

# Dunsborough Burrowing Crayfish (*Engaewa reducta*), Margaret River Burrowing Crayfish (*Engaewa pseudoreducta*) and Walpole Burrowing Crayfish (*Engaewa walpolea*) Recovery Plan 2007 –2016

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Wildlife Management Program No. 41



Department of  
**Environment and Conservation**

Our environment, our future 



**Australian Government**

**Dunsborough Burrowing Crayfish (*Engaewa reducta*), Margaret River Burrowing Crayfish (*Engaewa pseudoreducta*) and Walpole Burrowing Crayfish (*Engaewa walpolea*)**

**Recovery Plan 2007-2016**



23 January 2008

Species and Communities Branch  
Department of Conservation and Land Management  
Locked Bag 104, Bentley Delivery Centre WA 6983

Above: Dunsborough Burrowing Crayfish (*Engaewa reducta*) Photo: Kelly Rogerson  
Cover: Walpole Burrowing Crayfish (*Engaewa walpolea*) Photo: Kelly Rogerson

## **FOREWORD**

Recovery Plans are developed within the framework laid down in Department of Conservation and Land Management (CALM) Policy Statements No 44 and 50.

Recovery Plans outline the recovery actions that are required to address those threatening processes most affecting the ongoing survival of threatened taxa or ecological communities, and begin the recovery process.

Recovery Plans delineate, justify and schedule management actions necessary to support the recovery of threatened species and ecological communities. The attainment of objectives and the provision of funds necessary to implement actions are subject to budgetary and other constraints affecting the parties involved, as well as the need to address other priorities. Recovery Plans do not necessarily represent the views or the official position of individuals or organisations represented on the Recovery Team.

This Recovery Plan was approved by the Department of Environment and Conservation, Western Australia. Approved Recovery Plans are subject to modification as dictated by new findings, changes in status of the taxon or ecological community and the completion of recovery actions. The provision of funds identified in this Recovery Plan is dependent on budgetary and other constraints affecting the Department, as well as the need to address other priorities.

Information in this Recovery Plan was accurate at 30 June 2007.

### **RECOVERY PLAN PREPARATION**

This Recovery Plan was prepared by Kellie Mantle<sup>1</sup> for the Burrowing Crayfish Recovery Team.

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## SUMMARY

### Dunsborough Burrowing Crayfish *Engaewa reducta* Riek 1967

<b>Family:</b>	Parastacidae
<b>DEC Region:</b>	South West
<b>DEC District:</b>	Blackwood
<b>Current status of taxon:</b>	Endangered
<b>Habitat/Distribution:</b>	Vegetated surface seepages, swamp plains and shallow swampy headwater tributaries of Carburnup River/Mary Brook and Station Gully catchments and other small coastal watercourses draining into Geographe Bay.

### Margaret River Burrowing Crayfish *Engaewa pseudoreducta* Horwitz & Adams 2000

<b>Family:</b>	Parastacidae
<b>DEC Region:</b>	South West
<b>DEC District:</b>	Blackwood
<b>Current status of taxon:</b>	Critically Endangered
<b>Habitat/Distribution:</b>	Vegetated shallow swampy headwater tributaries of Margaret River near Osmington.

### Walpole Burrowing Crayfish *Engaewa walpolea* Horwitz & Adams 2000

<b>Family:</b>	Parastacidae
<b>DEC Region:</b>	Warren
<b>DEC District:</b>	Frankland
<b>Current status of taxon:</b>	Vulnerable
<b>Habitat/Distribution:</b>	Surface seepages, swamp plains and shallow swampy creeklines in Walpole-Nornalup National Park

**Habitat critical for survival of *E. reducta*, *E. pseudoreducta* and *E. walpolea*:** The area of habitat important for the conservation of *Engaewa* spp. can be described as all areas currently occupied by the species throughout their geographical ranges, plus their upstream catchments which are important for the maintenance of the areas where they do occur. The survival of each habitat and its population is important because the extremely limited dispersal abilities of *Engaewa* spp. make it unlikely that recruitment from other populations occurs.

**Recovery Team:** The co-ordination and implementation of this recovery plan will be supervised by a Recovery Team. This team is to include representatives from the Department of Environment and Conservation (DEC) Blackwood and Frankland Districts, Edith Cowan University (ECU), Augusta-Margaret River and Busselton Shires, Department of Fisheries, and community based management bodies including South-west Catchment Council's Cape to Cape Catchment Group and GeoCatch.

**Recovery Objective:** To ensure the survival of existing populations and to improve their conservation status for possible future downlisting by:

<b>Determining the current distribution and identifying additional populations of <i>Engaewa</i></b>	<b>Increasing public awareness and participation in threatened species protection</b>	<b>Protecting habitat</b>	<b>Improving knowledge of <i>Engaewa</i> life history and ecology</b>
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<b>Criteria for success</b>	Extent of occurrence remains stable or increases	Provision of information resources and interpretative materials	Increase in area of habitat managed for conservation	Improved understanding of habitat requirements, life cycle & threatening processes
	Area of occupancy remains stable or increases			Fire management prescriptions developed
	The number of known populations remains stable or increases			Feasibility of captive breeding/translocations determined

<b>Criteria for failure</b>	Extent of occurrence decreases by 30% or more	No deployment of information resources or interpretative materials	Area of habitat managed for conservation decreases by 20% or more	No improved understanding of habitat requirements, life cycle & threatening processes
	Area of occupancy decreases by 30% or more			Fire management prescriptions not developed
	The number of known populations decreases by 10% or more			Feasibility of captive breeding/translocations not determined

<b>Actions</b>	Habitat surveys	Promote community awareness and involvement	Off-park conservation programs	Research and population and habitat monitoring
	Population and habitat monitoring		SEA roadside marking	
			Habitat acquisition	

## 1. INTRODUCTION

*Engaewa* spp. are small terrestrial freshwater crayfish belonging to the Parastacidae family. Parastacids have characteristics such as poor powers of dispersal, long life-cycles and slow maturation that lead to short-range endemism, making them vulnerable to human disturbances (Harvey 2002). In Australia the Parastacidae family has 122 described species found in nine genera, making it one of the most diverse freshwater crayfish faunas in the world. More than one-quarter of these are considered to be in need of conservation efforts (Whiting *et al.* 2000).

The *Engaewa* genus is distinct from others within the Parastacidae family having been separated from the rest of crayfish for a long evolutionary period (Krandall *et al.* 1999). There are currently five\* recognised species within the *Engaewa* genus which is endemic to south-western Australia (**Figure 1**). Occurring within the Warren Bioregion, *Engaewa* spp. are seepage or palusplain inhabitants (coastal flats, headwater seepages, peat swamps etc) in the highest rainfall zone. Three of the five recognised *Engaewa* spp., the Dunsborough Burrowing Crayfish (*Engaewa reducta*), Margaret River Burrowing Crayfish (*Engaewa pseudoreducta*) and Walpole Burrowing Crayfish (*Engaewa walpolea*) have narrow geographical ranges and few known populations and subsequently listed on Schedule 1 – Fauna that is rare or likely to become extinct pursuant to Section 14(2)(ba) of the Western Australian *Wildlife Conservation Act 1950*.

The swamp systems that they are associated with are becoming increasingly fragmented and exposed to threatening processes, particularly in the north. Therefore, any recovery actions undertaken to benefit one species are likely to apply to the others and this is why a combined Recovery Plan for the Dunsborough Burrowing Crayfish (*Engaewa reducta*), Margaret River Burrowing Crayfish (*Engaewa pseudoreducta*) and Walpole Burrowing Crayfish (*Engaewa walpolea*) has been prepared.

\* Studies by Burnham (2005) have indicated that further investigation of the species *Engaewa similis* is warranted and it is not improbable that with more extensive sampling and analysis the number of species/sub-species will increase given the cryptic nature of these creatures.



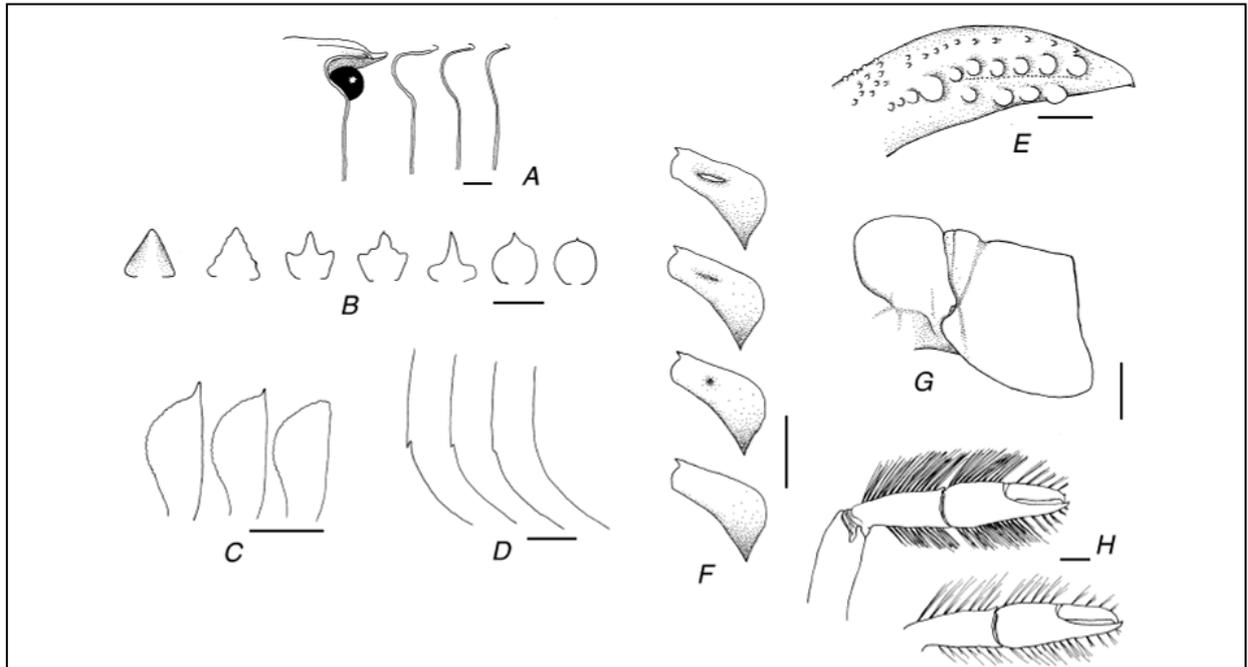
**Figure 1** Distribution of the five species currently recognised in the *Engaewa* genus (Map modified from Burnham, 2005)

## 1.1. General Description

*Engaewa* spp. are small obligate burrowing freshwater crayfish ( $\leq 50$ mm total length). The upper surface of chelae are notably coloured, ranging from pale purple to bright cobalt blue. The remainder of the body is translucently pale although some have been observed to have darker translucency. *Engaewa* spp. are grouped along with crayfish from genera such as *Engaeus* and *Tenuibranchiurus* in a category of strong or primary burrowers. The characteristics of a primary burrowing crayfish include a narrow abdomen which may be shorter and narrower than the cephalothorax, reduced eye size, chelae that are depressed and broadened with fingers moving in a vertical plane. All of these are considered adaptations to burrowing lifestyle as they allow for easier passage through burrows and are more effective in blocking the burrows against invaders (Holdich 2002). The Key to *Engaewa* species is provided in Appendix 1 and Figures 2a & 2b illustrate some of the morphological characters used to distinguish between species of *Engaewa*.

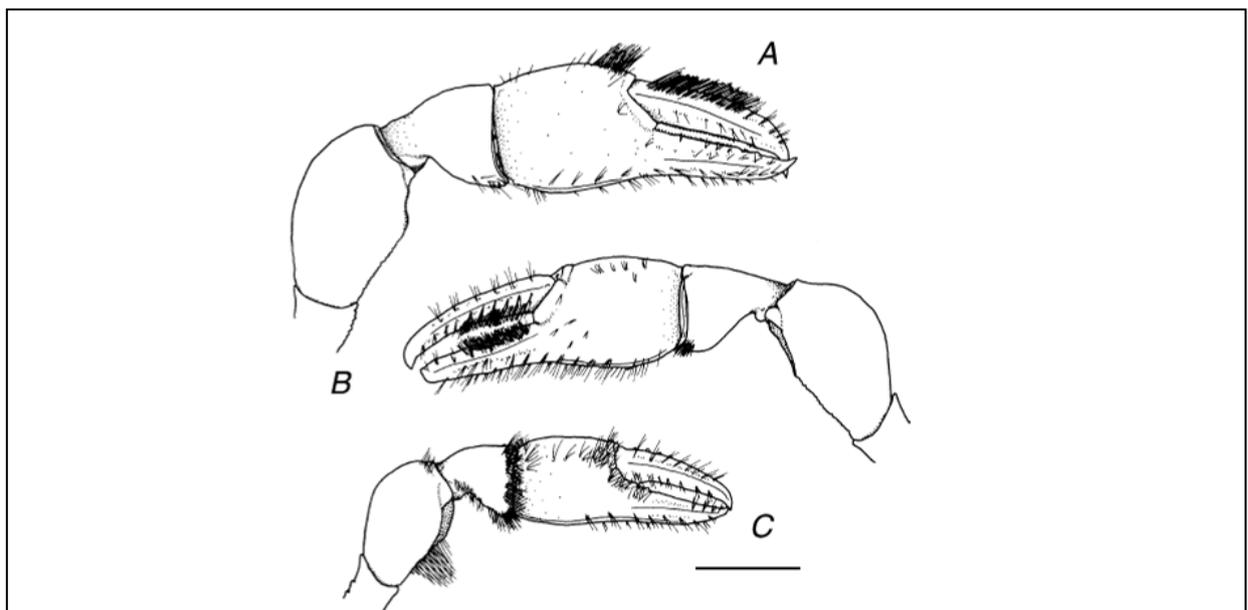
Horwitz and Richardson (1986) classified the *Engaewa* spp. burrows as Type 2. Burrows in this group are not connected to surface water-bodies but crayfish dig down to the water-table where burrows are filled with the interstitial water from the surrounding soil. These burrows may obtain water seasonally from the surface if nearby water-body floods or when the water-table approaches the surface. It is assumed at such times that *Engaewa* spp. may appear on the surface.

Burrows, particularly *E. reducta*, *E. similis* and *E. subcoerulea*, can be easily identified by the conspicuous chimneys of soil pellets that are expelled at the burrow opening (Figure 3). *Engaewa* burrows can generally be distinguished from those of *Cherax* as they are usually far more substantial and the pellets of soil are much smaller. *Cherax* typically dig short, straight tunnels and, as such, have small chimneys with much larger pellets due to their larger body size. *Engaewa* chimneys can vary in size from a few centimetres in height to approximately thirty centimetres and are mostly easily identified during the wetter months when *Engaewa* spp. are actively digging and maintaining burrows. In drier months *Engaewa* spp. retreat downwards following the water table, and burrowing activity is much reduced. During these drier periods chimneys become rounded mounds of soil eroded by wind and rain and with no obvious entrance hole.



**Figure 2a.** Morphological characters (additional to those used by Horwitz 1990) used in generic diagnosis and the separation of species in the genus *Engaewa*: *A*, supraorbital angle, progressing from somewhat acute (about 100°), to about 120°, to about 140°, and finally to an almost obsolete condition; *B*, variation (shapes along a continuum) found for the interantennal spine, shapes B-I, B-II, B-III, B-IV, B-V, B-VI, B-VII; *C*, conditions of the antennal scale, where the scale tip is prominent (about 1/6 of overall length of scale), small, or absent; *D*, conditions of the caudolateral corner of the telson, with a prominent spine, a small spine, a notch, and an undeveloped corner without notch or spine; *E*, dorsal view of the cutting edge of the propodal finger, showing the cutting edge teeth, plus longitudinal groove, plus extra teeth mesial to the groove; *F*, character states of the lateral process of the third pereopod, with a well-developed and open slit-like pore, a closed slit-like pore, and closed pit-like pore, and a process with no pit or pore; *G*, lateral view of the first and second abdominal somites, showing a bilobed pleurum of the first somite partially overlapped by the forward extension of the pleurum of the second somite; *H*, states of tufts of long bristle setae on the carpus, propodus and dactyl of the second pereopod (dense setae and sparse setae). Scale bars: 1 mm.

(From Horwitz and Adams 2000)



**Figure 2b.** Lateral view of merus, carpus, propodus and dactyl of chela for species in the *Engaewa reducta* complex, showing diagnostic setation patterns: *A*, small dimorph from holotype of *E. reducta*; *B*, small dimorph from holotype of *Engaewa similis*; *C*, small isomorph from holotype of *E. pseudoreducta*. Scale bar: 5 mm.

(From Horwitz and Adams 2000)

**Figure 2** Morphological characters used to distinguish between species of *Engaewa*



**Figure 3.** Chimney structures of *Engaewa* burrow openings. (**A&B**- size variation in chimney structures of *E. reducta*, **C**- small soil pellets characteristic of *Engaewa*, example in photo from *E. similis*, **D** high density of chimneys in pristine habitat, example in photo *E. subcoerulea*)

## **1.2. Biology and ecology**

There has been no research into the biology or ecology of species in the *Engaewa* genus. Aspects of their biology and ecology can only be implied by comparing habits of closely related genera (e.g. *Engaeus* spp.) from the eastern states of Australia. Riek (1972) reported that the morphologically similar burrowing crayfish from Eastern Australia, *Engaeus*, live in social units with both parents and juveniles occupying a single burrow. It also appears plausible that *Engaewa* possess a similar habit with multiple crayfish having been collected from a single burrow. It is unusual for crayfish to exist with any form of social structure as generally hatchlings will be consumed by non-brooding females immediately upon leaving the mother (Reynolds 2002), which may promote a sedentary existence.

Research has commenced (PhD candidate, Edith Cowan University) which aims to study the evolution and biogeography of *Engaewa*. One component of this research will be to target detailed habitat description, biological and demographic information, including those related to reproduction, life-history, soil, vegetation, climate, food, competition, predation and, behaviour (Burnham 2006a).

## **2. DUNSBOROUGH BURROWING CRAYFISH**

### **2.1. History and taxonomic relationships**

The Dunsborough Burrowing Crayfish, *Engaewa reducta*, was found by dam builders on a block of land in the Dunsborough area in 1960 and subsequently described by Riek (1967) as one of the three species belonging to an endemic genus. A revision of the genus by Horwitz and Adams (2000) re-affirmed the validity of the taxon using a combination of morphological characters and allozyme electrophoresis. It was also demonstrated that it belongs to a species complex (*reducta* complex) which extends from Dunsborough to the Mt Chudalup region in the far south-western corner of the state. The species complex includes *Engaewa similis* from north and east of Augusta, and *Engaewa pseudoreducta* from near Margaret River. A review of the systematics of the *reducta* complex was performed using morphological, morphometric and molecular techniques and provided strong support for the recognition of the three current species and the possible additional division within the range of animals currently considered to belong to *E. similis* (Burnham 2005).

## 2.2. Distribution, habitat and movements

To date all *Engaewa reducta* records have been within the Busselton Shire boundary, bounded by the Caribunup River to the east and the Leeuwin-Naturaliste Ridge to the west. They are all located in the headwater seepage/swamp areas of drainage systems that flow north into Caribunup River, Mary Brook and Station Gully or directly into Geographe Bay. The Busselton area receives approximately 860mm annual rainfall with the majority of rain falling between May-September (BOM 2007) supporting the ephemeral drainage swamp systems in which *Engaewa* spp. are commonly found. The vegetation is usually very dense heathland dominated by myrtaceous shrubs and the soils have a high sand content. (Burnham 2005).

## 2.3. Conservation status

In Western Australia, *Engaewa reducta* has been declared threatened fauna since July 2004 and is listed on Schedule 1 – Fauna that is rare or likely to become extinct pursuant to the Western Australian *Wildlife Conservation (Specially Protected Fauna) Notice 2008*. It is currently not listed under the Commonwealth *EPBC Act 1999*, however a nomination is in preparation for listing as Endangered using the ICUN Red list criteria - A4c;B1+B2ab(i,ii,iii).

The extent of occurrence for *E. reducta* (calculated by drawing a boundary around all the known sighting records) is approximately 108 km<sup>2</sup>. Human induced fragmentation of the swamp systems in the northern Capes area through vegetation clearing for agriculture, dam construction, water extraction and sand mining have contributed significantly in reducing the area of its occupancy to less than 6km<sup>2</sup> (calculated from area of remnant vegetation associated with swamps and drainage lines).

*E. reducta* is poorly represented in the reserve system with Haag Nature Reserve (↑A37010) and (proposed) Yelverton Forest Conservation Area (↑O139/25) the only Department of Environment and Conservation (DEC) managed lands containing populations. Haag Nature Reserve is only 0.09km<sup>2</sup> in size but is considered the current stronghold for the species. Smaller populations have been found in the narrow easterly and south-easterly flowing drainages lines within the timber reserve adjoining Yelverton National Park (↑A47672). The Forest Management Plan 2004-2013 (Conservation Commission 2003), identified this timber reserve for a proposed FCA (Forest Conservation Area). A museum record from 1976 falls within the Yelverton National Park boundary however the exact location is uncertain and the existence of the population has yet to be reconfirmed.

There have not been any comprehensive surveys of the region to establish its whereabouts and it is uncertain if populations still exist where specimens had been previously collected in the 1960's and prior to 1995. **Figure 4** indicates the current distribution of *E. reducta* with historical records and locations of burrow sightings (specimens not yet collected to confirm identification) found during surveys conducted during the writing of the recovery plan.



**Figure 4** Dunsborough Burrowing Crayfish (*Engaewa reducta*) records.

### **3. MARGARET RIVER BURROWING CRAYFISH**

#### **3.1. History and taxonomic relationships**

Margaret River Burrowing Crayfish, *Engaewa pseudoreducta*, was collected in 1985 from a site where a dam had just been built and was later described in a revision of the *Engaewa* genus by Horwitz and Adams (2000), prior to which it had not been recognised. Horwitz and Adams (2000) demonstrated that it belongs to the *reducta* complex which includes *Engaewa similis* from north and east of Augusta, and *Engaewa reducta* (see previous section).

#### **3.2. Distribution, habitat and movements**

Since the 1985 collection of 11 specimens from a newly constructed farm dam site (the type locality) it has not been recollected from this site despite numerous attempts to find it. In 2003 one specimen was collected from Treeton Forest Block in the North East Margaret River State Forest (↑ F62). No further sampling has occurred at this site and it remains the only known population of *E. pseudoreducta*. Surveys of suitable habitat surrounding the known extant population were undertaken in 2005 and 2006 by DEC staff and PhD researcher but no additional populations have been discovered.

The two sites where *E. pseudoreducta* have been collected are the headwater drainage swamp of one small southerly flowing tributary (<3km in length) of the Margaret River in its middle reaches.

Burnham (pers. comm.) has suggested it has similarities to *E. walpolea* in that the chimney building is not as conspicuous as other *Engaewa* spp (*E. reducta*, *E. subcoerulea* and *E. similis*). This combined with the difficult environment (impenetrable vegetation with serrated blady grass) could be why previous attempts to locate it visually have been unsuccessful.

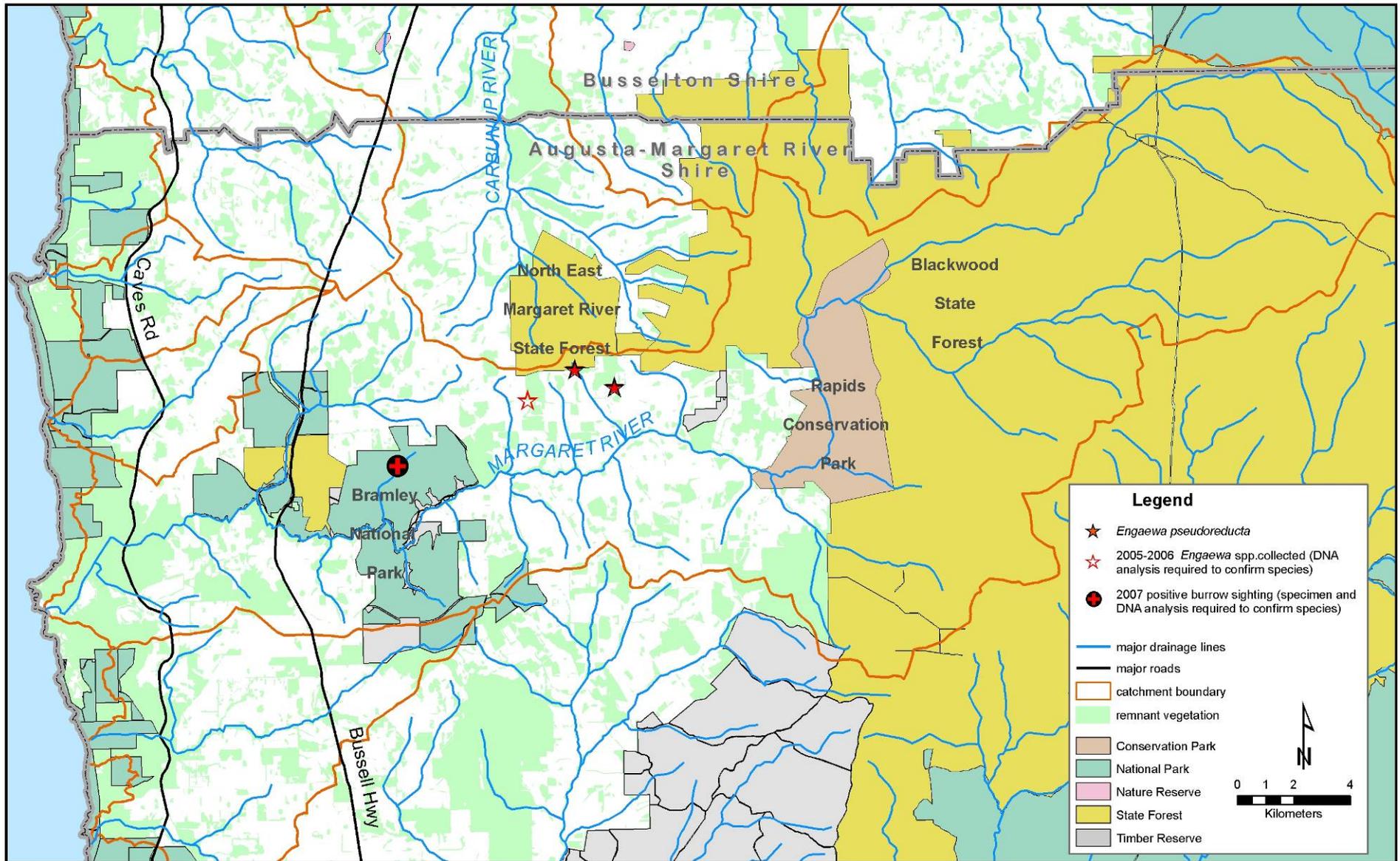
#### **3.3. Conservation status**

In Western Australia, *Engaewa pseudoreducta* has been declared threatened fauna since July 2004 and is listed on Schedule 1 – Fauna that is rare or likely to become extinct pursuant to the Western Australian *Wildlife Conservation (Specially Protected Fauna) Notice 2008*. It is currently not listed under the Commonwealth *EPBC Act 1999*, however a nomination is in

preparation for listing as Critically Endangered using the ICUN Red list criteria - A2c; B1+2ab(i,ii,iii,iv)

The two locations where *E. pseudoreducta* have been collected are less than 2km apart and are part of the same small tributary draining into the Margaret River. It is difficult to estimate the extent of occurrence with such a small sample of records. Establishing the possible distribution of *E. pseudoreducta* is further complicated by the very close proximity (<2km) on another small southerly flowing tributary of the Margaret River of another *Engaewa* record. Morphologically this specimen is most similar to *E. similis*, but has an unusual allozyme which is being examined further using DNA techniques to determine exactly which species it belongs (Burnham 2005).

It is believed that the population in Treeton Forest Block still persists although it is difficult to determine their presence as the chimneys are much less conspicuous than *E. reducta* and the site has been observed to support a large population of gilgies (*Cherax quinquecarinatus*) (Burnham, pers. comm.). The site where *E. pseudoreducta* is thought to persist is at the very headwater of a drainage line and the area of occupancy is less than 0.025km<sup>2</sup>. Outside of the Treeton Forest Block this drainage line has been severely degraded with approximately 70% of native vegetation cover removed and a large farm dam situated at around the midpoint. On one of the major branches of this drainage line is the type locality, found in 1985 around a recently constructed farm dam. Since its discovery this site was subjected to cattle grazing and has subsequently transformed into bluegum forest plantation. The swamp system on this branch is degraded and no further specimens have been collected despite numerous attempts to find it (Horwitz 2003a).



**Figure 5** Margaret River Burrowing Crayfish (*Engaewa pseudoreducta*) records

## 4. WALPOLE BURROWING CRAYFISH

### 4.1. History and taxonomic relationships

*Engaewa walpolea* was first discovered in 1981, identified then as being different to all known *Engaewa* but it was only formally recognised by Horwitz and Adams in 2000 describing *E. pseudoreducta* and *E. walpolea* as two new species, as well as providing support for the previous three species using a combination of morphological characters and allozyme electrophoresis.

### 4.2. Distribution, habitat and movements

Since its discovery in 1981 on a recently logged section of private property on Valley of the Giants Road near Bow Bridge, subsequent population discoveries have all been located within the Walpole-Nornalup National Park (↑A31362/↑A46682). The park lies in one of the highest rainfall areas of the State with an average of 1324 mm per annum at Walpole. Although rainfall decreases markedly from the south-west to the north-east of the park, it receives an average of 1200 mm of rain per annum. Rain falls on average 185 days per year, the consistency of which allows for the continued existence of relictual Gondwana invertebrates in the Park (CALM, 1992). Peatlands occurring in this area may ameliorate the effects of seasonal drying by providing moist microclimates year round by releasing moisture soaked up in organic rich soils (Horwitz *et al.* 1998). Observations of *E. walpolea* indicate a reliance on this steady rainfall and moist surface conditions. Specimens collected in spring 2006 were either hand picked from peaty areas with shallow surface pools (at night using torchlight) or dug from very shallow burrows. Burrow entrances were small holes or very small chimneys unlike the conspicuous large soil chimneys that *E. reducta* and the non-listed species *E. subcoerulea* and *E. similis* build, suggesting that there is a reduced need for digging to reach consistent moisture.

*E. walpolea* are to be found in headwater seepages and broad drainage depressions. They have been collected from various soil types ranging from coarse gravelly sand, sandy loams and organic rich silty loams. The vegetation types also vary from Karri woodlands with understorey of thick sedge grass, peatbogs (pitcher plants), heathlands and also an instance of non-native vegetation (tree ferns *Dicksonia* spp., with kikuyu grass and Cape Gooseberry *Physalis peruviana* understorey).

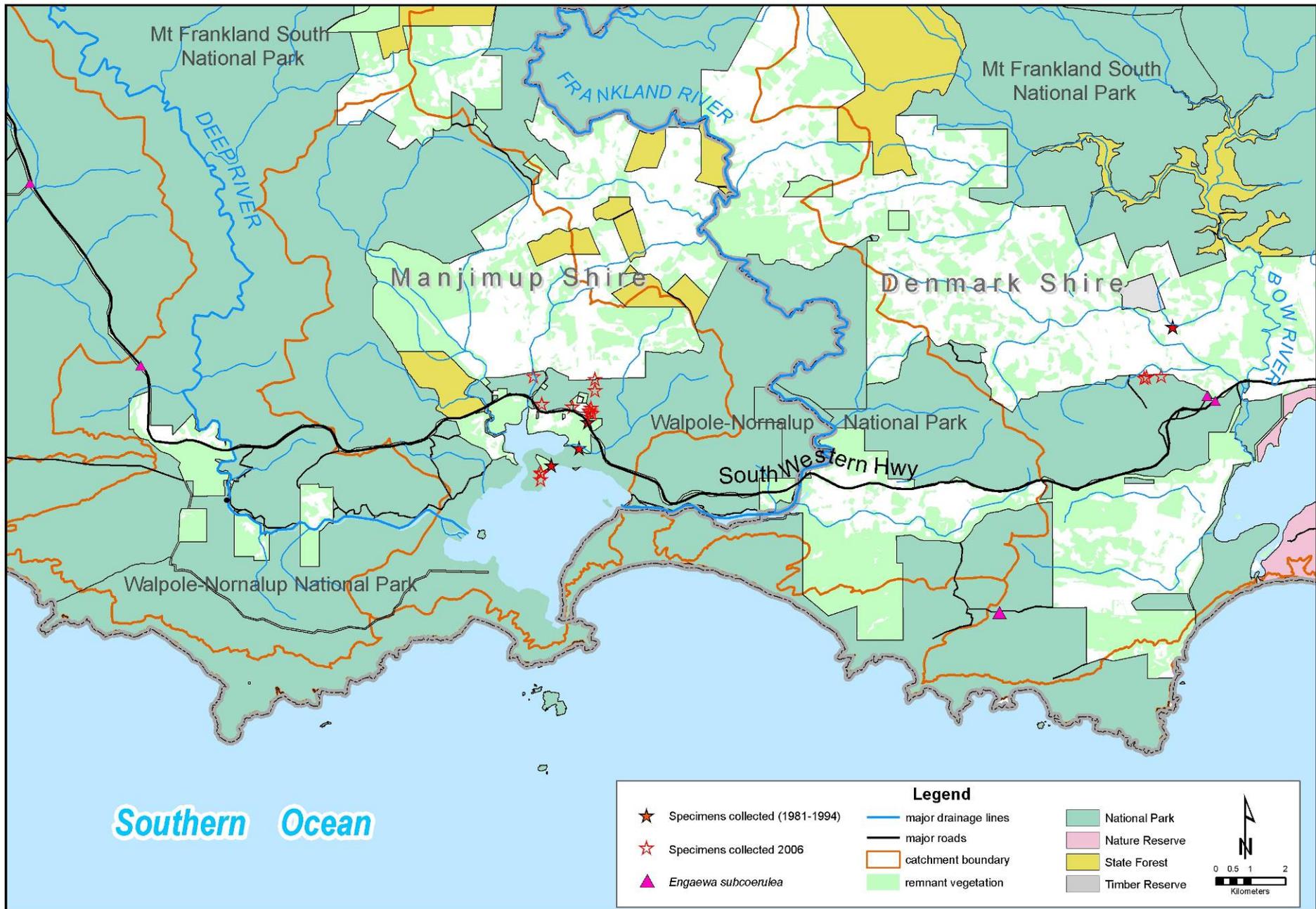
The movement and dispersal abilities of *Engaewa* spp. are poorly understood. Collections of *E. walpolea* in spring 2006 were a significant event with the first ever observations of *Engaewa* spp. walking around in the bottom of shallow puddles. Previously, a specimen of *E. similis* was collected at night (raining) from a small shallow pool of water from Spearwood Creek, however no other specimens were observed at the time. The time of year, weather conditions, habitat and the *Engaewa* spp. involved are all likely factors influencing these events of surface movement (Burnham 2006b).

#### **4.3. Conservation status**

In Western Australia, *Engaewa walpolea* has been declared threatened fauna since July 2004 and is listed on Schedule 1 – Fauna that is rare or likely to become extinct pursuant to the Western Australian *Wildlife Conservation (Specially Protected Fauna) Notice 2008*. It is currently not listed under the Commonwealth *EPBC Act 1999*, however a nomination is in preparation for listing as Vulnerable using the ICUN Red list criteria - A4c;B1ab+2ab.

The private property from which *E. walpolea* was collected in May 1981 in a clear felled logging coupe in water-filled tractor tyre ruts following recent logging and heavy rain, is now plantation forest and subject to grazing. *E. walpolea* has not been found again at that site despite repeated searching.

It was collected again in 1992/1993 in Walpole-Nornalup NP close to the township of Walpole. Surveys in 2006 found additional populations in Walpole-Nornalup NP. From these survey records the current area of occurrence is calculated to be approximately 55km<sup>2</sup>. Approximately 16 percent of this area is mapped as shrub/herbs/sedgelands which may contain potential habitat. Using this as a guide, the current area of occupancy can be calculated to be approximately 10km<sup>2</sup>.



**Figure 6** Walpole Burrowing Crayfish (*Engaewa walpolea*) records

## **5. GUIDE FOR DECISION MAKERS**

Section 6 provides details of current and possible future threats to burrowing crayfish. Developments in the immediate vicinity of the populations or within the habitat that is defined as critical to survival require assessment. Any on-ground works (clearing, firebreaks, road works, burning, drainage, grazing or plantation forestry) in the immediate vicinity of burrowing crayfish habitat will require assessment. Proponents should demonstrate that on-ground works will not have an impact on the species, or on its habitat or potential habitat.

## **6. THREATENING PROCESSES**

### **6.1. Habitat Loss & Habitat Degradation**

The south-west region of Western Australia is a major farming and viticulture area with increasing farm forestry activities. There are a number of threats both direct and indirect resulting from these industries impacting on the survival of *Engaewa* spp.

Clearing of riparian habitats has directly affected the connectivity of *Engaewa* spp. populations. *E. reducta* and *E. pseudoreducta* in particular have very discontinuous habitats. Clearing of land for agriculture or logging can increase salinity in wetlands as well as introducing pesticides and unnaturally high nutrient levels through runoff from surrounding landscapes. An assessment of the Carburnup River, indicates that the recommended level for Total Phosphorus is periodically exceeded and the recommended level for Total Nitrogen is frequently exceeded. Less than 15% of the stream bank is considered to be in pristine or near pristine condition. The Carburnup River is considered one of the healthiest rivers in comparison to others in the Geographe catchment (Community Environmental Mgt 2000).

The alteration of drainage from activities such as dam construction, water extraction, soil compaction by livestock and road/bridge development results in changes to water-table hydrology. Low water-table levels force crayfish to dig deeper (which may not be possible or beneficial) and the option for migration would be extremely unlikely due to the fragmentation of habitat and the poor dispersal abilities of crayfish exacerbated by an unnaturally rapid change in hydrological conditions. The inundation of swamps to form farm dams or larger dams irrevocably alters and degrades the nature of the burrowing freshwater crayfish habitat. This has been evidenced by both *E. reducta* and *E. pseudoreducta* which were recorded

during dam construction but were consequently never again found from those sites (Horwitz 2003a; Horwitz 2003b). There are concerns that acidification and heavy metal contamination of groundwater may result through the exposure and subsequent hydration of acid sulphate soils in wetland areas (Horwitz and Adams 2000).

Disturbances to habitat caused by illegal drug growing have been observed, evidenced by the presence of weed species, fertilisers and rubbish. Activities of feral pigs can lead to soil compaction which impairs permeability and water holding capacity. Localized disturbances caused by illegal drug growers and feral pigs could be considered significant for small restricted populations such *E. pseudoreducta*.

## **6.2. Fire & Fire Management**

The impacts of fire on *Engaewa* have not been investigated. Burnham (pers. comm) suggests that *Engaewa* inside their burrows should be buffered from the heat of fire. However, the recent captures of *Engaewa* outside their burrows suggest some surface activity and interaction, albeit in moist surface conditions. Understanding the timing and cues of this behavior will be important as fire may either kill them directly or possibly affect the timing of reproductive events.

The secondary impacts of fire may be of more concern. Burning of organic rich sediments such as peatlands, can either remove them completely or alter their water holding capacity so that the microhabitat is no longer moisture rich and therefore make it conducive to burning in subsequent fires (Horwitz *et al.* 1998). The underlying mineral soil may also be lost which alters local hydrology, either by creating surface pools or by increasing drainage. This can result in the acidification and metal toxicification that is caused by drying and re-wetting soils (Horwitz and Rogan 2003).

Fire management practices may also have negative impacts on *Engaewa* spp. Applying fire retardant chemicals can contaminate the water and soil, and could be potentially toxic to *Engaewa* spp. Mechanical alteration to the environment for fire containment such as digging trenches, dozer lines and building access tracks etc. may interfere with the soil profile and alter drainage patterns (Horwitz and Rogan 2003).

Prescribed burning for asset and community protection, particularly in the vicinity of the Walpole townsite, will continue but will be planned for and carried out when wetland soil substrates are moist and least likely to be impacted by fire.

### **6.3. Climate Change**

The Third Assessment Report of the Intergovernmental Panel on Climate Change (IPCC 2001ab) concludes that Australia has significant vulnerability to the changes in temperature and rainfall that are projected over the next 100 years. The IPCC findings identify Southwest Western Australia as a region of particular vulnerability, and there will be an increased risk of extinction for species that are already vulnerable. Species with limited climatic ranges, limited dispersal ability, specialised habitat requirements, small populations and/or low genetic diversity are typically the most vulnerable to extinction. In addition to climatic changes, the associated increase of the carbon dioxide concentration in the atmosphere will lead to changes in plant growth, nutrient composition, plant–animal interactions and ecosystem nutrient cycles. This will interact with temperature and rainfall changes (DEH 2004).

The annual rainfall has gradually decreased in the lower Walpole-Nornalup catchment since 1951, when the first rainfall records were recorded. Between 1956 and 1985 the mean annual rainfall at Walpole decreased about 200 mm or 14 percent (Hodgkin and Clarke 1988). The trend overall has seen winter rainfall in the south-west of Western Australia also decrease substantially since the mid-twentieth century, and since the mid-1970s in particular. For hydrological systems of the region, particularly rivers, wetlands and shallow groundwaters, the impact of the decrease in rainfall has been exacerbated by the concurrent increase in both maximum and minimum temperatures through winter (IOCI 2002).

These changes (current & predicted) pose a serious concern to the conservation of *Engaewa* spp. that are already at an extreme climatic boundary and are very limited in their dispersal abilities. The seasonal swampy wetlands are likely to contract or disappear, if not from the direct effect of lower rainfall on groundwater levels, then from increased demands for groundwater use for the urban population (Arnold 1988). The fire proneness of these habitats is also likely to increase with the drying climate. In addition to these issues, there is a paucity of information on the biology of *Engaewa* spp. The lack of baseline data makes predictions of their response to changes in temperature and amount and distribution of rainfall very uncertain or impossible.

#### **6.4. Disease potential with introduction of other Crayfish (*Cherax* spp.)**

Cotton tail or Porcelain disease is caused by a microscopic microsporidian *Thelohania*. The disease is easily detected in the late stages, when the underside of the tail turns white and the walking legs often become splayed and rigid. It is invariably fatal and appears to be transmitted by cannibalism of dead or dying crayfish. The majority of infections have been recorded in the introduced Yabby (*Cherax albidus* and *C. destructor*) that have come from areas east of the Albany Highway.

The disease was reportedly found in gilgies (*Cherax quinquecarinatus* and *C. crassimanus*) in the late 1990s (Department of Environment and Water Resources 2007). Gilgies are often co-habiting with *Engaewa*, giving rise to a potential disease threat. The concern for the protection of the marron (*C. cainii*/*C. tenuimanus*) industry from the disease in the Southwest Western Australia has led to the Department of Fisheries implementing a zoning system within Western Australia, to restrict the movement of yabbies and other crayfish that may be infected. All unauthorised live transfers of Australian freshwater crayfish into Western Australia are prohibited. Likewise the importation of all overseas crayfish species into Australia is prohibited to prevent the introduction of the crayfish plague fungus *Aphanomyces astaci* which has devastated many overseas native crayfish populations and to which Australian crayfish including *Engaewa* spp. would be susceptible.

### **7. RECOVERY OBJECTIVE AND CRITERIA**

To ensure the survival of existing populations and to improve their conservation status for possible future downlisting by:

- Determining the current distribution and identifying additional populations of *Engaewa*
- Increasing public awareness and participation in threatened species protection
- Protecting habitat
- Improving knowledge of *Engaewa* life history and ecology

## 7.1. Criteria for success

This Recovery Plan will be deemed successful if for each species:

- The extent of occurrence remains stable or increases
- The area of occupancy remains stable or increases
- The number of known populations\* remains stable or increases
- There is wider public awareness and understanding of *Engaewa* spp.
- There is an increase in area of habitat managed for conservation
- There is improved understanding of biological/ecological parameters
- Appropriate fire management prescriptions are developed
- The feasibility of captive breeding/translocations determined for *E pseudoreducta* and *E. reducta* using non-threatened congeners for initial studies.

\*Note: reference to populations is predominantly for *E. reducta* and *E. pseudoreducta*, where discrete populations have resulted through habitat fragmentation. For *E. walpolea*, where habitat is relatively continuous, increases in known area of occupancy can taken to indicate an increase in the known population.

## 7.2. Criteria for failure

This Recovery Plan will be deemed unsuccessful if for each species:

- The extent of occurrence decreases by 30% or more
- The area of occupancy decreases by 30% or more
- The number of known populations decreases by 10% or more
- There is no increase in public awareness of *Engaewa* spp.
- The area of habitat managed for conservation decreases by 20% or more
- There is no further understanding of biological/ecological parameters
- No fire management prescriptions are developed
- The feasibility of captive breeding/translocations not determined

### **7.3. Evaluation**

The Department of Environment and Conservation, in consultation with the *Engaewa* Recovery Team, will evaluate the performance of this 10 year Recovery Plan. The plan will be reviewed within five years of its implementation. The recovery actions carried out and any changes to management and recovery actions will be documented accordingly.

### **7.4. Existing conservation measures**

All currently known *Engaewa walpolea* populations occur within National Park.

The only population of *E. pseudoreducta*, presumed to persist, occurs in State Forest which has an informal reservation class (river and stream zones) established in the Forest Management Plan 2004-2013 (Conservation Commission 2003). Efforts are being made to provide protection for a small area of adjoining stream occurring on private property.

*E. reducta* is represented in a Nature Reserve and Forest Conservation Area (proposed), however the majority of its occurrence is on private property. A number of properties identified as containing populations are owned by registrants with the Land for Wildlife program or have conservation covenants over the land.

Public awareness of these species has been initiated (February 2007) with press articles at the local, regional: The Capes Herald, South Western Times and Augusta Margaret River Mail, and state/national level: Landscape Vol. 22(2). A factsheet for *Engaewa reducta* (Appendix 2) was produced for a letter mailout to property owners identified as containing suitable habitat. Direct contact with several landholders has been made to raise their awareness to the existence of the species (*E. reducta* and *E. pseudoreducta*) and there has been an enthusiastic and positive response from the majority of property owners.

Research by ECU PhD candidate for thesis “Biogeography of the Australian burrowing freshwater crayfish genus *Engaewa* (Decapoda:Parastacidae)” is currently in the data collection and monitoring phase and will follow on from the research conducted for the honours thesis “The systematics of the *reducta* complex of the burrowing freshwater crayfish *Engaewa Riek*” by Burnham (2005).

## 8. ACTIONS

The following recovery actions are presented in order of descending priority but this should not prevent the implementation of 'lower' priority actions where opportunities arise and funding is available. Where sub-populations occur on lands other than those managed by DEC, permission must be sought from the relevant land managers prior to recovery actions being undertaken.

### 8.1. Habitat surveys

An accurate knowledge of the distribution and location of populations is the first step towards achieving recovery. Comprehensive surveys of the area will help determine more accurately their conservation status through better information on the extent of occurrence, area of occupancy and location of populations.

Habitat surveys are likely to be most successful in wet/inundated conditions when *Engaewa* are presumed to be closer to the surface where they can more easily be sampled. Identification and collection techniques currently available are the observation of chimneys (cannot determine species), night time observation/collection using torchlight and the digging up of burrows (see Research and Monitoring section).

#### *E. reducta*

At the time of writing the recovery plan survey efforts were being made to confirm previous *E. reducta* records and to identify additional populations on private lands within the Busselton Shire. A simple desktop survey of vegetated creek lines identified from orthophotos were used to target high priority areas and with owner's permission conduct a property search. Letter mailouts were sent to a number of landholders who appeared to have suitable habitat inviting them to respond with possible sightings. Media releases were circulated in local and regional papers in the hope of also generating some responses from landholders. All enquires that were received were followed up and it is likely that there will be further responses as awareness of the *Engaewa* gradually increases.

The headwaters of the Carburnup River in Treeton Forest Block in the North East Margaret River State Forest is an area for further investigation. *E. reducta* was collected in 1995 approximately 5km downstream from the Treeton Forest Block. If *E. reducta* were to be

found in this area it would represent a significant area of continuous habitat that has some protection afforded to it by an informal reservation class established in the Forest Management Plan 2004-2013 (Conservation Commission 2003).

### *E. walpolea*

Unlike *E. reducta* and *E. pseudoreducta*, the swamp and drainage systems where *E. walpolea* are found, are mostly undisturbed and belong to continuous natural landscape protected in a reserve system, giving the potential for further *E. walpolea* populations to be identified and extending their extent of occurrence and area of occupancy.

Continue searches within Walpole-Nornalup NP particularly in the swamp systems between the outlying *E. walpolea* records (refer **Figure 6**).

Surveys also need to be conducted in the swampy headwater tributaries of Walpole River west of Walpole Township. Mt Frankland South NP and Crown Reserve R31501 (airport strip) contain relatively large continuous areas of swamp vegetation which may be suitable habitat and appear to have connectivity with the swamp system that contains *E. walpolea*.

Headwater tributaries of Bow River falling within Mt Roe NP, Mt Frankland South NP and Frankland SF could also be surveyed as there have been records of *E. walpolea* on the lower tributaries of this drainage system.

### *E. pseudoreducta*

Like *E. walpolea*, chimney structures are not as well defined and spotlighting may be a useful technique to identifying specimens. Search remaining vegetated headwater drainage swamps (tributaries of Margaret River) of Treton Forest Blocks in North East Margaret River SF and Blackwood SF near the two known collection sites. Relatively undisturbed drainage lines on private property should also be searched with landowner permission.

## **8.2. Community Awareness**

Protection of habitat on private land is thought to be most effectively achieved by increased public awareness, information exchange and encouragement of local landholders. Public awareness of *Engaewa* spp. has been greatly overshadowed by the commercially and

recreationally important crayfish species such as the smooth marron (*Cherax cainii*), koonacs (*Cherax plebejus* and *C. glaber*) and the yabby (*C. albidus* and *C. destructor*). The gilgie (*C. quinquecarinatus* and *C. crassimanus*) is also well known and many people have attributed the *Engaewa* spp. chimney-like burrows (particularly *E. reducta*) to the more visible gilgie which is commonly found inhabiting the *Engaewa* burrows.

Raising awareness of the existence of *Engaewa* spp. (both threatened and non-listed species) can be achieved through additions to interpretative material and resources e.g. DEC park signage and brochures, online resources such as Commonwealth Department of Environment and Water Resources (DEW) - Species Bank and DEC's Naturebase – Fauna Species Profiles, Department of Fisheries publication *Freshwater Crayfish of south-west WA identification*, and development of new interpretative materials such as poster displays/fact sheets/education kits for field days, local shows, and community group meetings.

### ***E. reducta***

Follow up initial local media release with updates of conservation status (e.g. significant population discoveries) and events such as funded landholder projects (e.g. fencing).

Develop access to interpretative materials (e.g. online resources, fact sheets), as a number of eco-resorts/accommodation in the area contain populations of *Engaewa reducta* on their property and they are likely to be interested in promoting this feature to their clients.

Investigate potential public relations proposal with local wine grape industry. Sponsorship/fundraising from a specially labelled wine release could raise a wide level of public attention to *Engaewa reducta* and achieve agreed conservation outcomes.

### ***E. walpolea***

There is the opportunity to develop interpretative resources to raise the profile of *Engaewa walpolea* and *Engaewa* spp. generally. Walpole-Nornalup National Park has well developed facilities for public visitation and interpretive signage at visitor centres and information shelters while giving the opportunity to view the easily detectable *Engaewa subcoerulea* burrows thereby giving some connection to *E. walpolea* and other *Engaewa* species.

### ***E. pseudoreducta***

DNA studies are currently proposed to determine the number of burrowing crayfish species occurring in the Margaret River catchment. In the meantime the profile of burrowing crayfish needs to be raised in this region that has successfully brought attention to the critically endangered Margaret River (Hairy) Marron (*Cherax tenuimanus*). It is likely that whatever the outcome of DNA analyses, populations of *Engaewa* in the Margaret River catchment will have poor conservation status and community participation on private property will be necessary for continued survival.

## **8.3. Habitat Protection**

### **Off-park Conservation Programs**

Protection of habitat on private land is thought to be most effectively achieved by public awareness and community participation. There are various mechanisms available for protecting and managing threatened species habitat on private property such as management agreements, conservation covenants, and stewardship support from DEC's Land for Wildlife Program and community based catchment management groups such as GeoCatch (Geographic Catchment Council) and Cape to Capes Catchment Group.

### ***E. reducta***

The majority of habitat is on private property and off-park conservation programs will be crucial for *E. reducta* conservation. Reservation status is very poor in this region with very few options for improvement. Although the swamp systems are very fragmented, there is likely to be a considerable number of properties containing or adjoining potential *E. reducta* habitat.

Four key areas have been identified that contain relatively large continuous areas of suitable *E. reducta* habitat. A field day inviting involved and interested landholders would improve communication and co-ordination between neighbours within these key areas and contribute to positive conservation outcomes. Support should be provided to landholders making funding applications for critical habitat fencing and continue to encourage the revegetation and rehabilitation of drainage lines throughout the catchment, particularly those in the vicinity of critical *E. reducta* habitat. While it is not likely that these areas will be recolonised until

the very long term, the short and medium term benefits of water quality improvements and providing a buffer to critical habitat will contribute to the survival of existing populations.

### ***E. pseudoreducta***

Support should be provided to landholders to develop funding applications for remnant riparian vegetation protection and continue to encourage the revegetation and rehabilitation of drainage lines throughout the catchment.

### **Roadside Marking**

Impacts associated with road infrastructure construction and roadside maintenance can be reduced by identifying 'at risk' areas of *Engaewa* habitat for inclusion in the Special Environmental Area (SEA) roadside marking system. These markers may also act as a deterrent to potential drug growers as they imply these areas are of significance to authorities and therefore may be monitored.

The *E. pseudoreducta* site has been recorded and marked and there are a number of *E. reducta* sites that need to be added to the system.

### **Acquisition of habitat into conservation reserve system**

Adjoining the northern boundary of (proposed) Yelverton Forest Conservation Area (↑O139/25) is Crown Reserve R 29192 (36 hectares) containing a drainage line that has a good *E. reducta* population. Its location is complimentary with reserve design principles and has high catchment values that help maintain ecosystem health for *E. reducta* populations that continue downstream into private land.

## **8.4. Research and Monitoring**

### **Life History and Ecology Research**

There is a vast gap in knowledge of the *Engaewa* genus. Systematic reviews by Riek (1967), Horwitz and Adams (2000) and more recently Burnham (2005) are the only substantial

reviews and provide only general ecological notes on these crayfish. Improving knowledge of the species' biology and habitat requirements is necessary to support management and conservation of these species. Understanding these parameters will also be crucial for conservation management in response to climate change. The lower risk *Engaewa* species (*E. subcoerulea* and *E. similis*) provide an opportunity to research and monitor some of the key biological and habitat requirements (lifespan, fecundity, recruitment, feeding strategy, competition, diseases and predators) without significantly impacting on threatened populations.

Increasing public pressure for hazard reduction burning (as well as prescriptive burning for certain flora species e.g. Albany pitcher plant) is driving an urgent need to improve the understanding of the effects of fire on *Engaewa* spp. The burrowing nature affords them direct fire protection, but there is a need for knowledge on the indirect impacts of fire (altered edaphic conditions) and potential toxicity of fire retardants on *Engaewa* spp.

The population and habitat monitoring programs will be a key component in data collation for researching some of these aspects. Presently, piezometers have been installed at various *Engaewa* spp. locations to monitor groundwater as part of the research currently being conducted for PhD study (Burnham 2006a & Burnham 2006b). Groundwater monitoring will investigate seasonal variances in water depth, pH, conductivity, temperature and chemical components.

### **Establish population and habitat monitoring**

Maintain established piezometers after completion of the PhD study. Expand the groundwater monitoring system, particularly in the vicinity of the Walpole township where impacts of urban runoff and drainage need to be determined.

Establish a monitoring program to ensure that the number of known locations remains stable and that there is stability within locations i.e. measures of burrow density.

Develop a research monitoring program to determine the effects of stock grazing, acid sulphate soil exposure, and the impacts of fire.

Establish a series of experimental sites to measure capability to colonise and recover in previously degraded landscapes. This would require public participation and support as these sites are most likely to be drainage lines crossing onto private property from adjoining swamp systems containing *Engaewa* populations.

### **Research & Develop Translocation Techniques**

The conservation status of *Engaewa pseudoreducta* may benefit from a translocation program. However there are a number of issues to be addressed before translocation can be considered a feasible conservation management option.

1. Determine the biogeography (DNA analysis) of *Engaewa* genus. There is evidence of variation between specimens collected in very close proximity to *E. pseudoreducta* in the Margaret River catchment. It is likely that with more extensive sampling in the Margaret River and elsewhere, the number of species/sub-species may increase.
2. Identify additional *E. pseudoreducta* populations before taking any specimens from the wild and/or develop efficient, non-destructive capture techniques (see below).
3. Develop an understanding of habitat requirements/tolerances of burrowing crayfish (soil characteristics, pH, temperature, moisture regimes, herbaceous structure and components species etc) to identify unoccupied sites containing suitable habitat or to restore suitable habitat conditions for potential reintroduction or translocation.
4. Develop captive breeding techniques. Research on captive breeding of *Engaewa* spp. can be conducted initially using the lower risk species *E. similis* and *E. subcoerulea*. As techniques are refined, *E. walpolea* and *E. reducta* could be used to trial translocations and further improve their conservation status. Captive breeding and experimental translocations will also provide the opportunity to learn about the species and its habitat requirements (see 8.4(b)). This could be implemented concurrently with 1) and 2) above.

Any translocation should be conducted in accordance with the provisions of CALM Policy Statement No.29.

**Develop improved methods of identifying and capturing *Engaewa* spp.**

Determining the presence/absence of *Engaewa* can be problematic and is due in part to our very limited understanding of their ecology. The time of year, weather conditions, habitat and the *Engaewa* spp. all contribute to our ability to observe and capture them. Identifying chimney structures of *E. walpolea* and *E. pseudoreducta* is not as reliable as for *E. reducta*, as they are quite small or even absent. This observation technique (particularly for *E. reducta*) is not effective under dry conditions (summer) when burrow chimneys collapse and are difficult to distinguish, especially from *Cherax* spp. burrows. The current method of capturing *Engaewa* spp. by digging, is extremely laborious, destructive and inefficient. Hand capture of specimens using spotlighting is a very effective technique but its use may be limited to the rare and unpredictable surfacing events.

Design a suite of survey techniques that can provide high level of certainty for observers and ability to collect specimens if necessary to confirm observation, in both wet and dry seasons.

## 9. SUMMARY OF RECOVERY ACTIONS

Action	Responsibility	Cost											
		2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Total	
Survey habitat to determine populations and distribution.	DEC, ECU												
Develop interpretive materials and resources to promote community awareness.	DEC,DF,DEW												
Support Off-park Conservation Programs.	DEC,GC,CCCG												
Implement roadside marking SEA (Special Environment Areas)	DEC												
Acquisition of habitat into conservation reserve system.	DEC, BS												
Life History and Ecological Research	DEC, TI												
Develop improved methods of identifying and capturing <i>Engaewa spp</i>	DEC, TI												
Research & develop translocation techniques	DEC, TI												
Establish population and habitat monitoring	DEC, CCCG, GC, Public												
Annual Cost													

BS = Busselton Shire, CCCG = Cape to Cape Catchment Group, DEC = Department of Conservation and Land Management Western Australia, DEW = Department of Environment and Water Resource (Commonwealth) , DF = Department of Fisheries Western Australia, ECU = Edith Cowan University, GC = Geocatch Public = Landholders and Community Groups, TI = Tertiary Institutions

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## APPENDIX 1

### Key to *Engaewa* species (from Horwitz and Adams, 2000)

1. Cervical groove broadly U-shaped at meson; tubercles on dorsal edge of propodal palm markedly reduced, extending at most to halfway along edge; LP 1st P and 2nd P indistinctly raised, usually with closed slit- or pit-like pores; LP 3rd P indistinctly raised but with larger, open, elongate pore..... *E. subcoerulea*
- Cervical groove broadly V-shaped at meson; tubercles on dorsal edge of propodal palm extending all or most of the way along edge; LP 1st P and 2nd P indistinctly raised, without closed slit- or pit-like pores; LP 3rd P indistinctly raised and usually without pore..... 2
2. Rostral carinae absent; ventral carina of propodal palm granulate minutely; inflated portion of keel at 3rd P pointed anteriorly; antennal flagella extending to AS 5 or 6; antennules with inner flagellum 0.7–0.8× as long as outer..... *Engaewa walpolea*, sp. nov.
- Rostral carinae present but low and short, or if not present: inflated portion of keel at 3rd P rounded anteriorly, or if not: ventral carina of propodal palm smooth along edge, antennal flagella extending to AS3, 4 or 5; antennules with inner flagellum 0.4–0.7× as long as outer..... 3 (*Engaewa reducta* complex)
3. Chelae: isomorphs and small dimorphs (on adult individuals only) with dense patch of setae on dorsal surface of dactyl; large dimorphs and large isomorphs with dorsal surface of dactyl bearing two rows of small granulations, with some extra granulations between or adjacent to rows. LP 3rd P with pit or pore; sternal keel not terminating at LP 4th P, and LP 4th P sloping in posterior direction; rostrum with apex usually broadly rounded; rostral carinae usually present on anterior part of rostrum. Telson with caudolateral corners spineless (but may be notched) ..... *Engaewa reducta*
- Chelae: most chelae on most individuals with patches of setae on lateral sides of cutting edges; large dimorphs and large isomorphs with dorsal surface of dactyl bearing two rows of large granulations, where granulations are paired transversely. LP 3rd P without pit or pore; sternal keel usually terminating at LP 4th P, and LP 4th P usually sloping inwards; rostrum with apex broadly pointed; rostral carinae usually present on anterior part of rostrum. Caudolateral corners of telson each usually with spine (but may be notched)..... *Engaewa similis*
- Chelae: adult individuals with patches of setae on ventral surface of merus, ventrally and distally on carpus, laterally adjacent to cutting edges, and occasionally on propodal palm as well; large dimorphs and large isomorphs with dactyl dorsally with two rows of small granulations, with some extra granulations between or adjacent to rows. LP 3rd P without pit or pore; sternal keel not terminating at LP 4th P, and LP 4th P sloping in posterior direction; rostrum with apex variable (pointed or rounded); rostral carinae absent. Telson with caudolateral corners spineless (but may be notched) ..... *Engaewa pseudoreducta*, sp. nov.

## APPENDIX 2

### Dunsborough Burrowing Crayfish Factsheet

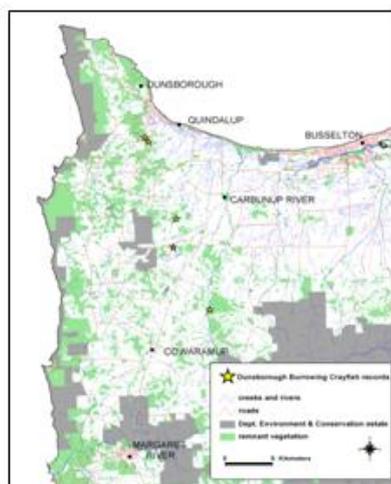
## Endangered Species - FACT SHEET



Dunsborough Burrowing Crayfish  
*Engaewa reducta*



Examples of the distinctive chimney like structure at burrow entrance



Geographic extent of Dunsborough Burrowing Crayfish

**Common Name:** Dunsborough Burrowing Crayfish

**Species Name:** *Engaewa reducta*

**Status:** ENDANGERED.

There are currently five recognised species of burrowing crayfish (*Engaewa* spp.) in Western Australia and this represents a significant proportion of freshwater crayfish species in Western Australia. In addition to the Dunsborough Burrowing Crayfish (*Engaewa reducta*) there are two other *Engaewa* spp. declared Threatened Fauna under WA legislation. The Margaret River Burrowing Crayfish (*Engaewa pseudoreducta*) ranked CRITICALLY ENDANGERED and the Walpole Burrowing Crayfish (*Engaewa walpolea*) ranked VULNERABLE.

**Description:** The Dunsborough Burrowing Crayfish is small ( $\leq 5$ cm) and has a narrow abdomen. The cephalothorax and claws are large in comparison, adapted to a life of digging. While the body of the crayfish is usually colourless the upper surface of the claws can be a striking purple colour. Unlike *Cherax* spp. (gilgies, marron, koonacs etc) who hold their claws in a horizontal plane, *Engaewa* spp. claws are in a vertical plane. It is very unlikely to see a burrowing crayfish outside of its burrow but there have been rare sightings during night spotlights.

**Habitat:** Burrowing crayfish are found in drainage depressions with vegetated swampy floors that may be seasonally inundated. Their underground burrows can be deep and extensively branched to reach the water table where they take refuge in drier months. The chimney like structure of earth pellets at opening of the burrows are very distinctive and are the only indication of the presence of burrowing crayfish. They are very often found with *Cherax* spp. present which can lead to some confusion.

**Distribution:** First discovered near Dunsborough in 1960 it is known from only a handful of records collected from private property in the 1960's and 1970's around Dunsborough, Yelverton and Metricup areas. It is restricted to the north west corner of the Capes region between Dunsborough and Margaret River and is likely to be found in vegetated drainage systems that have not been significantly altered.

**Threats:** The north west Capes region has seen drastic hydrological changes to natural drainage systems resulting from dam construction and water extraction for various farming and horticultural industries. The alteration of surface and subsurface water flow and the clearing of vegetation has had a significant impact on this species. Soil compaction and degradation of swamp systems from stock grazing is also a significant threat.

**Why we need to act:** The survival of each habitat and its population is particularly important because the extremely limited dispersal abilities of the burrowing crayfish make it unlikely that recruitment from other populations occurs. Currently only one known population exists in a reserve system and urgent action is required to identify and manage other populations to ensure their survival and to maintain the unique biodiversity of the region.

**Contact:** If you require information regarding the conservation of the Dunsborough Burrowing Crayfish or you wish to report a possible sighting please contact:

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