

A REVISION OF THE TASMANIAN FRESHWATER CRAYFISH GENUS *ASTACOPSIS* HUXLEY (DECAPODA: PARASTACIDAE).

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(with three text-figures)

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During a broad study of the biology of the freshwater crayfishes in the Tasmanian genus *Astacopsis*, two distinct forms of *Astacopsis franklinii* were recognised. These "forms" were found to differ in terms of their general morphology and distribution. As a result, the taxonomy of *Astacopsis* has been revised to re-establish the three species originally described by Ellen Clark. *Astacopsis franklinii* Gray has been divided into two separate species, the eastern *Astacopsis franklinii* and the western *Astacopsis tricornis*, while the status of *Astacopsis gouldi* remains unaltered.

Key Words: *Astacopsis*, Tasmania, distribution, taxonomy.

INTRODUCTION

The members of the genus *Astacopsis*, which include the world's largest freshwater crayfish (and therefore invertebrate) species, are associated with riverine and lacustrine habitats throughout Tasmania (Swain *et al.* 1982). Taxonomically and ecologically their closest relatives are the crayfishes of the genera *Euastacus* and *Astacoides* (Hobbs 1987, 1988, Riek 1972). The genus was first erected by Huxley in 1878 but earlier accounts and descriptions of crayfish now placed in this genus are available (Gray 1845, Gould 1870). Perhaps the earliest representation of *Astacopsis* is a painting made in 1832 by the convict artist William Buelow Gould in his "Book of Fishes". The pictured crayfish is clearly identifiable as the large western form of *A. franklinii*, probably from the lower reaches of the Gordon River.

The existence of several Tasmanian varieties of crayfishes within the genus was recognised by Smith (1909, 1912) but he retained a single specific name, *A. franklinii*, for all Tasmanian members of the genus. Clark (1936) separated the Australian and Tasmanian members of the genus, assigning the former to a new genus *Euastacus* while reserving *Astacopsis* for the latter. At the same time, she revised *Astacopsis* adding two new species: *A. gouldi* (from northern Tasmania) and *A. tricornis* (from the Lake St Clair region). *A. franklinii* was retained and used for the smaller *Astacopsis* from the Launceston and Hobart regions. Riek (1969) added another species, separating *A. franklinii* into *A. fluviatilis* (from southern Tasmania) and *A. franklinii* (from northern Tasmania). Swain *et al.* (1982) revised the genus and reduced the number of species from four to two by including *A. fluviatilis* and *A. tricornis* within *A. franklinii*.

A. gouldi, the giant freshwater crayfish or "lobster", as it is called locally, is the world's largest known crayfish, attaining weights of more than three kilograms (Smith 1909, Lynch 1967, Hobbs 1988). The species is restricted to the north of Tasmania, where it can be found in streams, rivers and reservoirs draining into the Bass Strait, as well as in the Arthur River system in the extreme northwest (Swain *et al.* 1982).

A. franklinii is found throughout most of Tasmania (Swain *et al.* 1982) in, or in association with streams, rivers and lakes. Although generally smaller than *A. gouldi*, it appears

to vary greatly in size and spininess. In their re-examination of the various morphological characters, Swain *et al.* (1982) found that the variation in spininess and size had a geographical basis. It will be shown in this study that this variation is, in fact, at least partly due to the occurrence of two distinct forms within *A. franklinii*, and it is further proposed that these two forms should be treated as two separate species.

METHODS

The specimens used in the diagnosis of the species of *Astacopsis* were collected during a broad study of population structure and reproductive biology of the crayfishes in this genus (Hamr 1990). The morphometric descriptions and measurements were obtained from individuals collected at various sites throughout Tasmania between 1985 and 1989. Individuals from numerous populations throughout the range of each species were examined and compared.

Crayfish were captured using baited nets and hand lines, as well as by hand, using snorkelling equipment and turning over rocks and submerged logs.

Morphometric measurements for all specimens used in this revision were measured with Vernier callipers and recorded to the nearest tenth of a millimetre, including carapace length (CPL = rostrum tip to back edge of carapace) which was used as a standard measure. Rostral width (RW) refers to the maximum width of the rostrum between the eyes. The inter-ocular width was chosen as it was least affected by growth-related changes in the morphology of the rostrum. The mean-size adjusted inter-ocular rostral width refers to the ratio between rostral width and carapace length (RW/CPL). Populations of *A. franklinii* from Hobart Rivulet and the Lake St Clair region (Clarence Lagoon) were used in the rostral morphometry comparisons because they correspond to the original *Astacopsis* species described by Ellen Clark (1936).

Some of the specimens examined, as well as new distributional information, were obtained from Dr A.M.M. Richardson's taxonomic collection at the University of Tasmania, as well as from surveys conducted by the Inland Fisheries Commission (Tasmania).

RESULTS AND DISCUSSION

During the examination of Tasmanian populations of *Astacopsis franklinii*, two distinct forms were recognised. These forms appear to have non-overlapping distributions (fig. 1) and were found to differ in terms of their general morphology as well as their size at maturity (Hamr 1990). Because of these differences, these forms are here referred to as two species.

The most reliable morphological characters separating the species of *Astacopsis* were found on the rostrum. *A. gouldi* can be clearly distinguished from the other two species by the presence of a median rostral carina, while *A. franklinii* can be separated from *A. tricornis* on the basis of rostral width and depth (fig. 2) Figure 3A & B shows the difference in the inter-ocular rostrum width between the species. In addition, the mean-size adjusted inter-ocular rostral widths of *A. tricornis* (mean = 0.126, s.d. = 0.013, n = 35) and *A. franklinii* (mean = 0.11, s.d. = 0.006, n = 51) were found to be significantly different ($t = -7.92$, $df = 84$, $p < 0.0001$).

Although some differences in rostral morphology were noted by previous authors (Riek 1936, Swain *et al.* 1982), no characters other than the presence or absence of the median rostral carina and the morphology of spines on the lateral carinae were examined.

As shown by Swain *et al.* (1982), the exact number and location of spines are clearly unreliable taxonomic characters for separating *Astacopsis* species. There is, however, a clear difference in overall spininess between *A. franklinii* and *A. tricornis*, especially in adult individuals. This difference was shown by Swain *et al.* (1982) who stated: "Examination of the material in our collection suggested that much of the variation in general spininess of *A. franklinii* had a geographical basis, with a reduction in spininess both from west to east and north to south". Similarly they found that "large animals were present only in collections from river systems draining north or west". This corresponds directly with the distribution of the two species previously grouped under *A. franklinii* as identified in this study (fig. 1). Their failure to detect the clear east-west separation was probably due to sampling discrepancies (such as low numbers of crayfish from the northeastern region) and the large size/age range of animals in their samples. As it is generally more difficult to recognise the specific characters in juveniles of closely related crayfish species, the best results in keying out members of the genus *Astacopsis* are obtained when adults are compared.

The findings of this study suggest that the two previously recognised forms of *A. franklinii* can be treated as separate species. The "western form" description in this study corresponds closely to the initial description of *Astacopsis tricornis* by Clark (1936), who recognised differences between the southeastern and western populations of *A. franklinii*. Her sampling of the western form, however, was restricted to the Lake St Clair region and therefore, she failed to recognise the wider distribution of this species. Nevertheless, it is suggested that *A. tricornis* should be re-erected and assigned to the larger, western form of the present *A. franklinii*.

The differences between the two species arising from *A. franklinii* and the revised key for the genus *Astacopsis* are described as follows:

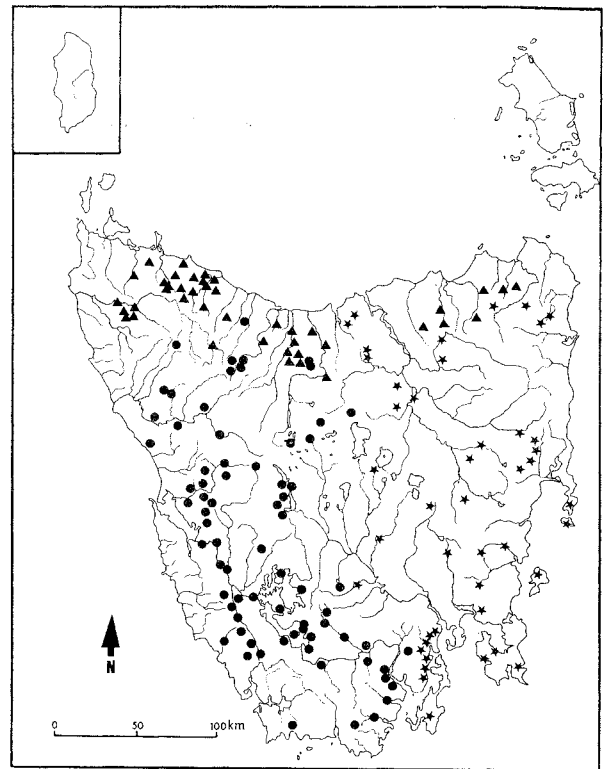


FIG. 1 — Distribution of *Astacopsis gouldi* (triangle), *Astacopsis franklinii* (star) and *Astacopsis tricornis* (circle) in Tasmania.

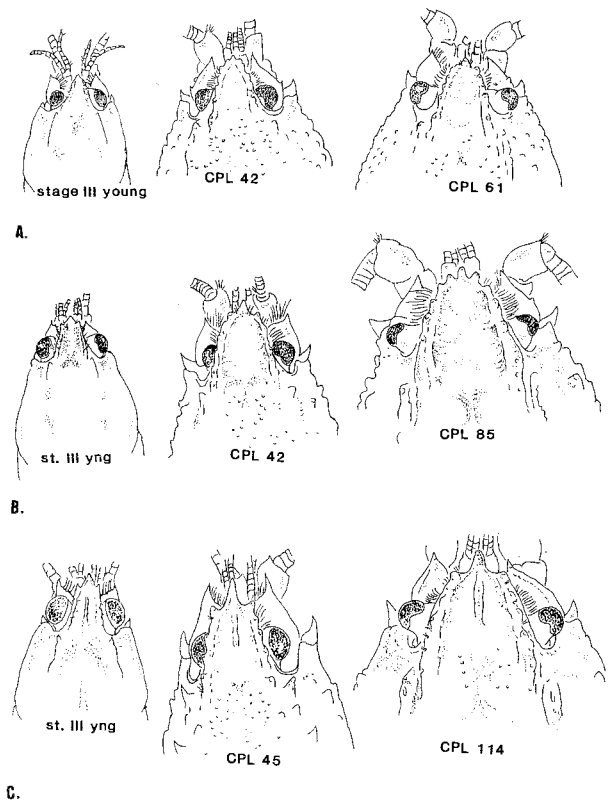


FIG. 2 — Comparison of rostral morphology (stage III young to large adult) in *Astacopsis franklinii* (A), *Astacopsis tricornis* (B) and *Astacopsis gouldi* (C). CPL = carapace length.

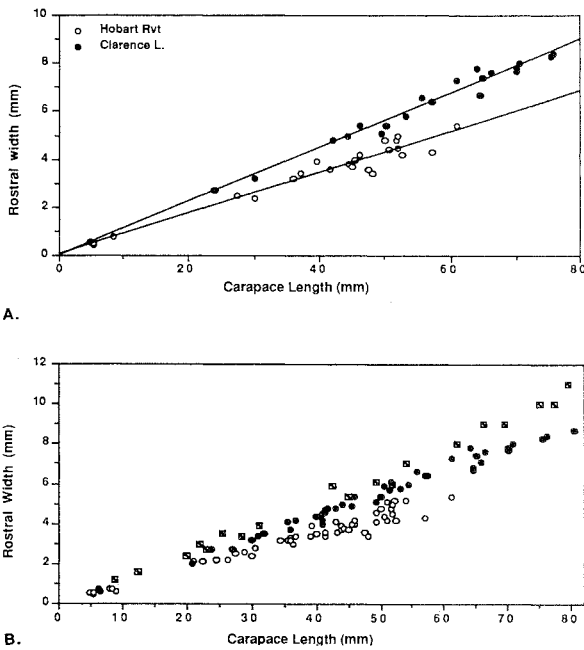


FIG. 3 — (A) The relationship between interocular rostral width and carapace length in *Astacopsis franklinii*, from Hobart Rivulet (open circle; $y = 0.055 + 0.085x$, $r^2 = 0.953$) and *Astacopsis tricornis*, from Clarence Lagoon (closed circle; $y = 0.024 + 0.113x$, $r^2 = 0.971$). (B) The relationship between interocular rostral width and carapace length in *Astacopsis franklinii* (open circle; $y = 2.0379e-2 + 8.7363e-2x$, $r^2 = 0.952$), *Astacopsis tricornis* (closed circle; $y = 0.17927 + 0.10614x$, $r^2 = 0.981$), and *Astacopsis gouldi* (open square with dot; $y = -0.21848 + 0.13415x$, $r^2 = 0.990$) in various Tasmanian populations.

KEY TO THE GENUS *ASTACOPSIS*

- 1a. Rostrum divided by a median longitudinal carina.....
..... A. gouldi Clark.
- 1b. Rostrum without a median longitudinal carina 2.
- 2a. Rostrum broad, concave, U-shaped. Adults large with numerous, prominent spines and tubercles
..... A. tricornis Clark.
- 2b. Rostrum narrower, flat, V-shaped. Adults small with less prominent spines and tubercles..... A. franklinii Gray.

SPECIES DESCRIPTIONS

Astacopsis franklinii

Astacopsis franklinii Gray, 1845: 409.
Astacopsis tasmanicus Smith, 1909: 65.
Astacopsis franklinii v ar. *tasmanicus* Smith, 1912: 156.
Astacopsis franklinii Clark, 1936:34; 1939:119; Riek, 1969 : 898.
Astacopsis fluviatilis Riek, 1969: 912.
Astacopsis franklinii Swain et al., 1982: 700.

Diagnosis

Adults small (largest specimen: 61 mm CPL, 0.060 kg); Rostrum narrower anteriorly, V-shaped, shallow (flat), apex

terminated in single blunt spine; lateral rostral carinae blunt, with 6–7 low tubercles; small tubercle at base of carinae (fig. 2); eyes large; body armature relatively heavy, spines less sharp overall, tubercles on brachistegites small and uniform; great chelae short and stout with large palm and short fingers, covered with small depressions (on palm) and tubercles (on fingers); large spine on merus; held horizontally with respect to substrate; sternal keel blunt, lateral processes low, unsculptured, little tuberculation; male genital papilla with complete calcified tube, separated from basal portion of coxopodite in mature individuals; tube sculptured, less cylindrical; telson calcified, without transverse suture, with single spine on lateral margins; uropods calcified uniformly in immature individuals and adult males, decalcified distally in mature females; juveniles: basically light orange brown; adults: basically dark brown, tubercles orange, underside light orange brown; blue morphs are infrequently found among adults.

Distribution

Eastern half of Tasmania, approximately east of a line from the Wellington Range in the south through the midlands to the Asbestos Range in the north (fig. 1). New locality records: Fortescue Bay, Lagoon Creek, Allens Creek (Tasman Peninsula); Guy Fawkes Rivulet; Appledorf Creek; Tyenna River; Captain Cook Creek tributary (Bruny Island), Falls Creek tributary (Bruny Island); Browns Creek (Asbestos Range N.P.); Swan Rivulet tributary; Crocketts Creek (Schouten Island); Eastern Rivulet, Jimmy Rivulet and Cooks Beach–Mt Graham track (Freycinet Peninsula).

Astacopsis tricornis

Astacopsis tricornis Clark, 1936: 36; 1939: 120.
Astacopsis franklinii Swain et al., 1982: 700.

Diagnosis

Adults medium to large (largest specimen: 148.4 mm CPL, 1.00 kg; rostrum broad, deep (concave), strongly U-shaped, apex terminated in several spines; lateral rostral carinae sharp, raised with 5–6 raised tubercles (fig. 2); eyes large; body armature heavy; spines on abdomen, chelae and walking legs, large and sharp in specimens of all sizes; prominent raised tubercles of variable size and sharpness, laterally on brachistegites and cephalic region; great chelae large; fingers long, covered with prominent tubercles/spines; prominent sharp spine on merus; palm without depressions; held horizontally with respect to substrate; sternal keel sharp, lateral processes raised, sculptured, tuberculate with winglike appearance in adults; male genital papilla with complete calcified tube, separated from basal portion of coxopodite in mature individuals; tube more cylindrical, less sculptured, with prominent raised keel; telson calcified, without transverse suture, with single spine on lateral margins; uropods calcified uniformly in immature individuals and adult males, decalcified distally in mature females; colour — juveniles: very light brown, sometimes grey; underside ivory; adults: basically brown to light brown; tubercles and spines yellow; those on brachistegites especially prominent; blue marking on brachistegites and cephalic region present in very large individuals; underside ivory; blue morphs not noted.

Distribution

Western half of Tasmania, approximately from the Huon River in the south through the western edge of the Central Plateau to the Gog Range in the north (fig. 1). New locality records: Pigsty Ponds; Pelverata Falls; Arve River tributary; creek draining into Reservoir Lake; Meander River; Croanna Creek; Prince Rivulet; Weld River; Harlequin Hill (burrow in buttongrass plain); Sandfly Creek (Scotts Peak road); Scotts Peak (rainforest creek draining into Lake Pedder); Swampy Creek; Dozer Creek; two un-named creeks running into Bonnett Bay, Lake Pedder; Serpentine River (below dam); Melaleuca Creek (Melaleuca); Giblin River; Lake Meston; Clarence Lagoon; Lake Dixon; Lake Margaret; Ring River tributary (near Murchison Highway); Murchison River; Princess River; Comstock Creek; Heazlewood River tributary; Jean Brook; Eel Hole Creek.

Astacopsis gouldi Clark

Astacus sp. Gould, 1870: 42.

Astacopsis franklinii Huxley, 1978: 764; Smith, 1909: 65; 1912: 154.

Astacopsis gouldi Clark, 1936: 35; 1939: 119; Riek, 1969: 898; Swain *et al.*, 1982: 701.

Diagnosis

Adults very large (largest specimen: 214 mm CPL, 4.0 kg); rostrum broad, relatively shallow, V to U-shaped, apex sharp, terminated in single prominent spine, longitudinal carina in centre of rostrum (generally well-defined but can be weak on some small specimens), lateral rostral carinae raised with 3–6 blunt tubercles on each side, blunt spine at base of rostral carinae (fig. 2); eyes large; body armature heavy; spines and tubercles on chelae, walking legs, carapace and abdomen; cephalothoracic and abdominal spines much sharper in smaller specimens becoming blunter in large specimens (fig. 2); great chelae stout and very large, especially in adult males (adult female chelae less robust, thinner and more elongate), outer surface of both fingers covered with small, yellow tubercles/spines; prominent sharp spine on merus; held horizontally with respect to substrate; sternal keel moderately sharp, with a sharp, ventrally facing spine on process between second and third pereopods; male genital papilla with complete calcified tube, separated from basal portion of coxopodite in mature individuals; telson calcified, without transverse suture, with single spine on lateral margins; uropods calcified uniformly in immature individuals and adult males, decalcified distally in mature females; colour-juveniles: basically brown with green mottling, spines and tubercles white, underside of cephalothorax ivory; adults: basically dark brown-green, sometimes almost black, chelae brown with greenish tips, tubercles and spines yellow; characteristic blue marking laterally on brachiolegites and cephalic region; blue morphs are often found among adults, in these the basic overall colour is bright blue.

Distribution

The known distribution of *A. gouldi* is shown in figure 1. New locality records: Pearly Brook (Horwitz, pers.comm.); St Patricks River (introduced population); Garden of Eden Creek; Gunns Plains Caves; Lake Barrington; West Gawler

River; Inglis River tributary (near Henrietta); Big Creek; Hellyer River; Detention River; Wilsons Creek; Sumac Rivulet.

In Gunns Plains caves, specimens ranging in carapace lengths from 55 mm to 147mm were collected from the creek running through the cave as far as 300 m from the tourist entrance. From this study, as well as the observations of Mr Des Wing, the cave caretaker, it appears the crayfish live and breed inside the cave (Mr Wing reports seeing berried females as well as small juveniles deep within the cave). This constitutes the first report of such a phenomenon in Tasmania.

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