U.S. Fish and Wildlife Service

Thermocyclops crassus
Ecological Risk Screening Summary

U.S. Fish and Wildlife Service, October 2016

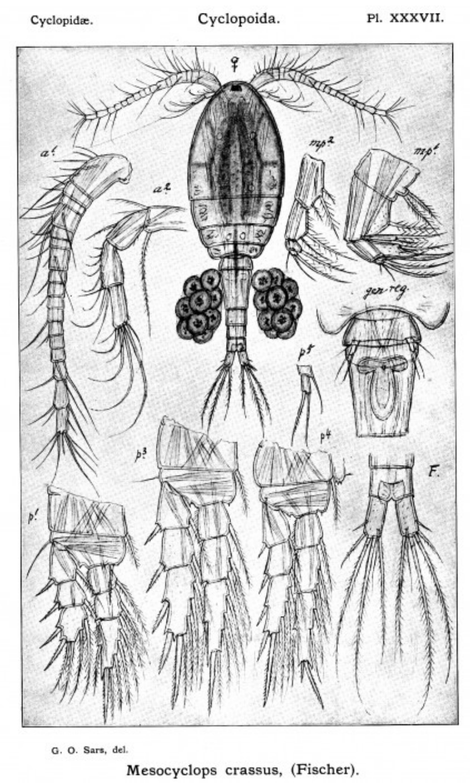

Photo: *Mesocyclops crassus* [accepted as *Thermocyclops crassus*] from Sars, G.O. 1914, Plate 37. Licensed under CC BY-NC-SA. Available: http://www.marinespecies.org/copepoda/aphia.php?p=image&pic=82133. (October 2016).

1 Native Range and Status in the United States

Native Range
From Reid (1989):

"present throughout the Palearctic, Australia, South and Southeast Asia, occurring most commonly in tropical Africa"

Status in the United States
From Duchovnay et al. (1992):

“The cyclopoid copepod *Thermocyclops crassus* was collected in Missisquoi Bay, Lake Champlain, Vermont, U.S.A., in May and August 1991. Since this is the first confirmed record of the species in North America, the population is considered to be introduced.”

“The date of introduction of the Lake Champlain population is uncertain. Its localized distribution with the lake indicates that introduction was recent […] In spite of its inclusion in the widely used key of Yeatman (1959), *T. crassus* has not been reported in North America in recent decades. For this reason we do not believe that the species is presently distributed widely on this continent.”

“Most published records of *T. crassus* from the Americas were found by Reid (1989) to refer to the similar pantropical species *T. decipiens* Kiefer 1929.”

Means of Introductions in the United States

From Duchovnay et al. (1992):

“The origin and means of introduction are unknown.”

From Duggan et al. (2005):

“Here, we assess whether residual water and sediments of NOBOB [“no-ballast-on board”] ships provide an invasion risk to the Great Lakes. We examine the identity, abundances, and frequencies of live organisms associated with these residuals in NOBOB ships entering the Great Lakes. […] A total of 35 copepod species were identified from the 33 ships. […] Four species, *Mesocyclops leuckarti*, *Paracyclops fimbriatus*, *Thermocyclops crassus*, and *Thermocyclops oithonoides*, are freshwater species that do not have established populations in the Great Lakes.”

Remarks

From Walter (2015):

“Synonymised names
Mesocyclops brevifurcatus Harada, 1931
Mesocyclops crassus (Fischer, 1853)”

From Duchovnay et al. (1992):

“Because of the difficulty of discrimination of *T. crassus* and similar congeners, information on this species appears in the scientific literature under a confusing variety of names. Kiefer (1978) and Rylov [1948 (1963)] discussed its taxonomic history in detail and provided a list of synonyms, the most common of which is *Thermocyclops* (or *Mesocyclops*) *hyalinus* Rehberg 1880. Additional nomenclatural confusion has been caused by the former inclusion of species of *Thermocyclops* in the genus *Mesocyclops*, or, in older literature, *Cyclops*.”

From Reid (1989):

"[As of 1989,] the only confirmed record of this species in the western hemisphere is that of Collado, Defaye et al. (1984[a]) from three small ponds in San Jose Province, Costa Rica […] B. H. Dussart, C. H. Fernando (in litt.) and co-workers (Collado, Fernando & Sephton, 1984[b]) agree that most published records of *T. crassus* in South and Central America and the Caribbean region refer to *T. decipiens*"

2 Biology and Ecology

Taxonomic Hierarchy and Taxonomic Standing

From ITIS (2016):

"Kingdom Animalia
Subkingdom Bilateria
Infrakingdom Protostomia
Superphylum Ecdysozoa
Phylum Arthropoda
Subphylum Crustacea
Class Maxillopoda
Subclass Copepoda
Infraclass Neocopepoda
Superorder Podoplea
Order Cyclopoida
Family Cyclopidae
Genus *Thermocyclops* Kiefer, 1927
Species *Thermocyclops crassus* (Fischer, 1853)"

"Current Standing: valid"

Size, Weight, and Age Range

From NINA (2016):

"Female: Length 0.9-1.1 mm
Male: Length 0.7 mm"

From Duchovnay et al. (1992):

"Maturation time can be as short as a few weeks at tropical temperatures, with multiple generations per year (Lewis 1979), although in temperate waters, the species may have as few as two generations annually [Rylov 1948 (1963)]."

Environment

From Duchovnay et al. (1992):

"It has been collected from waters of pH 5.9-8.4, but the optimum pH is 7-8 [Rylov 1948 (1963)]. It is tolerant of salinities up to 7.2 o/oo (Löffler 1961)."

Climate/Range

From Tackx et al. (2004):

"*T. crassus* exhibits an optimal development around 25°C. At lower temperature, the rate of development decreases […]"

From Kobari and Ban (1998):

"In laboratory experiments, this species did not produce eggs below 10°C (Maier, [1989]). In the present study, reproduction of *T.crassus* also occurred at water temperatures >10°C in both ponds. This suggests that *T.crassus* is adapted to the warm season, and winter diapause of this species may be a strategy to avoid low temperature. Water temperature may be an important factor influencing the life cycle pattern of *T.crassus*"

Distribution Outside the United States

Native

From Reid (1989):

"present throughout the Palearctic, Australia, South and Southeast Asia, occurring most commonly in tropical Africa"

Introduced

From Gutiérrez-Aguirre and Suárez-Morales (2000):

"A limnological survey carried out during January 1998 in the state of Tabasco, southeastern Mexico, established the occurrence of the Eurasian freshwater copepod *Thermocyclops* (Fischer, 1853) at several sites."

"It has been found in Costa Rica […] (Collado et al., 1984[a]; Reid, 1990; Reid & Pinto-Coelho, 1994), and has been recorded recently from Nicaragua (Reid, pers. comm.)."

Means of Introduction Outside the United States

From Gutiérrez-Aguirre and Suárez-Morales (2000):

"The introduction of this eurytopic species in freshwater systems of Tabasco [Mexico] is probably related to aquacultural activities."

Short description

From NINA (2016):

"The body of *T. crassus* is rather short and stout and its furca is about twice as long as wide. The ratio between the outer and the inner setae attached to the furca [is] 1:3 […] Its colour is very pellucid with a faint yellowish tinge."

Biology

From Duchovnay et al. (1992):

"[…] occurring in large and small natural and artificial lakes and reservoirs, and occasionally in rivers [Kiefer 1978, Rylov 1948 (1963)]. The species is primarily pelagic but can also attain high populations among dense littoral immersed macrophytes [Flössner 1967, Rylov 1948 (1963)]. It is thermophilic and in more temperate regions comprises a significant component of the plankton only during the warmer months. In tropical climates this species is often among the dominant crustacean plankters (Fernando 1980, Hodgkiss 1977, Lewis 1979). […] It is herbaceous, feeding on diatoms, cryptomonads, and cyanophyceans (Fernando 1980, Lewis 1979), and thrives in mesotrophic and eutrophic waters [Patalas and Patalas 1966, Rylov 1948 (1963)]. […] *Thermocyclops crassus* may diapause as a CIV or CV copepodid. In several Italian lakes, *T. crassus* overwinters in the benthos as diapausing copepodid CV stages (Stella *et al.* 1972; E. Stella, personal communication to J. W. R., 1992), whereas in several German lakes, *T. crassus* overwinters as a CIV copepodid (Maier 1990)."

Human uses

From Nam et al. (1998):

"In 1993, the World Health Assembly officially designated dengue control and prevention as a high priority […] However, success has been limited by a lack of effective methods to control the principal vector, *Aedes aegypti* (L.), an urban mosquito that breeds in water storage containers as well as discarded containers that collect rainwater. […] Herein we report the success of a relatively new control method: cyclopoid copepods. […] Predacious cyclopoids are particularly effective because of their broad diet, consisting of algae, protozoa, rotifers, and most aquatic animals up to their own size and because they do not depend on the supply of mosquito larvae."

Diseases

No information available.

Threat to humans

No information available.

3 Impacts of Introductions

No information available.

4 Global Distribution

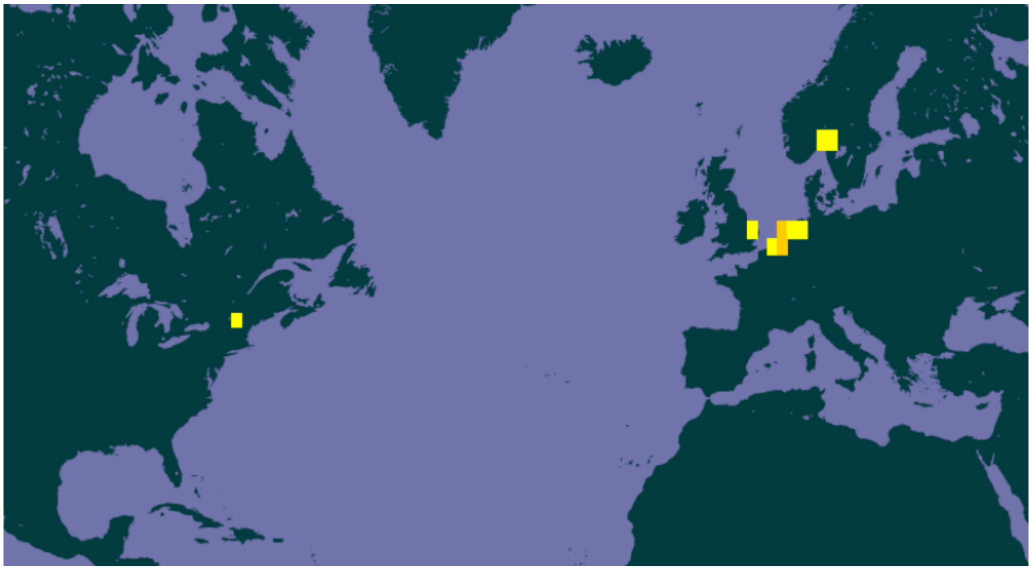

Figure 1. Known global established locations of *Thermocyclops crassus* according to GBIF (2016).

5 Distribution within the United States

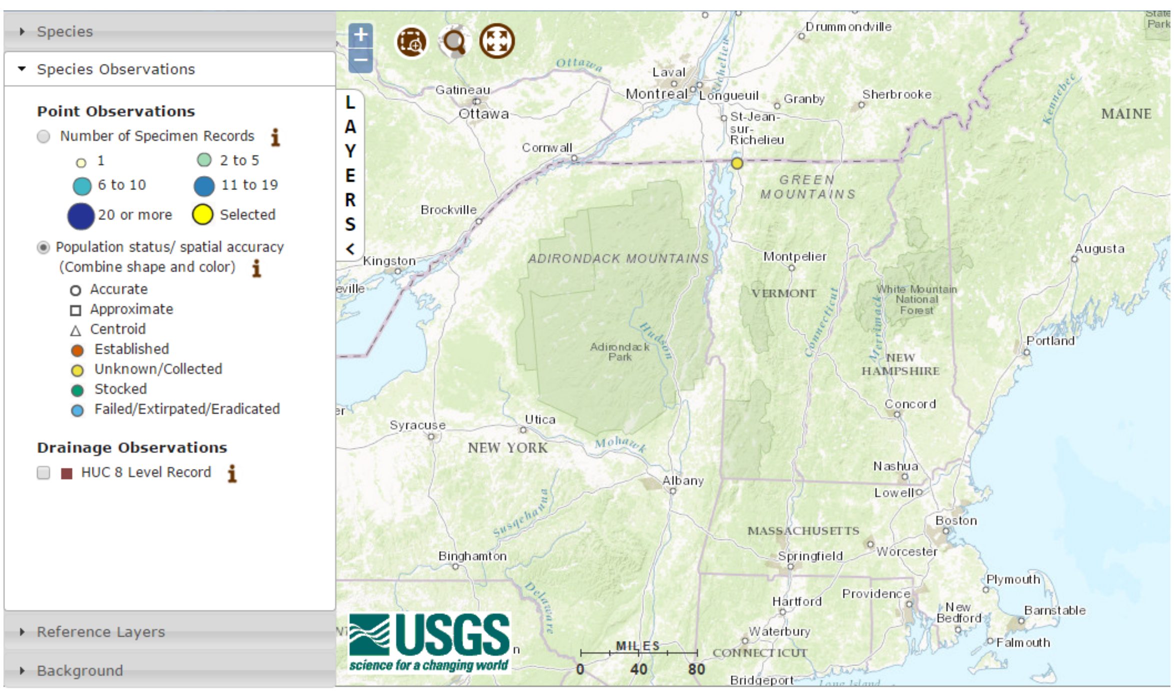

Figure 2. Distribution of *Thermocyclops crassus* in the United States. Map from USGS (2016).

6 Climate Matching

Summary of Climate Matching Analysis

The climate match (Sanders et al. 2014; 16 climate variables; Euclidean Distance) was high in the Northeast, Great Lakes region, and much of California. Climate match was medium for the Mid-Atlantic region, much of the Midwest, and Florida. The Pacific Northwest and South-central U.S. exhibited low climate match. The Interior West was a patchwork of high, medium, and low climate matches. The Climate6 score for *Thermocyclops crassus* indicates a high climate match to the continental U.S. Climate6 scores of 0.103 and greater indicate high climate match; Climate6 score for *T. crassus* was 0.186.

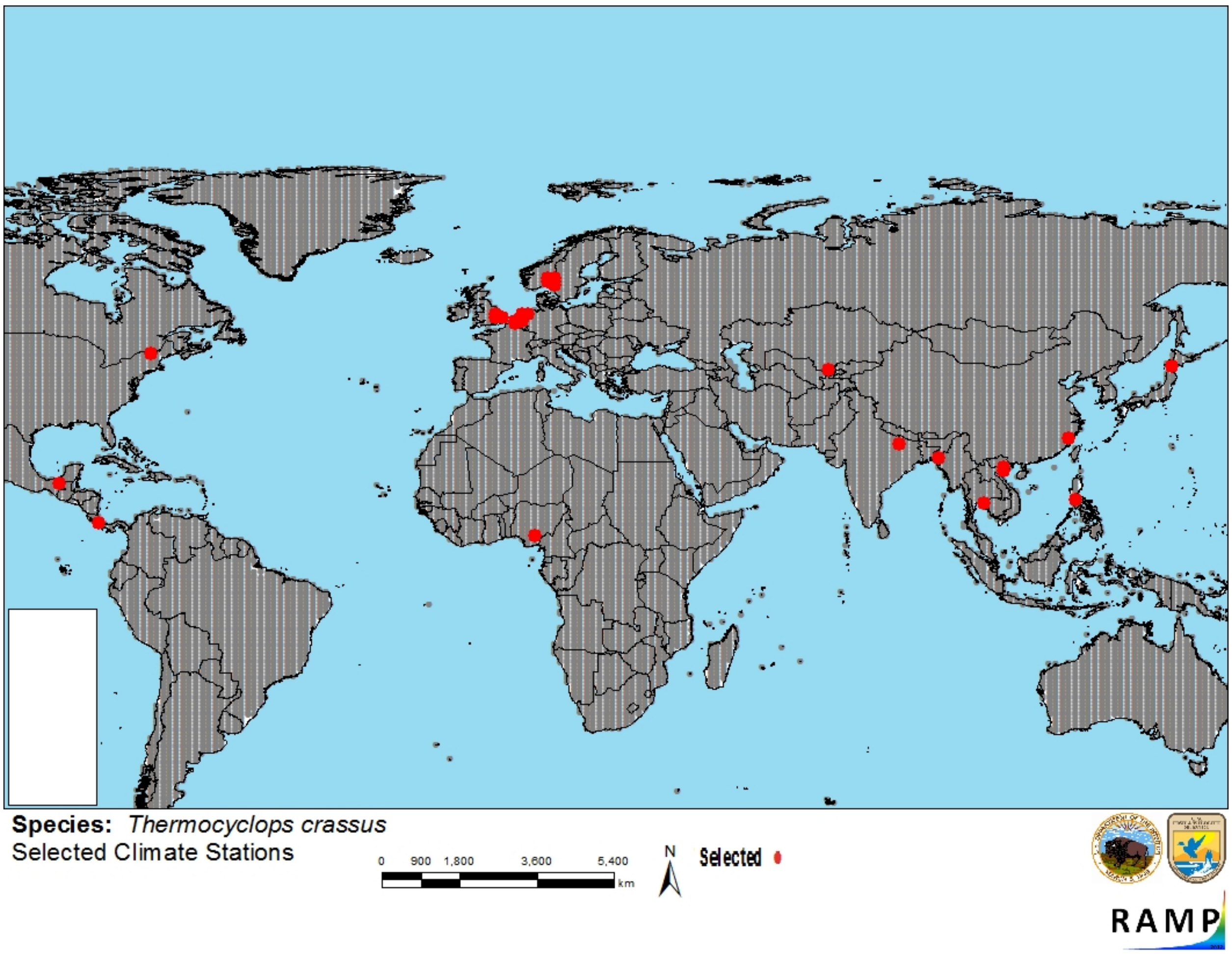

Figure 3. RAMP (Sanders et al. 2014) source map showing weather stations selected as source locations (red) and non-source locations (gray) for *Thermocyclops crassus* climate matching. Source locations from GBIF (2016) and Discover Life (2016). One source location in Russia from Discover Life (2016) was omitted because the locational accuracy could not be confirmed. Additional source locations in Nigeria from Jeje (1988), in Costa Rica from Reid (1989), in Japan from Kobari and Ban (1998), in Vietnam from Nam et al. (1998), in Mexico from Gutiérrez-Aguirre and Suárez-Morales (2000), in India from Kumar et al. (2011), and in the Philippines from Papa and Zafarella (2011).

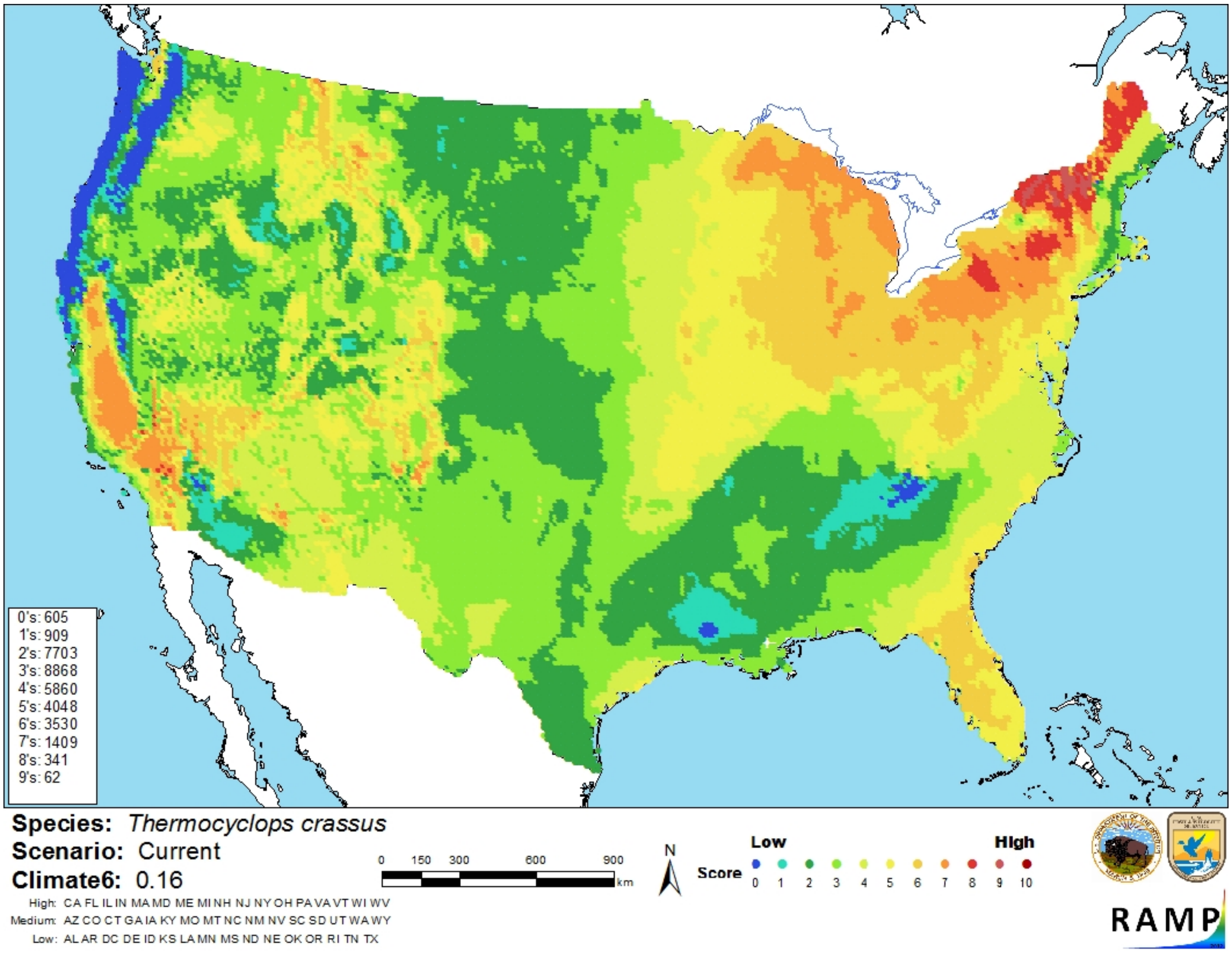

Figure 4. Map of RAMP (Sanders et al. 2014) climate matches for *Thermocyclops crassus* in the continental United States based on source locations reported by Jeje (1988), Reid (1989), Kobari and Ban (1998), Nam et al. (1998), Gutiérrez-Aguirre and Suárez-Morales (2000), Kumar et al. (2011), Papa and Zafarella (2011), Discover Life (2016), and GBIF (2016). 0= Lowest match, 10=Highest match.

7 Certainty of Assessment

Limited information is available on the distribution and biology of *Thermocyclops crassus* and no information is available on impacts of introductions. More research will be necessary to determine the impact of this species where it has been introduced in North and Central America. Certainty of this assessment is low.

8 Risk Assessment

Summary of Risk to the Contiguous United States

Thermocyclops crassus is a cyclopoid copepod native to Eurasia, Africa, and Australia. In the Americas, it has a highly localized distribution in Costa Rica, Nicaragua, Mexico, and the U.S. (Lake Champlain), assumed to be the result of recent introductions. Difficulty in identifying this species has resulted in other erroneous reports of *T. crassus* in the Americas. Current research on *T. crassus* is focused on describing its distribution and basic biology, and no impacts of introductions have yet been reported. *T. crassus* has been observed in residual ballast water in ships arriving in the Great Lakes, raising the possibility of transoceanic shipping as an introduction pathway, although the means of past introductions are unknown. *T. crassus* has a high climate match to the continental United States, particularly in the Northeast, Great Lakes region, and California. While these locations of high climate match are quite different in terms of temperature and precipitation, the climate match may be responding to a combination of any of 16 different climate variables included in the matching process. Additionally, climate match to the continental U.S. may be underestimated, given that *T. crassus* is broadly distributed across Europe, Africa, Asia, and Australia, and likely not limited to the locations pinpointed in climate matching. Overall risk posed by this species is uncertain.

Assessment Elements

- **History of Invasiveness (Sec. 3):** None Documented
- **Climate Match (Sec.6):** High
- **Certainty of Assessment (Sec. 7):** Low
- **Overall Risk Assessment Category: Uncertain**

9 References

Note: The following references were accessed for this ERSS. References cited within quoted text but not accessed are included below in Section 10.

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Note: The following references are cited within quoted text within this ERSS, but were not accessed for its preparation. They are included here to provide the reader with more information.

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