacobs was very concerned about the burial of the carvings and insisted that no women or young boys should be allowed to enter the sacred cave.

Mr Jacobs located a very unusual rock and traced out a great semi-circle from it and suggested it could have been a corroboree ground. Campbell, in 1899, had commented on how the area formed a natural amphitheatre. Another short walk and Mr Jacobs located a heap of shells or midden. Adjacent to the road where the carvings are buried is a large rock shelter that had obviously been used for hundreds of years. Mr Jacobs felt strongly that the area should be given protection because of its religious significance to the Australian aborigines.

But is that possible?

The National Parks and Wildlife Service has been considering for some time whether it should acquire the lands for dedication as an aboriginal area but has not as yet made a decision.

The NSW Planning and Environment Commission has been considering for many years what plans it should make for the non-urban land in Warringah. Should they allow several hundred thousand people to settle in the area or should they take into consideration the serious environmental effects such an action would have?

Meanwhile actions by utilities such as Mackellar County Council, and trail bike users, reduce the possible options open to the planners, by changing the character of the landscape... In other parts of the world the rock carvings would be recognised as incredibly valuable primitive art.

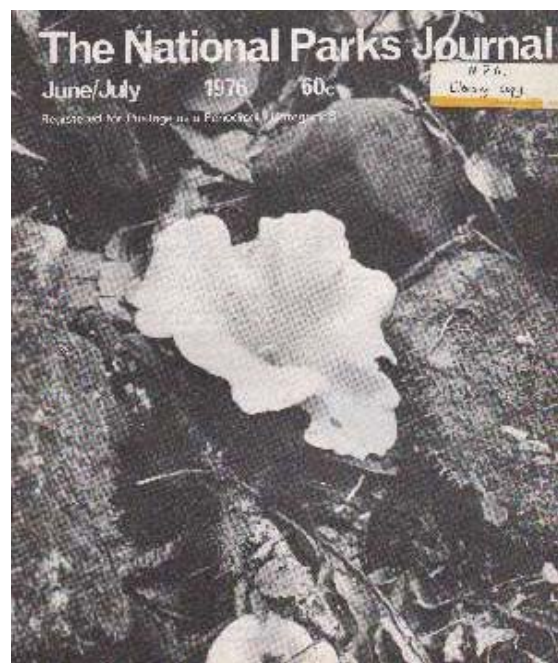


Since 1961 the National Parks Association has been urging the state government and Warringah Shire to recognise the value of the non-urban land for Regional Open Space. The NPA in 1961 described the area as one of the country's finest primitive areas having great recreational, aesthetic and scientific value.

....

It is to be hoped that the Planning and Environment Commission and Warringah Council will take the initiative and reserve the area for its archeological cultural and natural values and in this way provide evidence of the state's commitment to maintaining the quality of Sydney's environment.

Unfortunately, there was no date on the paper kept by Yvonne but research by Karen Petley of NPA through the archives of the National Parks Association revealed it was printed on pages 5,6 and 7 of the June-July, 1976, National Parks Journal.



The Sydney Morning Herald, Tues, Jan 27, 1975 2

Poles, road desecrate Aboriginal rock carvings

By JOSEPH GLASCOTT,
Environment Writer

One of the most valuable Aboriginal rock-carving sites in the Sydney region has been desecrated by power lines, a service road and trail bikes.

The carvings are on a large rock ridge over Wheeler Creek, behind the suburb of Cromer near Narrabeen.

In spite of State laws protecting Aboriginal rock carvings, the Maccellar County Council has constructed a power line through the valley.

One power pole has been placed beside the most important rock of carvings.

Two steel stanchions have been driven into the rock to hold the pole.

A road has been bulldozed through Wheeler Creek Valley to service the lines and it has covered parts of another important rock carving on the other side of the valley.

By opening up the area the county council also has made it a venue for trail bike riders.

Riders congregate beside the rock carving site, ride over the carvings as part of their trail and park their bikes on the rock.

The carvings were recorded in 1899 by Mr W. D. Campbell, a sur-

vveyor for the then Department of Mines and Agriculture.

Mr Campbell's book *Aboriginal Carvings of Port Jackson and Broken Bay* is still considered the most authoritative on Aboriginal relics for the Sydney region.

Mr Campbell described the Cromer carvings "as altogether one of the finest groups the writer has come across."

More than 76 years after Mr Campbell's discovery and hundreds of years after Aboriginal tribes carved them, the drawings remain deeply etched and easily defined.

Recent research has revealed 120 figures on the Cromer rock face. They illustrate kangaroos, fish, moons, almost life-size men and a series of secret signs.

Mr Jackson Jacobs, a Mornington Island Aboriginal from the Gulf of Carpentaria who lectures on Aboriginal art and culture for the Australian Museum, explained the significance of the carvings to me yesterday.

Barefooted and with his family moonstone slung around his neck, he said: "This is a very powerful place.

"It was a sub-initiation area where the magic men congregated."

While he explained the meanings of the carvings and signs, motor cycles roared around us.

Protests by local conservationists and Aboriginal historical groups al-

ready have caused Maccellar County Council to have second thoughts.

The council has unhooked the powerline stay ropes from the rock face, and it has indicated that it will re-survey the powerline. But the damage already has been done.

The desecration of the carving demonstrate the ineffectiveness of laws to protect Aboriginal relics.

Under the National Parks and Wildlife Service Act Aboriginal carving sites are protected under penalty of fines of up to \$1,000 but public authorities and the workmen, either unaware of the law or of the significance of the relics, have no check on their operations.

Mr John Lough, of Double Bay a recorder of Aboriginal carvings sites said yesterday: "Public authorities can go to the National Park and Wildlife Service for information.

"They are referred to the old W.D. Campbell recordings made last century.

"For the uninitiated and also because of new mapping over the period, that is of little help."

Nevertheless, the Cromer carvings were so well defined that no one could miss them.

Archaeologists and conservationists say the Wheeler Creek Valley should be preserved from all residential and service development because of its historic importance to the Aboriginal race.



Mr Jackson Jacobs (right), his wife Enid and Mr Ken Thompson, of Mornington, looking at one of the Aboriginal carvings on a large rock between Cromer and Oxford Falls.

Appendix 12 - Comment by Dennis Foley

Email from Dennis Foley concerning the statement in Stanbury and Clegg's book "*A field Guide to Aboriginal Rock Carvings*" that the carvings in Wheeler Creek were not particularly significant because there were no depictions of cult heroes.

The email said.....

Lastly one thing that needs stressing is the comment that there were "no cult heroes". It needs to be written that this concept and overpublication of cult heroes in our land by white academics is the work of ethnocentric anthropologists who are influenced by their Christian beliefs when they attempt to interpret our rock engravings. The western interpretation of 'cult heroes' is nonsense and should be recorded in the same contempt in which it is an insult to our religion, our beliefs and our ancestors.

Much of the recording of our spiritual beliefs which are represented in our engravings are the interpretation of people who are of another world - an ethnocentric male dominated Christian indoctrinated world that sees our religion as sorcery in the overlay of their God. I might add that their Christian belief is a modern religion in comparison to ours, theirs is a religion that has its foundations in an Indigenous religion that has similarities to ours, so why do they say "oh there are no cult heroes, therefore the site is insignificant"

Every grain of sand, every leaf, even the air we breathe is significant to Indigenous Australians. It is the white anthropologist that treats these same things with contempt! This site has important meaning, much of which I cannot explain, the meanings are for Indigenous ears only. What I can say is that each mark on the stone is VERY VERY significant. Do not disregard the marks just because they do not agree with the fictional thesis of an ethnocentric academic.

To the anthropologist I say "You are ignorant!". The dolphin, the ray, the bream - they ARE a link in an ontology and epistemology that is as old as time (and I might add a scientific knowledge that is far richer than that of the gravediggers of Sydney University). The anthropologist is comparing apples with potatoes. - two distinctly different things. The engravings do not need 'cult' figures, that is a different story, from a different place.

To better explain, in Westminster Law, the law is made in the courts under common law or in parliament under statute law. When you walk out of the court room and/or parliament are not these same laws applicable. It is the same in Aboriginal concepts, we do not need to have 'mega cult figures' to ordain each and every site. Different figures mean different things, but the importance of law still is evident outside of our "parliament" or "court room". I hope this helps to explain.

Dennis Foley, July 2002.