



Distribution and abundance of freshwater polychaetes, *Manayunkia speciosa* (Polychaeta), in the Great Lakes with a 70-year case history for western Lake Erie

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ARTICLE INFO

Article history:

Received 23 October 2012

Accepted 25 March 2013

Available online 30 April 2013

Communicated by David Barton

Keywords:

Manayunkia

Polychaete

Great Lakes

Chinook salmon

Lake Erie

ABSTRACT

Manayunkia speciosa has been a taxonomic curiosity for 150 years with little interest until 1977 when it was identified as an intermediate host of a fish parasite (*Ceratomyxa shasta*) responsible for fish mortalities (e.g., chinook salmon). *Manayunkia* was first reported in the Great Lakes in 1929. Since its discovery, the taxon has been reported in 50% (20 of 40 studies) of benthos studies published between 1960 and 2007. When found, *Manayunkia* comprised <1% of benthos in 70% of examined studies. In one extensive study, *Manayunkia* occurred in only 26% of 378 sampled events (1991–2009). The taxon was found at higher densities in one area of Lake Erie (mean = 3658/m²) and Georgian Bay (1790/m²) than in five other areas (mean = 60 to 553/m²) of the lakes. A 70-year history of *Manayunkia* in western Lake Erie indicates it was not found in 1930, was most abundant in 1961 (mean = 8039, maximum = 67,748/m²), and decreased in successive periods of 1982 (3529, 49,639/m²), 1993 (1876, 25,332/m²), and 2003 (79, 2583/m²). It occurred at 48% of stations in 1961, 58% in 1982, 52% in 1993, and 6% of stations in 2003. In all years, *Manayunkia* was distributed primarily near the mouth of the Detroit River. Causes for declines in distribution and abundance are unknown, but may be related to pollution-abatement programs that began in the 1970s, and invasion of dreissenid mussels in the late-1980s which contributed to de-eutrophication of western Lake Erie. At present, importance of the long-term decline of *Manayunkia* in Lake Erie is unknown.

Published by Elsevier B.V. on behalf of International Association for Great Lakes Research.

Introduction

Little is known about *Manayunkia speciosa* Leidy, 1858 (*Manayunkia*) and, probably as a result, it has only been a scientific curiosity without any known social importance (Britt, 1965; Mackie and Qadri, 1971; Poe and Stefan, 1974). However, in 1977, Bartholomew et al. (1997) demonstrated that *M. speciosa* was an intermediate host of a myxosporean parasite (*Ceratomyxa shasta*) that causes intestinal infections and mortality of juvenile chinook salmon (*Oncorhynchus tshawytscha*). This parasite causes a fatal condition of ceratomyxosis in juvenile salmon (Koie, 2002). In the Klamath River that flows into the Pacific ocean, *C. shasta* caused a 40 to 80% mortality of out-migrating juvenile chinook salmon released from fish hatcheries. Infestation of juvenile chinook was traced to a 16 mile stretch of river where *Manayunkia* occurred. *Manayunkia* has also been shown to be an intermediate host for *Parvicapsula minibicornis*, another parasite of chinook salmon (Bartholomew et al., 2006).

The known distribution of *Manayunkia* in 1978 was succinctly summarized by Brehm (1978). Briefly, *Manayunkia* was discovered by Joseph Leidy (1858) in the Schuylkill River near Philadelphia, Pennsylvania in 1858. It was reported a few more times in Pennsylvania and New Jersey

in the late-1800s (Leidy, 1883; Potts, 1884) and in Lakes Superior and Erie of the Laurentian Great Lakes in the 1920s and 1930s (Meehan, 1929; Krecker, 1939). Between the 1930s and 1950s, little information on this taxon can be found (Krecker, 1939; Pettibone, 1953). In the 1960s and 1970s, *Manayunkia* was recorded in the Sacramento-San Joaquin Delta, California; Agency Lake, Oregon; north Alaska; the Hudson and Delaware rivers of northeast United States; and, the Gulf of Mexico coast in Mississippi (Brehm, 1978). Much of this literature emphasized that the distribution of *Manayunkia* was probably discontinuous. To date, there is still little information on the distribution and abundance of this taxon.

Leidy (1883) was the first to describe *Manayunkia* in detail from a few specimens collected in Egg Harbor River, New Jersey (Fig. 1). Leidy (1883) also included notes on the behavior, morphology, and taxonomic status of this taxon. To date, there have been two to five other species of *Manayunkia* recognized—examples include; *M. aestuarina*, *M. baicalensis*, *M. caspica*, and *M. cursoria* (Mackie and Qadri, 1971; Croskery, 1978; Stocking and Bartholomew, 2007). However, in North America, *M. speciosa* is the only species restricted to freshwater (Mackie and Qadri, 1971). Descriptive characteristics of mature specimens of *M. speciosa* (i.e., *Manayunkia*) include: 1) they are approximately 3 to 4 mm long and about 0.25 mm wide, 2) individuals live in slender-body contoured tubes constructed of fine mud particles from which it extends its head

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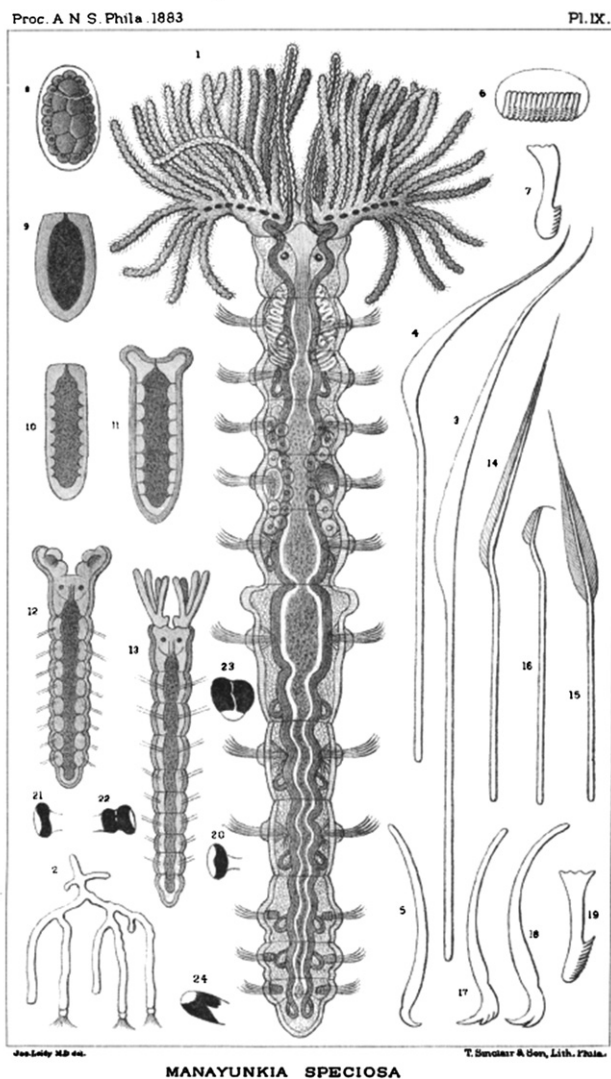


Fig. 1. Plate IX (with 24 inset figures) of *Manayunkia speciosa* originally published by Leidy (1883). "The worm in the ordinary condition of extension, with its tentacles spread (Figure 1 = 3–4 mm long)." Other distinctive morphological characteristics (given in insets 2–24).

and tentacles, 3) heads have crowns of ciliated tentacles composed of two rows with 18 tentacles/row, 4) tentacles are believed to gather drifting food and be used to build tubes for habitation, 5) adults have separate sexes with some observable dimorphism that may help in identification of male and female individuals (Leidy, 1883; Pettibone, 1953; Willson et al., 2010; pers. comm. Sarah Willson and David Malakauskas, Michigan State University, East Lansing, Michigan) and, 6) young (ca. 0.7 mm long) are produced in tubes and likely colonize close to adults since young have no way to disperse, except by currents and attachment to objects moved by external events (Leidy, 1858; Croskery, 1978; Stocking and Bartholomew, 2007; pers. observ.).

In the Great Lakes, *Manayunkia* was first reported in Duluth Harbor of Lake Superior in 1929 (Meehan, 1929). Since 1929, the occurrence of *Manayunkia* in the Great Lakes has been sporadically described as a minor component of benthic fauna, except in 1961 when it surprised scientists as a major numerical component of the benthic fauna in western Lake Erie (Hiltunen, 1965). The first occurrences of *Manayunkia* in harbors, low abundance of this taxon before the 1950s, discontinuous distribution, and low abundance of *Manayunkia* in the Great Lakes led Meehan (1929) and Croskery (1978) to suggest this taxon was an

exotic taxon to the Great Lakes. Although several benthic studies were conducted in the Great Lakes prior to 1910 (qualitative and descriptive) and the 1920s and 1930s (quantitative), no *Manayunkia* were reported, except for a few specimens in Duluth Harbor of Lake Superior and in Lake Erie in 1936 (Meehan, 1929; Krecker, 1939; Wright, 1955). Although undocumented, it is possible that vessels from the eastern United States transported this taxon to isolated areas such as Duluth Harbor and Lake Erie as early as the 1800s (Croskery, 1978). This argument is supported by Croskery (1978) who believed *Manayunkia* is a euryhaline species that resulted from marine incursions of water into freshwater environments. Practically all accounts of this taxon occur in close proximity to marine environments and often co-occur with species of recent marine ancestry (Holmquist, 1967; Croskery, 1978). Young of *Manayunkia* are dispersed passively because it has no free-swimming stage. Therefore, it is likely that some form of active transport would be required to move this taxon from a near-marine environment to an inland site such as Duluth Harbor. Croskery (1978) suggests "The water taken in by ocean-going vessels traveling the Great Lakes could have included the first specimens (of *M. speciosa*) released into the western basin of Lake Erie." Therefore, ships could have transported and introduced *Manayunkia* from rivers of the northeast United States where it was first described in 1858 (Leidy, 1858, 1883). Other occurrences of *Manayunkia* in the United States have been postulated to have occurred via transportation of live fish (Hazel, 1966; Croskery, 1978).

The present study was done to compile known information about *M. speciosa* in the Great Lakes. At present, it is not known if *Manayunkia* in the Great Lakes contain fish parasites but this review is a first step to assess if investigation of parasites is warranted. In addition, this study presents a 70-year case history of the distribution and abundance of this taxon based on historic benthic surveys in western Lake Erie in 1930, 1982, 1993, and 2003 (Wright, 1955; Carr and Hiltunen, 1965; Manny and Schloesser, 1999).

Methods

Information on the abundance and, presence and absence of *Manayunkia* in published studies of the Great Lakes was compiled by manual searches of Proceedings of Conferences on Great Lakes Research (1960–1974, University of Michigan, Ann Arbor) and of the Journal of Great Lakes Research (1974–2007) to determine how frequently the taxon was found and how abundant it was in the Great Lakes. These proceedings and journal articles contain a relatively high proportion of benthic studies performed in waters of the Great Lakes as confirmed by a survey of electronic bibliographic databases. Studies selected for this meta-analysis included those that: 1) list and/or discuss the taxon, 2) had adequate description of methods to reasonably believe they obtained benthic organisms 2–4 mm long (e.g., collected sediments and sieve sizes <550 μ); and, 3) had species lists that include taxonomic divisions below Annelida.

The distribution and abundance of *Manayunkia* over a wide geographic area and 18 years was made available for 164 sites located along coastlines of the Great Lakes in Canada (Lake Superior [31 sites], Lake Huron [6 sites], Georgian Bay of Lake Huron [44 sites], North Channel of Lake Huron [30 sites], Lake Erie [24 sites], Lake Ontario [23 sites], and the St. Lawrence River [6 sites]; unpublished data, Lee Granpentine, Environment Canada, Burlington, Ontario) (Fig. 2). Some of these sites were sampled multiple times for a total of 378 sampled events (Lake Superior [103 events], Lake Huron [12], Georgian Bay of Lake Huron [74], North Channel of Lake Huron [64], Lake Erie [61], Lake Ontario [57], and the St. Lawrence River [6 events]). Samples were collected in 1991 (41 sites), 1992 (78), 1993 (80), 1997 (24), 1998 (43), 1999 (8), 2000 (27), 2002 (17), 2006 (13), 2007 (20), 2008 (13), and 2009 (14 sites). Presentation and interpretation of polychaetes found in these surveys was limited to identification and summarized for large geographic areas (i.e., seven water bodies) because of the

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