A photograph of a large ocean wave with several birds flying over it. The wave is breaking, creating white foam. The sky is a pale blue-grey. The text is overlaid on the image.

Ecological Implications of Wave Energy Conversion Installations

Scott Terrill

H. T. Harvey and Associates

Ecological Consultants

Wave Energy

- Wave energy conversion technology relatively new
- Scope of environmental effects is unknown; including general effects and site-specific effects
- By February 08, FERC had issued 47 preliminary permits for ocean, wave and tidal energy projects

Siting Considerations

- Spatial availability of wave energy
- Temporal availability of wave energy
- Predictability



Scope of Environmental Impacts

- Physical (wave energy diminishment; sediment dynamics, etc.)
- Benthic invertebrates
- Fishes
- Seabirds
- Marine mammals

Basic Design Components

- Buoys and other floating devices
- Anchor and guy lines
- Anchoring systems
- Power cable
- On-shore infrastructure to transport power



Baseline Data

- Adequate baseline data should be collected from each site for as long as is feasible prior to installation
- Standardized survey methodology that can be employed before, during and after installation and implementation should be used

Monitoring

- Potential impacts unknown
- Monitoring will help determine impacts, if impacts occur
- Determining impacts should help avoid, reduce or minimize impacts
- Mitigation for residual impacts

Potential Avian Issues

Artificial Lighting

- Lighting will be present at the tops of buoys
- Collision-related mortality of seabirds attracted to lights well documented
- Birds more attracted to artificial sources of lights during conditions that reduce visibility

Threatened and Endangered Species



	FESA	CESA
• Short-tailed Albatross	E	
• Marbled Murrelet	T	E
• Xantus's Murrelet (CESA)		T
• California Brown Pelican	D	pD
• [Black-footed Albatross]	Petition	
• [Ashy Storm-Petrel]	Petition	
• Other protections under state and federal law		









Potential Effects of Artificial Lighting on Seabirds

- Attraction away from normal activities
- Disorientation
- Collision
- Mortality

Differential Vulnerability

- Nocturnal Seabirds (planktivorous nocturnal species)
- Perhaps greatest among species that feed on bioluminescent prey
- Immatures more susceptible than adults



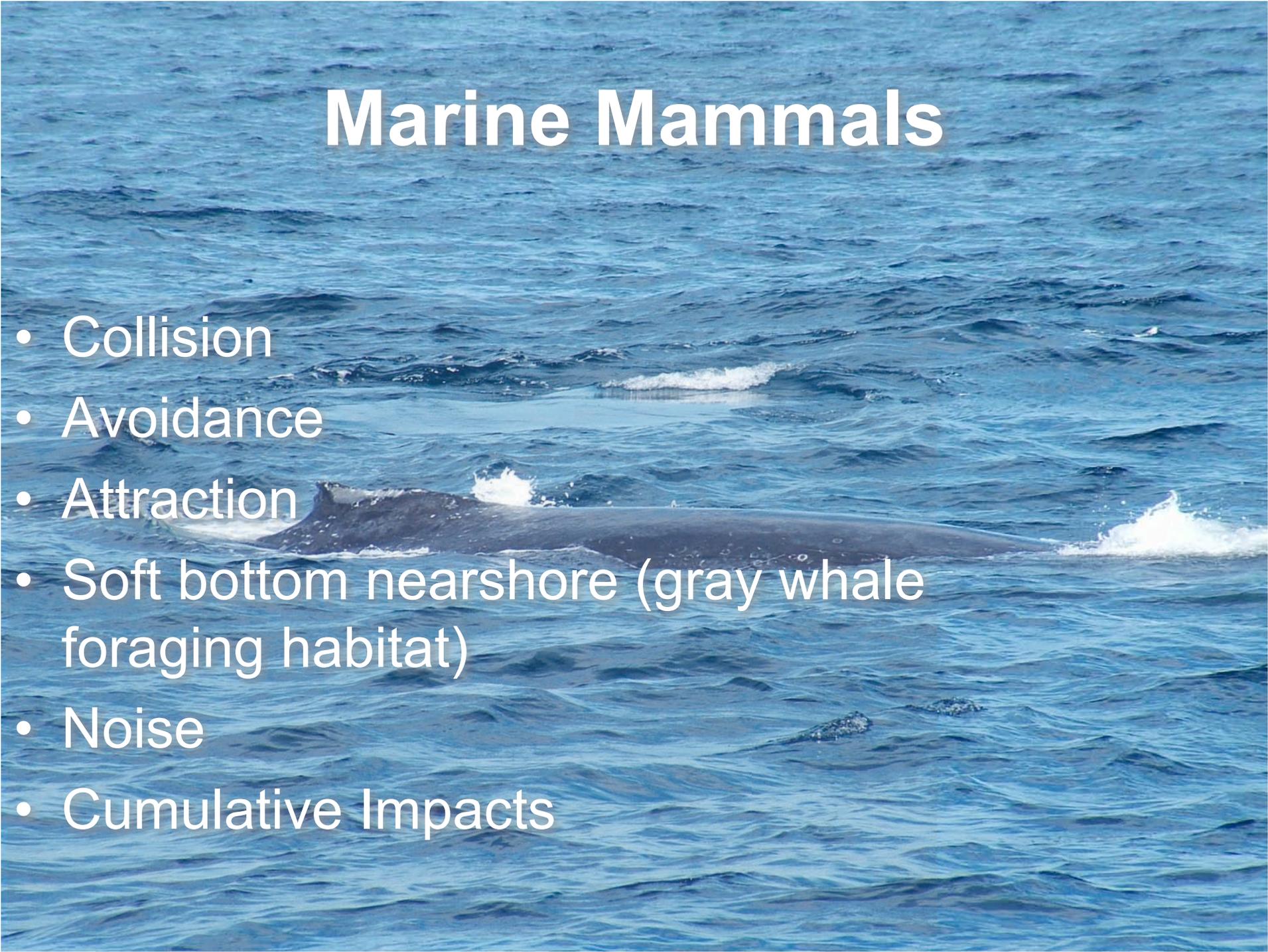
Monitoring Avian Impacts

- Degree to which buoy lights might attract birds largely unknown
- Very difficult to monitor
- Innovative monitoring still WIP
- Methods using radar and visual data for modeling seabird fatality at windfarms are being proposed for wave energy projects

Other Potential Avian Issues

- Direct collisions with buoys (above surface)
- Collisions with structures underwater (diving)
- Avoidance of areas with buoys
- Attraction to areas with buoys

Marine Mammals

A large whale, likely a gray whale, is shown breaching the surface of the blue ocean. The whale's dark, sleek body is visible above the water, with white spray and foam around its head and tail. The water is a deep blue with small waves and ripples. The whale is moving from left to right across the frame.

- Collision
- Avoidance
- Attraction
- Soft bottom nearshore (gray whale foraging habitat)
- Noise
- Cumulative Impacts

Marine Fish

- EMF generated by subsea transmission cables and buoys
- Particular concern
 - Elasmobranches, salmon, green sturgeon, Dungeness crab
- Might disrupt migration and increase predation of salmon
- May attract sharks
- Artificial Structure in water

Conclusion

- Potential biological effects largely untested (new technology)
- Currently doing “white paper” for the Ocean Protection Council. Compile and Review existing data and identify data gaps
- Collect data to fill gaps
- Estimate potential impacts
- Monitor: adaptive management