Diversity and distribution of planktonic gastropods & hyperiid amphipods in the Atlantic Ocean

Alice K. Burridge

Katja T.C.A. Peijnenburg
Erica Goetze

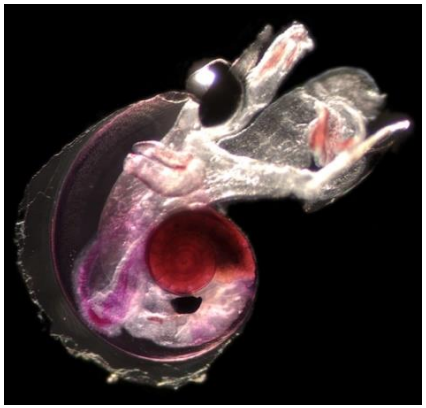
Deborah Wall-Palmer
Serena Le Double
Jef Huisman

Ronald Vonk
Marloes Tump

Macrozooplankton

Pteropods

Heteropods



Hyperiid amphipods

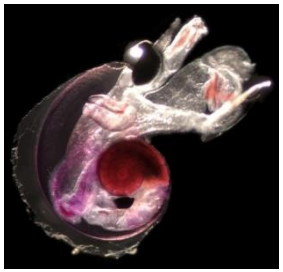
Latitudinal diversity gradient?

Community composition?

Abundance?

Biomass?

Pteropods, Heteropods & Hyperiids Diversity and distribution



Diversity and abundance of pteropods and heteropods along a latitudinal gradient across the Atlantic Ocean

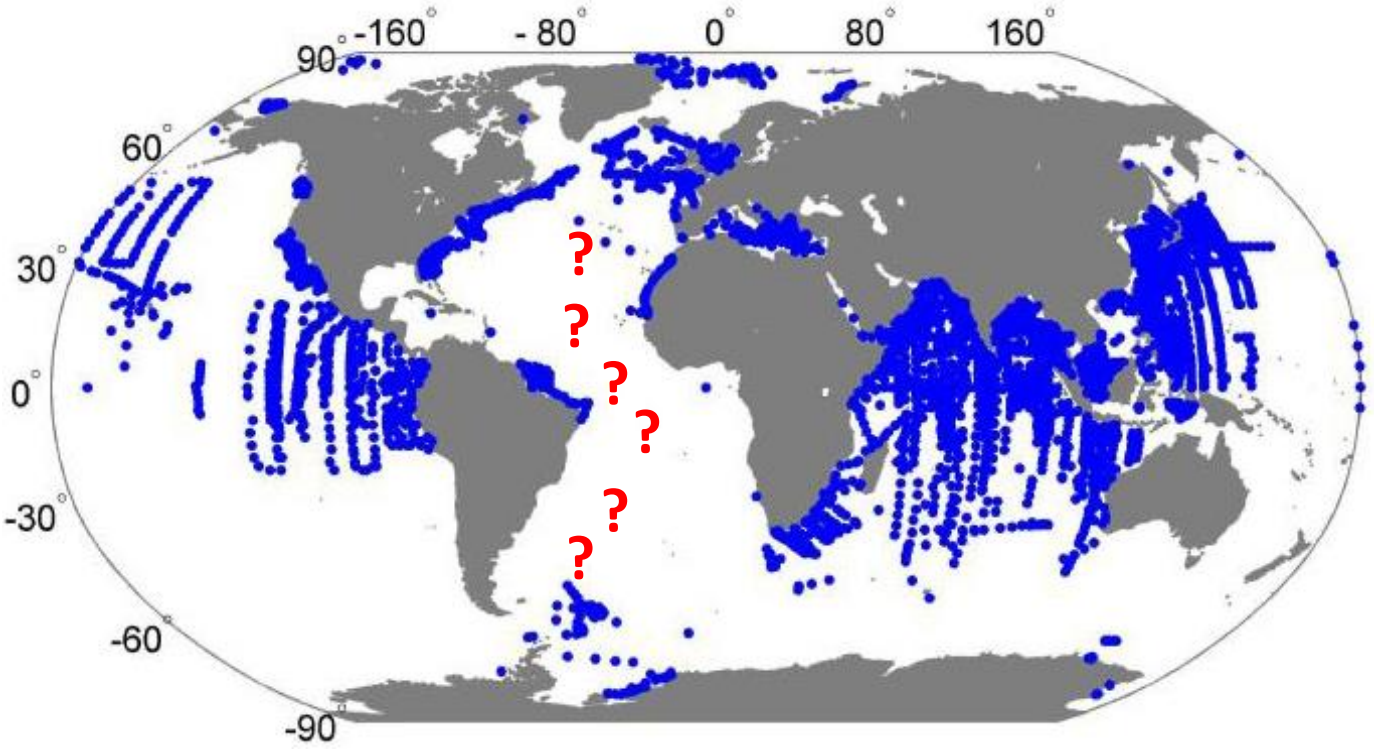
Burridge, Goetze, Wall-Palmer, Le Double, Huisman, Peijnenburg (in review, *Progress in Oceanography*)

Diversity and distribution of hyperiid amphiphods along a latitudinal transect in the Atlantic Ocean

Burridge, Tump, Vonk, Goetze, Peijnenburg (in review, *Progress in Oceanography*)

Pteropods, Heteropods, Hyperiid amphipods

Missing information in the Atlantic Ocean

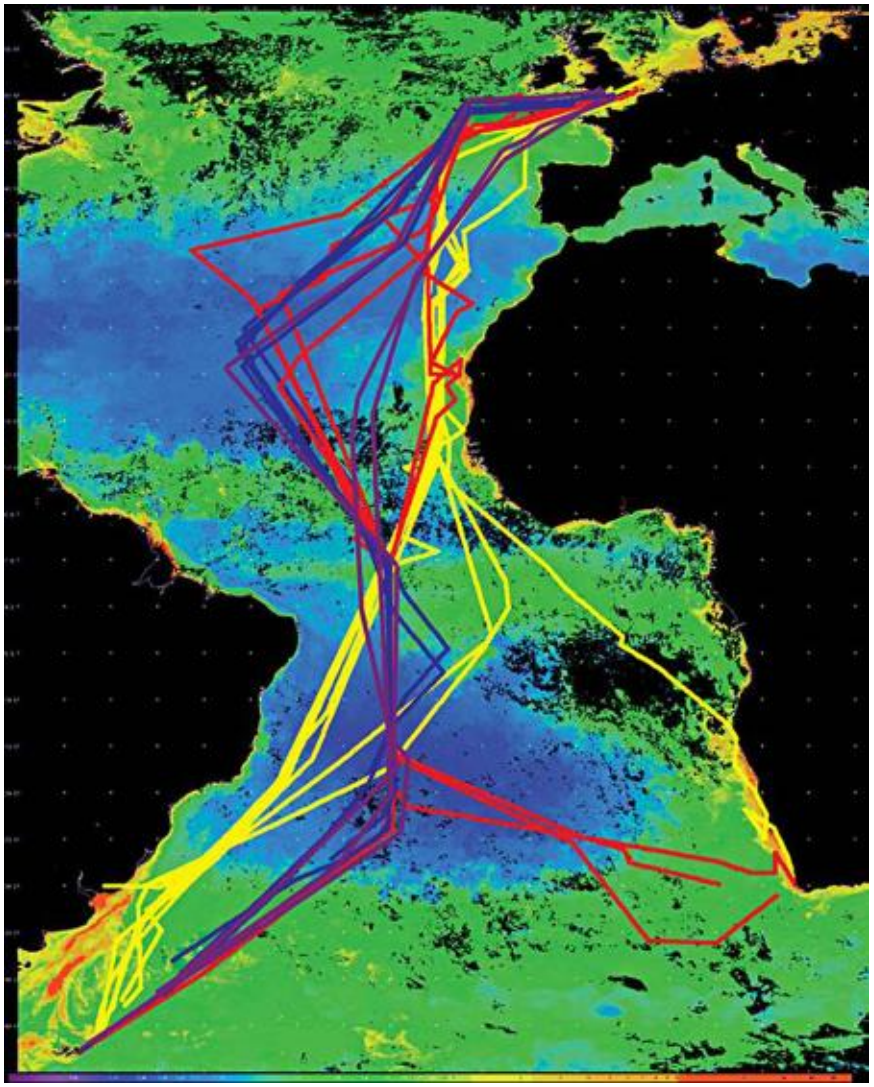


Existing pteropod records

Bednarsek et al. 2012, *Earth System Science Data*

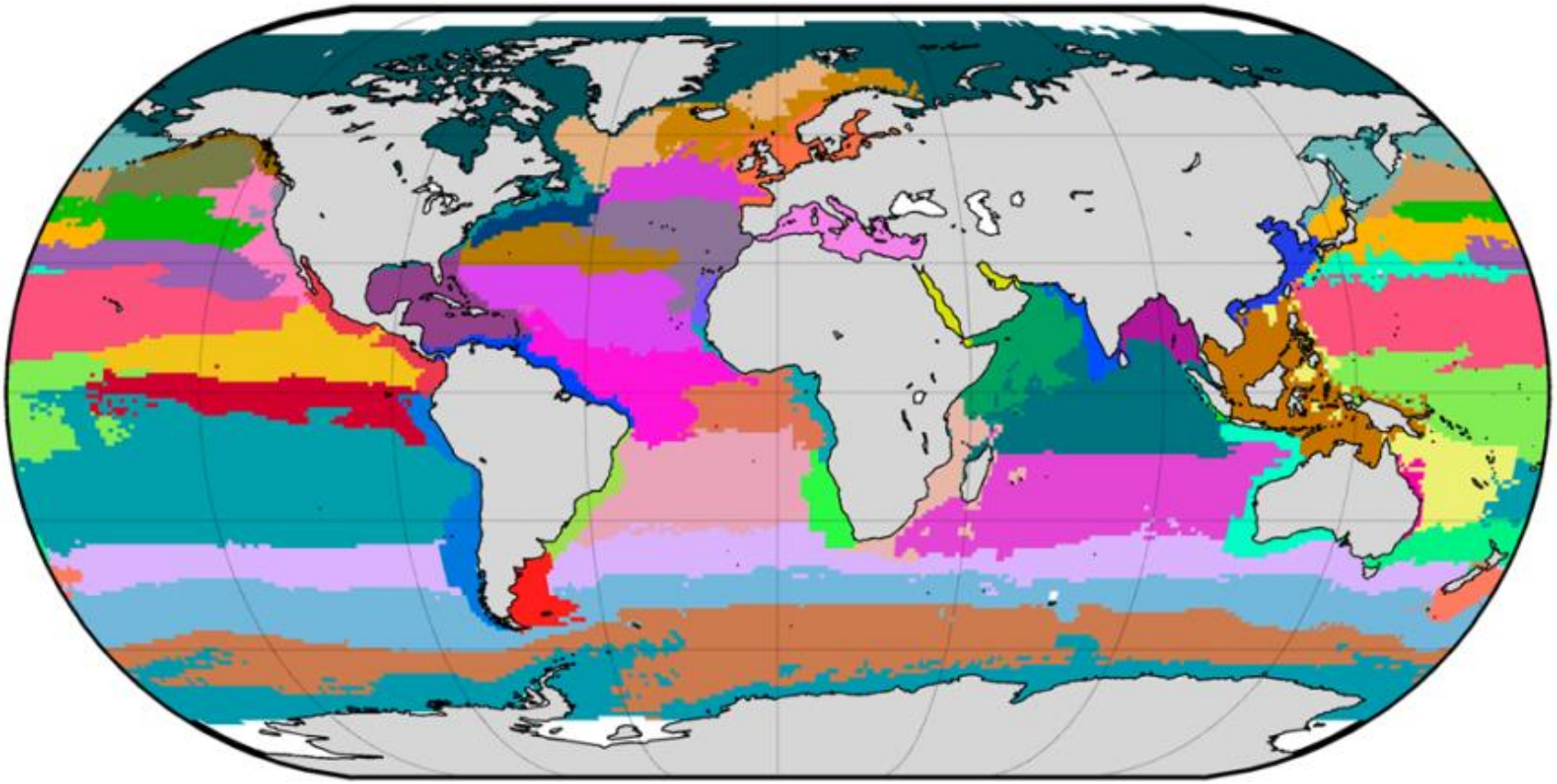
Atlantic Meridional Transect (AMT)

- 13,500 km
- Crossing distinct ocean provinces
- Annual cruise (Oct-Nov)
- Oceanographic data available



AMT 20 years
1995-2015
www.amt-uk.org

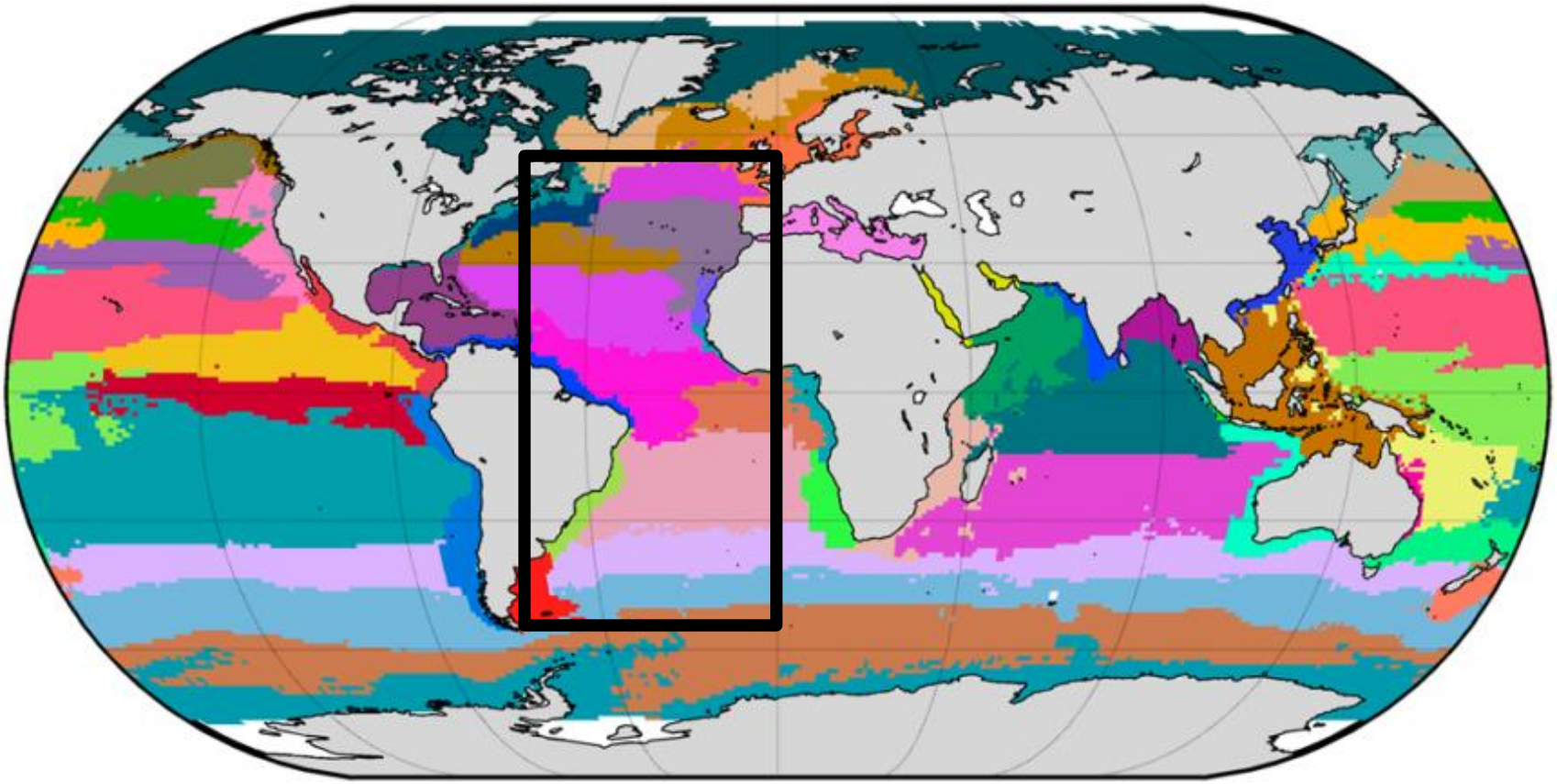
Ocean provinces



Biogeochemical provinces

Reygondeau et al. 2013, *Global biogeochemical cycles*
Updated from Longhurst 1995, 2007

Ocean provinces



Biogeochemical provinces

Reygondeau et al. 2013, *Global biogeochemical cycles*

Updated from Longhurst 1995, 2007

Zooplankton sampling

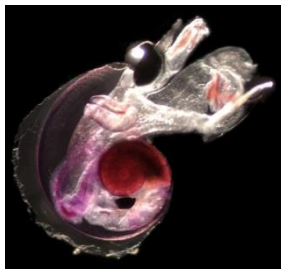
Pteropods & Heteropods

AMT24, autumn 2014

Bongo net (333um)

Oblique tows, ~1h, ~300m depth

Quantitative sampling

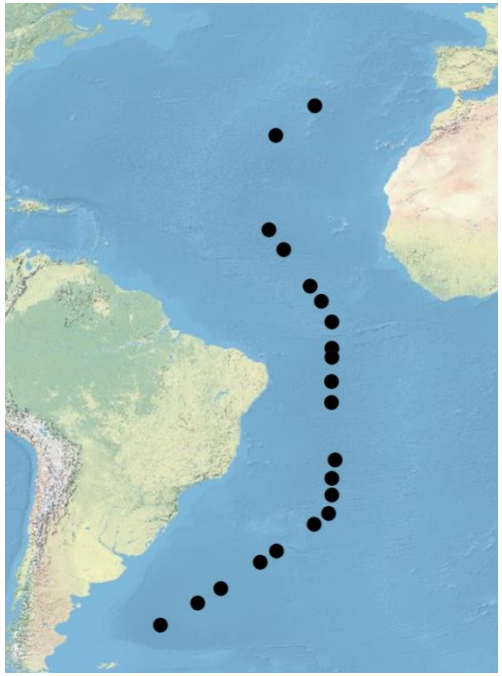


Hyperiid amphipods

AMT22, autumn 2012

RMT & Bongo nets (333um)

Oblique tows, ~1h, ~300m depth



Pteropods & Heteropods

Pictures by Peijnenburg & Goetze, AMT22

Pteropods

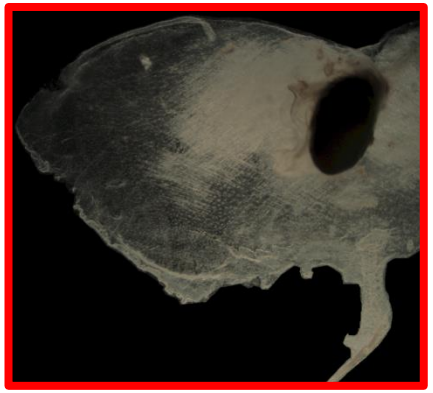
“Sea butterflies”, thecosomes:
mucus web feeders

“Sea angels”:
active predators

Euthecosomes:
uncoiled shells

Euthecosomes:
coiled shells

Pseudothecosomes:
coiled/internal shells



Gymnosomes:
shell-less as adults

Heteropods

“Sea elephants”:

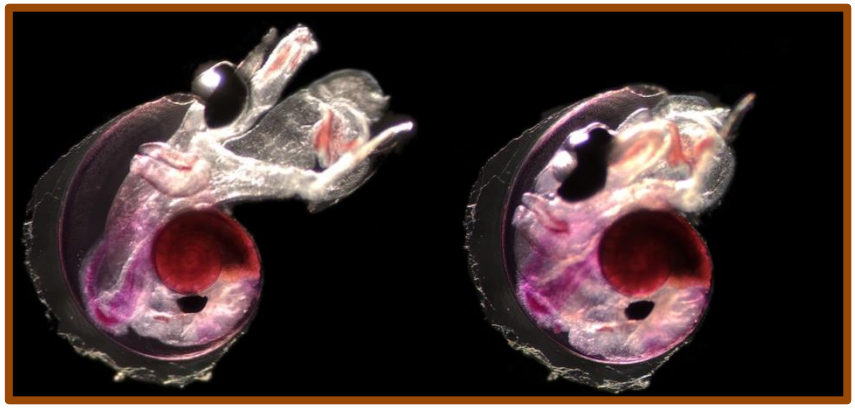
visual predators

Atlantidae:

Small, can retract in shell,
shell has keel

Carinariidae, Pterotracheidae:

Large animals,
much larger than shell
or shell-less as adults

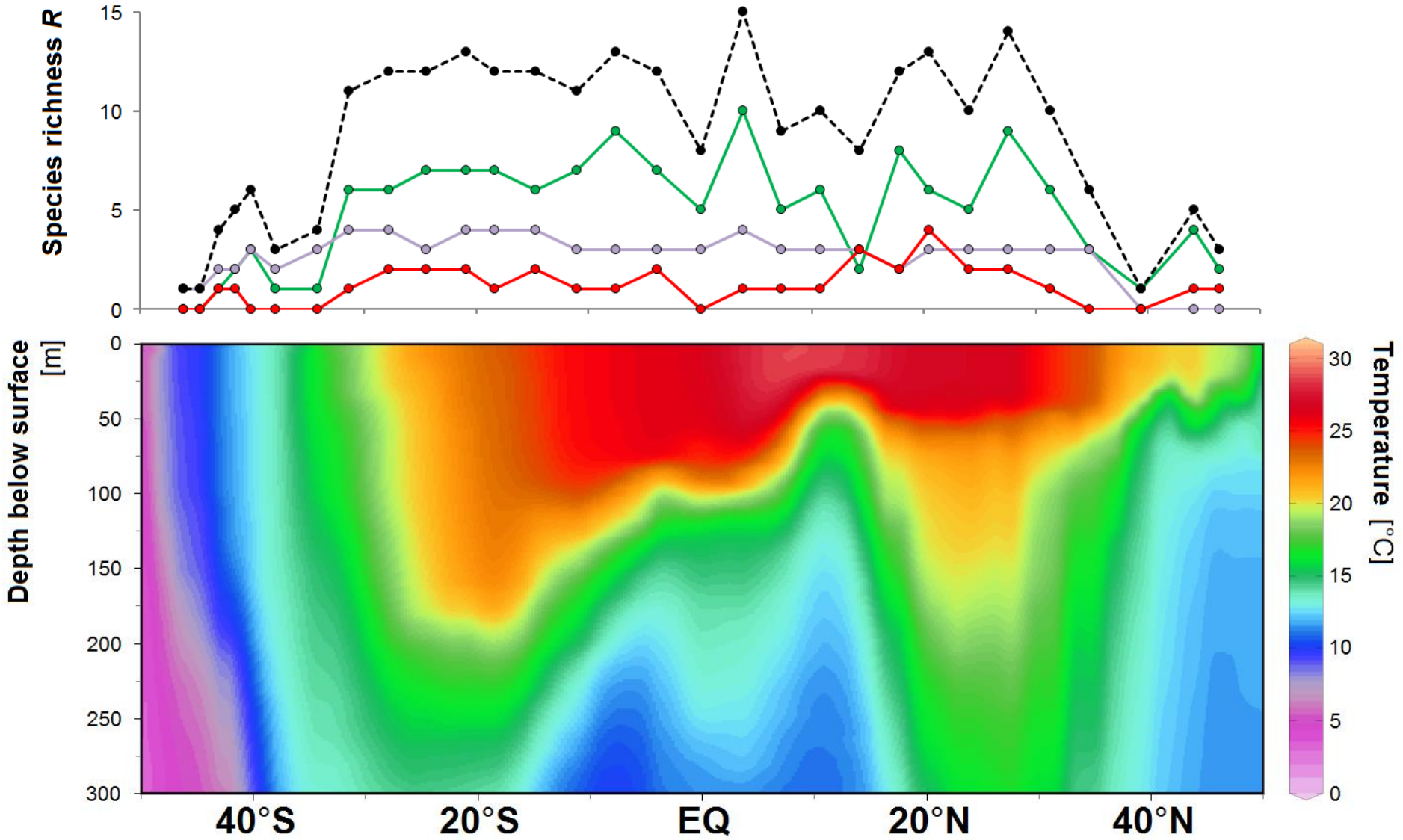


Pteropods
Species richness

Uncoiled shells

Coiled shells

Coiled/internal shells

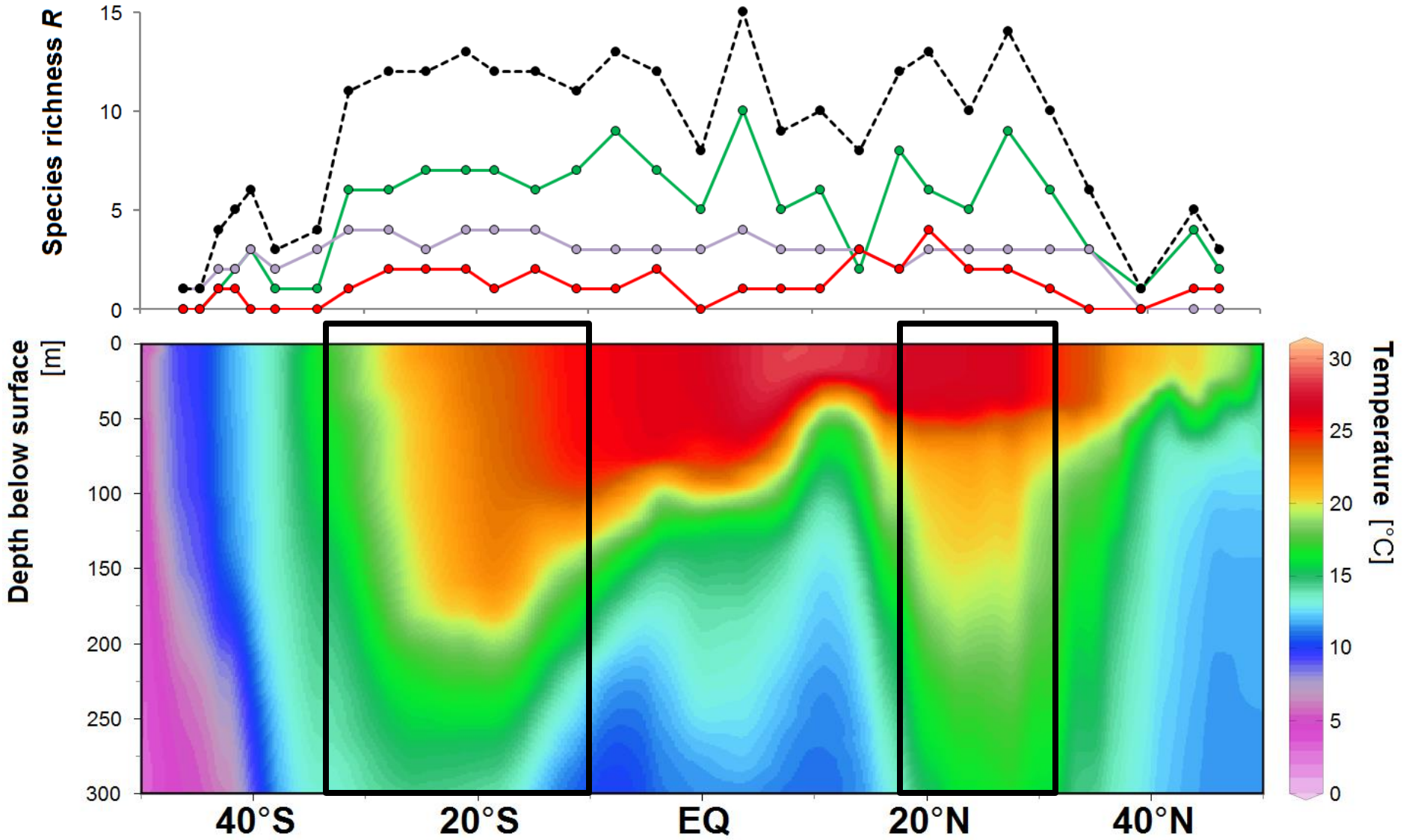


Uncoiled shells

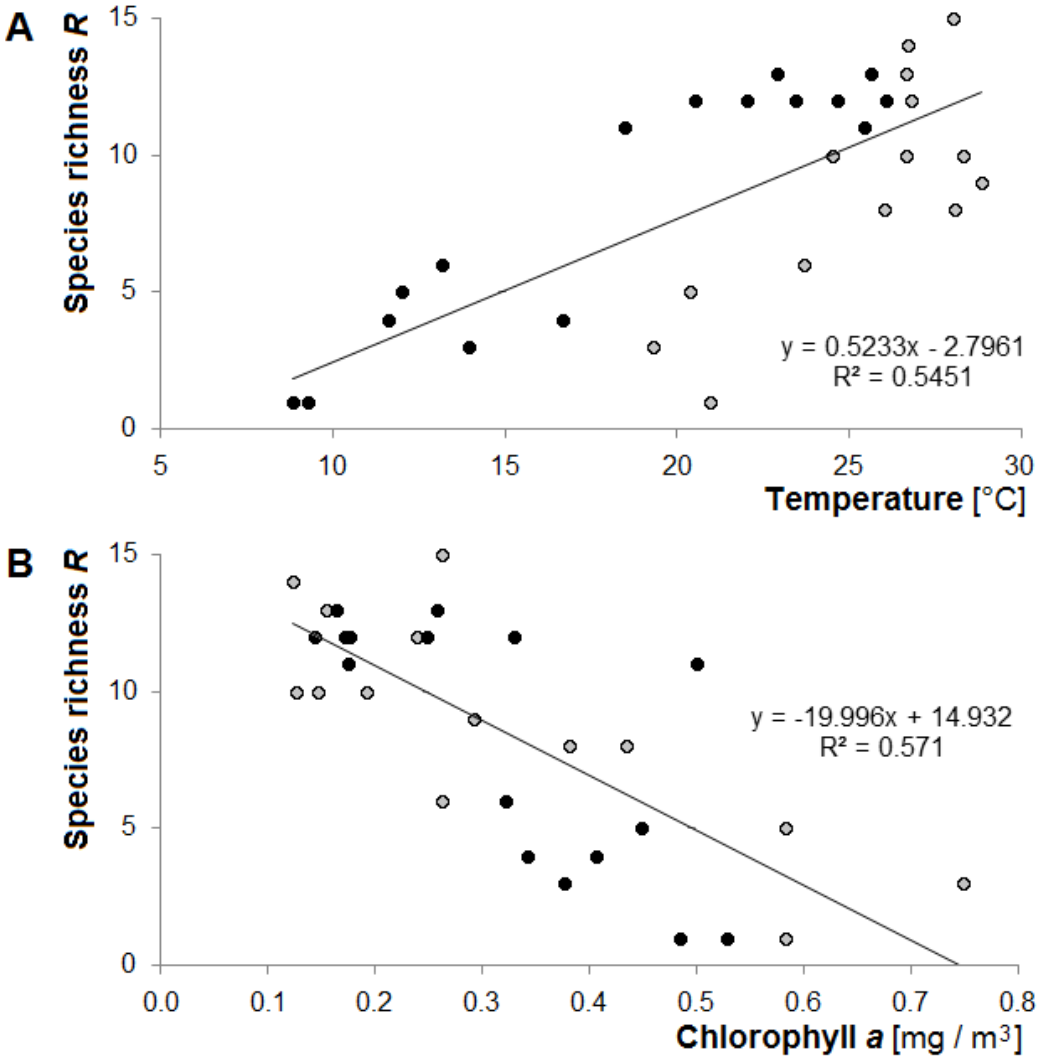
Coiled shells

Coiled/internal shells

Pteropods
Species richness



Pteropods
Species richness



Sea surface temperature

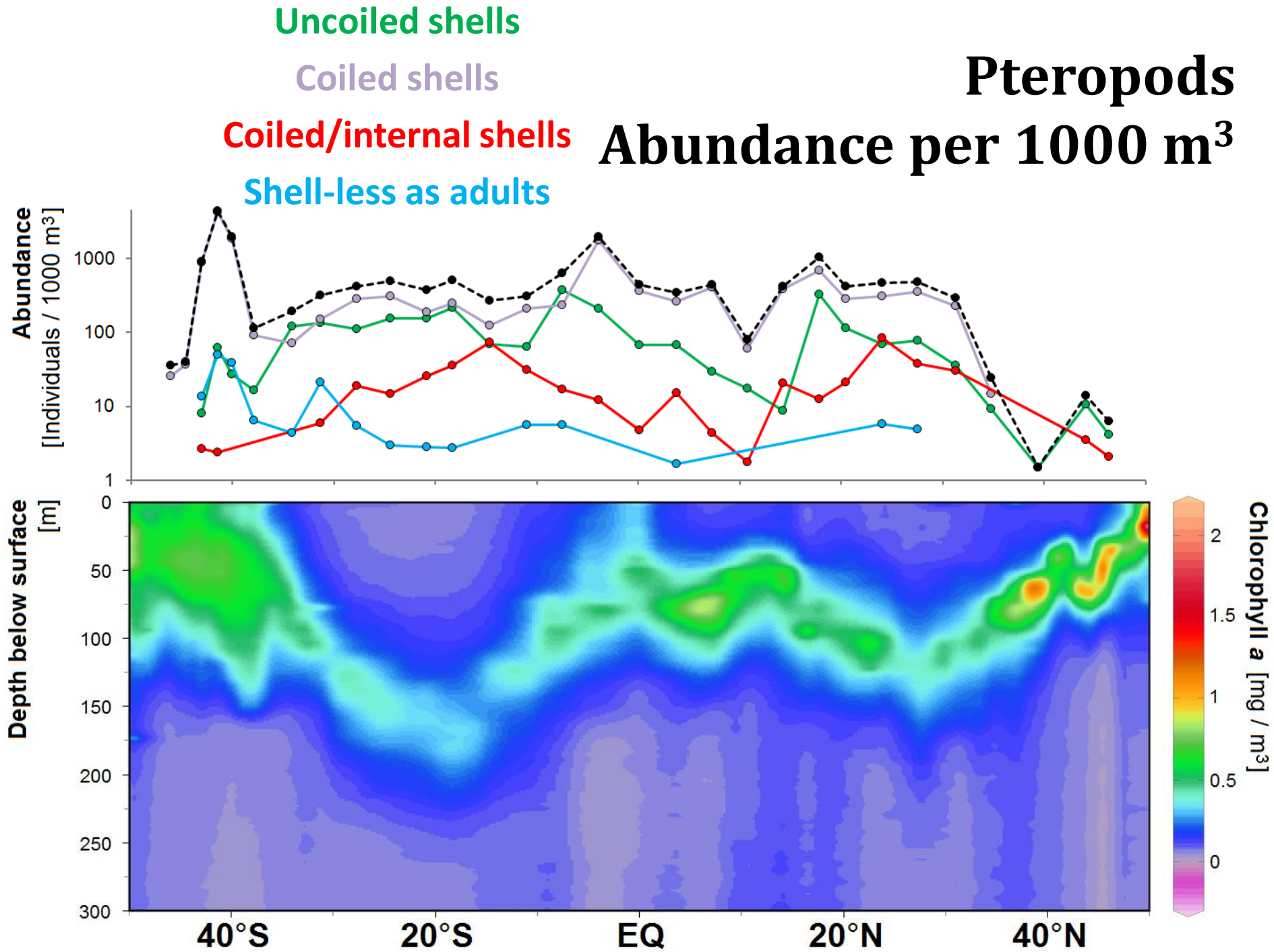
positive, $p<0.001$

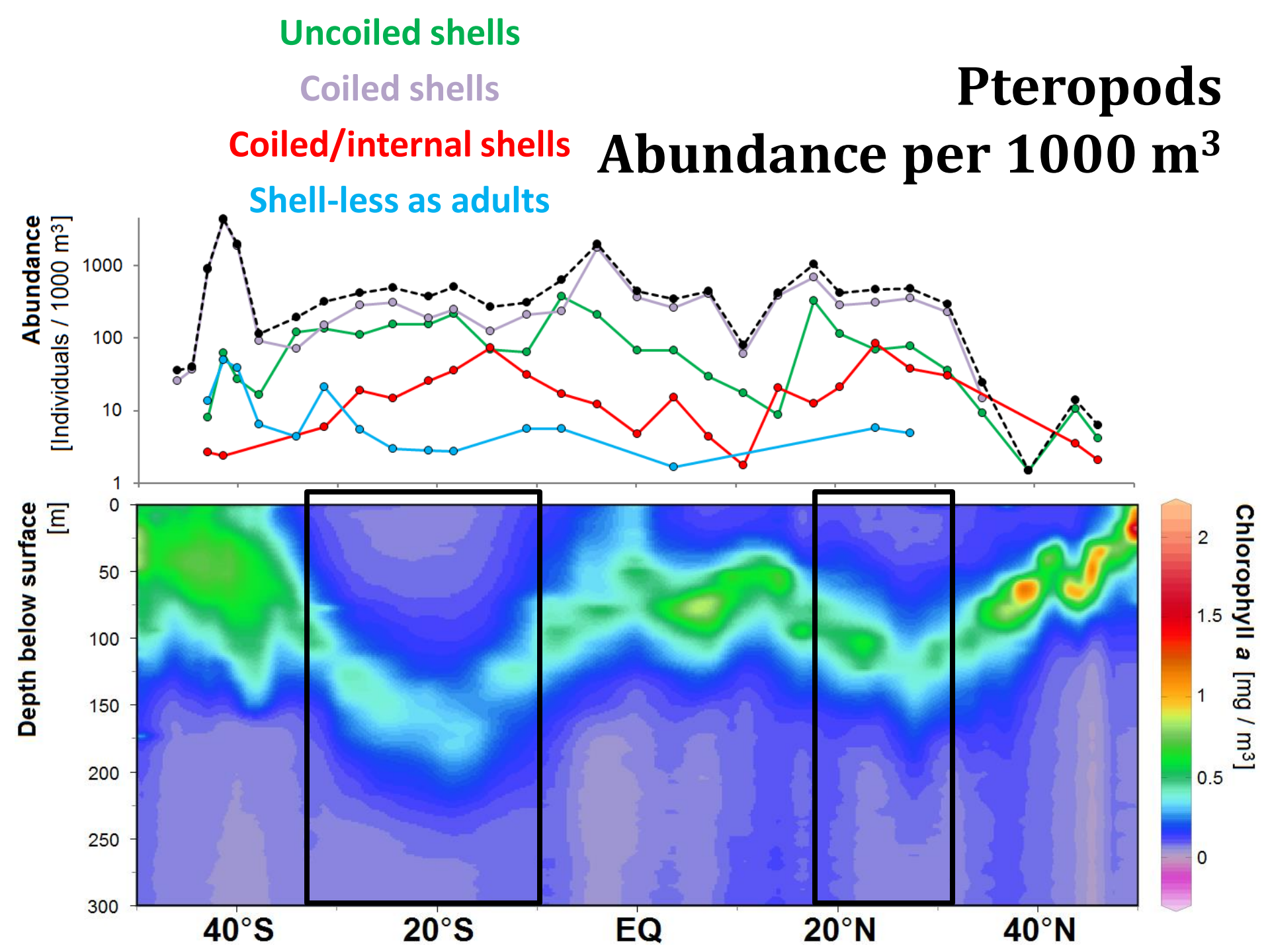
Chlorophyll *a* at DCM

negative, $p<0.001$

N latitudes **S latitudes**

Pteropods
Abundance per 1000 m³




Uncoiled shells
Coiled shells
Coiled/internal shells
Shell-less as adults
Pteropods
Abundance per 1000 m³
Abundance
[Individuals / 1000 m³]
1000
100
10
1
Depth below surface
[m]
0
50
100
150
200
250
300
40°S
20°S
EQ
20°N
40°N
Chlorophyll a [mg / m³]
2
1.5
1
0.5
0

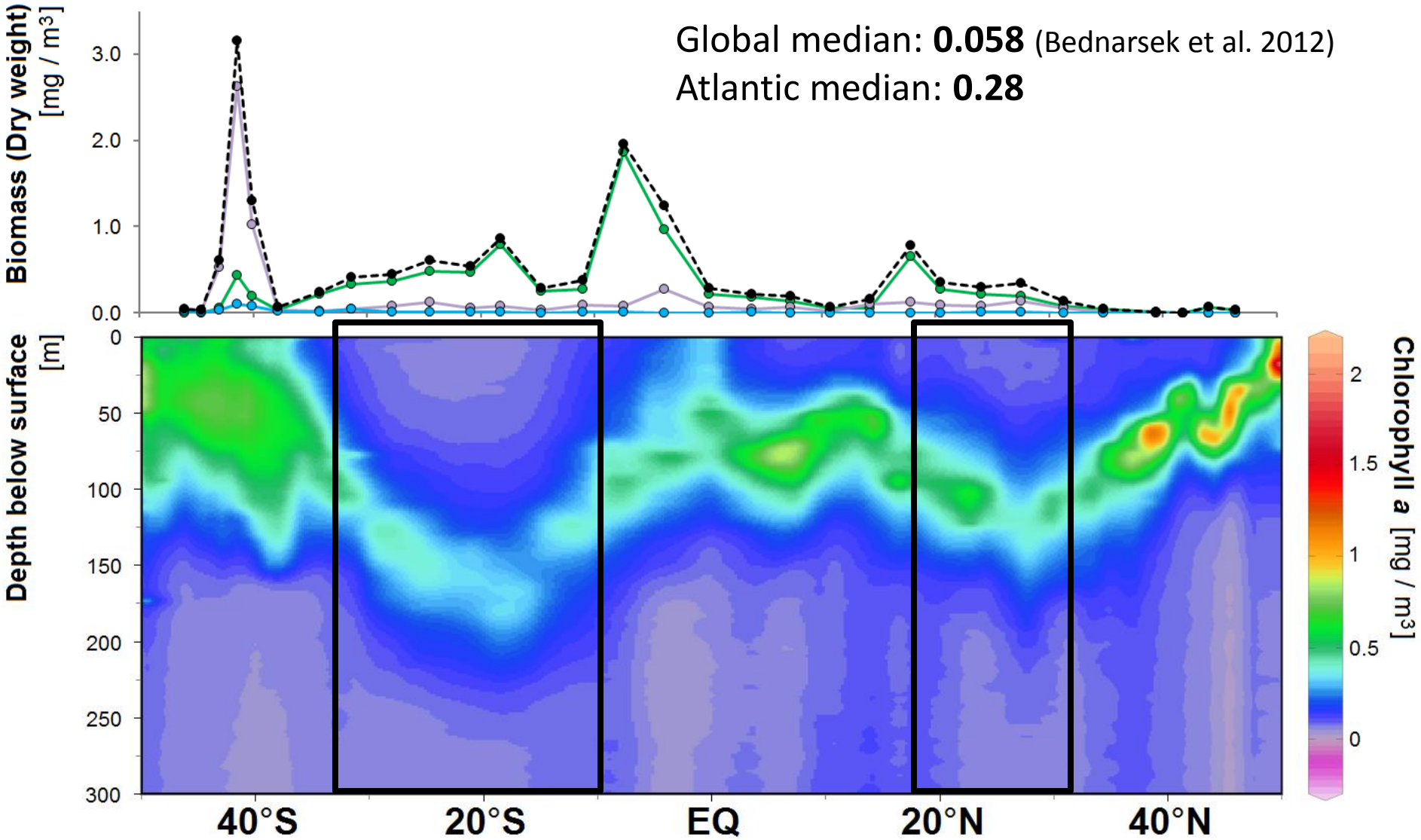
Uncoiled shells

Coiled shells

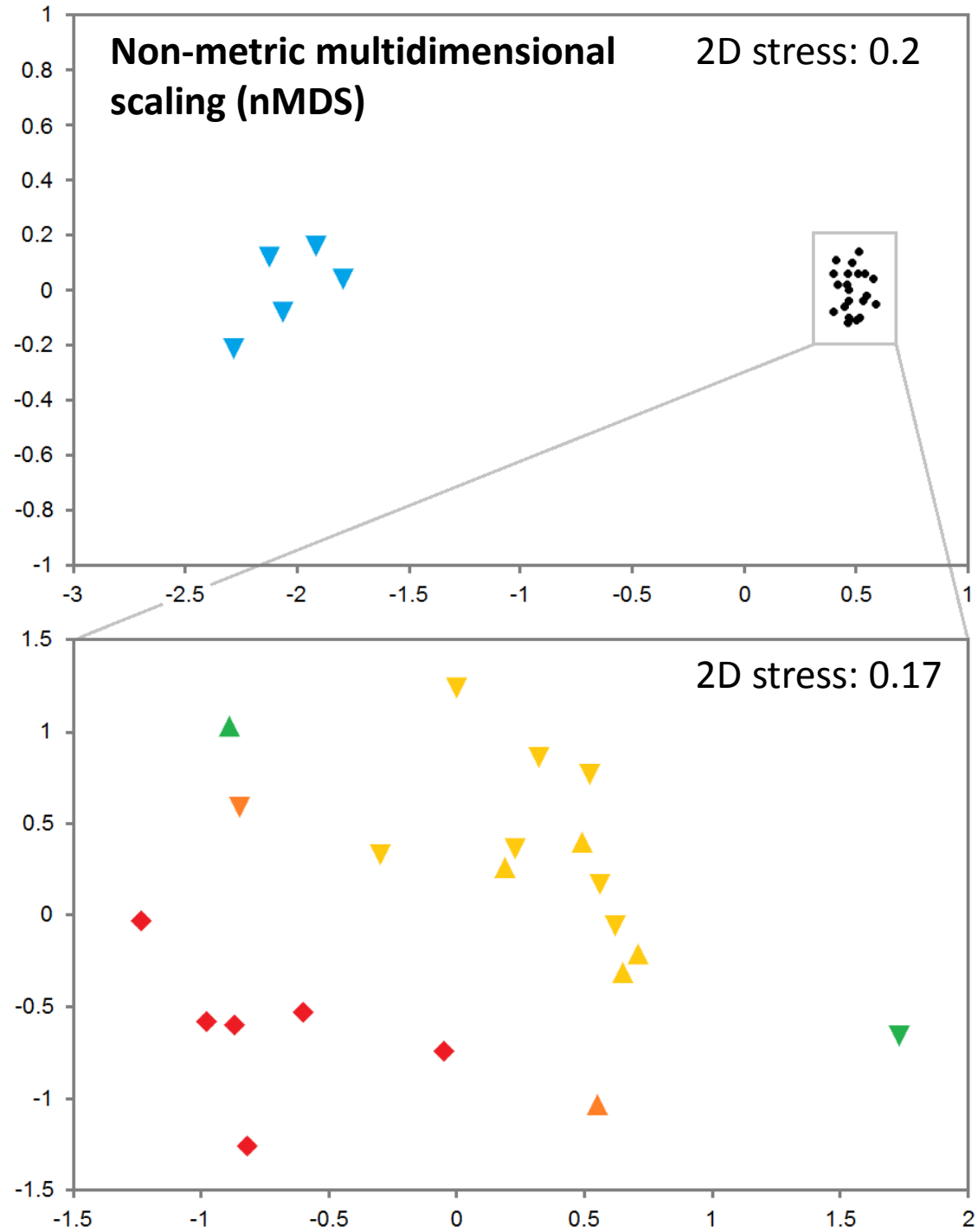
Shell-less as adults

Pteropods

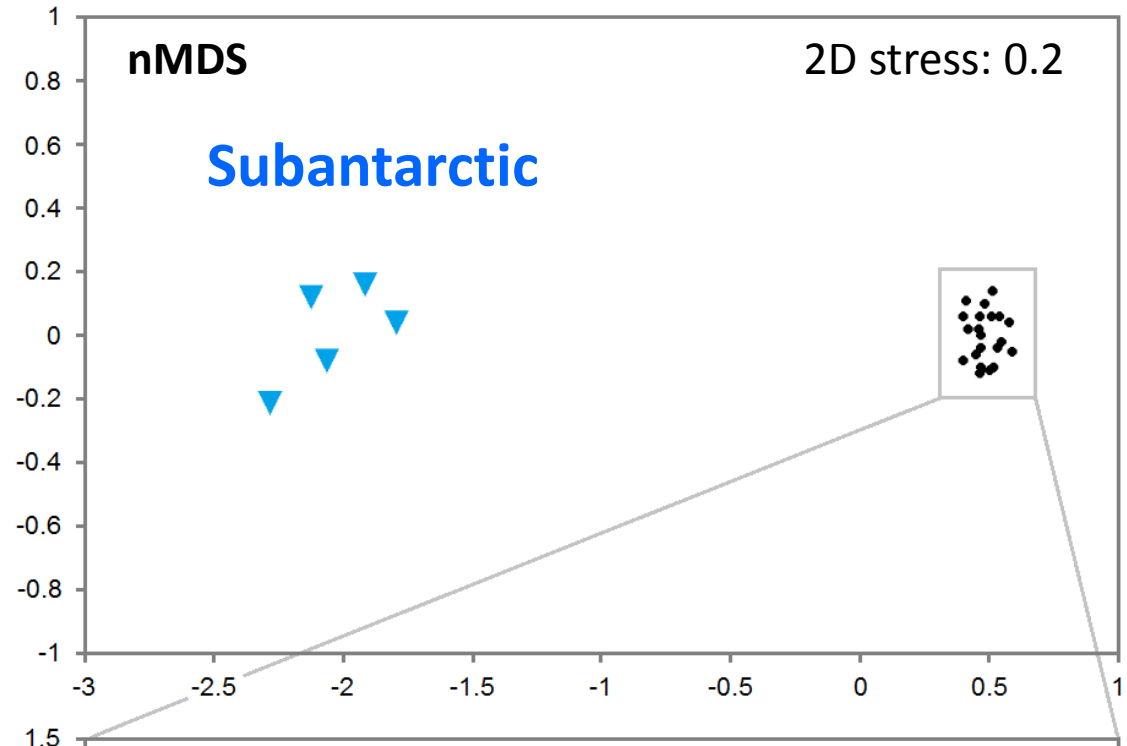
Biomass [mg / m³]

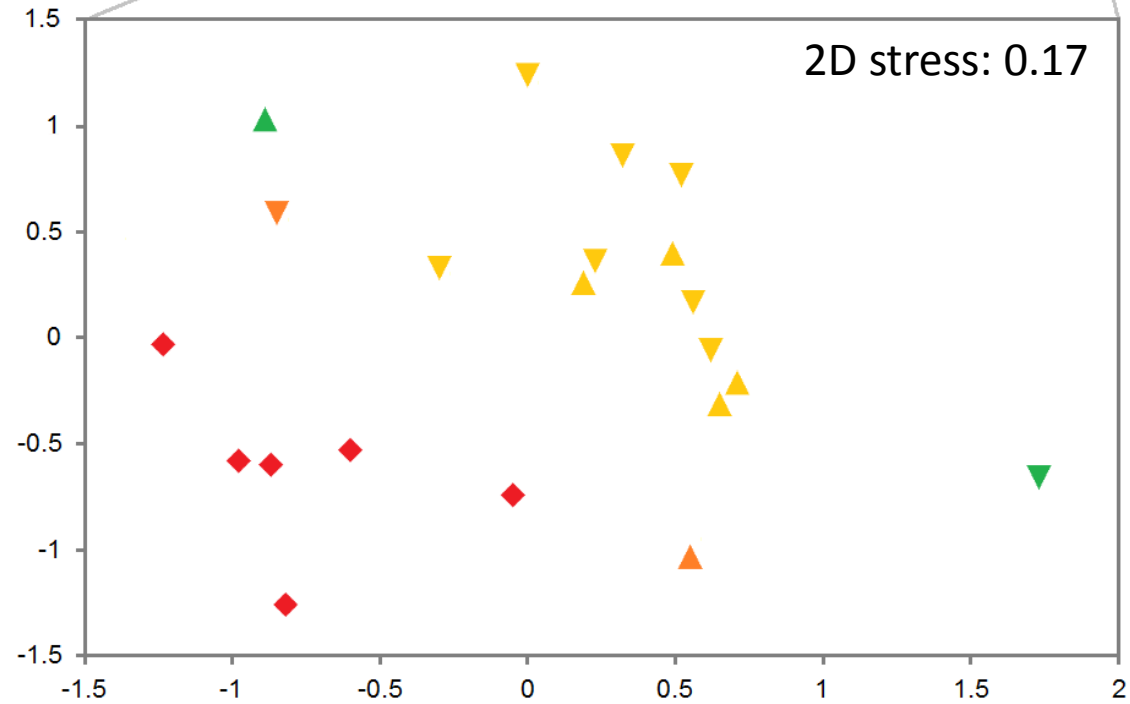


Pteropods
Species composition



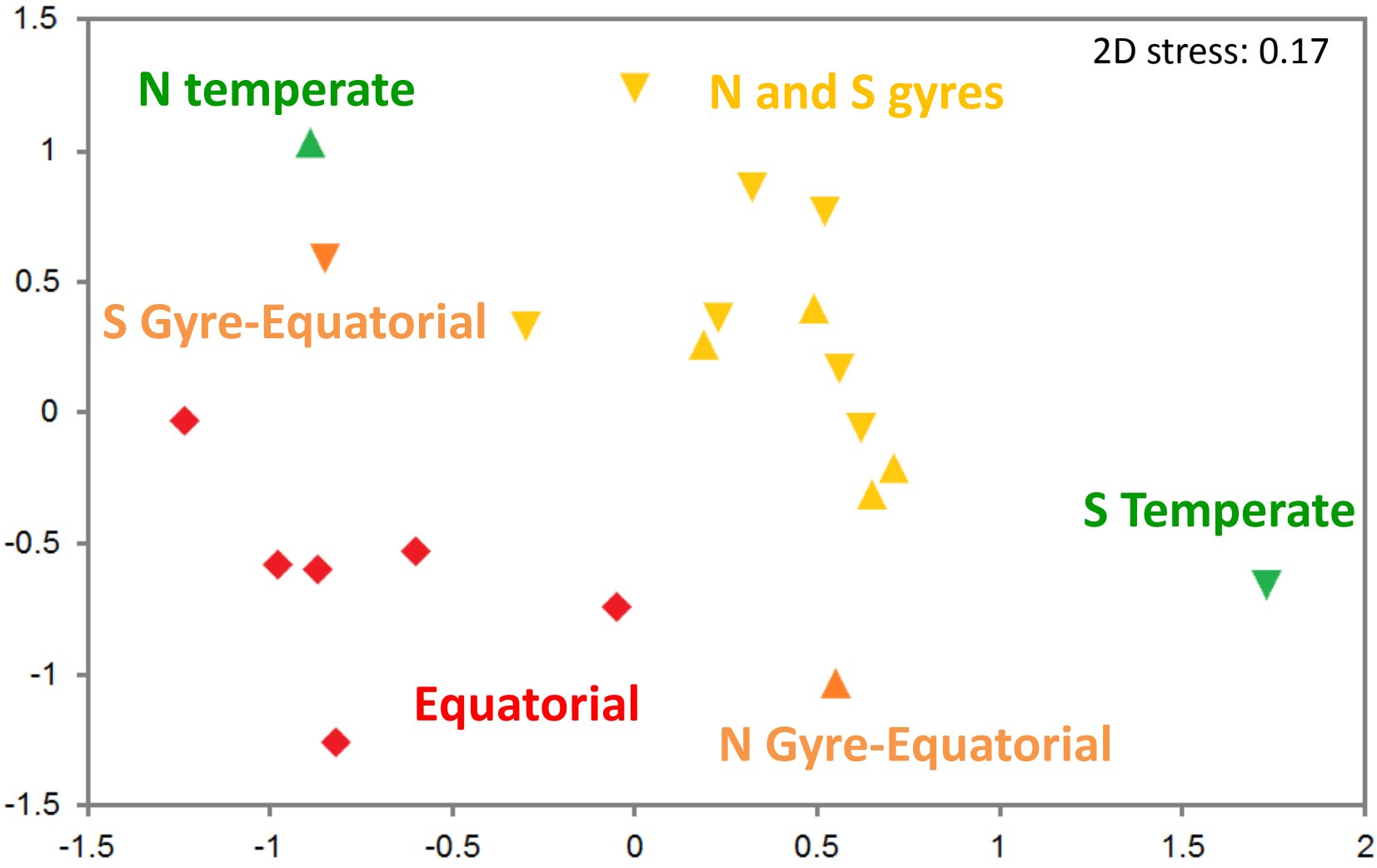
Pteropods
Species composition



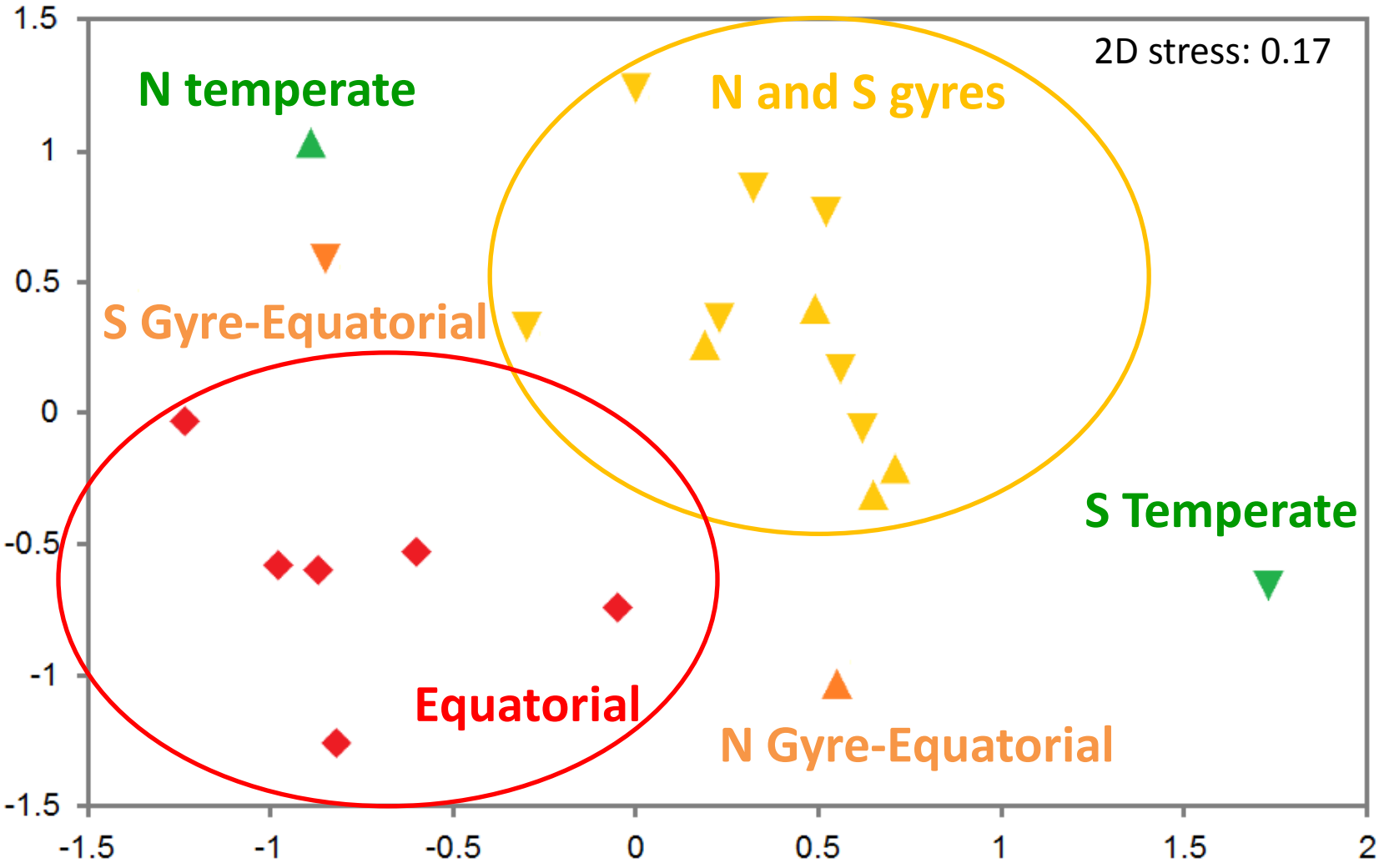


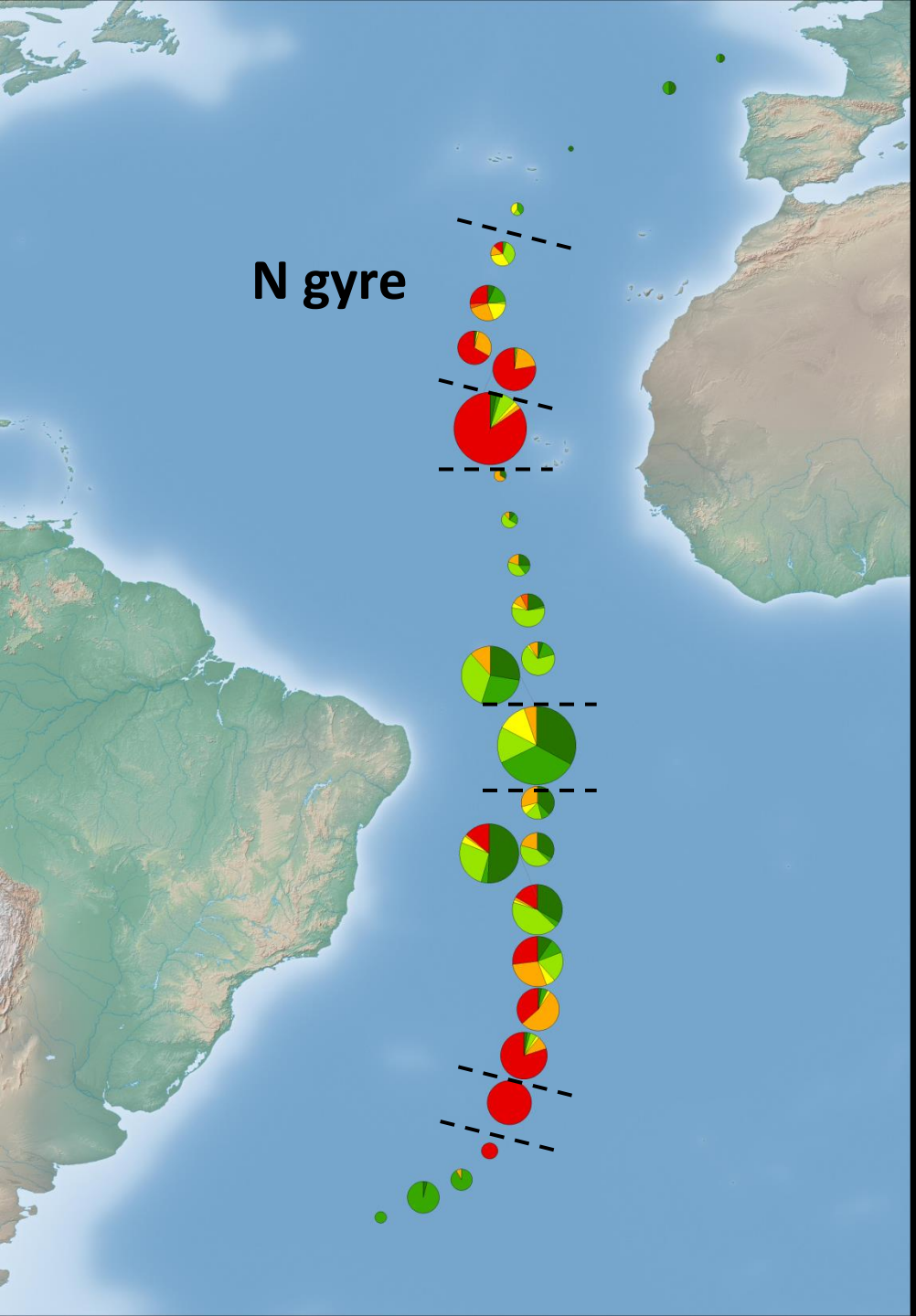
equatorial
N and S gyre-equatorial
N and S gyre
N and S temperate
subantarctic

Pteropods
Species composition



Pteropods
Species composition





Uncoiled pteropods

Genus composition

20°N

EQ

20°S

40°S

(Dia-)Cavolinia

Clio

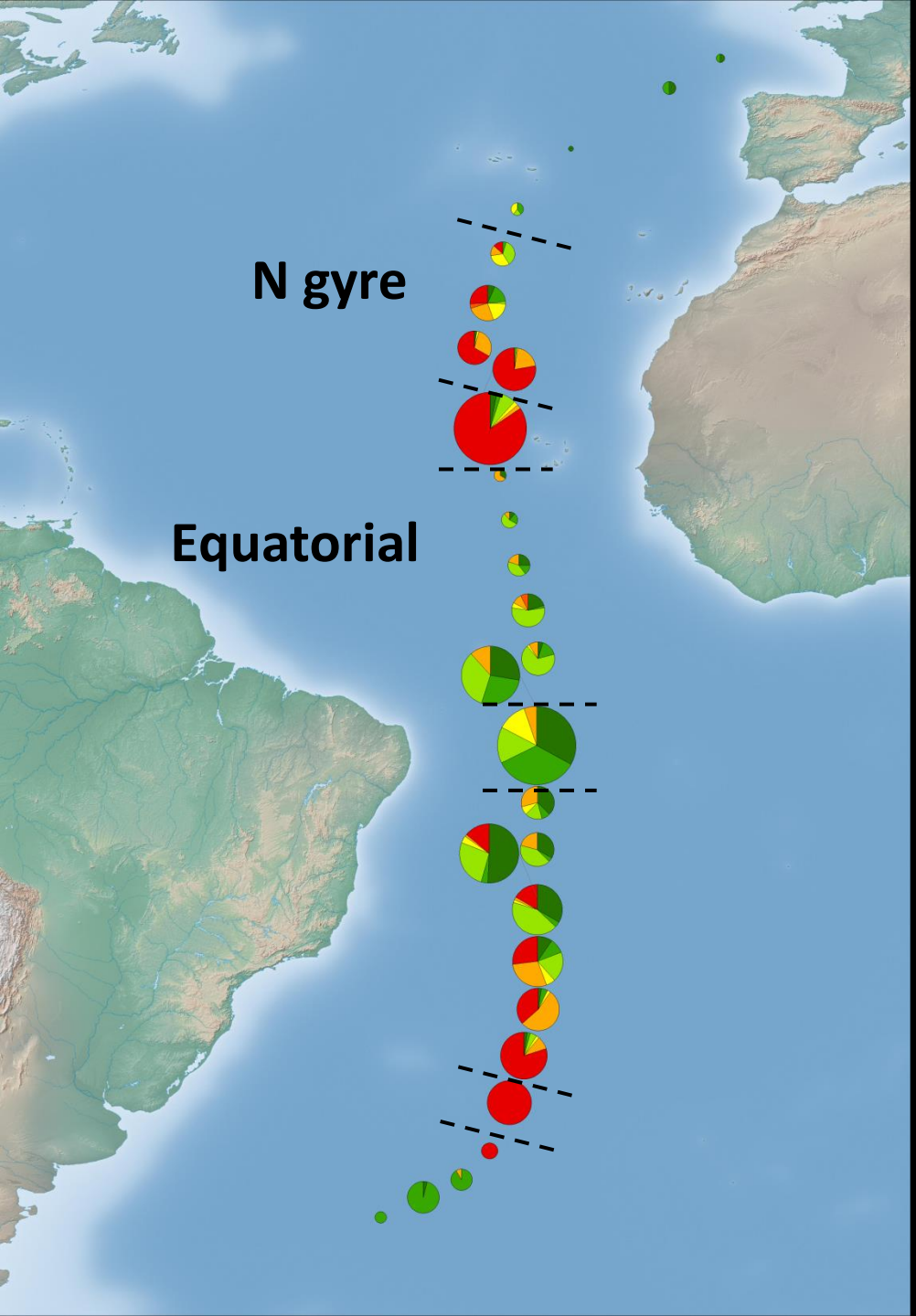
Creseis

Cuvierina

Diacria

Hyalocylis

Styliola



Uncoiled pteropods

Genus composition

20°N

EQ

20°S

40°S

(Dia-)Cavolinia

Clio

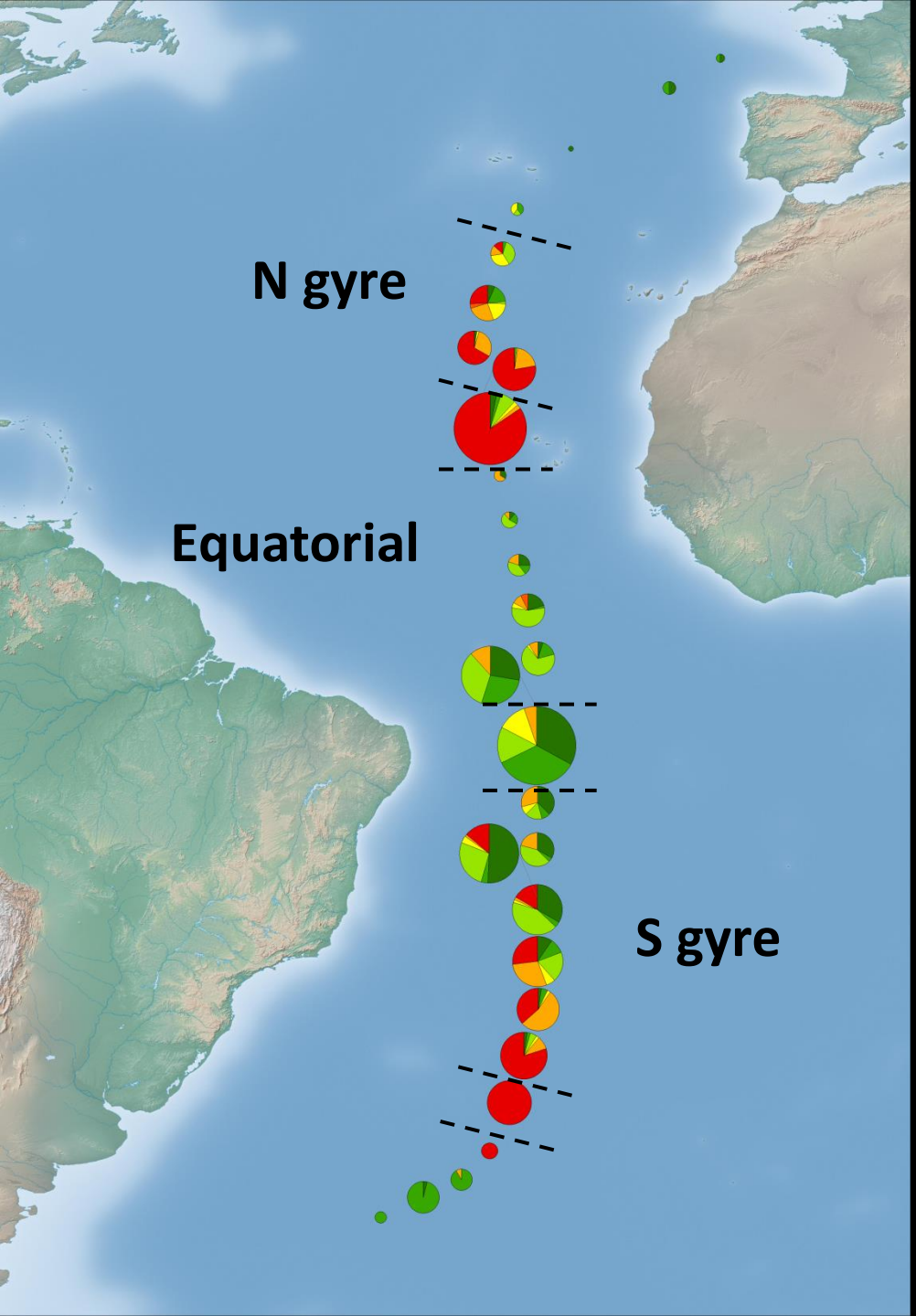
Creseis

Cuvierina

Diacria

Hyalocylis

Styliola



Uncoiled pteropods

Genus composition

20°N

EQ

20°S

40°S

(Dia-)Cavolinia

Clio

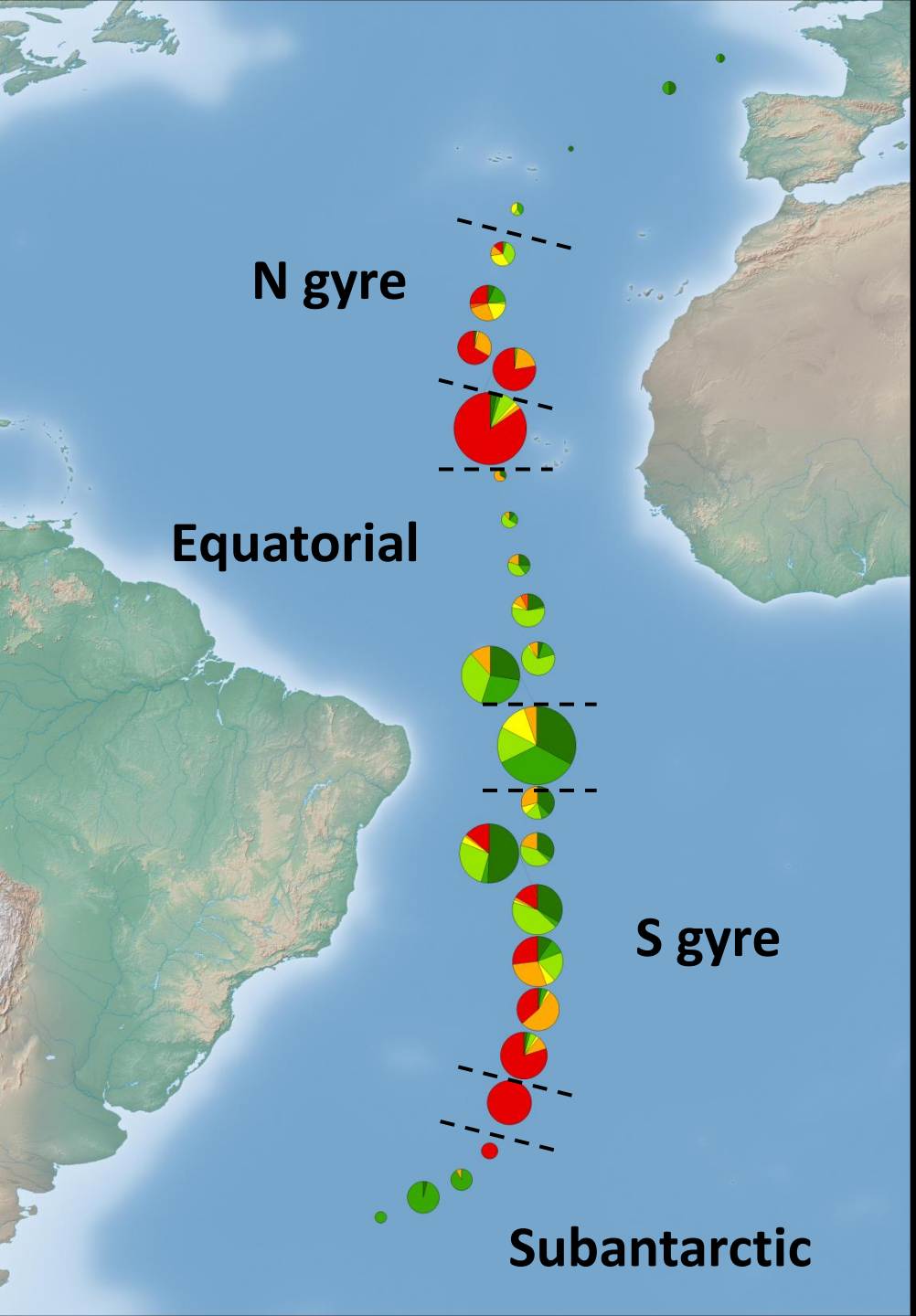
Creseis

Cuvierina

Diacria

Hyalocylis

Styliola



Uncoiled pteropods

Genus composition

20°N

EQ

20°S

40°S

(Dia-)Cavolinia

Clio

Creseis

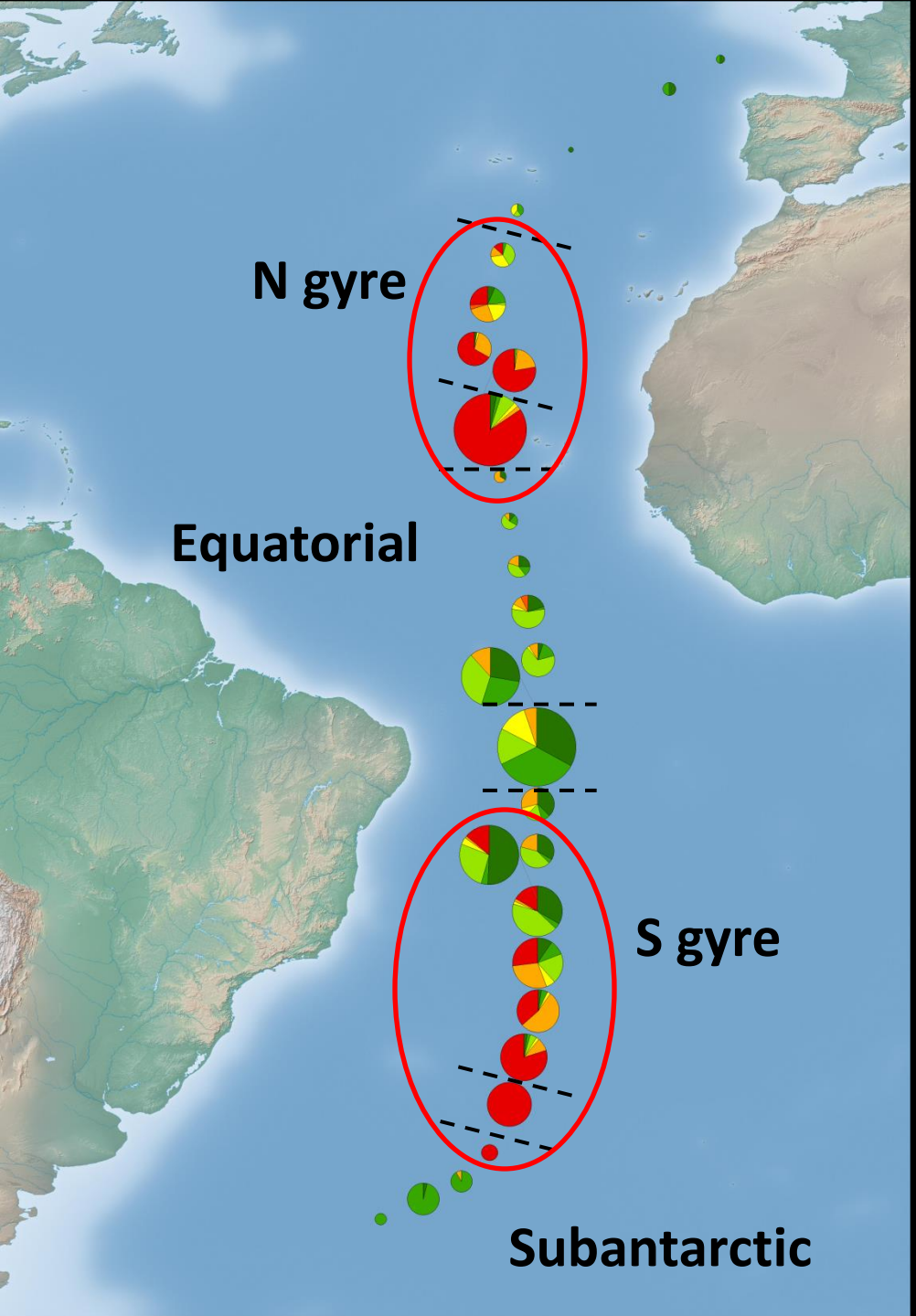
Cuvierina

Diacria

Hyalocylis

Styliola

Uncoiled pteropods
Genus composition



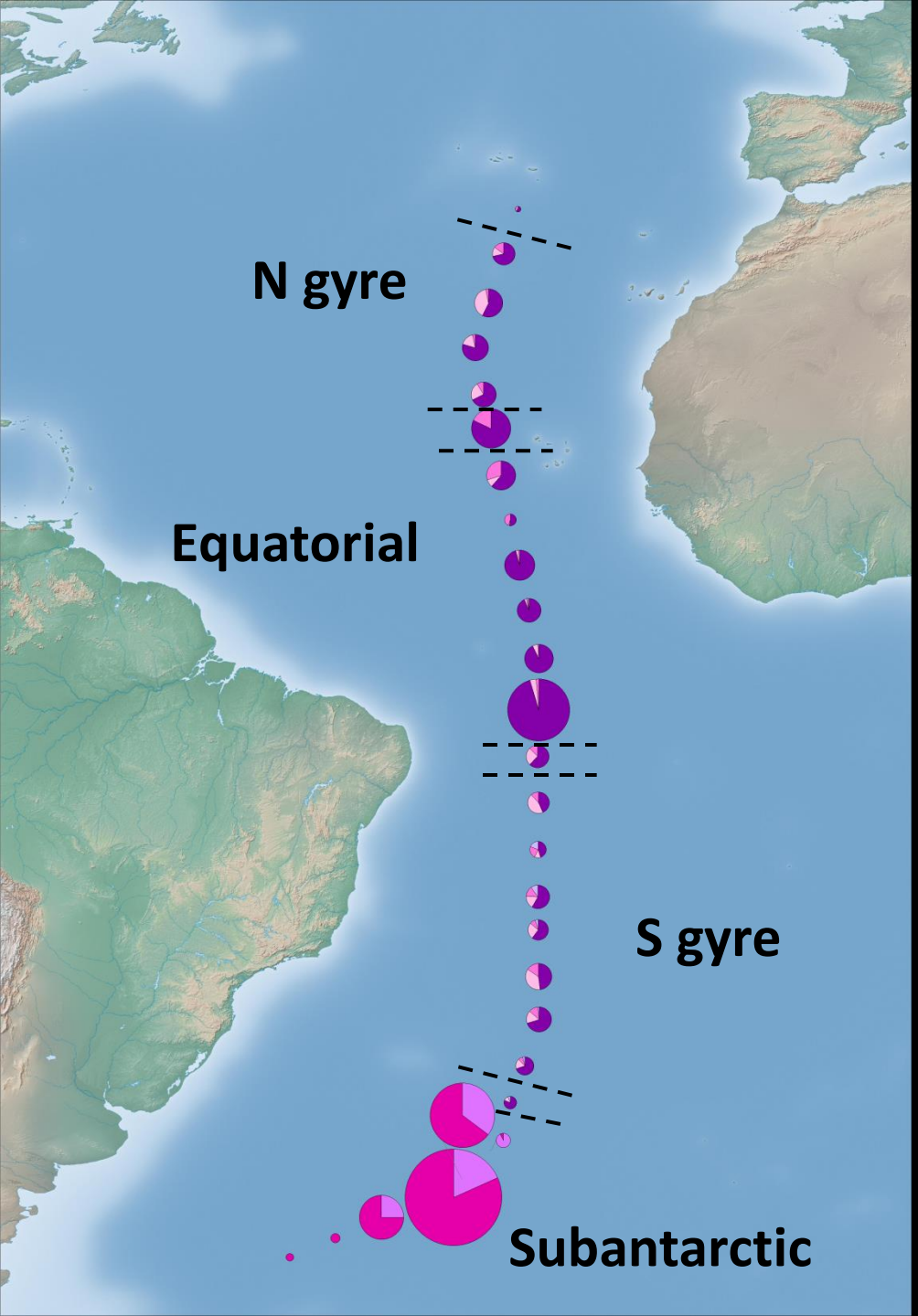
20°N

Styliola subula

EQ

20°S

40°S



Coiled pteropods
Species composition

Heliconoides inflatus

20°N

EQ

Limacina helicina antarctica

20°S

40°S

Coiled pteropods
Species composition

N gyre

Equatorial

S gyre

Subantarctic

Heliconoides inflatus

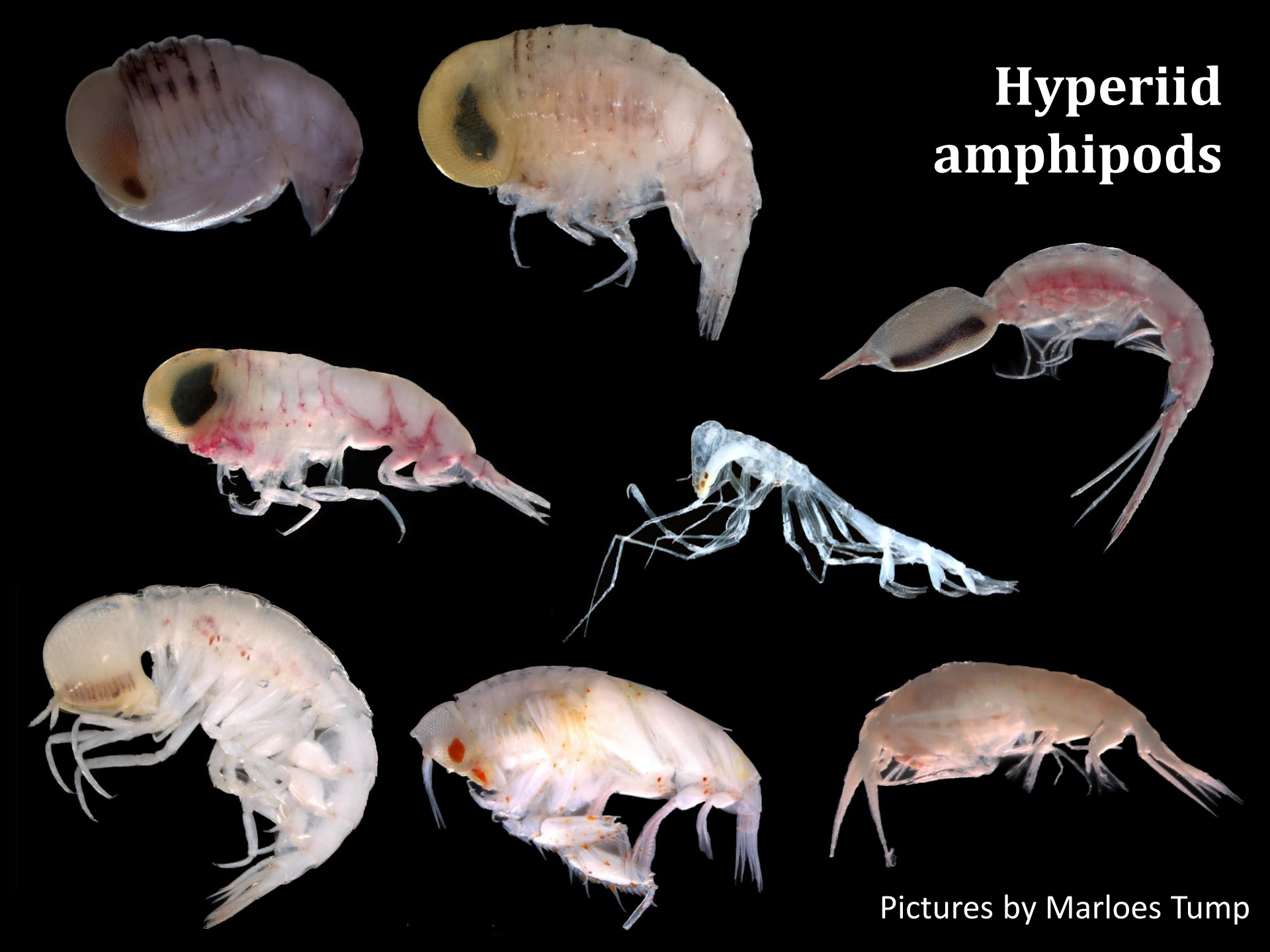
20°N

EQ

Limacina helicina antarctica

20°S

40°S


Hyperiid amphipods
Pictures by Marloes Tump

Hyperiids

Mostly commensals/parasites of gelatinous zooplankton

Physocephalata:

Epi- and mesopelagic

~ 65% of extant hyperiid species

68 species, **34** genera, **15** families

Physosomata:

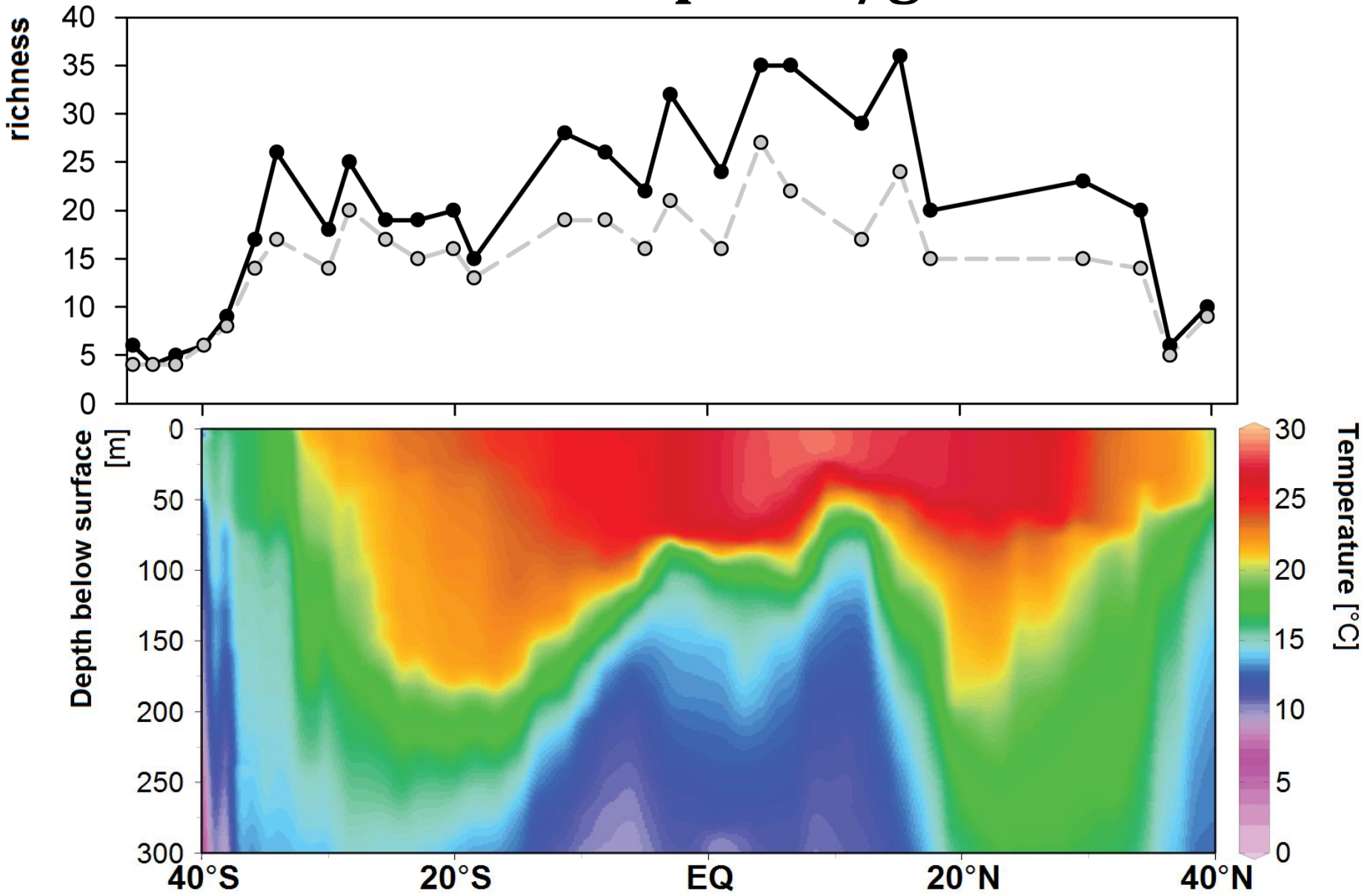
Primarily bathypelagic

~35% of extant hyperiid species

3 species, **3** genera, **3** families

Gelatinous hosts: Tunicates (salps, pyrosomes), Ctenophores, Siphonophores, Medusans, Scyphozoans

Hyperiids
Species/genus richness



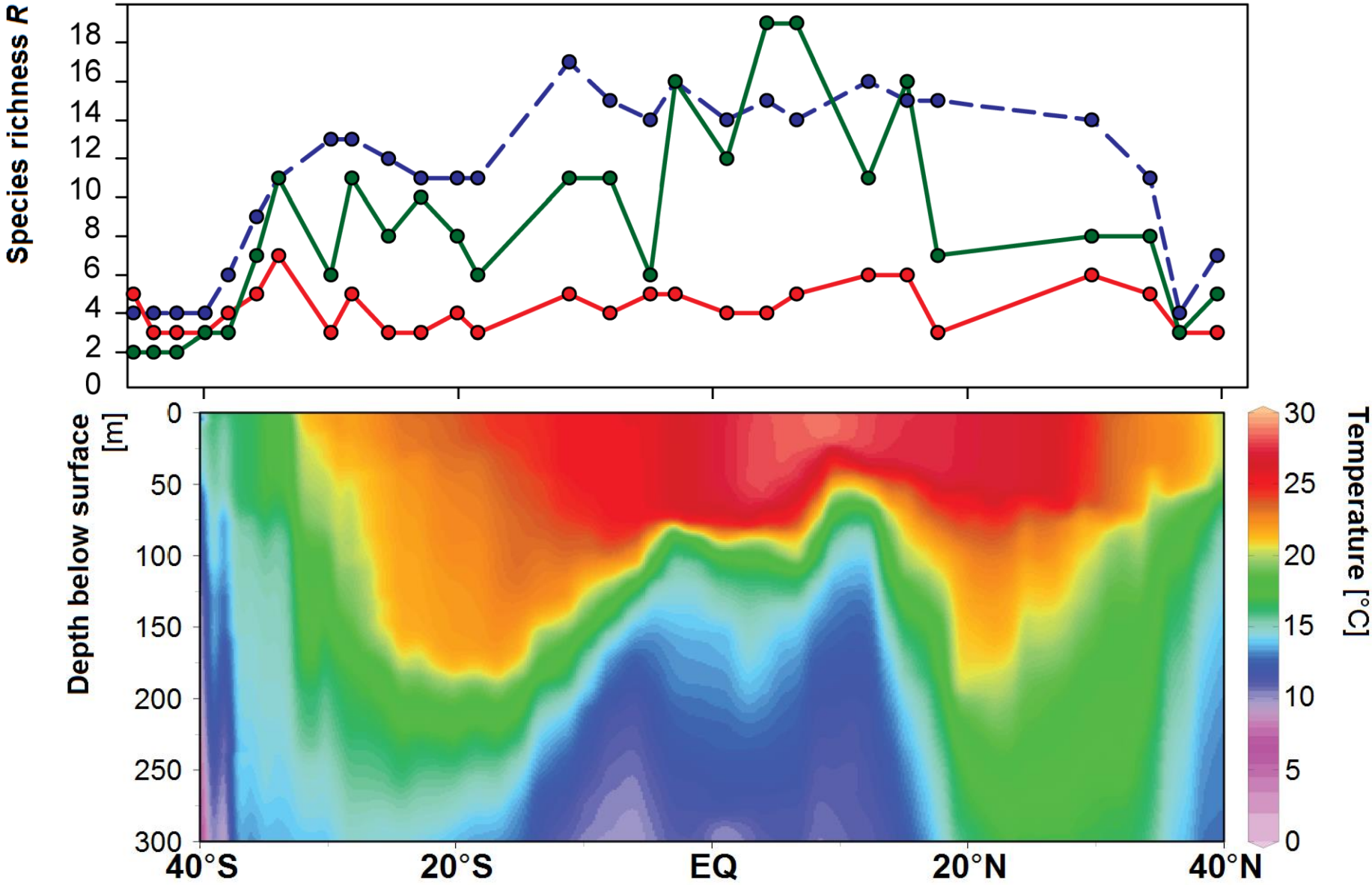
Phronimoidea

Platysceloidea

Vibilioidea

Hyperiids: Physocephalata

Species richness

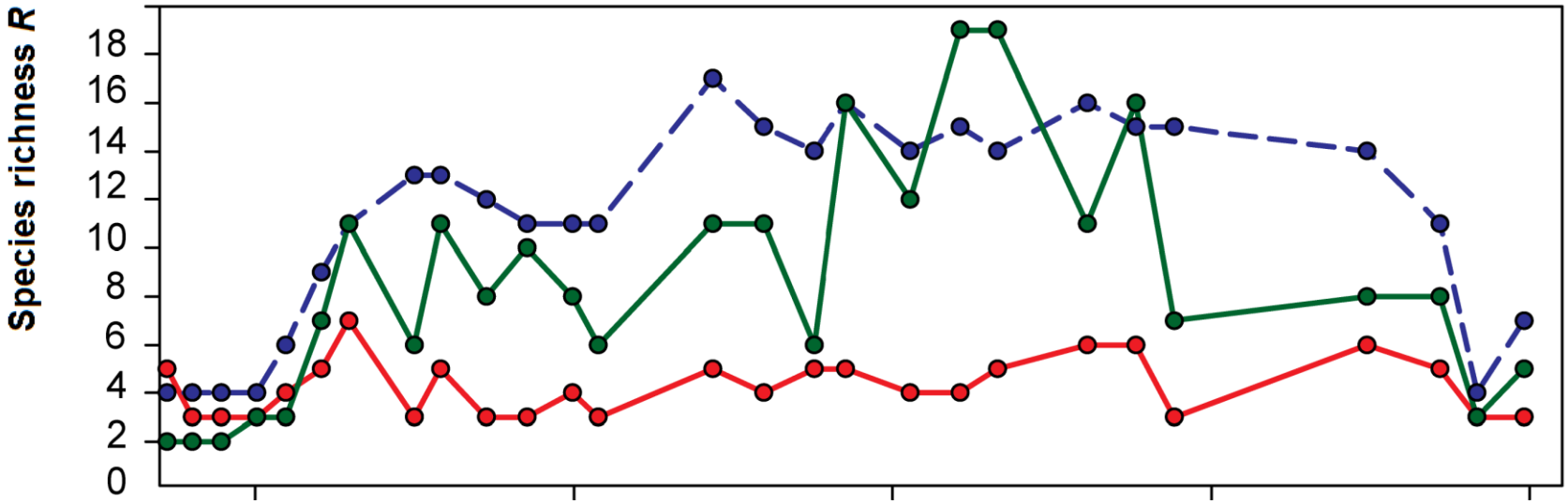


Phronimoidea

Platysceloidea

Vibilioidea

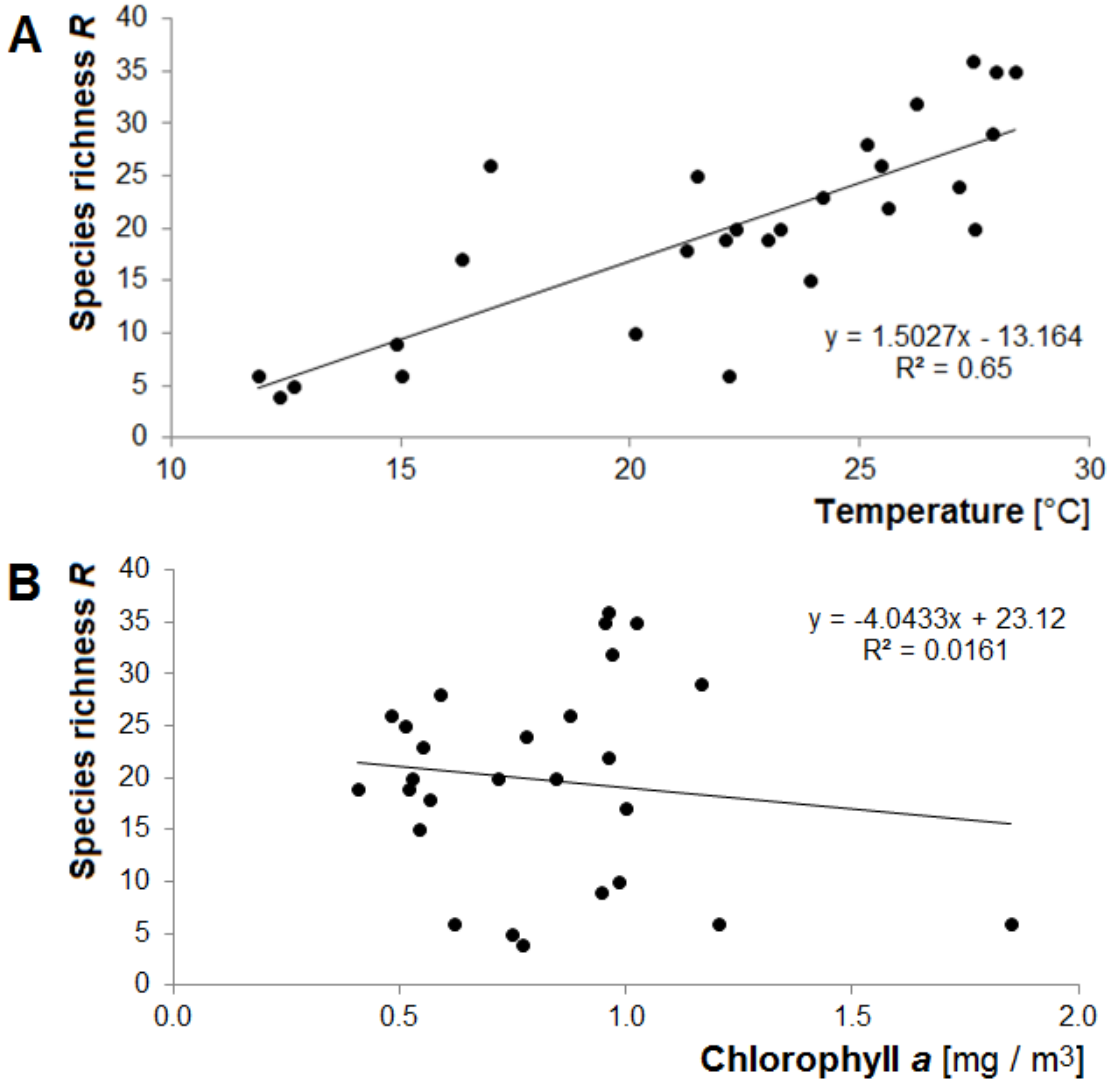
Hyperiids: Physocephalata Species richness



Platysceloidea

- More specific host associations than **Phronimoidea**
- Tunicate hosts: equatorial species diversity peak

Hyperiids
Species richness



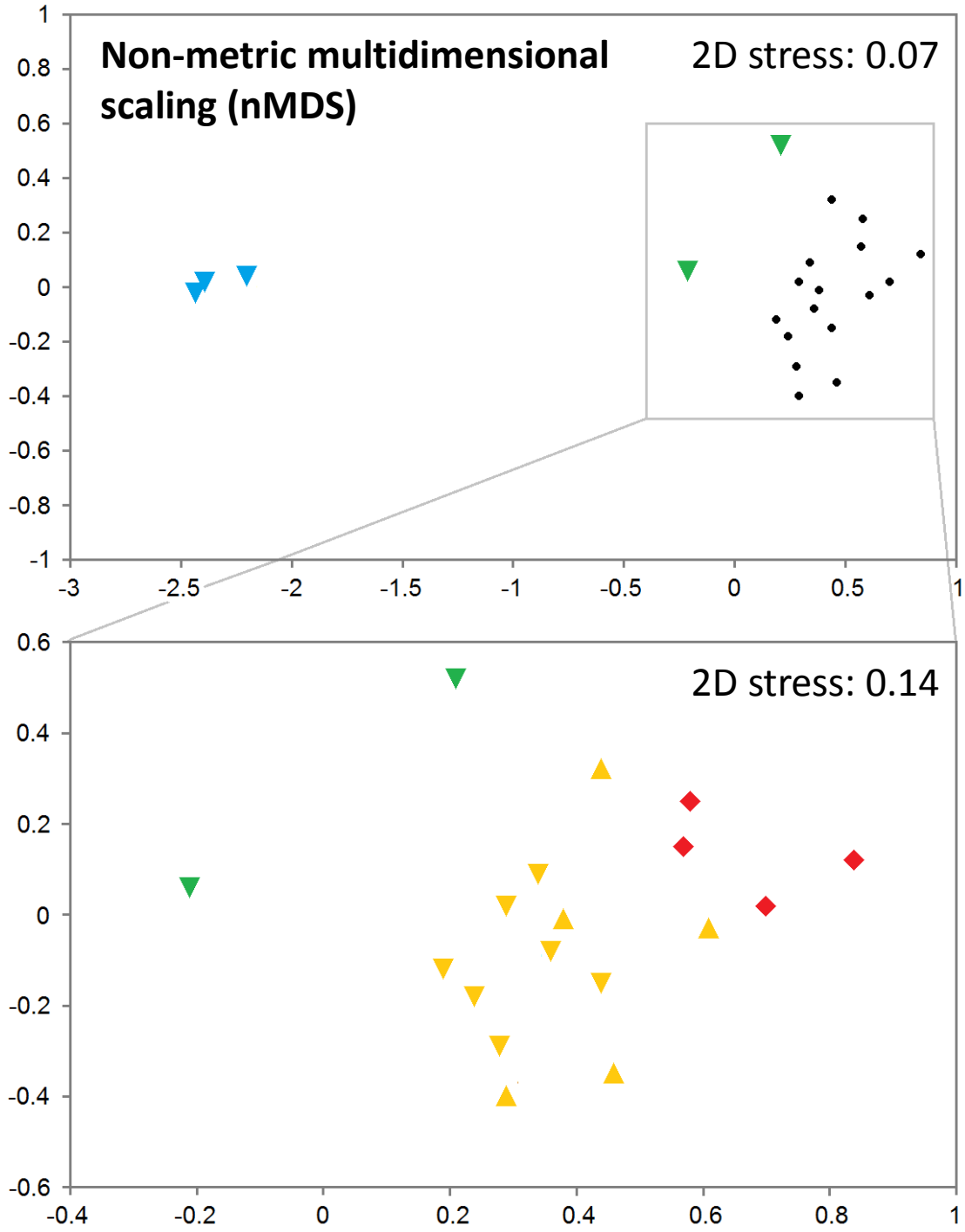
Sea surface temperature

positive, $p<0.001$

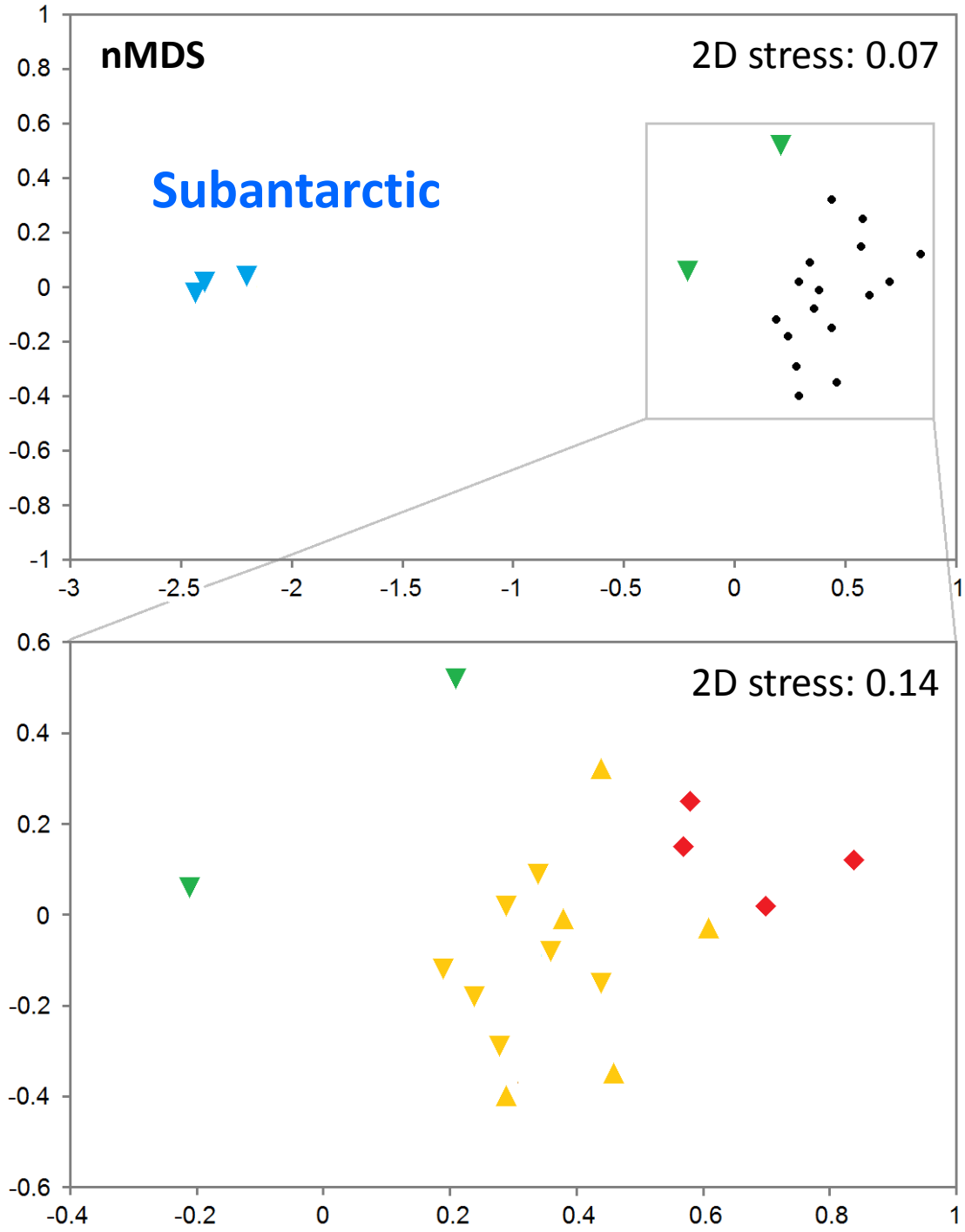
Chlorophyll *a* at DCM

No significant relationship

Hyperiids
Species composition

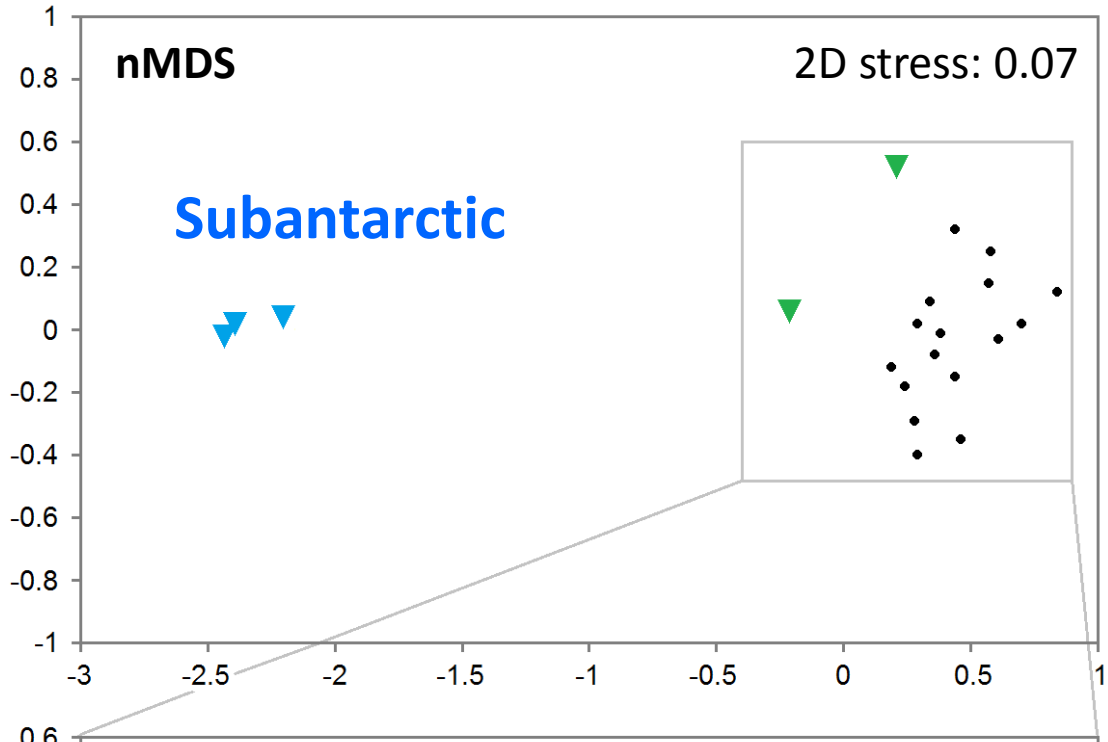


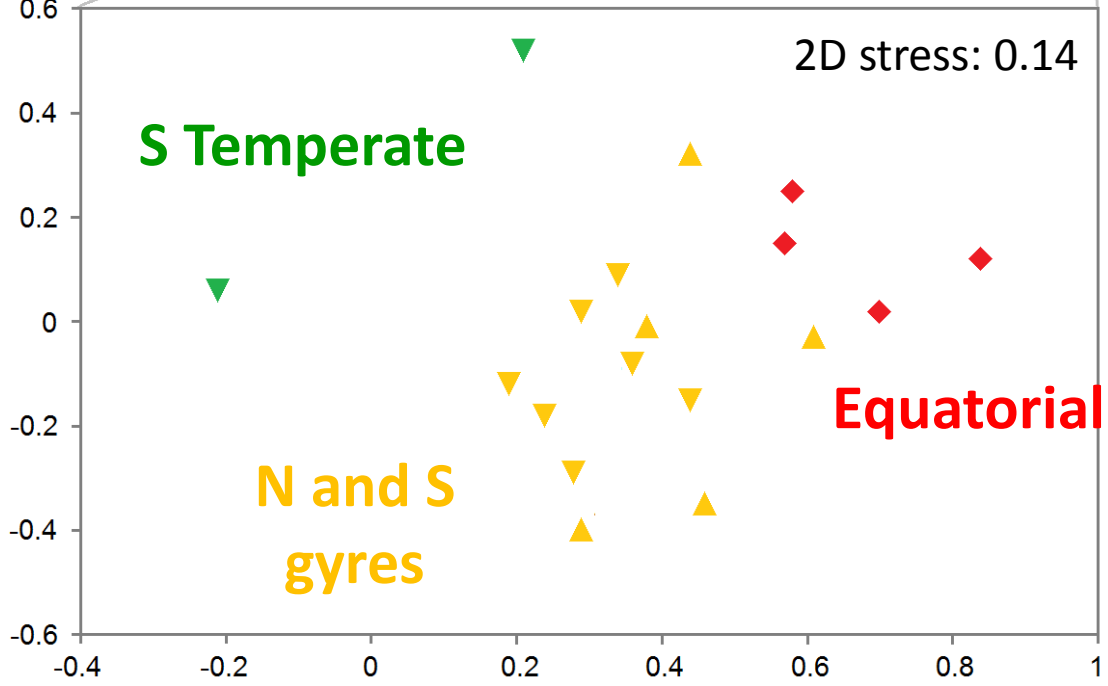
Hyperiids
Species composition



equatorial
N and S gyre
S temperate
subantarctic

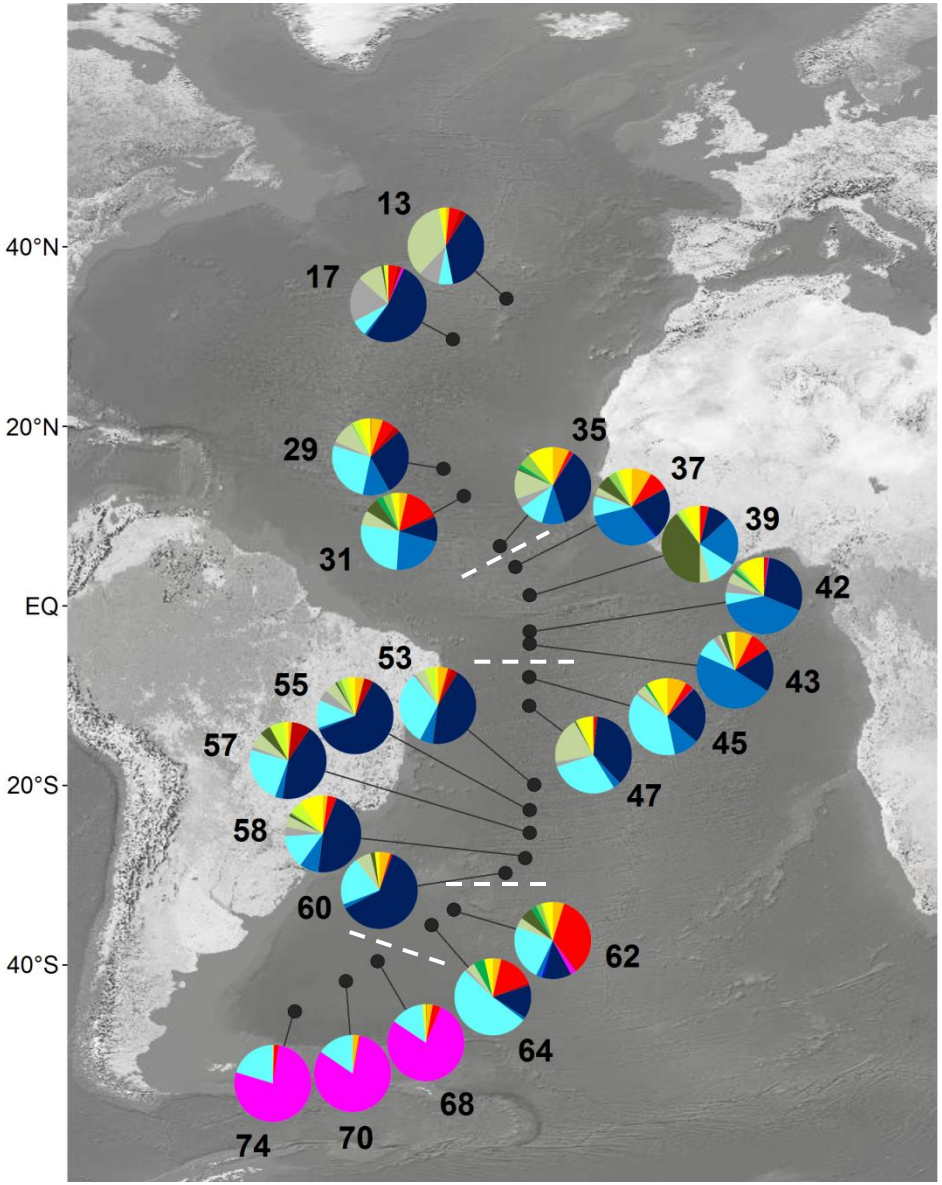
Hyperiids
Species composition





- equatorial
- N and S gyre
- S temperate
- subantarctic

Hyperiids
Family composition



N gyre

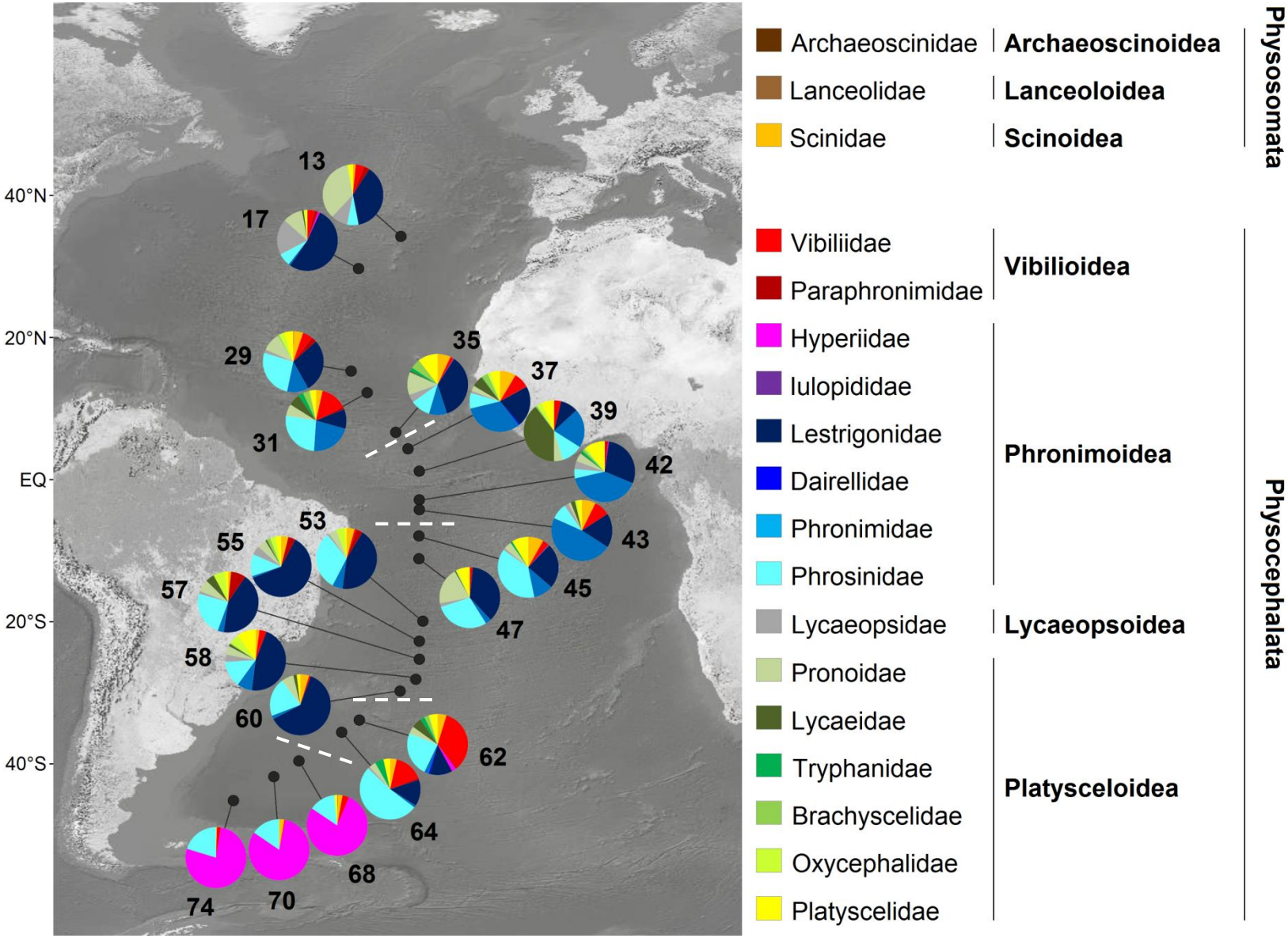
Equatorial

S gyre

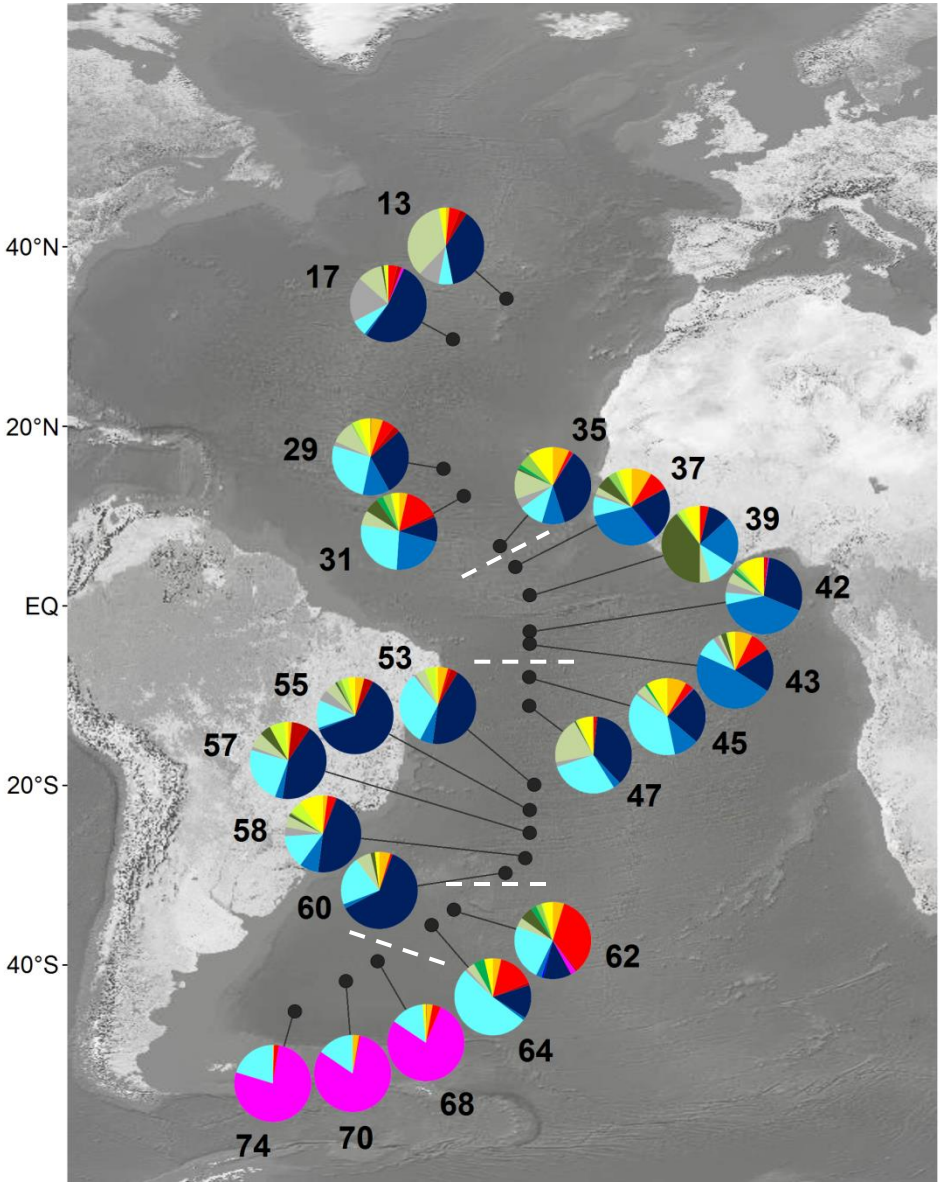
S temperate

Subantarctic

Hyperiids
Family composition



Hyperiids
Family composition

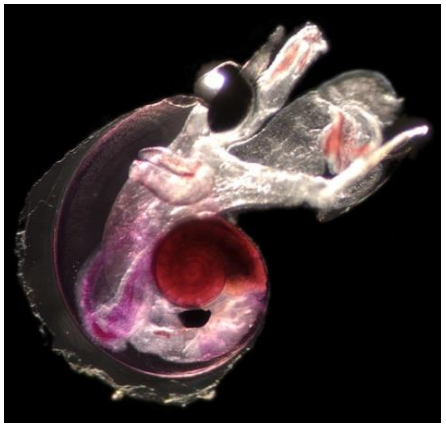


Hyperiidae

Themisto gaudichaudii

Subantarctic

Conclusions



- **Pteropods**:
  - Most diverse in warm, oligotrophic (sub)tropical waters
  - Most abundant in the subantarctic
  - Species assemblages largely correspond with Longhurst's biogeochemical provinces

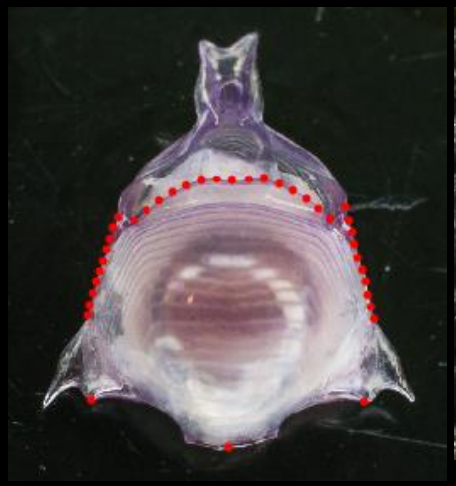
- **Heteropods**:
  - Most species occur in warm waters, but some occur in the subantarctic

Conclusions

- **Hyperiid amphipods**:
  - Most diverse across a narrow equatorial zone, mainly driven by Platysceloidea
  - Depend more on distributions of gelatinous hosts

Conclusions

- Latitudinal diversity gradients vary per zooplankton group
- The subtropical convergence zone is a common transition



Naturalis Biodiversity Center

Posters

akburridge@yahoo.co.uk

S4

Species boundaries in Diacavolinia pteropods

Burridge AK, van der Hulst R, Goetze E, Peijnenburg KTCA

S2

Adaptive potential of pteropods along a latitudinal gradient of ocean acidification

Peijnenburg KTCA, Dragozet A, Kruijt S, Kitidis V, Roessingh P, Huisman J, Goetze E, Renema W

S3

DNA barcoding of hyperiid amphipods along the 2012 Atlantic Meridional Transect

Tump M, Vonk R, Burridge AK, Goetze E, Peijnenburg KTCA

Thank you

6th ZPS Travel grant

Naturalis Biodiversity Center

Willem Renema

Arie Janssen

Michelle Jungbluth

Sara Cregeen

Rob Thomas

& all other AMT22 and/or AMT24 cruise participants / crew

The Malacological Society of London

KONINKLIJKE NEDERLANDSE AKADEMIE VAN WETENSCHAPPEN

PML

British Antarctic Survey

NATURAL ENVIRONMENT RESEARCH COUNCIL