Exploring Brisbane's Invertebrates

Compiled by Dr Tracey Churchill

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Queensland Government

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Queensland Centre for Biodiversity

Brisbane City
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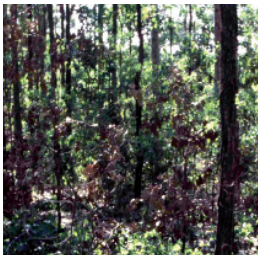
The Green-head Ant *Rhytidoponera metallica*

Summary

- In 2005, the Brisbane City Council, through its Natural Environment & Sustainability Branch, engaged the services of the Queensland Museum's Centre for Biodiversity to undertake surveys across the City's conservation reserves to inform planning and management of the City's biodiversity.
- Across the City's reserve network, 10 sites were selected to represent a range of broad vegetation groups as part of a year-long project to investigate the composition of the invertebrate fauna.
- The survey targeted specific bio-indicator groups: ants, ground beetles, sucking bugs, spiders and land snails and to a lesser extent, butterflies and dragonflies.
- An extraordinary diversity of species were collected.
- There were many species new to science, rediscoveries of long-lost species and significant range extensions.
- Introduced species were a relatively minor component of the bushland fauna, with the exception of the Coastal Brown Ant *Pheidole megacephala*.
- There were major differences in the composition of invertebrate communities across the 10 bushland sites showing that the reserve network is important for achieving conservation goals.
- The information collected provides the first significant database of invertebrate fauna for Brisbane City and is an important step forward for urban biodiversity conservation.
- The survey of more sites representing a broader range of ecosystems, and further taxonomic studies, would expand the species inventory and help develop a list of significant invertebrate species.
- A variety of sampling techniques is required to document the invertebrate fauna. Patterns of seasonality showed that summer was the most productive sampling period, except for trapdoor spiders.
- The results show that there is a diverse and abundant invertebrate fauna to help monitor ecosystem health, investigate impacts of specific management practices on biodiversity and identify emerging threats to our bushlands.

Small Green-banded Blue
Psychonotis caelius



The Common Bluetail *Ischnura heterosticta*

Why survey Brisbane's invertebrates?

Brisbane is part of the fastest growing region in Australia: 200,000 people are predicted to move into the area over the next 20 years. It is also the most biologically diverse capital city, with a magnificent variety of habitat types that contain flora and fauna of high conservation significance. The challenge is to protect the city's rich biological assets and the services they deliver whilst accommodating some urban growth.

Brisbane City Council (BCC) recognises this challenge and is committed to protecting and enhancing the City's biodiversity and achieving a vision of a clean green city. A key commitment is to achieve 40% natural habitat coverage of the city by 2026.

Since 1991, BCC has spent over $90 million to acquire and manage approximately 1800 hectares of significant natural habitat. The recent focus has been to consolidate and connect the reserve network, enhancing its resilience to key threats such as climate change.

BCC has introduced the Natural Assets Local Law to prevent the indiscriminate clearing of vegetation and to control weeds. The Council also encourages community involvement in voluntary conservation agreements on private lands, community partnerships, habitat restoration, and awareness programs.

Through a co-operative biodiversity research program, Council undertakes flora and fauna surveys with community and industry partners to better understand and manage the city's biodiversity. Faunal surveys, however, have been almost exclusively based on vertebrate animals (eg. mammals, birds, reptiles) despite the fact that the invertebrates (eg. insects, spiders, snails) constitute the bulk of biodiversity (beetles alone comprise about 30% of all animals worldwide).

Invertebrates play such diverse and crucial roles in nutrient cycling, energy storage and transfer that maintaining their populations is critical to sustaining our natural ecosystems. The protection and sustainable management of these ecological areas thus ensures the provision essential ecosystem services on which we all depend: clean air, clean water, recreational and economic resources.

Council recognizes the valuable potential of using invertebrates as 'bio-indicators' for the health of our natural environments. Yet, the invertebrate fauna of the City's natural reserves had been unexplored.

This project focused on selected invertebrate groups to:

- survey and identify fauna across a range of habitats
- describe species richness and abundance
- identify significant species and their locations
- identify important microhabitats for invertebrate diversity
- provide data for inclusion in BCC's Wildlife database
- highlight any management issues that come to light from this initial survey
- make recommendations for future surveys and monitoring programs

The introduced European Garden Snail *Cantareus aspersus*

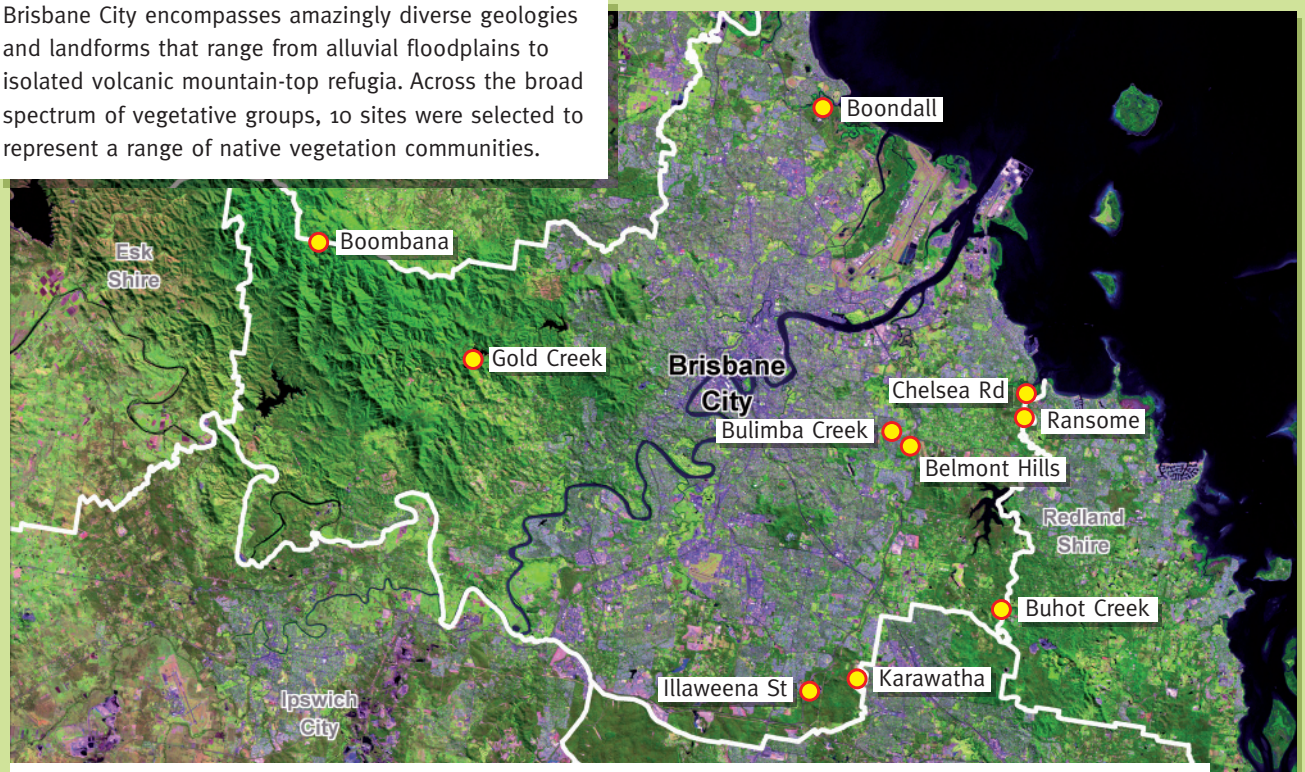





Left to right: Boondall Wetlands, Buhot Creek and Bulimba Creek.

Study sites

Brisbane City encompasses amazingly diverse geologies and landforms that range from alluvial floodplains to isolated volcanic mountain-top refugia. Across the broad spectrum of vegetative groups, 10 sites were selected to represent a range of native vegetation communities.



The location of the 10 study sites in relation to the Brisbane 'urban footprint' (© Commonwealth of Australia – ACRES, Geoscience Australia – 2003).

Belmont Hills Bushland Reserve

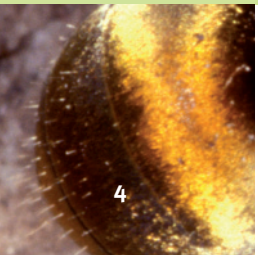
Vegetation Type: Mixed dry eucalypt woodland

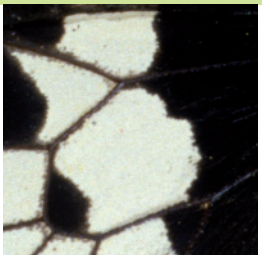
Belmont Hills Bushland Reserve is located in the urban-dominated middle and lower reaches of the Bulimba Creek Catchment, in south-east Brisbane. The Belmont Hills range to 105m and include heath, eucalypt open forest and woodland, remnant dry rainforest and riparian communities.

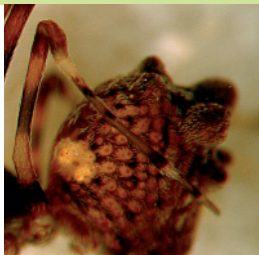
Boombana

Vegetation Type: Sub-Tropical Rainforest

Boombana, now part of D'Aguilar Range National Park, lies within Brisbane Forest Park (BFP). BFP is the largest protected area adjacent to a capital city in Australia and features a wide range of landforms and geologies, vegetation (including rainforest) and significant fauna. Much of the area has suffered from major disturbance in the past including logging and bushfires.









Left to right: Chelsea Road Bushland Reserve, Gold Creek Reservoir and Karawatha Forest Park.

Boondall Wetlands

Vegetation Type: *Melaleuca* woodlands

The Boondall Wetlands, located on the edge of Moreton Bay, are Brisbane's largest wetlands and have international significance under the Ramsar convention. They comprise one of four core areas in the 1,700 ha North East Wetlands which encompass tidal flats, mangroves, saltmarshes, grasslands, *Eucalypt* and *Melaleuca* woodlands.

Buhot Creek

Vegetation Type: Riparian

Buhot Creek, is one of five core bushland areas with high conservation significance within the Brisbane Koala Bushlands. There are diverse landforms and biotic habitats and the remnant vegetation communities have regional significance.

Bulimba Creek

Vegetation Type: Forest Red Gum on river flats

Within the Belmont Hills Bushland Reserve, the Bulimba Creek study site comprised true riparian vegetation including Flooded Gums (*Eucalyptus grandis*) and an adjacent low ridge of eucalypt woodland with *Allocasuarina littoralis*. A number of introduced plant and tree species were also present.

Chelsea Road Bushland Reserve

Vegetation Type: Coastal ironbark open forest

Chelsea Road Bushland Reserve is largely *Eucalyptus tereticornis* woodland with grass understorey in the lower portions giving rise to ironbark woodland on the ridges. This reserve is one of a series of natural areas along the foreshores of Moreton Bay called the Bayside Parklands that include bushland, wetland and tidal ecosystems.

Gold Creek Reservoir

Vegetation Type: Mixed dry eucalypt open forest

Gold Creek Reservoir is within the Brisbane Forest Park and the D'Aguilar Range National Park, but at a lower elevation than Boombana. This site has a history of selective logging, bushfires and disturbance through reservoir construction.

Illaweena Street

Vegetation Type: Scribbly Gum dry woodland with grass/ heath understorey

The Illaweena Street site is on sandy soils and dominated by large Scribbly gums *Eucalyptus racemosa*, a food tree for yellow-bellied gliders and koalas. It lies within the Karawatha Forest Park.

Karawatha Forest Park

Vegetation Type: Mixed dry eucalypt woodland

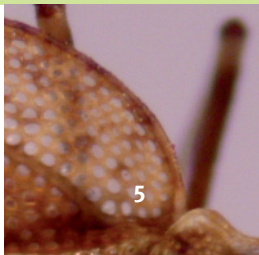
Karawatha Forest covers 642.5 ha and is geologically and biologically important, harbouring a unique combination of habitats. Floristically the forest contains remnant communities and of particular significance are the *Eucalyptus planchoniana* and *E. baileyana* associations of the sandstone ridges, the heath communities with emergent *E. carnea*, and the *E. seeana* dominated communities.

Ransome Bushland Reserve

Vegetation Type: *Casuarina glauca* ecotone

Ransome Bushland Reserve also contributes to the natural corridors of the Bayside Parklands. This reserve comprises lowlands of *Melaleuca* swamps and an ecotone of *Casuarina glauca* that gives rise to stands of the Carbeen *Corymbia tessellaris*.









Top: The Spiny Ant *Polyrhachis ammon*; the sucking bug *Ethaltomarus terrareginae*; the Red and Blue Damsel *Xanthagrion erythroneurum*. **Bottom**: The carabid beetle *Carenum brisbanense*; the Clearwing Swallowtail *Cressida cressida*; a rare arboreal snail in the Family Camaenidae and the Garden Orb Weaver *Eriophora transmarina*.

Target groups

The invertebrate groups targeted have been previously used for biodiversity assessment and as indicators of ecosystem health given their role in key ecological processes such as decomposition, herbivory, predation, soil formation, seed dispersal and pollination.

Ants:

Order Hymenoptera: Family Formicidae

- Ants are very common in bushands throughout the year
- Ants have successfully been used in bio-monitoring programs in Australia
- Ant species are predators, general scavengers, seed dispersers and soil turners

Beetles:

Order Coleoptera

- Beetles are the most diverse group of animals worldwide
- Ground beetles have widely used as bio-indicators overseas
- Dung beetle distribution is influenced by soil and vegetation types and local vertebrate fauna

Sucking bugs:

Hemiptera

- Sucking bugs are a diverse group that include aphids, shield bugs, cicadas, and leaf hoppers
- Some species are predators, others are fungus, seed or root feeders
- Most species feed on plant sap and on a limited range of host plants

Butterflies:

Lepidoptera: Papilionoidea & Hesperioidea

- Butterflies are conspicuous due to their behaviour and attractive colours
- Most species breed on specific food-plants and vegetation types

Dragonflies and Damselflies:

Odonata

- Adults are aerial predators that hunt with excellent vision
- Juveniles are aquatic predators and useful indicators of the health of freshwater habitats

Land snails:

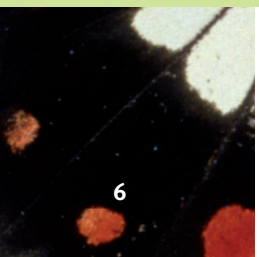
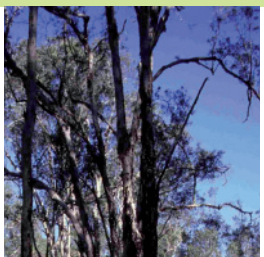
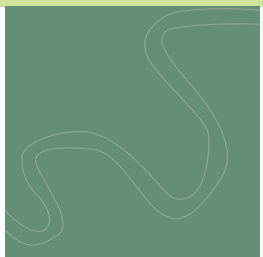
Gastropoda

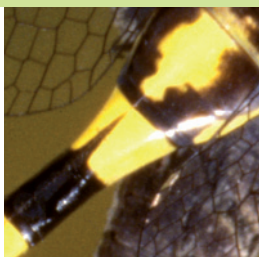
- Land snails, not as common as some other organisms, are sensitive to human induced changes in bushland
- Land snails depend on moisture so are most active in wet periods and common in rainforests
- Snail species can feed on algae, plants, fungi, decomposing organic matter or other invertebrates

Spiders:

Araneida

- Spiders are dominant and diverse predators that occur in all habitat types
- Trapdoor spiders are long-lived and depend on healthy ground cover in bushlands
- Spider species include specialist predators that require the availability of certain microhabitats




Some of the sampling methods used: pitfall trap; dung-baited pitfall trap; hand netting and hand collecting.

Sampling methods

A range of sampling methods, that target different behaviours or microhabitats, were required to capture the various invertebrate groups.

Pitfall traps

- Pitfall traps sampled ground active invertebrates
- At each site, five 2 litre ice-cream containers with a roof were placed 5m apart along a transect line
- Pitfall traps were operated continuously and cleared every month

Dung-baited pitfall traps

- Dung-baited pitfall traps specifically targeted dung beetles
- A frozen ball of wallaby dung, suspended over the mouth of the trap, attracted dung beetles as it thawed
- Two traps were placed at each site for 24 hours on three occasions

Hand collecting: day and night

- Hand collecting of insects and spiders was carried out for three person hours per site
- Collections at each site were made by day on three occasions, and by night on two occasions

Land snail collecting

- Hand collecting for land snails targeted their preferred habitats for three person hours per site on two occasions

Pyrethrum knockdown

- A fast acting pyrethroid insecticide was sprayed on the base of 10 trees to sample invertebrates on or in trunk crevices
- At each site, four of these samples were taken

Sweep netting

- A sweep net with a fine mesh material was used to capture fauna on low vegetation
- Sweep netting was carried out for 15 minutes at each site on three occasions

Hand netting

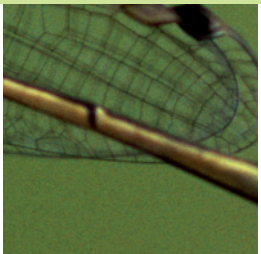
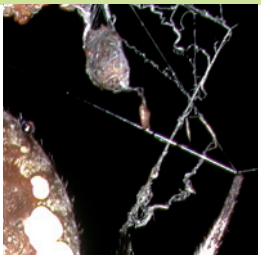
- A hand net with 1 mm square mesh material was used to target flying butterflies and dragonflies
- Hand netting was carried out for two person hours at each site on three occasions

Leaf litter berleseates

- Three litres of sieved leaf litter were collected from thick litter areas at each site on three occasions
- Invertebrates were extracted from the litter in Berlese funnels over eight hours

Litter sorting for snails

- Litter habitat from the base of trees and fallen logs was sorted specifically for live snails or their shells
- Three litres of bark, litter and forest debris was collected from each site on two occasions


Left: Graphic Flutterer *Rhyothemis graphiptera*. **Right:** A rare lace bug from Boombana – *Allocader cordatus*.

An extraordinary diversity

More than 1200 species were identified from this survey, many more than was expected by the specialists. Moreover, this is an underestimate: only 3 of the 40 beetle families, and 3 of the 17 sucking bug families were identified to species level.

Group	No. families or subfamilies*	No. species recorded
Ants	12*	256
Beetles	40	164+
Bugs	17	84+
Butterflies	5	82
Dragonflies & Damselflies	12	34
Snails	12	43
Spiders	56	568

Of all the groups surveyed, spiders had the the most species collected and over 70% of these had no scientific name. The richness of the 10 study sites for this important predator group on its own makes Brisbane City significant for invertebrates.

A rich diversity of spiders, and all other invertebrate groups, is indicative of a healthy bushland ecosystem.

Special Patterns of Distribution

The survey revealed interesting species distribution patterns that highlight the importance of a network of reserves to ensure the conservation of biodiversity. Whilst many insects have wings and can disperse readily, they may not do so across unfavourable habitat, making habitat corridors crucial to their survival. Other species can move only small distances, making them dependant on particular microhabitats within a healthy landscape and therefore vulnerable to habitat change or disturbance.

Top: The rare rainforest charopid *Ngairea corticicola*.
Bottom: The Brisbane Brush-footed Trapdoor Spider *Seqocrypta jakara*.

Charopid land snails and most trapdoor spiders are capable of dispersing only very short distances. Consequently, these taxa show high degrees of endemicity across fragmented natural areas. These groups are good indicators of historical connections between sites and the long-term persistence of stable environmental moisture regimes in bushland sites.

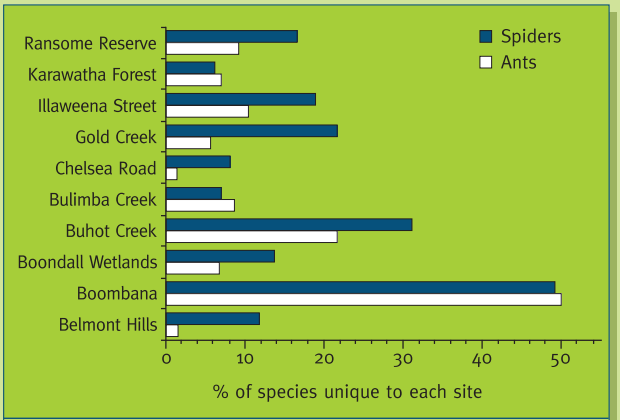
Sampling Biodiversity

To document the extent of invertebrate diversity in bushland, it is important to use different sampling methods. Many surveys use only pitfall traps because they capture many animals with relatively little effort. However, this samples only the ground active fauna and not the very different species that live elsewhere within the bushland.

Left: Buhot Creek had the most diverse and distinctive dragonfly fauna, including the Australian Tiger *Ictinogomphus australis*, because of the variety of nearby freshwater habitats. **Right:** Boombana had the most unique sucking bug fauna including Australia's largest flat bug *Drakiessa hackeri*.

Our unique bushland remnants

The invertebrate fauna of each of the ten bushand sites was unique. This highlights the importance of protecting a range of habitat types and the same habitat type in different locations.



The percentage of ant and spider species unique to each of the 10 bushland sites. The rainforest habitat at Boombana had the most unique fauna, followed by the riparian habitat along Buhot Creek.

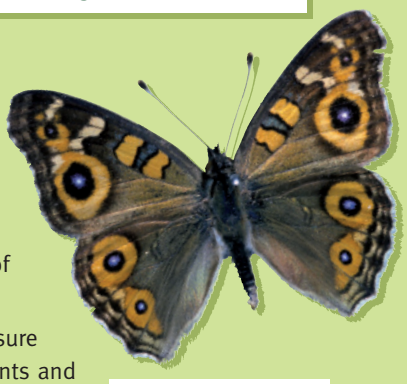
Apart from this, the pattern across sites differed between ants and spiders.

The importance of the seasons

Invertebrates typically respond to environmental factors such as rainfall and critical temperatures which determine their level of activity. The patterns of these responses are unique for each species.

This then influences the chance of capturing a certain species with a particular sampling method.

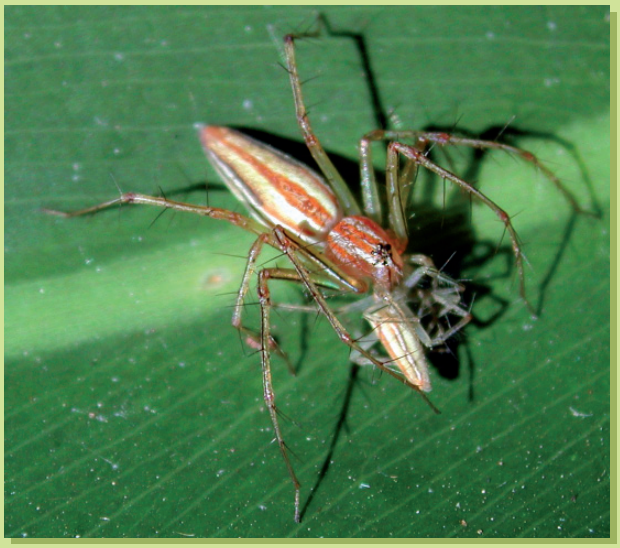
To capture many different species, sampling should be conducted across all seasons. Although, in the warmer months of the year, the activity of many invertebrates is greater and their abundance is higher, so sampling is more productive.



The Meadow Argus *Junonia villida*

The visual spectacle of certain butterfly species in flight is well known to be linked to certain times of the year.

The timing is crucial to ensure the availability of food plants and developmental temperatures for the larvae.



The Lynx Spider *Oxyopes molaris*

Spiders such as these lynx spiders in the Family Oxyopidae are most active in summer whilst male spiders of some ancient trapdoor families only move about in the winter months to find mates.

Land snails and slugs are most active during and after rainfall and typically aestivate in the winter months.

The Red Triangle Slug

Significant range extensions were recorded for the ant genus *Calyptomyrmex* (**left**) and the dung beetle *Onthophagus tenebrosus* (**right**).

Exciting new discoveries

This study was the first comprehensive survey of the invertebrate fauna of a major Australian city. Scientists are invariably lured by more remote locations, yet here, in Brisbane City was a wealth of fascinating new discoveries.

New species

This spider from Boombana and Buhot Creek represents both a new genus and new species in the Family Tengellidae.

Two undescribed species of native dung beetles were collected during the survey. One belongs to the genus *Lepanus* collected at Bulimba, Gold Creek and Boombana. The other undescribed species, in the genus *Onthophagus* was only found in the rainforest of Boombana.

A dung beetle of the genus *Lepanus*

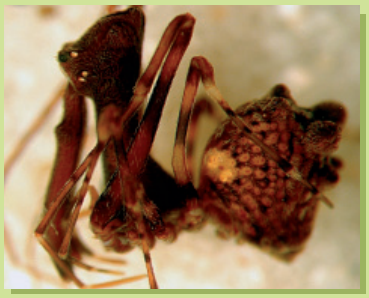
It is remarkable that new species of such a well known group of insects occur on our very doorstep.

Significant range extensions

Ants of the genus *Calyptomyrmex* are rare and limited to Queensland rainforests. There are at least eight species and only one has a scientific name. Known from northern Queensland, the most southerly record has been from Mackay. In this survey, a *Calyptomyrmex* queen was discovered at Boombana, which is a significant range extension for the genus.

The large, roughly-sculptured dung beetle *Onthophagus tenebrosus* was found at the Karawatha Forest Park and Illaweena Street sites. These were the first records of this species from east of the Great Dividing Range.

Rare species



First described in 1956, the small and peculiar spider *Austrarchaea nodosa*, is a rare member of the Family Archaeidae. The discovery of more members of this species on silk lines on shrubs at Boombana was very significant.

Species rediscovered

A tiny spider *Malkara loricata* (Family Malkaridae) that lives only in deep moist leaf litter, was first described in 1980 from the lower slopes of Mt Coot-tha. The microhabitat has since been removed and the spider not found since. Experts were delighted to find members of this species again at Belmont Hills.

Species of the genus *Peronomyrmex* are some of Australia's rarest ants. Three species are known from only five specimens. At Ransome Reserve, specialists collected the second specimen ever known of *Peronomyrmex overbecki*. The first specimen had been collected more than 85 years ago from Trial Bay in New South Wales.



Threats to our local invertebrates include the Coastal Brown Ant *Pheidole megacephala*, the Red Imported Fire Ant *Solenopsis invicta* and fire.

Threats to our local invertebrates

Natural plant communities, and hence the invertebrates that maintain them, are under threat from various sources:

- **Land clearance, habitat loss and fragmentation**. A priority threat due to the extent of urban expansion.
- **Weeds**. Invasive plants can drastically impact the viability and habitat value of native vegetation communities.
- **Habitat degradation** through arson, vandalism, inappropriate recreational use and pollution.
- **Invasive and exotic fauna**. Feral and pest animals can have devastating effects on natural areas.
  - The Red Imported Fire Ant *Solenopsis invicta* was fortunately not recorded from the 10 study sites.
  - The introduced Coastal Brown Ant *Pheidole megacephala* dominated the ant fauna of the Gold Creek Reservoir study site. There is evidence that this species can invade natural habitats with detrimental effects on native invertebrate communities. The results of this study recommend that the full extent of the infestation at Gold Creek Reservoir be established, that its ecological effects be the focus of a future study, and that management practices be reviewed to minimize potential spread of this pest species.
- **Fire**.

  The effect of hazard reduction burning and un-planned fires on the native invertebrate fauna, especially across the Brisbane landscape, is little understood. This study identified many species that require specific microhabitats provided by moist ground cover (eg. leaf litter, fallen logs and bark) and minimal fire exposure. Given the significant role fire plays in shaping our natural vegetation communities, research and monitoring into the effects of fire is a priority for the conservation of invertebrate biodiversity.
- **Climate change**.

  The effects of rising temperatures, changing air chemistry and rainfall patterns will have unpredictable effects on natural communities. Invertebrates will be necessarily affected since their behaviour, life cycles and breeding success are temperature and rainfall dependant. Relevant research is required to determine which groups will be the most useful as indicators in this context, which taxa will be the most vulnerable to change and which are the most appropriate to inform management decisions regarding our biodiversity.

Acknowledgements

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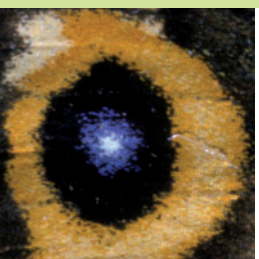
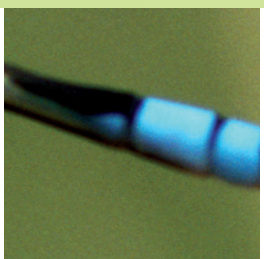
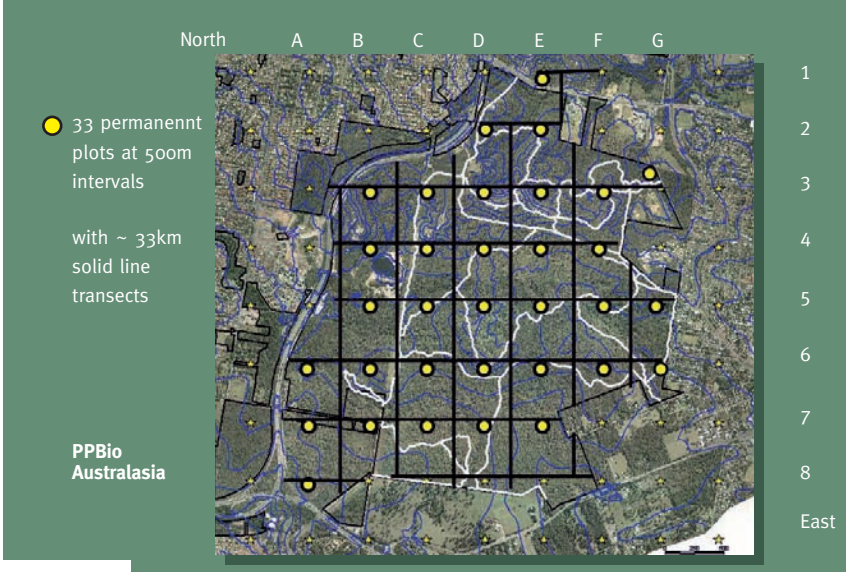
Dr Tracey Churchill, of EcoSpider Consulting, compiled the brochure with the support of Stacey McLean (BCC) and Dr Chris Burwell (QCB). Graphic design services were provided by the Queensland Museum.









Left: A PPBio site has been established at Karawatha Forest Park.
Right: Locations of permanent plots and transect grid at Karawatha Forest Park.

Where to from here?

A Benchmark study

This booklet has outlined the Terrestrial Invertebrate Status Review which was the initial phase of a Brisbane City Council (BCC) funded program. This survey has represented a benchmark initiative for local government nationally and significantly advanced our knowledge of the city's invertebrate biodiversity. The full report can be downloaded from http://www.qm.qld.gov.au/organisation/biodiversity.asp.

Program for Planned Biodiversity Studies

BCC has now formed a partnership with the Centre for Innovative Conservation Strategies, Griffith University (CICS) to implement the Program for Planned Biodiversity Studies in Australasia (PPBio).

PPBio is a meso-scale, multi-disciplinary program designed to assist agencies and land managers in collecting long-term data on biodiversity assessment on public and private lands. The first Australian PPBio site has been established at Karawatha Forest Park: see http://www.griffith.edu.au/centre/cics/ppbio/home.html.

The program includes two important components:

1. Integrated, standardised long-term ecological plots
2. All data collected will be publicly available on a dedicated website

Monitoring Bushland Health – Investigating fire, climate change & invertebrates in Karawatha Forest

In conjunction with the CICS and the PPBio, Phase II will commence in 2008 in collaboration with the Queensland Centre for Biodiversity, at the Queensland Museum.

The outcomes and objectives are:

- Initiate the use of selected invertebrate indicator taxa in monitoring and evaluation of (natural area reserve) management decisions and practices, particularly in relation to the use of fire.
- Enhance our understanding of the role of invertebrates in sustaining the Karawatha ecosystem
- Develop an integrated, cost-effective and standardised sampling protocol for invertebrate indicator taxa to facilitate long term management and monitoring for the impacts of climate change

Other research agencies or corporations interested in the program are encouraged to discuss collaborative opportunities.

Benefits of collaboration include:

- Join existing founding investors in this benchmark study into the health of South-east Queensland bushland
- Contribute to practical and affordable responses to climate change
- Contribute to better assessment and management of fire risk

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