METAZOAN PARASITE COMMUNITY STRUCTURE IN BLUEGILL (*LEPOMIS MACROCHIRUS*) AS AN INDICATOR OF THE IMPACT OF URBANIZATION ON TWO STREAMS IN SAN ANTONIO, TEXAS

Philosophical Perspective

- Not a "litmus test" or simple indicator of pollution
- Rather, an integrative measure of urbanization's impacts on water quality, biodiversity, and aquatic community structure--an ecoassay of overall stream ecosystem health

Background: Urbanization in Watersheds

- Physical changes
  - Water-flow diversion: dams, development, agriculture
- Chemical changes
  - Pollution: sewage overflow, urban runoff
  - May increase nitrates, phosphates, trace metals…

Background: Urbanization in Watersheds (cont'd)

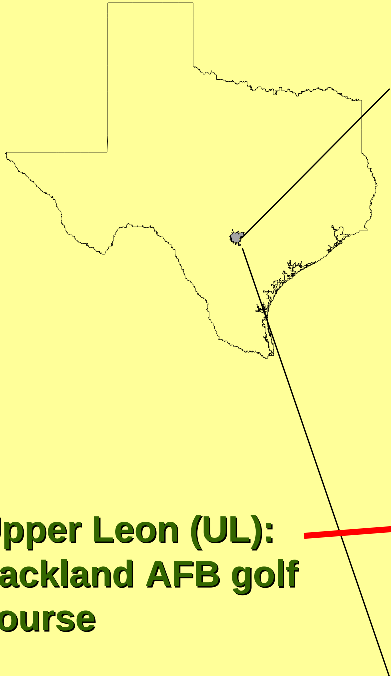
- Biological changes
  - Biodiversity: less diversity in disturbed areas
  - Change in community dominance or absence of species
  - Bottom-up trophic effects

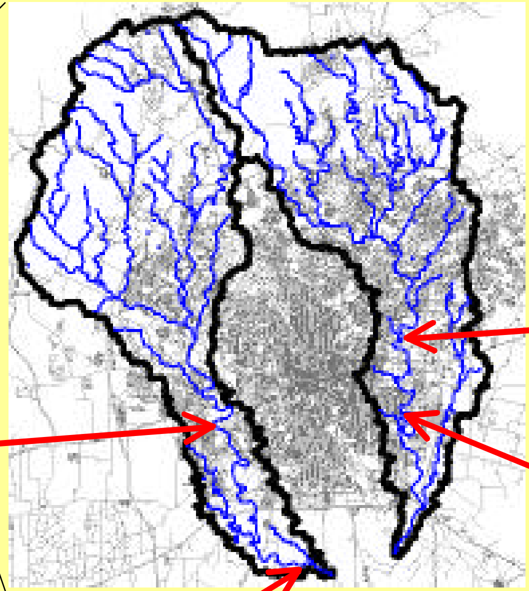
Study Site

- Leon and Salado creeks flow through City of San Antonio
- Stream flows have been modified
- Point and non-point source pollution
- Declared hazardous for human and wildlife use by the Texas Natural Resource Conservation Commission (TNRCC) and US EPA

Study Site

City of San Antonio, Texas





Upper Salado (US): Ft. Sam Houston above Salado Park

Upper Leon (UL): Lackland AFB golf course

Lower Salado (LS): between Graineri Farm and Comanche Park

Lower Leon (LL): ~50m above confluence with Comanche Creek, a conduit for the tertiary-treated effluent from SAWS

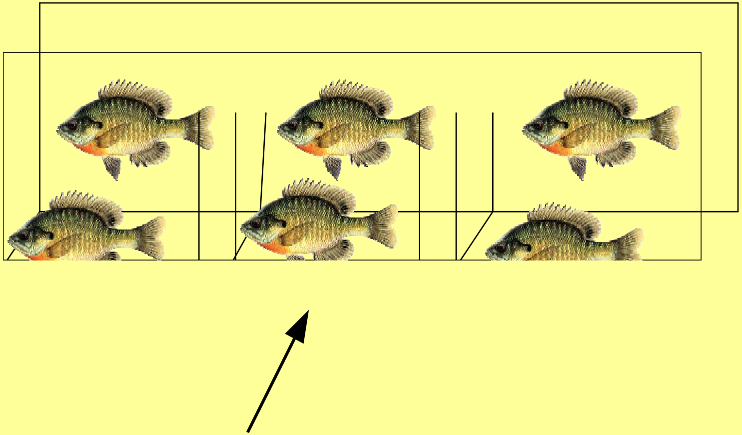
Methods

- Strategy: Expose caged fish to ambient parasites
- Use bluegill (*Lepomis macrochirus*) from local aquaculturist (Tank Hollow Fisheries) as host
- Timetable: Late summer 1999 and 2000
- Part of larger project
- Slightly different methodology between years

Cage Schematic

60 cm X 90 cm X 30 cm, partitioned into 6, 900-cm ^{3} compartments

90-cm PVC pipes with capped ends to float them at the water surface



Plastic-coated wire mesh panels-- retain the fish but allowed natural feeding and prevented algae from building up

Fiberglass screening on inside floor to prevent supplemented food from falling through the cage

- **Cages anchored into stream bed with fence post**
- **2 cages, 12 fish per site**

Methods (cont'd)

- Fish weighed when put into system and at end of experiment
- Bluegill in system for ~20 days to establish parasite communities and expose fish to stream conditions
- Fed supplemental food
- Water-chemistry samples taken from each site

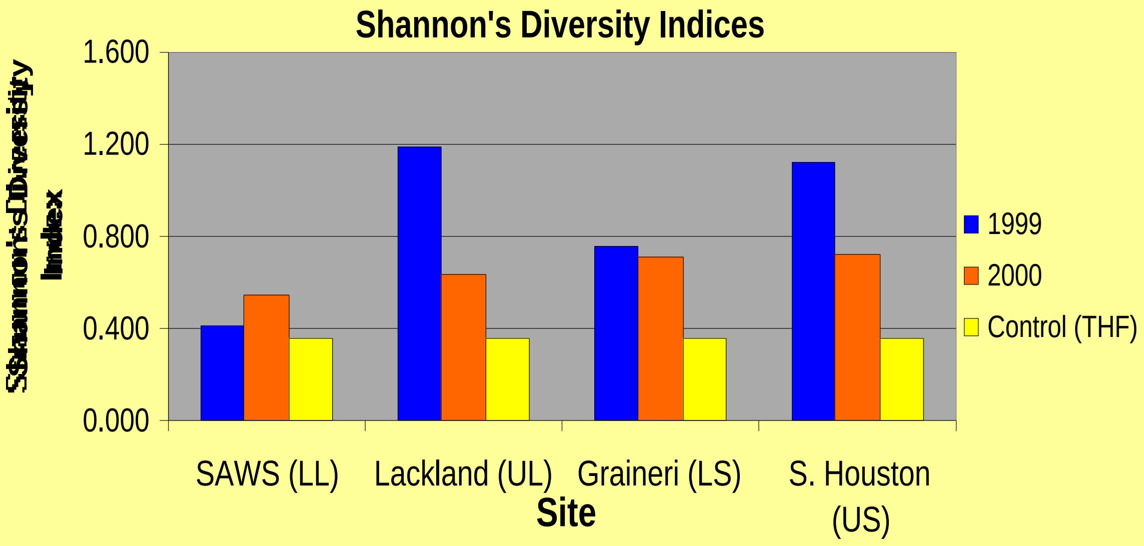
Parasitology

- Fish euthanized with overdose of MS-222
- Whole fish stored in 10% buffered formalin for transport to lab
- External surfaces examined for ectoparasites
- Gill arches excised, mucous and gill filaments scraped
- Internal organs (e.g. heart, liver, intestine, and stomach) teased apart and examined
- All metazoan parasites counted and identified to lowest taxonomic group

Parasitology (cont'd)

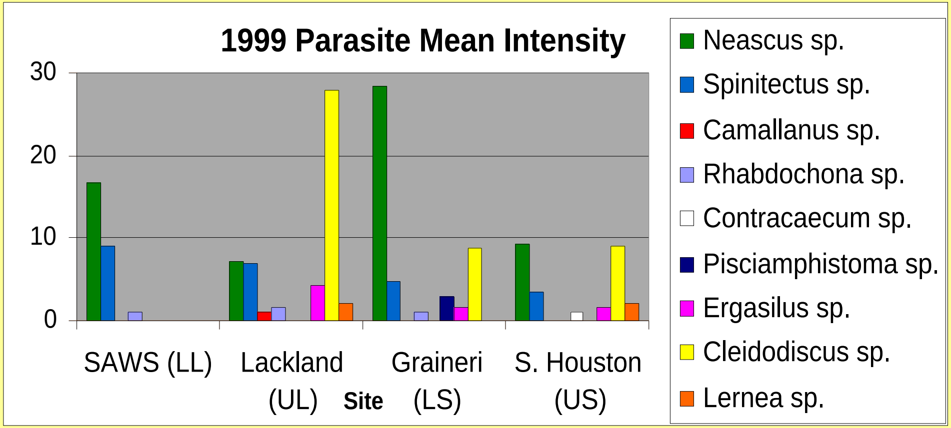
- Trematodes and monogeneans stained with Semichon's carmine; dehydrated with 70%, 80%, 95%, and 100% ethanol; cleared using xylene; and, mounted in Kleermount®
- Nematodes cleared using a 50:50, ethanol:glycerine solution and stored in glycerine
- Copepods were stored in 70% ethanol

Results: Parasites



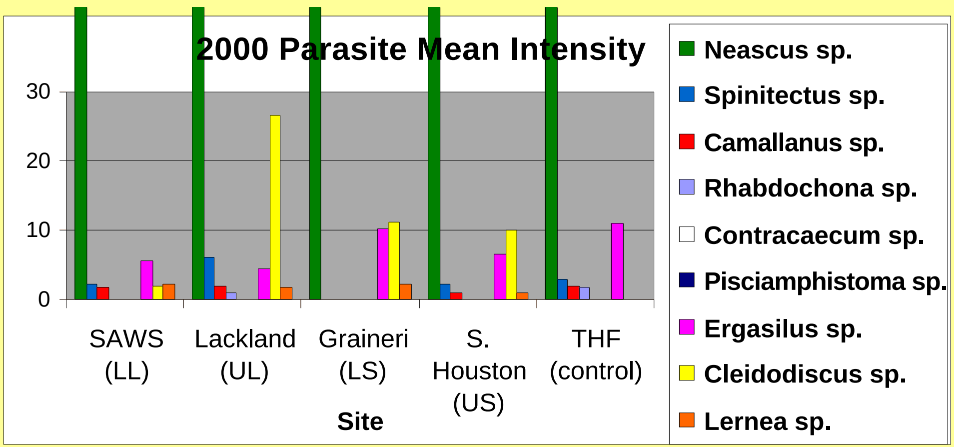
* Control diversity from 1 sample, not 4 samples

Results: Parasites



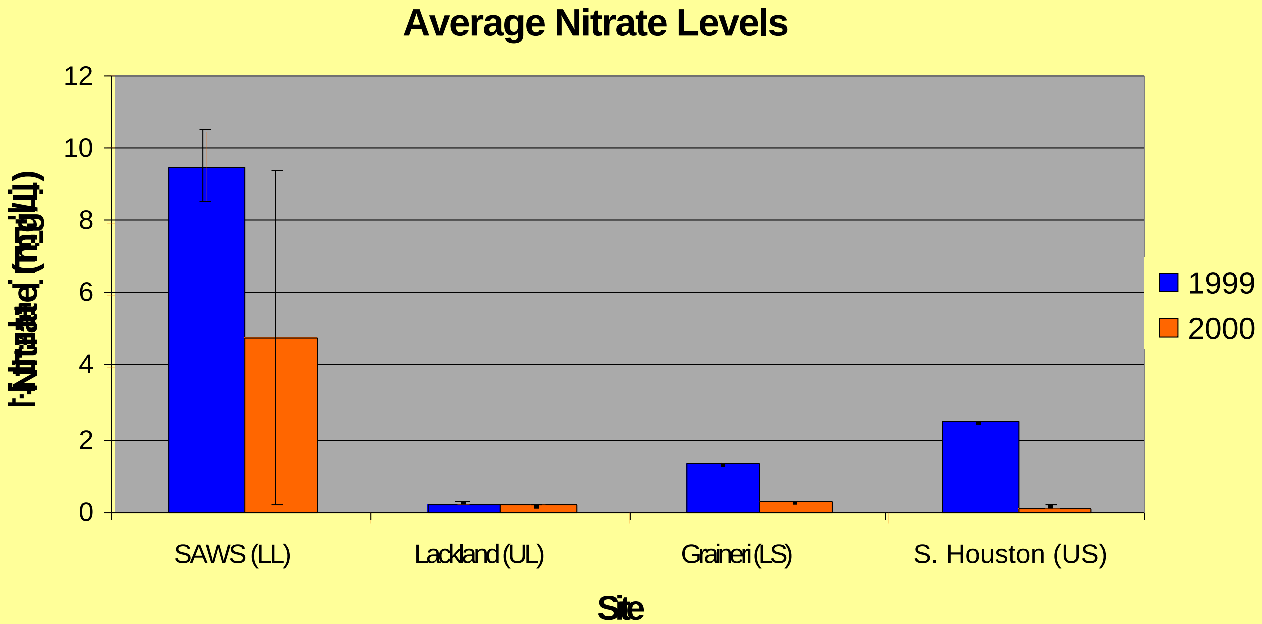
Kruskal-Wallis

Parasite	P value (sig <0.05)
Lernea spp.	0.0829
Cleidodiscus spp.	0.0003
Ergasilus spp.	0.0069
Spinitectus spp.	0.9388
Camallanus spp.	0.3916



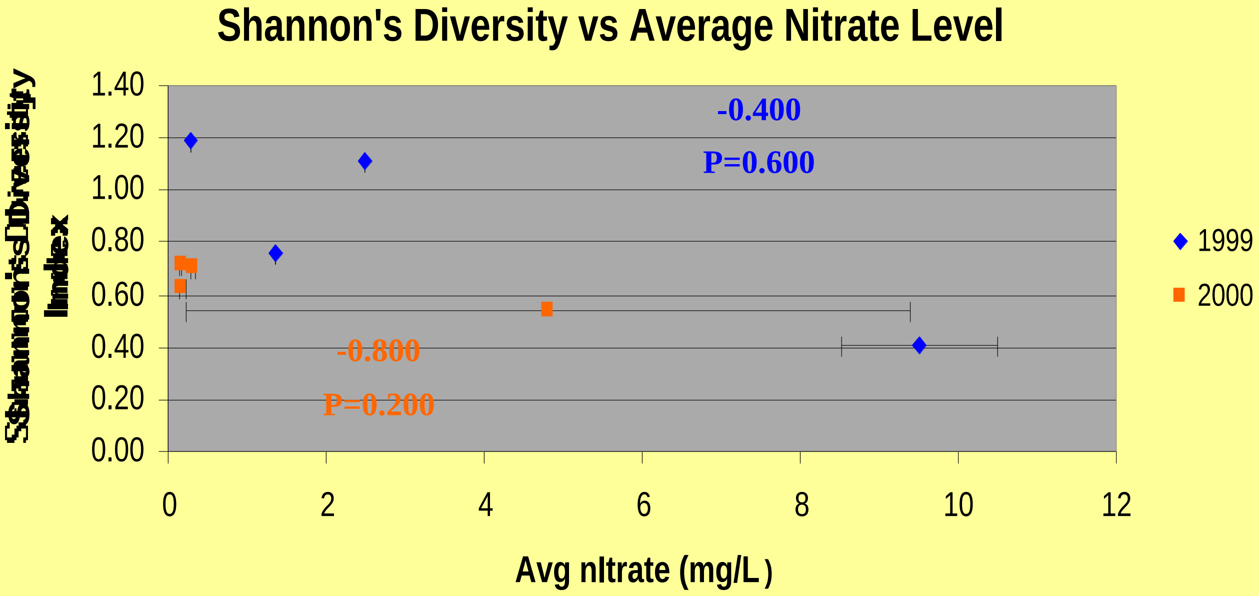
Parasite	P value (sig <0.05)
Lernea spp.	0.0131
Cleidodiscus spp.	0.0005
Ergasilus spp.	0.0130
Spinitectus spp.	0.2983
Camallanus spp.	0.4880

Results: Nitrates



Adapted from Murawski, unpublished data

Results



Shannon's Diversity vs Average Nitrate Level
Shannon's Diversity Index
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
0
2
4
6
8
10
12
Avg nItrate (mg/L)
-0.400
P=0.600
-0.800
P=0.200
1999
2000

Results

Parasite species vs. average nitrate level

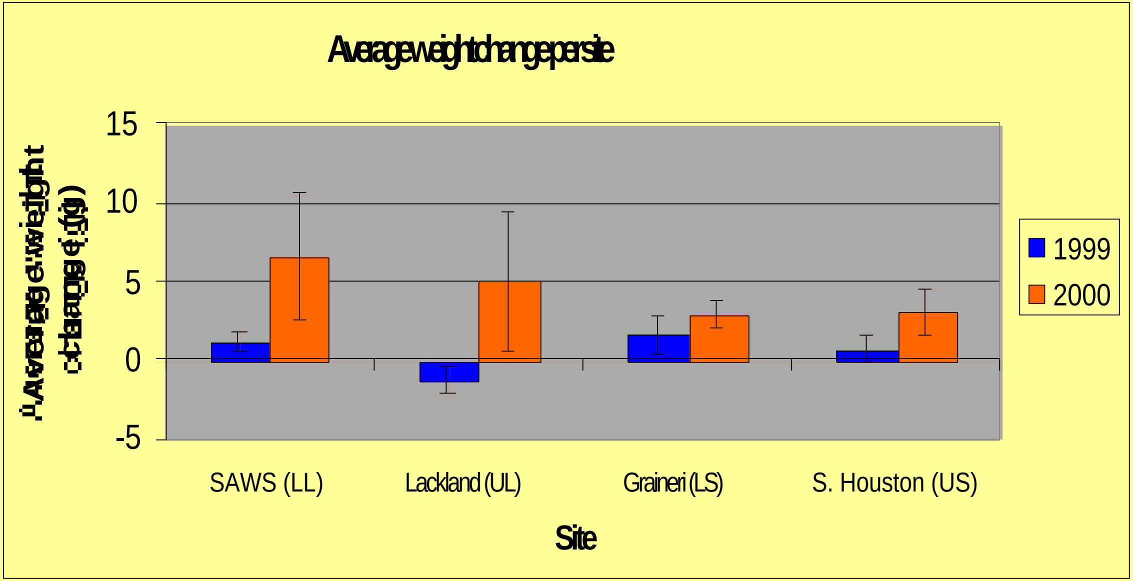
Spearman's correlation $P < 0.05$

Parasite	1999	2000
Cleidodiscus spp.	--	--
Lernea spp.	--	+
Ergasilus spp.	--	NC
Neascus spp.	+	--

Summary of Results

- Downstream sites had lower diversity and higher nitrate levels than upstream sites
- Lower Leon site had the highest dissolved nitrate level and lowest diversity
- In 1999 only endoparasites found at lower Leon site; in 2000 only ectoparasites found at lower Salado site
- Mean intensity of ***Cleidodiscus*** spp. and ***Ergasilus*** spp. significantly different among sites in both years
- ***Cleidodiscus*** spp., ***Lernea*** spp., ***Ergasilus*** spp., and ***Neascus*** spp. correlated with nitrate levels

Results: Fish Weight Change

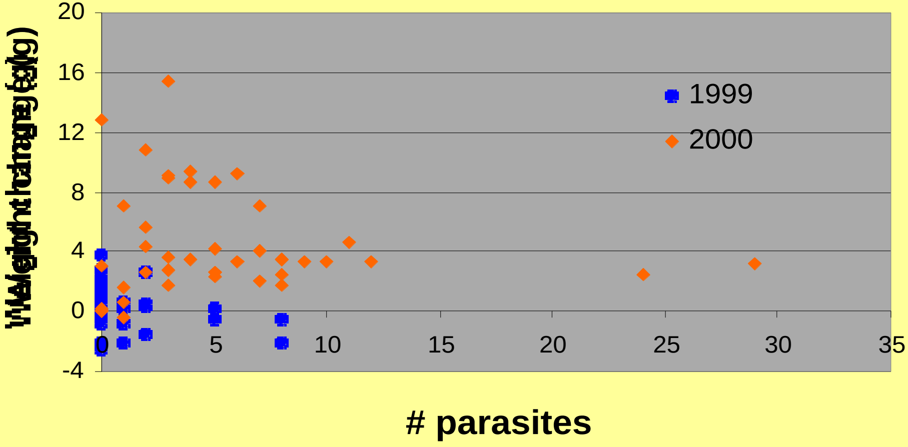


Kruskal-Wallis	P-value
1999	<0.0001
2000	0.0074

- Both average nitrate level and Shannon's Diversity Index were uncorrelated with average weight change of fish, using Spearman’s correlation

Results: Fish Weight Change

Individual Bluegill Weight Change vs *Ergasilus* spp.



Spearman's Correlation

ρ=

ρ=

Summary of Results

- Fish weight change significantly different among sites
- Fish at downstream sites gained more weight than at upstream sites
- Load of ***Ergasilus*** spp. correlated significantly with fish weight change--but negatively in 1999 and positively in 2000

Conclusions

- Patterns among sites were different in 1999 and 2000, but there were consistent trends between years

- Data from downstream sites suggest impacts of urbanization: higher nitrate levels, lower parasite metazoan community diversity, greater bluegill weight change, and differences in metazoan community structure

- Because they were associated with nitrate and weight change, monoxenous ectoparasites like ***Cleidodiscus*** spp. and ***Ergasilus*** spp. could possibly be used as an indicator of stream and fish health

- Wild caught fish were sampled from each site in 2000 and trace metals were assayed. Results will be addressed at the ASP meeting

Acknowledgments

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