

Disentangling structural complexity with a three-dimensional coral model

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We acknowledge the Baiyungu, Thalanyji and Yinikurtura People, the Traditional Owners and original custodians of the Ningaloo Coast and pay our respect to their elders past and present.



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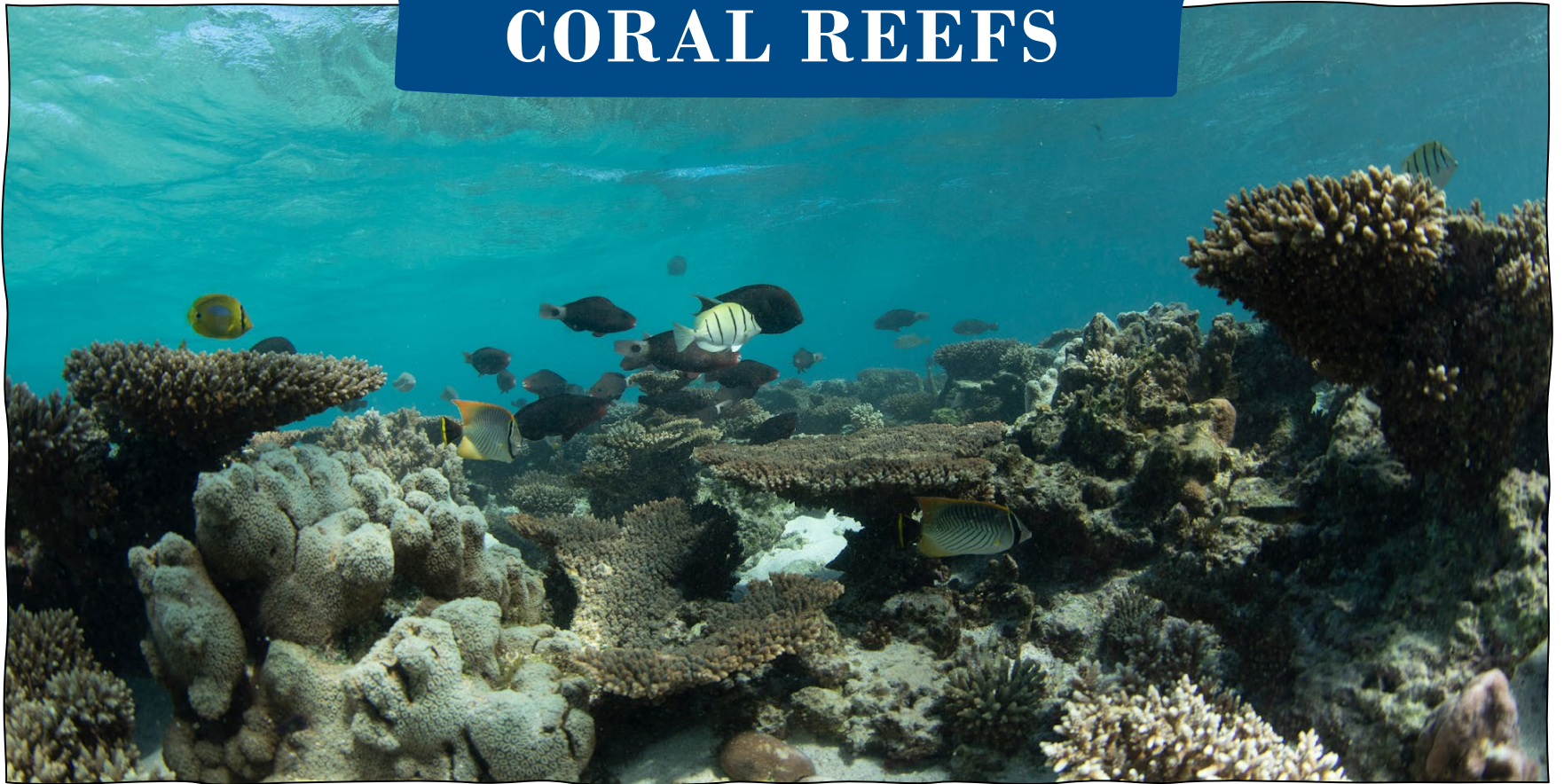
ningaloo
outlook





2003/12/20

CORAL REEFS



HARD CORALS

Form structural foundation

Provide essential habitats



HARD CORALS

Form structural foundation

Provide essential habitats





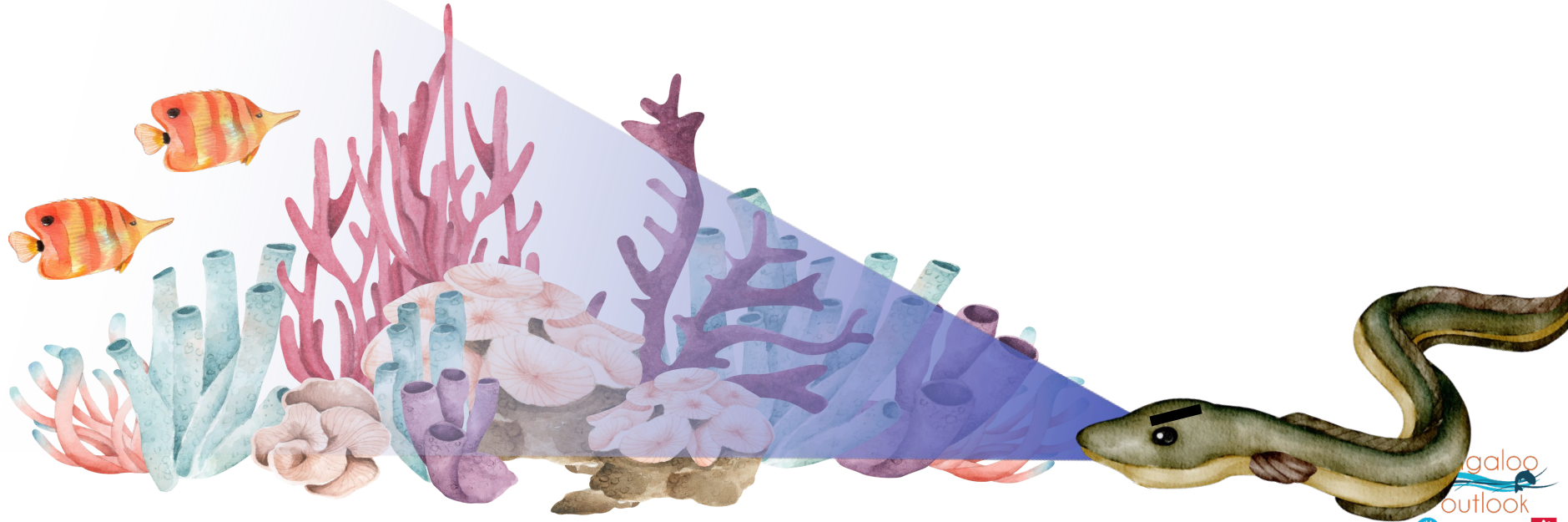




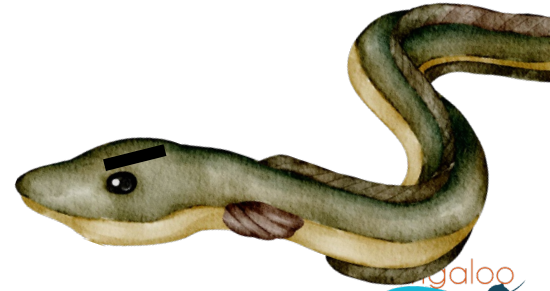
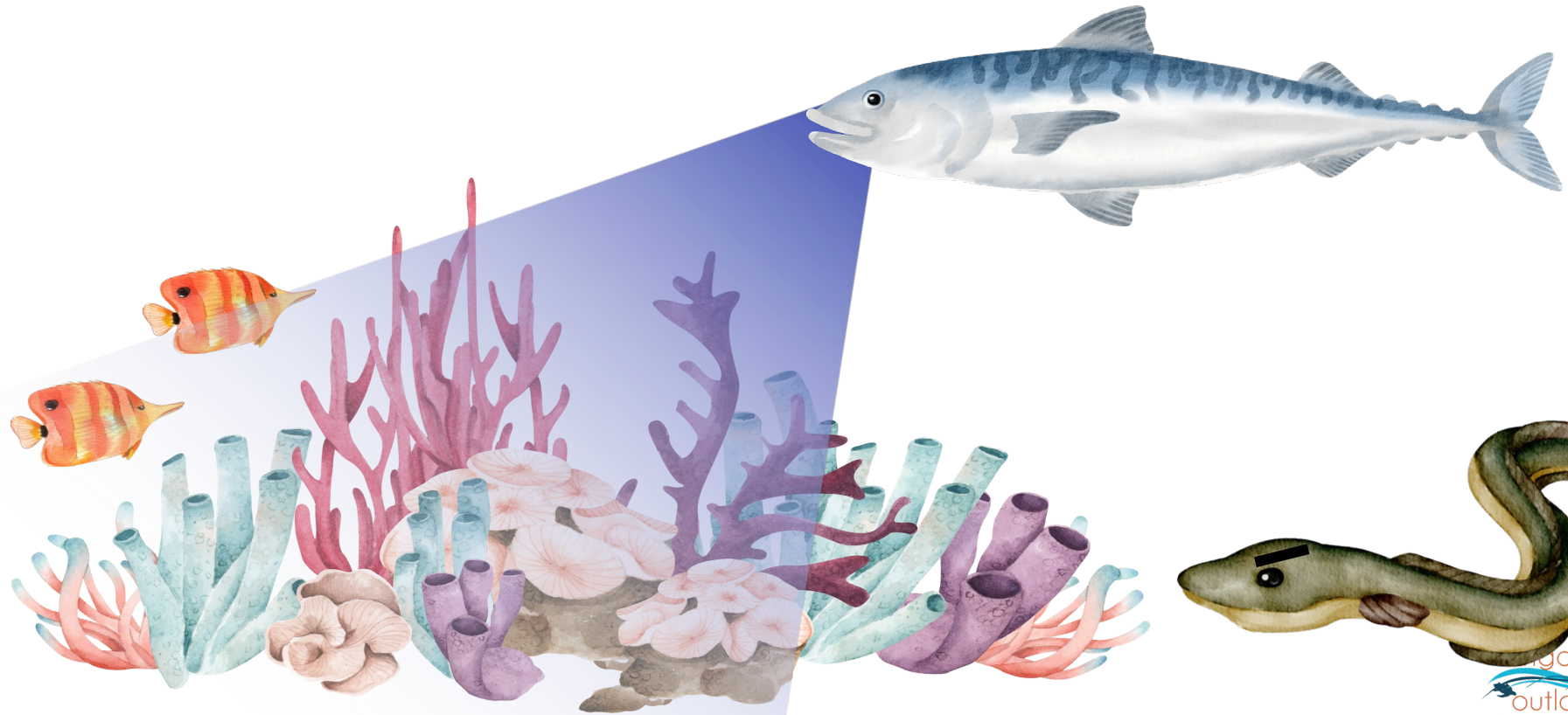
Shelter from Predation



Shelter from Predation



Shelter from Predation

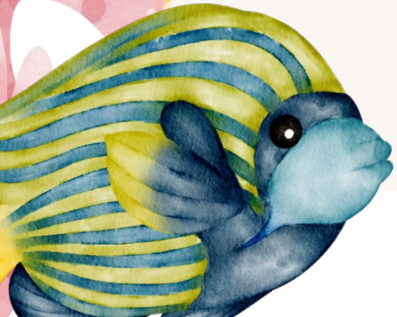


Research Questions

How to measure shelter?

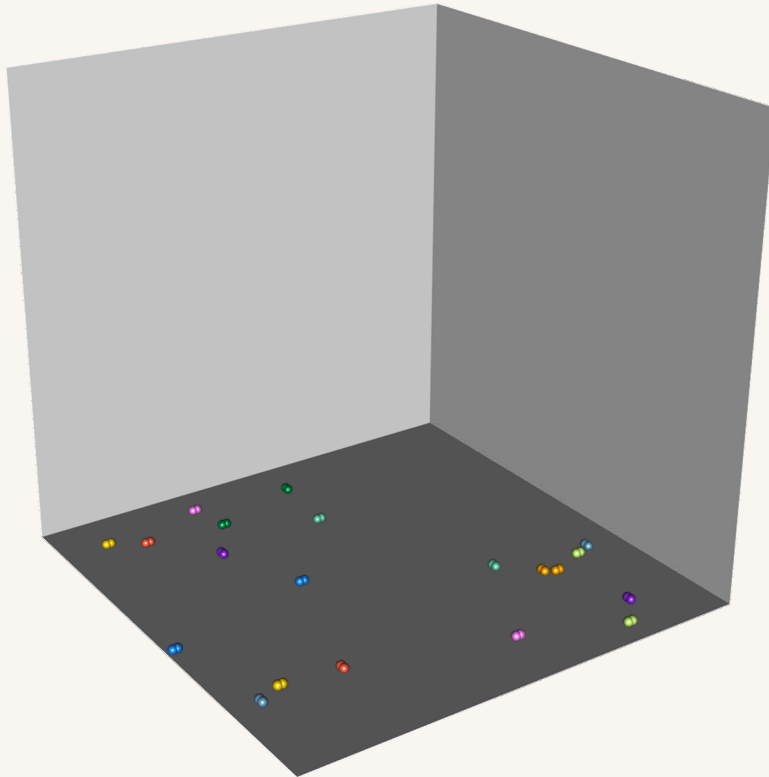
How different coral communities influence metrics over time?

Are there any correlations between metrics?



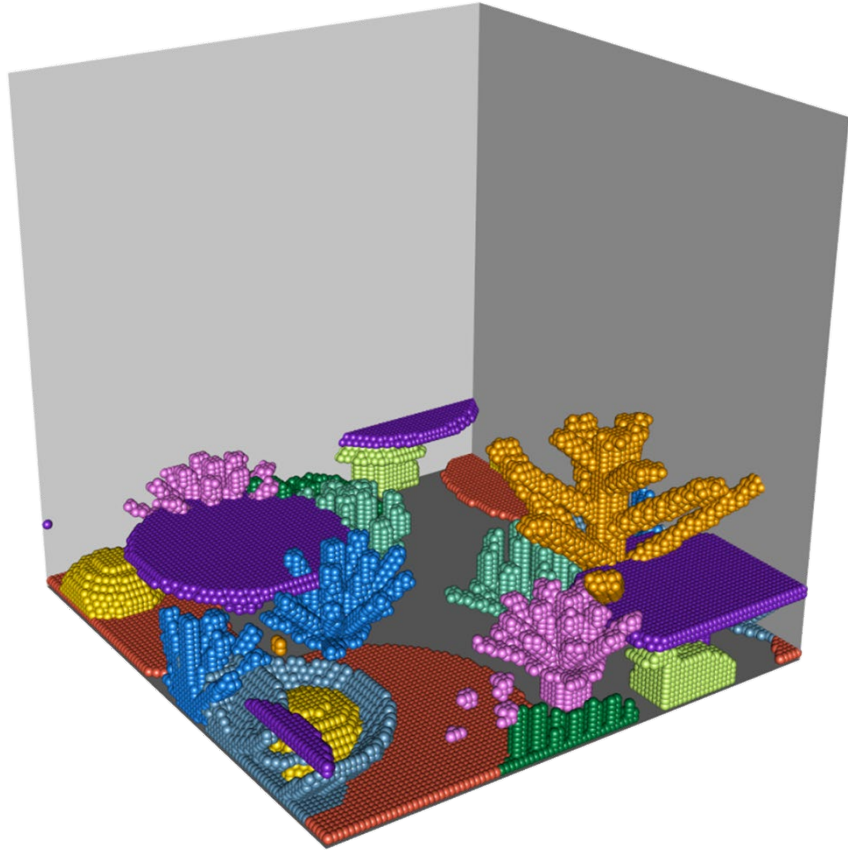
Coralcraft

Cresswell *et al.* 2020



3D simulation model





Metrics

Linear Rugosity

Surface Rugosity

Fractal Dimension

Shelter Volume

Shelter from predators

Size-dependent shelter

Linear Rugosity

Linear Distance



Chain

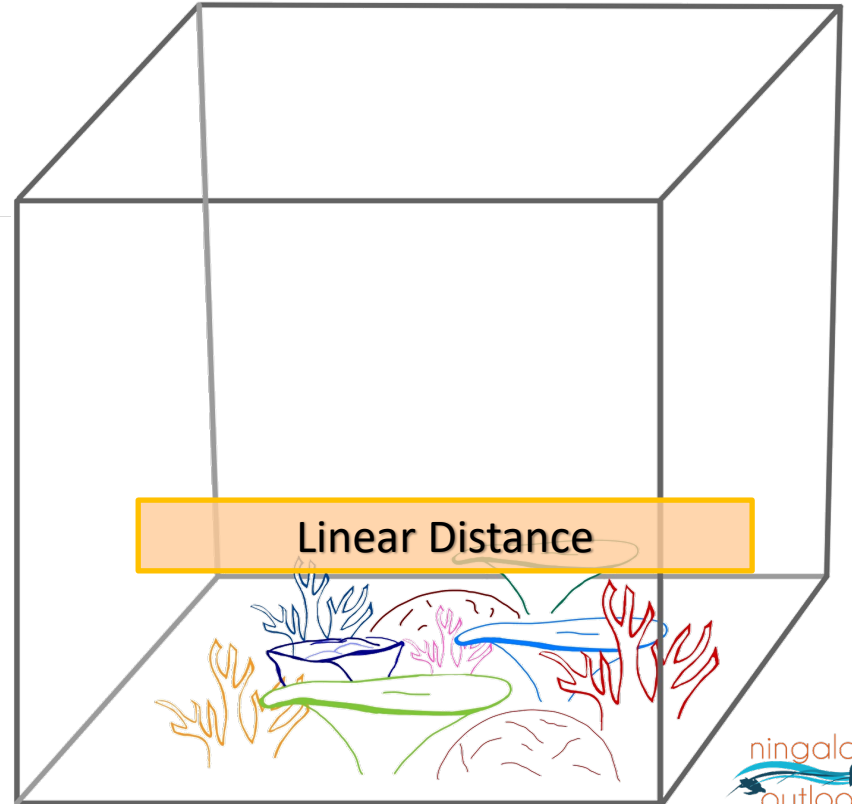


Linear Rugosity

Linear Distance



Chain



Linear Rugosity

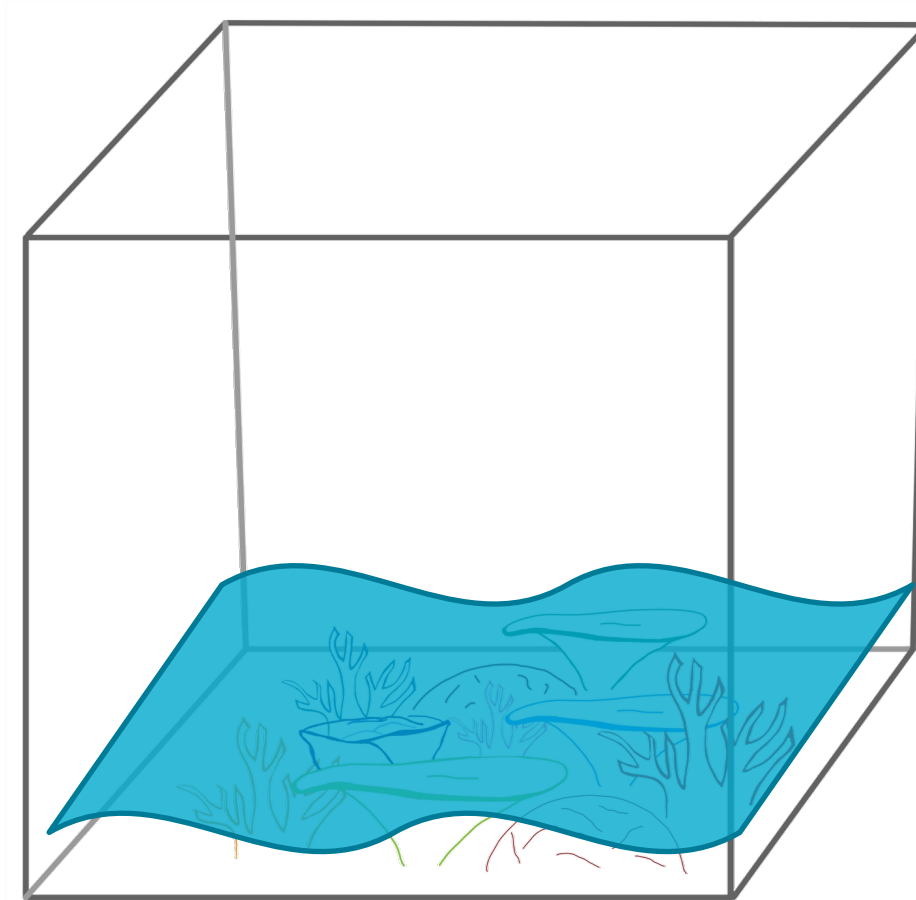
Linear Distance



Chain

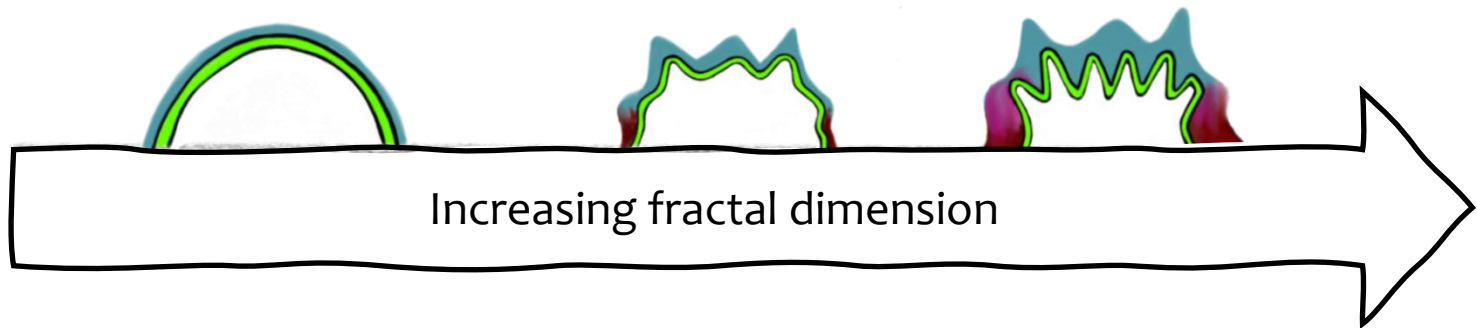


Surface Rugosity



Fractal Dimension

Captures how fragmented surfaces are

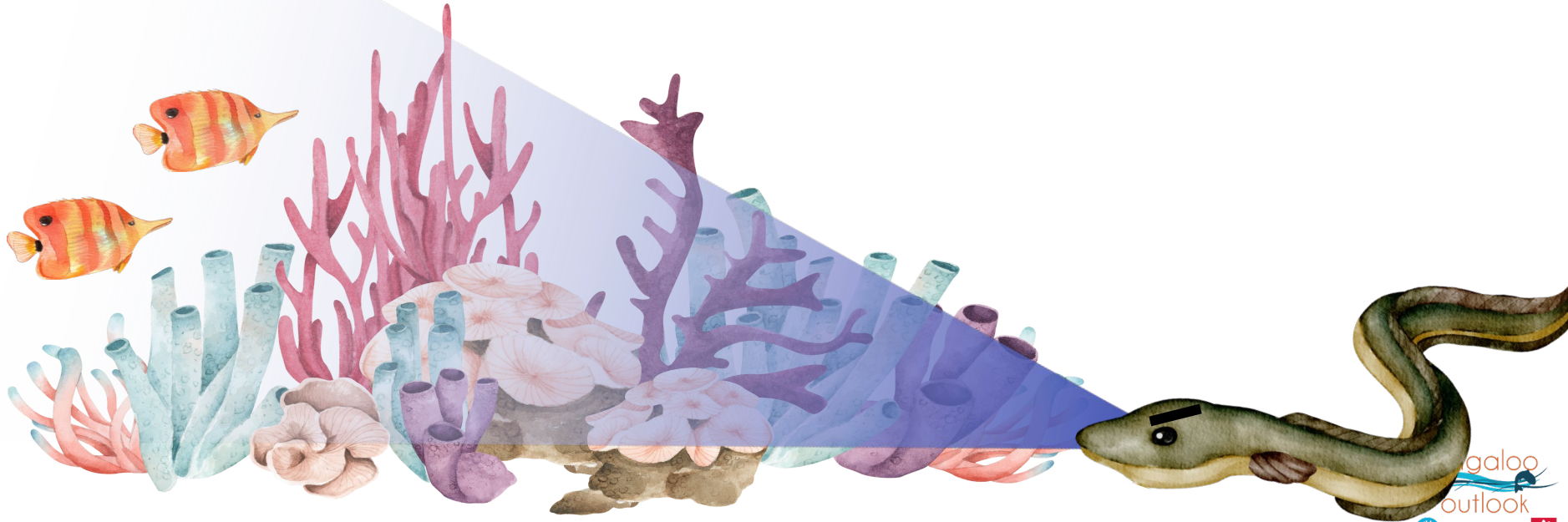


Shelter Volume

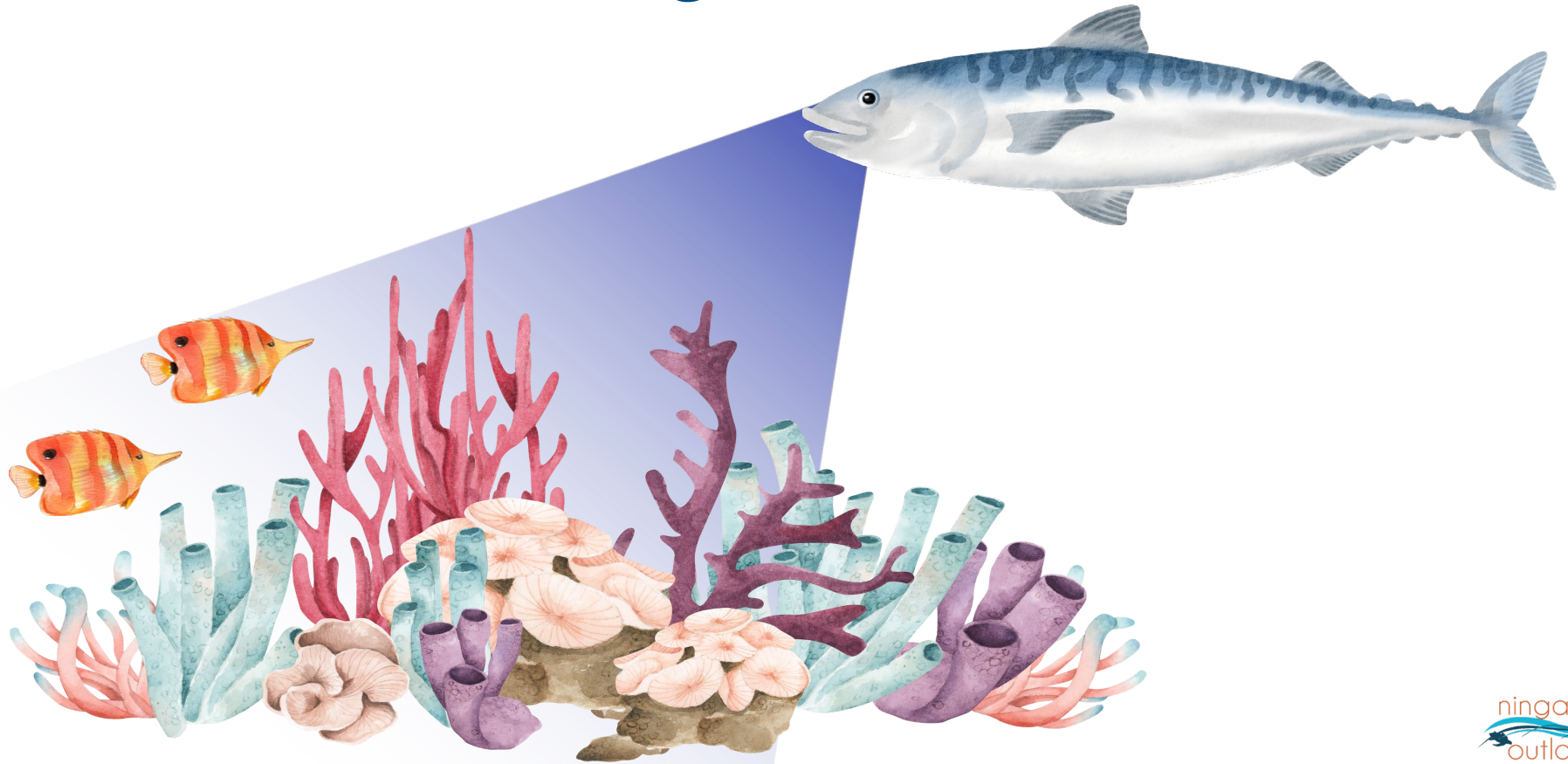
Total volume of space below corals



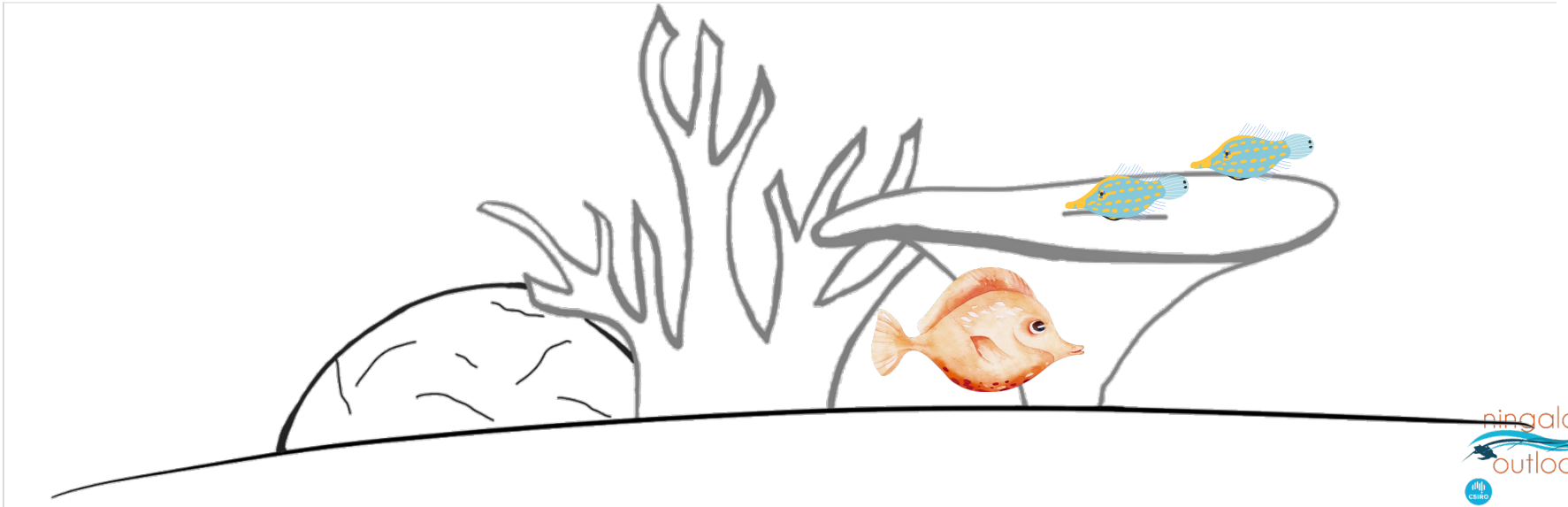
Demersal Shelter



Pelagic Shelter



Size-dependent Shelter



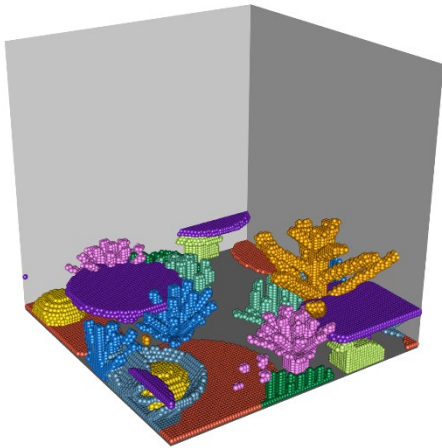
Size-dependent Shelter

I see food but corals are in the way



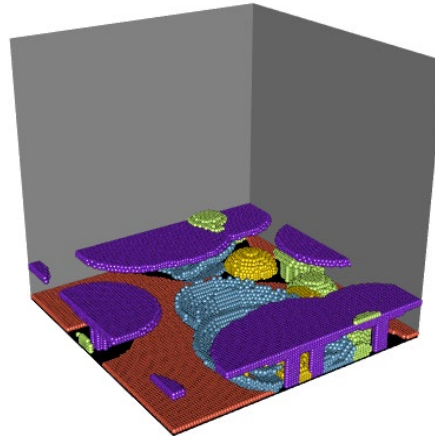
Coral Community Types

Max. Diversity



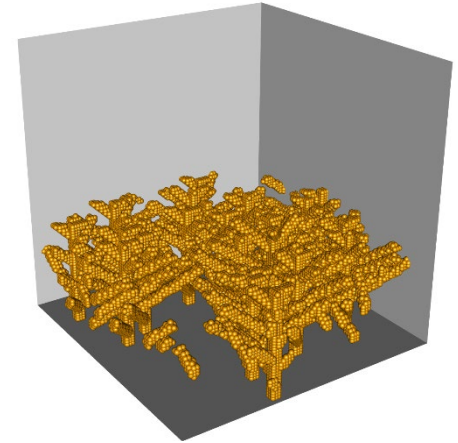
All 10 coral types

Semi Diversity



5 coral types

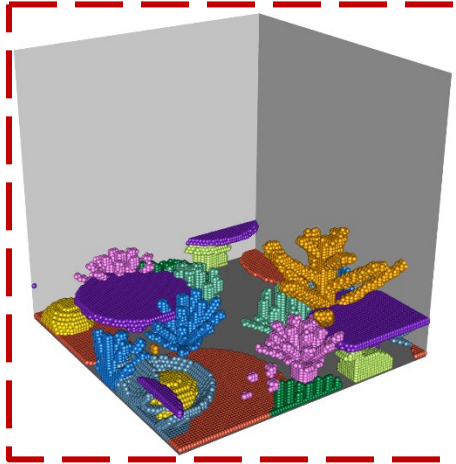
Monospecific



1 coral type

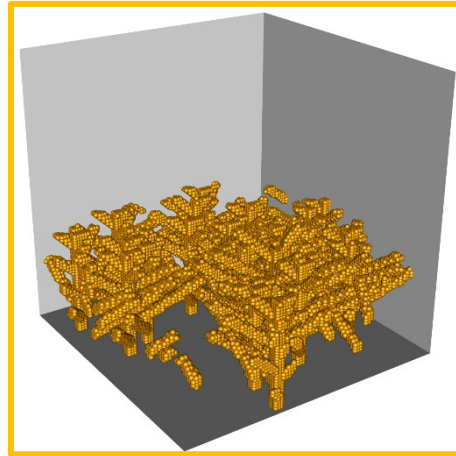
Coral Community Types

Max. Diversity



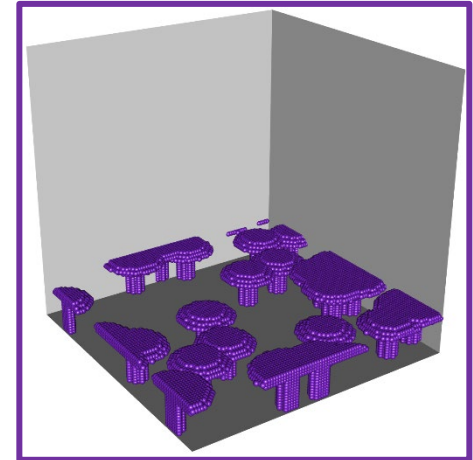
All 10 coral types

Monospecific



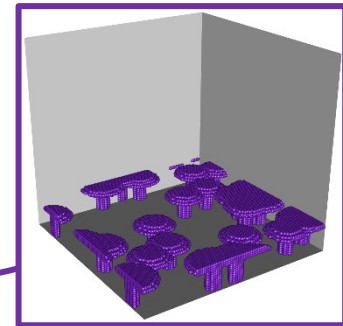
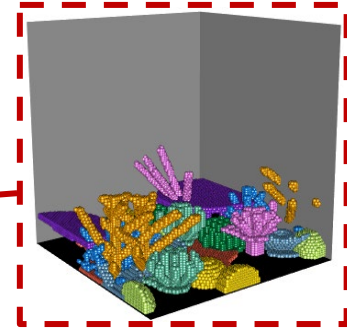
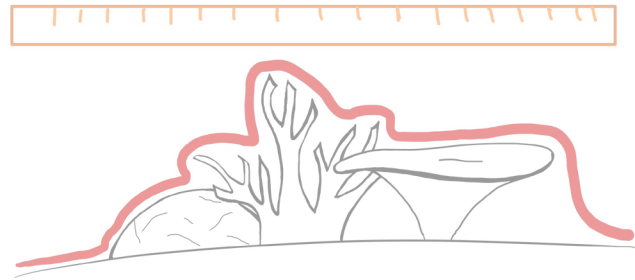
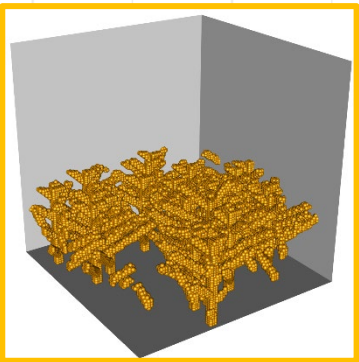
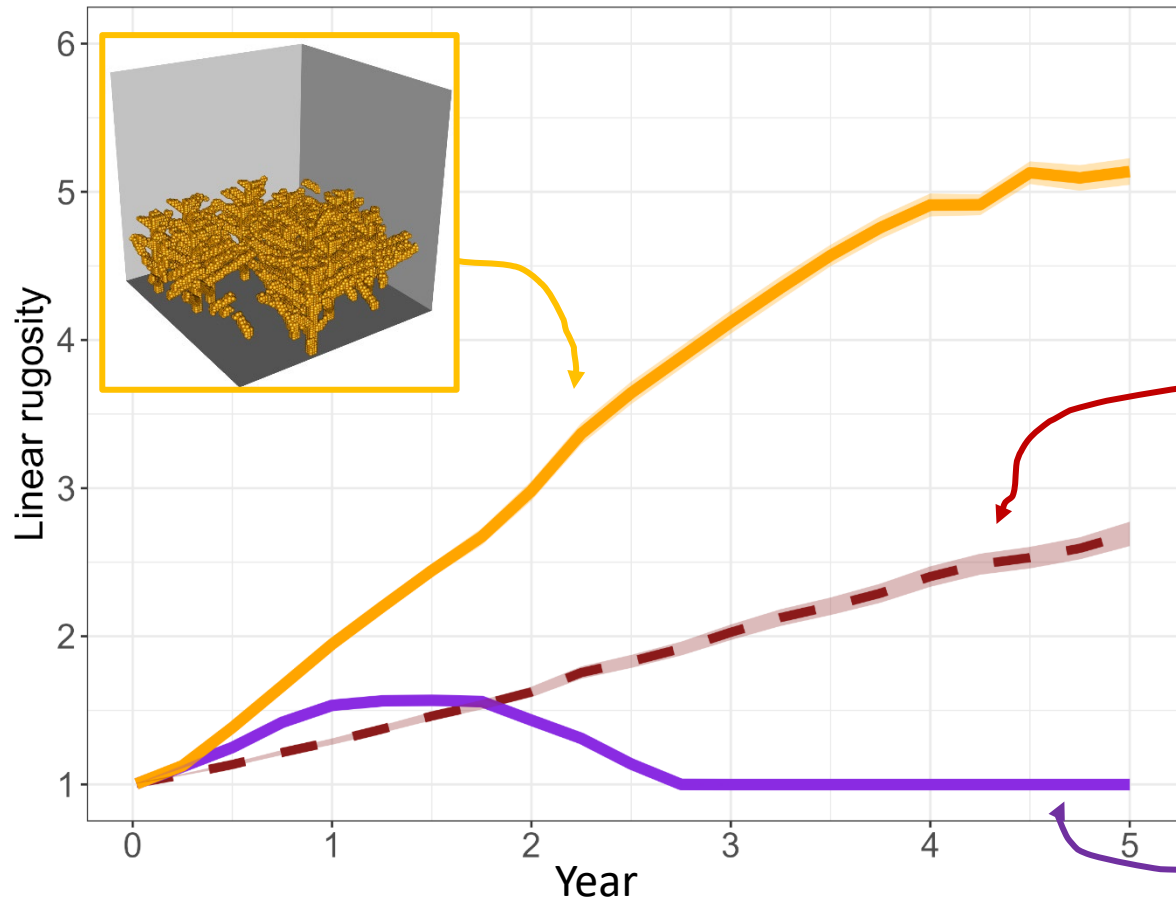
Branching

Monospecific

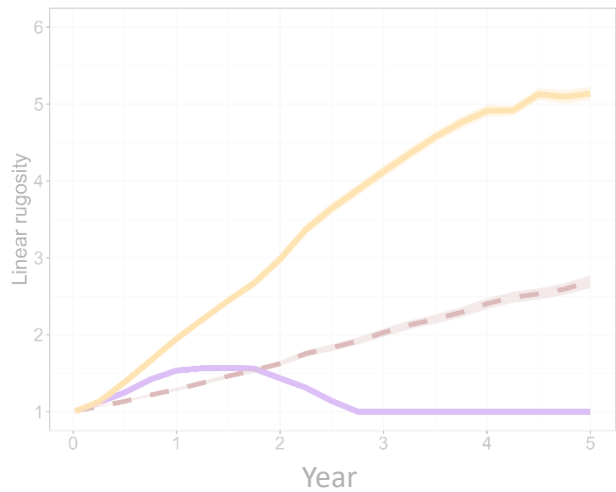


Tabular

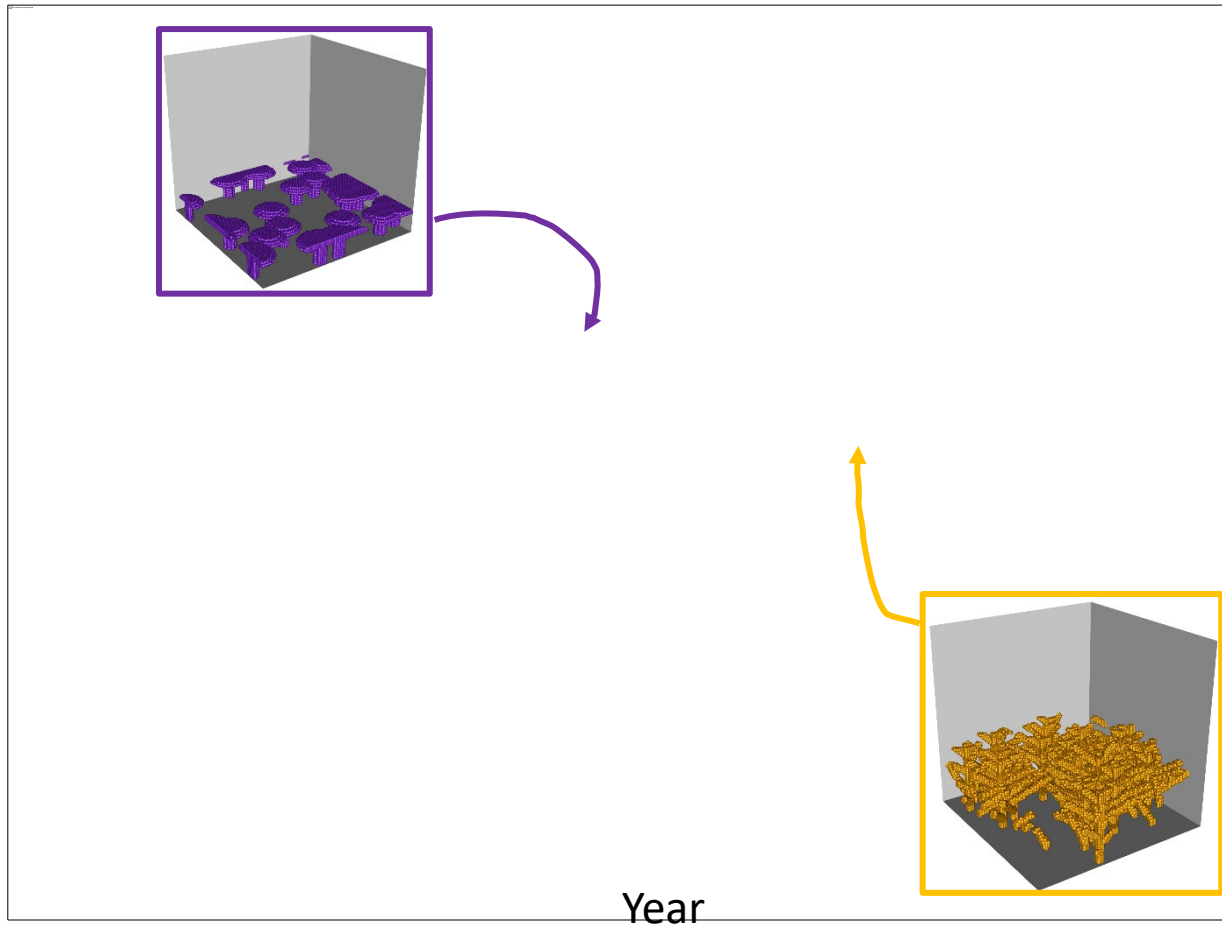
Linear Rugosity



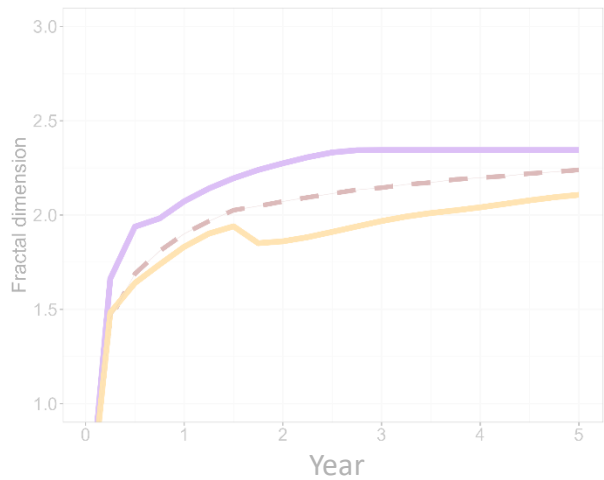
Linear Rugosity



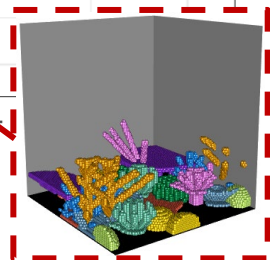
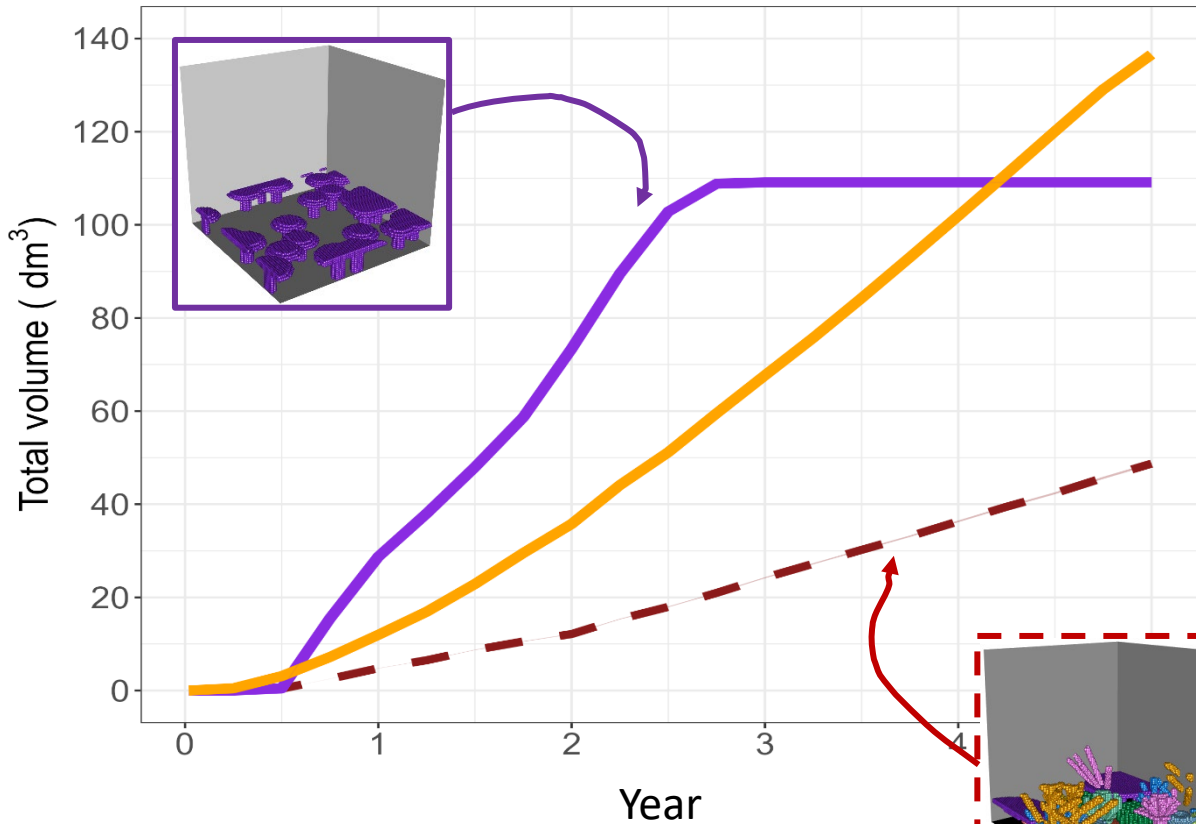
Fractal Dimension



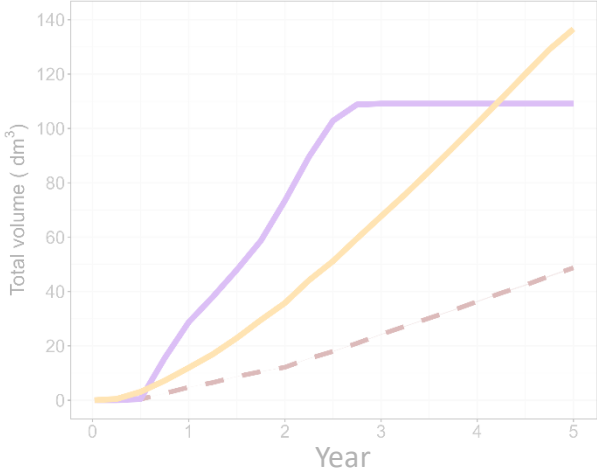
Fractal Dimension



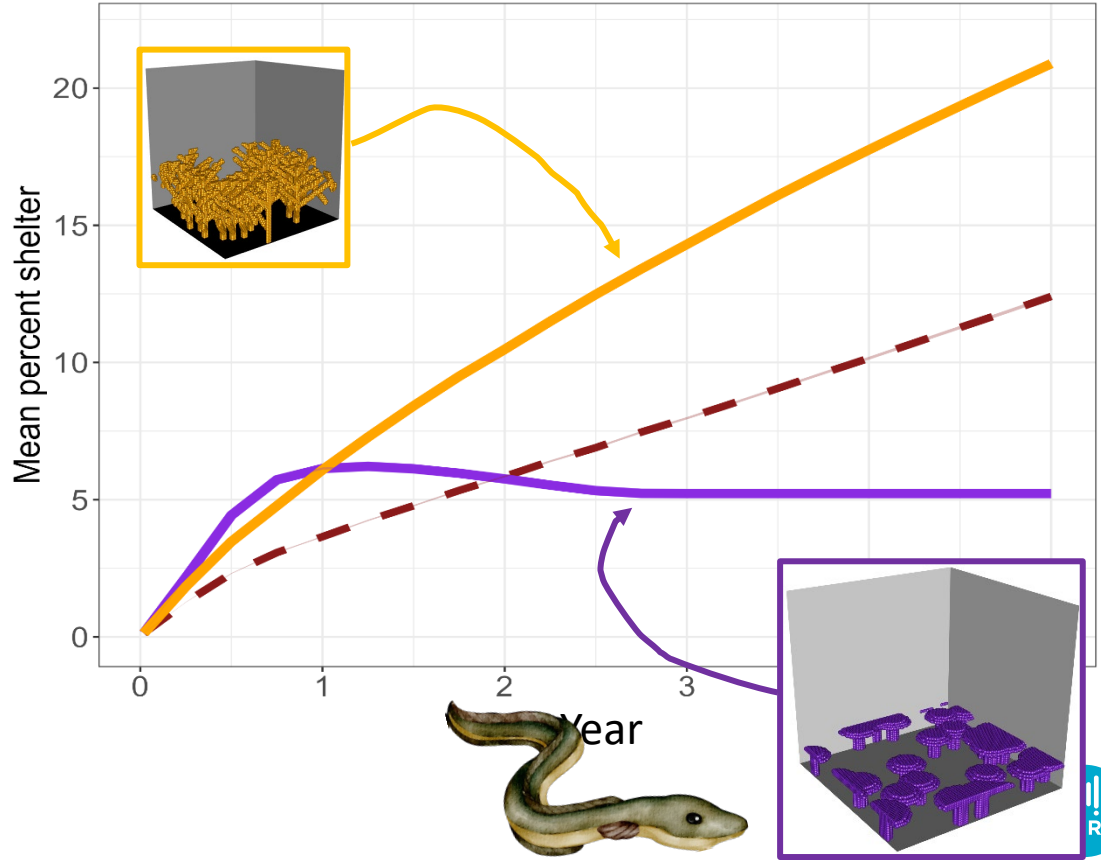
Shelter Volume



Shelter Volume

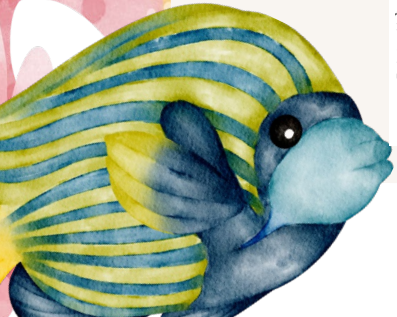
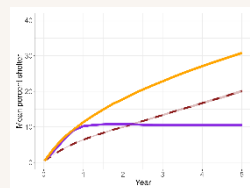
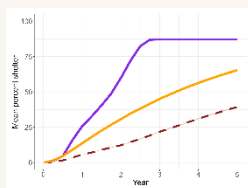
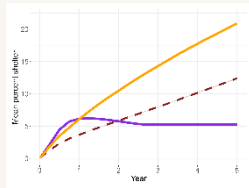
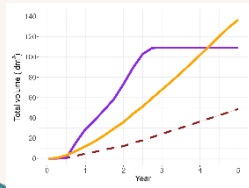
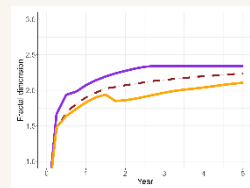
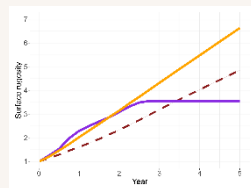
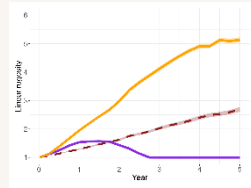


Demersal shelter



What it means

Different coral communities influence metrics differently over time



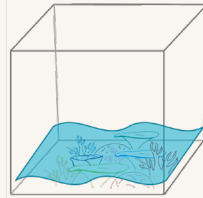
Correlation between metrics

Structural Complexity

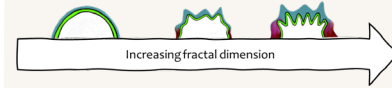
Linear rugosity



Surface rugosity



Fractal dimension



Shelter metrics

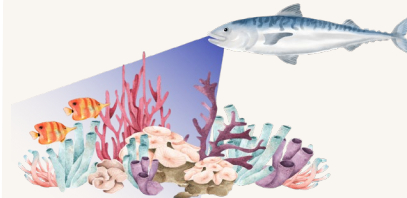
Shelter volume



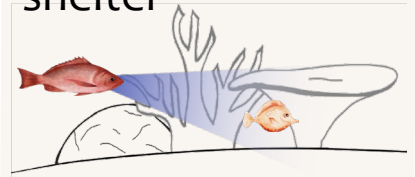
Demersal shelter



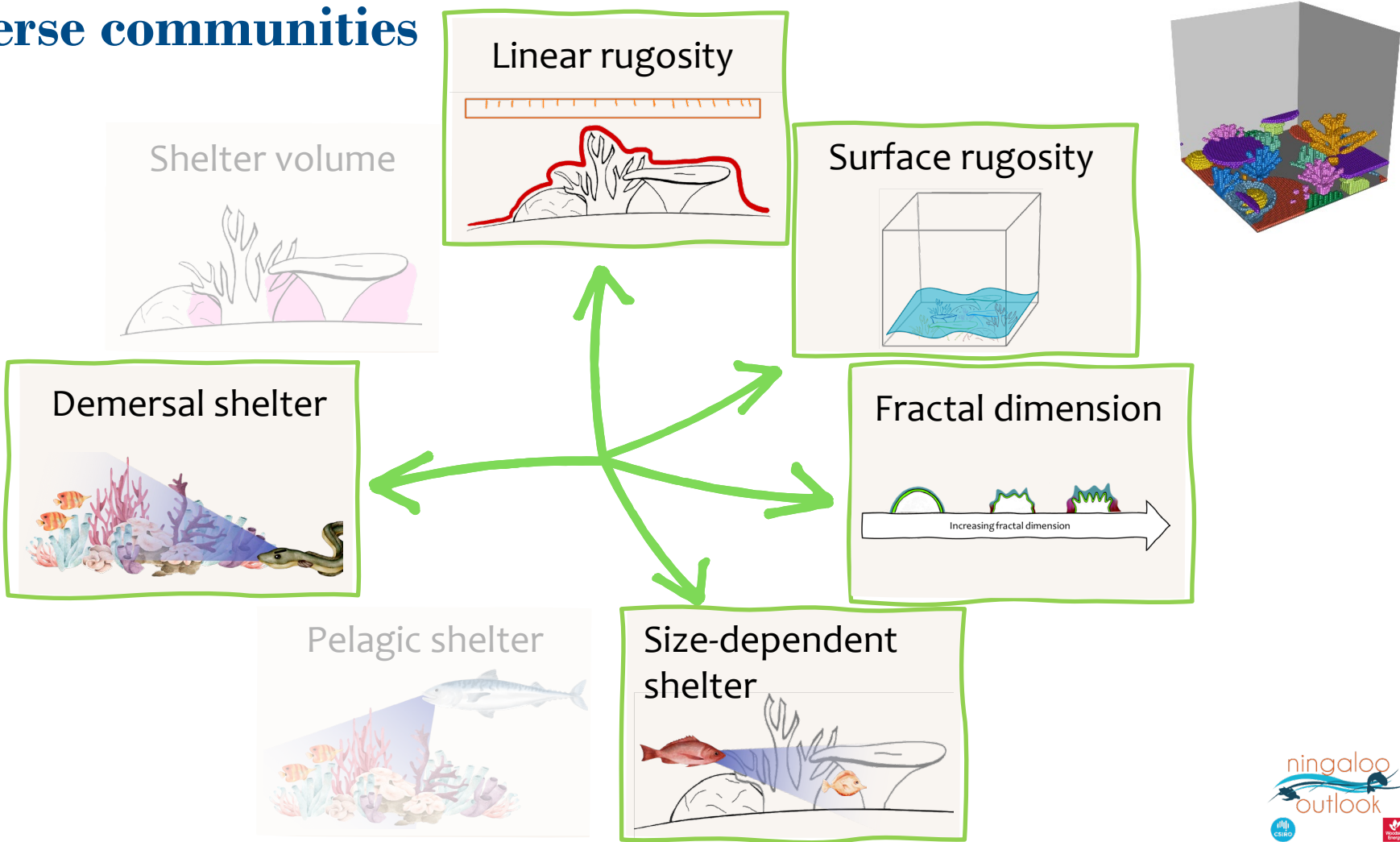
Pelagic shelter



Size-dependent shelter



Diverse communities

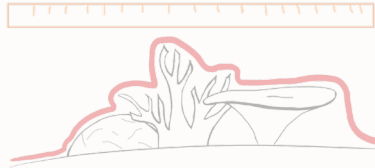


Diverse communities

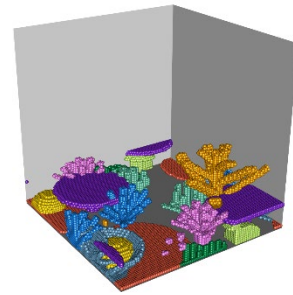
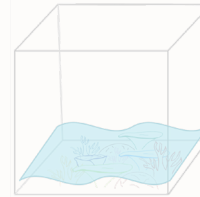
Shelter volume



Linear rugosity



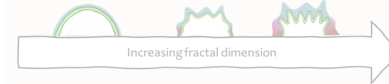
Surface rugosity



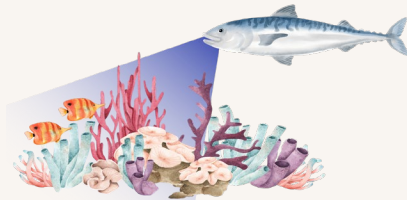
Demersal shelter



Fractal dimension



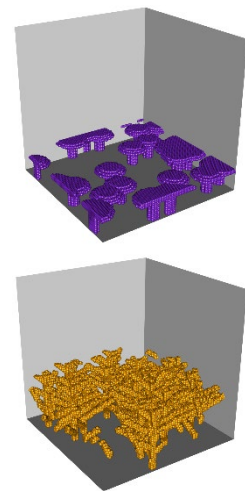
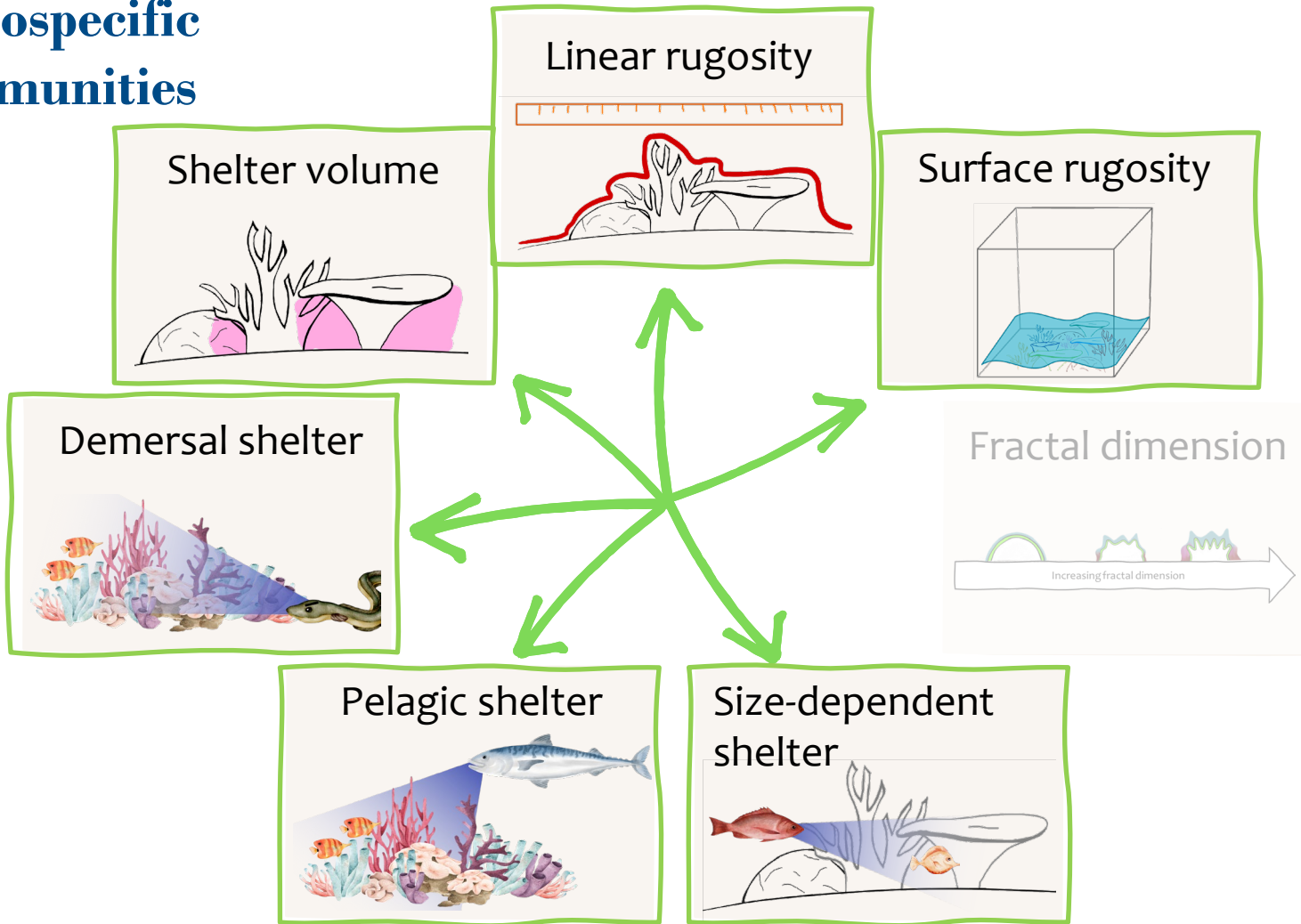
Pelagic shelter



Size-dependent shelter



Monospecific communities



Key Messages

Different metrics give different conclusions

↑ Coral diversity

≠

↑ Structural complexity & shelter

Important to consider
>1 metric and coral community types



What's Next?



Moral of the story

No, but yes, swimming is good for marine biologist





Photo credits: N. Thake

Special thanks to CSIRO and Woodside

Appreciation for my supervisors:
Anna Cresswell, Michael Renton and Damian Thomson

Appreciation for all CSIRO – Crawley staff

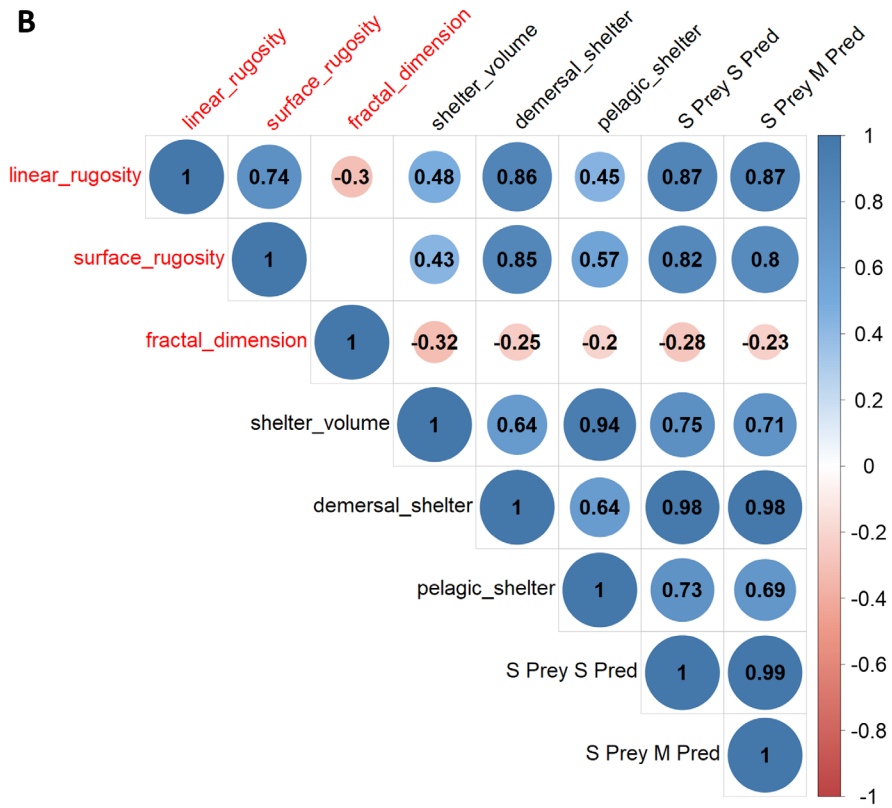
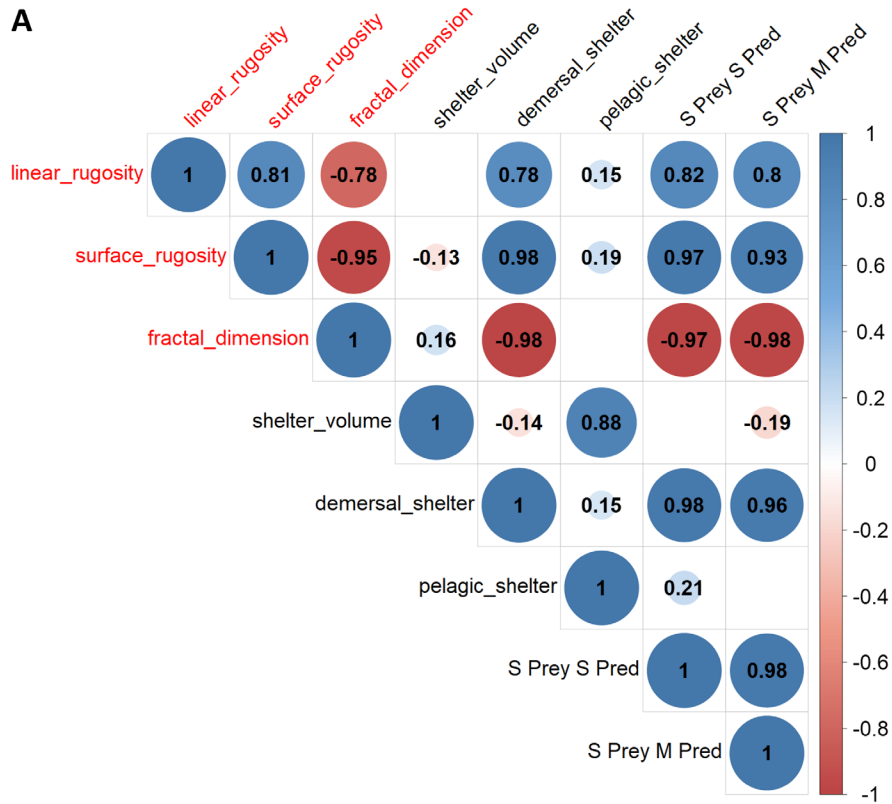


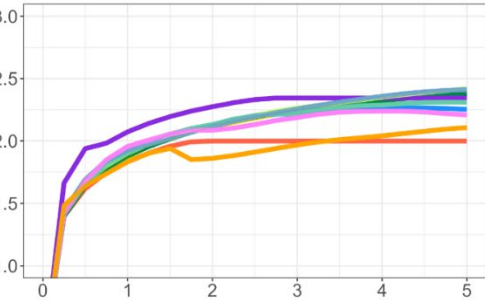
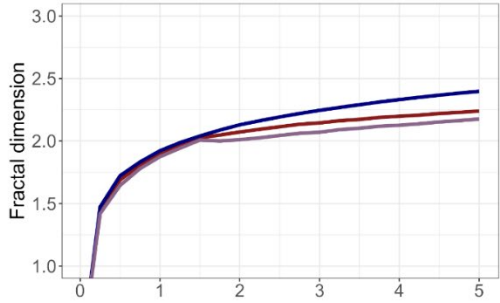
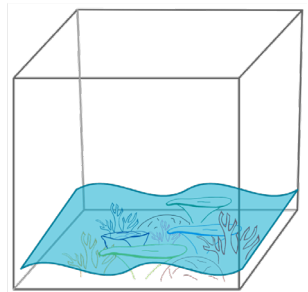
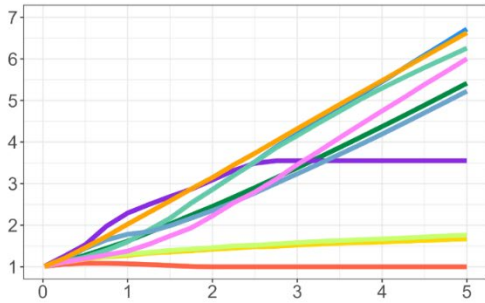
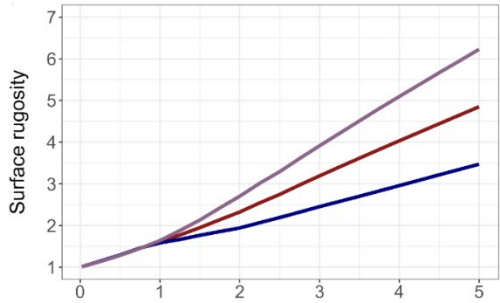
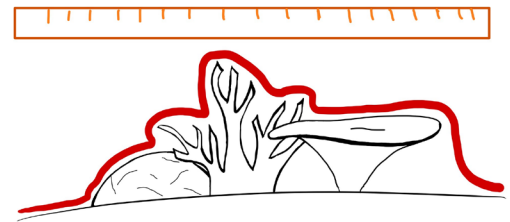
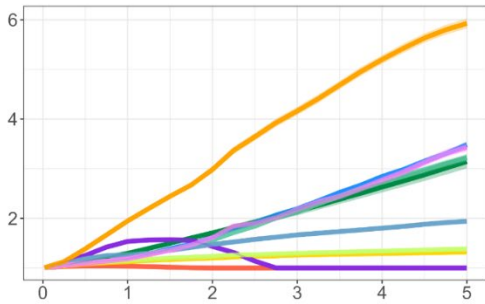
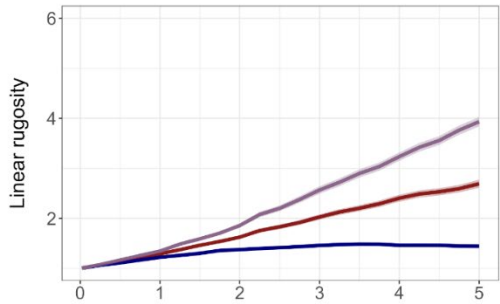
daphne.oh@csiro.au



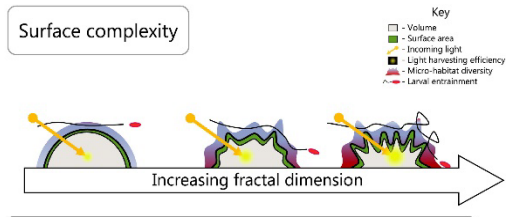
@DaphneXYOh

Correlation Analysis





Surface complexity

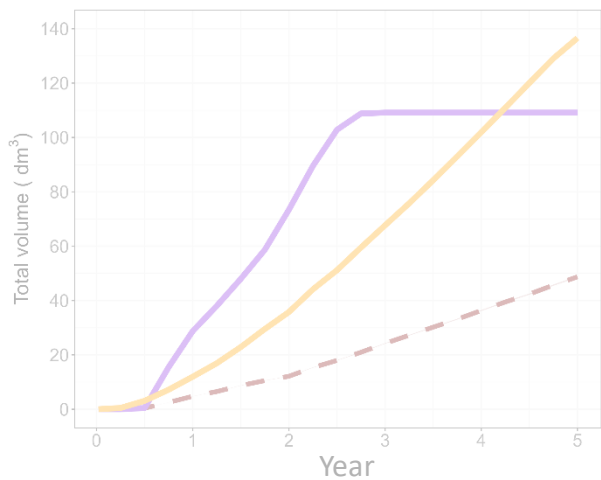


MaxDiv Simple Complex

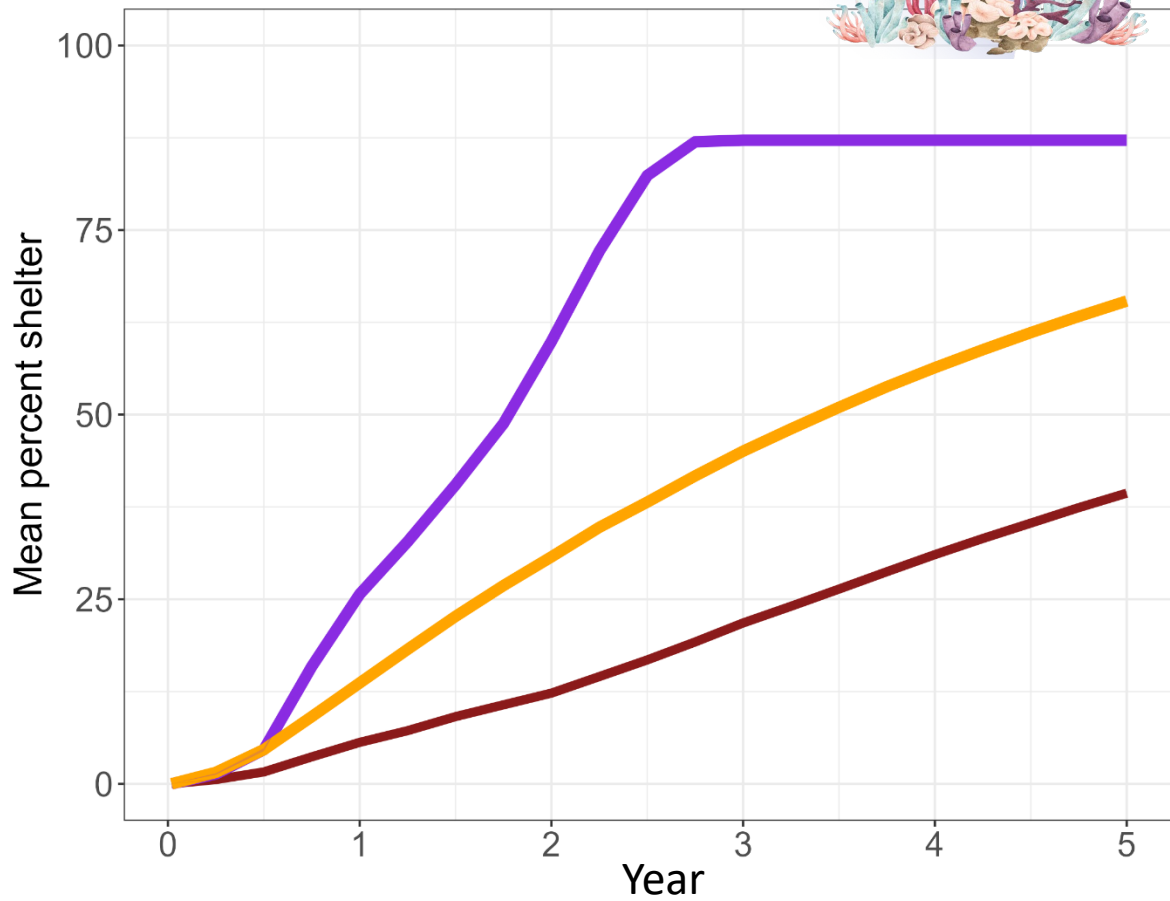
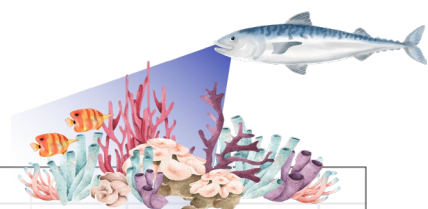
Encrusting Hemispherical Digitate Corymbose Mushroom Tabular Columnar Bushy Cone Branching



Demersal shelter



Pelagic shelter



Demersal Shelter

