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First Report of *Sabella spallanzanii* (Gmelin, 1791) (Annelida: Polychaeta) from Botany Bay, New South Wales, a northern range extension for the invasive species within Australia

ANNA MURRAY[1] & STEPHEN J. KEABLE
Marine Invertebrates, Australian Museum, 6 College Street, Sydney, NSW 2010 Australia
[1]Corresponding author. E-mail: anna.murray@austmus.gov.au

The European Fanworm, *Sabella spallanzanii* (Gmelin, 1791), is a known invasive species in Australian coastal waters (Global Invasive Species Database 2013) and has been listed as:

- an 'introduced marine pest' by the National Introduced Marine Pest Information System (NIMPIS 2013)
- a 'target introduced pest species' by the Australian Ballast Water Management Advisory Council (ABWMAC) (Currie *et al.* 1998)
- a 'medium priority species' (a species which has a reasonably high impact/or invasion potential) in a ranking of Australian marine pests (Hayes *et al.* 2005).
- a reportable marine pest (NSW DPI 2013).

Sabella spallanzanii has the potential to alter native marine ecosystems and compete with native organisms for food and space. In high densities it also has the potential to impact aquaculture operations both as a nuisance fouler, and as a competitor to cultured filter-feeding species such as oysters and mussels (NSW DPI 2013; Currie *et al.* 2000).

The invasive capabilities of this polychaete worm have received considerable attention. It has been shown to inhibit recruitment of many sessile species on hard surfaces and some infaunal species in soft sediments due to the combined 'canopy effect' of the feeding ‘fans’ in a population (Holloway & Keogh 2002; O'Brien *et al.* 2006), and the efficiency and strength of its filtration during feeding (Lemmens *et al.* 1996). This high filtration capacity may also have a deleterious effect on nutrient recycling processes in areas where there are high densities of *S. spallanzanii* in soft sediments (Murray & Parslow 1999; Stabilia *et al*. 2006).

This annelid is considered native to the Mediterranean Sea and to the European Atlantic coast, but was also recorded as early as 1856 from Brazil under seven different synonyms (Knight-Jones & Perkins 1998) and has also been reported as a recently introduced species to New Zealand (Read *et al.* 2011). Within Australia *S. spallanzanii* was first discovered in southern Western Australia in 1965 (Wells & McDonald 2010), and has since been recorded from Victoria, South Australia, Tasmania and New South Wales (NSW) (see Fig. 1 for distribution records in Australia). In some locations it appears to be a “boom-or-bust” species. For example, densities in Port Phillip Bay have declined to relatively low levels compared with the period following its initial establishment and expansion in the late 1980s to mid-1990s (Ross *et al.* 2007).

In New South Wales, *S. spallanzanii* was first discovered in Twofold Bay (~37°S, 150°E) in November 1996 where the species is still present despite eradication attempts by diver hand-removal., This population steadily increased until 2008, followed by a decline to pre-2005 numbers (NSW DPI 2013; Creese & Glasby pers. comm.). Due to concerns regarding the impact of introduced marine pests, Australian ports were surveyed for invasive species during the late 1990s and early 2000s (Hewitt & Martin 1996). Despite extensive diver-surveys of piles, rocky reefs and soft substrates undertaken in 1998 in Botany Bay during a port survey, no *S. spallanzanii* were recorded (O'Donnell 2000; Pollard & Pethebridge 2002a). A study undertaken in 2004 of the soft-sediment polychaete assemblages of Botany Bay also did not report any *S. spallanzanii* (Fraser *et al*. 2006). Likewise, it was not recorded from other major international and domestic shipping ports immediately to the south and north of Botany Bay which were also sampled during similar port surveys, namely Port Kembla (in 2000), Port Jackson/Sydney Harbour (in 2001) and Newcastle (in 1997), (Hewitt *et al.* 1998; Australian Museum Business Services 2002; Pollard & Pethebridge 2002b). There has been no record of a northern extension of the range of *S. spallanzanii* along the NSW east coast, until now (Capa, pers. comm.).

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On 28 March 2013, during a regular Australian Museum collection dive to survey the local fauna, two large tube-dwelling sabellid polychaete specimens were obtained from a single locality off Inscription Point in Botany Bay (approximately 34°00'08"S, 151°13'30"E) (see Fig.1). On 11 April 2013, after identification (by the first author), including comparison with reference specimens held in Australian Museum collections and an independent check (see Acknowledgements), the NSW Department of Primary Industries (DPI) was notified of the species' presence in Botany Bay. A subsequent dive, undertaken on 18 April 2013 targeting further collection of the species in the same vicinity, yielded another 6 specimens from a 100 m transect during a combined dive time of 120 minutes. After fixation and preservation, all specimens were deposited in the Australian Museum Marine Invertebrate Collection (registration numbers AM W43514–5, AM W43462–4). Six specimens were fixed in 7% formalin and preserved in 80% ethanol, 2 specimens (AM W43514, AM W43462) were fixed and preserved in 95% ethanol for future molecular analysis. Small amounts of tissue were also dissected prior to preservation from 2 specimens (AM W43515, W43514) and frozen for future molecular analysis.

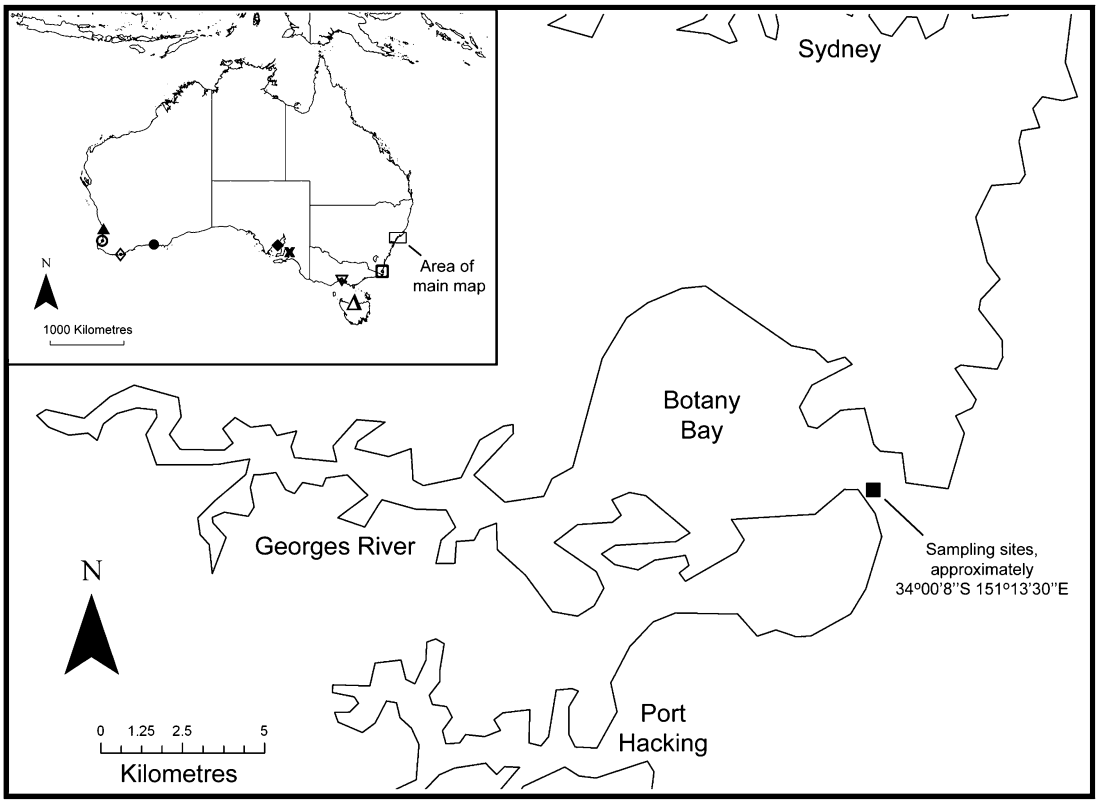

FIGURE 1. Map showing collecting location of *Sabella spallanzanii* in Botany Bay. Inset: recorded locations of *S. spallanzanii* populations in Australia. ■ = Botany Bay. **X** = Port Adelaide. ▽= Port Phillip Bay. **Δ** = Devonport. □ = Eden Harbour (Twofold Bay). ● = Esperance. ○ = Bunbury. ◊ = Albany. ♦ = Spencer Gulf. ▲= Cockburn Sound and Fremantle.

A detailed description of *S. spallanzanii* is given in Knight-Jones & Perkins (1998). Diagnostic characters (visible in Fig. 2) that distinguish it from other similar sabellid polychaetes include a tough leathery tube (which may be covered by other sessile invertebrates), a feeding 'fan' (or branchial crown) which may be brightly coloured with bands of orange, purple and white (Fig. 2A) with two asymmetric lobes, one of which is spiralled and the other semicircular (Fig. 2B), the presence of thoracic companion chaetae, and abdominal chaetae arranged in spiralled fascicles (Fig. 2C) — the latter two characters only visible under a dissecting microscope.

The specimens collected from Botany Bay range in size from 30–112 mm body length (with worm total length of 55–153 mm including branchial crown). The largest specimen (112 mm body length, from AM W43464) has intratubular maturing oocytes extruded in a mucus mass from the body around the region of the mid abdomen indicating reproductive viability. None of the other smaller specimens appear to have mature gametes, as the colour of the coelomic fluid when freshly examined was brown, rather than turquoise or green (which indicates mature oocytes), or white (which indicates mature spermatozoa) (Giangrande *et al.* 2000; Currie *et al.* 2000). These observations agree with Currie *et al.* (2000), who found that Australian *S. spallanzanii* <50 mm body length were sexually immature, and based on their growth

estimates of 30 mm in 2 months (over warmer months in Port Phillip Bay), suggests that the individuals from Botany Bay may be from 2–10 months old. The water temperature measured in Botany Bay at the time of collection was 19–20°C. In the southern hemisphere, spawning of *S. spallanzanii* has been recorded during autumn-winter, and coincides with falling seawater temperatures (11–14°C, Port Phillip Bay, Currie *et al*. 2000) suggesting that any individuals >50 mm body length in the Botany Bay population may be approaching maturity and able to spawn as water temperatures fall.

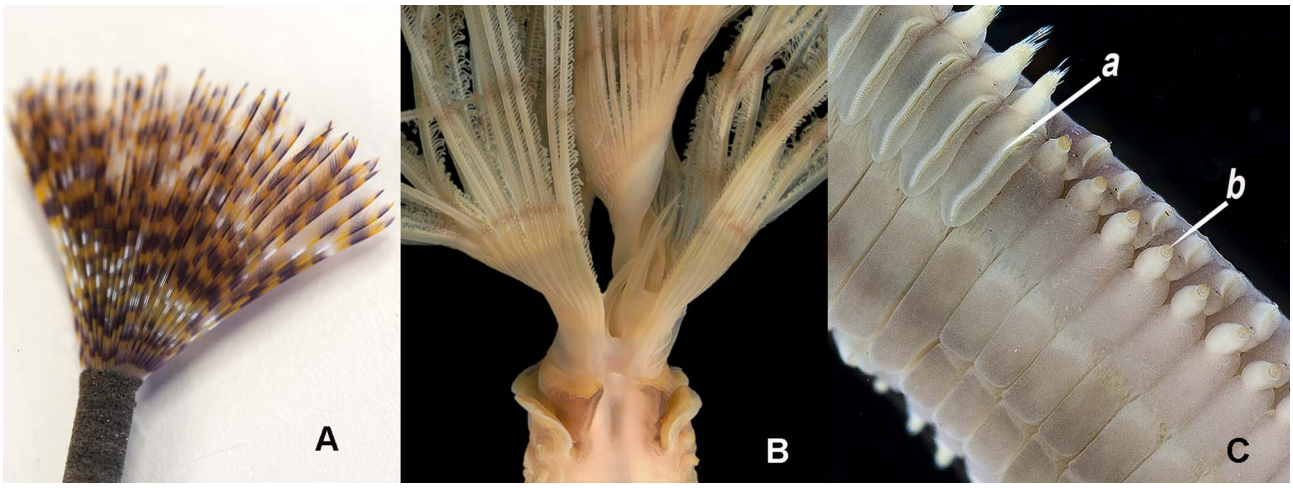

FIGURE 2. Diagnostic features of *Sabella spallanzanii*. A, branchial crown emerging from tube, showing colour pattern. Live specimen from Botany Bay (one from AM W43464), photo by S. Humphreys. B, branchial crown showing asymmetric lobes. Preserved specimen (AM W24270, from North Haven, South Australia), photo by E. Wong. C, junction of thorax and abdomen showing: a, thoracic companion chaetae; b, spiralled fascicle of abdominal chaetae. Live specimen from Botany Bay (one from AM W43464), photo by S. Humphreys.

The specimens were obtained from 10–12 metres depth in an area at the mouth of Botany Bay where the tidal current flow is relatively strong. None were located a further 50 metres eastward where wave exposure was high and the current stronger. The worm tubes were attached to substrates such as large rocks, or on sediment among the rocks attached to small dead shells. The tubes presented as highly visible, unlike the more cryptic habit of many other similar large sabellid polychaete species, such as *Sabellastarte australiensis* and *Bispira* spp. where the major proportion of the tube is usually embedded within the substrate. The preferred habitat of *S. spallanzanii* is reported as shallow subtidal areas (1–30 m), in harbours and embayments rich in nutrients and sheltered from direct wave action (Currie *et al.* 2000). Therefore, the site where they were found in Botany Bay is probably not ideal for high densities and further exploration of more sheltered areas inside the bay may yield more specimens.

Botany Bay is a major domestic and international port. In the year 2011/2012, 1601 vessels visited Botany Bay (Sydney Ports 2012). An assessment of the likelihood of marine pest introductions in estuaries in the Sydney region (Glasby & Lobb 2008), including Botany Bay, rated *S. spallanzanii* as having a high likelihood of summer and winter survival and ranked it, equally with other species, as having the fourth highest overall impact (which considers both ecological effects and invasive potential) of the 30 taxa considered. This study also listed *S. spallanzanii* as number 20 out of 30 taxa of concern in terms of relative risk of reaching Botany Bay from international ports, but fifth most likely pest arrival from domestic ports. The top three species in that list, however, had already been recorded from Botany Bay so *S. spallanzanii* was effectively ranked the second most likely new pest to be introduced into Botany Bay from a domestic port. Glasby & Lobb (2008) ranked commercial shipping from the port of Melbourne as the most important domestic vector resulting in a new pest incursions into Botany Bay. They also ranked the international ports of Hong Kong, Auckland, Tauranga (New Zealand), and Kaohsiung (Taiwan) and Ningbo (China) as the most likely international origins of the source of new pest introductions from overseas. Of these international ports *S. spallanzanii* has to date only been reported from Auckland (Read *et al*. 2011).

Genetic analyses before 2001 suggest that Australian *S. spallanzanii* populations probably derive from a single, or at most several, initial introductions via shiphull-fouling or ballast water, because of their reduced genetic variability as compared with Mediterranean populations—the "founder effect" (Andrew & Ward 1997; Patti & Gambi 2001). Because of the species' high fecundity and extended spawning periodicity (Currie *et al.* 2000), it is considered to be of high risk to spread to other temperate-water ports via domestic shipping (Glasby & Lobb 2008). Information from life history studies

show that their pelagic larval phase of ~14 days before settlement, or 20+ days under stressful conditions (Giangrande *et al.* 2000), could be a contributary factor in their translocation between Australian ports via ballast water from domestic shipping. The discharge of this domestic ballast water is only strictly controlled in Victorian waters, though uptake is not, as it is deemed by AQIS to be 'low-risk' (DAFF Biosecurity 2011). Spread of *S. spallanzanii* into Botany Bay via hull-fouling is also a possibility, most likely either from adult spawning while vessels are in port or hull-cleaning of recreational vessels, as in-water hull-cleaning of commercial vessels is generally prohibited in Botany Bay (Pollard & Pethebridge 2002a; Floerl *et al.* 2010).

At this point it is unclear which vectors have led to the spread of *S. spallanzanii* to Botany Bay or how widely distributed it is within the bay. Further underwater exploration is recommended to examine the extent of the distribution of *S. spallanzanii* within Botany Bay, whether it is the result of a recent introduction (smaller scattered individuals) or has been present for more than a year (an established population with large mature adult individuals in colonies), and the impact it is having.

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