

Tools for Evaluating Effects of Marine Hydrokinetic Energy

A framework for using data to inform decision-making


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P Nelson, S Woo (H.T. Harvey)

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- The background of the slide is a photograph of a vast, calm ocean under a clear, bright blue sky. The horizon line is visible in the upper third of the image, separating the deep blue water from the lighter blue sky. The water's surface shows subtle ripples and reflections of light.
- If sited properly, MHK technologies could become a renewable environmentally benign source of power
 - As projects move forward, many stakeholders will need to be engaged
 - Many potential conflicting uses and issues
 - Many potential issues not well understood

RE Vision, LLC was selected by DOE under their Market Acceleration Program to:

- Apply a scenario-based assessment approach to marine hydrokinetic technologies
- Improve the understanding of potential environmental and navigation impacts of technology

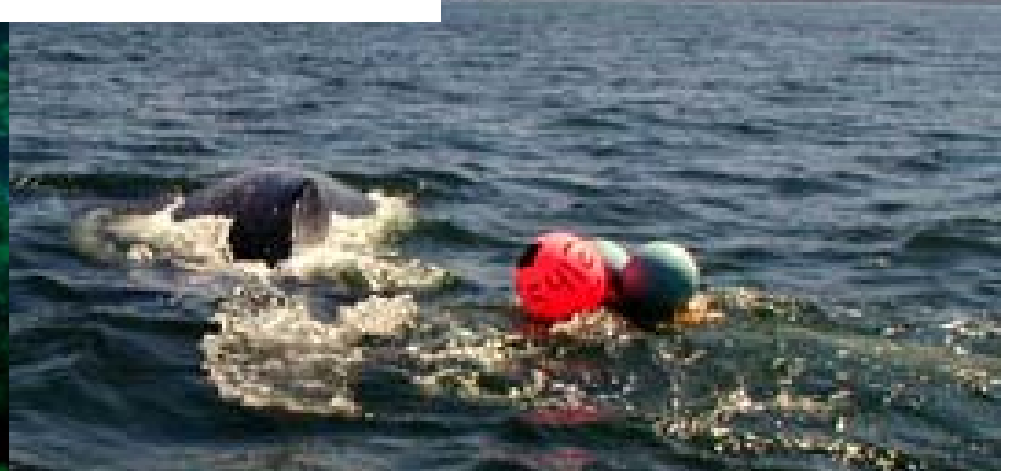


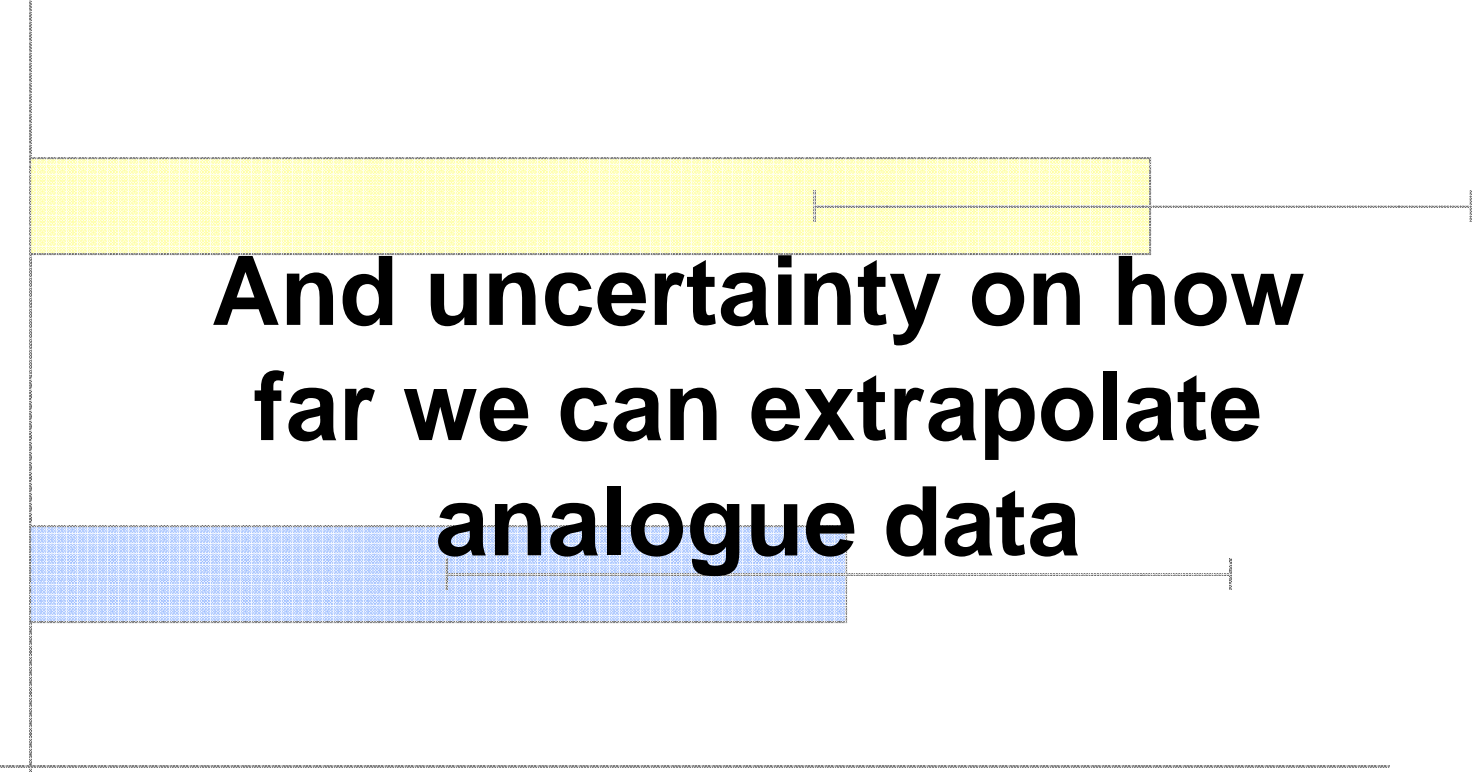
H. T. Harvey and Associates developed the environmental framework for this process



Numerous species,
habitats, project
components

Lots of analogue
data





**And uncertainty on how
far we can extrapolate
analogue data**

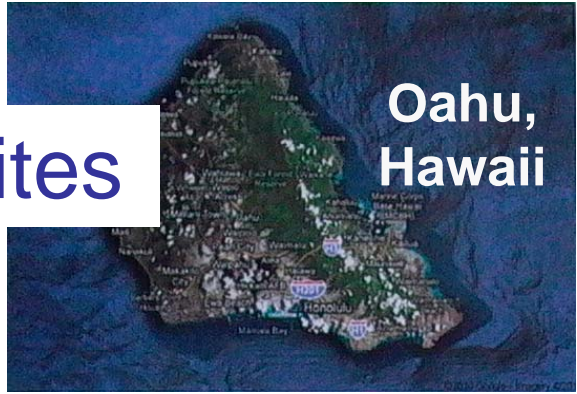
Objectives:

- Introduce our tools for identifying key environmental issues
- Discuss how these tools could be adapted for offshore wind energy development





2 sites



To meet the study goals, we established 24 wave energy scenarios



4 MHK types

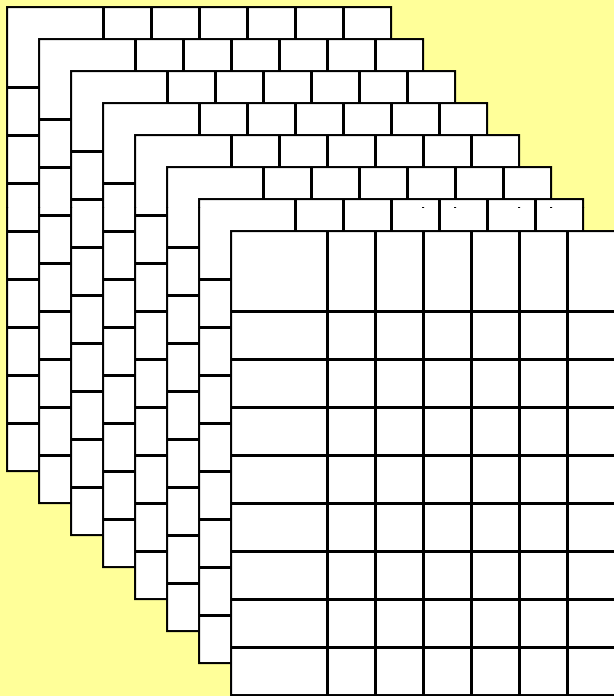


3 project scales

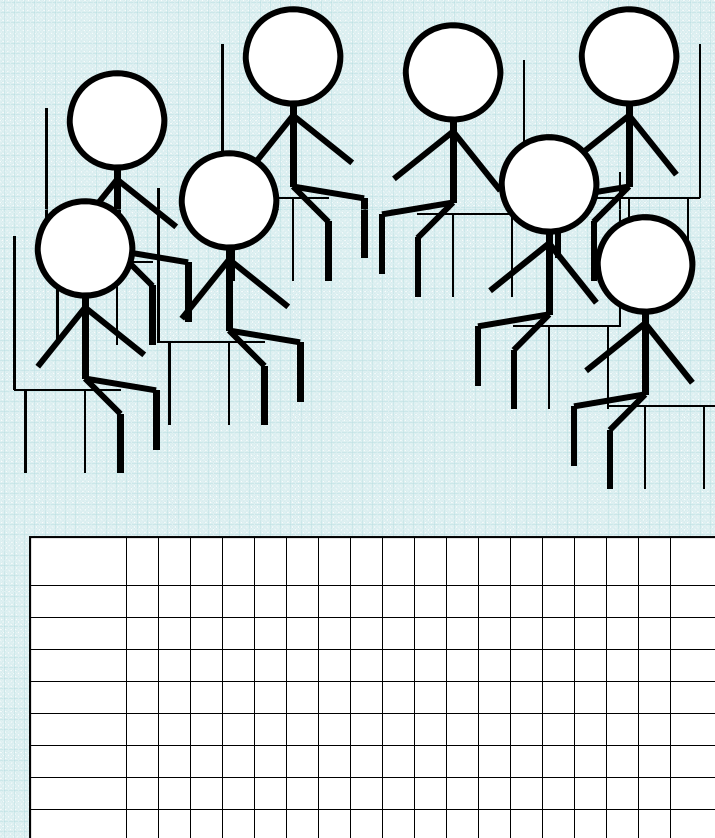
Pilot Small commercial

LARGE commercial

Tool 1. Risk approach



Tool 2. Raptools



RISK APPROACH

- What is the temporal and spatial exposure on species
- What are the project effects on species
- What measures could minimize, mitigate or eliminate negative impacts
- Are there potential effects or species responses that are highly uncertain and warrant additional study?

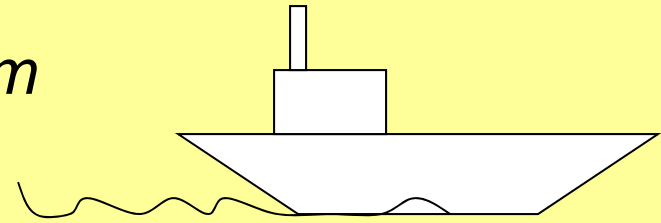
RAPTOOLS APPROACH

- Based on Rapfish, a multi-disciplinary ordination technique using multidimensional scaling of a set of scored attributes
- Can use collaboration to define and rank issues and effects

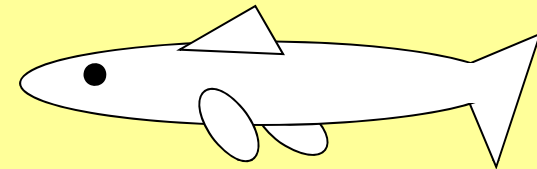
RAPTOOLS APPROACH

- Addresses following questions:
 - How do scenarios compare in terms of exposure, risks and effects to ecological and human environment?
 - Are there sites that seem to present effects regardless of technology?
 - Which attributes account for much of the effects associated with MHK development?

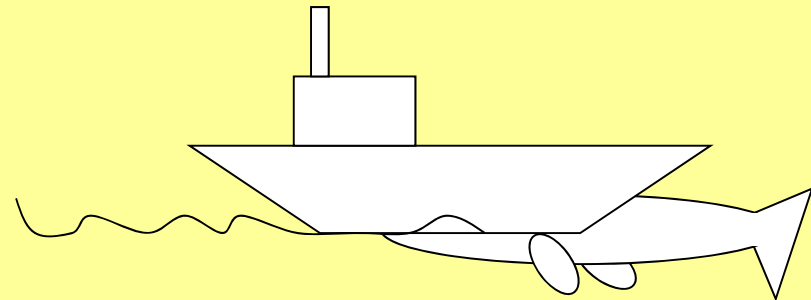
Step 1. *Gather existing data from literature and project developer (also identify data gaps)*



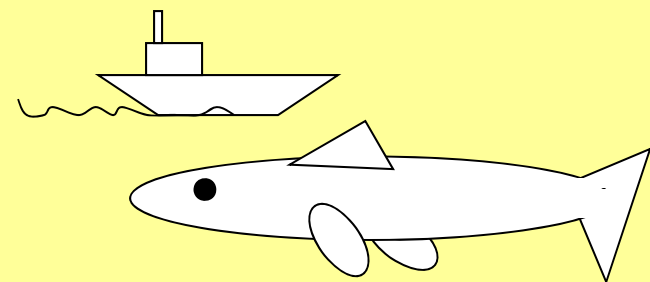
Step 2. *Select indicator species and habitats*



Step 3. *Identify overlaps*



Step 4. *Design mitigation and avoidance into project.*



TWO LEVELS OF RISK ASSESSMENT

- Generic project actions and effects
- Scenario specific assessments

Examples of Generic Effects

- Noise and vibration
- Seabed disturbance
- Structure in the water
- Electromagnetic fields
- Lights
- Chemical releases

Environmental Assessment Methodology

- Detailed project description
- Description of site's affected environments
- Perform environmental effect analysis

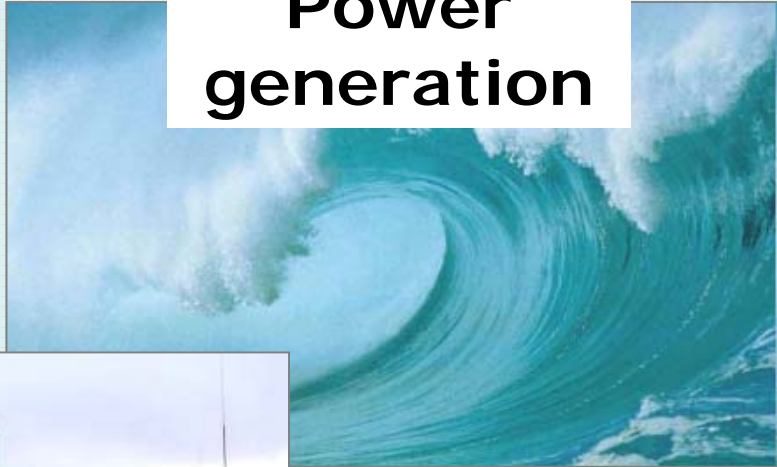
EX: Effects on frigatebirds from 10-MW Pelamis at Makapu'u Point, Oahu

Project Activity	Action	Action's effects	Spatial extent of effect	Temporal extent of effect	Effects overlap w/ crit life stage	Source citation
Boat traffic	Noise	Disrupt foraging	Small	Short	Overlap w/ nesting and foraging	NaiKun 2009, USFWS 2005
<p>10+ project activities, 5-10 actions, on birds, fish, marine mammals</p>						

Risk Approach Results	Pros	Cons
The approach “worked”. Results were sensitive to location, project scale, and MHK technology	X	
Able to identify which environmental effects were the most uncertain, helping to prioritize future studies	X	
Analysis was very complete	X	
Analysis was very time consuming		X
Extremely useful for permitting	X	

Raptools Results

Power
generation



Human
uses



Environ-
ment



Infrastructure



Device type
and size



RAPTOOLS APPROACH

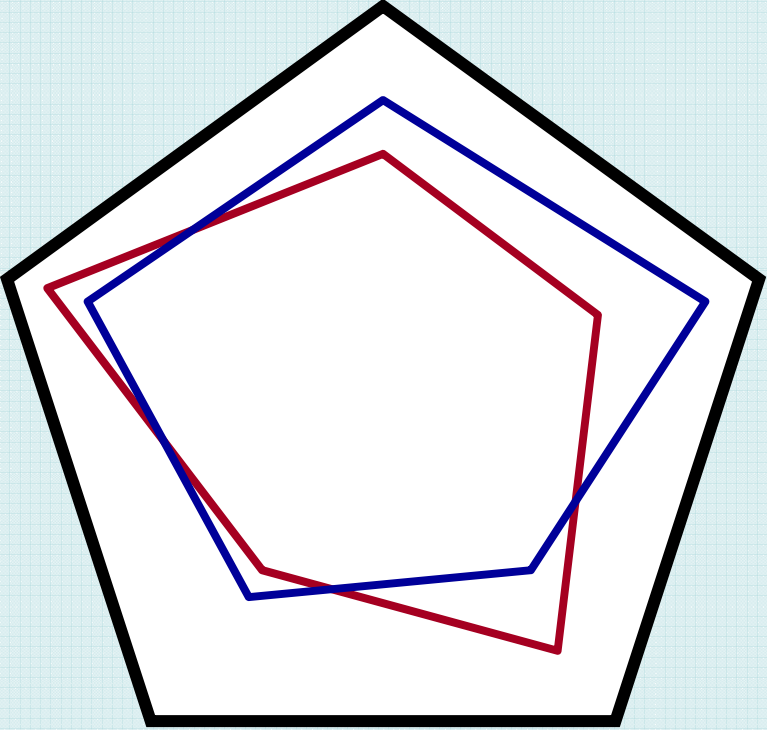
- Allows us to objectively and quantitatively evaluate and compare multiple attributes of numerous scenarios (e.g., screen alternative sites) and to compare alternative scenarios.
- Primary utility: ability to compare multiple scenarios using a standard and objective approach.
- Results can be represented graphically

Raptools kite diagram

Power generation

Environment

Human uses



Infrastructure

Device type and size

**Kite diagram
uncertainty**

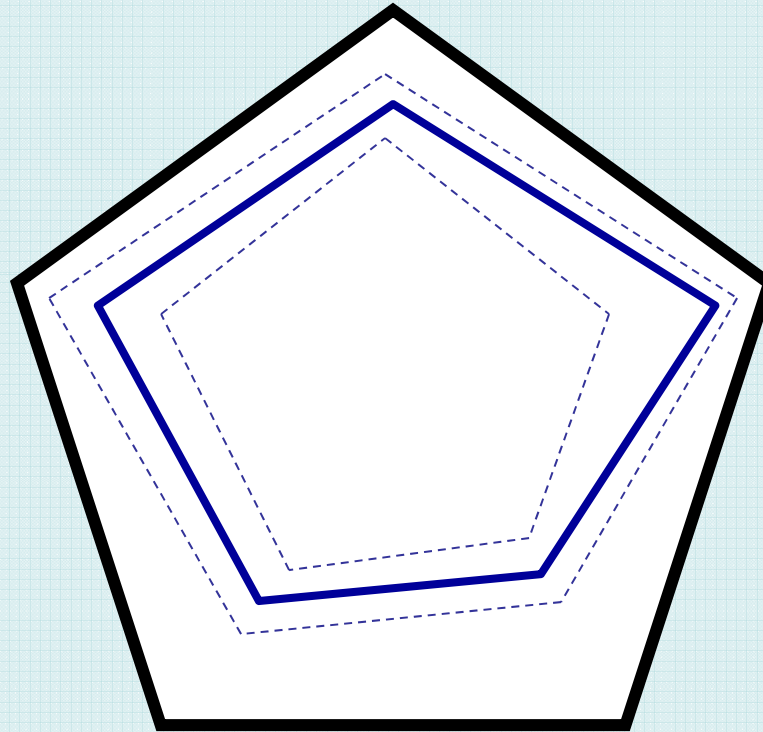
**Power
generation**

**Human
uses**

**Environ-
ment**

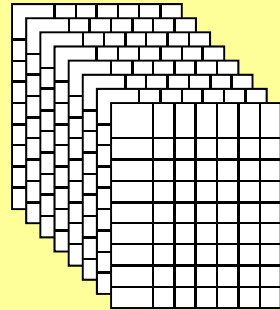
Infrastructure

**Device type
and size**

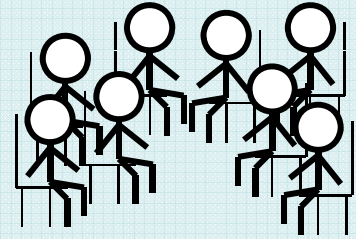


Raptools Results	Pros	Cons
The approach “worked”. Results were sensitive to the 5 categories	X	
Able to identify which effects were the most uncertain, helping to prioritize future studies	X	
Approach readily includes social and economic effects	X	
Analysis not as transparent and is difficult to explain		X
Good approach for initial planning	X	
Requires collaboration of stakeholders	X	

**Tool 1. Risk
approach**



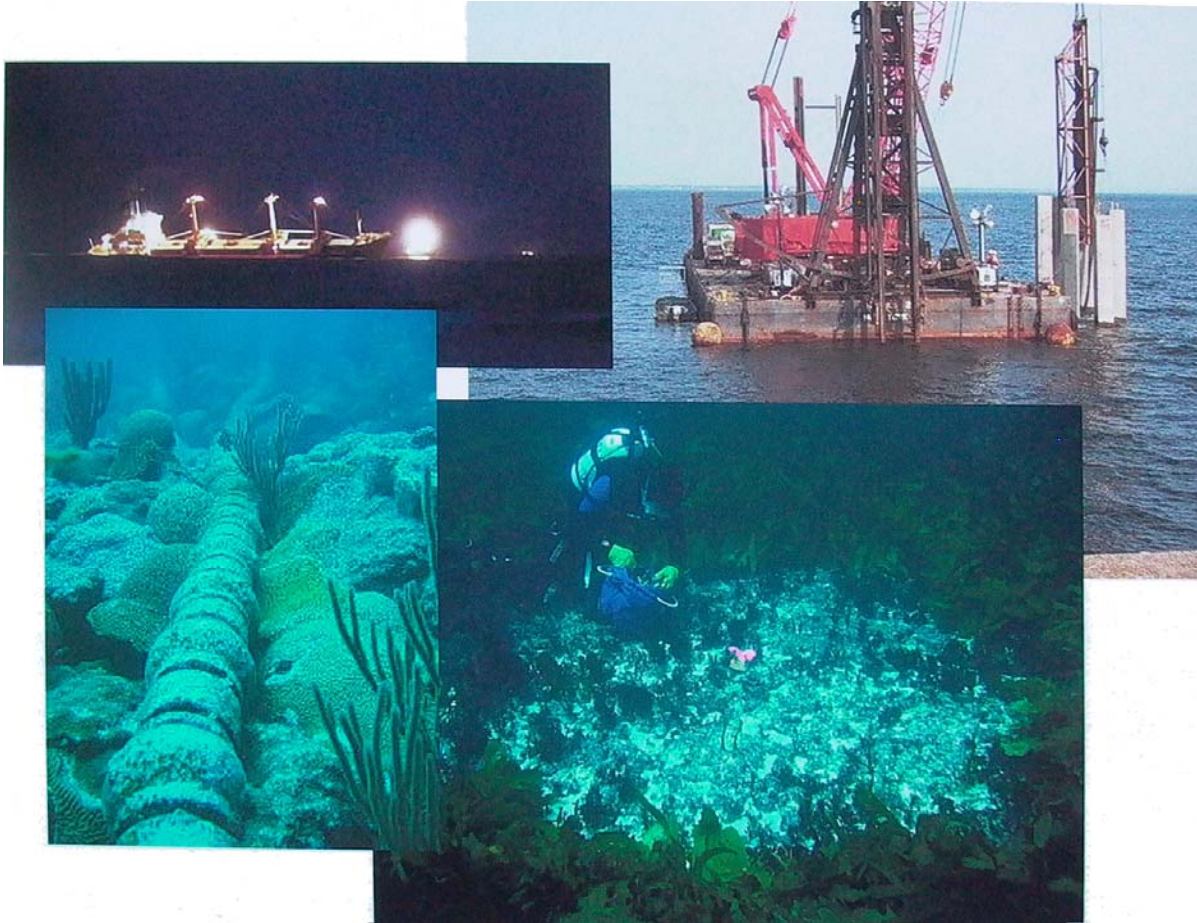
**Tool 2.
Raptools**



***Use both tools
together***

Future application to offshore wind?

Some offshore wind energy effects are likely similar to wave energy effects, including:



Construction & navigation lights

Construction noise

Benthic disturbance

EMF effects

FAD effects

Cable collision or entanglement

Animal and ship collision



To apply risk approach and Raptools to offshore wind development, we need to consider, for example:

- **Special-status species specific to the proposed site**
- **Avian collisions**
- **Impacts on boat traffic**
- **Artificial reef effects**
- **Aesthetic concerns dependent on distance from shore**
- **Any other issues that are site specific**

Thanks. Questions?

Kramer S, M Previsic, P Nelson, S Woo. 2010. Framework for identifying key environmental concerns in marine renewable energy projects. U.S. Department of Energy, Advanced Waterpower Program. 318 p. incl. report and appendices.

http://www.harveyecology.com/PDF/DOE/FINAL_ENVIRONMENTAL_REPORT_MP_6-17-10.pdf