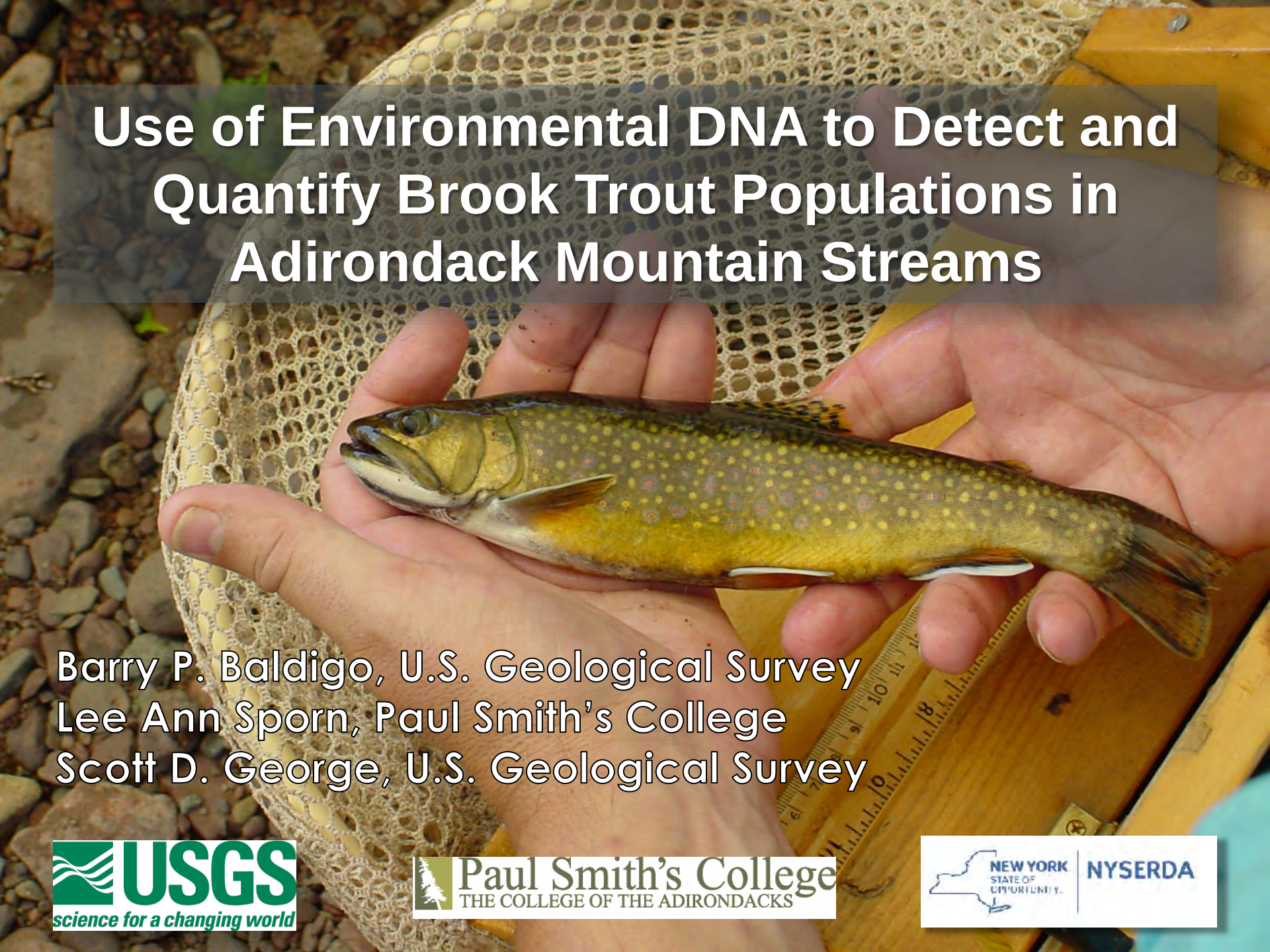
Use of Environmental DNA to Detect and Quantify Brook Trout Populations in Adirondack Mountain Streams



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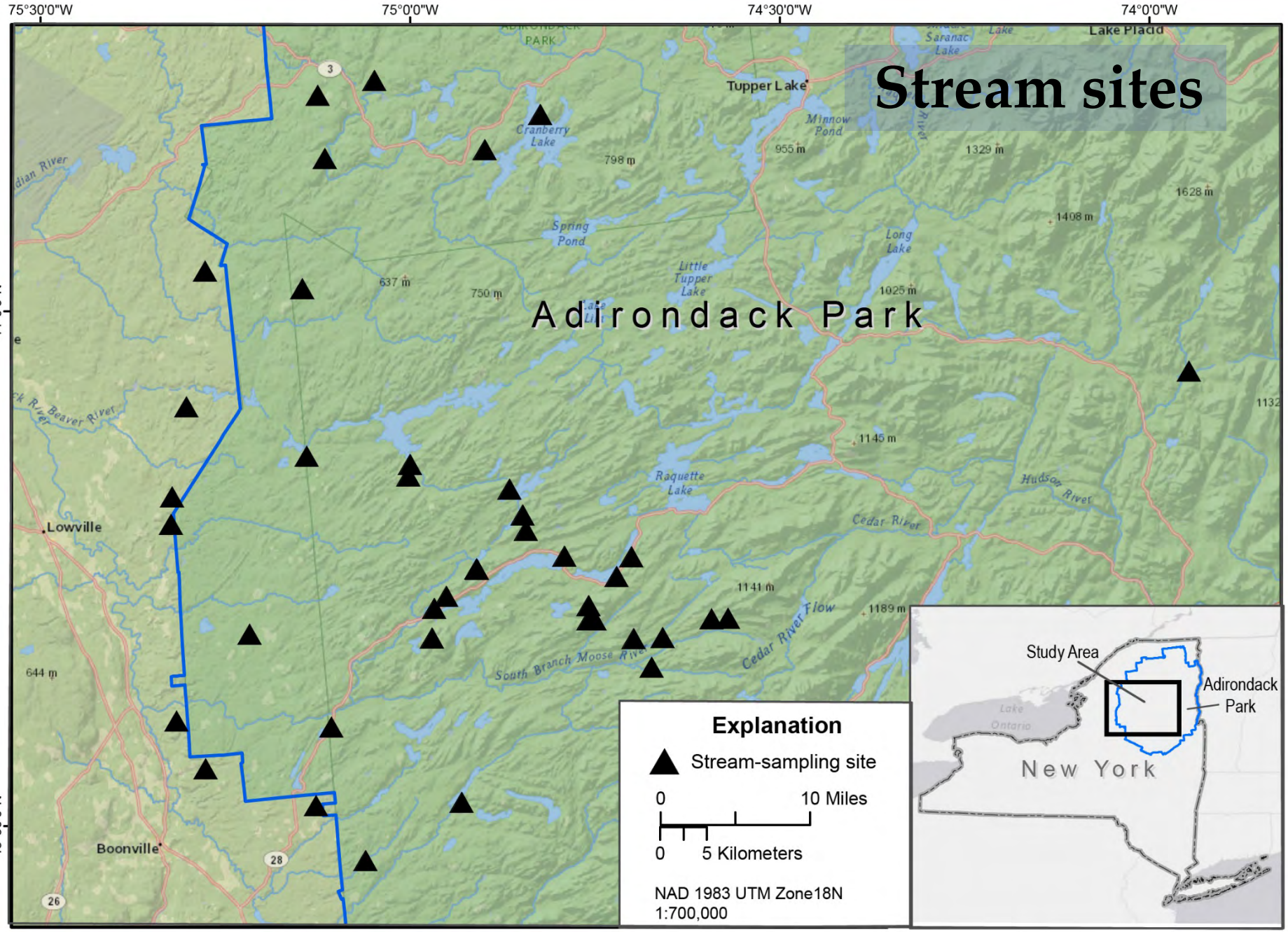
Background

- **Fish communities were surveyed 40 SW Adirondack streams by the USGS and NYSDEC, summer 2014-15**
- **Density and biomass of Brook Trout populations were quantified**
- **eDNA samples were collected in late summer 2015**



Base from National Geographic, Esri, DeLorme, HERE, UNEP-WCMC, USGS, NASA,

Primary Objective

- **Determine if eDNA can be an effective tool for assessing the distribution and abundance of Brook Trout in remote/headwater streams of the region.**
- **Related research goals were to:**
  a. **Compare the effectiveness of water and sediment to retain Brook Trout DNA**
  b. **Evaluate eDNA water-filtration volumes**
  c. **Assess the accuracy of eDNA to predict presence/absence**
  d. **Assess the accuracy of eDNA to predict density and biomass**
  e. **Weigh costs and benefits of standard e-fish survey vs. eDNA sampling efforts**

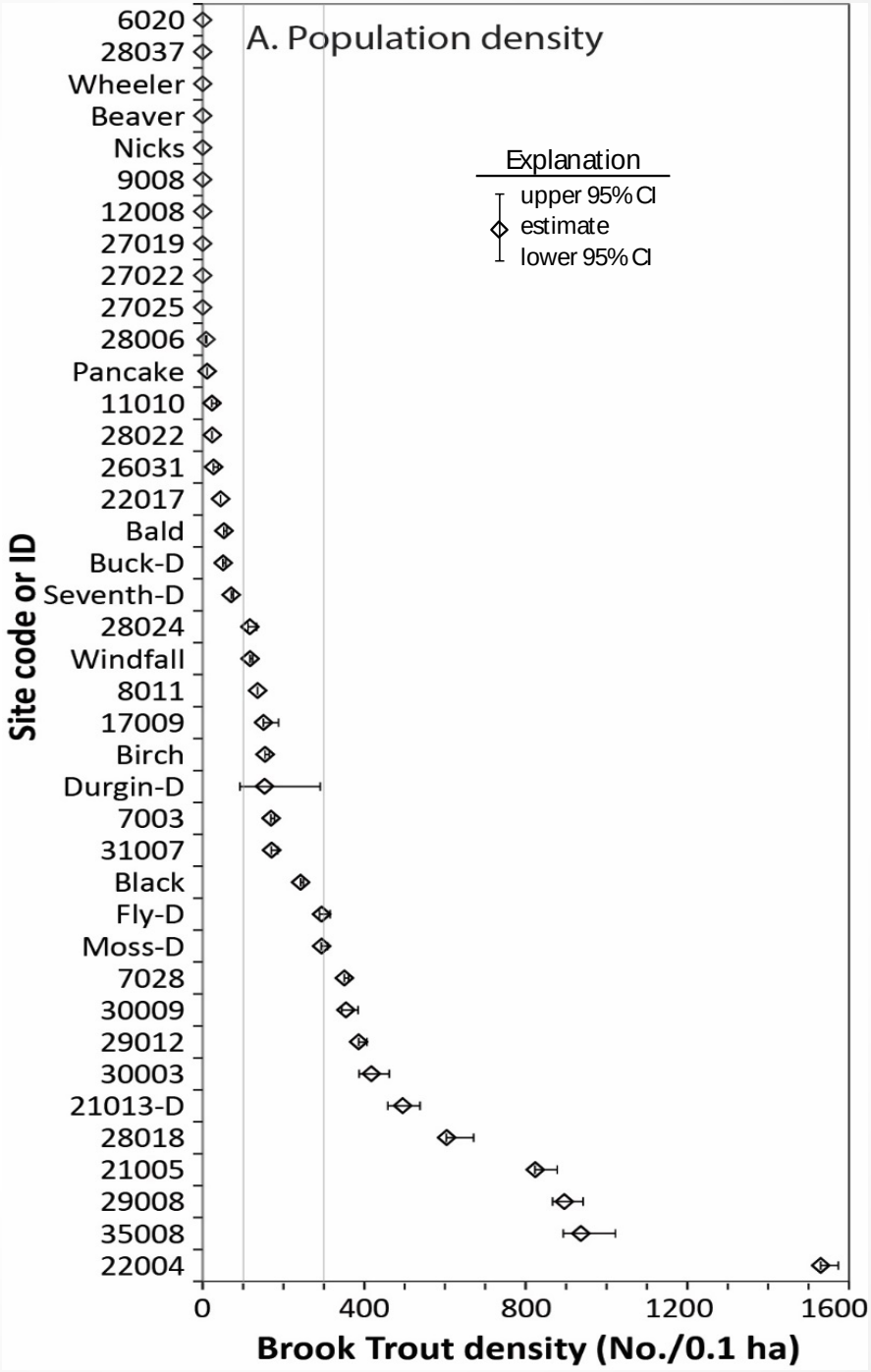
Fish surveys

- Selected study streams that represented a wide range in acid-base chemistry
- Isolated sampling reach using blocking seines
- Collected all fish using 3+ electroshocking passes
- Identified & measured lengths and weights of each fish
- Collected basic habitat data at each study reach
- Computed metrics for fish communities and Brook Trout populations

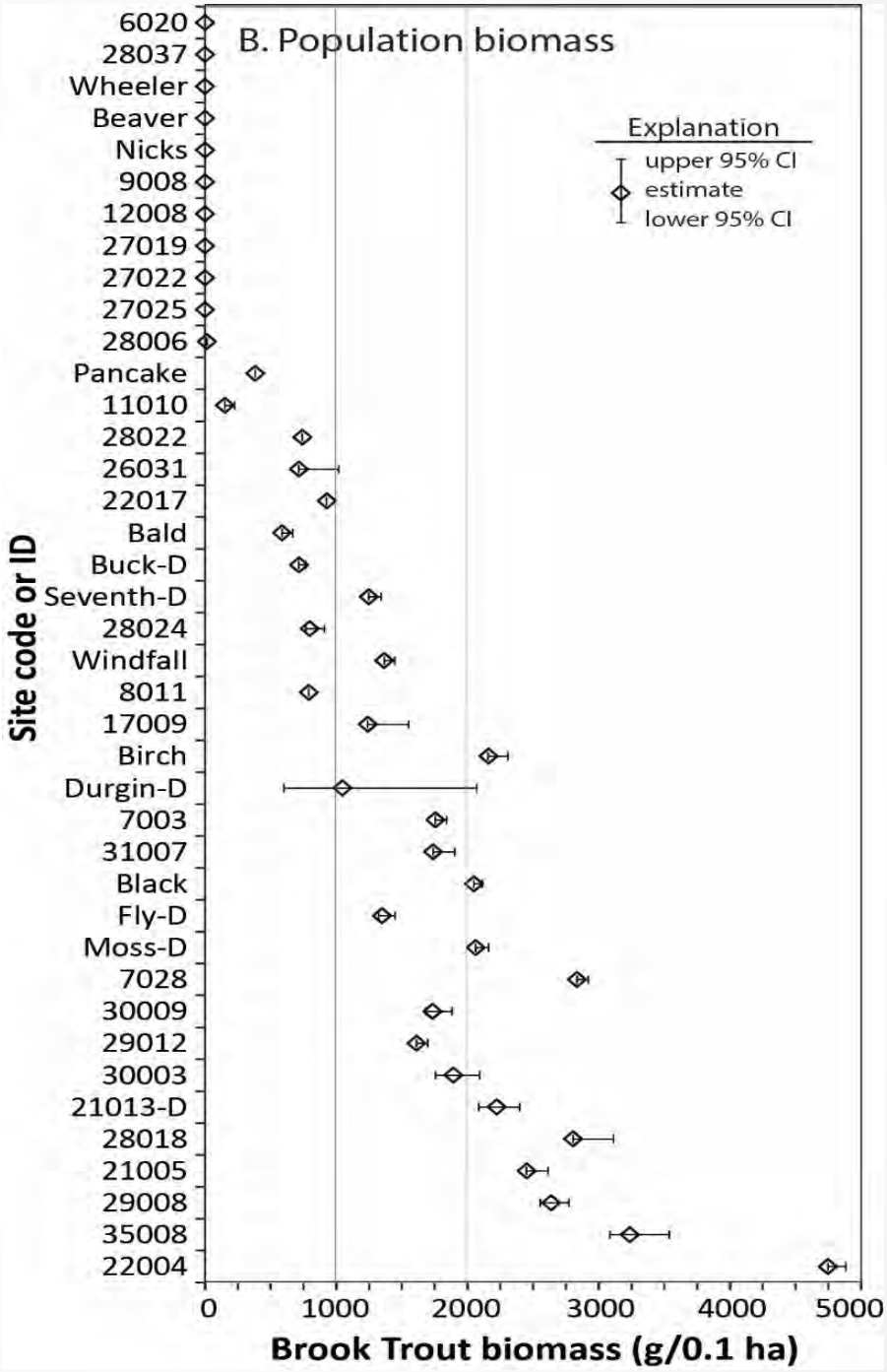
Brook Trout eDNA

- **Decontaminate all gear with 10% bleach & rinse well with site water**
- **Collect 2-300 g sediment, filter up to 6L water thru 1.5μm GFF, and freeze**
- **Extract, purify eDNA from filters and sediment using DNA isolation kits**
- **Detect copies of Brook Trout DNA with the TaqMan® MGB assay using a Step One™ qPCR system, Environmental Master Mix 2.0, and reaction components:** 250 nM BRK2 probe; 900 nM BRK2 primers; VIC -labeled internal positive control (IPC) primer/probe; and IPC target DNA with forward primer = ccacagtgcttcaccttctatttcta, reverse primer = gccaagtaatatagctacaaaacctaatagatc, and FAM-labeled probe = actccgacgctgacaa
- **Each assay used 1μl of eluted DNA and all samples were run in triplicate**
- **Average cycle threshold (Ct) value for each sample was calculated from all triplicates with < 40 amplification cycles**
- **The relative concentration of Brook Trout DNA (ng/μl) in each sample was estimated from a standard curve ($10^{(Ct-26.685)/-3.615}$; R^2 = 0.998) between mean Ct and total genomic DNA (purified from local Brook Trout tissues)**

RESULTS


A. Population density
Explanation
upper 95% CI
estimate
lower 95% CI
Site code or ID
6020
28037
Wheeler
Beaver
Nicks
9008
12008
27019
27022
27025
28006
Pancake
11010
28022
26031
22017
Bald
Buck-D
Seventh-D
28024
Windfall
8011
17009
Birch
Durgin-D
7003
31007
Black
Fly-D
Moss-D
7028
30009
29012
30003
21013-D
28018
21005
29008
35008
22004
0
400
800
1200
1600
Brook Trout density (No./0.1 ha)

RESULTS


B. Population biomass
Explanation
upper 95% CI
estimate
lower 95% CI
Site code or ID
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Beaver
Nicks
9008
12008
27019
27022
27025
28006
Pancake
11010
28022
26031
22017
Bald
Buck-D
Seventh-D
28024
Windfall
8011
17009
Birch
Durgin-D
7003
31007
Black
Fly-D
Moss-D
7028
30009
29012
30003
21013-D
28018
21005
29008
35008
22004
0
1000
2000
3000
4000
5000
Brook Trout biomass (g/0.1 ha)

eDNA RESULTS

Predicting presence:

- **After the first survey, eDNA correctly detected Brook Trout at 25 of the 30 sites where populations were observed (83% classified correctly)**
- **After resampling 2 of 5 misclassified sites, eDNA detected Brook Trout at 27 out of 30 sites (90% classified correctly)**
- **The remaining three sites were not resampled**

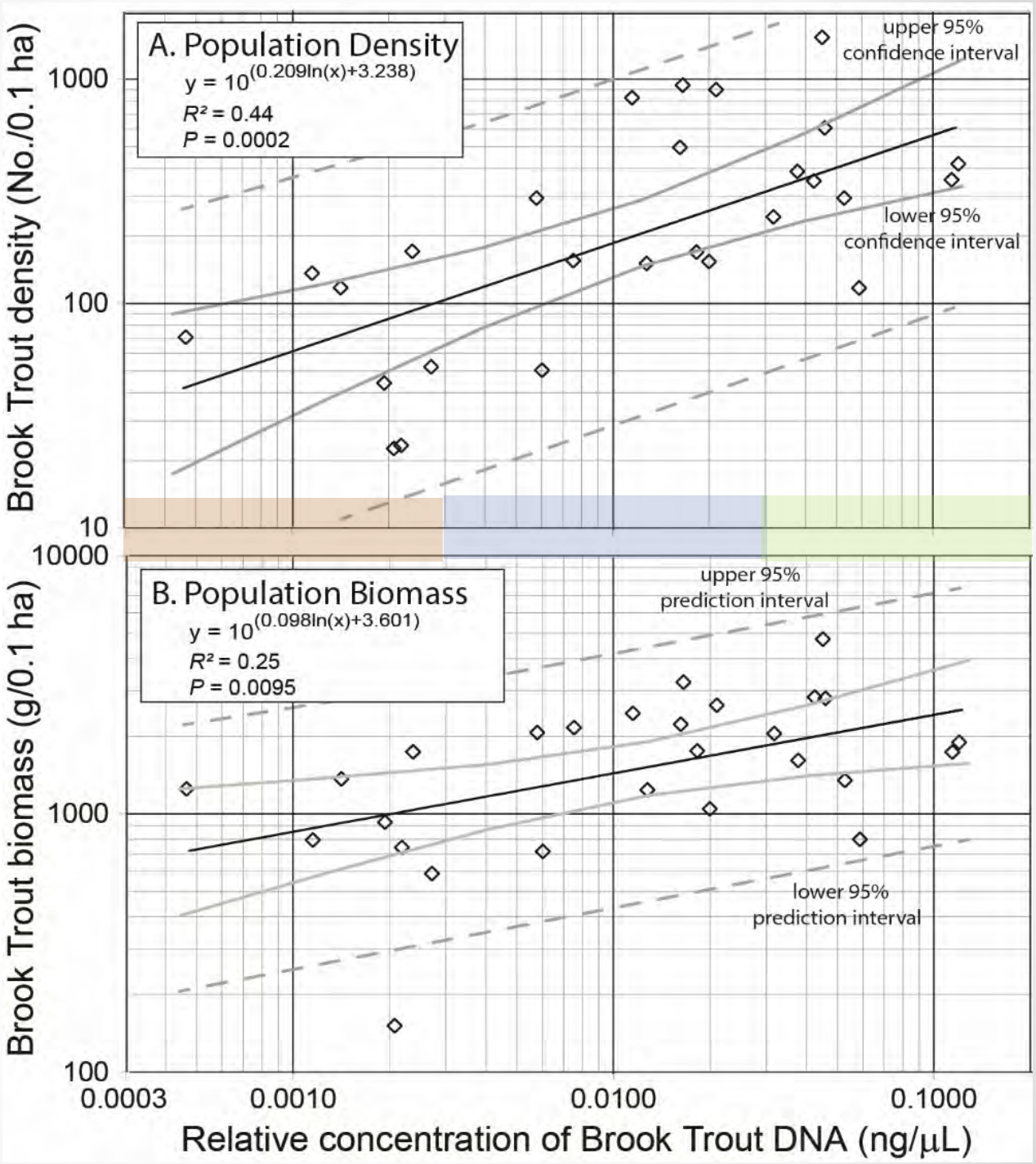
Predicting absence:

- **After the first survey, eDNA did not detect Brook Trout at 9 of 10 sites (90% classified correctly) where populations were not found**
- **After resampling 1 misclassified site, eDNA did not detect Brook Trout at all 10 sites (100% classified correctly)**

- **Overall, eDNA correctly classified the P/A of Brook Trout populations in 93% of study sites**

RESULTS

Ability to predict Brook Trout density and biomass



Discussion - Conclusions

- **Sediments did not retain Brook Trout DNA in head-water Adirondack streams**
- **Decontamination & rinsing procedures for eDNA samples need to be thorough**
- **Large sample volumes and/or field duplicates are crucial for detecting rare targets (threshold)**
- **Costs to analyze an eDNA sample ($10-50) can be a fraction of that for a crew to survey fisheries ($0.5-3K)**
- **eDNA is an effective tool for detecting the P/A and relative abundance of Brook Trout populations in small headwater streams**
- **eDNA is appropriate for large/broad/synoptic surveys; standard surveys are generally more effective when characterizing the health of entire fish assemblages**

THE "END"

QUESTIONS?

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