Project Overview

Can we tell if water is polluted or not just by examining fish for parasites? If so, costly and time-consuming pollution tests could be avoided. To test the usefulness of parasites to detect pollution, we evaluated the parasite loads of common estuarine fish at polluted and unpolluted sites. We tested for differences in parasites that have direct life cycles (one host, like a fish) and parasites that have indirect life cycles (multiple required hosts, such as first a snail and then a fish). While we predicted that most one-host species parasites would change in number in polluted areas, we did not predict whether the parasites would increase or decrease. We predicted that parasites that require multiple hosts would show a uniform and consistent decrease in number. The reduction in the numbers of these parasites would be caused mainly by pollution-induced high mortality rates of intermediate hosts of these parasites; as hosts such as snails died, so would their parasites, which would then not be around to infect fish.

For the most part, we found these predictions were true; one-host parasites can be used, to a limited extent, to detect pollutants by documenting changes in parasite numbers, and multiple-host parasites can indicate the presence of pollutants when parasite numbers decline in fishes collected in contaminated habitats.

Background

The primary objective of this study was to determine the degree to which helminth (worm) parasites can be used as bioindicators of pollution in aquatic habitats. Specifically, we wished to determine whether the parasites of common estuarine fishes could be used to detect the presence of organic and heavy metal pollution in the Lake Pontchartrain Basin.

To test the usefulness of parasites to detect contaminated aquatic habitats, we chose a polluted site, Bayou Trepagnier, whose pollution history is well known. The bayou has received the discharge of refinery effluents for several decades and is contaminated with polyaromatic hydrocarbons and heavy metals. We compared parasite community structure in fishes from Bayou Trepagnier with parasite communities that occurred at unpolluted reference sites. We refined our basic hypothesis to test for differences in monogene parasites that have direct life cycles (requiring one host) and digene parasites that have indirect life cycles (requiring 2+ hosts). The monogenes studied have direct life cycles, meaning that the parasites are transmitted from fish to fish. We predicted that most one-host species parasites would have altered population structures in polluted areas. However, we were unable to predict whether the parasite loads of fishes in polluted areas would increase or decrease. Why?

• If pollutants adversely affect parasites, then a decrease in their abundance should be seen.

Conversely, if the hosts (fish) of these parasites are stressed by pollutants in a manner that reduces their ability to resist parasitic infections,
then parasite numbers should show an increase. We predicted that parasites that require multiple hosts (digenes) would show a uniform and consistent decrease in abundance. The reduction in the numbers of these parasites would be caused mainly by pollution-induced high mortality rates of intermediate hosts of these parasites. Most of these parasites have indirect, three-host life cycles. They use snails as first intermediate hosts, fishes as second intermediate hosts, and fish-eating birds and mammals as definitive (final) hosts. We predicted that fish parasites would be less abundant in polluted Bayou Trepagnier than in our unpolluted reference site, Bayou Traverse. We also predicted that a reduction in numbers of parasites in fish second intermediate hosts would be the result of a reduction in the numbers of snail first intermediate hosts because of their susceptibility to environmental pollutants. To test this, we exposed snails to sediments from polluted and unpolluted areas and measured the mortality rates.

**Results**

Results of the study of one-host parasites show that for most species, there were no significant differences in levels of parasitism between polluted and unpolluted sites. Mosquitofish were most heavily infected with *Salsuginus seculus*, one species of parasite, at Bayou Trepagnier nearest the point source of pollution and showed a decrease in abundance downstream from the pollution source. Mosquitofish were least parasitized by this species in one of the unpolluted reference sites. Although a significant pollution effect was also demonstrated for the parasite, *Gyrodactylus hargasi*, the effect was opposite that of *S. seculus*, with the most heavily infected fish occurring at an unpolluted site.

The study of the effects of environmental pollutants on multiple-host parasites was conducted in two parts. The first part of the study simply documented the effects of pollutants on the multiple-host parasites of the mosquitofish. Because this initial study demonstrated, as we hypothesized, that fish collected in polluted Bayou Trepagnier had smaller parasite loads than fish from our unpolluted reference site, a follow-up study was conducted to determine the reason for the decline in parasite levels. Habitat water and sediments were collected from the polluted (Bayou Trepagnier) and unpolluted (Bayou Traverse) sites. Snails, intermediate hosts for the multiple-host parasites, were exposed to this water and/or sediments. Mortality was much higher in snails exposed to the polluted sediments from the bottom of Bayou Trepagnier. Polluted bayou water caused greater snail mortality than unpolluted water, but less so than polluted sediments.