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CAWTHRON

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Te Whare Wānanga o Waitaha
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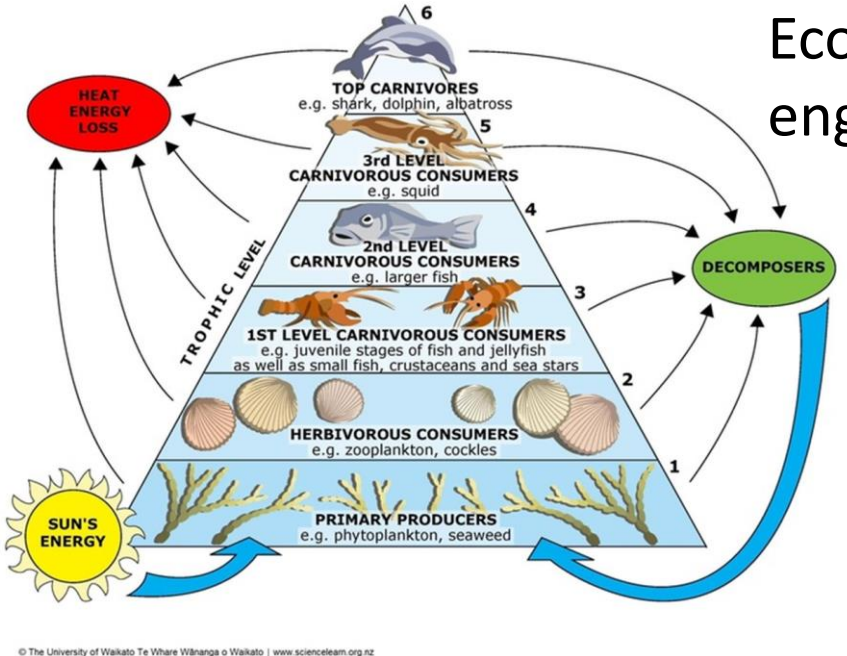
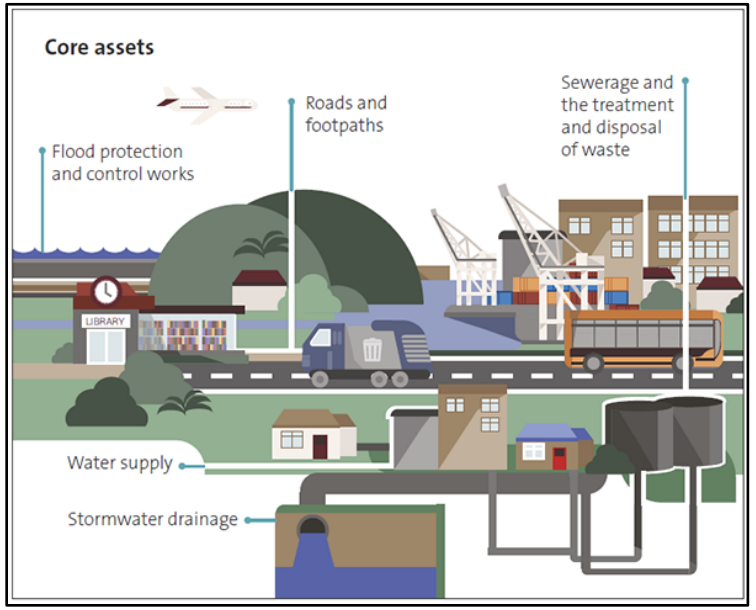
Large brown algal recruitment in response to an earthquake and ensuing multiple coastal stressors

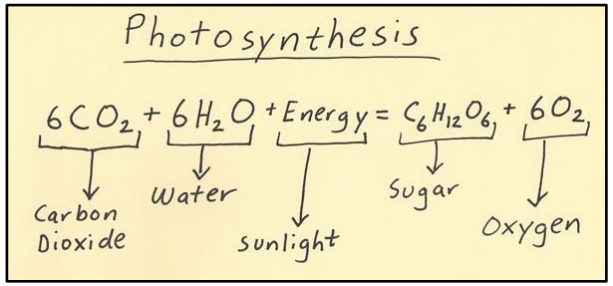
Ecosystem engineers

Large brown algae





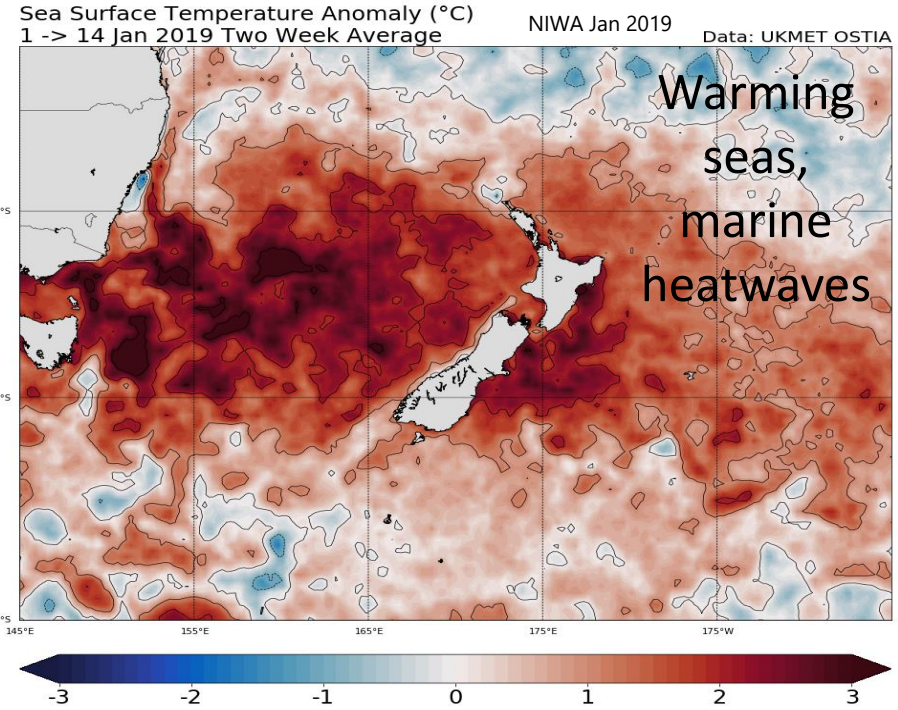
Infrastructure

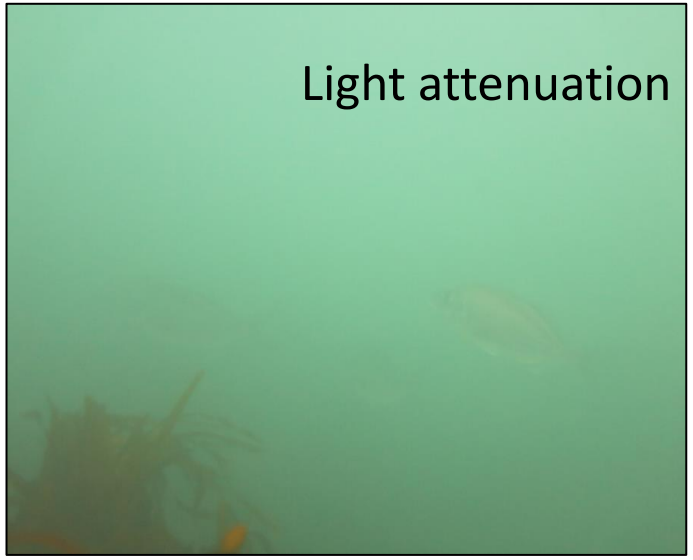


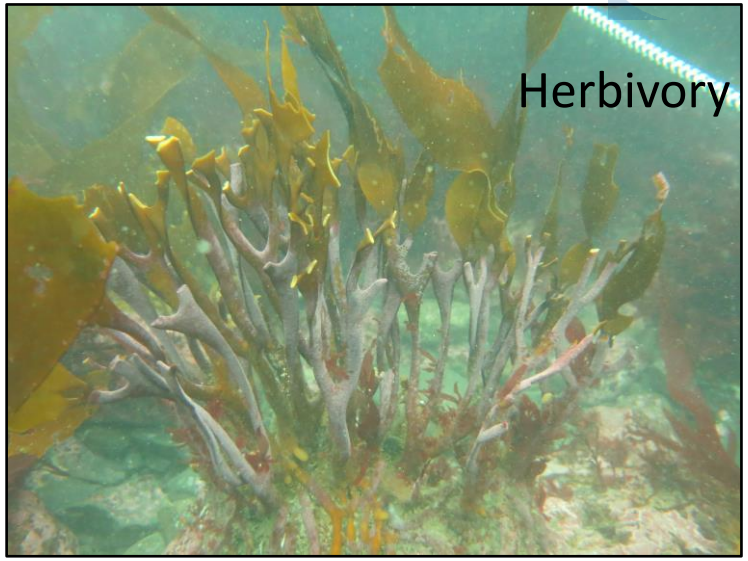
Currency

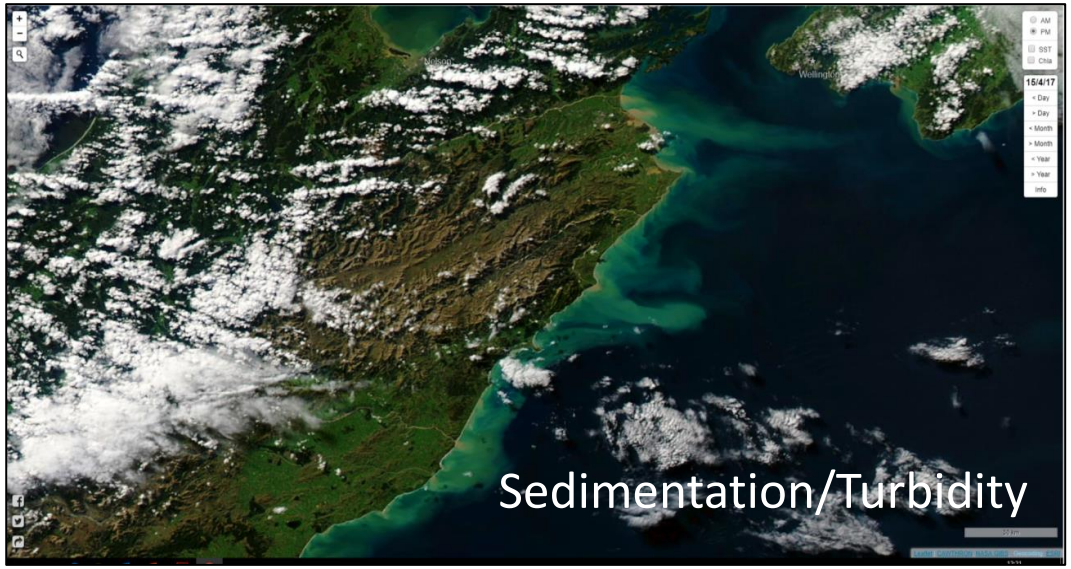
We know…

However, significant algal stressors:









And then…7.8 mW Kaikōura earthquake, November 2016

Post EQ, and ensuing stressors resulted in:

Along many medium and high uplift areas

But can we quantify the degree of disruption to this cycle…

H_1: Does algal cover influence habitat recovery?

H_2: Does algal recruitment increase with increasing algal cover?

Schiel 1988, Edgar et al. 2004, Tait & Schiel 2011, Schiel & Lilley 2011, Menge et al. 2017

Reed & Foster 1984, Melville & Connell 2001, Valentine & Johnson 2003, Edgar et al. 2004, Taylor & Schiel 2005, Wernberg et al. 2005, Toohey & Kendrick 2007, Castroni et al. 2021

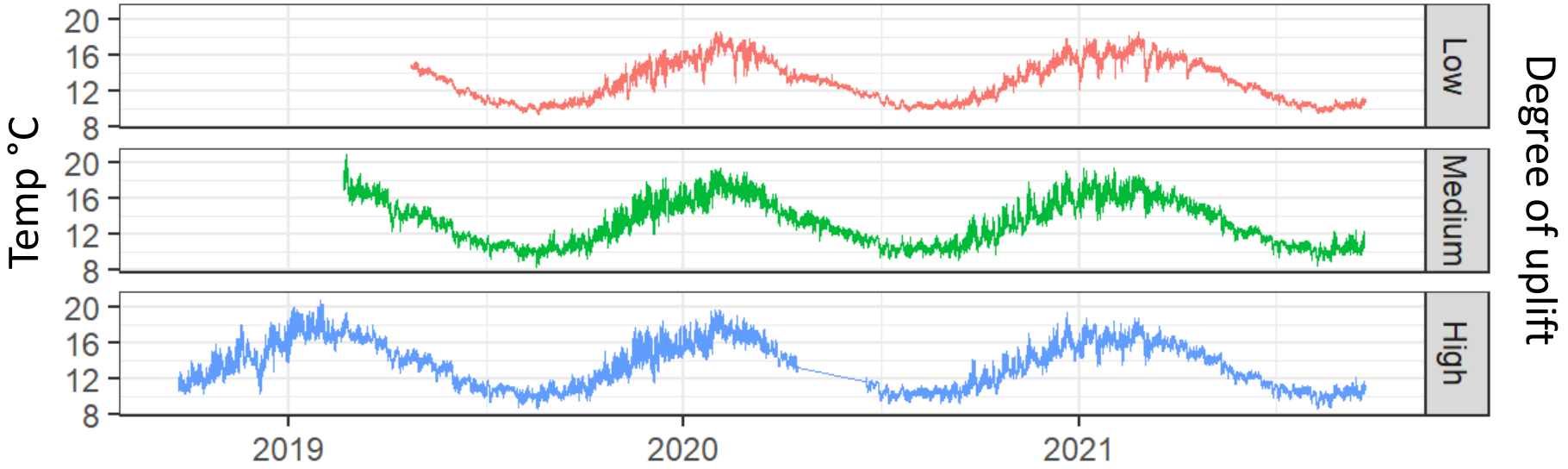
H_3: Does coralline algae increase algal recruitment?

Steneck 1986, Reed 1990, Kennelly & Underwood 1993, Camus 1994, Melville & Connell 2001, Buller et al. 2002, Taylor & Schiel 2005, Castroni et al. 2021

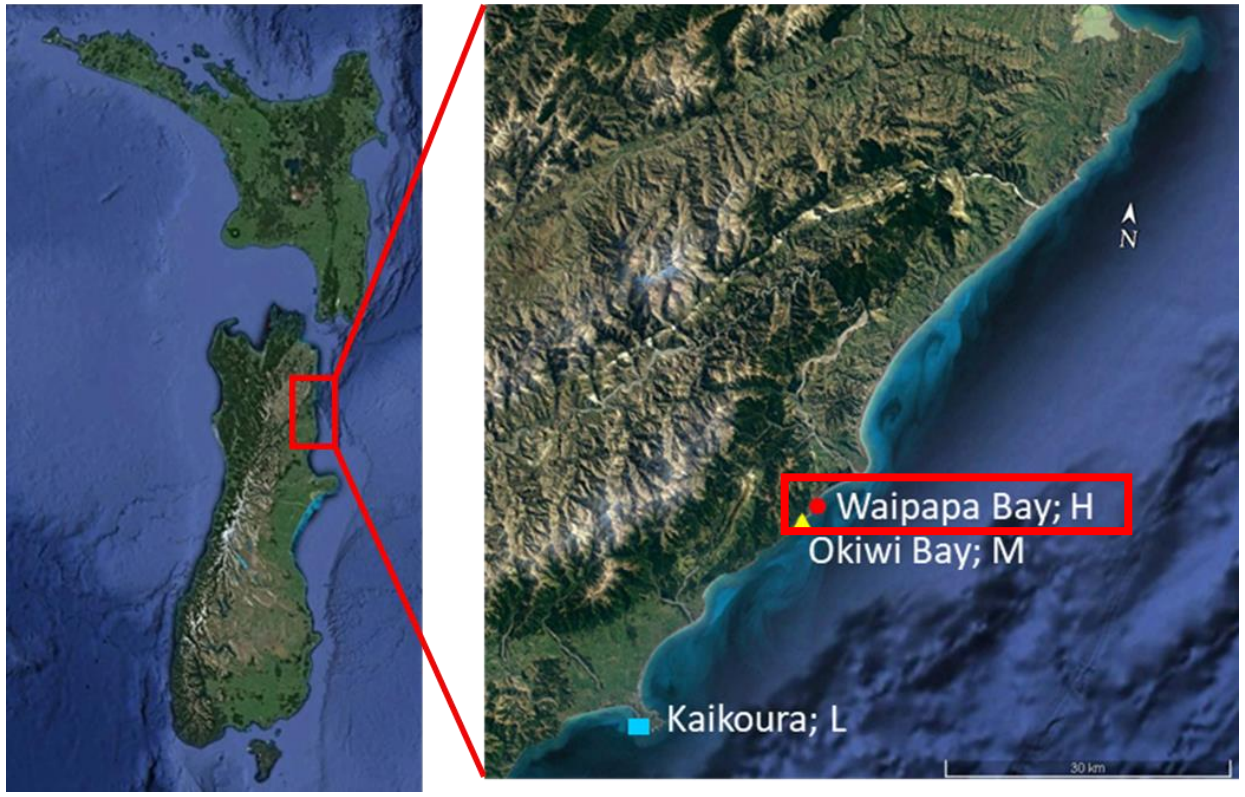


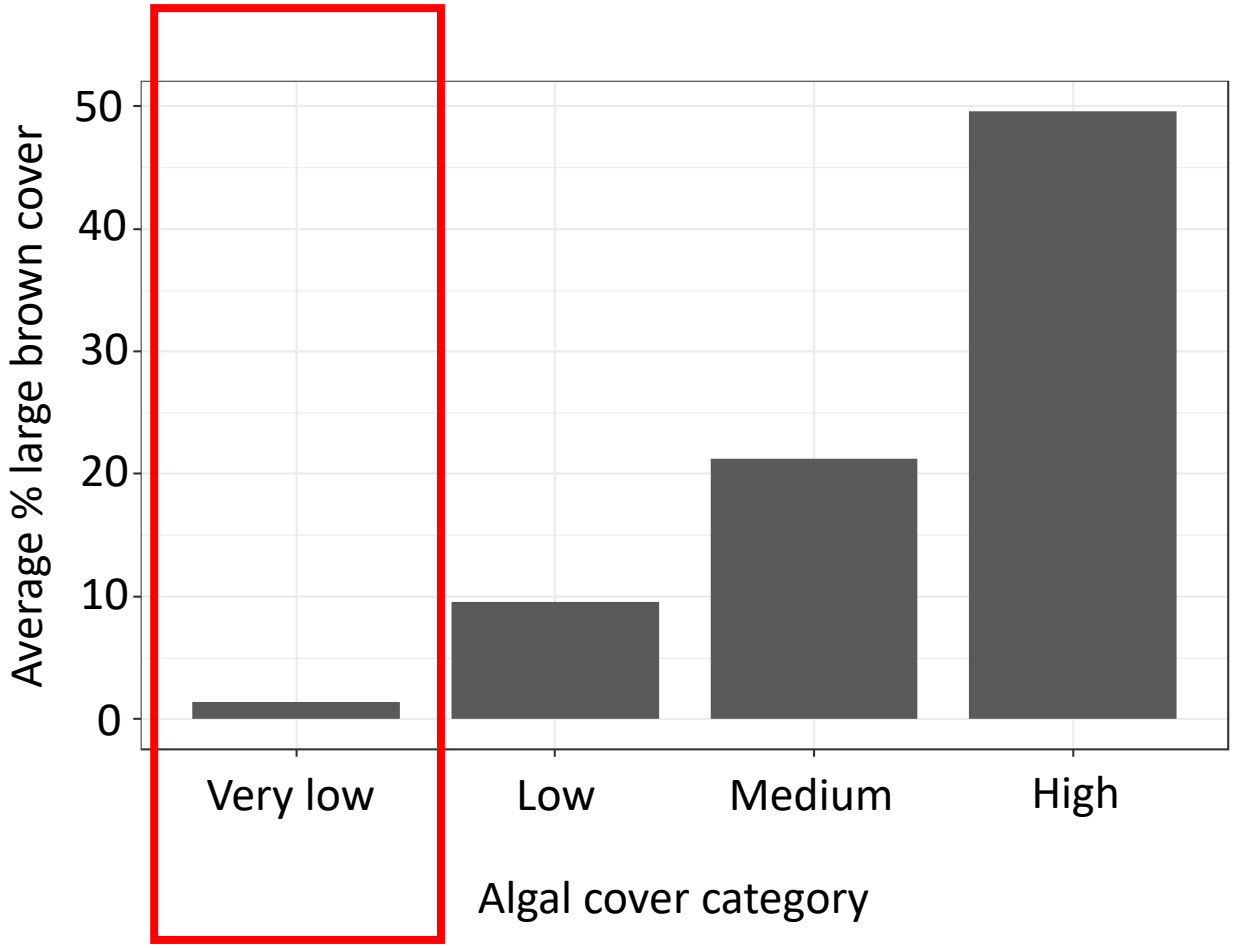

H_4: Is there greater recruitment in summer or winter?

Reed & Foster 1984, Vadas et al. 1992, Schiel & Foster 2006, Schiel et al. 2016, Wernberg et al. 2019



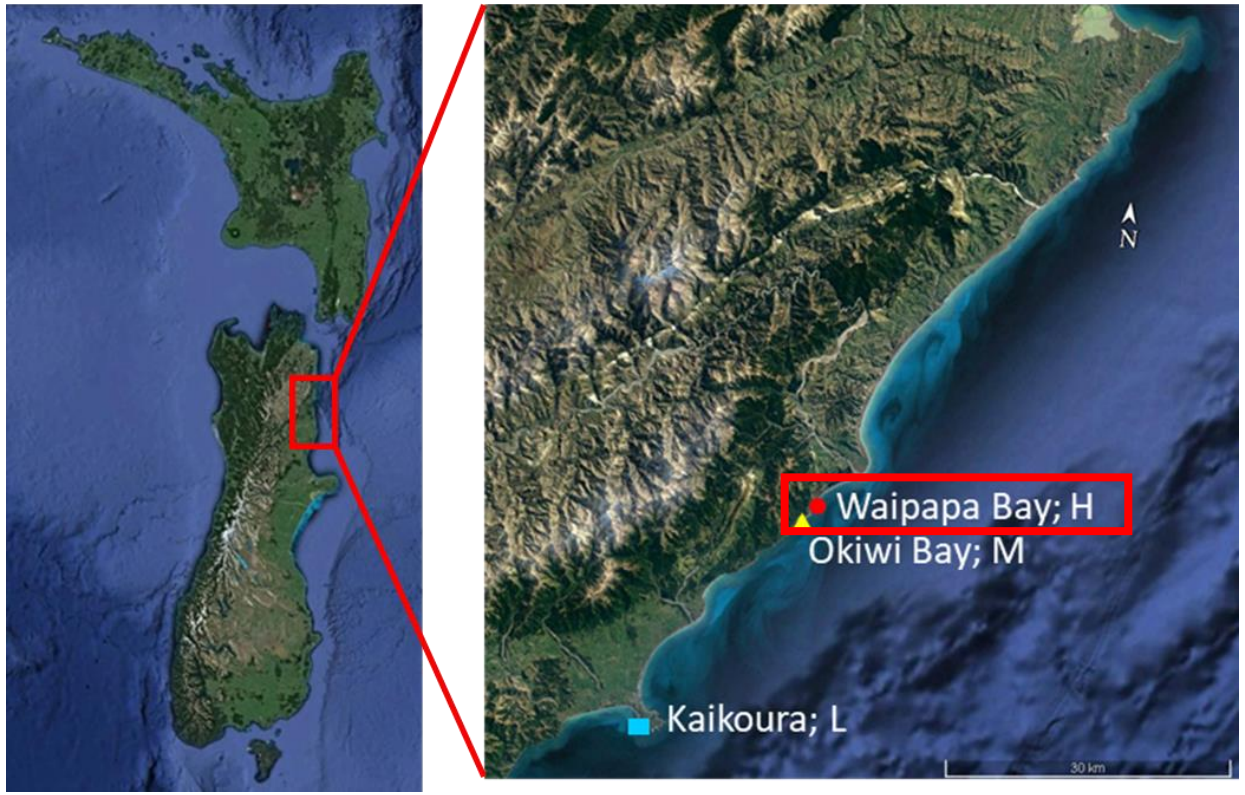
Assignment of fine spatial scale sites based on large spatial-scale surveys

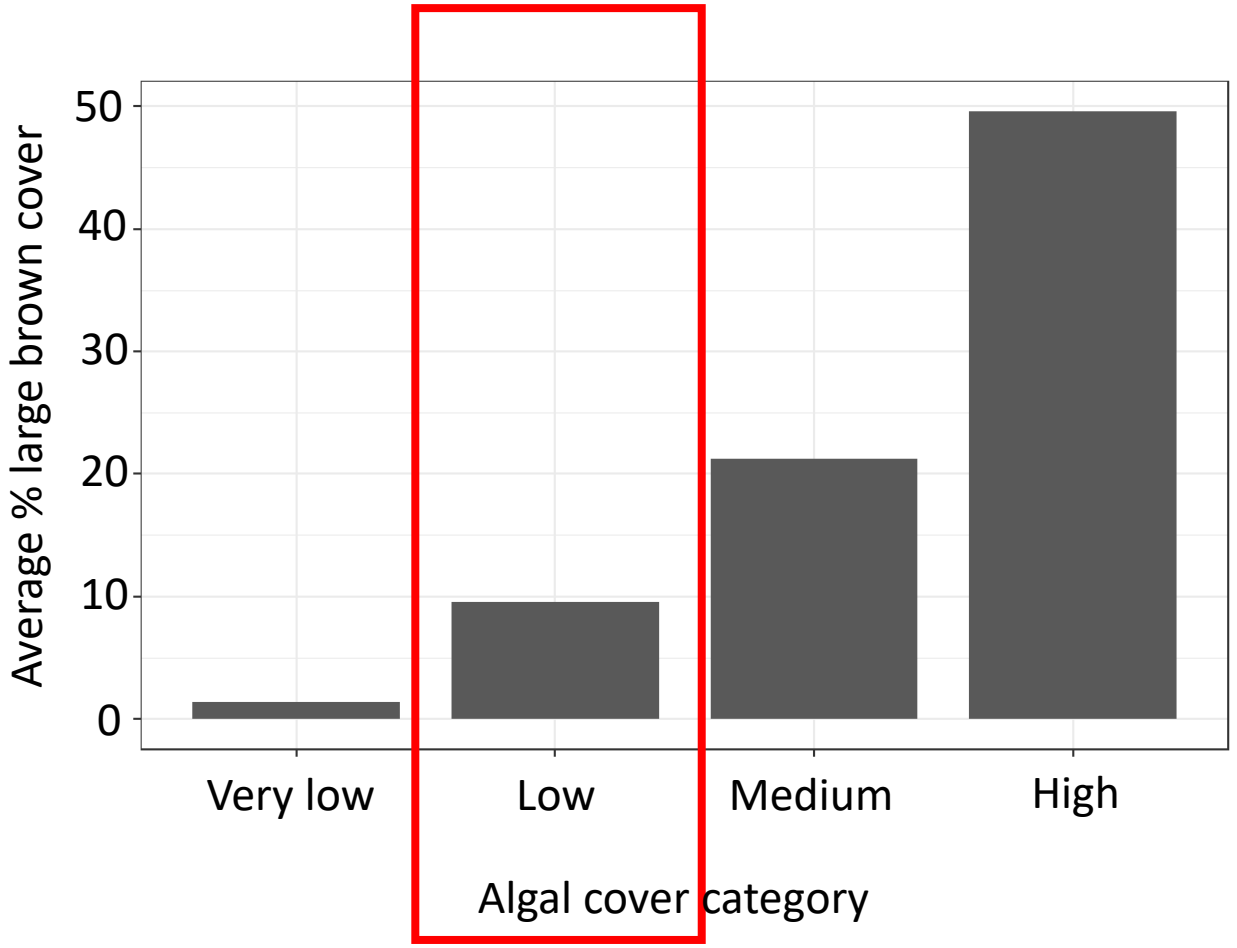




Waipapa Bay North: High uplift, Very low adult large brown cover

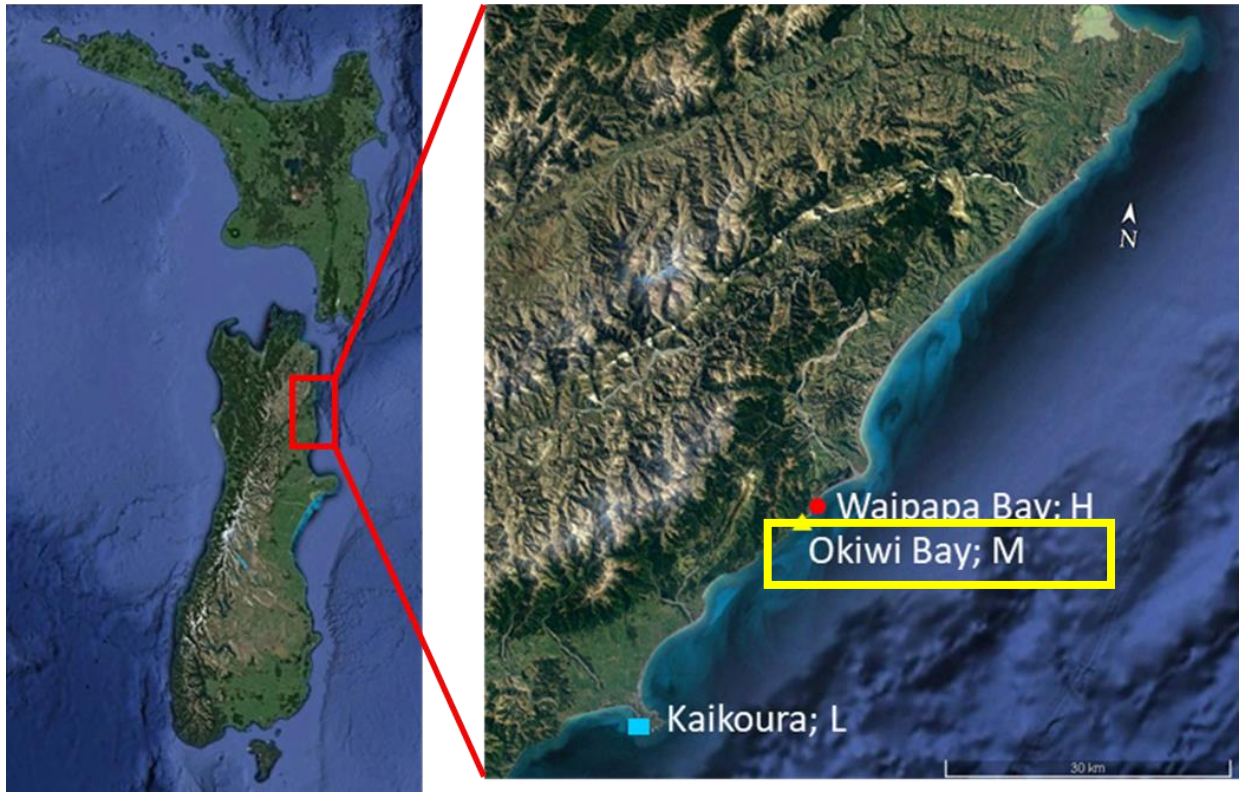
Assignment of fine spatial scale sites based on large spatial-scale surveys

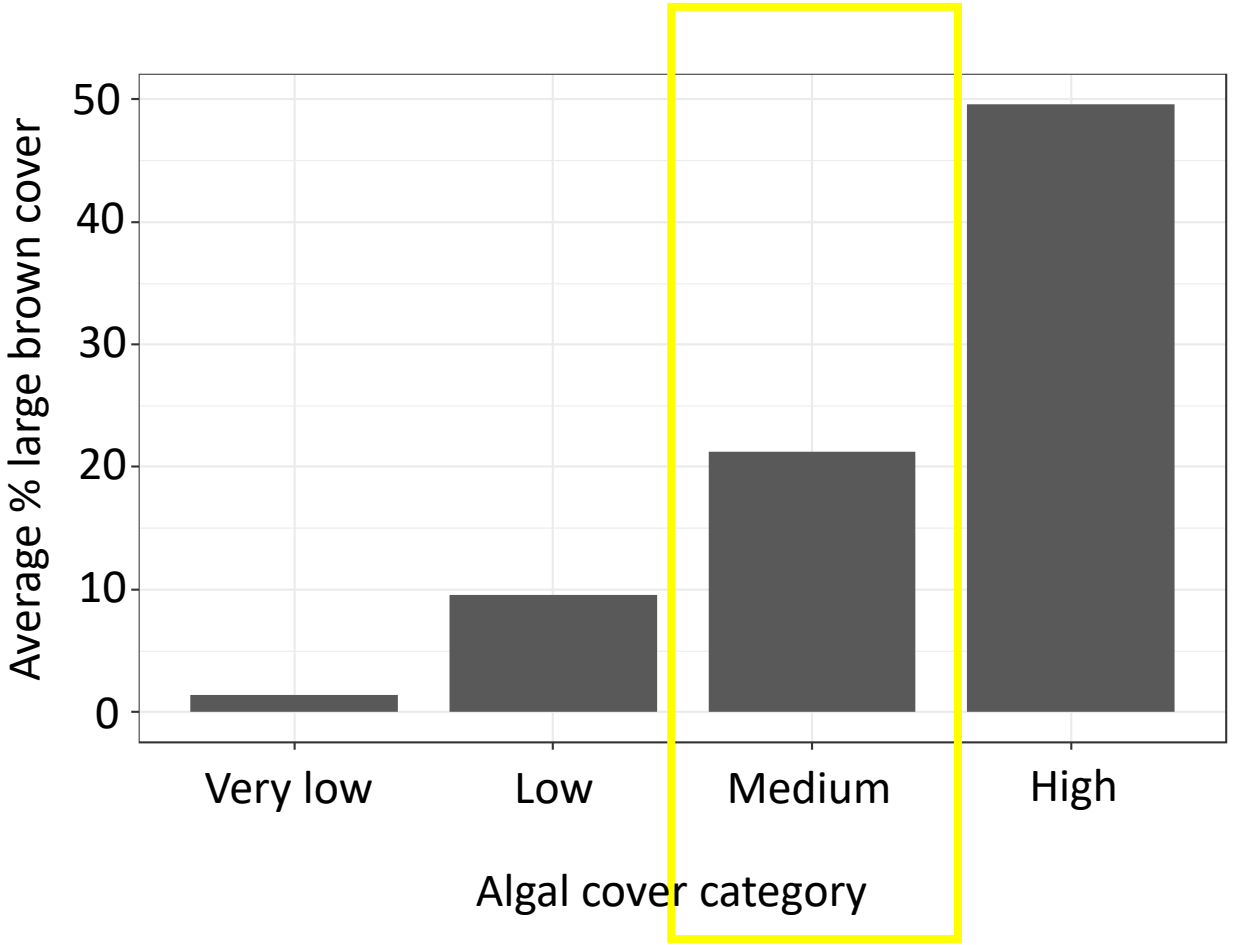




Waipapa Bay South: High uplift, <u>Low</u> adult large brown cover

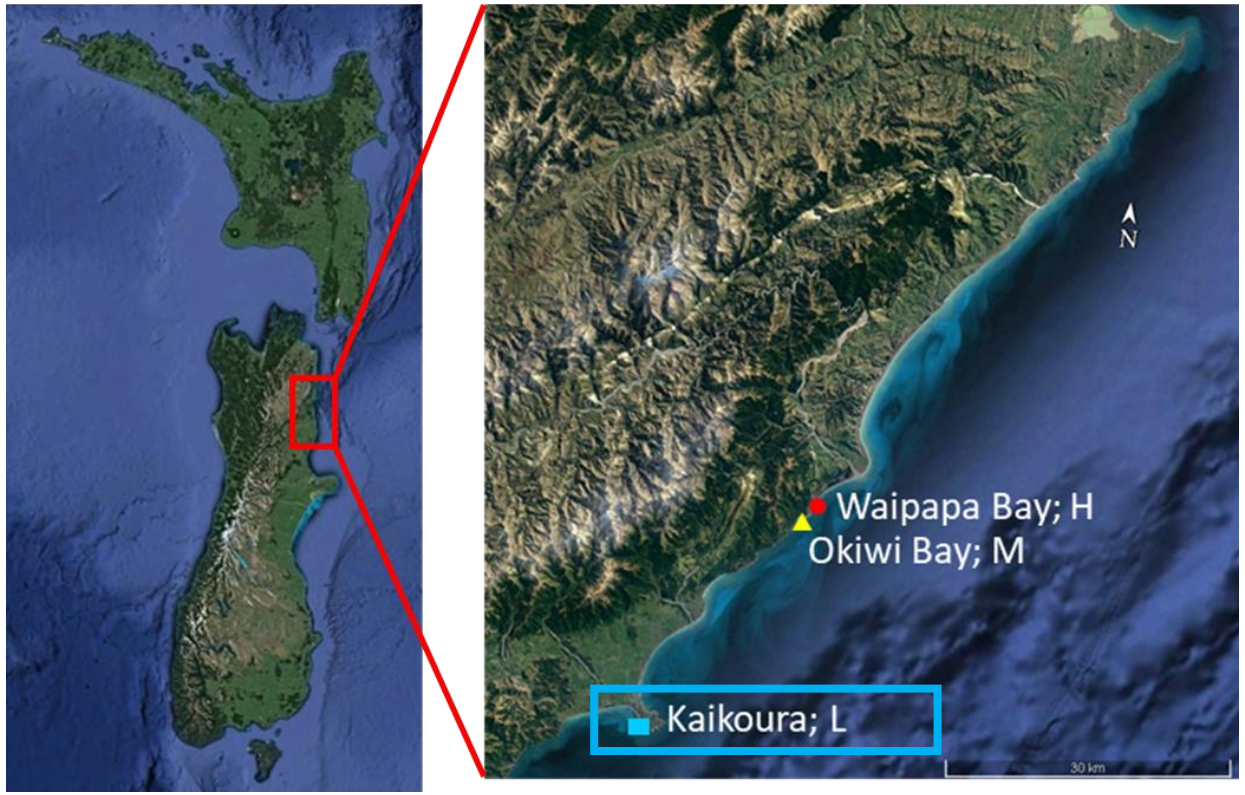
Assignment of fine spatial scale sites based on large spatial-scale surveys

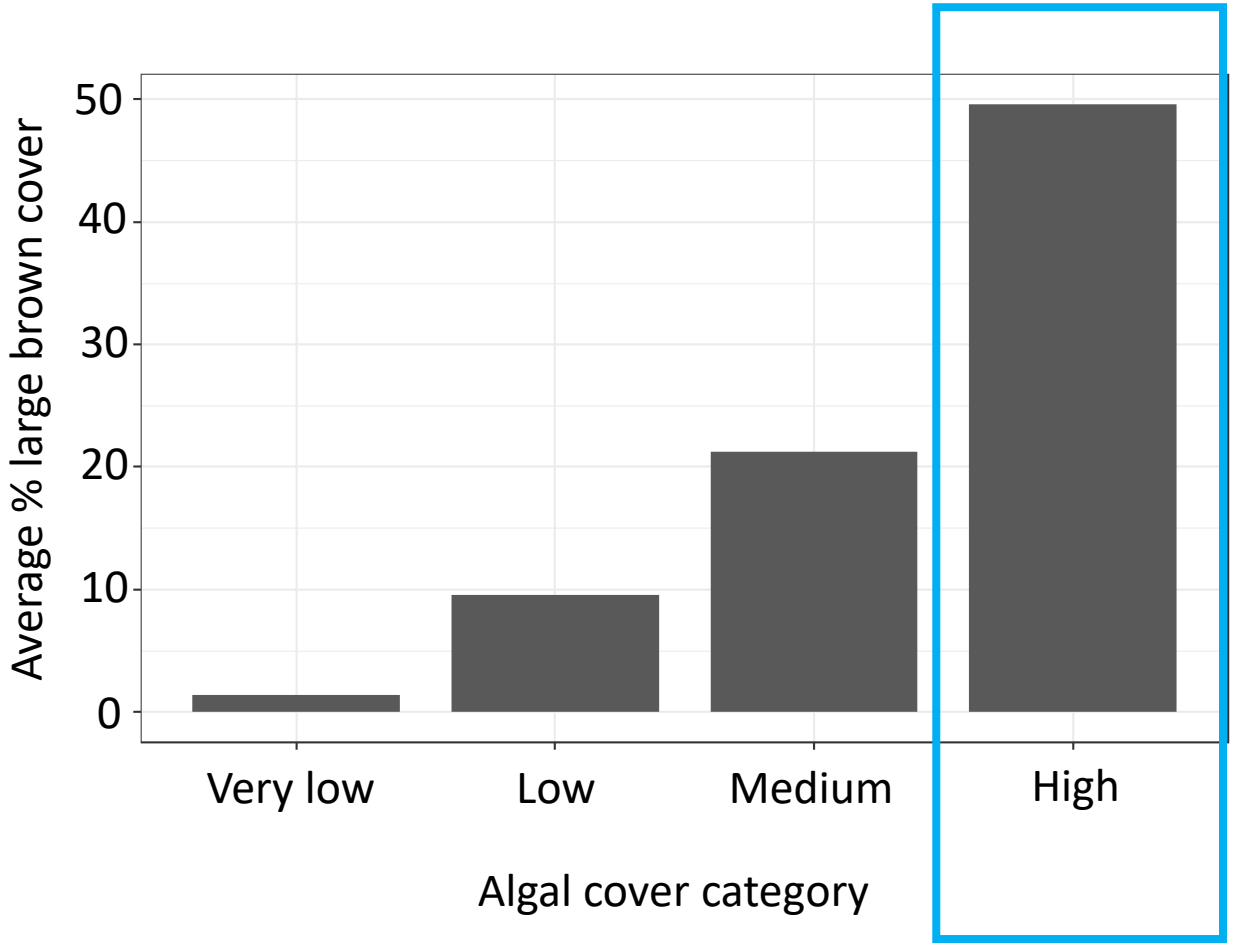




Okiwi Bay: Medium uplift, Medium adult large brown cover

Assignment of fine spatial scale sites based on large spatial-scale surveys





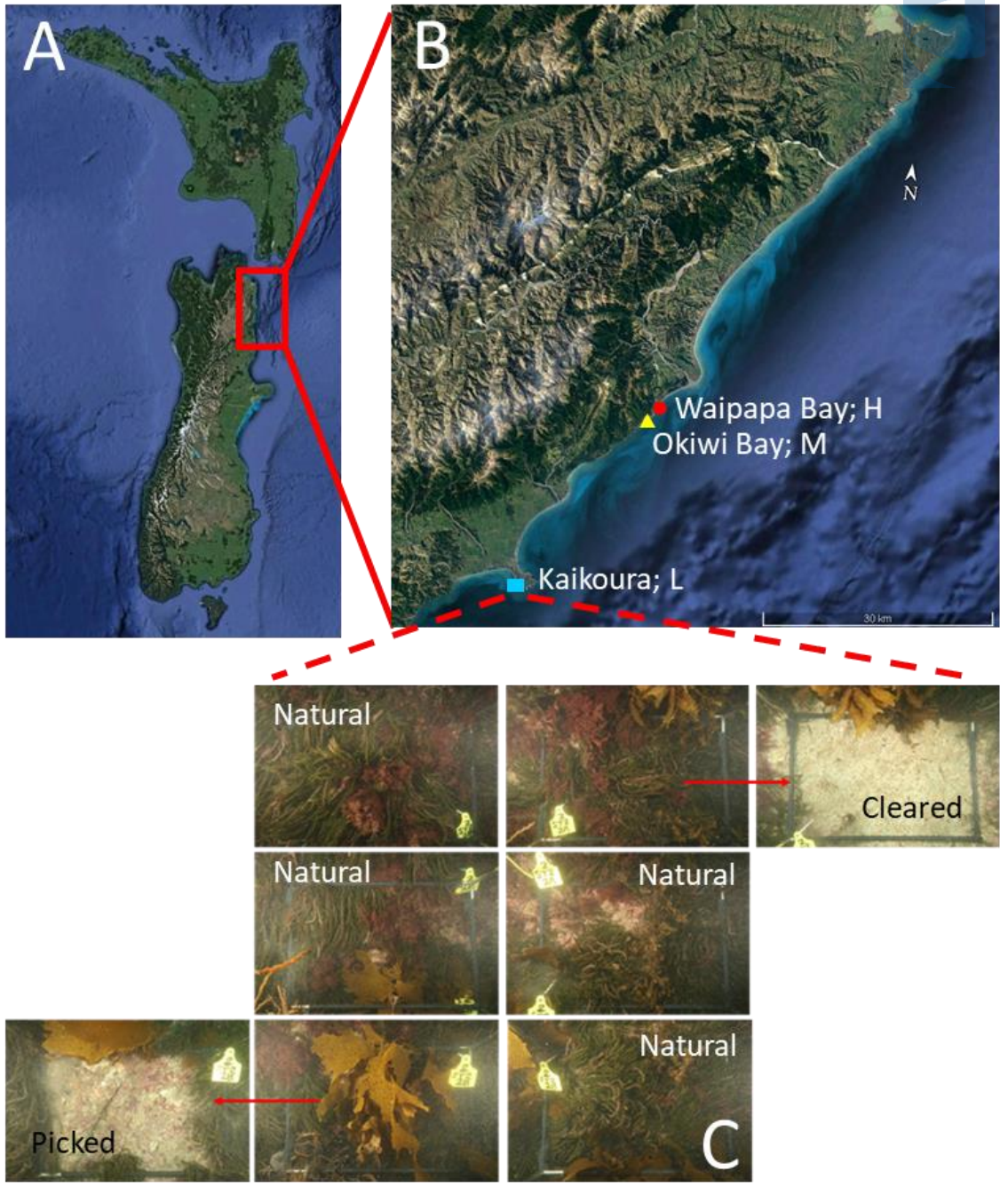
Kaikoura Peninsula: Low uplift, <u>High</u> adult large brown cover

Per Site:

- Two stations
- 16 Natural, 4 Picked and 4 Cleared quads per station
- Original clearance in Summer 2019
- 5 sampling points over 3 years

Per 0.25 m^2 quad:

- % cover of all macroscopic algae
- Count, size and species of all large brown recruits
- 215 hours UW

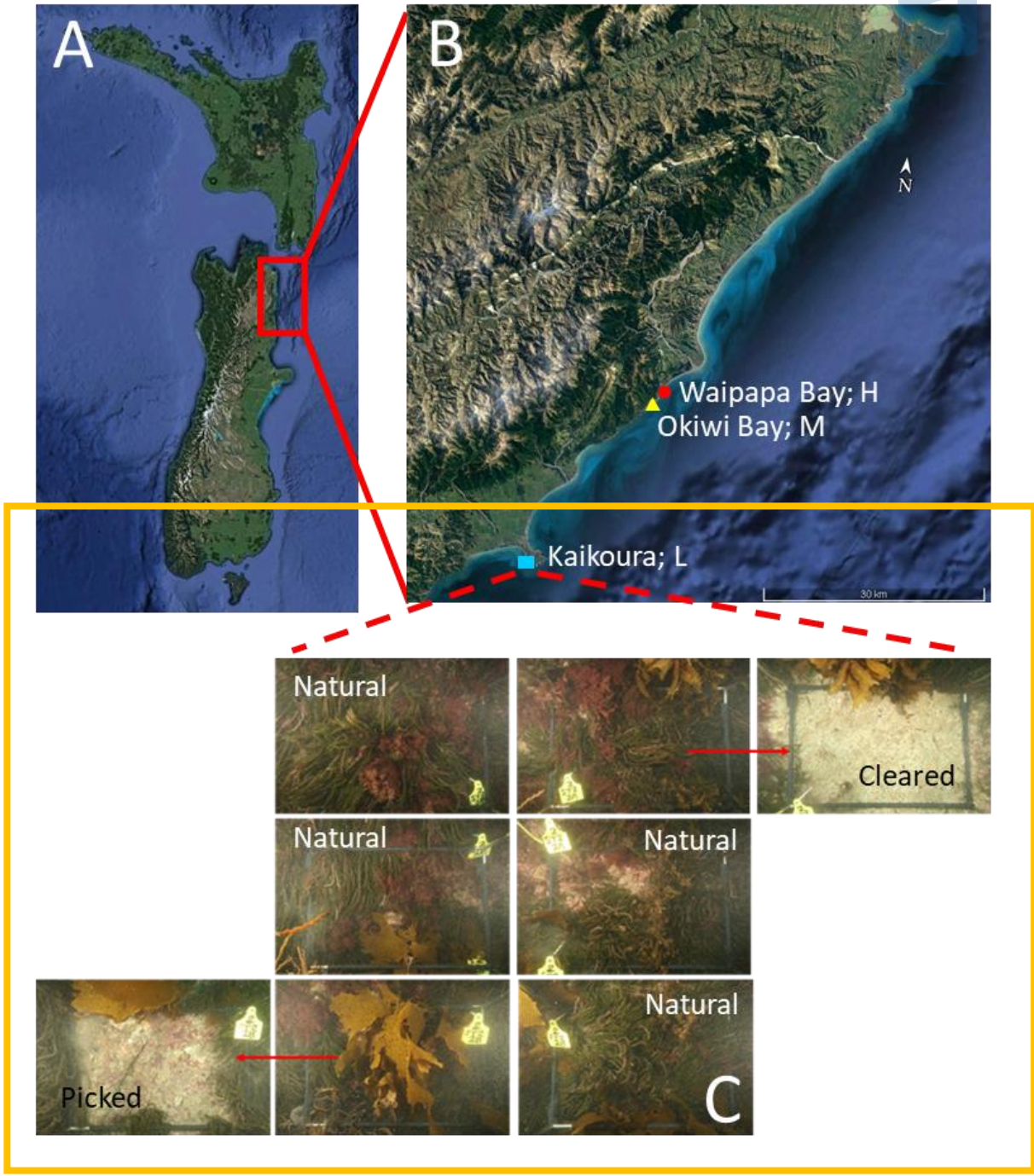


Influence of seasonality

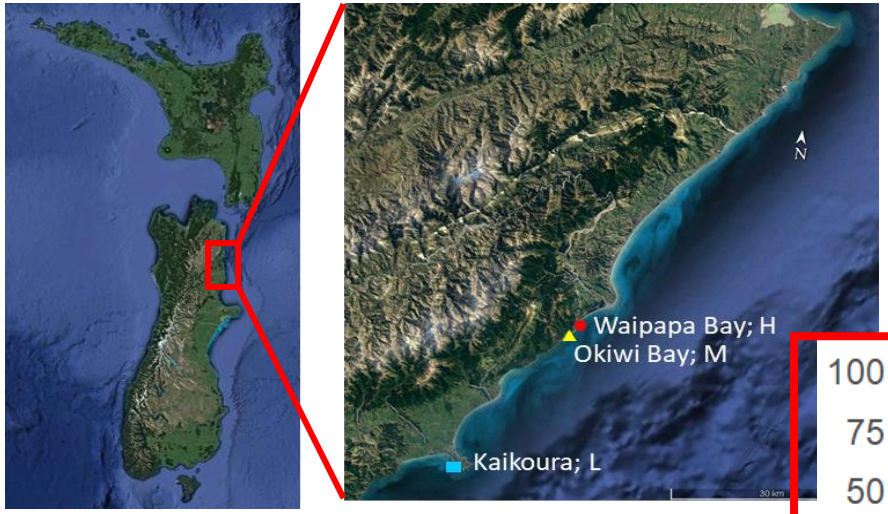
Same quads re-treated 26 months (Fall 2021) after original clearance at Kaikoura stations

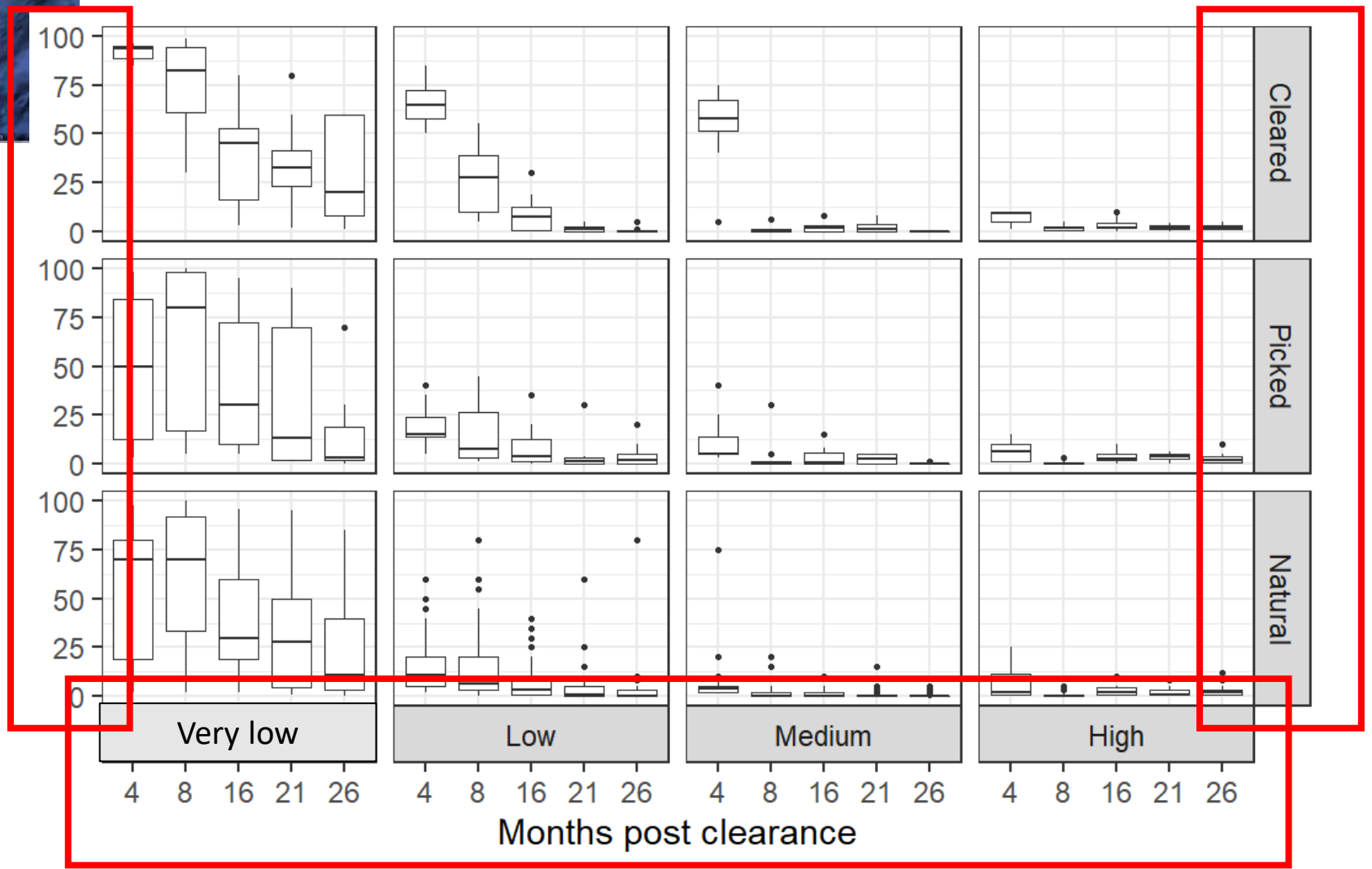
<u>Per 0.25 m^2 quad:</u>

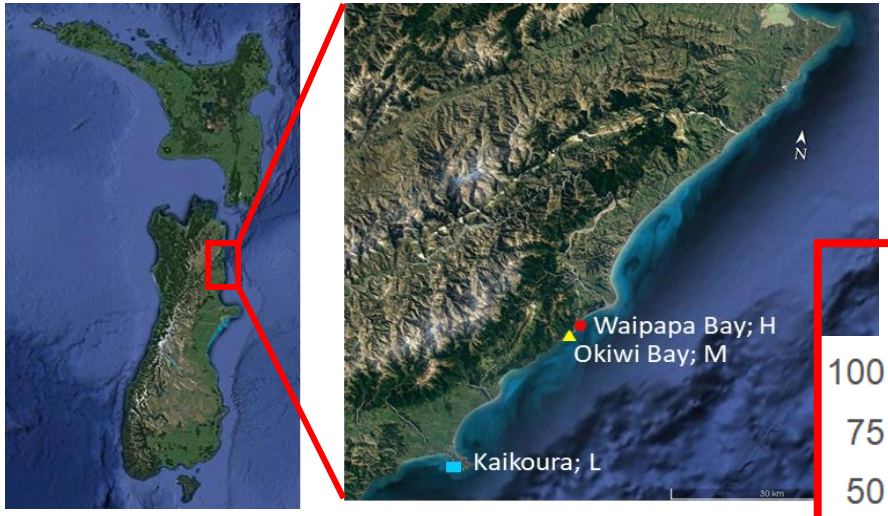
- % cover all macroscopic algae
- Count, size and species of all large brown recruits



Percent bare space



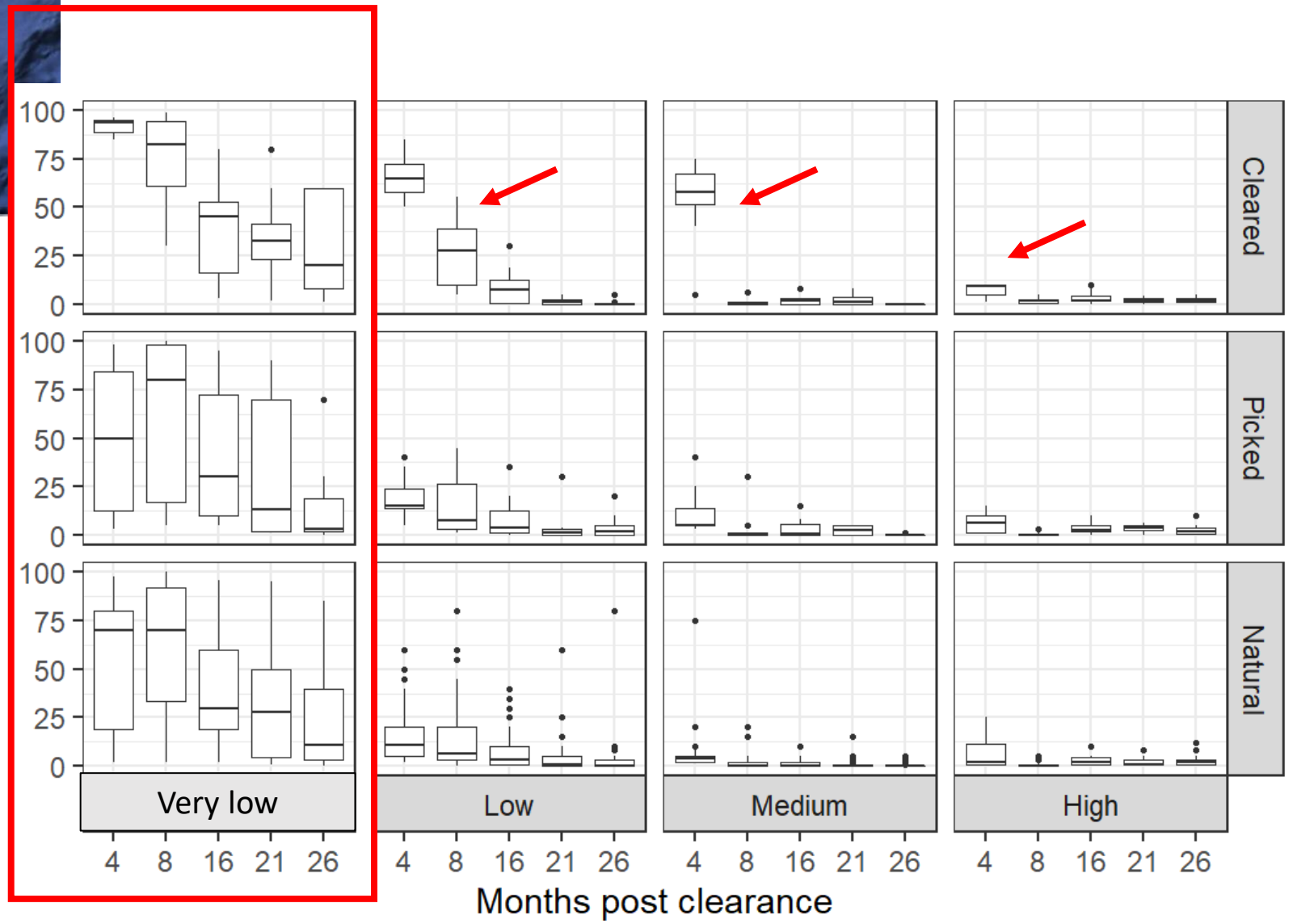




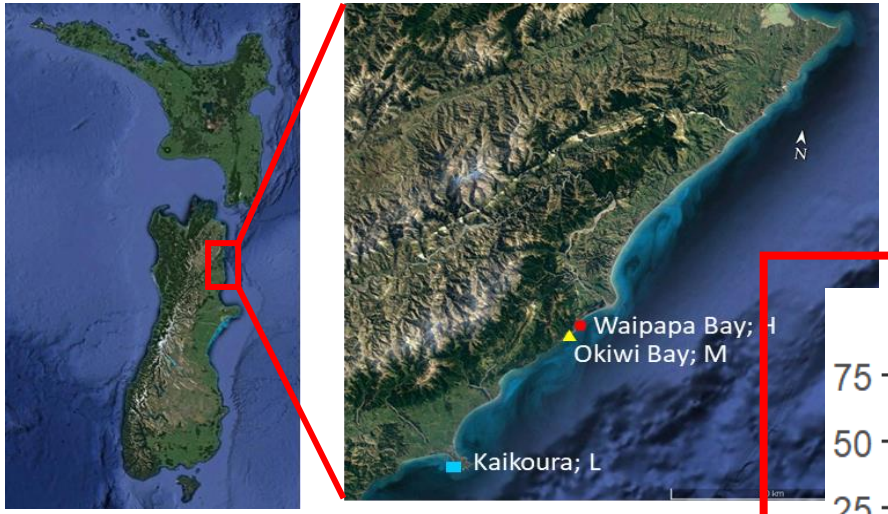
Percent bare space

Very low algal cover;

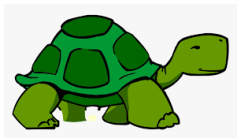
Very slow recovery of bare space



Percent encrusting coralline algae

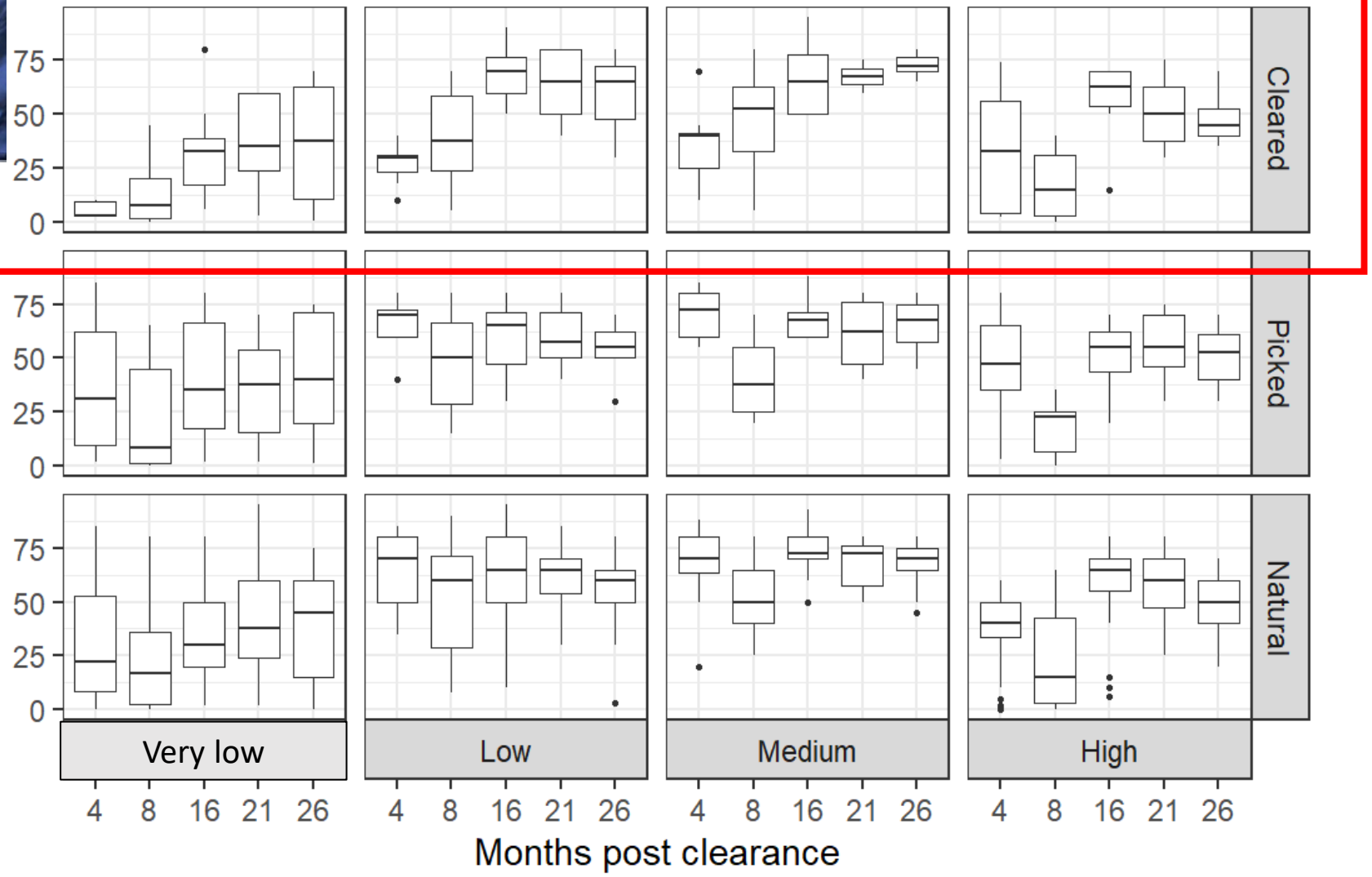


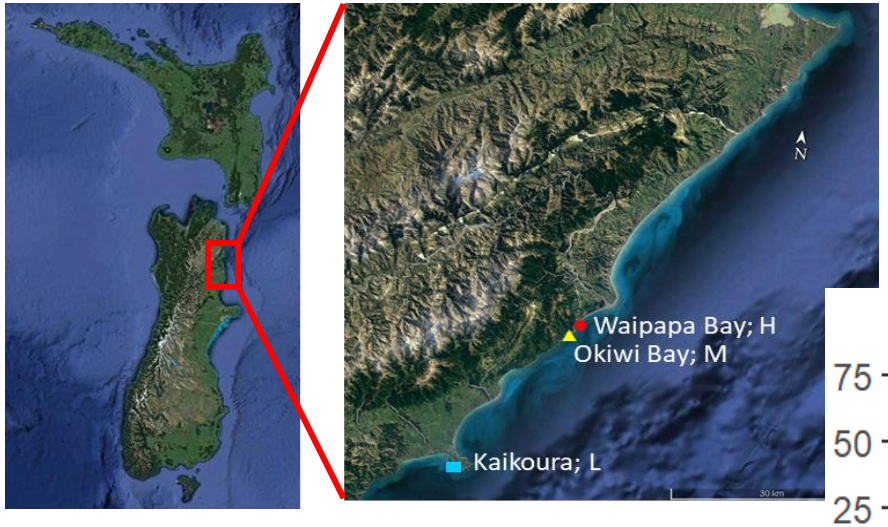
Very low algal cover



Low algal cover

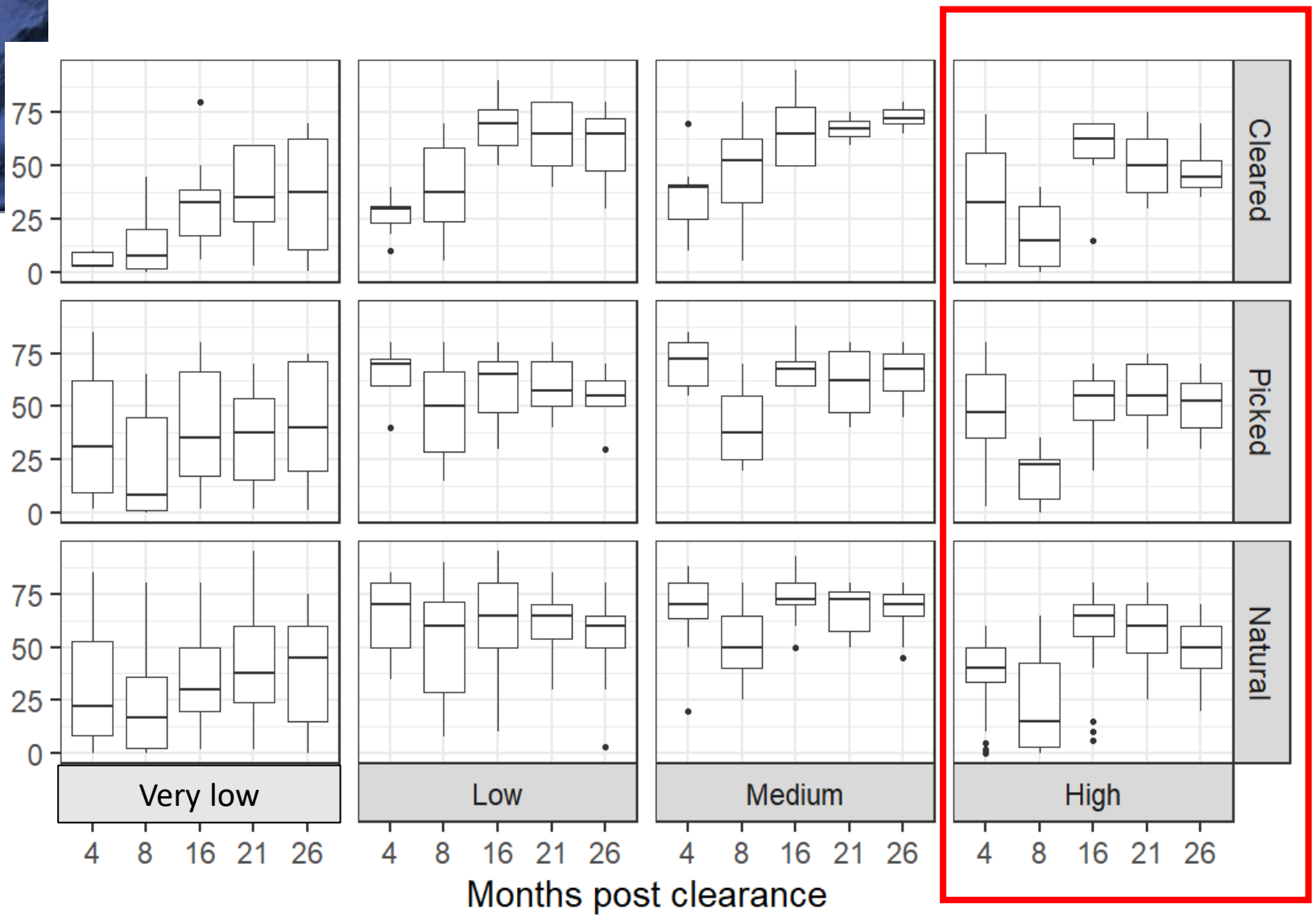
Medium algal cover

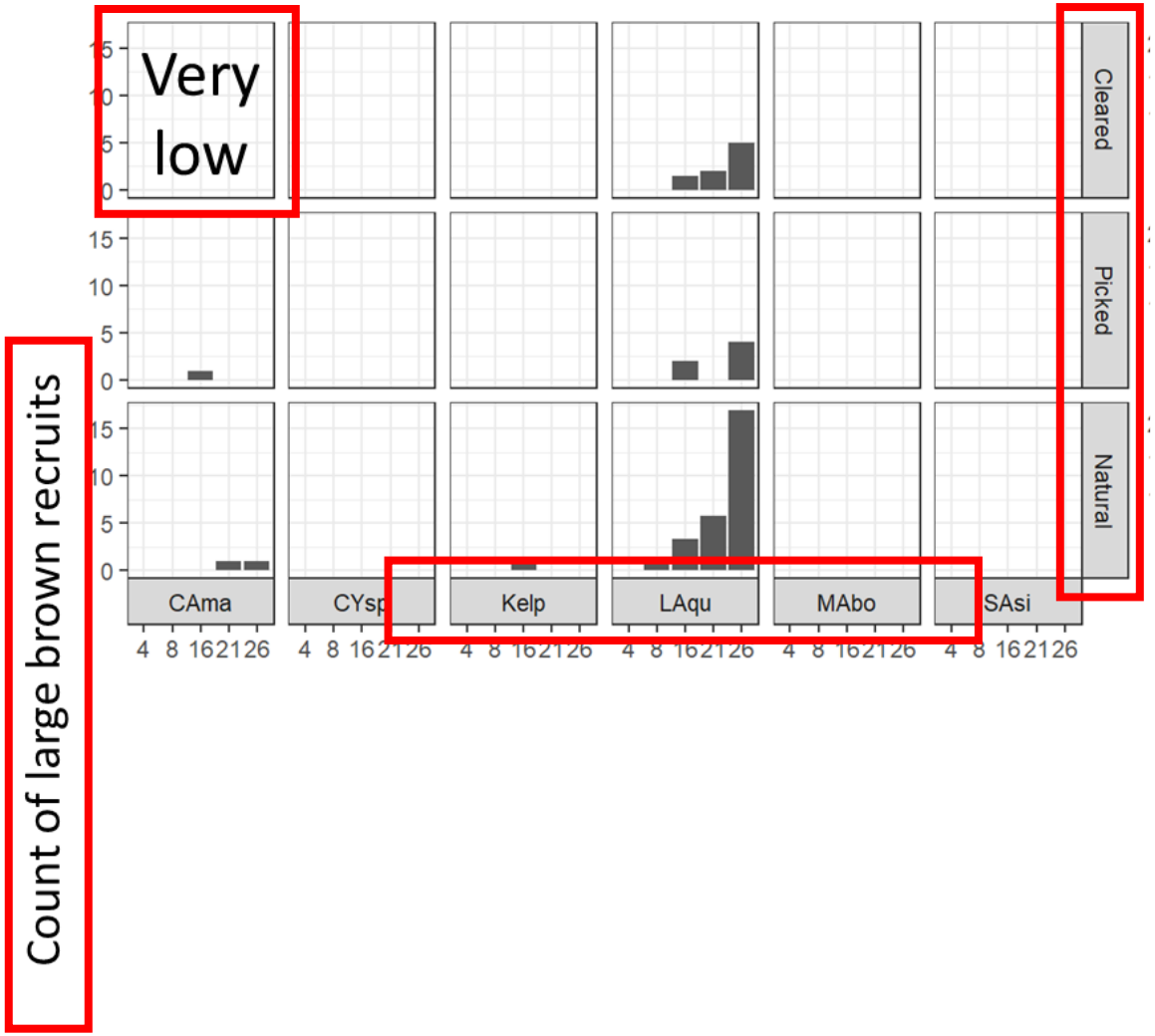




Percent encrusting coralline algae

High algal cover





CAma = *Carpophyllum maschalocarpum*

CYsp = *Cystophora* spp.

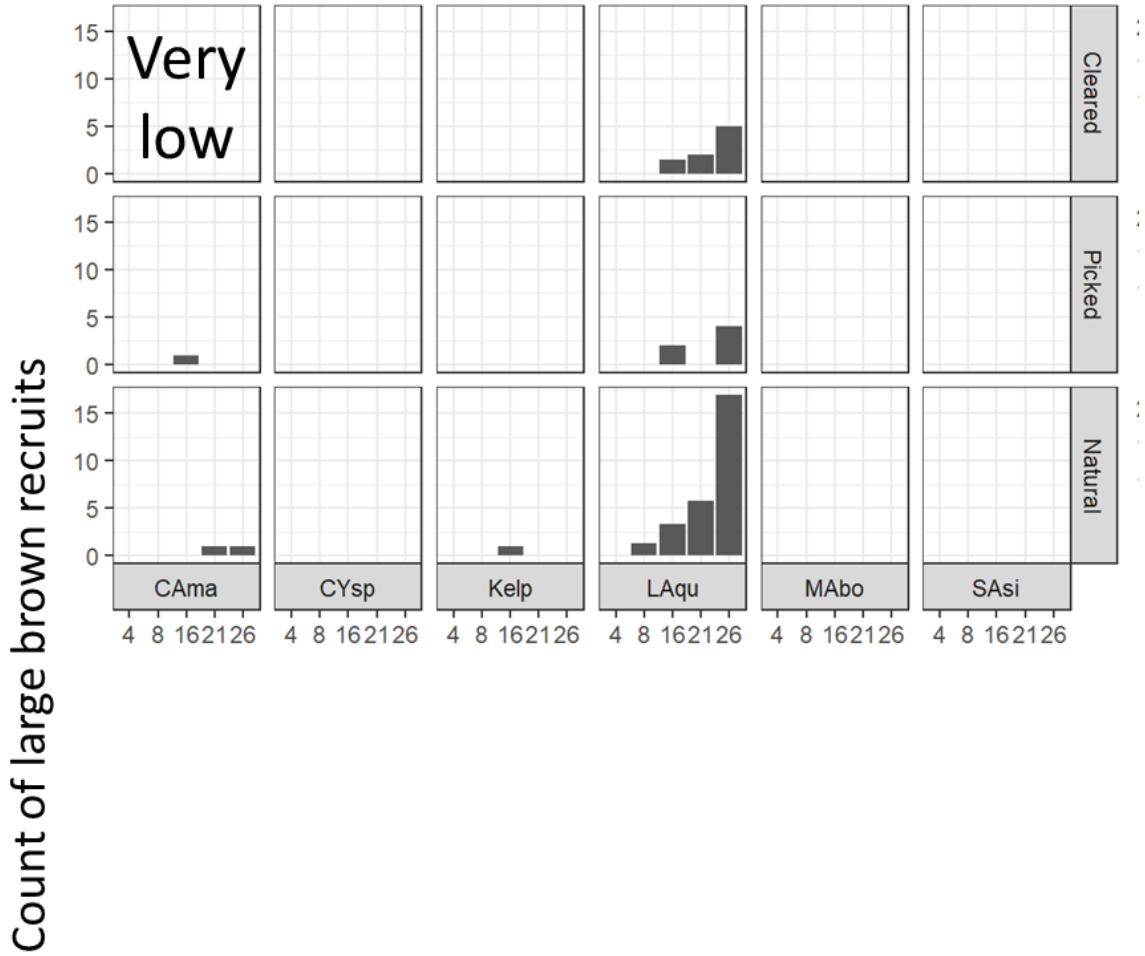
Kelp = *Lessonia variegata* or *Ecklonia radiata*

LAqu = *Landsburgia querifolia*

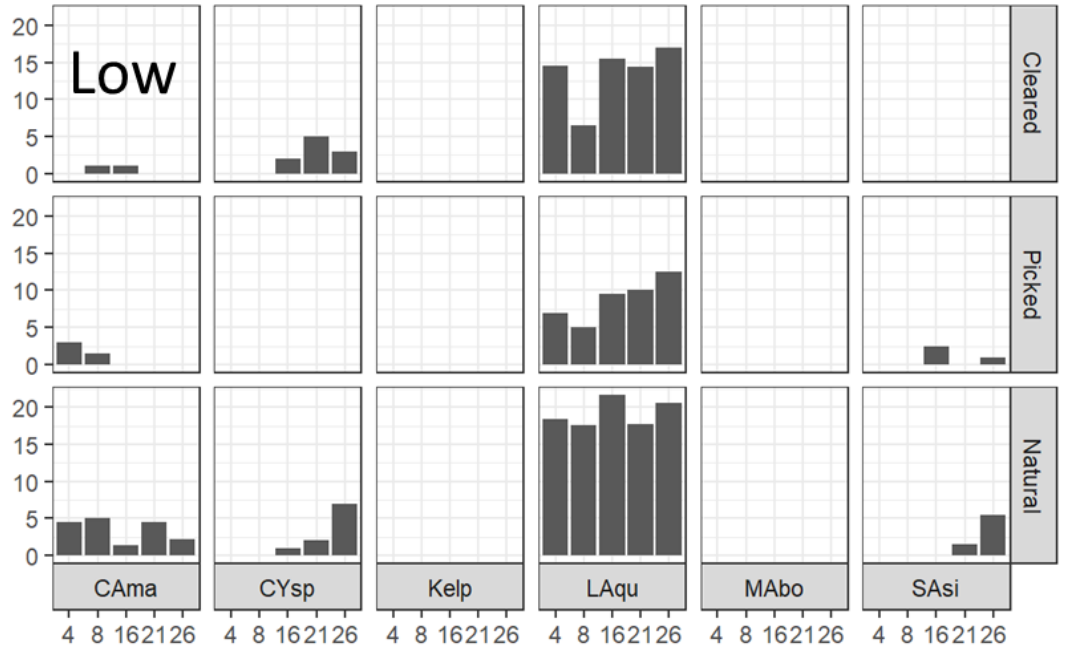
MAbo = *Marginariella boryana*

SAsi = *Sargassum sinclairii*

Very low algal cover



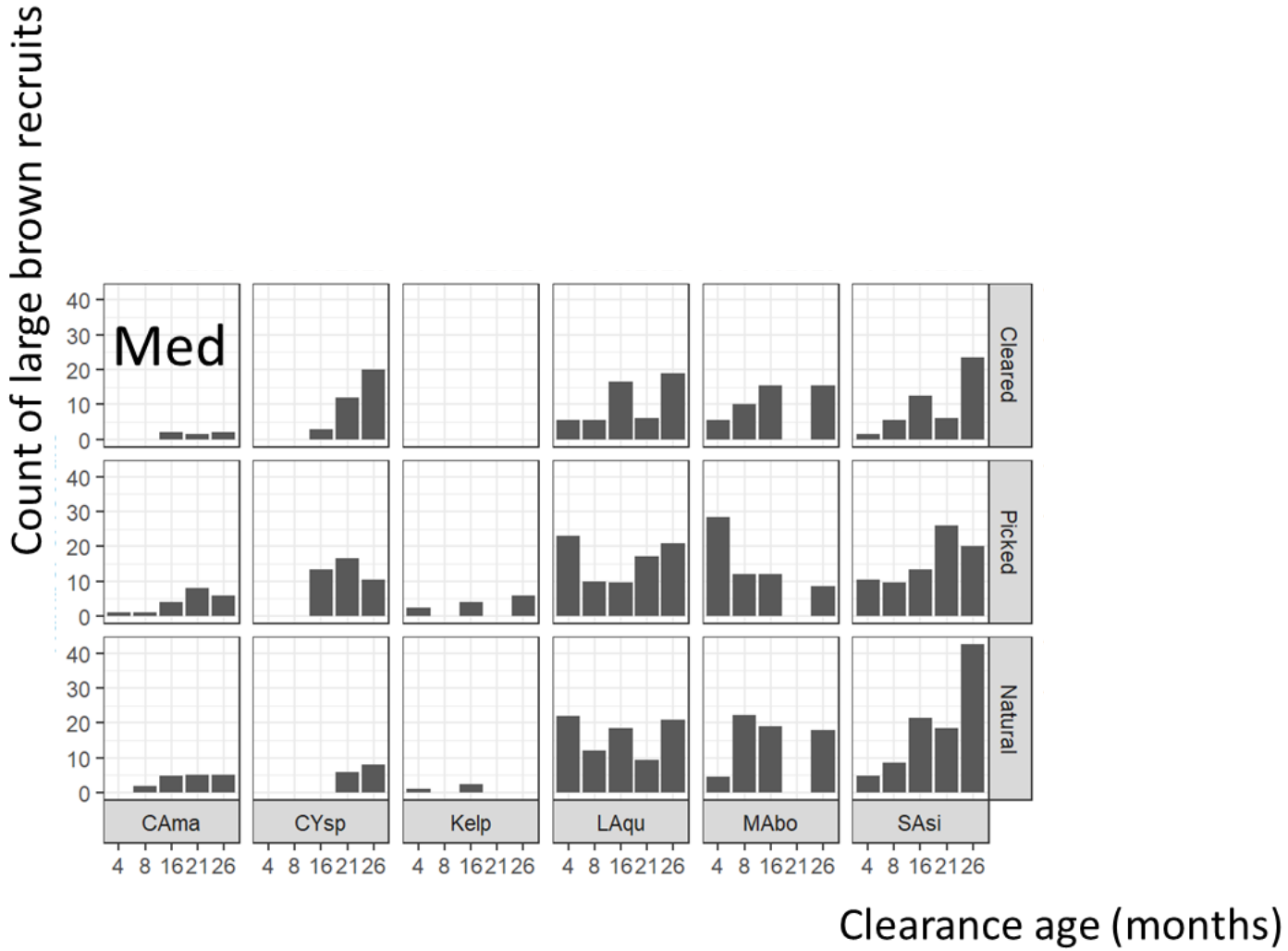
Low algal cover



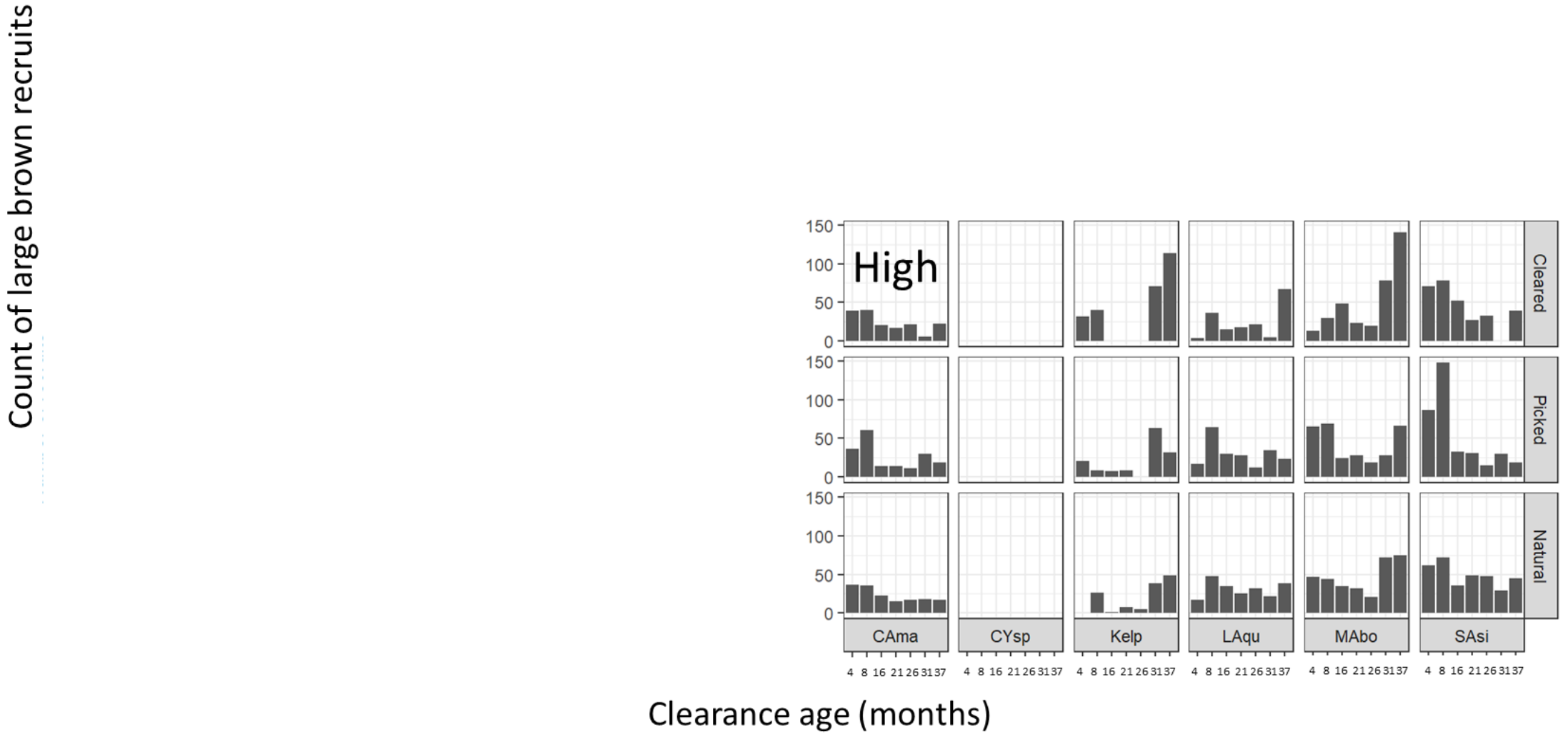
Count of large brown recruits

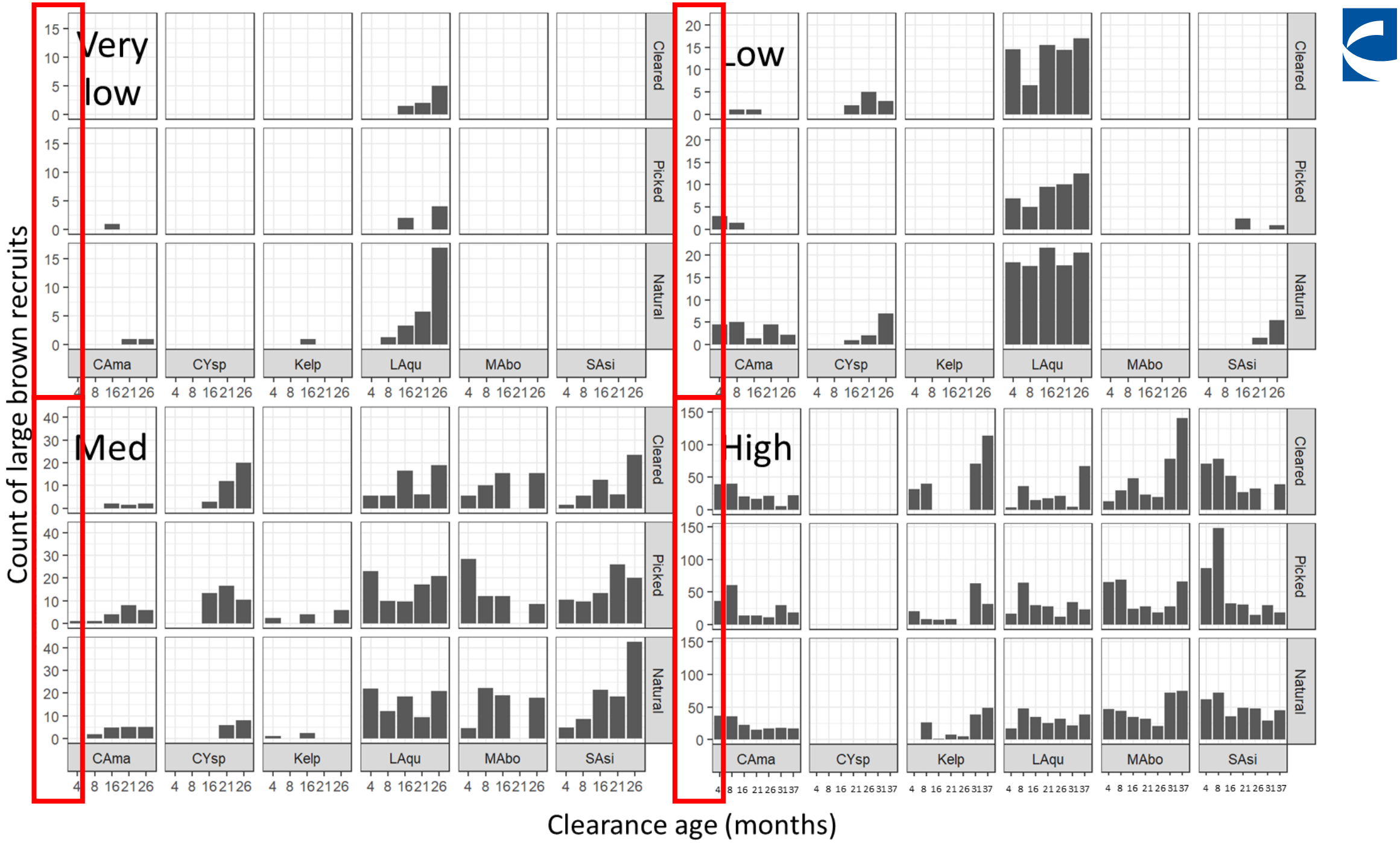
Clearance age (months)

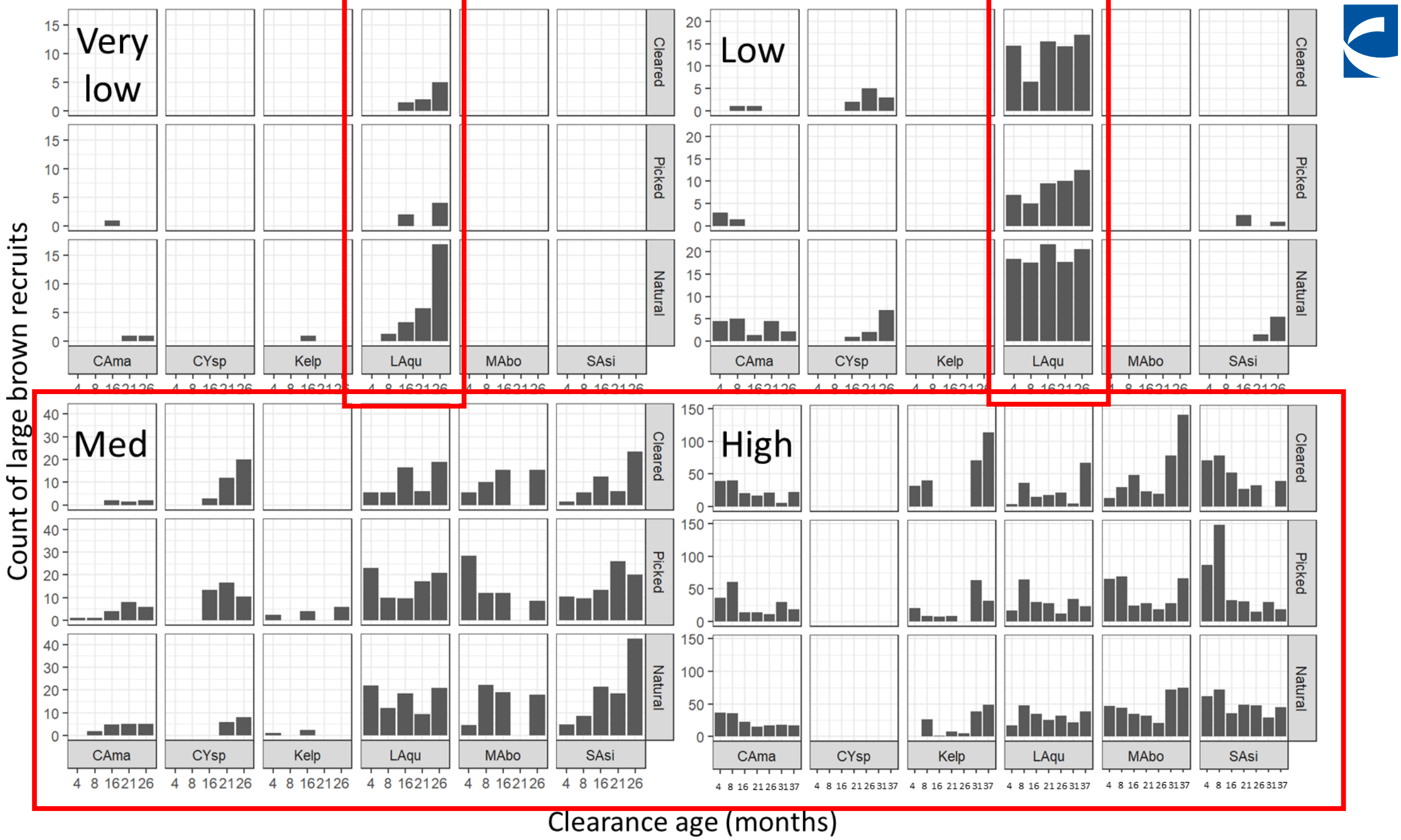
Medium algal cover



High algal cover




Very low
Low
Med
High
Cleared
Picked
Natural
CAma
CYsp
Kelp
LAqu
MAbo
SAsi
Count of large brown recruits
Clearance age (months)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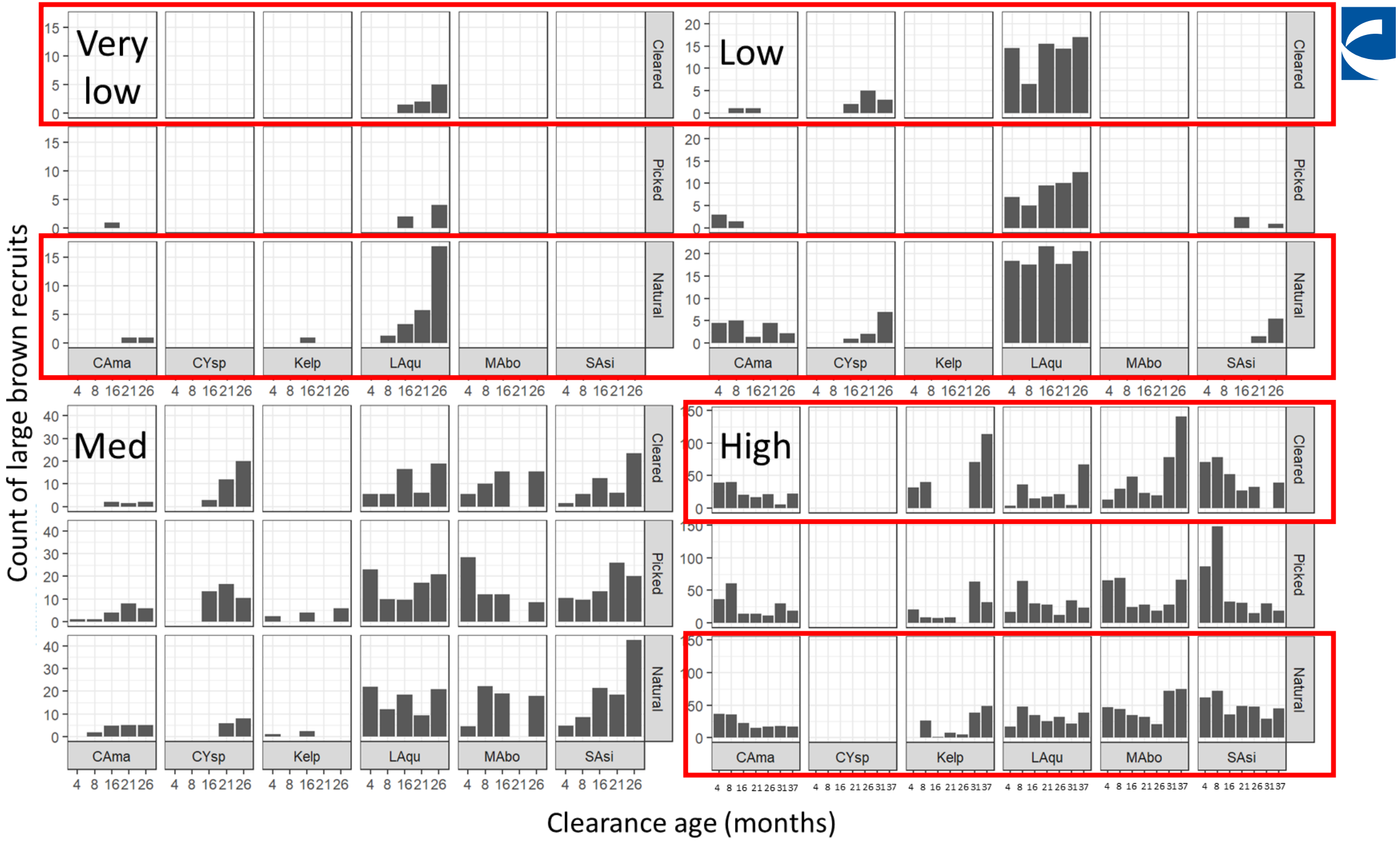
Very low
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Med
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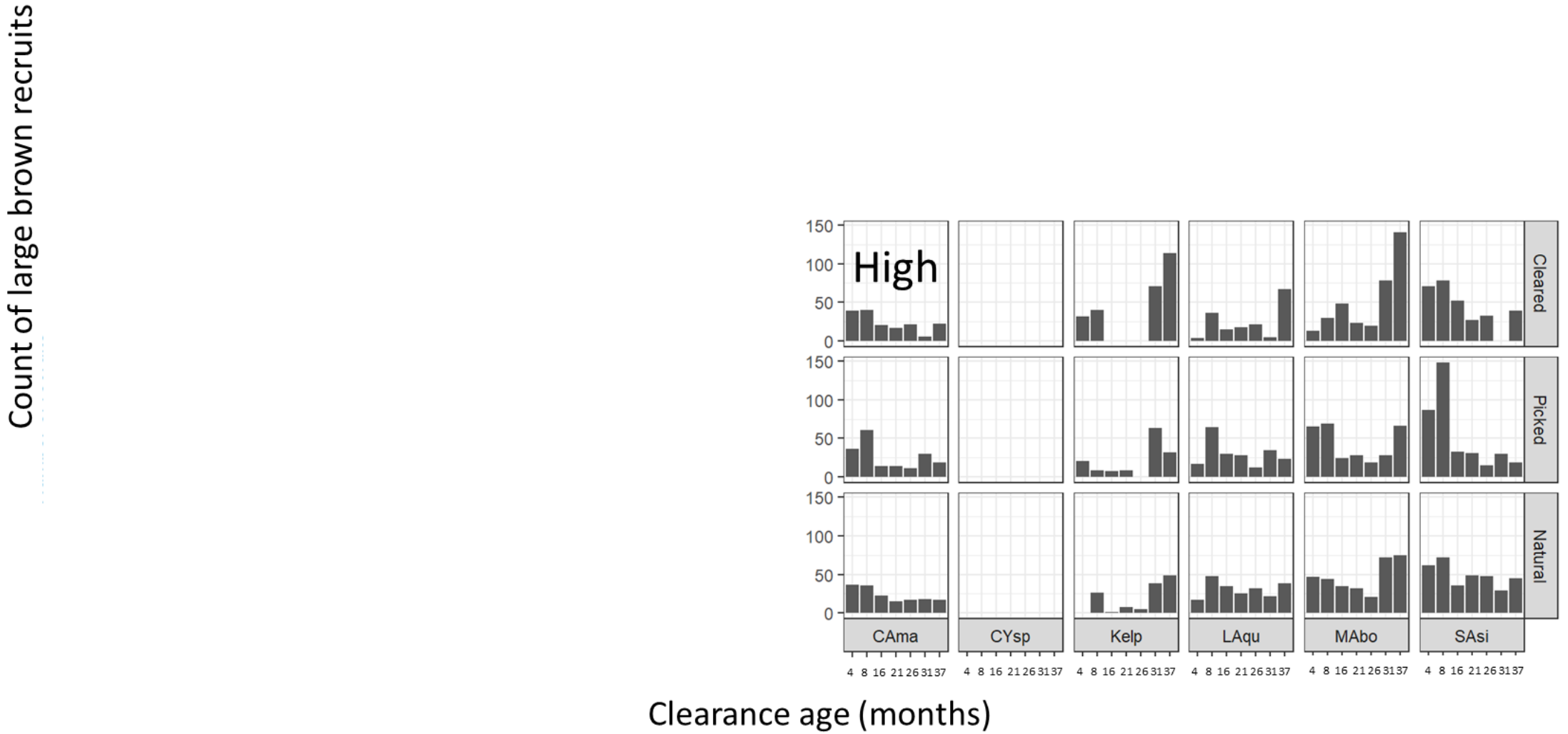
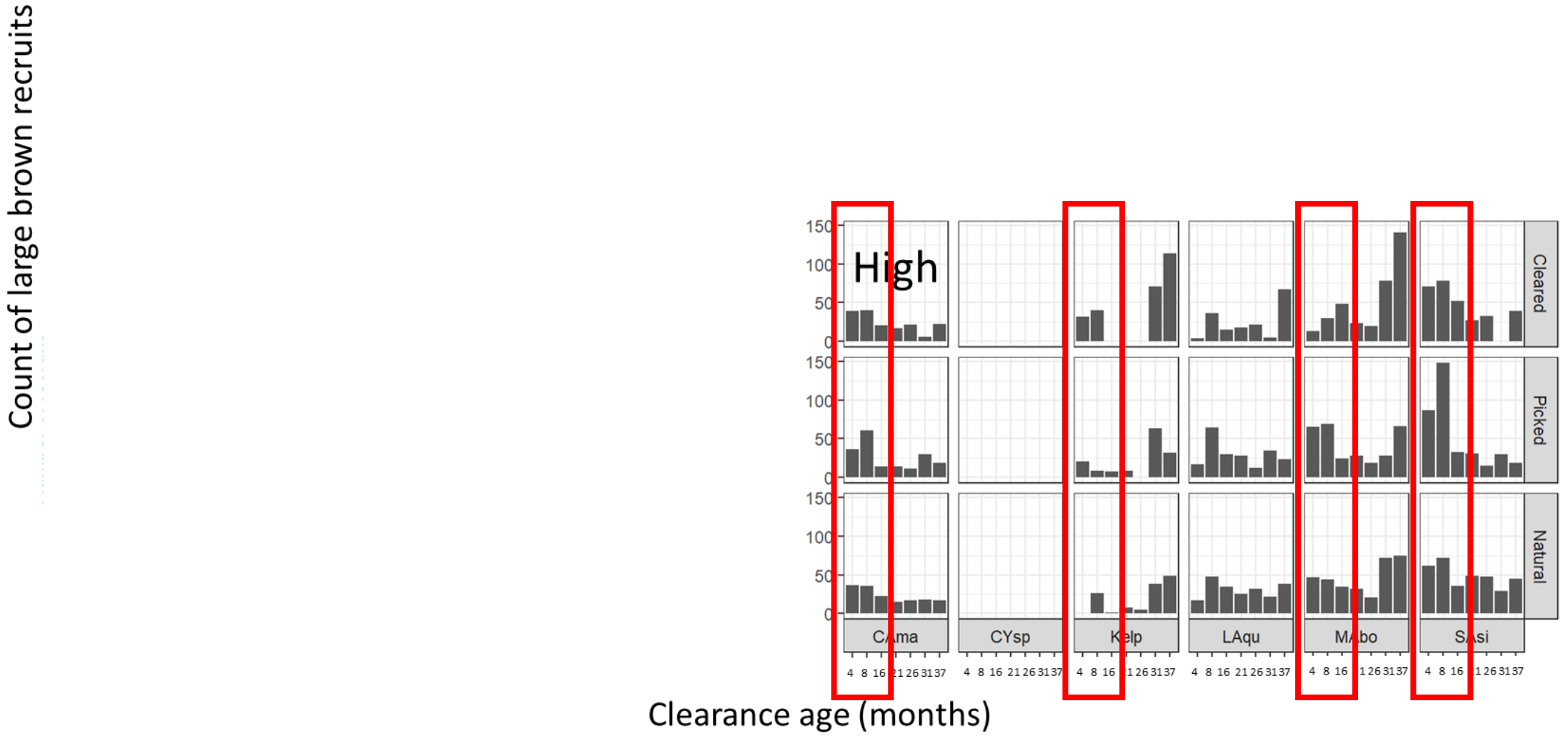
Count of large brown recruits
Clearance age (months)

Effect of seasonality

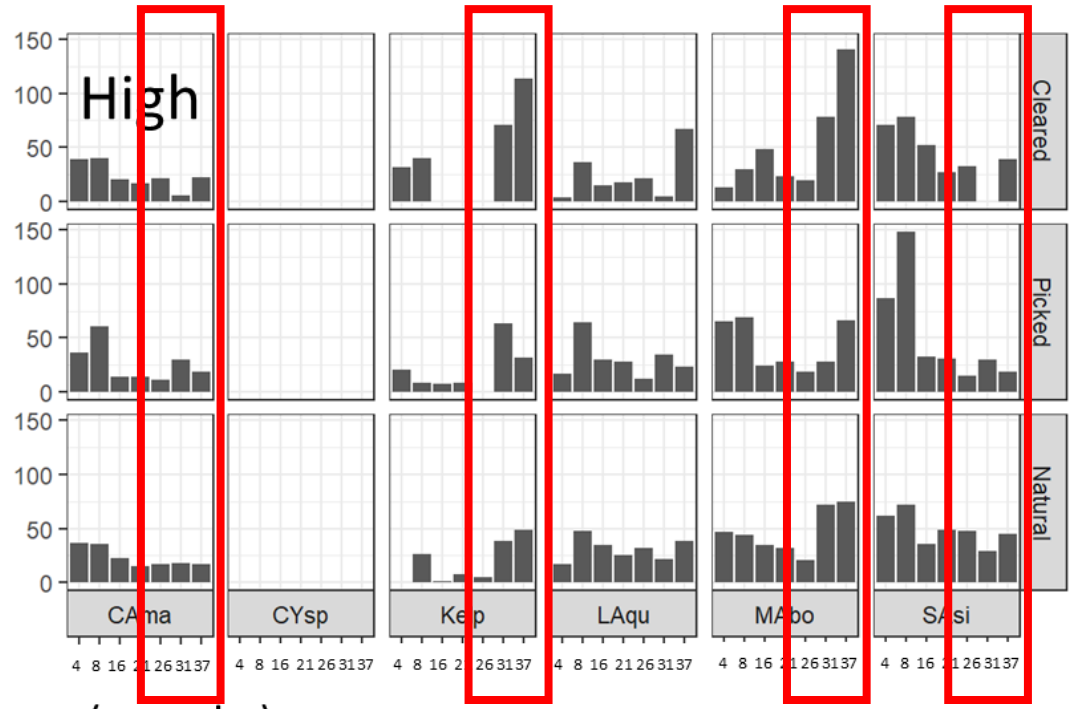


Effect of seasonality



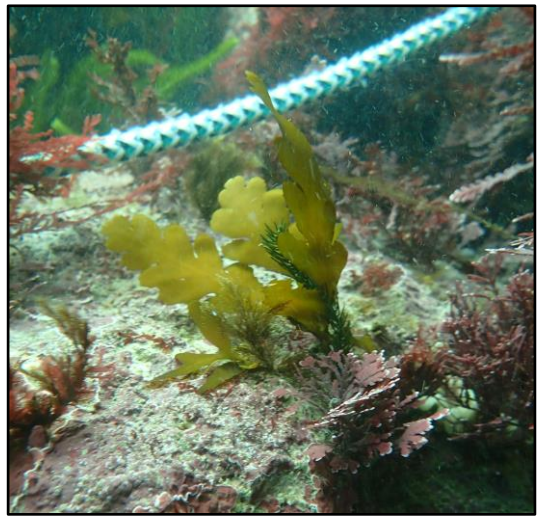
Effect of seasonality

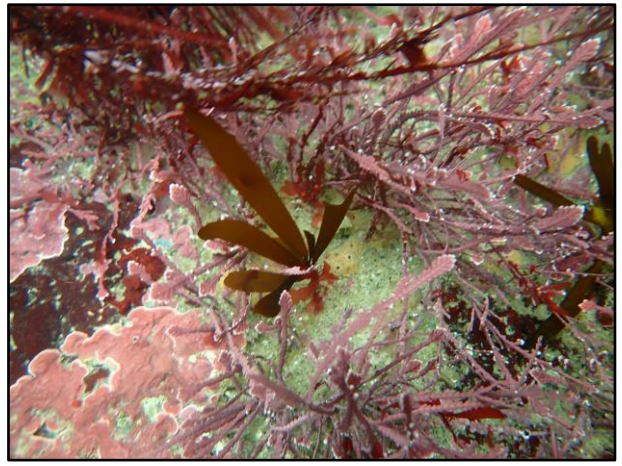
Count of large brown recruits



Clearance age (months)

Winter/early Spring reproduction



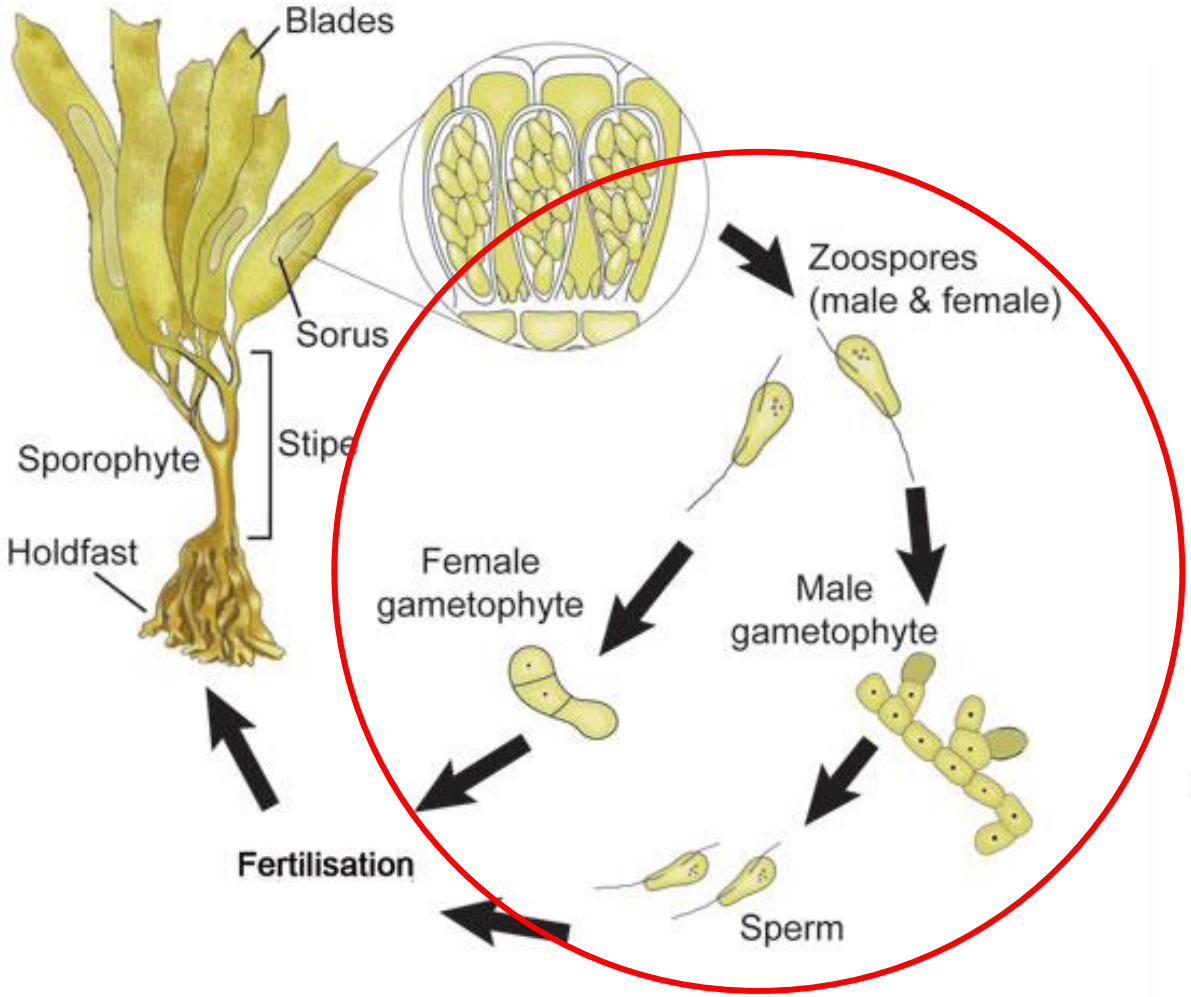


VS

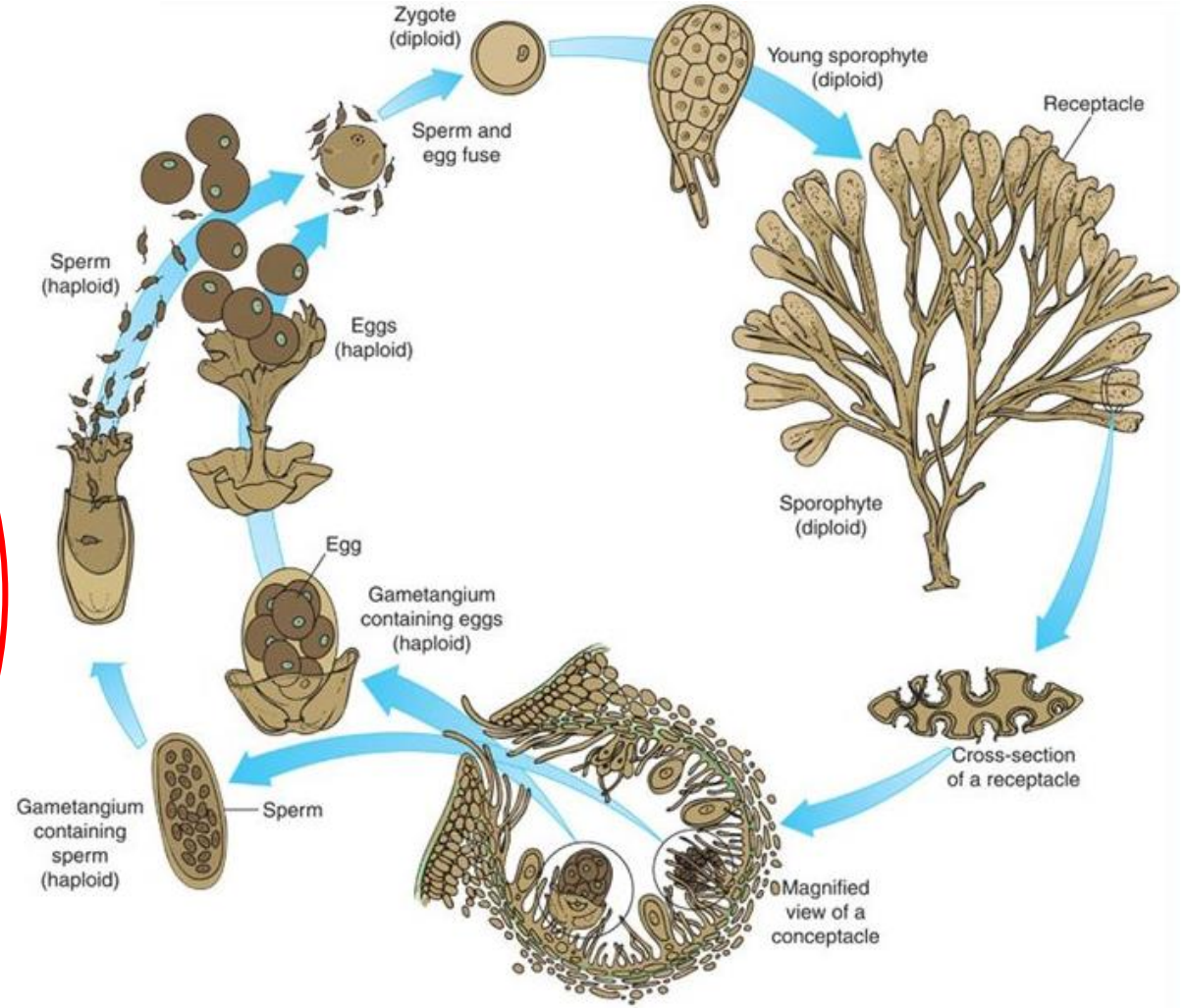
Spring/early Summer reproduction

But also different life cycles

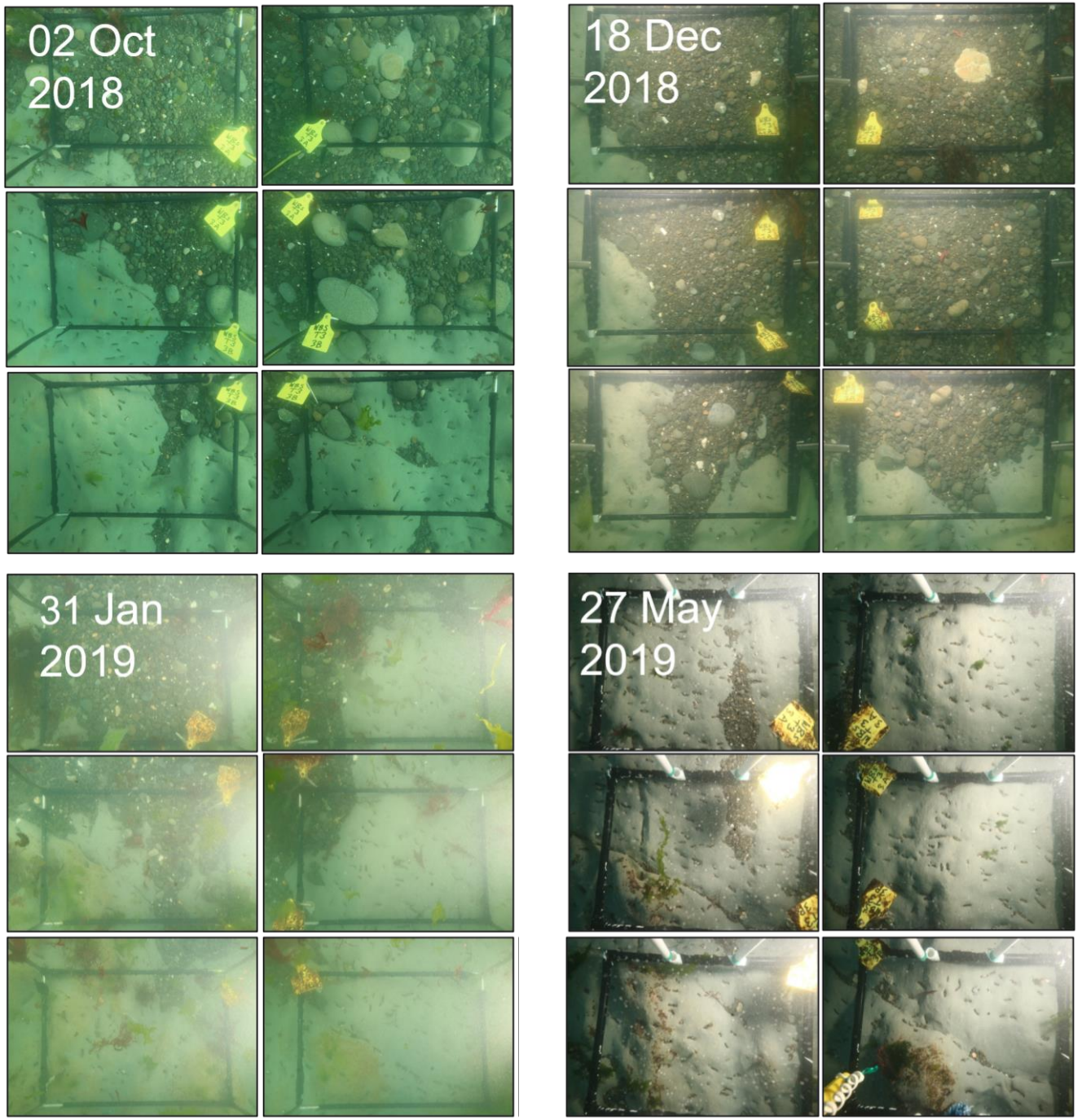
Kelp



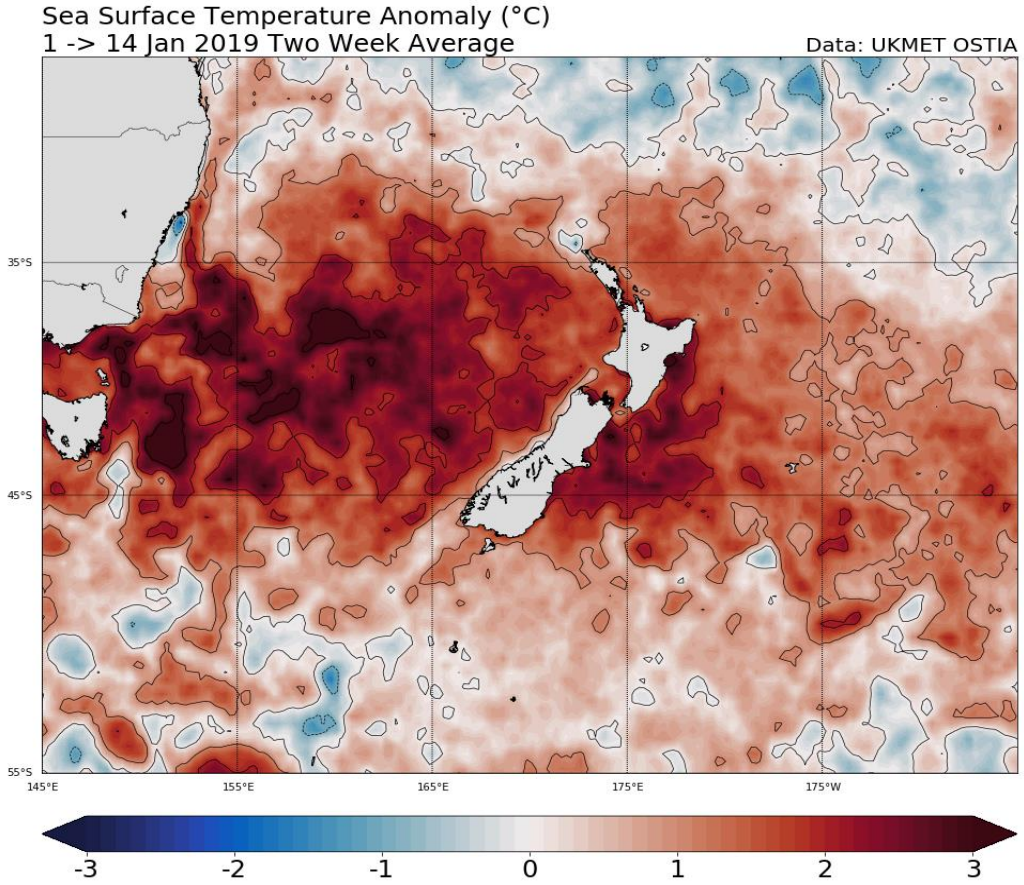
Fucoid



Consequence of life cycle and mobile substrata

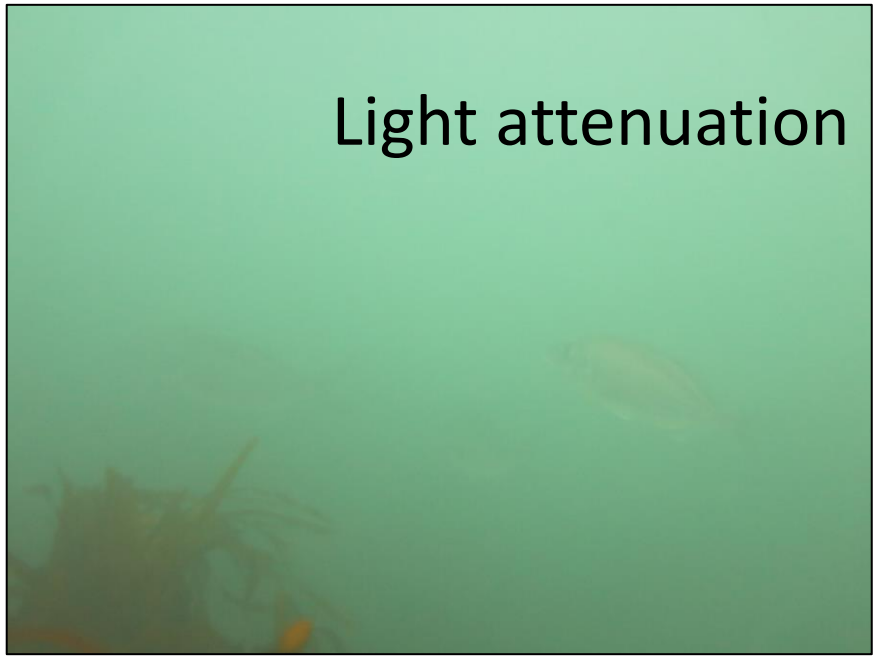


It is also likely that species responded differently to:



NIWA Jan 2019

Marine heatwaves, warming seas.



Take home

- EQ caused fragmentation of populations and significant habitat disruption in high uplift areas
- Accumulating stressors: sedimentation, EQ-related habitat modification, marine heatwave intensified these effects.
- H_1: Faster recovery of bare space in proximity to high algal cover.
- H_2: More recruits with increasing algal cover but no refuge benefit on number of recruits.
- H_3: Greater recruitment on bare substrate in proximity to high algal cover.
- H_4: Seasonal influence important to recruitment; species-specific!
- *Landsburgia quercifolia* most resilient to EQ and ensuing stressors.
- Lab experiment also found *L. quercifolia* most resilient to increasing temp and decreasing light.
- And that sediment had greater negative effect on growth than shade.

Acknowledgements

- **Supervisors: Dr. Robyn Dunmore and Prof. David Schiel**
- Nearly ten days underwater requires help! Thanks to Cawthron's technical team, diving team and manager support; James Brodie and the crew from Marlborough Commercial Diving Services; The Reader family; Local support along the Kaikoura coast for boat launching and weather conditions; Te Rūnanga o Kaikōura; and MERG.

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