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Digenea, Heterophyidae, *Centrocestus formosanus* (Nishigori, 1924) metacercariae: Distribution extension for Mexico, new state record, and geographic distribution map

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*Centrocestus formosanus* (Nishigori, 1924) is a minute trematode species inhabiting the intestine of fish-eating birds and mammals (Scholz and Salgado-Maldonado 2000). This trematode was apparently introduced to Mexico as larval stage (sporocyst or redia) within its first intermediate host, i.e., the thiarid snail *Thiara tuberculata* (Müller, 1774) (Amaya-Huerta and Almeyda-Artigas 1994). The second intermediate host includes various species of freshwater fish; to date, metacercariae of *C. formosanus* has been recorded parasitizing 59 freshwater fish species, both native and introduced, in 12 states of central and southeastern Mexico (Pérez-Ponce de León et al. 2007). However, the occurrence of this trematode species in fishes of northern Mexico has not been documented even though the snail *T. tuberculata* has been reported in hydrological systems of Chihuahua and Coahuila (Contreras-Arquieta 1998).

During a prospective study addressed to establish the parasitological fauna of freshwater fishes occurring in arid regions of Mexico, particularly associated with the Río Bravo basin, the metacercarie of *Centrocestus formosanus* parasitizing the gills of the native fish *Cyprinella lutrensis* (Baird & Girard, 1853) (Cyprinidae; Figure 1) was found.

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stages of *C. formosanus*. Even though, the presence of the snail in the locality is important to correlate the presence of the trematode species and it explains its high infection levels.

Northern Mexico is predominantly an arid region, with important hydrological systems inhabited by numerous native freshwater fish species, including an endemic component (Miller et al. 2005). However, a comparison with central and southeastern Mexico show a few number of studies conducted on the helminth fauna of freshwater fishes. These few studies do not report the presence of metacercariae of *Centrocestus formosanus*, although its occurrence should be correlated with previous records of the gastropod intermediate host in the region, and the high capacity of the digenean to disperse and infect a large number of second intermediate host species. Our findings represent the first record of the metacercariae of *C. formosanus* in freshwater fish of northern Mexico, where this invasive parasite could represent a potential risk factor to the survival of native fish fauna because its high prevalence and pathological effects over the host (Vélez-Hernández et al. 1998; Alcaraz et al. 1999; Ortega et al. 2005).

The snail *Thiara tuberculata* serves as the first intermediate host of *Centrocestus formosanus* in Mexico (Scholz and Salgado-Maldonado 2000). This snail species has been purposely introduced into some localities to control other snail populations that act as vectors for human schistosomiasis, a control mechanism that has been used for other snails (Pointier et al. 1991; Scholz and Salgado-Maldonado 2000). Instead, it was apparently introduced to Mexico as a food source for the black carp *Mylopharyngodon piceus* (Richardson, 1846), a species that was imported from China with aquaculture purposes (Amaya-Huerta and Almeyda-Artigas 1994).

![Figure 2. Map of Mexico showing the geographic distribution of Centrocestus formosanus (based on Pérez-Ponce de León et al. 2007).](image-url)
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The high dispersal capability of *Centrocestus formosanus* and its occurrence in a wide range of freshwater fish species throughout Mexico represents a potential problem not only for aquaculture, but also for establishing proper conservation practices in wild native fish. Knowledge about distributional range of the metacercariae of this trematode species, along with further research in other stages of its life cycle, will contribute with relevant data that, added to information derived from the host biology and the deterioration of the ecosystems they live in, will allow conservationists to propose proper management strategies to preserve biological resources in the area.

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**Figure 3.** Metacercariae of *Centrocestus formosanus*. A, Ventral view, scale bar 100 μm; B, Detail of the anterior end showing the rows of spines, scale bar 25 μm.

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