



Streams of high biodiversity value in the Moreton Bay Region

prepared for

Environmental Planning & Compliance Department
Moreton Bay Regional Council

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1. Synopsis

This report identifies streams of **high biodiversity value (HBV)** throughout the Moreton Bay Region based on the presence of rare and locally significant species of aquatic macroinvertebrates (or **HBV species**). The outcome of the study provides Council with a tool to set strategic planning and management priorities for the protection of aquatic ecosystem health and biodiversity. Thus, it advances the achievement of the *Desired Regional Outcomes 2 and 11* (Natural Environment and Water Management) of the SEQ Regional Plan. It also advances achieving one of the objectives of the *Environmental Protection Policy [Water] 2009* (EPP Water), which is to protect the environmental value *aquatic ecosystem*.

Nineteen stream reaches of high biodiversity value were identified, most of which are located in healthy headwaters and upper catchments. A further 5 HBV stream sites are located somewhat isolated amid impacted stream reaches. These findings are translated into a **HBV stream map**. In addition, recommendations are listed, and the report gives details on the HBV streams and 29 HBV species they sustain.

This way of identifying and mapping HBV freshwater ecosystems based on the presence of HBV species of aquatic macroinvertebrate is a truly pioneering work. It is a sharp tool to pinpoint ecosystems of high conservation value and markedly expands knowledge on South East Queensland's biodiversity.

It is important to understand that high biodiversity value streams fall into the category "high ecological value waters" ("hev waters") of the EPP Water. However, "hev waters" need not necessarily house rare and locally significant species. In other words, HBV streams are a sub-set of "hev waters", in fact a high-quality sub-set, which is of **highest protection priority** to safeguard the Region's unique and rich biodiversity.

The HBV stream map is a support tool for environmental planning and management to identify which of the Region's streams are of highest protection priority and/or of high rehabilitation priority.

In identifying and mapping streams of high biodiversity value Council is addressing a number of state legislation, policies and strategies, including the

- Environmental Protection Policy [Water] 2009 – **EPP Water**
- Queensland Water Quality Guidelines 2009 – **QWQG**
- South East Queensland Regional Plan 2009-2031 – **SEQ-RP**
- Queensland Biodiversity Strategy (DERM 2010, draft) – **QBS**

2. Legislative framework

2.1 Environmental Protection Policy [Water] and QWQG

The EPP Water, which is subordinate legislation under the Environment Protection Act 1994, identifies “high ecological value waters” or “hev waters” throughout Queensland. The definition is that hev waters “are effectively unmodified or other highly valued systems, typically (but not always) occurring in national parks, conservation reserves or in remote and/or inaccessible locations. [...] The ecological integrity of hev systems is regarded as intact” (QWQG, 2.2.1).

EPP Water legislates to “maintain” Environmental Values (EV) and Water Quality Objectives (WQO) of hev waters and their catchments. However, EV in a purely ecological sense (as opposed to human use) are not specified other than “aquatic ecosystems”. WQO are outlined in the QWQG 2009.

Brief discussion concerning the Moreton Bay Region (MBR):

EV and WQO defined in EPP Water are inevitably of a general nature due to the lack of detailed on-site data throughout Queensland. The Pine Rivers District is an exception in this regard because specific EV and WQO for streams – prepared by the then Pine Rivers Shire Council (AFS 2001, Nolte & Loose 2004) – were available and therefore included in the EPP Water (2006 amendments) and the QWQG.

This report is closing the gap for the Redcliffe and Caboolture Districts in identifying high ecological value streams (to be precise: high biodiversity value streams) and their EV based on on-site data. It also updates the 2001 baseline assessment of the Pine Rivers District. .

Environmental Values defined in this report are locally significant species of aquatic macroinvertebrates (or **HBV species**) and their occurrence in the MBR. These are more tangible EV compared to the vague EV “aquatic ecosystems” in the EPP Water and, most importantly, they are measurable. The presence and number of HBV species indicate HBV streams. And, in future monitoring rounds the presence of HBV species will indicate which stream reaches maintained their high biodiversity and ecological value.

2.2 South East Queensland Regional Plan

The SEQ-RP 2009-2031 sets the desired regional outcome (DRO 2) to achieve a healthy natural environment, which is to be based on the principle to “Protect, manage and enhance the region’s biodiversity values and associated ecosystem services [...]”

Policy statements include:

“Avoid impacts on areas with significant biodiversity values in”...

2.1.1 ... “the Regional Landscape and Rural Production Area [...]”

2.1.2 ... “the Urban Footprint or Rural Living Area [...]”

- 2.1.5 “[...] protect significant biodiversity values, improve ecological connectivity, enhance habitat extent and condition, and rehabilitate degraded areas.”
- 2.1.6 “Optimise biodiversity conservation outcomes by [...] giving a high priority to the protection or rehabilitation of significant biodiversity values.”

Policy statements include:

- 2.1.9 “Implement actions to help achieve the nature conservation targets in the *South East Queensland Natural Resource Management Plan 2009–2031*.”
- 2.1.11 “Integrate an agreed biodiversity mapping approach for the region, including methods to map and represent biodiversity networks for use in state, regional and local planning and management.”

The plan also sets the desired regional outcome (DRO 11) to achieve sustainable waterway health, which is to be based on the principle to “Protect and enhance the ecological health, environmental values and water quality of surface and groundwater, including waterways, wetlands, estuaries and Moreton Bay” through policies and programs which:

- 11.4.1 “Ensure that development is planned, designed, constructed and operated in accordance with best practice environmental management to protect environmental values and meet the water quality objectives of all regional surface waters, groundwaters, wetlands and coastal waters.”
- 11.4.3 “Avoid impacts on wetlands, waterways and associated buffers.”
- 11.4.4 “Minimise impacts from required community infrastructure located in a wetland or waterway buffer on water quality, natural hydrological processes, ecological functions and ecosystem services.”
- 11.4.6 “Avoid allocating areas identified as High Ecological Value (HEV) waters for urban purposes.”
- 11.4.7 “Insure that the development of urban land draining directly to HEV waters demonstrates achievement of the relevant urban stormwater design objectives.”

Brief discussion concerning the Moreton Bay Region:

The issues listed above are addressed in this report.

2.3 Queensland Biodiversity Strategy

The QBS (DERM 2010, draft) sets the “target(s) for biodiversity in Queensland” to “reverse the decline in biodiversity”. To achieve this goal the QBS lays out “primary objectives” and “supporting objectives” each with “key outcomes”.

Primary objectives include:

1. “Building protected areas” (primary objective) “on public and private land provide sound foundations for landscape resilience” (key outcome)

2. “Conserving species” (primary objective) means a “greater protection of species and their habitats” (key outcome) and “at risk species populations are stabilised or recovered” (key outcome).
3. “Managing extent, condition and connectivity” of high biodiversity value ecosystems (primary objective) to promote “stronger natural systems that can respond to threats and stressors” (key Outcome).

Supporting objectives include:

1. “Building knowledge” (supporting objective) so that
 - “Decisions affecting the resilience of Queensland’s biodiversity are based on best available science.” (key outcome)
 - “Biodiversity benchmarks and indicators inform biodiversity management practices and decisions across the landscape.” (key outcome)
 - “The role of freshwater and marine ecosystems in the broader landscape is better understood and valued.” (key outcome) and
 - “Biodiversity data is accessible and used to support better policy development and decision making.” (key outcome)
2. “Managing responsively” (supporting objective) means
 - “Biodiversity conservation is a core consideration of state, regional and local planning strategies and development decisions.” (key outcome)
 - “Accountability for meeting biodiversity outcomes is improved.” (key outcome)

Brief discussion concerning the Moreton Bay Region:

The primary and supporting objectives and key outcomes listed above are addressed in the present report.

This report is broadening the existing knowledge on the kind and number of rare and locally significant species that occur in the MBR. The first biodiversity assessment of aquatic invertebrates in the Region was undertaken ten years ago in the Pine Rivers District (AFS 2001) where 488 species were recorded, which included 18 locally significant species. Using the same method (as part of Council’s Stream Health Monitoring), this biodiversity assessment was expanded to also cover the Caboolture and Redcliffe Districts. A total of 619 species of aquatic macroinvertebrates are recorded so far for freshwater streams the MBR, including 29 locally significant species.

This knowledge together with the understanding where the habitats of these species are located (map of HBV streams) is a prerequisite for achieving the target of the Queensland Biodiversity Strategy to “reverse the decline in biodiversity” through “greater protection of species and their habitats”.

3. Purpose of this Report

The core of this report – the **HBV stream map** – is a decision support tool as it identifies key areas for conservation in the MBR.

The report informs local environmental planning and management about where streams of high biodiversity value are located, and about the rare and locally significant freshwater species these ecosystems sustain.

The HBV map is suited to inform strategic planning and development assessment to advance the principle to “protect [...] the region’s biodiversity values and associated ecosystem services” and to “protect and enhance the ecological health, environmental values and water quality of surface and groundwater, including waterways, wetlands, estuaries and Moreton Bay” (SEQ-RP, DRO 2 and 11).

Freshwater biodiversity is experiencing much greater rates of decline than other environments and is threatened by pollution, over-exploitation of water, modification of water flows and hydrology, habitat destruction and degradation, and species invasion (SEQ Natural Resource Management Plan).

Protection of habitats – such as HBV streams – is the only way to conserve high value biodiversity and work towards achieving the relevant parts of D RO 2 and 11.

4. Recommendations resulting from this Study

Recommendation 1: Amend the EPP Water hev mapping.

Based on on-ground data, this study identifies 19 stream reaches plus 5 stream sites of **high biodiversity value (HBV)** in the Moreton Bay Region. The indicators used are rare and locally significant animal species (aquatic macroinvertebrates) of high biodiversity value (HBV species or “priority species” in the SEQ-RP). Hbv streams are a sub-set of “**high ecological value**”(hev) ecosystems mapped quite generally (without on-ground truthing) in the *Environmental Protection Policy [Water] 2009*, with the “intent for hev areas is to protect their current condition [...], biodiversity and habitat.” (EPP Water). This study shows that not all HBV streams are covered by the hev mapping of the EPP Water.

It is recommended to amend the EPP Water hev mapping based on the present findings as shown in the High Biodiversity Value Stream Map (Figure 2, page 14). This will turn the hev framework provided by the state legislation into a decision support tool for local environmental planning as it is built on local on-site data.

Recommendation 2: Protect all 19 HBV stream reaches.

The **current protection status** of the 19 HBV reaches and 5 sites is as follows:

- Four HBV reaches are located in Forest Reserves,

- three reaches are half inside / half outside a National Park, and
- twelve reaches have nil protection status on State or Commonwealth level. The latter, however, include two stream reaches, which in part benefit from protection through Council Environmental Reserves (middle Cedar Creek and middle Antbidawa Creek). One HBV stream with currently no protection stands out (Gregors Creek) because it is the only known habitat stream of a microcaddisfly, which is likely to be **endemic to the MBR**.
- None of the five isolated or ‘disconnected’ HBV stream sites has any protection status.

It is recommended to protect all 19 HBV stream reaches, with Gregors Creek being of high protection priority and the upper North Pine River of high protection and rehabilitation priority. Out of the five HBV stream sites, two sites are of highest protection and rehabilitation priority: lower Branch Creek and lower Freshwater Creek.

The protection of habitats – such as HBV streams – is the only way to conserve high value biodiversity. Protection is the benchmark for achieving the Desired Regional Outcome 2 of the *SEQ Regional Plan*.

Recommendation 3: Protect all four confirmed habitat sites of the North Pine River Snail. Protection of these HBV streams is of very high priority.

Field data were able to confirm the presence of the rare North Pine River Snail (*Fluvidona anodonta*) in the MBR. Prior to Council’s Stream Health Monitoring, ongoing since 2001, the snail was recorded only twice, in 1892 and 1982. The North Pine River Snail is likely to be **endemic to the MBR** and is listed as **vulnerable** (IUCN 2010). Over the past ten years, the rare snail was recorded at only 4 out of 160 monitoring sites. The streams are:

- (1.) Headwaters of the South Pine River, a stream reach located in the D’Aguilar National Park, which nevertheless is impacted by the traffic (Mount Glorious Road) and degraded riparian vegetation.
- (2.) Headwaters of the North Pine River, located in the D’Aguilar National Park. However, this valuable habitat is seriously threatened by habitat fragmentation as detailed in Chapter 6.3.2, and urgently needs proper protection and rehabilitation.
- (3.) Kobble Creek, a stream reach currently not covered by any protection status.
- (4.) Lower Branch Creek, a ‘disconnected’ HBV stream site in urgent need of protection and rehabilitation (Chapter 6.4.1).

To protect and, where needed, rehabilitate these stream reaches and sites will be a significant step towards achieving the primary objective of the *Queensland Biodiversity Strategy*: “Conserving species” with a “greater protection of species and their habitats” (key outcome) and “at risk species populations are stabilised or recovered” (key outcome). This in turn supports the policy statement 2.1.6. of the *SEQ Regional Plan*, to “optimise biodiversity conservation outcomes by [...] giving a high priority to the protection or rehabilitation of significant biodiversity values.”

Recommendation 4: Protect, manage and enhance the last significant freshwater wetland remaining in the MBR.

The wetland on lower Freshwater Creek is the last significant freshwater wetland remaining in the MBR. The wetland is of **high biodiversity value** and provides vital **ecosystem services** as discussed in Chapter 6.4.2. The wetland is under serious threat from residential, commercial and infrastructure development in Mango Hill and Griffin. It is recommended to protect, manage and enhance the freshwater wetland and its remaining stands of paperbark trees.

The protection of habitats – such as HBV streams – is the only way to conserve high value biodiversity. Protection is the benchmark for achieving the Desired Regional Outcome 2 of the *SEQ Regional Plan*.

Out of the 24 stream reaches and sites of high biodiversity value identified in the MBR, those are of highest protection (and rehabilitation) priority which are habitat sites of endemic species, or which are the last ecosystem of its kind in the Region.

5. Method

5.1 Raw data

Biodiversity assessment of freshwater streams is part of Council's long-term Stream Health Monitoring (SHM), which commenced in 2001 in the Pine Rivers District (AFS 2001) and has been extended to the entire Moreton Bay Region.

The method used is detailed elsewhere (AFS 2001, Haase & Nolte 2008). In this context of biodiversity assessment and HBV mapping, the most important thing to understand is that the animals (aquatic macroinvertebrates) collected at each of the 160 SHM sites were identified to species level. Taxonomic resolution to species level yields high quality data, and only these contain the information necessary to appraise the biodiversity and biodiversity value (definition see below) of the Region's freshwater streams.

Identification of macroinvertebrates to species level requires expert knowledge, in particular in our biogeographic region (SEQ) where little is known about these animals and many species are yet to be discovered and described. To assure correct identification, specimens were sent to experts for the respective animal group (see list Chapter 7), and reference specimens were deposited in scientific collections (Australian National Insect Collection in Canberra, Australian Museum in Sydney) to allow a later verification of identification (if required) and/or the formal description of species, which are new to science.

Assessing and mapping the biodiversity value of freshwater ecosystems based on on-site data and macroinvertebrate species is a pioneering work, which significantly enhances the knowledge on South East Queensland's biodiversity.

5.2 Definition of terms

5.2.1 Biodiversity *versus* Biodiversity Value

The term **biological diversity** or **biodiversity** is *not* clearly defined and is very broadly used. Probably most commonly “biodiversity” is used by biologists and ecologists instead of “species diversity” and “species richness”, which are both clearly defined technical terms to calculate indices. In this sense biodiversity is used in a non-judgmental way in that no differentiation between native and introduced species is made.

Another common use of “biodiversity” is a multi-level construct referring to the totality of genes, species and ecosystems, or the “variation of life at all levels of biological organization” (Gaston & Spicer 2004). This broad concept is adopted in the *Queensland Biodiversity Strategy*, which gives the definition (DERM 2010):

“Biodiversity is the variety of all life forms on earth – the different plants, animals and micro-organisms, their genes, and the terrestrial, marine and freshwater ecosystems of which they are a part. This diversity exists at different scales: regional diversity, ecosystem diversity, species diversity and genetic diversity. Biodiversity is not static, but constantly changing. It is increased by genetic change and evolutionary processes and reduced by processes such as habitat degradation, population decline and extinction.”

Brief discussion of the word “biodiversity” concerning the Moreton Bay Region:

An advantage of the above definition is that it describes most circumstances so that it is valid for all regions and ecosystems throughout Queensland. Like all broad concepts, however, it does not show clear-cut ideas necessary to develop plans and strategies.

For Council – to effectively protect and enhance local biodiversity – a ranking of “issues” (here: species and stream reaches) is required to be able to set priorities. From the above “biodiversity” definition, however, no ranking can be derived, such as the well-known need for differential weighting of rare species *vs* common species when it comes to conservation and biodiversity management. For example, the Sacred Ibis (*Threskiornis aethiopica*) does not need protection – the Glossy Black-Cockatoo (*Calyptorhynchus lathami*) does. Or, in case of freshwater species: the Gold-fronted Riverdamsel (*Pseudagrion aureofrons*) is not in need of protection – the North Pine River Snail (*Fluvidona anodonta*) is.

For ranking purposes the term **biodiversity value** is introduced. Rare and locally significant species are of **high biodiversity value** compared to common species.

5.2.2 High Biodiversity Value (HBV)

For identifying species of high biodiversity value, good knowledge about the fauna and flora of the Region is required. While knowledge about certain groups is excellent (e.g. birds) it is rudimentary about others, including freshwater macroinvertebrates. This dearth of knowledge is also the reason why aquatic invertebrates are not listed under the *Environmental Protection Act 1994* and *Environment Protection and Biodiversity Conservation Act 1999*. This is not because there are no threatened species

among them, but simply not enough knowledge is available to do this. Consequently the labelling of HBV species – done here for the first time in Queensland – relies on best professional judgement inevitably containing a subjective element. It is scientifically founded on the three corner stones: (1) the array of data collected by the author (U.N.) over the past 14 years in SEQ, with focus on the MBR, (2) literature review and (3) discussions with fellow ecologists and taxonomists (see Chapter 7).

Species of high biodiversity value (HBV species) are called “priority species” in the *Queensland Planning Provisions 2010*, the *Queensland Biodiversity Strategy* (draft 2010) and other recent state government documents.

6. Results and Discussion

A high biodiversity value stream is a stream, which sustains one or more HBV species. Therefore – before presenting the results on where and how many HBV streams were identified in the MBR – some observations on HBV species are considered first.

6.1 High biodiversity value species (overview)

In the process of identifying HBV species, five categories of why a species is of high biodiversity value became apparent. These categories are listed below with the aim to promote the understanding of the Region’s biodiversity, *not* because they attract different management actions.

All species of high biodiversity value need to be protected.

Category One:

Species that are endemic to the Moreton Bay Region (until proven otherwise). As many as three species were recorded in this very special category. These are the two hydrobiid snails *Fluvidona anodonta* and *Jardinella new sp.*, and a new micro-caddisfly species from the *Orthotrichia aberrans*-group.

This is an unexpected finding, because hardly any other local government is likely to have ‘its own’ endemic species within its boundaries. Discussions with the Australian authorities for freshwater snails (W. Ponder, Sydney) and micro-caddisflies (A. Wells, Canberra) lead to the conclusion that these species are in all likelihood endemic to the MBR.

The snail *Fluvidona anodonta* was described as early as 1892 from the North Pine River (being the type locality). In the 1980s, the Australian Museum, Sydney mounted several excursions to try and find this snail elsewhere in this biogeographic region – without success (W. Ponder, personal communication). In 1996 the snail’s endemism to the MBR was recognised in giving *F. anodonta* the common name North Pine River Freshwater Snail, and listing it as vulnerable in the IUCN Red List of Threatened Species (IUCN 2010). Even in the MBR this snail is rare. During Council’s region-wide ‘Stream Health Monitoring’ (since

2001) it was recorded at four stream sites only, and only in the Pine Rivers system, not in the neighbouring Caboolture or Stanley River systems.

The other two species listed in this category were collected for the first time in the scope of this study (Stream Health Monitoring). They are new to science and yet to be described and named. Specimens are deposited in scientific collections.

Category Two:

Species that are understood to be **generally rare**, also in other regions of Australia. Example: the green diving beetle *Onychohydrus atratus*.

Category Three:

Species that are **rare in the MBR** because the specific **habitat is rare** in the MBR (e.g. waterfalls in cool rainforest creeks) Example: the stonefly *Riekoperla perkinsi*.

Category Four:

Species that are **rare in the MBR** because their distribution centre lies either in more tropical or in more temperate climate zones, so that the MBR (SEQ) is their southern or northern **distribution fringe** beyond which the species does not expand. Examples are the damselfly *Austroargiolestes chrysoides* (tropical fauna element) and the non-biting midge *Austrobrillia longipes* (temperate fauna element).

Category Five:

A further category should be mentioned here, which contains species that are **fairly common in the MBR** because their distribution centre lies in this biogeographic region, while they are rather uncommon and of limited distribution in neighbouring regions. Example: the Sapphire Rockmaster *Diphlebia coerulescens* (Figure 1).

In the present context species from Category Five were excluded from data sets used to identify high biodiversity value stream reaches, because their comparative commonness in the MBR would have blurred the findings and the resulting map. However, these species, too, are of high biodiversity value, and their habitat sites are documented in Council's database on freshwater macroinvertebrates.



Figure 1. The Sapphire Rockmaster is a common damselfly in rocky headwater streams of the MBR, but uncommon in neighbouring regions. (Photo © U. Nolte)

A total of 29 HBV species were identified and used to pinpoint streams of high biodiversity value. They are listed in Table 1, and details on each species are given in Chapter 6.5.

Table 1. The 29 HBV species of freshwater invertebrates recorded, which were used to identify high biodiversity value stream reaches in the Moreton Bay Region.

(‘No. of sites’ is the number of stream sites each species was recorded – out of a total of 160 stream monitoring sites. Ordering of species according to zoological systematics.)

Common name	Family	Genus & Species	No. of sites
North Pine River Snail	Hydrobiidae	<i>Fluvidona anodonta</i>	4
Mud Snail	Hydrobiidae	<i>Jardinella</i> new sp.1	2
Mayfly	Ameletopsidae	<i>Mirawara</i> sp.1	2
Mayfly	Leptophlebiidae	<i>Atalomicria</i> sp. AV1b	6
Damselfly: Arrowhead Rockmaster	Diphlebiidae	<i>Diphlebia nymphoides</i>	2
Damselfly: Golden Flatwing	Megapodagrionidae	<i>Austroargiolestes chrysoides</i>	1
Damselfly: Coastal Flatwing	Megapodagrionidae	<i>Griseargiolestes albescens</i>	2
Damselfly: Southern Whitetip	Synlestidae	<i>Episynlestes albicauda</i>	10
Damselfly: Bronze Needle	Synlestidae	<i>Synlestes weyersii</i>	5
Dragonfly: Black Tigertail	Synthemistidae	<i>Eusynthemis nigra</i>	3
Dragonfly: Conehead Darner	Telephlebiidae	<i>Austroaeschna subapicalis</i>	3
Dragonfly: Northern Evening Darner	Telephlebiidae	<i>Telephlebia cyclops</i>	1
Stonefly	Gripopterygidae	<i>Riekoperla perkinsi</i>	1
Diving Beetle	Dytiscidae	<i>Onychohydrus atratus</i>	1
Riffle Beetle	Elmidae	<i>Ovolara</i> sp. (<i>O. ?australis</i>)	3
Toe-winged Beetle	Ptilodactylidae	<i>Byrrocryptus</i> sp.	6
Caddisfly	Antipodoeciidae	<i>Antipodoecia turneri</i>	6
Caddisfly	Helicophidae	<i>Helicopha ?queenslandensis</i>	6
Micro-Caddisfly	Hydroptilidae	<i>Orthotrichia aberrans</i> -group	1
Caddisfly	Leptoceridae	<i>Triplexa villa</i>	1
Caddisfly	Odontoceridae	<i>Barynema</i> sp.1	1
Caddisfly	Tasimiidae	<i>Tasiagma ciliata</i>	6
Caddisfly	Tasimiidae	<i>Tasimia ?palpata</i>	2
Non-biting Midge	Chironomidae	<i>Aphroteniella filicornis</i>	2
Non-biting Midge	Chironomidae	<i>Apsectrotanypus</i> sp.1	2
Non-biting Midge	Chironomidae	<i>Austrobrillia longipes</i>	1
Non-biting Midge	Chironomidae	<i>Paralimnophyes</i> sp.	1
Non-biting Midge	Chironomidae	<i>Stempellinella</i> new sp.1	6
Blackfly	Simuliidae	<i>Austrosimulium mirabile</i>	4

6.2 High biodiversity value streams (HBV stream map)

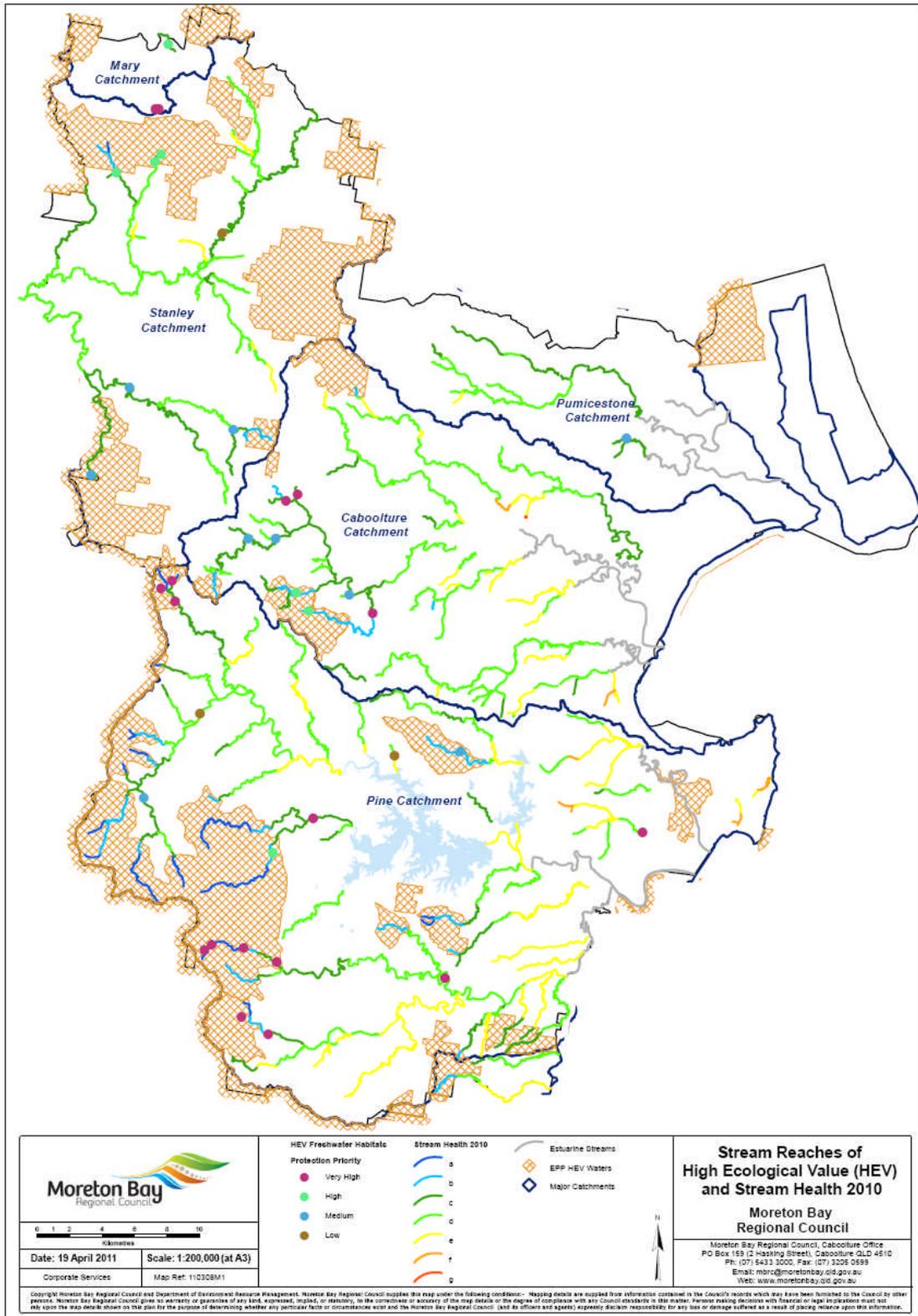


Figure 2. The High Biodiversity Value (HBV) Stream Map

Based on the 29 HBV species used as indicators, 35 out of 160 stream sites monitored in the MBR were identified as habitats of high biodiversity value. The sites are shown in the **High Biodiversity Value Stream Map** (HBV stream map, Figure 2) (see also Tables 2 & 5).

An assessment of location and general setting of each of the 35 sites resulted in the distinction of two groups of HBV streams. These groups were labelled HBV stream **reaches** (which may include more than one monitoring site) and HBV stream **sites** as explained below. In the contexts of stream and biodiversity management this distinction is made because the different groups require different management actions: Generally speaking, HBV stream reaches need to be protected, while HBV stream sites are also in need of habitat rehabilitation.

The data collected throughout the Moreton Bay Region show that connected habitats (reaches) are of higher biodiversity value than disconnected, fragmented habitats (sites):

1. Out of the 35 monitoring sites housing HBV species, as many as 30 sites were part of HBV stream reaches (blue columns in Figure 3), and only 5 were isolated HBV stream sites (green column in Figure 3).
2. The 5 isolated HBV stream **sites** supported 1 HBV species each, whereas most sites located within an HBV stream **reach** sustained 2 or more HBV species (73%) with up to an outstanding 9 HBV species recorded at a single site (Figure 3).

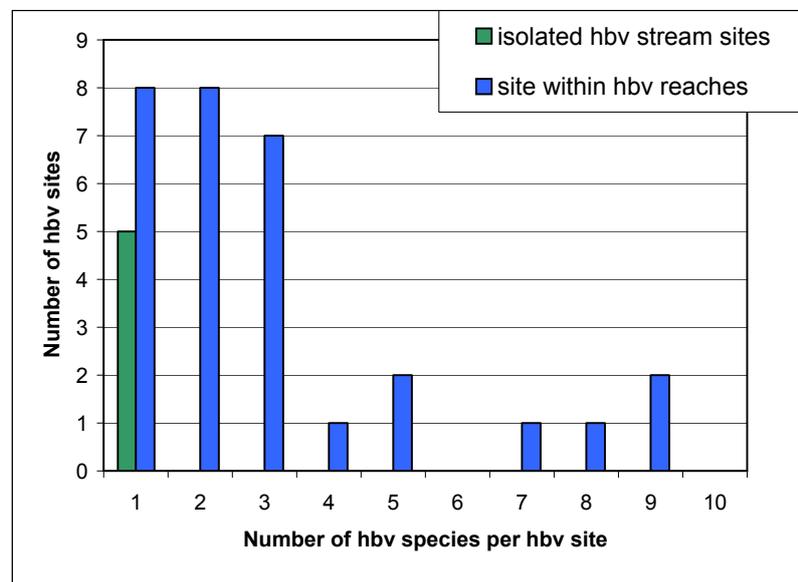


Figure 3. Number of species of high biodiversity value (HBV) per monitoring site. Stream reaches of good habitat connectivity evidently sustain more HBV species than isolated sites, illustrating the negative impact of habitat fragmentation on biodiversity value.

These basic data readily show the link of habitat connectivity and biodiversity value.

6.2.1 Hbv stream reaches

High biodiversity value stream reaches are characterised through good **habitat connectivity**. A monitoring site housing HBV species were judged to be part of a HBV stream reach when located within a network of healthy streams (Council's Stream Health Map, EPP[Water] *hev* mapped catchments). Connectivity is seen also from the fact that the 19 HBV reaches identified included 30 monitoring sites (Figure 2).

Aquatic habitat connectivity is an ecosystem function that refers to the capacity of a stream to allow for the upstream, downstream or lateral dispersal and migration of aquatic organisms within a catchment area via permanent or intermittent stream channels or floodplain areas (condensed definition quoted after U.S. EPA). Such landscape-level connectivity is the desired situation for biodiversity conservation because of its intrinsic "ecosystem resilience" as outlined in the *Queensland Biodiversity Strategy* (Qld Government, draft December 2010).

In addition to good habitat connectivity, most HBV reaches were of excellent habitat structure and are of **high protection priority**.

The following list gives an overview of HBV stream reaches identified in the major river systems in the MBR. (Details are presented later, Chapter 6.3.)

Out of the 19 HBV stream reaches

- six are located in the Pine Rivers system (headwaters of South Pine River, Cedar Creek, North Pine River, Mosquito Creek, upper Laceys Creek, upper to middle Kobble Creek);
- five are located in the Caboolture River system (Gregors Creek, headwaters Caboolture River South, upper Zillman Creek, headwaters Caboolture River North including Antibidawa Creek, lower Lucys Creek);
- one is part of the Pumicestone Passage catchment (middle Ningi Creek)
- five are located in the Stanley River system (upper Neurum Creek, upper Delaneys Creek, lower Delaneys Creek, upper Mountford Creek, upper Stony Creek);
- two are located in the Mary River system, of which only a few headwater streams lie within the MBR boundaries (headwaters of tributaries to Camp Creek, middle Scrub Creek).

6.2.2 Hbv stream sites

All high biodiversity value stream sites are relatively **isolated** spots amid disturbed streams (which otherwise house no HBV species) in a developed landscape. Hbv species occur at isolated sites when some quality microhabitat structure is present in the stream. This can be a fallen tree submerged for a longer period of time, or a 'reliable' water-rapid over bedrock, or another stable microhabitat.

Isolated HBV streams sites are the result of **habitat fragmentation**, and there is a risk to the survival of rare species linked to such habitat ‘islands’ (Laurance 2008). Habitat fragmentation is frequently the trigger for a species to become a ‘threatened species’.

The dynamic of habitat fragmentation is understood to work in a way that the initial habitat connectivity (of the undisturbed landscape) decreases in a non-linear fashion such that close to a lower threshold level of habitat availability a minimal extra loss of habitat will suddenly disconnect the landscape and, as a consequence, destabilise the population and eventually wipe it out (Hanski 1999, Fahrig 2003).

Isolated sites are understood as ‘remnants of high biodiversity value’ scattered in a converted and developed landscape. For some rare species they may be vital habitat islands. If so, **site protection and rehabilitation** is a significant management action of **highest priority** in the attempt to support the HBV species of concern and maintain biodiversity values.

In the converted landscape HBV stream sites are good starting points for restoration projects. While “re-connecting” isolated sites through habitat corridors may not be possible – due to the very isolation of the sites – it might be realistic to **enhance size and internal structure of the habitat ‘islands’**. Such measures are life-sustaining for smaller animals such as snails, beetles and other invertebrates (but also vertebrates such as frogs, fishes, birds). It is important to undertake rehabilitation projects always in conjunction with the control of negative factors in the surrounding environment to reduce (prevent) stress on the HBV stream sites.

Out of the 5 HBV stream sites identified in the MBR

- four are located in rural catchments in the hinterland, and
- one site, at lower Freshwater Creek, lies in the urban footprint just above the tidal reach.

Details are given in Chapter 6.4.

6.3 The HBV stream reaches in the Moreton Bay Region

Based on biological data collected from 2007 to 2010, a total of 19 stream reaches of high biodiversity value were identified in the MBR. Most were healthy creeks of Stream Health Class **a**, **b** and **c**¹ (Nolte 2010), and part of a stream network in headwater and upper catchment areas. Localities are given in the HBV stream map (Figure 2).

Habitat connectivity was good as explained earlier, but the HBV reaches differed markedly in habitat quality related to the condition of the riparian zone. It ranged from “excellent”¹ in protected rainforest areas down to “fair”¹ in streams running through rural land – mainly extensively used or abandoned pasture land near forest fragments, and with well structured remnants of riparian vegetation in place.

¹ For details on Stream Health Classes see Council’s *Stream Health Manual* (Nolte & Loose 2004), Haase & Nolte 2008.

Before three typical examples of the Region's HBV stream reaches are described in detail, an overview of all 19 HBV stream reaches is given in Table 2. Listed are the 30 monitoring sites located within the 19 reaches. The focus is set on the current protection status and landuse of the adjacent catchment area so as to facilitate the prioritising of stream management actions, with the aim to preserve and improve the existing high biodiversity value.

Table 2. The 30 monitoring sites located within the 19 stream reaches (#) of high biodiversity value, identified in the MBR based on field data collected between 2007 and 2010. Summarised is their general setting and protection status.

Catchment	# reach	Stream	Site ID	Stream section	No. HBV species [§]	SHC ^{§§}	Protection status *	Landuse	hev area** EPP[Water]
Pine Rivers	1	South Pine River	1	headwater	4	b	NP	forest	yes
Pine Rivers	1	South Pine River	2	upper	2	b	NP	forest / non-urban living	yes
Pine Rivers	2	Cedar Creek	13	headwater	9	a	NP	forest	yes
Pine Rivers	2	Cedar Creek	14	headwater	8	a	NP	forest	yes
Pine Rivers	2	Cedar Creek	15	upper	3	b	C-Park	forest / non-urban living	yes
Pine Rivers	2	Cedar Creek	16	upper	2	c	C-Reserve	forest / non-urban living	yes (border)
Pine Rivers	3	North Pine River	37	headwater	8	b	NP	forest	yes
Pine Rivers	3	North Pine River	38	upper	3	c	none	forest / rural	yes (border)
Pine Rivers	4	Raynbird Creek	40	upper	2	c	none	forest / rural	no
Pine Rivers	5	Kobble Creek South	53	upper	3	b	none	rural / non-urban living	yes
Pine Rivers	5	Kobble Creek	54	middle	1	c	none	non-urban living / rural	no
Pine Rivers	6	Mosquito Creek	58	upper	2	b	none	non-urban living	yes
Caboolture River	7	Zillman Creek	101	upper	1	c	none	rural	no
Caboolture River	7	Zillman Creek	102	upper	1	c	none	rural	no
Caboolture River	8	Antibidawa Creek	103	middle	7	c	C-Reserve	forest / rural	no
Caboolture River	8	Caboolture R. North	104	upper	3	c	none	forest / rural	no
Caboolture River	9	Caboolture R. South	109	headwater	3	b	VCA	forest / non-urban living	yes
Caboolture River	10	Lucys Creek	110	lower	2	c	VCA	forest / rural	no
Caboolture River	11	Gregors Creek	112	headwater	3	b	none	forest / non-urban living	yes
Caboolture River	11	Gregors Creek	113	middle	4	b	C-Park	rural / non-urban living	no
Pumicestone Pss.	12	Ningi Creek	133	middle	1	c	State Forest	timber plantation	no
Stanley River	13	Delaneys Creek	217	middle	1	c	none	forest / rural	yes
Stanley River	14	Delaneys Creek	218	lower	1	c	none	forest / rural	no
Stanley River	15	Neurum Creek	219	middle	1	c	NP	forest	no
Stanley River	16	Mountford Creek	209	middle	2	b	FR	forest	no
Stanley River	17	tribut. to Stony Ck	223	lower	4	a	FR	forest	yes (border)
Stanley River	17	Stony Creek	224	middle	2	c	FR	forest	yes (border)
Mary River	18	'Trib.1' to Camp Ck	201	headwater	1	d	VCA	forest / rural	no
Mary River	18	'Trib.2' to Camp Ck	202	headwater	5	c	VCA	forest/ rural	no
Mary River	19	Scrub Creek	225	middle	3	c	FR	forest	no

* NP = D'Aguilar National Park, FR = Forest Reserve; C-Reserve & C-Park = Council-owned land; VCA = Voluntary Conservation Agreement
 ** mapped as "catchment of high ecological value" in the *EPP[Water] 2009*; (border) means sites is just inside - or outside - of hev area mapped
 § HBV species = aquatic macroinvertebrates of high biodiversity value §§ SHC = Stream Health Class (see Council's *Stream Health Manual*)

Table 2 contains the following information:

1. The healthiest streams of highest biodiversity value are those, which are most efficiently protected from human activities:
 - More than half of all monitoring sites (60%) located in HBV stream reaches enjoy a certain degree of protection through National Parks, Forest Reserves, Council Environmental Reserves or Council Parks, or through Voluntary Conservation Agreements with land owners.
 - An additional three sites in non-protected HBV stream reaches are either adjacent to the D'Aguilar National Park (Raynbird Creek, upper Kobble Creek South, middle Delaneys Creek)
 - The three sites with most HBV species are located in National Park, which provides the highest protection level.

2. Forest is the foremost protector of high biodiversity value streams:
 - Most HBV streams are located in or near forested areas (23 monitoring sites or 77%), either with or without nearby houses. (Note: forest in contrast to a strip of riparian vegetation.)
 - Forested streams in general sustain high numbers of HBV species.
 - Out of the 29 HBV species identified, 19 species occurred in forest streams only (Details are given in Chapter 6.5).

3. The mapping of “high environmental value” (hev) catchments in the *Environmental Protection [Water] Policy 2009*² is incomplete and should be amended.
 - Out of the 30 monitoring sites, 11 sites are located within mapped “hev” catchments. Further 4 sites lie on the “hev” mapping border leaving it open to discussion whether or not the particular stream reach is “hev” covered. The remaining 15 sites are located outside of mapped “hev” areas.
 - Catchments of HBV streams in the Pine Rivers system are well covered by the EPP[Water] “hev” mapping. This is not the case for the Caboolture, Stanley and Mary Rivers systems.

Based on the present findings shown in the High Biodiversity Value Stream Map (Figure 2), it is recommended to amend the map of “high ecological value” catchment areas of the EPP Water.

To illustrate typical settings of HBV stream reaches in the Moreton Bay Region, three streams are presented in some detail.

² EPP[Water] maps covering the MBR are Plan WQ1421, WQ1422, WQ1413 and WQ1439.

6.3.1 Headwaters and upper reaches of Cedar Creek (South Pine River system)

The headwaters of Cedar Creek are a prime example of a **near-natural ecosystem**. Their catchment area is located in the Maiala Reserve – part of the D’Aguilar National Park – and at first glance it might look like an “effectively unmodified” system (as per QWQG 2009). However, this is not so. Instead the Maiala Reserve is a fine example of successful rainforest rehabilitation – through protection – after years of most severe disturbance, as the following historic account attests (summarised and quoted after Long 1963):

“Timber from Mt. Glorious, including that for [...] the Hornibrook Bridge, was removed [...] through Cedar Creek. In 1918, P.J. Leahy installed the first sawmill on the site of the Maiala picnic ground [...] He operated a steam mill using water pumped from a creek far below. A chute was erected to dispatch timber from Mt. Glorious down the valley, however, after the initial logs were smashed, the idea was abandoned.” [...] “Some trees on the mountain were so large that saws had to be modified” [...] “Cedar Creek and its valley were sites of considerable timber activity [...supporting] the largest concentration of sawmills in the Pine Rivers.”

Maiala was declared the first National Park in the D’Aguilar Range in 1930.



Figure 4. The crystal clear water in one of the many spring brooks of Cedar Creek arising in the Maiala Reserve rainforest (**Site 13**).

This spring brook, upstream of Greene’s Falls, sustains 9 HBV species, out of a total of 64 aquatic macroinvertebrates recorded here.

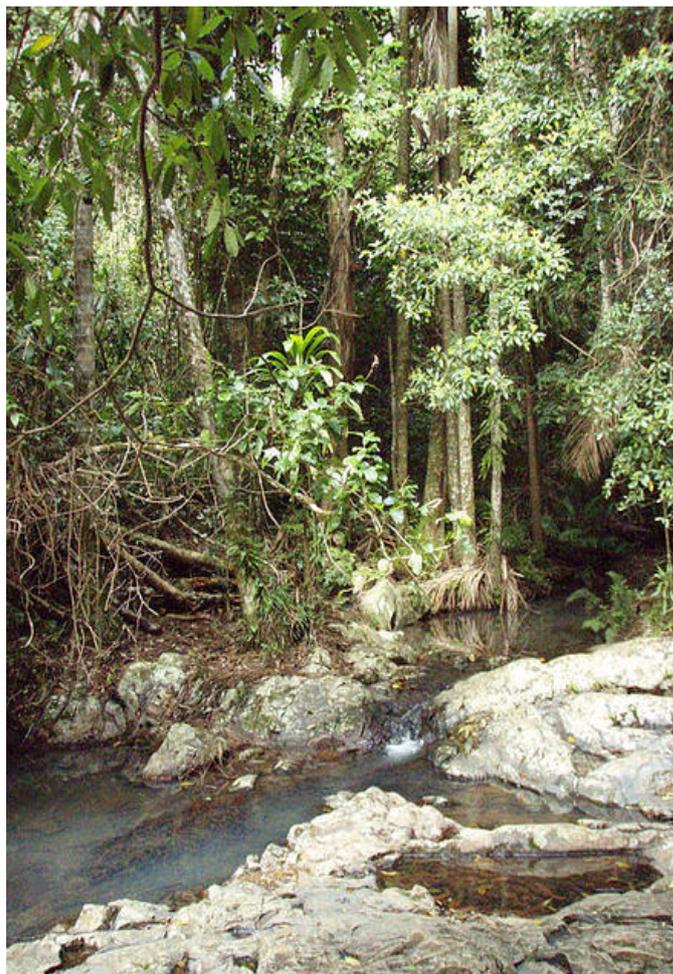


Figure 5. Cedar Creek at the head of Greene’s Falls. Rockpools with accumulated rainforest litter are a significant aquatic habitat (**Site 14**).

Figure 6. Greene's Falls. Downstream view into the rain forested catchment of the headwaters of Cedar Creek. The healthy riparian zone sustains highly diverse in-stream habitats and aquatic communities. (Photo: August 2005)



The present study substantiates the general notion that Cedar Creek is one of the most valuable freshwater streams in the MBR. This is seen from the high number of HBV species (up to 9 HBV species per site) as well as the extended riparian forest of excellent habitat structure and connectivity along a stream. The upper 7 km of Cedar Creek sustain as many as 14 HBV species (Table 3). With increasing downstream disturbance, habitat integrity and number of HBV species decreases.

Table 3. Aquatic invertebrates of high biodiversity value recorded in Cedar Creek (Site Numbers as per 'HBV stream map' and Council's *Atlas of Stream Monitoring Sites*)

Common name	Species	Site 13	Site 14	Site 15	Site 16
Mud Snail	<i>Jardinella</i> new sp.1 (endemic MBR)	+			
Mayfly	<i>Atalomicria</i> sp. AV1b	+			+
Damselfly: Southern Whitetip	<i>Episynlestes albicauda</i>	+	+		
Dragonfly: Black Tigertail	<i>Eusynthemis nigra</i>		+		
Dragonfly: Conehead Darner	<i>Austroaeschna subapicalis</i>			+	
Dragonfly: Northern Evening Darner	<i>Telephlebia cyclops</i>	+			
Stonefly	<i>Riekoperla perkinsi</i>		+		
Toe-winged Beetle	<i>Byrroncryptus</i> sp.	+	+		+
Caddisfly	<i>Antipodoecia turneri</i>		+	+	
Caddisfly	<i>Helicophya ?queenslandensis</i>	+	+		
Non-biting Midge	<i>Aphroteniella filicornis</i>	+			
Non-biting Midge	<i>Apsectrotanypus</i> sp.1		+		
Non-biting Midge	<i>Stempellinella</i> new sp.1	+	+		
Blackfly	<i>Austrosimulium mirabile</i>	+	+	+	
	Total no. of HBV species per site	9	9	3	2

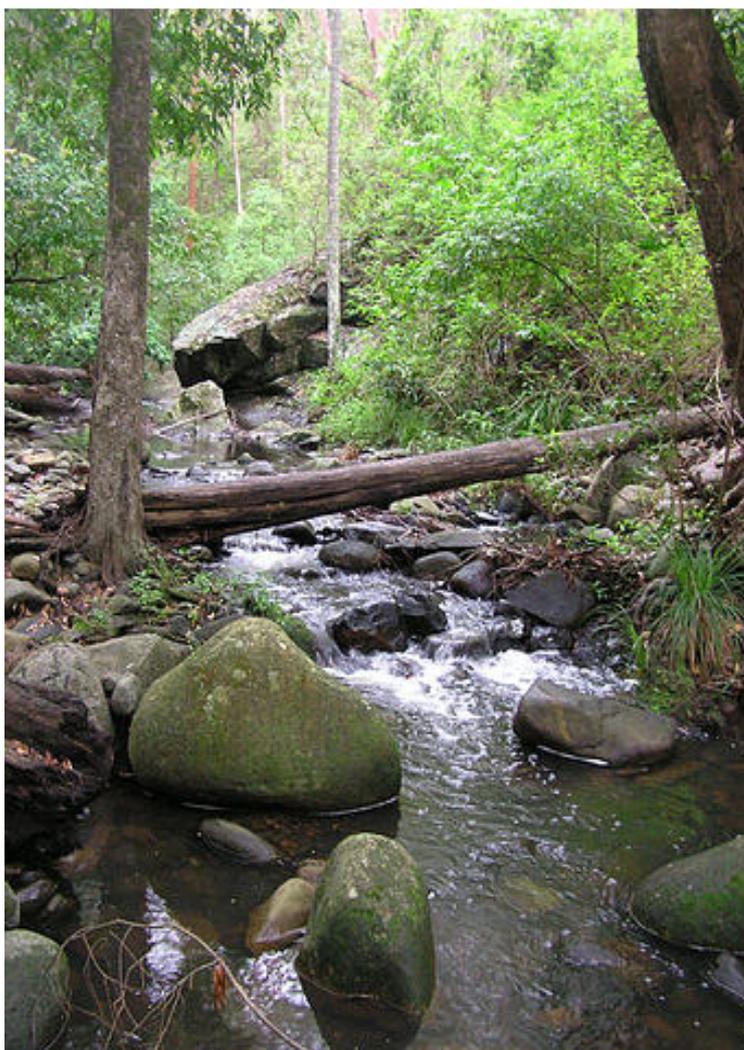


Figure 7. The popular swimming hole at upper Cedar Creek (**Site 15**) is of high biodiversity value as it provides special habitat structures for aquatic wildlife. However, despite its ‘pristine’ look it is slightly impacted as indicated by the lower number of HBV species in comparison to the protected headwaters some 3 to 4 km upstream.

Figure 8. Cedar Creek, 6.5 km downstream from its rainforest springs, in the *Bolwarra* Bushland Environmental Reserve (**Site 16**).

In 2006 Council purchased the land (1.47 ha), which includes both stream banks along a 580 m section, in order to enhance habitat connectivity and protect the high biodiversity value of upper Cedar Creek. (Photo: Nov. 05)

Downstream of the *Bolwarra* Reserve, the natural integrity of Cedar Creek decreases markedly with increasing disturbance and degradation of the riparian zone caused by current landuse practices.



6.3.2 Headwaters and upper reaches of the North Pine River

The North Pine River is an example for a setting, where entirely cleared pasture land harshly disconnects two extensive stream reaches of excellent habitat quality and biodiversity value – here: headwaters and upper reaches.



Figure 9. The headwaters of the North Pine River are in excellent condition due to the naturalness of the upper catchment, which sustains stream reaches of very high biodiversity value. (The catchment upstream of Site 37 in March 2008)



Figure 10. Cleared land disconnects the forested headwaters of the North Pine River (background) from its upper reaches (downstream of this spot).

In addition to the clearing's detrimental effect on flora and fauna, the flow regime is severely disturbed. Deforested land results in longer periods of dry creeks, along with more frequent bursts of flash flooding.



Figure 11. One of several spring brooks of the North Pine River at the interface rainforest // paddock where the HBV ecosystem becomes disconnected. (Site 37) (Photo: March 2008)



Figure 12. The North Pine River at the end of Mt Brisbane Road: Riparian forest was cleared and the original aquatic habitat destroyed and thus the forested headwaters (in the background) disconnected from downstream forested sections. (Photo: March 2008)

Table 4. Hbv species recorded in the North Pine River upstream (Site 37) and downstream (38) of cleared farm land.

Common Name	Species	Site 37	Site 38
North Pine River Snail	<i>Fluvidona anodonta</i> (endemic MBR)	+	
Mud Snail	<i>Jardinella</i> new sp.1 (endemic MBR)	+	
Mayfly	<i>Atalomicria</i> sp. AV1b	+	+
Damselfly: Southern Whitetip	<i>Episynlestes albicauda</i>	+	+
Dragonfly: Black Tigertail	<i>Eusynthemis nigra</i>	+	+
Caddisfly	<i>Helicopha ?queenslandensis</i>	+	
Caddisfly	<i>Triplexa villa</i>	+	
Caddisfly	<i>Tasiagma ciliata</i>	+	
Total no. of HBV species per site		8	3



Figure 13. The upper North Pine River directly downstream of upper crossing Mt Brisbane Rd (Site 38) (Photo: January 2001)

Both sections of the North Pine River, the headwaters and the upper reaches, are of high ecological and biodiversity value. The natural habitat-continuum is now disconnected by several hundred meters of cleared farmland, and a drop in HBV species from 8 species upstream to 3 species downstream of the farm was recorded (Table 4).

Very important is the finding that the headwaters of the North Pine River are home to two freshwater snails (Table 4), which are most likely **endemic to the Moreton Bay Region** (personal communication W. Ponder, Australian Museum Sydney³). Snails have a very limited dispersal power (compared to strong flyers such as dragonflies), become easily isolated through habitat fragmentation, and therefore depend even more on good habitat connectivity to maintain viable populations.

The **North Pine River Snail** (*Fluvidona anodonta*) is known only from streams in the Pine Rivers System – and from nowhere else in the world. To date it has not even been found in neighbouring streams of the Caboolture and Stanley River systems (Council’s database on aquatic macroinvertebrates). The snail was recorded in the headwaters of the North Pine River upstream of the cleared farmland, but not further downstream. It was also recorded from Kobble Creek (Site 54) and the South Pine River system (Sites 1, 2, 21). Its locally very restricted distribution makes the species extremely prone to extinction. Therefore *Fluvidona anodonta* has been listed as ‘**vulnerable**’ in the IUCN Red List of Threatened Species (IUCN 2010).



Figure 14. The ‘North Pine River Snail’ lives in the headwaters of the North Pine River down to the rainforest’s edge where land is cleared for grazing. This species is endemic to the MBR. (Photo © U. Nolte)

The other hydrobiid snail recorded upstream of the cleared farmland in all likelihood is also endemic to the MBR. Nothing is known, however, about this *Jardinella* species as it was collected for the very first time in the scope of Council’s Stream Health Monitoring. The snail is new to science and has been recorded so far at two sites only, i.e. in the headwaters of the North Pine River (Site 37) and Cedar Creek (Site 13) (Tables 3 and 4). *Jardinella* is a genus known to contain many species in Australia, which are endemic to small areas (W. Ponder, pers. comm; see list in DERM ‘Back on Track’).

Rehabilitation of cleared land in the uppermost catchment would restore critical landscape links to stabilise crucial populations of two species endemic to the MBR

³ See also Chapter 6.1 of this report.

6.3.3 Upper reaches of Zillman Creek (Caboolture River system)

The setting of Zillman Creek, characterised by extensive land clearing, is quite typical for streams in the coastal range of the Moreton Bay Region.

The headwaters are often the most degraded stream reach due to intensive farming and landuse on the high plateau. The upper reaches then recover slightly on the slopes down through extensively used (or abandoned) pasture land. This recovery, however, only happens when live stock is prevented from trampling the creek, a mechanical disturbance that constantly destroys the in-stream stability of vital micro-habitats for aquatic life. Equally essential for stream health recovery is quality riparian vegetation that provides habitat structure, shade and shelter. It also supports a balanced flow regime in counteracting the harsh local climate created through converting native forest into grass land (Figure 10). Further downstream, remnant rainforest patches – preserved in steep, inaccessible gullies – significantly improve stream health of the middle reaches.

It is noteworthy that in this landuse-pattern stream health is affected exactly the other way round from what usually happens to streams (increasing degradation from spring to mouth). This showcases the ‘healing properties’ of riparian vegetation on disturbed streams.

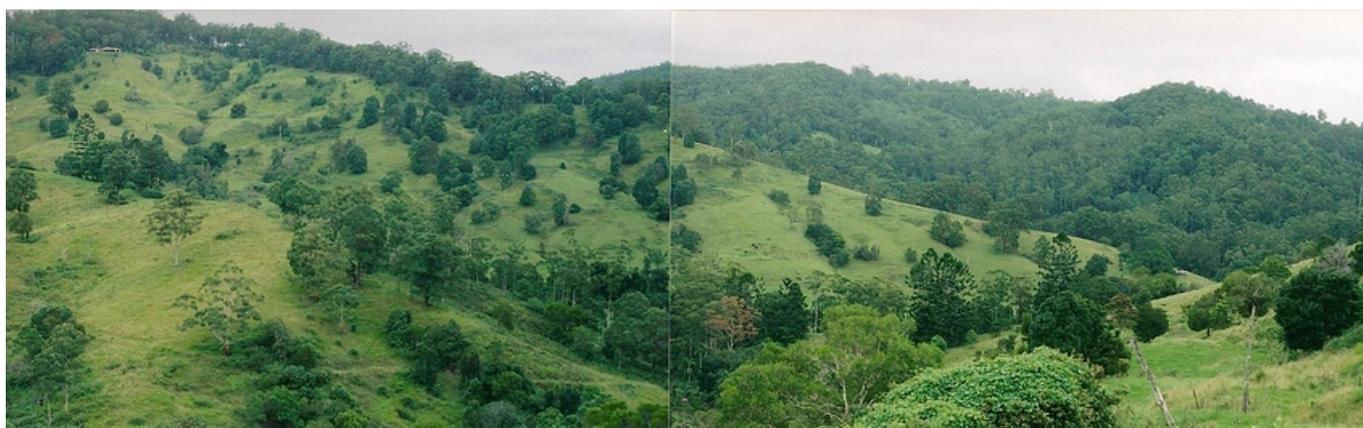


Figure 15. The upper catchment area of Zillman Creek is visibly degraded but still upholds some habitat connectivity through remnant riparian vegetation. (view down to the creek at Campbells Pocket, February 2004)

In the case of Zillman Creek, the riparian zone of the upper reaches has some habitat connectivity left as forest clearing was not as complete as for instance in the upper North Pine River catchment (Figure 15, compare Figure 10). On grazing land, remnants of riparian vegetation support pockets of well structured habitat (Figure 16), and the stream benefits from a slow change in landuse leaving paddocks abandoned. Most beneficial for restoring stream health are the distances, though short, Zillman Creek flows through rainforest remnants in steep gullies (Figure 17).

The indicator used to identify upper Zillman Creek as a stream of high biodiversity value is the caddisfly *Antipodoecia turneri*, which occurred at both monitoring sites (Sites 101,102). It is the only HBV species recorded in this HBV stream reach.



Figure 16. Remnant vegetation support pockets of well structured stream habitat at upper Zillman Creek (**Site 101**).



Figure 17. Rainforest fragments remain intact in a steep gully of the upper catchment area of Zillman Creek. (Photo: February 2004)

6.4 Isolated HBV stream sites in the Moreton Bay Region

Five stream sites were found to provide the right habitat for rare species of high biodiversity value, despite their ‘isolated setting’ comparatively far away from “high ecological value” (hev) areas (EPP Water). All sites are located in middle or lower stream reaches (in contrast to the HBV stream reaches, see above 6.3) and are disturbed and eutrophicated (Stream Health Class **d**, Nolte 2010). None of these sites is protected or covered by hev mapping of EPP Water (Table 5). At each of the five sites a single HBV species was recorded as listed in Table 6.

Table 5. Setting, landuse and protection status of five ‘isolated’ HBV stream sites.

Stream	Site ID	Stream section	Locality	SHC ^{§§}	Landuse	Protection Status	hev area ^{**} <i>EPP[Water]</i>
Stanley River	204	middle	hinterland	c	rural	none	no
Laceys Creek	42	middle	hinterland	d	rural	none	no
Forbes Creek	51	lower	hinterland	d	rural	none	no
Branch Creek	21	lower	hinterland	d	non-urban living	none	no
Freshwater Creek	77	lower	coast	d	urban devlpmt.	none	no

^{**} mapped as “catchment of high ecological value” in the *EPP Water*

^{§§} SHC = Stream Health Class (see Council’s *Stream Health Manual*)

Table 6. The high biodiversity value species recorded at the five HBV stream sites

Site ID	Common name	Scientific name	Dispersal power	Other records in the MBR
204	Dragonfly: Conehead Darner	<i>Austroaeschna subapicalis</i>	excellent	yes, 2 other records
42	Damselfly: Arrowhead Rockmaster	<i>Diphlebia nymphoides</i>	excellent	yes, 1 other record
51	Damselfly: Coastal Flatwing	<i>Griseargiolestes albescens</i>	excellent	yes, 1 other record
21	North Pine River Snail	<i>Fluvidona anodonta</i>	very poor	yes, 3 other records
77	Green Diving Beetle	<i>Onychohydrus atratus</i>	limited	none

At three sites (42, 51, 204) the HBV species were dragonflies, which are strong flyers and therefore of excellent dispersal power. This enables the species to use relatively isolated sites for feeding and breeding. All three species, though rare, also occur in HBV stream reaches elsewhere in the Moreton Bay Region (Table 6). This leaves the sites of lower priority for management action compared to the remaining two HBV stream sites, as detailed below.

6.4.1 Lower Branch Creek (South Pine River system)

The lower Branch Creek, just upstream of its junction with Cedar Creek, is a habitat site of the North Pine River Snail, the rare species most likely to be endemic to the Pine Rivers system (see above, 6.3.2). So far it has been found at four locations only, and lower Branch Creek (Site 21) is one of them (Figure 18).

Snails rely strongly on habitat connectivity and appropriate habitat structure for dispersal and migration, which are vital movements for sustaining any viable population. It was therefore unexpected to find *Fluvidona anodonta* in lower Branch Creek, as it is quite disconnected from 'hev' areas (EPP Water Plan WQ1421, and Council's Stream Health Map).

The predominant landuse in the adjacent catchment area of lower Branch Creek (Clear Mountain) is non-urban living, which typically comes with many horses in this part of the Region. Horses are often seen in creeks and unfortunately there is little awareness about the damaging effect of horse hoofs on stream health. The constant mechanical disturbance of the stream bed destroys bottom-living (benthic) in-stream communities, which are a vital component of the stream ecosystem. In the middle catchment area of the South Pine



Figure 18. Lower Branch Creek is one of only four sites where the endemic North Pine River Snail is known to occur (**Site 21**). (Photo: Nov. 2004 during a long dry period)

River and its tributaries the problem lies mainly in the number and frequency of horses in the streams (Figure 19). In case of the ‘*Fluvidona* site’, land on the right creek bank near Site 21 is used as a horse paddock.

Due to landuse pattern, past and present, lower Branch Creek is moderately disturbed and loaded with nutrient (Stream Health Class **d**). This shows that *Fluvidona anodonta* is tolerant of a certain degree of eutrophication, which is an interesting finding as virtually nothing is known about the biology of this snail. (The other known three habitat sites of the North Pine River Snail are in much better condition, and are all located within a network of healthy stream reaches of good habitat connectivity.)

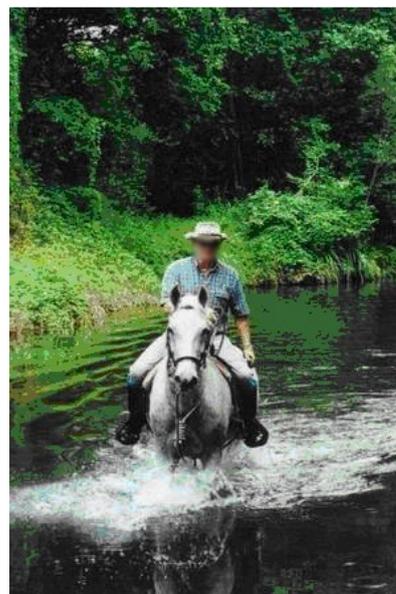


Figure 19. Non-urban living often means horses. ‘Sunday leisure in the South Pine River’ shows a lack of awareness that horses in creeks damage aquatic life and stream health. (SPR near Samford)

To protect the endemic North Pine River Snail, every single habitat site known **needs to be protected**. It should also be a **priority to enhance** the condition of the disturbed riparian zone at lower Branch Creek because this will improve the quality of in-stream habitat as well as landscape connectivity.

6.4.2 The freshwater wetland on lower Freshwater Creek (Griffin)

Natural freshwater wetlands occur on active flood plains adjacent to creeks in the coastal plain. Most have been drained and cleared for grazing purposes many years ago, and the few remaining wetlands are now under threat from residential and commercial development. Freshwater wetlands are unique ecosystems and play a key role in supporting the region's distinctive biodiversity (Qld EPA 2003).

The Queensland Government developed the *Queensland Wetlands Program (2003-2009)* (Qld EPA 2009) to retain freshwater wetlands and protect them from destruction, in compliance with the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.

In the Moreton Bay Region the only one significant near-natural freshwater wetland remaining is the wetland on lower Freshwater Creek (Site 77, Figure 20). Though man-made (to stop saline water from entering the creek) decades ago, it is an essential



Figure 20. The wetland on lower Freshwater Creek is the only one of its kind in the MBR. It is a significant habitat for many species of high biodiversity value (Site 77). (Photo: March 2007)

refuge for wetland plant and animal species of high biodiversity value because of its size and mature habitat structure.

The green diving beetle *Onychohydus atratus* (Figure 21) is such an HBV species, which depends for its survival in the Region on this wetland. The species is endemic to Australia, and is rare throughout its distribution area in the Tropics and Subtropics, where it lives in freshwater wetlands in coastal plains (ABRS).



Figure 21. The green diving beetle *Onychohydus atratus* is a rare species. In the MBR it is only known to occur in the wetland at lower Freshwater Creek (Photo: anonymous)

The conspicuous beetle is a strong predator and with 40 mm Australia's largest water beetle. It is a clumsy flyer and consequently of limited dispersal power, what puts this species at risk when habitat sites are damaged or destroyed.

In the MBR the green diving beetle is only known from the wetland on lower Freshwater Creek (Site 77) the last significant coastal freshwater wetland we have.

In 2001, baseline monitoring of this wetland established its high ecological and biodiversity value because it supported rare and locally significant species (AFS 2001, Figure 22).

In the *PineRiversPlan(2006)* the wetland is mapped as "Coastal Wetland Area" (Waterway Overlay) with "Endangered Remnant Vegetation" (Biodiversity Overlay). In 2007 a field survey confirmed the significance of the wetland as habitat for larger animals such as frogs, birds and marsupials (Green 2007).

Since 2001 the adjacent northern catchment is subject to large-scale residential and commercial development at North Lakes and Mango Hill putting the wetland at risk. The more recent development in the southern catchment encroached even directly on the wetland, truncating with its road infrastructure the formerly deep paperbark stand on the creek's south bank at Griffin (Figure 23) which, part of the ecosystem, sheltered the central wetland.

In addition of being a unique ecosystem in the MBR, which sustains species of high biodiversity value, it also provides **vital ecosystem services**. Through its inherent biological water-purifying capacity the wetland provides the treatment and cleaning of surface runoff in removing biological available nutrients (BN) from the water. This is measured in Stream Health Class (SHC)¹.

Upstream of the wetland in the urban catchment of Kallangur, Freshwater Creek constantly scores SHC e (polluted with BN, see Council's database), which corresponds with a "Level 4" or "highly disturbed" waterway that requires "to improve water quality [...] towards the Water Quality Objectives" (QWQG 2009).

¹ For details on Stream Health Classes see Council's *Stream Health Manual* (Nolte & Loose 2004), and Haase & Nolte 2008



Figure 22. The paperbark stand on lower Freshwater Creek. The wetland is the green area in the background sustained and sheltered by a belt of paperbark trees, January 2001 (**Site 77**).



Figure 23 The wetland's paperbark stand at Griffin is truncated by residential development, January 2011 (**Site 77**).

In the wetland, some 5 km downstream of Kallangur, stream health has improved to SHC **d** (strongly loaded with BN), which corresponds with “Level 3” or “moderately disturbed”. [...] “Most waters in Queensland fall within the moderately disturbed category, and Water Quality Objectives have been set in recognition of this condition. The intent for these areas is to maintain or improve current condition, biodiversity and habitat” (QWQG 2009).

This ecosystem service is delivered for free through natural biological processes in the wetland, whereas elsewhere it is dearly paid for (i.e. through constructed wetlands to treat stormwater at considerable cost).

The SEQ-RP 2009-2031 sets the desired regional outcome (DRO 2) to achieve a healthy natural environment based on the principle to “**Protect, manage and enhance** the region’s biodiversity values and associated **ecosystem services** [...]” Policies statements include to “Avoid impacts on areas with significant biodiversity values in the Urban Footprint or Rural Living Area” (2.1.2).

It is important to protect, manage and enhance this freshwater wetland.

The wetland is of **high biodiversity value** and the last ecosystem of its kind in the Moreton Bay Region.

The wetland also provides vital **ecosystem services** that need to be protected.

6.5 Freshwater species of high biodiversity value in the Moreton Bay Region

In the freshwater streams of the Moreton Bay Region 619 species of aquatic macro-invertebrates have been recorded so far, and used to monitor and assess stream health (AFS 2001, Haase et al. 2003, Nolte & Loose 2004, Campin et al. 2005, Haase & Nolte 2008, Nolte 2008). Out of these 619 species, 29 species were appraised rare and/or of local significance in the MBR (for details see under 5.2.2).

The 29 species are of high biodiversity value (HBV species) and match with what is called “priority species” in the *Queensland Planning Provisions 2010*, the *Queensland Biodiversity Strategy* (draft 2010) and other recent state government documents.

As pointed out earlier (5.2.2) little is known about freshwater macroinvertebrates of the Region and of Queensland in general, about their biology and ecological requirements. In this regard the present study and Council’s Stream Health Monitoring is a pioneering approach, contributing considerably to the knowledge on the Region’s biodiversity. In the following the current knowledge about each of the 29 HBV species is briefly presented.

Photographs are by Ulrike Nolte (© U. Nolte) if not specified otherwise.

- **North Pine River Freshwater Snail** *Fluvidona anodonta*, Hydrobiidae

Status: **Vulnerable** (IUCN 2010) **endemic to MBR** until proven otherwise (DEWHA 2009, and W. Ponder personal communication)

Records in the MBR: Rare, recorded in four stream reaches in the Pine Rivers system.

Localities: Headwaters South Pine River (Sites 1 & 2), lower Branch Creek (Site 21), Headwaters North Pine River (Sites 37), middle Kobble Creek (Site 54).

Stream Health Class: recorded in SHC **a, b, c** and **d** streams of good in-stream habitat structure; riparian condition excellent to fair¹.

Comments: Some 30 years ago, the Australian Museum mounted a scientific sampling tour to SEQ to find again the rare snail *Fluvidona anodonta* which was described by Hedley & Musson in 1892 from the North Pine River. The samples yielded a single broken shell of *F. anodonta* (Miller et al. 1999). Since then Dr. W. Ponder tried to find this tiny snail (it is just 2 mm long) at numerous locations but only saw it again when material was sent to him during Council’s stream health and biodiversity assessment (AFS 2001). Therefore, we know this snail is



Figure 24. The North Pine River Snail *Fluvidona anodonta* is endemic to the MBR.

¹ For details on Stream Health Classes and riparian condition see Council’s *Stream Health Manual* (Nolte & Loose 2004), and Haase & Nolte 2008

very rare indeed. Even in the MBR it seems to be of very limited distribution, as over the ten years it was only recorded in the Pine Rivers system, and here only at the four locations listed above. In 1996 the snail's endemism to the MBR was recognised in giving *F. anodonta* the common name North Pine River Freshwater Snail, and listing it as vulnerable in the IUCN Red List of Threatened Species (IUCN 2010).

Species that are restricted to very small areas (due to their limited dispersal power) are of extreme high biodiversity, phylogenetic and genetic value. *Fluvidona anodonta* is such a high value species as it is only known from the Moreton Bay Region. It needs to be protected, together with the streams it lives in.

- **Mud Snail** *Jardinella* sp.1 (new species), Hydrobiidae

Status: Rare, **endemic to MBR** until proven otherwise (W. Ponder, Australian Museum, Sydney, personal communication)

Records in the MBR: Rare, recorded just in 2 headwater streams of the Pine Rivers.

Localities: Rainforest spring brook of Cedar Creek (Site 13) upstream of Greene's Falls, and headwaters of the North Pine River (Site 37)

Stream Health Class: recorded in SHC **a** and **b**

Comments: This new species of the genus *Jardinella* is yet to be formally described and named (W. Ponder, personal communication). It is very likely that this species is endemic to the MBR (Ponder 1991) based on the fact that the genus *Jardinella* includes a remarkable high number of species confined to small areas, even to a single isolated springs (Ponder 1995). *Jardinella* sp.1 is currently known from the North Pine River's headwaters only, where it was first collected in 2001 (AFS 2001).

- **Micro-Caddisfly** *Orthotrichia aberrans*-group (new species), Hydroptilidae

Status: Rare, likely **endemic to the MBR** (A. Wells, ANIC Canberra, personal communication)

Records in the MBR: Recorded from a single site at lower Gregors Creek (Site 113)

Stream Health Class: recorded in SHC **a** and **b**

Comments: The *aberrans*-group of the genus *Orthotrichia* has an extremely unusual biology in that the last larval instars turn into a parasitic life-form feeding on other caddisflies. Such a behaviour is only known from these Australian micro-caddisflies (Wells 2005). The species from Gregors Creek (Caboolture River catchment) has never been found before (Wells, personal communication) and is yet to be formally described and named. This species seems to be very rare as it has never been collected before in SEQ or northern NSW during the past thirteen years (unpublished data, Nolte).

- **Mayfly** *Mirawara* sp., Ameletopsidae

Status: Rare

Records in the MBR: Rare, recorded at 2 localities, both upland forest creeks.

Localities: Antbidawa Creek (Site 103) in the upper Caboolture River system, and in upper Stony Creek (Sites 223, 224) a tributary of the Stanley River.

Stream Health Class: recorded in SHC **a** and **c**

Comments: *Mirawara* nymphs occur in fast flowing cobbled streams, burrowing into the sediment during the day and returning to the surface at night to feed. Nymphs are nocturnal predators feeding on smaller invertebrates such as other mayflies and chironomids. This is a very unusual feeding behaviour because mayflies are 'usually' grazers. *Mirawara* is the only predatory mayfly in Australia (MDFRC) and, with up to 20 mm body length, it is our largest mayfly.

Mirawara is one of the few mayflies in the world "whose range is now largely restricted to the remaining indigenous forest" (Hitchings 2008). *Mirawara* is endemic to Australia's east coast; three species are described.



Figure 25. *Mirawara* is Australia's largest mayfly. It is a rare resident of our native east coast rainforests. The photo shows a female caught in a hand-net (...took off after photo opportunity).

- **Mayfly** *Atalomicria* sp.AV1b, Leptophlebiidae

Status: Rare (The entire genus seems to be rare, and is little understood.)

Records in the MBR: Rare, recorded in 4 stream reaches.

Localities: Cedar Creek from its spring brooks down to the *Bolwarra Reserve* (Sites 13, 16), headwaters (Site 37) and upper reaches of the North Pine River (Site 38), headwaters Caboolture River North including Antbidawa Creek (Sites 103, 104).

Stream Health Class: recorded in SHC **a**, **b** and **c**

Comments: The species is code-named after the published larvae *Atalomicria* sp.AV1 (Dean 1999) which is a very similar, but clearly different species.

The genus *Atalomicria* is rare throughout its distribution area of eastern Australia. Six of the seven described species are known from their type localities only, including three *Atalomicria* species described from a single stream, Booloumba Creek in the Conondale Range (Campbell & Peters 1993).

- **Damselfly: Arrowhead Rockmaster** *Diphlebia nymphoides*, Diphlebiidae

Status: Rare in MBR; limited in SEQ (Natrass 2006)

Records in the MBR: Rare, confirmed records only from upper to middle reaches of Lacey's Creek (Sites 40, 42), North Pine River system. Also reported from the South Pine River near Highvale (Natrass 2006).

Stream Health Class: recorded in SHC **c** and **d**

Comments: *D. nymphoides* is able to breed in intermittent streams (Theischinger & Hawking 2006).

- **Damselfly: Golden Flatwing** *Austroargiolestes chrysoides*, Megapodagrionidae

Status: Uncommon in SEQ (Natrass 2006)

Records in the MBR: Rare, confirmed from the headwaters of the South Pine River (Site 1); also reported from upper Cedar Creek in the Maijala NP (Natrass 2006).

Stream Health Class: recorded in SHC **a** and **b** streams of excellent habitat structure.

Comments: Limited to streams in dense montane rainforest (Natrass 2006), where eggs are laid in moss (Theischinger & Hawking 2006). This damselfly is a tropical fauna element, endemic to Queensland (CSIRO 2009) with its southernmost verified occurrence in the headwaters of the South Pine River (Theischinger, personal communication).

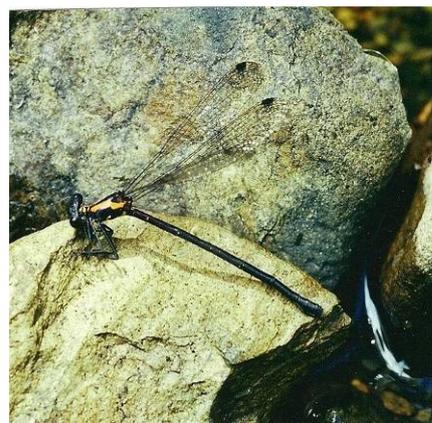


Figure 26. The Golden Flatwing is rare in the MBR. This more tropical damselfly has its southern distribution limit in the forested headwaters of the South Pine River.

- **Damselfly: Coastal Flatwing** *Griseargiolestes albescens*, Megapodagrionidae

Status: Uncommon in SEQ (Natrass 2006)

Records in the MBR: Rare, recorded in 2 streams.

Localities: lower Gregors Creek (Site 113), and lower Forbes Creek (Site 51)

Stream Health Class: recorded in SHC **b** and **d**

Comments: An uncommon coastal damselfly, which occasionally is found in forested streams of the coastal range (Natrass 2006, Theischinger & Hawking 2006)

- **Damselfly: Southern Whitetip** *Episynlestes albicauda*, Synlestidae

Status: "Localised and rare [...] appears to be declining" (Natrass 2006).

Records in the MBR: Widespread in rainforest headwater creeks, but never abundant; recorded in 9 stream reaches.

Localities: Headwaters of South Pine River (Site 1), headwaters Cedar Creek (Sites 13, 14), headwaters of North Pine River (Site 37) upper North Pine River (Site38), upper Kobbler Creek Sth (Site 53), upper Mosquito Creek (Site 58), headwaters Gregors Creek (Site 112), Antipidawa Creek (Site 103), headwaters Caboolture River Sth (Site 109).

Stream Health Class: recorded in SHC **a**, **b** and **c** streams of excellent habitat structure.

Comments: Montane rainforest streams (Theischinger & Hawking 2006).

Damselfly: Bronze Needle *Synlestes weyersii*, Synlestidae

Status: Rare and “possibly declining” (Natrass 2006).

Records in the MBR: Rare, recorded in 4 streams.

Localities: upper Kobbler Creek Sth (Site 53), Antipidawa Creek (Site 103), headwaters Caboolture River Sth (Site 109), Gregors Creek (Sites 112, 113).

Stream Health Class: recorded in SHC **b** and **c**

Comments: A southern fauna element with its northern distribution limit in SEQ, where it lives in forested upland streams (Natrass 2006 Theischinger & Hawking 2006).



Figure 27. The Bronze Needle is uncommon in the MBR. The more temperate damselfly has its northern distribution limit in the forested upland streams of SEQ.
(Photo: National Parks Victoria)

• **Dragonfly: Black Tigertail** *Eusynthemis nigra*, Synthemistidae

Status: Uncommon (Natrass 2006) to rare (Theischinger, personal communication).

Records in the MBR: Rare, recorded in 3 stream reaches.

Localities: headwaters Cedar Creek at Greene’s Falls (Site 14), headwaters of North Pine River (Site 37) upper North Pine River (Site38).

Stream Health Class: recorded in SHC **a** and **b** streams of excellent habitat structure.

Comments: A rare dragonfly of Australia’s central east coast, where it lives in upland streams (Natrass 2006). The larvae hunt among gravel in areas of accumulated fine sediment and detritus (Theischinger & Hawking 2006).

• **Dragonfly: Conehead Darner** *Austroaeschna subapicalis*, Telephlebiidae +53

Status: Rare in SEQ, not listed in Natrass (2006).

Records in the MBR: Rare, recorded at 3 streams.

Localities: Upper Cedar Creek (Site 15), upper Kobbler Creek Sth (Site 53), middle Stanley River (Site 204)

Stream Health Class: recorded in SHC **b** and **c**

Comments: The Conehead Darner is a large dark conspicuous dragonfly of well shaded fast flowing streams. The large nymphs are found under rocks and logs (Theischinger & Hawking 2006). This more temperate/southern species has its northern distribution limit in SEQ.

- **Dragonfly: Northern Evening Darner** *Telephlebia cyclops*, Telephlebiidae

Status: Very rare (Theischinger, personal communication)

Records in the MBR: Rare, known from a single rainforest spring brook, headwater Cedar Creek (Site 13), Maiala Reserve.

Stream Health Class: recorded in SHC **a**

Comments: This rare species seems to be restricted to stream reaches near waterfalls in rainforest (Theischinger & Hawking 2006).

- **Stonefly** *Riekoperla perkinsi*, Gripopterygidae

Status: Very rare (Theischinger, personal communication)

Records in the MBR: Rare, known from a single site at the head of Greene's Falls in a 'film of flowing water' on rock (hygropetric habitat) (Site 14)

Stream Health Class: recorded in SHC **a**

Comments: Habitat requirements of this very rare stonefly are little understood and its biology is unknown (Theischinger, personal communication).



Figure 28. The stonefly *Riekoperla* is a predator in fast flowing streams. (Photo from Gooderham & Tsyrlin 2002)

- **Green Diving Beetle** *Onychohydrus atratus*, Dytiscidae

Status: Rare (Watts 2002)

Records in the MBR: Rare, known from a single site, the wetland at the lower Freshwater Creek (Site 77) at Griffin.

Stream Health Class: recorded in SHC **d**

Comments: The green shiny-metallic diving beetle is Australia largest water beetle measuring up to 40 mm (adult). This large predator relies on coastal freshwater wetlands of stable habitat structure such as undisturbed *Melaleuca* wetlands (ABRS). The beetle seems to tolerate a certain level of eutrophication (water loaded with nutrients). The rapidly decreasing number of freshwater wetlands poses a real and serious threat to the survival of this species. *O. atratus* is endemic to tropical and subtropical Australia.

- **Riffle Beetle** *Ovolara* sp. (could be *O. australis*), Elmidae

Status: Rare (rarely ever recorded, ABRS)

Records in the MBR: Rare, known from three streams.

Localities: lower Gregors Creek (Site 113), middle Neurum Creek (Site 219), lower Delaneys Creek (Site 218).

Stream Health Class: recorded in SHC **b** and **c** streams of excellent habitat structure.

Comments: Other than *Ovolara* lives in running waters nothing is known on the biology of this genus. Known from eastern NSW and Qld (ABRS, MDFRC).

- **Toe-winged Beetle** *Byrrhoeptus* sp., Ptilodactylidae

Status: Uncommon

Records in the MBR: Recorded at in streams.

Localities: headwaters of Cedar Creek down to Bolwarra Reserve (Sites 13, 14, 16), Raynbird Creek (North Pine River system) and Antibidawa Creek (Site 103) and Lucys Creek (Site 110) (both Caboolture River system).

Stream Health Class: recorded in SHC **a** and **c** streams of excellent to good habitat structure.

Comments: *Byrrhoeptus* is relatively rare in the MBR. It is widely distributed in forest streams of eastern Australia, and can be locally quite common (ABRS).

- **Caddisfly** *Antipodoecia turneri*, Antipodoeciidae

Status: Rare (Gooderham & Tsyrlin 2002, Williams 2002)

Records in the MBR: Widespread though never abundant, recorded in 7 headwater streams of the Pine, Caboolture and Mary River systems.

Localities: Cedar Creek (Sites 14, 16), Terrors Creek (Site 46), Zillman Creek (Sites 101,102), Caboolture River South (Site 109), Mary River (Site 201)

Stream Health Class: recorded in a very wide range of SHC, from **a** to **e**

Comments: The caddisfly family Antipodoeciidae is endemic to Australia, where it occurs in small creeks near the east coast, with a single species, namely *Antipodoecia turneri*. Little is known about the biology and habitat requirements of this caddisfly (as seen from reviewing scientific literature). Interestingly, the Stream Health Monitoring data from the MBR reveal that *A. turneri* occurs only in headwater streams, while being very tolerant of eutrophication. This indicates that the distribution pattern of this caddisfly is limited by (relatively low) temperatures and / or (high) oxygen in the water.

- **Caddisfly** *Helicopha* sp. (could be *Helicopha queenslandensis*), Helicophidae

Status: Rare (?) (Little known)

Records in the MBR: Recorded in 5 forested headwater streams.

Localities: Cedar Creek (Sites 13, 14), North Pine River (Site 37), Antidaw Creek (Site 103), Caboolture River North (Site 104), Mary River (Site 202)

Stream Health Class: recorded in SHC **a**, **b** & **c**

Comments Helicophidae is a Gondwanan family, with the genus *Helicopha* known from New Caledonia and from Australia's south-east coast, including Tasmania. Recently the species *H. queenslandensis* was described from the Bunya Mountains (on the wing), which is the first published record of *Helicopha* from Queensland (Källsen & Johanson 2010). Its larva is not yet known, and it is well possible that the larvae collected in the MBR belong to this recently described species. Nothing is known about the biology and habitat requirements of the species. However, the SHM data show that the larvae live in upland rainforest creeks in the splash zone of waterfalls and on rocks in swift flowing water where they are grazing on algae (Figure 30).



Figure 29. Small shaded waterfalls in forested headwater streams are the typical habitat of *Helicopha* in the MBR. Here a headwater stream of the Mary River (Site 202).



Figure 30. Larvae of the caddisfly *Helicopha* in their cone-shaped case, made of sand grains. On shaded rock faces in the splash-zone of waterfalls the larvae are grazing on algae (Site 202).

- **Caddisfly** *Triplexa villa*, Leptoceridae

Status: Uncommon (St Clair 2000)

Records in the MBR: Recorded from a single site only, the headwaters of the North Pine River (Site 37), a Stream Health Class **b** stream.

Comments: The rainforest caddisfly *Triplexa villa* relies on the existence of a special microhabitat, namely shaded rocks coated with a film of clean running water or

underneath waterfalls (St Clair 2000). A strong population of *T. villa* exists in the headwaters of the North Pine River. The species is also known from the upper Brisbane River catchment (AFS 2001). *T. villa* is a tropical fauna element.

- **Caddisfly** *Barynema* sp., Odontoceridae

Status: Rare (St Clair, personal communication)

Records in the MBR: Recorded from a single site in the headwaters of the Mary River (Site 202) where a single larva was collected from fine sediment in this Stream Health Class **c** stream.

Comments: The caddisfly genus *Barynema* is endemic to the south east coast of mainland Australia. Two described species are known, and some undescribed larvae await description until sufficient specimens and life-stages are available (St Clair 2000). *Barynema* is rarely encountered and, even in seemingly suitable habitats, occurs in low population densities. Nothing is known about its biology or specific habitat requirements.

- **Caddisfly** *Tasiagma ciliata*, Tasimiidae

Status: Uncommon

Records in the MBR: Recorded from 6 forest streams.

Localities: headwaters North Pine River (Site 37), upper Mosquito Creek (Site 58), middle Mountford Creek (Site 209), tributary to middle Stony Creek (Site 223), headwater Mary River (Site 202), middle Scrub Creek (Site 225).

Stream Health Class: recorded in SHC **a**, **b** and **c** streams.

Comments: *Tasiagma ciliata* is endemic to the south east coast of Australia, with its northern distribution limit in SEQ (ABRS). In SEQ it occurs in upland rainforest creeks, where in suitable habitat sites it often occurs in larger numbers (Council's Stream Health Monitoring database; Hughes et al 1998). Larvae of *T. ciliata* live on rock and stone surfaces in splash zones of waterfalls, and rapids of fast flowing streams.

Caddisflies of the family Tasimiidae are listed under the "Biodiversity Summary for NRM Regions" SEQ and "may be a focus of conservation activity in the region" (DEWHA 2009).

- **Caddisfly** *Tasimia ?palpata*, Tasimiidae

Status: Rare, rain forest-restricted species (Hughes et al. 1998)

Records in the MBR: Recorded from 2 upland rainforest creeks.

Localities: middle Antbidawa Creek (Site 103) and tributary to upper reaches of Stony Creek (Site 223).

Stream Health Class: recorded in SHC **a** and **c** streams.

Comments: In SEQ *Tasimia palpata* is restricted to cool rainforest streams, where it occurs on rocks in splash zones of rapids and small waterfalls.

The type locality of this caddisfly (from where it was described by Mosley in 1936) is Tasmania, where this species is widely distributed (ABRS). The Conondale Range in SEQ (Hughes et al. 1998, Murria & Hughes 2008) seems to be the only record on mainland Australia (ABRS). Such disjunct distribution is very rare and from a biogeographical point of view quite unlikely. The distribution pattern rather suggests the presence of a different *Tasimia* species in SEQ. However, this has to be confirmed by an expert for this taxon. For this purpose specimens (larvae and pupae) collected from Stony Creek (Site 223) in the Conondale Range were sent to Dr. Ros St Clair, EPA Victoria; response is pending.

- **Non-biting Midge** *Aphroteniella filicornis*, Chironomidae

Status: Uncommon

Records in the MBR: Recorded from 5 forest streams, mostly in the Stanley & Mary River systems.

Localities: Headwater of Cedar Creek (Site 13), middle Delaneys Creek (Site 217), middle Mountford Creek (Site 209), tributary to upper reaches of Stony Creek (Site 223), middle Scrub Creek (225).

Stream Health Class: recorded in SHC **a,b** and **c** streams of excellent habitat structure.

Comments: *Aphroteniella filicornis* is endemic to Australia where it seems to be widely distributed (Cranston 2000) though it is rarely encountered. The current understanding is that the geographical distribution centre of this rare and ancient insect is SEQ, from Mt Tamborine to Fraser Island (Cranston & Edward 1992). The genus *Aphroteniella* is very special because it is ancestral and relictual taxon, and is for insects what platypus is for mammals.

Aphroteniella filicornis is locally very limited to individual habitat sites (rather than stream reaches), where it may be episodically abundant while remaining cryptic over years (Cranston & Edward 1992). Noteworthy in this context is the conspicuously strong population recorded at Stony Creek (Site 223) in September 2010. Samples from this site yielded 28 larvae plus 3 pupae, while a ‘usual’ set of samples yields 1 or 2 larvae per site, if at all Council’s SHM database).

Aphroteniella filicornis is known from clear running and standing waters, where the larvae live among fine sediment and leaf litter (Cranston & Edward 1992, Haase & Nolte 2008). New is the finding that the species tolerates a light nutrient enrichment of its native waters, which is apparent from the species’ occurrence in streams of SHC **c** (Sites 217, 225). However, all habitat streams of *A. filicornis* in the MBR were well forested and of excellent riparian condition and in-stream habitat structure.

Aphroteniella filicornis is definitely what state government documents call “priority species” or “iconic species”, though the latter might be hampered by its small size of just 2 mm.

- **Non-biting Midge** *Apsectrotanypus* sp.1, Chironomidae

Status: Rare in SEQ

Records in the MBR: Rare, recorded only in two upland rainforest streams.

Localities: Greene's Falls (Site 14), headwater Mary River (Site 202).

Stream Health Class: recorded in SHC **a** and **c** streams.

Comments: Only recently the occurrence of *Apsectrotanypus* was confirmed for Queensland (Wright & Burgin 2007, Haase & Nolte 2008). Previously only known from temperate climate zones in Australia (Cranston 1996, ABRS 2009) it was long inferred that this genus should be present in Queensland as well (Fittkau & Roback 1983) as the genus is known from other tropical and subtropical regions in the world. Larvae were mainly found in fine humus sediment, confirming the Cranston's (1996) assessment that *Apsectrotanypus* prefers humic and acid habitats.



Figure 31. The larva of *Apsectrotanypus* is a stern predator (shown is just its head), whereas adults feed on plant sap.

- **Non-biting Midge** *Austrobrillia longipes*, Chironomidae

Status: Rare

Records in the MBR: Rare, recorded at a single site: headwater of the Mary River (Site 202).

Stream Health Class: recorded in SHC **c** stream.

Comments: Previous to the record in the MBR, *Austrobrillia longipes* was known from temperate Australia (TAS, VIC, NSW) this species a southern fauna element in SEQ. The two larvae found in submerged timber represent the first record of this species for Queensland (ABRS 2009).

- **Non-biting Midge** *Paralimnophyes* sp., Chironomidae

Status: Not known

Records in the MBR: Rare, recorded in one coastal stream.

Localities: Ningi Creek (Site 133) of Stream Health Class **c**

Comments: First record for Queensland. Another SEQ habitat locality is Eighteen Miles Swamp, North Stradbroke Island (Nolte, unpublished data). *Paralimnophyes* seems to prefer wallum streams and dystrophic ('blackwater') wetlands, uncommon habitats in the MBR. Hence this species is expected to be more common in regions such as the Sunshine Coast; however, this is yet to be confirmed.

A different species of *Paralimnophyes* is known from temperate Australia (Cranston 1996). *Paralimnophyes* is a southern fauna element in SEQ.

- **Non-biting Midge** *Stempellinella* new sp., Chironomidae

Status: Rare

Records in the MBR: Rare, recorded in four forested upland streams.

Localities: headwaters South Pine River (Sites 1, 2), headwaters Cedar Creek (Sites 13, 14), headwaters Gregors Creek (Site 112), middle Stony Creek (Site 224).

Stream Health Class: recorded in SHC **a** and **b**

Comments: First record for Queensland (Cranston 1996, ABRS). The new, undescribed species found in the MBR is restricted to healthy rainforest streams. Material was sent to T. Ekrem, Norway, who is currently undertaking a revision of this genus that will include the description of new species from several regions on the world.



Figure 32. *Stempellinella* is a delicate small midge with a wingspan of 2-3 mm. (Photo by Eiso Inoue, Japan)

- **Blackflies** *Austrosimulium mirabile*, Simuliidae

Status: Rare (ABRS)

Records in the MBR: Rare, recorded only from forested headwaters in the South Pine River system at Mount Glorious.

Localities: Headwaters South Pine River (Site 1) and Cedar Creek (Sites 13, 14, 15).

Stream Health Class: recorded in SHC **a** and **b**

Comments: *Austrosimulium mirabile* was described from “Dawson Ck on slopes of Mt. Glorious” (type locality) from larvae found “on dead leaves in moderately fast, clear water” (Mackerras & Mackerras 1948).

According to the Australian Biodiversity Resource Study database (ABRS 2008) in SEQ *Austrosimulium mirabile* is restricted to streams on the slopes of Mt Glorious. There is a further reporting of the species from Mount Spec in Queensland (ABRS 2008). However, the ABRS assessment of *A. mirabile* being endemic to Queensland seems to need revision as there are confirmed records of this species from the Acheron River in southern Victoria (Schreiber 1995). This is just mentioned here as it clearly shows the dearth of knowledge on Australian aquatic macroinvertebrates.

Interestingly in the MBR, *A. mirabile* was indeed only found in streams on the slopes of Mt Glorious over the last ten years of Stream Health Monitoring (Council’s SHM database). Noteworthy is also the fact that Dawson Creek, the type locality, does not sustain the species anymore, probably due to stream degradation since 1948.

This finding highlights the need to focus on habitat protection when trying to achieve biodiversity conservation. (SEQ-RP, Desired Regional Outcome 2)

7. List of Taxonomists

Stream Health Monitoring and Biodiversity Assessment in the MBR is a long-term project, which relies on the correct identification of freshwater macroinvertebrates. Over the past years species identification was undertaken or confirmed by the following taxonomists:

Mollusca – Dr. Winston Ponder, Australian Museum Sydney

Odonata, Plecoptera and Megaloptera – Günther Theischinger, NSW EPA Lidcombe

Heteroptera – Dr. Tom Weir, CSIRO Canberra

Gyrinidae – Dr. Geoff Monteith, Qld Museum Brisbane

Trichoptera: Hydroptilidae – Dr. Alice Wells, Australian Biological Resources Study, Canberra

Trichoptera: Leptoceridae, Odontoceridae, Tasimiidae – Dr. Rosalind St. Clair, VIC EPA, Macleod

Diptera: Chironomidae – Dr. Ulrike Nolte, Environmental Consultant, Qld

Diptera: Ceratopogonidae – Dr. Art Borkent, Environmental Consultant, Canada

A reference collection is held at the laboratory of Ulrike Nolte, Scarborough Qld. Voucher specimens of selected taxa are incorporated into the ANIC (Australian National Insect Collection) in Canberra, and the scientific collection of the Australian Museum in Sydney.

8. References

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Appendix. Which site sustains which species of high biodiversity value.

Site ID		1	2	13	14	15	16	21	37	38	40	42	51	53	54	58	77	101	102	103	104	109	110	112	113	133	201	202	204	209	217	218	219	223	224	225			
Common name	Genus & Species																																						
North Pine River Snail	<i>Fluvidona anodonta</i>	✓	✓					✓	✓						✓																								
Mud Snail	<i>Jardinella new sp.1</i>			✓					✓																														
Mayfly	<i>Mirawara sp.1</i>																			✓															✓	✓			
Mayfly	<i>Atalomicria sp. AV1b</i>			✓			✓	✓	✓											✓	✓																		
Arrowhead Rockmaster	<i>Diphlebia nymphoides</i>										✓	✓																											
Damselfly: Golden Flatwing	<i>Austroargiolestes chrysoides</i>	✓																																					
Damselfly: Coastal Flatwing	<i>Griseargiolestes albescens</i>													✓												✓													
Damselfly: Southern Whitetip	<i>Episynlestes albicauda</i>	✓		✓	✓			✓	✓					✓		✓				✓		✓		✓															
Damselfly: Bronze Needle	<i>Synlestes weyersii</i>														✓					✓		✓		✓	✓														
Dragonfly: Black Tigertail	<i>Eusynthemis nigra</i>				✓			✓	✓																														
Dragonfly: Conehead Darner	<i>Austroaeschna subapicalis</i>					✓									✓														✓										
Dragonfly: Nth Evening Darner	<i>Telephlebia cyclops</i>			✓																																			
Stonefly	<i>Riekoperla perkinsi</i>				✓																																		
Green Diving Beetle	<i>Onychohydrus atratus</i>																✓																						
Riffle Beetle	<i>Ovolara sp. (O. ?australis)</i>																							✓									✓	✓					
Toe-winged Beetle	<i>Byrrhocryptus sp.</i>			✓	✓		✓				✓										✓			✓															
Caddisfly	<i>Antipodoecia turneri</i>				✓	✓													✓	✓			✓					✓											
Caddisfly	<i>Helicopha ?queenslandensis</i>			✓	✓			✓													✓	✓							✓										
Micro-Caddisfly	<i>Orthotrichia aberrans-group</i>																								✓														
Caddisfly	<i>Triplexa villa</i>							✓																															
Caddisfly	<i>Barynema sp.1</i>																												✓										
Caddisfly	<i>Tasiagma ciliata</i>							✓								✓													✓		✓					✓		✓	
Caddisfly	<i>Tasimia ?palpata</i>																				✓															✓			
Non-biting Midge	<i>Aphroteniella filicornis</i>			✓																										✓	✓				✓		✓		
Non-biting Midge	<i>Apsectrotanypus sp.1</i>				✓																								✓										
Non-biting Midge	<i>Austrobrillia longipes</i>																												✓										
Non-biting Midge	<i>Paralimnophyes sp.</i>																									✓													
Non-biting Midge	<i>Stempellinella new sp.1</i>	✓	✓	✓	✓																			✓													✓		
Blackfly	<i>Austrosimulium mirabile</i>	✓		✓	✓	✓																																	