DEPARTMENT *of*
PRIMARY INDUSTRIES,
WATER *and* ENVIRONMENT

Tasmania

# Aquatic Ecology Of Rivers In the Brid Catchment

**A Report Forming Part of The Requirements for State of Rivers Reporting**

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## *Summary*

This report deals with aspects of the aquatic ecology of the Brid River and associated tributaries. The first section provides a brief overview of the aquatic fauna found in the catchment and provides some detail of the habitat requirements and potential threats to some of the more vulnerable and endangered species found in the Brid catchment. The main focus of the chapter details work carried out in the Brid catchment under the Monitoring Riverine Health Initiative (MRHI), a national program aimed at the development of models to assess riverine health using macroinvertebrates as bio-indicators. Finally, algal community composition at selected sites in the Brid catchment is examined in respect to potential impacts. Algae were sampled concurrently with macroinvertebrates under the MRHI program in spring and autumn of 1997.

Some of the major findings of this report are:

- The Brid River and its tributaries are home to a number of threatened species including the Giant Freshwater Crayfish *Astacopsis Gouldi,* and an undescribed species of hydrobiid snail in the genus *Beddomia*. Threats to these species include habitat degradation, deterioration in water quality and, in some cases, competition with introduced species.

- The Brid River mainstream is in good condition with 10 of the 14 sites sampled in the main channel receiving an unimpaired or better rating. The tributaries are in fair condition with 6 of the 10 sites sampled receiving a slightly impaired rating. The impaired sites are impacted by factors other than water quality, however some sites appear to undergo periodic deterioration in water quality, particularly during periods of low flow.

- Fifty genera of algae were recorded from the Brid catchment. The number of genera of algae recorded per site ranged from 16 to 21 with little variation between autumn and spring sampling rounds. The composition and diversity of the algal communities are characteristic of healthy unimpacted streams.

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## Glossary of Terms

**Anadromous** Refers to fishes which migrate from saltwater to freshwater to spawn

**Diadromous** Refers to fishes that migrate freely between freshwater and saltwater in either direction.

**Macroinvertebrate** Animals without a backbone which can be seen with the naked eye. In rivers, common macroinvertebrates include insects, crustaceans, worms and snails.

**Riparian Vegetation** Riparian vegetation are plants (trees, shrubs, ground covers and grasses) which grow on the banks and floodplains of rivers. A 'healthy' riparian zone is characterised by a homogeneous mix of plant species (usually native to the area) of various ages. This zone is important in protecting water quality and sustaining the aquatic life of rivers.

## 1. Introduction

This report deals with aspects of the aquatic ecology of the Brid River and associated tributaries. It provides a brief overview of the aquatic fauna found in the catchment and provides some detail of the habitat requirements and potential threats to some of the more vulnerable and endangered species found in the Brid catchment. Another section deals specifically with endangered species found in the catchment and covers potential threats to the distribution of each species. The main focus of the chapter details work carried out in the Brid catchment under the Monitoring Riverine Health Initiative (MRHI), a national program aimed at the development of models to assess riverine health using macroinvertebrates as bio-indicators. These models are comprehensive in their development and allow a relatively rapid assessment of riverine health at specific sites along the river and surrounding tributaries. Finally, algal community composition at selected sites in the Brid catchment is examined in respect to potential impacts. Algae were sampled concurrently with macroinvertebrates under the MRHI program in spring and autumn of 1997.

## 2. Aquatic Fauna

At least four different species of frogs are found in the Brid catchment including the brown froglet *Crinia signifera*, the Tasmanian froglet *Crinia tasmaniensis*, the banjo frog *Limnodastes dumerilii* and the green and gold frog *Litoria raniformis*. The Northeast region has been identified as a significant region for frogs due to extensive coastal wetlands which form excellent frog habitat (Brown, 1996). It is especially significant to the species *Litoria raniformis*, which is classified as 'vulnerable' in the State. Loss of habitat through drainage of wetlands is perhaps the greatest single threat to frog species diversity. Other significant pressures include the spread of trout and a decline in water quality.

There are 18 freshwater fish species found in northeast Tasmania, three of which are introduced species (Chilcott and Humphries, 1995). Most of these species are diadromous and have a Tasmania wide distribution. Three of the native fish species are confined entirely to freshwater areas (Table 1), and all three have the most limited natural distributions of species occurring in the northeast (Fulton, 1990).

Of the species listed below, the dwarf galaxias, *Galaxiella pusilla* Mack (dwarf galaxiid), is the only species having a conservation status of 'rare' in Tasmania. This species is also considered 'vulnerable' on mainland Australia, with causes of decline being seen as drainage of wetlands, river channelisation, removal of riparian vegetation and interactions with introduced fish (Koehn, 1990a; Koehn, 1990b). The only other species currently requiring conservation attention is *Prototroctes maraena* Gunther (Australian grayling), which is considered 'vulnerable'. Two other species, *Galaxias cleaveri* Scott (Tasmanian mudfish) and *Lovettia sealli* Johnston (Tasmanian whitebait) although quite common (Fulton, 1990), are subject to various pressures that may limit their abundance and distribution on a local scale. The juvenile *G. cleaveri*, together with other galaxiid juveniles form part of the whitebait runs on their return from the sea in spring and they take up residence in the lower part of coastal streams (Fulton,1990).

The usual habitat of *G. cleaveri* is swampy areas near the coast and the species is found mostly in still waters, heavily vegetated mud bottomed swamps and drains (McDowall, 1996; Fulton, 1996). Mudfish are regarded as widespread and common around Tasmania (Fulton,1990), although its habitat is under continual threat from drainage of swamps and reclamation of estuarine marshes.

The true whitebait *L. sealli* exhibits an anadromous lifestyle migrating into freshwater to breed. Spawning occurs during spring and early summer when large schools of year old adults migrate into freshwater. Eggs are attached in clusters to submerged logs, stones or plants and hatching occurs in 2-3 weeks. The larvae are then washed down into the sea. In the past, this species was the basis of an important commercial fishery, however since the 1940's populations have declined to the point where the fishery was closed from 1973 to 1990. The fishery has since been opened on a restricted basis.

There are two major genera of freshwater crayfish found in the northeast region, *Astacopsis* (including the Giant Freshwater Crayfish, *Astacopsis gouldi*) and *Engaeus* (a smaller burrowing crayfish) which consist of about eight species in northeast Tasmania (Horwitz, 1996). There is very little data on *Astacopsis gouldi*, Clark and *Astacopsis franklinii*, Gray in the Brid catchment. A recent survey, has confirmed the presence of *A. gouldi* in the Brid River (T. Walsh *pers comm*) and it is highly probable that *A. franklinii* is also present given it's distribution in the northeast region of Tasmania (Hamr,1992). Three species of *Engaeus* are known to occur, the most threatened of which is the Mt. Arthur burrowing crayfish (*Engaeus orramakkunna*). It is presently registered as 'vulnerable' due to its very restricted distribution and disturbance of its habitat. *Astacopsis gouldi* is also registered as a 'vulnerable' species and is now protected under the Rare and Threatened Species Act and will be discussed in the next section.

**Table 1:** Freshwater Fish of northeast Tasmania

Life History: M = migrates to and from sea or estuary, F = freshwater only
Habitat: R = rivers, L = lake, W = wetlands

| **Common Name** | **Scientific Name** | **Life History** | **Habitat** |
|---|---|---|---|
| ***Native Fish*** | | | |
| short-headed lamprey | *Mordacia mordax* | M | R |
| pouched lamprey | *Geotria australis* | M | R |
| short-finned eel | *Anguilla australis* | M | R/L/W |
| long-finned eel | *Anguilla reinhardtii* | M | R/L/W |
| jollytail | *Galaxias maculatus* | M | R/L |
| spotted galaxias | *G. truttaceus* | M | R/L |
| climbing galaxias | *G. brevipinnus* | M | R |
| Tasmanian mudfish | *G. cleaveri* | M | R/W |
| dwarf galaxias | *Galaxiella pusilla* | F | R/W |
| Tasmanian whitebait | *Lovettia sealii* | M | R |
| Australian grayling | *Prototroctes maraena* | M | R |
| Tasmanian smelt | *Retropinna tasmanica* | M | R |
| river blackfish | *Gadopsis marmoratus* | F | R/L |
| southern pygmy perch | *Nannoperca australis* | F | R/W |
| sandy flathead | *Pseudaphritis urvillii* | M | R |
| ***Introduced Fish*** | | | |
| brown Trout | *Salmo trutta* | M | R/L |
| Atlantic salmon | *Salmo salar* | M | R/L |
| rainbow trout | *Oncorhynchus mykiss* | M | R/L |

# Taken from Chilcott and Humphries (1995)

## *3. Endangered Species*

A species is regarded as endangered if it is in danger of extinction because long term survival is unlikely while the factors causing them to be endangered continue operating. Approximately 4 endangered aquatic species are listed that occur in the Brid catchment. The best known of these is *Astacopsis gouldi* ( the Giant Freshwater Crayfish). *A. gouldi* is listed as "vulnerable" under Tasmanian *Threatened Species Protection Act* 1995. At the beginning of 1998 *A. gouldi* was declared a "protected fish" under the *Inland Fisheries Act* 1995 ending recreational fishing for the species.

*Astacopsis gouldi* has been the subject of numerous scientific studies (Hamr, 1990; Horwitz, 1994; Growns, 1995) and a draft recovery plan currently exists for the species (Bluhdorn, 1997). *A. gouldi* is a lowland wet forest/rainforest species with a preferred habitat in heavily forested stream and creeks. Distribution is limited between sea level and around 400m altitude although most animals are found below 200m (Horwitz, 1994). *A. gouldi* requires streams with high quality water ( low nutrients and sedimentation ), a stable thermal regime of relatively low water temperature, and habitat cover in the form of woody debris, undercut banks and ample canopy cover (Growns, 1995; Bluhdorn, 1997). Large scale habitat disturbance from agricultural and urban landuse, forestry activity and fishing pressure has reduced both the species abundance and viability of some populations. Localised extinction's or large depletion's of stocks are thought to have occurred in the Brid River as well as many other northeastern rivers (Bryant, 1998a).

(Bryant, 1998b) listed key issues associated with the protection of the habitat of *A. gouldi* as follows:

- Protection of stream side vegetation
- Appropriate willow removal and retention of stumps and rehabilitation of native riparian vegetation
- Retention of large woody debris
- Management of stock access
- Appropriate use of fertilisers and chemicals

The Mt Arthur burrowing crayfish (*Engaeus orramakunna*) is restricted to an area centred on Mt. Arthur and bounded approximately by Lilydale, Nabowla, the Sideling Range and Nunamara. The crayfish has been found in a variety of habitats including undisturbed rainforest, eucalypt forest, open pasture, roadside gutters and pine plantation. The burrows are made in areas of high soil moisture and clay content, and can be some distance from streams. Threats to *E. orramakunna* include drainage of swamps and factors affecting water quality (Jackson & Munks, 1998).

The Hydrobiidae family of aquatic snails is the most diverse family of freshwater molluscs in the world. There are over 62 species in the genus *Beddomia*, several of which are locally endemic to the northeast of the state. However most of these are very restricted in their distribution, with many species known only from one or a few sites. One of these is a new species that is known from only a few specimens collected from two sites in the Brid catchment. It has not yet been described, however it is very similar in shell characteristics to *B. inflata* from the mid north coast and its globose shell makes it one of the more distinctive of the *Beddomia* species found in this region (Ponder, 1996).

The survival of hydrobiid snail populations primarily depends on the retention of native riparian vegetation and maintenance of good water quality. Ponder (1988) also suggests that landuse impacts and competition with introduced species such as *Potamopyrgus antipodarium* are also having a deleterious effect on snail populations and these impacts are primarily in lowland rural and urban streams (Davies, 1995).

*Prototroctes maraena* (Australian Grayling) lives in coastal streams and rivers around the Tasmanian coast and occurs most commonly in clear gravelly streams with a moderate flow. Its need to migrate to and from the sea makes it vulnerable to depletion in rivers that prevent fish passage as a result of barriers to upstream and downstream migration (McDowall, 1986). Spawning takes place in autumn and once larvae have hatched, they are swept downstream towards the sea. Larval life is marine and juveniles return to rivers from the sea during spring and the rest of their life is spent in rivers. The current status of this species is vulnerable due to a decline in its population resulting in decreased numbers across much of its former range. The Australian grayling requires free movement between freshwater and marine habitats, therefore construction of objects (i.e. dams, weirs and culverts) which prevent fish passage should be avoided. Other threats to the distribution of this species include, removal of riparian vegetation and deterioration in water quality

In summary, many of these species are affected by habitat degradation. Management prescriptions in the form of retention and rehabilitation of native riparian vegetation and minimal disturbance to instream habitat particularly in the lower reaches of the Brid River will increase the chances of recovery for many of these species.

## *4. River Health*

### 4.1 Methodology

The National River Health Program was formed in 1993 by the Federal Government to provide a means of assessing the ecological condition of Australia's river systems. MRHI in Tasmania commenced in 1994 and the programs primary objectives were to develop predictive models to allow assessment of river health using macroinvertebrates as biological indicators. Over 120 sites in Northern Tasmania were sampled in order to build the bioassessment models. As part of this sampling, three sites were sampled at various times from spring 1994 to spring 1997 in the Brid catchment. Reference sites are defined as sites that are least disturbed and are suitable for use in the construction of predictive models. Test sites are those sites defined to be of importance in assessing the condition of a river known or thought to be experiencing an impact from water quality or habitat degradation. Three test sites (Brid at Bridport Back Road, Brid at Duncraggen Road, and Brid at Tasman Highway) were sampled in autumn and spring 1997 (see Table 3, Fig. 1). Because the selection of sites in the Brid catchment was primarily aimed at the development and testing of the river health model, the overall coverage of the catchment was not extensive. However, an additional 27 sites were sampled under the Index of River Condition (IRC) study undertaken in autumn 1998, ranging from small tributaries in both the upper and lower catchment as well as the mainstream channel of the Brid River (see Fig. 2).

As a comprehensive description of sampling protocols is given in CEPA (1994) and Oldmeadow *et al.*(1998), a detailed description of these procedures will not be given here. The biological monitoring package AusRivAS (Australian River Assessment System) was used to provide a broad scale picture of the health of previously sampled sites in the Brid catchment at different times.

### 4.2 AusRivAS Modelling

The AusRivAS model essentially predicts the aquatic macroinvertebrate fauna that would be expected to occur at a site in the absence of environmental stress such as pollution or habitat degradation. The first step of the model building process is classifying reference sites into groups which have similar invertebrate composition, based on family level presence/absence data. This is done using the agglomerative clustering technique, flexible unweighted pair-group arithmetic averaging (UPGMA). The reference site groups from the classification are entered into the reference habitat data set and a

stepwise multiple discriminant function analysis (MDFA) is used to select the predictor variables used in a model. This procedure selects a subset of habitat variables which best discriminate between the groups of sites formed from the faunal classifications. The subset of habitat variables obtained from the stepwise MDFA is used as predictor variables for the AusRivAS model being constructed. The predictor variables and the reference site invertebrate classification form the foundation of AusRivAS, allowing predictions of which taxa should be found at new sites to be made. A comparison of the invertebrates predicted to occur at the test sites with those actually collected provides a measure of biological impairment at the tested sites.

## 4.3 O/E Indices

Each site is classified into five categories based on the ratio of macroinvertebrates "Observed" (or sampled) to the macroinvertebrates "Expected". This ratio is known as the observed / expected score or "OE". Table 2 presents the categories used and the OE ratio ranges for each cut off. The O/E ratio represents the percentage of taxa sampled at a site. From the table below, a site with less than 25 percent of the taxa expected to be present at the site is considered to be severely impaired. The advantage of these river health models is that not only the presence of an impact but also the magnitude can be determined for a specific site.

**Table 2:** River Health categories and Associated OE scores

| Band Label | O/E Scores | Band Name | Comments |
|---|---|---|---|
| X | >1.15 | Richer than Reference | • More families than expected<br>• Potentialy biodiverse site<br>• Possible mild organic enrichment |
| A | 0.85-1.14 | Unimpaired | • Index value within range of the central 80% of reference sites |
| B | 0.55-0.84 | Slightly Impaired | • Fewer families than expected<br>• Potential mild impact on water quality, habitat or both, resulting in the loss of families |
| C | 0.25-0.54 | Moderately Impaired | • Considerably fewer families than expected<br>• Loss of families due to moderate to severe impact on water and/or habitat quality |
| D | <0.25 | Severely Impaired | • Very few families collected<br>• Highly degraded<br>• Very poor water and/or habitat quality |

Another biotic index is incorporated into the model output to provide an insight into the nature of the disturbance or impact at a site (see Fig. 2). (SIGNAL, Stream Invertebrate Grade Number Average Level, (Chessman, 1995) is a ratio of the observed (sampled) SIGNAL score to the expected signal score. The index is based on the sensitivity of macroinvertebrates to pollution. Each family of macroinvertebrates is assigned a grade according to their tolerance where a grade of 10 represents a high sensitivity to pollution and a grade of 1 represents a high tolerance to pollution. The "observed" SIGNAL score is the sum of the grades divided by the number of taxa collected and the "expected" score is the sum of the grades divided by the number of taxa expected.

O/E is sensitive to a wide variety of disturbances provided they result in the loss of families of macroinvertebrates from the habitats sampled at a site. Thus this index should detect not only loss of families due to deteriorated water quality, but also loss because of physical habitat degradation. O/E SIGNAL weights the families by their sensitivity to water pollution. Accordingly, O/E SIGNAL can detect situations where water pollution has resulted in the loss of only a few, but very sensitive, families of macroinvertebrates.

The procedure first requires a choice of the most appropriate habitat model for computing the indices. Six sites (5,6,7,17,18,25) sampled in the IRC study were deemed to have insufficient or unsuitable riffle habitat. These sites were therefore analysed using the regional autumn edgewater model developed in 1996. Twenty sites were analysed using the autumn riffle model and a further 2 sites (16,26) were dry and were therefore excluded from the analysis. The predictor variables for the autumn edgewater model are conductivity, longitude, percentage pool area and percentage snag cover. The predictor variables for the autumn riffle model are catchment area, conductivity, latitude and alkalinity (mg $CaCO_3$/l). However alkalinity was measured at only 6 of the 21 index of river condition sites. This posed a problem because multivariate analyses used in AusRivAS models do not permit missing data. However Simpson *et al.*(1996) suggest that extrapolations using data from similar sites or means from previous years can be used to fill missing data. On closer examination, the concentration of calcium carbonate was uniformly low in the catchment ranging from 18mg/l at Brid off Forestry Rd. (site 4) to 32mg/l at Little Brid at Dafts Rd. (site 19). Given the low variability, sites with missing data were given an average alkalinity score of 21.6mg/l. While this was not ideal, it was done to prevent the exclusion of the majority of the sites from the analysis and should not compromise the banding scores.

## 4.4 Identification Of Macroinvertebrates

All macroinvertebrates were identified to family level except in the following cases: Chironomidae (midges) were identified to sub-family level Oligochaeta (worms), Hirudinea (leeches), Acarina (mites) and Turbellaria (flatworms) were identified to order and class level. A total of 38 families were identified from edgewater habitats and 57 families from riffle habitats. These taxa represented all the major taxonomic groups typical of freshwater streams. Insects were the most dominant, representing around 77% of the total number of taxa collected and accounting for 90% of the total number of individuals collected. In the edgewater habitat, the most dominant families both in terms of distribution and abundance were Leptoceridae (Caddisflies), Chironomidae (Midges) and Leptophlebiidae (mayflies). The two most dominant families in riffle habitats were Leptophlebiidae (Mayflies) and Elmidae (riffle beetles).

## 4.5 Results

Figure 1 is a plot of the O/E scores against the OESIGNAL scores for the riffle habitat for sites collected under the Index of River Condition study. The majority of impacted sites indicate the usefulness of including OESIGNAL for interpretation and diagnosis. All the impacted sites indicate that the lower health ratings are due to a potential impact other than water quality. For example site 23 (Trib of Brid off Forestry Rd) has an OE value of 0.6 indicating a substantial loss of taxa (40%) relative to the reference sites, whereas OESIGNAL (0.89) shows that the taxa collected were mostly sensitive taxa. Inspection of the diagnostic data shows that taxa that were expected but not found at this site included Psephenidae (water pennies), Baetidae, Leptophlebiidae (mayflies) Eustheniidae (stoneflies), and Hydropsychidae (caddisflies). All of these taxa are adapted to life in fast flowing water either by having a streamlined shape and/or some means of attachment to such as claws, suckers or hooks.

| Site | Name | Easting | Northing | Autumn 97 | | Spring 98 | | IRC Autumn 98 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Riffle | Edge | Riffle | Edge | OE | OESIGNAL | Riffle | Edge |
| DT20 | Brid at Duncraggen Rd | 535100 | 5452300 | NS | A | NS | A | | | | |
| DT21 | Brid at Bridport Back Rd | 530400 | 5455800 | A | A | A | B | | | | |
| DT44 | Brid at Tasman Hwy | 538400 | 5435200 | A | A | B | A | | | | |
| 1 | Brid d/s Gauging Station | 532000 | 5459100 | | | | | 1.07 | 0.98 | A | |
| 2 | Brid at Bridport Rd | 530200 | 5457400 | | | | | 0.8 | 1 | B | |
| 3 | Brid at Bridport Back Rd | 530400 | 5455800 | | | | | 0.94 | 1 | A | |
| 4 | Brid off Forestry Rd | 531700 | 5454600 | | | | | 0.87 | 0.99 | A | |
| 5 | Brid at Duncraggen Rd | 535100 | 5452300 | | | | | 0.73 | 1.13 | | B |
| 6 | Brid off forestry road | 535700 | 5449200 | | | | | 1.15 | 0.94 | | X |
| 7 | Brid below confluence off Richs Rd | 537000 | 5446400 | | | | | 1.06 | 0.93 | | A |
| 8 | Brid at Golconda Rd | 539000 | 5444500 | | | | | 0.81 | 0.978 | B | |
| 9 | Brid at Sledge Track | 540000 | 5440500 | | | | | 1.006 | 0.96 | A | |
| 10 | Brid off Private Rd | 539000 | 5437100 | | | | | 0.81 | 1.02 | B | |
| 11 | Brid at Tasman Hwy | 538400 | 5435200 | | | | | 0.88 | 0.92 | A | |
| 12 | Brid off Unwins Rd | 538400 | 5434000 | | | | | 0.94 | 0.94 | A | |
| 13 | Brid at Upper Brid Rd | 538500 | 5432400 | | | | | 1.06 | 0.98 | A | |
| 14 | Brid off East Diddleum Rd | 539600 | 5428800 | | | | | 0.99 | 0.99 | A | |
| 15 | Shanty Ck at Bridport Rd | 531800 | 5458800 | This site is outside the experience of the model | | | | | | | |
| 16 | Shanty Ck Upper | 532800 | 5455100 | | | | | | | **NS** | |
| 17 | Tributary at Cairns Rd | 534600 | 5444800 | | | | | 1.03 | 1 | | A |
| 18 | Small Trib u/s Brid | 534600 | 5445200 | | | | | 1.04 | 1.07 | | A |
| 19 | Little Brid at Dafts Rd | 538500 | 5444000 | | | | | 0.81 | 1 | B | |
| 20 | Little Brid at McKays Rd | 537800 | 5439300 | | | | | 0.83 | 0.97 | B | |
| 21 | Little Brid off Forestry Rd | 537500 | 5436900 | | | | | 0.73 | 0.93 | B | |
| 22 | Trib off Little Brid at Koomeela Rd | 537700 | 5442100 | | | | | 0.743 | 0.94 | B | |
| 23 | Trib of Brid off Forestry Rd | 538300 | 5436400 | | | | | 0.6 | 0.89 | B | |
| 24 | Weelaty Ck at Private Rd | 538200 | 5434900 | | | | | 0.86 | 0.98 | A | |
| 25 | Weelaty Ck at Oneira Rd | 536700 | 5433400 | | | | | 0.69 | 1.03 | | B |
| 26 | Trib off Upper Brid Rd | 538500 | 5433300 | | | | | | | **NS** | |
| 27 | West Arm Ck at Upper Brid Rd | 537900 | 5431400 | | | | | 0.93 | 0.966 | A | |

**Table 3**: River Health Categories for Riffle and Edgewater Habitats at sites visited under the Monitoring River Health Initiative 1996-1997 and the Index of River Condition study in Autumn 1998. Ratings are as follows:

Category X - Above Reference Condition (Biodiverse Sites)
A - Unimpaired
B - Slightly Impaired
C - Impaired
D - Severely Impaired
NS - Not Sampled

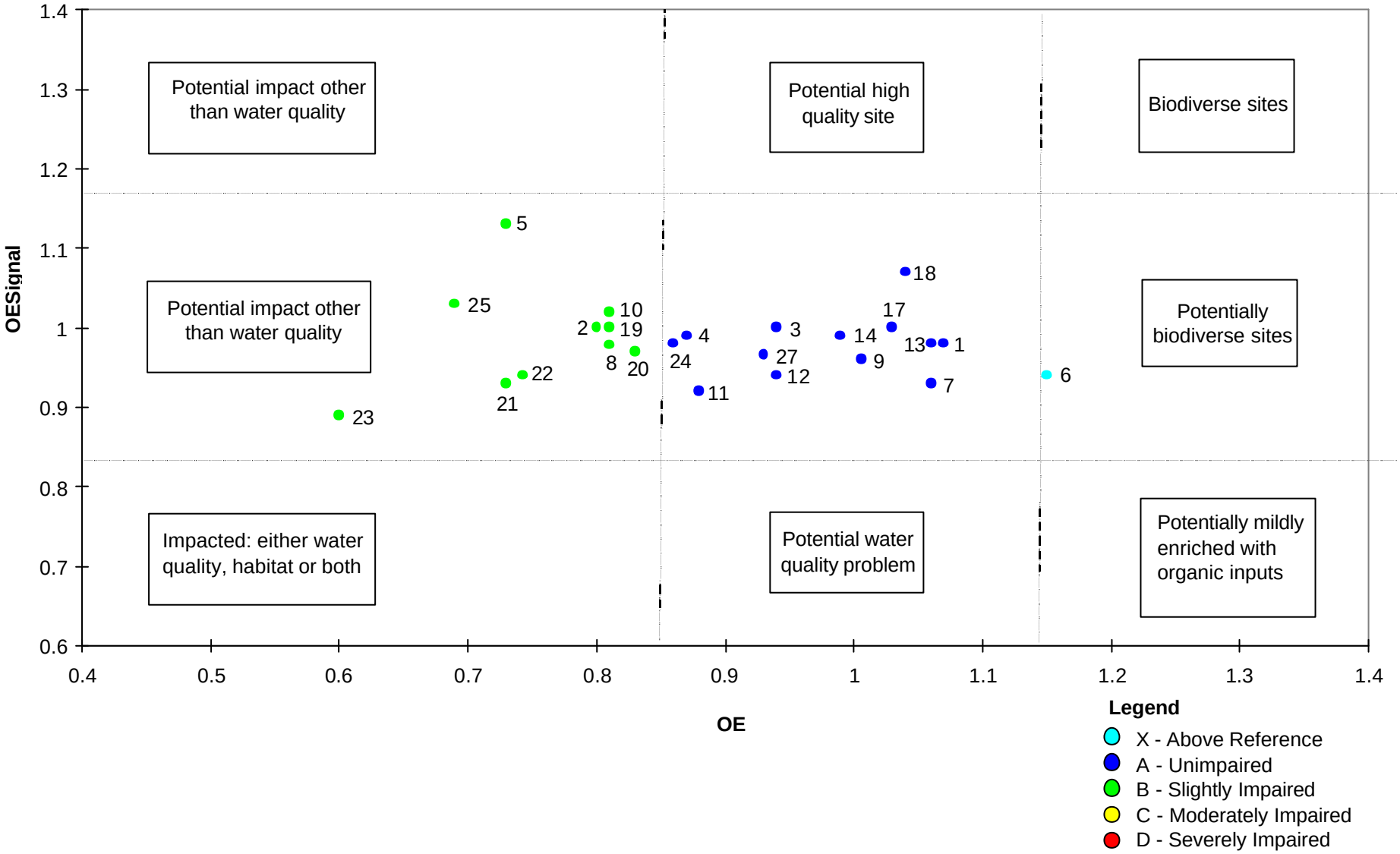



Figure 2. Plot of OE vs OE signal for riffle habitats at each site sampled under the Index of River Condition study and possible interpretations for situations where the two indices place sites in different bands. The vertical and horizontal dashed lines indicate the upper and lower bounds for unimaired (A) high quality sites

These taxa are generally found under cobbles or boulders or submerged objects such as coarse woody debris. However many of the impacted sites are dominated by a sand or silt substrate, in some cases approaching 90%. The few boulders and cobbles at these sites tend to be completely surrounded by the finer sediment , thus restricting the available habitat for the aforementioned taxa. It has long been recognized that macroinvertebrate diversity and abundance increase with increasing substrate size and substrate heterogeneity (Minshall, 1984). This lack of substrate diversity, in addition to clearance of riparian vegetation may be the primary factors in determining the lower river health ratings observed at many of these sites.

## A. Brid River Mainstream

Fourteen sites were sampled on the Brid mainstream (See Fig. 2). Assessment of these sites classed 1 site above reference (band X), 9 sites as equivalent to reference (band A), and 4 sites as slightly impaired (band B). The impaired sites were dispersed throughout the mid- to lower reaches of the catchment. However unlike the Great Forester River (Krasnicki, 1999) there was no clear pattern of river health deterioration longitudinally down the catchment. This may be due to the diverse nature of land use in the Brid river catchment (See Index of River Condition report). The impacted sites (2,5,8,10) have OE values ranging from 0.76 to 0.81. In contrast, OESignal scores remain high indicating a potential impact other than water quality. These sites are characterised by moderate to extensive erosion and evidence of stock access. Riparian vegetation at these sites was sparse and was dominated by pasture and exotic species such as willows and blackberries. In contrast, the biodiverse site (6) was located in medium to dense State forest. Although there are forestry operations upstream of this site, it has healthy native riparian vegetation, large amounts of instream detritus and coarse woody debris and little evidence of human impact.

The three sites on the Brid River which were also sampled under the MRHI program (Brid at Bridport Back Rd, Brid at Duncraggen Rd and Brid at Tasman Hwy) were rated as unimpaired for the majority of occasions. OE and OEsignal scores were similar to those obtained in the IRC study.

## B. Brid River Tributaries

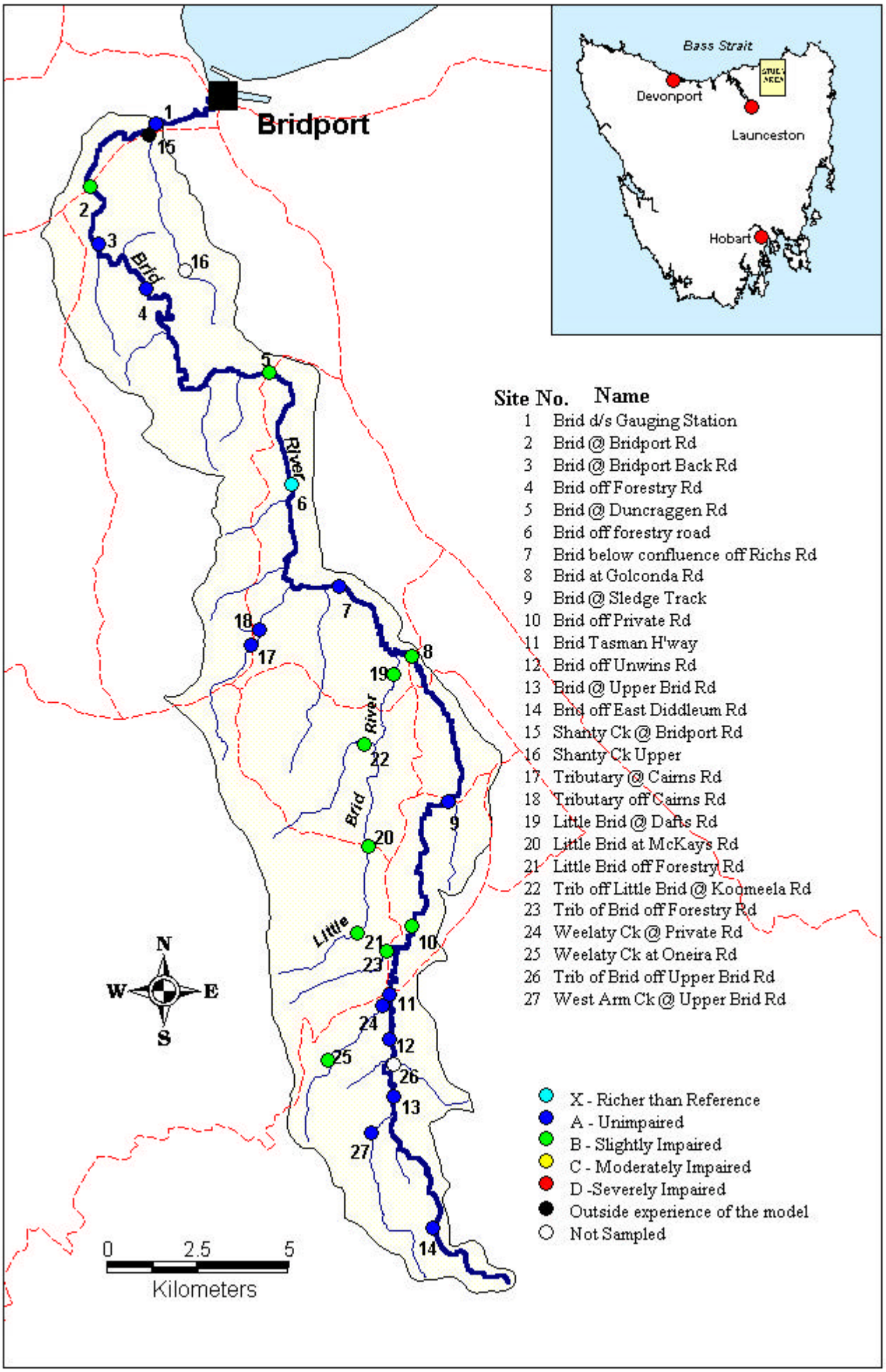
### *Shanty Creek (sites 15 and 16)*

The upper site (16) was dry, hence no data was collected for this site. The lower site was analysed, however due to its close proximity to the coast, it had very high value for conductivity (4300µS/cm) which placed this site outside the experience of the model. However, only 71 macroinvertebrates representing 13 taxa were collected. Worms and snails accounted for over 50% of the individuals collected, indicating that this site was moderately to severely degraded.

### *Unnamed tributary off Cairns Road (sites 17 and 18)*

The upper site (17) is situated in an area of intensive farming whereas site 18 is in the upper section of an area impacted by forestry activity. Both sites were analysed using the edgewater model and received an unimpaired rating. Sites 17 and 18 are among the more diverse sites in the catchment with 24 and 25 taxa recorded respectively. This is surprising, given that it is generally expected that macroinvertebrate diversity would be lower in relatively disturbed environments. Nevertheless the amount of habitat available is a crucial factor in determining community structure. Both sites had macrophytes and relatively good riparian vegetation. The edgewater habitat is closely linked to the riparian zone. Riparian vegetation provides habitat and a food source for many macroinvertebrates by dropping logs, leaves and branches into streams. Water quality measurements show that both these sites have high conductivity and turbidity levels suggesting that there may be mild organic enrichment at this site which could explain the higher than expected diversity of macroinvertebrates.

Figure 2: AusRivAS River health ratings for sites sampled under the Index of River Condition study.



*Little Brid River. (Sites 19, 20, 21, and 22)*

All sites in the Little Brid River as well as the unnamed tributary (22) received a slightly impaired rating. Sites 19, 20, and 22 are clearly impacted by intensive agricultural activities.The combination of riparian vegetation clearance and unrestricted stock access has contributed to bankside erosion. These factors along with elevated turbidity and conductivity levels are likely to have contributed to the lower river health ratings at these sites. Site 21 is located in a forested area. It is a small sandy bottomed stream so there is little habitat in which macroinvertebrates can live which may explain the lower OE score.

*Weelaty Creek. (Sites 24 and 25)*

Weelaty Creek at Private Rd (24) received an unimpaired rating while Wheelaty Creek at Oneira Road (25) received a slightly impaired rating. Only 14 taxa were collected from site 25 and these comprised mainly of fly larvae, amphipods and small water striders. Although this site had a low OE score of 0.69, the OESIGNAL score remained high at 1.03, indicating that the impairment is due to a potential impact other than water quality. However it is worth noting that this site had low dissolved oxygen levels (6.0 mg/l) which may be detrimental to aquatic life. Low pH (4.39) and relatively high turbidity (5.7) were also observed.

## 4.6 Summary

In general, the Brid River and its associated tributaries are in fair condition. Sites in the upper part of the main channel down to Tasman Highway received an unimpaired rating. There were four slightly impaired sites in the mid- to lower catchment. The tributaries are generally unimpaired with the exception of the Little Brid River, which was slightly impaired along its entire length. This is most probably due to the impact of agricultural activities in this catchment.

The impaired sites are impacted by habitat degradation or other factors other than water quality (Fig. 2), however some sites i.e. 25 may undergo periodic deterioration in water quality, particularly during periods of low flow. Implementation of better riparian vegetation management practices has been singled out as one positive step towards improving water quality in the Brid River. (See Water Quality section).

Edgewater habitats, in general, received better OE scores than riffle habitats, however a comparison between sites analysed by different models cannot be made because of the different sensitivity of the models used. Edgewater models are thought to less sensitive than riffle models because edgewaters are likely to harbour a more tolerant fauna. Many taxa that are able to live in depositional environments are 'pre adapted' to cope with moderate impacts on rivers such as mild sedimentation and organic enrichment (Oldmeadow *et al.* 1998). Further sampling from both habitats is required before valid comparison to be made.

# *5. Algae*

Algae are simple plants that vary considerably in size, shape and colour, and are found in a range of habitats. They are a natural part of the surface water ecosystem and are encountered in every water body that is exposed to sunlight. While a few algae are found in soils and in surfaces exposed to air, the great majority are truly aquatic and grow submerged in ponds, lakes, water supply storages, streams, estuaries and oceans. In water storages the phytoplankton, or floating microscopic plants, are

of major importance, and are the basic food source of small aquatic animals. There are four main types of freshwater algae: Green Algae (Chlorophyceae), of which the threadlike filamentous form is the most common, Blue-green Algae (Cyanophyceae), Diatoms (Bacillariophyceae) and Euglenoids (Euglenieae). Excessive growth of algae can cause numerous problems in waterways. Blooms can severely reduce the oxygen content of the water and cause the death of fish and other aquatic animals. Mats of filamentous algae can clog irrigation channels and pipes and severely reduce flow and certain blue-green algal blooms (in particular *Anacystis cyanea*) are toxic and have been known to kill live stock, including cattle, sheep, horses and domestic fowl.

Algae has many advantages over traditional indicators of water quality particularly in an urban setting (Round, 1991). Unlike macroinvertebrates, algae are a ubiquitous component of a water environment and are even found in concrete drains (common in urban environments). Algae have particular advantages as bio-indicators over other animals such as fish and macroinvertebrates in that they are often present before and after pollution incidents, reflect nutrient composition of the water more closely than animals and are often different to macroinvertebrates in their sensitivity to toxic materials (Whitton & Kelly, 1995).

In many Australian states, algae have been used on small spatial scales for bio-monitoring (Chessman, 1986; Sonnerman & Breen, 1997). There have been investigations into the feasibility of using algal taxa to assess river health and many researchers have suggested various protocols for bioassessment of rivers using algae as indicators (Hotzel & Croome, 1998). The development of river health models such as AusRivAS, the current platform for using macroinvertebrates to assess river health, has prompted various workers to develop similar models using algae as the indicator taxa.

In this vein, DPIWE has been sampling algae at sites where macroinvertebrates have been sampled for the Monitoring Riverine Health Initiative (MRHI) and the First National Assessment of River Health (FNARH) since late 1996 with the long term plan to develop bioassessment models for algae similar to those currently being developed for macroinvertebrates. To date, over 247 genera have been identified from over 350 sites around Tasmania.

As part of this program algal samples were collected from 3 sites in the Brid catchment in autumn and spring 1997. These sites were located on the Brid mainstream at Bridport back Rd, at Duncraggen Rd and at Tasman Highway. Samples were taken from both riffle and edgewater habitats by scraping the top surface of a cobble. They were preserved in 5% formalin and identified to genus level under a compound microscope in the laboratory.

Fifty genera of algae were identified from the Brid catchment, including Diatoms, Green algae, Blue-green algae and Euglenoids. These species are common throughout Tasmania and as such pose no public risk.

The number of genera of algae recorded per site ranged from 16 to 21 (see Fig. 3). Low numbers in algal taxa are most likely due to nutrient limitation, and hence likely to be recorded from relatively undisturbed sites. Conversely, high algae taxa numbers correspond to rivers with high Total Nitrogen and bacterial levels. The Brid river at Bridport Back Rd and at Tasman Highway recorded a slight decrease in taxa numbers in spring. This may be due to increased flows at this time. All three sites show a good diversity of algal taxa with most families well represented with the exception of blue green algae. The most likely reason for the low numbers of blue green algal taxa is the low pH of the water. Dallas(1993) reported that low pH conditions are responsible for reductions in the types and number of blue green algae present at a site. The types of algae encountered at all sites in this study such as *Cymbella*, *Fragilaria*, *Navicula* and *Synedra* are generally characteristic of healthy

unimpacted streams (Chessman, 1986) and contain a high diversity of algal groups with the exception of blue green algae.

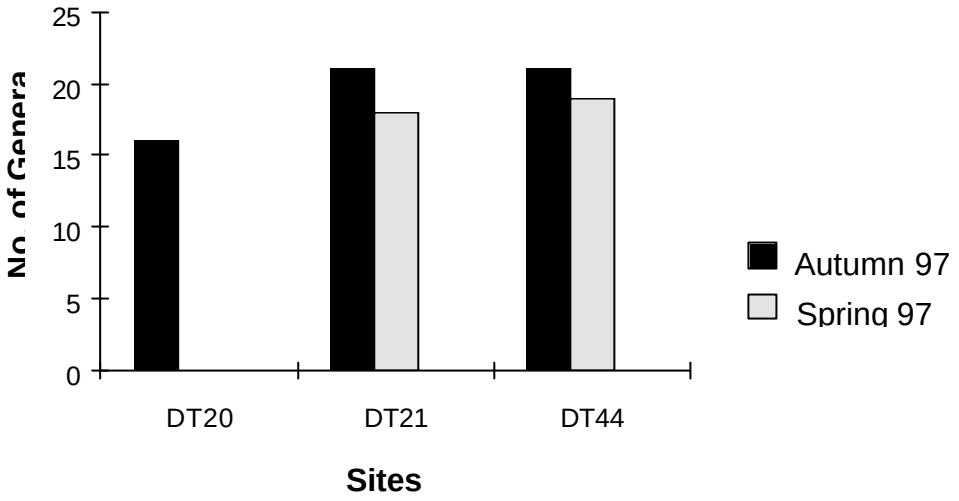



**Figure 3**: Number of algal genera sampled at each site in the Brid catchment in autumn 1997 and spring 1997: Site codes for the following sites are as follows

DT20 Brid at DuncraggenRd
DT21 Brid at Bridport Back Rd.
DT44 Brid at Tasman Highway

To make further comments on the composition of algal communities and how these relate to specific water quality impacts or habitat degradation in the Brid catchment would be inappropriate as too few sites were sampled in 1997 for a rigorous analysis. However the brief survey carried out at this time indicates that algal communities at all sites are diverse and indicative of good river health. Some sites with high numbers of algae are possibly responding to elevated nutrient levels and sites with low numbers of algal taxa are commonly in undisturbed low nutrient streams and tributaries of the Brid River.

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