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SHORT NOTE

Sven Thatje · Anne-Nina Lörz

First record of lithodid crabs from Antarctic waters off the Balleny Islands

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Abstract Four specimens of *Neolithodes brodiei* Dawson and Yaldwyn (1970) have been obtained for the first time from bottom trawls deployed in Antarctic waters off the Balleny Islands (about 67°S) in March 2004. The Lithodidae constitute the only anomuran crab family so far known to be able to thrive under high-Antarctic conditions, and lithodids in the Ross Sea have previously only been recorded off Scott Island. The new record of *N. brodiei*, commonly found in waters off New Zealand, clearly extends its geographic range into the Southern Ocean. The significance of this finding with respect to the biodiversity and distribution of the Lithodidae from the Southern Ocean is briefly discussed.

Introduction

Antarctic invertebrate biodiversity is characterised by a low species diversity of decapod crustaceans (Arntz et al. 1994; Clarke and Johnston 2003). Among the few representatives of reptant crabs only the anomuran family Lithodidae has been able to thrive under Antarctic conditions (Thatje and Arntz 2004). An increased record of lithodid specimens from the Southern Ocean (Macpherson 1988a, 2004) in recent years has raised interest in elucidating their biogeography and eco-physiological life history features, in order to explain their ability to sustain polar conditions (Thatje 2004). Among other life history adaptations in adult Lithodidae, such as prolonged brooding off embryos, extended hatching periods, slow growth and delayed age at maturity (Thatje 2004; Thatje et al. 2004), their larval lecithotrophy and energy saving traits to abbreviate larval development have been shown to be especially important for lithodid survival in high latitudes (Anger et al. 2004; Thatje et al. 2004). Larval lecithotrophy allows to uncouple from the mismatch of prolonged developmental times and short periods of planktonic food availability which, under polar conditions, selects against complex and planktotrophic life cycles (Arntz et al. 1994; Thatje et al. 2003). Physiological constraints, mainly the lacking capability of reptant crabs to down-regulate high Mg^{2+} concentrations in the haemolymph, which in combination with low temperatures reduces activity and may even lead to paralysing conditions (Frederich et al. 2001; Thatje et al. 2004), have been suggested to set limits to the colonisation of the high Antarctic continental shelves under present climate conditions, where temperatures drop permanently below critical thresholds (about 0°C) for lithodid existence (e.g. Anger et. al. 2004; Thatje 2004).

The present record of *Neolithodes brodiei* from waters off the Balleny Islands (Fig. 1) significantly enhances our knowledge of the circum-Antarctic distribution of the Lithodidae, and increases the number of lithodid species known from the Southern Ocean.

Materials and methods

Four specimens of *N. brodiei* (Dawson and Yaldwyn 1970) were collected by means of bottom trawling at four separate locations (Fig. 1) during a biodiversity survey of the northwestern Ross Sea and Balleny Islands undertaken between January and March 2004. Two specimens of the lithodid crab were deep-frozen at

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S. Thatje (✉)
Alfred Wegener Institute for Polar and Marine Research,
P.O. Box 120-161, 27515 Bremerhaven, Germany
E-mail: sthatje@awi-bremerhaven.de

A.-N. Lörz
National Institute of Water & Atmospheric Research (NIWA),
P.O. Box 14-901, Kilbirnie, Wellington, New Zealand

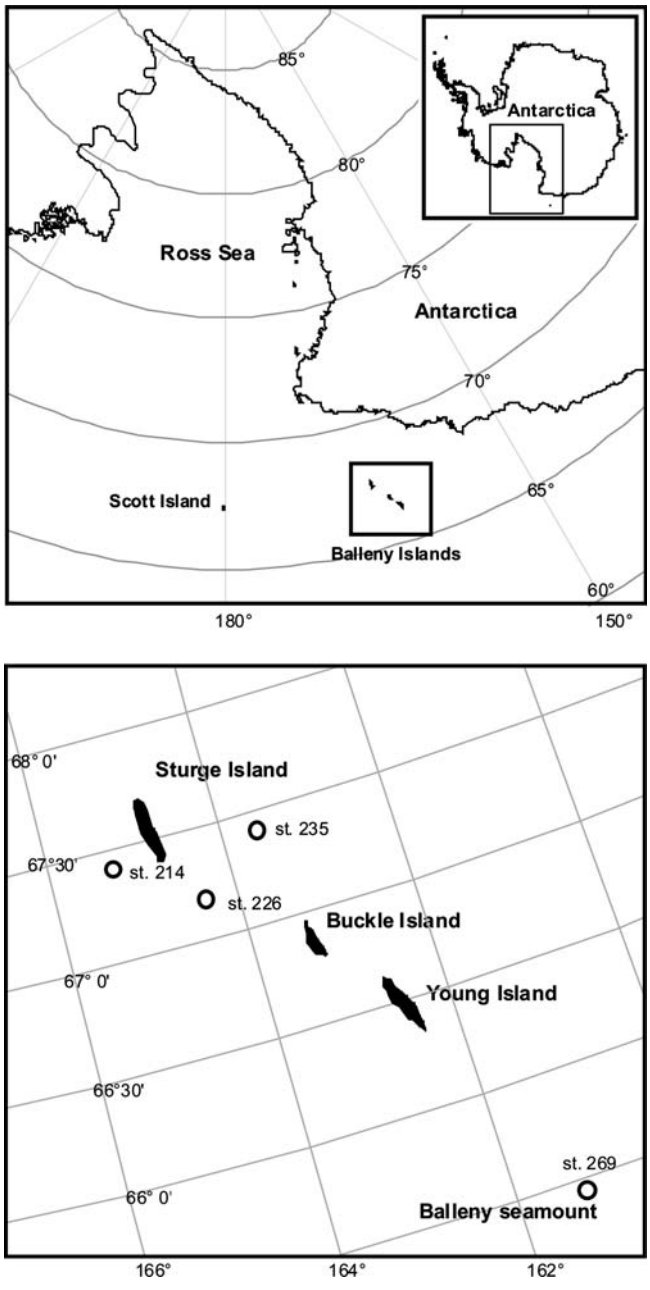

Fig. 1 Map showing the sampling area and locations of *Neolithodes brodiei* (Dawson and Yaldwyn 1970), off the Balleny Islands

−30°C in order to record colouring whilst two others were directly fixed in absolute ethanol to allow genetic sampling.

The carapace length (CL) was measured from the base of the orbit (excluding rostrum and lateral spines) to the posterior margin of the carapace (terminology follows that of Macpherson 1988a, 2004). Since photographic material and/or drawings of the holotype are missing in the original description of *N. brodiei* by Dawson and Yaldwyn (1970), the specimens were compared with the holotype curated in NIWA's marine invertebrate collection (NIWA 735, Fig. 2a).

Results and discussion

Material examined

Family Lithodidae Samouelle, 1819; Genus: *Neolithodes* A. Milne Edwards and Bouvier, 1894; *N. brodiei* (Dawson and Yaldwyn 1970). Material examined: Holotype, ovigerous female, CL = 112 mm (NIWA 735), NZOI Sta. F 135, 50°58′S, 173°57′E, 832 m, Campbell Plateau, HMNZS "Endeavour", 30 January 1965 (Fig. 2a, after Dawson and Yaldwyn 1970).

Female, CL = 75 mm (NIWA 3432), TAN0402/269, 65°28′53S, 161°02′88E to 65°28′97°S, 161°02′75E, 760–750 m, Balleny seamount, RV "Tangaroa", 7 March 2004

Male, CL = 126 mm (NIWA 3433), TAN0402/235, 67°26′09S, 163°52′98E to 67°26′37S, 163°51′79E, 124–170 m, seamount west off Sturge Island (Balleny Islands), RV "Tangaroa", 4 March 2004.

Female, CL = 148 mm (Fig. 2b, NIWA 3434), TAN0402/226, 67°13′22S, 164°17′78E to 67°11′97S, 164°14′87E, 522–538 m, north off Sturge Island (Balleny Islands, Fig. 1), RV "Tangaroa", 3 March 2004 (Fig. 2b).

Ovigerous female, material severely damaged (NIWA 3435), TAN0402/214, 67°25′37S, 165°15′82E, 1389 m, east off Sturge Island (Balleny Islands), RV "Tangaroa", 3 March 2004.

Biogeographic remarks

Dawson and Yaldwyn (1970) described *N. brodiei* based on a single ovigerous female sampled on the Campbell Plateau (about 51°S) at 832 m water depth. Little is known from the literature about the geographic and bathymetric distribution of this species, although it is widespread in waters off New Zealand and southeast Australia (Dawson and Yaldwyn 1970; Dawson 1989; Zaklan 2002; Poore 2004). The present record of *N. brodiei* extends its distribution south by almost 20° of latitude, and is the first record of the species in Antarctic waters. The Lithodidae now comprise a total of ten species known to occur in Antarctic waters south of the Antarctic Convergence (cf. Macpherson 2004; Thatje and Arntz 2004). Based on present data, the bathymetric range of *N. brodiei* extends from 124 to 1389 m (see also Macpherson 2001), which implies that *N. brodiei* is capable of invading the Southern Ocean from the deep sea. This finding supports the hypothesis that lithodid crabs may have taken the deep-sea to shallow-water pathway to recolonize the Southern Ocean following the extinction of crabs in Antarctic waters in the middle Miocene (for discussion see Thatje et al. 2004).

Only one further species of the genus *Neolithodes* has been discovered so far from waters south of the Antarctic Convergence: *N. diomedeae* (Benedict, 1895). This species has been reported from waters off South Georgia (for review see Macpherson 2004; Thatje and Arntz 2004).

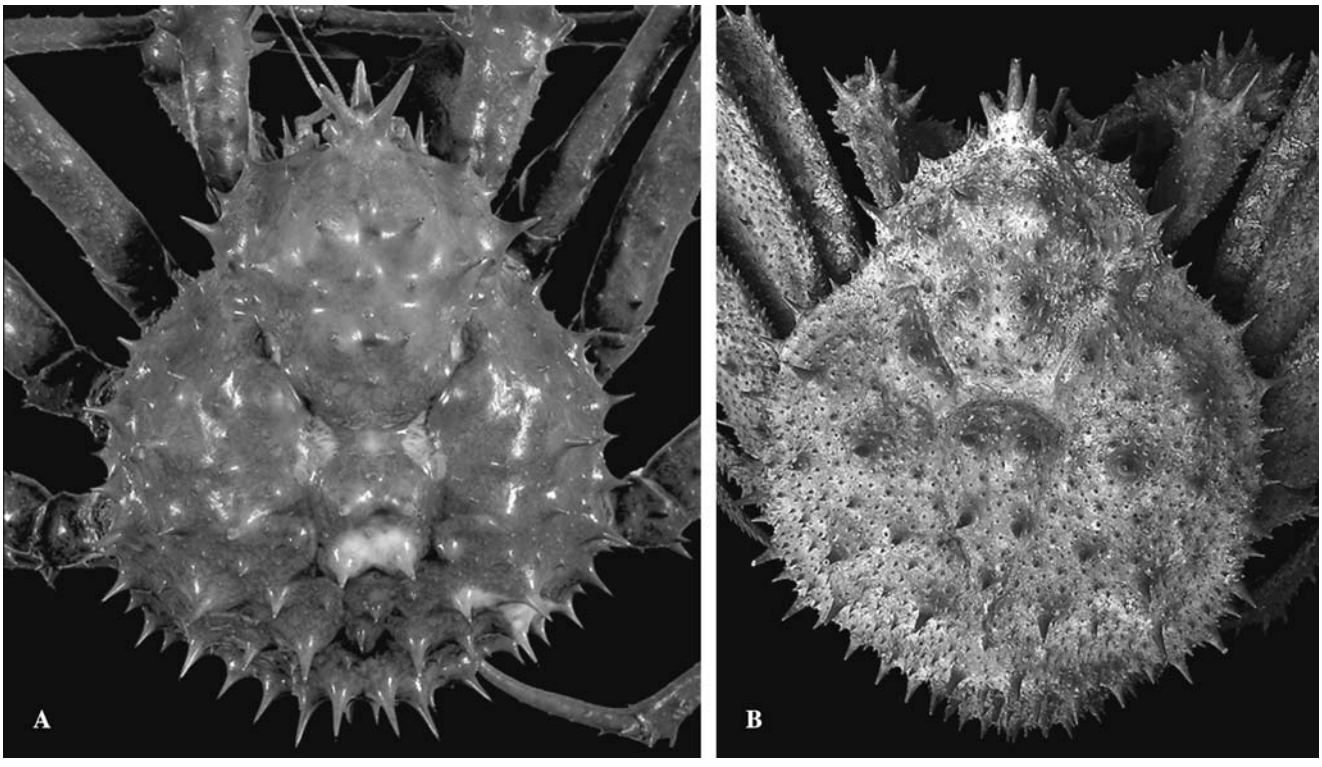

Fig. 2 *Neolithodes brodiei* (Dawson and Yaldwyn 1970). **a** Female holotype, dried material, dorsal aspect (CL = 112 mm, NIWA 735), from Campbell Plateau, New Zealand. **b** Female, frozen material, dorsal aspect (CL = 148 mm, NIWA 3434), from off Sturge Island (Balleny Islands), Antarctica (photos: Alan Blacklock, NIWA, Wellington)

N. brodiei can be distinguished from the other eight representatives of the genus (Macpherson 2004) mainly by numerous secondary and acute spines, scattered among the major spines on the carapace (best represented in the photo of dried material, Fig. 2a) and the dorsal surface of the merus of the walking legs. However, the thorny carapace and walking legs relate *N. brodiei* to *N. aggassizi* from the northwestern Atlantic, *N. asperrimus* and *N. capensis* from waters off South Africa (Dawson and Yaldwyn 1970; Dawson 1989; Macpherson 1988b; Zaklan 2002). Lithodid carapace spination appears to be highly variable within the same species, especially as it regards carapace and rostral spine length and orientation (as examples see Macpherson 1988b). Spine length usually decreases with increasing individual size, but is also strongly dependent on the life conditions. The Antarctic specimens of *N. brodiei* (Fig. 2a) show longer and more pronounced spines than the smaller holotype (Fig. 2b). However, orientation and position of the carapace spines remain identical. It should be underlined that the numerous secondary spines in the holotype are more conspicuous in the photo of dried material (Fig. 2b), whereas the tiny secondary spines in the Antarctic specimen (frozen material, Fig. 2a) are less obvious due to lack of contrast. Certainly, *N. brodiei* from the Balleny Islands shows lower densities in secondary spines (see also Poore 2004), which might be due to morphological changes in bigger specimens, which is typical of lithodid crabs. Future molecular analyses, however, will have to reveal whether the present specimens of *N. brodiei* belong to a new subspecies endemic to Antarctic waters.

The current record of *N. brodiei* is the first for its genus from Ross Sea waters. In the Ross Sea, around Scott Island (Fig 1), only two lithodid species (*Paralomis spectabilis* Hansen 1908, and *P. birsteini* Macpherson, 1988) have so far been found (for review see Macpherson 1988a; Thatje and Arntz 2004). The record of *N. brodiei* at the Balleny Islands supports the view of a circum-Antarctic distribution of the Lithodidae (Thatje and Arntz 2004).

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