

Accessory Publication

**The systematics of freshwater crayfish of the genus *Cherax* Erichson
(Decapoda : Parastacidae) in eastern Australia re-examined using nucleotide
sequences from *12S* rRNA and *16S* rRNA genes**

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Abstract. Nucleotide sequence data were used to re-examine systematic relationships and species boundaries within the genus *Cherax* from eastern Australia. Partial sequences were amplified from the *16S* (~365 bp) and *12S* (~545 bp) rRNA mitochondrial gene regions. Levels of intra- and inter-specific divergence for *Cherax* species were very similar between the two gene regions and similar to that reported for other freshwater crayfish for *16S* rRNA. Phylogenetic analyses using the combined data provided strong support for a monophyletic group containing 11 eastern Australian species and comprising three well-defined species-groups: the '*C. destructor*' group containing three species, the '*C. cairnsensis*' group containing four species and the '*C. cuspidatus*' group containing two species. *Cherax dispar* and *C. robustus* are distinct from all other species and each other. In addition, two northern Australian and a New Guinean species were placed in the '*Astaconephrops*' group, which is the sister-group to the eastern Australian *Cherax* lineage. Several relationships were clarified, including: the status of northern and southern *C. cuspidatus* as separate species; a close relationship between *C. cairnsensis* and *C. depressus*; the validity of *C. rotundus* and *C. setosus* as separate species and their close affinities with *C. destructor*; and the distinctiveness of the northern forms of *Cherax*. The analysis of the *12S* rRNA and *16S* rRNA data is highly concordant with the results of previous allozyme studies.

Table 1. Average percentage of sequence divergence between *Cherax* taxa for the 12S gene region

Above diagonal corrected divergence (GTR+G model of evolution) and below diagonal uncorrected divergence

Species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1. <i>C. cuspidatus</i>	–	8.39	13.07	19.77	14.79	16.24	13.59	12.66	11.28	13.54	13.92	16.13	39.89	34.89	18.66	27.62	25.37	24.38
2. <i>C. sp. nov.</i>	5.89	–	12.08	13.71	13.27	13.78	12.83	10.68	10.17	12.53	12.21	14.02	38.45	31.14	20.05	26.87	23.32	24.59
3. <i>C. punctatus</i>	7.24	7.17	–	14.77	13.17	9.40	7.31	11.19	19.52	23.60	20.61	21.89	48.66	47.46	28.98	38.86	27.18	27.48
4. <i>C. parvus</i>	9.51	7.66	8.24	–	20.05	13.87	13.88	19.25	14.55	20.88	19.16	21.45	41.93	38.18	33.28	35.99	31.83	40.16
5. <i>C. robustus</i>	7.96	7.74	7.62	9.93	–	15.48	15.34	18.88	16.30	18.93	17.17	20.88	52.09	45.92	27.67	30.92	24.87	27.39
6. <i>C. depressus</i>	8.81	8.12	6.51	7.91	8.78	–	4.97	15.68	16.74	18.50	17.00	20.16	47.83	40.05	30.11	26.59	19.68	26.93
7. <i>C. cairnsensis</i>	7.86	7.83	5.22	7.91	8.47	3.95	–	12.62	15.83	19.11	15.69	18.61	38.76	37.58	23.06	25.35	18.34	23.59
8. <i>C. dispar</i>	7.41	6.77	6.43	9.18	9.53	8.51	7.32	–	17.89	21.21	20.14	20.94	53.04	48.19	30.63	42.30	31.65	34.07
9. <i>C. d. destructor</i>	7.13	6.89	10.29	8.04	9.07	10.49	9.16	9.83	–	4.48	7.06	7.30	39.61	30.42	19.96	28.00	26.09	26.83
10. <i>C. d. albidus</i>	8.03	7.93	11.62	10.21	9.93	8.93	10.49	10.97	3.68	–	6.36	7.58	42.27	34.64	22.49	34.75	30.77	30.51
11. <i>C. setosus</i>	7.84	7.46	10.06	9.50	8.78	8.93	8.66	10.31	5.09	4.81	–	6.47	35.38	29.43	21.57	33.32	25.57	28.36
12. <i>C. rotundus</i>	8.33	7.85	9.94	9.95	9.65	9.65	9.38	10.13	5.11	5.39	4.81	–	38.13	35.04	23.65	39.73	32.68	35.75
13. <i>C. quadricarinatus</i>	13.12	13.53	14.54	13.73	15.25	14.85	13.12	16.20	13.83	14.31	12.61	13.15	–	14.92	16.27	50.26	48.43	63.71
14. <i>C. rhynchotus</i>	12.57	12.24	14.98	12.72	14.70	13.83	13.41	15.82	11.97	13.01	11.58	12.97	8.71	–	10.89	39.78	42.55	56.33
15. <i>C. sp. (New Guinea)</i>	8.87	9.83	11.61	12.50	11.34	12.48	10.46	12.65	9.76	10.53	9.67	10.22	8.74	7.04	–	32.73	32.56	35.65
16. <i>C. quinquecarinatus</i>	11.06	11.22	13.83	12.76	11.86	11.04	10.74	14.54	11.61	13.32	12.46	13.33	14.84	12.74	11.63	–	11.47	16.27
17. <i>C. tenuimanus</i>	10.87	10.69	11.32	12.24	10.77	9.37	8.93	12.61	11.66	12.81	10.80	12.25	14.72	13.33	12.23	7.09	–	13.84
18. <i>C. preissii</i>	10.66	10.72	11.06	13.39	10.79	10.81	9.94	12.46	11.15	11.98	10.84	12.28	16.08	14.78	11.69	8.23	7.65	–

Table 2. Average percentage sequence divergence between *Cherax* taxa for the 16S gene region

Above diagonal corrected divergence (K81uf+I+G model of evolution) and below diagonal uncorrected divergence

Species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1. <i>C. cuspidatus</i>	–	13.20	19.04	16.02	15.91	14.65	16.04	17.98	17.17	16.19	19.32	18.33	23.95	21.36	20.76	27.35	28.96	24.66
2. <i>C. sp. nov</i>	9.19	–	16.52	15.48	16.34	16.14	16.56	14.88	18.28	18.38	19.18	18.76	23.92	20.17	20.35	25.17	24.73	27.18
3. <i>C. parvus</i>	11.48	10.39	–	12.26	17.02	10.59	11.09	12.99	15.15	14.66	17.69	16.08	28.03	22.12	25.03	31.58	30.13	31.65
4. <i>C. punctatus</i>	10.76	10.27	8.90	–	14.58	6.16	6.64	13.31	13.03	14.20	14.98	13.00	25.23	19.72	20.23	25.86	24.33	22.23
5. <i>C. robustus</i>	10.74	10.77	10.57	10.07	–	13.14	14.27	13.71	17.19	15.14	17.45	13.74	24.02	21.02	22.14	23.76	23.19	25.13
6. <i>C. depressus</i>	10.13	10.49	7.75	5.34	9.29	–	2.02	8.75	10.45	10.37	11.88	11.07	22.71	17.68	18.02	26.67	22.49	24.98
7. <i>C. cairnsensis</i>	10.66	10.67	8.06	5.64	9.74	2.52	–	10.39	10.95	11.77	12.37	11.19	25.04	19.25	19.75	27.55	24.49	26.84
8. <i>C. dispar</i>	11.76	10.12	9.05	9.55	9.39	6.83	7.77	–	11.45	10.91	10.27	91.02	21.31	17.87	16.43	24.17	21.06	21.88
9. <i>C. d. destructor</i>	11.21	11.65	9.64	9.00	10.99	7.45	7.66	8.36	–	2.33	6.48	8.02	23.86	20.83	18.87	26.17	25.99	21.66
10. <i>C. d. albidus</i>	10.70	11.78	8.45	9.69	10.04	7.38	8.16	8.03	2.20	–	7.19	8.82	24.72	20.99	18.90	25.68	25.18	21.67
11. <i>C. setosus</i>	11.95	11.71	10.74	9.85	10.97	8.12	8.32	7.49	5.22	5.66	–	6.00	22.35	20.30	20.44	24.62	24.51	23.88
12. <i>C. rotundus</i>	11.82	11.83	10.55	9.29	9.64	8.13	8.05	7.15	6.41	6.97	5.09	–	22.95	18.44	16.68	23.06	22.74	21.50
13. <i>C. quadricarinatus</i>	13.67	13.19	14.49	13.79	13.21	12.78	13.47	12.95	13.94	14.13	13.45	13.56	–	6.04	12.84	25.04	22.61	25.42
14. <i>C. rhyinchotus</i>	12.79	11.80	12.80	12.09	12.26	11.09	11.59	11.77	12.81	12.81	12.31	11.66	5.11	–	11.79	22.15	17.61	22.00
15. <i>C. sp. (New Guinea)</i>	12.81	12.19	13.95	12.30	13.03	11.28	11.88	10.93	12.17	12.04	12.69	11.08	9.70	9.12	–	20.58	14.55	17.56
16. <i>C. quinquecarinatus</i>	14.67	13.84	15.83	14.15	13.38	14.29	14.56	14.23	14.83	14.51	14.09	13.92	14.44	12.97	12.39	–	8.07	12.04
17. <i>C. tenuimanus</i>	15.46	13.68	15.17	13.74	13.15	12.92	13.45	13.09	14.57	14.06	13.82	13.67	13.68	11.25	9.92	6.45	–	11.59
18. <i>C. preissii</i>	14.70	15.15	15.94	12.97	14.28	14.25	14.70	13.45	13.49	13.12	13.93	13.47	14.89	13.41	11.48	8.72	8.51	–