Subtropical sea urchin poses a novel threat in northeastern New Zealand

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Photo : Paul Caiger

National Science Challenges
SUSTAINABLE SEAS
Ko ngā moana whakauka

THE UNIVERSITY OF AUCKLAND
Te Whare Wānanga o Tāmaki Makaurau
NEW ZEALAND

Changes in species patterns

Anthropogenic stressors such as climate change and overfishing are resulting in

- Changes to species distributions
  - Range extension of the long-spined sea urchin (*Centrostephanus rodgersii*) in Tasmania
- Irruptions of “native pest” species
  - Crown of thorns starfish (*Acanthaster spp.)*

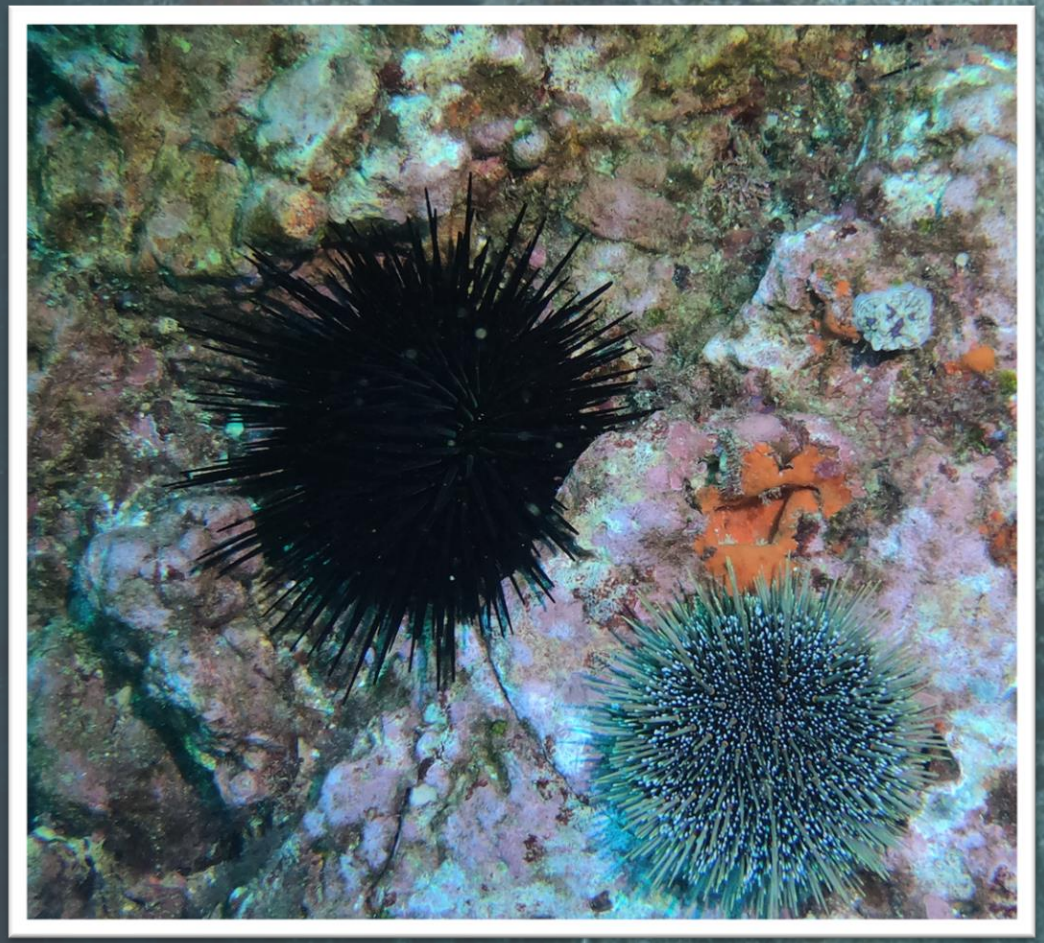

Photo :AIMS


Photo : IMAS

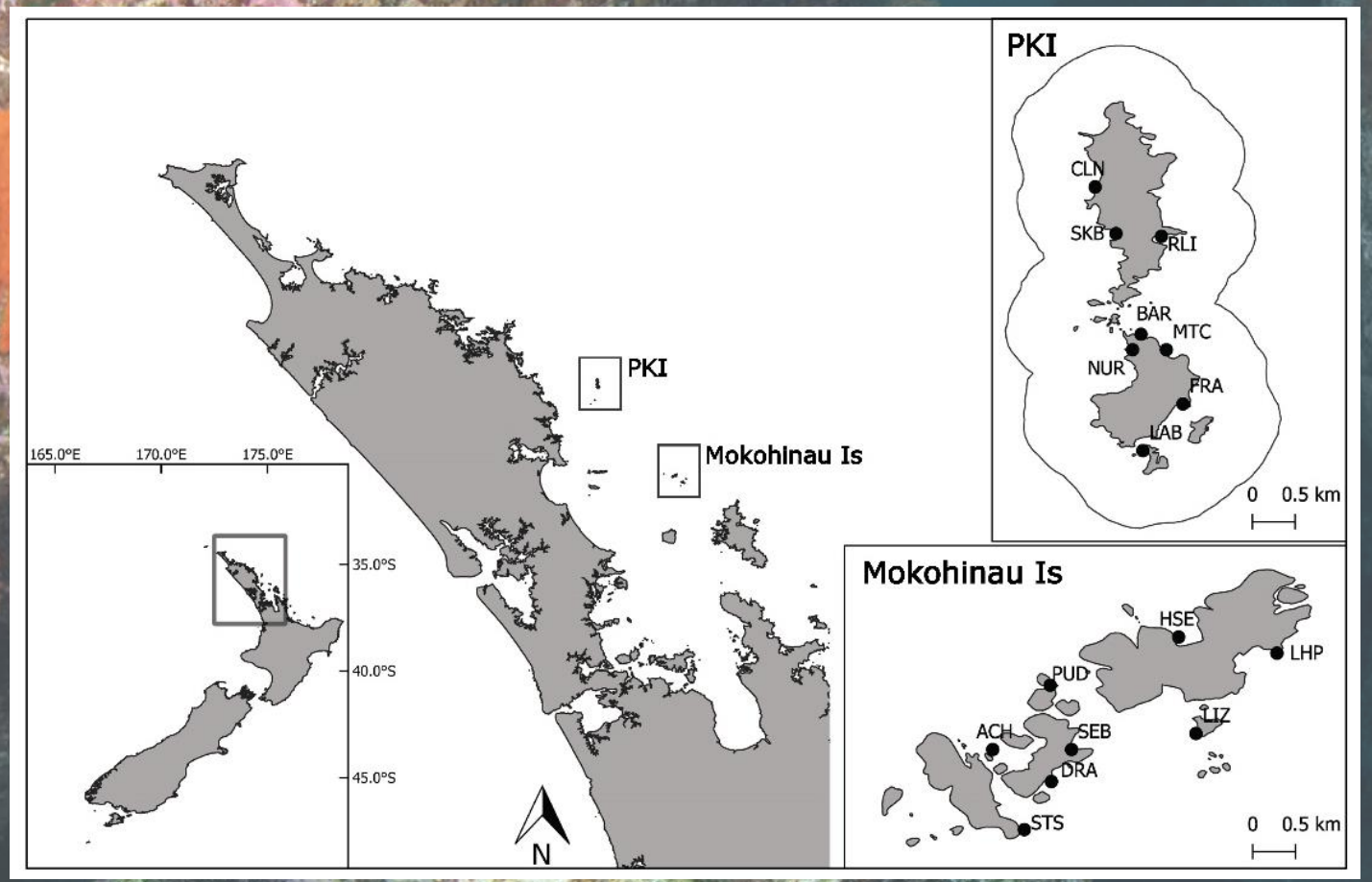
What is happening in Aotearoa New Zealand?

C. rodgersii is also present in New Zealand

- Native
- Historically maintained low numbers
- *Evechinus chloroticus* (kina) main barren former



Study locations



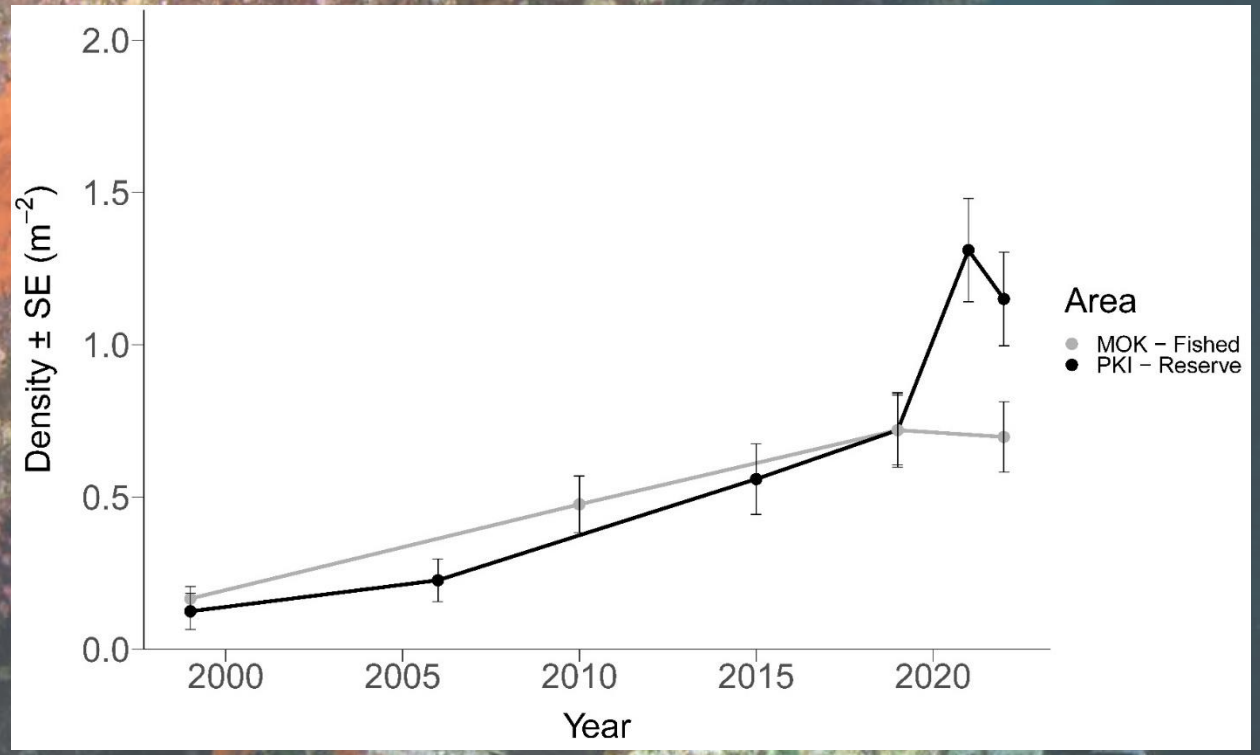
Poor Knights Islands (Labrid Channel/Ngaoi Rock)

***Wild South* documentary - Masters of Inner Space (1992)**

https://www.nzonscreen.com/title/masters-of-inner-space-1992

Photo : Nick Shears

But.....


2.0
1.5
1.0
0.5
0.0
Density ± SE (m^{-2})
2000
2005
2010
2015
2020
Year
Area
MOK − Fished
PKI − Reserve


Video : Nick Shears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So we know *C. rodgersii* are increasing on rocky reefs but what about other habitats?

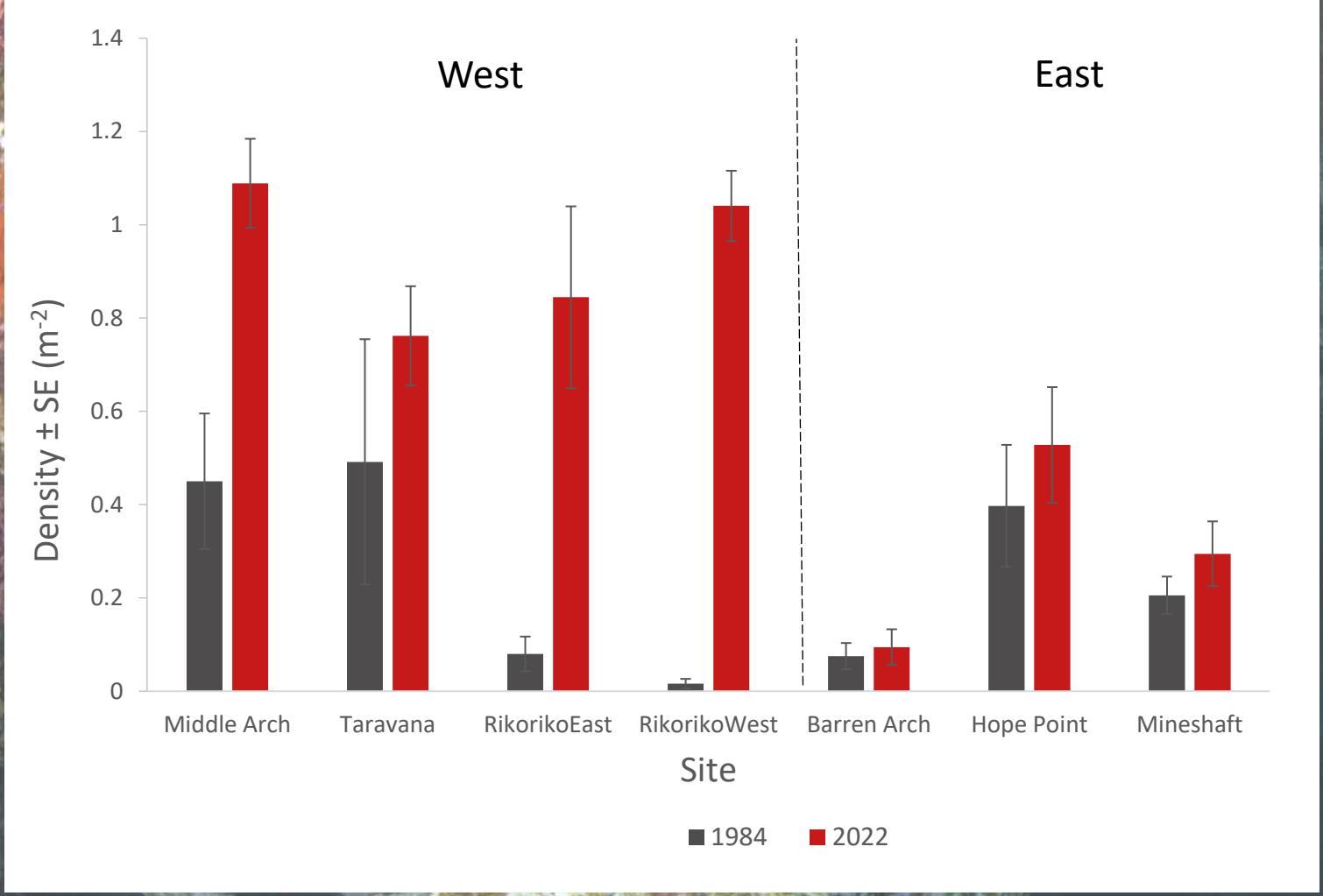
- E.g. caves, walls and archways (typically dominated by sessile encrusting invertebrates)

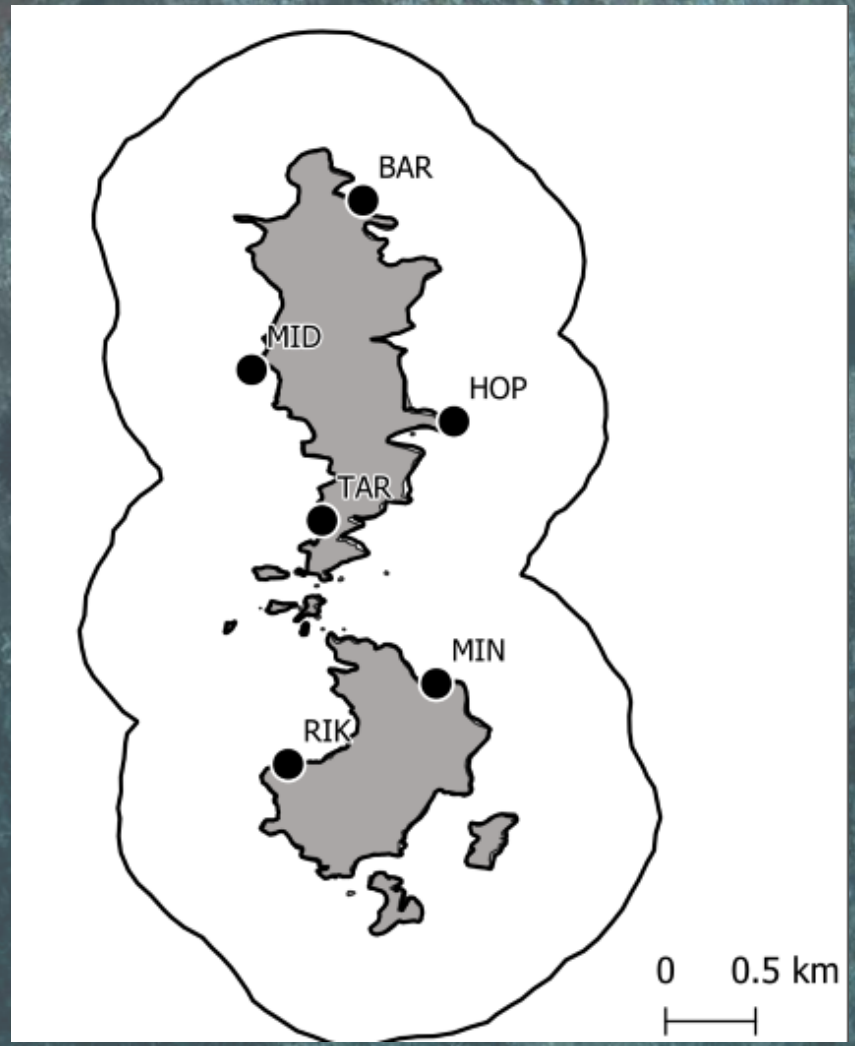
Rocky wall surveys

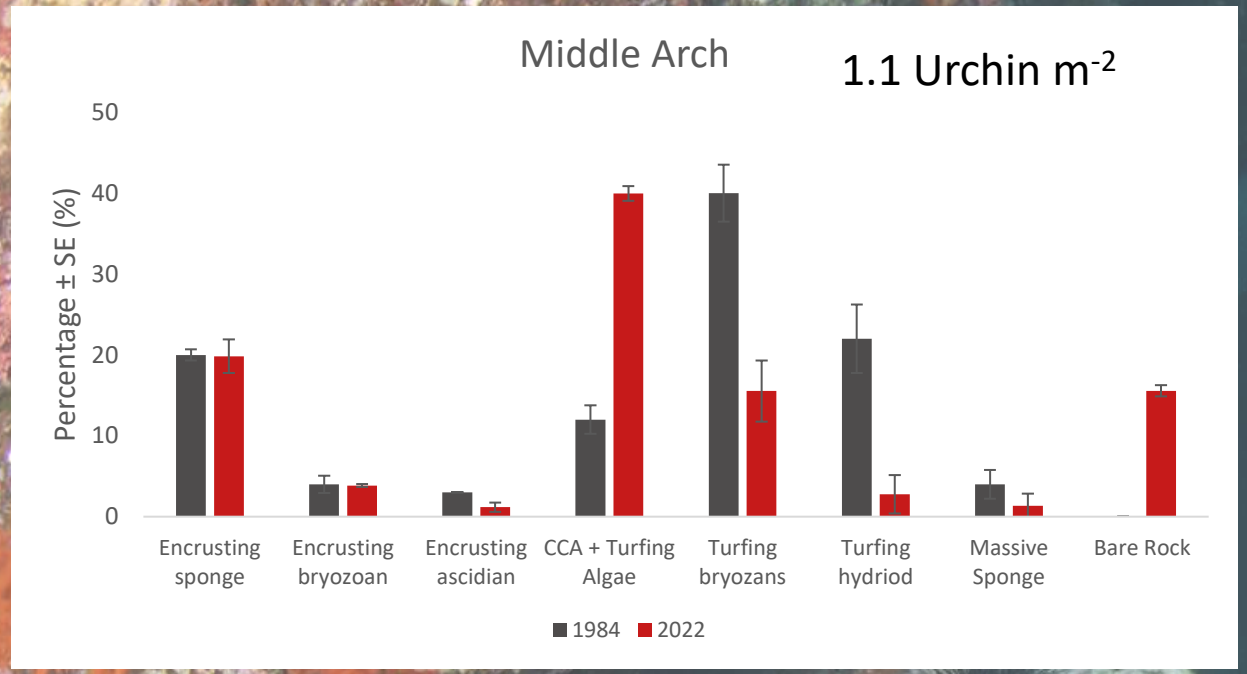
Repeated methods by Battershill, 1986

- Surveyed two archway, wall and cave sites
- Urchin transects
- Photo quadrats to assess fauna

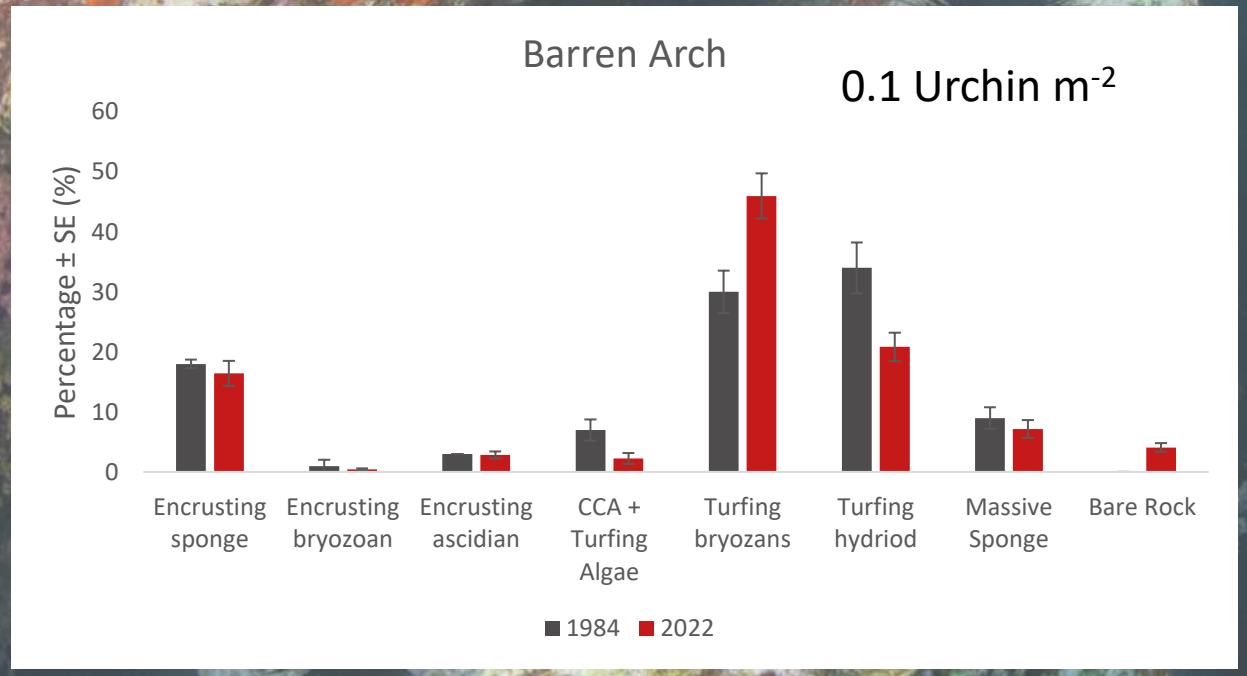
Changes in density






Middle Arch
1.1 Urchin m-2
Percentage ± SE (%)
50
40
30
20
10
0
Encrusting sponge
Encrusting bryozoan
Encrusting ascidian
CCA + Turfing Algae
Turfing bryozans
Turfing hydriod
Massive Sponge
Bare Rock
1984
2022


Grazed

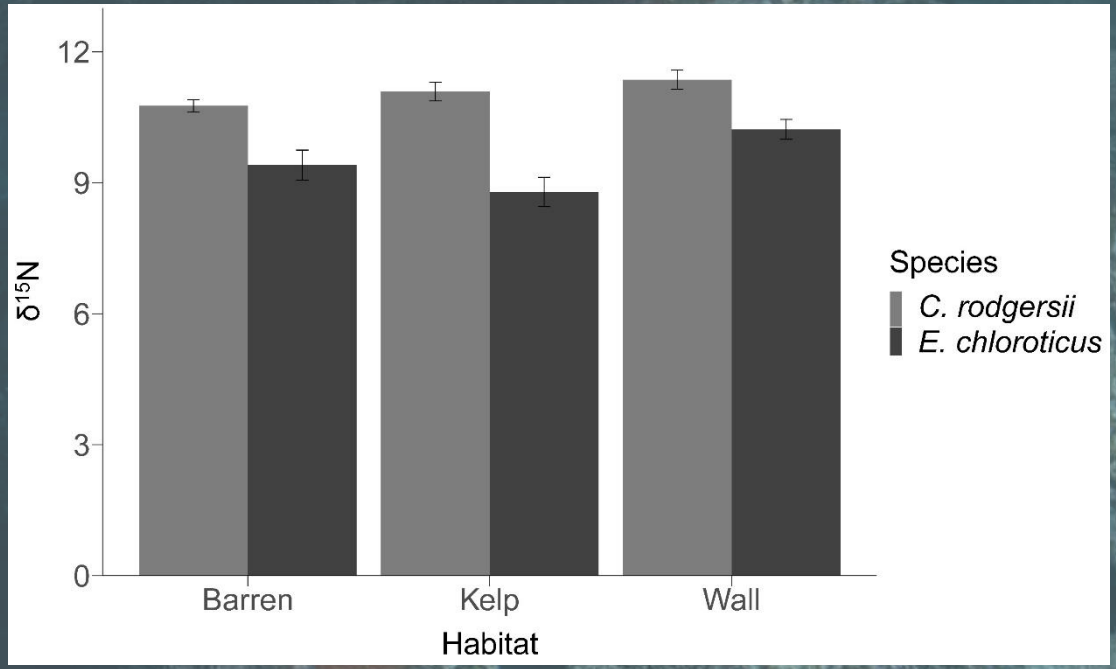

Barren Arch
0.1 Urchin m-2
Percentage ± SE (%)
60
50
40
30
20
10
0
Encrusting sponge
Encrusting bryozoan
Encrusting ascidian
CCA + Turfing Algae
Turfing bryozans
Turfing hydriod
Massive Sponge
Bare Rock
1984
2022

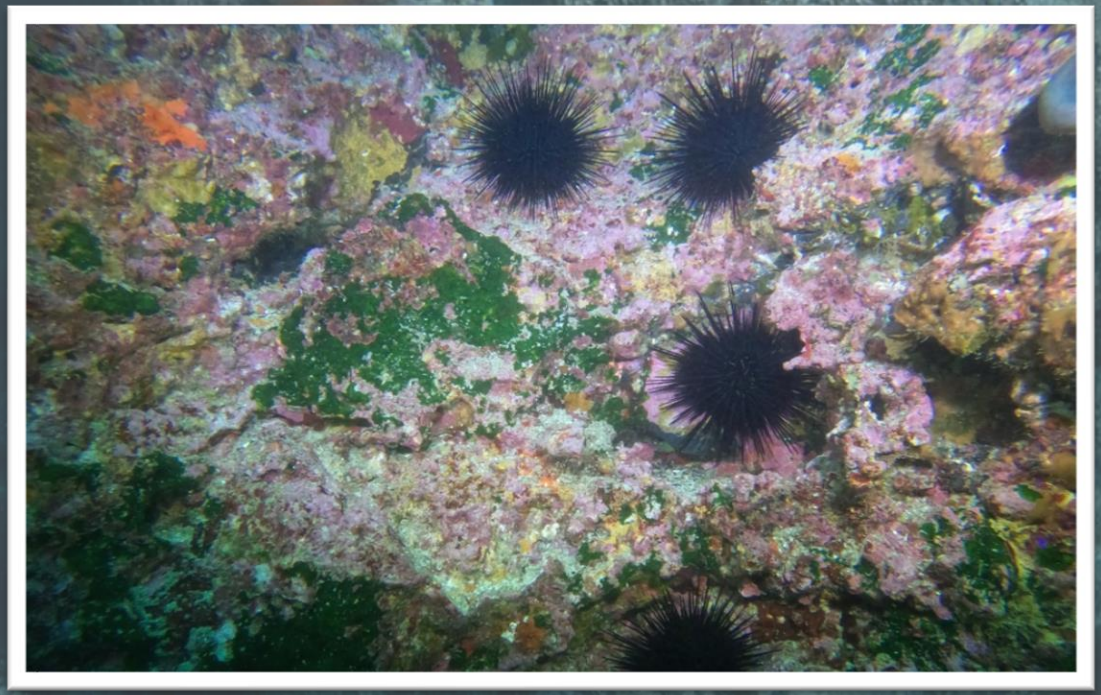

Not Grazed

Feeding preferences

Results from feeding experiments, gut contents and stable isotope analysis showed that

- *C. rodgersii* were more generalist feeders
- *E. chloroticus* preferred kelp when available
- *C. rodgersii* consumed more animal material and fed at a higher trophic level than *E. chloroticus*



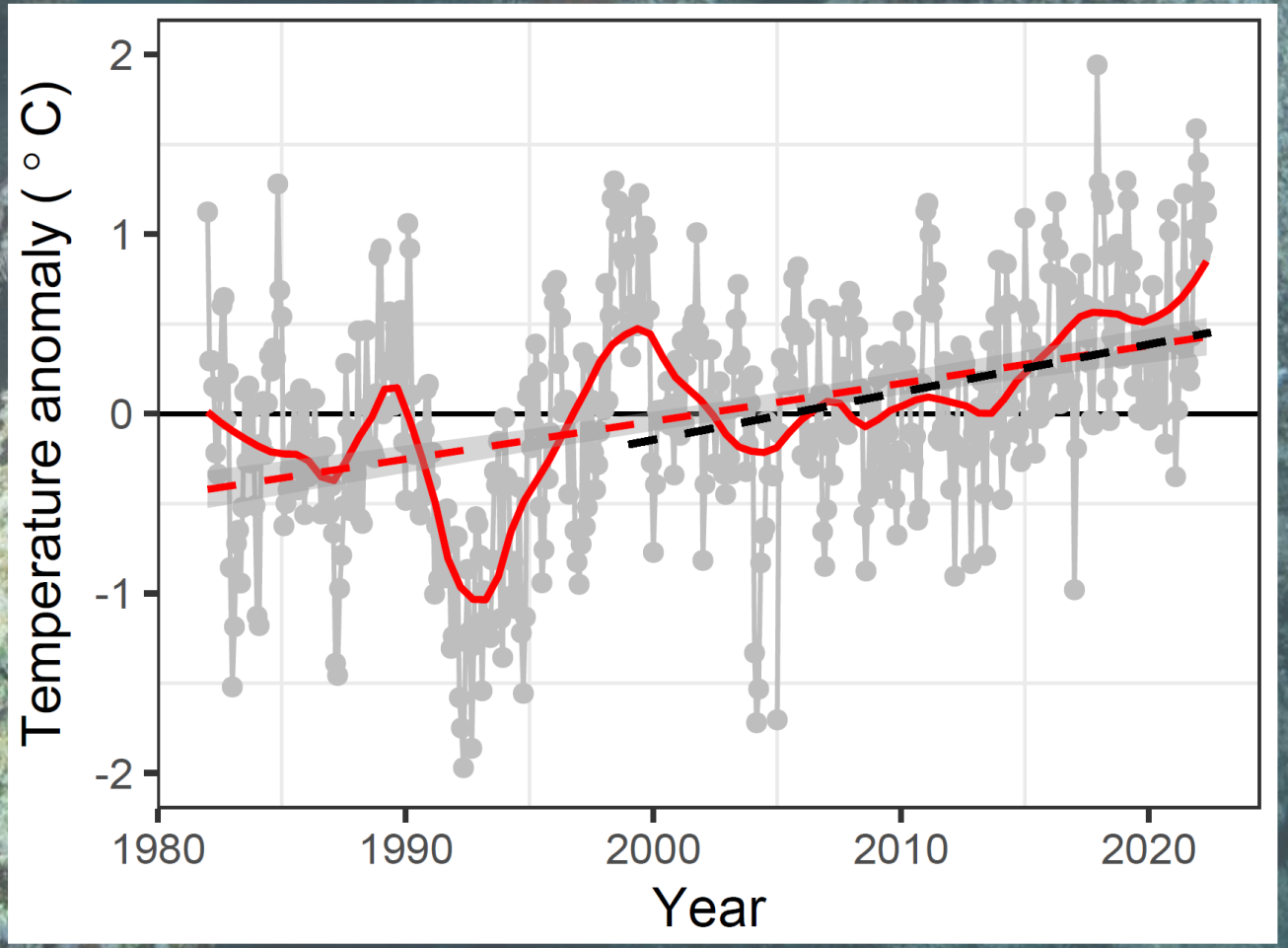


So why is this happening and in a highly protected marine reserve?

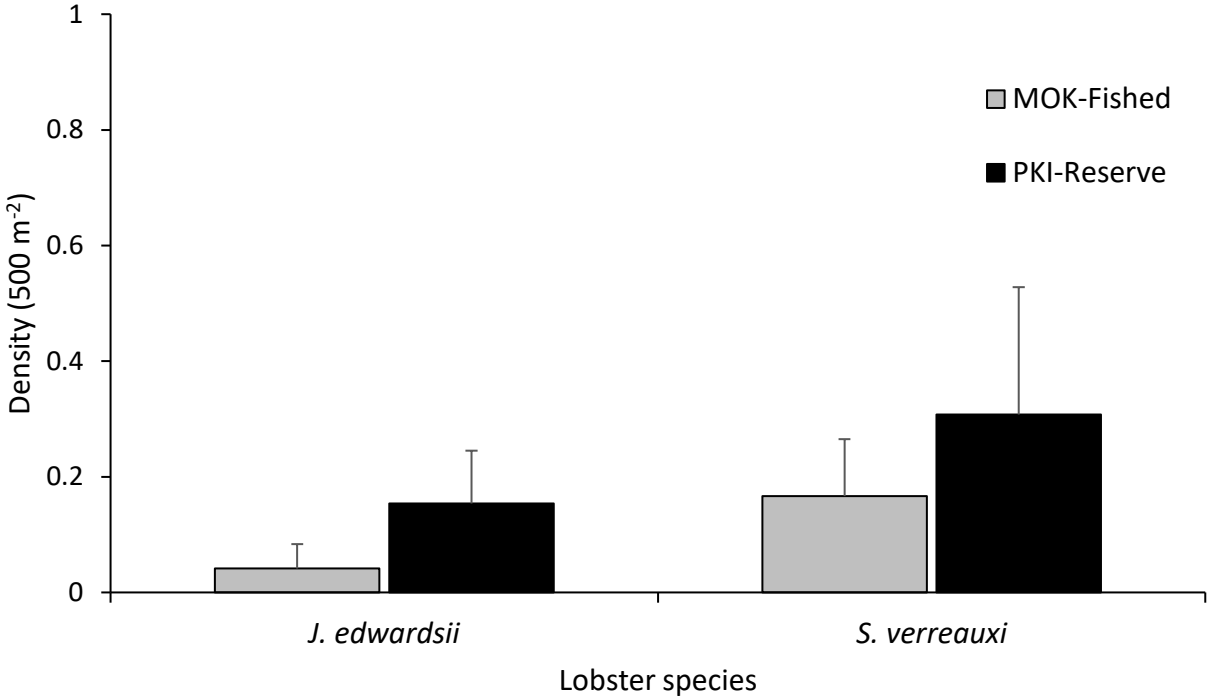
Warming in NE New Zealand

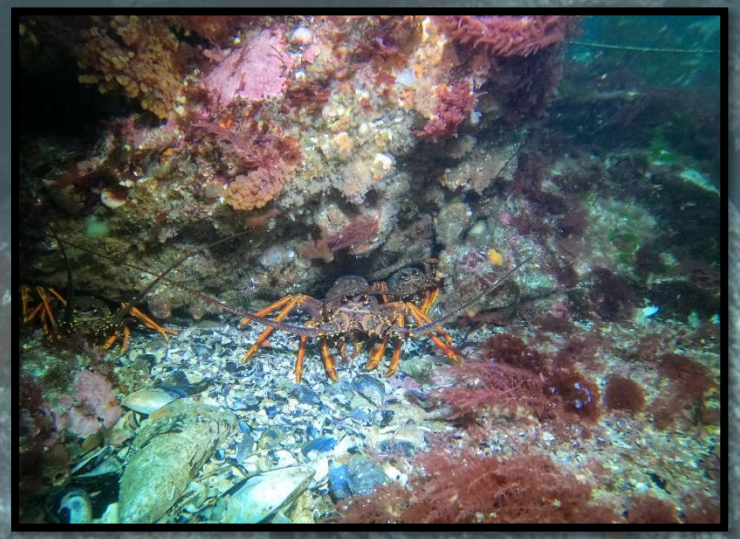
NOAA OISST v.2 from the PKI from 1982 – 2022 indicates a warming of 0.21 ± 0.02°C per decade $^{-1}$

Slightly higher trend over the monitoring period (1999 – 2022): 0.26 ± 0.05°C decade^{-1}



Lack of predators





Conclusions

- Unprecedented increase in *C. rodgersii* numbers
- Increase is likely linked to warm water and insufficient predators
- Will continue to get worse
- Will impact a wider depth band and range of habitats than *E. chloroticus*

Potential solutions

- Rebuild wider lobster populations
- Lobster translocations
- Large protected areas
- Sea urchin removals

Thank you!
Questions?

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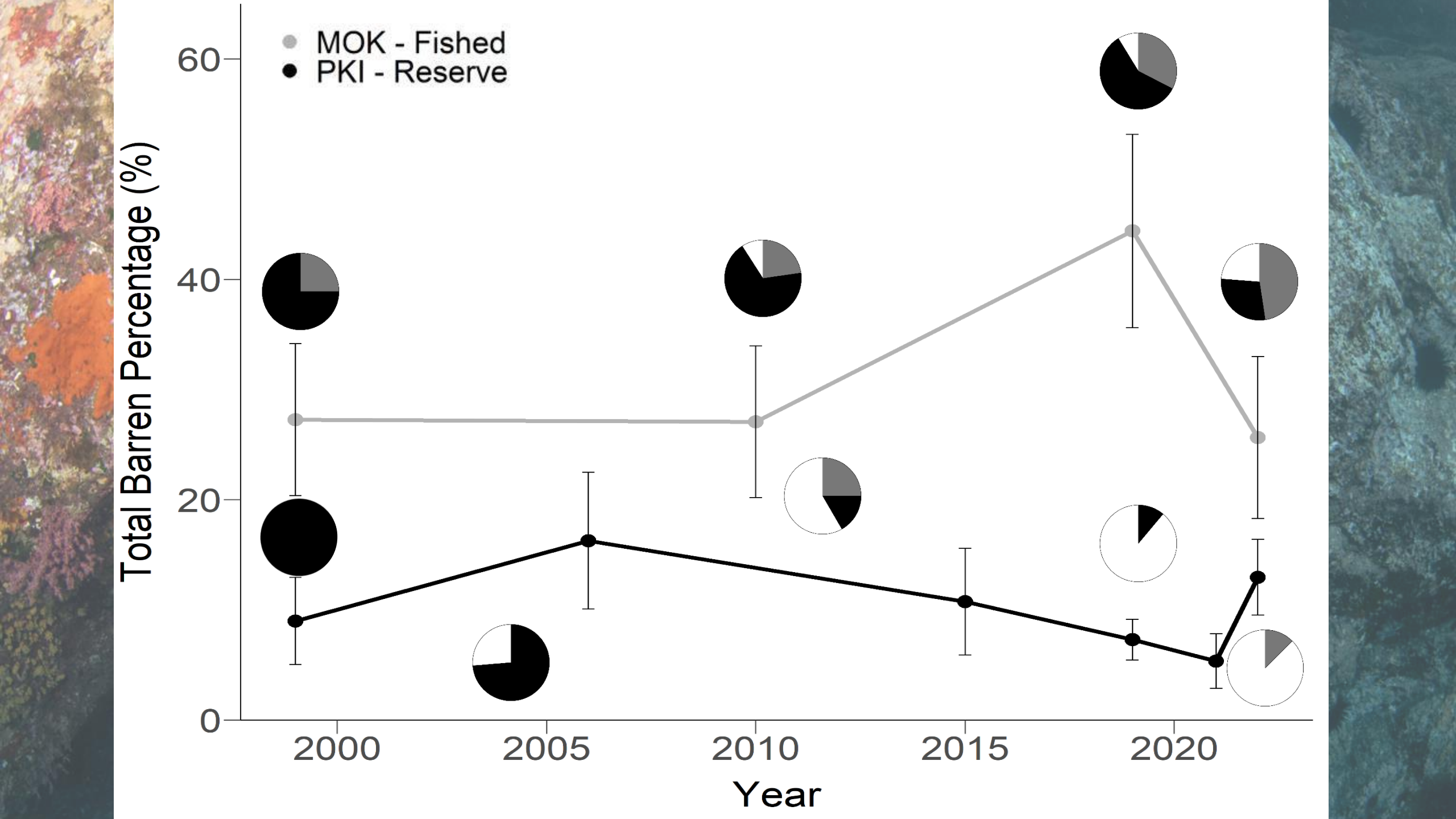
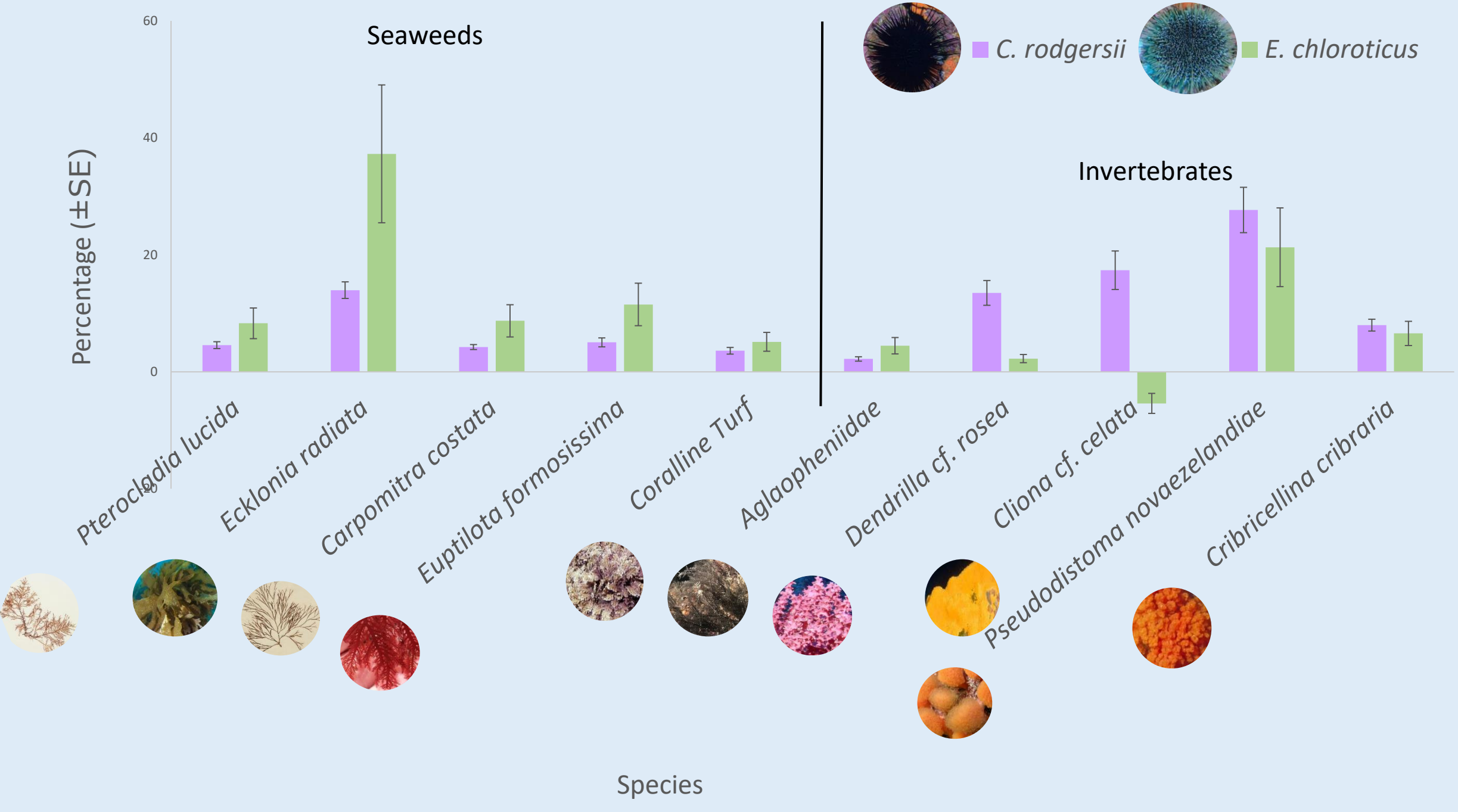
Video : Brady Doak


MOK - Fished
PKI - Reserve
Total Barren Percentage (%)
0
20
40
60
2000
2005
2010
2015
2020
Year

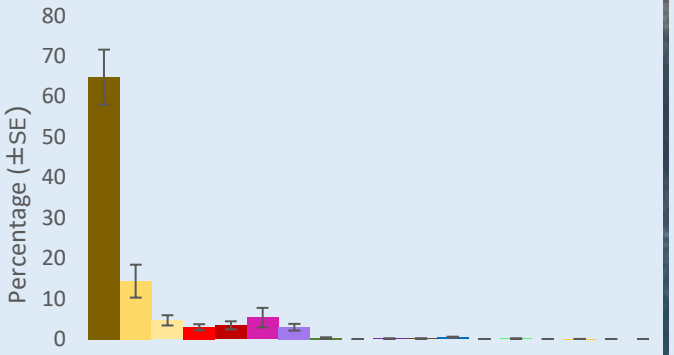

Seaweeds
Invertebrates
C. rodgersii
E. chloroticus
Percentage (±SE)
60
40
20
0
Pterocladia lucida
Ecklonia radiata
Carpomitra costata
Euptilota formosissima
Coralline Turf
Aglaopheniidae
Dendrilla cf. rosea
Cliona cf. celata
Pseudodistoma novaezelandiae
Cribricellina cribraria
Species

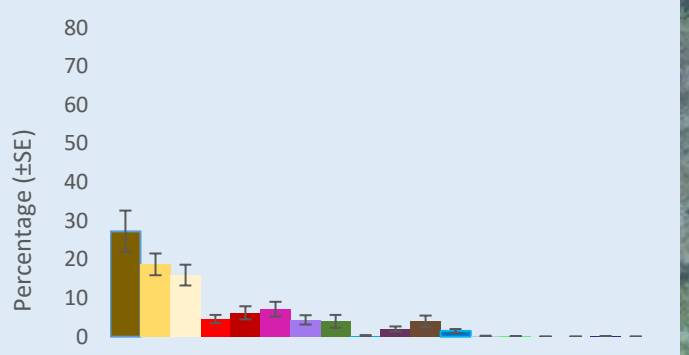
Gut Analysis

- Kelp
- CaCO3
- Detritus
- Red Fila
- Red Flat
- Crustose Algae
- Sediment
- Green algae
- Sponge
- Coraline Turf
- Other Brown
- Bryozoan
- Ascidian
- Univalve
- Unknown
- Crustacean
- Hydroid
- Bivalve

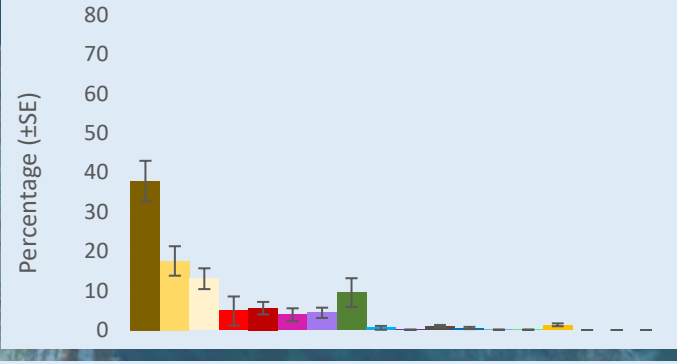
E. chloroticus | *C. rodgersii*

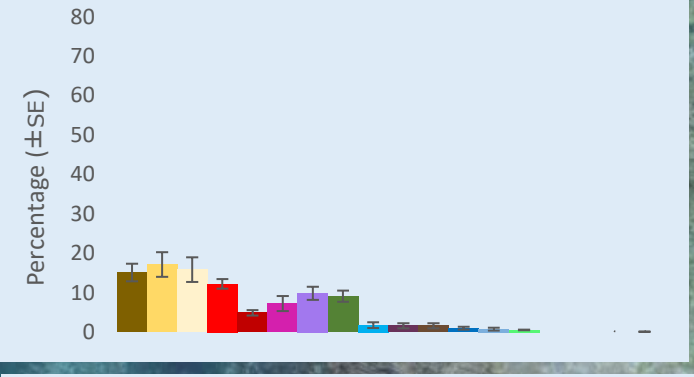
Kelp





Barren





Wall