A NEW SPECIES OF *CALAMOECIA* (COPEPODA: CALANOIDA) FROM SOUTH AUSTRALIA, AND COMMENTS ON THREE CONGENERS

by I. A. E. BAYLY*

Summary

BAYLY I. A. E. (1984) A new species of *Calamoecia* (Copepoda: Calanoida) from South Australia, and comments on three congeners. *Trans. R. Soc. S. Aust.* **108**(3), 147-154, 13 December, 1984.

Calamoecia zeidleri sp.nov., a comparatively large species of *Calamoecia*, is described from fresh waters near Lake Eyre and Oodnadatta.

Two Western Australian populations of *C. lucasi*, which have diverged markedly both structurally and ecologically from populations in the eastern half of Australia and in New Zealand, are described in detail. Both populations have an abnormally large body size for this species, and the clutch size of the females of one is unusually high. A palaeoclimatological explanation for the subspecific divergence of Western Australian populations of *C. lucasi* and *C. gibbosa* from those in the east is presented.

New information is presented on the distribution of *C. canberra*.

KEY WORDS: Copepoda, Calanoida, *Calamoecia*, fresh water.

Introduction

The genus *Calamoecia*, which contains small non-marine calanoids, was revised by Bayly (1961, 1962). A further species was added (Bayly 1979) to bring the total number of described species to 13.

During 1981 and 1982 I examined a series of 80 collections of zooplankton made by Mr Wolfgang Zeidler of the South Australian Museum (SAM) from inland waters of South Australia and the Northern Territory. Included amongst this material were five collections from the northern part of S.A. (to the north of Oodnadatta and west of Lake Eyre) which contained a highly distinctive undescribed species of *Calamoecia*. This is described below.

Additionally, two isolated and peculiar populations of *C. lucasi* Brady sampled during the field work associated with the paper of Geddes *et al.* (1981) on saline lakes in Western Australia (but not recorded in that work because of their occurrence in fresh waters) and passed on to me are described.

Possible reasons for the east-west divergence in the morphology of *C. lucasi* and *C. gibbosa* are discussed.

Finally, new information is presented on the distribution of *C. canberra* Bayly hitherto known from few localities but which occurred in 15 of the Zeidler collections.

Although two species of *Calamoecia* occur in saline waters, and saline waters are common in those general regions of Australia referred to in this paper, all *Calamoecia* material discussed below came from fresh waters.

* Zoology Department, Monash University, Clayton, Vic. 3168

Calamoecia zeidleri sp.nov.
FIGS 1-2

Type Material: Holotype ♂, allotype ♀, paratypes 30♂, 30♀ (from swamp 29°57′S., 136°14′E) nr Billa Kalina Hstd; holotype and allotype stained with Chlorazol Black, dissected and mounted in balsam on microslides, paratypes preserved in formalin, unmounted in vial; SAM C. 3961-7. Paratypes from dam nr William Creek (28°55′S., 136°20′E.) 30♂, 30♀, unmounted in formalin in vial; SAM C. 3969-70.

Description of Male:
Size. (a) Swamp nr Billa Kalina Hstd: mean (n = 10) length to end of uropods (formerly furcal rami) 1.10 mm. (b) Dam 16 km N. William Creek: mean length as above 0.99 mm.

Fifth legs (Figs 1A-1B). Right exopod with comparatively short proximal segment, middle segment with tooth on inner edge slightly proximal of mid point and second tooth on outer distal edge near point of insertion of seta on posterior face (Fig. 1A), distal claw strongly bent inwards through approximate right-angle (as in *C. gibbosa*) then curving outwards towards distal extremity, lacking secondary spur (present in seven other species of *Calamoecia*) on inner proximal edge of claw; right endopod 2-segmented, proximal segment only about ⅓ length distal segment, distal segment with highly distinctive thumb-like spur arising at outer distal corner and orientated at right-angles to long axis of segment, with two long spines at distal extremity, that next to "thumb" (= "index finger") strongly curved near base, minute spine occasionally present at inner distal corner near base of inner distal spine (Fig. 1A); left exopod 2-segmented on anterior face (Fig. 1B) but line of segmentation largely obscured on posterior face (Fig. 1A), distal

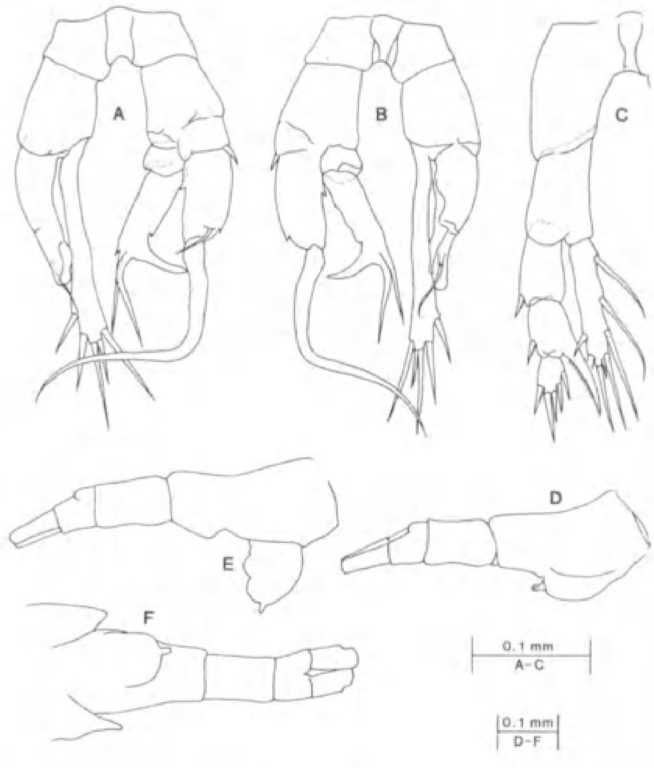

Fig. 1. *Calamoecia zeidleri* sp.nov. A and B, ♂ fifth legs, showing posterior and anterior aspects, respectively; C, ♀ fifth leg; D and E, lateral aspect of ♀ urosome showing, respectively, the ventral bulge, or genital operculum, closed and open; F, ♀ urosome, ventral aspect.

segment with conspicuous seta inserted short of extremity on anterior face and with elongate concavity on posterior face near inner edge; left endopod 1-segmented expanded distally and typically with five spines—two (1 long, 1 short) terminal, two subterminal, and one on outer edge ⅙ of total length of segment from distal extremity.

Description of Female:

Size. (a) Swamp nr Billa Kalina Hstd: mean (n = 10) length to end of uropods 1.42 mm. (b) Dam 16 km N. William Creek: mean length as above 1.26 mm.

Fifth legs (Fig. 1C). Terminal exopod segment with five spines, largest or terminal spine only slightly longer (*ca* 1.3x) than segment itself (compare with most species of *Calamoecia* in which terminal spine > 2 x length segment); endopod 1-segmented bearing eight (or occasionally seven) setae, seta immediately to inside of terminal seta very short and spine-like.

Genital segment (Figs 1D–1F). No lateral outgrowths (Fig. 1F) as in *C. gibbosa, C. clitellata* and W.A. forms of *C. lucasi,* genital operculum with distinct posterior "nipple" as in *C. lucasi, C. australica* and *C. canberra.*

Remarks: This species is easily recognised by the large outer distal spur on the right endopod of the fifth legs in the male, and by the relatively short terminal spine on the terminal exopod segment of the fifth legs in the female. In the latter feature only *C. salina,* in which the terminal spine is about 1.6x the length of the segment bearing it, approaches *C. zeidleri.* In *C. salina,* however, the terminal exopod segment of the female fifth legs bears only two spines (cf five in *C. zeidleri*).

The body size of the female of this species is relatively large for *Calamoecia* and may be compared with that of the female of *C. attenuata.*

C. zeidleri coexisted with *C. canberra* Bayly at all five localities and also with *Boeckella triarticulata* (Thomson) at three of the five localities. The size relationships existing for one situation in which *C. zeidleri* was one of three coexisting calanoids, and another in which it was one of two, are shown in Table 1. There was no overlap in the mean lengths of the adults of different species.

Congeneric occurrences are not common for *Calamoecia* in Australasia as a whole (cf. Bayly &

TABLE 1. *Size relationships of coexisting calanoids.*

Species and sex	Swamp near Billa Kalina H.S.		Dam 16 km N. William Creek	
	$\bar{x}$ (n=10) length (mm)	$\bar{x}$ ♀ length / $\bar{x}$ ♂ length	$\bar{x}$ (n=10) length (mm)	$\bar{x}$ ♀ length / $\bar{x}$ ♂ length
Boeckella triarticulata (Thomson)		1.17		
female	1.81			
male	1.55			
Calamoecia zeidleri sp.nov.		1.29		1.27
female	1.42		1.26	
male	1.10		0.99	
C. canberra Bayly		1.16		1.13
female	0.88		0.77	
male	0.76		0.68	

Williams 1973, table 6:3). However, they are not uncommon in the far south-west of W.A. where *C. attenuata* may coexist with a smaller *Calamoecia* such as *C. tasmanica* or *C. elongata*.

Table 1 shows that the ratio (mean female length):(mean male length) for *C. zeidleri* is relatively high (1.27-1.29) for *Calamoecia* (cf. Bayly 1978, table 1, group C).

Material Examined: S.A.: Swamp (Devils Playground) 6 km S.E. of Billa Kalina Hstd (29°55'S., 136°11'E.), 45♂, 40♀, 5.xii.1974; dam 16 km N. of William Creek (28°55'S., 136°20'E.), 45♂, 40♀, May 1976; dam 35 km N. of William Creek, 1♂, May 1976; Alberga Creek road crossing 47 km N.N.W. of Oodnadatta, 1♂, 3.v.1976; waterhole 5 km N. of Mt Sarah (26°55'S., 135°20'E.), 2♂, 4.v.1976; all five coll. W. Zeidler. The distribution is shown in Fig. 2.

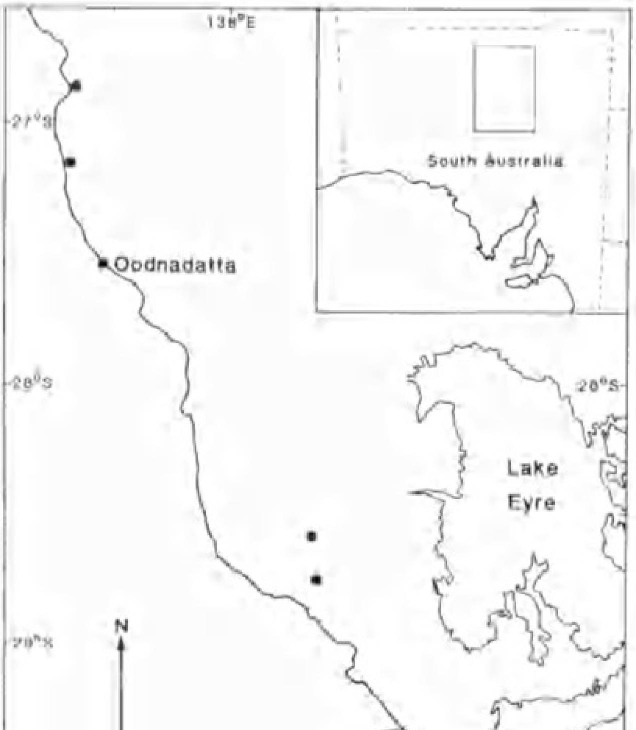

Fig. 2. Distribution of *Calamoecia zeidleri* sp.nov.

Isolated Western Australian populations of Calamoecia *and their marked morphological divergence*

Calamoecia lucasi Brady

As shown by Bayly & Williams (1973, Fig. 6:3), and as indicated in Fig. 3, most Australian popula-

Fig. 3. The main, eastern areas of Australia occupied by *Calamoecia lucasi* and *C. gibbosa* and the isolated W.A. populations of these species. The arrows indicate extensions to previously known distributions—not directions of dispersal.

tions of *C. lucasi* are restricted to the eastern half of the continent (the species also occurs in the North Island of New Zealand). However, the existence of some isolated populations in what are almost certainly temporary waters in arid regions of W.A. is now known. These W.A. populations have diverged remarkably, both morphologically and ecologically, from those in the eastern half of Australia and N.Z. The morphological divergence is evident with respect to both body size, which is much larger, and the details of secondary sexual characteristics. If one of these W.A. populations was transported to N.Z., I doubt if it would be immediately recognised as *C. lucasi* when first encountered there. The possibility exists that breeding experiments would justify the W.A. form being treated as a separate species. However, I consider the aberrant W.A. populations are properly referable to *C. lucasi*.

(a) *The Cue Population*
FIGS 4A-D

Material Examined: W.A.: 20♀, 10♂, pond close to Nallan (27°16'S, 117°59'E) 21 km N.N.E. of Cue, coll. M. C. Geddes *et al.*, viii.1978.

Body Size (mean prosome length). Female, 0.96 mm (n = 10); male 0.86 mm (n = 10).

Male Fifth Legs (Figs. 4A and 4B). These differ from those of eastern populations as follows:

(1) the proximal segment of the right exopod has no projection at the inner distal corner (compare Figs. 6A and 6B)

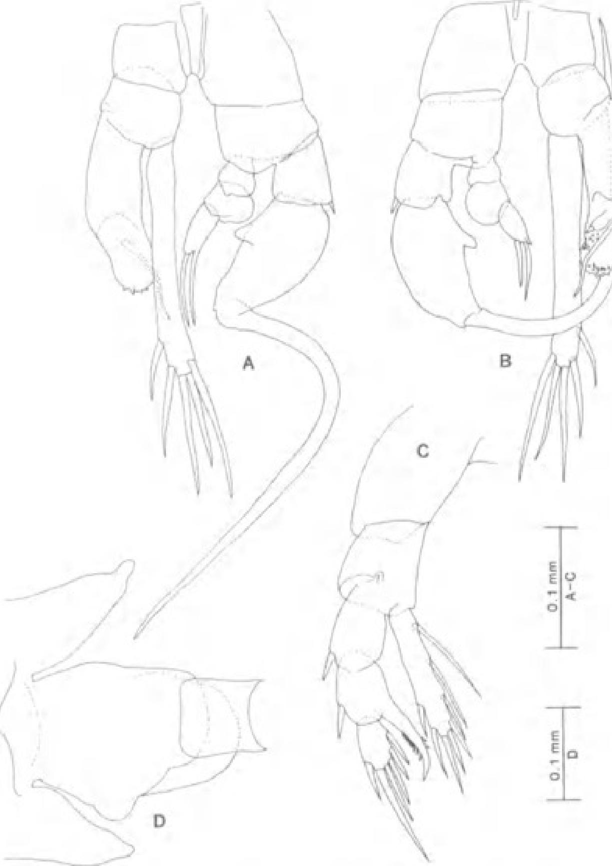

Fig. 4. *Calamoecia lucasi* Brady from population near Cue, W.A. A and B, ♂ fifth legs, showing posterior and anterior aspects, respectively; C, ♀ fifth leg; D, ♀ genital segment (and extensions of last prosomal segment), dorsal aspect.

(2) there is a strong projection on the inner edge of the middle segment of the right exopod which is not seen in eastern populations
(3) the distal segment, or terminal hook, of the right exopod is more strongly bent
(4) the middle segment of the right endopod is enlarged so as to present a semicircular outer edge
(5) the left endopod invariably has an armature of 5 spines (2 terminal, 3 sub-terminal) instead of the usual four spines; however, variation in spine number from two–five has already been documented (Bayly 1961)
(6) there are quite strongly developed denticles at or near the distal extremity of the left exopod

Female Fifth Legs (Fig. 4C). The distal exopod segment differs from that of eastern populations in bearing six spines instead of the usual five.

Female Genital Segment (Fig. 4D). This differs from that of eastern populations in having a more pronounced lateral bulge on the left side (compare Figs 6E and 6F).

Clutch Size. The mean number of eggs was an unusually (for this species) high 44 (Table 2).

Remarks: C. lucasi was the sole calanoid present in the zooplankton collection from this site which had a maximum depth of about a metre, a very high turbidity, and a T.D.S. value of 41 mg/l. The temporary nature of the pond was emphasised by the presence in the collection of an abundance of conchostracans. Also present were ostracods, cyclopoids, *Chydorus* and *Keratella.*

(b) *The Population Near Lake Grace*
FIGS 5A–5F

Material Examined: W.A.: 10♂, 10♀, roadside pool on northern side of road, 3.5 km W. of Lake Grace township, coll. M. C. Geddes *et al.,* viii.1978.

Body Size (mean prosome length). Female, 1.00 mm (n = 10); male, 0.93 mm (n = 10).

Male Fifth Legs (Figs 5A–5C). These differ from those of eastern populations as follows:
(1) the proximal segment of the right exopod has a more strongly developed projection at the inner distal corner
(2) the distal segment, or terminal claw, of the right exopod is more strongly bent, as for the Cue population
(3) the terminal segment of the right endopod typically (Figs 5A and 5B) has one or two greatly reduced, or only vestigial, setae, but occasionally (Fig. 5C) a longer seta is present
(4) the left leg has the same peculiarities as described above for the Cue population

Female Fifth Legs (Fig. 5D). These have the same peculiarity as detailed above for the Cue population.

Female Genital Segment (Figs 5E and 5F). This is distinctive in being essentially similar to that described above for the Cue population although the left lateral outgrowth is even more pronounced.

Remarks: Two other calanoid species, *Boeckella opaqua* Fairbridge and *B. robusta maxima* Sars, were also present in the collection examined. Both of these species are characteristic of shallow, temporary waters. A T.D.S. value of 980 mg/l was obtained for a water sample taken from the pool.

(c) C. lucasi *from New Zealand*
FIGS 6A–6F

Drawings of material collected by the author from Lake Alice (40°08′S, 175°20′E) near Marton,

TABLE 2. *Length and clutch size of* Calamoecia lucasi *females.*

Nature and location of population	$\bar{x}$ prosome length (mm)	No. females examined	Clutch size $\bar{x}$ no. eggs	Coeff. var. (%)
(A) *W.A. seasonal temporary-water populations*[a]				
Pool near Lake Grace[b]	1.00			
Pond near Cue	0.96	20	44.1	12
(B) *N.Z. perennial lacustrine populations*				
Lake Ototoa	0.57[c]		1.8–1.9	
Lake Rotorua	0.65[c]		3.3[e]	26[e]
Lake Rotoiti	0.64[c]		2.0[e]	27[e]
Nowell's Lagoon[d]	—	25	13.8	21

[a] Length data from 10 individuals measured along a mid-dorsal line and omitting the well developed, posteriorly projecting "wings" on the last segment of the prosome.

[b] No ovigerous females present.

[c] From Green (1976, table 5). The data represent annual means obtained from the measurement of a large number of individuals from each of a substantial series of samples.

[d] From Bayly (1961, table 2).

[e] From Chapman (1973, table 3). Mean data from a large number of individuals collected over a two- to three-year period.

N.Z., are included for comparison with the W.A. populations.

Discussion

As shown in Table 2, individuals from these two desert populations of *C. lucasi* are 50% or more (up to 75%) larger than those belonging to N.Z. populations. This probably underestimates the size discrepancy because the prosome measurements of the N.Z. specimens apparently include the postero-lateral "wings" of the last prosomal segment. The type of measurement specified in Table 2 for the W.A. specimens although slower is preferable because of intraspecific variation in the relative degree of development of these wings.

Gigantism in calanoids in Australian desert pools is noted by Mitchell (1984) who referred to *Boeckella triarticulata* reaching a length of up to 3.2 mm in a temporary pool near Lake Eyre. However, Mitchell's explanation, "Organisms in these localities often attain very large sizes *due to rapid growth rates* [my emphaisis]" seems invalid; in planktonic crustaceans large adult body size is associated with long development time (slow growth) and both of these correlate with low temperature alone if food is sufficiently abundant (McLaren 1963).

The large clutch size found for the Cue population (Table 2) is in accordance with the principle (Belk & Cole 1975) that where a calanoid species occurs in both permanent and temporary waters, populations in temporary waters typically have a larger clutch size than those from permanent waters. A larger clutch size also would be expected in this instance because a positive correlation between clutch size and female body size generally applies within the Copepoda (McLaren 1963). It may be noted, however, that in *Boeckella symmetrica* an increased clutch size in temporary waters (Bayly 1979) does not appear to be accompanied by the striking gigantism reported here for *C. lucasi.*

Typically, freshwater species of *Calamoecia* occur in permanent waters (Bayly 1978). The chief exceptions are the W.A. species, *C. attenuata* and *C. elongata*, W.A. populations of *C. ampulla*, and *C. canberra*, all of which occur not uncommonly in temporary waters even if they also occur in permanent ones. Maly (1984) confirms that, considering the genus *Calamoecia* as a whole, it is much less common than *Boeckella* in temporary pools. Timms (1970, table 12) assessed *C. lucasi* as having poorer powers of dispersal in north-eastern N.S.W. than three species of *Boeckella* that occurred in the same area. Additionally, *C. lucasi* seems not to have been recorded from temporary waters in N.Z.. Despite these generalizations concerning the genus *Calamoecia* as a whole, and *C. lucasi* in particular, at least two W.A. populations of this species undoubtedly are adapted for habitat ephemerality.

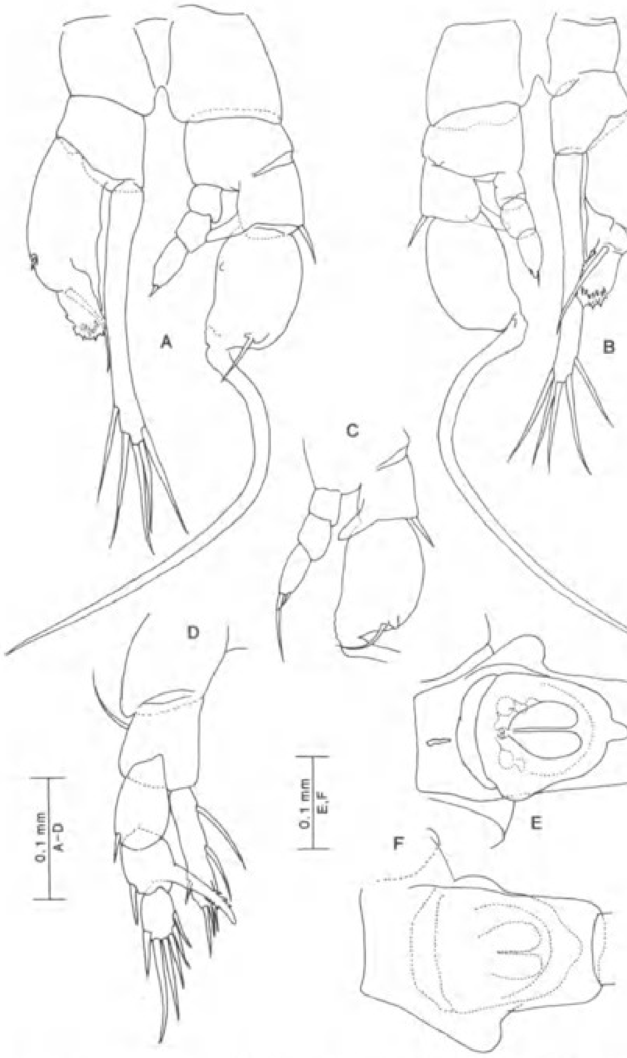

Fig. 5. *Calamoecia lucasi* Brady from population near Lake Grace, W.A. A and B, ♂ fifth legs, showing posterior and anterior aspects, respectively; C, portion of ♂ right fifth leg, showing endopod with (for this population) unusually long terminal seta; D, ♀ fifth leg; E and F, ventral and dorsal aspects, respectively, of ♀ genital segment, showing pronounced outgrowth on left side.

Should the W.A. populations be regarded as relictual in character or relatively recent derivatives from the east? Structural evidence favours the former view; the W.A. populations may be regarded as being more primitive in having a less reduced armature on the fifth legs of both sexes (the armature of the male right fifth endopod of the Lake Grace population excepted). The relatively poor dispersal ability of *Calamoecia* (Maly 1984), combined with the fact that westerly or south-westerly winds predominate throughout much of the southern half of Australia, would tend also to favour transport from west to east over the reverse.

Calamoecia gibbosa Brehm

A parallel situation exists for this species as for *C. lucasi* (Fig. 3). For many years *C. gibbosa* was known only from south-eastern Australia. It was first described in 1950 from Lake Dulverton in Tasmania. Two further Tasmanian records and one from Flinders Island were added by Bayly (1964), and three mainland records (all lakes at or near Mt Gambier) were added by Bayly & Williams (1964). Two further unpublished records (a fourth Tasmanian locality and a second one on Flinders Island), making nine in all, were known at the time of preparation of the map presented by Bayly & Williams (1973) for *C. gibbosa* showing it restricted to south-eastern Australia. However, in 1977 an isolated population was found at Newmann's Rocks in W.A. (Fig. 3) and described by Bayly (1979) as a new subspecies, *C. gibbosa newmannensis.*

A previously unpublished record of *C. gibbosa gibbosa* (incorporated into Fig. 3) is that from Fresh Dip Lake between Beachport and Robe at 37°16'S., 139°49'E. (collection 1.xi.1979).

General Discussion of Western Australian Forms of C. lucasi *and* C. gibbosa

The situation described above for *C. lucasi* and *C. gibbosa* is not unlike that recognized by Bayly (1961) for *C. tasmanica* (Smith), with *C. tasmanica tasmanica* in the east, and *C. tasmanica subattenuata* in the west [the position with *C. tasmanica* is,

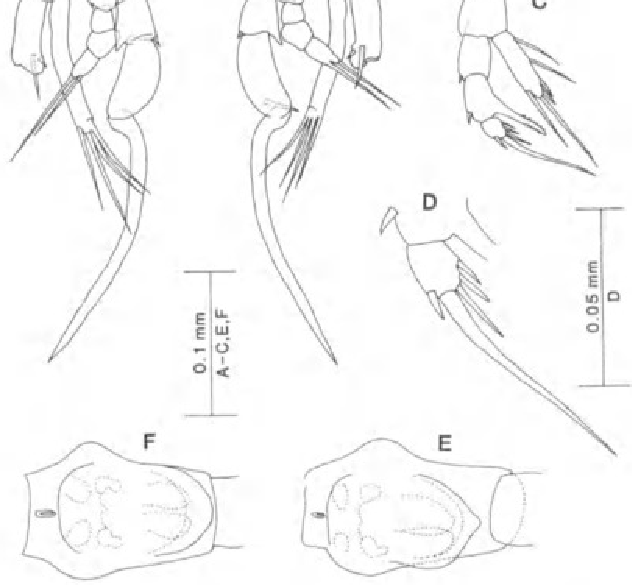

Fig. 6. *C. lucasi* Brady from Lake Alice near Marton, New Zealand. A and B, ♂ fifth legs, showing posterior and anterior aspects, respectively; C, ♀ fifth leg; D, terminal exopod segment of ♀ fifth leg enlarged; E and F, ♀ genital segment, dorsal aspect (different individuals and orientations).

however, more complex than originally supposed (Bayly 1979)]. What explanation can be offered for the subspecific divergence of W.A. populations of *C. lucasi* and *C. gibbosa* (and *C. tasmanica*) from those in the eastern half of Australia?

In the early Miocene, 20 million years ago, the environment on the southern coast of Australia was subject to high humidity that penetrated far into the continent (Bowler 1982). There were extensive freshwater lakes in the interior where now salt lakes dominate. Despite a summer maximum in the rain fall, Bowler (1982) considered that even in winter surplus moisture prevailed right across the continent and inland foggy conditions were common. With such a climate it might be supposed that populations of freshwater calanoids such as *C. lucasi* and *C. gibbosa* extended freely across the continent from east to west (except that marine transgressions into the Eucla and Murray basis would have interrupted the continuum along the southern border). Subsequently, however, the development of an intense zone of aridity in the Nullarbor region and its northward extension seems likely to have split the east-west continuum into two segments, the eastern being somewhat larger than the western one. In late Miocene times, six million years ago, there was intense seasonal aridity (winters were now dry) across southern Australia reaching a maximum in the Nullarbor region. In the late Pliocene, 2.5 million years ago, the present climatic zonation of Australia developed for the first time, and by one million years ago central Australia was already dry without necessarily being as arid as subsequently (Bowler 1982). However, there was a major phase during the late Pleistocene from 30–50 000 years B.P., the Mungo lacustrine phase, of lake expansion and (allowing for a reversal of seasonality in precipitation) a return almost to the conditions described for the early Miocene.

The W.A. populations of *C. lucasi* and *C. gibbosa* may be regarded as relictual, and a product of geographical isolation by arid north-south dissection of a previous east-west continuum. But which of the arid dissections was the operative one? In the absence of a fossil record we can presently say little concerning rates of evolution in calanoid copepods. However, the fact that we are dealing with only subspecific levels of differentiation would tend to suggest that an interruption to gene flow occurred in the late Pleistocene rather than at some earlier time. It is reasonable to suggest, therefore, that the relevant dissection post-dated the 30–50 000 years B.P. Mungo lacustrine phase referred to by Bowler (1982), but not the period of maximum aridity 18 000 years B.P.

The question still remains as to why populations of *C. lucasi* and *C. gibbosa* are not now found in the wet far south-west corner of W.A. (say to the south-west of a straight line from Busselton to Albany). One can only suppose that, although these species had almost continuous and extensive east-west distributions prior to dissection by an arid corridor through the Nullarbor region, they did not extend to the extreme south-west of W.A., and have been unable to achieve dispersal there since.

It may be noted that the population of *C. lucasi* near Cue inhabited a body of water that was probably at least partially of man-made origin; field notes stated that the depression was "likely to have been artificially deepened". The man-made nature of the pond occupied by *C. gibbosa* at Newmann's Rocks was emphasised by Bayly (1979). Populations of *C. lucasi* and *C. gibbosa* in the desert regions of W.A. must have been very sparse in recent times before the advent of European man, and it is possible that man-made excavations have allowed significant expansion of populations this century.

An alternative interpretation to that presented above is that the W.A. populations of *C. lucasi* and *C. gibbosa* represent recent penetrations from the east, such movement perhaps being favoured by anthropogenic modification of desert habitats. This, however, apparently runs counter to the morphological evidence in the case of *C. lucasi*.

Distribution of C. canberra *Bayly*

The triangular distribution shown for *C. canberra* by Bayly & Williams (1973, fig. 6:4) was based only on five records; the top left apex was for two dams close to Alice Springs, the top right apex was for two lakes (Barcoorah and Dunn) near Aramac, and the bottom apex was for the type locality, Lake George, near Canberra. New records, summarised and combined with the older ones in Fig. 7, are as follows:

S.A.: Kile's dam nr Farina (30°04'S., 138°17'E.), 27.xi.1974; waterhole nr Dulkaninna (29°01'S., 138°28'E.) Birdsville Track, 1.xii.1974; Cooper Creek crossing nr Etadunna H.S. (28°43'S., 138°38'E.) Birdsville Track, 1.xii.1974; dam S. of L. Phibbs (29°32'S., 137°09'E.) on road to Stuart Creek Station, 3.xii.1974; swamp (Devils Playground) 6 km S.E. of Billa Kalina H.S. (29°55'S., 136°11'E.), 5.xii.1974; Beresford Dam E. of William Creek (28°55'S., 136°20'E.), 6.xii.1974; Paradise Dam 19 km N. of William Creek, 7.xii.1974; dam 16 km N. of William Creek, v.1976; dam 35 km N. of William Creek, v.1976; Alberga Creek road crossing 46 km N.N.W. of Oodnadatta, 3.v.1976; waterhole 5 km N. of Mt Sarah (26°55'S., 135°20'E.), 4.v.1976; all 11 coll. W. Zeidler. Beresford railway dam (29°14'S., 136°39'E.), 1978, coll. B. D. Mitchell. Dam nr Carrieton (32°26'S., 138°32'E.), 16.xii.1970, coll. M. C. Geddes. Qld: L. Koolivoo (24°55'S., 139°35'E.) 65 km S. of Bedourie, 18.ix.1977; Longreach waterhole (22°46'S., 138°51'E.) between Glenormiston and Roxborough Downs stations, 20.ix.1977, both coll. W. Zeidler. N.S.W.: Dam 2 km from Wanaaring (29°42'S., 144°09'E.), i.1969, coll. W. D. Williams *et al.* Pond 16 km S.W. of Narrandera (34°45'S., 146°33'E.), 10.v.1982, coll. E. J. Maly. N.T.: Waterhole under McGrath Creek bridge 47 km N. of Alice Springs (23°19'S., 133°47'E.), 20.iv.1979; roadside ditch 7 km N. of Stirling (21°44'S., 133°46'E.), 20.iv.1979; both coll. D. Black.

These records show that *C. canberra* is widely distributed in the central arid portions of Australia to the east of the eastern border of W.A. Most of the water bodies from which it has been recorded are specifically described as being shallow and highly turbid.

Acknowledgments

I wish to thank W. Zeidler and other collectors mentioned above for providing me with the material on which this account is based.

Fig. 7. Distribution of *Calamoecia canberra* Bayly.

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