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A VICTORIAN EMIGRANT: FIRST OBSERVATION AND RANGE EXTENSION OF THE NUDIBRANCH *TENELLIA CATACHROMA* (BURN, 1963) IN WESTERN AUSTRALIA (MOLLUSCA: GASTROPODA)

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ABSTRACT: The southwest coast of Western Australia is heavily influenced by the south-flowing Leeuwin Current. In summer, the current shifts and the north-flowing Capes Current delivers water from the south to nearshore environments and with it a supply of larvae from cooler waters. The nudibranch *Tenellia catachroma* (Burn, 1963) was considered restricted to Victorian waters; however, its discovery in eastern South Australia in 2013 revealed its capacity to expand its range west. In March 2017 a single individual was observed in shallow subtidal waters at Cape Peron, Western Australia, some 2000 km to the west of its previous range limit. Moreover, its distribution has extended northwards, possibly aided by the Capes Current, into a location of warming. This observation significantly increases the range for this Victorian emigrant to encompass most of the southern Australian coast, and also represents an equatorward shift at a time when the reverse is expected.

Keywords: climate change, Cape Peron, range extension, Leeuwin Current, Capes Current

The fionid nudibranch *Tenellia catachroma* (Burn, 1963) was first described from two specimens found at Point Danger, near Torquay, Victoria, in 1961 (Burn 1963). Both specimens were small (~10 mm crawl length) and found in shallow water on brown algae. At the time, Burn included *T. catachroma* in the genus *Catriona* Winckworth, 1941, subgenus *Eurycatriona*, due to its ceratal and radular morphology, but it was later accepted as *Trinchesia* Von Ihering, 1879 after Miller (2004) (Burn 2006). Most species formerly in *Trinchesia* are now incorporated in the genus *Tenellia* A. Costa, 1866 as a result of the phylogenetic work of Cella et al. (2016).

The diversity of fionid nudibranchs in southern Australia is particularly rich, with 30 species found in southern Victoria alone (Burn 2015), although many remain undescribed (Burn 2006; 2015). Nevertheless, *T. catachroma* is morphologically distinct and not readily confused with other congeners. The head and lower part of the rhinophores are typically an orange–red colour. The brown or green–blue fusiform cerata are tipped in bright yellow and arranged in five rows along the long body (Burn 2015, p. 232). The oral tentacles and rhinophores are smooth, and the distal portion is an opaque white or yellow (Burn 1963).

Several endemic southern Australian nudibranchs have long been regarded as having short range distributions. The range of the dorid nudibranch *Platydoris galbana* (Burn, 1958) was considered to be restricted to Victoria for 40 years until it was reported from Wollongong, New South Wales (NSW) in 1998 (Rudman 2003). *Cuthona kuiteri* Rudman, 1981 (syn. *Trinchesia kuiteri*, *T. kuiterorum*), first found in southern NSW in 1979 (Rudman 1998), has been observed only a handful of times since and was also regarded as a short-range endemic until it was reported from Victorian waters in 2015 (Burn 2015, p. 232). Since Burn's original description, *T. catachroma* has been found on the central Victorian coast with such frequency that Burn (2015) described it as 'common'. Nevertheless, its distribution in Victorian waters remains restricted to the rocky shores of Bass Strait between Wilsons Promontory and Cape Otway, although some specimens have been observed just inside the entrance to Port Phillip Bay at Queenscliff and the artificial island Pope's Eye.

In 2013 its range was extended into South Australia (SA). Two separate observations, one on the Yorke Peninsula on 27 January, and another at Rapid Bay the next day on 28 January, increased its known distribution by 600 km westward (Baker et al. 2013; J. Baker, pers. comm.) (Table 1). A recent Western Australian observation reported in this paper increases that range considerably.

MATERIALS AND METHODS

Approximately 40 km south of Perth, WA, Cape Peron is the northwestern point of a substantial limestone promontory that projects westward from the long north–south oriented sandy beaches of Warnbro Sound to the south and the expansive, sheltered waters of Cockburn Sound to the north. The cape and its nearby islands are included in the Shoalwater Islands Marine Park, which supports a diverse mix of tropical and temperate marine biota (DOECWA 2007). Situated within the Leeuwin–Naturaliste IMCRA

bioregion, oceanographic conditions are dominated by a cool northward-flowing counter-current in early summer and the warm, southward-flowing Leeuwin Current during late summer and, in some years, during winter (COA 2006).

The southeastern shore of Cape Peron is characterised by a wide intertidal limestone platform punctuated by numerous channels, arches and swim-throughs. Shallow subtidal shoals extend seaward, providing considerable protection from the prevailing southwest swell (Figure 1). Located in the most populous part of WA, Cape Peron has been well-studied and is considered a biodiversity hot spot for marine algae (DOECWA 2007). Ready access to the intertidal platform and shallow subtidal reefs provide ideal conditions for aquatic recreation activities such as snorkeling and diving. The observations reported in this paper were made during recreational snorkeling and, as a result, only photographs were taken.

Photographs were taken using a housed Olympus TG-3 digital camera and iTorch Pro 7 video light. Image processing was carried out using Adobe Lightroom to remove haze and to increase clarity.

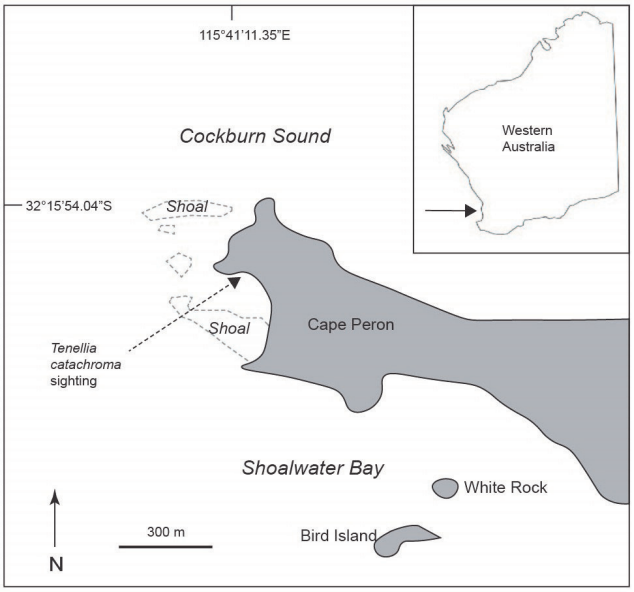

Figure 1: Map of Cape Peron with location of *Tenellia catachroma* observation indicated. Shading represents land.

RESULTS AND DISCUSSION

On 21 March 2017, a single 9 mm specimen of *T. catachroma* was observed crawling on brown algae in a narrow gutter on a shallow subtidal rock shelf at Cape Peron (Figure 2). This important observation represents a 2000 km westward range extension for this species. Thus, with the exception of eastern Victoria, the distribution range for this species can now be assumed to encompass the entire southern Australian coast (Figure 3, Table 1), although surveys of the south coast of WA and western SA are needed to confirm its occurrence there.

In Australian waters, sea slug diversity has been found to be greater adjacent to areas of high human population (Burn 2006; Nimbs & Smith 2017). This is most likely the result of increased survey effort in populated areas, and southwest WA is no exception, with the greatest number of sea slug observations reported from the Perth area (Wells & Bryce 2000; ALA 2015). Sea slug diversity in this region is comparatively well documented (Wells & Bryce 2000) and therefore the presence of previously undocumented occurrences can be readily recognised.

In southern Australia, both the east and west coasts are vulnerable to marine climate change, with southward shifts in distribution a likely outcome (Przeslawski et al. 2008; Beger et al. 2014; Richards et al. 2016). Several recent range extensions have been reported for sea slugs on the east coast and these may be attributed to a combination of increased survey effort and shifts in distribution in response to ocean warming (Nimbs et al. 2015; Nimbs et al. 2016; Nimbs & Smith 2016, 2017).

The coast of southwest WA is dominated for most of the year by the poleward flowing Leeuwin Current, which acts as a barrier to the northward dispersal of sea slug larvae (Pearce & Pattiaratchi 1999). It is possible, however, that an intermittent supply of temperate species larvae can be delivered in summer by the inshore, north-flowing Capes counter-current (Pearce & Pattiaratchi 1999) (Figure 3). Richards et al. (2016) discussed the presence of poleward range shifts in a variety of taxa into southern WA and increasing tropicalisation driven by rising

Table 1: Selected records of *Tenellia catachroma* from Australian waters.

Location	Record Coordinates	Year	Reference
Point Danger, Vic	38º20'00"S 144º19'00"E	1961	Burn (1963)
Anglesea, Vic	38º25'03"S 144º11'00"E	2010	Museum Victoria (2010)
Cape Paterson, Vic	38º54'17"S 145º55'26"E	2012	Museum Victoria (2012)
Barker Rocks, SA.	34º42'58"S 137º29'02"E	2013	Baker *et al.* (2013)
Rapid Bay, SA	35º31'24"S 138º11'16"E	2013	Baker *et al.* (2013)
Cape Peron, WA	32º15'54"S 115º41'11"E	2017	This paper

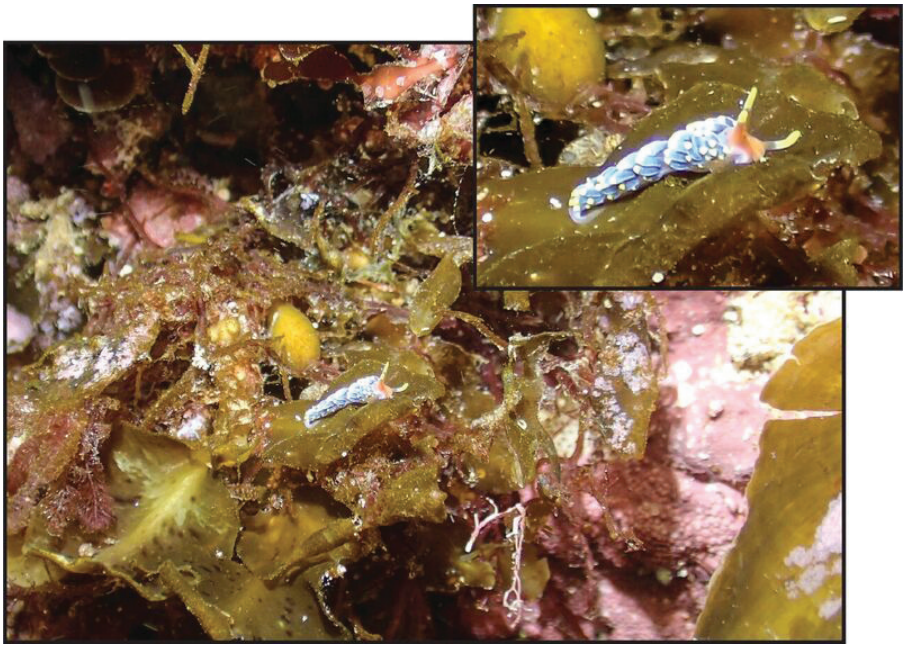

Figure 2: *Tenellia catachroma* at Cape Peron, WA on 23 March 2017, shallow subtidal.

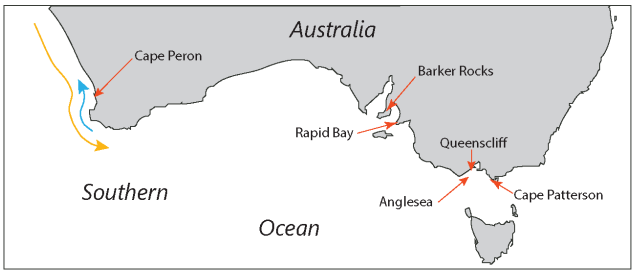

Figure 3: Locations of historic and recent observations of the fionid nudibranch *Tenellia catachroma* in southern Australia. Details in Table 1. The flow direction of the dominant southern Western Australian summer currents are indicated: Leeuwin Current = orange, Capes Current = blue (After Pearce & Pattiaratchi 1999).

water temperatures. In southwestern WA coastal ocean temperatures have steadily warmed over the last 65 years by 0.013°C per year (Pearce 2014). The observation of a temperate taxon not only 2000 km west of its previously known western range limit at Barker Rocks, SA, but also a further 300 km equatorward illustrates the complexity of spatio-temporal factors associated with change in marine ecosystems and indicates that northern range shifts in temperate species can occur even in the presence of warming. Nevertheless, any inferences derived from large range extensions among rarely observed species need to be treated with caution. Indeed, sea slugs are well known for their ephemerality and spatio-temporal rarity (Marshall & Willan 1999; Nimbs et al. 2016; Smith & Nimbs 2017) and thus novel observations can be attributed as much to increased survey effort as they are to environmental change.

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References

ALA, 2015. Atlas of Living Australia. *Atlas of Living Australia*. Available at: http://www.ala.org.au. Retrieved 26 March 2017.

Baker, J.L., Mercurio, P., Crawford, H., Lewis, J., Falconer, A., Muirhead, D., Velzeboer, R., Smith, K., Brook, J. & Kutyna, D., 2013. *Rarely Recorded and Endemic Marine Invertebrates in the Northern & Yorke NRM Region – Results of 2012 Surveys*. Natural Resources and Management, Adelaide.

Beger, M., Sommer, B., Harrison, P.L., Smith, S.D.A. & Pandolfi, J.M., 2014. Conserving potential coral reef refuges at high latitudes. *Diversity and Distributions* 20: 245–257. https://doi.org/10.1111/ddi.12140

Burn, R., 1963. Descriptions of Australian Eolidacea

(Mollusca: Opisthobranchia). *Journal of the Malacological Society of Australia* 1: 12–20.

Burn, R., 2006. A checklist and bibliography of the Opisthobranchia (Mollusca: Gastropoda) of Victoria and the Bass Strait area, south-eastern Australia. *Museum Victoria Science Reports* 10: 7–13.

Burn, R., 2015. *Nudibranchs and Related Molluscs*. Museum Victoria, Melbourne.

Cella, K., Carmona, L., Ekimova, I., Chichvarkhin, A., Schepetov, D. & Gosliner, T.M., 2016. A radical solution: the phylogeny of the nudibranch family Fionidae. *PloS one* 11 (1 https://doi.org/10.1371/journal.pone.0167800

COA, 2006. *A Guide to the Integrated Marine and Coastal Regionalisation of Australia Version 4.0*. Commonwealth of Australia, Department of the Environment. Available at: http://www.environment.gov.au/system/files/resources/2660e2d2-7623-459d-bcab-1110265d2c86/files/imcra4.pdf. Retrieved 26 March 2017.

DOECWA, 2007. *Shoalwater Islands Marine Park Management Plan.* Department of Environment and Conservation, Perth, Western Australia.

Marshall, J.G. & Willan, R.C., 1999. *Nudibranchs of Heron Island, Great Barrier Reef: A Survey of the Opisthobranchia (Sea Slugs) of Heron and Wistari Reefs*. Backhuys, Leiden, Netherlands.

Museum Victoria, 2010. *Trinchesia catachroma*. Invertebrate record: F185953. *Atlas of Living Australia*. Available at: http://biocache.ala.org.au/occurrences/9154c2b6-8374-46c4-aa83-8480da9fd85c. Retrieved 25 March 2017.

Museum Victoria, 2012. *Trinchesia catachroma* invertebrate Record: F194015. *Atlas of Living Australia*. Available at: http://biocache.ala.org.au/occurrences/0080341f-ecb0-4d68-948c-ebdf9913a2f3. Retrieved 25 March 2017.

Nimbs, M.J. & Smith, S.D.A., 2016. Welcome strangers: southern range extensions for seven heterobranch sea slugs (Mollusca: Gastropoda) on the subtropical east Australian coast, a climate change hot spot. *Regional Studies in Marine Science* 8: 27–32. https://doi.org/10.1016/j.rsma.2016.08.008

Nimbs, M.J. & Smith, S.D.A., 2017. An illustrated inventory of the sea slugs of New South Wales, Australia (Gastropoda: Heterobranchia). *Proceedings of the Royal Society of Victoria* 128: 44–113. https://doi.org/10.1071/RS16011

Nimbs, M.J., Willan, R.C., Larkin, M., Davis, T.R. & Smith, S.D.A., 2016. Southern range extensions for twelve heterobranch sea slugs (Gastropoda: Heterobranchia) on the eastern coast of Australia. *Marine Biodiversity Records* 9: 27. https://doi.org/10.1186/s41200-016-0027-4

Nimbs, M.J., Willan, R.C. & Smith, S.D.A., 2015. Range extensions for heterobranch sea slugs (formerly opisthobranch) belonging to the families Diaphanidae, Plakobranchidae and Facelinidae on the eastern coast of Australia. *Marine Biodiversity Records* 8 (e76): 1–6.

Pearce, A. & Pattiaratchi, C., 1999. The Capes Current: a summer countercurrent flowing past Cape Leeuwin and Cape Naturaliste, Western Australia. *Continental Shelf Research* 19: 401–420. https://doi.org/10.1016/S0278-4343(98)00089-2

Pearce, A.F. & Hutchins, J.B., 2014. *Record Breaking Temperatures and Tropical Fish Recruitment at Rottnest Island.* Fisheries Research Report (Western Australia), IMAS: Perth, Australia. pp. 25–26.

Przeslawski, R., Ahyong, S., Byrne, M., Woerheide, G. & Hutchings, P., 2008. Beyond corals and fish: the effects of climate change on noncoral benthic invertebrates of tropical reefs. *Global Change Biology* 14: 2773–2795. https://doi.org/10.1111/j.1365-2486.2008.01693.x

Richards, Z., Kirkendale, L., Moore, G., Hosie, A., Huisman, J., Bryce, M., Marsh, L., Bryce, C., Hara, A. & Wilson, N., 2016. Marine biodiversity in temperate Western Australia: multi-taxon surveys of Minden and Roe Reefs. *Diversity* 8: 7. https://doi.org/10.3390/d8020007

Rudman, W.B., 2003. *Platydoris galbanus* Burn, 1958. *Sea Slug Forum* 2016. Available at: http://www.seaslugforum.net/showall/platygal. Retrieved 26 March 2017.

Rudman, W.B., 1998. Sea Slug Forum: *Cuthona kuiteri*. Available at: http://www.seaslugforum.net/find/cuthkuit. Retrieved 26 March 2017.

Smith, S.D.A. & Nimbs, M.J., 2017. Quantifying temporal variation in heterobranch (Mollusca: Gastropoda) sea slug assemblages: tests of alternate models. *Molluscan Research*, 37(2): 140–147. https://doi.org/10.1080/13235818.2017.1279472

Wells, F.E.& Bryce, C.W., 2000. *Sea Slugs of Western Australia: A Guide for Species from the Indian to West Pacific Oceans*. Western Australian Museum, Perth, WA.