Trematode Parasites in Salt Marshes as Indicators of Biological, Chemical, and Physical Characteristics

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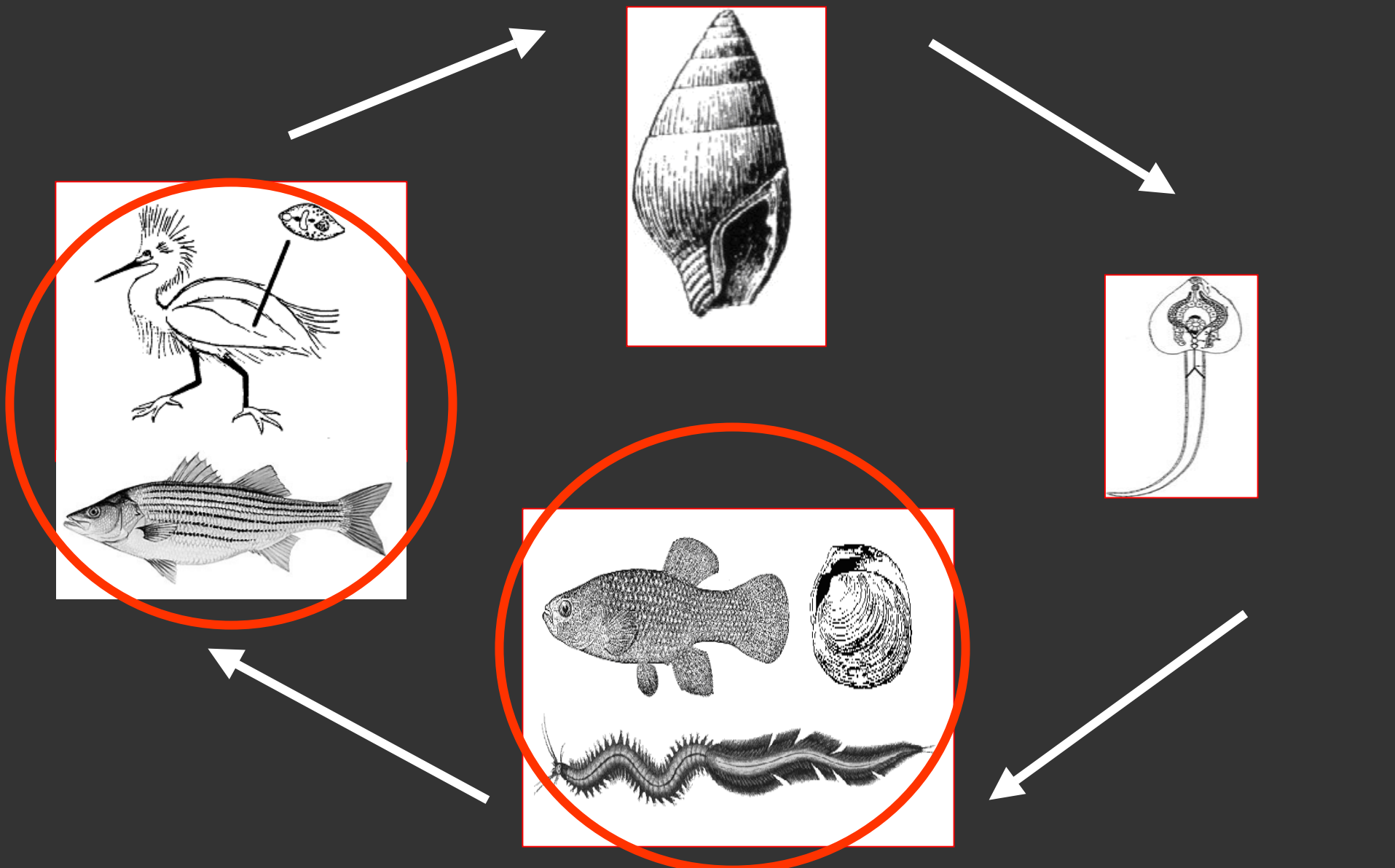
Trematode Life Cycle



Trematode Life Cycle

Ilyanassa obsoleta

Ilyanassa obsoleta

- Host to 8 trematode species

- Native distribution from Labrador to Florida

- Highly abundant in estuarine environments

Objectives

Quantify relationships between trematode abundance and…

1) host abundance

2) anthropogenic stress (contaminants, nitrogen, roads)

3) environmental variables (temp, latitude, marsh area)

Methods: Independent variables

- Biological host communities
  - Polychaete worms (2 species)
  - Bivalves (2 species)
  - Fish (*Fundulus heteroclitus*)
  - Birds (wetland sp)
  - Definitive host fish (piscivores)
- Environmental characteristics
  - Temperature
  - Latitude
  - Estuarine intertidal area
  - Esturaine subtidal area
  - Upland area
  - Distance to Ocean
- Anthropogenic stressors
  - Nitrogen
  - Roads
  - Metal PC1
  - Metal PC2

1km

Estuarine intertidal

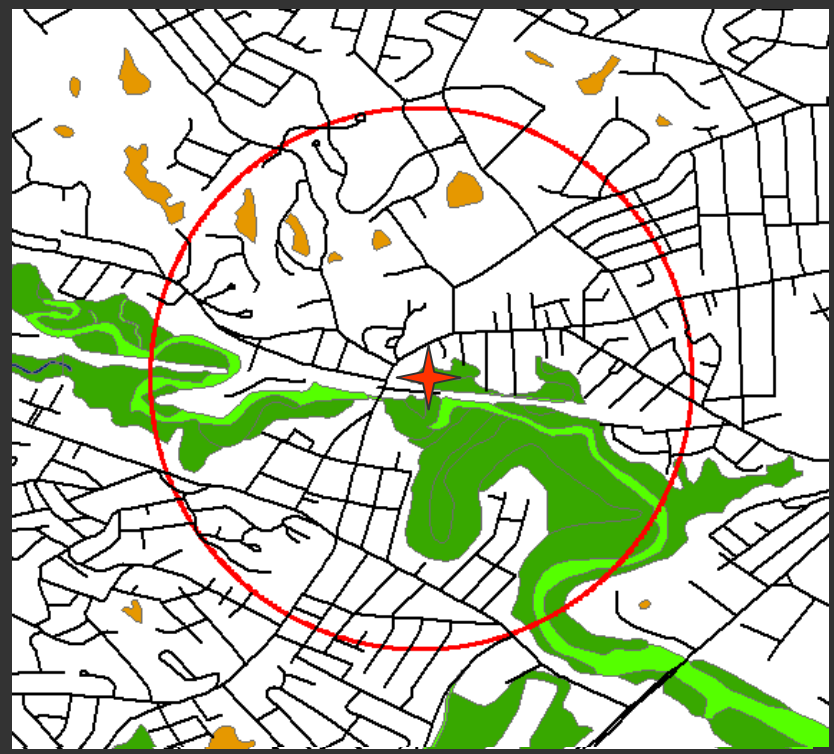
Estuarine subtidal

Marine

Upland

Roads

1km



Estuarine intertidal

Estuarine subtidal

Marine

Upland

Roads

Lepocreadium setiferoides

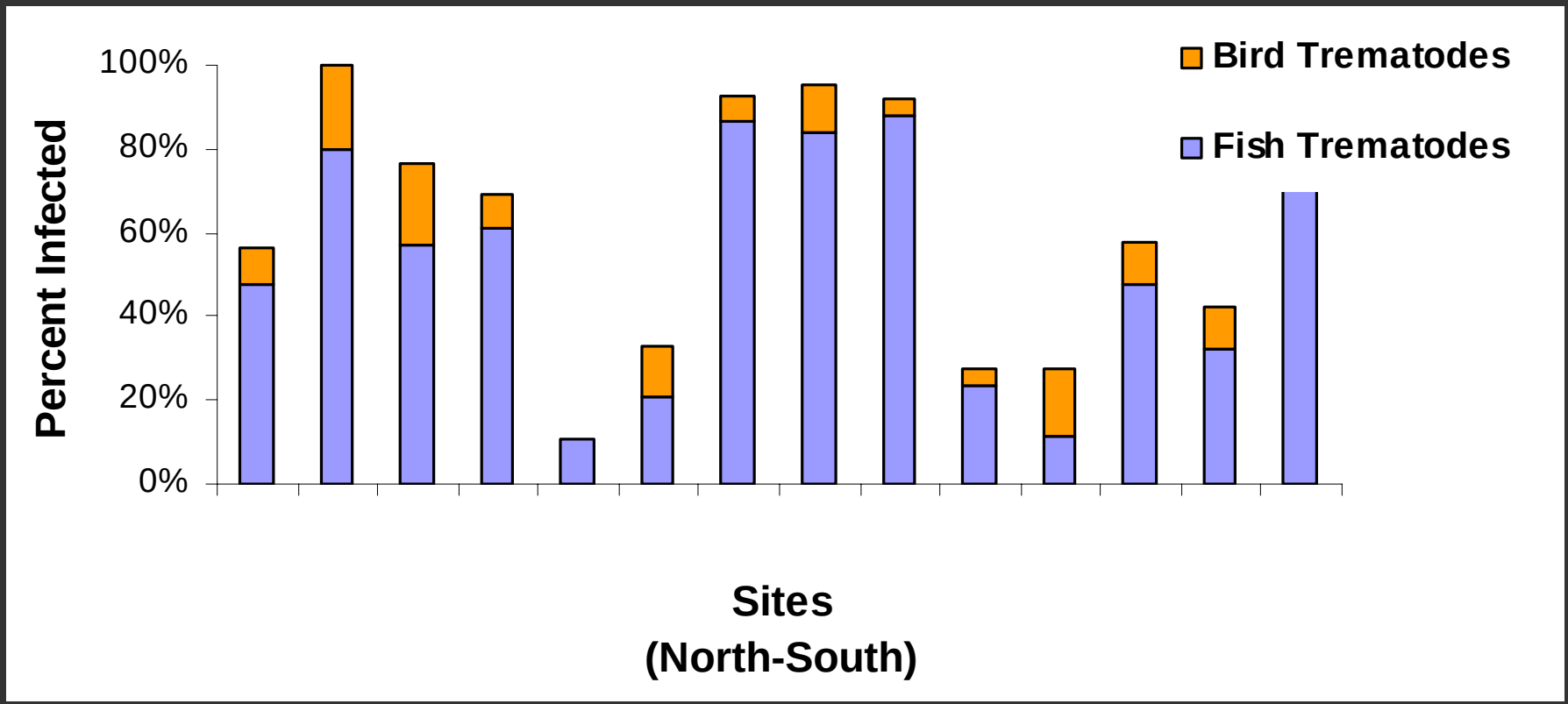
Austrobilharzia variglandis

TREMATODE SPECIES	Prevalence
Stephanostomum dentatum	11%
Stephanostomum tenue	
Zoogonus rubellus	10.1%
Lepocreadium setiferoides	3.6%
Himasthla quissetensis	2.3%
Gynaecotyla adunca	0.7%
Austrobilharzia variglandis	0.4%
Diplostomum nassa	0.2%

Total = 27.3%

TREMATODE SPECIES	2nd INTERMEDIATE HOST	FINAL HOST	Prevalence
Stephanostomum dentatum	Polychaete	Fish	11%
Stephanostomum tenue	Fish	Fish	
Zoogonus rubellus	Fish	Fish	10.1%
Lepocreadium setiferoides	Polychaete	Fish	3.6%
Himasthla quissetensis	Bivalve	Bird	2.3%
Gynaecotyla adunca	Crustacean	Bird	0.7%
Austrobilharzia variglandis	None	Bird	0.4%
Diplostomum nassa	Fish	Bird	0.2%

Trematode infection in *I. obsoleta*



Multiple regression

Dependent variable: Overall prevalence

Parameter	Direction	Adj R2
Nitrogen (log)	+	0.42
Roads (log)	-	0.68
Distance to ocean (log)	+	0.79
Clay	+	0.93

Multiple regression

Dependent variable: Prevalence Stephanostomum sp.

Parameter	Direction	Adj R2
Nitrogen (log)	+	0.43
Roads (log)	-	0.62
Distance to ocean (log)	+	0.76

Multiple regression

Dependent variable: Prevalence Zoogonus rubellus

Parameter	Direction	Adj R2
Final fish hosts	+	0.42
Metals PC2	+	0.63
Distance to ocean (log)	+	0.82

Multiple regression

Dependent variable: Prevalence Lepocraedium setiferoides

Parameter	Direction	Adj R2
Roads (log)	-	0.41
Clay	+	0.69

Multiple regression

Dependent variable: Species Richness

Parameter	Direction	Adj R2
Roads (log)	-	0.49
Unvegetated intertidal habitat (log)	-	0.71

Multiple regression

Dependent variable: H' Diversity

Parameter	Direction	Adj R2
Roads (log)	-	0.51

Summary

- Roads (-)
  - Effects on host populations
  - Run -off
- Nitrogen (+)
  - May reflect anthropogenic stress
  - Drives increase in host abundance
  - May increase likelihood of infection to snails
- Distance to Ocean (+)
  - Flushing rate
  - Host use

Summary

- Metal PC 2 (+)
  - Iron and manganese
  - Not associated with pollutants
  - Important in biogeochemical pathways

- Fish (+)
  - Consistent with patterns in other systems

    (Huspeni and Lafferty 2004, Hechinger and 2007)

Conclusions

- Strong relationships between trematodes and some biological, chemical, physical attributes
- Variety of trematode response variables provides many windows into various site specific attributes
- Need to understand the mechanisms in order to determine the reliability of their use as indicators

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Austrobilharzia variglandis	None	Bird	0.4%
Diplostomum nassa	Fish	Bird	0.2%
Pleurogonius malaclemys	None	Terrapin	0%

Acknowledgements

COMMITTEE

- Dave Burdick
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- Jeb Byers

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Diplostomum nassa	Fish	Bird

Methods

- Biological host communities
  - polychaete worms, bivalves, fish, birds
- Environmental characteristics
  - temp, latitude, sediment grain size, marsh size
- Anthropogenic stressors
  - Metals, organic contaminants, nitrogen
  - GIS
    - habitat size
    - road density

Multiple regression

- Collinearity reduction
- Remove highly correlated variables (correlation coefficient > 0.60)
- 13 metals—Principal component analysis

	PC 1	PC 2
Cum Percent	61 %	79 %
aluminum	-0.09	-0.20
aresenic	0.28	0.21
cadmium	0.30	-0.25
chromium	0.31	0.01
copper	0.31	-0.20
iron	0.22	0.47
lead	0.32	-0.19
manganese	0.18	0.50
mercury	0.29	-0.12
nickel	0.23	0.36
selenium	0.16	0.23
silver	0.31	-0.18
tin	0.30	-0.26
zinc	0.33	-0.07

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Multiple regression

Dependent variable: Fish trematodes

Parameter	Direction	Adj R2	P value

Multiple regression

Dependent variable: Fish trematodes

Parameter	Direction	Adj R2	P value
metal PC 2	**+**	0.58	0.02

Multiple regression

Dependent variable: Fish trematodes

Parameter	Direction	Adj R2	P value
metal PC 2	**+**	0.58	0.02
fish	+	0.77	< 0.01

Multiple regression

Dependent variable: Fish trematodes

Parameter	Direction	Adj R2	P value
metal PC 2	+	0.58	0.02
fish	+	0.77	< 0.01
nitrogen	+	0.82	< 0.01

Multiple regression: independent variables

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  - Roads
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  - **Nitrogen**
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- Anthropogenic stressors
  - Roads
  - Metal PC1

Multiple regression

Dependent variable: Fish trematodes

Parameter	Direction	Adj R2	P value
roads	-	0.21	0.05
metal PC 1	+	0.52	0.01

Alternative models

Model 1

Adj R2 = 0.82

Cp = 4

- Metal PC 2 (+)
- Fish (+)
- Nitrogen (+)

Model 2

Adj R2 = 0.52

Cp = 22.3

- Roads (-)
- Metal PC 1 (+)