Fish Tales of Newtown Creek

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SUMMARY:

Newtown Creek is a 3.8 mile heavily industrialized waterway separating Queens and Brooklyn, NY. Designated a Superfund site in 2010, it remains significantly polluted and subject to frequent sewage overflow. Here we apply environmental DNA (eDNA) metabarcoding to analyze fish presence and relative abundance at multiple sites along the Creek. To our knowledge, this represents the first fish eDNA survey of Newtown Creek and the first fish survey of any kind since 2001.
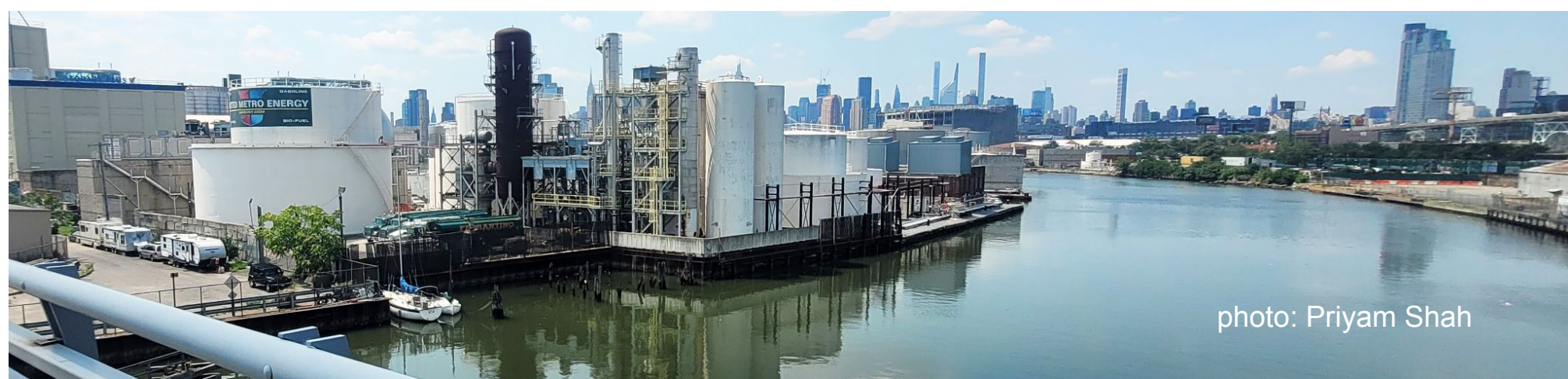
BACKGROUND:

Figure 1. Newtown Creek at Greenpoint AVE Bridge (sampling site 2, see Methods for map).

The creek's coastline is lined with wastewater facilities, factories, warehouses, and oil storage tanks (Figures 1,2) (1-5). The water contains a toxic mix of heavy metals, pesticides, and carcinogenic chemicals. In upper reaches of Newtown Creek , dissolved oxygen is often below threshold for fish survival (Figure 3), although this may have improved with installation of aeration systems in 2014 and 2018.
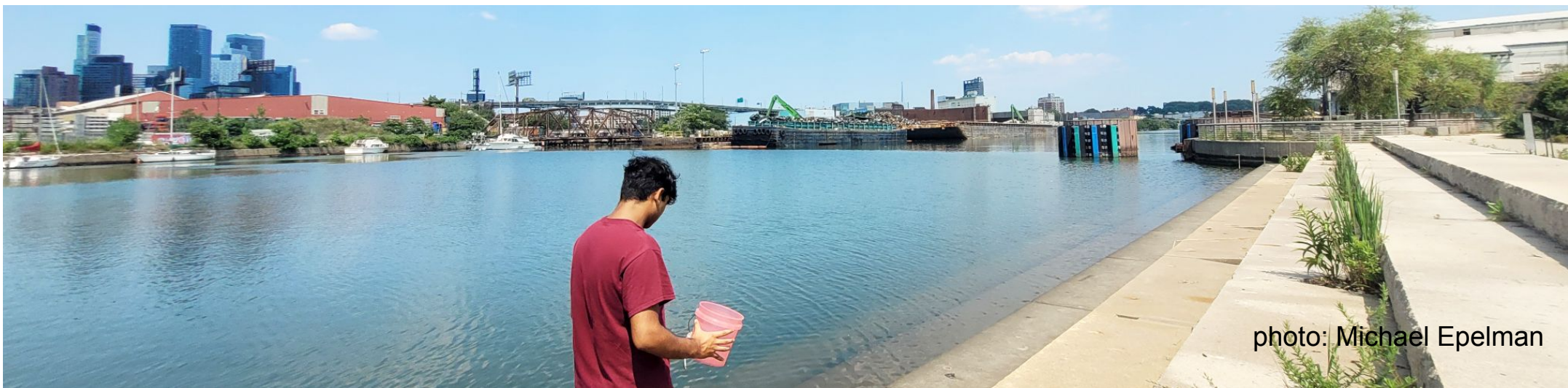

Figure 2. Newtown Creek at Nature Walk (sampling site 3, see Methods for map).

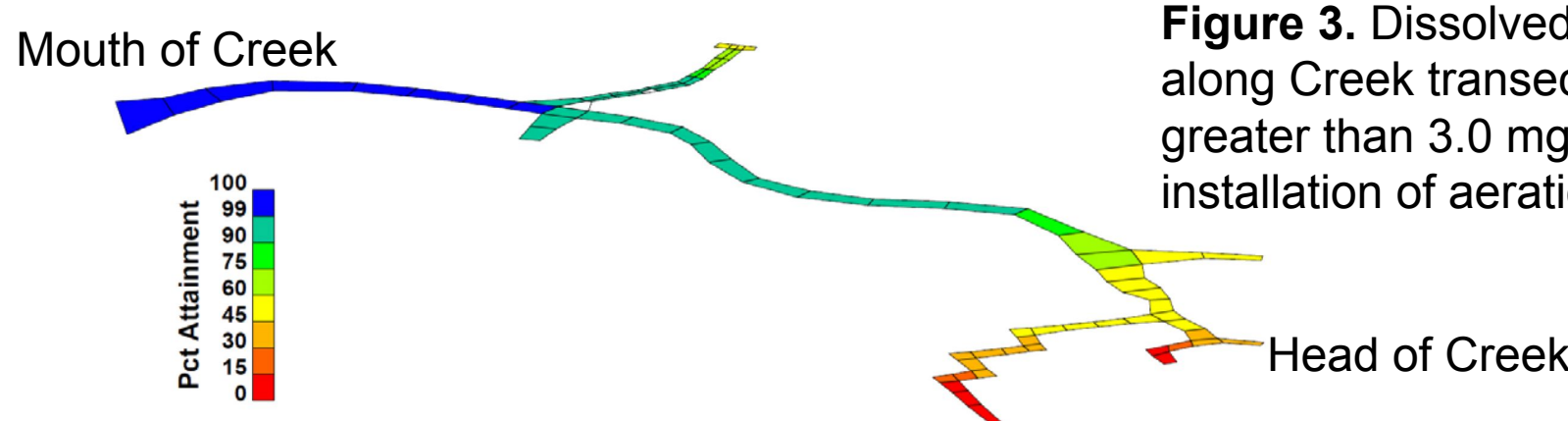

Mouth of Creek

Head of Creek

Figure 3. Dissolved oxygen concentration along Creek transects (percent summer days greater than 3.0 mg/L at bottom), prior to installation of aeration systems (1).

Despite strong government and community interest in restoring Newtown Creek, relatively little is known about fish species presence and abundance and whether these have changed with cleanup efforts. The most recent surveys were conducted in 2001 (6). These included ichthyoplankton tows for fish eggs and larvae, performed at 3 sites over 4 months, which identified 18 species (9-12 per site), and trawl and gill net tows done at 1 site in 1 month, which found 3 fish species.

METHODS :

Water samples were collected at 5 sites on Newtown Creek, ranging from upstream reach at Grand ST Bridge to mouth where Creek enters into East River (Figure 3a). In addition, water samples were also collected at East River adjacent to Rockefeller University and from laboratory tap water as a negative control (Figure 3b).
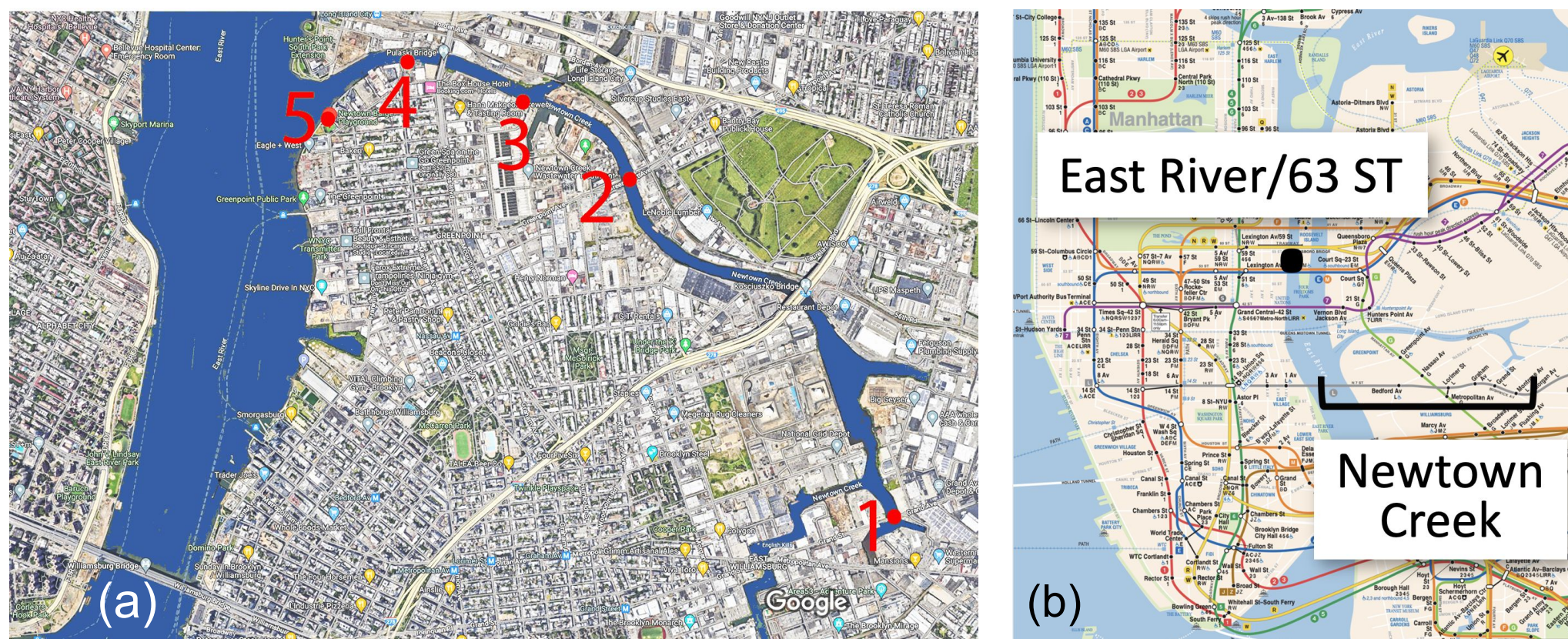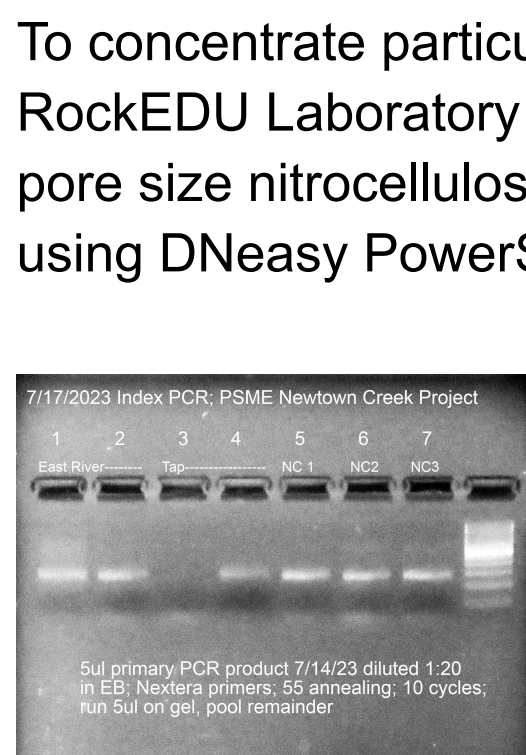

Figure 4. Water collection sites on Newtown Creek (a) and East River (b).

One L surface samples were collected at each site from the shoreline or from a bridge using a bucket on a rope and transferred to plastic bottles (Fig. 5).

To concentrate particulate matter, water samples were filtered in RockEDU Laboratory using wall suction and 4.5 cm, 0.45 micron pore size nitrocellulose filters, and DNA was extracted from filters using DNeasy PowerSoil kit.

Figure 5 a,b. Water collection.

DNA was amplified with vertebrate metabarcoding primers targeting a 110 bp segment of mitochondrial 12S gene. Samples were indexed with NEXTERA XT kit, visualized on gel (Figure 6) and sequencing was done with MiSeq 2 x 150bp at AZENTA. Demultiplexed fastq files were processed with a DADA2 pipeline.

Figure 6. Indexed PCR products visualized on 1.2% agarose gel stained with SyberSafe.

RESULTS:

NEWTOWN CREEK FISH eDNA SURVEY, JULY 2023
MISEQ 30-901171716

RANK NC	SEQ ID	NEWTOWN CREEK READS	EAST RIVER READS
1	Atlantic silverside	650271	8248
2	Tautog	565134	358998
3	Atlantic menhaden, river herrings	424318	66190
4	Striped bass	241405	63187
5	Skilletfish	198914	114153
6	Black drum, Spot	150073	2678
7	Cunner	115829	27864
8	Bluefish	69530	90479
9	Hogchoker	56528	13658
10	Naked goby	53498	0
11	Feather blenny	49241	188378
12	Scup	44867	44932
13	Seaboard goby	44136	93153
14	Bay anchovy	42217	28090
15	Black sea bass	34081	66053
16	White perch	31653	4588
17	Summer flounder	29858	0
18	Mummichog	29230	2188
19	American eel	26076	20313
20	Oyster toadfish	11578	141131
21	Grubby, other sculpins	9135	0
22	Northern pipefish	6140	1868
23	Weakfish	5971	4541
24	Winter flounder, Yellowtail flounder	4122	0
25	American gizzard shad	2073	0
26	Broad striped anchovy	1791	0
27	Atlantic needlefish	245	0
28	Striped sea robin	0	2319
29	Striped cusk eel	0	3424
30	Silver hake	0	2958
31	Crested blenny	0	2424
32	American conger	0	1836
33	Northern sea robin	0	1374
34	Red, White, or Spotted hake	0	969

Table 1 (left). Fish detected by eDNA, ranked by decreasing reads. 27 and 28 species were identified in Newtown Creek and East River samples, respectively.

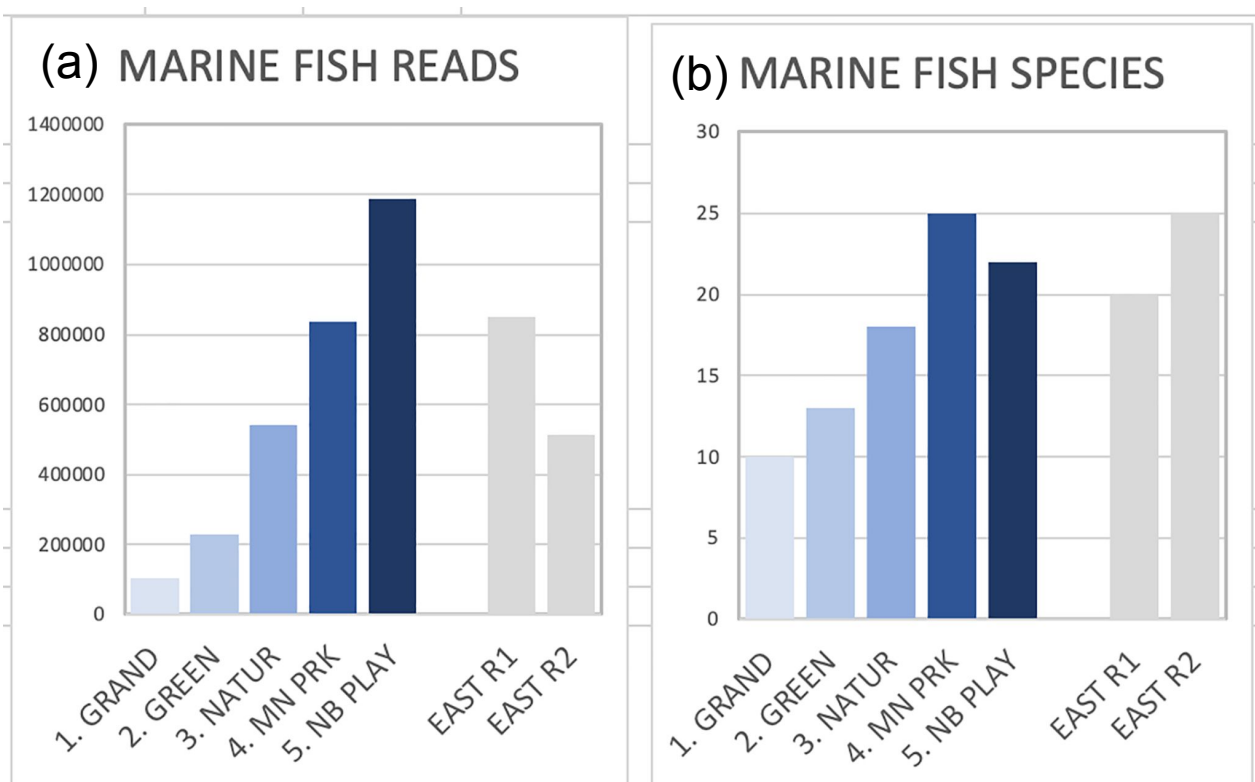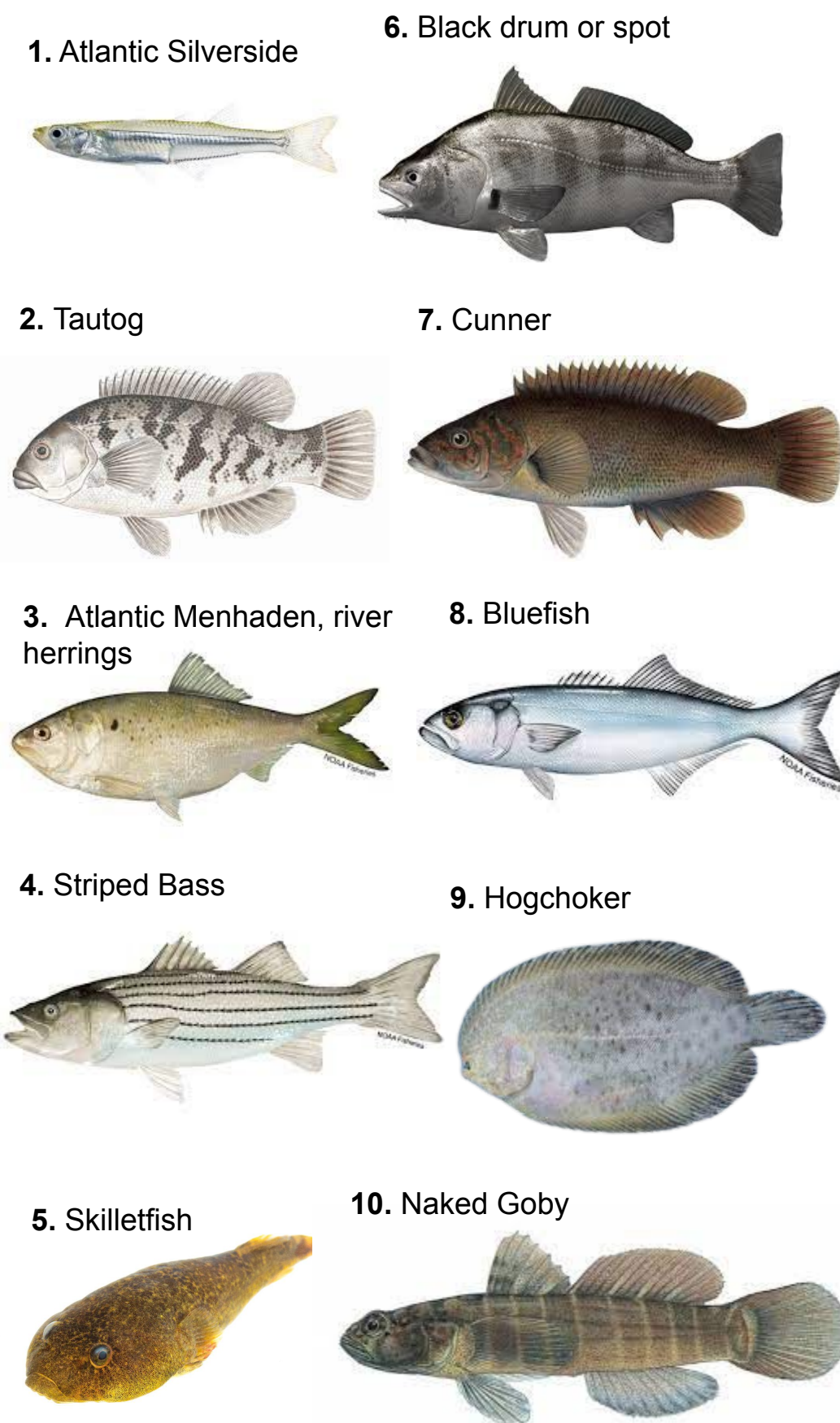**Figure 7.** Top 10 fish species in Newtown Creek by eDNA reads.

1. Atlantic Silverside
2. Tautog
3. Atlantic Menhaden, river herrings
4. Striped Bass
5. Skilletfish
6. Black drum or spot
7. Cunner
8. Bluefish
9. Hogchoker
10. Naked Goby

(a) MARINE FISH READS
(b) MARINE FISH SPECIES

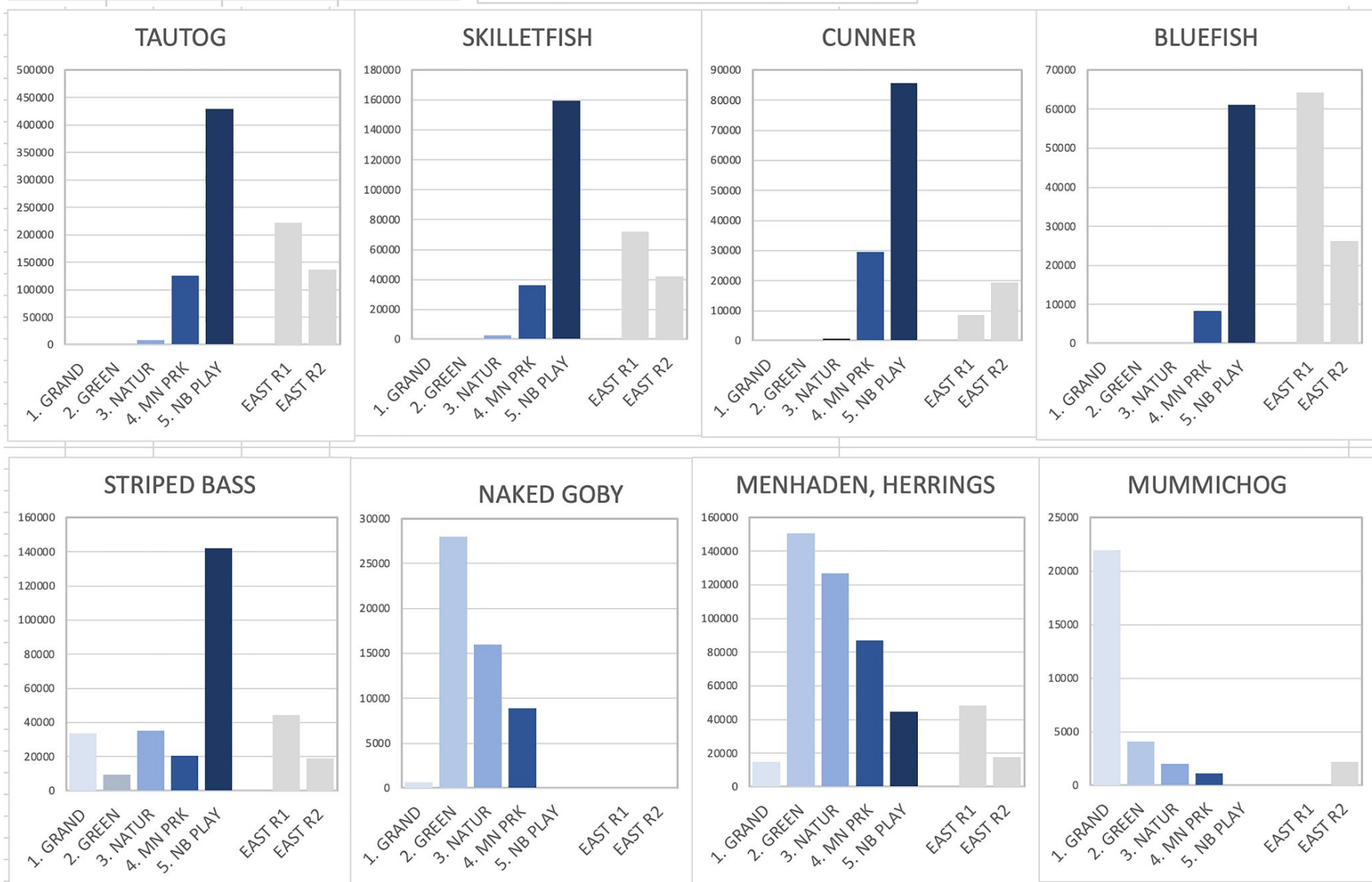**Figure 8 (left).** Fish reads (a) and number of species (b) obtained from Newtown Creek and East River samples.

Figure 9 (below). Reads for individual species at Newtown Creek and East River sites.

TAUTOG | SKILLETFISH | CUNNER | BLUEFISH
STRIPED BASS | NAKED GOBY | MENHADEN, HERRINGS | MUMMICHOG

CONCLUSIONS:

eDNA detected a surprising diversity of fish in Newtown Creek, despite ongoing pollution and sewage overflow. The number and relative abundance of fish species differed among sites consistent with species habitat preference and pollution tolerance. Our data support eDNA as a cost-effective, non-destructive method for monitoring fish populations and assessing habitat restoration efforts in Newtown Creek and other Superfund sites.

ACKNOWLEDGEMENTS:

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