

TASMANIA'S BURROWING CRAYFISH

INTRODUCTION

Tasmania has 15 known and identified species of this unusual group of crayfish. A recent exciting discovery may make it 16 species but one of the interesting things about these species is their often very restricted distribution within Tasmania. A few such as *Engaeus cisternarius*, *E. fossor* and *E. mairener* are spread over large areas of the *Engaeus* distribution while others are known only within a small localised area where disturbance and loss of habitat can have disastrous effects. Amongst these are the species listed as threatened.

Rarely seen above ground, the presence of *Engaeus* is usually characterised by the "chimneys" they build over their burrows. Some of these structures have been measured at over 30 cm high and their purpose (like so much about these fascinating species and their life history) is as yet unknown.

ENGAEUS

Evolution of Freshwater Crayfish

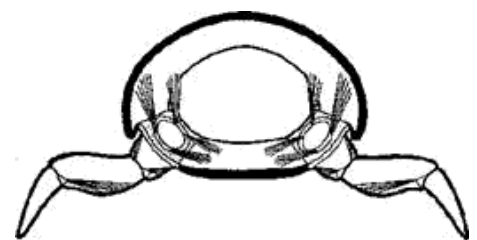
Freshwater Crayfish have a fascinating evolutionary history. Occurring on nearly every continent (except India and Africa), freshwater crayfish show incredible diversity and a high degree of speciation. They are officially called the Astacids.

Freshwater crayfish split from their marine counterparts, the Homarids, over 285 million years ago during the Permian age when the super-continent Pangea was just forming (Freshwater Crayfish, Volume 12, Scholtz, 1999).

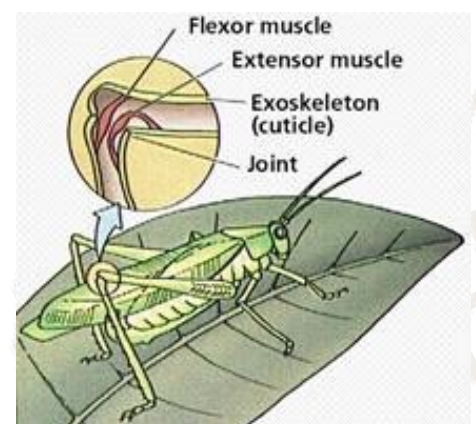
Though superficially similar, marine and freshwater crayfish have few similarities and are related only distantly.

Freshwater crayfish are crustaceans: non-insect representatives of the Arthropoda phylum bearing a hard exoskeleton, many pairs of appendages (three of which have adapted to form mouthparts), two sets of antenna and a strong pair of claws or chelae. Marine crayfish rarely have claws. Australian marine crayfish (or lobsters) never have claws.

Possessing a common set of characteristics which date back to their earliest ancestors, the freshwater crayfish group is believed to have emerged from the sea only once. Though where it began remains unknown, a single group of crayfish (the oldest ancestors of modern freshwater crayfish) developed adaptations to the freshwater environment and radiated to become common in most parts of the world.



Transverse section of an invertebrate showing the absence of an internal skeleton



Useful definition:

Exoskeleton (or outside skeleton)

A strong layer on the outside of the body which provides a structure for organs and muscles to hang from

Crayfish Cladistics

Freshwater Crayfish occur in two groups: the Northern Hemisphere Astacoidea and the Southern Hemisphere Parastacoidea. The Astacoidea are divided into two smaller groups, the Astacidae: found in Europe and western North America and the Cambaridae: found in North America to middle America and east Asia.

Parastacoidea are the southern Hemisphere group and can be found in South America, Madagascar, Australia, New Guinea and New Zealand. There are 14 genera of crayfish in the Parastacoidea subfamily.

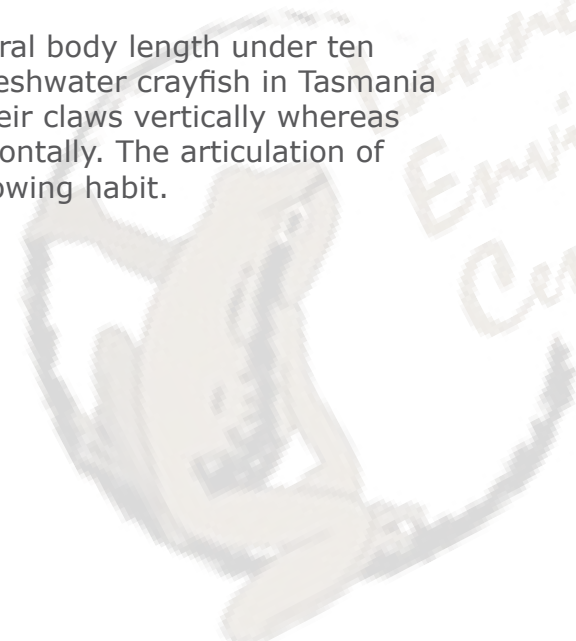
Over 85% of known species of Parastacid crayfish can be found on the Australian continent and nearby islands (Hobbs, 1988; Hobbs, 1991). Recognised in terms of species richness and ecological and morphological diversity, the unique Australian freshwater crayfish fauna is considered the best in the world. In Queensland, *Tenuibranchiurus glypticus* (the Swamp Crayfish) reaches only 25mm in length and is the smallest freshwater crayfish in the world. The Tasmanian Giant Freshwater Lobster (*Astacopsis gouldi*) is the largest in the world and reaches over 5kg and 80cm in length. Due to overfishing the average size of the animal has been greatly reduced, even though it is now a fully protected species.

Tasmania's Freshwater Burrowing Crayfish

The only group of crayfish able to complete their entire life cycle independent of surface water (Crandall et al 1999): *Engaeus* dominates the freshwater crayfish fauna in Tasmania. Competing with three other native genera as well as the introduced yabby (*Cherax destructor*, an introduced pest crayfish species brought to Tasmania from the mainland several times over the last 200 years) the highly evolved *Engaeus* group is the most diverse group of freshwater crayfish in Tasmania.

The four genera of freshwater crayfish native to Tasmania are: *Astacopsis* (3 species), *Parastacoides* (14- 15 species and currently under revision), *Geocharex* (1 species) and *Engaeus* (the freshwater burrowing crayfish) which has fifteen species occurring Tasmania, thirteen of which are endemic. The two species shared with Victoria shed important light on the zoogeography of Gondwana and the speciation of *Engaeus* both before and after the last glaciation (approximately 10,000 years ago).

Engaeus are small freshwater burrowing crayfish, with a general body length under ten centimetres. They can be distinguished from other types of freshwater crayfish in Tasmania by the way they hold their claws (or chelae). *Engaeus* hold their claws vertically whereas all other groups of crayfish hold their claws more or less horizontally. The articulation of *Engaeus*' claws are believed to be an adaptation to their burrowing habit.

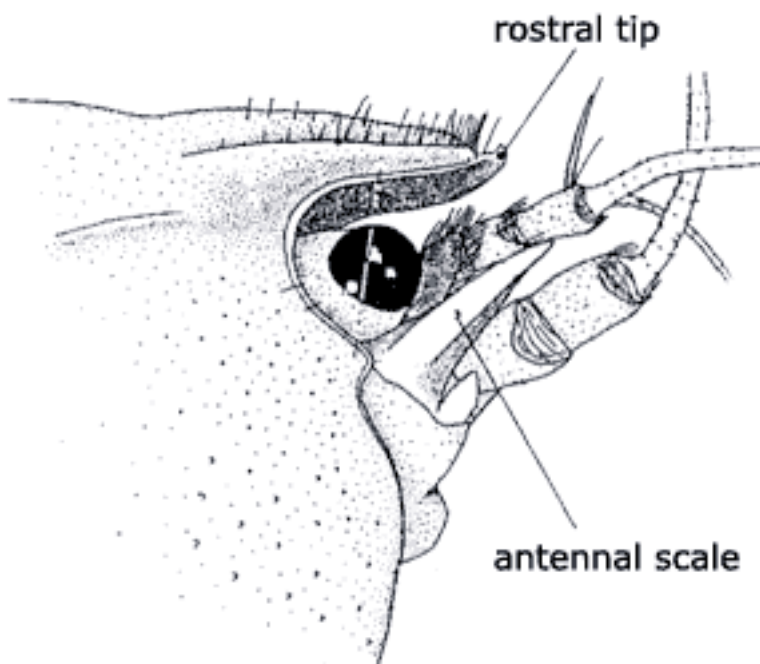


Engaeus are mostly found in the north of the state, with both the north-east and north-west characterised by their own distinct subgroups. Some species have very broad geographical ranges, while others are very restricted (see Habitat) A handful of species are relatively unknown and require further attention.

Taxonomists distinguish Engaeus species by various combinations of the following characters: rostrum shape and length, the presence or absence of sutures on the outer rami of the tail fan, differences in the antennal scale, antennal length, and the third maxilliped and its exopodite and the presence or absence of different shaped pores on the lateral processes. By using the combination of the distribution map followed by the identification table it should be possible for the layman to determine the species of an individual from a particular area of Tasmania.

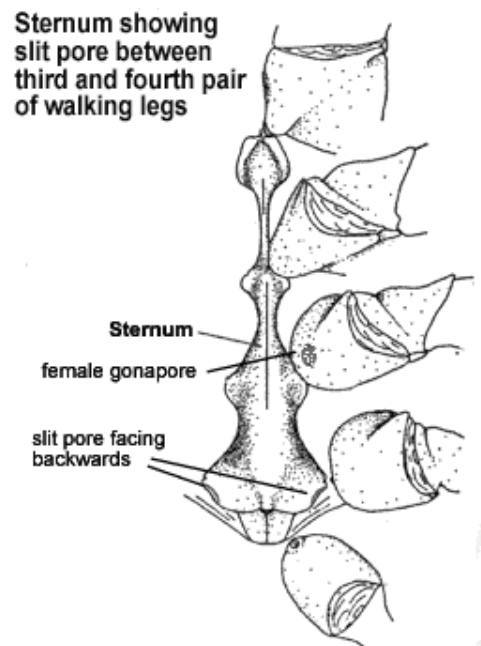
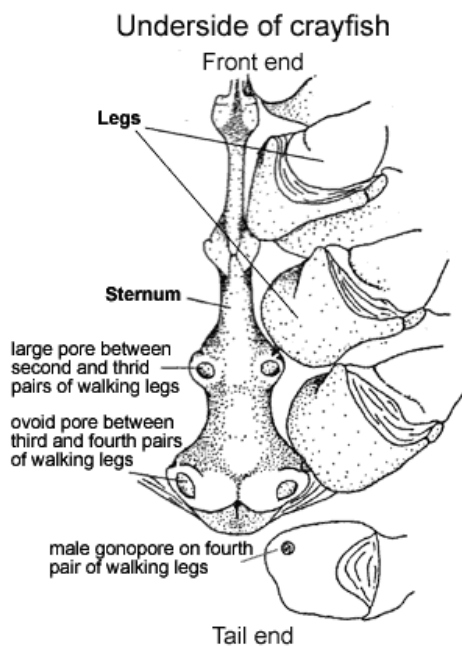
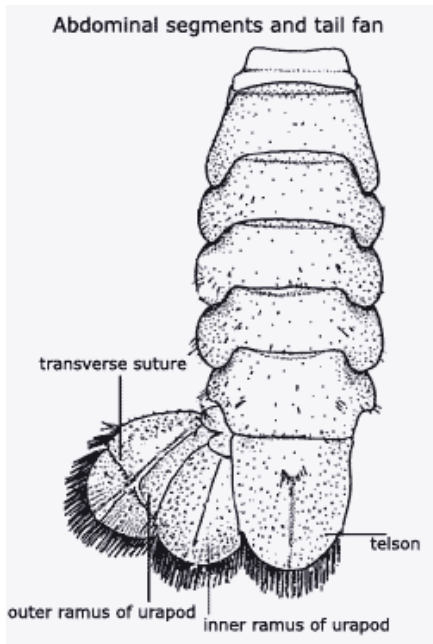
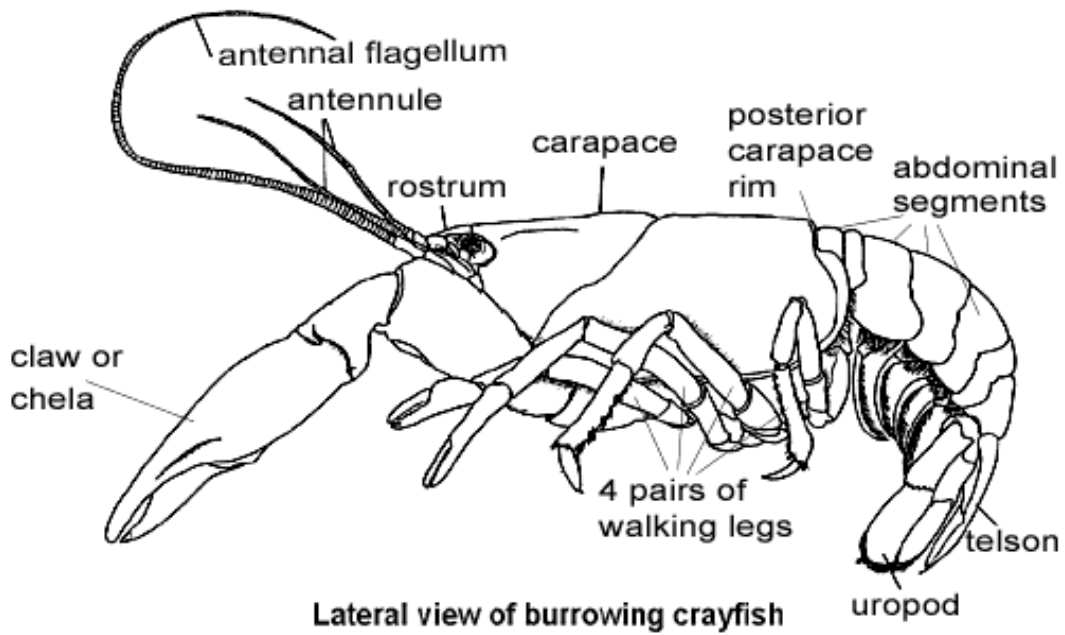


Engaeus mairener showing horizontal articulation of claws and small body size which are characteristic of the genus.



Head of burrowing crayfish





ENGAEUS HABIT AND HABITAT TYPE

Several studies have been carried out on Engaeus species, covering such topics as habitat partitioning and preferences, burrow structure, food, and other general ecology (Suter & Richardson 1977, Richardson & Swain 1980, Horwitz et al. 1985a+b, Horwitz 1986, Richardson & Horwitz 1987). Most species of Engaeus are characterised by their ability to burrow, often to considerable depths, and specimens are only rarely seen above ground or in standing water (Horwitz 1990a, Doran and Richards 1997) usually during mating.

Engaeus prefer wet muddy areas but can be found in a range of habitat types as long as water can be made available. Their preference for various habitat types determined (sometimes finely) by the local topography. Most Engaeus species prefer wet areas dominated by ferns whereas Engaeus spinicaudatus (Scottsdale Burrowing Crayfish) is found primarily in buttongrass (*Gymnoschoenus sphaerocephalus*) moorland.

Other species can be found in a variety of habitats including highly modified areas of pasture, roadsides and recently burnt forestry coupes. Even in seemingly dry areas, populations of burrowing crayfish have been known to thrive.

While crayfish may not be communal per se (Horwitz et al. 1985b), mature females show an unusual degree of maternity and up to four generations of crayfish can exist within a single burrow system at one time. The generations are represented by:

a mature female crayfish

over 100 hundred eggs carried under the tail of the mature female crayfish (fecundity has been shown to correlate with animal size).

young crayfish (5mm long) which stay in the burrow with the mature female crayfish for several months

offspring from the season before (10-16mm long) which are beginning to leave the parental burrow, to dig, disperse and find burrows of their own (A. Richardson, pers. comm.).

Engaeus burrows can be quite simple and shallow, or complex and extensive (image) and can often be the product of several generations of crayfish burrowing activity (A. Richardson, pers. comm.)



Buttongrass moorland, North Scottsdale, Tasmania



Gymnoschoenus sphaerocephalus (Buttongrass)

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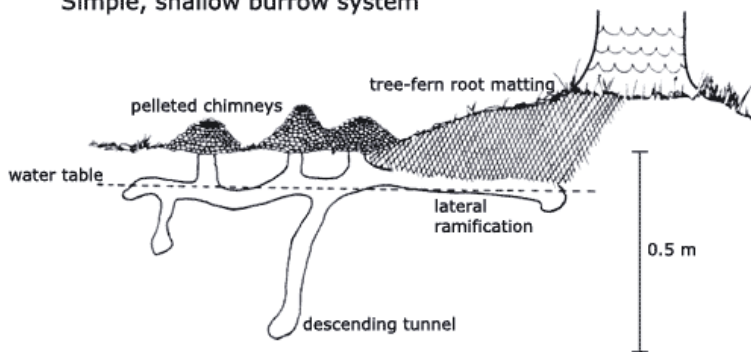
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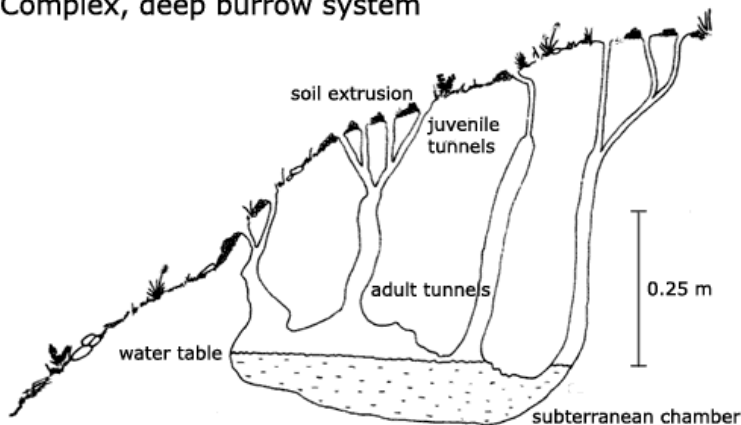
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Simple, shallow burrow system



Complex, deep burrow system



CAN I ACCESS THE DATA?

Waterwatch data from this project as well as data from DPIWE sites will be accessible online via the WIST (Water Information System for Tasmania) website soon.

FOR MORE INFORMATION

LEC -Launceston Environment Centre
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p: 03 6331 8558
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e: info@lec.org.au

PO Box 392
Launceston TAS 7250.

ACKNOWLEDGEMENTS

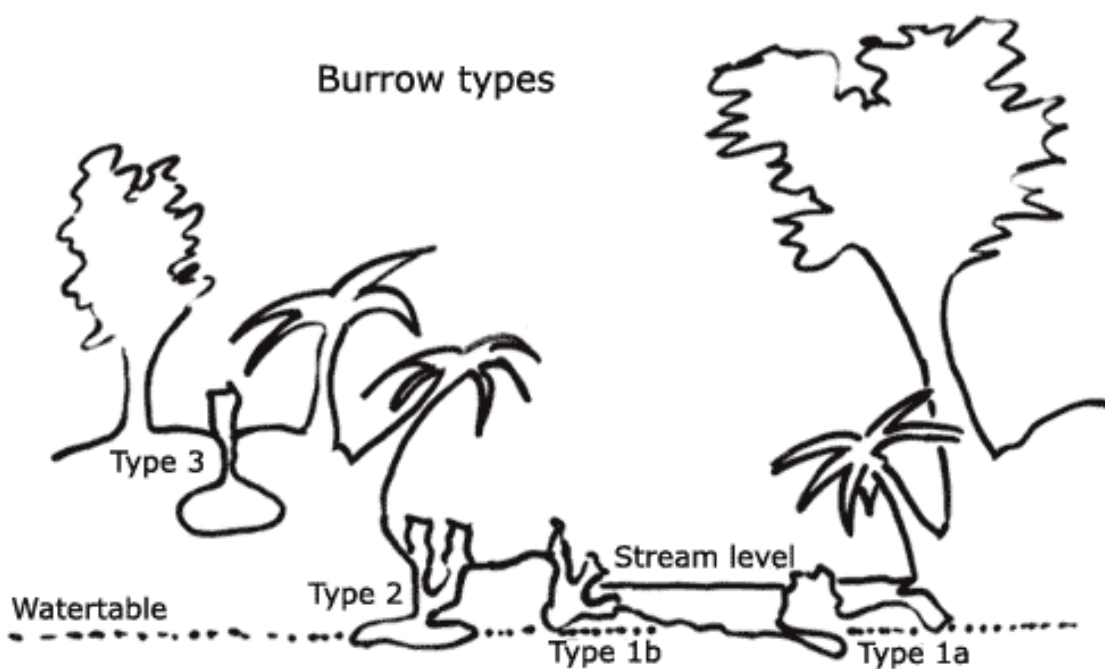
This project has strong community support. Many thanks to the wonderful Waterwatch volunteers, landholders and schools involved, DPIWE Water Assessment and Planning Branch, DPIWE Rivercare section, Waterwatch Australia, Five Rivers Waterwatch, Southern Waterwatch and to all the municipal councils in the region.



ENGAEUS BURROW TYPE

Crayfish burrows can be classified according to their location and hydrologic character (Horwitz & Richardson 1986). Type 1a and type 1b burrows are found in or connected to permanent waters such as streams or lakes, and this provides their source of water. Type 2 burrows are found connected to the water-table and receive their water from both groundwater and surface runoff, while type 3 burrows are independent of the water-table and derive their water from run-off only (See figure below).

Type 3 burrows are only found in Australia, and are only known to be constructed by *Engaeus* species (Horwitz & Richardson 1986, A. Richardson pers. comm.). As a result they are the most terrestrial of the world's freshwater crayfish, which may limit their dispersal through waterways and promote restricted ranges and speciation. These factors may play a role in the high diversity of the genus over such a small geographical area, while leaving species particularly prone to threatening processes.



ENGAEUS IDENTIFICATION

The Engaeus genus is restricted to the green shaded area within Tasmania. This area is overlapped by the presence of the other Tasmanian crayfish species mentioned in the Description section under Tasmania's Freshwater Burrowing Crayfish.



MANAGEMENT GUIDELINES

General

The Engaeus group of crayfish includes the most terrestrial of all known crayfish species. Many of the species have very restricted distributions and are reliant on specific habitat conditions such as climate, vegetation and soil types. As the crayfish have gills, all species require moisture within the soil, from seepages, ground water, streams or collected run-off. Hence these species are vulnerable to changes in hydrology affecting water quality and quantity. Threatening processes come from agricultural and forestry activities, industry and continued urban sprawl which can impact on the burrowing crayfish habitat through pollution, fire, loss of native vegetation, sedimentation and disturbances within the waterways including dam-building and drainage works.

Where there is evidence of burrowing crayfish, steps should be taken to protect their habitat from major disturbance. On private land this often simply means fencing the streams and wet areas to prevent stock access, replanting or encouraging regrowth of native vegetation and ensuring weeds do not become established within the area.

Where chemical herbicides are unavoidable it is essential that only those registered for use along waterways are used (at time of writing, Bioactive Roundup® and Weed master 360®). Surfactants contained in herbicides not registered for use along waterways are known to kill aquatic fauna. Mulching of weeds may be an environmentally friendly option using material free of weed-seeds - click here for the Rivercare Guideline for Safe and Effective Herbicide Use Near Water.

Management guidelines for threatened species

Engaeus spinicaudatus

This is our most endangered burrowing crayfish species due principally to the species very restricted distribution in the NE of Tasmania. Their chief habitat includes buttongrass and heathy plains particularly with peaty soils. As a result hot fires that can burn the peat soils are a direct threat to the survival of the species. Equally, absence of fire from these fire-adapted areas for long periods can also impact on the species through changes in the vegetation type impacting on the water table and water availability for the Scottsdale Burrowing Crayfish.

Species and associated vegetation management guidelines are currently being determined for this particular species and the unique habitat it requires. If the Scottsdale Burrowing Crayfish is found on your property, seek advice from the Threatened Species Unit of the Department of Primary Industries, Water and Environment.

Engaeus orramakunna

Agricultural and forestry activities pose the most serious threats to the Mt Arthur Burrowing Crayfish. While adherence to the Forest Practices Code may minimise impact on the species through restricting activities within streamside areas, forestry activities which lead to changes in hydrology, sedimentation and disruption of their habitat can still impact severely on the survival of the species.

Within agricultural land, the species is probably more at risk as there is no code of practice to protect *E. orramakunna*. Major threats in this environment are loss of water quality and disruption of habitat through stock access, dam building, drainage works and streamside vegetation clearance.

To protect the species, areas known to have populations of *E. orramakunna* as well as suitable habitat for colonisation, should be fenced from stock access and revegetated or where remnant native vegetation remains, allowed to regenerate. The area should be protected from weed invasion.

Engaeus yabbimunna

Changes to quality and quantity of water and habitat removal impact on populations of the Burnie Burrowing Crayfish. Increasing urbanisation and industrial pollution in particular are thought to be contributing to the reduction of populations of this species. Agricultural and forestry activities also impact on populations through changes to the hydrology of the area through drainage, roading, dam building, streamside land clearance, soil compaction, sedimentation and changes to water quality. Stock access can be especially detrimental, causing disruption of colonies by soil compaction, sedimentation and loss of water quality. Widespread streamside land clearance over many years has left few of the smaller streams with this species preferred habitat of native vegetation, particularly including treeferns.

To protect the species, areas known to have populations of *E. yabbimunna* as well as suitable habitat for colonisation, should be fenced from stock access and revegetated or where remnant native vegetation remains, allowed to regenerate. The area should be protected from weed invasion.

ENGAEUS PROJECTS

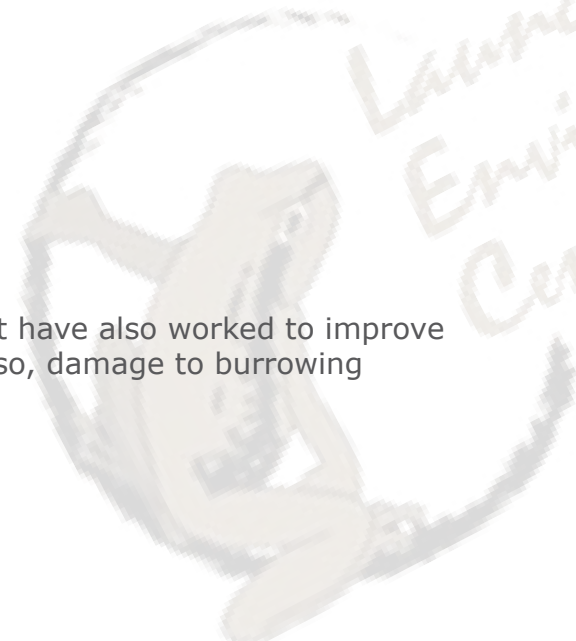
The Engaeus Project: "Habitat Management through Community Works for Burrowing Crayfish Species Engaeus" has been the driving force behind all initiatives to ensure that Engaeus species generally, but especially *Engaeus spinicaudatus* (Scottsdale Burrowing Crayfish), *Engaeus orramakunna* (Mt. Arthur Burrowing Crayfish) and *Engaeus yabbimunna* (Burnie Burrowing Crayfish) are protected.

In conjunction with the Engaeus Project several other groups have directed projects to ensure that crayfish issues and efforts to improve habitat remain a priority.

Groups involved:

Dorset Water Watch
Greening Burnie
Burnie Wildlife Project
The Mt. Arthur Management Group
Greening Australia
Bush Care
Land Care

Projects have focussed on rehabilitation of crayfish habitat but have also worked to improve community awareness of issues relating to crayfish. In doing so, damage to burrowing crayfish habitat has been mitigated.



Schools

Lilydale District High School has been actively involved in conservation of burrowing crayfish species for several years. In 2002 several students were involved in monitoring crayfish habitat. This involved counting crayfish burrows and assessing the level of crayfish burrowing activity. After collating results students compared the activity of burrowing crayfish in 2002 to the level of activity the previous year.



Home-schooled kids enjoying a “Crayfish Crawl” down the Great Forester River in the Northeast of Tasmania.

Other schools involved in protecting crayfish have propagated and planted trees in areas occupied by the crayfish. Yolla School in North west Tasmania has “adopted” an area of creek within the Elliott Research Station, rehabilitating a section of stream on Seabrook Creek through revegetation with local native species, ensuring an increasingly healthy environment for the crayfish.

Other schools involved in Engaeus habitat rehabilitation include: Brooklyn Primary, Stella Marist Primary, Havenview Primary and Miandetta Primary.

As well as planting, weeding is also an excellent way of improving habitat for burrowing crayfish. Keep in mind however, that altering above ground vegetation drastically can have an adverse impact on crayfish. Removing weeds from an area can alter the soil and water temperature so if weeds are the only things growing in an area, gradual removal of weeds along side planting of native seedlings is recommended. Also consideration should be paid to the type of herbicide used. (More information provided in Management Guidelines).

On private land, projects have focussed on fencing out stock. Especially in late winter and early spring when the ground is soft, stock can be very damaging to crayfish and their young. Keeping stock out of areas occupied by the crayfish is a simple but very effective way of improving habitat for burrowing crayfish.

Other projects focus on ensuring that land providing habitat for burrowing crayfish is protected. This can be done by entering into covenants or Land for Wild Life agreements with the government. Information about both these options can be found at www.papl.tas.gov.au.

Funding from Wetland Care Australia has provided the opportunity to ensure that an area of Buttongrass Moorland providing habitat for *Engaeus spinicaudatus* is managed more effectively. With advice from Forestry Tasmania, the Department of Primary Industries, Water and Environment and Dorset WaterWatch, an Action Plan for the area is currently being developed.

EDUCATIONAL RESOURCES












This is an educational resource created by Project officers for Tasmania's Freshwater Burrowing Crayfish, *Engaeus* group. The activities can be used by students statewide but are particularly applicable to students in the north, where burrowing crayfish are located. These activities focus on *Engaeus orramakunna* (Mt. Arthur burrowing crayfish), *Engaeus yabbimunna* (Burnie burrowing crayfish) and *Engaeus spinicaudatus* (the Scottsdale burrowing crayfish). These species are three of the four Tasmanian species of Freshwater Burrowing Crayfish which are threatened.

The activities are designed to help students and teachers develop a better appreciation of *Engaeus* species and the complexities that exists in areas of native bush. By examining *Engaeus* in relation to other parts of the landscape, students may begin view the landscape as a system in which humans and their actions play a role. By seeing themselves as connected to the system students may develop a sense of ownership followed by respect and appreciation for the natural world.

Below is a table of the activities available. The last section (Power Point Presentations) may be used by teachers or as a starter for students wanting to complete their own presentation. Information is provided to accompany each of the presentations.

The activities are designed to complement rather than detract from the material already taught within the class. All information required for completion of the activity is clearly labelled and located within the same folder on this disk and no background knowledge is required. Any information written in italics should be used by the teacher before beginning the activity and read to students to enhance their benefit from the activity. Material from other activities may be useful as background information in some cases. The information provided may be adapted or used by teachers to develop other activities more applicable to the region and/ or the abilities of the students in the class.



Activity	Subject	Name	Download
1	Comprehension	Be a burrowing crayfish for a day	 
2	Physics Comprehension Interpretation	The famous chela: chopstick comparison	
3	Art	Examine special crayfish more closely	
4	Comprehension Comparison Maths	Clearing up the feral concept - Yabbies and freshwater crayfish	 
5	Maths	Help 'Buttons' the freshwater burrowing crayfish find her way home	
6		PowerPoint Presentations Monsters and Mysteries (Burnie area) The other 90% (Scottsdale area)	   

Directions for use:

- Select activity from above table.
- Click on each icon to start downloading. You may need Microsoft Word, Microsoft PowerPoint or the free Adobe Acrobat Reader.
- Print out all downloaded files.
- Read italicised parts to students.
- Disseminate activity to class.



ENGAEUS RELATED LINKS

Below are several relevant links.

Information on Threatened Fauna

<http://www.bushcare.tas.gov.au/Threatend.htm>

Animals listed as extinct, endangered or vulnerable. Information sourced from Tasmanian Threatened Fauna Handbook Bryant and Jackson, 1999.

Burrowing Crayfish (Engaeus) Recovery Plan 2001-2005

<http://www.deh.gov.au/biodiversity/threatened/recovery/index.html>

Niall Doran, Department of Primary Industry, Water and the Environment Parks and Wildlife Service, Threatened Species Unit, November 1999.

DPIWE Threatened Species Site:Burrowing Crayfish

<http://www.dpiwe.tas.gov.au/inter.nsf/WebPages/LBUN-4WU72A>

Distribution, Habitat and Biology, Key Threats to Burrowing Crayfish Species, More Information, Tasmapp Sheets, Protecting Crayfish.

Marist College Burrowing Crayfish Project

<http://www.mrc.tas.edu.au/bbc/index.html>

DPIWE Burrowing Crayfish fact sheet

[http://www.dpiwe.tas.gov.au/inter.nsf/Attachments/SJON-5MB9E8/\\$FILE/BurrowingCray.pdf](http://www.dpiwe.tas.gov.au/inter.nsf/Attachments/SJON-5MB9E8/$FILE/BurrowingCray.pdf)

Habitat Management Recommendations for Threatened Aquatic Species

<http://www.dpiwe.tas.gov.au/inter.nsf/WebPages/JMUY-57A6M2>

Inland Fisheries Tasmanian Freshwater Crayfish site

http://www.ifc.tas.gov.au/fact_sheets/freshwater_crayfish.htm

Crayfish world for the crayfish enthusiast

<http://www.crayfishworld.com>

FOR MORE INFORMATION

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