Harnessing eDNA for reef monitoring: a continental scale comparison with visual surveys in Australia

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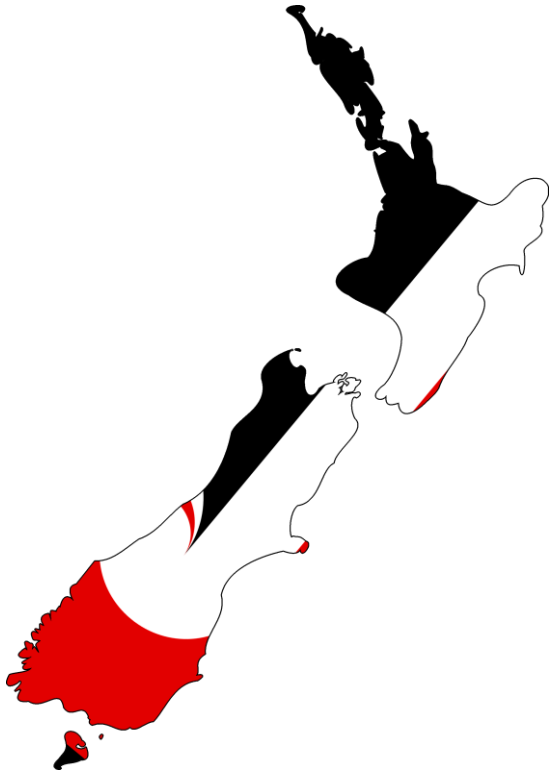

I acknowledge the Traditional custodians and First Nations, and pay my respect to their Elders, past, present and emerging.

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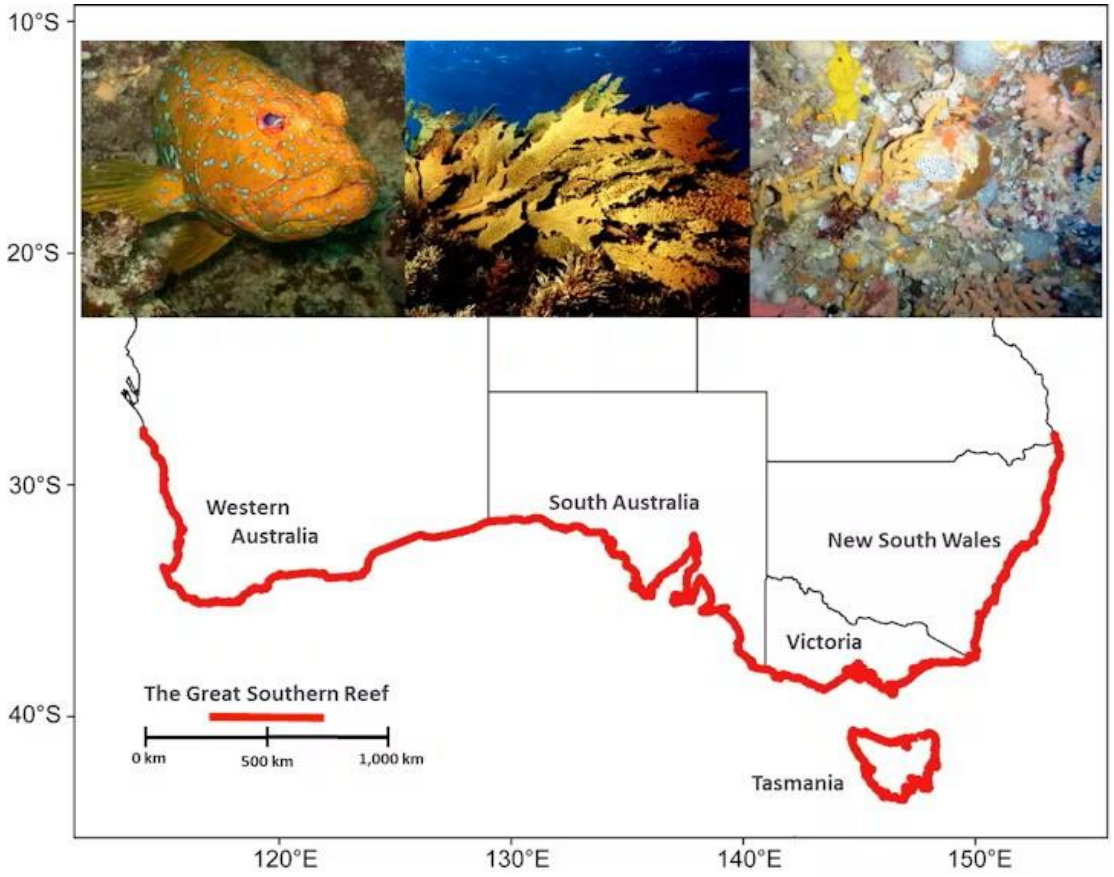
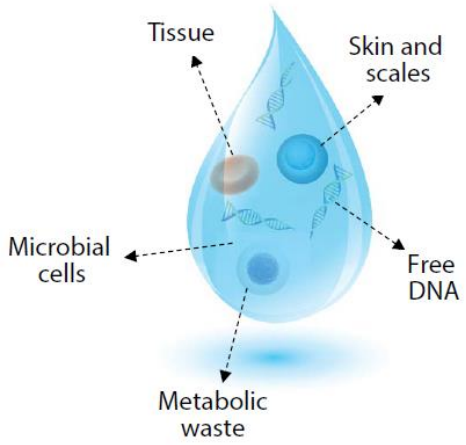


Bennett et al., 2015



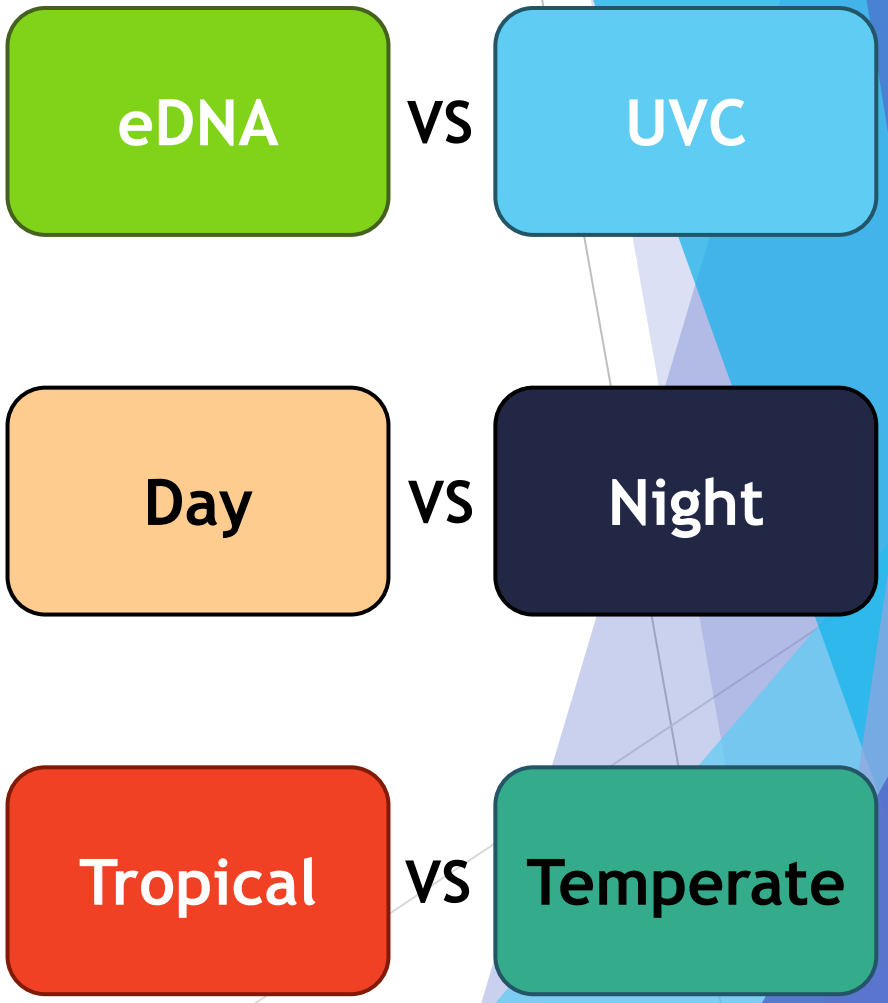
Chavez et al., 2021

Questions

(1) Detectability of taxa across the two methods?

(2) Detectability of nocturnal species?

(3) Differences among locations?



- Total: 54 sites
- Day/Night: 33 sites

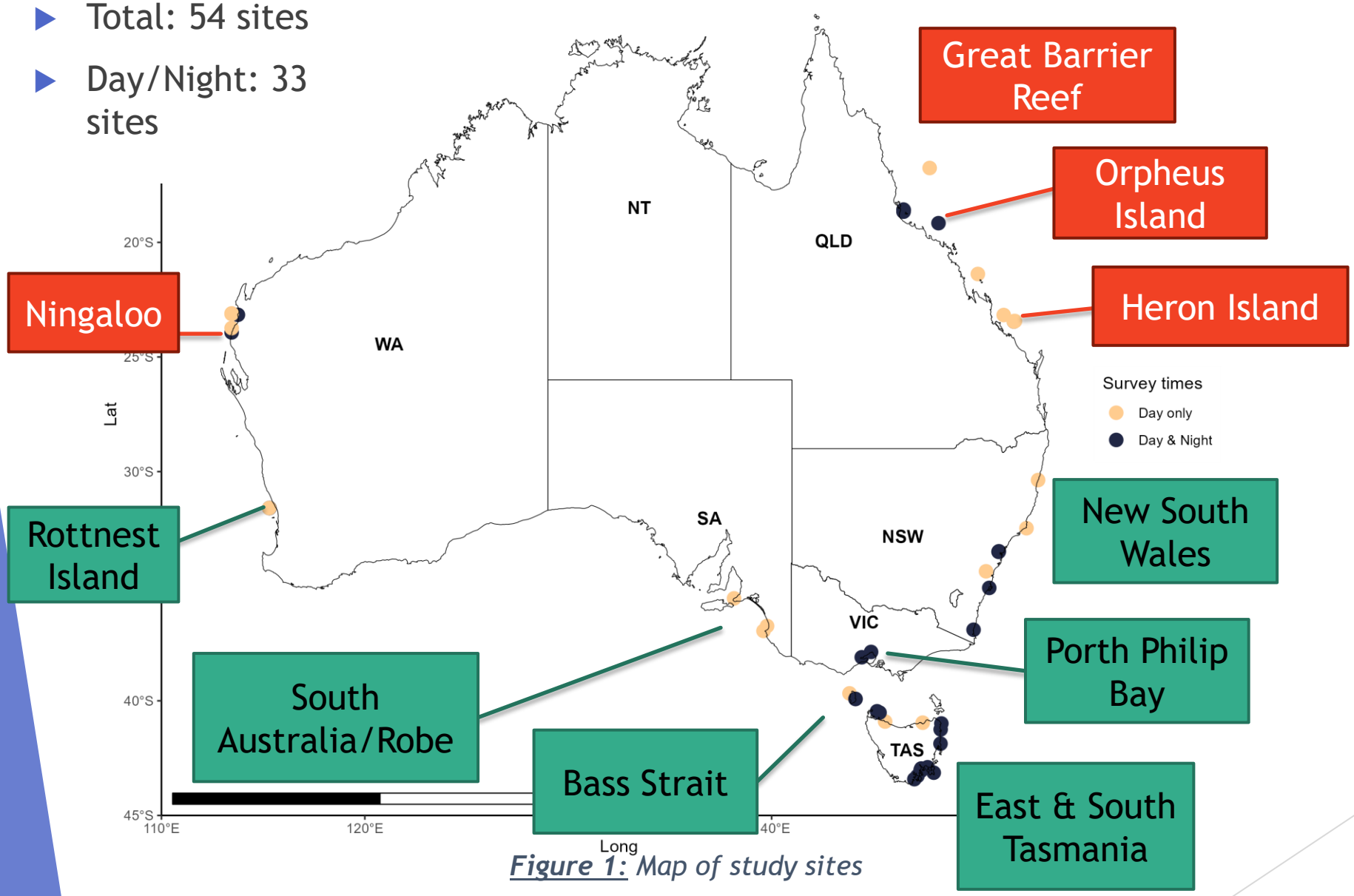


Figure 1: Map of study sites

DAY

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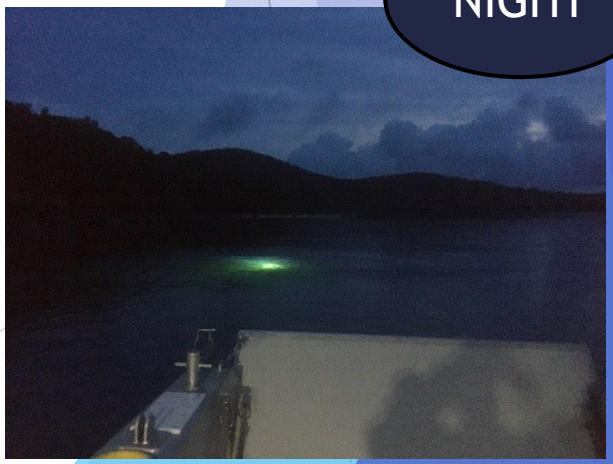
NIGHT



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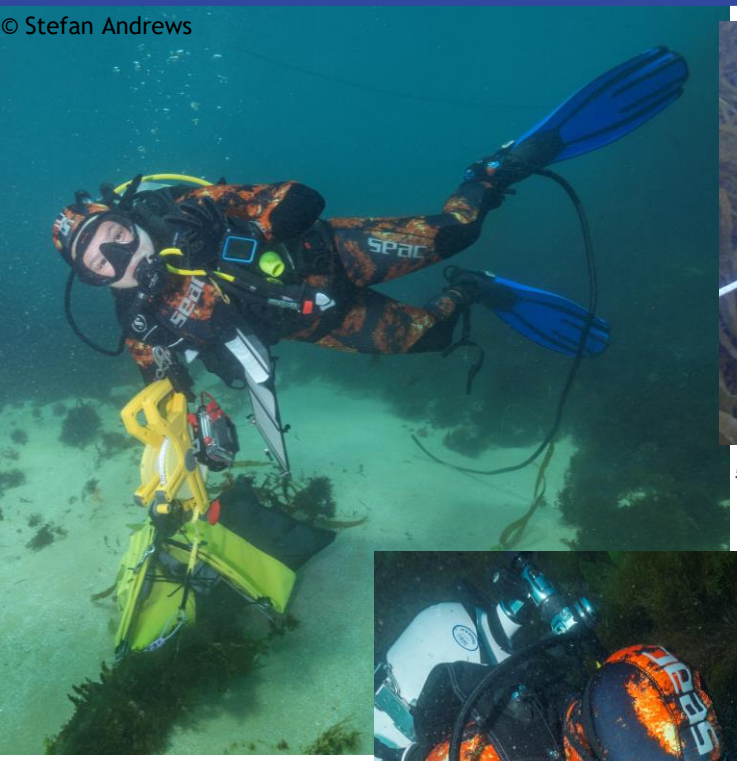
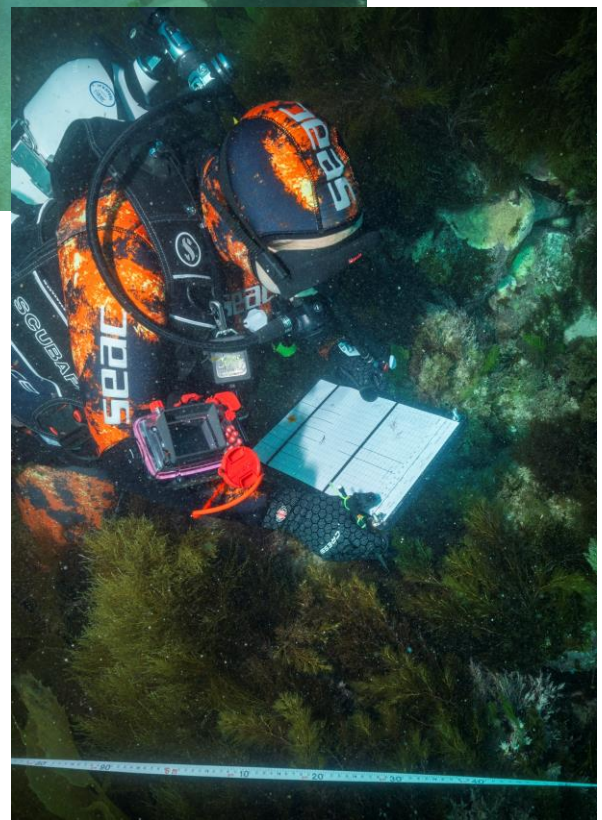
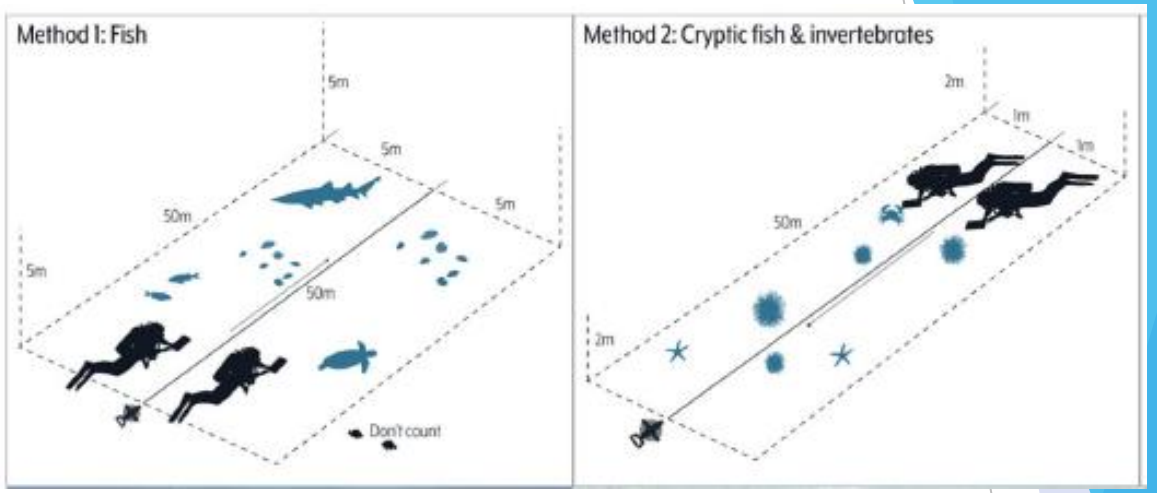




REEF LIFE SURVEY

Bass Strait - Old wife

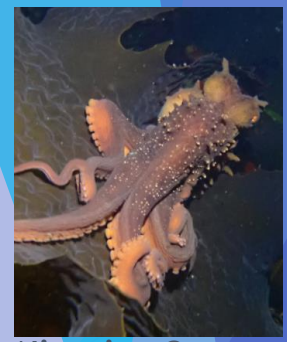


Bicheno - Big belly seahorse

Ninepin - Velvet fish

Spring Beach - Draughtboard shark

Rocky Cape - Crab



Ninepin - Octopus

Tinder box - Tosia

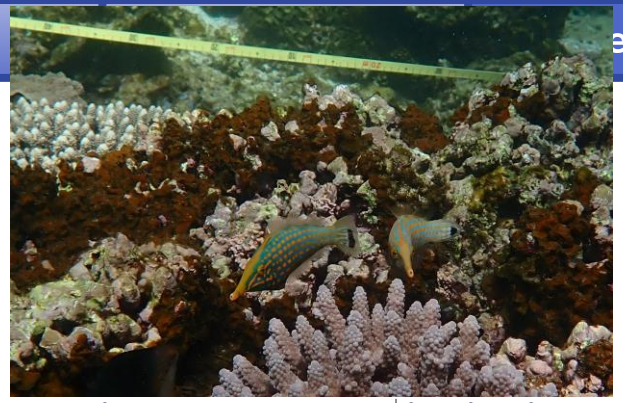
Binalong - Stingaree

Rocky Cape - Boarfish

Bass Strait - Weed fish

Spring beach - Ocellate Seastar

Rottnest Island - Wobbegong shark



Ningaloo - Harlequin filefish

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Heron Island - Green turtle

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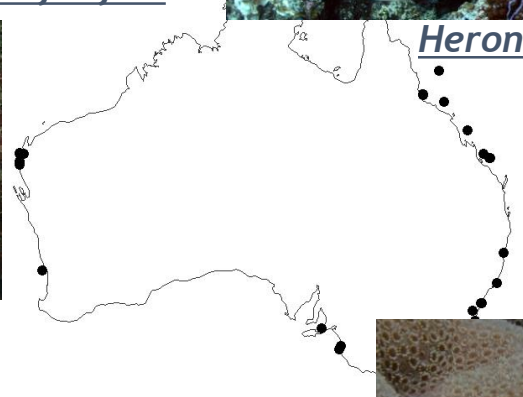
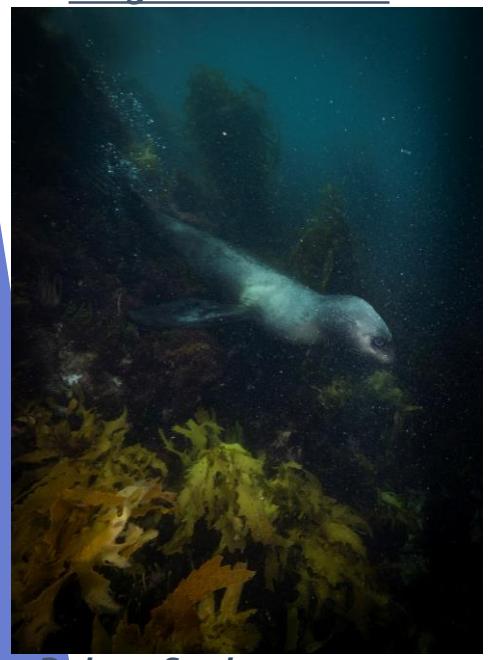
Jervis Bay - Eastern blue groper

Ningaloo - Blennie

Rottnest Island - Cardinal fish



GBR - Triplefin



Robe - Seal © Stefan Andrews

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King Island - Weedy Seadragon

Derwent - Spotted Handfish

Bicheno - Big belly seahorse

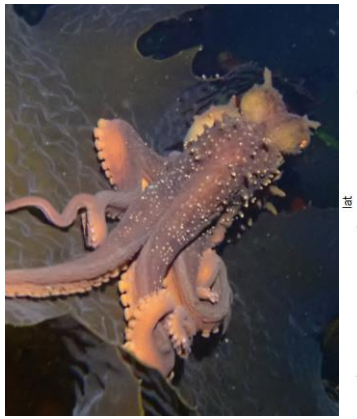
Ningaloo - Cardinal

Ningaloo - Crab

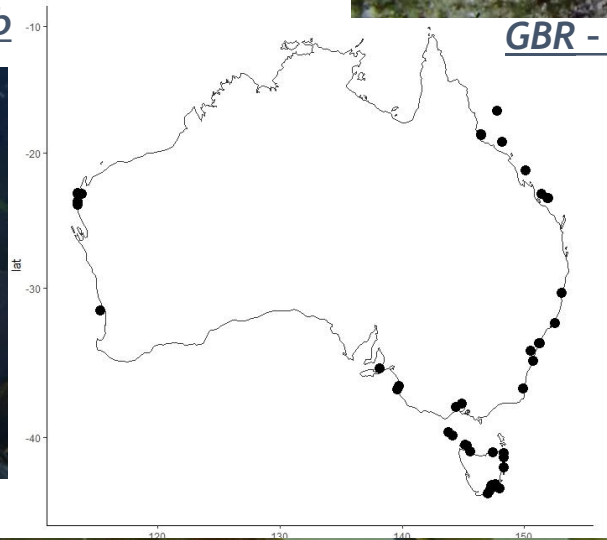
GBR - Giant hermit

GBR - Epualette shark

Rottnest Island - Cardinal



Ninepin - Octopus



Jervis - Scorpaena

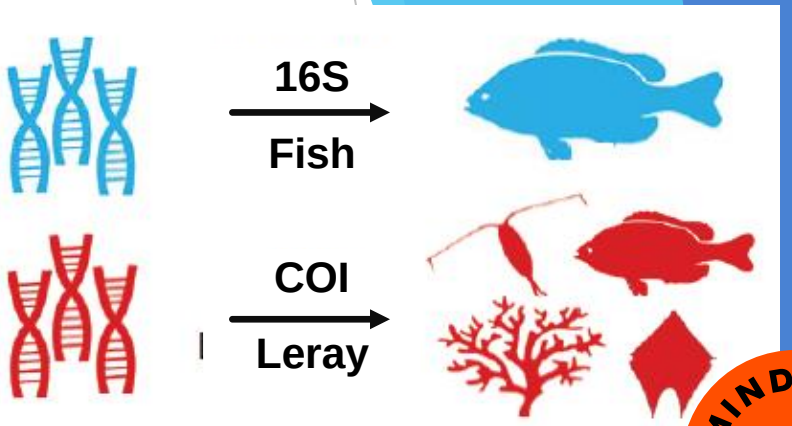
Sydney - Hydratina physis

Rottnest Island - Lobster

Three Hummock Island - Weedfish

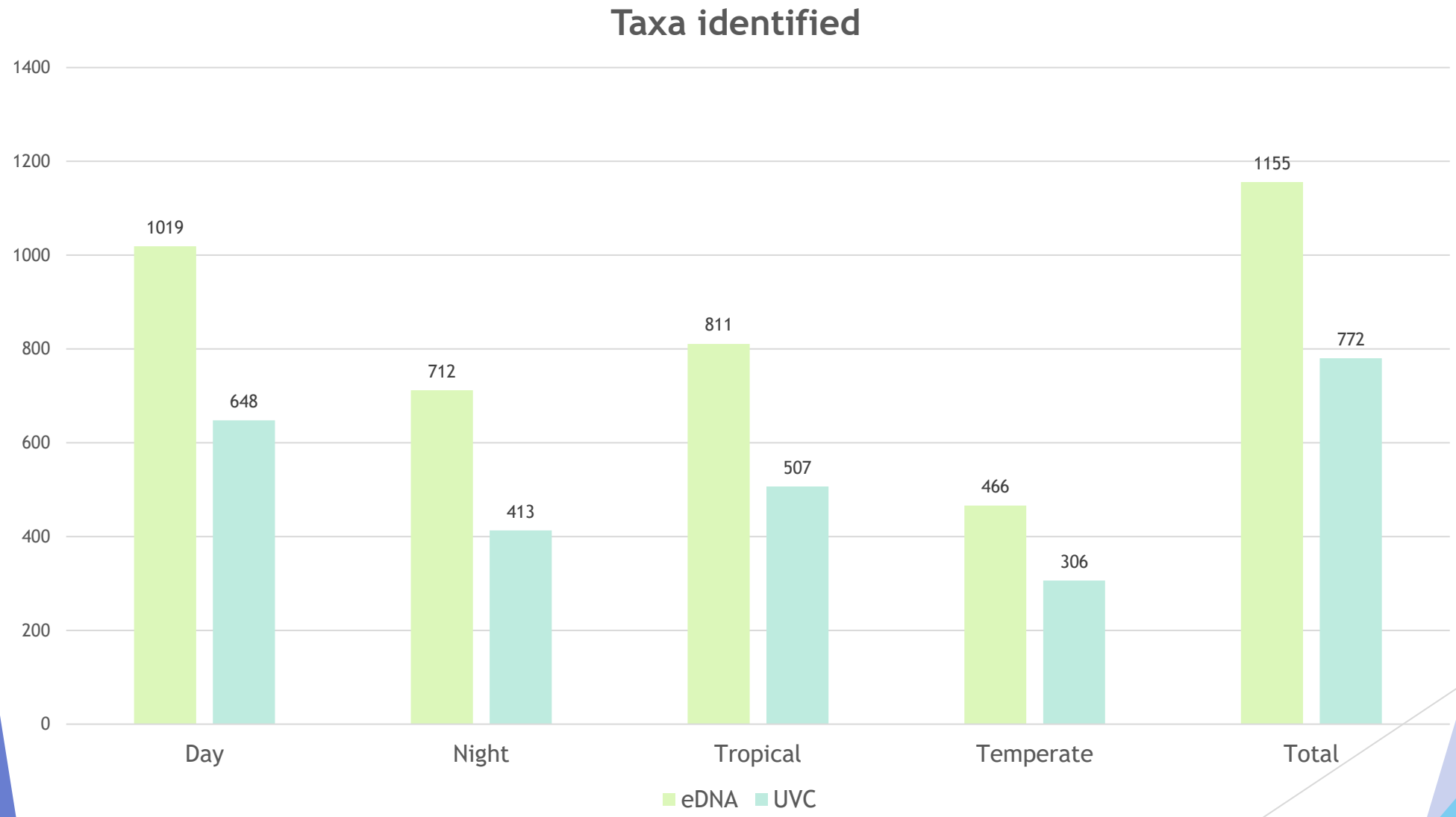
Eddystone - Port Jackson shark

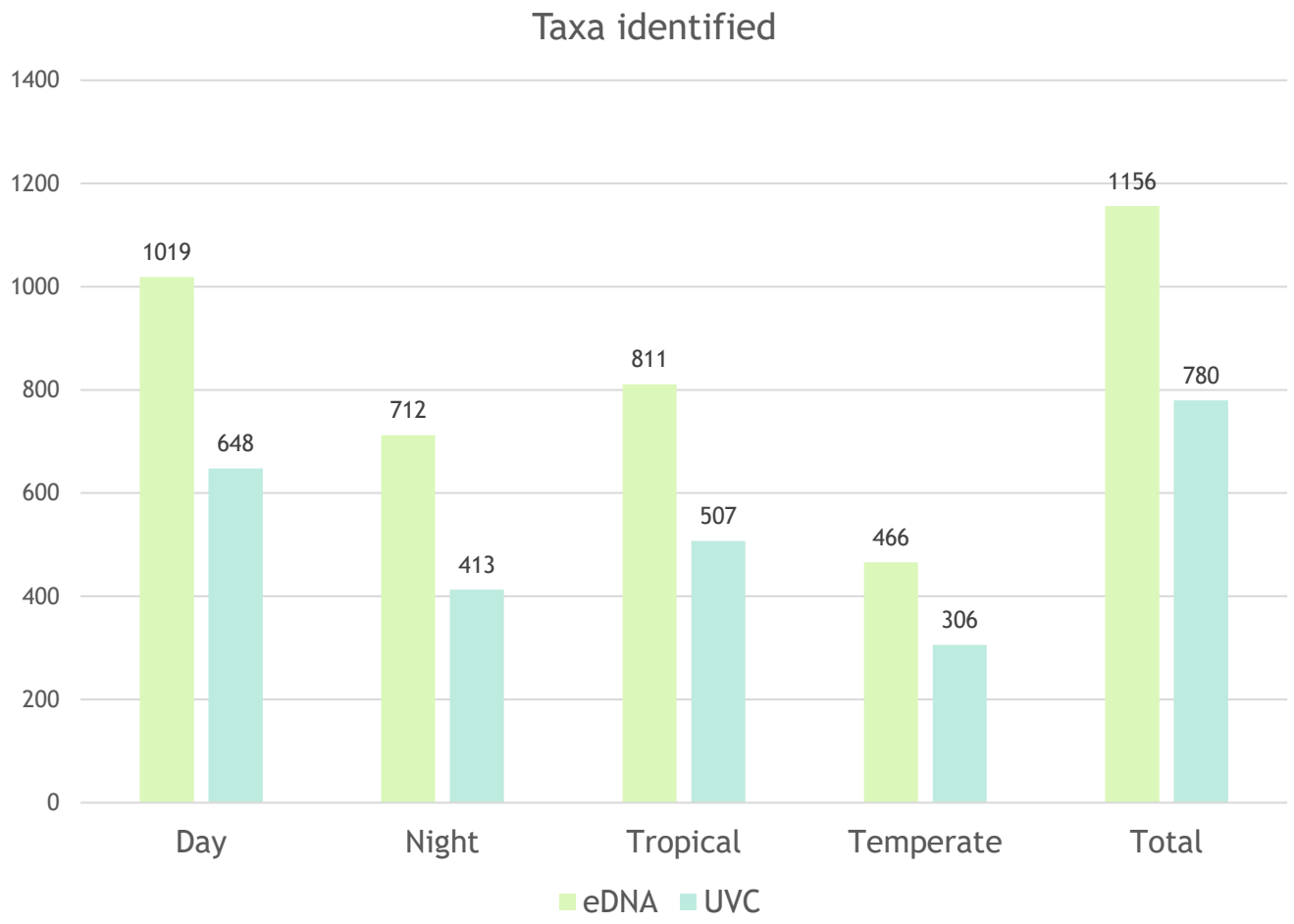
Collect seawater



Filter seawater

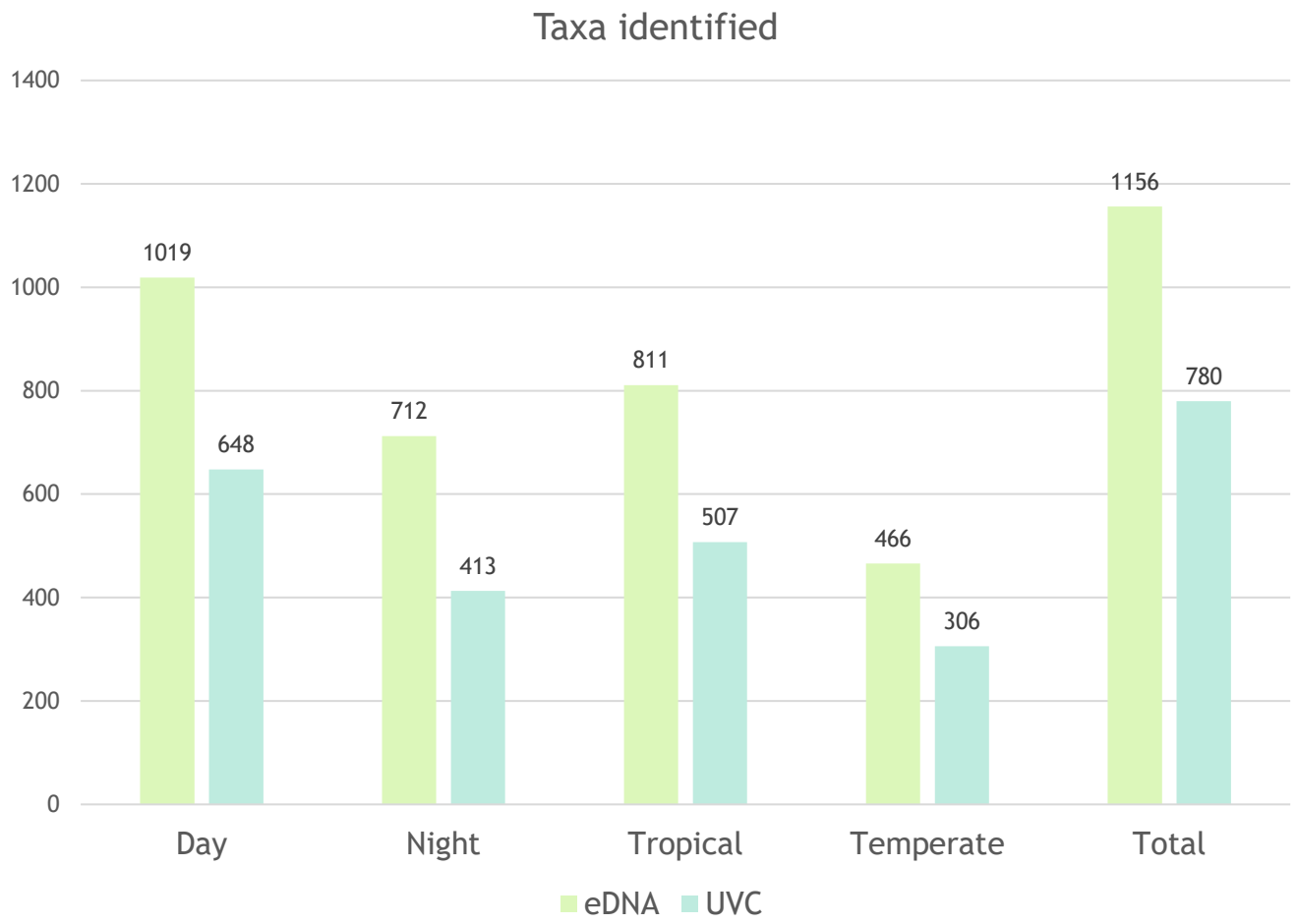
Capture eDNA in filter (0.45µm)


Taxa identified
1400
1200
1000
800
600
400
200
0
1019
648
712
413
811
507
466
306
1155
772
Day
Night
Tropical
Temperate
Total
eDNA
UVC



Nocturnal species

eDNA	138
UVC	132



Nocturnal species

eDNA	138
UVC	132

Tropical VS **Temperate**

eDNA: 127 species overlap
UVC: 33 species overlap

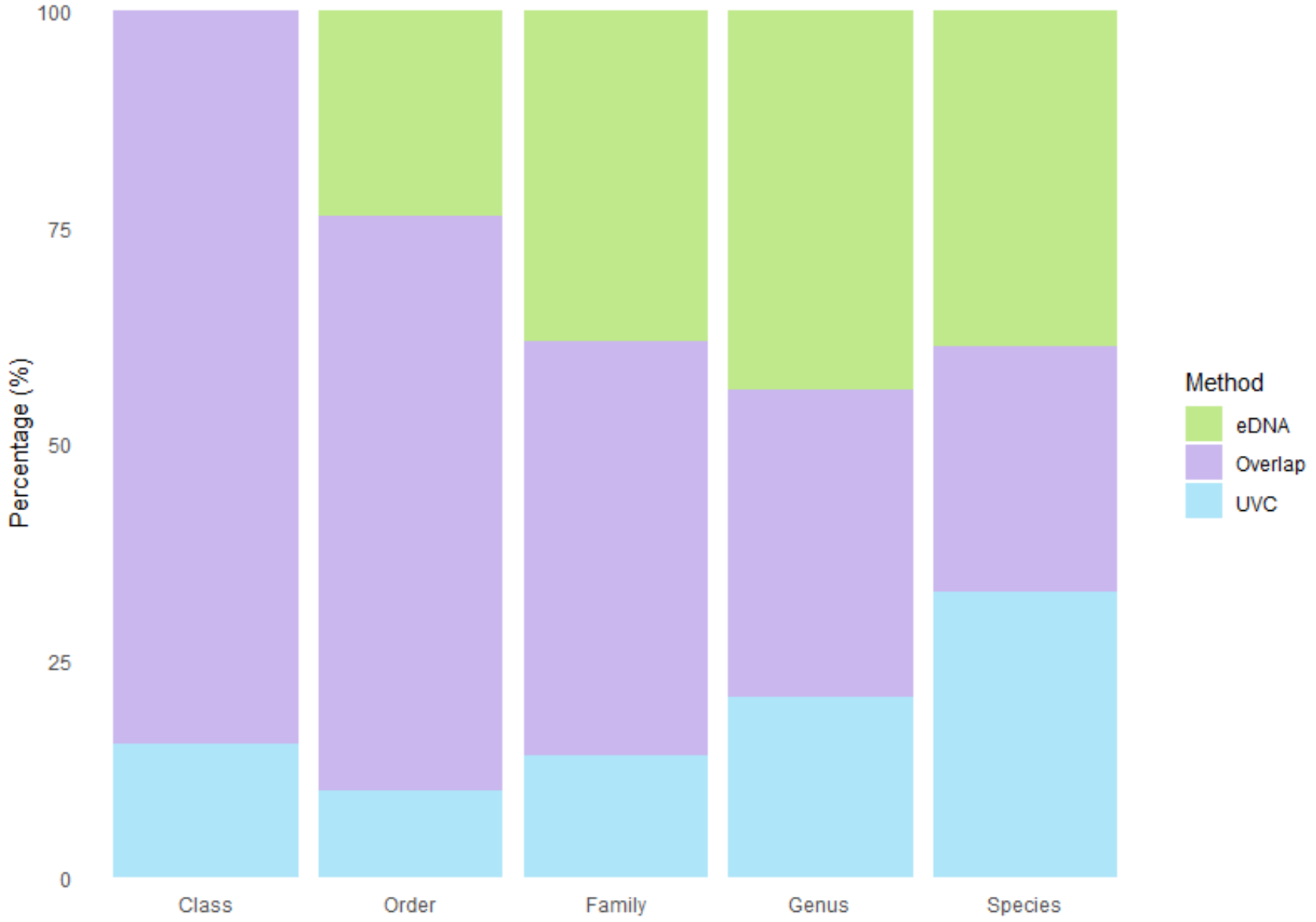


***Figure 2:** Percentage of taxa detected by UVC and eDNA methods, separately and combined, across taxonomic ranks.* *Only taxa fully identified at each specific taxonomic rank were included in the percentage calculations (e.g., taxa identified to the genus level were excluded from species-level calculations). Taxa identified at least to the family level were retained for 16S and infra-order for COI.*

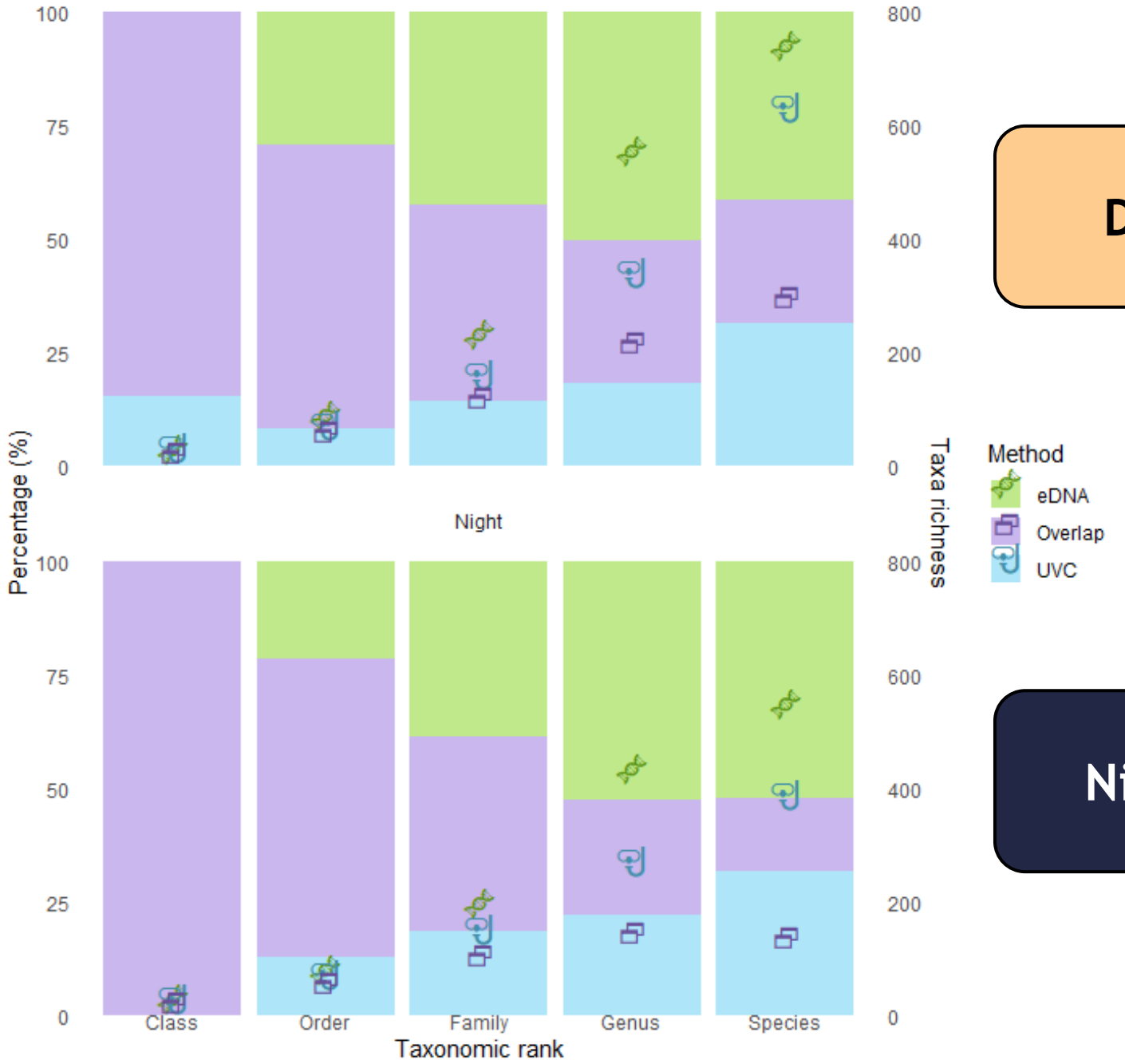


***Figure 3:** Percentage of taxa detected by UVC and eDNA methods, separately and combined, across taxonomic ranks during day and night. Overlaid with taxa richness.* *Only taxa fully identified at each specific taxonomic rank were included in the percentage calculations (e.g., taxa identified to the genus level were excluded from species-level calculations). Taxa identified at least to the family level were retained for 16S and infra-order for COI.*

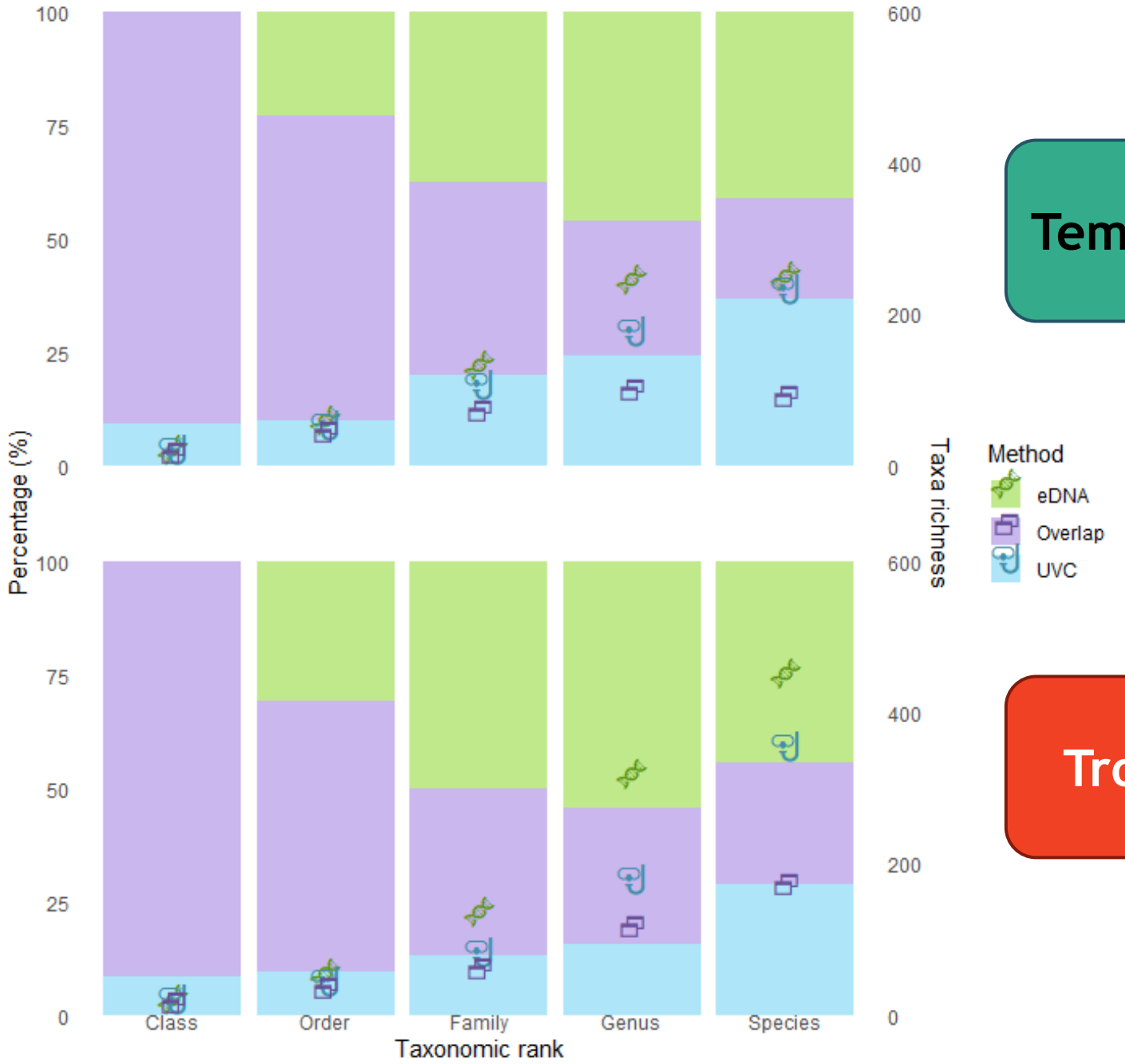
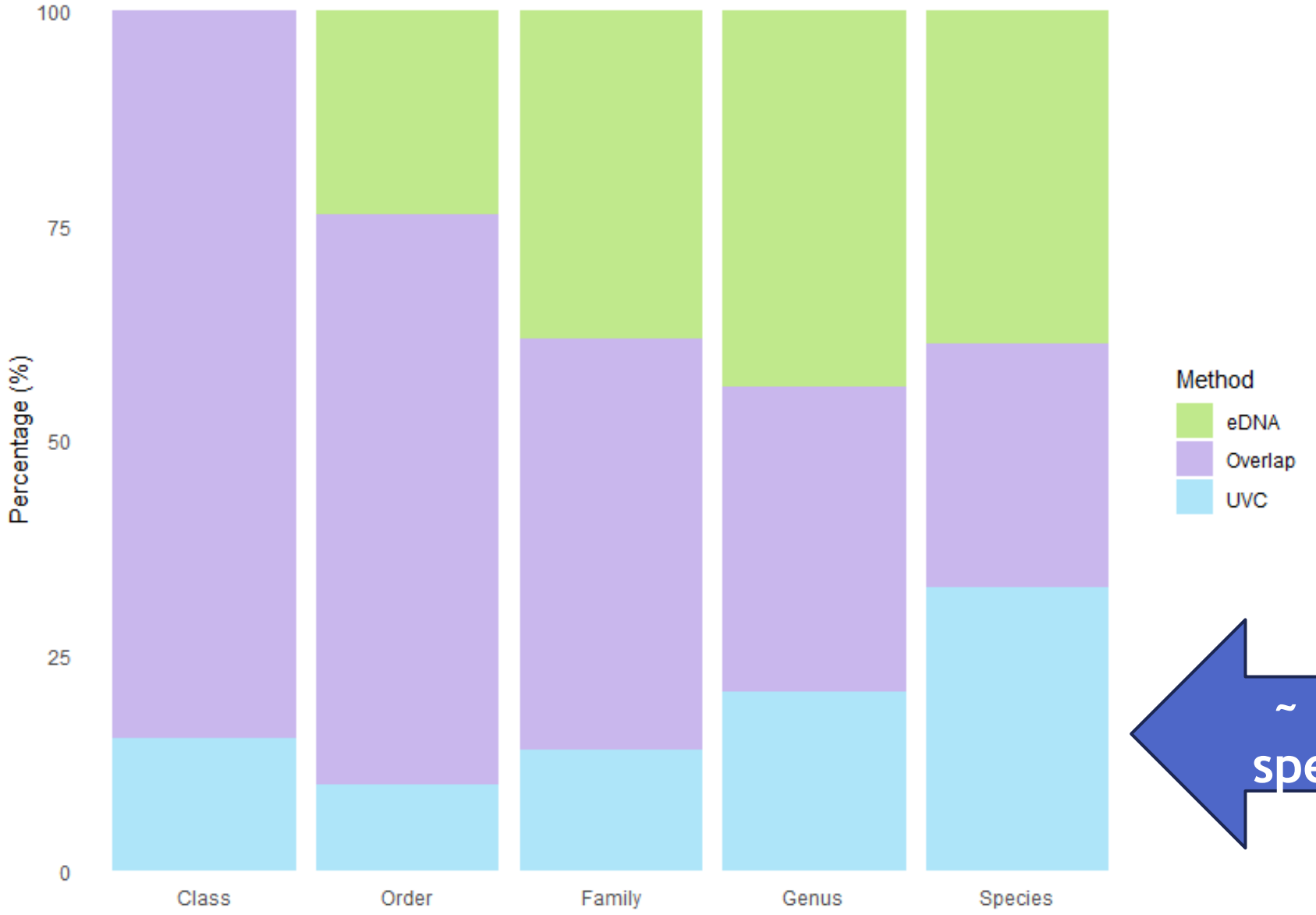


Figure 4: ***Percentage of taxa detected by UVC and eDNA methods, separately and combined, across taxonomic ranks in tropical and temperate reefs. Overlaid with taxa richness.*** *Only taxa fully identified at each specific taxonomic rank were included in the percentage calculations (e.g., taxa identified to the genus level were excluded from species-level calculations). Taxa identified at least to the family level were retained for 16S and infra-order for COI.*



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~ 388 species

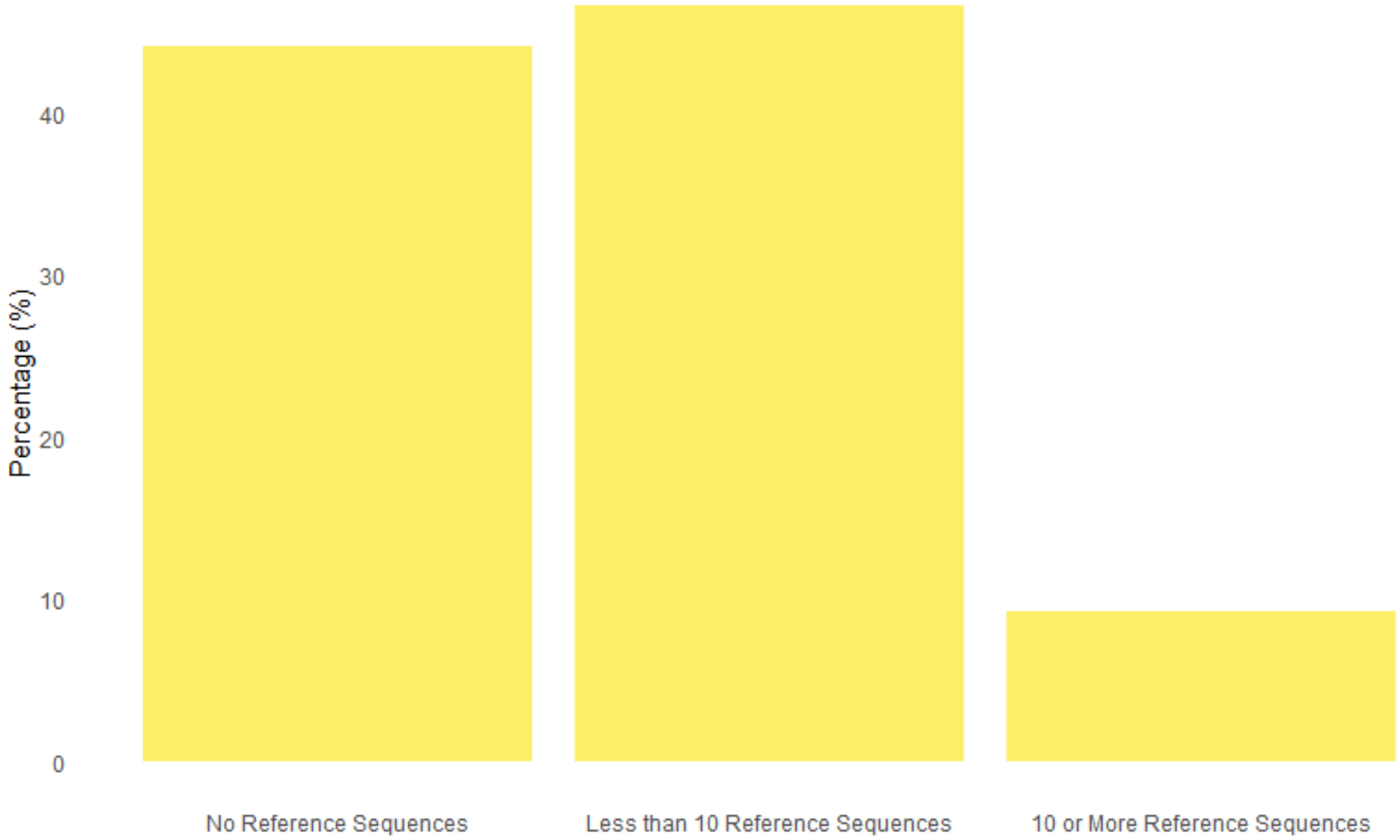


Figure 2: Percentage of taxa detected by UVC and not eDNA methods, separated by the number of reference sequences available on NCBI.

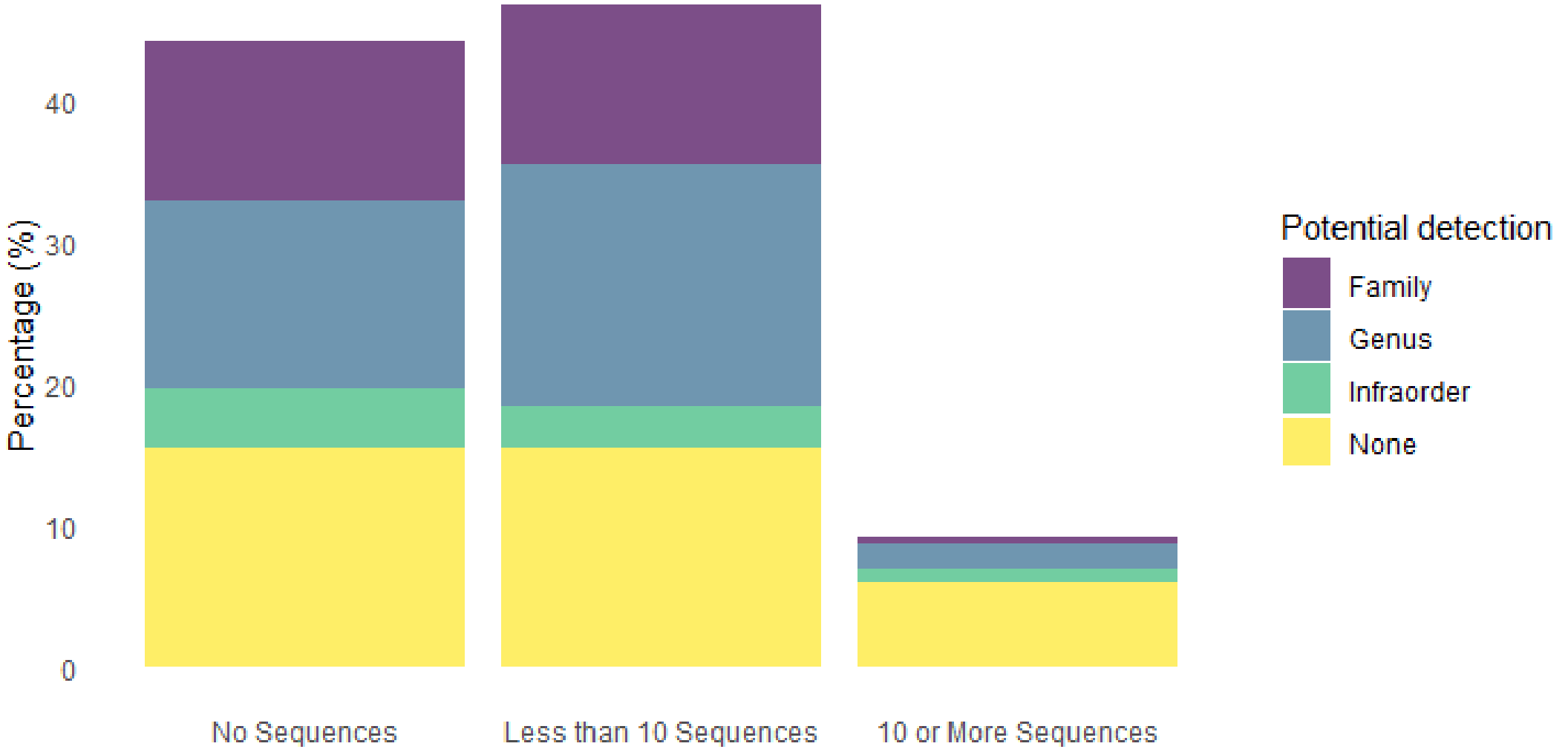


Figure: Percentage of taxa detected by UVC and not eDNA methods, separated by the number of reference sequences available on NCBI.

eDNA VS **UVC**

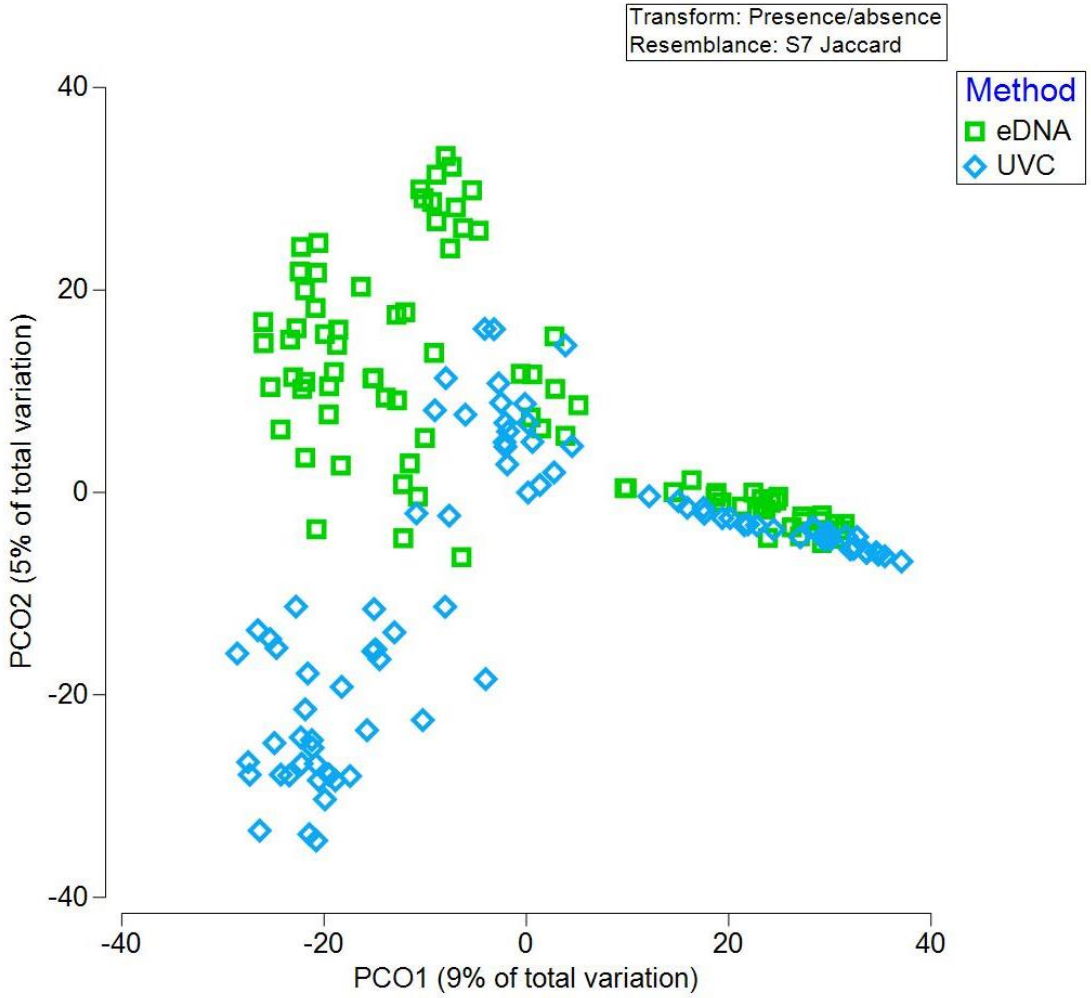
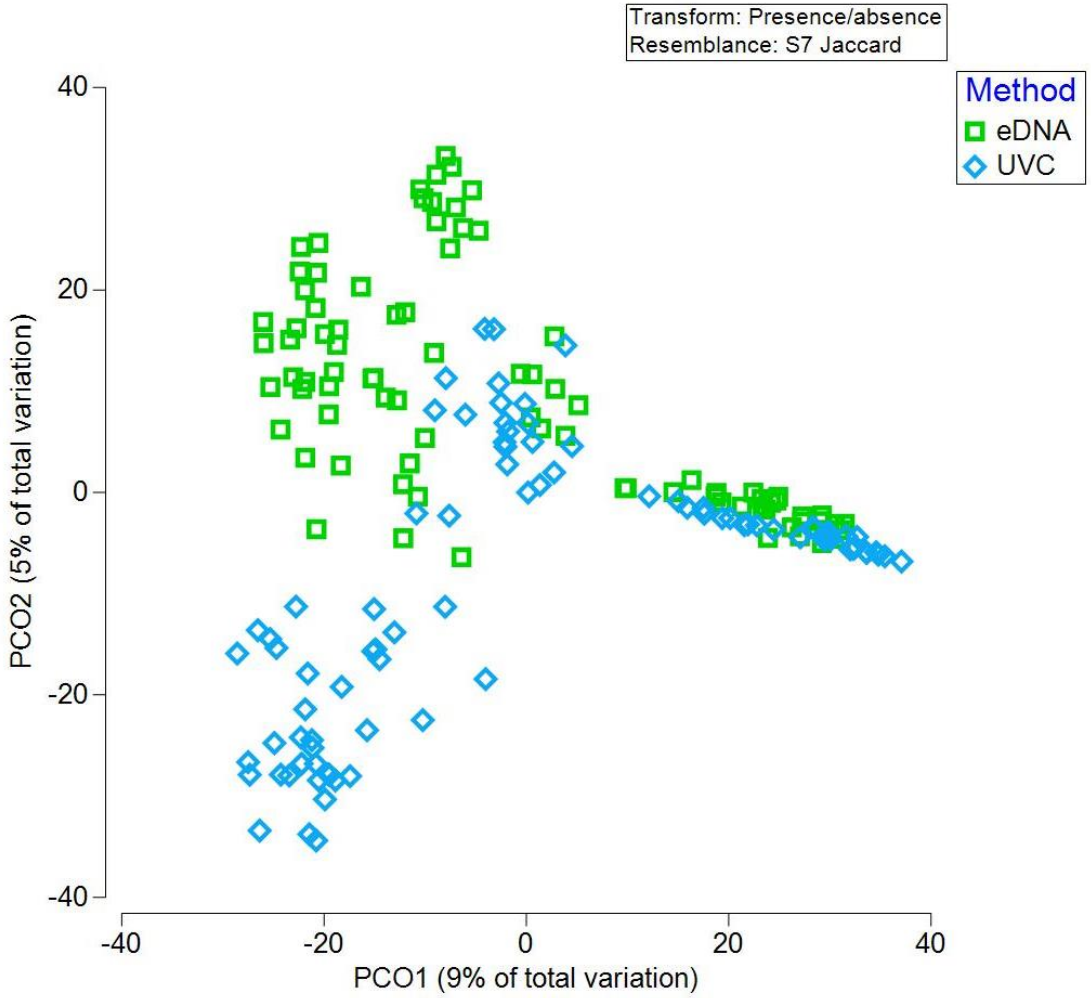
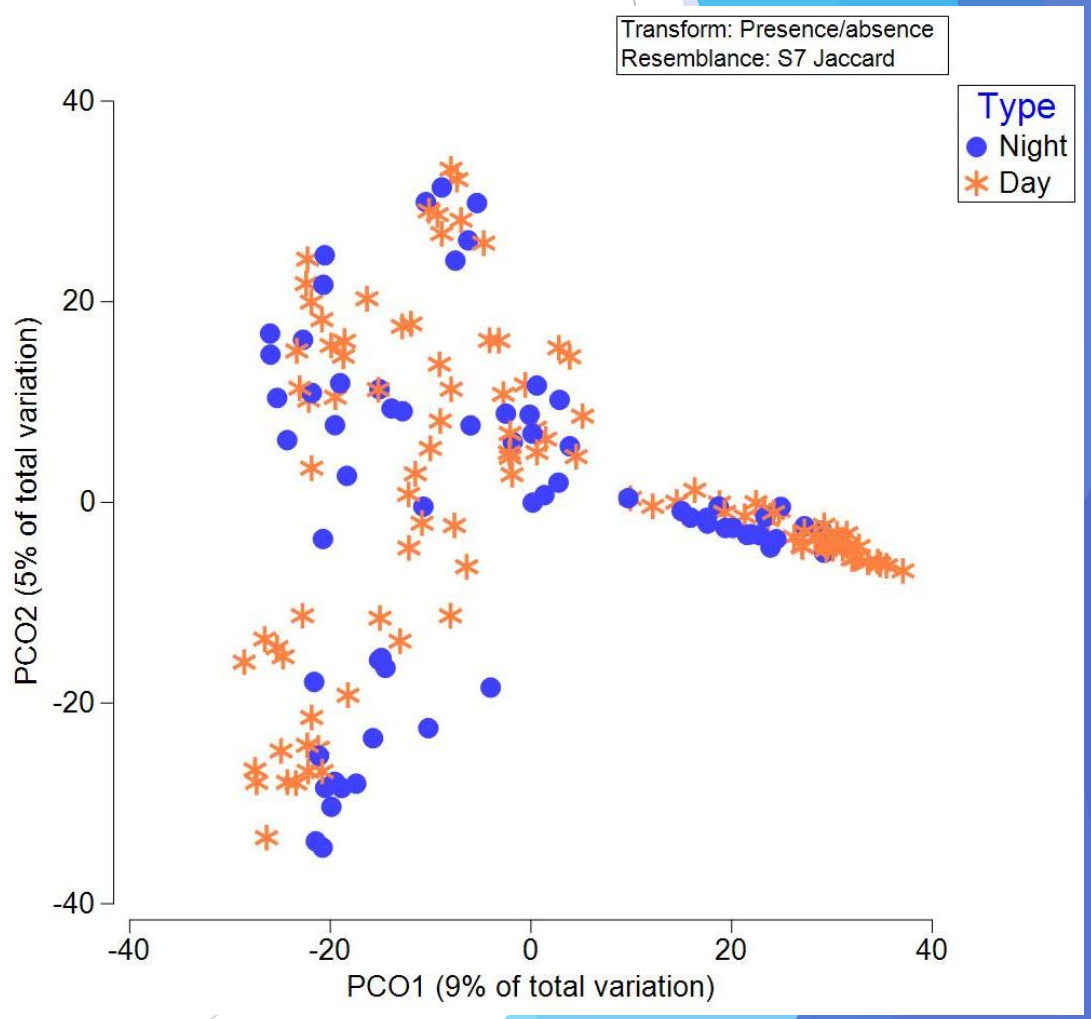


Figure: *Principal Coordinates Analysis of reef assemblages.*

eDNA VS UVC



Day VS Night



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Continual Day–Night eDNA Detectability Amidst Diel Reef Species Fluctuations on Diver Transects

Katrina M. West, Tyson R. Jones, Lara Denis-Roy, Olivia J. Johnson, Ella Clausius, Graham Edgar, Bruce Deagle

First published: 18 October 2024 | https://doi.org/10.1002/edn3.70018

ECOLOGY
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Fish and invertebrate communities show greater day–night partitioning on tropical than temperate reefs

Tyson R. Jones, Graham J. Edgar, Rowan Trebilco, Camille Mellin, Rick D. Stuart-Smith, Lara Denis-Roy, Olivia J. Johnson, Matthew Rose, Scott D. Ling

First published: 03 December 2024 | https://doi.org/10.1002/ecy.4477

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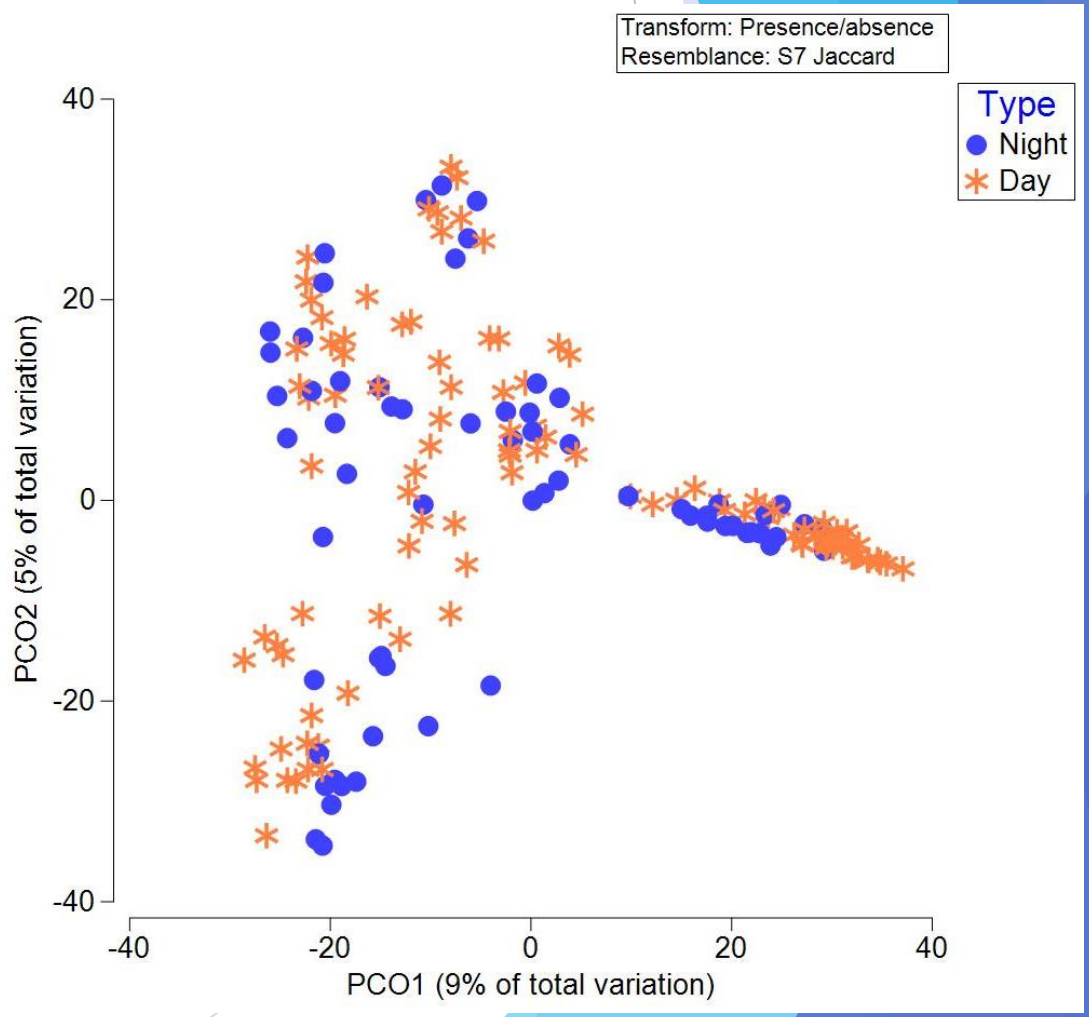
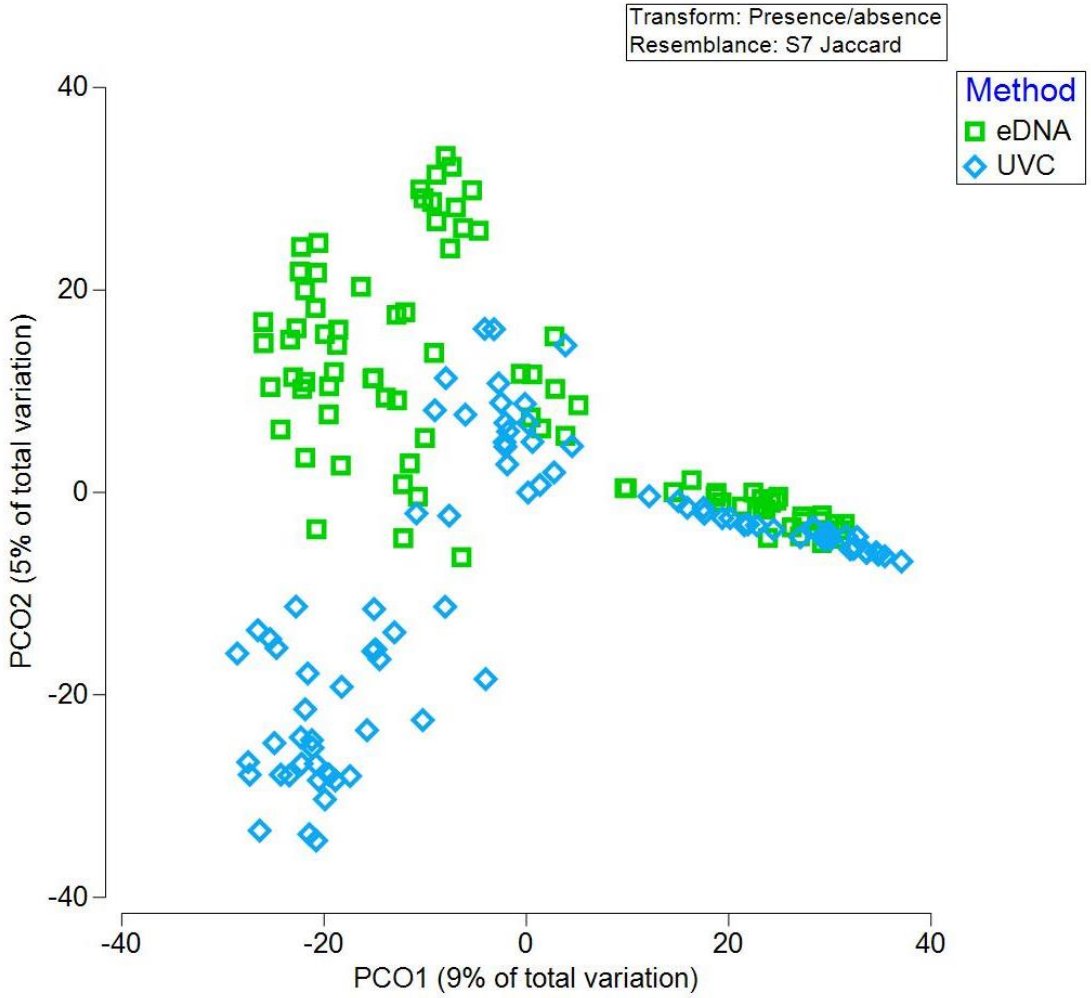
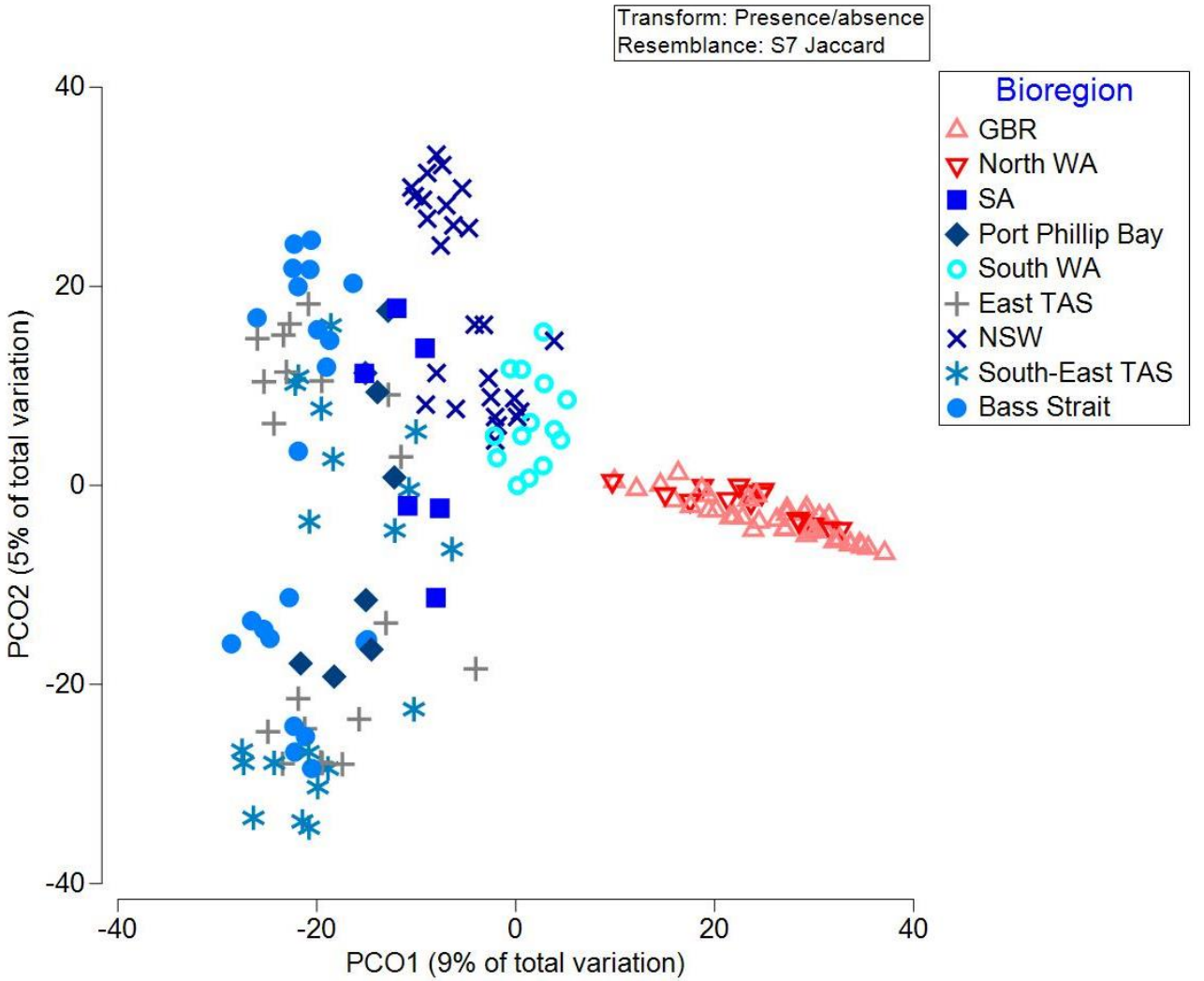
Day VS **Night**

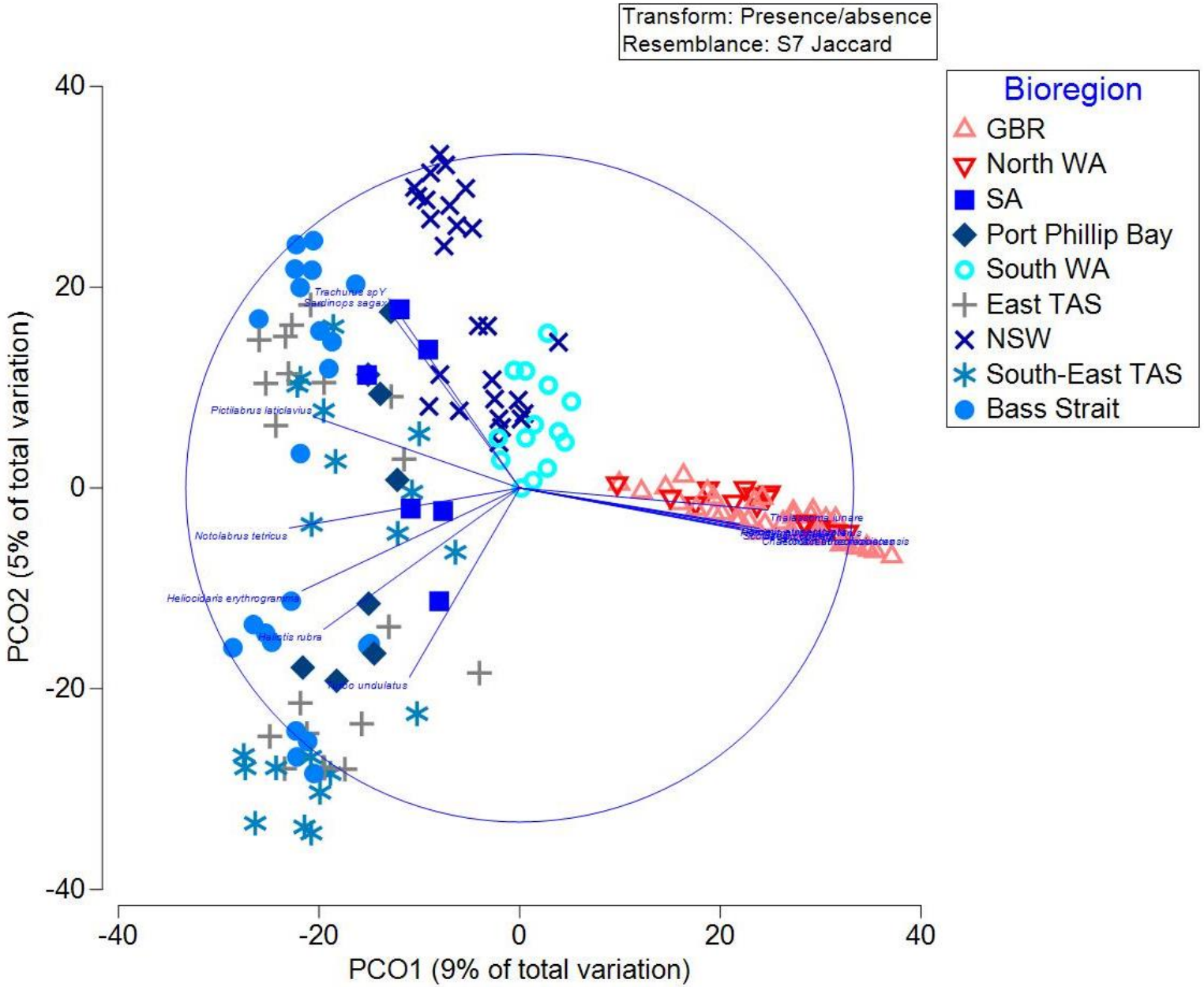


eDNA VS UVC



Tropical VS Temperate





Tropical

- Similar species identified by methods and driving differences across sites

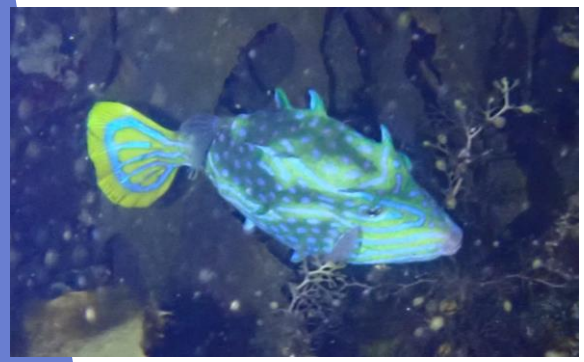
Temperate

- Higher variability among methods:
  - eDNA: pelagic
  - UVC: wrasse + specific inverts

Discussion

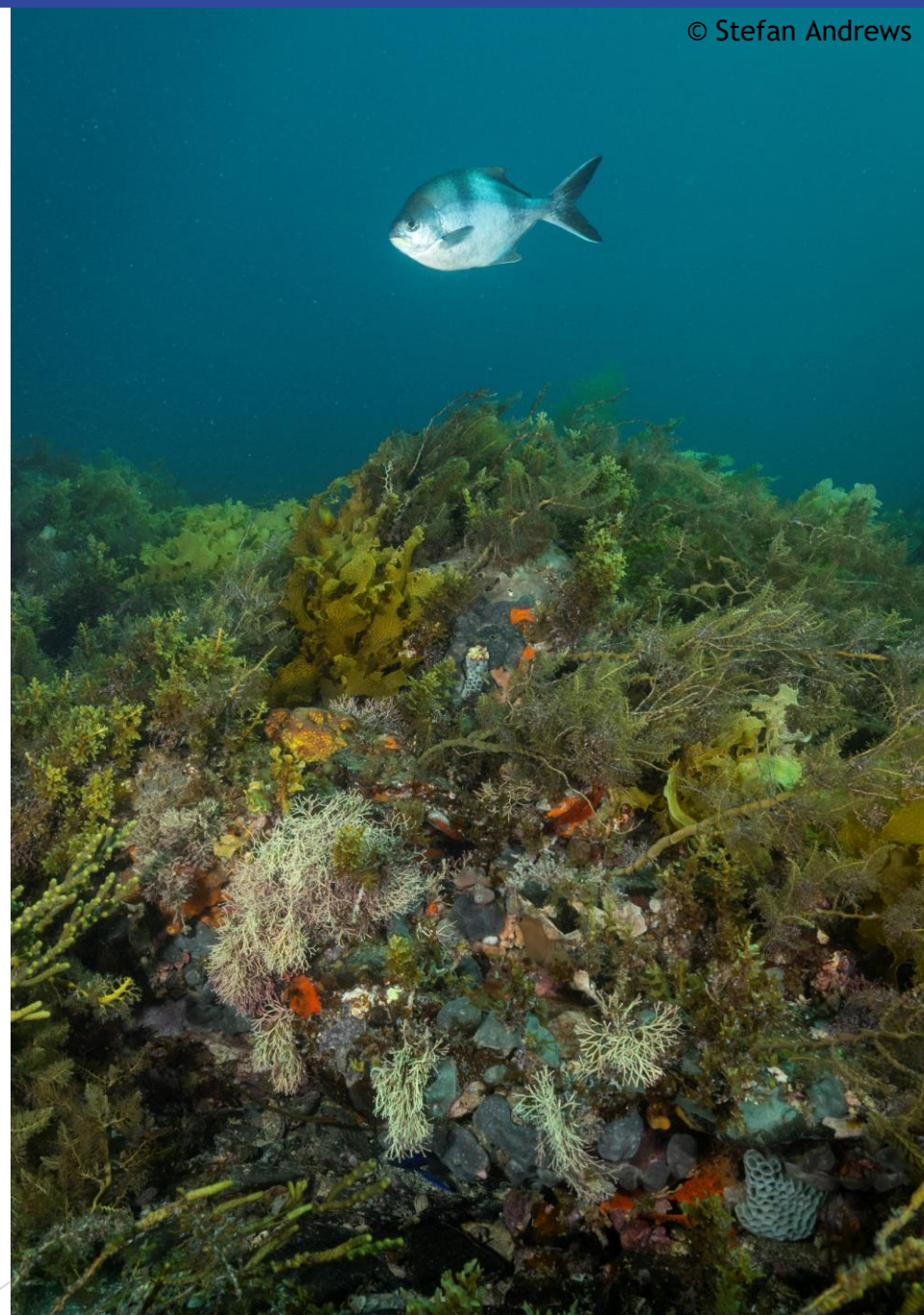
- Potential explanations:
  - The majority of taxa ‘missed’ by eDNA have no to few reference sequences in NCBI (for COI Leray & 16S).
  - Both methods pick up on nocturnal patterns
  - Big distinction between temperate and tropical
    - 16S could not differentiate leatherjackets and cowfish as well as UVC → eDNA method limitation (assay)
    - eDNA picked up on more cryptic and pelagic species, well-hidden or transit over reef

      → Visibility/Diver limitation



Cowfish - Aracana aurita

Leatherjackets



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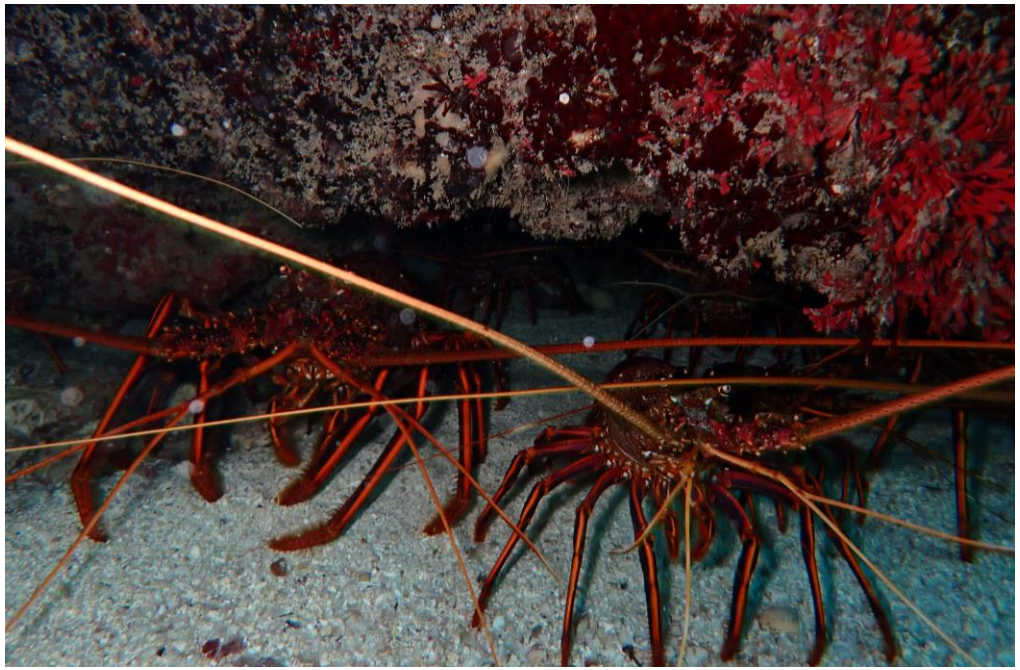
Future research



- Synchronous UVC & eDNA allows for a look into potential links between number of reads & abundance/biomass.

- COI Leray is a universal assay and detects a lot more than relevant to visual surveys → Investigate that diversity measured.

Key Takeaways

- **1. Comparative Insights:**
- eDNA and UVC surveys each detect unique and overlapping taxa.
- eDNA detected more taxa than UVC.
- **2. Method Limitations:**
- eDNA is constrained by the availability of reference sequences and the resolution of chosen assays.
- UVC is limited by diver visibility and availability of specialists
- **3. Environmental Implications:**
- Both methods reveal day-night and tropical-temperate variations across 54 reef sites in Australia.
- eDNA shows strong potential for monitoring large-scale marine biodiversity.
- **4. Future Directions:**
- Explore links between eDNA reads and species biomass.
- Conduct synchronous UVC & eDNA monitoring for enhanced ecological insights.

Thank you

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- Marcelle Ayad
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- Toni Cooper

- Shenae Willis
- Yann Herrera Fuchs
- Olivia Johnson
- Tyson Jones
- Matthew Rose
- Simon Hicks
- Claire Butler
- Stefan Andrews
- Alexis Lewis
- Iona Flett

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Team effort


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THE BIG BANANA
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Tasmania - Yellow sea spider

Pycnogonida (*P. ambigua*) & Reptilia (*C. mydas*)

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Heron Island - Green turtle