



The MARINER Program: Scaling Off-Shore Cultivation of Macroalgae

Marc von Keitz, PhD
Program Director
ARPA-E

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**Oceans are the largest untapped
growth opportunity for biomass**

70% of world's surface

Water

Nutrients

...and Macroalgae the quintessential ocean crop



- Current global seaweed production is nearly 30 million wet metric tons...more than ½ of global aquaculture production
- However, production is labor intensive and geographically limited to near shore, protected ocean environments

Current state of technology will never scale to meet ENERGY and CO₂ Capture demands!

ARPA-E's MARINER Program

MacroAlgae Research Inspiring Novel Energy Resources



Macroalgae Biomass:

No Land

No Freshwater

No Fertilizer

MARINER creates new biomass production opportunities for the vast ocean resources of the United States.

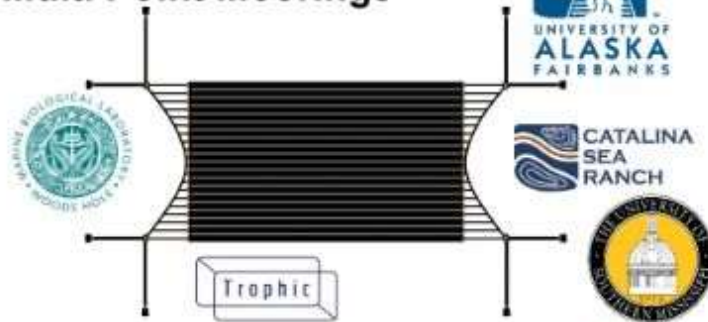
Photo courtesy of the authors:
Diana Bunko/Advanced Composite, The Ocean Institute, Drew Smith/Algaebio.com

18 MARINER Teams are tackling different aspects of scaling

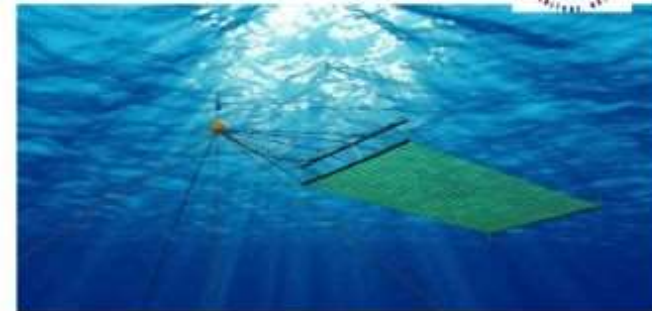
<p>Cat. 1: Design & Experimental Deployment of Cultivation and Harvesting Systems</p> 	 <p>Prime Sub</p>	
<p>Cat. 2: Design & Experimental Deployment of Cultivation and Harvesting System Component Technologies</p> 	<p>Cat. 4: Design & Deployment of Aquatic Monitoring Technology and Tools</p> 	<p>Geo-spatial Support Tools: Aquamapper & Ocean Reports</p> 
<p>Cat. 3: Design & Deployment of Computational Modeling Tools</p> 	<p>Cat. 5: Research & Development of Breeding and Genetic Tools</p> 	

Off-shore Cultivation & Harvest

Multi Point Moorings



Single Point Moorings



Floating Arrays



Pacific Northwest
NATIONAL LABORATORY

Seaweed Ranching



FEARLESS FUND

Autonomous Transportation



**C.A. Goudey
& Associates**

**Drone Tug &
Harvest Bag**

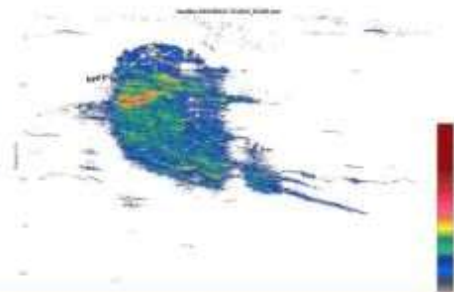


Remote Monitoring Technology and Tools

Autonomous Underwater Vehicle (AUV)



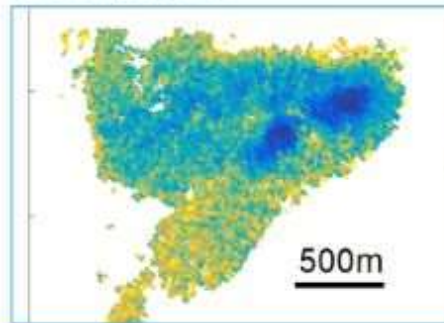
Sonar for biomass quantification & Farm inspection



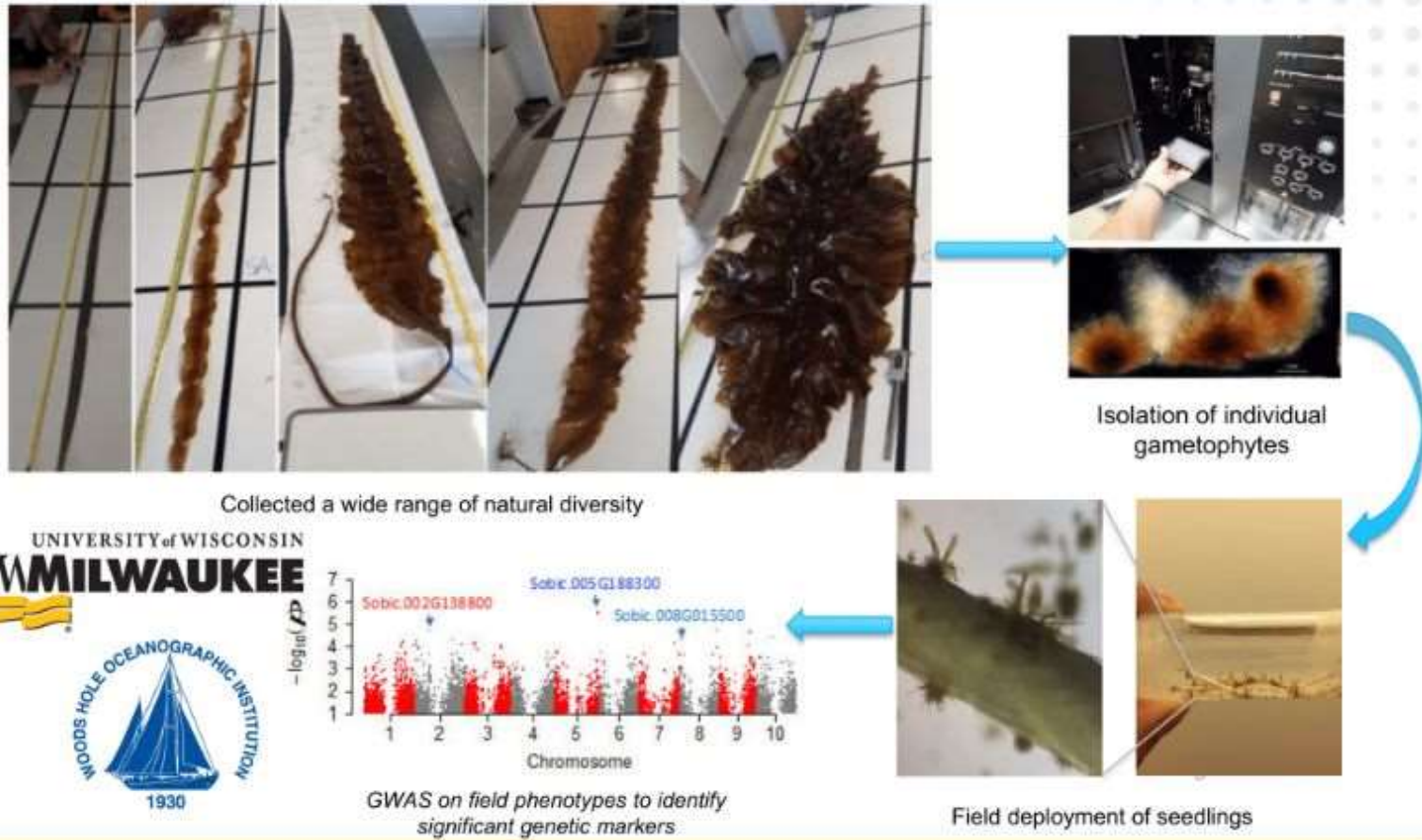
Unmanned Aerial Vehicle (UAV)



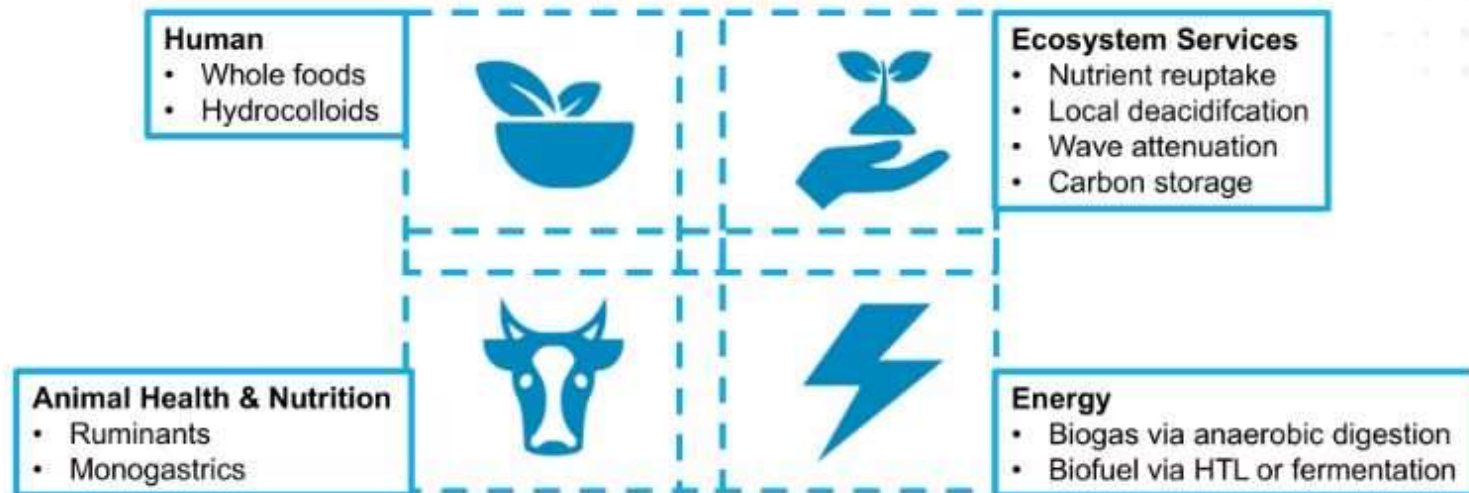
Hyperspectral reflectance for biomass quantification & composition



Development of Breeding and Genetic Tools



Driving towards new and growing markets...



Expanding the MARINER community is critical to scaling



Thank you!

Marc von Keitz
Program Director
Marc.vonkeitz@hq.doe.gov

Krishna Doraiswamy
T2M Advisor
Krishna.Doraiswamy@hq.doe.gov



<https://arpa-e.energy.gov>



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