# An Integrated Risk Framework for Offshore Wind Energy

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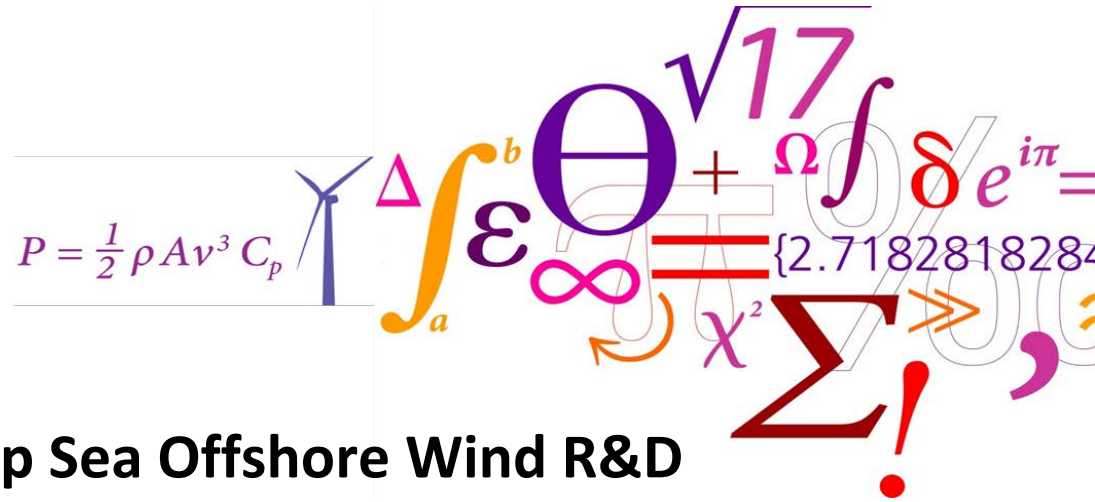


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DTU Wind Energy
Department of Wind Energy

# Presentation Outline

- Overview of the National Science Foundation (NSF) project objectives
- The integrated risk framework
- Desired project outcomes
- Highlights of annotated bibliography
- Highlights of questionnaire to experts
- Next steps


Picture from: http://peopleandplanet.org/navid14745

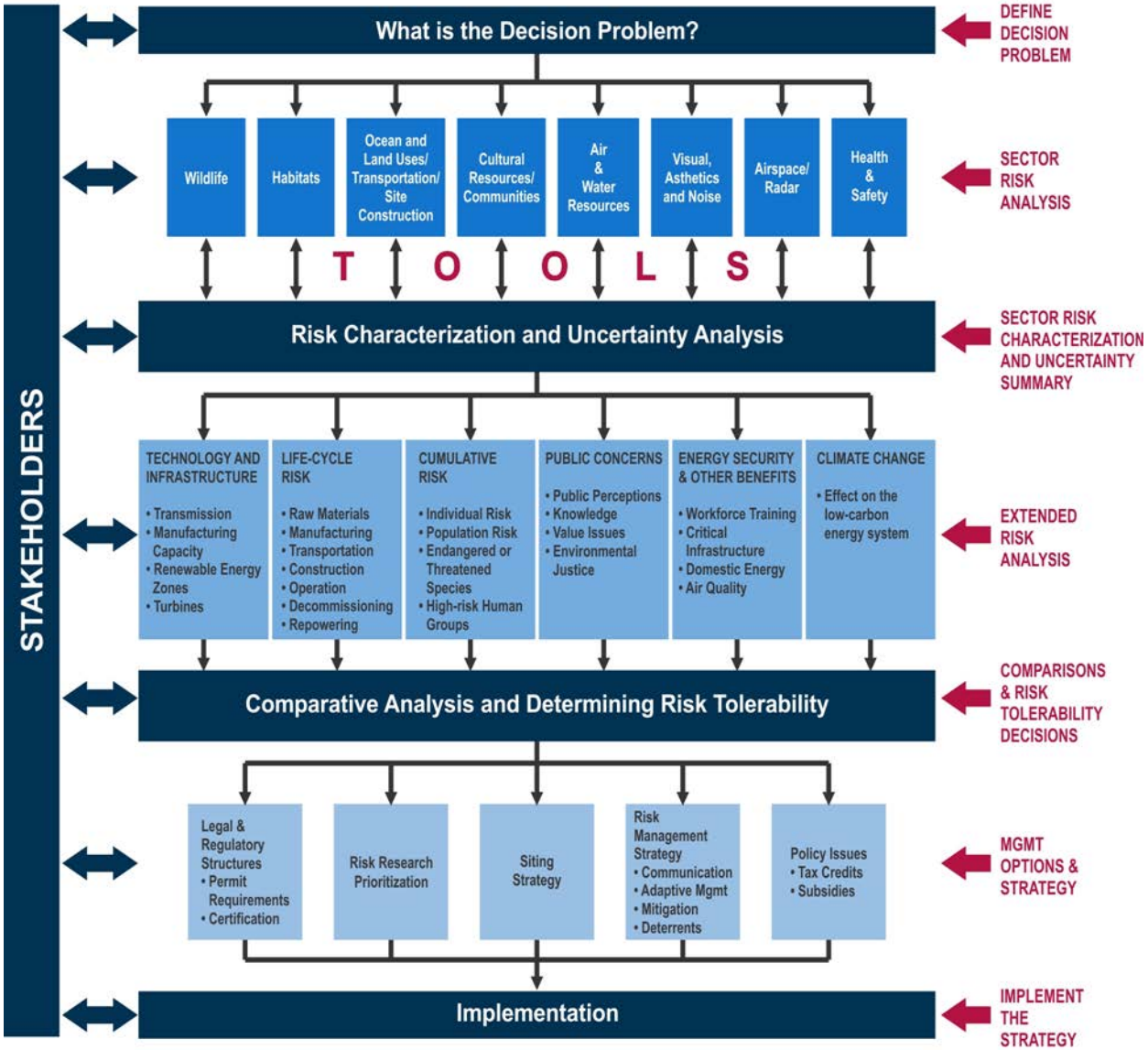
# Task- Innovations in Renewable Energy: Offshore Wind Goals

- Apply an integrated risk framework that characterizes significant risks and uncertainties and identifies management options for decision makers
- Expand partnerships with state and federal agencies responsible for siting offshore wind
- Influence public policy developments by disseminating research findings

# How was the risk framework developed?

- Developed an integrated risk framework for wind (Ram 2010)
- Analytical framework stems from work related to decision frameworks
  - –However, not a decision framework
  - –Provides crucial scientific information to decision makers
  - –Building a more robust knowledge base
- The framework integrates natural & social sciences
- Addresses stakeholder engagement
- Results in risk management options for decision makers

## Gigawatts–Scale Wind Energy Deployments: A Framework for Integrated Risk Analysis

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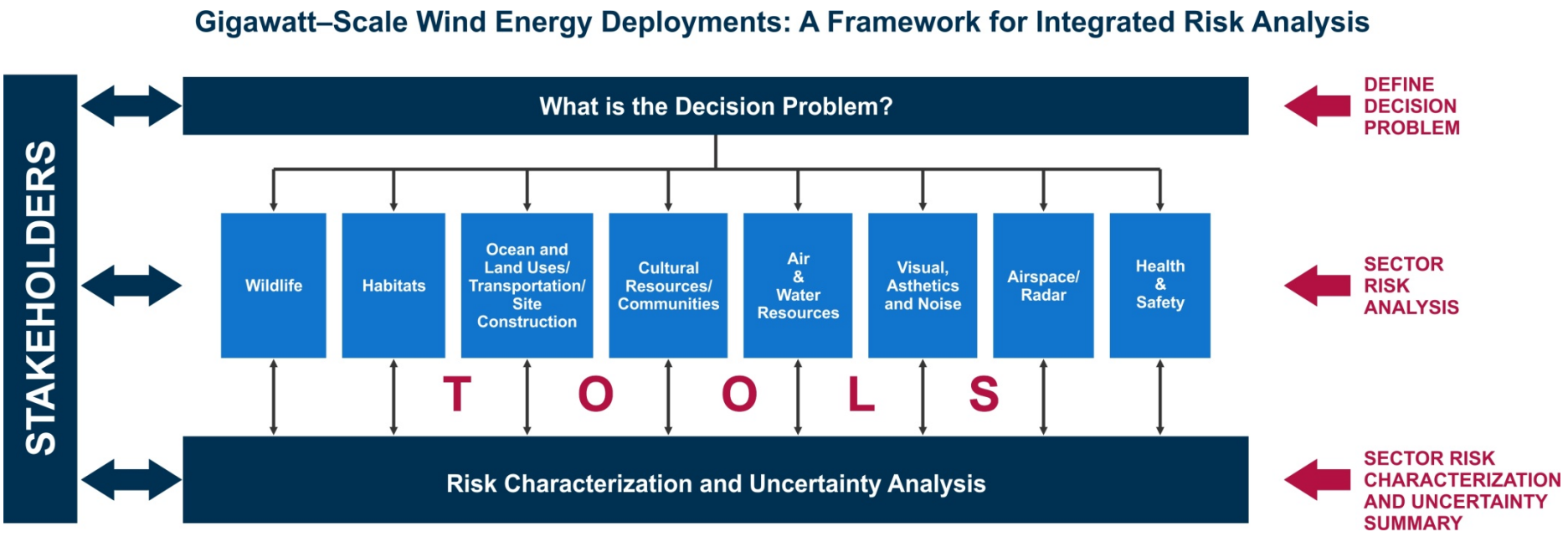
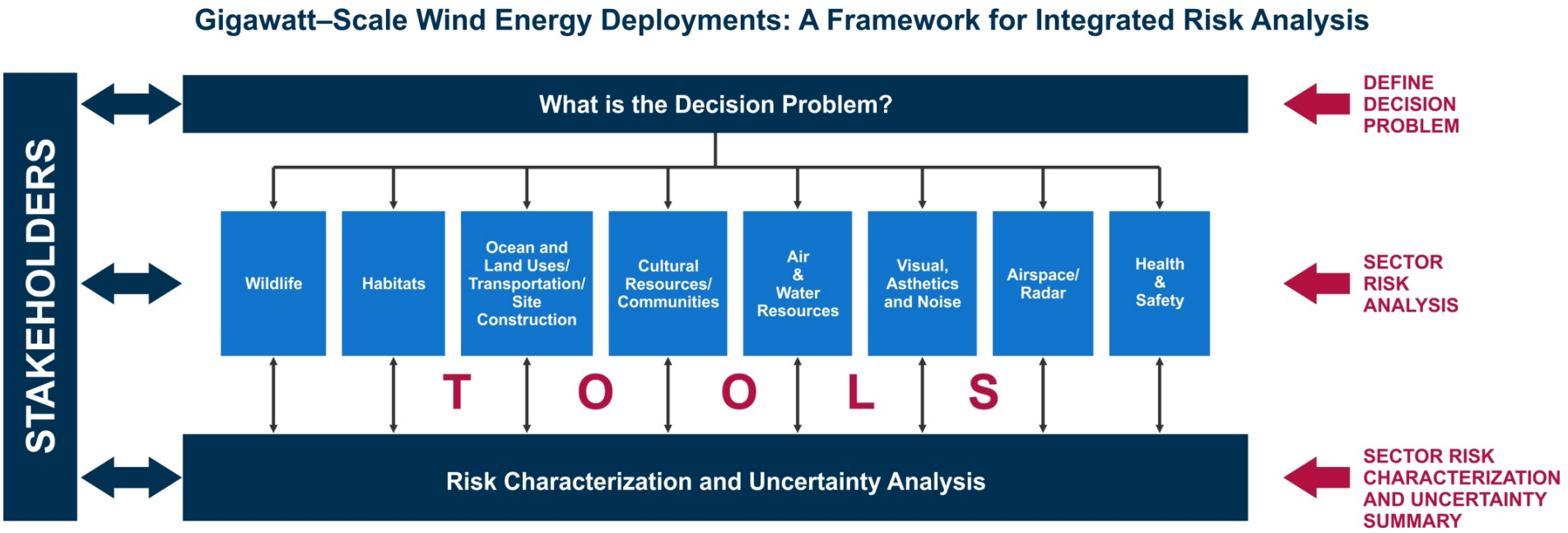
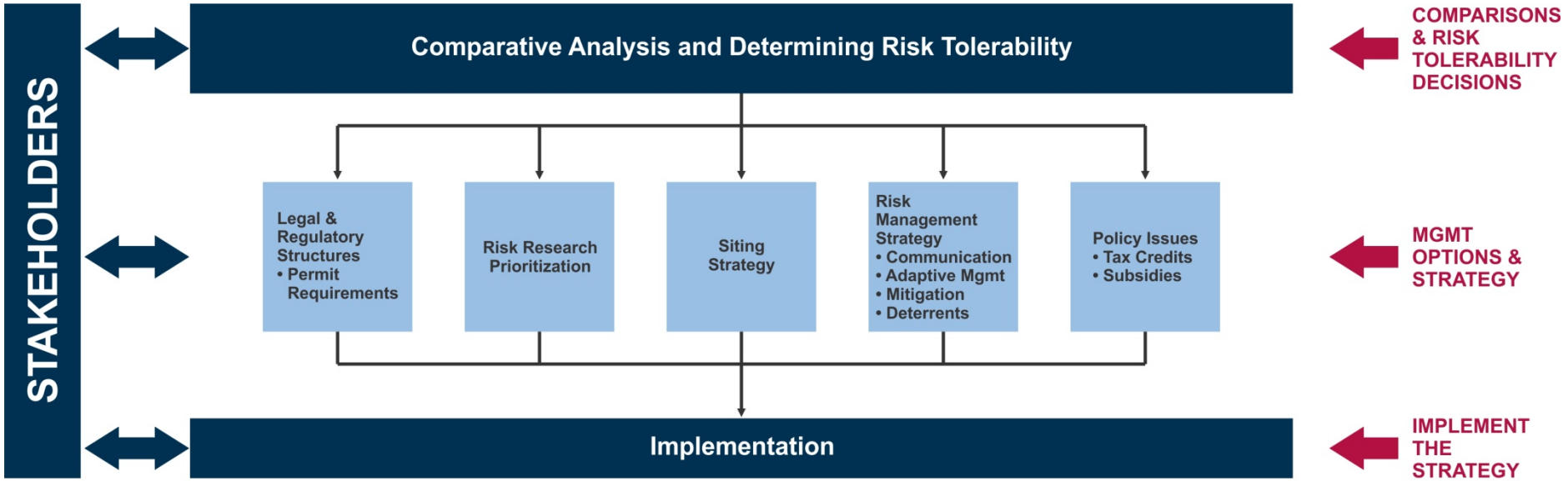
# Risk Characterization (Top levels)



# Determining Risk Tolerability (middle)



# Management Options (bottom)



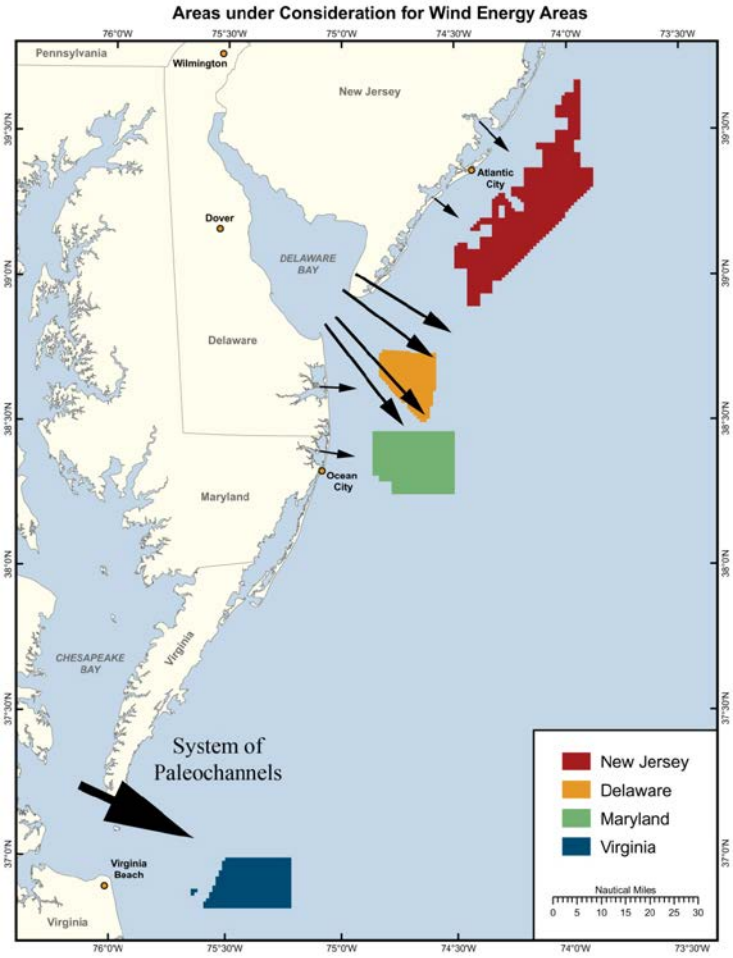
# What decisions will this information support?

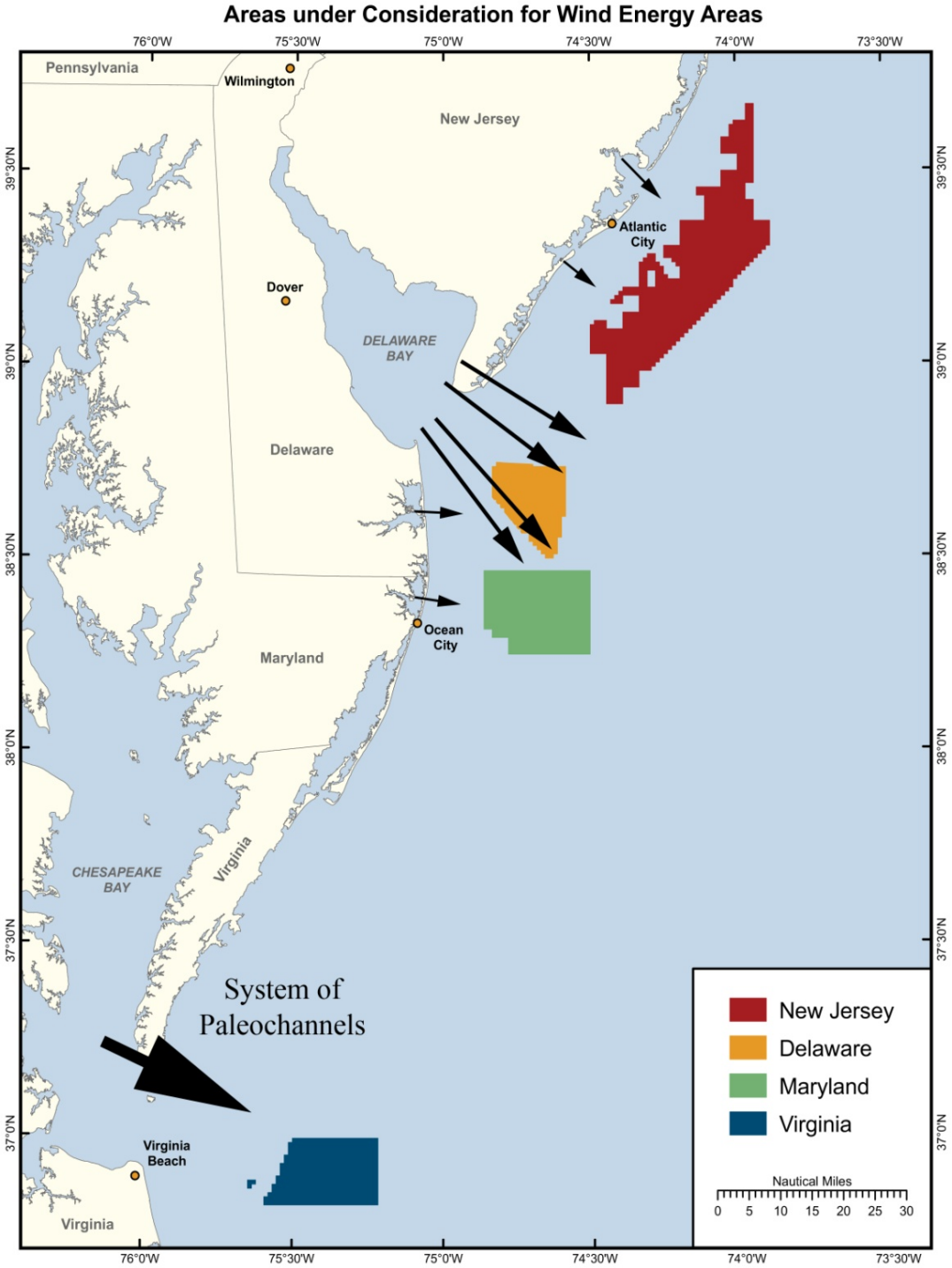
- Where along the Mid-Atlantic coast in general, and the offshore Wind Energy Areas (WEAs) in particular, are the most preferable sites for locating gigawatt-scale wind energy projects?

- What risks and benefits must be known to adequately inform a decision framework relating to offshore wind deployments along our coasts?

# Regional siting

- Defining the Mid-Atlantic region = MD, DE, NJ Wind Energy Areas
- NJ, MD are active
  - NJ baseline studies
  - Fishermen's Energy
  - MD utility funds/MET mast/auction
- Recreational & commercial fisheries




Areas under Consideration for Wind Energy Areas
76°0'W
75°30'W
75°0'W
74°30'W
74°0'W
73°30'W
39°30'N
39°0'N
38°30'N
38°0'N
37°30'N
37°0'N
Pennsylvania
Wilmington
New Jersey
Atlantic City
Dover
DELAWARE BAY
Delaware
Ocean City
Maryland
CHESAPEAKE BAY
Virginia
System of Paleochannels
Virginia Beach
Virginia
New Jersey
Delaware
Maryland
Virginia
Nautical Miles
0 5 10 15 20 25 30

# Annotated Bibliography: Highlights

# Thus far --- 59 studies reviewed

- Benthic – 4
- Birds – 6
- EMF – 4
- **Fish / fisheries / fishermen – 19**
- Miscellaneous European studies - 2
- Noise – 2
- **Noise – fish – 14**
- **Noise - marine mammals - 4**
- Risk frameworks – 1
- US NEPA studies - 3

# Risk Highlights

- **Focused on fish as our main risk cluster**
- **Search expanded after limited studies**
- Led to **EMF effects** --- a concern in Europe
  - Fish, rays and sharks respond to EMF cables
  - Are the risks significant or not?
  - More studies expected in the US
- Effects on **benthic environment**: foundations are colonized a few months after construction
  - Could have positive effect on the biodiversity, but further monitoring required
  - Studies are very short – a few weeks, or a few months

# Stressor and receptor highlights (cont.)

**Noise**: pile-driving sounds were recorded at offshore wind projects. Studies did not provide ranges of risks

## Noise effects on fish - Inconclusive results

- A lot of theoretical studies. Varying hearing levels
- Pile-driving sounds in fish tanks – some changes in swimming speed, *"twitching" fish* – a possible sign of stress; more research suggested
- Results are difficult to interpret for different populations

# Stressor and receptor highlights (cont.)

## Noise & marine mammals:

- In Europe, observed effects on harbor porpoise and seals from pile driving.
  - Temporal effects from pile-driving
- No studies on whales (a US concern)
- Differences in hearing between species
- Uncertainties about ranges that have impacts

# Key messages

- Few post-construction studies available and not in the specific risk clusters identified for study, e.g., fish, mammals, benthic

- Mostly anecdotal data or short-term monitoring studies (weeks to months)

- Endangered marine mammals are important on Atlantic Coast – more research is needed on noise effects (vibrations) during construction & operation

# Key messages (cont.)

- Benefits from artificial reefs – short terms studies

- Risks associated with fish are actually primarily about fishers' access to fishing grounds

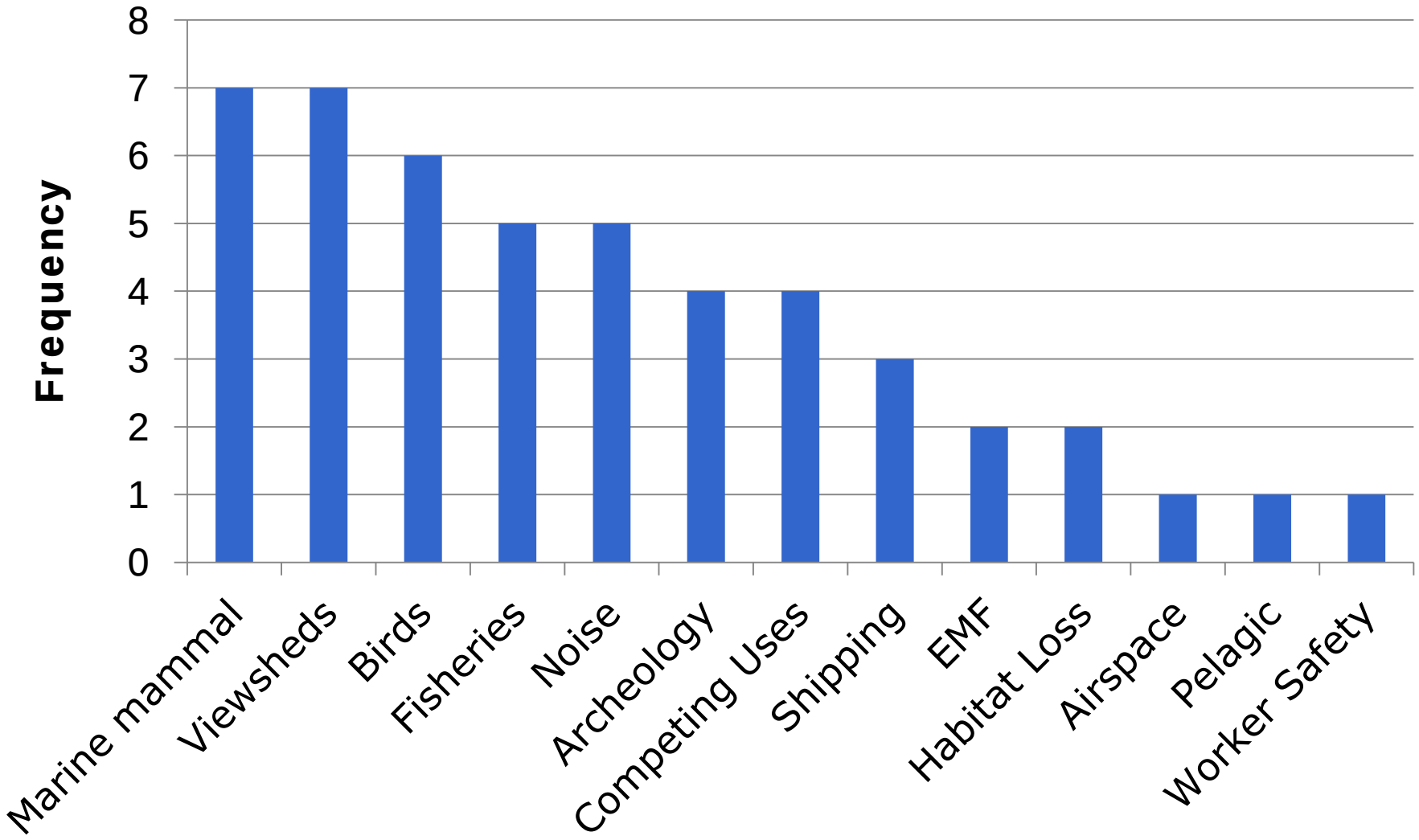
- Fishers perceived risks also includes loss of fishing areas & income, safety & vessel traffic, loss of heritage, & distrust of government.

# EXPERT INTERVIEWS: Summary of Results

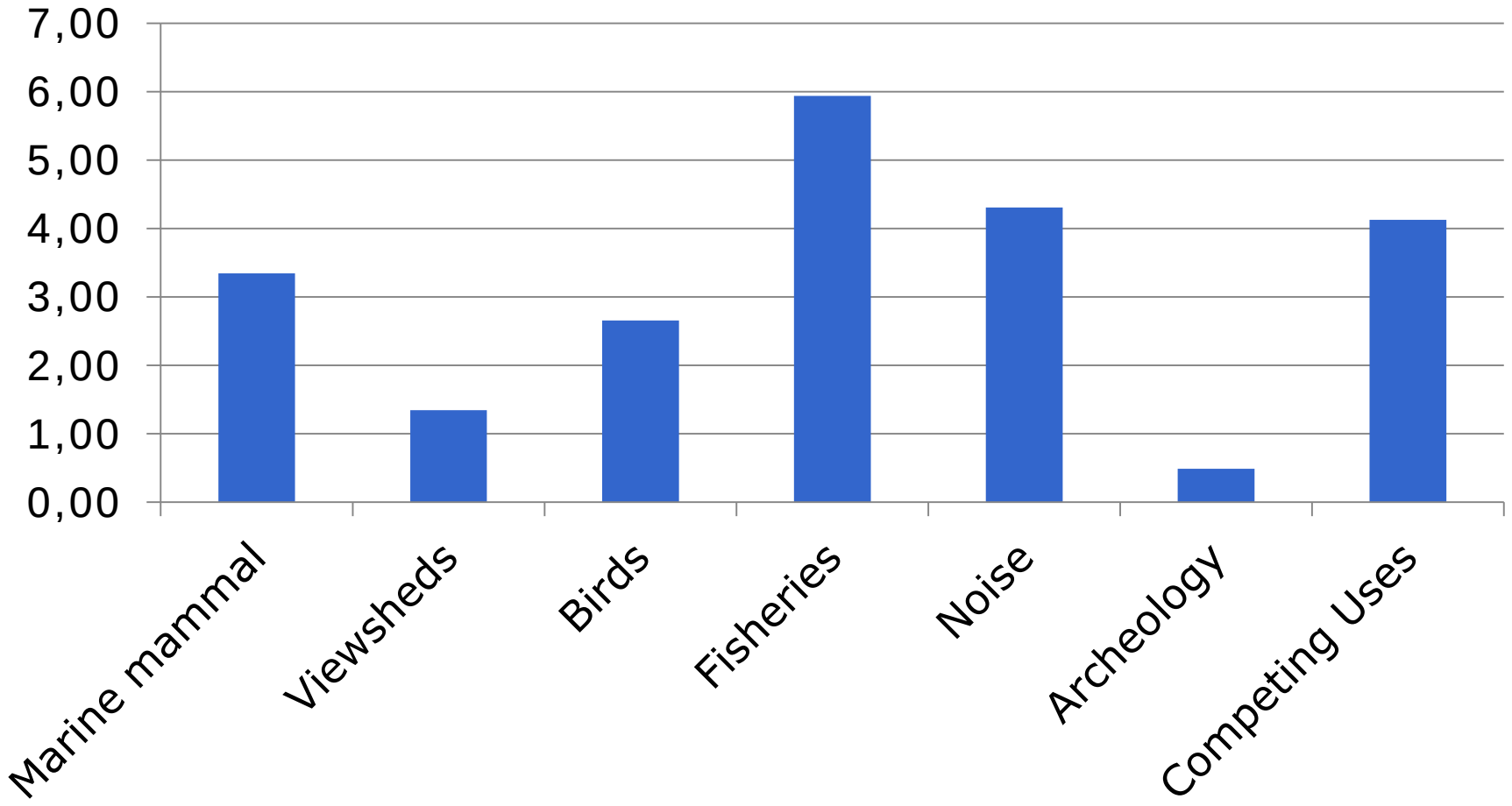
# Method & Target Interviewees

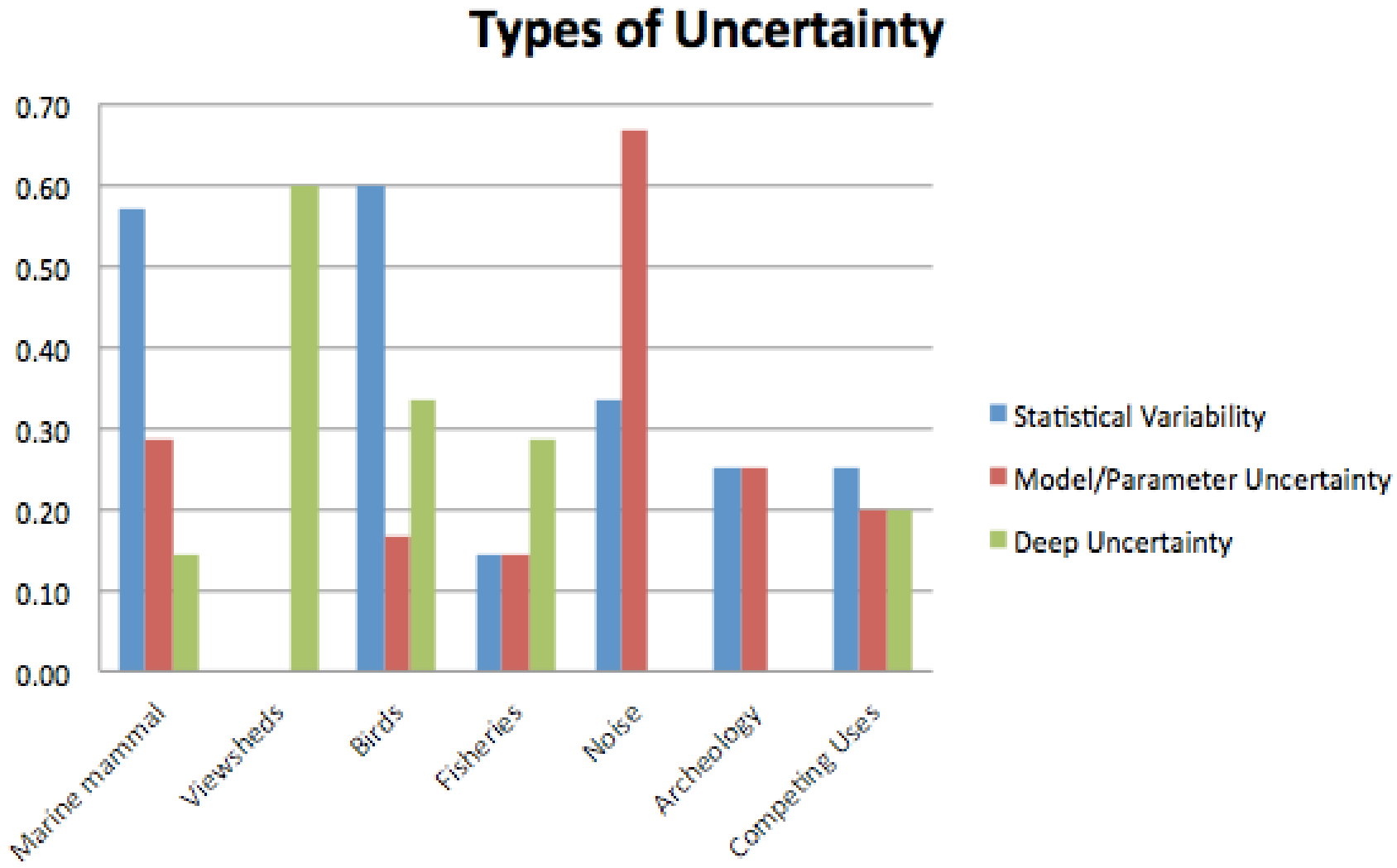
- American Wind Energy Association Meeting on Offshore Wind – Oct. 2013, RI
- Questionnaire Preparation, Internal Peer Review, Human Subject Training
- Administering questionnaire at conference
- 11 expert interviews – mostly permit managers
- Expert elicitation of key risks and benefits regarding offshore wind

# Top 5 Most Important Risks (Expert Interviews)



# Magnitude of Consequences (10 = worst effects)




Types of Uncertainty
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
Marine mammal
Viewsheds
Birds
Fisheries
Noise
Archeology
Competing Uses
Statistical Variability
Model/Parameter Uncertainty
Deep Uncertainty

# What did we learn?

- Selection of risk clusters for annotated bibliography are primary concerns of expert community
- Human factors are central to risk concerns
- Fisheries, competing uses, noise, marine mammals, & birds have “worst” magnitude of consequences expected
  - Fisheries & noise are the highest probably of occurring & magnitude of the consequence
- Uncertainties need further exploration
  - Very few “Deep Uncertainties,” e.g., viewsheds

# Player Groups (e.g., fishers)

| Decision Makers | Stakeholders |
|---|---|
| State agencies – CZMA, DNREC | Coastal communities |
| BOEM (DOI) – regulatory lead | Recreational & commercial fishers |
| Other federal agencies (USCG, NOAA, NMFS, OSHA, USACOE, DoD, etc.) | Boat owners, charter boat captains |
| Utilities and other Electric Power Buyers | Recreational Fishing Association (and other advocacy groups) |
| Board of Public Utilities, Public Utility Commissions | Ocean Conservancy (and other environmental NGOs) |
| Political decision makers | Community organizers (pro & con) |
| Regional planning bodies: MAFMC, MARCO | Academics & researchers |

Note: This list is dependent upon the scope of the decision problem and the use and conservation of the ocean space

# External Advisory Committee March 2014

- Identify risks/uncertainties that are "showstoppers"

- How relevant are EU studies in the Mid-Atlantic?
- Should the focus be on risks/benefits or process issues?

- Define better the key research objectives?
  - Building the knowledge base or improving the decision process?
  - How to better apply the risk framework & improve risk assessment?

# Path Forward from Year 1 - Options

- Integrated risk framework will continue to be the focus to address building the knowledge base
- Prepare a white paper or peer reviewed article on findings related to fisheries & selected marine wildlife in the Mid-Atlantic region
- Identify opportunities for dissemination of results & feedback
  - Society for Risk Analysis, AWEA, EERA, NGO communities

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# Thank you

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