# Defining headwater stream habitat suitability for juvenile *Astacopsis gouldi*

## Interim report.

***Report to the Forest Practices Board.***

## March 2005

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## *1. Introduction*

This document is an interim report on progress being made to define habitat suitability for *Astacopsis gouldi*, especially focussing on juvenile *Astacopsis gouldi*. Previous work (Davies and Cook 2004, Davies et al, submitted), defined the broad parameters of habitat suitability for juvenile *Astacopsis gouldi*, and explored relative differences in density between Class 4 streams (streams with catchment areas < 50 ha, as defined under the Forest Practices Code 2003) and larger streams (Class 3, 2 and 1). Two further lines of investigation are being pursued with the aim of:

1. exploring whether perennial (constantly flowing) Class 4 streams have substantially higher juvenile *Astacopsis gouldi* densities than non-perennial Class 4 streams.
2. defining habitat suitability for *Astacopsis gouldi*, especially focussing on juveniles to inform revision of the fauna provisions of the Code for additional protection of juvenile *Astacopsis gouldi* habitat;

### 1.1 Perennial Class 4 streams

Davies and Cook (2004) observed very low overall abundances of juvenile *Astacopsis gouldi* in Class 4 streams, with overall abundances being substantially lower than in Class

3 and 2 streams. However, one Class 4 stream sampled in the Flowerdale River catchment (a tributary of Coopers Creek), contained juvenile *Astacopsis gouldi* densities of a similar order to those observed in Class 2 streams, and was therefore anomalous. They suggested that this might be due to the presence of groundwater-sustained baseflows leading to perennial flows throughout the year. An initial inspection of similar streams in the area in August 2004 suggested that this pattern could be observed elsewhere, though high winter flows and low temperatures precluded further survey.

Discussion with a fluvial geomorphologist (K Jerie, DPIWE) and a geologist specialising in groundwater (Miladin Latinovic, MRT) indicated that these streams existed in a geomorphological context highly likely to sustain baseflows from groundwater discharge. The particular context was that of a basalt deposit overlying a sedimentary geology. Contact zones between basalt and a range of other rock types are known to result in springs and groundwater discharge to surface drainage systems in Tasmania.

We therefore proposed the hypothesis that streams with sustained baseflows would more likely be perennial, and therefore sustain suitable habitat for juvenile *Astacopsis gouldi* in subcatchments that contained a viable population of adult *A. gouldi*. If this were true, a case could be made for additional protection of Class 4 streams with these characteristics, as they may contribute toward the overall habitat area for juvenile *Astacopsis gouldi* in a subcatchment, and therefore may at least partially contribute to sustaining recruitment in a catchment's population.

To test this hypothesis, a further survey was initiated to compare overall survey densities of juvenile *Astacopsis gouldi* in perennial streams with those observed by Davies and Cook (2004) from non-perennial streams. The first part of this survey has been completed – of a set of streams in the same 'basalt headwater' geomorphological context as the original stream observed by Davies and Cook (2004). Further survey work will be conducted in 2005 to assess Class 4 stream juvenile *Astacopsis gouldi* densities in other geomorphological contexts in order to assess whether the results have any generality or are restricted to the 'basalt headwater' context.

## 1.2 Mapping habitat suitability

Davies and Cook (2004) provided sufficient information to allow the development of a set of mapping rules that could be applied to Tasmanian stream drainage in order to discriminate stream sections of high, medium or low suitability for juvenile *Astacopsis gouldi*. This information, as well as new information from further surveys of perennial Class 4 streams, has been used to develop an initial set of mapping rules.

This document is a report on the results of the first ‘basalt headwater’ Class 4 stream survey, as well as on the mapping rules developed for *A. gouldi* habitat suitability.

# 2. Methods

## 2.1 Field survey

Survey sites were selected using GIS by overlying the LIST stream drainage network onto the latest geology (MRT) map layer in ArcView 3.1. Sites were selected on streams with the following characteristics:

- catchment areas < 50 ha);
- headwaters overlying basalt; or
- headwaters arising downslope from a basalt boundary; and
- no significant instream (farm dam) or other structure (road, town) in its catchment.

Most such streams have a degree of agricultural or forestry development within their headwaters, particularly on the basalt. Streams were selected that had not experienced any substantial forest operations in the last 10 – 20 years at least.

Sites were surveyed as described by Davies and Cook (2004), by two personnel, conducting a visual search for 1.5 hrs at each site, typically over a stream length of 200-300 m, but ranging from 100 to 600 m, depending on the stream complexity and terrain. All juvenile *Astacopsis gouldi* encountered were measured (carapace length in mm), sexed and returned to the location where caught. All habitats were actively searched, and a number of environmental variable recorded. Site locations were recorded using a hand held GPS (AGD 1966 datum).

## 2.2 Mapping rules

Information available on the characteristics of habitat where *A. gouldi* occurs was reviewed (Growns 1995, Horwitz 1991, Horwitz 1994, Hamr 1990, Lynch 1967, Lynch and Bluhdorn 1997, Webb 2001, Walsh and Nash 2002, Davies and Cook 2004). This information and expert opinion was used to develop an initial set of rules discriminating classes of habitat suitability for *A. gouldi*.

# *3. Results*

## 3.1 Survey results

Results of the field surveys conducted in late 2004 - early 2005 are shown in Table 1.

A total of 16 Class 4 stream valleys were visited in this period. Two streams indicated on the 1:25 000 Tasmap were not present (ie were incorrectly mapped).

14 streams were successfully surveyed, of which two were dry. Four were observed to have very low flows and no indication of perennial baseflows, with one being partially underground.

Juvenile *Astacopsis gouldi* were observed in eight of the streams surveyed. This equates to 57% of all streams visited, and 100% of all perennial streams.

A total of 17 juvenile *Astacopsis gouldi* were observed, ranging from 27 to 115 mm carapace length (CL) and with a mean of 47 mm CL.

No juvenile *Astacopsis gouldi* were found in the four non-perennial streams. Thus, a mean of 1.21 JAG were observed from all Class 4 streams surveyed (ie all streams including the dry and non-perennial ones) in this geomorphological context. If only perennial streams are considered, the mean juvenile *Astacopsis gouldi* capture rate is 2.13 individuals per sampling event, equating to 0.94 individuals per 100m of stream searched.

**Table 1. Results of field surveys of Class 4 streams in a basalt-headwater geomorphological context, in late 2004 – early 2005.**

| Catchment | Site | Date | Easting (AGD 66) | Northing (AGD 66) | Catchment area (ha) | Stream order | Bankfull width (m) | Length searched (m) | *A. gouldi* observed: N | *A. gouldi* observed: Carapace Length (mm, m = male, f = female) | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Flowerdale R | Pinebrae Rd Ck 1 | 1/12/2004 | 377300 | 5450600 | 24 | 1 | 5 | 200 | 1 | 85m | Good flows, probably spring fed. |
| | Pinebrae Rd Ck 2 | 30/11/2004 | 377435 | 5451807 | 29.4 | 1 | 4 | 200 | 1 | 115m | " |
| | Pinebrae Rd Ck 3 | 2/12/2004 | 378478 | 5452828 | 20.5 | 1 | 5 | 250 | 1 | 35m | " |
| | Pinebrae Rd Ck 4 | 1/12/2004 | 378861 | 5452925 | 16.7 | 1 | 1.5 | 100 | 0 | | Very little flow, possibly not spring fed. |
| | Pinebrae Rd Ck 5 | 1/12/2004 | 379603 | 5453735 | 15.7 | 1 | 4 | 350 | 0 | | Stream shallow, frequently underground. |
| Inglis R | Jefferson Rd 1 | 4/01/2005 | 382707 | 5450899 | 30.8 | 1 | 1 | 350 | 0 | | Very little flow, possibly not spring fed. |
| | Jefferson Rd 3 | 5/01/2005 | 382275 | 5451350 | 38.8 | 2 | 2 | 455 | 0 | | " |
| Calder R | Bassetts Rd 1 | 5/01/2005 | 384425 | 5451313 | 31.1 | 1 | 1.5 | 350 | 2 | 36m, 70m | Good flows, probably spring fed. |
| | Upstream of Bassetts Rd | 5/01/2005 | 384626 | 5449037 | 42.1 | 2 | 1.5 | 300 | 1 | 32m | " |
| Blackfish R | Trib 1 | 6/01/2005 | 386648 | 5452604 | 39.9 | 1 | 3.5 | 575 | 2 | 43m, 39m | " |
| | Trib 2 | 6/01/2005 | 386589 | 5452451 | 45.8 | 2 | 2 | 160 | 7 | 31m, 31f, 27f, 42m, 35m, 44f, 39m | " |
| | Trib 3 | 6/01/2005 | 386694 | 5452292 | 24.5 | 2 | 1.5 | 393 | 2 | 47f, 48m | " |

## 3.2 Mapping rules

The mapping rules developed for discriminating habitat suitability classes for juvenile *Astacopsis gouldi* are as shown in Table 2. These rules do not take into account the impact of fishing. Two sets of criteria have yet to be defined (see items in red in Table 2):

- criteria describing all geomorphological contexts for which the probability of groundwater-sustained baseflows is high; and
- mapping attributes to discriminate the dominant stream substrate size (e.g. boulder/cobble vs sand/silt) present in a stream reach.

A workshop to define the geomorphological contexts was held in late February 2005, attended by M Latinovic (MRT), P Davies (Freshwater Systems), Peter Von Minden (GIS specialist), and representatives of the project management team (FPB, FT, Conservation Planning).

The stream substrate attributes will be derived from a state-wide fluvial geomorphological typology conducted for the CFEV (Conservation of Freshwater Ecosystem Values) project. This typology had been classified to discriminate stream reaches on the basis of dominant substrate type, based on the fluvial geomorphological context. This classification has already been applied to the stream drainage network at 1:25000 scale, but has yet to be formally ground-truthed.

**Table 2. Mapping rules for discriminating stream habitat suitability for *Astacopsis gouldi*.**

Rules to be used in numerical sequence (1 to 4) as follows:

1. UNSUITABLE HABITAT
   - all stream reaches > 400m elevation within catchments known or likely to contain A. gouldi as in current range boundary GIS layer (based on current known records and expert opinion).

2. HIGH SUITABILITY (ie, relatively undisturbed lowland perennial streams with coarse substrates)
   - stream classes 1 & 2 and 3, and stream class 4 in geomorphic contact zones (exact definition to be provided); with:
     a. < 250m elevation; and
     b. drainage section average slope < 10%; and
     c. geomorphic mosaics that represent optimal meso-habitat (ie, boulders & coarse substrates - exact classes to be provided) and snags; and
     d. riparian forest in relatively good condition (ie drainage section CFEV ripveg index > 0.8)

3. MEDIUM SUITABILITY
   - stream classes 1, 2 & 3, and class 4 streams in geomorphic contact zones, (ie, perennial streams):
     - with 250-400m elevation; and
     - that meet all the slope, mosaic and riparian forest rule conditions for High Suitability (b-d above);

   or

   - stream reaches < 250 m elevation that:
     - only meet one of the slope or mosaic conditions for High Suitability (b-c above)and have riparian vegetation in good condition (ie of CFEV ripveg index > 0.8); or
     - they meet both mosaic and slope conditions for High Suitability (b-c above)and riparian vegetation is not in good condition (ie CFEV ripveg index < 0.8).

4. LOW SUITABILITY
   - stream classes 1, 2 & 3, and class 4 streams in geomorphic contact zones, that have poor condition riparian forest (ie CFEV ripveg index < 0.2); or
   - all remaining class 4 streams (ie not in geomorphic contact zones); or
   - all remaining streams of 250 – 400 m elevation (ie those that fail one or more of the High Suitability rule conditions for mosaics, slope or riparian vegetation).

## 4. Discussion

Our survey results support the suggestion that perennial Class 4 streams have substantially higher juvenile *A. gouldi* densities than non-perennial Class 4 streams.

We observed a high incidence of juvenile *A. gouldi* in the 'basalt headwater' Class 4 streams – 60% overall streams selected by GIS, and 100% of all truly perennial streams .This contrasts markedly with the low incidence observed in non-perennial streams by Davies and Cook (2004) using the same search methods – only 1 juvenile *A. gouldi* observed in 17 streams surveyed, or an overall incidence of 5.9%. Catch per unit effort (CPUE) figures also contrast markedly – 1.2 and 2.1 individuals per 100m stream length for all 'basalt headwater' Class 4 streams and those confirmed to be perennial, respectively, compared to an average figure of 0.039 per 100 m for non perennial Class 4 streams reported by Davies and Cook (2004). This represents a difference in incidence and CPUE of 9.7 and 30.8 times between Class 4 streams in a 'basalt headwater' geomorphological context and non-perennial streams. The CPUE for perennial 'basalt headwater' streams approaches those observed for Class 2 streams by Davies and Cook (2004) (3.6 individuals per 100 m).

Further surveys are to be conducted in 2005 in other geomorphologicial contexts known to support perennial baseflows (e.g. Mathinna sandstones overlying turbidites, fractured dolerite overlying sandstones etc), to assess the possibility that groundwater-flows are the main factor and that the juvenile *A. gouldi* observations are not restricted to the 'basalt headwater' context alone.

Work will continue in 2005 on refining the mapping rules for discriminating habitat suitability for *A. gouldi*. Preliminary mapping will be undertaken to develop a draft 'habitat suitability' map to inform conservation planning for *A. gouldi*.

## *5. References*

Davies PE and Cook LSJ 2004. Juvenile *Astacopsis gouldi* in headwater streams –relative abundance and habitat. Report to the Forest Practices Board. April 2004. 42 pp.

Davies PE, Cook LSJ, Munks SA and Meggs J. (2005 - submitted). Juvenile *Astacopsis gouldi* in headwater streams – relative abundance and habitat. *Tasforests*

Growns I 1995. *Astacopsis gouldi* in streams of the Gog Range, northern Tasmania: the effects of catchment disturbance. Papers and proceedings of the Royal Society of Tasmania.

Hamr P 1990. Comparative reproductive biology of the Tasmanian freshwater crayfishes *Astacopsis gouldi* Clark, *Astacopis franklinii* Gray and *Parastacoides tasmanicus* Clark (Decapoda: Parastacidae). PhD Thesis, Department of Zoology, University of Tasmania.

Horwitz P 1991. On the distribution and exploitation of Tasmanian giant freshwater lobster *Astacopsis gouldi* Clark. Centre for Environmental Studies, University of Tasmania, Hobart.

Horwitz P 1994. The distribution and conservation status of the Tasmanian giant freshwater lobster *Astacopsis gouldi* Clark (Decapoda: Parastacidae). Biological Conservation 69: 199 – 206.

Lynch, DD 1967 A synopsis of biological data of the giant freshwater crayfish, *Astacopsis gouldi* Clark 1936, Inland Fisheries Commission, Hobart.

Lynch TP and Bluhdorn DR 1997 Reservation assessment and habitat requirements of the giant freshwater lobster, *Astacopsis gouldi*. Report to the Tasmanian RFA Environment and Heritage Technical Committee.

Walsh T and Nash W 2002. Factors influencing the health of the giant freshwater lobster in Tasmanian rivers. Unpub. report, Inland Fisheries Service Hobart, Tasmania.

Webb M 2001. Movement patterns and habitat use of adult *Astacopsis gouldi* in the Dip River, north-west Tasmania. Honours thesis, School of Zoology, University of Tasmania.