Is Parasite Biodiversity in Freshwater Fish Higher in Protected Areas? A Case Study in the Big Thicket National Preserve

Kyle McAndrews, Gunnar Orcutt, Taylor Herzog, & Michael Barger
Department of Natural Science, Peru State College

A long-term effort is ongoing to determine if the Big Thicket National Preserve (BTNP) in Texas effectively protects its aquatic habitats. Previous work demonstrated that parasite diversity and abundance in select catfishes (*Ictalurus punctatus* and *Ameiurus natalis*) is higher inside the BTNP than outside, largely because of higher diversity of adult endohelminths, particularly trematodes and nematodes. The present investigation expands this study to include results on parasite diversity in 4 species of ictalurid catfishes (*A. natalis*, *Ameiurus melas*, *I. punctatus*, and *Ictalurus furcatus*) and 6 species of suckers (Catastomidae) in 5 genera. Since 2006, 137 ictalurids (73 inside BTNP) from 20 sites (10 inside BTNP) and 133 catostomids (64 inside BTNP) from 15 sites (10 inside BTNP) were collected and examined for parasites. Observed parasite diversity was higher inside the BTNP than outside for ictalurids (34 vs. 20 species), primarily due to more adult nematodes, acanthocephalans, and adult trematodes. In addition, measures of abundance for catfish specialists and adult endohelminths, in general, were higher inside the Preserve than outside. These results suggest that the BTNP has some positive effects on the aquatic communities it was intended to protect via maintaining larger and more interactive fish and invertebrate communities. However, parasite diversity was similar for catostomids inside and outside the BTNP (26 vs. 24 species). The different feeding habits of catfishes and suckers might be responsible for the observed differences in patterns of parasite diversity. In addition, most catostomid species have been collected from only 1 or a few locales, statistically confounding host species and locale to some extent. Additional sampling is underway to fill in gaps in coverage and to include additional host groups, e.g., topminnows (*Fundulus*) and sunfishes (centrarchids).

Goals

To determine the extent to which the Preserve is conserving aquatic biodiversity and maintaining ecological interactions among species.

To utilize the parasites of fishes as proxies for overall biodiversity, including particularly:

Catfishes (Ictaluridae)—this study.
Suckers (Catostomidae)—this study.
Topminnows (Fundulidae)—ongoing.
Sunfishes (Centrarchidae)—planned.

Methods

Survey and inventory of catfishes and suckers in all major units of the Preserve since 2006.

137 catfishes: *Ameiurus natalis* Yellow Bullhead
Ameiurus melas Black Bullhead
Ictalurus furcatus Blue Catfish
Ictalurus punctatus Channel Catfish

133 suckers *Carpiodes carpio* River Carpsucker
Ictiobus bubalus Smallmouth Buffalo
Erimyzon oblongus Creek Chubsucker
Erimyzon sucetta Lake Chubsucker
Minytrema melanops Spotted Sucker
Moxostoma poecilurum Blacktail Redhorse

Species Accumulation Curves—rarefaction and extrapolation to compare species richness on standardized sample sizes.[1]

Species Lists, Abundance, & Life Cycles—Linking presence/absence of parasite taxa to their required life cycles.

NB: Parasite species identifications are ongoing, especially for those of the suckers. As such, conclusions presented herein are tentative.

Table 1. No. of parasite spp. of ictalurids in and outside of the BTNP with the no. occurring exclusively in parentheses.

	Inside	Outside
Trematoda	12 (3)	12 (4)
Cestoda	2 (1)	2 (1)
Monogenea	1 (0)	1 (0)
Acanthocephala	5 (5)	0 (0)
Nematoda	8 (5)	3 (0)
Myxozoa	1 (0)	0 (0)
Crustacea	4 (3)	2 (1)
Hirudinea	1 (1)	0 (0)
Adults	31 (16)	15 (2)
Larval	3 (2)	5 (4)
Simple life cycle	5 (1)	2 (1)
Complex life cycle	29 (17)	18 (5)
Ectoparasites	7 (4)	5 (3)
Endoparasites	27 (14)	15 (3)
Adult endohelminths	24 (12)	12 (1)

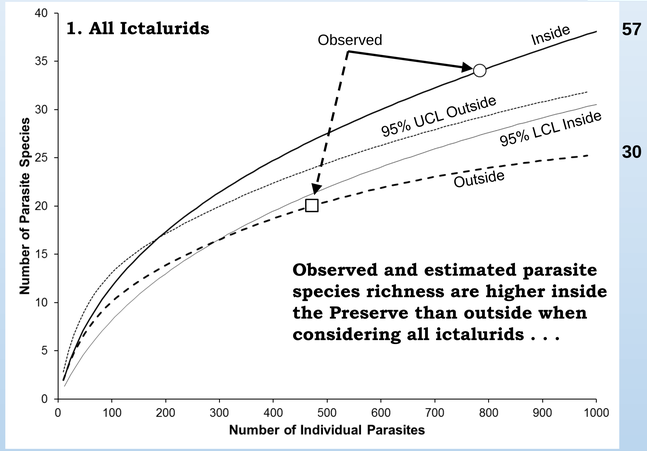
Table 2. No. of parasite spp. of *Ictalurus punctatus* in and outside of the BTNP with the no. occurring exclusively in parentheses.

	Inside	Outside
Trematoda	6 (4)	4 (2)
Cestoda	1 (0)	2 (1)
Monogenea	0 (0)	1 (1)
Acanthocephala	1 (0)	0 (0)
Nematoda	7 (4)	3 (0)
Myxozoa	1 (1)	0 (0)
Crustacea	2 (1)	2 (1)
Hirudinea	0 (0)	0 (0)
Adults	17 (11)	9 (3)
Larval	1 (0)	3 (2)
Simple life cycle	2 (1)	3 (2)
Complex life cycle	16 (10)	9 (3)
Ectoparasites	3 (2)	4 (3)
Endoparasites	15 (9)	8 (2)
Adult endohelminths	14 (9)	6 (1)

Table 3. No. of parasite spp. of catostomids in and outside of the BTNP with the no. occurring exclusively in parentheses.

	Inside	Outside
Trematoda	6 (4)	5 (3)
Cestoda	10 (4)	7 (1)
Monogenea	1 (1)	1 (1)
Acanthocephala	1 (1)	3 (3)
Nematoda	3 (0)	4 (1)
Myxozoa	2 (0)	4 (2)
Crustacea	1 (1)	0 (0)
Hirudinea	2 (2)	0 (0)
Adults	20 (11)	21 (11)
Larval	6 (2)	3 (0)
Simple life cycle	4 (2)	1 (0)
Complex life cycle	22 (11)	23 (11)
Ectoparasites	7 (5)	3 (1)
Endoparasites	19 (7)	21 (10)
Adult endohelminths	15 (7)	16 (8)

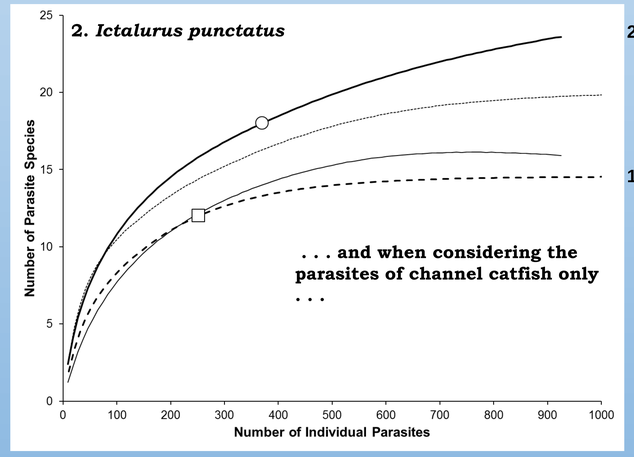
Figs 1-3. Parasite species rarefaction and accumulation curves.[1]



Assymptotic Spp. Richness[1]

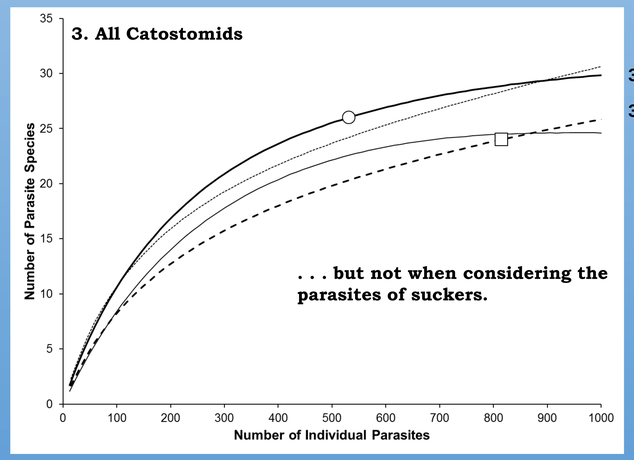
57

30



25

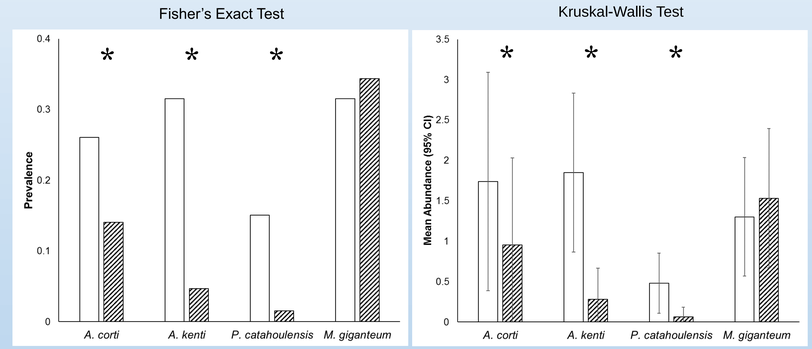
16

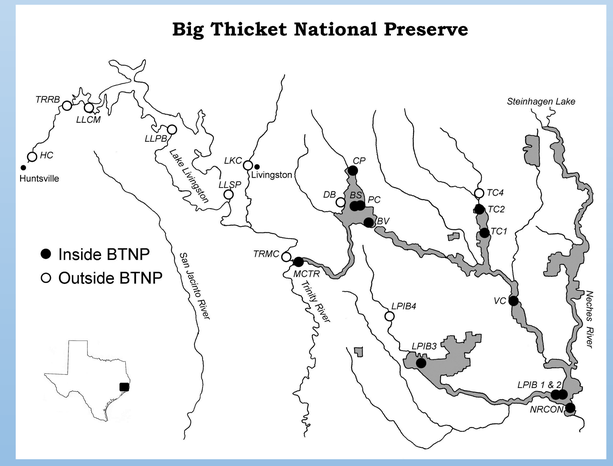


30

34

Fig. 4. Comparison of prevalence (left) and mean abundance (right) for 4 catfish specialists (*Alloglossidium corti*, *Alloglossidium kenti*, *Polylekithum catahoulensis* [Trematoda], and *Megathylacoides giganteum* [Cestoda]) inside (open bars) and outside (hatched bars) the Preserve. * = significant difference.





The Big Thicket National Preserve was established in 1974. In 1993, stream corridor units were added, and units have been expanded on a piecemeal basis since. The Preserve is comprised of 15 units covering 112,250 acres (equivalent of a circle with a diameter of 24 km) in southeastern Texas. Historically, the Big Thicket covered 1-2 million acres. The Preserve is arranged as a highly fragmented "string-of-pearls" in which the area-to-perimeter ratio is extremely low. Only about 15% of the area bounded by the Preserve's units are included within the boundaries of the Preserve itself. Threats to the watersheds in the Preserve include oil extraction, intensive timber farming, and recreational extractive activities.

Conclusions

Parasite communities in ictalurids appear to be more species rich and abundant inside the Preserve than outside. Most of the difference is due to differences in adult endohelminth diversity (often of generalist parasites of other fish species), and these results suggest that the aquatic habitats within the Preserve are supporting more diverse and interactive free-living communities than their unprotected counterparts nearby. In contrast, the diversity of parasite communities in suckers is not higher inside the Preserve. In part, this is due to incomplete sampling, because some catostomids have not been sampled both inside and outside the preserve. However, it could also be related to the generalized benthic feeding habits of catostomid fishes.

Acknowledgements

Haley Dutton, Drew Wellenstein, James Shaffer, Courtney Bryant, and Hayden Kusy assisted with collecting fish. Drs. Tami and Jerry Cook provided lodging and laboratory facilities. Sam Houston State University, the Big Thicket Association, and the National Park Service provided support. This work was supported in part by National Science Foundation award DEB 1253129.

Citations

1 Colwell, R.K. 2013. EstimateS: Statistical estimation of species richness and shared species from samples. Version 9. <purl.oclc.org/estimates>, Chao Incidence Based estimator, based on . . .
Colwell, R.K. et al. 2012. Models and estimators linking individual-based and sample-based rarefaction, extrapolation and comparison of assemblages. Journal of Plant Ecology 5: 3-21.