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ASPECTS OF THE LIFE HISTORY OF THE BURROWING FRESHWATER CRAYFISH *ENGAEUS LEPTORHYNCUS* AT RATTRAYS MARSH, NORTH EAST TASMANIA

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Freshwater crayfish live in a wide variety of habitats, ranging from open water (e.g. the Tasmanian freshwater lobster, *Astacopsis gouldi*), through burrows associated with permanent water bodies or the water table (e.g. species in the genus *Parastacoides* in south west Tasmania) to those which dig burrows which are neither alongside permanent water nor reach down to the water table. Species in the genus *Engaeus* span almost this entire range; they are found mainly in Victoria and Tasmania.

As part of a larger study into the taxonomy and distribution of the genus *Engaeus*, a search was undertaken for burrowing crayfish at Rattrays Marsh on the road between Ansons Bay and Priory (Tasmap Georges Bay 8515: 972 375) on 12 August, 1981. The area is within the known distribution of *Engaeus leptorhyncus*, a distinctive species which has a range roughly bounded by Upper Blessington, Mt. William and St. Helens.

At Rattrays Marsh, numerous burrow openings were observed on a gently sloping area of wet sedgeland, dominated by buttongrass *(Gymnoschoenus sphaerocephalus)*, to the west of the road alongside Rattrays Marsh. Clusters of eucalyptus occurred amongst the buttongrass where the ground was slightly raised. The burrows examined were about 400-500m away from the nearest water course and they were not connected to any surface water body.

The soil of the area consisted of 2-3cm of organic material and sands, matted with the roots of the sedgeland plants. Below this was approximately 40cm of sandy loam, and this was underlain by a horizon with a texture of sand, clay and numerous quartz chips about 5x5mm in size.

Digging was commenced in an area where there was a high density of burrow openings (15-20 per square metre). These holes were about 1-2cm in diameter and the passages leading down from clusters of these openings converged to form a large tunnel (6-7cm diameter). Each of these larger tunnels converged on a chamber the size of a soccer ball (approximately 30cm diameter), the base of which was about 90cm below the soil surface. A silt-filled descending tunnel terminated at a depth of over 1m. The general structure of the burrow is shown in Figure 1.

Water was encountered in the burrow tunnels at approximately 40-50cm below the surface and the burrow therefore contained in excess of 5 litres of water. It was while bailing out this water in order to catch the adult crayfish that we found many juveniles were being thrown out with the water. These juveniles came mainly from the chamber and a careful collection from the water and the walls of the chamber was made.

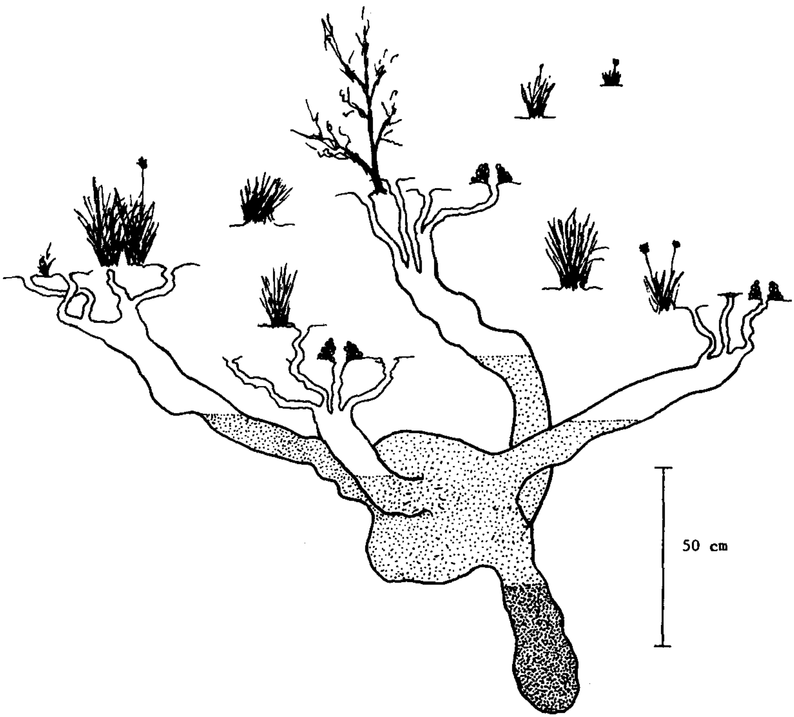

Figure 1. A schematic diagram of the burrow system investigated at Rattrays Marsh, north east Tasmania. Light stippling represents water in the burrow; darker stippling indicates the silt in the descending tunnel.

After excavating the entire burrow system (which did not connect with any others), a total of 52 juveniles, all of *Engaeus leptorhyncus* were found. Three adults were also found in the same burrow: a male, a non-reproductive female and a reproductive female carrying eggs. The lengths of these animals (from the orbit to the rear of the carapace, hereafter OCL) were 31.6, 24.8 and 33.5mm respectively. Non-reproductive females of *Engaeus* can be detected by the lack of setae around the genital pore and the absence of a antero-lateral flap on the side plates of the second segment of the abdomen (Horwitz, unpublished data).

The gravid female was carrying 108 eggs; each egg was ovoid with diameters of approximately 1.7 and 1.4mm, and coloured bright orange. Eye spots were not visible in the eggs, suggesting that they were in the early stages of development (Hopkins, 1967).

Of the juveniles, 28 were females, the rest male; no intersexed animals were recorded, though they are known in other crayfish species. Their sizes ranged from 6.4mm to 15.7mm OCL. The size frequencies of the entire collection are plotted in Figure 2. (While it appears that females are more frequent in the smaller size classes, there is no significant difference between the sizes of males and females.)

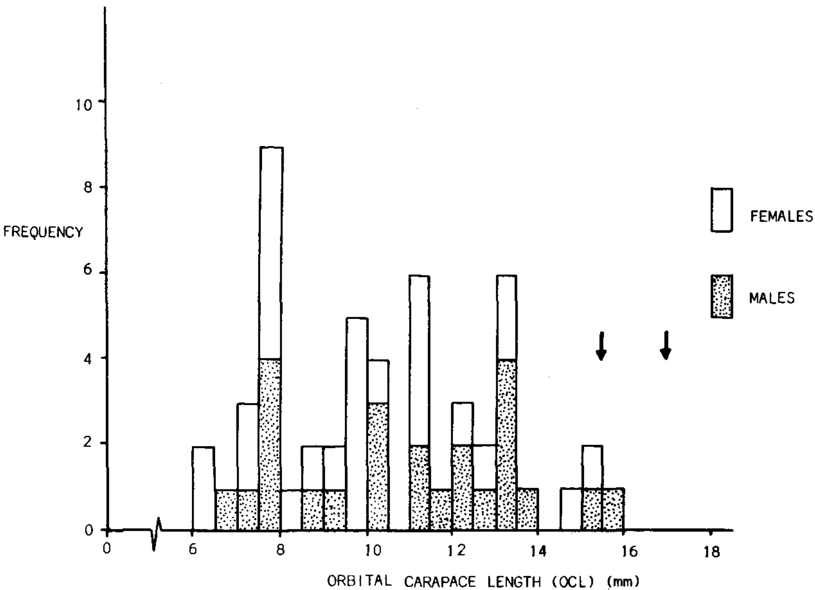

Figure 2. A size frequency histogram showing the number of crayfish juveniles of each sex in each 0.5mm size class. All individuals came from the same burrow and were measured to the nearest 0.1mm. Arrows indicate the sizes of two crayfish found on the surface at night.

Both the adults and juveniles were brightly coloured. The legs and lower portions of the cephalothorax were light red, while the carapace was dark red. The claws of the adults were pale blue to white ventrally and blue to red dorsally.

As many as four generations may have been present in this burrow. The youngest was represented by the developing eggs on the abdomen of the female, and the oldest by the adults. There were probably two generations of juveniles: those of 6-10.5mm OCL and those of 11-16mm OCL.

The area at Rattrays Marsh was searched at night for crayfish on the ground surface. Two small males were found; their sizes were 17.0 and 15.4mm OCL. When compared to the sizes of juveniles in the burrows (Figure 2), they fall at the upper extremity of the size distribution. This suggests that at an OCL size of 15-16mm, juveniles leave the parental burrow and disperse at night, to dig, or find, burrows of their own.

Several species of crayfish in the genus *Engaeus*, both in Victoria and Tasmania, are known to inhabit similar types of burrow system, and these burrows have been found to contain large numbers of juveniles of different sizes (Clark, 1936; Riek, 1969; Suter and Richardson, 1977). These observations have led some authors (Clark, 1936; Riek, 1969 and latterly Powers and Bliss, 1983) to suggest that these crayfish are "communal".

Our observations do not support this idea. We propose that these large groupings of crayfish are merely family groups with more than one generation of juveniles. In our experience, the occurrence of more than two adults in a burrow, as we found here, is very rare and does not justify the notion of "communities" of burrowing crayfish.

The existence of family groups of crayfish presents an intriguing paradox, since even the juveniles of many species are described as aggressive and thus seek solitude at an early age (Bovbjerg, 1956). Juveniles of *E. leptorhyncus*, and other species like it, may not develop aggressive tendencies until they are quite large, perhaps at the size at which they leave the parental burrow.

The three characteristics of *Engaeus leptorhyncus* highlighted in this study (the construction of a large chamber in the burrow, the presence of more than two generations together, and the late development of aggressive tendencies, leading to a late departure from the burrow) are adaptations to a more terrestrial mode of life than is shown by most freshwater crayfish. Species of *Engaeus* which burrow away from water bodies or the water table all share these characteristics, in contrast to those which burrow in, or close to, water.

Crayfish breeding in such a "water table-independent" habitat have had to develop means by which the juveniles can grow within the parental burrow until they are able to move to new burrows, since they cannot release them at an early age into a nearby water body, as other crayfish do.

Other Tasmanian species of *Engaeus* showing the same life style include *E. cisternarius* (Suter and Richardson, 1977), found in the north west and west and an as yet undescribed species known from the Asbestos Range region.

Acknowledgement:
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FOOD OF THE MASKED OWL *TYTO NOVAEHOLLANDIAE*

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A quantity of undigested food remains regurgitated by Masked Owls *Tyto novaehollandiae* was collected by Mr. Peter Duckworth at Triabunna between 3 November 1980 and 21 March 1981. It consisted of 94 complete pellets plus a bulked amount of loose material from disintegrated pellets. It was lodged with the Queen Victoria Museum where it has been photographed, measured and analysed to determine contents. Some results are given in Table 1. Cranial material only has been used in determining the figures for columns 2, 3 and 4. These reflect the minimal number of individuals taken and avoids the possible duplication which may occur in counts of larger prey species. For example, one Rabbit might satisfy an owl's appetite for a night, producing several pellets, whereas with smaller animals, such as House Mice, several might occur in one pellet. The material consisted almost exclusively of small mammals and birds with Rabbit *Oryctolagus cuniculus,* Ship Rat *Rattus rattus,* House Mouse *Mus musculus* and Common Starling *Sturnus vulgaris* the most prevalent.

It is suggested that this reflects opportunistic rather than selective feeding as those four species would be numerous and easily caught at that time of year. A somewhat similar predominance of introduced vermin species was found in pellets collected from beneath a Masked Owl's nest near Launceston in 1982 (Green 1982).

Pellets generally ranged in size from 35x23mm to 75x57mm. Those consisting mostly of mammal remains were tightly bound by fur whereas those consisting mostly of bird remains were fragile and often fell apart, feathers not binding the bones as well as fur. This resulted in a far greater proportion of bird remains in the loose bulked material, many bird skulls having separated from the pellets.

Skulls had often parted along the suture lines suggesting some of the prey to have been of subadults. All the Rabbit material was of young (less than half grown) animals. There was no evidence of skulls or post-cranial bones having been crushed before being swallowed.

Most pellets contained remains of more than one animal. For example, a Starling and two House Mice; Ship Rat and Rabbit; Starling and Rabbit; Rabbit, House Mouse and small bird; Starling and two Sugar Gliders; Swamp Quail and House Mouse; 5 House Mice.

Table 1. Analysis of 94 pellets and other such loose material regurgitated by the Masked Owl *Tyto novaehollandiae*. Column 1 gives the percentage of pellets in which a species were found; 2, the number of skulls found in all pellets; 3, skulls found in loose material; 4, total number of skulls in the pellets and loose material.

Prey Species	1	2	3	4
Sugar Glider *Petaurus breviceps*	2	3	3	6
Brown Bandicoot *Isoodon obesulus*	1	1	1	2
Eastern Swamp-rat *Rattus lutreolus*	1	-	2	2
Ship Rat *Rattus rattus*	19	12	14	26
Water Rat *Hydromys chrysogaster*	2	2	-	2
House Mouse *Mus musculus*	18	27	28	55
Rabbit *Oryctolagus cuniculus*	55	7	13	20
Swamp Quail *Coturnix ypsilophora*	1	1	-	1
Satin Flycatcher *Myiagra cyanoleuca*	-	-	1	1
House Sparrow *Passer domesticus*	-	-	1	1
Common Starling *Sturnus vulgaris*	20	13	87	100
Small birds Undetermined	2	2	1	3
Swift Moth (Hepialoidea)	About 20 in 2 pellets and loose material			
Bug (Pentatomoidea)	1 in 1 pellet			

The internal lining of stomachs (gizzards) of Starlings were found in numerous pellets.

It is evident that the Masked Owl, while continuing to feed upon indigenous animals, has efficiently adapted its predatory activities to include some introduced small mammals and birds and these now form a major part of its diet. While the Masked Owl's predation upon introduced animals might assist in vermin control, the abundance of such food items probably fosters a stronger than otherwise Masked Owl population.

Reference:

Green, R.H. 1982. Breeding and food of the Masked Owl *Tyto novaehollandiae*. *Tasm. Nat.* *69:*4-6.

BOOK REVIEW

Thylacine: The Tragedy of the Tasmanian Tiger by Eric R. Guiler. Published by Oxford University Press, Melbourne, 1985, 207pp.

Reviewed by A.V. and D.A. Ratkowsky

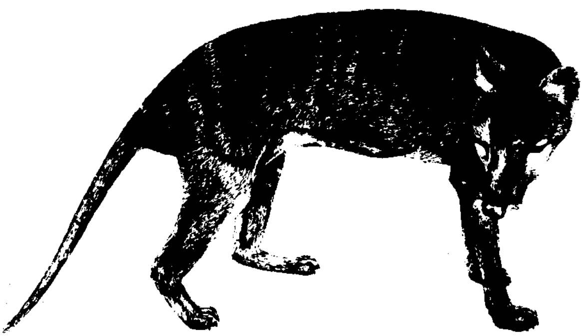
After a brief introductory chapter, the second chapter deals with the history of the thylacine and includes the animal's relationship with Aboriginal man and with the early white settlers. The thylacine quickly learned that sheep were easy prey, and as early as 1830, the Van Dieman's Land Company, with extensive grazing holdings in the northeast, introduced a bounty scheme and hired 'trappers' to combat the high sheep losses at its Woolnorth property. East coast landholders also claimed that thylacines caused enormous sheep losses, one estimate being that 30,000 to 40,000 sheep were killed each year on the east coast. Although it is now recognised that such claims were gross exaggerations, and that losses due to the thylacine were only a fraction of those claimed, the Tasmanian Parliament was repeatedly petitioned by landholders to take action against the thylacine. A motion to pay a £1 bounty in 1887 was carried by twelve votes to eleven. Guiler writes: "No other Tasmanian parliamentary action has had such a dreadful effect upon one of the state's fauna. The decision was based upon wildly exaggerated claims which in reality covered up bad farming practice. No attempt was made to check the veracity of the claims..."

Between the years 1888 and 1912, 2184 thylacines were presented for the government bounty. Not until 14 July 1936 was the thylacine declared a totally protected species. But this move came too late, for the last known living 'tiger' was to die in the Beaumaris Zoo in Hobart on 7 September 1936. Chapter 3 deals with the animal itself and describes its anatomy. Little is known of its physiology. A curious fact is its large brain size, which is large relative to other dasyurids even if the thylacine's larger body weight is taken into account. The fourth chapter is a chronicle of thylacines in zoos, which totalled only four Australian zoos and six overseas collections. The fifth chapter deals largely with deductions about its reproduction, locomotion and vocalization, as "pathetically little is known of the biology of the thylacine". Chapter 6 details the history of the Van Diemen's Land Company and its relationship, mostly one of persecution, to the thylacine. The seventh chapter is devoted to some of the many 'tiger tales' that have come down through the years.

Chapter 8 details the various official, and some private, expeditions and searches since 1937 to seek positive information of the thylacine's existence. Ten of these expeditions were led by the author. Despite some very extensive attempts at photography and snaring, no positive evidence of the tiger's continued existence was obtained. Snares caught a variety of other native animals such as pademelons, wombats and wallabies. Photographs similarly recorded wallabies, possums, devils and other native animals, but no thylacines. The brief ninth chapter deals with reports of thylacines arising from time to time from the Australian mainland. Although fossils confirm that thylacines once existed on the mainland, all recent reports of living thylacines are discounted. The concluding tenth chapter affirms the author's belief in the continued existence of the thylacine, despite "not even one positive recent sighting at the time I write..."

The book is marred by an uninteresting writing style and a paucity of good illustrations. It is of interest to compare this book with two other works on the thylacine, both published in 1981, the "Search for the Tasmanian Tiger" by Quentin Beresford and Garry Bailey, Blubber Head Press, Hobart, and "The Tasmanian Tiger - 1980" by Steven Smith, a Tasmanian National Parks and Wildlife Service Technical Report on the (then) current status of the thylacine. The Beresford-Bailey book is soft-covered, 54 pp., and written in the interesting style of a historian. It is well-illustrated, more modestly priced than Guiler's book, and although not as comprehensive as the latter, can be recommended both for local readers and visitors to Tasmania who wish to learn something about the history of this remarkable animal since white settlement. The Smith report is available to the general public through libraries and institutions, and its 133 pages cover much of the same material as Guiler's book.

Does the thylacine continue to exist? Although Guiler believes that it does, there are those who consider the species to be 'probably extinct'. Smith documents over 300 sightings of thylacine-like animals between 1936-1980, of which 103 were rated as 'good'. Nevertheless, in common with yeti or the Loch Ness 'monster', no quantity of sightings, no matter how reliable they seem to be, will equal one carcase or one live animal. It is now almost half a century since the last known living thylacine died. Is there really any hope that the species still exists?



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