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Endangered Fish Threatened by Asian Fish Tapeworm

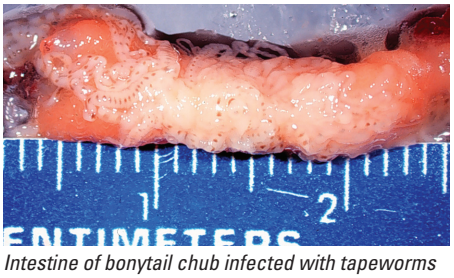
Adult humpback chub

The Asian fish tapeworm may inhibit the recovery of the humpback chub in the Grand Canyon.

The Asian fish tapeworm, an exotic parasite, has invaded the endangered humpback chub (*Gila cypha*) population from the Colorado and Little Colorado Rivers in Grand Canyon, Arizona. This parasite causes disease and death in carp in aquaculture settings and may retard growth in hatchery-reared roundtail chub (*Gila robusta*). Other consequences include destruction and dysfunction of the intestinal lining and adverse changes to certain blood parameters. Introduced into the U.S. in the 1970s with imported grass carp (*Ctenopharyngodon idella*), the Asian fish tapeworm (*Bothriocephalus acheilognathi*) was discovered in the Little Colorado River (LCR) by 1990. The LCR is the main tributary to the Colorado River in Grand Canyon and is an important spawning area for humpback chub.

Research by the USGS National Wildlife Health Center (NWHC) investigated the extent that the humpback chub population within the LCR is infected with this tapeworm. Considering the negative growth and physiological effects associated with this parasite, scientists at the NWHC conducted experimental infection trials to investigate its effects on native chub. Small chub face thermal stress when they are washed from the LCR (23.5 °C) to the cold waters of the Colorado River (9.5 °C) during monsoon floods. Experiments also examined whether tapeworm infections exacerbate these cold-shock effects.

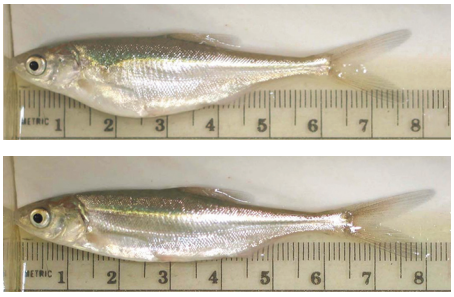
Seasonal field parasite surveys of fish in the LCR during 1999 and 2000 revealed that of the 1,435 native and non-native fish examined, all species could be infected



Intestine of bonytail chub infected with tapeworms

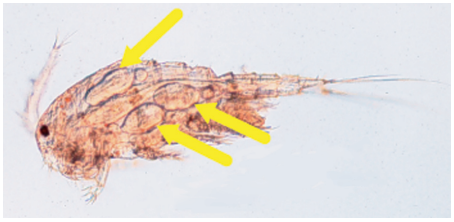
with the Asian fish tapeworm. However, humpback chub—while constituting only 8 percent of the total fish sampled—harbored over 54 percent of the tapeworms recovered, indicating that humpback chub could maintain this parasite in the LCR without the presence of carp or other non-native fish species.

Experimental work initiated in 2001 examined the effect of tapeworm infections on growth and physiological condition in bonytail chub (*Gila elegans*), closely related to humpback chub. Stressors such as cold shock and reduced food ration were introduced to examine their possible synergistic effects with tapeworm infections. Older juvenile fish (10 months old and 83 mm long) examined over 13 weeks post-infection revealed no negative impact on growth or physiological condition in infected fish when compared to control fish. Subsequent experiments with younger and smaller fish (2.5 months old and 22 mm long) demonstrated infected fish length was reduced by as much as 9 percent on average compared to control fish by the end of the 24-week study. Additionally, when food ration was restricted, infected fish began dying 20 days earlier and at nearly twice the rate of controls throughout the course of the trial. Infected fish were found to have significantly lower hematocrit (red blood cell volume) levels and a reduced amount of visceral fat when compared with control fish. Histological examination of gut tissue from infected fish revealed heavy white blood cell infiltration indicating an immune response. However, control and infected fish exhibited similar stress responses to the cold-shock experiment.



Infected bonytail chub with distended abdomen (above) compared with uninfected chub (below)

Previously, life cycle work with the Asian fish tapeworm demonstrated that for a fish to become infected it must eat an infected cyclopoid copepod (zooplankton intermediate host). However, studies at the NWHC indicate that fish that prey upon small infected fish can acquire infections as well. Thus, larger humpback chub that normally have few zooplankton in their diet can become infected by preying upon smaller infected fish. This evidence of the potential for post-cyclic transmission poses new questions of how infections with this parasite may affect older and larger fish.



*Intermediate host copepod (*Acanthocyclops robustus*) infected with three larval tapeworms*

These results demonstrate the importance of considering the role of Asian fish tapeworm infections when making management decisions focused on conservation of humpback chub. Furthermore, these data may be useful in developing ecological models concerning this fish and its environment. The results from this study provide insight into the potential implications of this parasite should it invade other ecosystems and fish species.

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