
Roger N. Bamber

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Anthropogenic spread of the immigrant sea-spider *Ammothea hilgendorfii* (Arthropoda: Pycnogonida: Ammotheidae) in UK waters

ROGER N. BAMBER

ARTOO Marine Biology Consultants, Ocean Quay Marina, Belvidere Road, Southampton SO14 5QY, UK

The ammotheid pycnogonid *Ammothea hilgendorfi* was first recorded outside its native range of the Pacific Ocean in 1978 in southern England and in the Lagoon of Venice in 1979 to 1981. Both occurrences are attributed to anthropogenic dispersion by shipping. Subsequently, it has spread further in the UK to Dorset and, most recently, to Essex. The world distribution of this species and the history of its occurrence outside the Pacific are reviewed, and hypotheses for its recent spread in the UK, via recreational boating, are presented.

Keywords: pycnogonids, Ammothea, anthropogenic introduction, alien, marinas

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INTRODUCTION

The pycnogonid *Ammothea hilgendorfi* (Böhm, 1879) (Figure 1) is a common littoral to infralittoral ammotheid species around the coasts of Japan, and has also long been known from the Pacific coasts of California and Mexico (for many years under the junior synonym *Lecythorhynchus marginatus* Cole, 1904).

While normally found free-living in epizoan and epiphytic communities and in heterogeneous sediments, this species has been recorded ectocommensally on the holothurian *Holothuria (Selenkothuria) moebii* (Ludwig) (Ohshima, 1927, as *Lecythorhynchus*) and on the starfish *Coscinasterias acutispina* (Stimpson) (Nakamura & Fujita, 2004). It is often associated with hydroids, such as species of *Abietinaria* Kirchenpauer (e.g. Hedgpeth, 1940); the protonymphon larvae have been found endoparasitically in association with the campanulariid *Orthopyxis everta* (Clark) (Russel & Hedgpeth, 1990, as *Eucopella everta*). The overall recorded depth-range for *A. hilgendorfi* is 0 to 15 m.

This Pacific species was discovered in the Lagoon of Venice in 1979 to 1981, where its presence was attributed to anthropogenic dispersion by ships’-hull fouling (Krapp & Sconfietti, 1983). In August 1978, two specimens were collected in Hampshire, UK (Bamber, 1985), on the south coast of England, the second record outside the Pacific; this occurrence of *A. hilgendorfi* was also attributed to anthropogenic dispersion by shipping. Subsequent records in the UK, including its most recent discovery on the east coast, are discussed herein.

DISTRIBUTION

Western Pacific records

The type locality of *Ammothea hilgendorfi* is at Enoshima, Honshu, Japan, at 5 to 7 m depth (Böhm, 1879, as *Corniger hilgendorfii* gen. nov. sp. nov.), since when it has been recorded throughout Japan in littoral to shallow waters (Helfer, 1938, as *Lecythorhynchus marginatus*; Hedgpeth, 1949, as *Lecythorhynchus*; Utinomi, 1951, as *Lecythorhynchus*; Utinomi, 1954, as *Lecythorhynchus*; Stock, 1954, as *L. marginatus*; Utinomi, 1959, as *Lecythorhynchus*; Utinomi, 1971, as *Lecythorhynchus*; Nakamura & Child, 1983; Nakamura, 1987 [with synonymy and literature]; Nakamura & Child, 1991; Nakamura, 1994; Turpaeva, 2001, as *Leionymphon marginatus*; Nakamura & Fujita, 2004). In addition, sparse records exist from Korea (Kim, 1984; Kim & Hong, 1986; Hong & Kim, 1987), from China (Lou, 1936, as *Lecythorhynchus*) and from the east coast of Russia (Losina-Losinsky, 1933, as *Lecythorhynchus marginatus*), again in littoral to shallow waters.

Mid-Pacific records

From mid-oceanic islands in the Pacific, *Ammothea hilgendorfi* has been recorded twice in the Society Islands (Child, 1970; Müllier, 1989) as well as in Hawaii (Hilton, 1942, as *Lecythorhynchus ovatus* sp. nov.).

Eastern Pacific records

*Ammothea hilgendorfi* has been recorded frequently along the coasts of California and Mexico (Cole, 1904, as *Lecythorhynchus marginatus* sp. nov.; Hall, 1913, as *L. marginatus*; Schmitt, 1934, as *L. marginatus*; Hedgpeth, 1940, as *L. marginatus*; Hedgpeth, 1941, in key, as...

**OCCURRENCE AS A XENOBIONT**

The first published record of *Ammothea hilgendorfi* outside the Pacific, as an anthropogenically-introduced species, was by Krapp & Sconfietti (1983; see also Candela *et al.*, 1983), who discovered *A. hilgendorfi* in the Lagoon of Venice amongst fouling communities in 1979 to 1981, in nearly fully-marine conditions. These authors attributed its presence to arrival from East Asian waters in the hull-fouling of ships: there is an extensive shipping trade from the Far or Middle East via the Suez Canal to the port of Venice (e.g. Galil, 2000; Streftaris *et al.*, 2005). There have been no subsequent records of *A. hilgendorfi* on the adjacent shores of the Adriatic Sea.

United Kingdom records are listed in Table 1, with a map showing the key locations as Figure 2. *Ammothea hilgendorfi* was first recorded in UK waters by Bamber (1985), from two immature specimens collected in August 1978 in Southampton Water, Hampshire (~50°49.5′N 01°19.3′W), in fully marine conditions. Southampton Water is a ria on the south coast of England, about 13 km long and 2 km wide at its widest; its southern (seaward) end connects with the Solent, a strait separating the Isle of Wight from the Hampshire mainland, while at its northern end lies Southampton, a major port with an extensive shipping trade, including with Japan. This area of coastline now supports resident populations of a number of Japanese species, including the tunicate *Styela clava* Hedman and the serpulid tube-worms *Pileolaria* (P.) *berkeleyana* (Rioja) and *Hydroides ezoensis* Okuda, although the latter may have crossed the English Channel from French coasts where the Japanese oyster *Crassostrea gigas* (Thunberg) had been transplanted. The establishment of *A. hilgendorfi* in Southampton Water was first confirmed with the discovery of an adult in October 1987 (Bamber, 1988).

*Ammothea hilgendorfi* was subsequently found in large numbers in Poole Harbour, Dorset (~50°41.8′N 01°59.0′W) (mistakenly cited as Portland Harbour in Bamber, 2010). The initial record was in July 2001, amongst epifaunal fouling material on a marina pontoon; by 2006, *A. hilgendorfi* was regularly found under boulders around the Harbour, in densities ranging from ‘occasional’ to ‘super-abundant’. In Poole Harbour, it now (2011) seems to be present intertidally (mid-tide level) virtually wherever there is suitable habitat, i.e. under small, rough boulders lying on medium to coarse sand, where several tens of animals may aggregate (L. Baldock, personal communication). By 2009, it had also been recorded outside Poole Harbour, at South Beach, Studland Bay, where it was certainly absent in 2006.

Meanwhile, by 2010, the Southampton Water population was well-established, with numerous intertidal records around the northern half of the ria particularly under boulders, but also subtidal records down the western shore to the mouth of the ria. In the same year *Ammothea hilgendorfi* was recorded elsewhere in the Solent, including Yarmouth on the Isle of Wight (~50°43.0′N 01°35.5′W), again amongst epifaunal fouling on a marina pontoon. In the spring of 2011, large numbers of *A. hilgendorfi* were taken from pontoon epifauna in Ocean Quay Marina, the site of the old Southampton Outer Dock (~50°53.7′N 01°23.3′W), as well as elsewhere in Southampton Water (Horton *et al.*, 2011).

In 2010, specimens of *Ammothea hilgendorfi* were collected for the first time from the southern North Sea on the east coast of England. During a benthic survey of the River Blackwater Estuary in Essex, in the vicinity of Bradwell Power Station (~51°44.7′N 05°35.5′E), *A. hilgendorfi* was the second-most-common of nine species of pycnogonid collected, with twenty individuals taken at six sites. These specimens were collected in grab samples from sedimentary habitats comprising mud with fine sand and shell, at depths between 6 and 31.5 m. The Blackwater Estuary is also an area of recreational yachting, with numerous moorings around Mersea Island to the north of the sampling area and at Bradwell Marina to the south-east. This area was subject to some intensive surveying in relation to existing and proposed power stations from the 1960s to the mid-1980s (e.g. Bamber & Henderson, 1981), and again in the late 1990s: *A. hilgendorfi* was certainly absent then.

**DISCUSSION**

Pycnogonids do not have an obligate dispersive phase in their life history. A few species have been observed swimming (e.g. Cole, 1901; Fage, 1912; Clark & Carpenter, 1977), but this appears to be a method of maintaining a position above the sea-bottom rather than for directional movement; it may allow for tidal dispersion (Morgan, 1977, 1978). Thus, achieving a wide distribution requires either a long time, or some assistance in dispersal, either in drifting algae or by anthropogenic transport. Pycnogonids have been recorded in ships’-hull fouling (e.g. Bamber, 1979), a habitat in which they might be expected to be able to complete their life-cycle.

![Image](image-url)

**Fig. 1.** *Ammothea hilgendorfi* (Bohm, 1879), adult female (after Bamber, 2010). Dark stippling on the trunk and legs indicates dark-brown pigmentation patches.
As well as being the location of a major port, Southampton Water and the adjacent Solent house the greatest concentration of marinas and recreational yachts in the UK. Poole Harbour is also a significant site for yacht marinas, and in easy sailing distance from Southampton. It is notable that the majority of the records of *A. hilgendorfi* from sites in Dorset, Hampshire and the Isle of Wight are from marinas. The River Blackwater Estuary is home to some commercial fishing (trawling) and a nuclear power station, but currently is largely a centre for recreation, notably with yacht marinas. Galil (2000) notes that the increase in spread of xenobiont species in the Mediterranean is associated with increases in seafaring, commercial and tourism activities, and cites lagoons, estuaries and marinas as habitats particularly susceptible to invasions. It thus seems likely that *A. hilgendorfi* was first introduced to the UK by international shipping into Southampton, and has subsequently spread westwards along the south coast to Dorset and eastwards to Essex with the assistance of recreational yachting. Other likely sites for the appearance of this species are Brighton (East Sussex) and the Channel Islands, both common destinations for short-distance recreational yachting from the Solent area.

Climatically, the UK is amenable to a species originating in Japan, as can be seen from the current distribution of the

<table>
<thead>
<tr>
<th>Area</th>
<th>Year</th>
<th>Location</th>
<th>Latitude–longitude</th>
</tr>
</thead>
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<tr>
<td>Southampton Water, Hampshire</td>
<td>1978</td>
<td>Fawley Marsh</td>
<td>50° 49.51′ N 001° 19.37′ W</td>
</tr>
<tr>
<td></td>
<td>1987</td>
<td>Fawley Marsh</td>
<td>50° 49.51′ N 001° 19.37′ W</td>
</tr>
<tr>
<td></td>
<td>2010</td>
<td>Marchwood</td>
<td>50° 44.07′ N 001° 21.10′ W</td>
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<td>2010</td>
<td>Victoria Country Park</td>
<td>50° 52.20′ N 001° 22.05′ W</td>
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<td></td>
<td>2010</td>
<td>River Test Estuary</td>
<td>50° 53.28′ N 001° 24.33′ W</td>
</tr>
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<td></td>
<td>2010</td>
<td>Western Shore</td>
<td>50° 52.94′ N 001° 22.05′ W</td>
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<td>Western Shelf</td>
<td>50° 53.38′ N 001° 23.01′ W</td>
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<td></td>
<td>2010</td>
<td>Hamble Point</td>
<td>50° 50.99′ N 001° 18.94′ W</td>
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<td>Yarmouth Marina</td>
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<td>Pennington to Lepe</td>
<td>50° 44′ N 001° 28′ W</td>
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<td></td>
<td>2010</td>
<td>Stanswood Bay</td>
<td>50° 48′ N 001° 18′ W</td>
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<td>2001</td>
<td>Poole Quay</td>
<td>50° 42.86′ N 001° 59.61′ W</td>
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<td>2006</td>
<td>Baiter</td>
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<tr>
<td>Blackwater Estuary, Essex</td>
<td>2010</td>
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<td>51° 44.73′ N 000° 53.46′ W</td>
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</table>

Fig. 2. Map of southern England showing locations of the UK records of *Ammothea hilgendorfi*. 
tunicate *Styela clava* around the British Isles (Davis & Davis, 2004). It appears to have taken *A. hilgendorfi* some two decades to spread from Southampton to Poole Harbour (where it has since proliferated), and three decades to reach the southern North Sea coast of England; the main dispersion (so far) of this species in the UK seems to have occurred during the past decade. It will be interesting to see how long it takes to achieve a similar spread around the UK as has *Styela clava*. Fortunately, while a successful anthropogenically-introduced species, *A. hilgendorfi* cannot be considered an ‘invasive’ species, as no threat to the local ecology is conceived (Eno *et al.*, 1997).

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REFERENCES


and


Correspondence should be addressed to:

R.N. Bamber

ARTOO Marine Biology Consultants

Ocean Quay Marina, Belvidere Road, Southampton SO14 5QY, UK

email: roger.bamber@artoo.co.uk