

# MACROSYSTEMS

## INNOVATIONS AND CRITICAL HURDLES FOR OFFSHORE CULTIVATION OF MACROCYSTIS PYRIFERA

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OCEAN  
RAINFORREST  
TEAM

# DESIGN OF LARGE SCALE MACROALGAE SYSTEMS PROJECT VISION

***Make macroalgae cultivation a commercially attractive business investment!***

- **Scalable** – in cultivation systems
- **Survivable** – in open ocean conditions
- **Sustainable** – in energy & marine ecosystems
- **Predictable** – in yield and quality
- **Profitable** – enabling return of investments



# PROJECT PLAN AND EXECUTION

## PHASE I

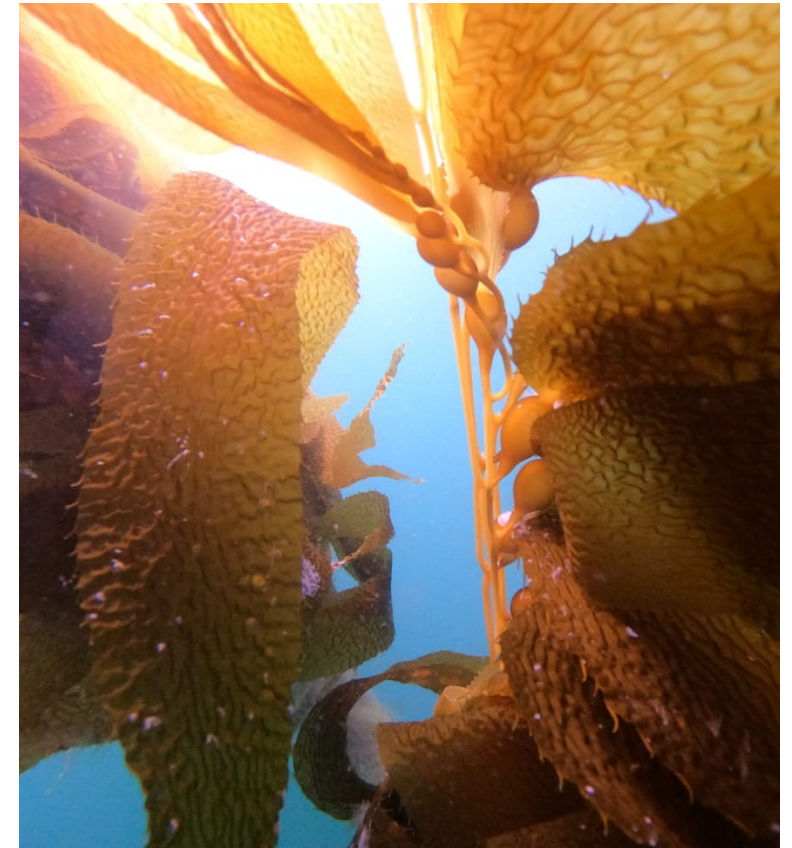
2018-2019

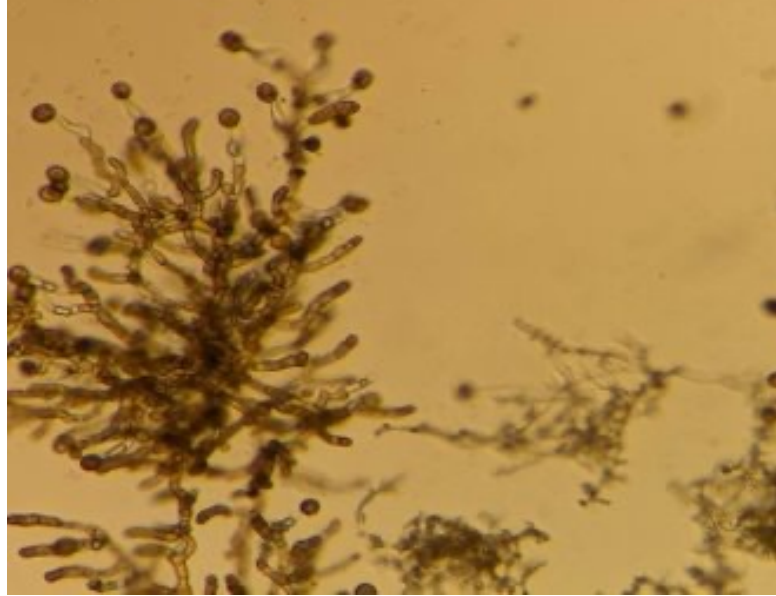
- Design scalable cultivation system >1000 ha
- Reduce cost by direct seeding
- Harvest up to 30 tons/ hour
- Profitability of operation with a production cost <\$80/DMT
- Identify over 100.000 ha suitable for *Macrocystis* cultivation

## PHASE 2

2020-2023

- De-risk the full chain from propagation to planting, cultivation and harvesting
- Demonstrate the capabilities of the proposed cultivation design
- Optimize the aspects and factors which have a great impact on the economics and scaling up of operations





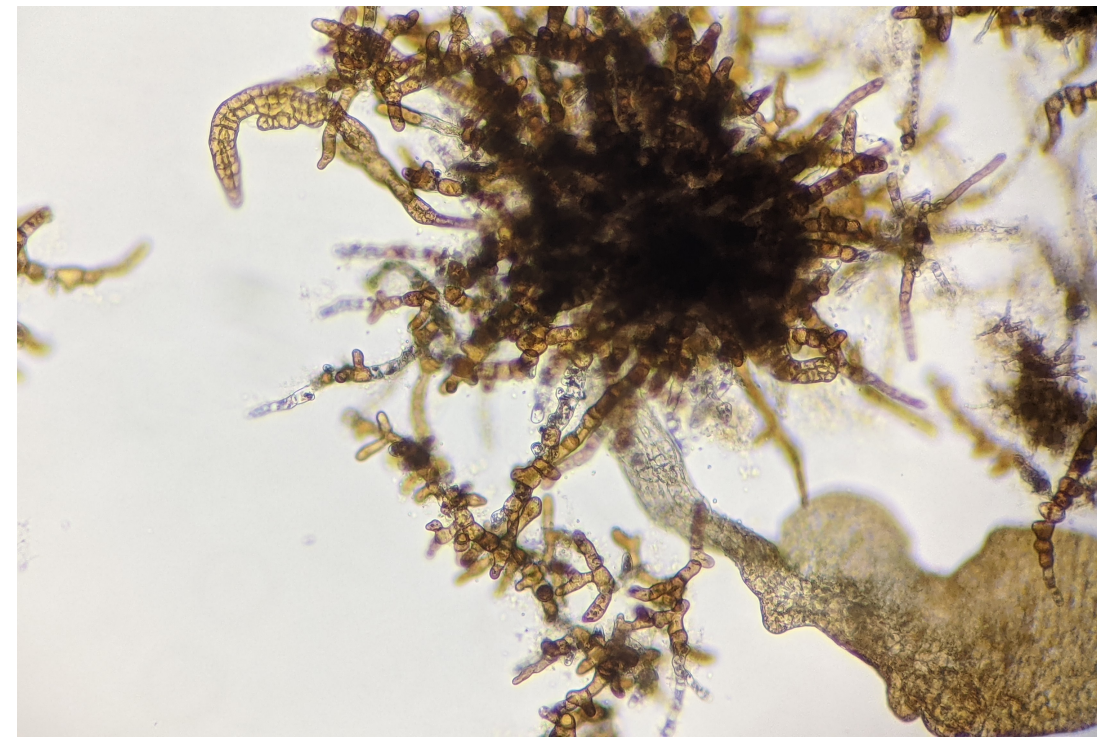
## YEAR I – HATCHERY OPERATION

- Installation of a hatchery facility at the Cultured Abalone Farm that was fully operational in February 2021
- Successful propagation and induction of gametophytes
- Produced the needed biomass for year I trials
- Gametophytes were ready for deployment in late March and early April 2021



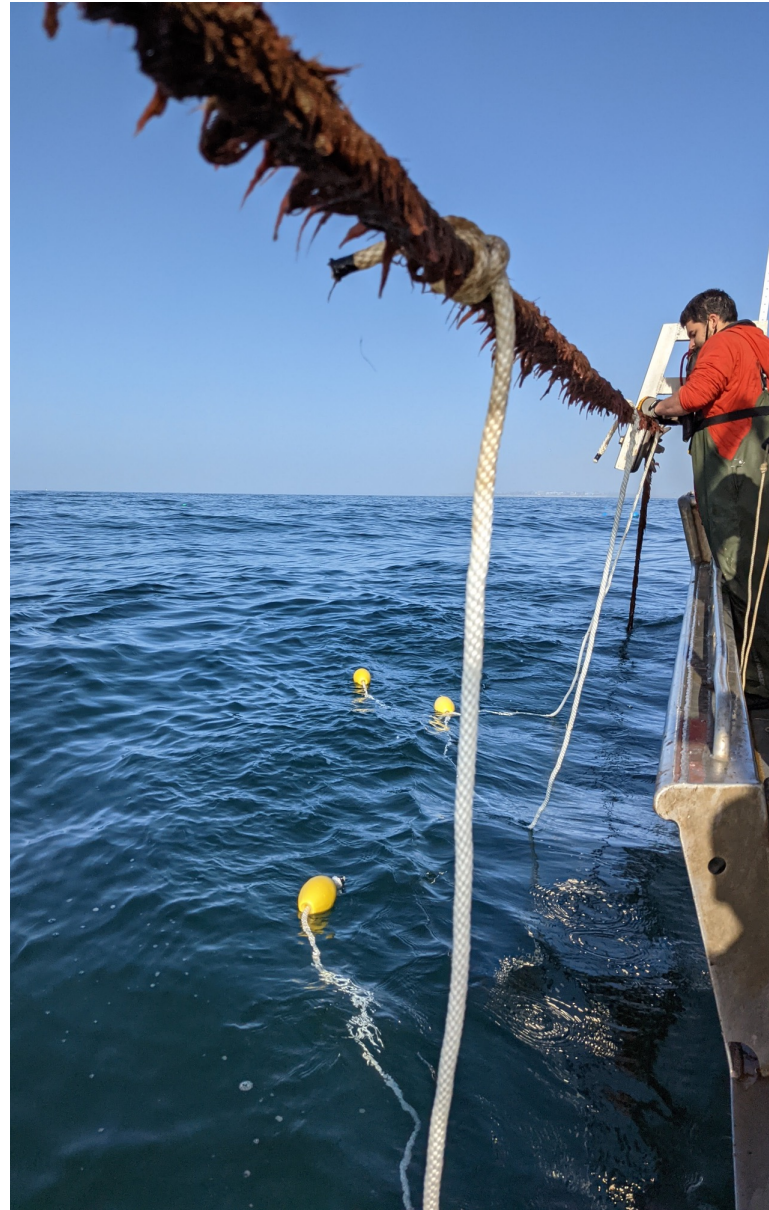
# YEAR I – HATCHERY OPERATION

- Executed preliminary trials and successfully executed with direct seeding methodology
- Continued to refine propagation, induction and seeding protocols
- First known trial of direct seeding with *Macrocystis* was **successful!**
- Developed innovative machine for direct seeding in partnership with SEAWISER



## YEAR 1 OPERATION - OPEN OCEAN

- Modified existing infrastructure at the Santa Barbara Mariculture Site to accommodate year 1 experiments
- Executed baseline survey and implemented bi-monthly environmental and biomass monitoring program.
- Directly seeded 1,000+ meters of grow lines





March 30



June 16

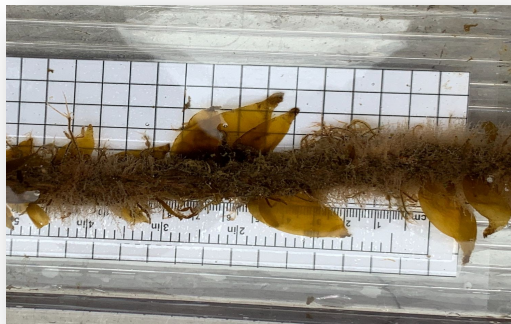


August 16



June 1

August 2

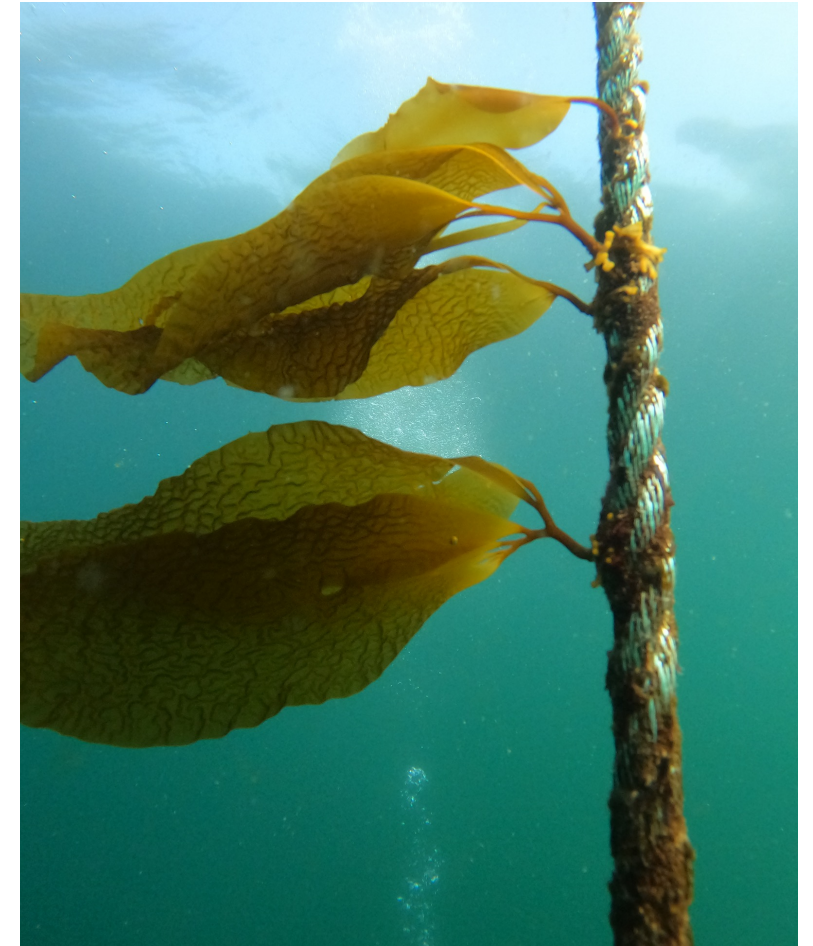


# YEAR I – OPERATION OPEN OCEAN



# YEAR 2 OPERATION - INFRASTRUCTURE AND SEEDING

- Deployed all infrastructure to support Year 2 and 3 experiments at the Santa Barbara Mariculture site
  - 12 backbone lines
  - 4,500+ m of grow lines
- Preliminary observations indicated good attachment of the directly seeded material to the grow lines





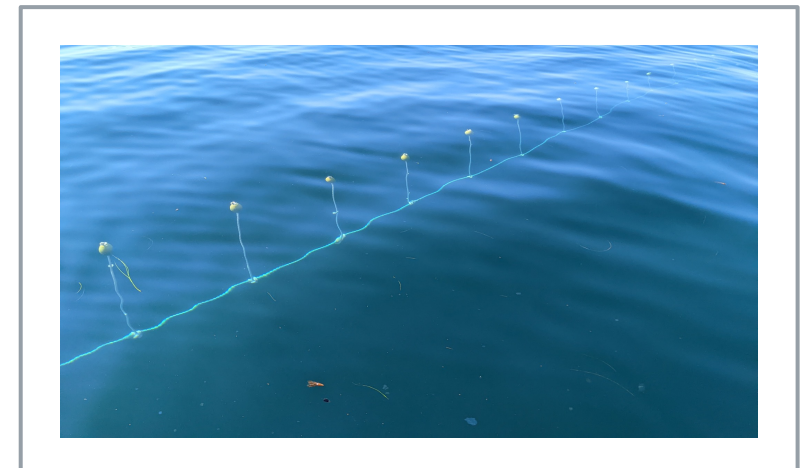
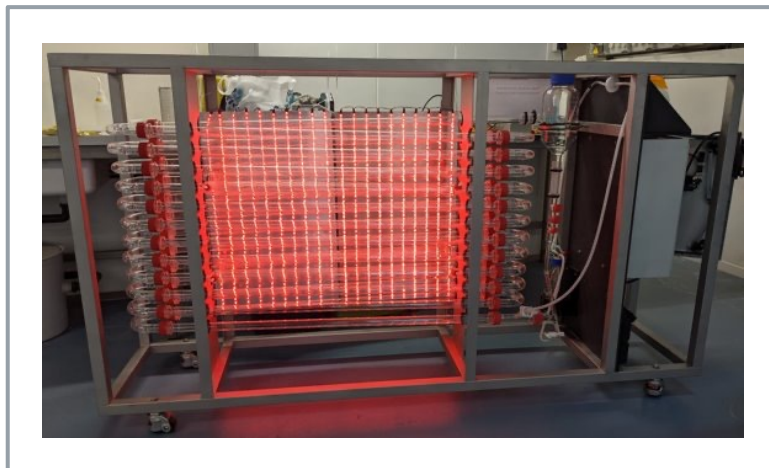
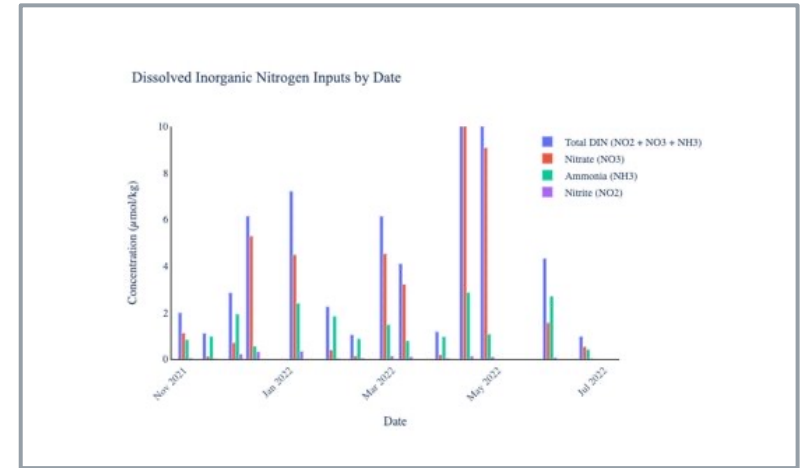
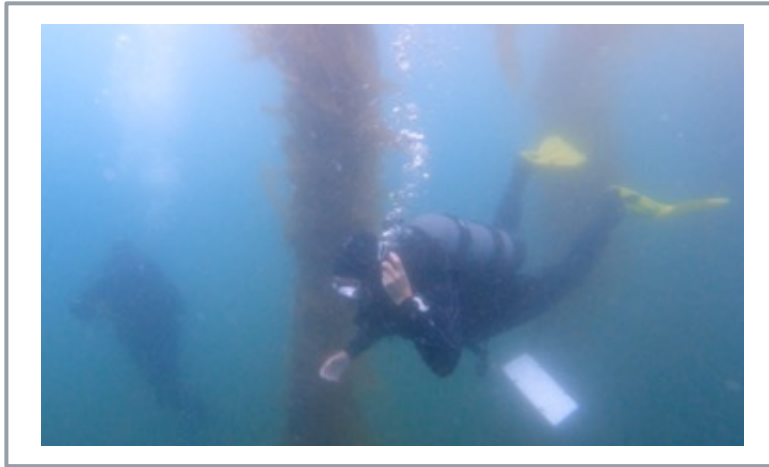
## YEAR 2 – CANOPY DEVELOPMENT

- There has been canopy development on virtually all experimental backbone lines across the farm.
- Biomass development has met or exceeded expectations for this year experiments.



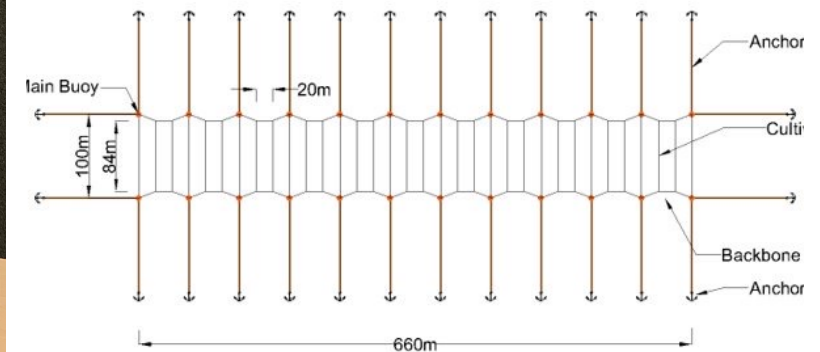
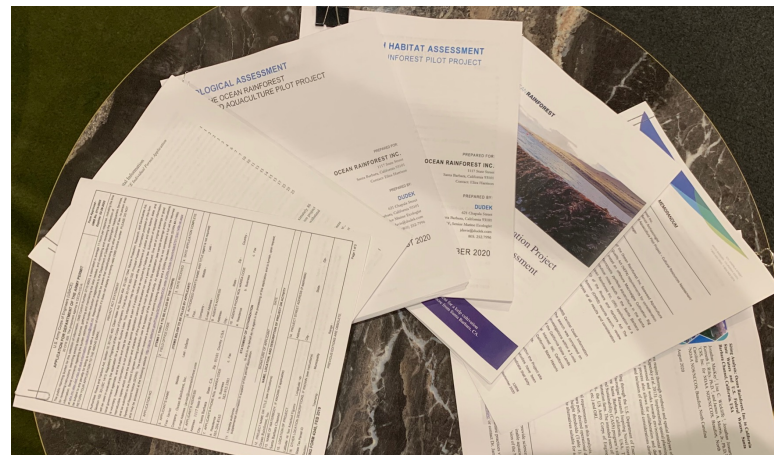
# YEAR 3 OPERATION - NEXT STEPS

- Continue environmental monitoring to complement yield data
- Test of new hatchery technologies:
  - Photobioreactor for propagation and induction,
  - Mechanized seeding machine
- Deploy infrastructure at offshore project location to confirm optimal cultivation methods



# INDIVIDUAL PERMIT APPLICATION

- Proposed as a research and development initiative to support the goals and objectives of the ARPA-E Mariner Program
- Demonstrate the feasibility of growing Giant kelp in true offshore conditions.
- Further validate the assumptions under our Technoeconomic Assessment and Finite Element Analysis





# PERMIT APPLICATION SUMMARY



# LOOKING AHEAD – MARKETS

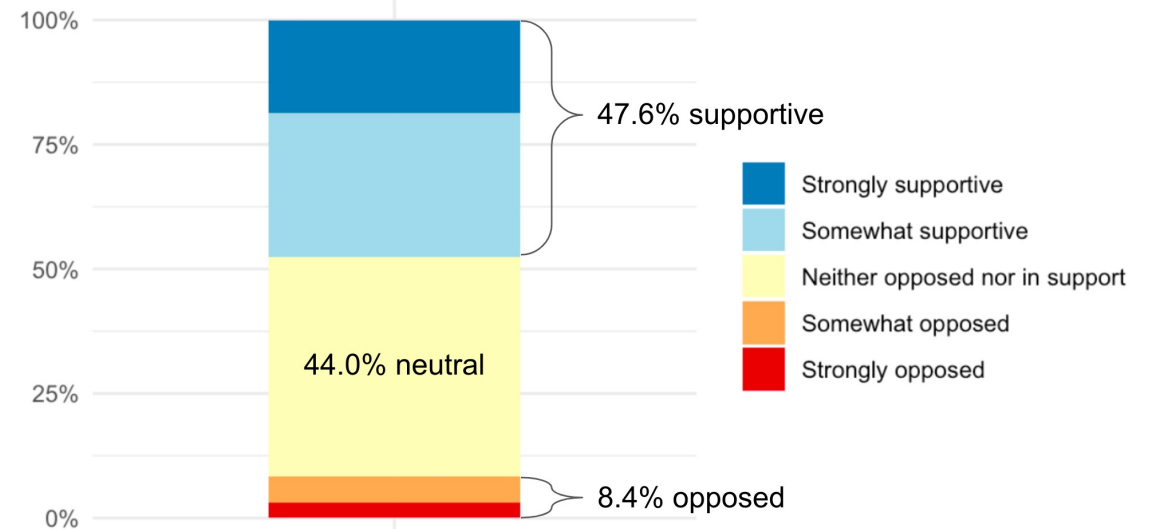
Pig feed shows significant opportunity for improved animal health

- Improved Feed Conversion Ratio
- Reduced mortality
- Increase in antibodies
- Reduced usage of antibiotics
- Improved animal welfare

# PUBLIC OPINION SURVEY - UCSB

- Survey to understand perceptions of seaweed aquaculture in Ventura and Santa Barbara County
- Intended to inform the type of informational material required to build social license in the region
- Questions specifically related to perceptions of seaweed aquaculture
- 350 responses from residents of Ventura and Santa Barbara County
- **A majority of residents support expanding kelp/seaweed aquaculture in the Santa Barbara Channel.**

Are you supportive of or opposed to expanding seaweed aquaculture off the California coast?





# THANK YOU!

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