First Record of *Hemiboeckella searli* Sars, 1912 (Calanoida: Centropagidae) in New South Wales

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Published on 3 September 2012 at http://escholarship.library.usyd.edu.au/journals/index.php/LIN

Kobayashi, T., Bayly, I.A.E., Hunter, S.J., Jacobs, S.J. and Treanor, M.B. (2012). First record of *Hemiboeckella searli* Sars, 1912 (Calanoida: Centropagidae) in New South Wales. *Proceedings of the Linnean Society of New South Wales* **134**, B199-B204.

The calanoid copepod *Hemiboeckella searli* Sars is recorded for the first time from New South Wales in Jibbon Lagoon, Royal National Park (34°05'12''S/151°09'53''E). This calanoid species is endemic to Australia and occurs in a narrow range of southern latitudes with a wide longitudinal distribution (Tasmania, Victoria and Western Australia). Our record of *H. searli* in Jibbon Lagoon represents a ~250 km northerly latitudinal extension from previous records of the species in south-eastern Australia.

Manuscript received 5 December 2011, accepted for publication 29 February 2012.

KEYWORDS: centropagid calanoid, *Hemiboeckella searli,* Jibbon Lagoon, New South Wales, Royal National Park

INTRODUCTION

Royal National Park (~15,000 ha) on the southern border of Sydney (34°05′S/151°09′E) is the oldest national park in Australia, dedicated by the NSW Government as a national domain for rest and recreation in 1879 (Thorvaldson 1978). The park has terrestrial and aquatic habitats including heathland, woodland, eucalypt forest, rainforest, creeks, rivers and wetlands (lagoons and upland swamps) (New South Wales National Parks and Wildlife Service 2000). The park is home to diverse terrestrial and aquatic vertebrates including ~50 species of mammals, 240 species of birds, 40 species of reptiles and 30 species of amphibians. The park also provides habitat for hundreds of species of terrestrial invertebrates such as insects and snails, but little is known about the aquatic invertebrates. As part of a study of aquatic invertebrates in the park, we collected zooplankton from Jibbon Lagoon (a deflation hollow with a sandy bottom) in September 2011. We report the first record of the centropagid calanoid *Hemiboeckella searli* in NSW.

MATERIALS AND METHODS

Study area

Jibbon Lagoon (34°05'12''S/151°09'53''E) is in the north-eastern area of sand dunes in Royal National Park (Figs. 1 and 2). The lagoon is a deflation hollow filled with fresh water, even though it is below sea level (New South Wales National Parks and Wildlife Service 2000; Mooney et al. 2001). It has an entire basin area of ~3.2 ha and a maximum depth of ~2 m. The water in the lagoon derives from direct precipitation and runoff from the surrounding small catchment, and it dries out almost completely during dry periods. The catchment vegetation is dominated by coastal heathland, Sydney Red Gum (*Angophora costata*) dune forest, and a *Cupaniopsis* littoral closed forest assemblage consisting of Tuckeroo (*Cupaniopsis anacardioides*) and Bangalay (*Eucalyptus botryoides*) (Chalson 1983). Parts of the lagoon are dominated by emergent Tall Spike Rush (*Eleocharis sphacelata*) which is surrounded by a closed sedgeland assemblage (Goldstein 1976).

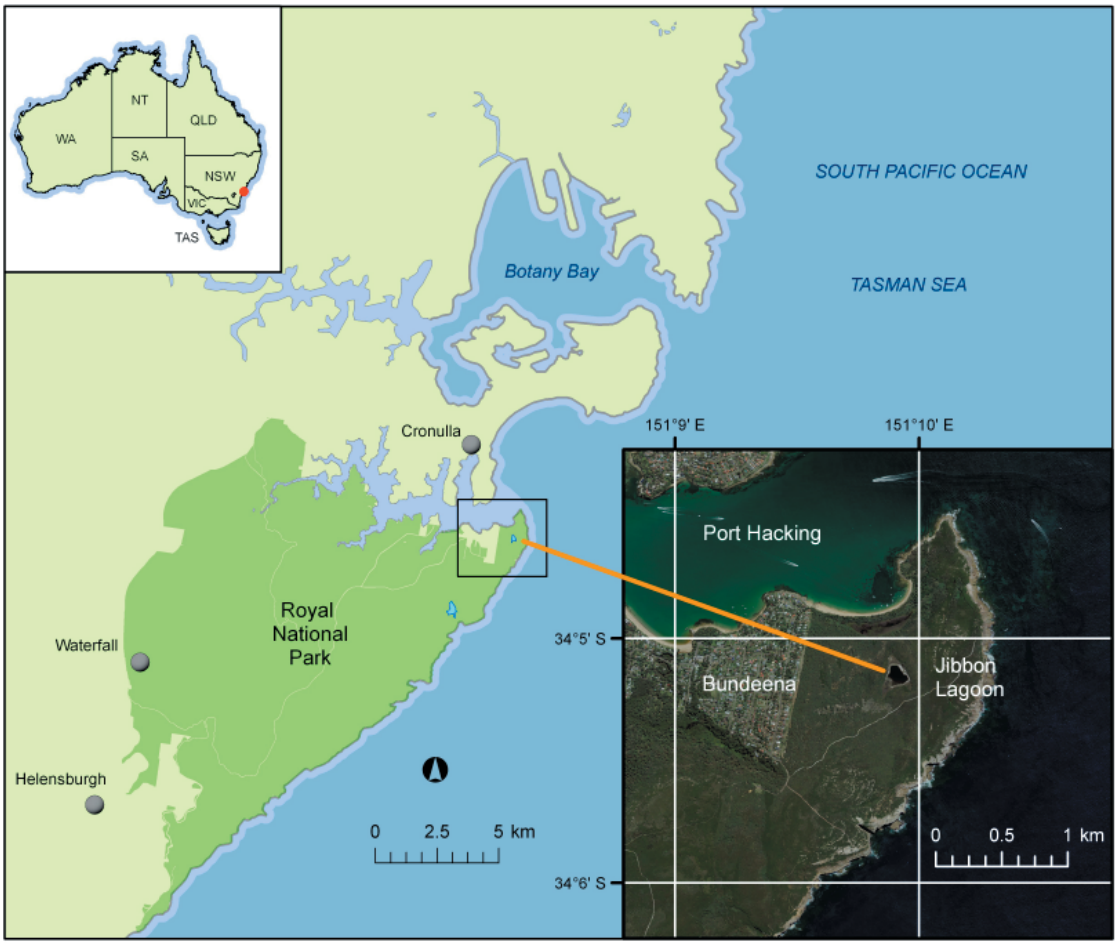

Figure 1. Location of Jibbon Lagoon in Royal National Park.

Figure 2. Jibbon Lagoon on 12 September 2011 (south-east view).

Zooplankton sampling and water quality measurements

We sampled zooplankton in Jibbon Lagoon on 1 and 12 September 2011, by towing two conical plankton nets (63 µm and 150 µm mesh sizes) around near shore areas (both open and littoral) for about 20 minutes. Specimens were preserved in 70% ethanol. In the laboratory, zooplankton specimens were examined and sorted under a Leica M80 stereomicroscope at a magnification of × 20 to × 50. Calanoid species were identified (Bayly 1992) under a Leica Diaplan compound microscope at a magnification of ×100. In the field, water temperature and dissolved oxygen

Figure 3. Microphotograph of *Hemiboeckella searli* Sars collected in Jibbon Lagoon on 12 September 2011 (left: female; right: male). Scale bar: 500 µm.

concentration were measured using a YSI Model 5100 Dissolved Oxygen/Temperature Metre (YSI Inc., Ohio). Water samples were also collected to measure conductivity (ORION Model 160 conductivity meter, Orion Research Inc., Massachusetts), turbidity (NTU) (HACH 2011AN turbidimeter, Hach Company, Colorado) and pH (ORION Thermo Model 720A pH meter, Orion Research Inc., Massachusetts), and to analyse nutrients in the laboratory. The method of nutrient analysis followed Hosomi and Sudo (1986) and Eaton et al. (2005).

RESULTS

Hemiboeckella searli was found in samples collected from Jibbon Lagoon on 1 and 12 September 2011 (Fig. 3). The prosomal length of *H. searli* was 1.00±0.011 mm (mean±standard error, *n*=16) for males and 1.44±0.019 for females (*n*=10). *Calamoecia tasmanica tasmanica* (Smith) was the only other centropagid calanoid found in the samples. Physico-chemical analyses indicated that Jibbon Lagoon water was fresh, acidic, with low levels of turbidity and nutrients. Water samples collected at ~1300 hrs on 1

September 2011 had the following properties: water temperature: 21.3 °C; dissolved oxygen: 9.1 mg l^{-1}; conductivity: 337 µS cm^{-1}; pH: 6.1; turbidity: 1.6 NTU; dissolved inorganic nitrogen: 185 µg l^{-1}; total nitrogen: 399 µg l^{-1}; dissolved inorganic phosphorus: 1 µg l^{-1}; and total phosphorus: 7 µg l^{-1}.

DISCUSSION

Hemiboeckella searli was first described by Sars (1912) from a collection of samples by J. Searle from Caulfield which is now an inner suburb of Melbourne city, Victoria. The species occurs mainly in temporary pools in coastal areas. It is also found in fringing littoral vegetation in inland permanent waters (Morton and Bayly 1977; Bayly 1979). Jibbon Lagoon is a particularly suitable habitat for the species because it is both a temporary water body and has well-developed littoral vegetation.

Of the three species of *Hemiboeckella* that occur in Australia, *Hemiboeckella searli* is the only species which occurs in both eastern and western Australia (Maly and Bayly 1991), with previous records from Tasmania (Bayly 1964), Victoria (Bayly 1964; Morton and Bayly 1977; Green and Shiel 1999) and Western Australia (Bayly 1992; Edward et al. 1994) (Fig. 4). All previous records of *H. searli* are in a relatively narrow latitudinal range in south-eastern Australia. Our record of *H. searli* in Jibbon Lagoon represents a significant (~250 km) northerly latitudinal extension in south-eastern Australia from the records of Green and Shiel (1999). However, it represents only a ~40 km northerly latitudinal extension from previous records in Western Australia (Edward et al. 1994).

In other locations, *Hemiboeckella searli* co-occurs with centropagid calanoids of different sizes such as *Boeckella major*, *B. pseudochelae* and *B. minuta* (Morton and Bayly 1977; Maly 1984; Green and Shiel 1999). In Jibbon Lagoon, *H. searli* co-occurs with *Calamoecia tasmanica tasmanica* whose distribution in eastern Australia is documented by Bayly (1964) and Timms (1982, 1997). These calanoid species differ in body size and feeding behaviour which most likely allow them to co-occur in the lagoon (i.e. food niche separation, Kobayashi 1995): the larger *H. searli* is carnivorous and the smaller *C. tasmanica tasmanica* is herbivorous (Maly 1984; Green and Shiel 1999; Kobayashi, personal observations). The prosomal lengths given above produce a female to male size ratio of 1.44 which is exceptionally high and comparable with the value of 1.51 given by Bayly (1978) who produced data showing that the degree of sexual dimorphism in *Hemiboeckella* is exceptionally high for non-marine calanoids. It is also possible that *H. searli* occurs as a shallow water/littoral fringe inhabitant, leaving the open water/eulimnetic habitat to *C. tasmanica tasmanica* (i.e. spatial niche separation). This aspect could be explored by carefully and independently sampling the open and littoral waters in the lagoon.

There are diverse coastal freshwater bodies in eastern Australia, with different modes of origin, water chemistry and biological features (Timms 1982, 1986). The species of calanoid copepods recorded in these water bodies in NSW now include *Calamoecia tasmanica tasmanica* (the most common), *Boeckella propinqua*, *Boeckella saycei* and *Hemiboeckella searli* (Bayly 1964; Timms 1982, 1997; present study). *B. saycei* was known only from temporary ponds in southern Victoria, mainly in the Gippsland region (Morton and Bayly 1977) until Timms (1997, p. 254) reported it in a dune-contact lake in southern NSW.

ACKNOWLEDGEMENTS

We thank Daniel Lunney and David Keith for initial advice, the officers of Royal National Park, NSW NPWS for logistic support, Ed Czobik for nutrient analyses, and two anonymous reviewers for helpful comments. We are grateful to Adam McSorley for producing a panoramic-view photograph of Jibbon Lagoon (Fig. 2), and Cheryl Tang for taking a microphotograph of *H. searli* (Fig. 3).

REFERENCES

Bayly, I.A.E. (1964). A revision of the Australasian species of the freshwater genera *Boeckella* and *Hemiboeckella* (Copepoda: Calanoida). *Australian Journal of Marine and Freshwater Research* **15**, 18-238.

Bayly, I.A.E. (1978). Variation in sexual dimorphism in nonmarine calanoid copepods and its ecological significance. *Limnology and Oceanography* **23**, 1224-1228.

Bayly, I.A.E. (1979). Further contributions to a knowledge of the centropagid genera *Boeckella*, *Hemiboeckella* and *Calamoecia* (athalassic calanoid copepods). *Australian Journal of Marine and Freshwater Research* **30**, 103-127.

Bayly, I.A.E. (1992). The non-marine Centropagidae (Copepoda: Calanoida) of the world. Guides to the identification of the microinvertebrates of the continental waters of the world 2. SPB Academic Publishing bv, The Hague. 30 pp.

Chalson, J. (1983). Palynology and Palaeoecology of Jibbon Swamp, Royal National Park. Honours thesis,

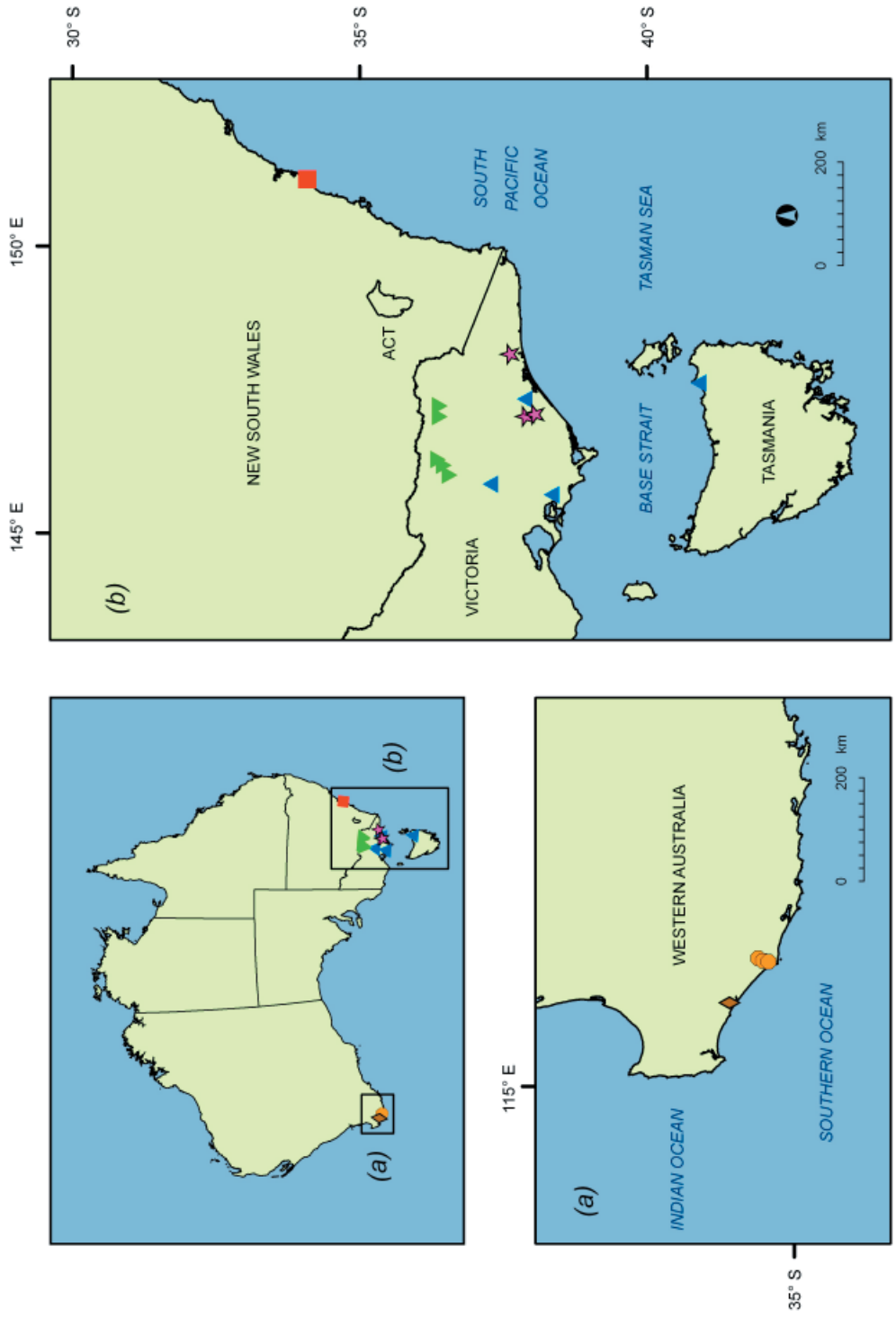

Figure 4. Geographical distribution of *Hemiboeckella searli* Sars in Australia (Bayly 1964, 1992; Edward et al. 1994; Green and Shiel 1999; Morton and Bayly 1977; present study).

University of New South Wales, Sydney.
Eaton, A.D., Clesceri, L.S., Rice, E.W. and Greenberg, A.E. (Eds) (2005). Standard methods for examination of water & wastewater. Centennial edition, 21st edn. (American Public Health Association: Washington, D.C., USA).
Edward, D.H.D., Gazey, P. and Davies, P.M. (1994). Invertebrate community structure related to physico-chemical parameters of permanent lakes of the south coast of Western Australia. *Journal of the Royal Society of Western Australia* **77**, 51-63.
Goldstein, W. (1976). Royal National Park. Environmental Education and Wildlife Extension Section, National Parks and Wildlife Service, Sydney.
Green, J.D. and Shiel, R.J. (1999). Mouthpart morphology of three calanoid copepods from Australian temporary pools: evidence for carnivory. *New Zealand Journal of Marine and Freshwater Research* **33**, 385-398.
Hosomi, M. and Sudo, R. (1986). Simultaneous determination of total nitrogen and total phosphorus in freshwater samples using persulfate digestion. *International Journal of Environmental Studies* **27**, 267-275.
Kobayashi, T. (1995). Different patterns of resource use between two coexisting freshwater calanoid species. *Marine and Freshwater Research* **46**, 481-484.
Maly, E.J. (1984). Dispersal ability and relative abundance of *Boeckella* and *Calamoecia* (Copepoda: Calanoida) in Australian and New Zealand waters. *Oecologia* **62**, 173-181.
Maly, E.J. and Bayly, I.A.E. (1991). Factors influencing biogeographic patterns of Australasian centropagid copepods. *Journal of Biogeography* **18**, 455-461.
Mooney, S. D., Radford, K. L. and Hancock, G. (2001). Clues to the 'burning question': pre-European fire in the Sydney coastal region from sedimentary charcoal and palynology. *Ecological Management and Restoration* **2**, 203-212.
Morton, D.W. and Bayly, I.A.E. (1977). Studies on the ecology of some temporary freshwater pools in Victoria with special reference to microcrustaceans. *Australian Journal of Marine and Freshwater Research* **28**, 439-454.
New South Wales National Parks and Wildlife Service (2000). Royal National Park, Heathcote National Park and Garawarra Recreation Area plan of management. New South Wales National Parks and Wildlife Service, Sydney.
Sars, G.O. (1912). Additional notes on freshwater Calanoida from Victoria, Southern Australia. Archiv for Mathematik og Naturvidenskab **32**, 3-20.
Thorvaldson, F. (1978). Royal National Park. An Illustrated Pocketbook. Colona Printing, Sydney.
Timms, B.V. (1982). Coastal dune waterbodies of north-eastern New South Wales. *Australian Journal of Marine and Freshwater Research* **33**, 203-222.
Timms, B.V. (1986). The coastal dune lakes of eastern Australia. In 'Limnology in Australia' (Eds P. De Deckker and W.D. Williams) pp. 421-432. (CSIRO/ Dr W. Junk Publ.: Melbourne, Australia/Dordrecht: The Netherlands).
Timms, B.V. (1997). Study of coastal freshwater lakes in southern New South Wales. *Marine and Freshwater Research* **48**, 249-256.