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Disjunct Lake Michigan Populations of Two Atlantic Coast Spiders, *Disembolus bairdi* and *Grammonota pallipes* (Araneae: Linyphiidae)

James F. Steffen^{1*} and Michael L. Draney²

Abstract

Two species of linyphiid spiders, *Disembolus bairdi* Edwards, 1999 and *Grammonota pallipes* Banks, 1895, were discovered along the southwestern coast of Lake Michigan in Lake County, Illinois representing an Atlantic Coastal Plain disjunct distribution. A brief discussion of known collection sites, habitat preferences, and possible modes of dispersal are given.

Disembolus bairdi Edwards, 1999 is a small erigonine spider species that was described by Edwards (1999) from the coastal marshes of Cape Cod, Massachusetts and Long Island, New York from material collected in 1985 through 1990 in Massachusetts and in 1995 in New York. The species was found under mats of organic debris, usually *Zostera* or *Spartina*, near the highest tide levels in areas protected from direct ocean influence. To our knowledge, it has not been reported from other locations since the publication of Edwards (1999) (type specimens deposited in United States National Museum, Washington D. C.; Museum of Comparative Zoology, Cambridge, Massachusetts; American Museum of Natural History, New York; and British Museum of Natural History, London). *Grammonota pallipes* Banks, 1895 is another erigonine spider that has been recorded from Long Island, New York (Banks 1895), Cape Cod, Massachusetts (Edwards 1993), Washington County, Maine (Jennings and Graham 2007), May's Landing, New Jersey (Bishop and Crosby 1932), Somersworth, New Hampshire (Canadian National Collection of Insects, Arachnids and Nematodes, K. W. Wu, pers. comm.), as well as several locations in Canada (unknown Nova Scotia record reported in Buckle et al. 2001; Quebec records reported in Bélanger and Hutchinson 1992; and Ontario, New Brunswick, and Quebec records in Canadian National Collection of Insects, Arachnids and Nematodes, K. W. Wu, pers. comm.). To our knowledge, these species have not previously been recorded for any of the states bordering Lake Michigan (Sierwald et al. 2005).

In late April of 2005, pitfall traps were established in the dunes and interdunal swales (panne) at Waukegan Beach along the west coast of Lake Michigan for the purpose of surveying the spider communities there. The beach area is located approximately 0.8 km (0.5 miles) north of the harbor in Waukegan, Lake County, Illinois (42° 22' 21" N, 87° 48' 47" W). The interdunal swales are flat, damp depressions located behind and between the foredune and backdunes. The substrate is damp sand with a sparse cover of *Salix* leaf litter. The vegetation, which was patchily distributed, consisted mostly of *Salix myricoides*,

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Schizachyrium scoparium, and *Juncus balticus*. The dunes surrounding these swales were covered by several grass species, including *Ammophila breviligulata*, *Calamovilfa longifolia*, and *Schizachyrium scoparium*. Several species of spiders from a number of families were sampled (see complete list in Table 1). One male of an unidentified species of Linyphiidae was trapped along with six seemingly conspecific females on 1 May 2005. The male was tentatively identified as *Disembolus bairdi* by the second author, and the identities of the male and female specimens were later confirmed by Robert L. Edwards (pers. comm. to first author). In an attempt to obtain more individuals of the species, litter collections were taken at the site. Interdunal litter samples from 5–9 May yielded 16 mature females, but no further males. The spider appeared to be restricted to the interdunal swales, as no individuals were obtained from litter collections on the dunes. The first author returned to the area on 27–28 December 2005 at which time 6 mature male and 35 mature female *D. bairdi* were found in the litter, and one female of *Grammonota pallipes* was found in a back-dune area of the beach.

Litter samples also were taken approximately 11 kilometers north of Waukegan Beach at the northern unit of Illinois Beach State Park in Lake County during similar seasons in subsequent years (7 and 30 August and 17 November 2008 and 27 March 2009) to see if *D. bairdi* was present in similar interdunal habitats. No individuals of this species were obtained from those samples. However, six individuals of *G. pallipes* were collected at this site (one male on 30 August 2008 and five females on 17 November 2008). A more recent litter sample (19 October 2012) from the southern unit of Illinois Beach State Park near the camp ground (42° 26' 00.43" N 87° 48' 15.55" W) produced one male and three females of *D. bairdi* in a black oak savanna close to the beach on a back-dune, approximately 55 meters from the water's edge. This location is approximately 7.2 kilometers north of Waukegan Beach.

One male and one female specimen of *D. bairdi* have been deposited in the collection of the Field Museum (FMNH) in Chicago, Illinois. Two males and seven females are in the second author's collection at the University of Wisconsin Green-Bay, Green Bay, Wisconsin, and two males and 42 females are in the first author's collection at the Chicago Botanic Garden, Glencoe, IL.

Table 1. Ground-dwelling spiders of Waukegan Beach, Waukegan, Lake Co., IL. All species were either trapped in pitfall traps or sorted from litter between 1 May 2005 and 28 December 2005.

Family	Species
Clubionidae	<i>Clubiona abboti</i> L. Koch, 1866
Dictynidae	<i>Phantyna bicornis</i> (Emerton, 1915)
Linyphiidae	<i>Agyneta fabra</i> (Keyserling, 1886)
	<i>Disembolus bairdi</i> Edwards, 1999
	<i>Eridantes erigonoides</i> (Emerton, 1882)
	<i>Grammonota pallipes</i> Banks, 1895
	<i>Collinsia plumosus</i> (Emerton, 1884)
	<i>Idionella formosa</i> (Banks, 1892)
	<i>Islandiana flaveola</i> (Banks, 1892)
Salticidae	<i>Marpissa pikei</i> (Peckham & Peckham, 1888)
	<i>Neon nelli</i> Peckham & Peckham, 1888

One male and one female also were sent to Robert L. Edwards at Woods Hole, MA. Two females of *G. pallipes* have been deposited at the Field Museum in Chicago while the remainder of the material is held by the authors.

Discussion

For *D. bairdi*, the Waukegan Beach site represents a range extension of approximately 1,287 km (800 miles) from the New York and Massachusetts collection localities of Edwards (1999). The known habitat distribution and collection records suggest that *D. bairdi* is a shoreline species. All known records (Edwards 1999 and the present report) are from littoral wrack, and no individuals have been found inland, although litter samples were collected in higher elevation areas at the Waukegan Beach site, approximately 260 meters from the water's edge.

Although *G. pallipes* appears to have a broader distribution than *D. bairdi*, the Illinois records for this species appear to be a westward range extension of approximately 850 km (528 miles) from the previous western collection site of Chatterton, Ontario. Looking at all the known records, the species still appears to be restricted to the Atlantic Coastal Plain and the Great Lakes/St. Lawrence Seaway region of the United States and Canada. Several specimens from the Canadian National Collection were collected within 10 km of the Ottawa River in Kingsmere, Quebec and Nepean and Torbolton, Ontario; other specimens were found within 20 km of Lake Ontario in Chatterton, Ontario (K. W. Wu, pers. comm.). The remainder of the known *G. pallipes* records are from within 25 km of the Atlantic coast from New Brunswick to New Jersey, with many specimens recorded from coastal Kouchibouguac National Park, New Brunswick. *G. pallipes* appears to be less confined to beach environments than *D. bairdi*. In addition to the inland records mentioned above, it has been collected 5 km inland in Maine and 20 km inland in New Jersey and approximately 23 km inland in Somersworth, New Hampshire (see records cited above). The available habitat information is consistent with coastal (and similar) microhabitats, with specimens having been collected from sand dunes, sandy beach, dunes, forest in beach heather (*Hudsonia tomentosa*) litter and under debris, and ponds, which probably means near the shoreline (Bélanger and Hutchinson 1992; K. W. Wu, CNC records, pers. comm.).

Peattie (1922) describes Atlantic Coastal Plain disjunct plant communities in the Great Lakes region, some of which are concentrated in the southern end of Lake Michigan. Reznicek (1994) gives a detailed discussion of 62 species of Atlantic Coastal plant species known to be disjunct in the Great Lakes region with the highest concentrations occurring in southwest Michigan, northern Indiana, and central and northwestern Wisconsin. McLaughlin (1932) provides a thorough discussion of several possible postglacial avenues of dispersal, including the Mississippi River basin, the Mohawk-Hudson outlet, and the Ottawa connective, which resulted in more Atlantic Coastal Plain plant species being found in the region of the southern end of Lake Michigan than any other inland location. The prevailing hypothesis is that these plant species gradually migrated along shorelines of postglacial lakes and drainages. Reznicek (1994) suggests that, although random long distance dispersal is unlikely, dispersal jumps of varying distance occurred between areas of suitable habitat created along postglacial drainages after which they became established in areas with extensive drying shorelines. While the plant component of these communities has been described, the animals accompanying them are less well known (Thomas 1951). Thomas (1951) mentions two grasshopper species that presumably followed the sand and gravel outwash plains during post-Wisconsin times, which have survived in sandy areas around the Great Lakes. Shapiro (1970) details the biogeography of several Atlantic Coastal Plain disjunct butterfly species. He suggests the post-Wisconsin Hudson-Mohawk outlet of Lake Ontario (12,500–10,500 B.P.), a corridor connecting the

Great Lakes and the Coastal Plain, as a means of dispersal for these organisms. He also suggests that the sedge-feeding marsh-living ecology of those insects was important in that dispersal, a pattern that is rare in butterflies with different non-sedge-feeding, non-marsh-living ecologies. In spiders, ballooning is known as a common means of long distance dispersal (Duffey 1998). However, Bonte et al. (2003) have shown that ballooning is negatively related to habitat specialization in spiders and also that habitat specialists are characterized by poorly developed dispersal behavior. Hawes (2007) suggests that high arctic Linyphiidae may have originally colonized those habitats by ballooning, and then ballooning behavior atrophied over evolutionary time. Therefore, although *D. bairdi* is currently an apparent habitat specialist, it may have initially dispersed by means of ballooning during a time of more or less continuous postglacial beach and shoreline habitat availability (McLaughlin 1932) and then later lost ballooning behavior as habitat became more restricted. The degree of habitat specialization for *G. pallipes* is less clear, but the species does seem to be present only within a few kilometers of the Atlantic Coast, Great Lakes, or Saint Lawrence/Ottawa River systems, which also suggests fairly specific microhabitat requirements and lack of long-distance ballooning ability.

Disembolus bairdi may be the first example of a true Atlantic Coastal Plain disjunct spider in the Great Lakes region. Although *G. pallipes* may also be an Atlantic Coastal Plain disjunct species, its status is less clear because of having a wider distribution, being found at least several kilometers away from littoral environments. Two wolf spider (Lycosidae) species, *Arctosa littoralis* (Hentz, 1844) and *Pardosa groenlandica* (Thorell, 1872) also are found in both geographical locations, but these species seem to be more widespread and less restricted to specific microhabitats. Although most populations of these species have been recorded from sandy (in the case of *A. littoralis*) or cobbly/pebbly (in the case of *P. groenlandica*) seashore and lakeshore habitats, *A. littoralis* also has been found in similar sandy habitats on riverbanks and inland, and *P. groenlandica* is found in alpine scree above timberline across Canada and in the mountain west (Dondale and Redner 1983; Dondale 1999). Only *D. bairdi* seems to be truly restricted to littoral microhabitats and may represent an ideal model organism to trace range expansion after the last glaciation.

Only a small segment of Lake Michigan shoreline was examined in this study. Therefore, it would be important to make a wider search of these littoral areas throughout the Great Lakes region, and in particular, those areas of high concentrations of disjunct plant species, to further document the distribution of *D. bairdi* and *G. pallipes* and search for other possible disjunct species restricted to the same microhabitat. Making these specimens available as identified and digitized museum collections will facilitate researchers in distinguishing habitat specialists and tracing their distributional history and possible mode of dispersal based on known geological events and timelines.

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