Regulating forces of rocky shore assemblages in the seasonal tropics

Jackson Wai Ting LAU, Tin Yan HUI, Gray A. WILLIAMS

The Swire Institute of Marine Science and School of Biological Sciences

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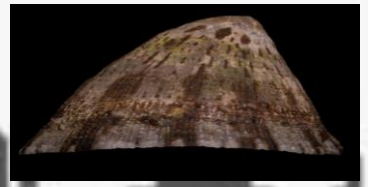
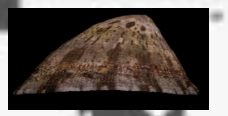
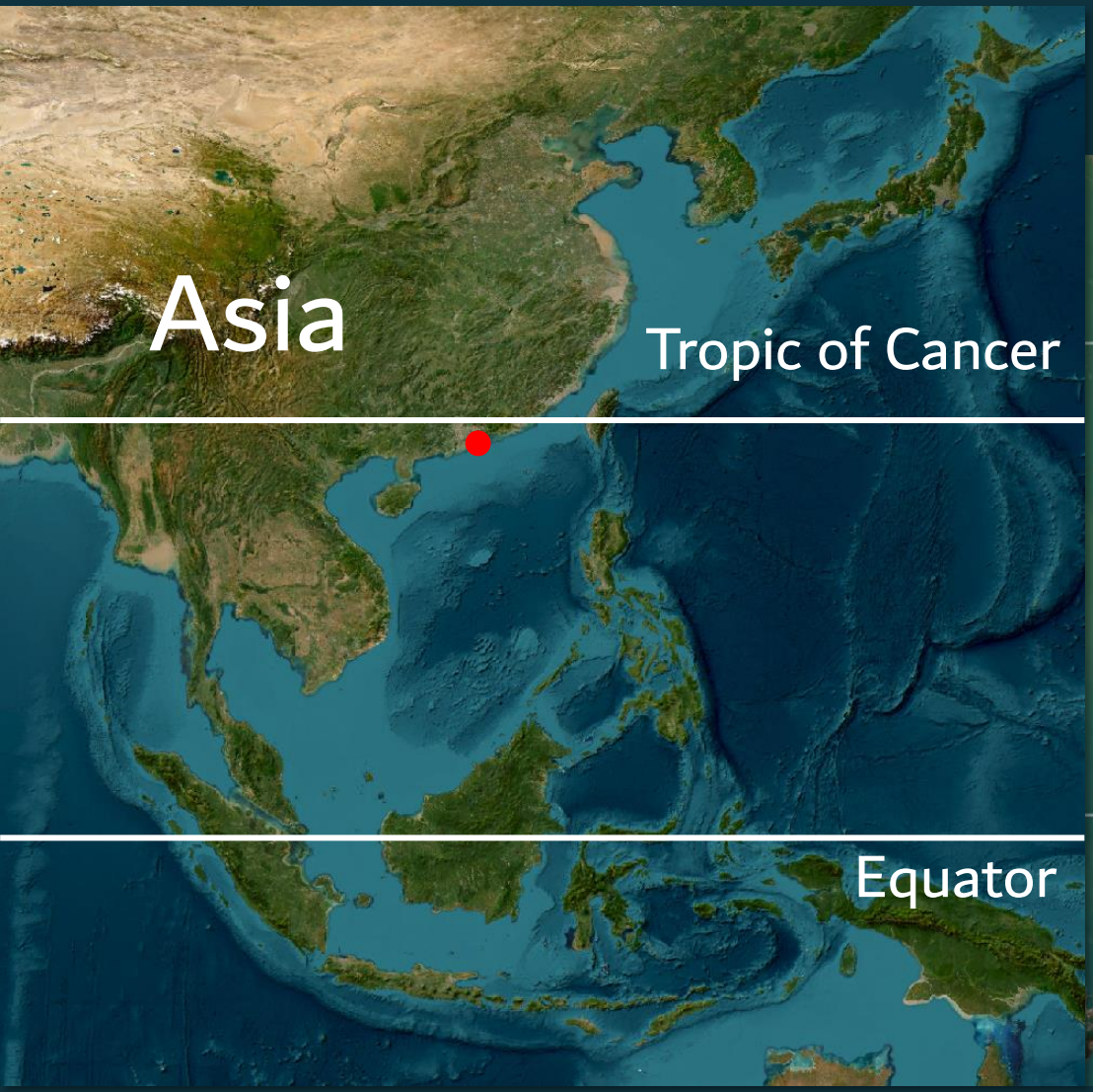
Seasonal tropics

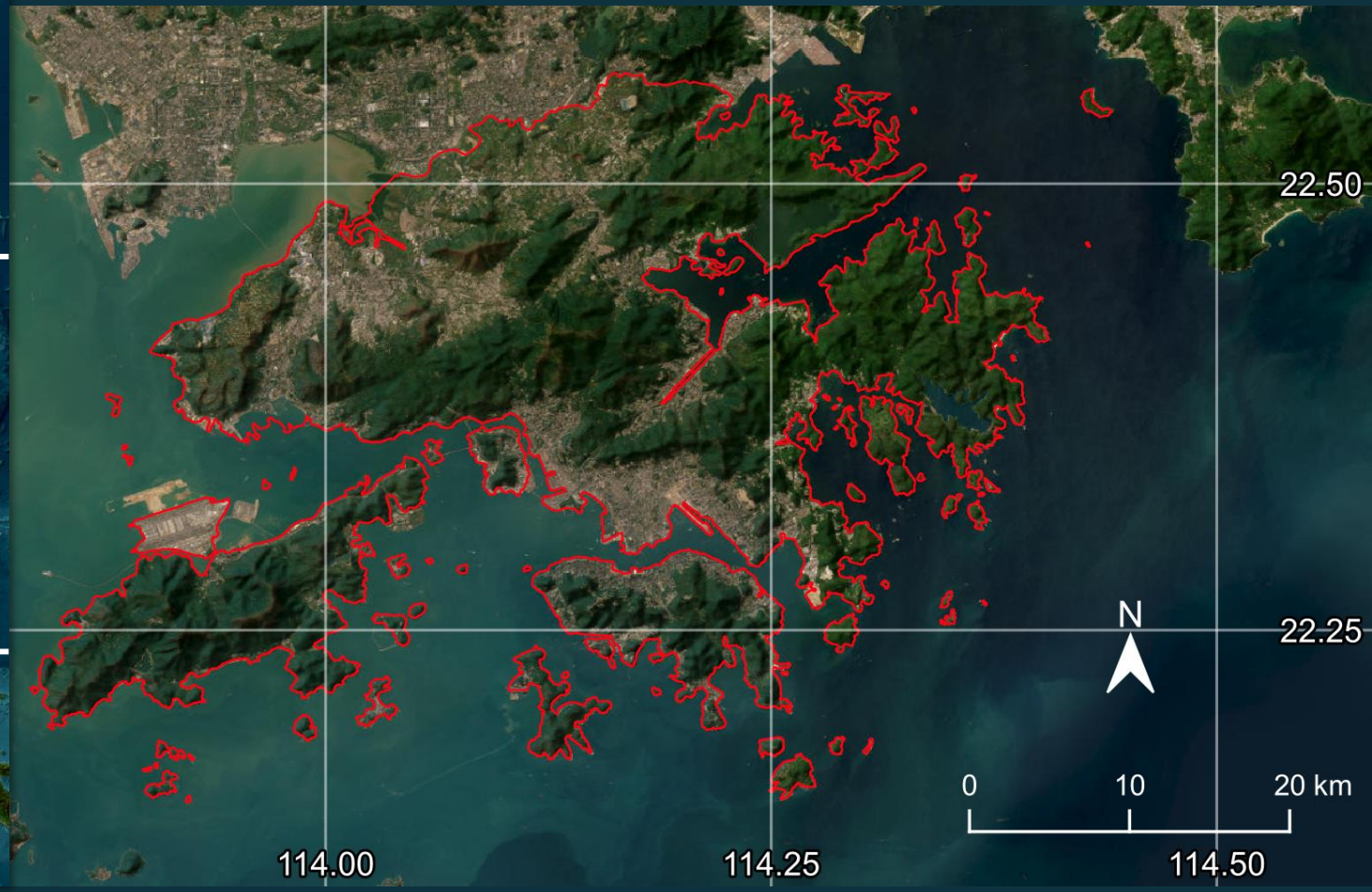


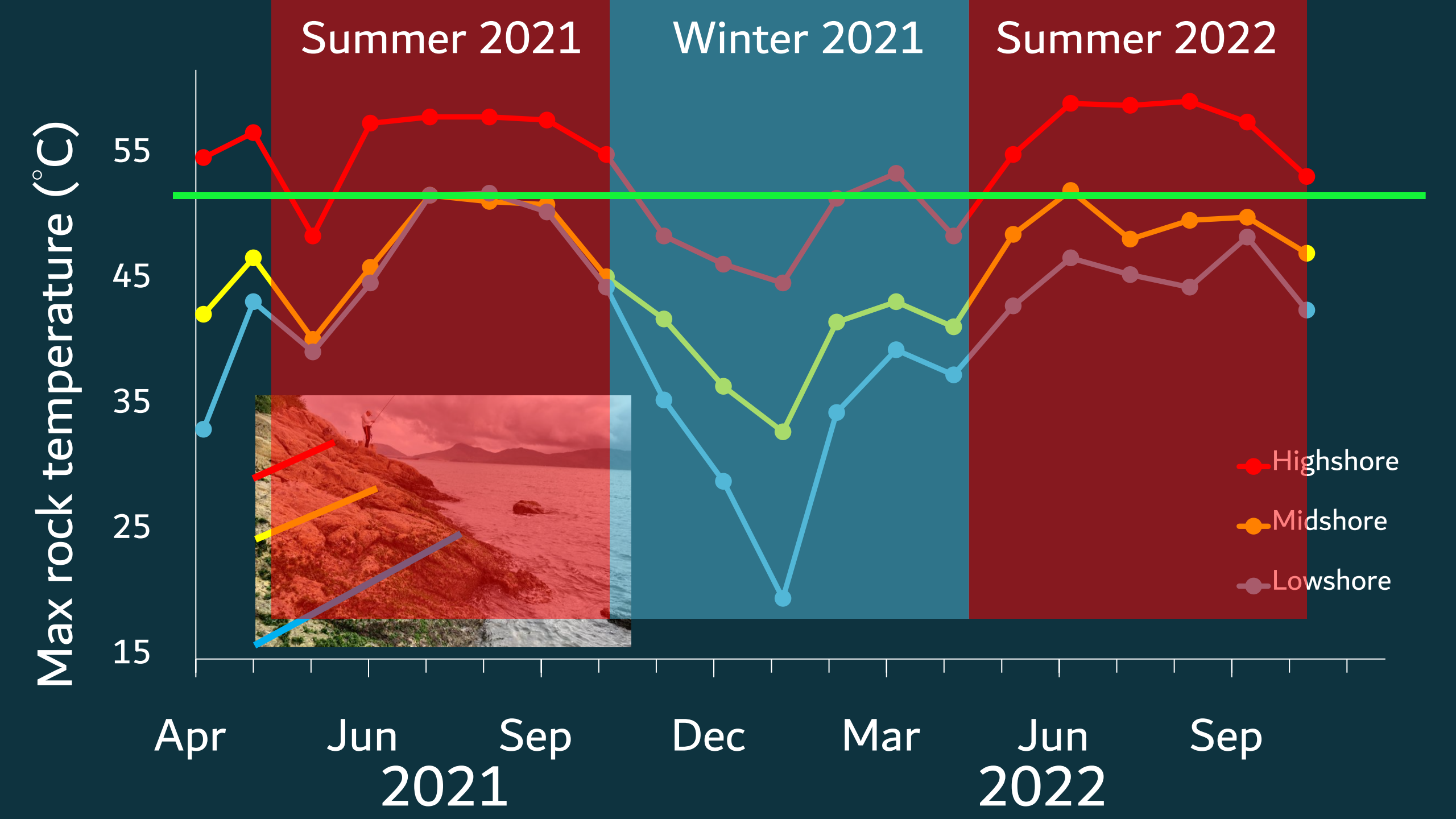


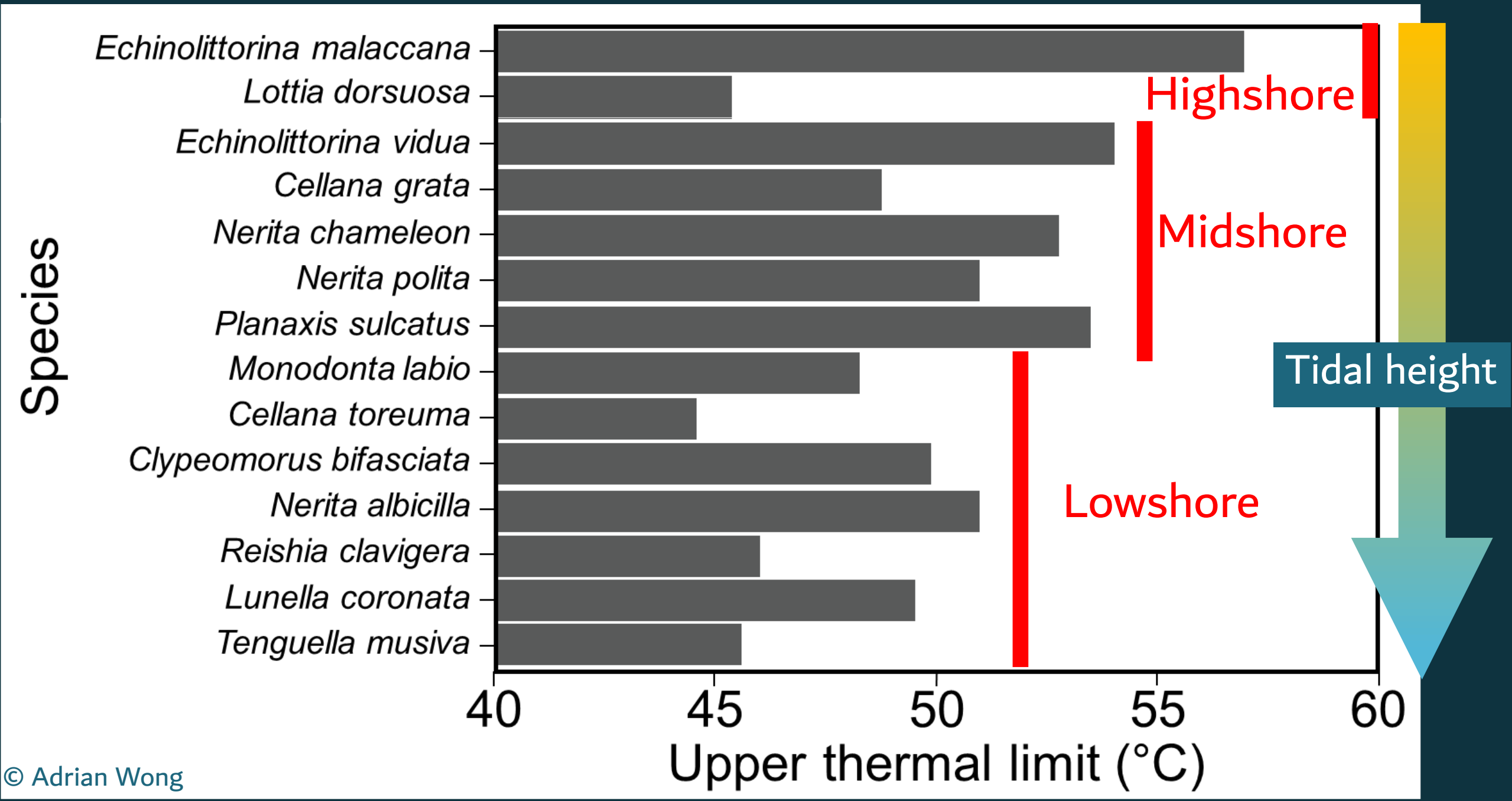





Asia
Tropic of Cancer
Equator


22.50
22.25
N
0
10
20 km
114.00
114.25
114.50


Summer 2021
Winter 2021
Summer 2022
Max rock temperature (°C)
55
45
35
25
15
Highshore
Midshore
Lowshore
Apr
Jun
Sep
Dec
Mar
Jun
Sep
2021
2022


Species
Echinolittorina malaccana
Lottia dorsuosa
Echinolittorina vidua
Cellana grata
Nerita chameleon
Nerita polita
Planaxis sulcatus
Monodonta labio
Cellana toreuma
Clypeomorus bifasciata
Nerita albicilla
Reishia clavigera
Lunella coronata
Tenguella musiva
Highshore
Midshore
Lowshore
Tidal height
40
45
50
55
60
Upper thermal limit (°C)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Home scars

Regulating forces of rocky shore assemblages in the seasonal tropics

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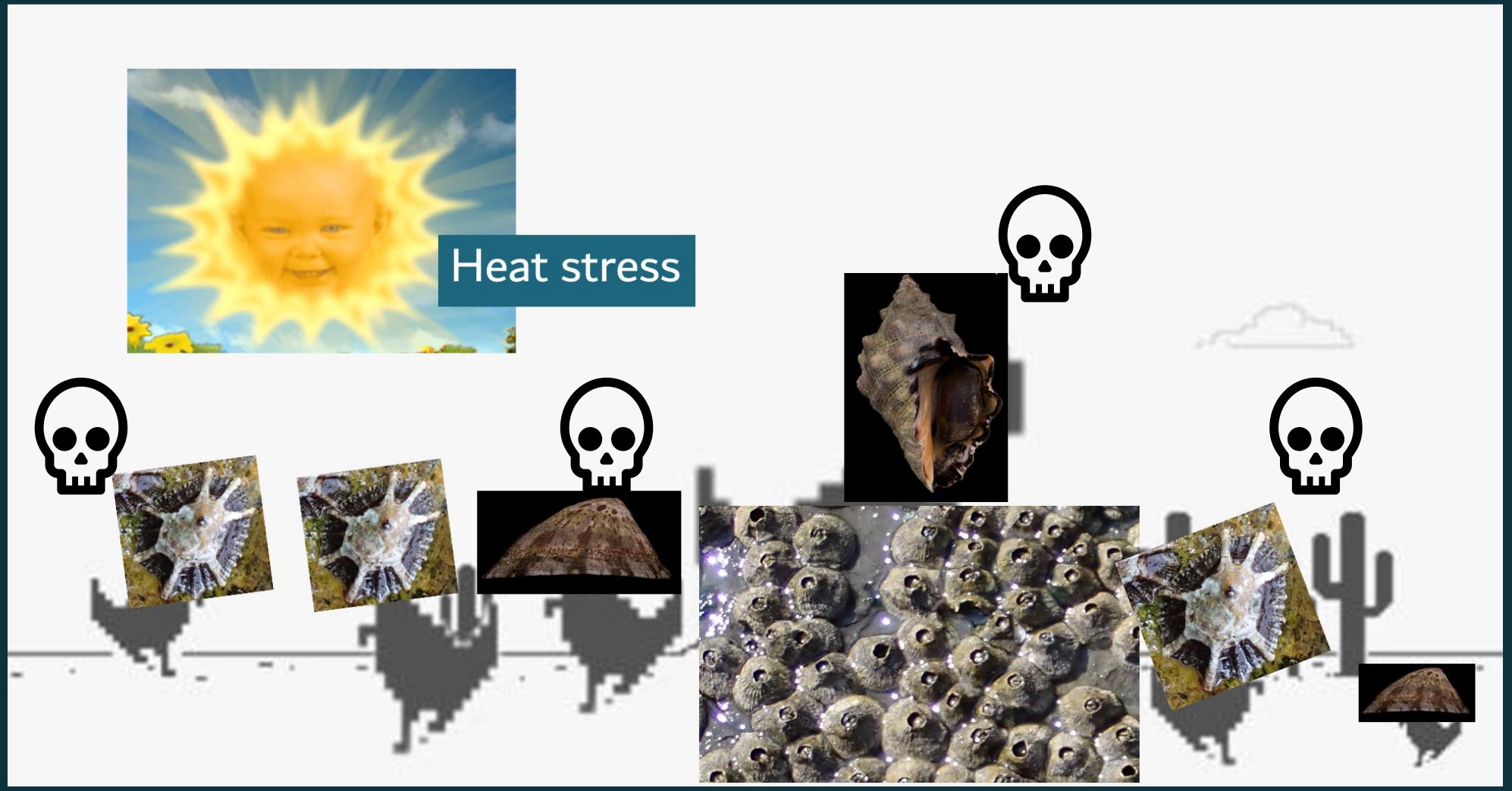
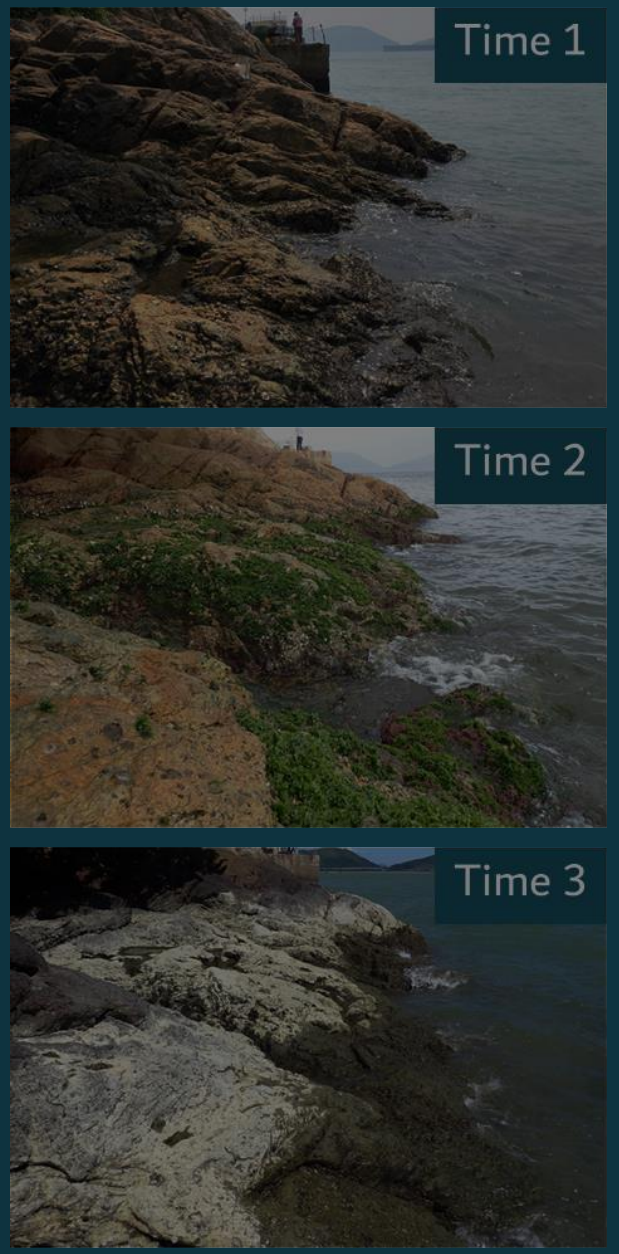
Is temperature an important driving force on the seasonal tropical rocky shore assemblages?



Mensurative approaches to study the drivers

Spatial variation



Time

Temporal variation

Physical filters & spatial variation

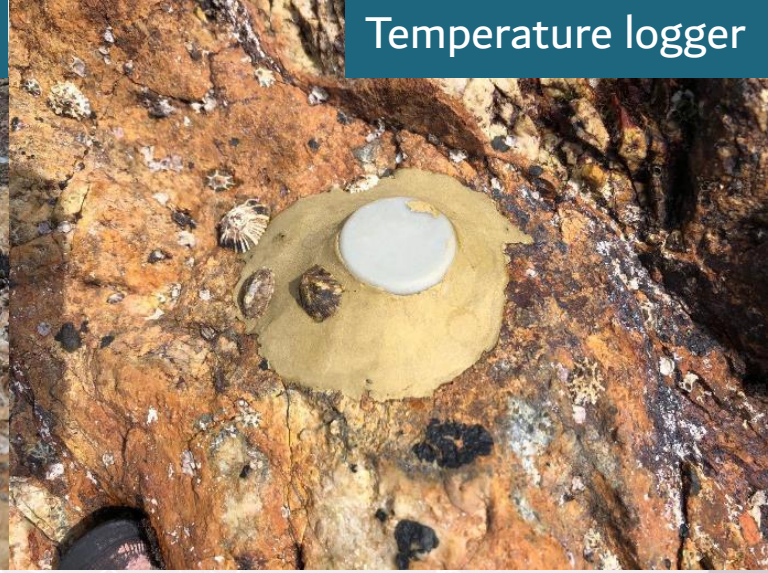
→ 24 sites

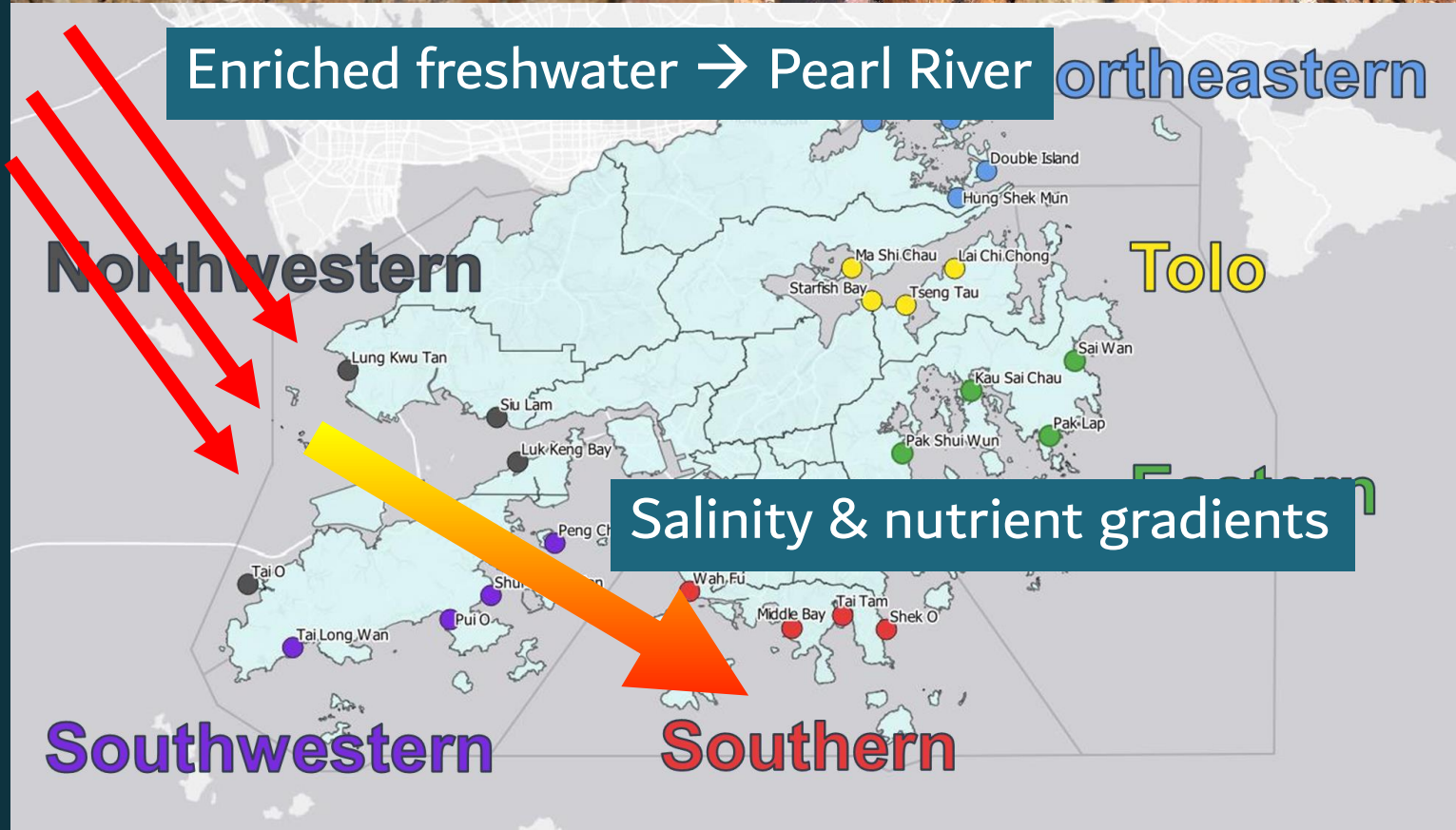
→ 6 tidal heights

- Mobile species – count
- Sessile species – % cover

- Shore aspects (slope, orientation, etc.)

- Algal biomass (chl *a*)
- Seawater quality

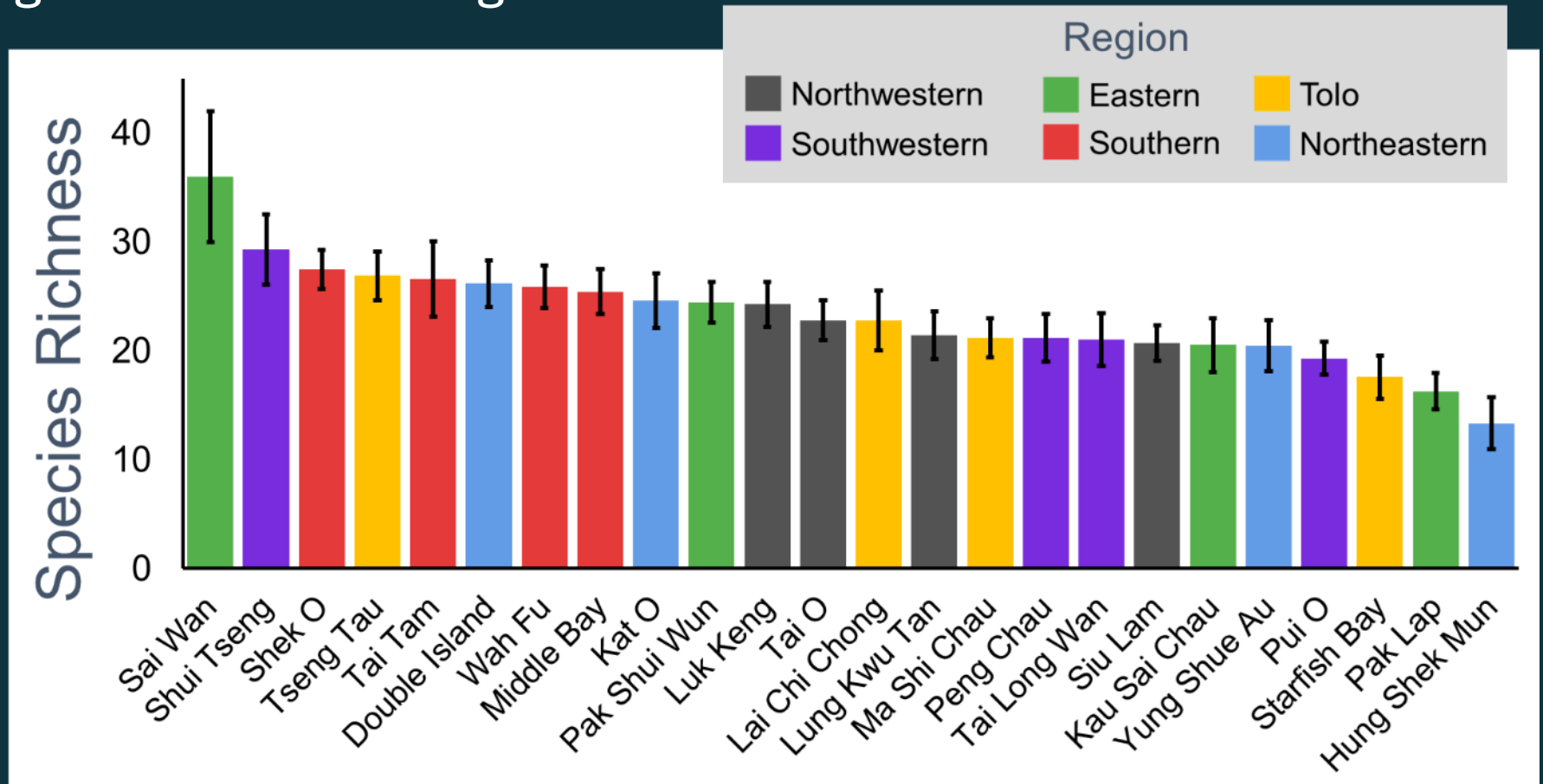




Physical filters & spatial variation

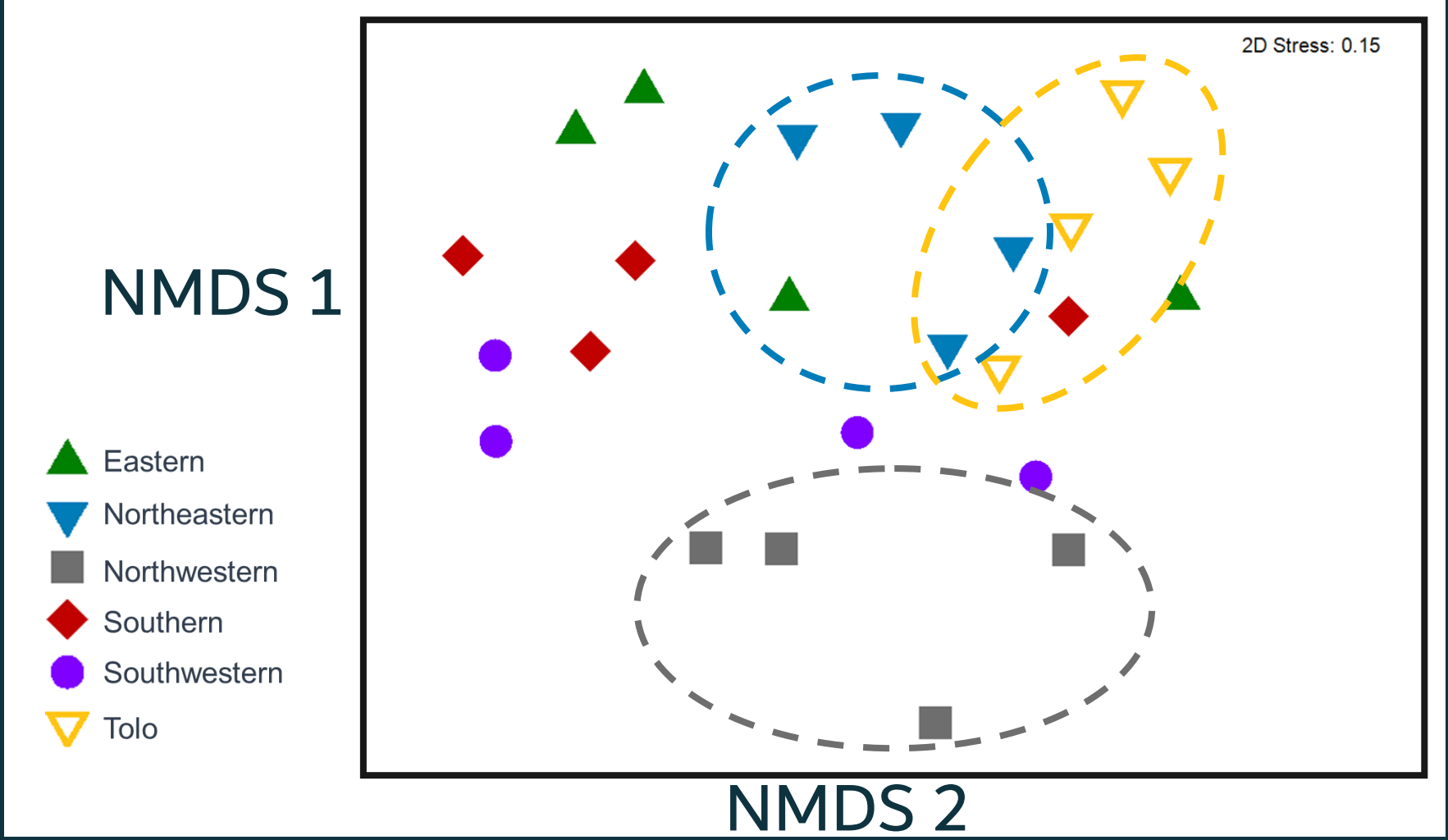
- 1. No pattern in species richness
  - → across geographical regions
  - → along the environmental gradients

Error bars = 95% CI



Physical filters & spatial variation

- 2. High beta diversity (great change in species composition)



Physical filters & spatial variation

1. Wave explained most of the beta diversity

2. Rock temperature was also important

* $p < 0.05$

Spatial pattern of the seasonal tropical rocky assemblages (Hong Kong)

Spatial variation

1. No sig. diff in no. of species

2. High variation in composition (i.e. high beta diversity)

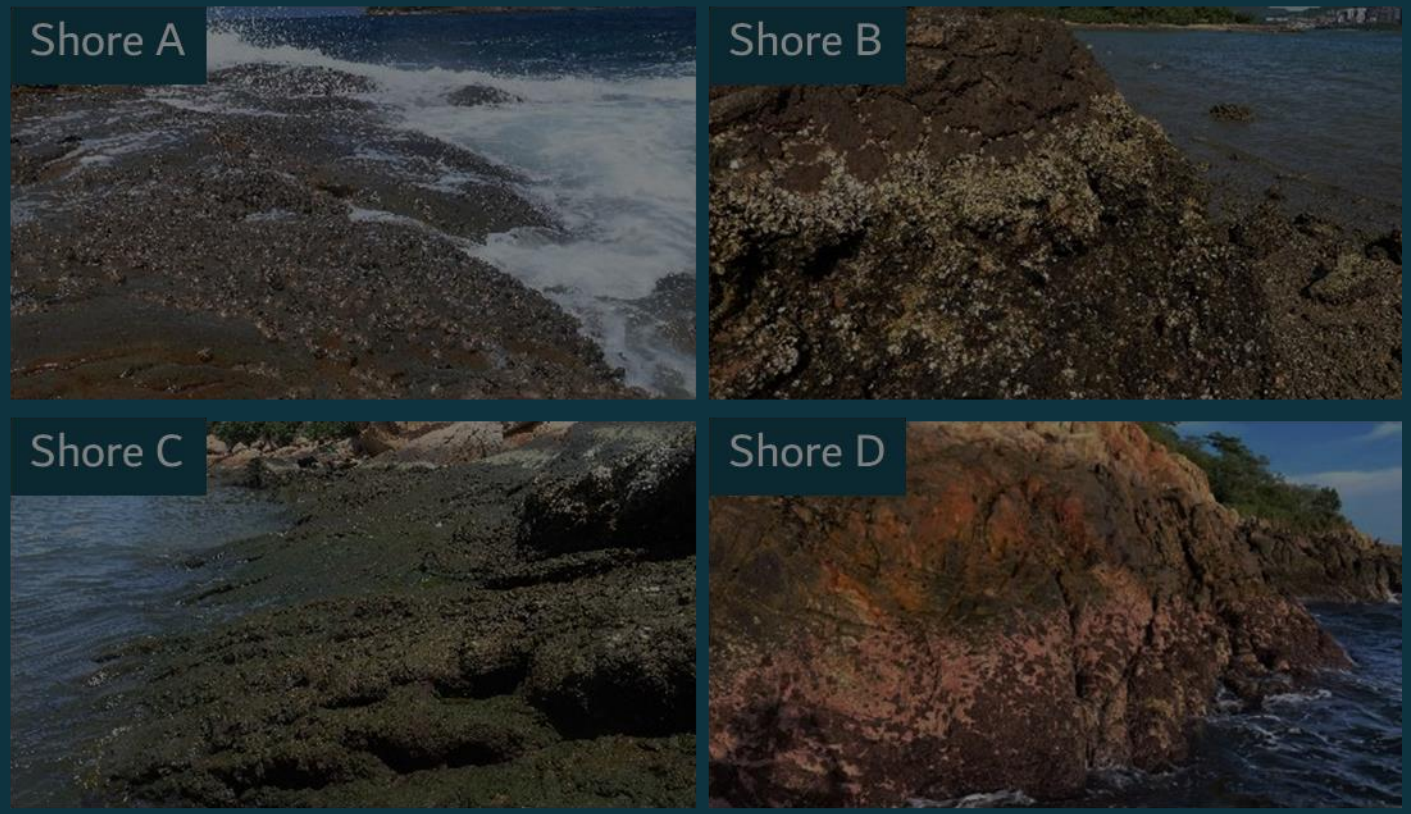
   Due to:

   → Wave

   → Temperature

   → Water nutrient

What drives temporal variation?



Spatial variation

Time

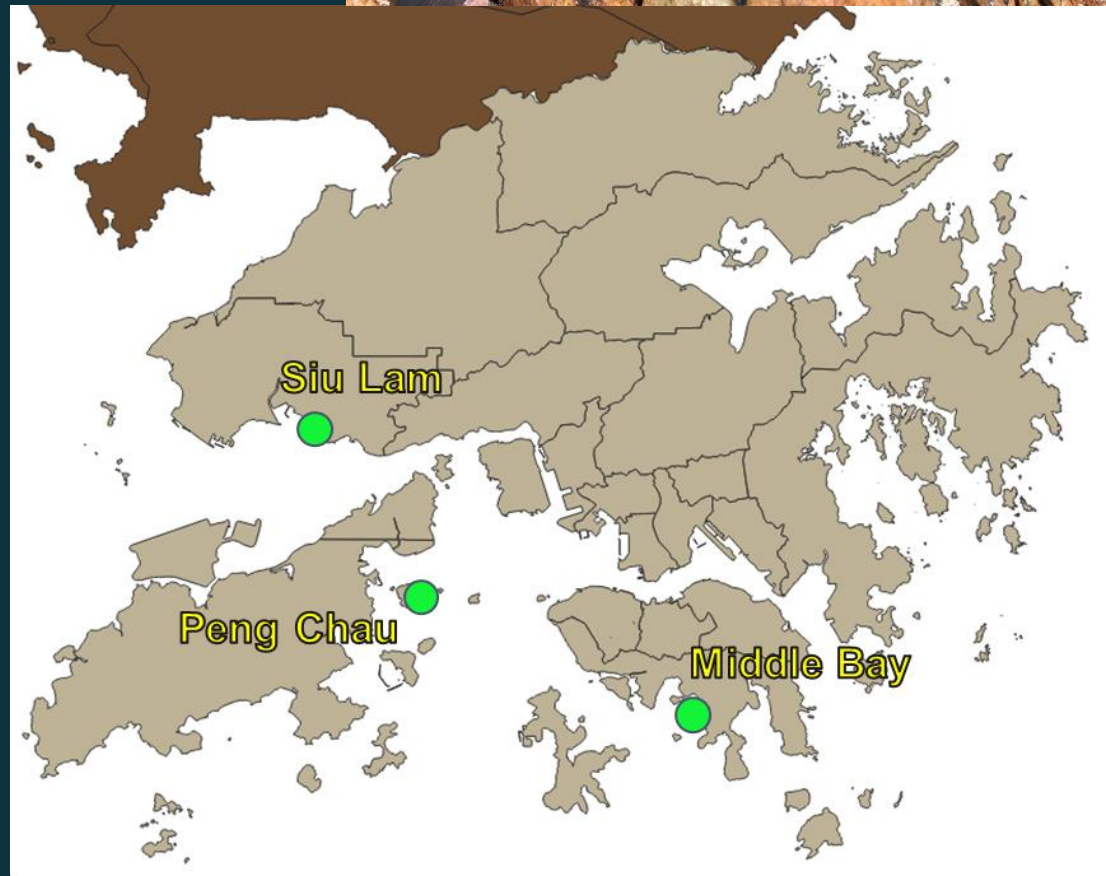
Temporal variation

Drivers of the temporal dynamics

- 3 sites
- Monthly surveys

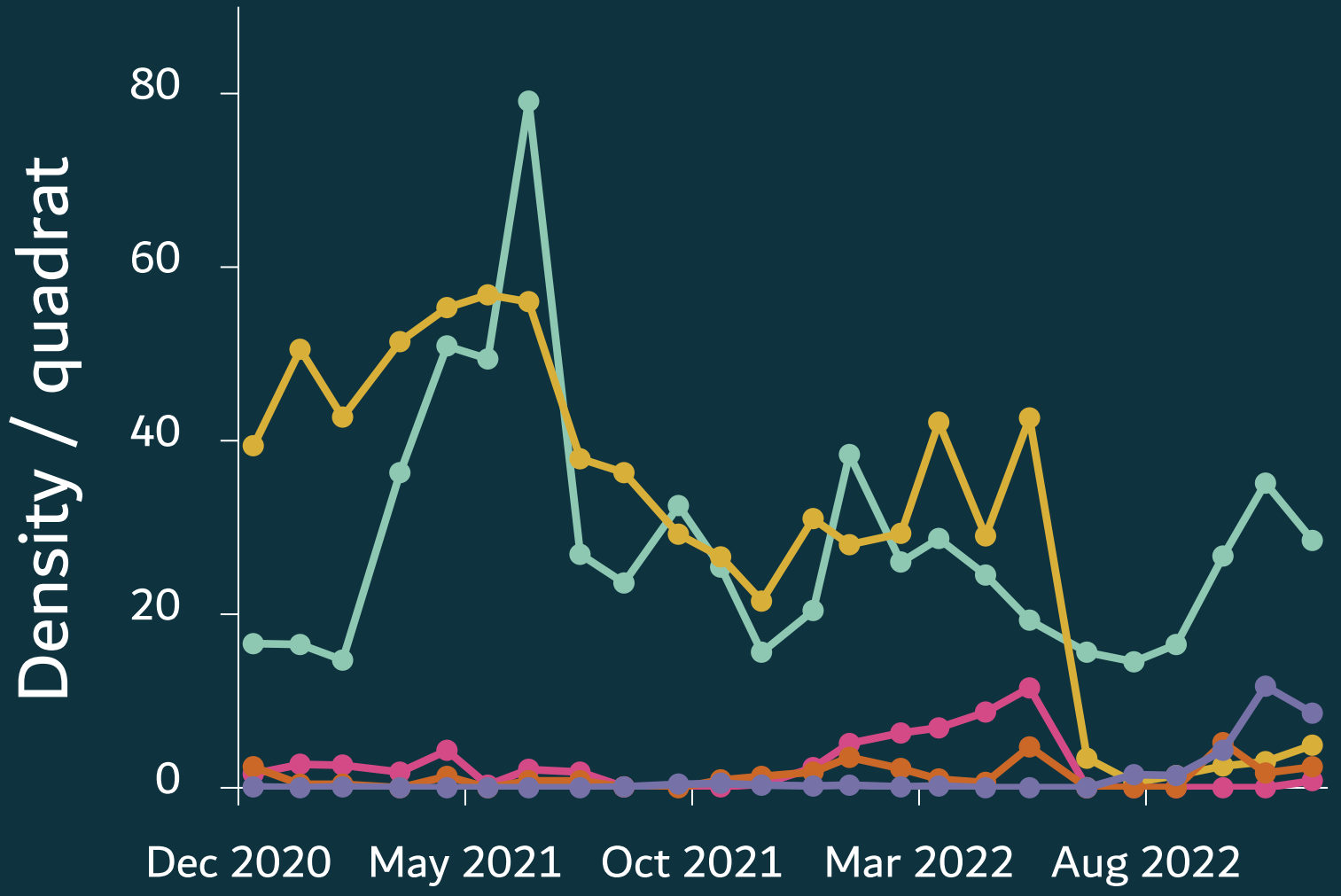
- Mobile species – count
- Sessile species – % cover

- Algal biomass (chlorophyll *a*)



Drivers of the temporal dynamics (Site A)

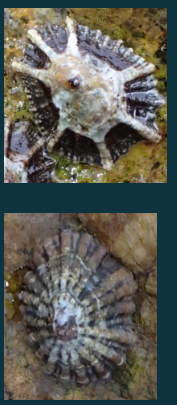
G = grazer
P = predator



Cellana toreuma (G)

Patelloida ryukyuensis (G)

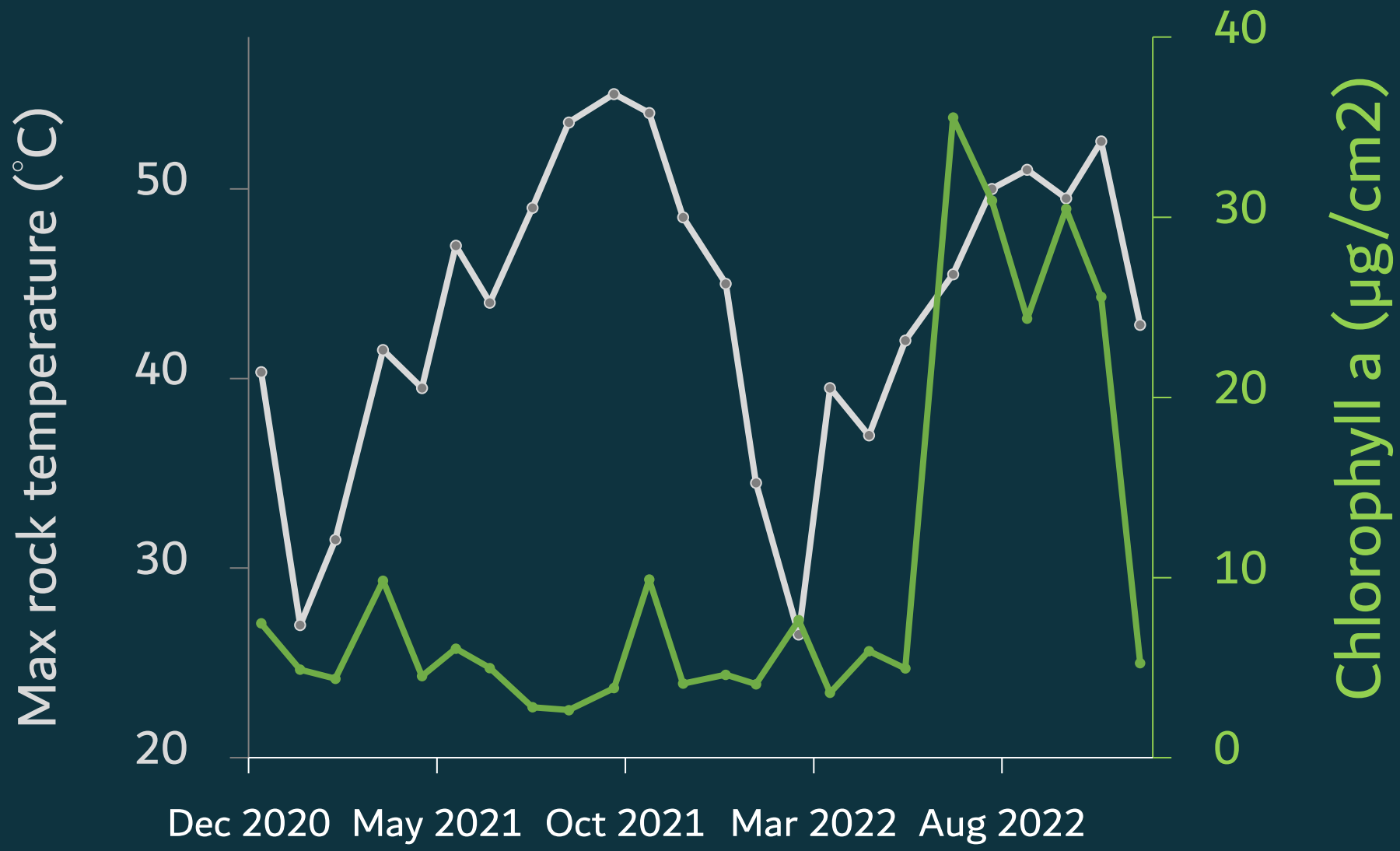
Patelloida saccharina (G)



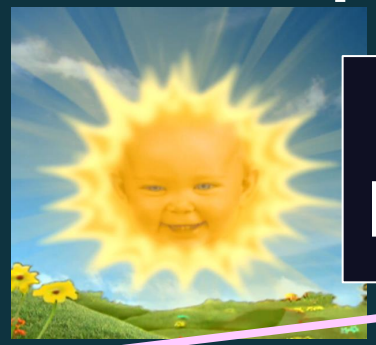
Siphonaria japonica (G)

Reishia clavigera (P)

Drivers of the temporal dynamics (Site A)



Drivers of the temporal dynamics (path analysis)



Heat stress:
Rock temperature

1. Direct impact of temperature
2. Bottom-up impact

G = grazer
P = predator

R. clavigera (P)

+ve relationship
-ve relationship

Strength of relationships

C. toreuma (G)

P. ryukyuensis (G)

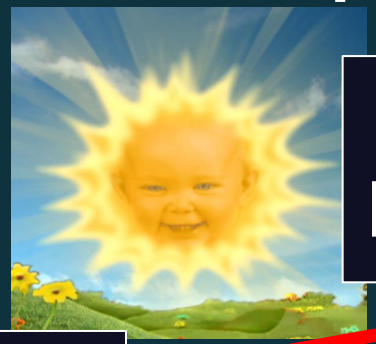
P. saccharina (G)

S. japonica (G)

Algal biomass
(primary producer)

Drivers of the temporal dynamics (Site A)

G = grazer
P = predator

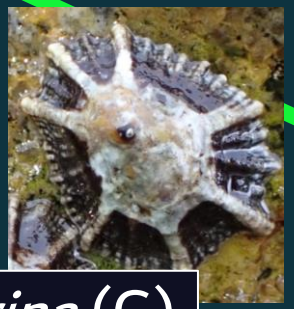


Heat stress:
Rock temperature

Reishia clavigera (P)

C. toreuma (G)

P. ryukyuensis (G)



P. saccharina (G)

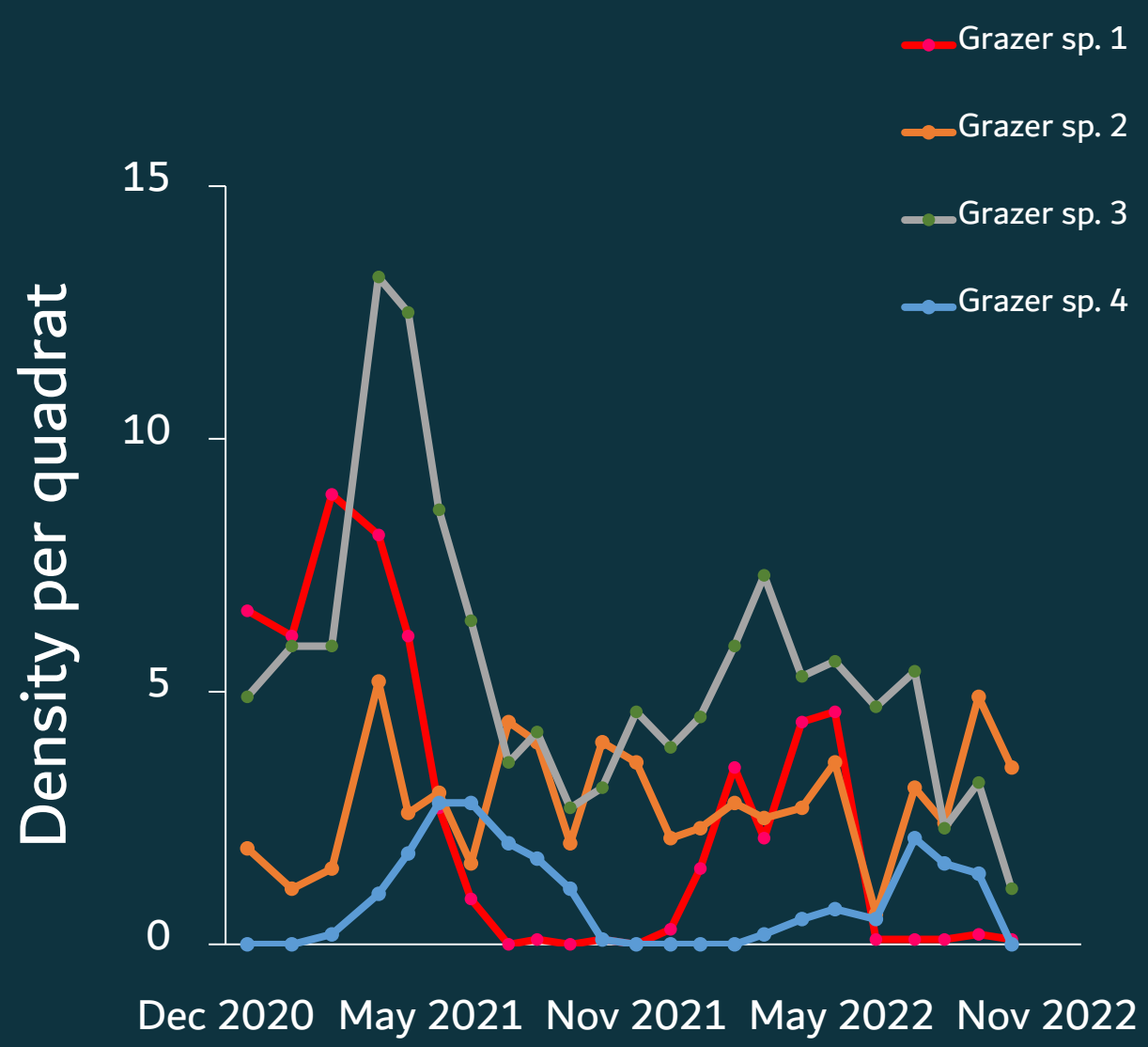
S. japonica (G)

Algal biomass
(primary producer)

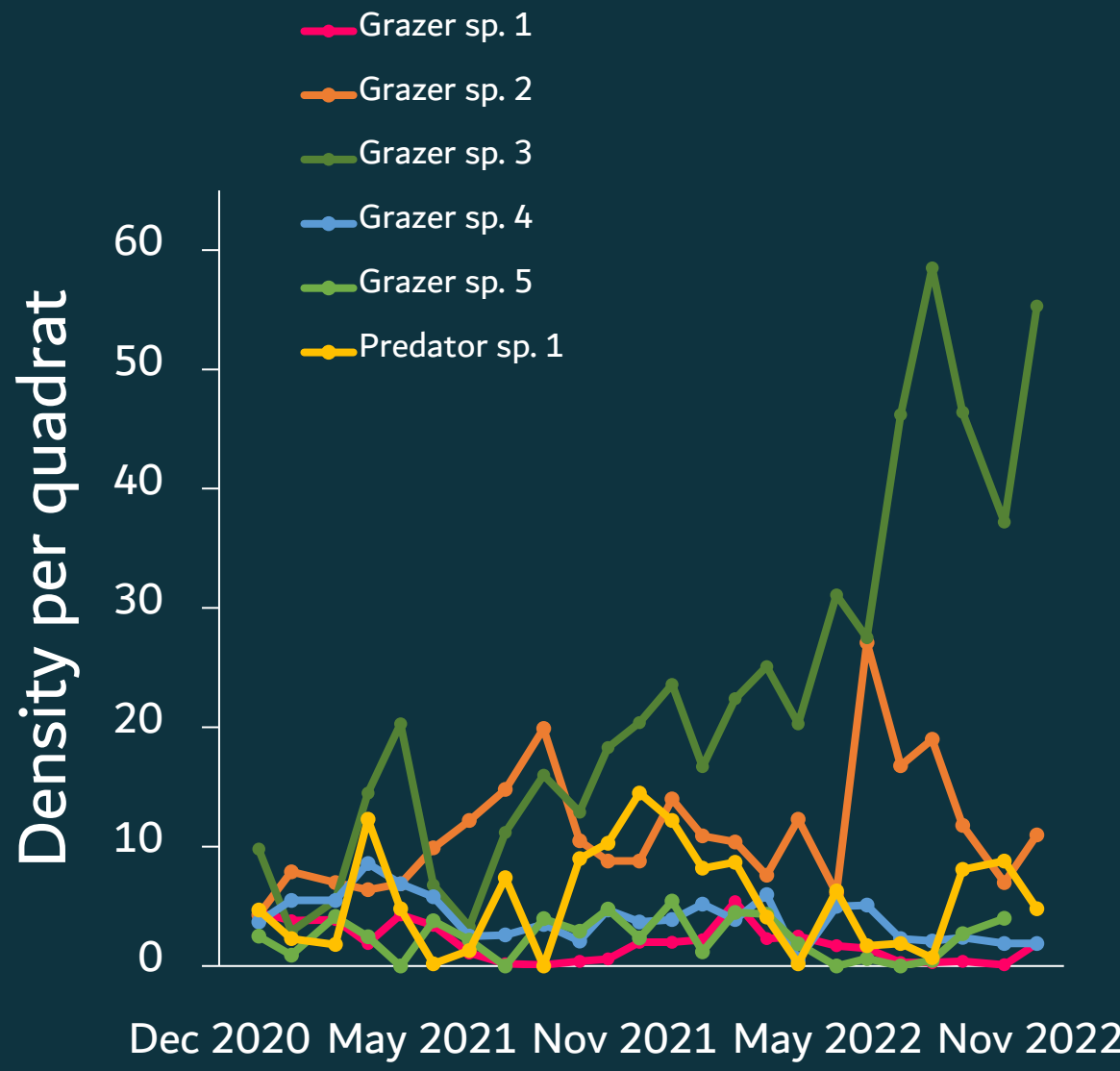
+ve relationship

-ve relationship

Site B


Grazer sp. 1
Grazer sp. 2
Grazer sp. 3
Grazer sp. 4
Density per quadrat
15
10
5
0
Dec 2020
May 2021
Nov 2021
May 2022
Nov 2022

Site C


Grazer sp. 1
Grazer sp. 2
Grazer sp. 3
Grazer sp. 4
Grazer sp. 5
Predator sp. 1
Density per quadrat
60
50
40
30
20
10
0
Dec 2020
May 2021
Nov 2021
May 2022
Nov 2022

Site B

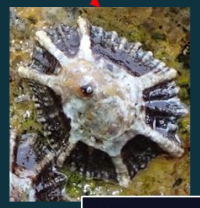
+ve relationship

-ve relationship

Heat stress:
Rock temperature

Grazer sp. 1

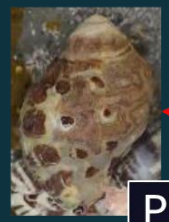
Grazer sp. 2



Grazer sp. 3

Grazer sp. 4

Algal biomass
(primary producer)



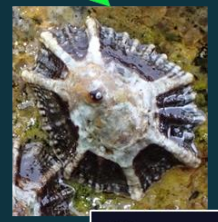
Predator sp. 1

Heat stress:
Rock temperature

Grazer sp. 5

Barnacle sp. 1

Grazer sp. 2



Grazer sp. 3

Grazer sp. 4

Grazer sp. 1

Algal biomass
(primary producer)

Site C

Take home messages

Spatial variation

Wave + **Temperature**

Temperature (heat stress?)

Time

Temporal variation

Acknowledgements

- Environment and Conservation Fund (ECF 2019 – 105)
- Department of Civil Engineering
- Tropical IntertiDal Ecology Group members
- Dr. Toby Tsang

ECF Team