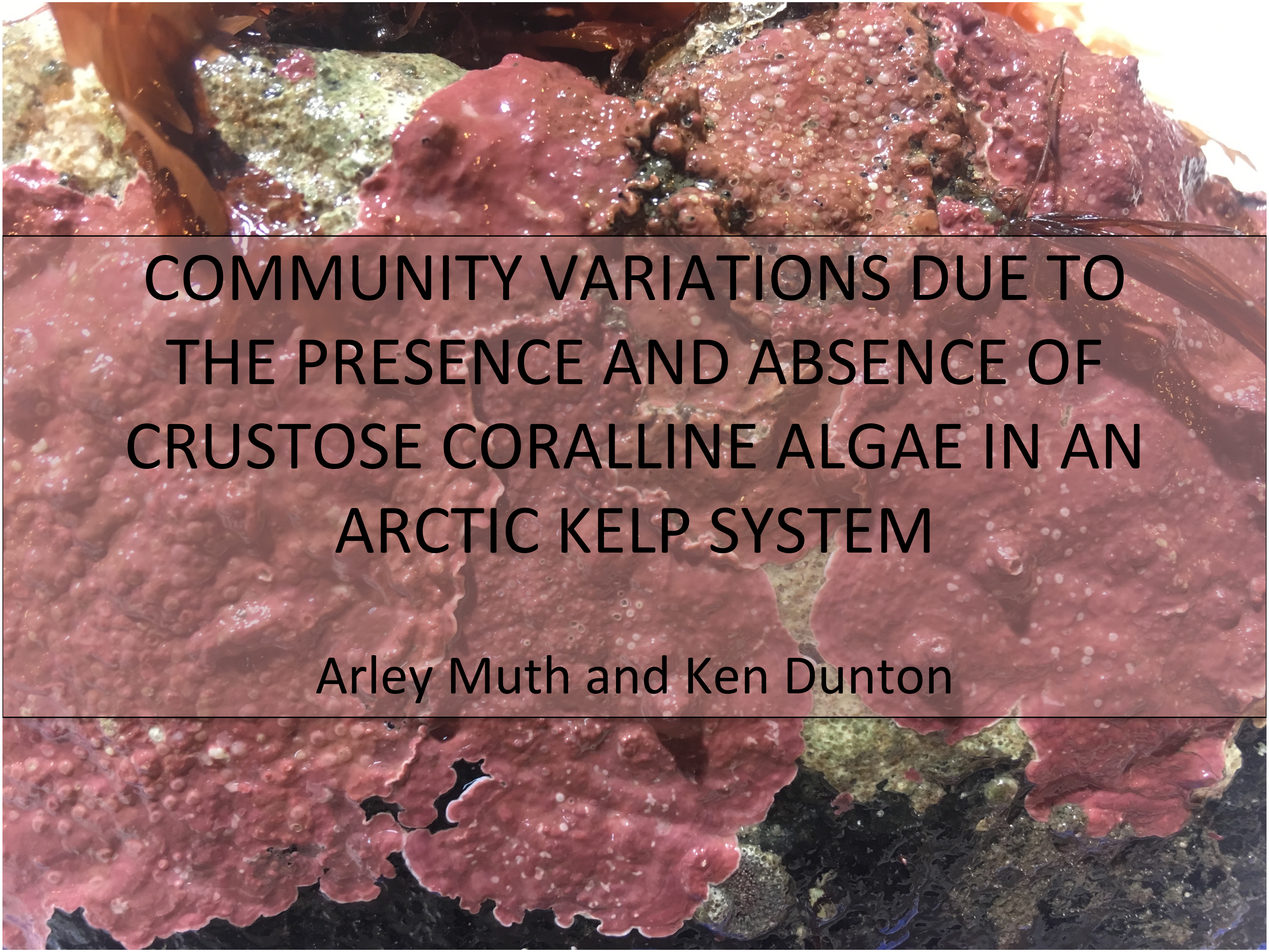


COMMUNITY VARIATIONS DUE TO THE PRESENCE AND ABSENCE OF CRUSTOSE CORALLINE ALGAE IN AN ARCTIC KELP SYSTEM

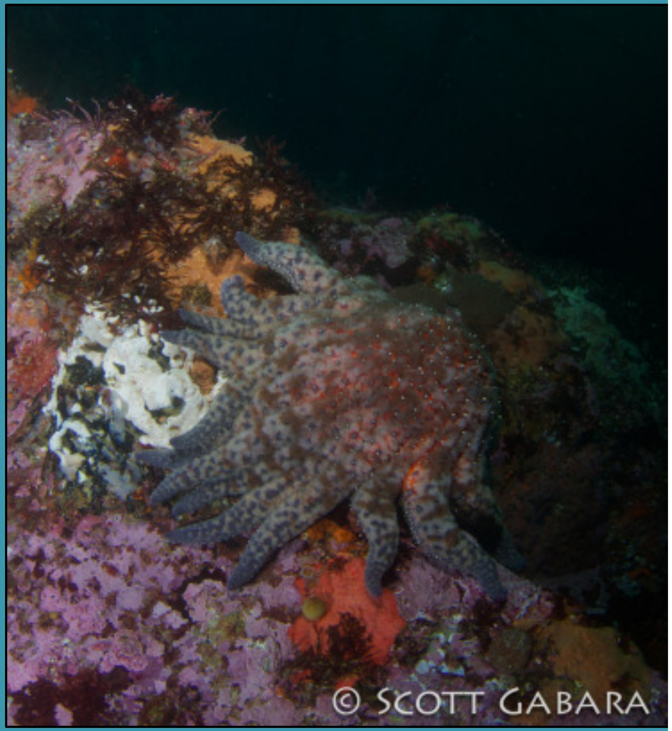
Arley Muth and Ken Dunton

Importance of CCA

- Crustose Coralline Algae (CCA)
  - Most widely distributed algal group (Steneck 1986)
    - Reef consolidation, grazer deterrent, low light adapted

Importance of CCA

- Increased interest in recent years
  - Molecular sequencing
  - Susceptibility to climate change (ocean acidification)
  - Paleoclimate proxies

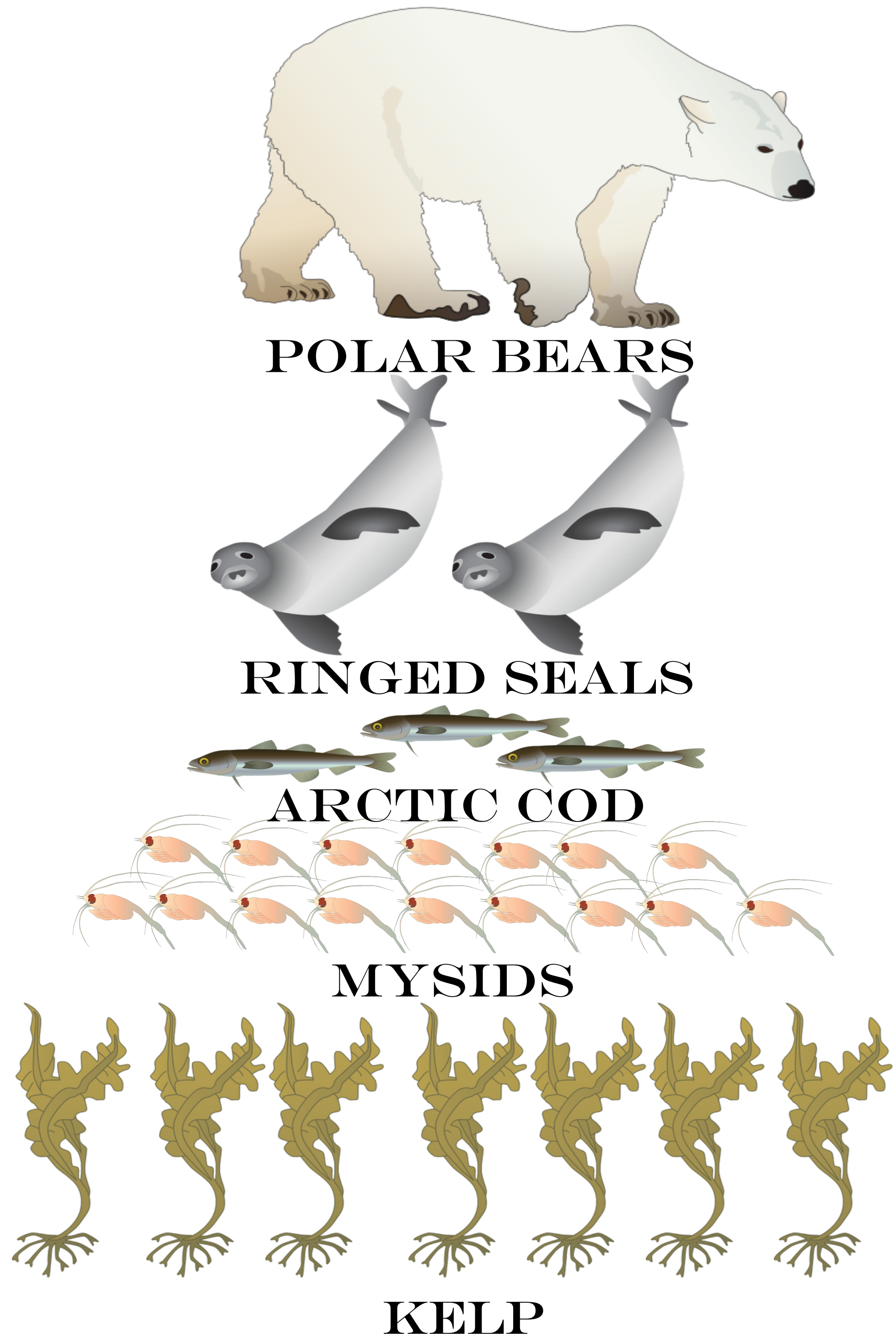


CCA in the Arctic

- CCA are important species in Arctic subtidal areas (Roberts et al. 2012, Adey and Hayek 2011, Teichert et al. 2012)
- Algal and biofilm regulator without the use of grazers (Johnson 1986)
- CCA covers the benthos in *Laminaria solidungula* systems of N. Alaska

Glacially deposited boulders and cobbles create biodiversity "hotspots"

Up to 50% of mysid body carbon was derived from kelp detritus, when ice was present (Dunton and Schell 1987)



Boulder Patch, Stefansson Sound

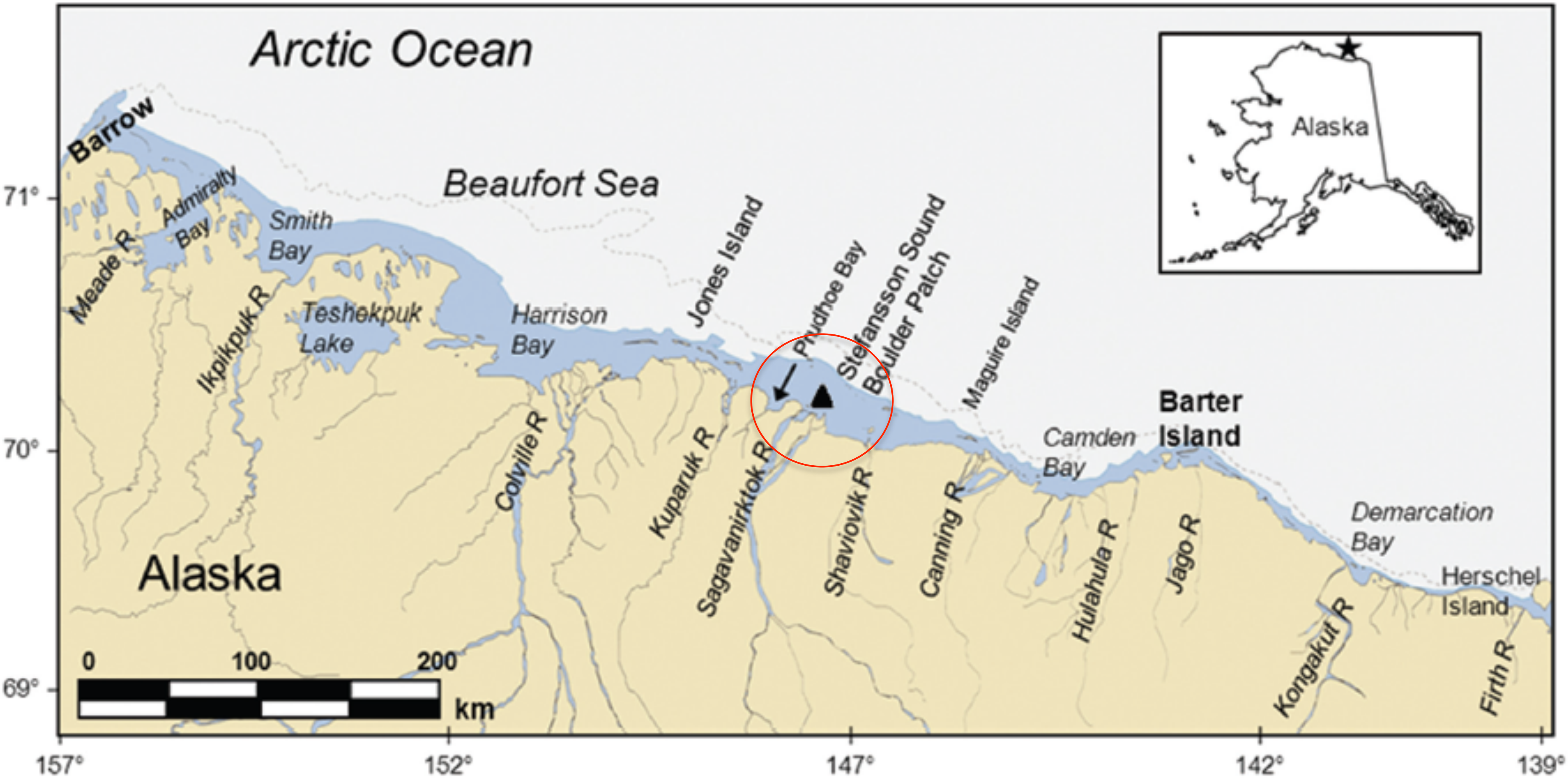
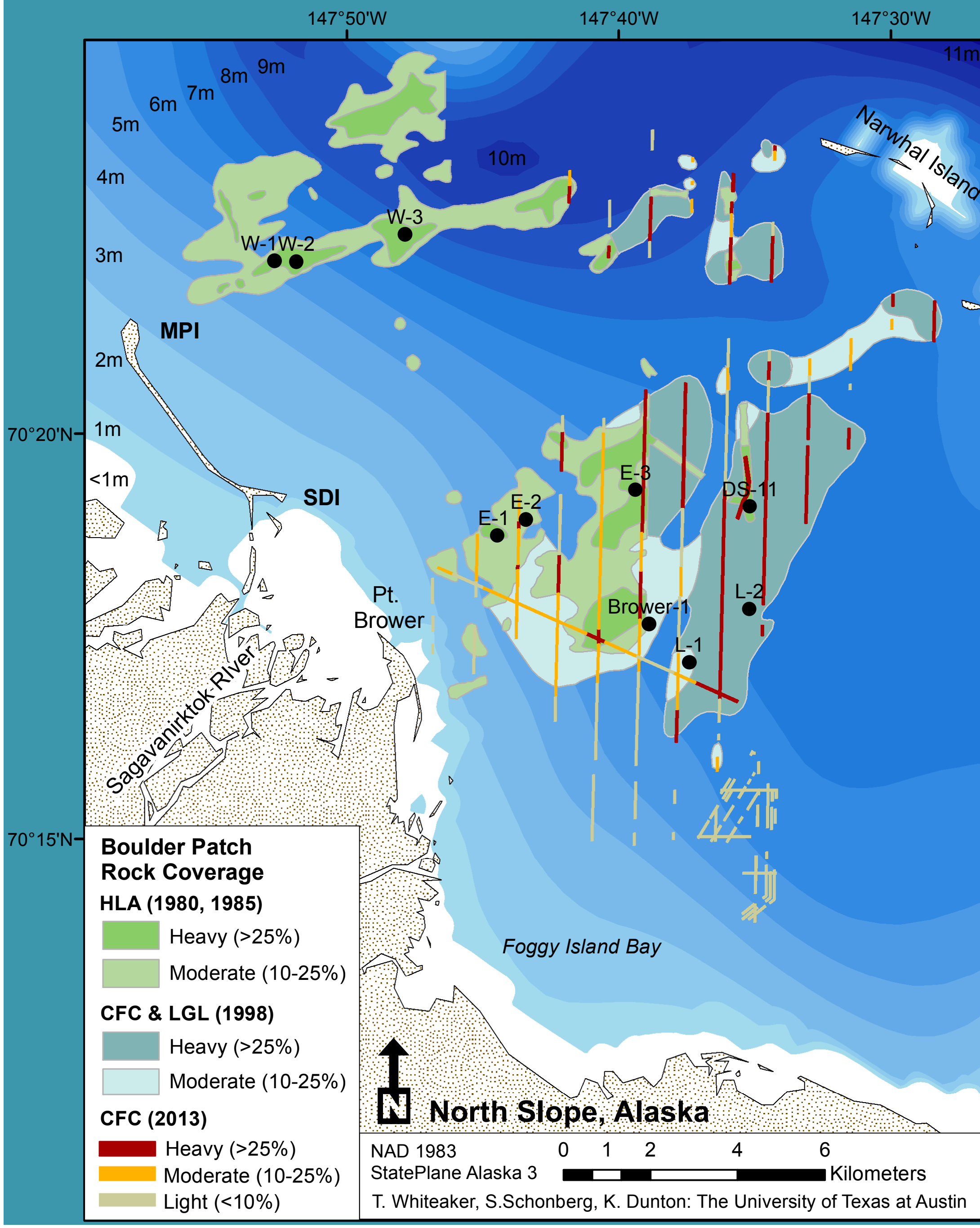


FIG. 1. The Alaska Beaufort Sea coast, showing the linked river-estuarine-lagoon system of the eastern shelf. Triangle denotes the location of the Boulder Patch, east of Prudhoe Bay.

Wilce and Dunton 2014

Boulder Patch, Stefansson Sound



Recent Changes

- Loss of sea ice
- Increase of freshwater run-off ~ 30% over 35 years (Peterson 2003)

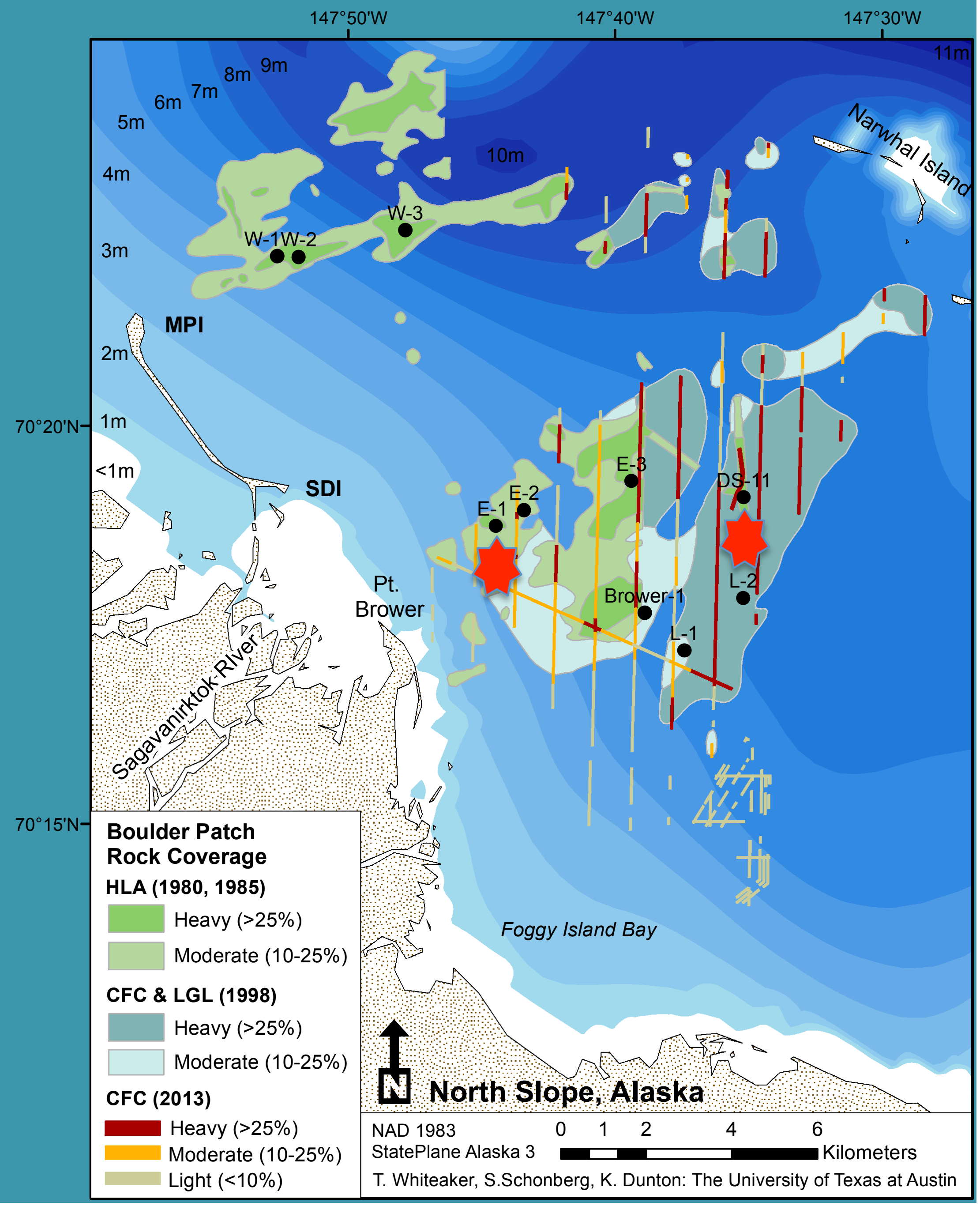
Patterns observed through monitoring in the Boulder Patch (Dunton, Konar, and Iken)

- Decreasing CCA coverage at inshore sites

Goals

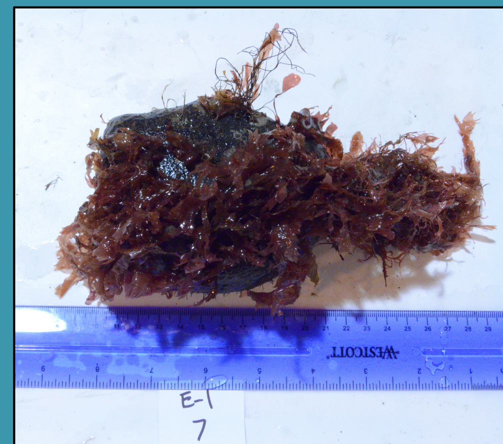
1) Compare epilithic community assemblages between sites with CCA present and CCA absent
   - Interest in *Laminaria solidungula* densities

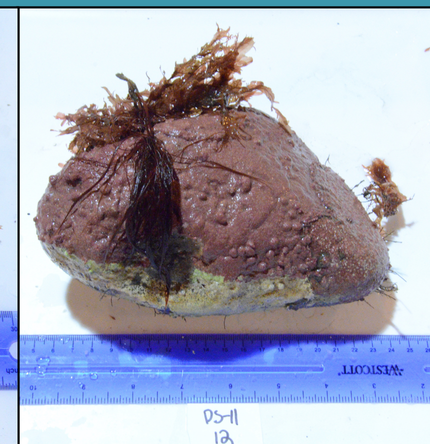
2) Genetic analysis of CCA specimens



Methods

- 15 cobbles (10-25 cm) collected
  - DS11 (offshore; 6 m) – CCA present
  - E1 (inshore; 4 m) – CCA absent
    - Algal species present and biomass
    - Invertebrate species (only focusing on branched invertebrates)
    - % cover of CCA and rock (photos and ImageJ)





- CCA samples for genetic sequencing (P. Gabrielson, UNC Chapel Hill)
  - psbA amplified
  - exact matches found

Methods

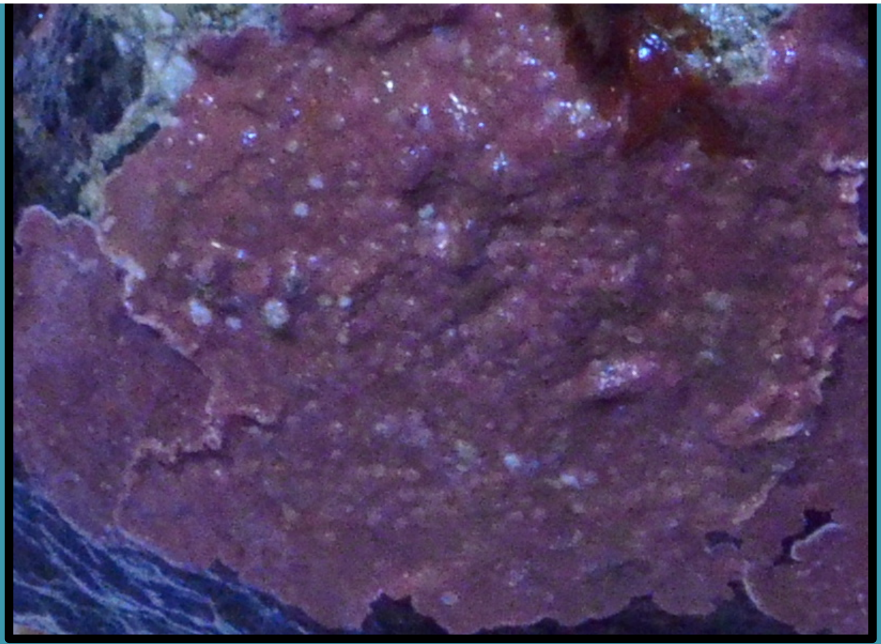
Photo quadrats completed by C. Bonsell

- Photo quadrats ($0.050\ m^2$) taken at each site were used for *Laminaria solidungula* density estimates (n=22 at each site)
  - >75% rock coverage

Results

		CCA	No CCA
Rhodophyta	*Phycodrys fimbriata*	x	x
	Coccotylus truncatus	x	x
	Rhodomela confervoides	x	x
	Odonthalia dentata	x	x
	Dilsea socialis	x	x
	Ahnfeltia plicata		x
Chlorophyta	*Chaetomorpha* sp.		x
Ochrophyta	*Laminaria solidungula*	x	x
	Sphacelaria plumosa		x
	Ecotocarpus siliculosus		x

Phymatolithon foecundum
*Wilce and Dunton 2014



Phymatolithon tenue
*Wilce and Dunton 2014

Mesophyllum or gen. nov. *foecundum*

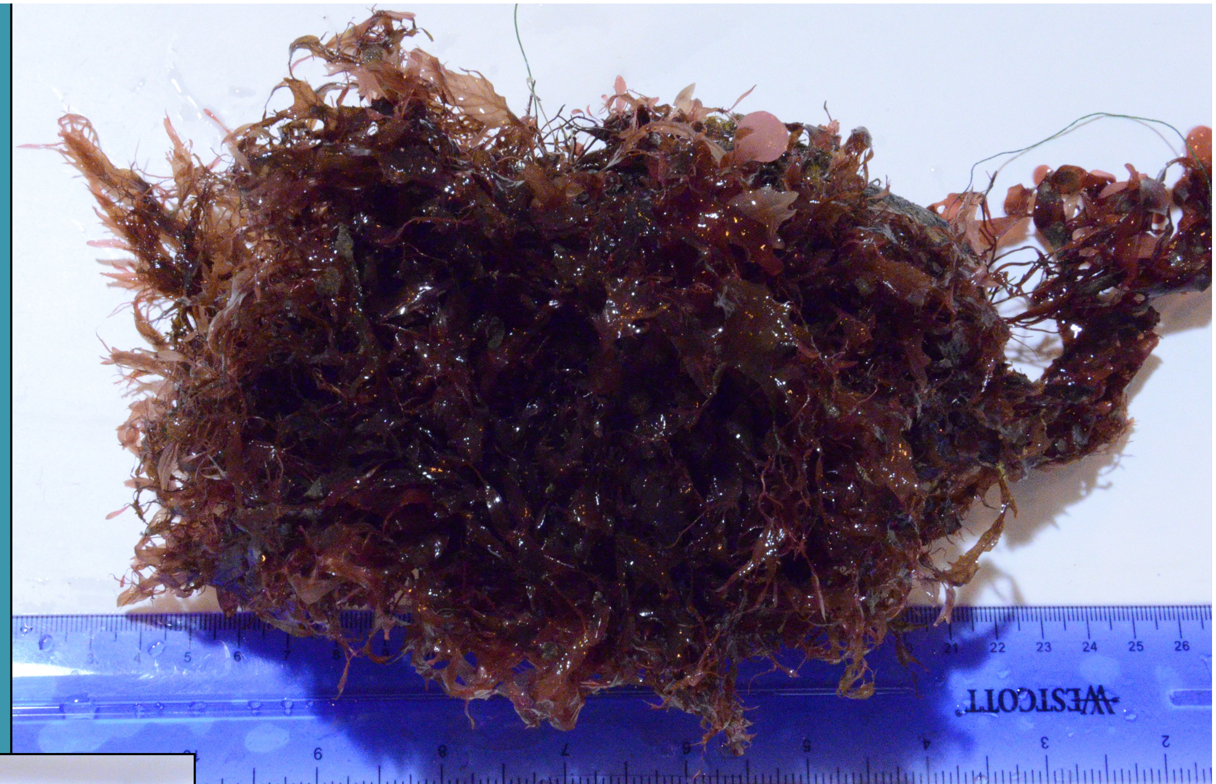
Leptophytum laeve = Phymatolithon tenue
Leptophytum tenue?

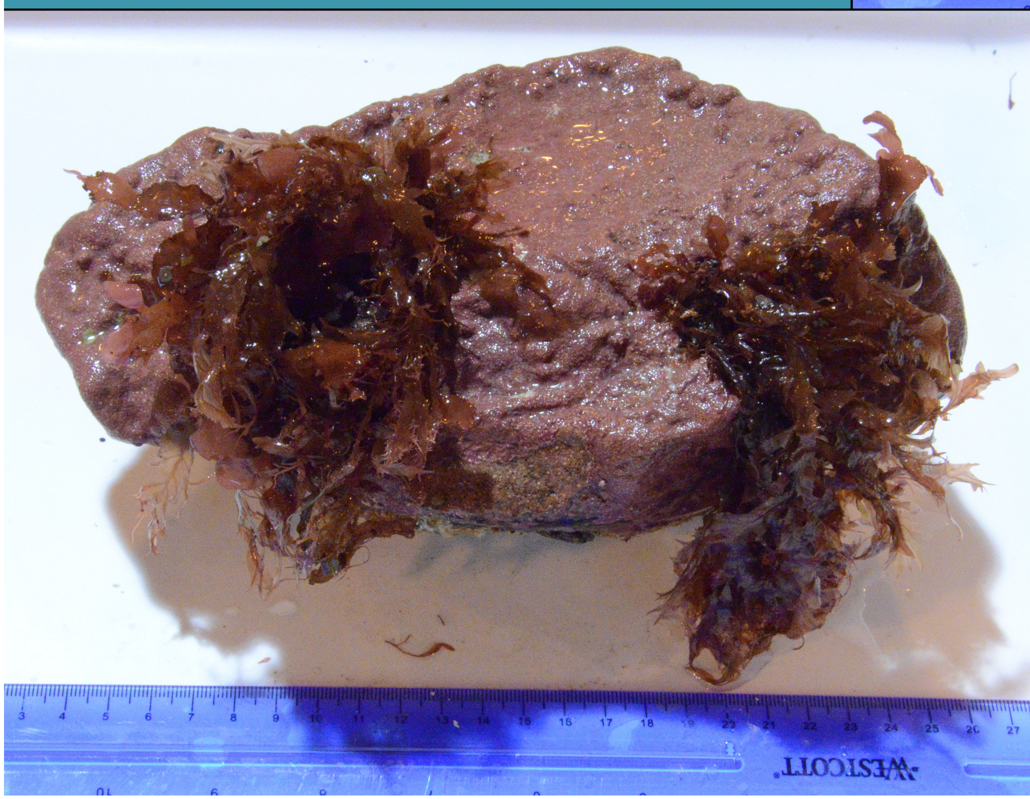
Leptophytum foecundum
Paul Gabrielson

Leptophytum laeve
Paul Gabrielson

CCA Present

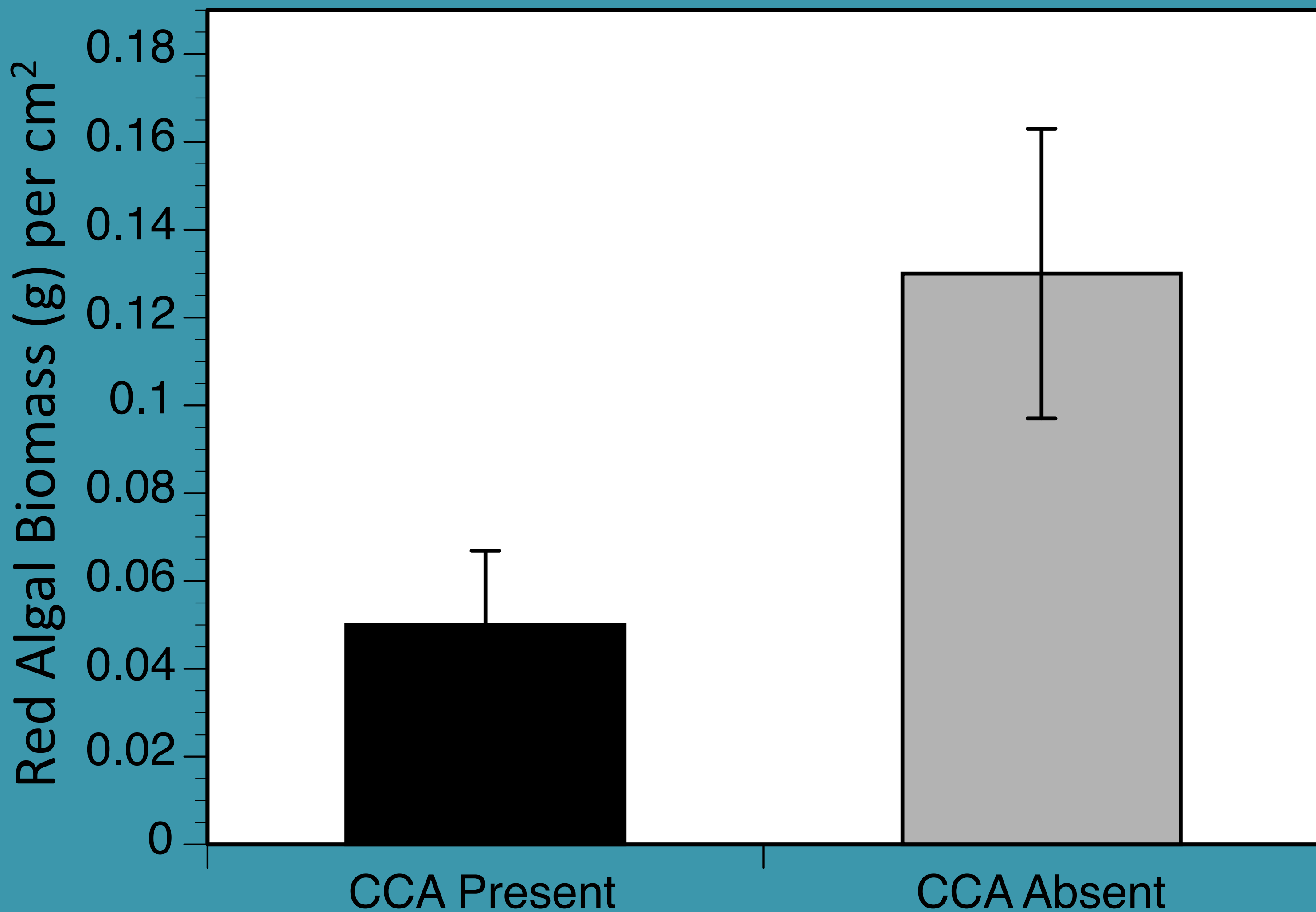
77.5% ± 3.8%



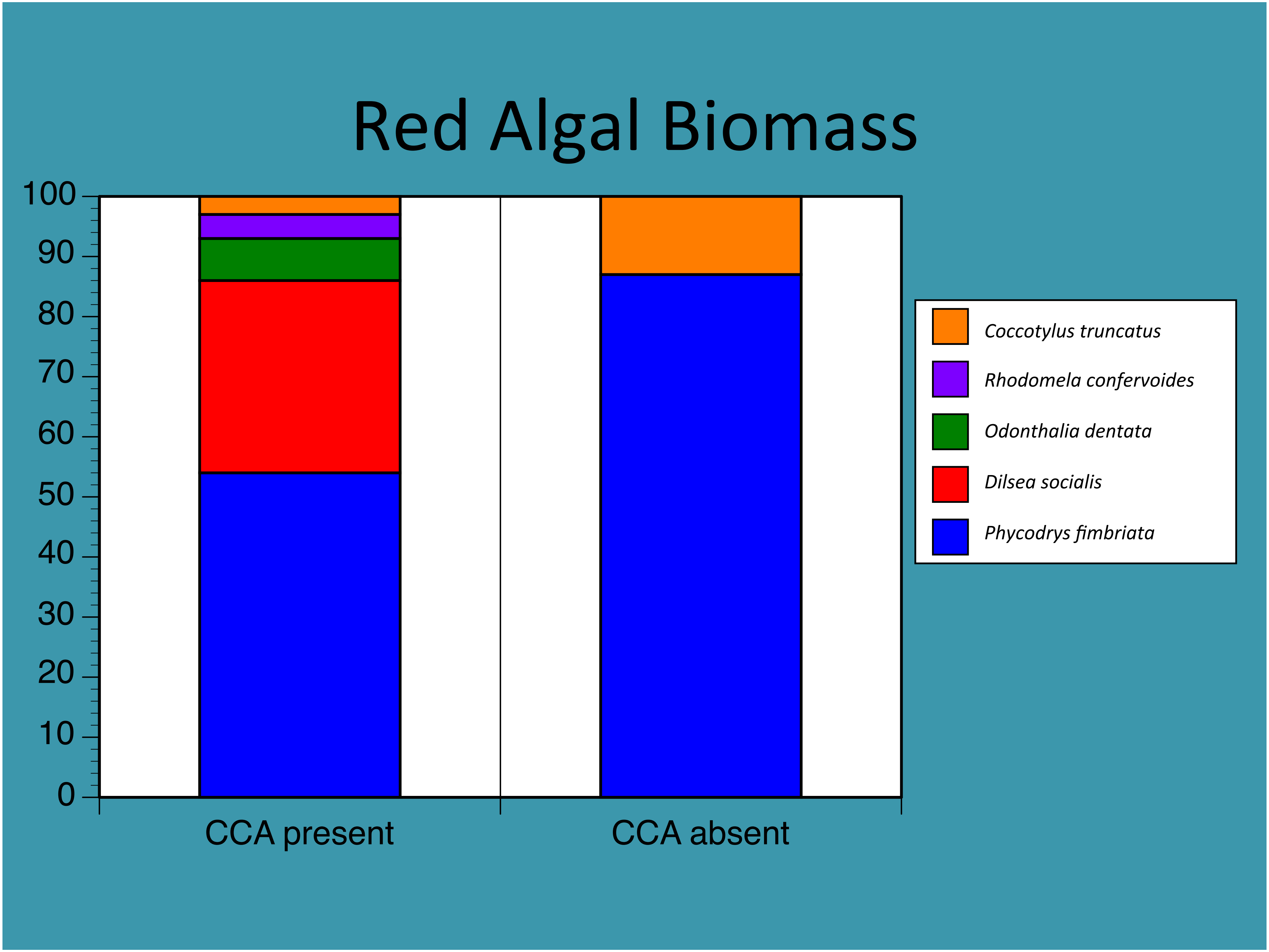


CCA Absent

Red Algal Biomass



T-test: $t_{20.72}$=-2.2762, p=0.03


Red Algal Biomass
100
90
80
70
60
50
40
30
20
10
0
CCA present
CCA absent
Coccotylus truncatus
Rhodomela confervoides
Odonthalia dentata
Dilsea socialis
Phycodrys fimbriata

Branching invertebrates

CCA Present

Sertularia cupressoides

hydroid

Fringes of CCA

~0.009 g per cm^2 ± SE 0.0004

CCA Absent

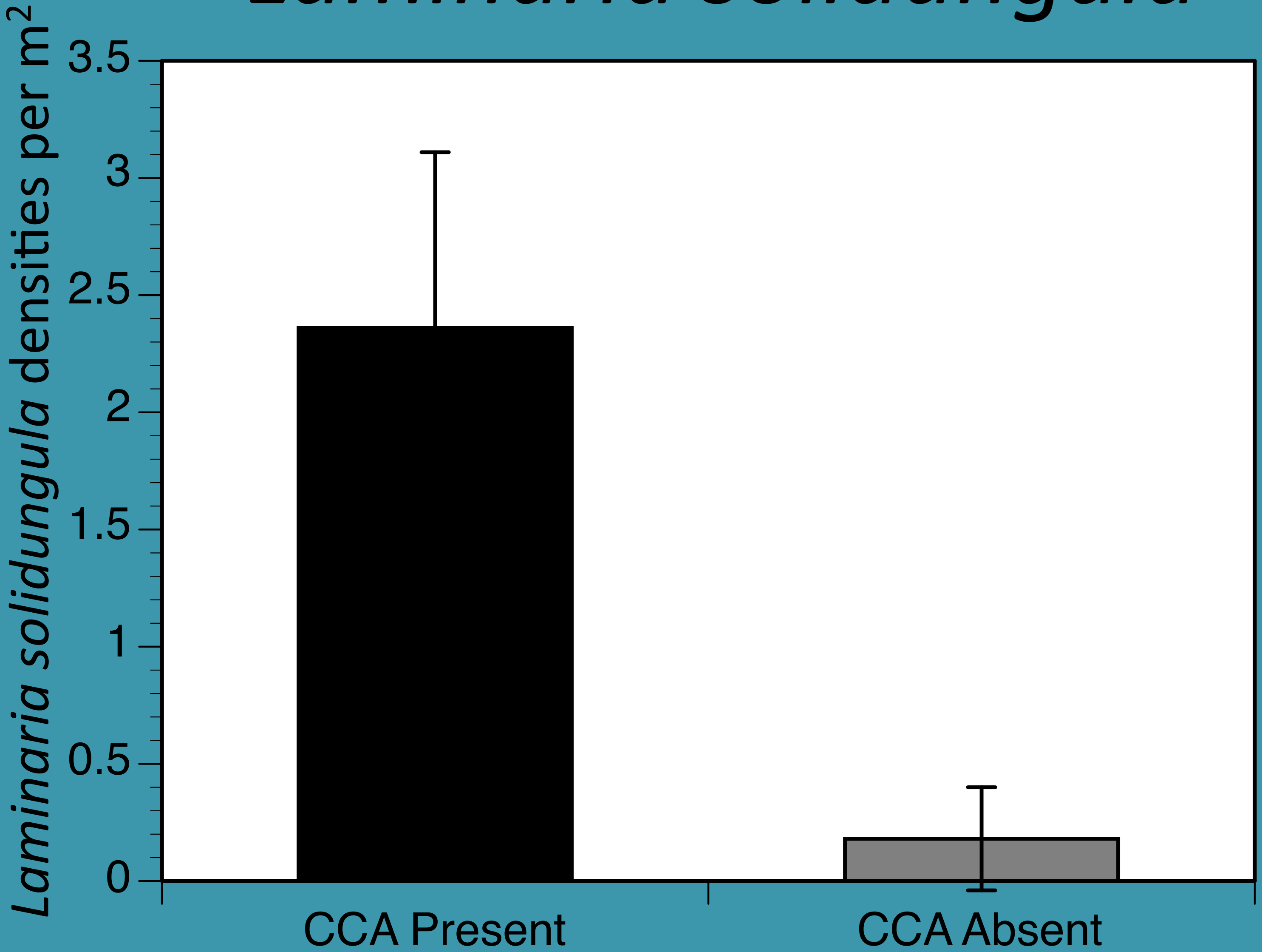
Eucratea loricata

bryozoan

Tops of Cobbles

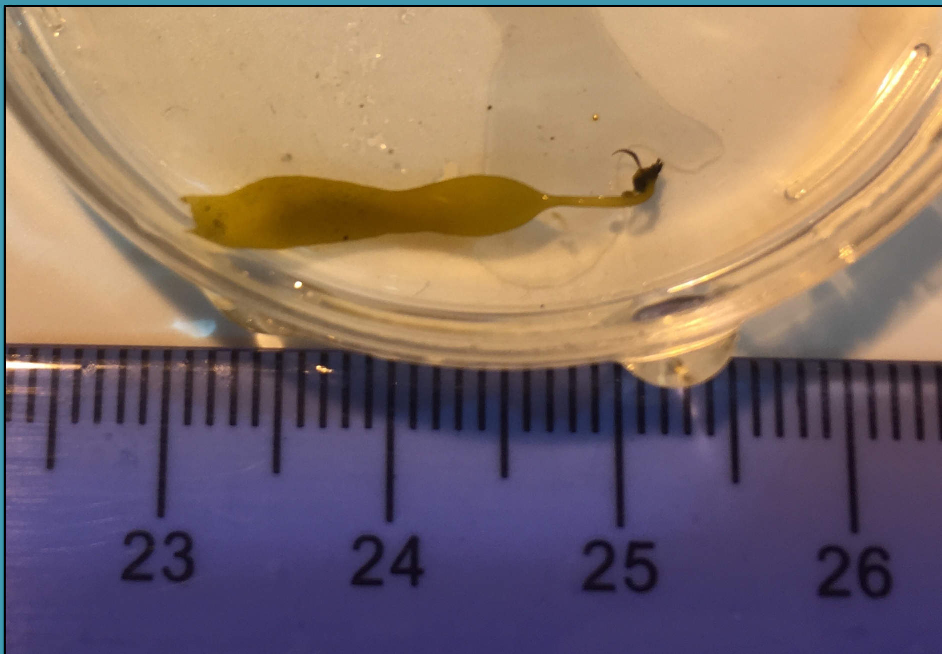
~0.01 g per cm^2 ± SE 0.002

Laminaria solidungula



T-test: $t_{24.51}=3.3466$, $p<0.01$

Data collected by C. Bonsell



~ 2 cm
3 years

~ 1.5 m
9-10 years

** only species observed growing on CCA were *Laminaria solidungula* and *Rhodomela confervoides*

Why are CCAs absent?

- Environmental Conditions

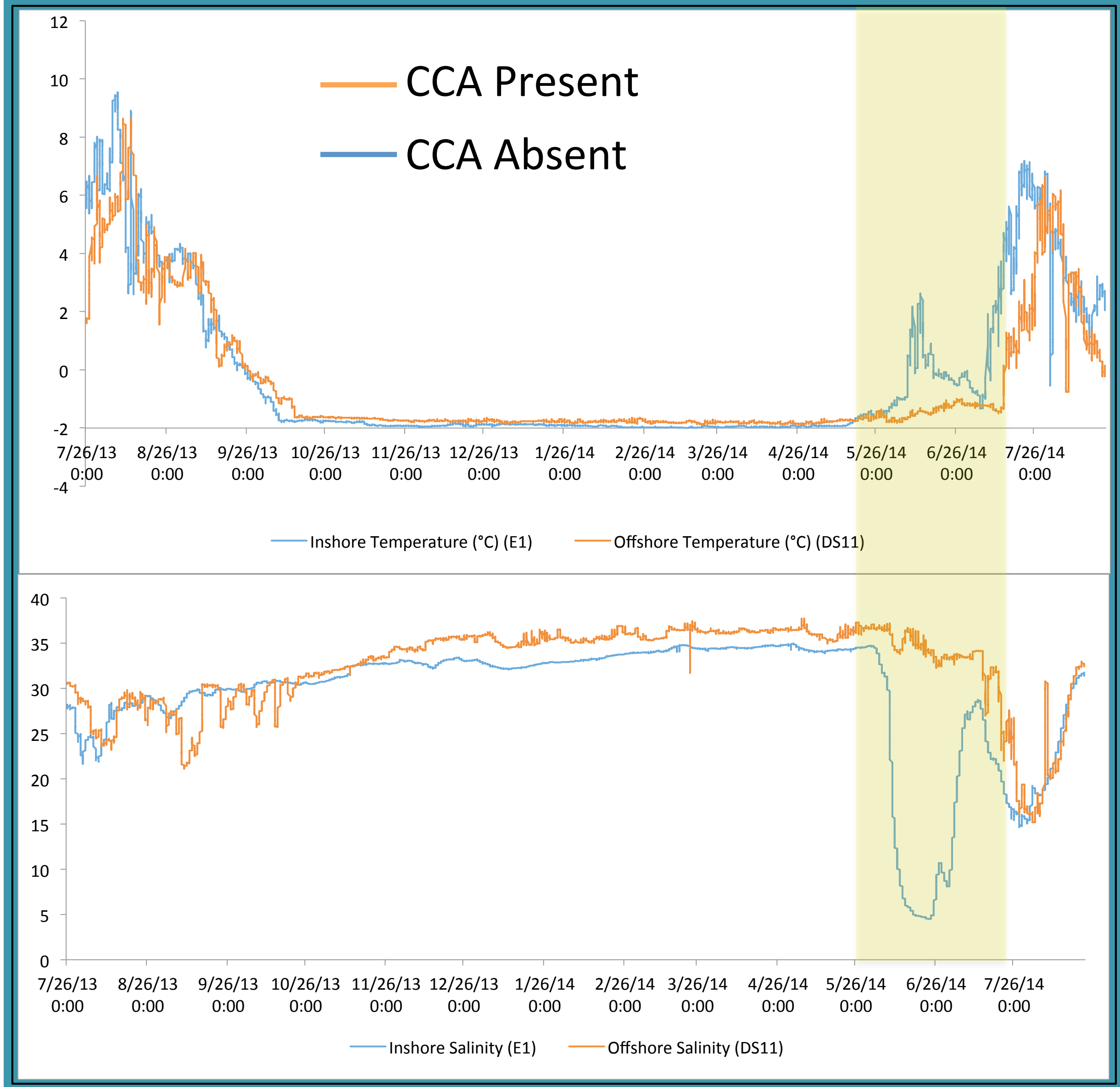
Why are CCAs absent?

- Environmental Conditions
  - Light and sedimentation?
    - Algal species are similar between sites
    - Lower light where CCA are absent
    - Not a depositional area
    - All areas are subjected to sedimentation during break-up and summer storms

Why are CCAs absent?

- Environmental Conditions
  - Temperature and Salinity?

Why are CCAs absent?



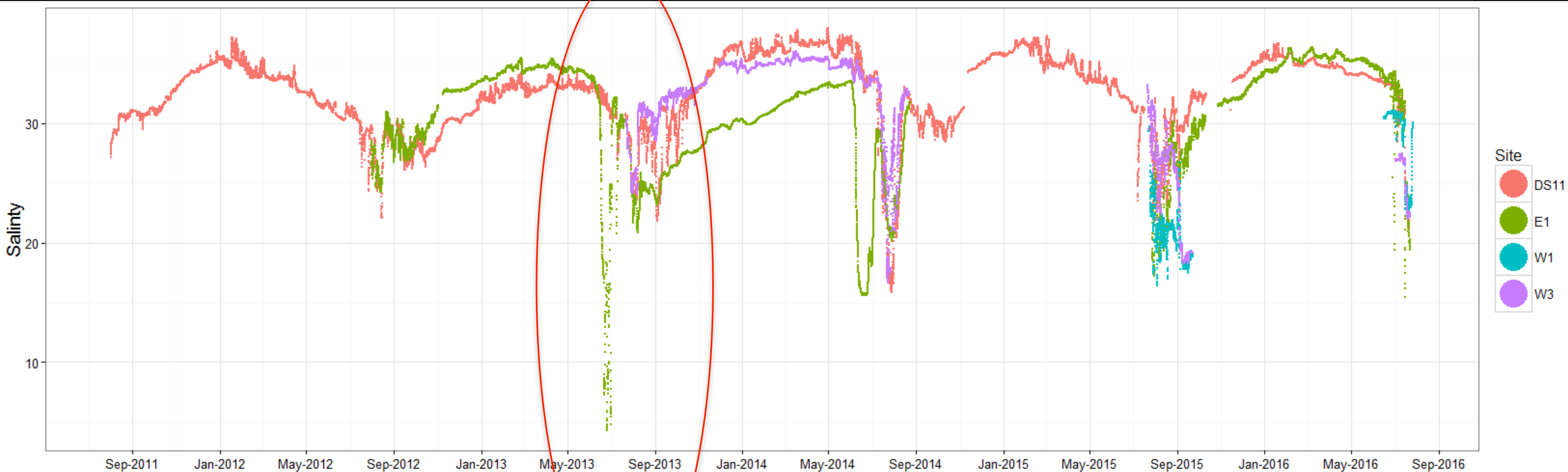
2013-2014

**Temperature is a bit higher at the inshore site, but basically tracks offshore site (CCA present)

**Salinity drops to 4 at the inshore site (CCA absent)

Bonsell et al. 2016

Why are CCAs absent?



* * * * *

* Freshet

Bonsell et al. 2016

Why are CCAs absent?

- Environmental Conditions
  - pH?

Naturally lower pH in the Beaufort Sea

-low aragonite saturation levels by 2025 (Mathis et al. 2015)

-cold temperatures

-low chl *a* (CO_2 uptake)

-**freshwater (lower TA)**

-anthropogenic factors

Decreased pH in the Beaufort Sea?

Accurate salinity and pH data

- SeapHOx (Sea-Bird Electronics)
- Future mesocosm experiments to disentangle pH and salinity effects

Conclusions

- CCA covered on average 78% of the cobbles from the offshore site to 0% at the inshore site
- When CCA were present, kelp densities were significantly higher
- When CCA was absent red algal biomass was significantly higher, but was dominated by 2 species
- CCA appear to play an important role in *L. solidungula* population persistence.

Acknowledgments

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Questions?