

Assessing introduction risk using species' rank-abundance distributions

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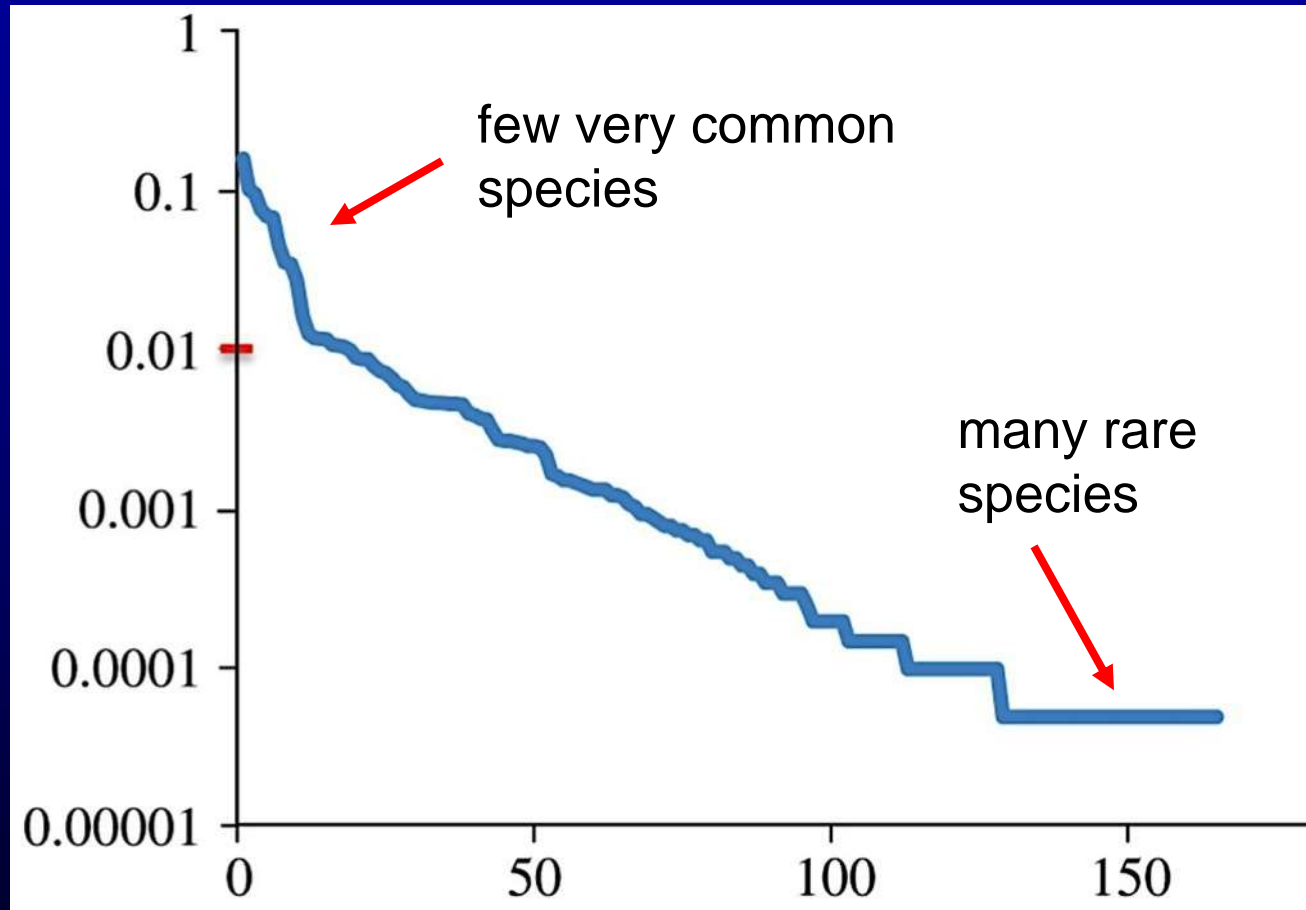
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Species' rank-abundance distribution

Freshwater fish assemblage in the Amazon

Relative abundance



Species rank

Species assemblage transported by vectors

Hull fouling



Ballast water



Bait worm packaging



Wood dunnage

Two parameters define introduction risk

1. Propagule pressure (PP)

- Number of introduction events
- Number of propagules introduced per event
- Condition of the propagules

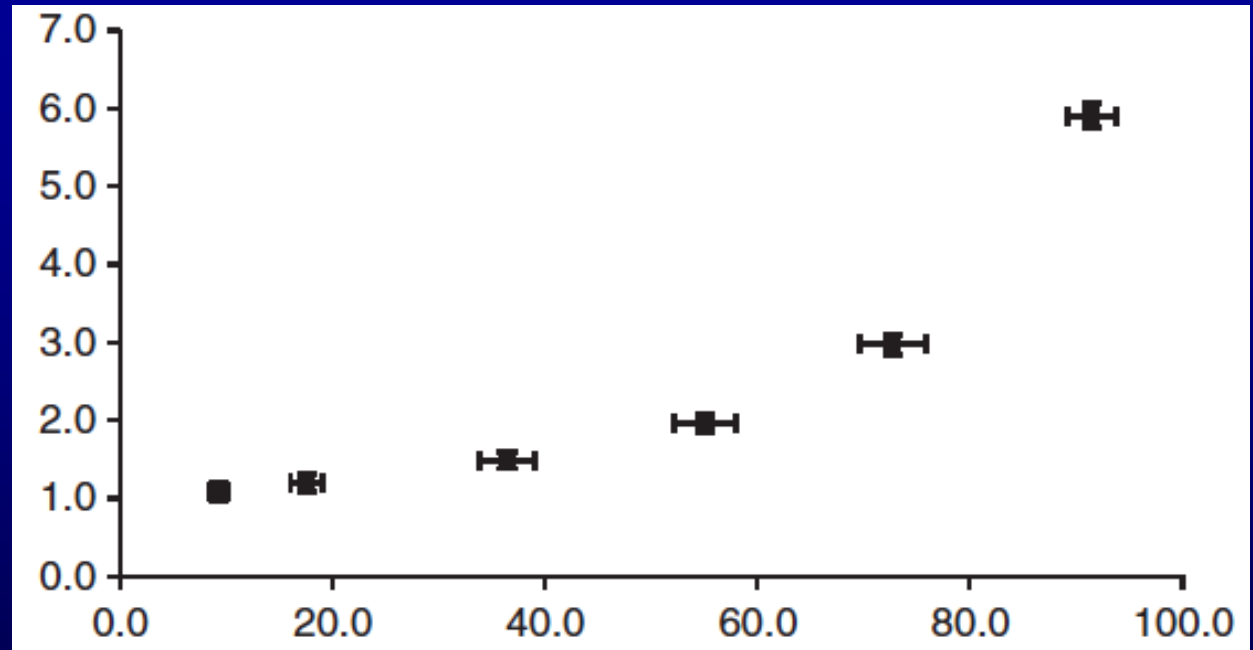
2. Colonization pressure (CP)

- Number of species introduced

CP:PP relationship

Simulated log-series ballast water communities

Mean propagule pressure (abundance)



Mean colonization pressure (species)

- CP and PP are positively related
- Larger sample size increases the likelihood of inclusion of rare species (random sampling theory)

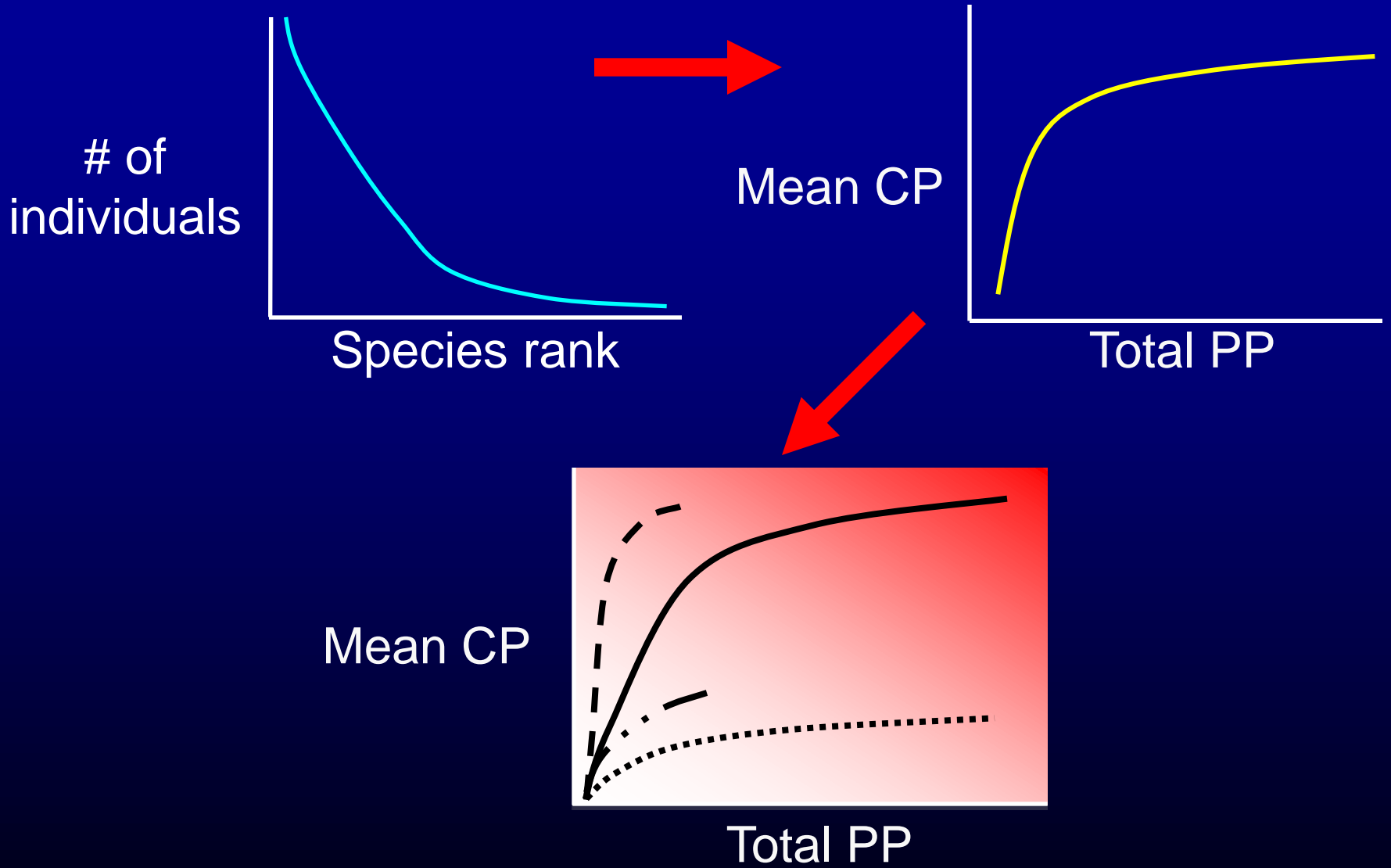
CP:PP during transportation

Case study: ballast water community

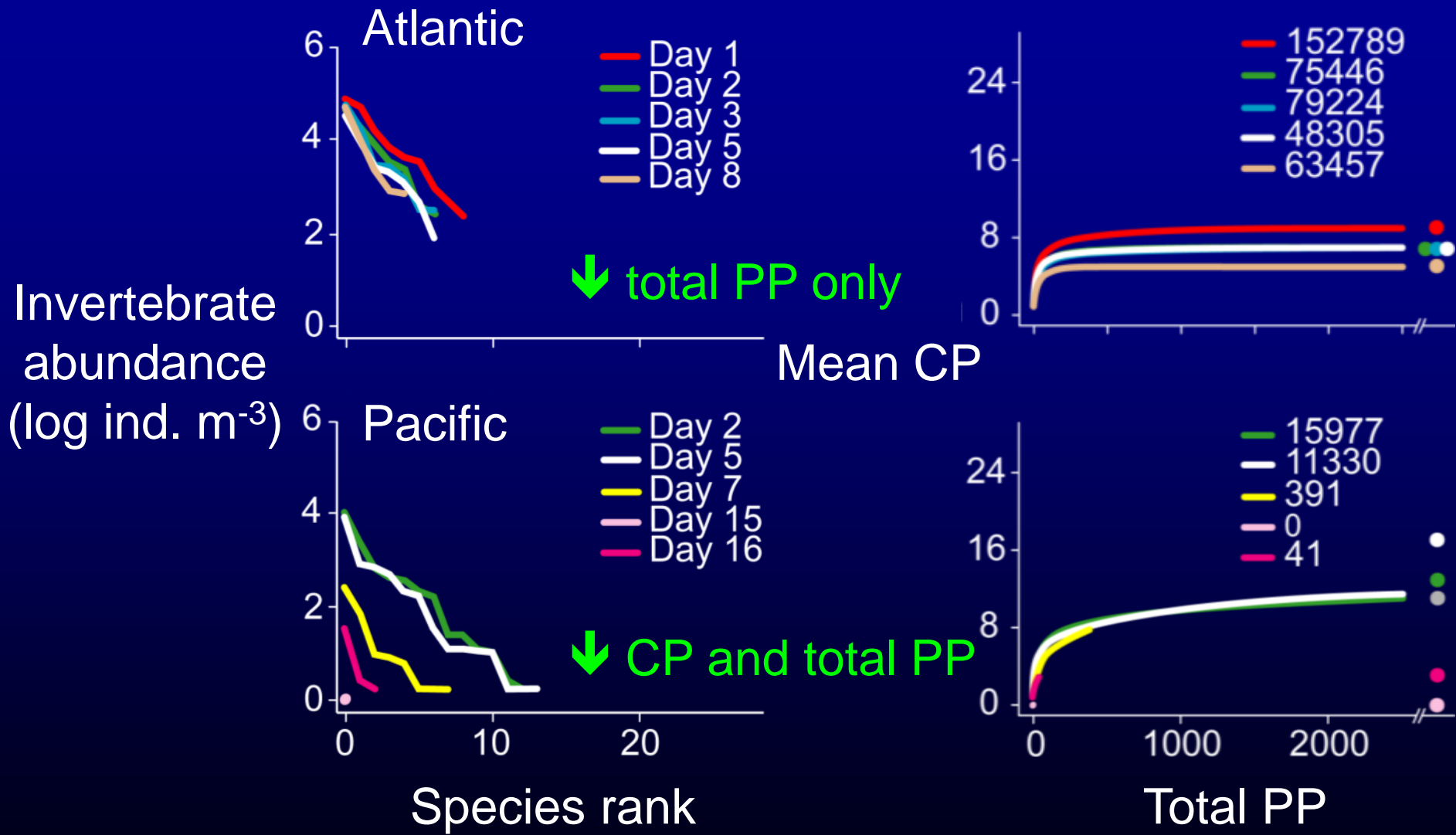
Hypotheses

- Changes in rank-abundance distributions and CP:PP relationships during transportation are the same for:
 - Different voyage routes (Atlantic vs. Pacific)
 - Different taxonomic groups (invertebrates, diatoms, and dinoflagellates)
 - In response to ballast water exchange (BWE)

Methods



Trans-Atlantic vs. trans-Pacific



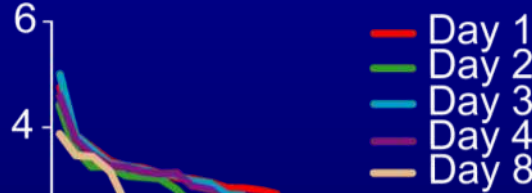
Trans-Atlantic taxon-based analysis

Invertebrate abundance
(log ind. m⁻³)



↓ total PP only

Diatom abundance
(log cells L⁻¹)



↓ CP only

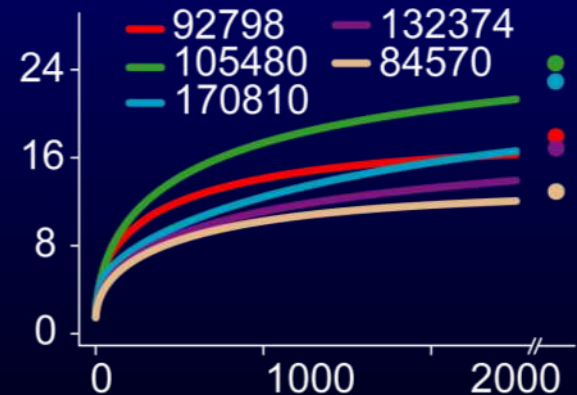
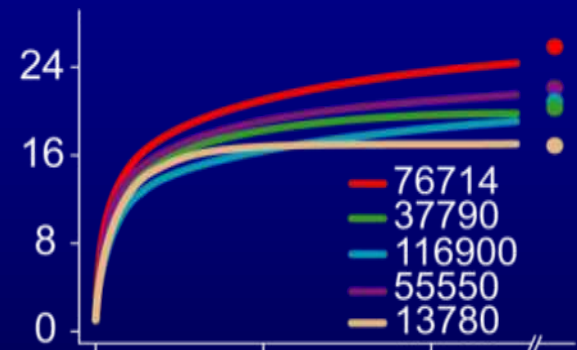
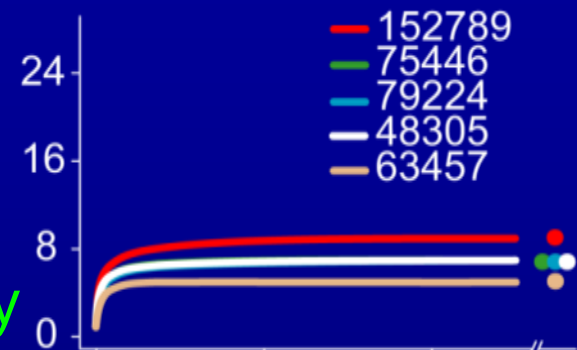
Dinoflagellate abundance
(log cells L⁻¹)



↓ CP only

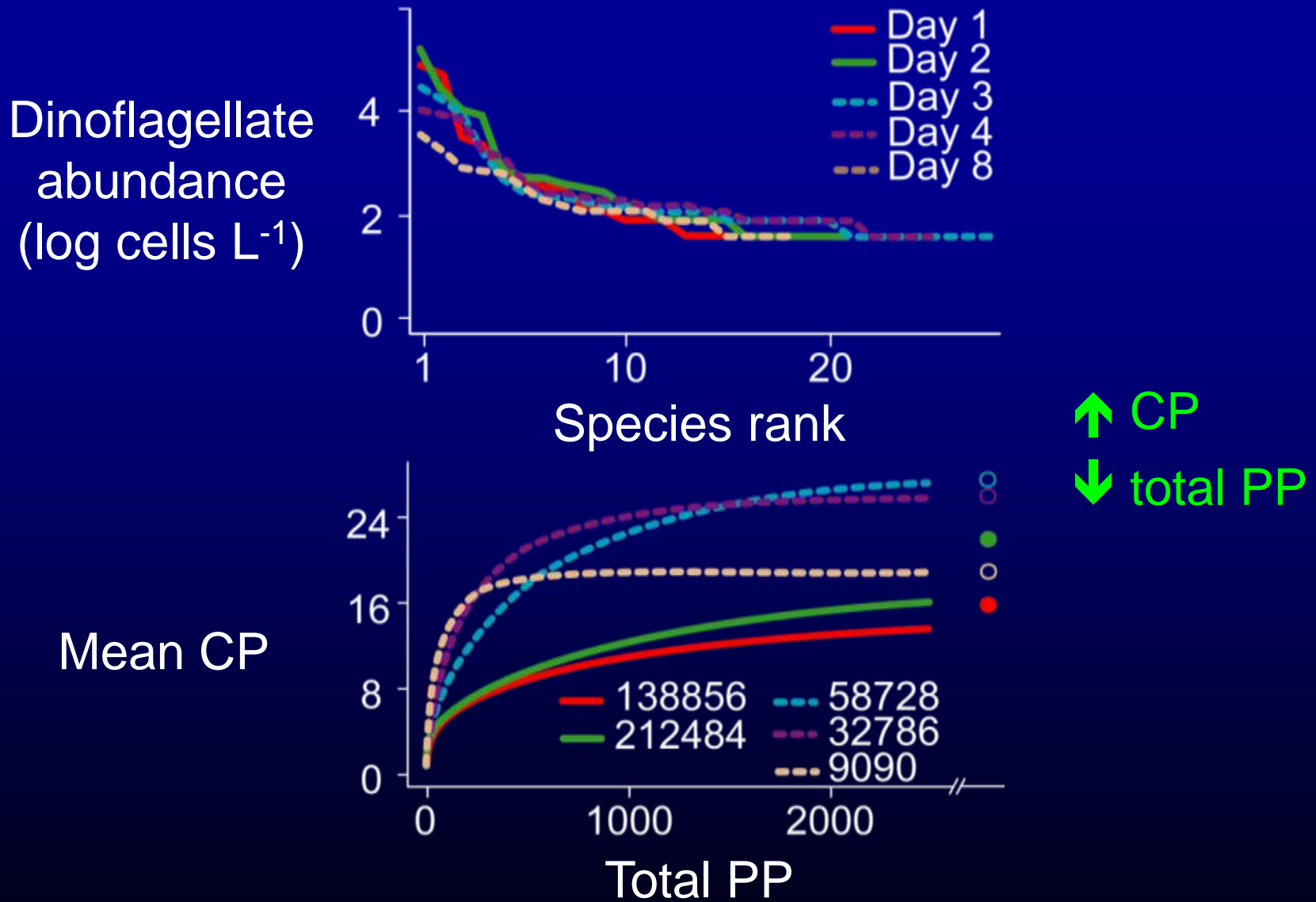
Species rank

Mean CP

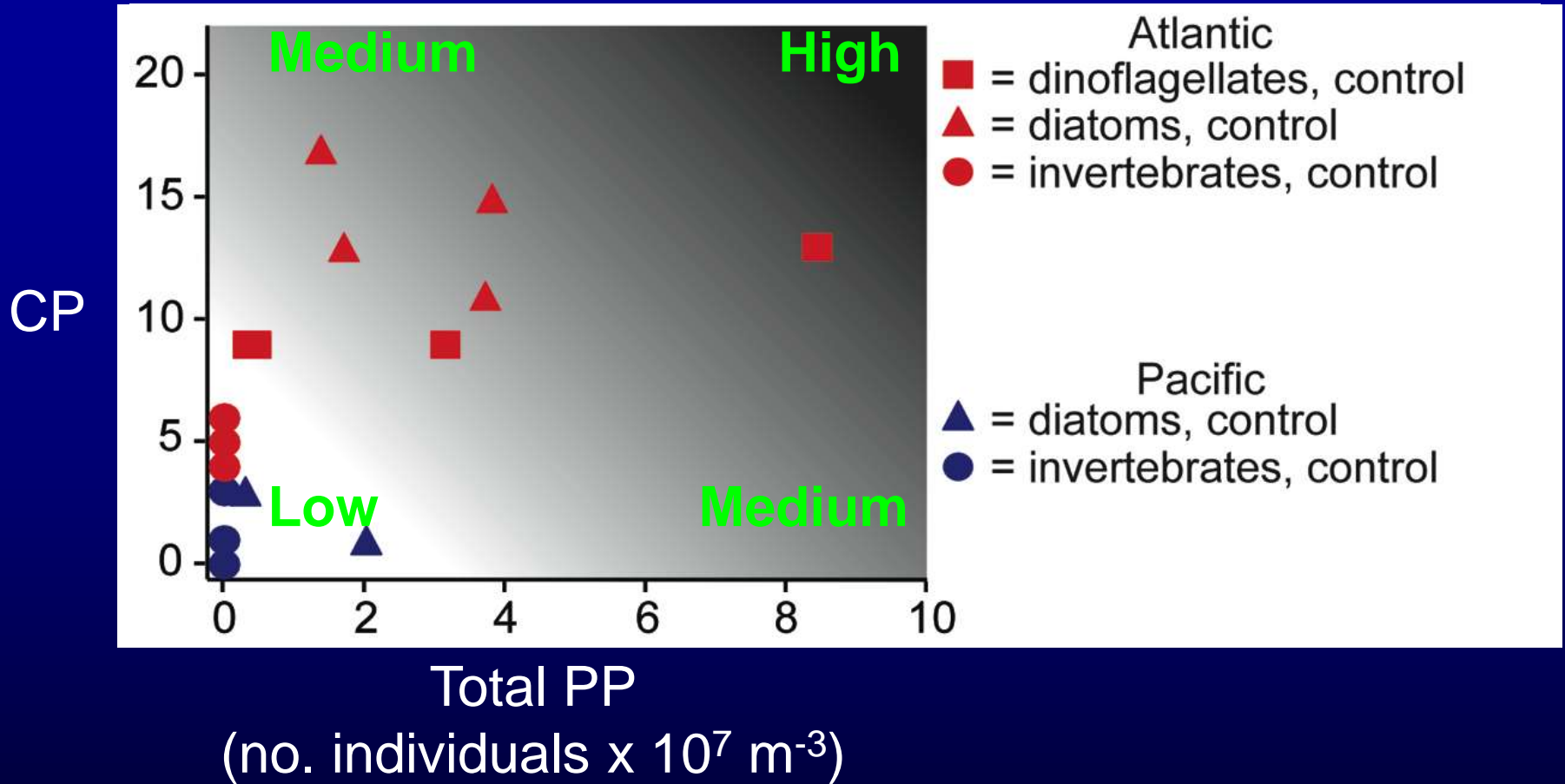


Total PP

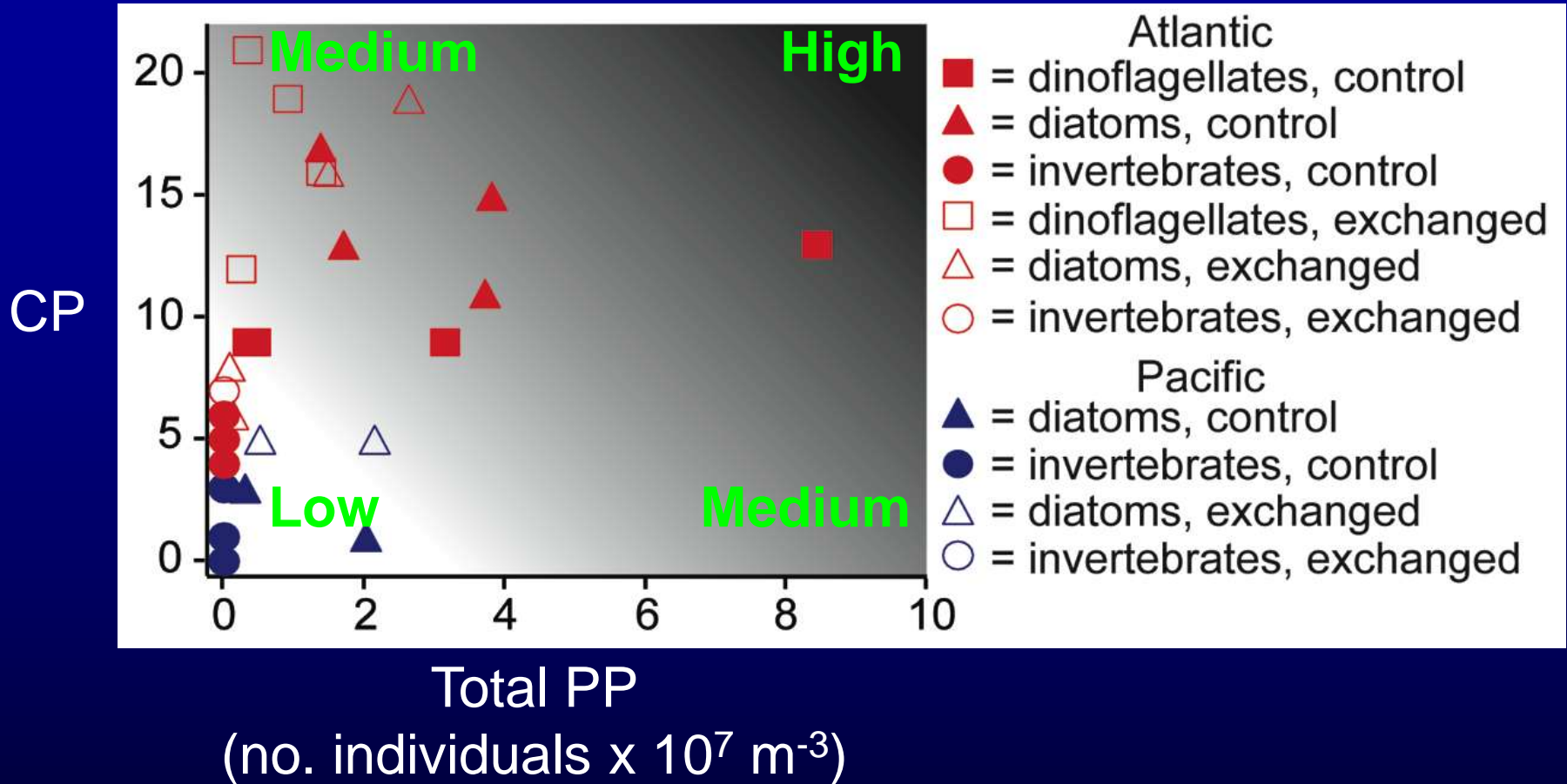
Trans-Atlantic voyage with BWE on day 3



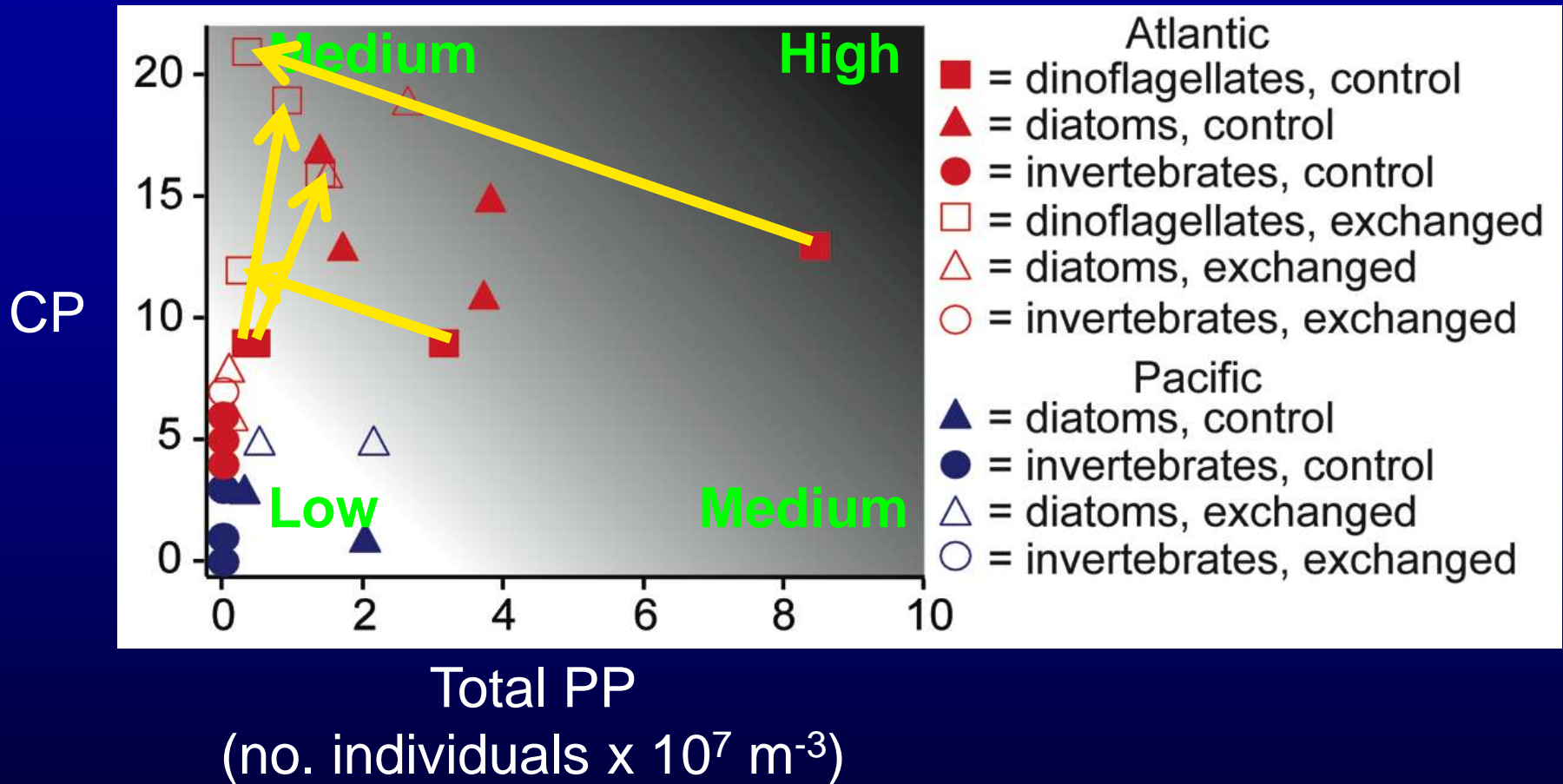
Final CP:PP



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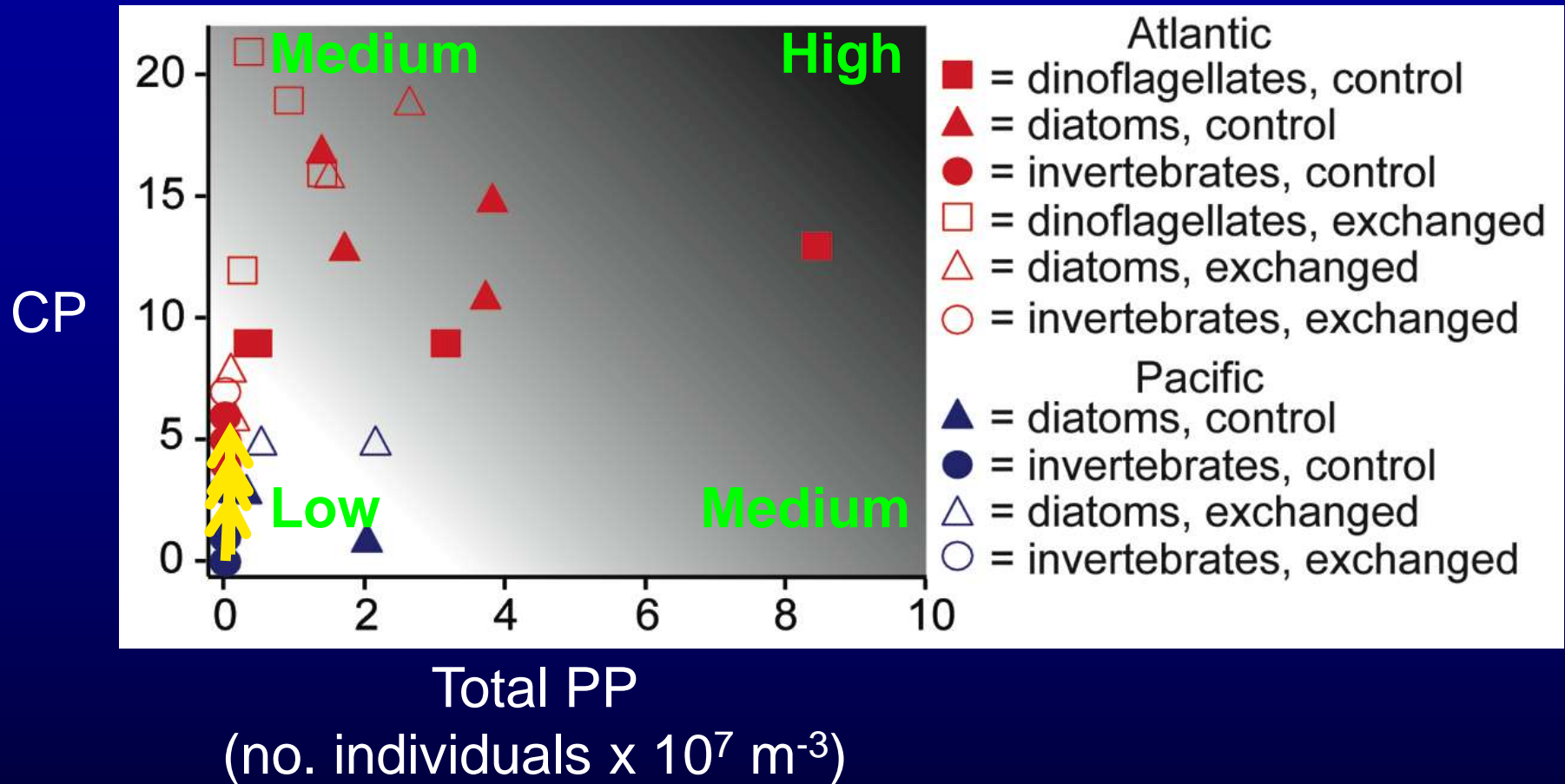


Final CP:PP



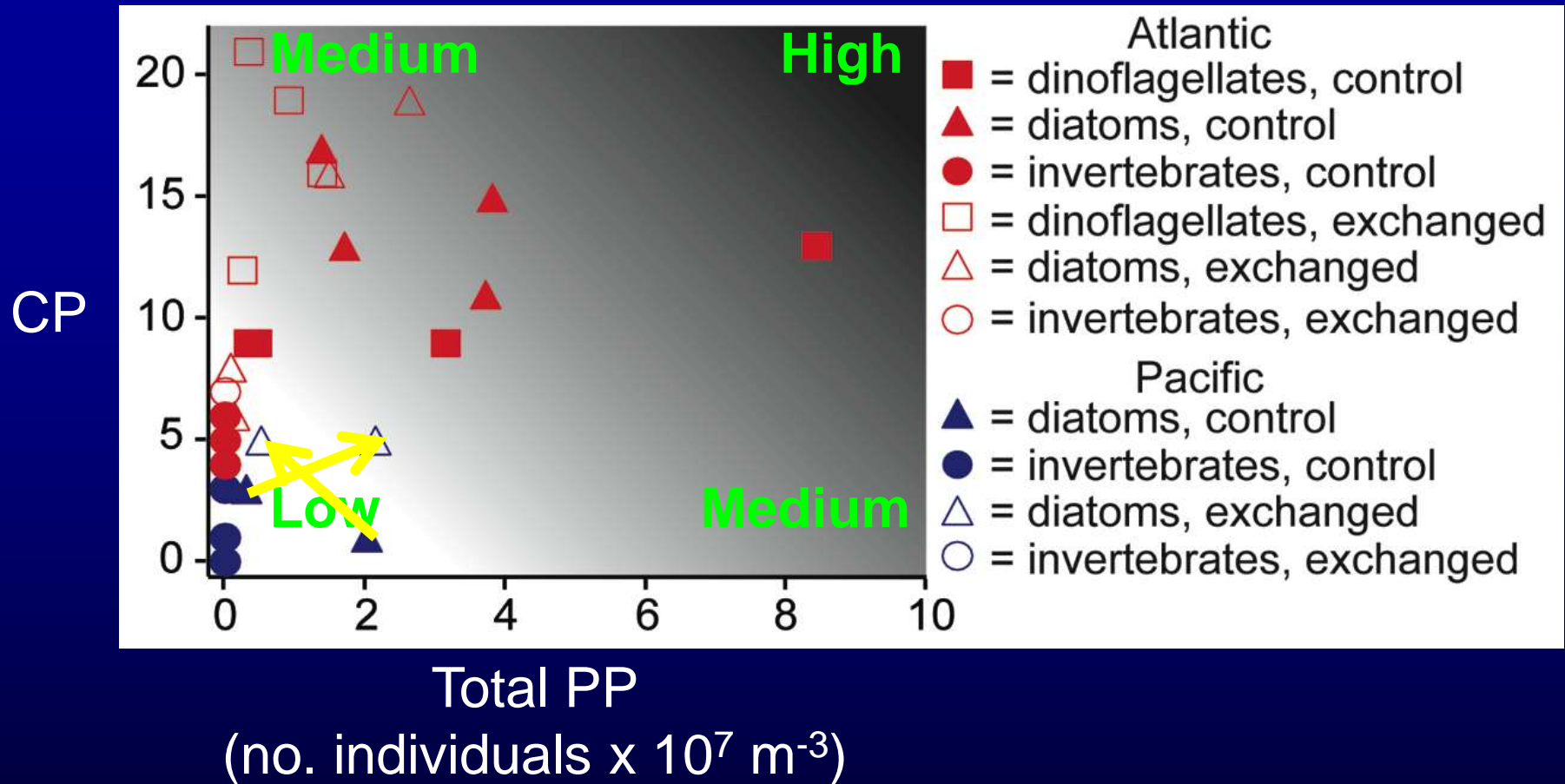
- BWE lowered risk for all except for dinoflagellates on Atlantic voyages and invertebrates and diatoms on Pacific voyages

Final CP:PP



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Conclusions

- Trans-Pacific trips appear to pose much lower risk than trans-Atlantic ones owing to very strong attenuation of both CP and PP (zooplankton data)
- Responses varied by taxonomic group, with some experiencing losses mainly in CP (diatoms, dinoflagellates), and others in PP (zooplankton)
- Ballast water exchange may serve to increase CP or PP or both, and thus the risk for some groups

Acknowledgements

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