Winter 1-17-2020

Assessment of bacterial pathogens on edible microalgae in coastal waters

Carrie J. Byron

Olivia N. Barberi

Kristin M. Burkholder

Adam T. St. Gelais

Alicia K. Williams

Journal of Applied Phycology
https://doi.org/10.1007/s10811-019-01993-5

Assessment of bacterial pathogens on edible macroalgae in coastal waters

Olivia N. Barberi [1] · Carrie J. Byron [1] · Kristin M. Burkholder [2] · Adam T. St. Gelais [1,3] · Alicia K. Williams [1]

UNIVERSITY OF NEW ENGLAND
School of Marine Programs

Maine Aquaculture Research, Development & Education Summit

17 January 2020

Carrie J. Byron, Ph.D. cbyron@une.edu 207-602-2287

https://sites.une.edu/byronlab/seaweed-project/

FDA U.S. FOOD & DRUG ADMINISTRATION

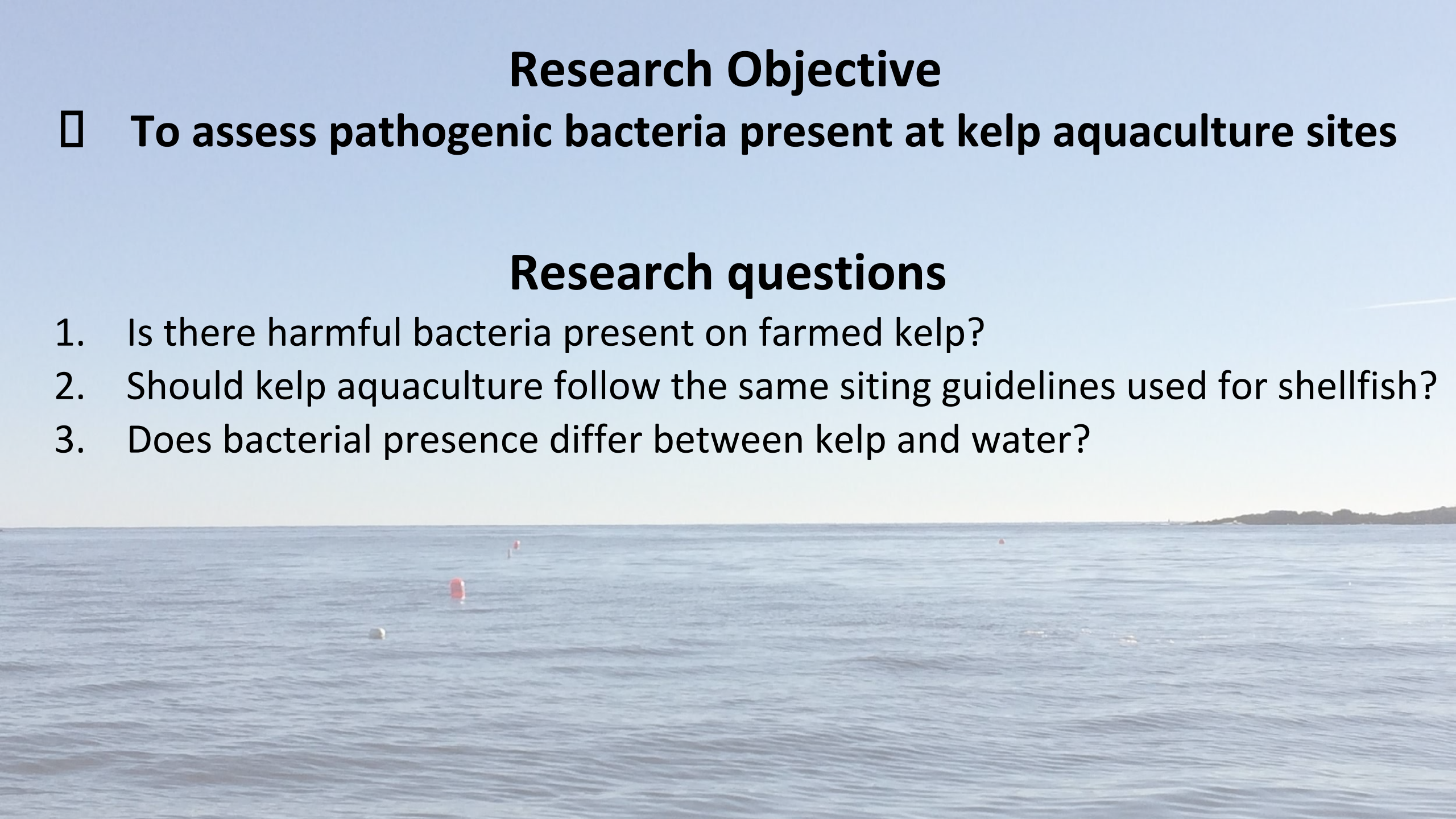
- 48 mil foodborne illnesses
- Food Safety Modernization Act (FSMA)
- Hazards Analysis Critical Control Points (HACCP)
- National Shellfish Sanitation Program (NSSP)

Research Objective

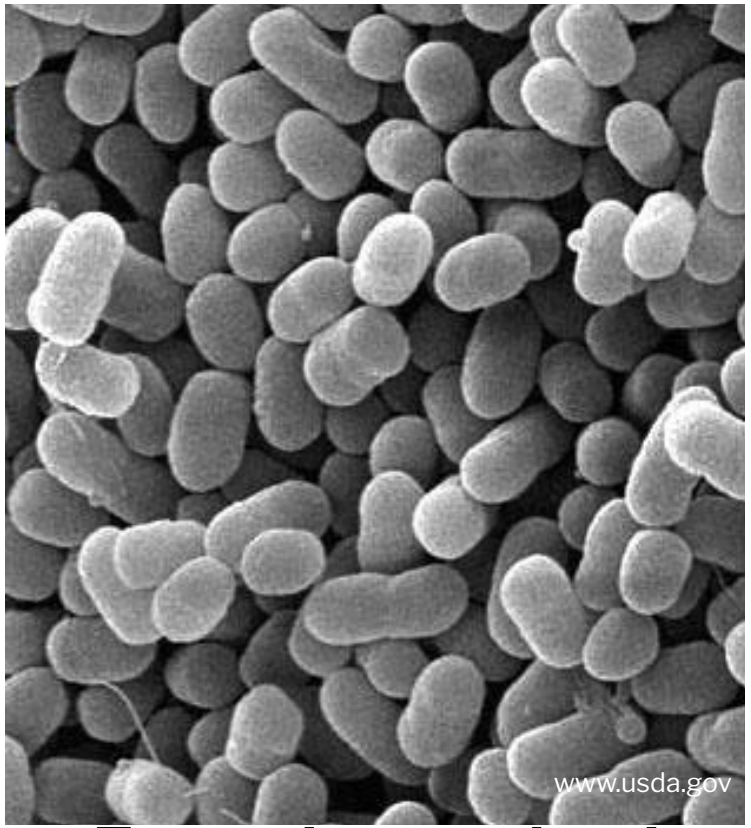
- **To assess pathogenic bacteria present at kelp aquaculture sites**

Research questions

1. Is there harmful bacteria present on farmed kelp?
2. Should kelp aquaculture follow the same siting guidelines used for shellfish?
3. Does bacterial presence differ between kelp and water?



Foodborne bacterial pathogens



Enterohemorrhagic *Escherichia coli* (EHEC)

***Salmonella enterica* Typhimurium**

Vibrio parahaemolyticus

Sampling

- Casco Bay: 2 farms
  - CB I (6 sampling events)
  - CB II (4 events)
- Saco Bay: UNE farm (8 events)

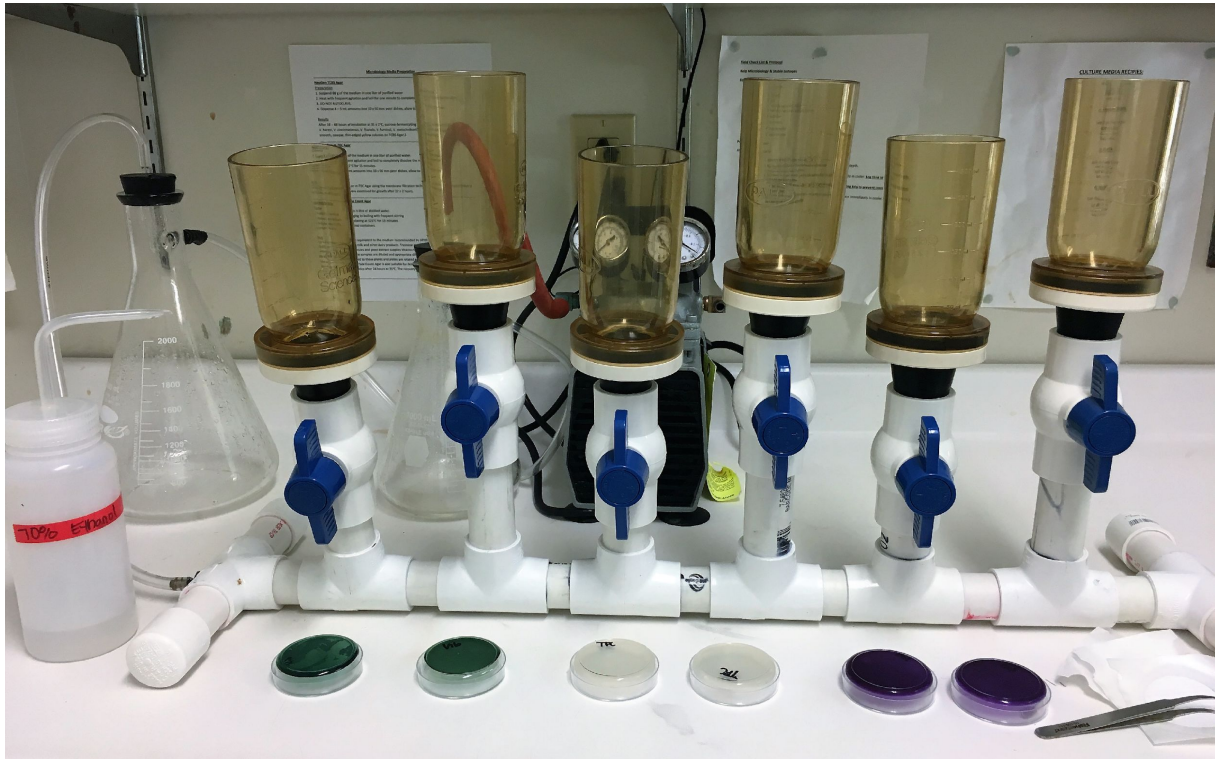
- February – May 2018

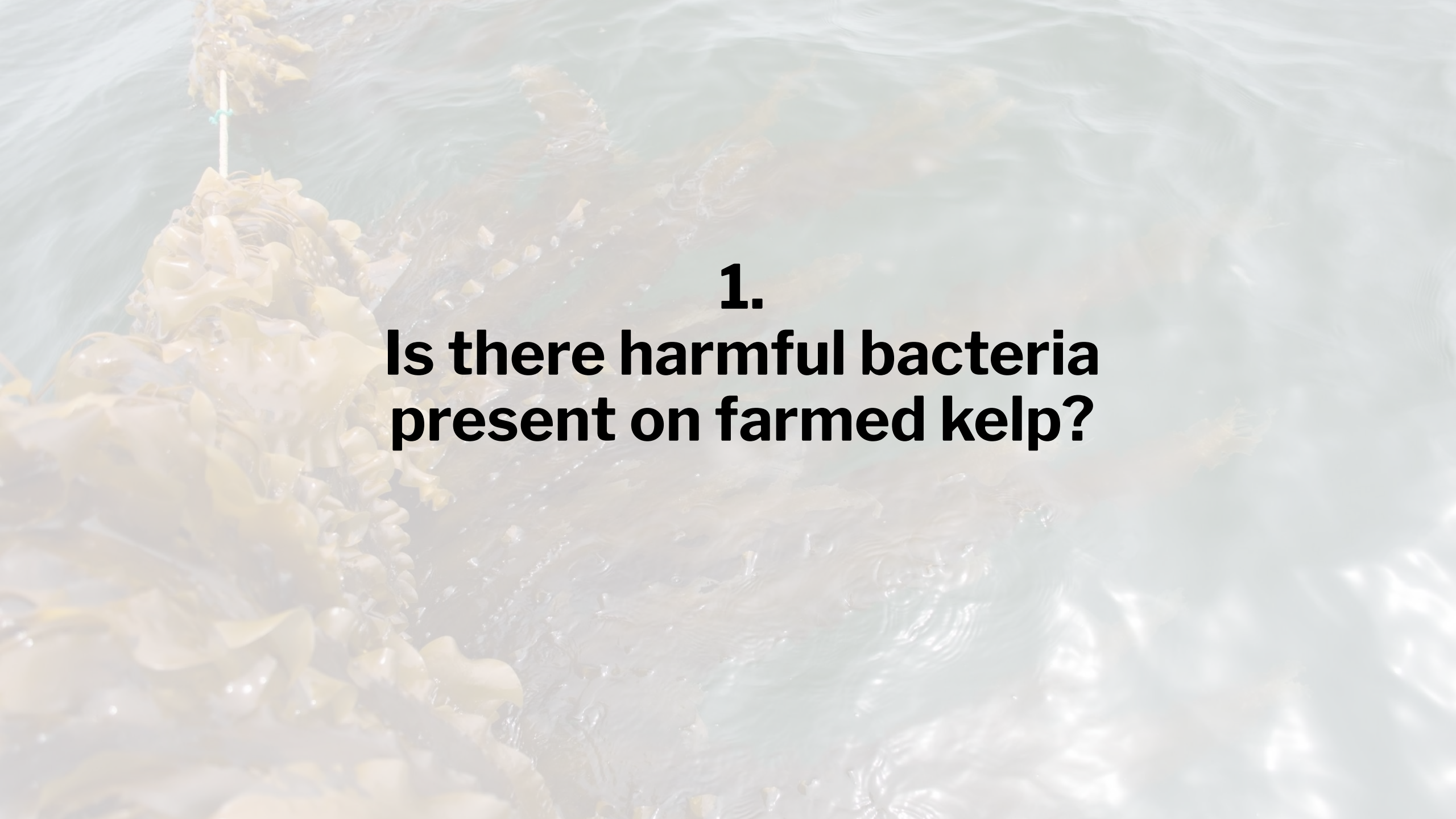
- Kelp collected from 3-4 points on longline
- Paired with water

- Samples transported at <2°C and processed within 3 h of return

Kelp processing

- Blades cut horizontally
- Strips from several blades/sample combined
- Bunches agitated in sterile, filtered seawater
- Seawater then surveyed for bacterial pathogens

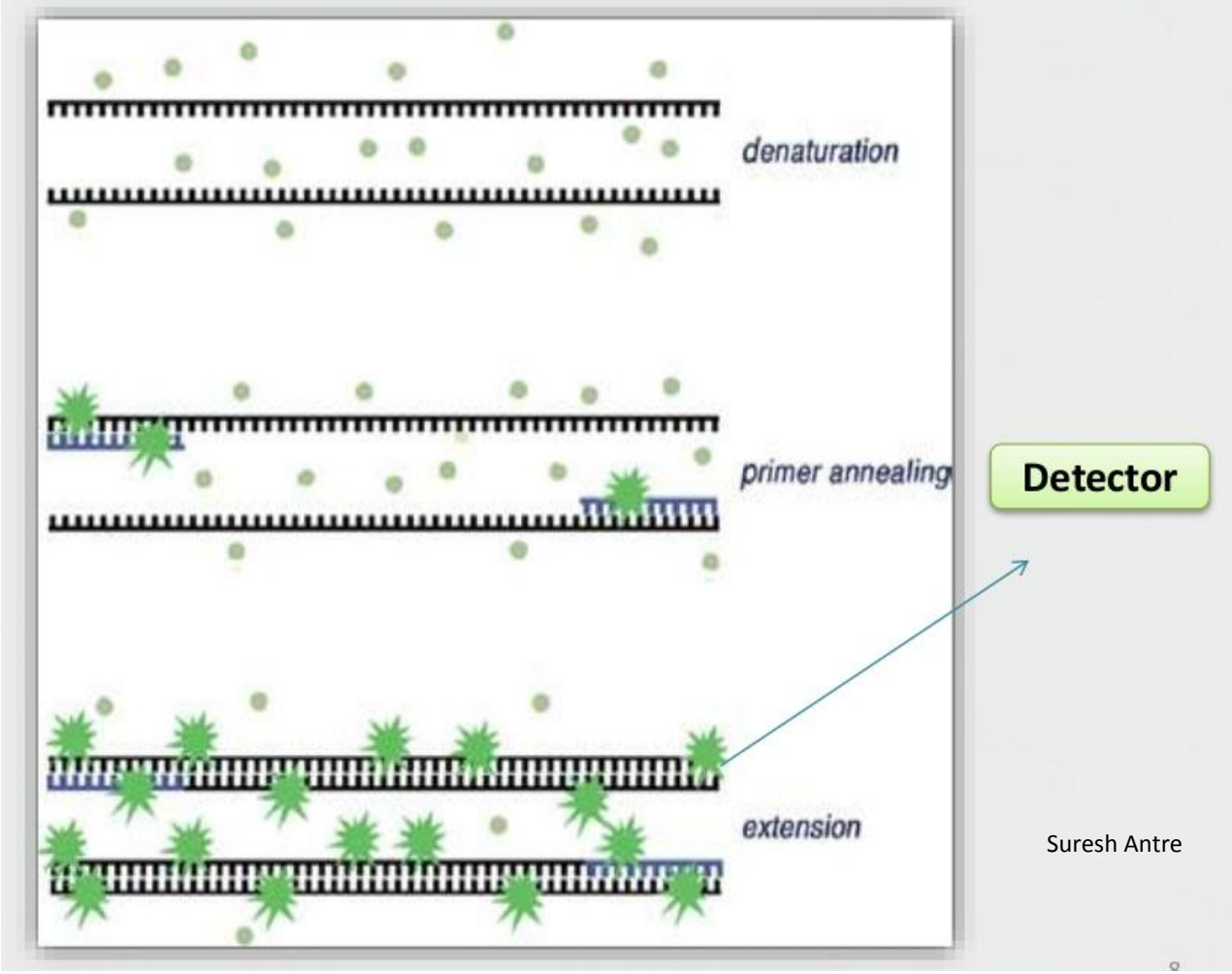




1.
Is there harmful bacteria present on farmed kelp?

Detection with qPCR

- Amplifies a target DNA sequence
  - *V. parahaemolyticus* (*trh*)
  - EHEC (*eaeA*)
  - *S. enterica* Typhimurium (*iroB*)
- Sensitive
- Rapid detection
- Enrichment enhances ability to detect low concentrations

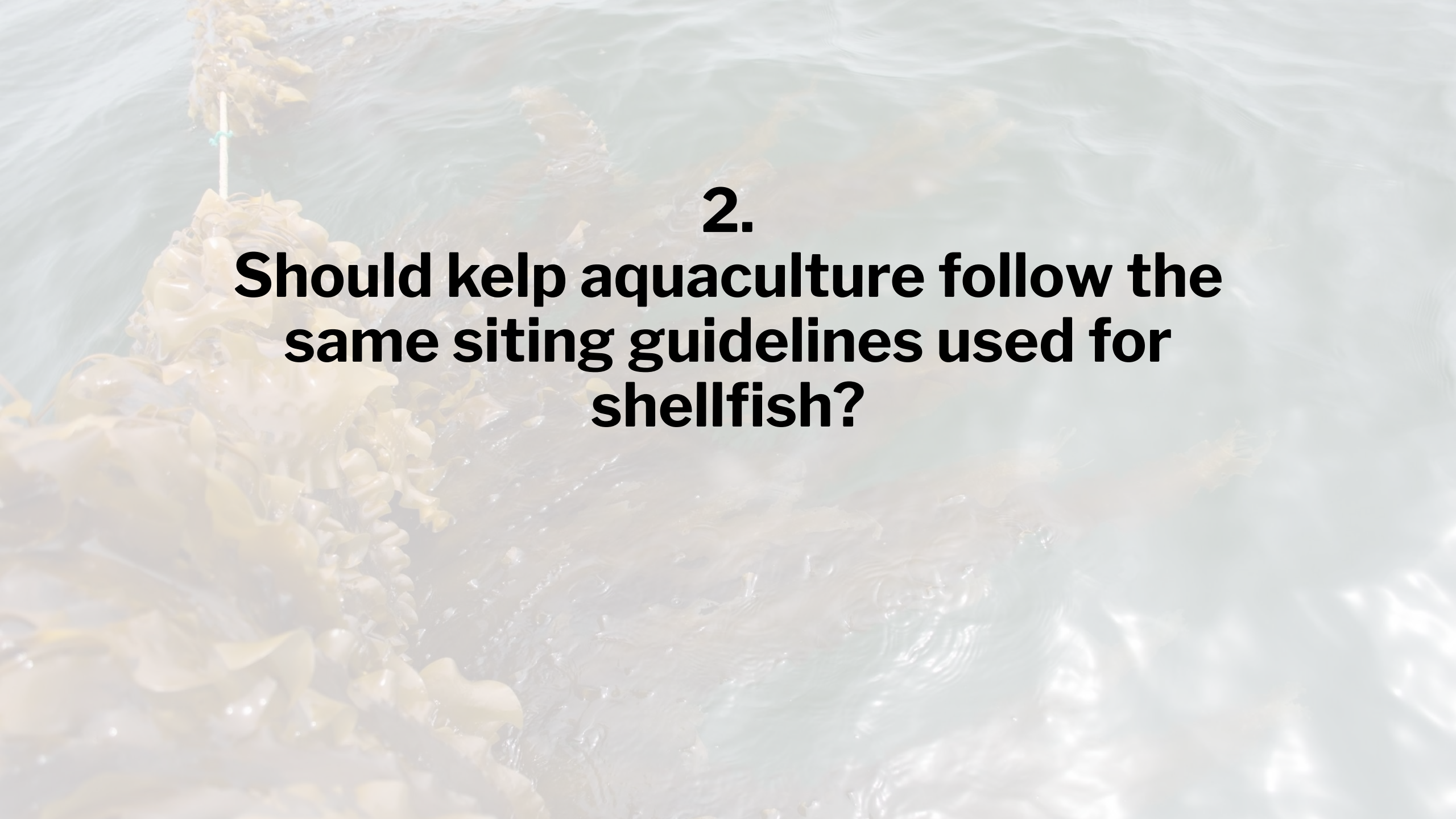


qPCR detection at all sites

Bacterium	% of + events (n=18)	% of + replicates (n=50)
V. parahaemolyticus	78%	52%
S. Typhimurium	83%	60%
EHEC	56%	46%

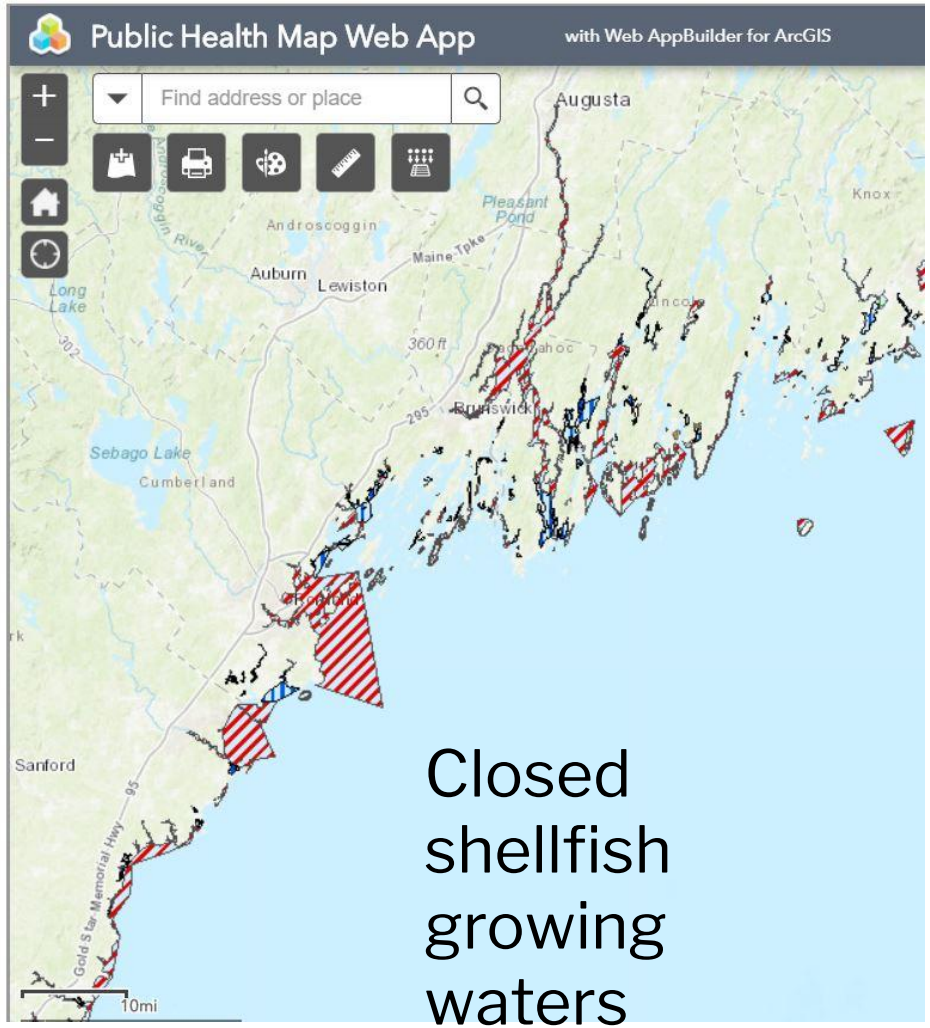
Is there harmful bacteria present on farmed kelp?

- Yes, frequent detection of 3 pathogens
- At least 2 pathogens per event
- But in low quantity
- May create risk after harvest



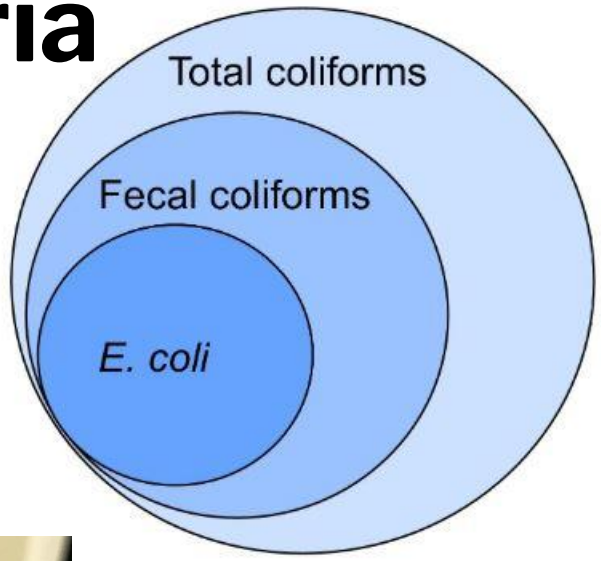
2.
Should kelp aquaculture follow the same siting guidelines used for shellfish?

Plating for fecal bacteria



Closed shellfish growing waters

NSSP



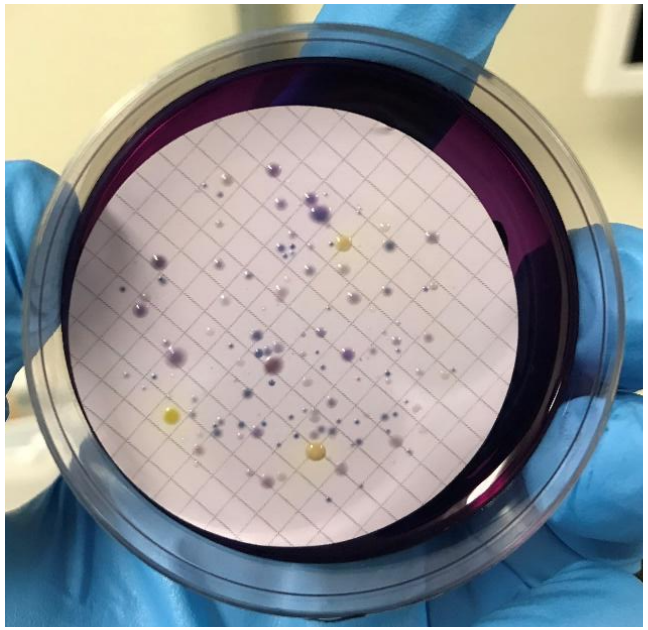
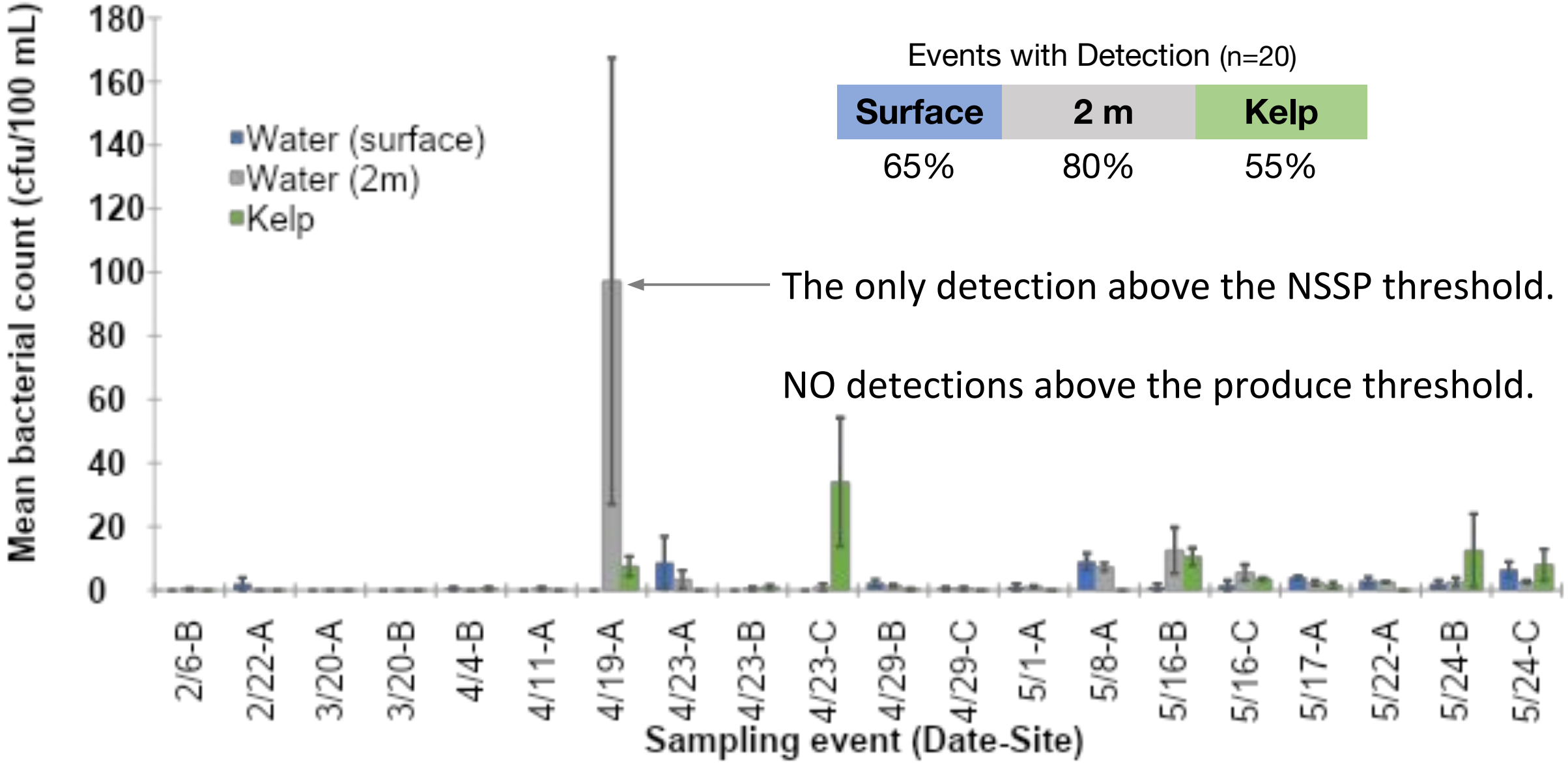


Plate counts: *E. coli*



Events with Detection (n=20)

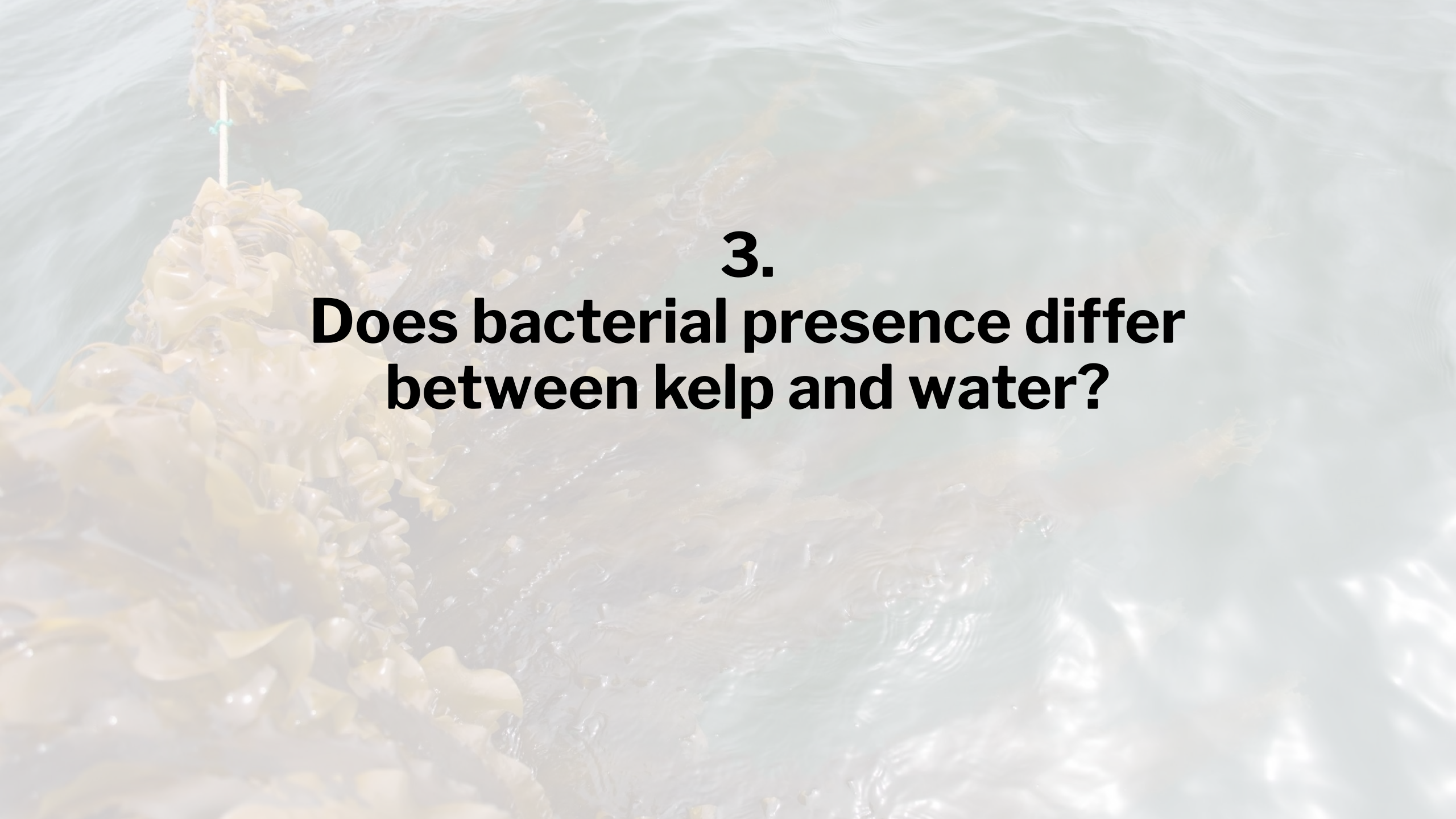
Surface	2 m	Kelp
65%	80%	55%

The only detection above the NSSP threshold.

NO detections above the produce threshold.

Should kelp aquaculture follow the same siting guidelines used for shellfish?

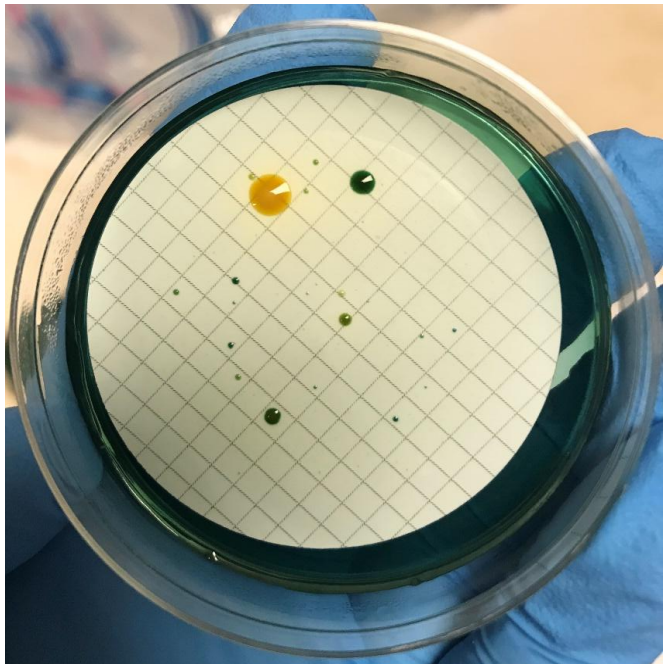
- Shellfish guidelines likely too restrictive for kelp
- Sample kelp directly
- No change in risk throughout season

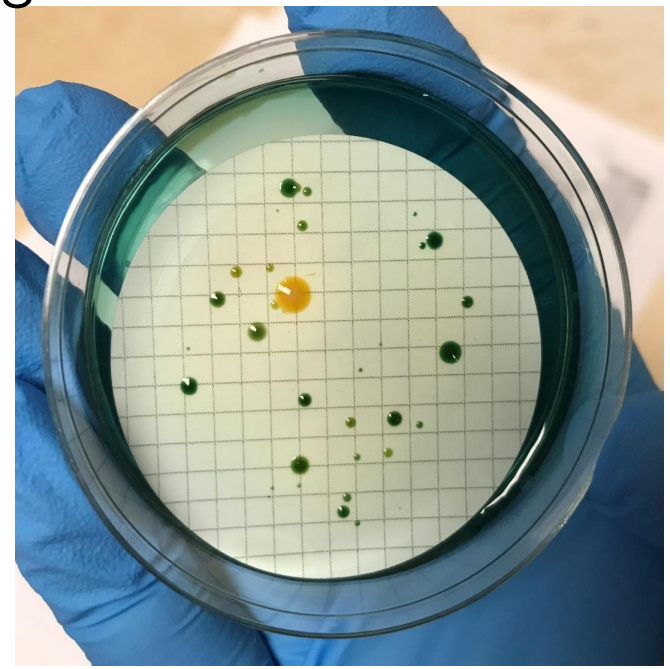


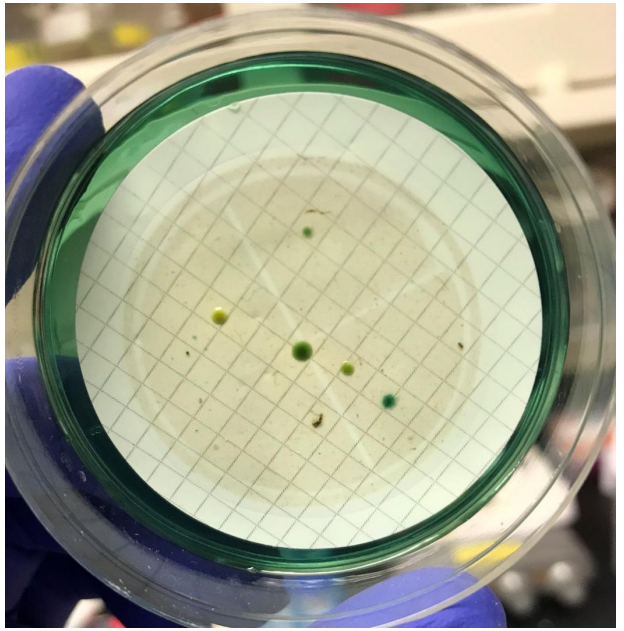
3.
Does bacterial presence differ between kelp and water?

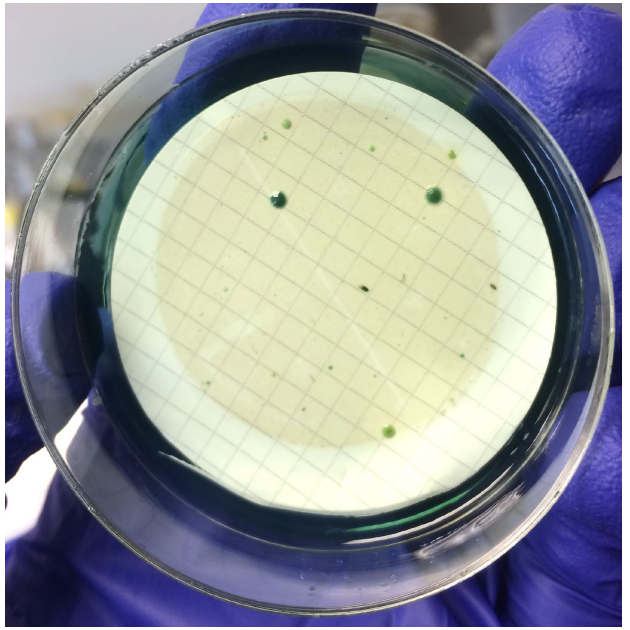
Enumeration of Vibrio

- TCBS agar
- Blue-green identified as *V. parahaemolyticus*
- Yellow as *V. alginolyticus*









Kelp vs Water

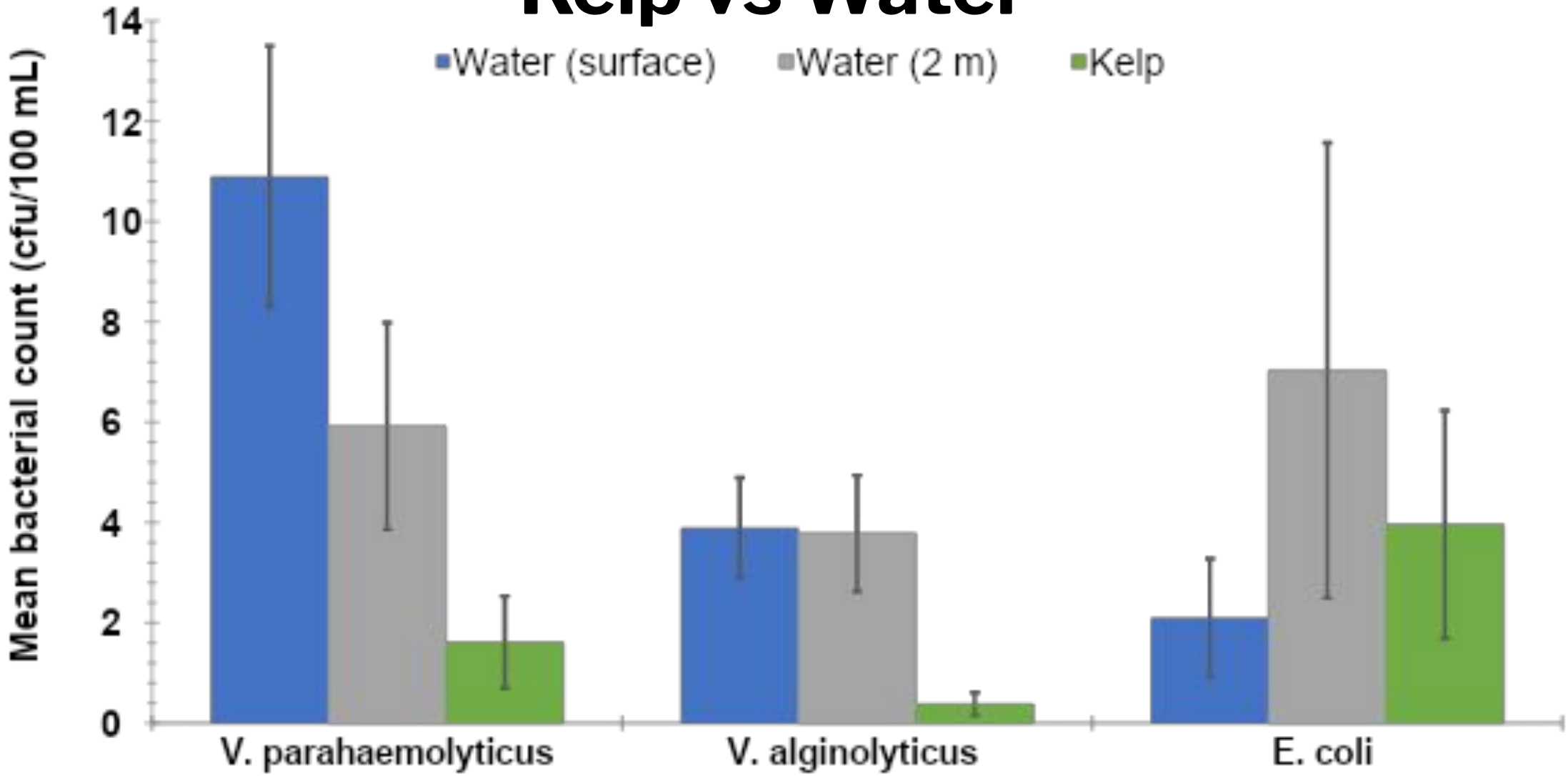
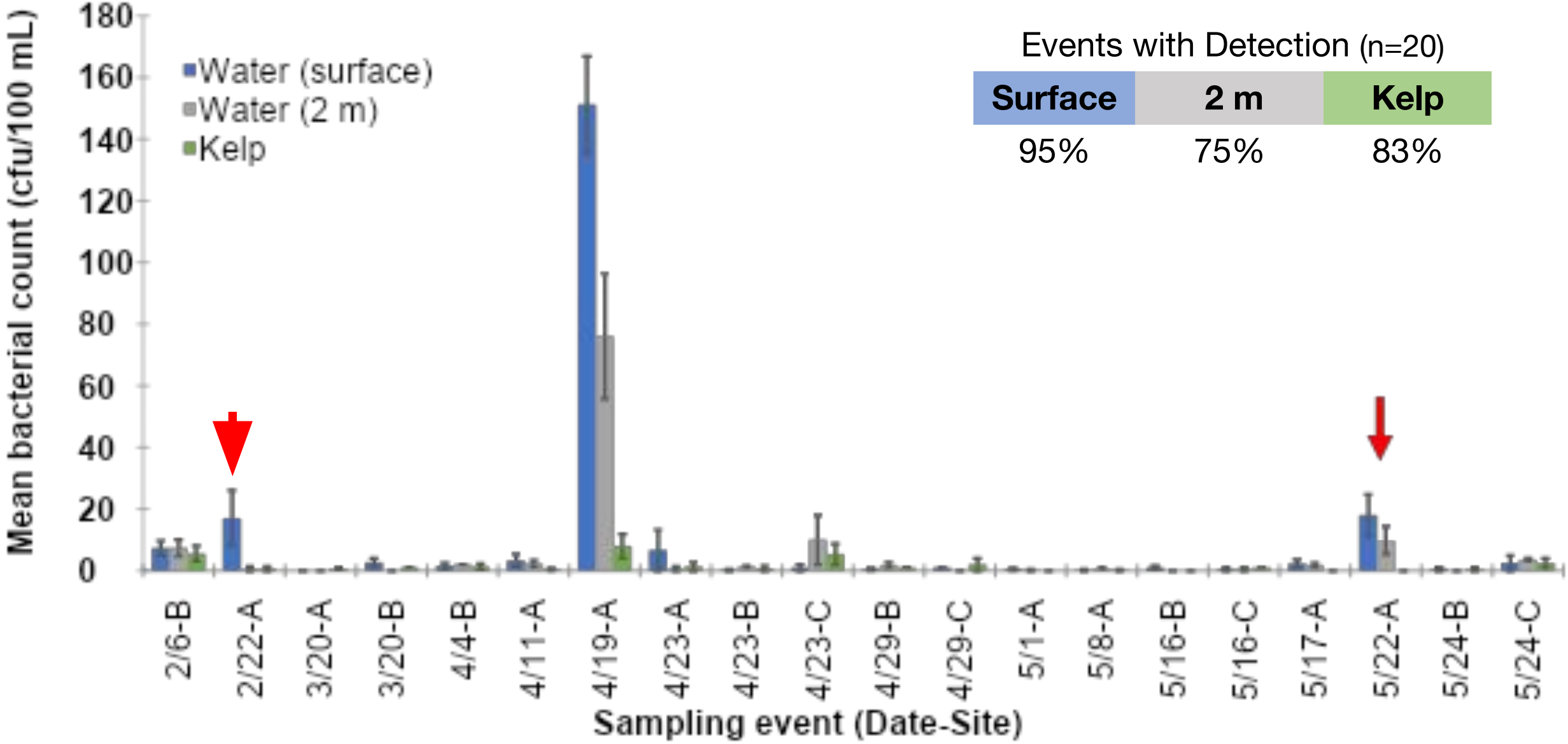


Plate counts: *V. parahaemolyticus*



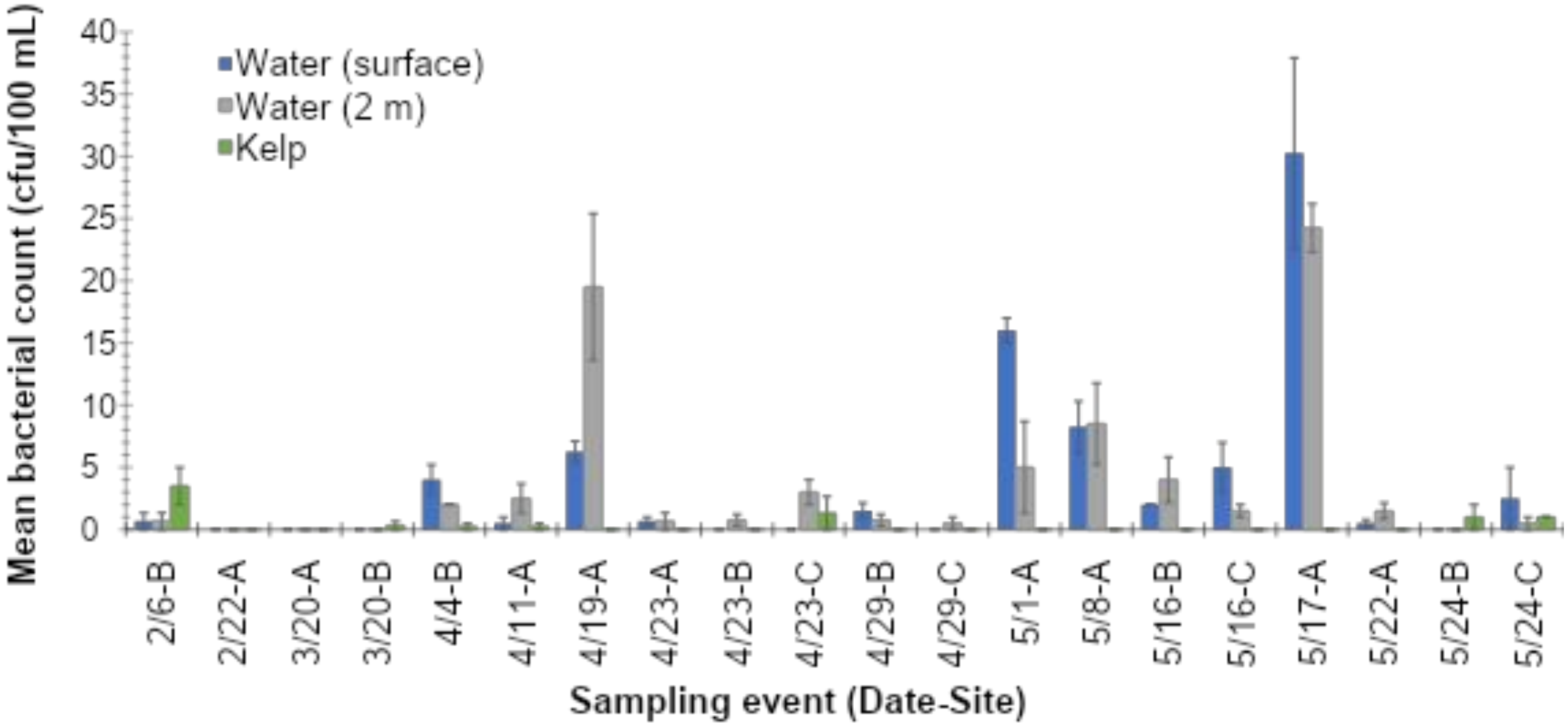
Events with Detection (n=20)

Surface	2 m	Kelp
95%	75%	83%

Plate counts: *V. alginolyticus*

Events with Detection (n=20)

Surface	2 m	Kelp
65%	80%	37%



Does bacterial presence differ between kelp and water?

- Variation in kelp-seawater relationship
- *E. coli* associates with kelp
- Vibrio less frequently associates

Conclusions

1. Risk of pathogens confirmed by frequent qPCR detection

2. Low abundance on kelp; need siting guidelines specific to kelp

3. Variation in bacterial abundance between kelp and water

Industry-established food safety guidelines for post-harvest handling of edible seaweed towards a more resilient coastal community

https://sites.une.edu/byronlab/seaweed-project/

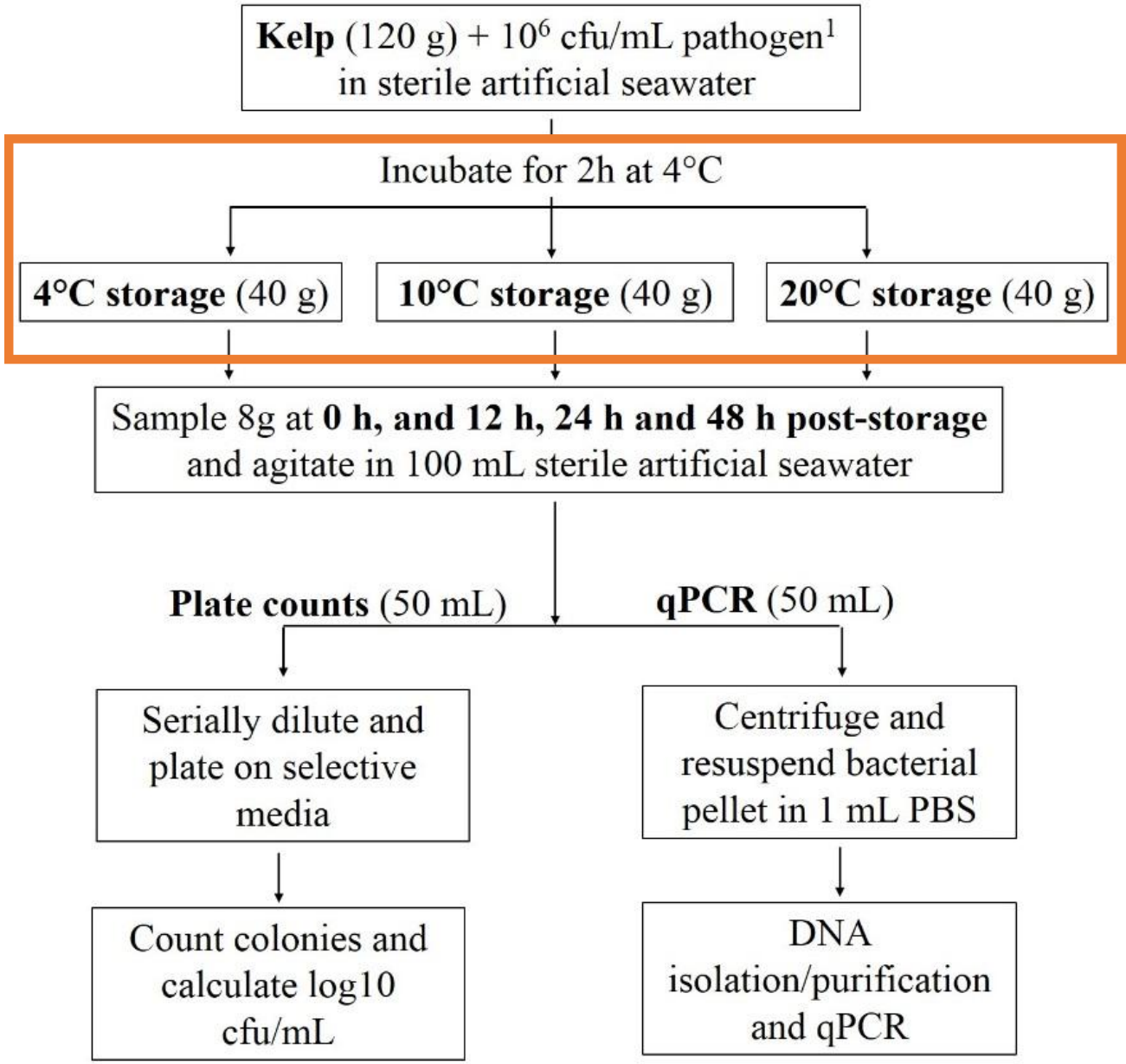
- **Objective 1:** Examine effect of post-harvest storage temperature on seaweed microbial pathogen load.
- **Objective 2:** Investigate effects of post-harvest drying processes on seaweed microbial pathogen load.
- **Objective 3:** Develop data-driven and industry-informed guidelines for safe post-harvest handling and processing of edible seaweed.

Microbiological analysis of kelp subjected to differential temperature storage

(Objective 1)

Experiment will be performed with six individual pathogens:

- *V. parahaemolyticus,*
- *V. vulnificus*,
- EHEC (*E.coli*),
- *S*. Typhimurium,
- *S. aureus*
- *L. monocytogenes.*



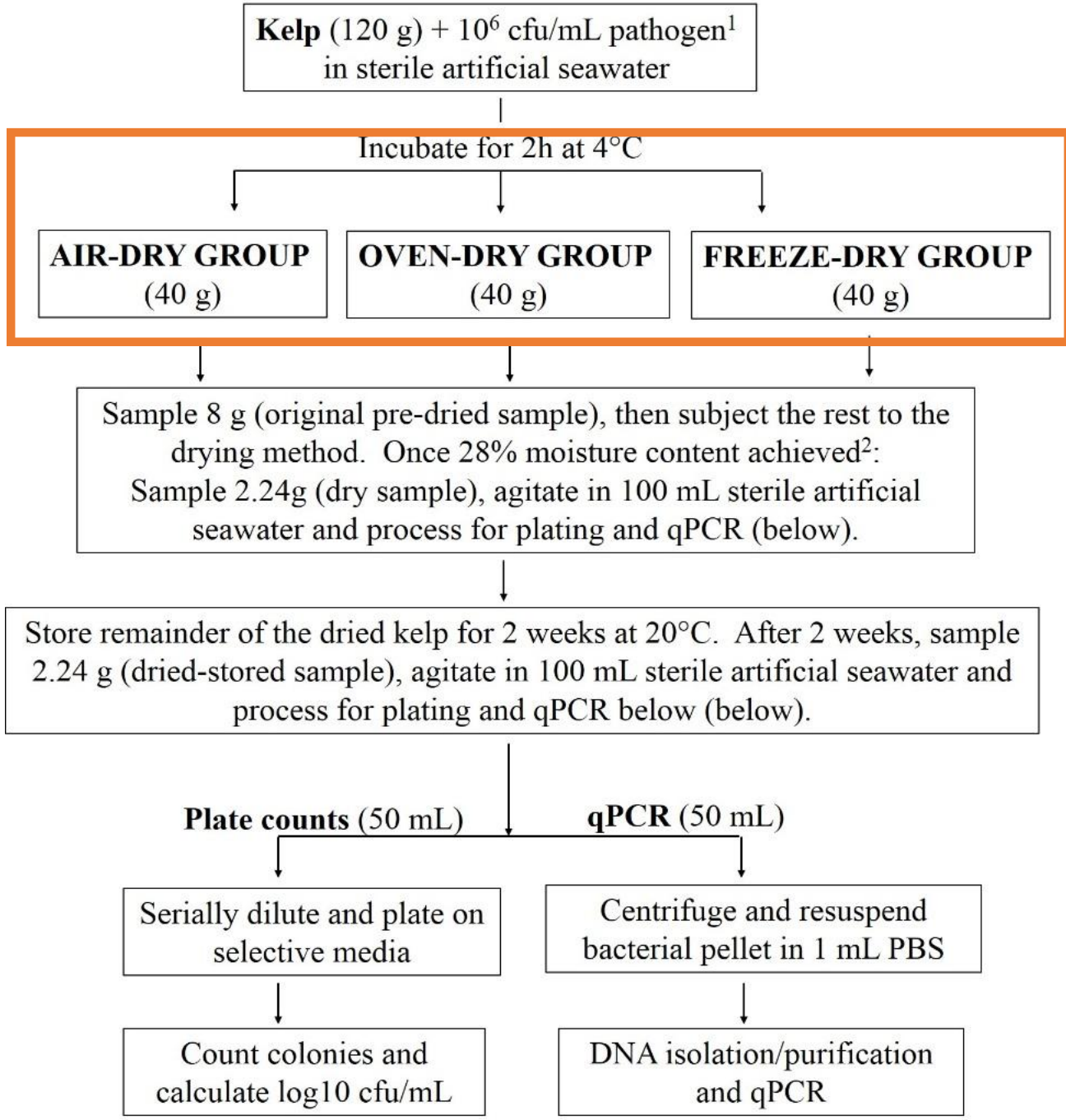
Microbiological analysis of kelp subjected to different drying conditions

(Objective 2)

Experiment will be performed with six individual pathogens:

- *V. parahaemolyticus,*
- *V. vulnificus*,
- EHEC,
- *S. Typhimurium,*
- *S. Aureus*
- *L. monocytogenes*.

Moisture content will be estimated by weighing a subsample prior to drying and at specified intervals during drying process.



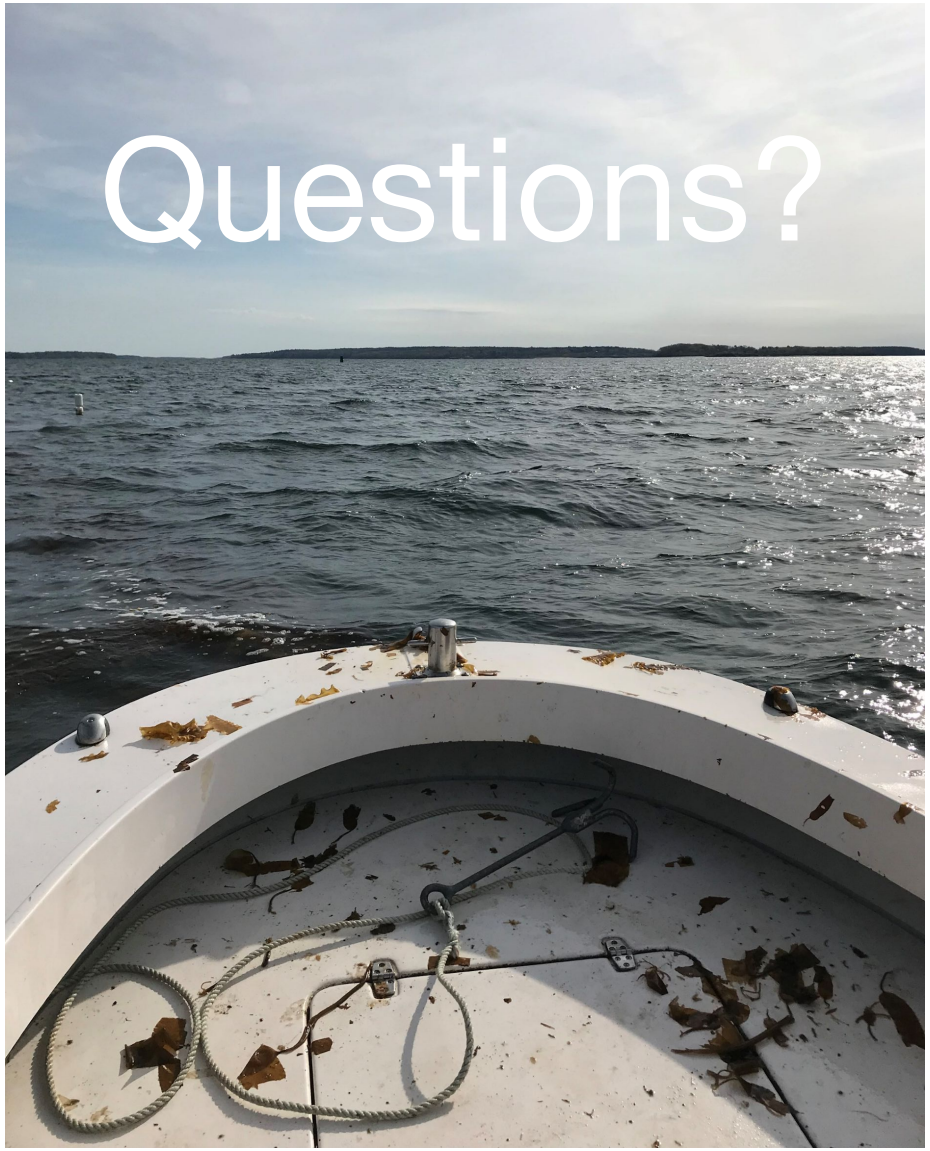
Develop data-driven and industry-informed guidelines for safe post-harvest handling and processing of edible seaweed

(Objective 3)

- **a) Host an information session for targeted stakeholders**
- **b) Organize and convene an industry advisory panel**
- **c) Develop a publicly-available guidance document for the post-harvest production of seaweed**

Carrie J. Byron, Ph.D. cbyron@une.edu 207-602-2287

https://sites.une.edu/byronlab/seaweed-project/



Carrie J. Byron, Ph.D. cbyron@une.edu 207-602-2287

https://sites.une.edu/byronlab/seaweed-project/