Cal Poly and the Blue Economy: offshore renewable energy and sustainable aquaculture on the Central Coast: a model for California

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The Cal Poly Blue Economy Initiative: The Ocean-based solutions to the Climate Crisis

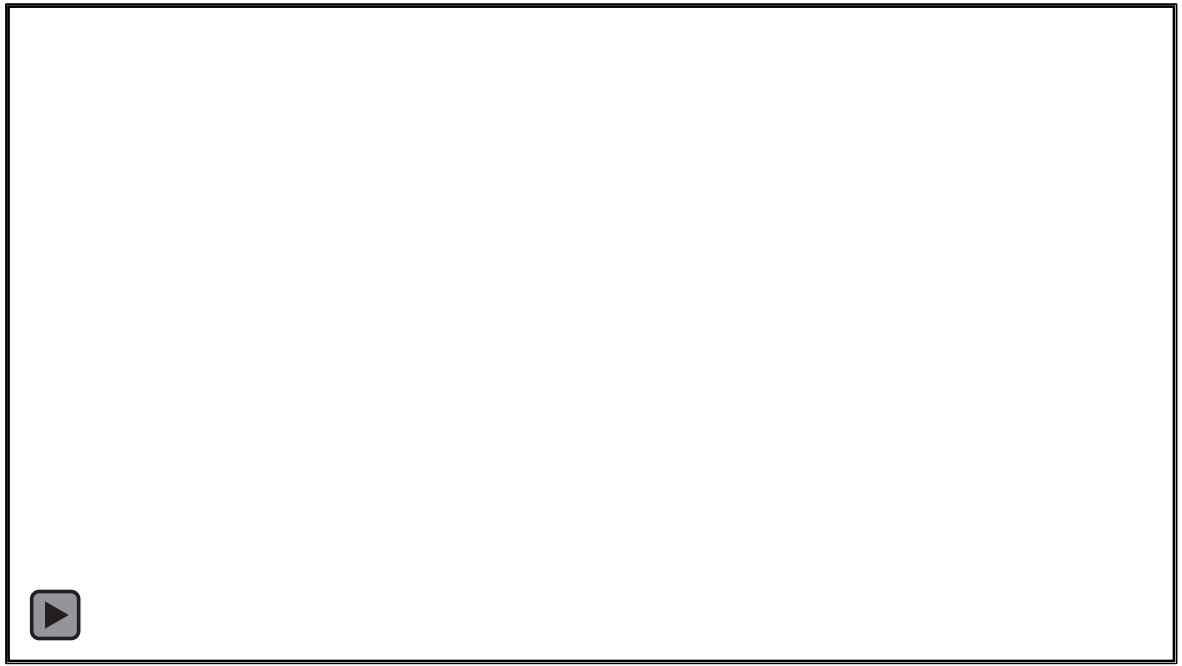
- Identify gaps, challenges, opportunities in science, technology, & policy in marine renewable energy, sustainable aquaculture, and working waterfronts
- Work with local, statewide, & federal stakeholders to develop economically-viable, scalable climate solutions
- Create a model to export throughout California and beyond
- Train the next generation of climate leaders and innovators

Environmental impacts of OSW

- Include: marine mammals, birds, benthic/bottom habitats, fish/fisheries, physical factors (winds/upwelling, EMF, etc.), plus other socioeconomic effects
- Lots of OSW in Europe, mostly shallow (<60m), fixed bottom
- CA will be well offshore in deeper water (up to 1300m)
- Challenge: few data exist this far offshore

Environmental impacts of OSW

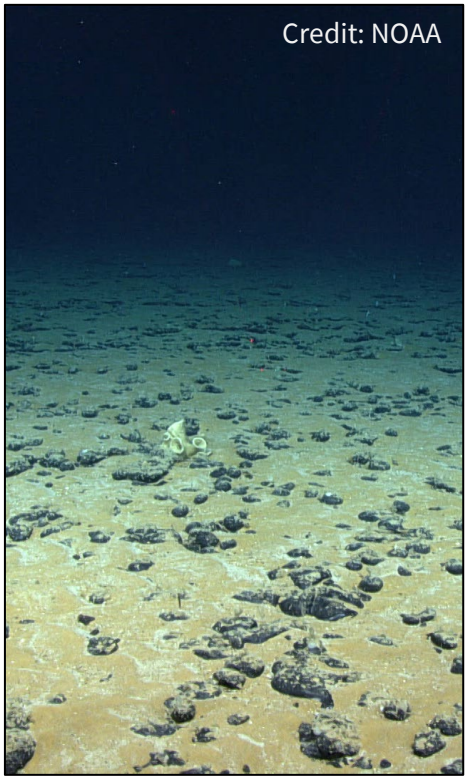
- Understanding impacts will require new data and new approaches to analyze/interpret
- Currently 3 floating wind farms (all in Europe), but little environmental monitoring; a lost opportunity?

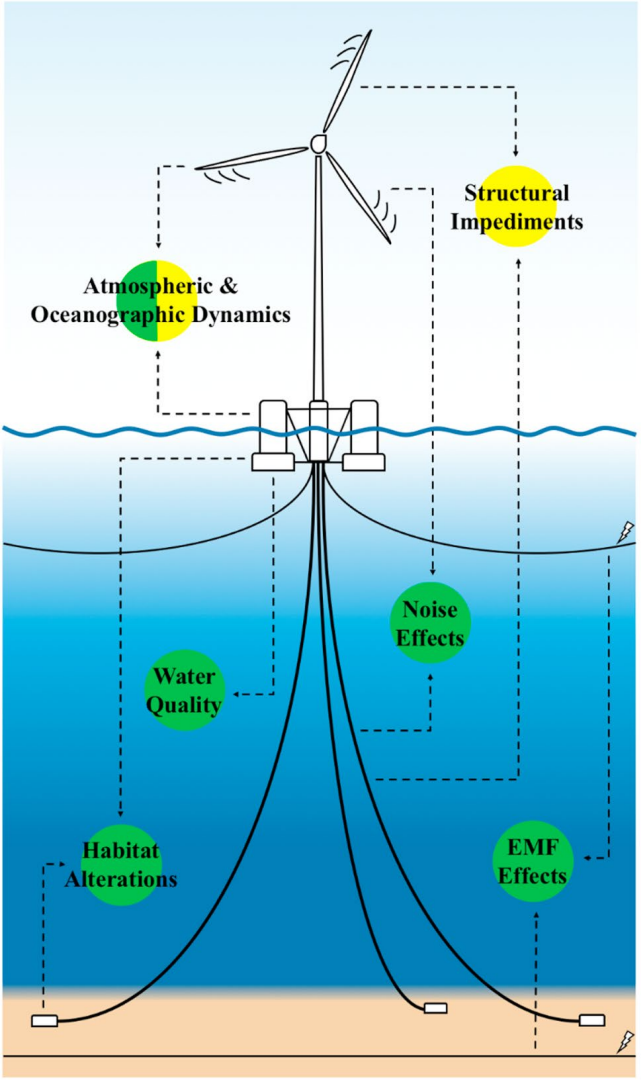


So what do we need and how do we do it?

Approaches:
Proxies, Modeling, and Monitoring

- Proxies: similar information in other places or other equipment
- Good first step when little is known





Magnitude of Effect

Negligible **Moderate**

Minimal **Major**

- **Minimal:**

Electromagnetic (EMF) Effects; Habitat; Noise; Water Quality; Atmos. & Ocean. Dynamics

- Possible reduction of downstream windspeed
- May impact local circulation & regional upwelling (biological effects unknown)

- **Moderate**

Structural Impediments

Farr et al. 2021

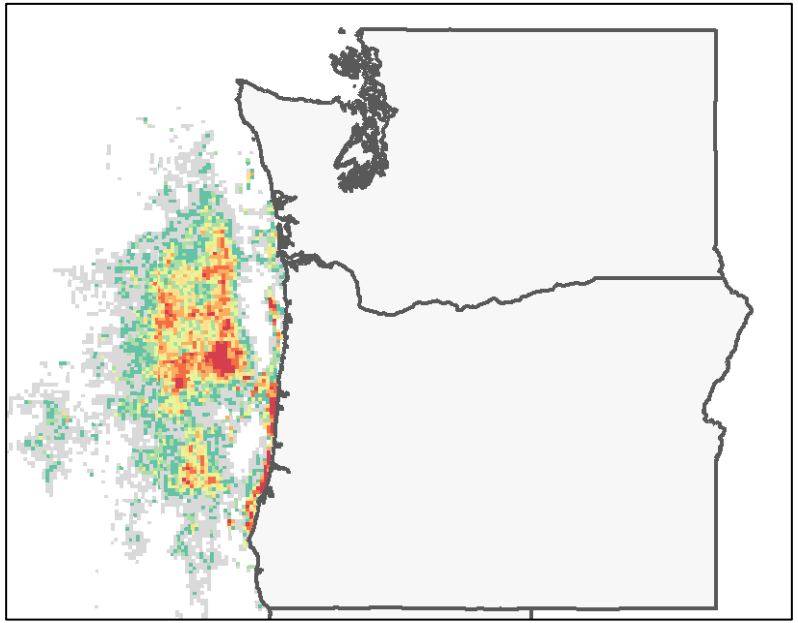
Modeling

- Uses available data to understand a system (e.g., where species are/may be, how species may interact with equipment, etc.)
- Can generate or test hypotheses
- Can provide information about key factors or features for empirical study

And for Climate change:

- Ongoing modeling to help understand where things are now and where they will be in the future
- Feedback among all approaches improves knowledge

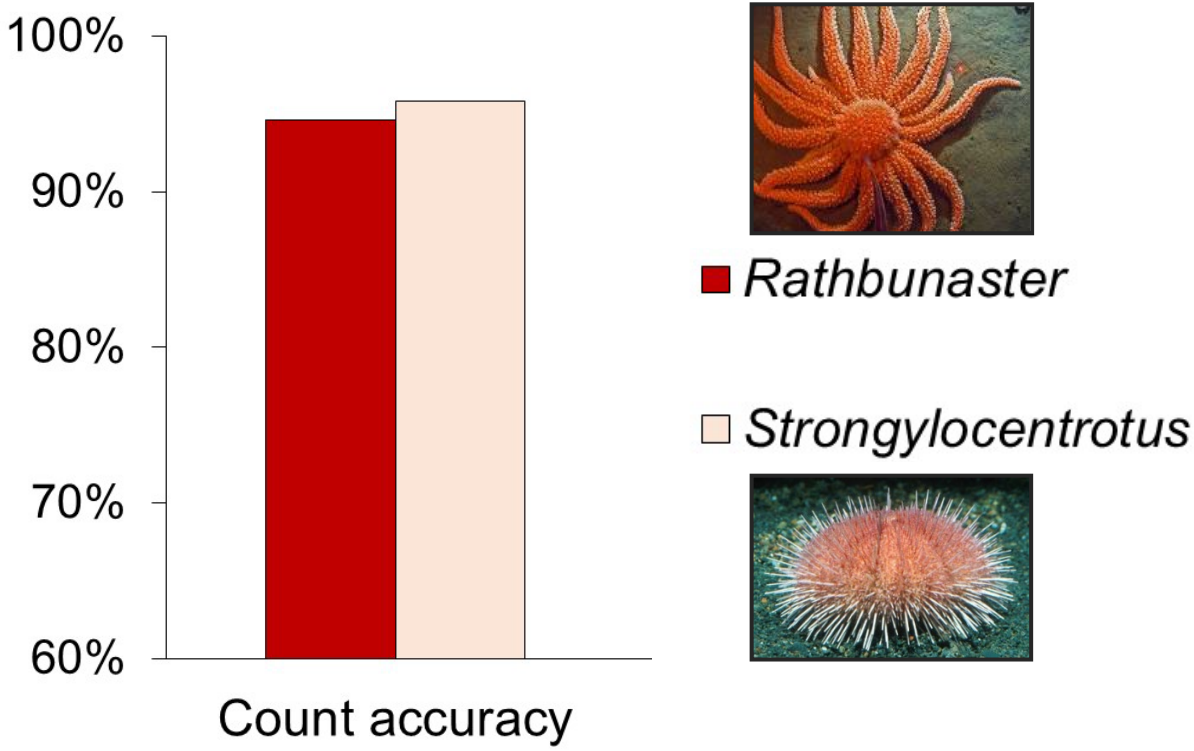
OR-WA Highly Migratory Species Fishery Effort



Monitoring

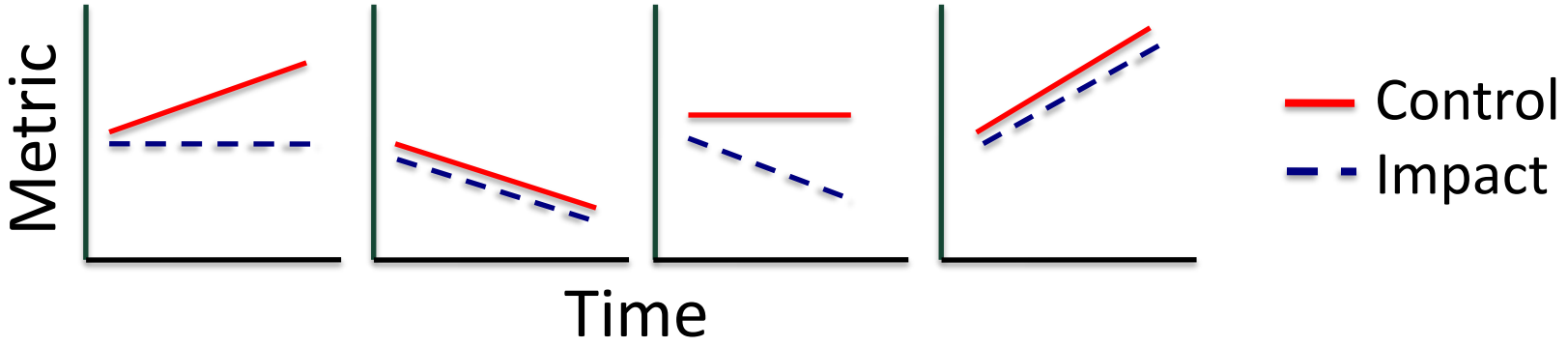
- Collection of field data from places that might be impacted
- Will need LOTS of new technology
- Example: Cal Poly Deep Sea AI (CEC funded)
  - Developed Web application for creating training data; users can generate and quality check training data efficiently
  - During pilot, created 8,000 annotations for several species

AI Model Performance



Monitoring

- Need info beyond just the areas that will be impacted
- ‘Gold standard’ in impact assessment is Before-After Control-Impact (BACI)
- Will need large monitoring framework beyond just the WEAs (for some groups, scale will be VERY large)



The Cal Poly Blue Economy Initiative: Work to date and future projects

Completed:

- Complementarity of OSW and other renewables (esp. solar) & power production of Morro Bay WEA
- Proxies for environmental impacts of OSW
- Development of AI workflows for benthic assessment
- Spatial distribution of fishing effort along US west coast and landings in CA

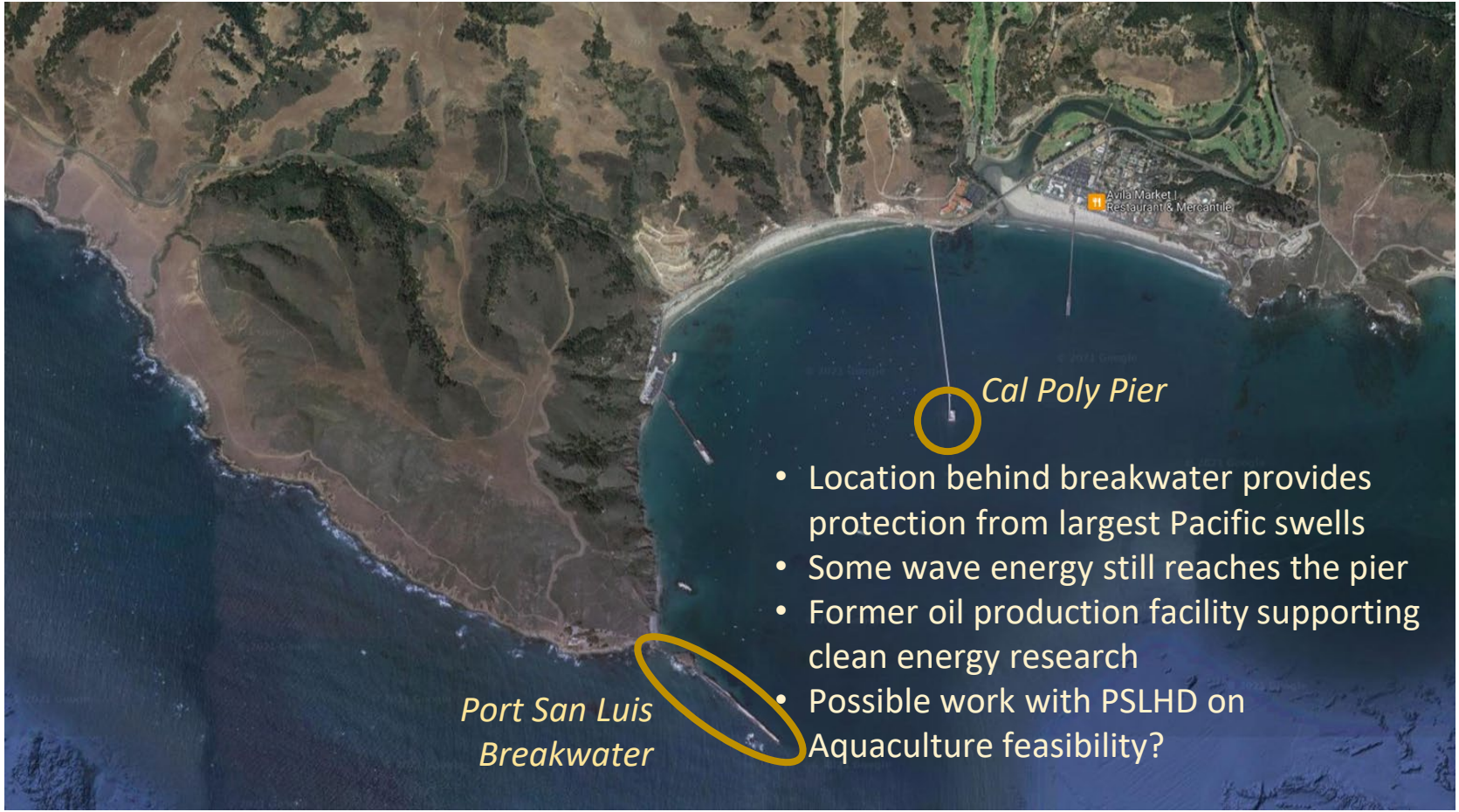
Next :

- Join POET/DOE Network for marine tech testing;
- Join with Humboldt and OSU for DOE OSW Center of Excellence; incl. local, statewide, federal stakeholders to develop workforce training and science to guide OSW

Link to Cal Poly OSW Research

Cal Poly Pier

- 1 km long, 40 ft depth
- Secured facility
- Flow-thru seawater system for aquaculture & organismal studies
- Lower landing with access to waterline to deploy small experiments/equipment
- 2-ton crane for boats, equipment
- Potential to deploy marine energy test devices
- Classroom/lab/meeting space and small, well-equipped shop


Avila Market |
Restaurant & Mercantile
Cal Poly Pier
Port San Luis
Breakwater
• Location behind breakwater provides protection from largest Pacific swells
• Some wave energy still reaches the pier
• Former oil production facility supporting clean energy research
• Possible work with PSLHD on Aquaculture feasibility?

Cal Poly Pier: hub for Blue Economy activity

- Testing marine renewable energy systems (especially wave energy)
- Testing/deployment of AUVs
- Testing marine sensor and monitoring systems/technologies
- Aquaculture development
- Testing co-location of offshore renewables & aquaculture
- Testing devices that could use ocean cooling
- Other projects requiring accessible offshore platform

Sustainable Aquaculture: Harmony Coast Aquaculture Institute (HCAI)

HARMONY COAST
AQUACULTURE INSTITUTE

- Created non-profit to take over shuttered Cayucos Abalone Farm (18 acres, incl. tanks, filtration, permitted seawater intake pipe)
- Would be largest land-based seawater aquaculture facility in US
- Goal: create Center for Aquaculture Innovation, Conservation, Research and Education

The Mission of Harmony Coast Aquaculture Institute

1. Promote and support local sustainable aquaculture, reduce carbon footprint and environmental impacts of seafood production
2. Restore depleted marine species
3. Educate public and regulators of benefits of sustainable marine aquaculture
4. Reconnect coastal people with resource stewardship
5. Develop a scalable model for sustainable, low-carbon, low-environmental impact aquaculture

HCAI First priority: jump-start sustainable commercial aquaculture

- Maintain ground and pipeline leases, upgrade physical facilities
- Establish guidelines for sustainable, low-impact, land-based marine aquaculture
- Educate public and agencies about sustainable aquaculture, helps create social license

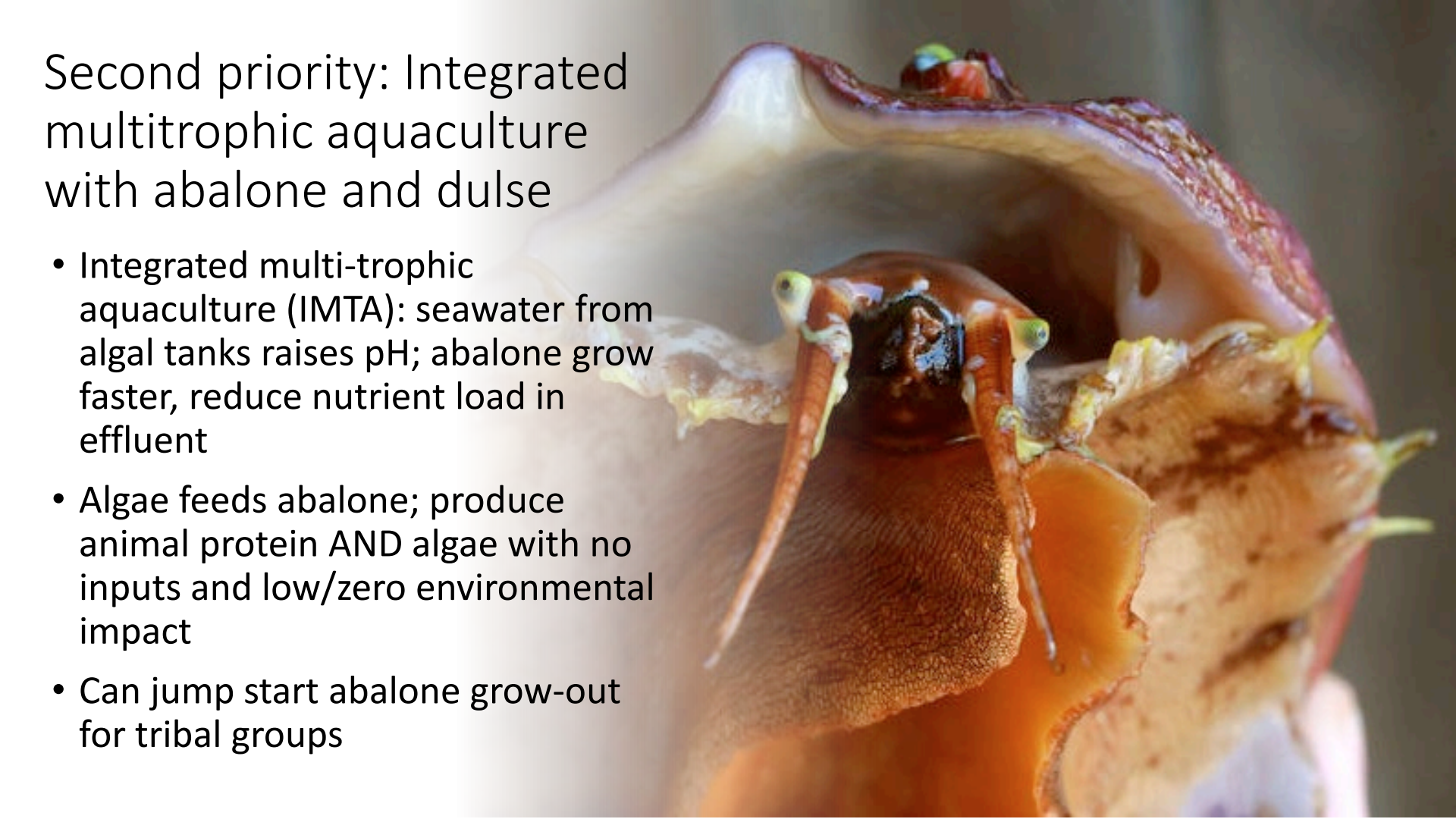
Harmonycoast.org

First commercial organisms: Algae

- Algae: fast-growing, requires no inputs other than seawater
- Commercial value as food product, feed for other aquaculture species (abalone), may reduce methane emissions as livestock feed
- Will demonstrate economic viability of land-based aquaculture

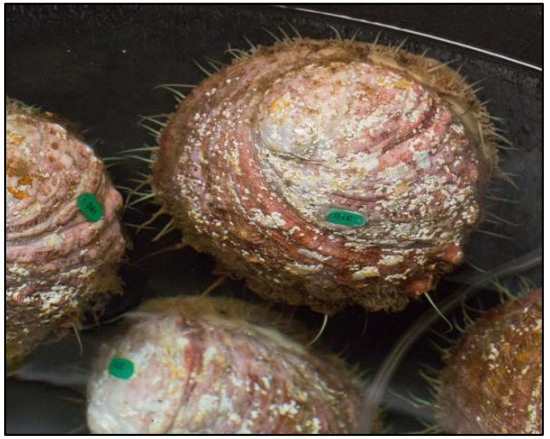
Second priority: Integrated multitrophic aquaculture with abalone and dulse

- Integrated multi-trophic aquaculture (IMTA): seawater from algal tanks raises pH; abalone grow faster, reduce nutrient load in effluent
- Algae feeds abalone; produce animal protein AND algae with no inputs and low/zero environmental impact
- Can jump start abalone grow-out for tribal groups



Third priority:
Coastal ecosystem rewilding

- Expand juvenile white abalone grow-out for out-planting to save endangered species
- With stable commercial operations, HCAI can expand ecologically critical non-commercial species to restore California ecosystems (e.g., Sunflower Seastar, urchin ranching, etc.)



Funding this work

All of these approaches will cost money

- OSW: Developers should pay for most of monitoring work, but need to avoid real ***and*** perceived conflicts of interest
- One option? Developers pay into fund managed by a new entity (AB 80?); ensures rigorous science, provides stakeholders with confidence in the findings
- New technology development and aquaculture (e.g., wave energy): requires collaboration between industry and agencies
- Need to streamline/facilitate permitting, collaboration, and funding

We can do this!

- We have or can develop technology and approaches to understand effects and develop new technology for offshore renewables and aquaculture
- Rigorous science is essential to understand effects ***and*** potential mitigation
- Will require sustained commitment and strong cooperation among developers, state and federal governments, academics, other stakeholders

Acknowledgments

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Cal Poly Collaborators and students

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Other Collaborators

Danelle Cline, Owen Liu, Jameal Samhouri, Don Chartrand, Mike Graham

Plus many, many more Cal Poly students, Bio Dept, and other collaborators on related projects

Proxies for Fishes and Fisheries

- Recent work in wind farms suggest minor/zero impacts & some positive artificial reef/fish aggregation effects
- Extensive research that (de facto) closed areas benefit fish pops
- Little information on sound/EMF on fish; effects may be minimal?