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Marine Renewable Energy: How can we have our orcas and low carbon energy?

Andrea Copping
Pacific Northwest National Laboratory &
University of Washington

Northwest Straits Commission
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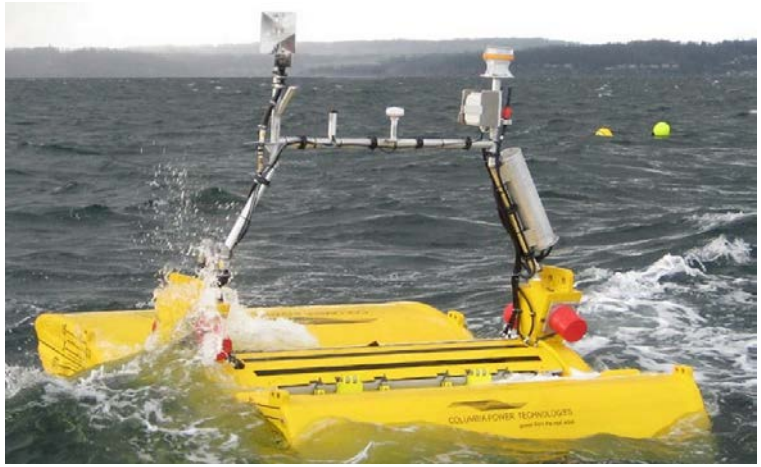
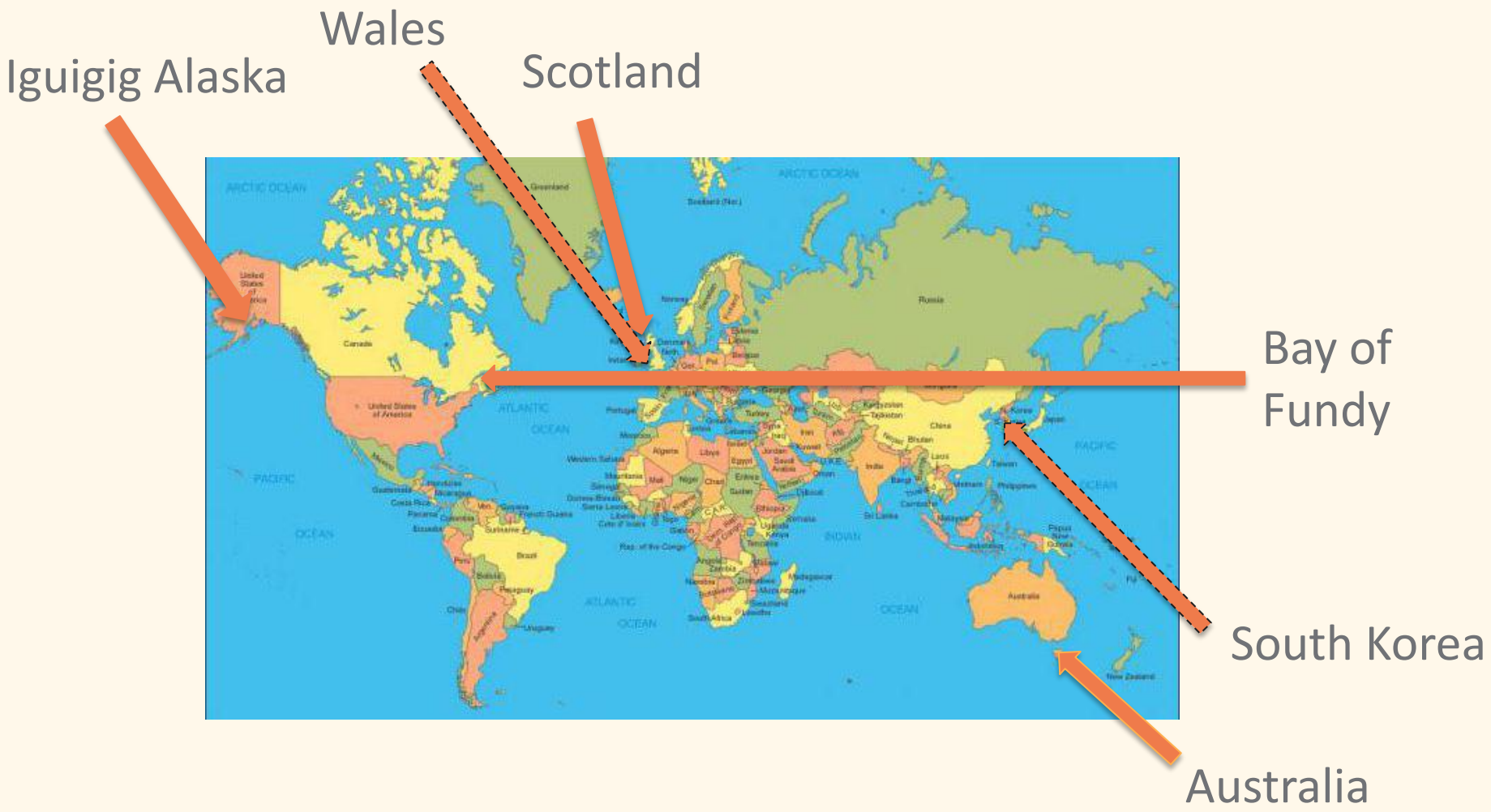
Bellingham WA

Today…..

- What can we learn from other parts of the world?
- What progress have been made of getting devices in the water?
- How have we progressed on understanding environmental effects?
- Can we safely deploy and operate small numbers of wave, tidal, offshore wind devices?
- What about larger commercial arrays?



Tidal and Riverine Testing and Development



Wave Energy Testing and Development

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Offshore Wind Development

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Rhode Island

All over Europe, esp. UK, Denmark, Germany

China

Offshore Wind Resources on the West Coast

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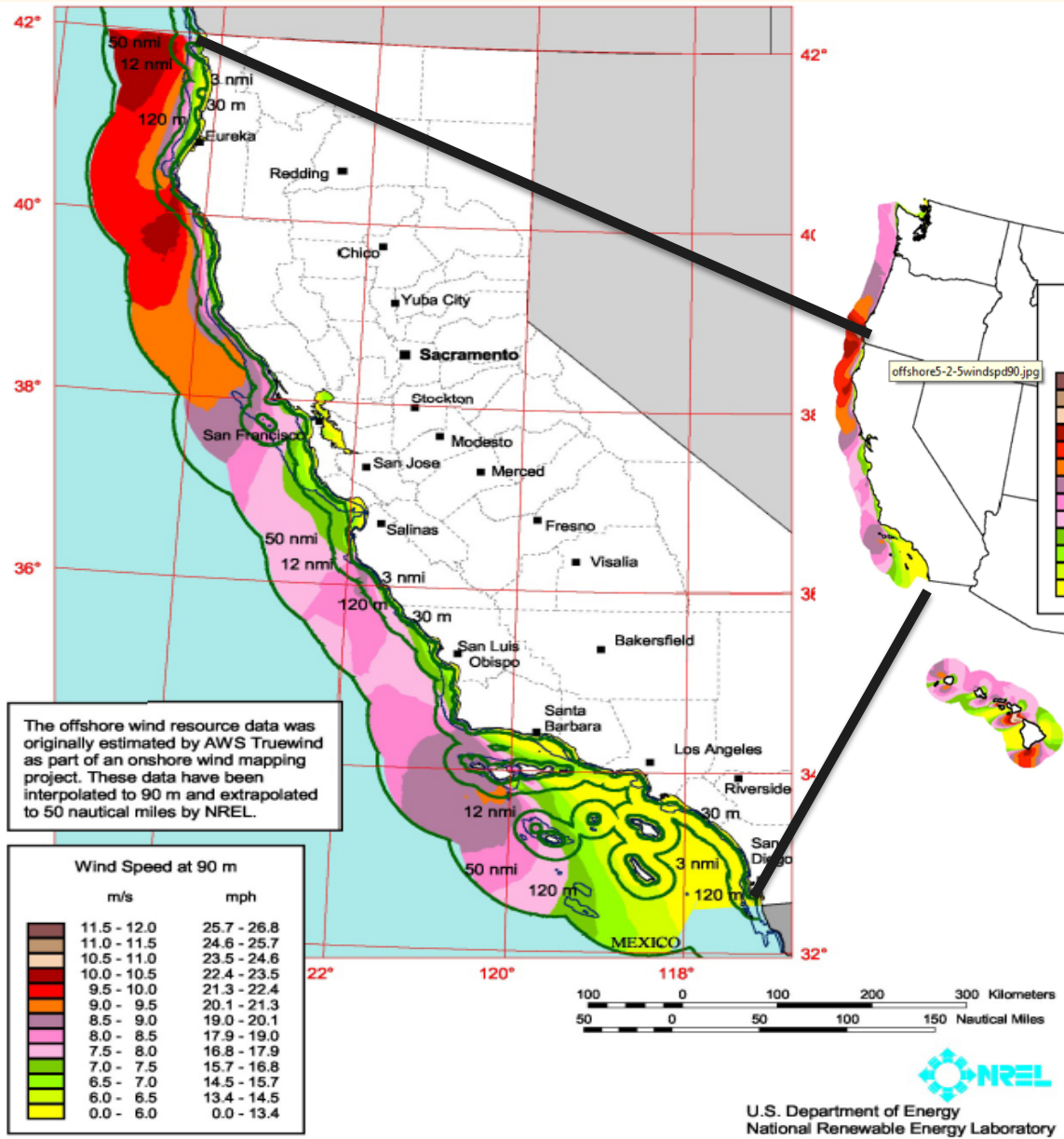
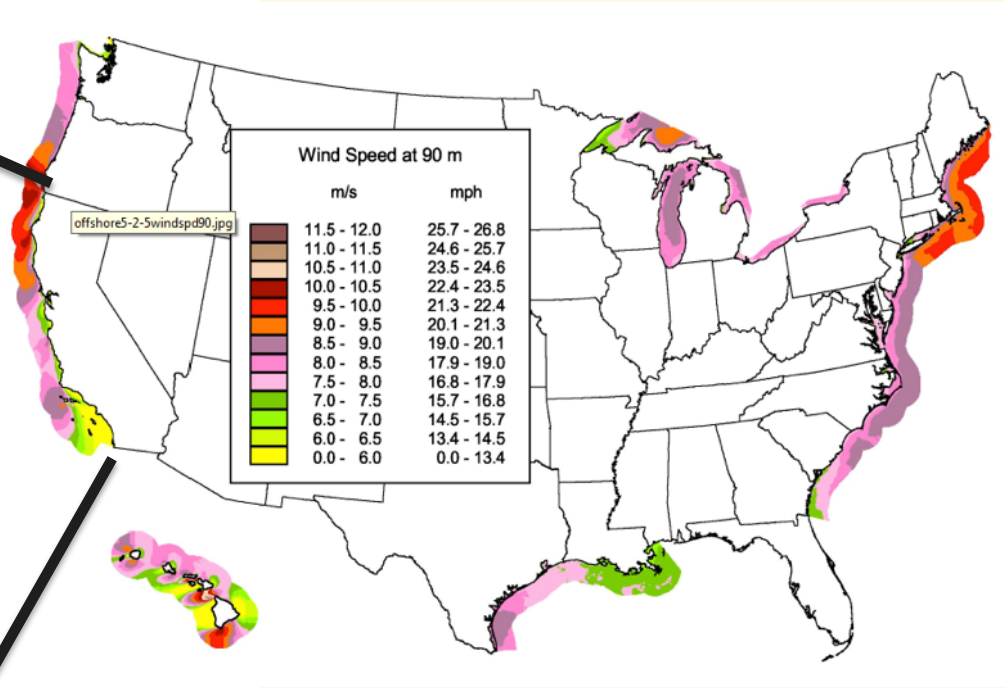


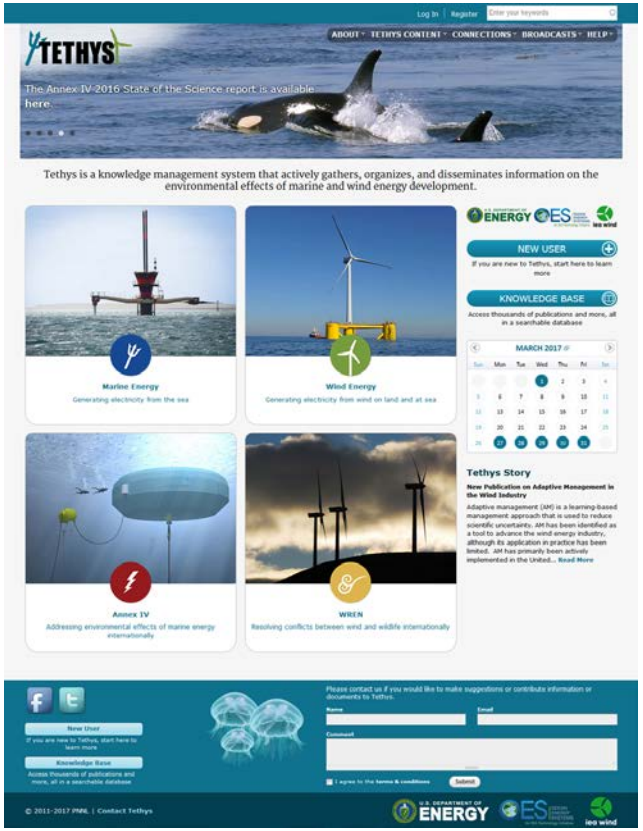


What have we learned (MRE and OSW)?

- Very challenging environment to test, deploy, maintain, recover devices.
- Very expensive to develop technologies, work at sea.
- Small scale tests (tanks and sheltered water) have helped, but it is not enough.
- Supply chain does not exist.
- Permitting still a real challenge, due to:
  - Novelty of technologies;
  - Uncertainty of potential environmental effects; and
  - Suspicion of social and economic risks (and also benefits).

Environmental Effects – what do we know?

- Information gathered from laboratory, modeling, and field studies
- Still little data from monitoring around deployed full scale devices
- Knowledge pieced together from different parts of the world
- Collection of that information (metadata) on *Tethys*
- Comprehensive look in 2016 (SoS)
- More recent literature review shows little change in current understanding of risks



https://tethys.pnnl.gov

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2016 Annex IV State of the Science Report

ENVIRONMENTAL EFFECTS OF MARINE ENERGY DEVELOPMENT AROUND THE WORLD

http://tethys.pnnl.gov/publications/state-of-the-science-2016

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

iea Energy Technology Network

OES OCEAN ENERGY SYSTEMS
An IEA Technology Initiative

ANNEX IV
Environmental Effects of Marine Energy Development around the World

Collision with Tidal Turbines

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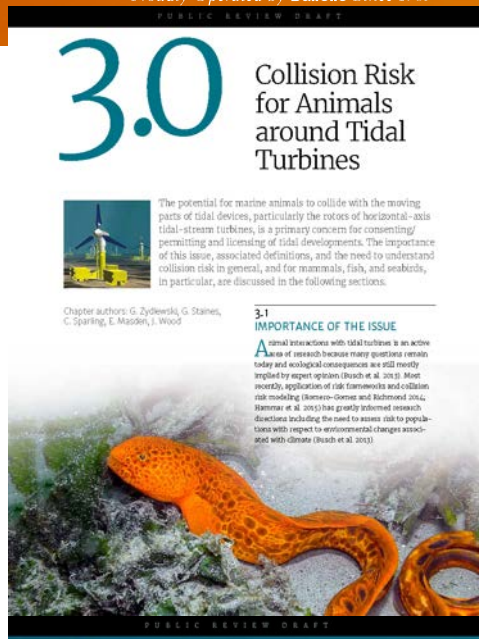
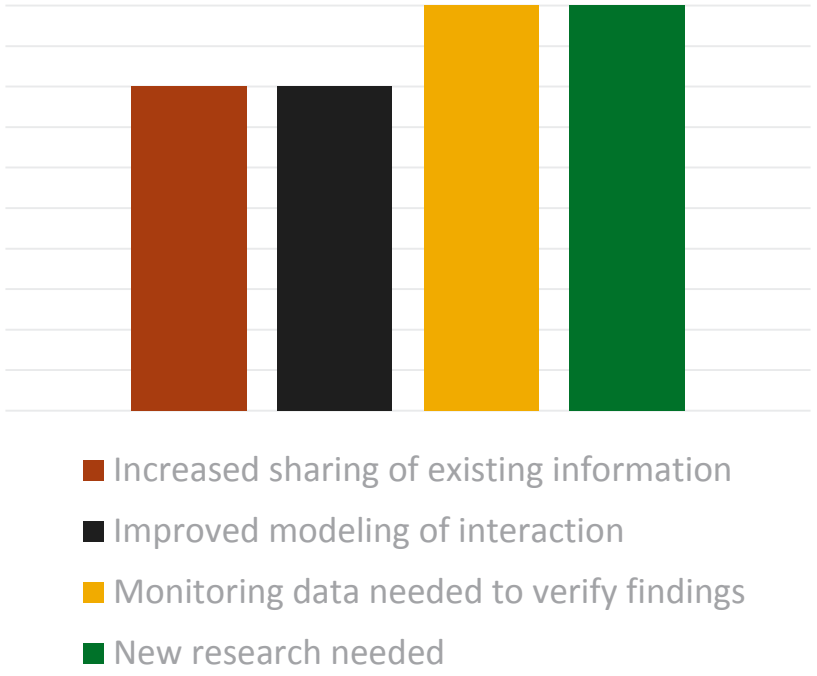
- Animals considered to be at potential risk include:
  - marine mammals
  - fish
  - diving seabirds
- Lack of observations
- Observation technologies not well developed, difficult to operate
- Quantitatively estimate number of animals in area of turbines, understand capability to sense and evade devices
- We look at individual animals; need to extrapolate to populations.



Collision Risk (tidal) - Dashboard



Copping, A.; Kramer, S.; Sather, N.; Nelson, P. (2017) Pacific Region Marine Renewables Environmental Regulatory Workshop Report.

Other Environmental Topics

- Offshore wind
  - Collision risk
- Wave and Tidal:
  - Effects of underwater sound from wave and tidal devices on marine animals
  - Effects of EMF on animals
  - Changes in benthic habitat, reefing of fish around devices
  - Changes in physical changes (WQ, ecosystem changes)
  - Marine Spatial Planning
  - Case studies of permitted projects: lesson learned
  - Path forward for getting through permitting

Social and Economic Challenges and Benefits

- To move towards commercial scale MRE development, we need:
  - Infrastructure for transport, deployment, maintenance, maybe manufacturer
  - But also for worker housing, schools, road improvements, worker training …..
- Risks include competition with existing uses, especially:
  - Fishing (commercial and recreational)
  - Shipping and shipping lanes
  - Conservation areas
  - Security and safety (DoD and USCG)
  - Recreational boating
  - Aesthetics – viewsheds, etc.
- Benefits are jobs!

Risk Perception

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Likely three causes (and solutions):

1. Lack of awareness of what is known
   - Need strong outreach and engagement program

2. Concerns about applying information from one location or jurisdiction to another
   - Data Transferability and Collection Consistency (2018 Annex IV thrust)

3. Need for new research
   - Coordinated strategic research studies

If you would like to know more:

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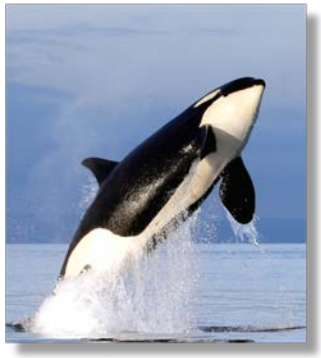
- Visit *Tethys* (https://tethys.pnnl.gov)
- Sign up for webinars, Tethys Blasts (every 2 weeks)
- Annex IV is international collaboration of 12 nations (Canada, China, Denmark, Ireland, Japan, Norway, Portugal, South Africa, Spain, Sweden, UK, US).
- Annex IV has sponsored:
  - quarterly webinars,
  - expert forums,
  - workshops on:
    - collision risk,
    - management measures for wave and tidal development,
    - information needs for social and economic benefits and risks.
- All archived on *Tethys*



Thank you!

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Andrea Copping
Andrea.copping@pnnl.gov
+1.206.528.3049

I would like to thank my very talented research team at PNNL, Aquatera Limited, the Annex IV and OES representatives, DOE's Water Power Technologies Office, the many marine energy developers and researchers around the world.

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