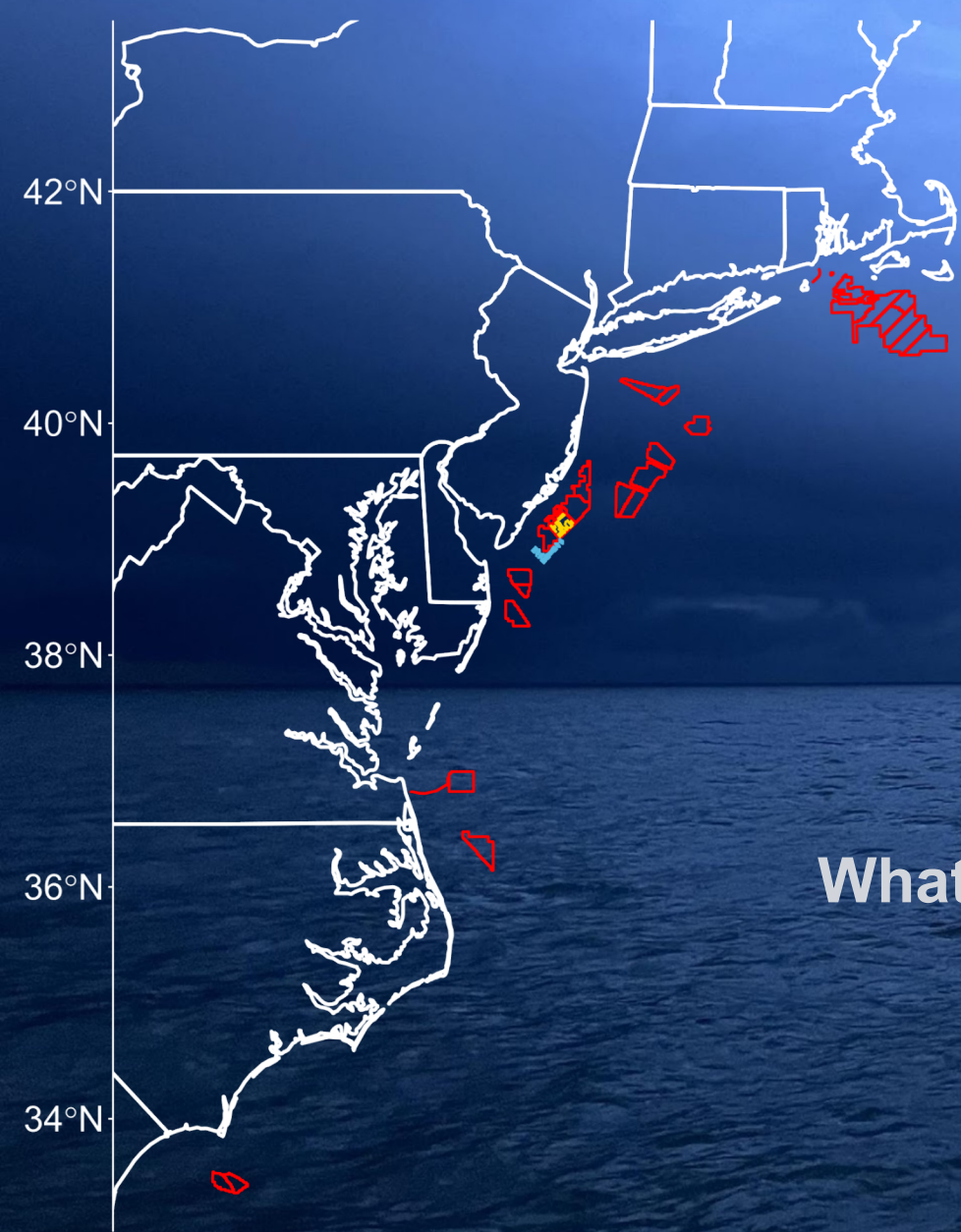


A scenic background image showing a sunset or sunrise over the ocean. The sky is filled with soft, pinkish-orange clouds, and the horizon line is visible with a faint city skyline in the distance. The water in the foreground is dark blue with gentle ripples.

Pre-construction monitoring of offshore wind leasing areas using eDNA metabarcoding

Sam Chew Chin, Shannon O'Leary, Jason Morson, Doug Zemeckis, Keith Dunton, Jason Adolf



What fish are under there?

What effects will wind farms have on them?

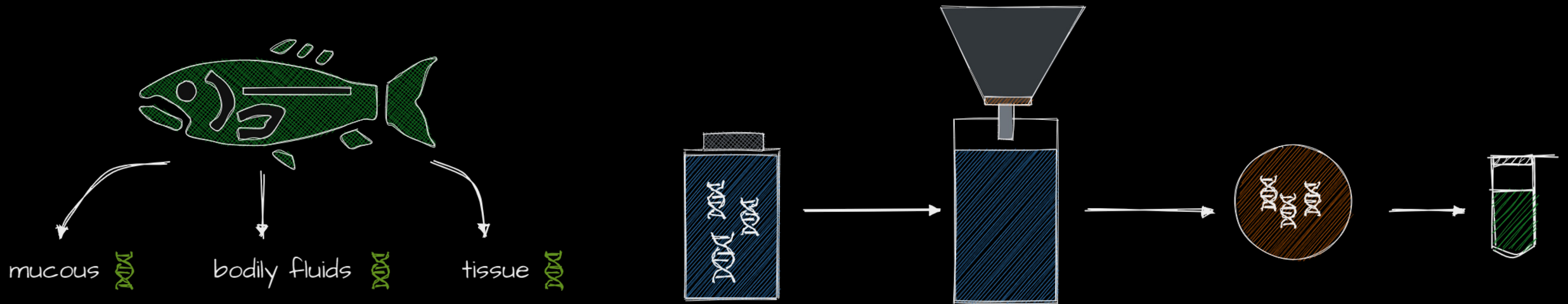
eDNA is here to help

What is eDNA?

DNA is shed as cellular or extracellular material into the surrounding water

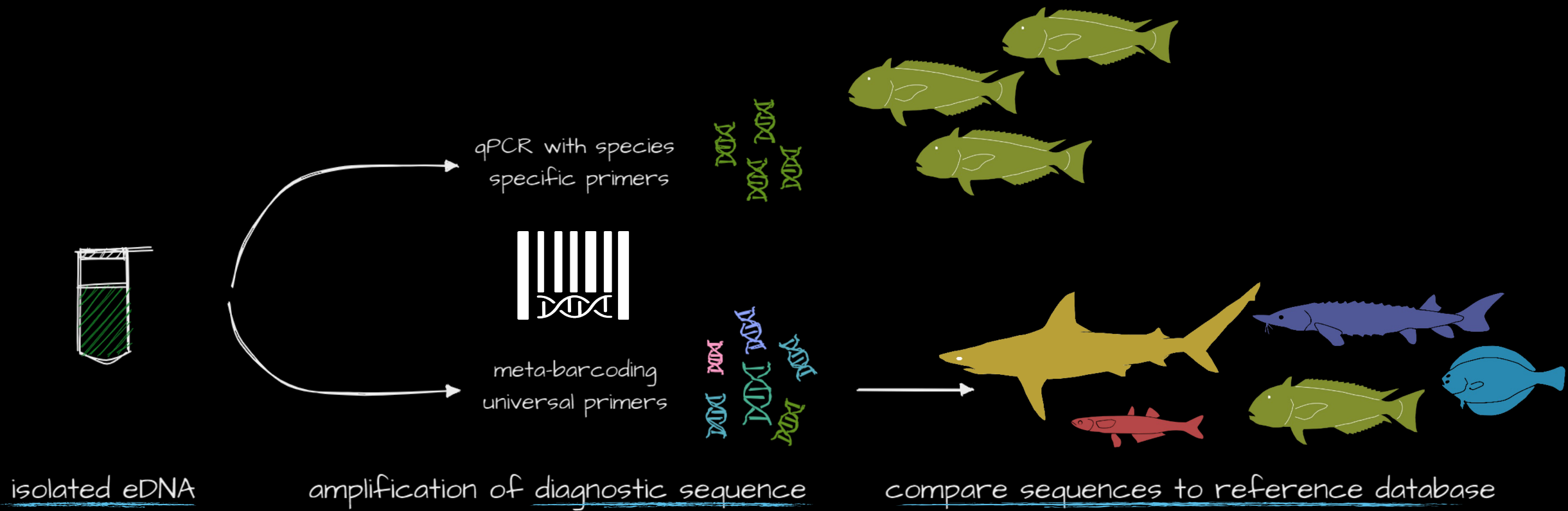
collect & filter water from aquatic systems

extract DNA from filters



Environmental DNA = DNA isolated from an environmental sample

eDNA analytical workflows



**eDNA is useful for species-specific assessments
and to characterize communities**

eDNA sampling

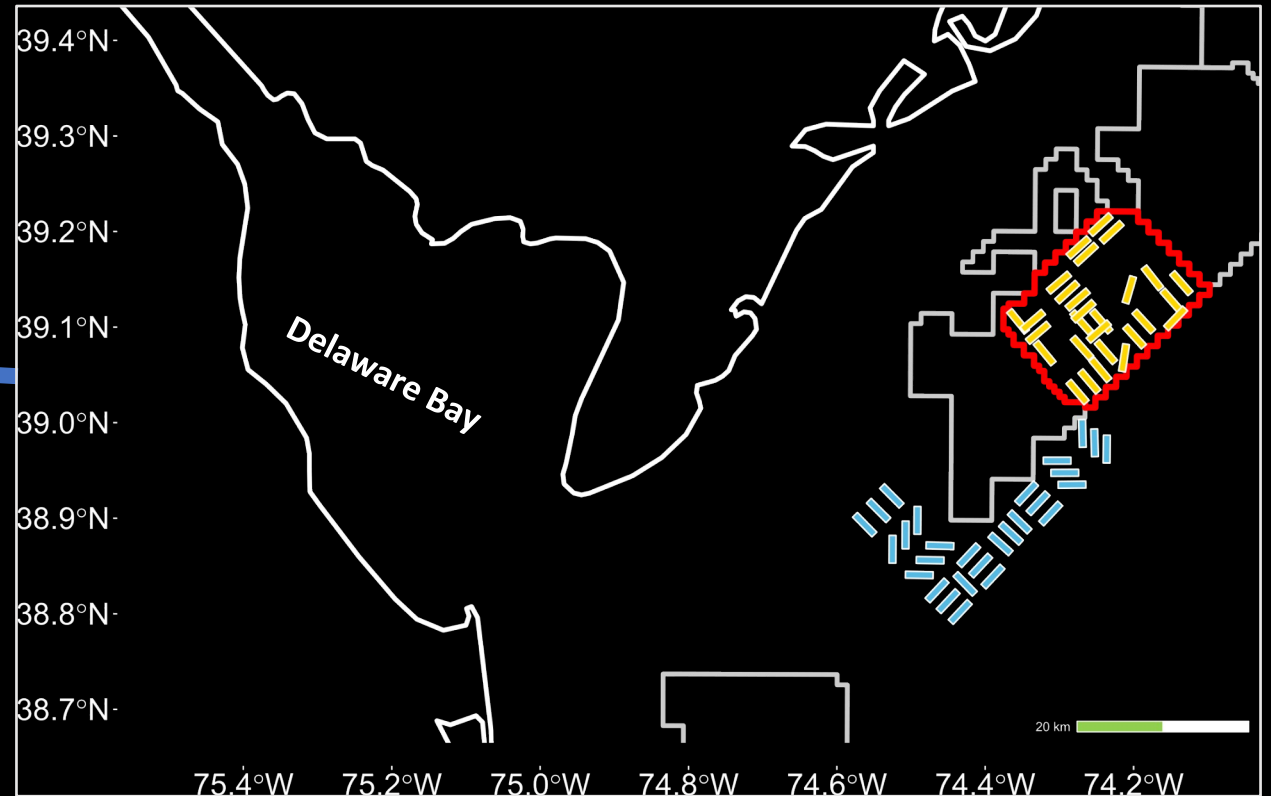
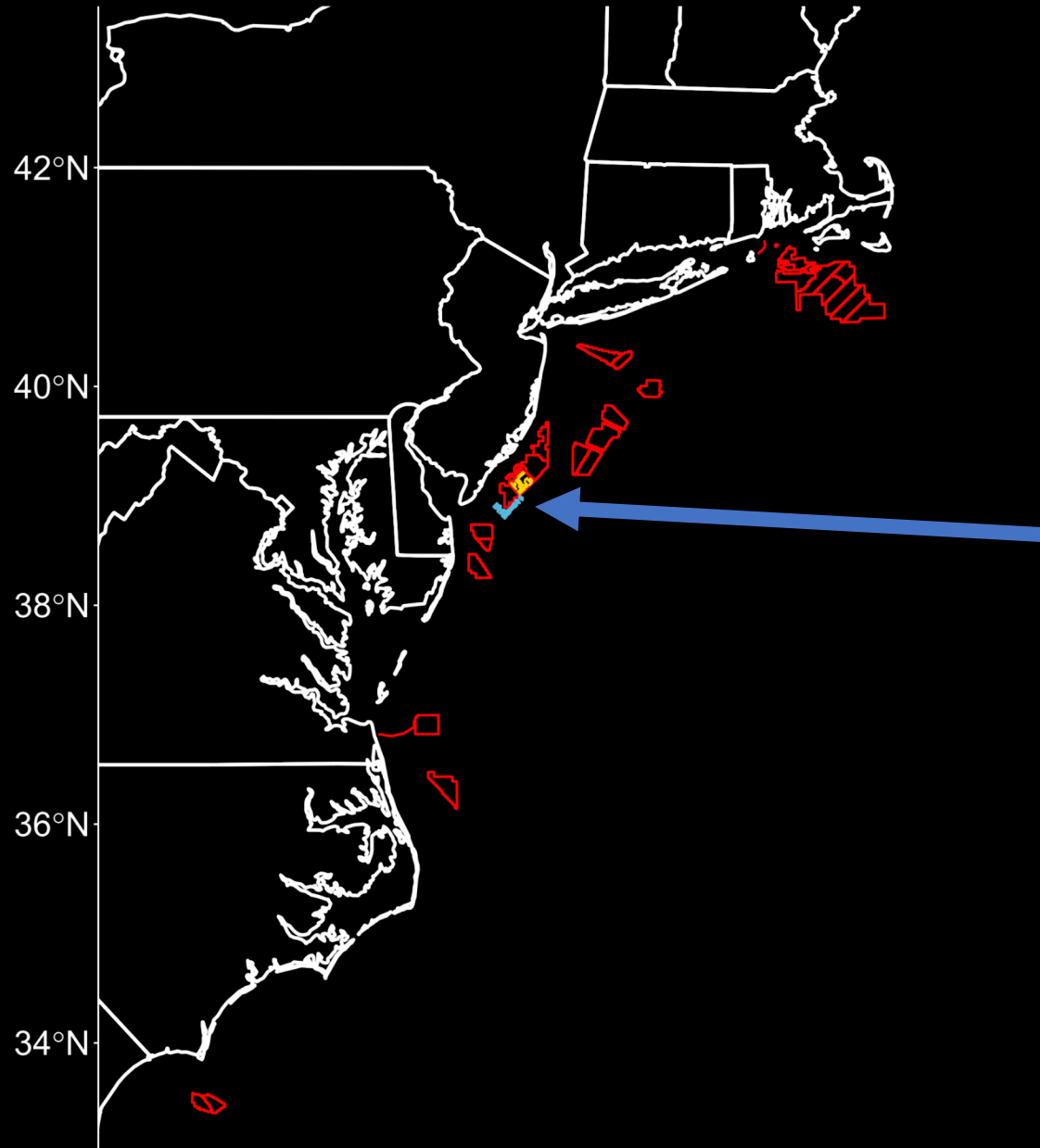
- Low cost, simple, flexible sampling methods (scalable)
- Standardizable methods across wide range
- Minimal damage to habitat, target/bycatch species
- few permitting issues
- Limited information
- Need more calibration studies to understand gear bias



Capture survey (trawl)

- Detailed biological data of captured specimens
- Existing long-term data sets
- Gear-bias well-understood
- Established methods for analysis & management

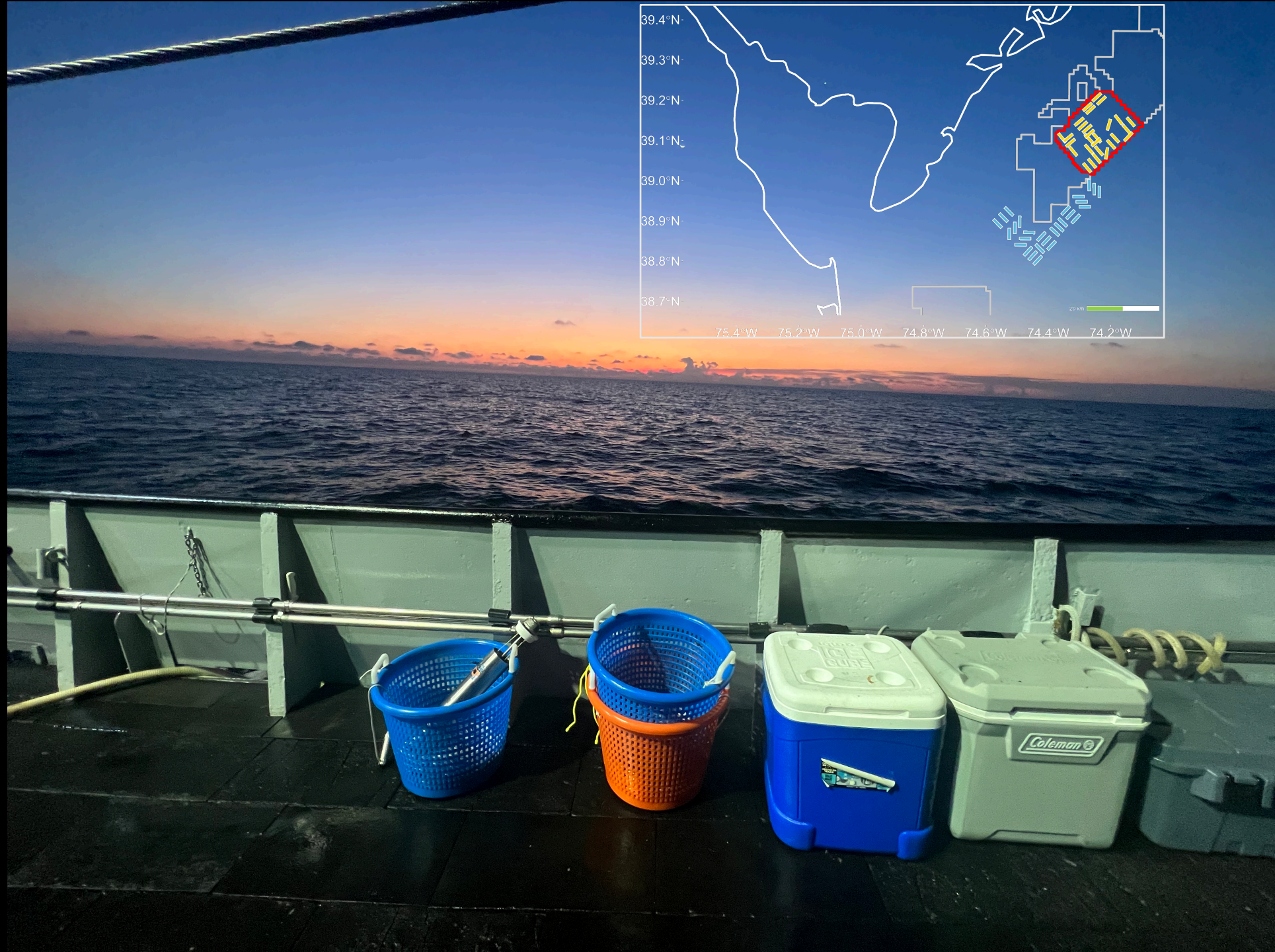
Study region: New Jersey wind leasing areas



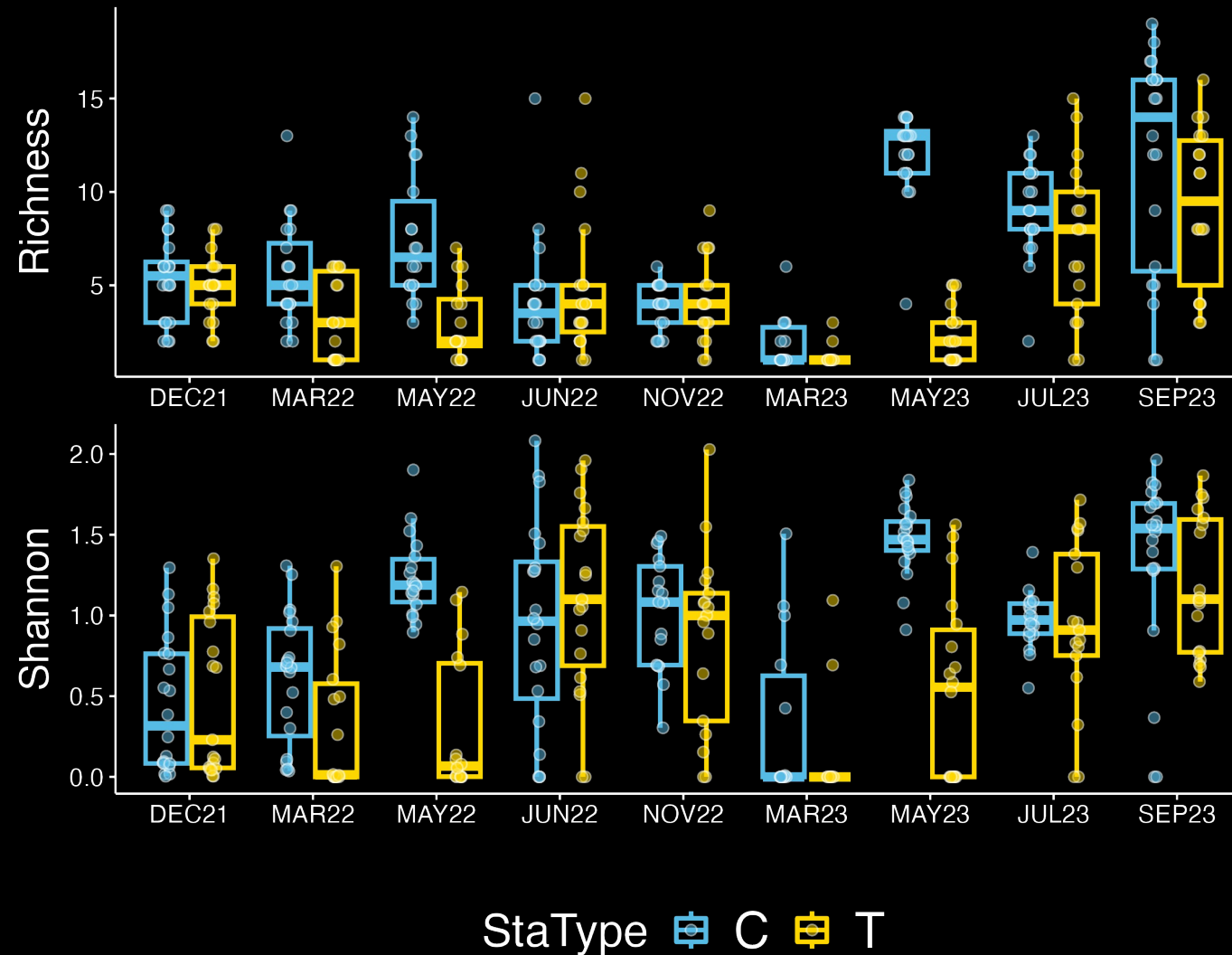
- Quarterly eDNA sampling bouts since December 2021
- Paired trawl-eDNA sampling July and September 2023

Sampling

- F/V Darana R,
Captains Jimmy
and Robert Ruhle
- 20 tows each of
Turbine and
Control sites
- 1 L water sample
from 2m above
floor
- 2 sampling bouts:
July and
September 2023



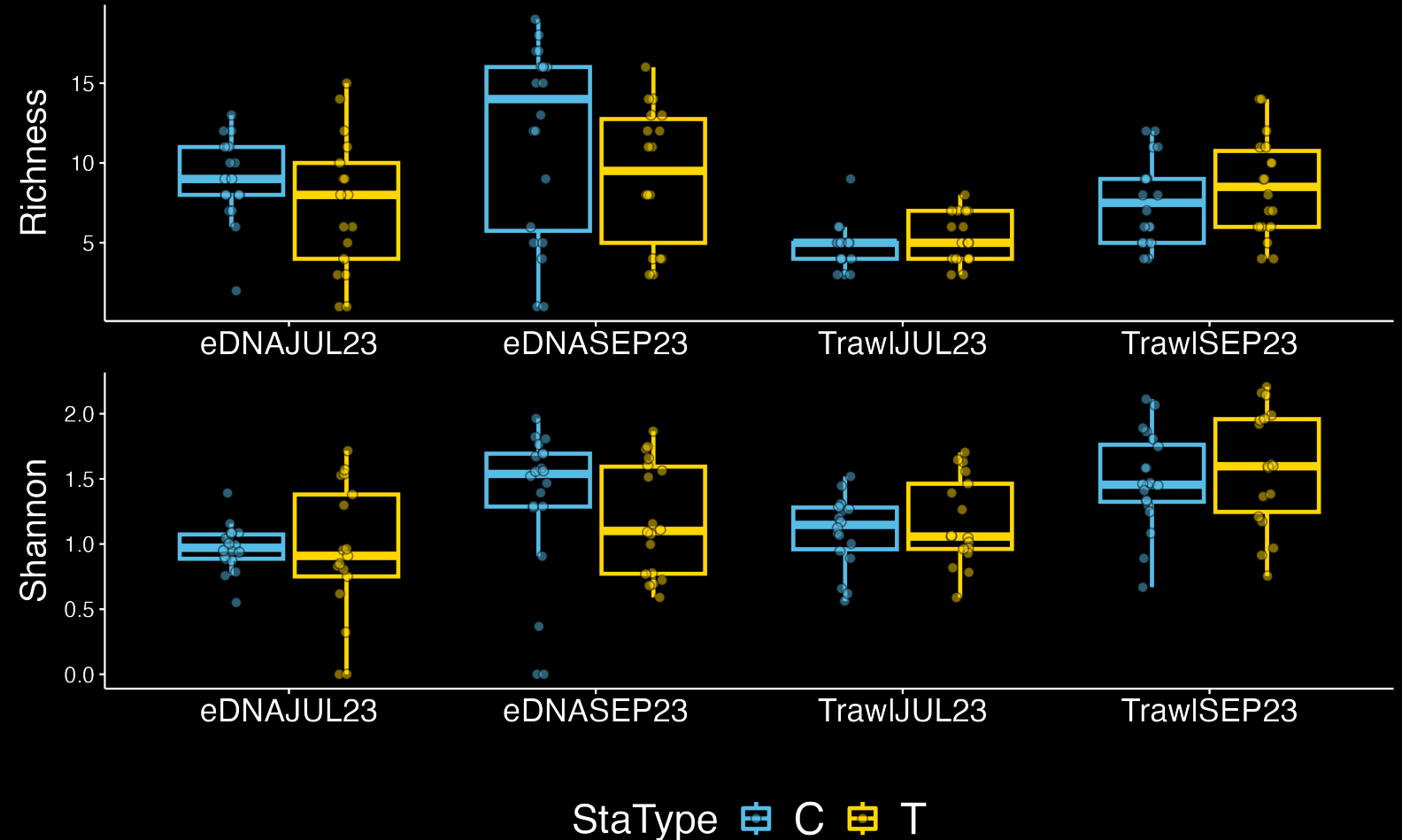
eDNA diversity metrics 2021-2023



eDNA-Trawl diversity metrics

Teleost richness

	JUL 2023	SEP 2023	total
Trawl	18	31	35
eDNA	34	47	48



Catch/detection frequencies

>10 samples

	Trawl	Both	eDNA
Nor_sea_robin	1.00	1.00	1.00
Am_butterfish	0.83	0.82	0.99
Black_sea_bass	0.79	0.79	0.99
Red_White_or_Spotted_hake	0.70	0.60	0.84
Windowpane_flounder	0.47	0.35	0.69
Str_sea_robin	0.47	0.27	0.65
Summ_flounder	0.30	0.23	0.70
Rough_scad	0.29	0.13	0.30
Black_drum_or_Spot	0.23	0.22	0.49
Scup	0.22	0.19	0.71
Fourspot_flounder	0.21	0.18	0.30
Atl_croaker	0.19	0.17	0.64
Atl_moonfish	0.13	0.09	0.22
Smallmouth_flounder	0.09	0.03	0.44
Red_eye_round_herring	0.08	0.05	0.19
Nor_kingfish	0.05	0.00	0.23
Weakfish_Cyn	0.04	0.00	0.14
King_mackerel	0.03	0.03	0.36
Bay_anchovy	0.00	0.00	0.34
Atl_or_nor_sand_lance	0.00	0.00	0.16
Thread_herring	0.00	0.00	0.14

- Most frequently reported species same by both methods
- For most species (n=47), eDNA detection more frequent than trawl capture



Catch/detection frequencies - rarer species

<10 samples

	Trawl	Both	eDNA
Brd_striped_anchovy	0.03	0.03	0.12
ROUND SCAD	0.12	0.00	0.00
Atl_mackerel	0.10	0.00	0.00
Southern_kingfish	0.00	0.00	0.10
Summ_flounder	0.00	0.00	0.10
ATLANTIC CUTLASSFISH	0.09	0.00	0.00
Atl_chub_mackerel	0.01	0.00	0.08
Atl_menhaden_LS17	0.00	0.00	0.08
Silver_hake	0.00	0.00	0.08
Tautog	0.00	0.00	0.08
Frigate_or_bullet_tuna	0.00	0.00	0.06
Gulf_stream_flounder	0.00	0.00	0.06
Menhaden_or_river_herrings	0.01	0.00	0.04
Silver_anchovy	0.00	0.00	0.05
Bluefish	0.00	0.00	0.04
Red_drum	0.00	0.00	0.04
Str_bass	0.00	0.00	0.04
Str_cusk_eel	0.00	0.00	0.04
Blue_catfish	0.00	0.00	0.03
Giant_trevally99	0.00	0.00	0.03
LESSER AMBERJACK	0.03	0.00	0.00

<2 samples

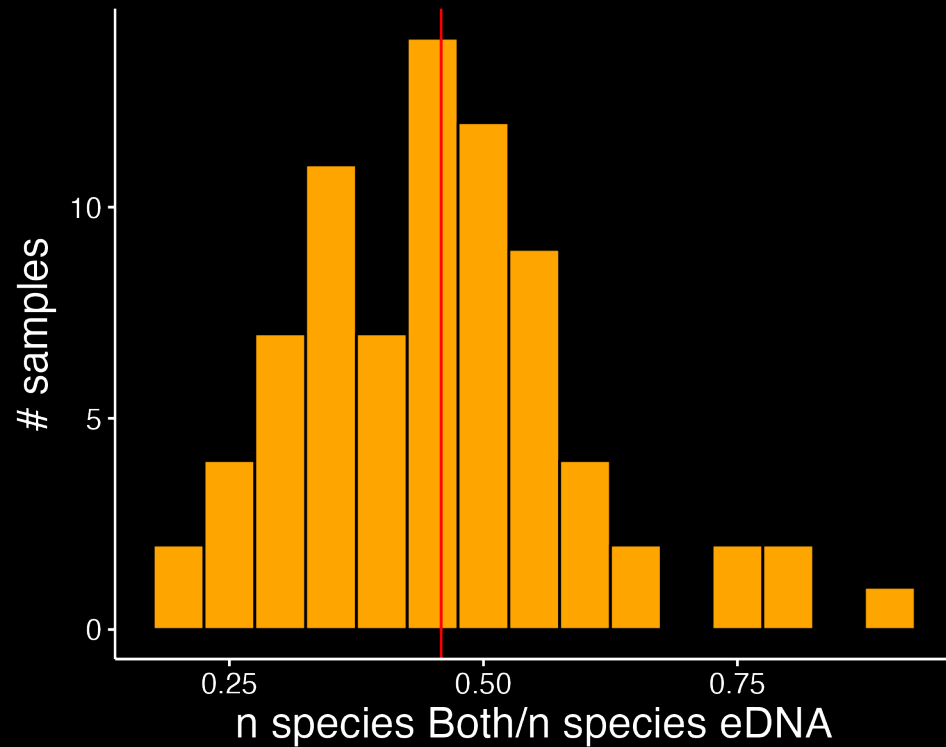
	Trawl	Both	eDNA
Little_tunny_or_skipjack_tuna	0.00	0.00	0.03
PIPEFISH SEAHORSE UNCL	0.03	0.00	0.00
SMOOTH PUFFER	0.03	0.00	0.00
Tuna_sp	0.00	0.00	0.03
Winter_or_Yellowtail_flounder	0.00	0.00	0.03
ATLANTIC BONITO	0.01	0.00	0.00
Am_anglerfish	0.00	0.00	0.01
Am_conger	0.00	0.00	0.01
Atl_herring	0.01	0.00	0.00
BLUE RUNNER	0.01	0.00	0.00
BLUESPOTTED CORNETFISH	0.01	0.00	0.00
Fawn_cuskeel	0.00	0.00	0.01
GREATER AMBERJACK	0.01	0.00	0.00
Golden_shiner	0.00	0.00	0.01
Mummichog	0.00	0.00	0.01
Nor_puffer	0.01	0.00	0.00
Offshore_hake	0.00	0.00	0.01
SHORT BIGEYE	0.01	0.00	0.00
SPANISH SARDINE	0.01	0.00	0.00
Silver_perch	0.00	0.00	0.01

- 14 species caught more often than detected
- Of these, 11 absent from reference database (DNA may be present in sample, but not assignable)

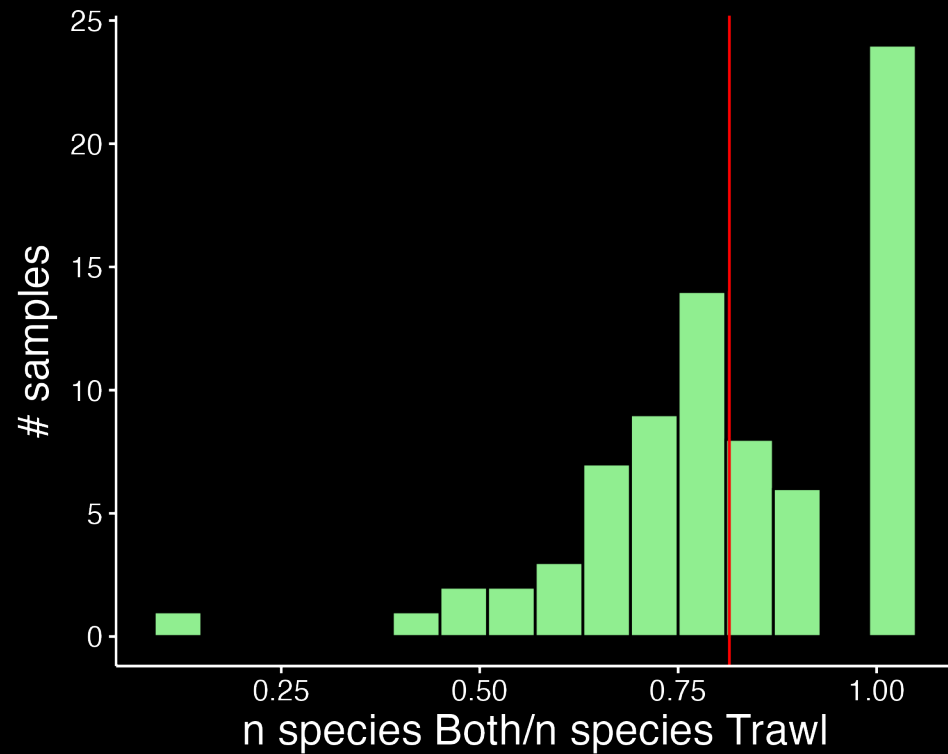


RED CAPS = reference sequence missing

More trawl species detected by eDNA than eDNA species caught by trawl



46% of species detected in each eDNA sample were **caught** in corresponding tow



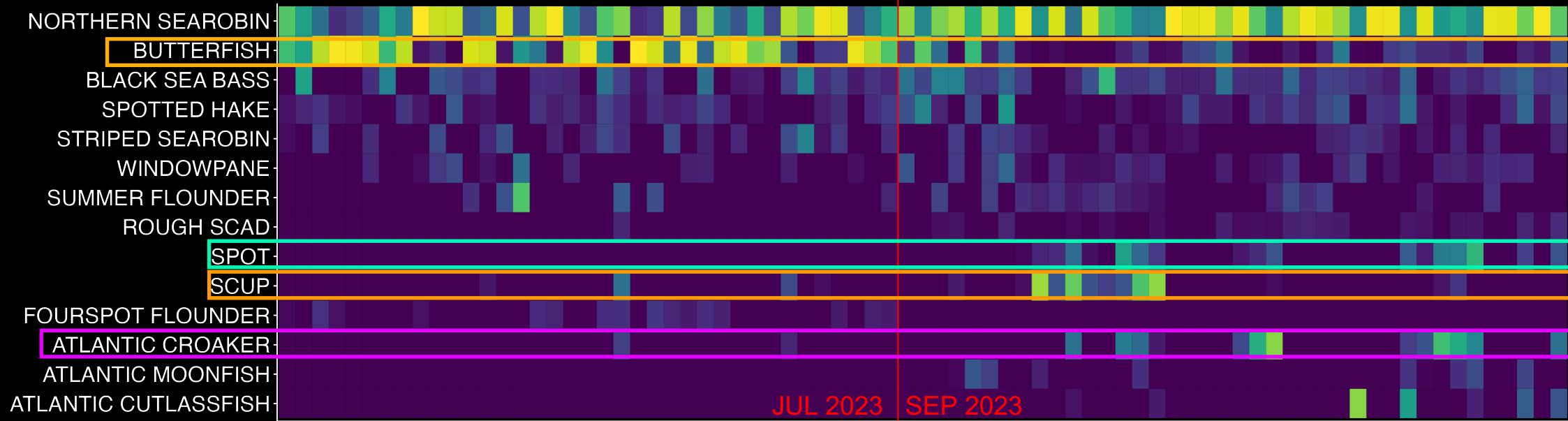
81% of species caught in each tow were **detected** in corresponding eDNA sample

Relative abundance comparisons

- eDNA sequencing read counts vs trawl biomass density
- Hellinger transformed (square root of relative abundance)

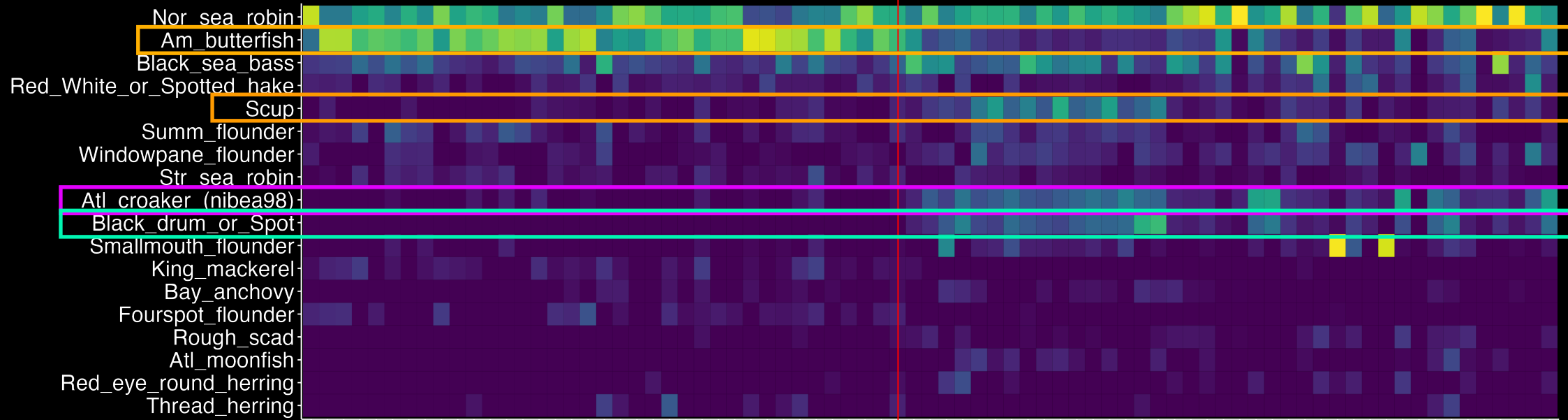


Trawl



Biomass density 0.00 0.25 0.50 0.75

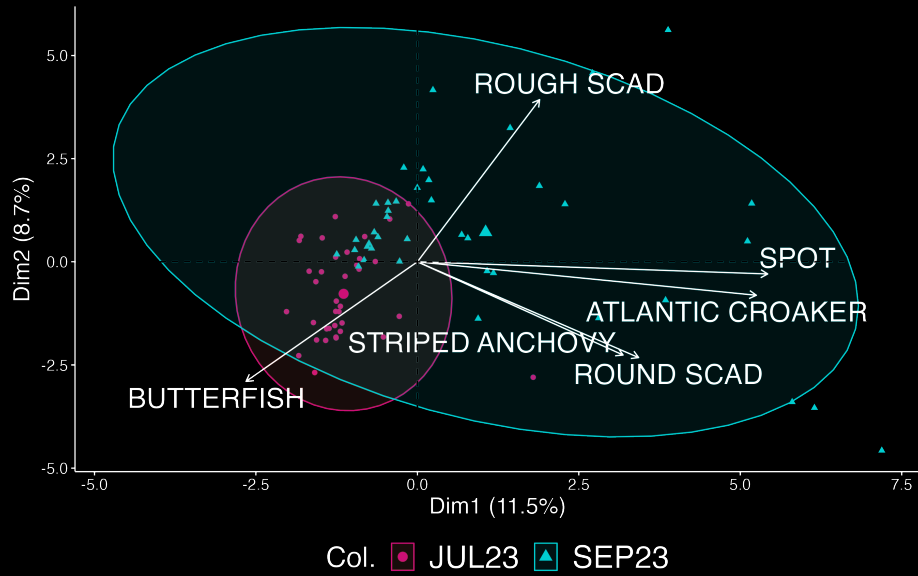
eDNA



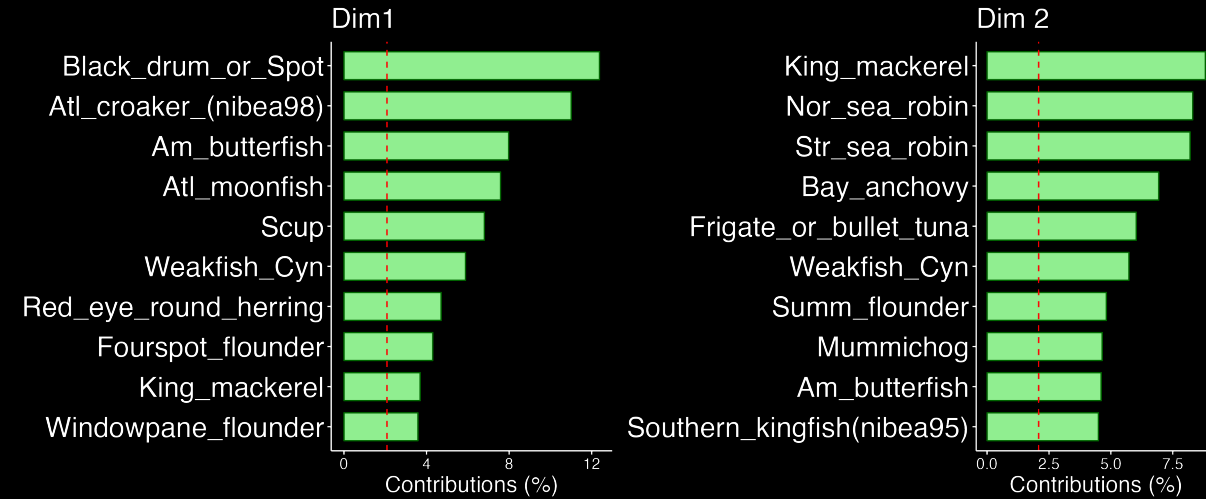
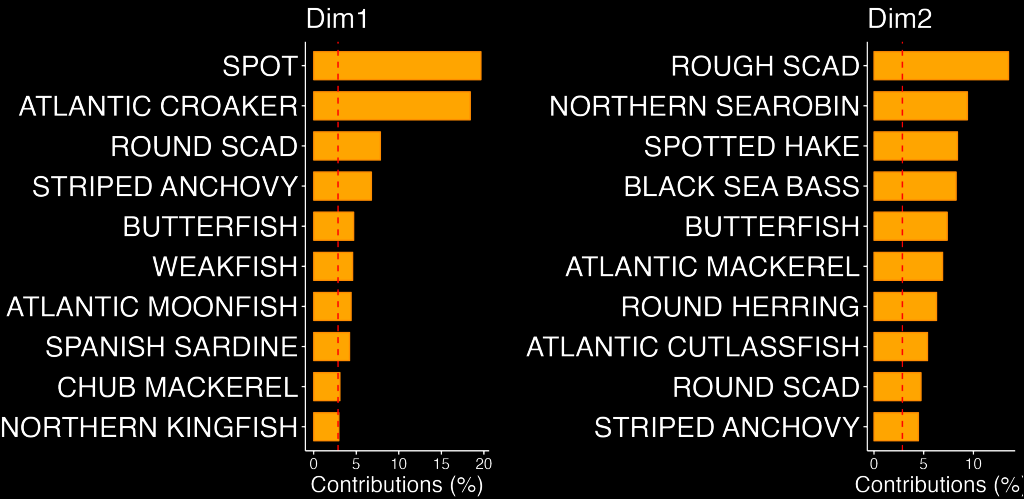
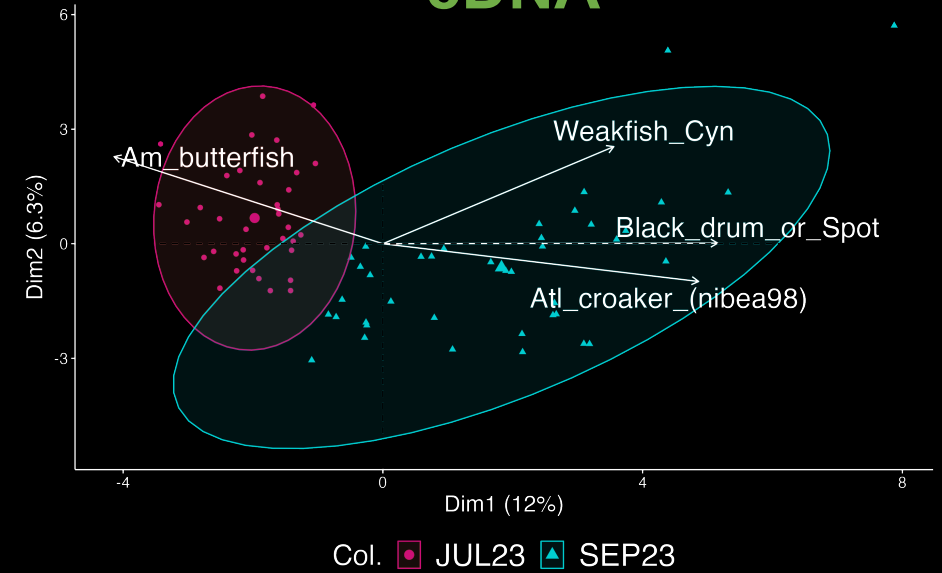
DNA read abundance 0.00 0.25 0.50 0.75

PCA: Fish community change July-September

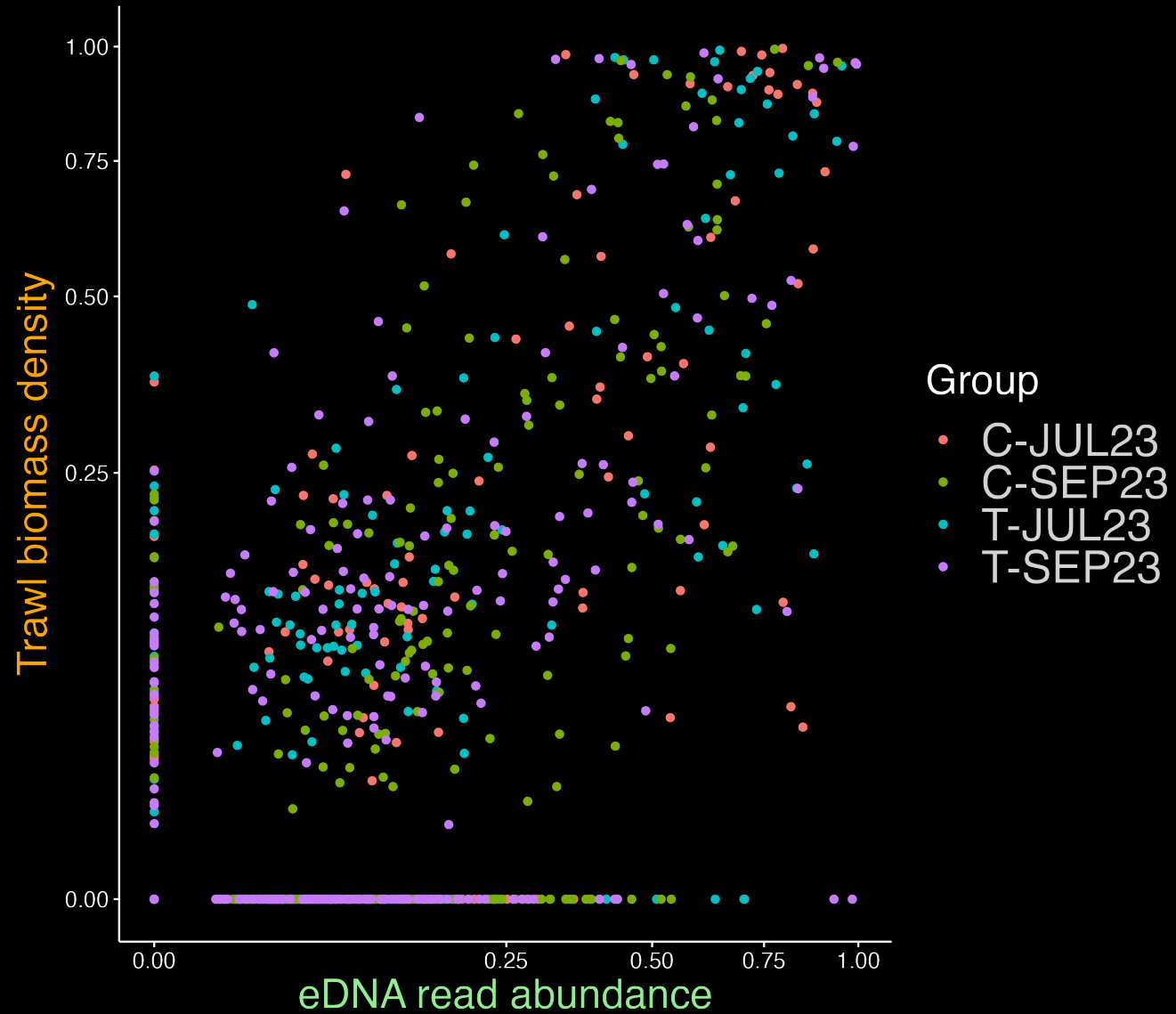
Trawl



eDNA

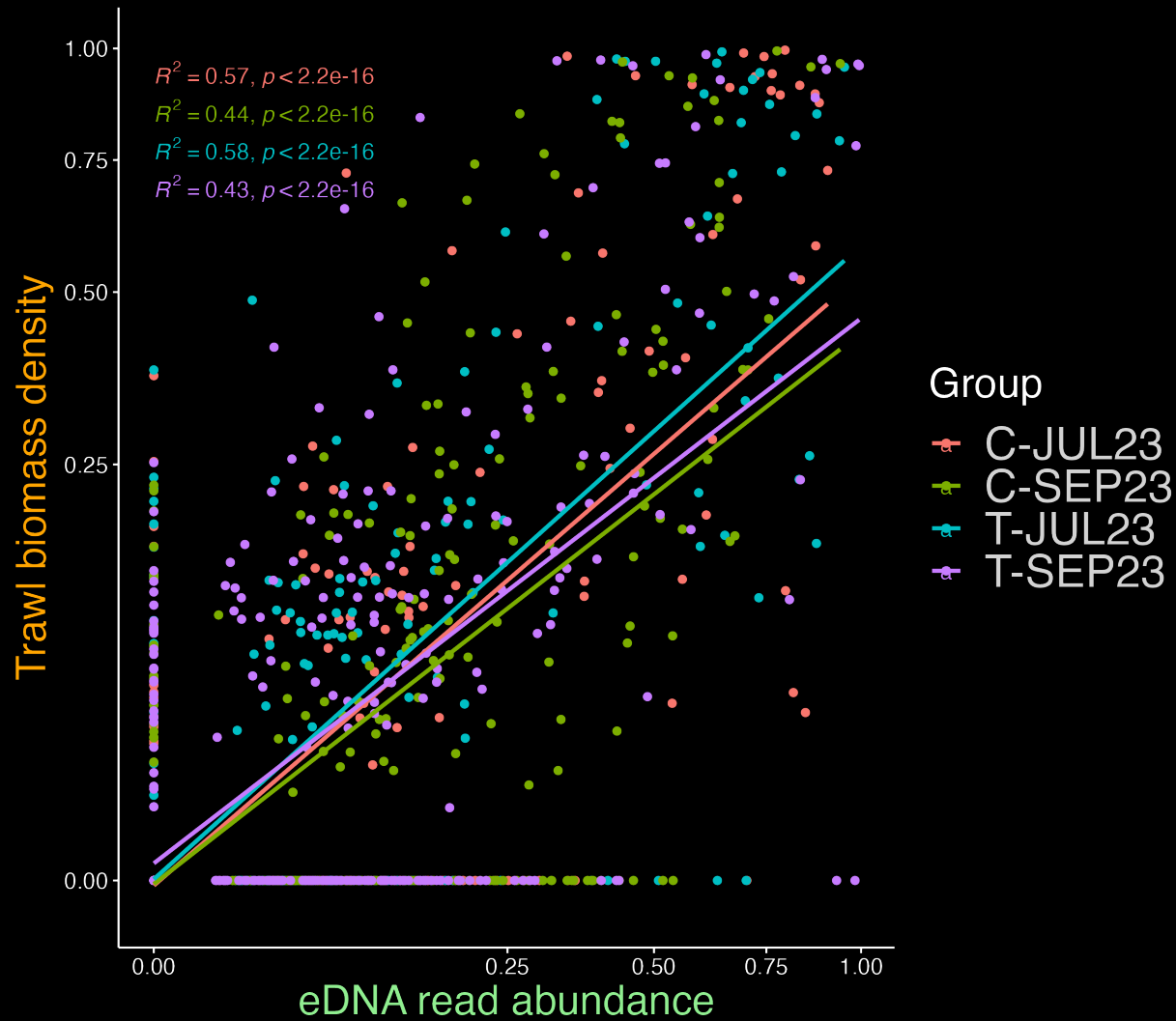


Relative abundance trawl vs eDNA

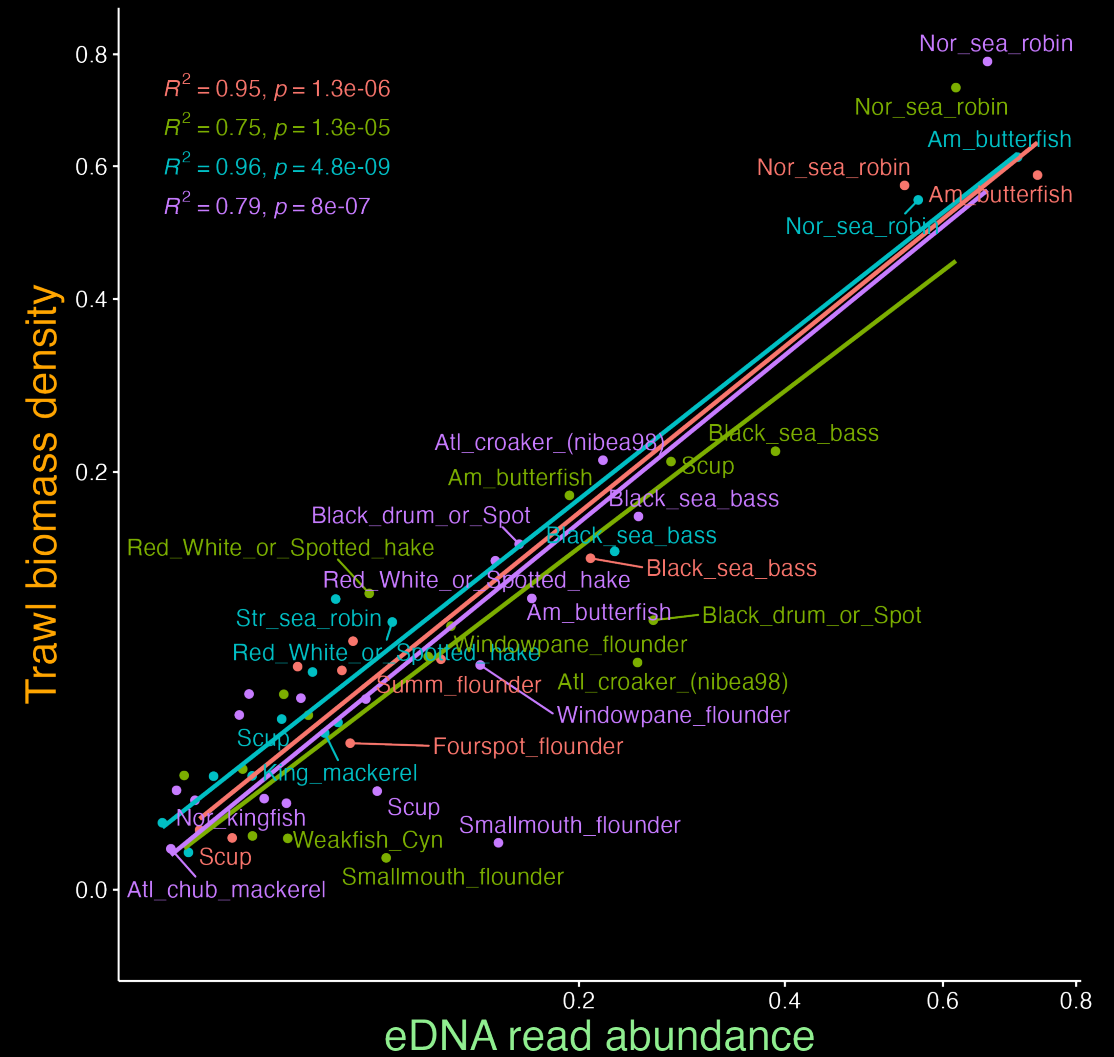


Relative abundance regression

Grouping by bout, area

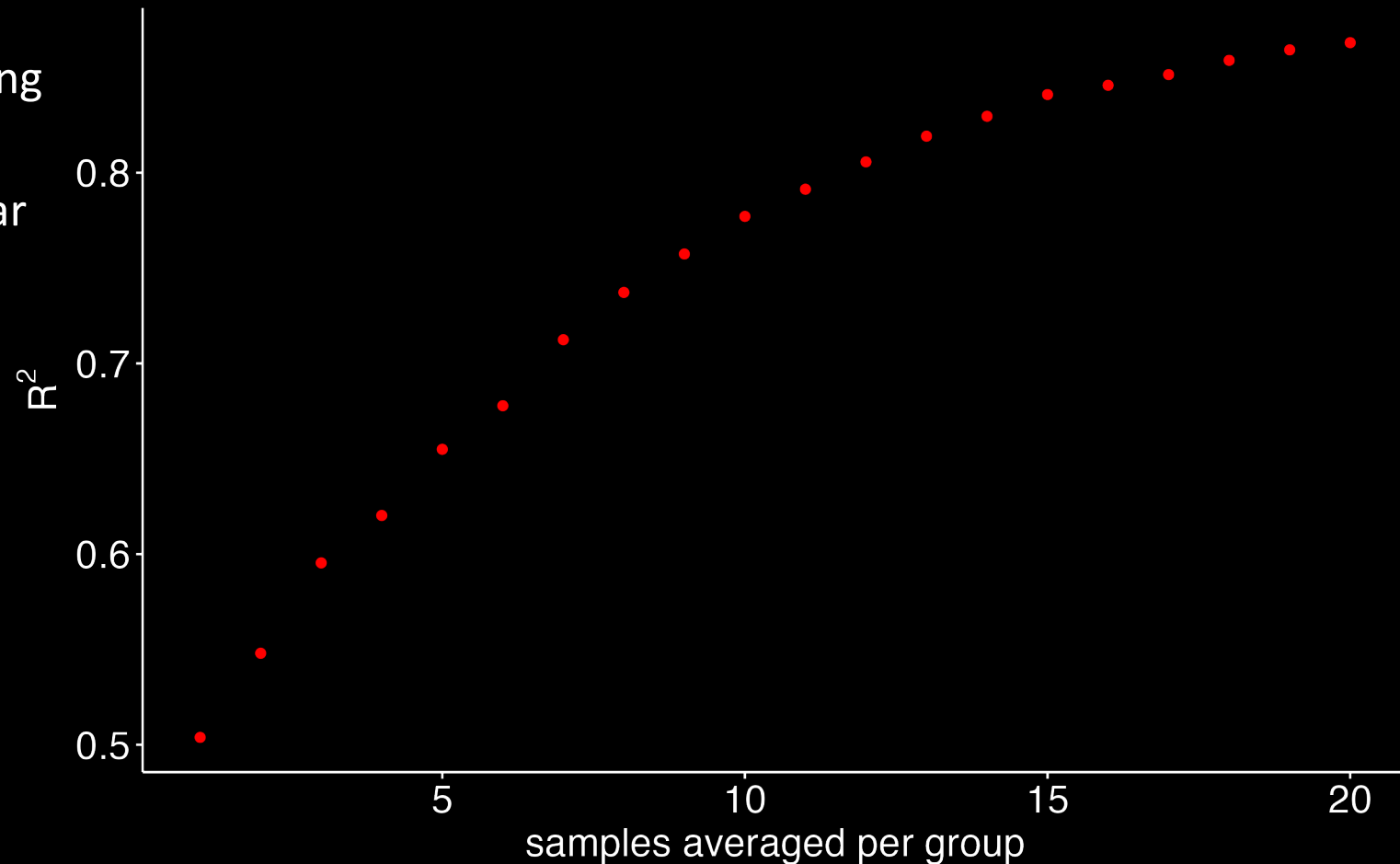


Mean by species, bout, area (T or C)



More samples, better agreement

- Randomized resampling of our data
- R^2 of trawl-eDNA linear model improves as more samples are included in comparisons



Summary

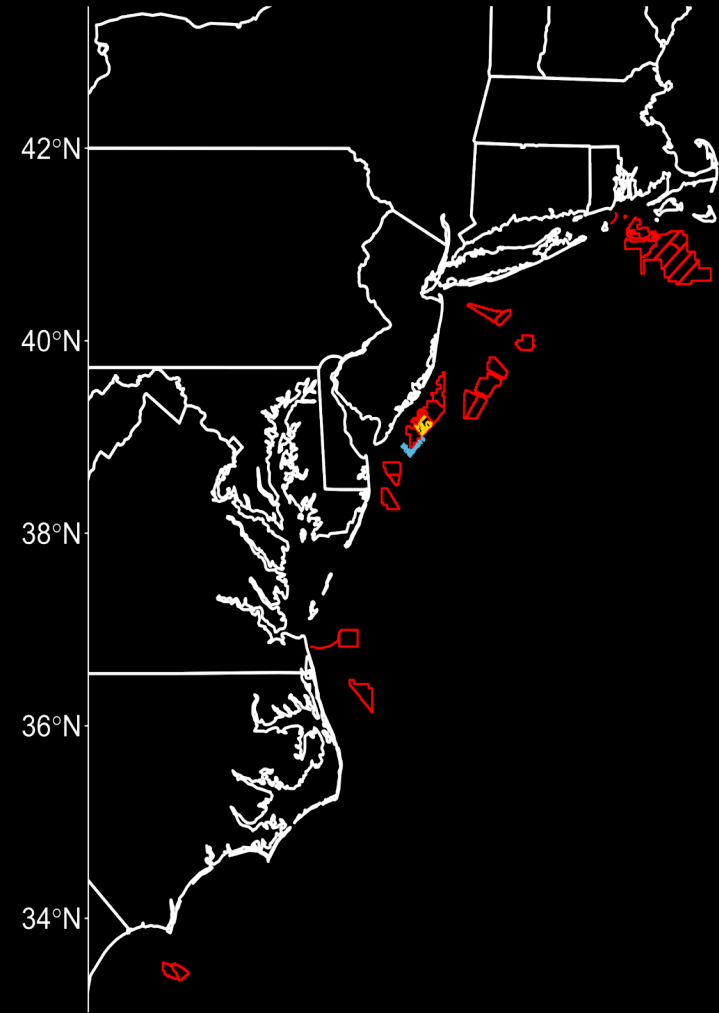
- eDNA metabarcoding tends to detect more teleost species than trawl
- Seasonal shifts in species abundance recorded by both
- Relative abundance:
 - Variable between methods on a **per-tow** basis
 - **Averaging** abundances from many samples produces significant positive relationships



What's next?

NJ Research Monitoring Initiative

- Quarterly eDNA sampling at wind lease areas with concurrent surf sampling
- **Citizen science** sampling at surf zone
- New Jersey Ocean Trawl paired eDNA
- Raritan Inventory Project, Trawl-eDNA
- NJ Artificial Reefs, trap-eDNA



Funding:



Questions?

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We are hiring!

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Library Prep & Sequencing: Sabeena Nazar (BASLab)