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)”
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“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).

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 predatory 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.


10 References Quoted But Not Accessed

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.


Maier, G. 1990. Spatial distribution of resting stages, rate of emergence from diapause and times to adulthood and to the appearance of the first clutch in 3 species of cyclopoid copepods. Hydrobiologia 206:11-18.


