

Understanding the potential for marine megafauna entanglement risk from marine renewable energy developments

Steven Benjamins, Violette Harnois, Helen Smith,
Lars Johanning, Lucy Greenhill, Caroline Carter,
Ben Wilson

Entanglement

- Global conservation problem for many species
- Involves ropes, chains, etc.
- Are MRE moorings a risk?



Marine megafauna



Legal requirements (e.g. EC Habitats Directive)
necessitate risk assessment



Review of entanglement

• Fisheries



- Aquaculture
- Subsea cables
- Moorings & anchors



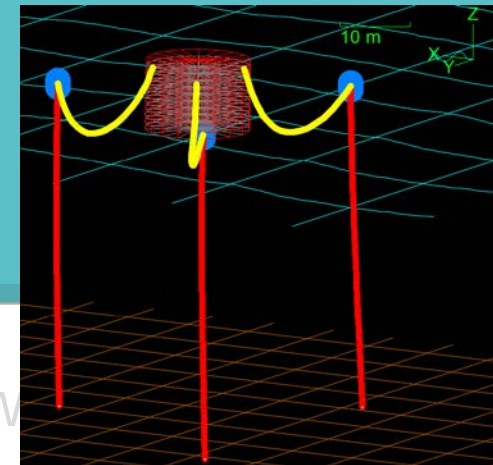
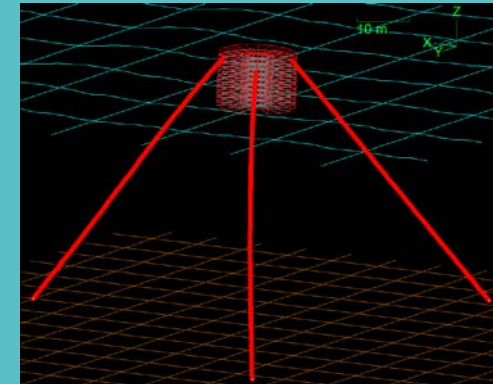
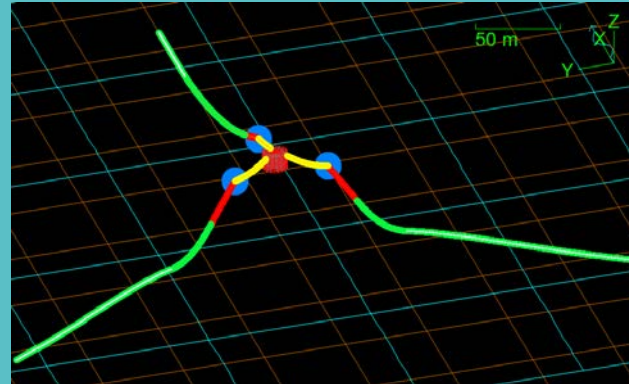
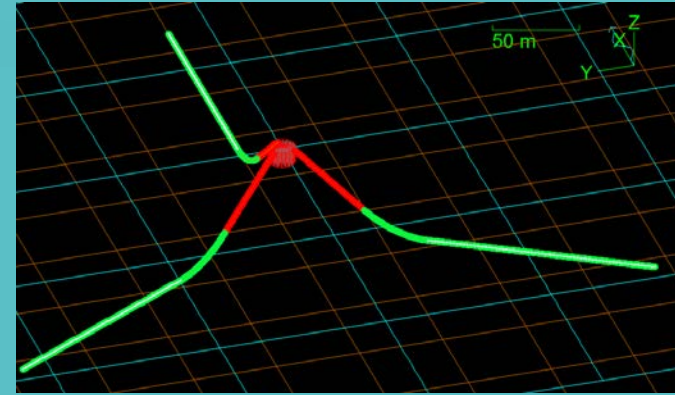
Main group of concern:
Baleen whales

Additional concern:

- Derelict fishing gears snagged in moorings

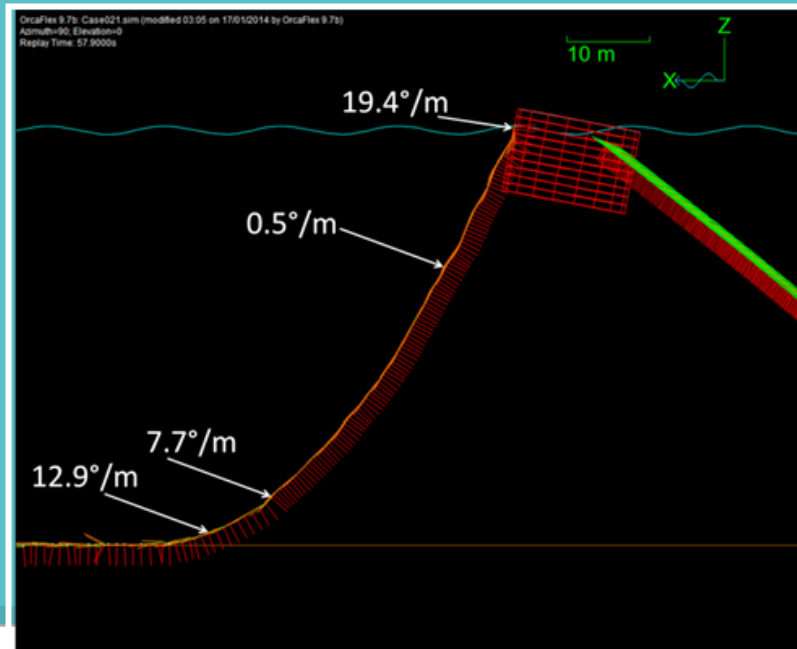
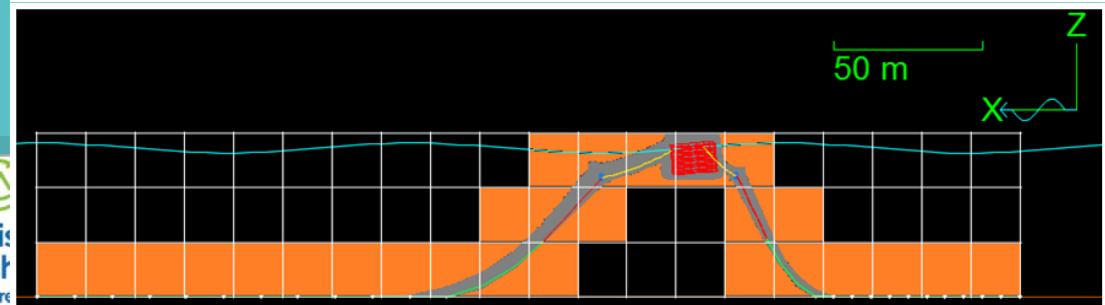
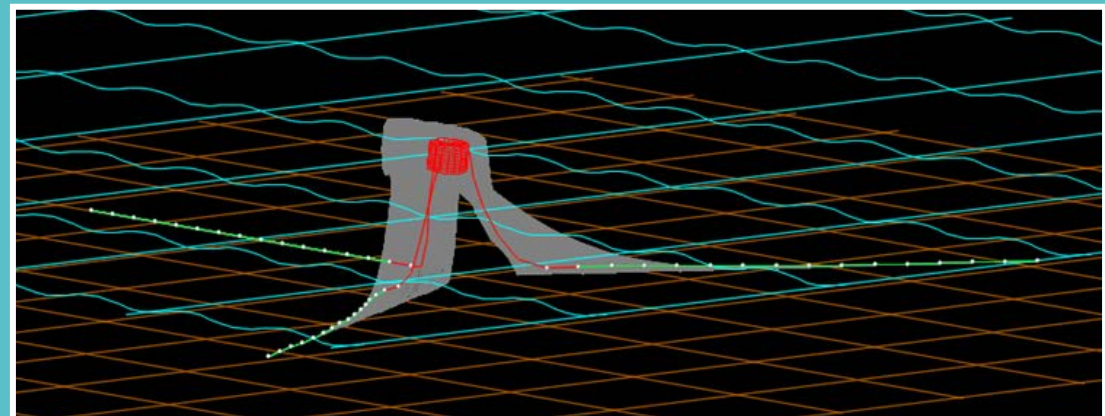
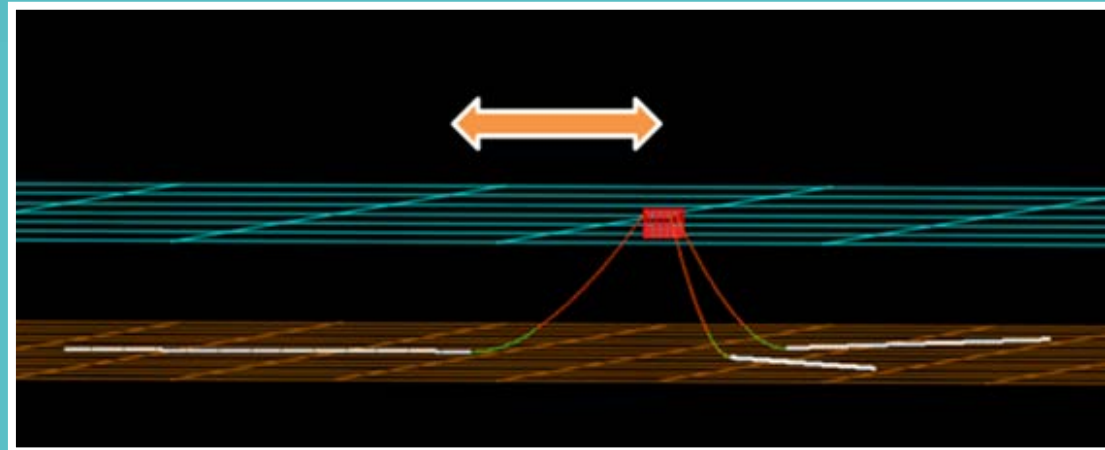
Risk assessment: Mooring modelling

- Simulated floating structure
- 6 different mooring configurations:
 - Catenary
 - With chain
 - With chain and Nylon
 - With chain and Polyester
 - Catenary with accessory buoy
 - With Nylon
 - Taut
 - With Nylon
 - Taut with accessory buoy
- Mooring behaviour was simulated across wave periods of 1-10 s, wave heights of 1, 5, 10 m



Risk assessment: Mooring modelling

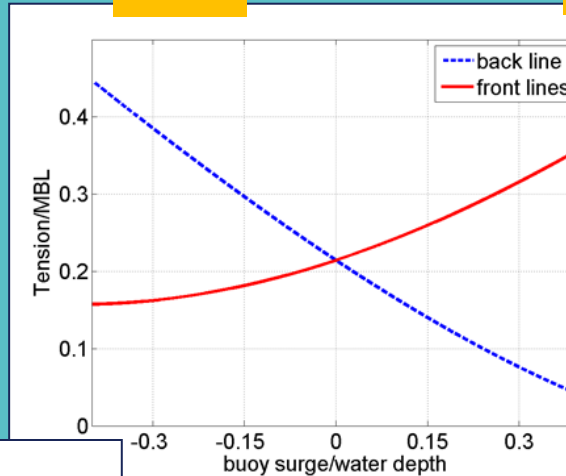
- Tension characteristics
- Swept volume
- Curvature



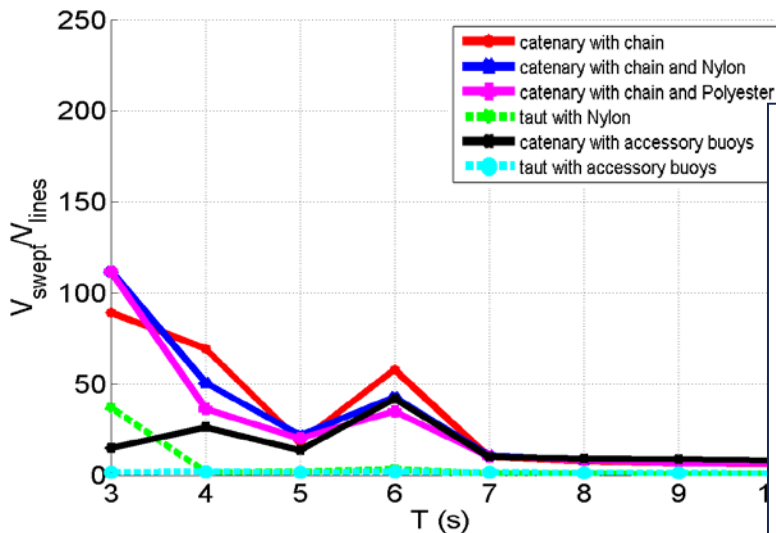
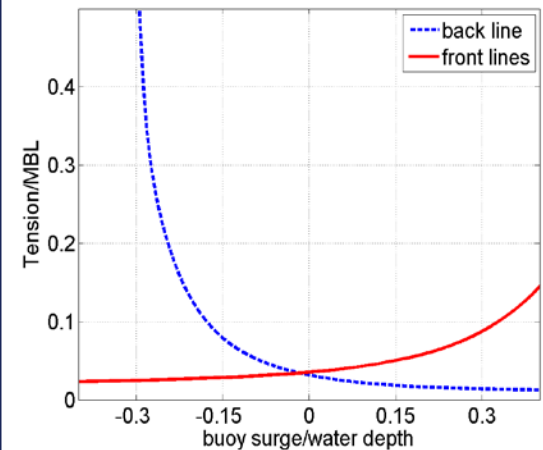
Risk factors: Mooring design

- Tension characteristics
- Swept volume
- Curvature

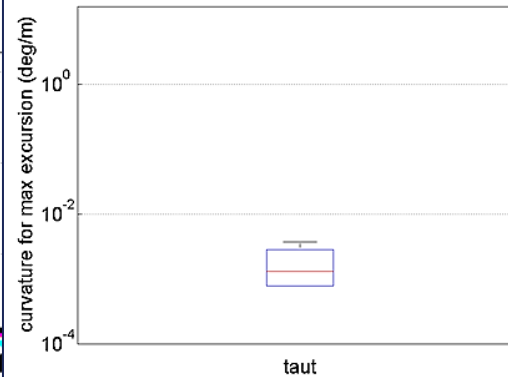
Taut



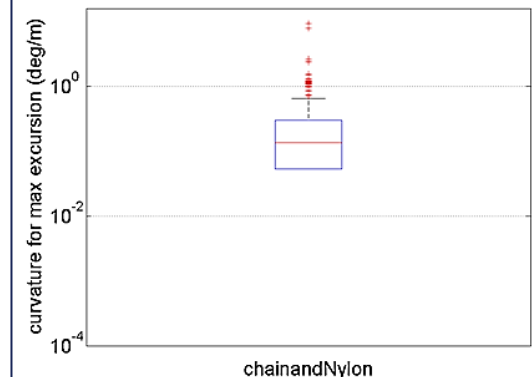
Catenary with chain/Nylon



Taut

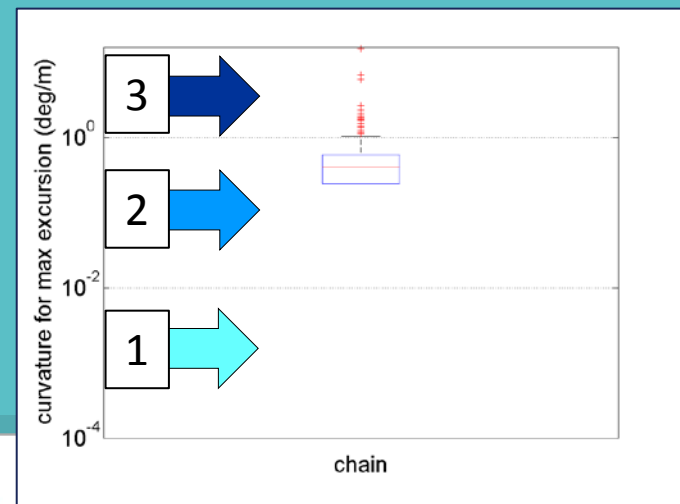
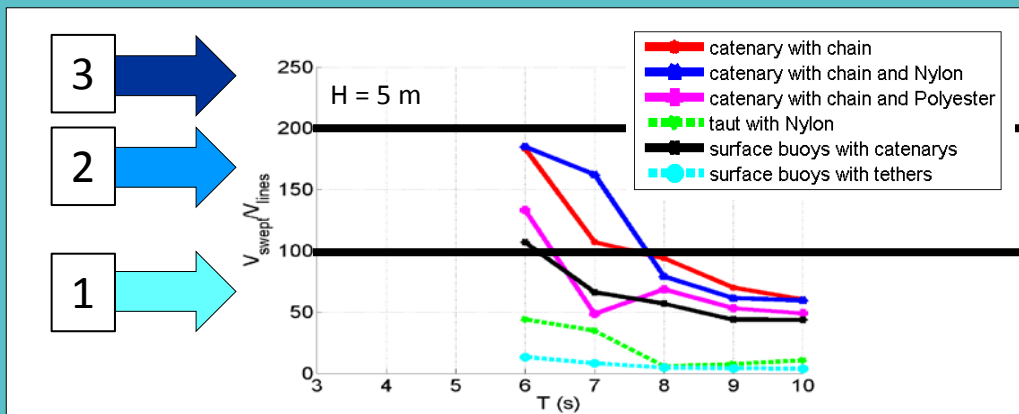
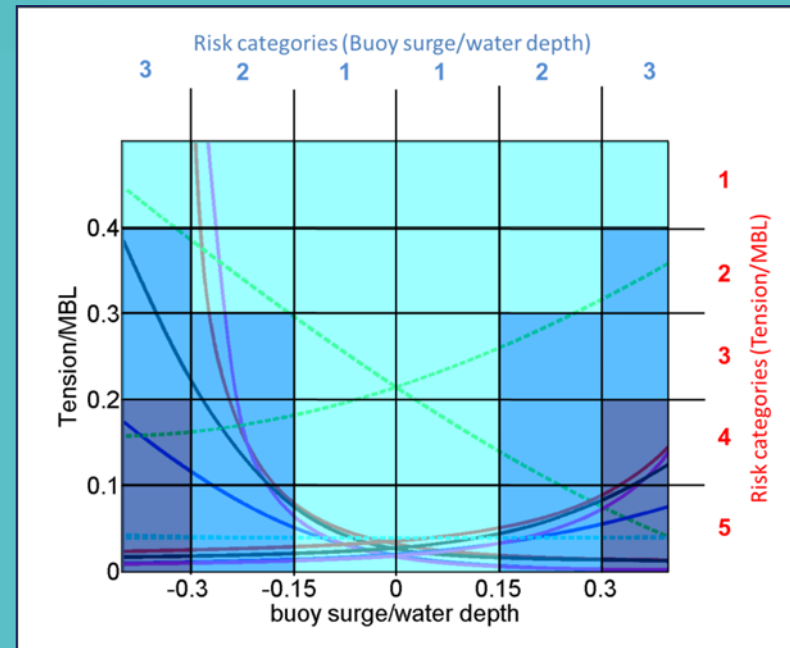


Catenary with chain/Nylon



Risk factors: Mooring design

- Tension (high = good; low = bad)
- Swept volume (small = good; large = bad)
- Curvature (limited = good; large = bad)



Risk factors: Biology

- Body size (small = good; large = bad)
- Flexibility (flexible = good; rigid = bad)
- Sensory systems (long-range = good; short-range = bad)
- Feeding mode (pursuit hunting = good; lunge feeding = bad)



Relative risk assessment

Species group		Catenary & chain	Catenary & chain & nylon	Catenary & chain & polyester	Taut & nylon	Catenary & accessory buoy	Taut & accessory buoy
Cetaceans	Baleen whales	Large whales					
		Medium-sized whales					
	Toothed whales	Sperm whale					
		Medium-sized whales and dolphins					
		Small whales, dolphins and porpoises					
Pinnipeds	Seals						
	Sea lions/fur seals						
Sea turtles							
Sharks	Basking sharks						
	Other large sharks						
Ocean sunfish							

Conclusions

- Very limited data on non-fisheries entanglements
- Mooring entanglement risk likely low for most megafauna
- Possible exception: **Baleen whales**
- Mooring design influences relative risk; assessment approach to be refined as more data become available
- Important to consider risk early during project development
- Risks around arrays will depend upon device distribution, densities, extent of mooring sharing between devices
- Need to assess risk of derelict fishing gears