The Potential for a Pilot Macroalgae Farm Within the Venetian Lagoon

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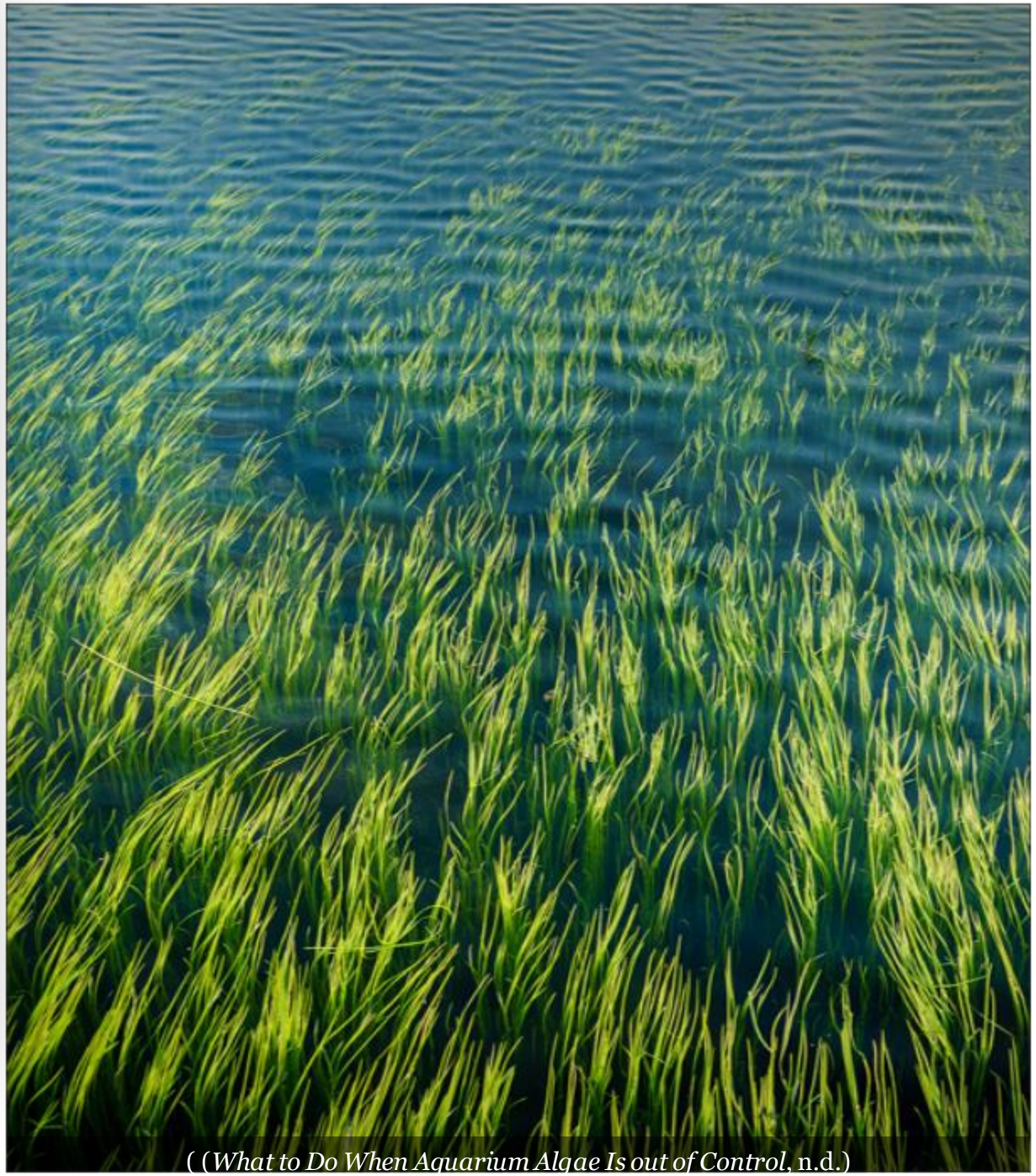
WPI

Human activity pollutes marine environments

- Production of fossil fuels
  - Increases carbon dioxide
  - Decreases water pH
- Floating plastic debris
- Accumulation of heavy metals

Macroalgae are a sustainable solution to pollution

- Absorbs carbon dioxide
- Increases water pH
- Traps plastic debris
- Soaks up heavy metals



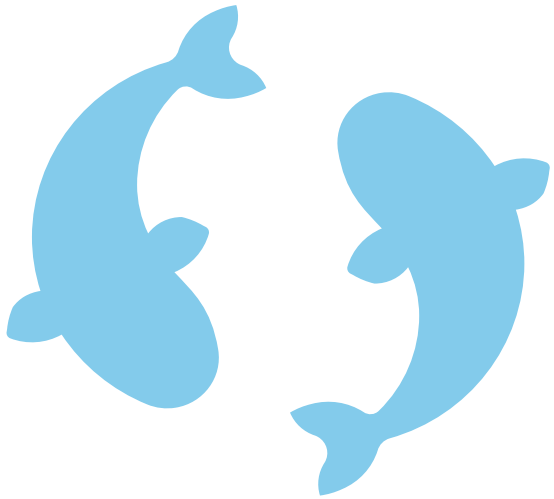
((*What to Do When Aquarium Algae Is out of Control*, n.d.)

"Marine algae account for about 50 percent of global carbon dioxide absorbed today on Earth” (“Farming Algae for Carbon Capture,” 2023)

Macroalgae can be controlled in a farming system to benefit the community

- Grow in nursery period
- Use buoy infrastructure
- Harvest every 1-4 months
- Create jobs
- Shelter species

("Ocean-Based Carbon Dioxide Removal," n.d.)



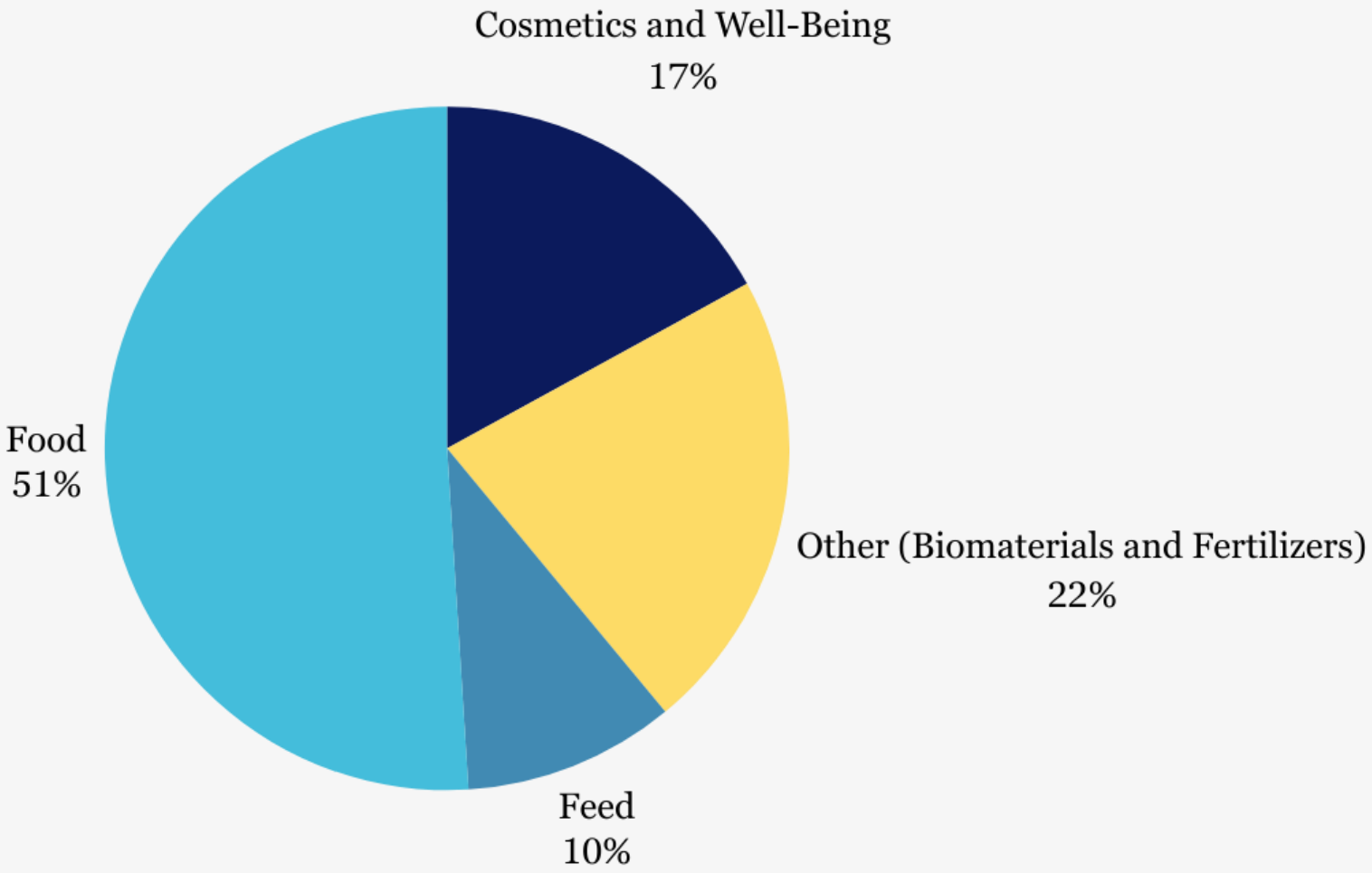
Macroalgae farms promote “50% higher abundance of organisms and 30% higher species richness” (Ahmed et al., 2020)

Seaweed industry has employed 26,000 farmers worldwide (Msuya & Hurtado, 2017)

Macroalgae farms are becoming more common within the EU

About 163 macroalgae producing companies in Europe

(European Union, 2023) based on information from the European Marine Observation and Data Network (EMODnet)



(European Union, 2023)

Growing market for algal bioproducts

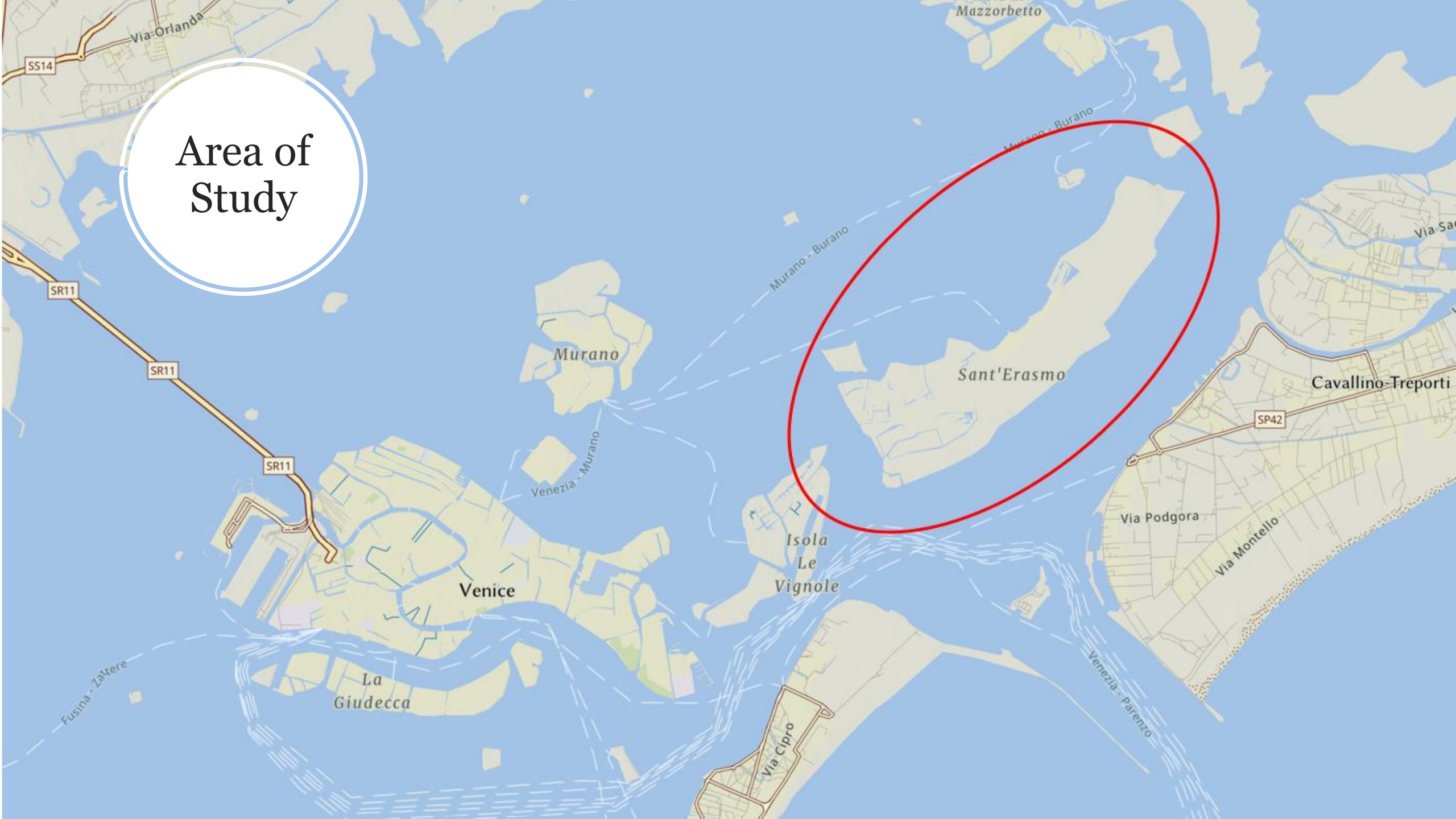
In 2019 the European algae sector produced 287, 000 tonnes of algal biomass, 99.9% of that being from macroalgae

ALGAE SCOPE

MIT DESIGN X

- 2 farms in Japan and 1 pilot in Saudi Arabia
- Looking to expand to Venice
- 2023 MITdesignX Venice competition winners

Our goal was to determine the feasibility of implementing a pilot macroalgae farm in Sant'Erasmo using an *Ulva* species of algae.


Area of Study
Mazzorbetto
Via Orlanda
SS14
SR11
SR11
SR11
Murano - Burano
Murano
Sant'Erasmo
Via Sa
Cavallino-Treporti
SP42
Venezia - Murano
Isola Le Vignole
Via Podgora
Via Montello
Venice
La Giudecca
Fusina - Zattere
Via Cipro
Venezia - Parenzo

Ulva has potential for macroalgae farming in Venice

- Wide environmental tolerance
- Native to the Venetian Lagoon
- Rapid growth rate
- Bioremediation abilities
- Bioproduct potential

Objectives

Environmental Assessment

Industry Analysis

Site Recommendations

Objectives

Environmental Assessment

Industry Analysis

Site Recommendations

We interviewed 4 experts

Dr. Alejandra Noren
Carbon Market Development

Dr. Jeremy Pal
Environmental Consultant

Dr. Roberto Pastres
Environmental Scientist

Dr. Adriano Sfriso
Environmental Scientist

Macroalgae farms can benefit the Venetian Lagoon

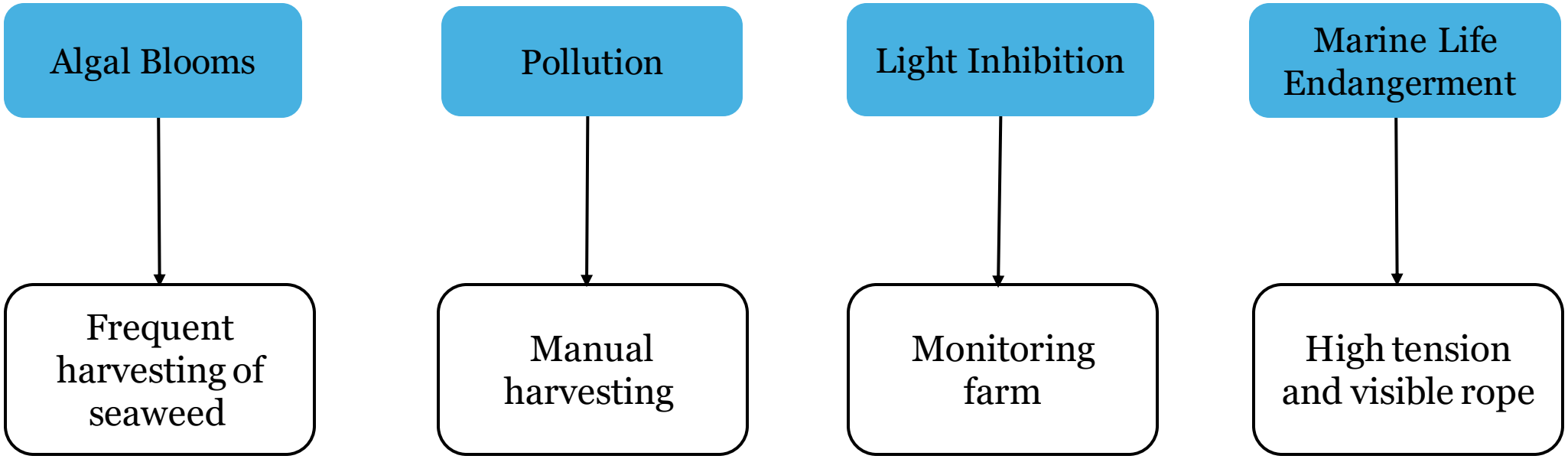
- Return pH to favorable conditions
- Absorb pollution from drainage basins
- Provide insight on lagoon pollutants
- Shelter bird and migratory fish species
- Protect Sant'Erasmo shoreline

(*Exploring the Venetian Lagoon Islands*, n.d.)

In the Venetian Lagoon a one-hectare farm using *Ulva* algae can sequester **5.5 tons** of carbon dioxide per year

5.5 tons is equivalent to the average carbon footprint of one Italian over a one-year period

The risks of Venetian macroalgae farming can be mitigated



Recommendations to achieve best practices in farming

Infrastructure

Eco-friendly equipment

Harvesting Techniques

Nursery period
Harvest once a month

Experimentation

pH
Heavy metal concentration
Salinity
Temperature
Nutrients

Weekly observations

Pollution
Species presence

Objectives

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Site Recommendations

We interviewed 2 experts

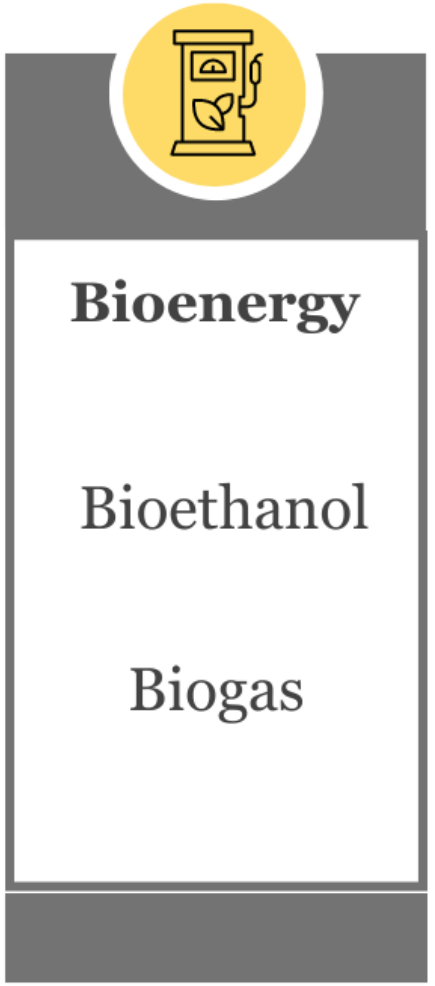
Dr. Farshid Pahlevani

Material Scientist

Dr. Elvira Rakova

Sustainable Energy

Achievable bioproducts for Sant'Erasmo:



Macroalgae farms can create a circular economy within Sant'Erasmo

Digital Collection of Single-Page Summaries

- Combat Climate Change with Macroalgae
- Macroalgae Farming's Potential for a Circular Bioeconomy
- Macroalgae Farm Benefits
- Risks of Macroalgae Farming can be Mitigated
- *Ulva* Species
- *Ulva* Cultivation
- Bioproduct Production
- Macroalgae Bioproducts Application
- Growing Industry for Bioproducts

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The Venetian Lagoon supports *Ulva* growth

Water Characteristics	*Ulva* Cultivation	Venetian Lagoon	Compatibility
Water Turbidity	Low	0.15-9 m (low)	✓
Depth	1-5 m	1-1.2 m	✓
Temperature	Up to 40°C	5-30°C	✓
Salinity	26-32 ppt	28-33 ppt	✓
pH	6-10	6.9-9.5	✓
Tidal Flow	Preferred	Present	✓

Three potential pilot farm locations around Sant'Erasmo

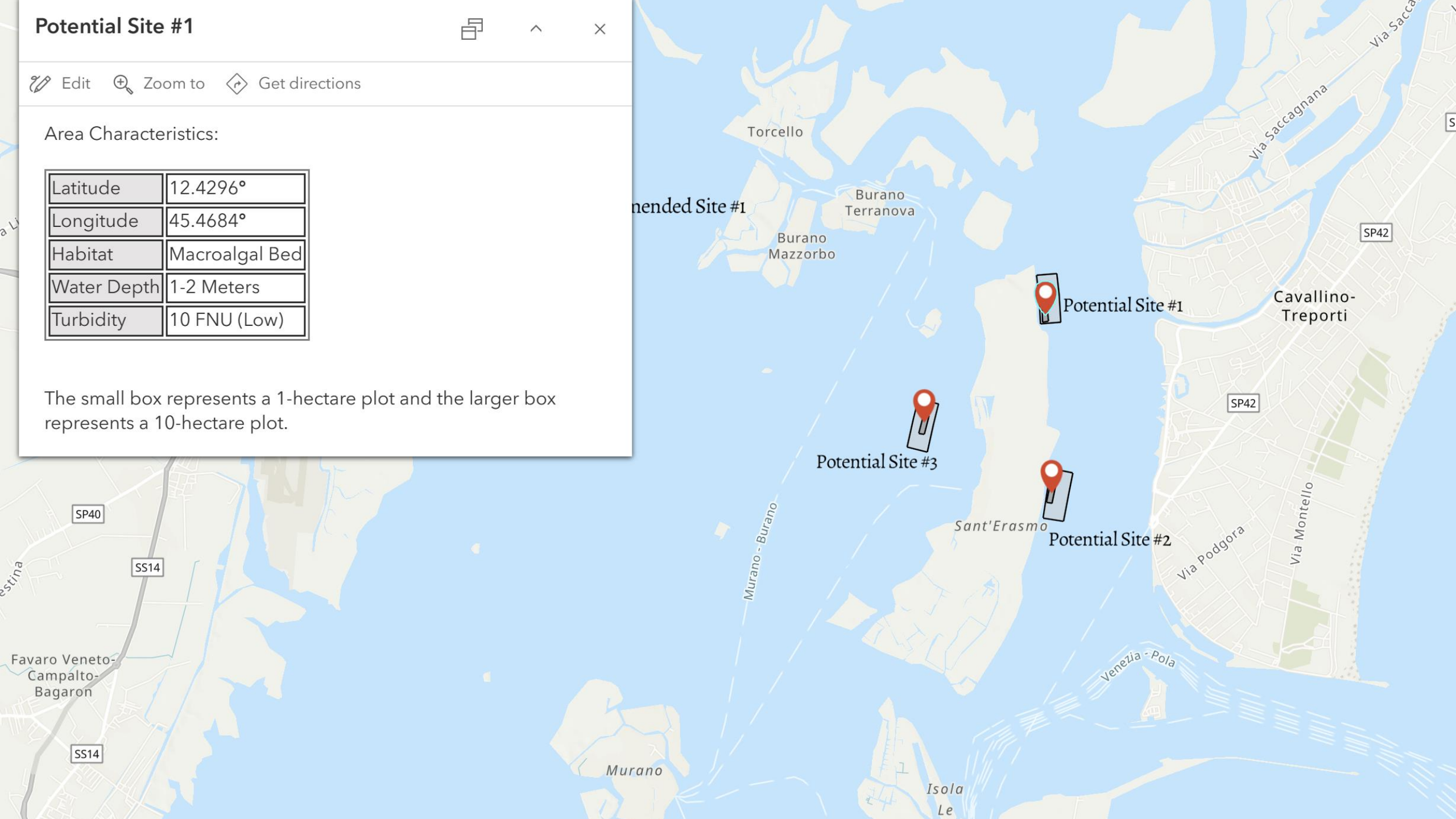
Potential Site #1

Edit | Zoom to | Get directions

Area Characteristics:

Latitude	12.4296°
Longitude	45.4684°
Habitat	Macroalgal Bed
Water Depth	1-2 Meters
Turbidity	10 FNU (Low)

The small box represents a 1-hectare plot and the larger box represents a 10-hectare plot.



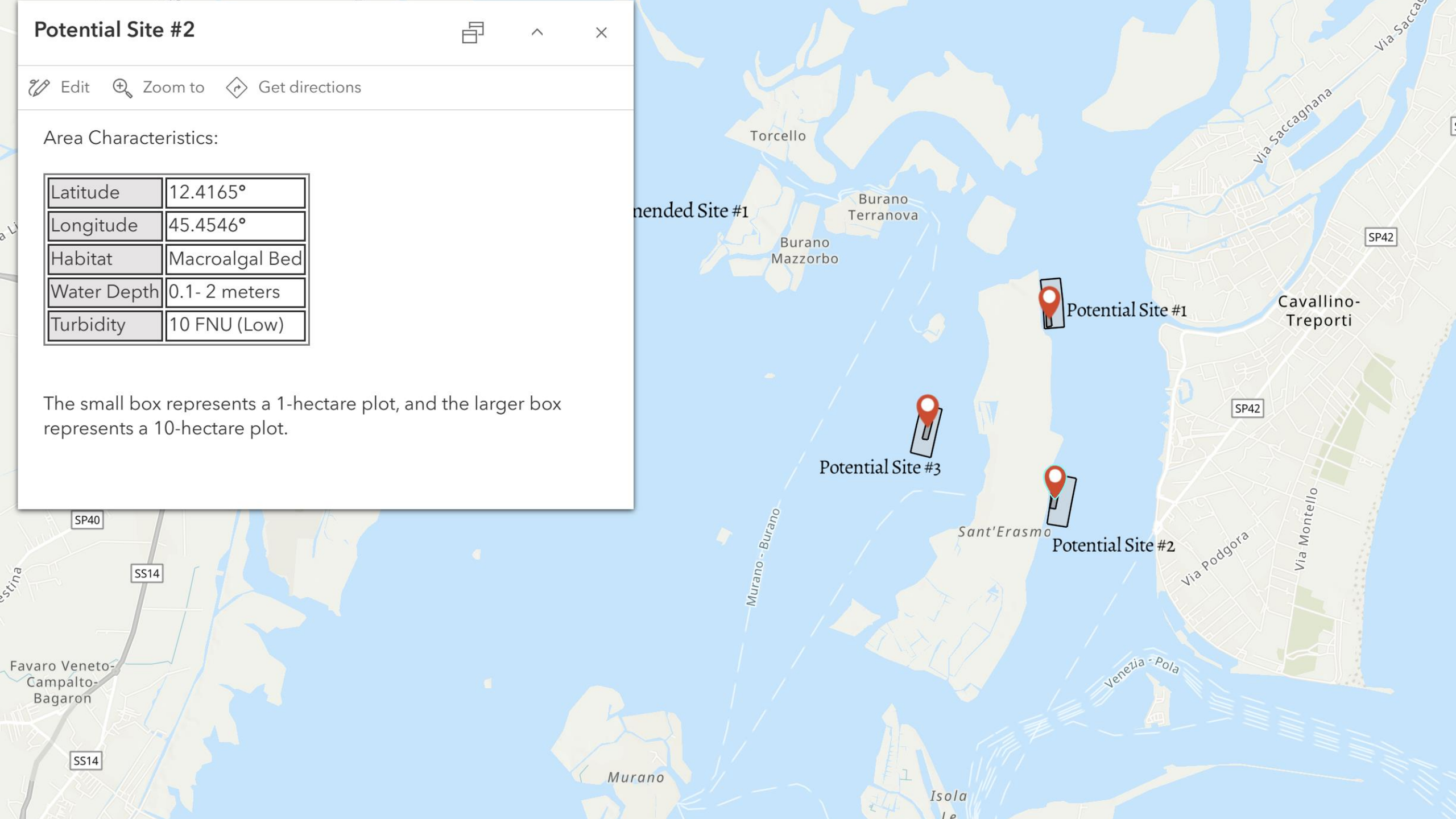
Potential Site #2

Edit | Zoom to | Get directions

Area Characteristics:

Latitude	12.4165°
Longitude	45.4546°
Habitat	Macroalgal Bed
Water Depth	0.1- 2 meters
Turbidity	10 FNU (Low)

The small box represents a 1-hectare plot, and the larger box represents a 10-hectare plot.



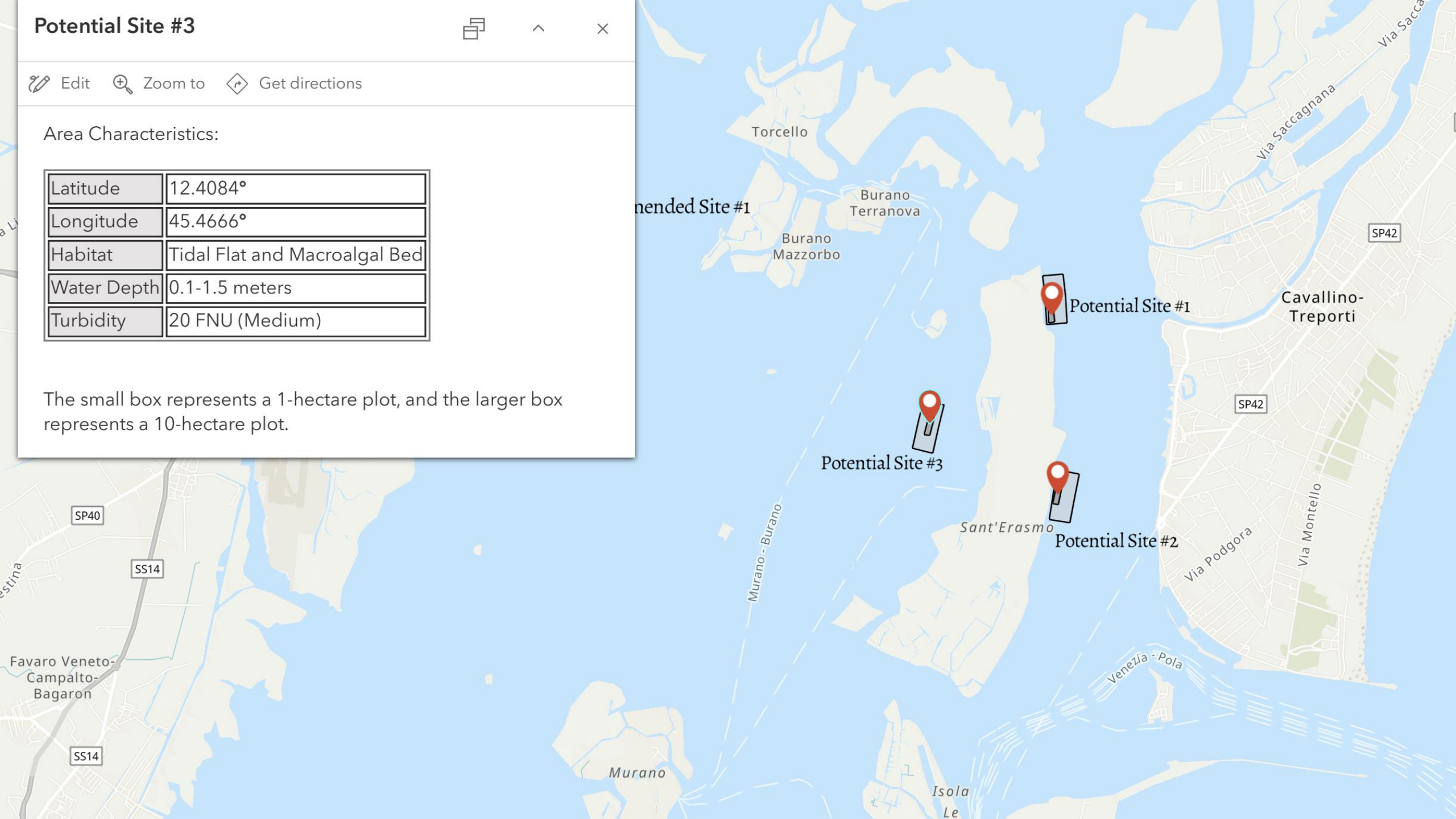
Potential Site #3

Edit | Zoom to | Get directions

Area Characteristics:

Latitude	12.4084°
Longitude	45.4666°
Habitat	Tidal Flat and Macroalgal Bed
Water Depth	0.1-1.5 meters
Turbidity	20 FNU (Medium)

The small box represents a 1-hectare plot, and the larger box represents a 10-hectare plot.



Future directions to ensure the success of a Venetian macroalgae farm

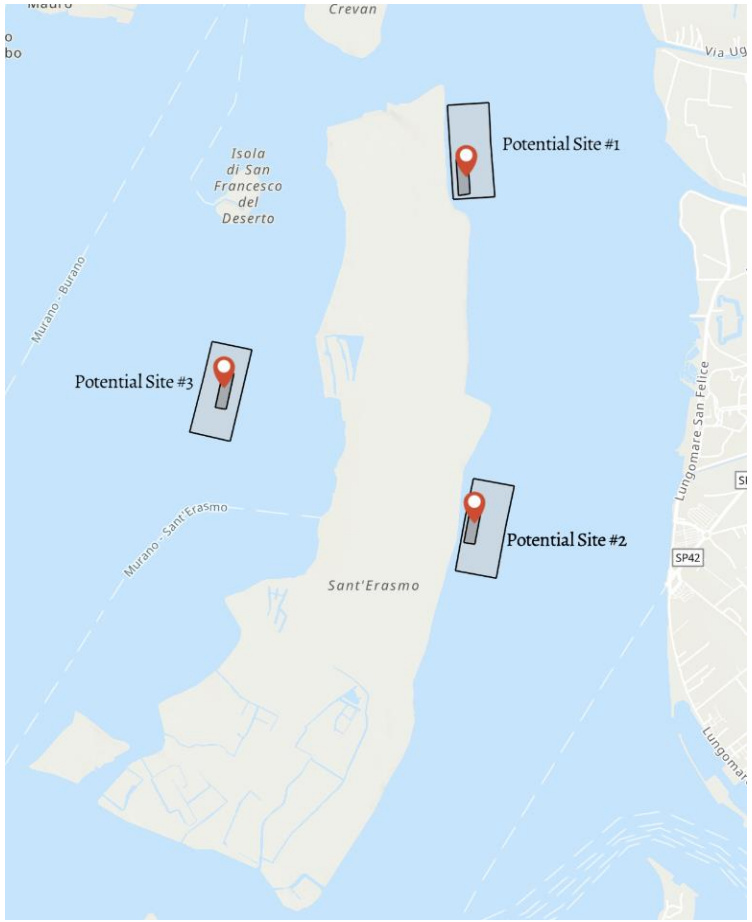
Collect information regarding legislation and usage for the lagoon

Meet with mussel/clam farmers that have established farms

Gain trust within the Venetian community

Share concrete data from preliminary testing

The Venetian Lagoon can sustain macroalgae farming



- **3** Potential Sites
- Focus on biofertilizers
- Establish best practices for farming
- **5.5 tons** of carbon dioxide sequestered per year

Special Thanks to:

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- Dr. Jeremy Pal
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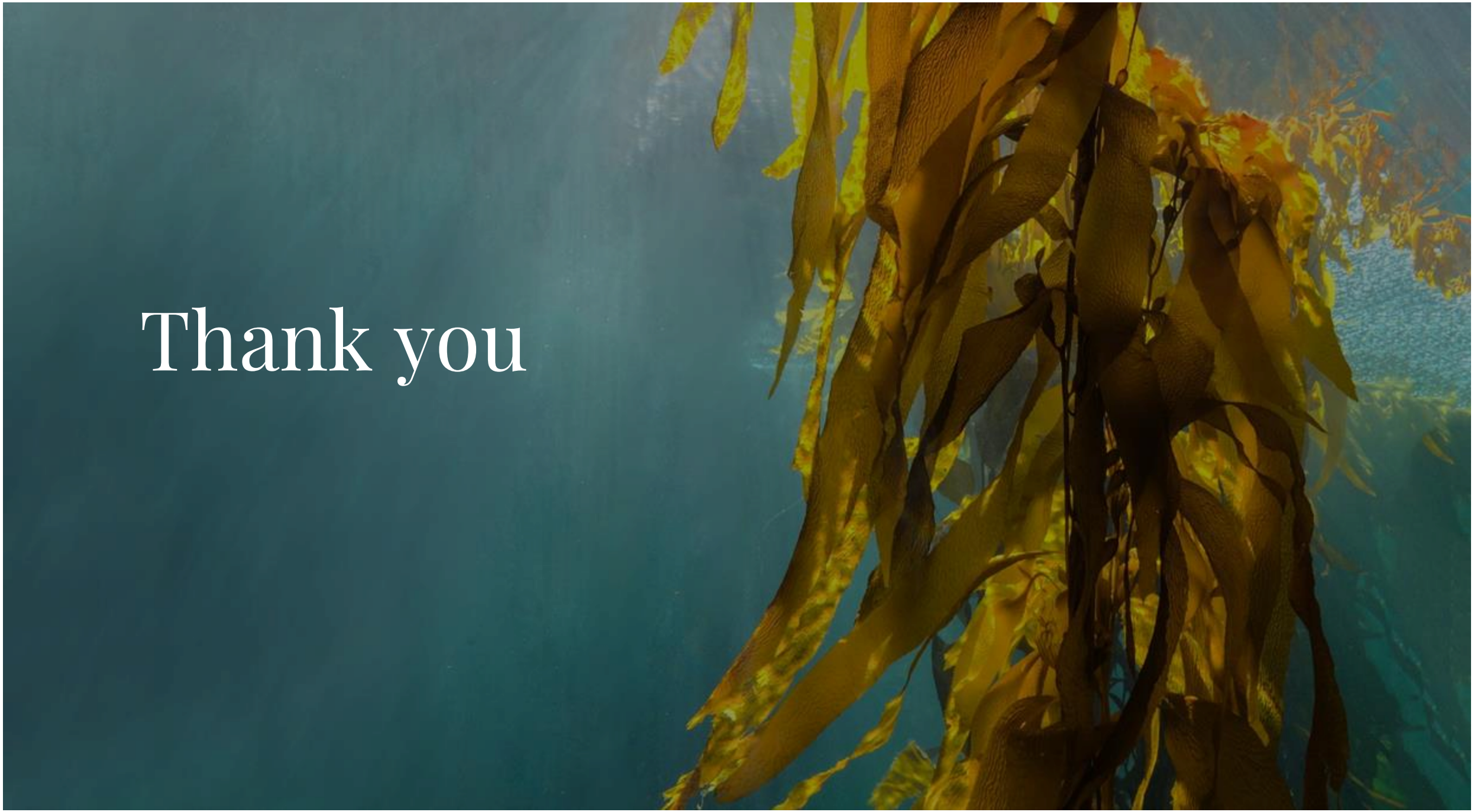
Thank you