Swim bladder parasite (*Anguillicola crassus*) prevalence and trace metal loads of the American eel (*Anguilla rostrata*) along an urban gradient in New Jersey estuaries

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Introduction

• The American eel (*Anguilla rostrata*) is a critical component of estuarine ecosystems and a key source of bait for fishers, yet its status is uncertain over portions of its North American range.

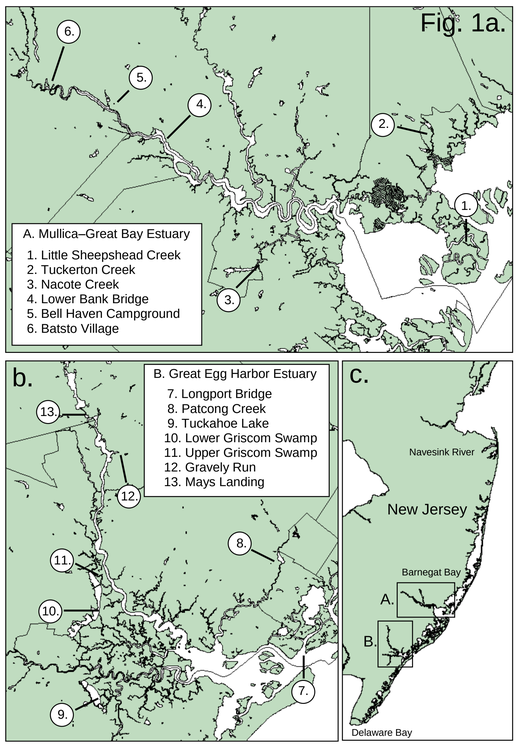
• Although the U.S. Fish and Wildlife Service determined the population is stable, concern exists over the recent spread of *Anguillicola crassus* , an invasive nematode swim bladder parasite.

• Recent studies hypothesize repeated infection may cause reproductive failure for out-migrating silver eels.

• *Objective 1*: Quantify direct parasite prevalence over a range of size classes (50 – 700 mm TL) in New Jersey estuaries along an urbanized gradient through eel necropsies.

• *Objective 2*: Quantify indirect evidence of infection via a Swim bladder Degenerative Index (SDI).

• *Objective 3*: Quantify trace metal loads as a possible vector of increased parasite prevalence along a north-to-south gradient.



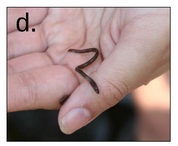


Fig. 1. American eel sampling locations in southern New Jersey (a - c) for prevalence of *A. crassus*. Navesink River and Delware Bay samples were additionally used for trace metal analyses. Right (d-h) size dependent methods for collecting American eels. Glass eels – young elvers (d): Eel resettlement collectors (e-f; Silberschneider et al. 2001) constructed out of tufts of polyethylene rope fiber attached to a weighted base. Elvers – yellow eels: 15 ' beach seine. Yellow – silver eels (h): Commercial eel pot fishers in coordination with New Jersey Department of Environmental Protection Nacote Creek Research Station (P. Clarke).

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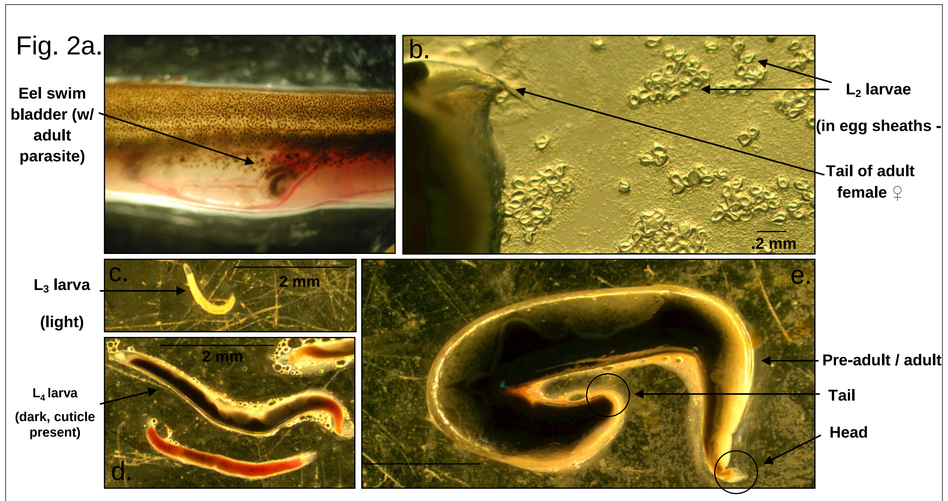

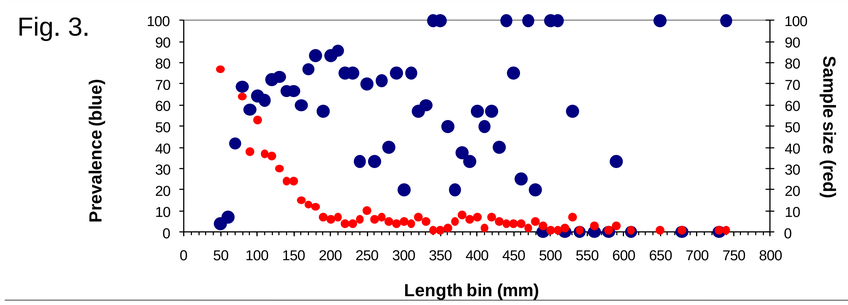

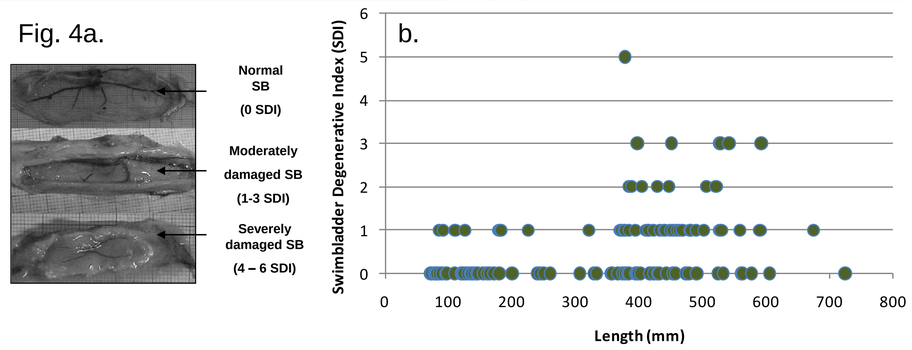

Table 1a.

Stage	Total	Infected	Prevalence
1	4	0	0
2	22	0	0
3	44	0	0
4	77	3	3.896103896
5	144	6	4.166666667
6	182	14	7.692307692
7	432	257	59.49074074

b.

Length (mm)	Infected	Total	Prevalence
0-99	145	712	20.4
100-199	170	251	67.7
200-299	38	59	64.4
300-399	20	44	45.5
400-499	22	43	51.2
500-599	7	19	36.8
600-699	1	3	33.3

Fig. 2. American eels were measured (TL), assigned a stage, and frozen or anaesthetized with MS-222 before dissection in the lab (a). Swim bladders were removed, opened, and *Anguillicola crassus* present enumerated and staged (b-e).

Fig. 3. Prevalence was calculated by length bin as the percentage of individuals infected / total sampled.

Fig. 4. Swim bladders were assigned a Swimbladder Degenerative Index (SDI – 0-6) value based on overall transparency (0-2), presence of exudate (0-2), thickness (0-2) pre and post-dissection (a-b).

Table 1. Prevalence by life stage (a) and total length (b).

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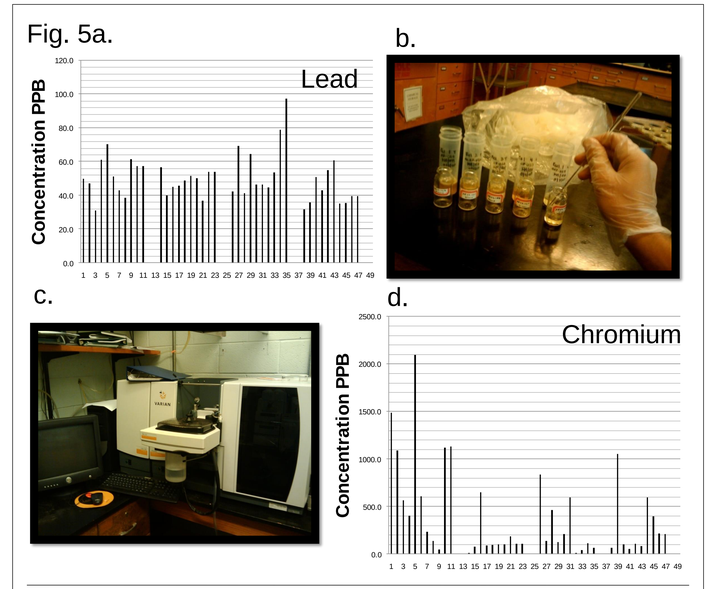

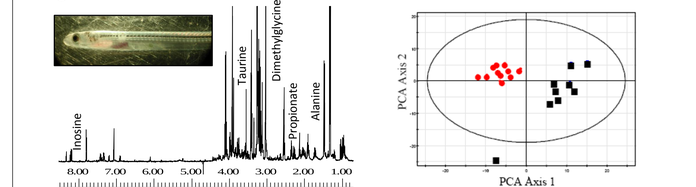

Fig. 5. Trace metal analyses (ongoing) were performed on Navesink River / Delaware Bay yellow eel tissue (a, d) / kidney / liver samples dissolved in nitric acid (b)and quantified using a (c) GTZAAS (Graphite Tube Atomizer Zeeman Atomic Absorption Spectrometer). Lead (a) concentrations were at the low end of elemental detection limits for both sites, while chromium (d) displayed high levels both north and south (elevated in the Navesink). Samples will be run in the future for arsenic, cadmium, zinc.

Fig. 6. A concurrent goal of this study is to test the biological consequences of parasite infection / urbanization via environmental metabolomics – which measures the metabolic response of an organism to stressors by assessing organism health at the molecular level (Viant 2007). (a) Nuclear magnetic resonance (NMR) spectrum of an American eel glass eel .(b) Principle Component Analysis (PCA) score plot of NMR spectra.

Results and Conclusions

• *Anguillicola crassus* prevalence was very high in young juvenile yellow eels < 300 mm TL (~65%), with stage 4 elvers (~60 mm TL) representing the smallest eels infected (3% prevalence rate).

• Although parasite prevalence was low, SDI values were high in older juvenile yellow eels >300 mm TL – possibly indicating previous infection history.

• No significant differences in prevalence were found along a north-to-south gradient (i.e. Navesink, 44% - Delaware Bay, 42%).

• Initial trace metal work indicates low levels of lead from tissue samples, but abnormally high concentrations of chromium (enhanced in the Navesink).

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