The effect of distal-end trimming on *Saccharina latissima* morphology, composition, and productivity

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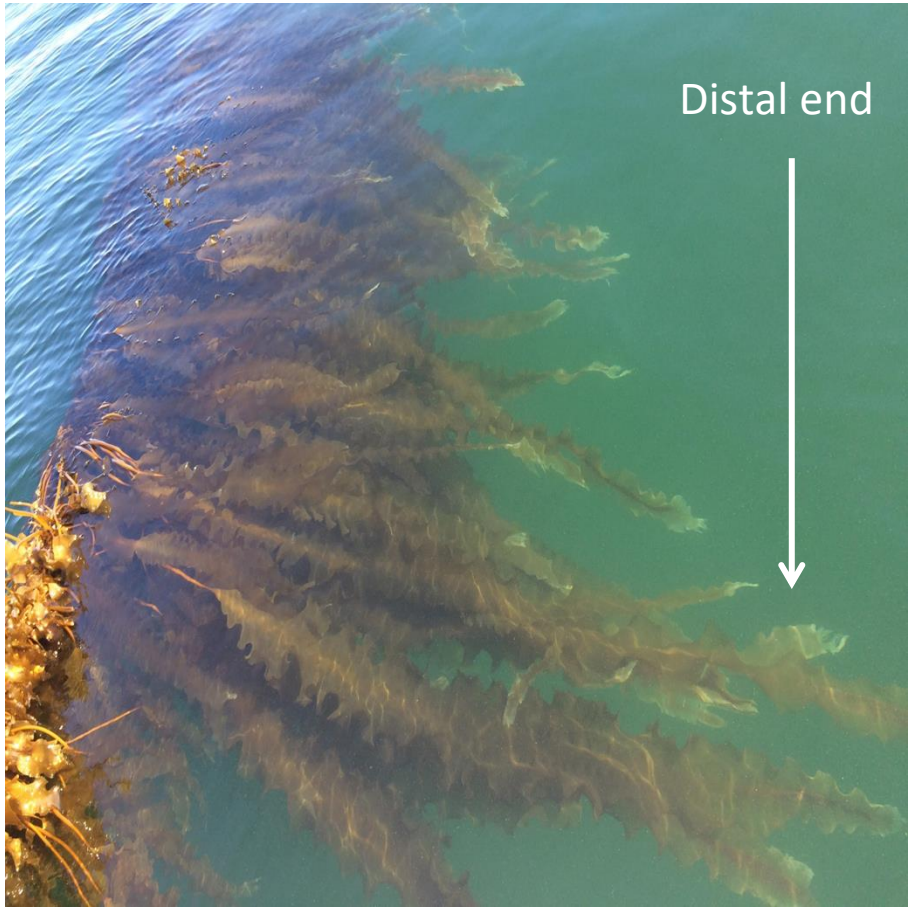
THE UNIVERSITY OF MAINE 1865 NSF MAINE EPSCoR NORTHEAST SARE Sustainable Agriculture Research & Education UNE UNIVERSITY OF NEW ENGLAND INNOVATION FOR A HEALTHIER PLANET

Context

- Large disparity between max/min revenue from farmed *S. latissima* harvest

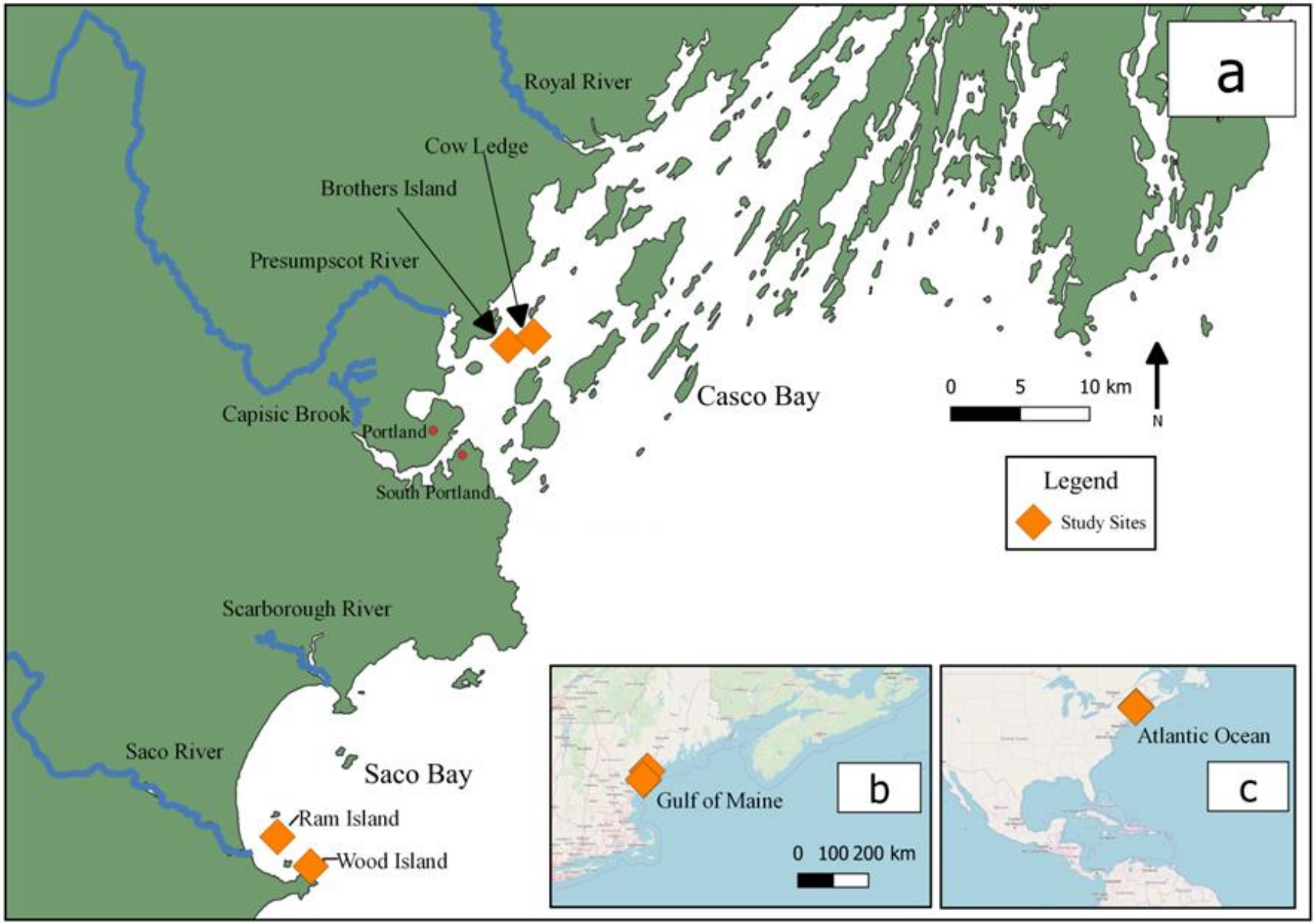
- Could mid-season trimming (haircut) increase production or nutrient assimilation?



Previous research

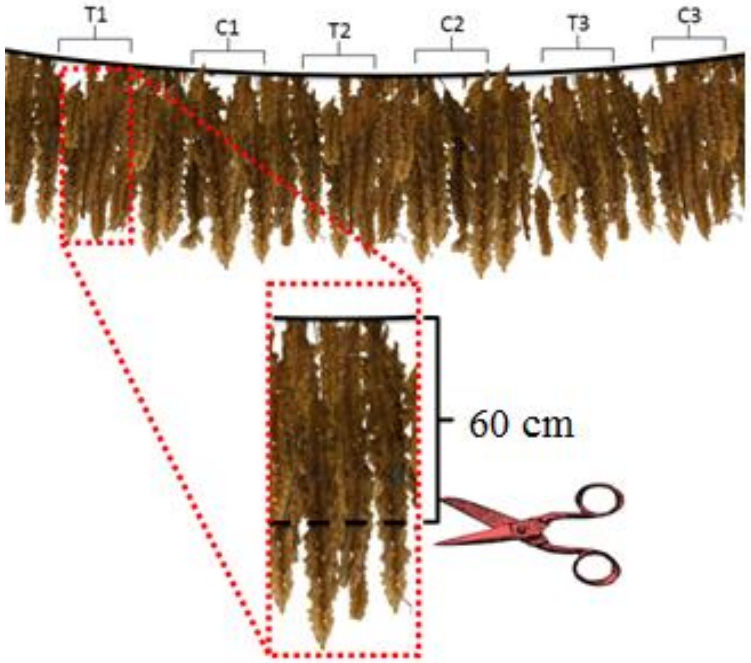
- Mid-season trimming (Tseng 1987; Kim et al. 2015; Bak et al. 2018; Bak 2019; Goul 2019; Seth Barker, pers. comm 2020)
- N uptake active over entire thallus, but concentrated in basal part (Boderskov *et al.*, 2016)
- Early spring *S. latissima* ↑ tender and ↑ flavor (Fossberg et al. 2018)
- Growth-phase *Undaria pinnatifida* sells for 5x ↑ price than adult thalli (Gao et al. 2013)

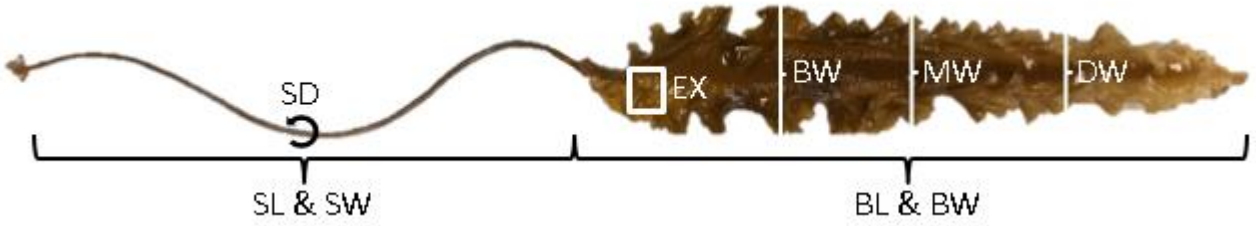
Study sites


a
Royal River
Cow Ledge
Brothers Island
Presumpscot River
Capisic Brook
Portland
South Portland
Casco Bay
0 5 10 km
N
Legend
Study Sites
Scarborough River
Saco River
Saco Bay
Ram Island
Wood Island
b
Gulf of Maine
0 100 200 km
c
Atlantic Ocean

Methods

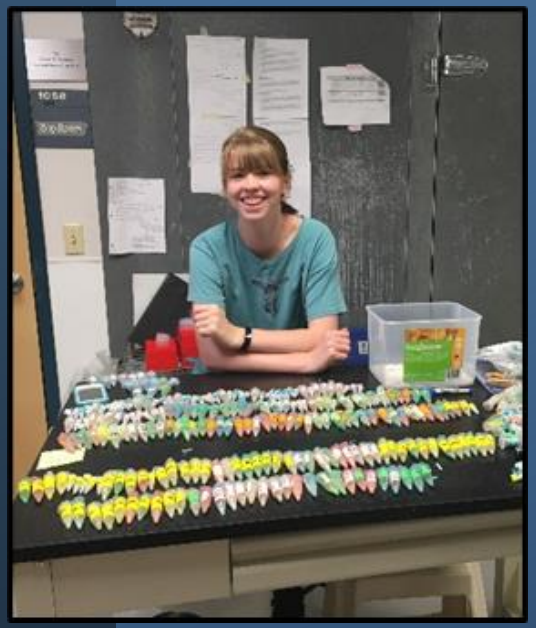
- Blades trimmed mid-March to mid-May (Spring ’18 & ’19)
- Measured morphology, yield, total C & N in kelp tissue, $\delta^{15}N$, $\delta^{13}C$, and nitrate reductase activity
- Monitored environmental conds. (temp, light (PAR), salinity, NO^{-3}-N (surface & 2m), current, pH
- Specific growth rates and harvesting scenarios → biomass production and harvesting model (Maine as case study)



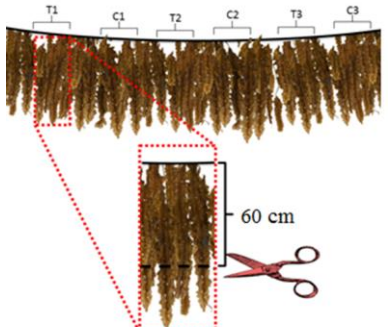



A


B

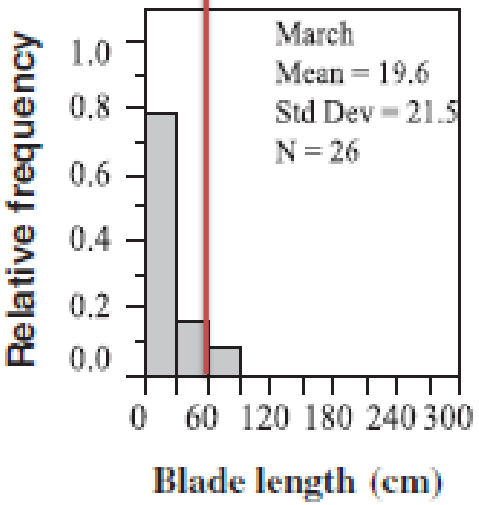


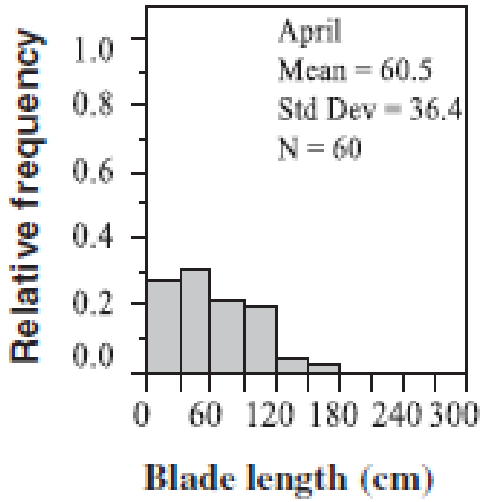
Analytical blade classes

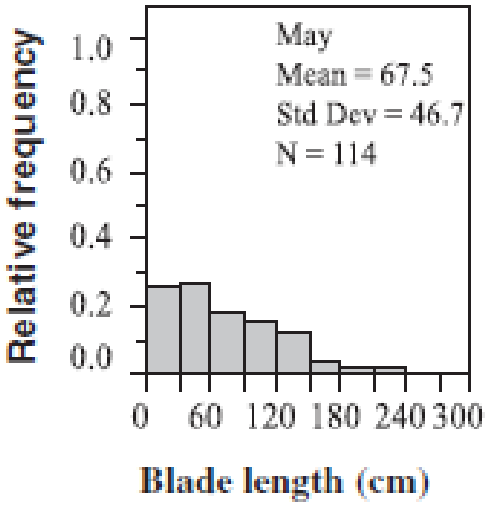


SBC LBC

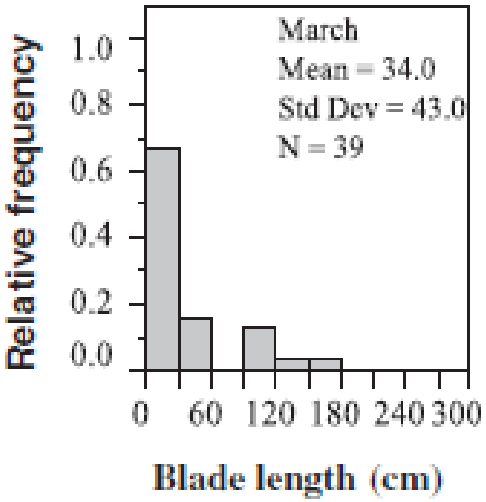
Wood 2018

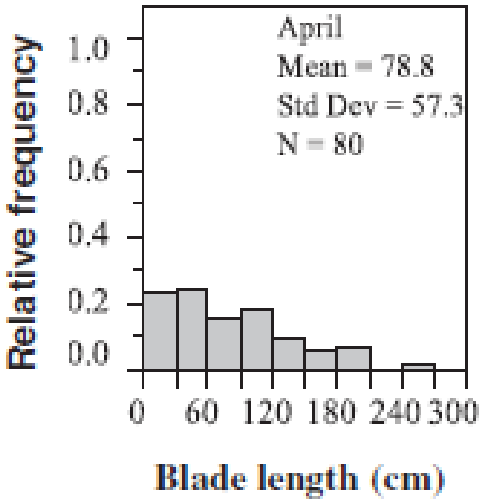


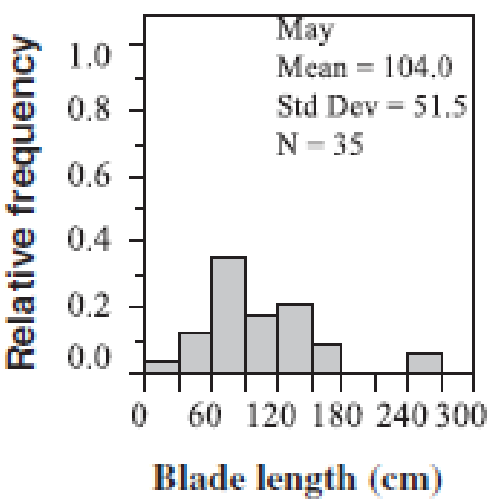




Wood 2019







Morphological differences

- Distal-end trimming had a significant affect on *S. latissima* stipe and blade morphology
- Similar patterns in small blades observed at Brothers Island site

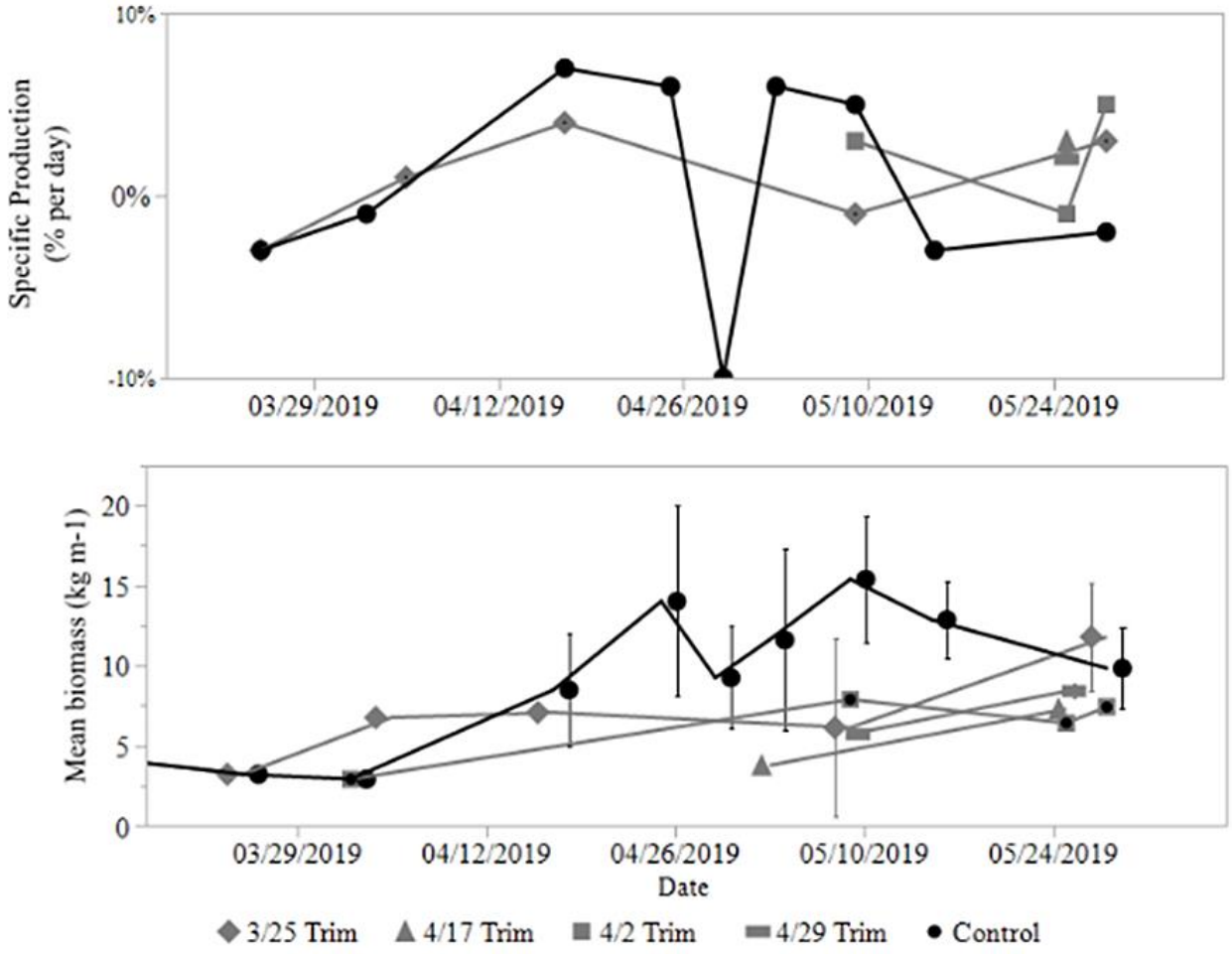
Wood Island Site 2019
Trimmed vs. Control

Long blade class (≥ 60 cm)	Short blade class (< 60 cm)
Stipe length (12%) ↑	Blade length (37%) ↑
Stipe diameter (16%) ↑	Basal width (75%) ↑
Stipe weight (25%) ↑	Mid width (52%) ↑
	Distal width (16%) ↑
	Blade weight (144%) ↑
	Stipe length (57%) ↑
	Stipe diameter (63%) ↑
	Stipe weight (28%) ↑

Composition and yield

- No consistently significant effect on % nitrogen, $\delta^{15}N$ or nitrate reductase activity
- Higher % C in trimmed SBC
- Trimming increased late-season production yields
- →Reduced sloughing (-2 – 3% per day

→ Prevented storm loss



Biomass and harvesting

For 2035: 2722 MT total US production (Piconi et al. 2020)

13 scenarios total: 2019 and 2035

5A:

- harvest on May 15 with - 3% percentage yield (PY) May 1 -15

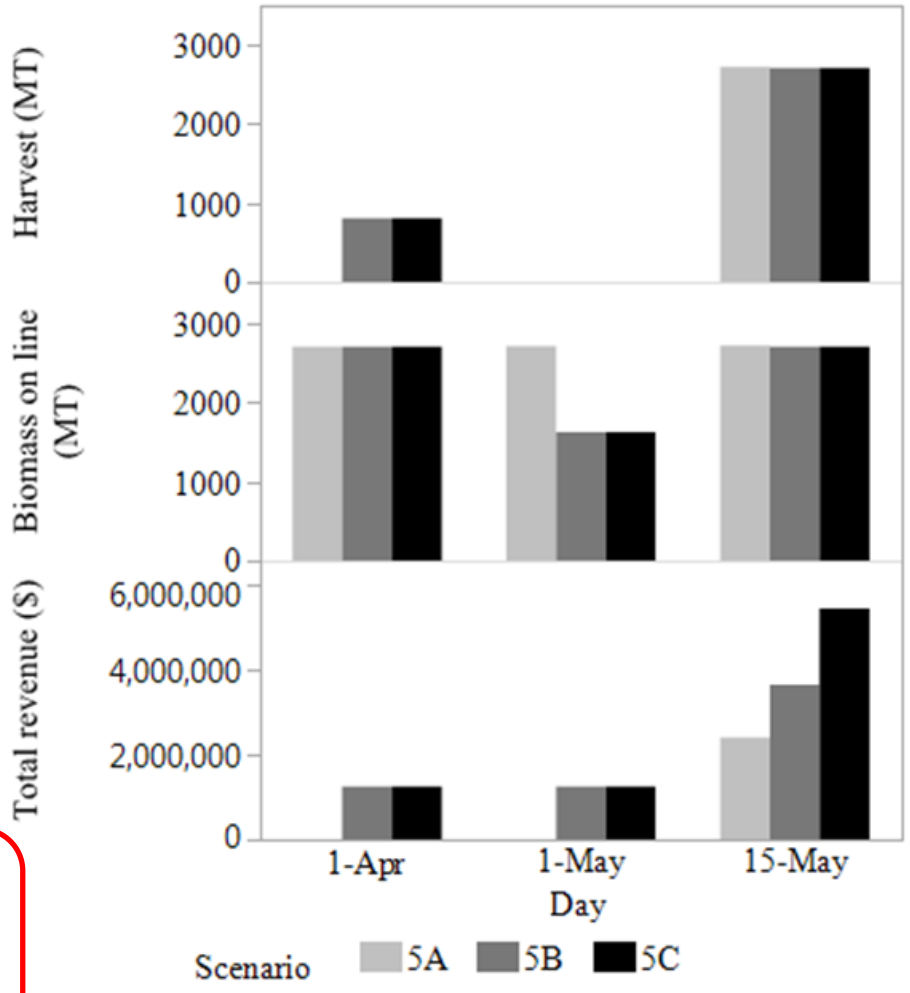
5B:

- removal of 30% biomass on April 1
- 3% PY after trim, high sale price ($1540 WW t^{-1}) April 1 harvest
- low sale price ($880 WW t^{-1}) May 15 harvest (+ 1.2 million in 2035)

5C:

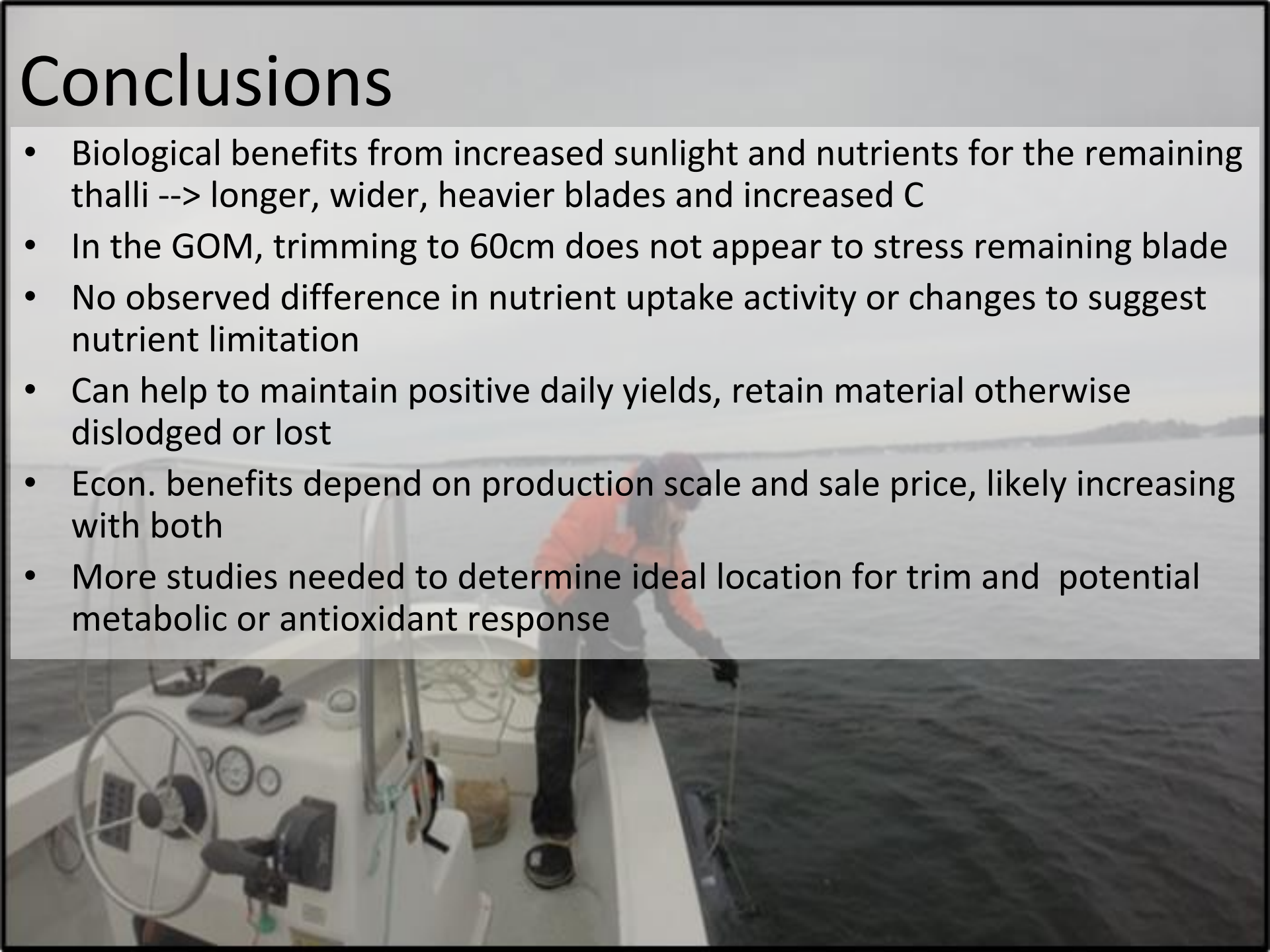
- Same as 5B, but high sale price both harvests

≥ $3 million additional revenue for US producers if all trimmed kelp was sold at highest price in 2035



Conclusions

- Biological benefits from increased sunlight and nutrients for the remaining thalli --> longer, wider, heavier blades and increased C
- In the GOM, trimming to 60cm does not appear to stress remaining blade
- No observed difference in nutrient uptake activity or changes to suggest nutrient limitation
- Can help to maintain positive daily yields, retain material otherwise dislodged or lost
- Econ. benefits depend on production scale and sale price, likely increasing with both
- More studies needed to determine ideal location for trim and potential metabolic or antioxidant response



Many thanks to all who helped with this work!

Check out the publication in JWAS:

Grebe, G.S., Byron, C.J, Brady, D.C, St. Gelais, A., Costa-Pierce, B.A. 2021. The effect of distal-end trimming on *Saccharina latissima* morphology, composition, and productivity. *Journal of the World Aquaculture Society*, 52(5): 1 - 18. https://doi.org/10.1111/jwas.12814