



Experiments on the near-field and far-field wave effects of WEC arrays



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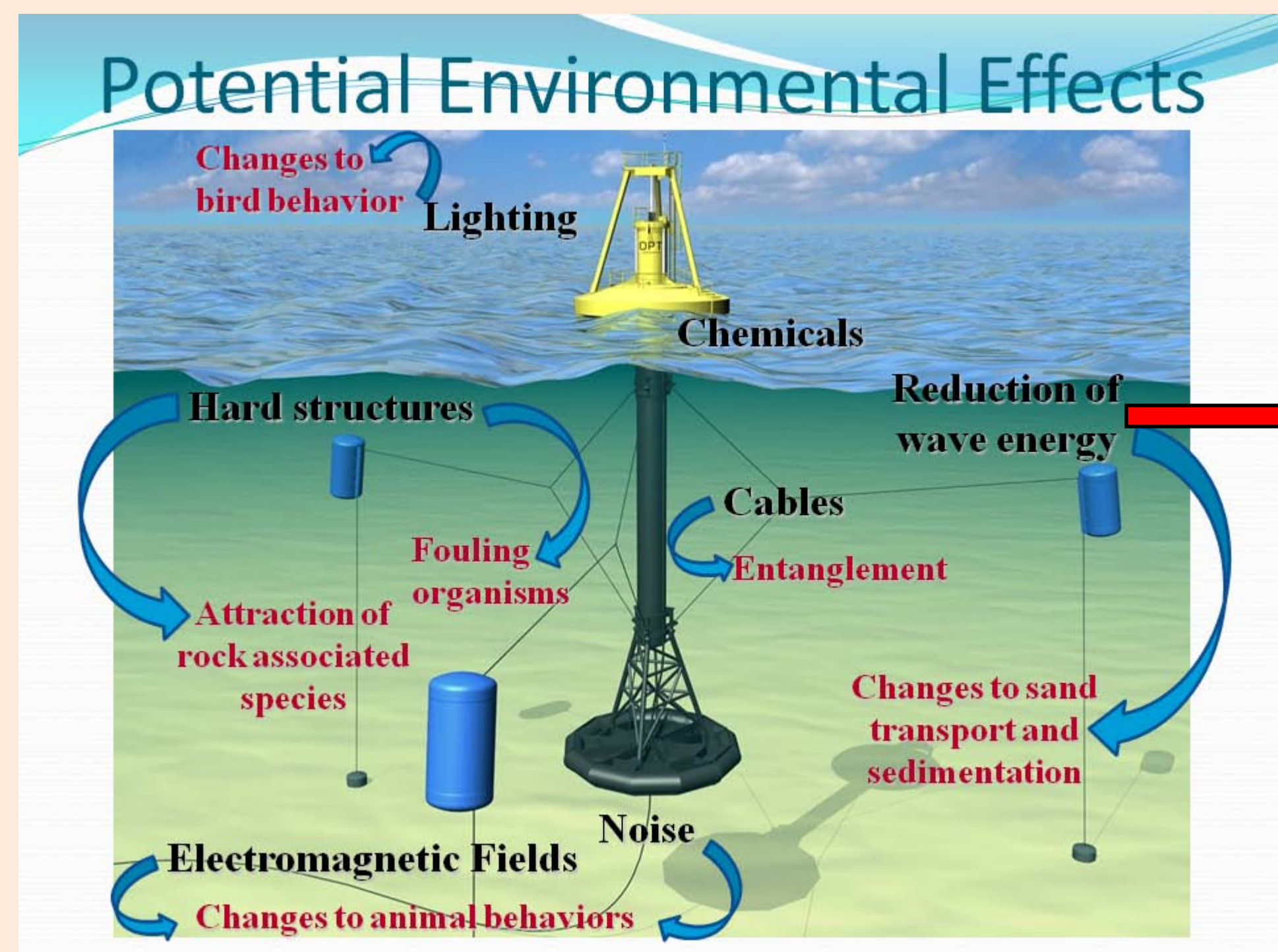
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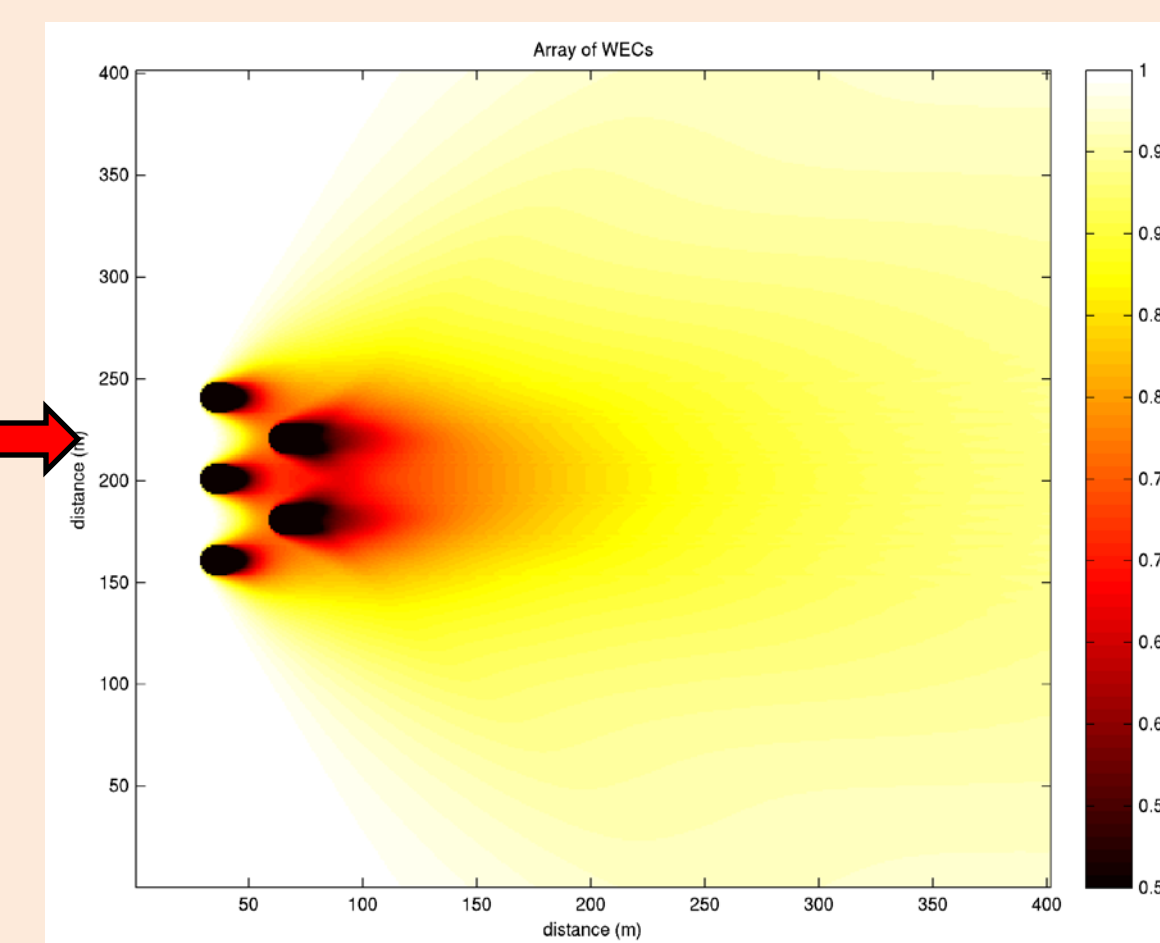
Objectives

The objective of this work is to fill a data gap in our present knowledge of the near-field and far-field effects of Wave Energy Conversion arrays (WEC-arrays). Specifically, we have performed lab experiments using five (1:33 scale) moored, point-absorbing WECs (Columbia Power Technology “Mantas”). Analysis has focused on near- and far-field effects on the wave field as well as WEC-array performance.



(Graphic from the Northwest National Marine Renewable Energy Center, Oregon State University/University of Washington)

Model predictions of wave shadowing by WEC-arrays need verification



SWAN model simulation of wave shadowing from a 5 device WEC-array

Experimental Wave Conditions*

Laboratory scale (1:33)

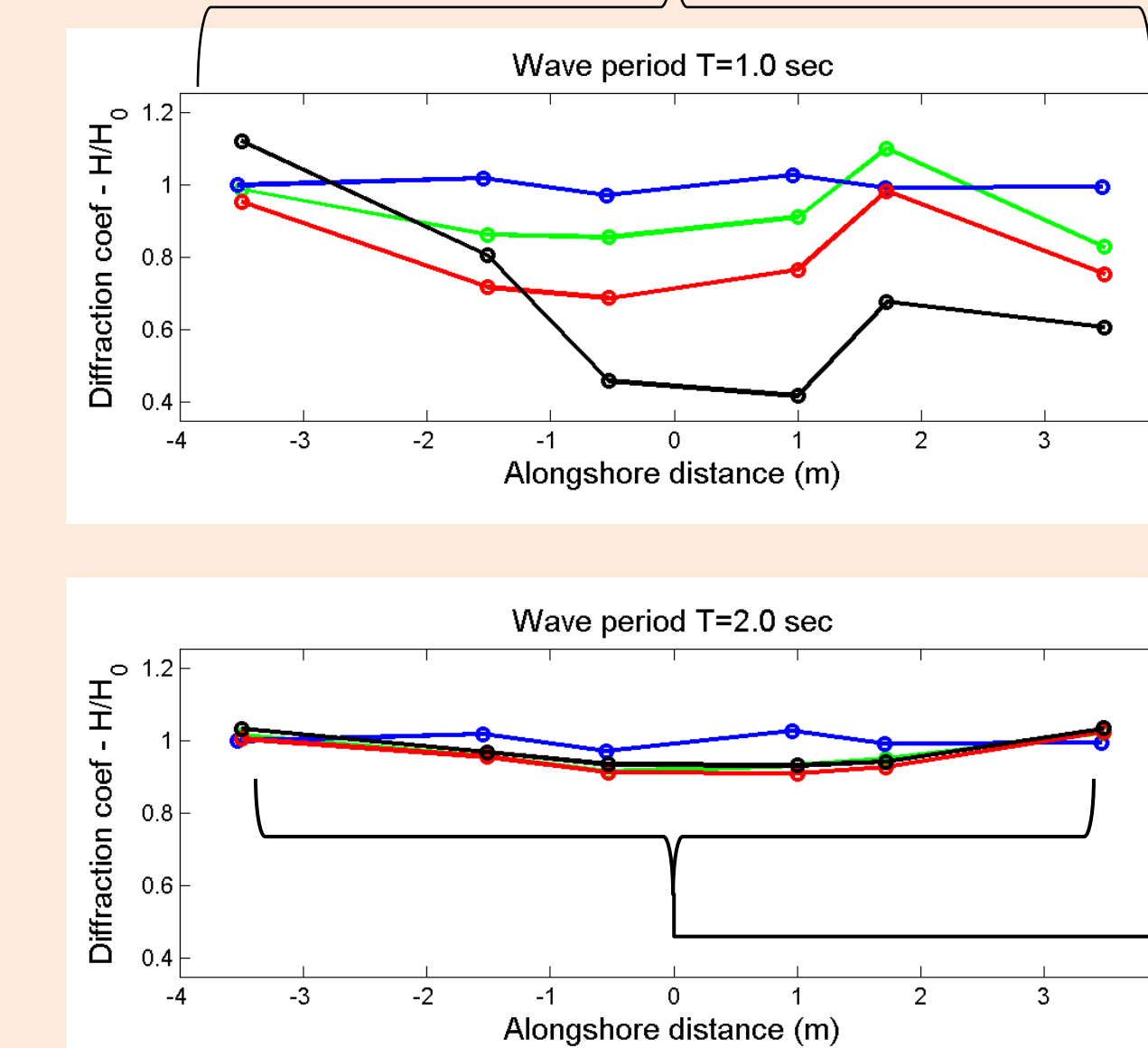
H ₀ (cm)	T ₁ (s)	T ₂ (s)	T ₃ (s)	T ₄ (s)	T ₅ (s)	T ₆ (s)
6	1.0	1.2	1.4	1.6	2.0	
9	1.0	1.2	1.4		2.0	2.6
12			1.4		2.0	2.6
15					2.0	2.6

Prototype scale

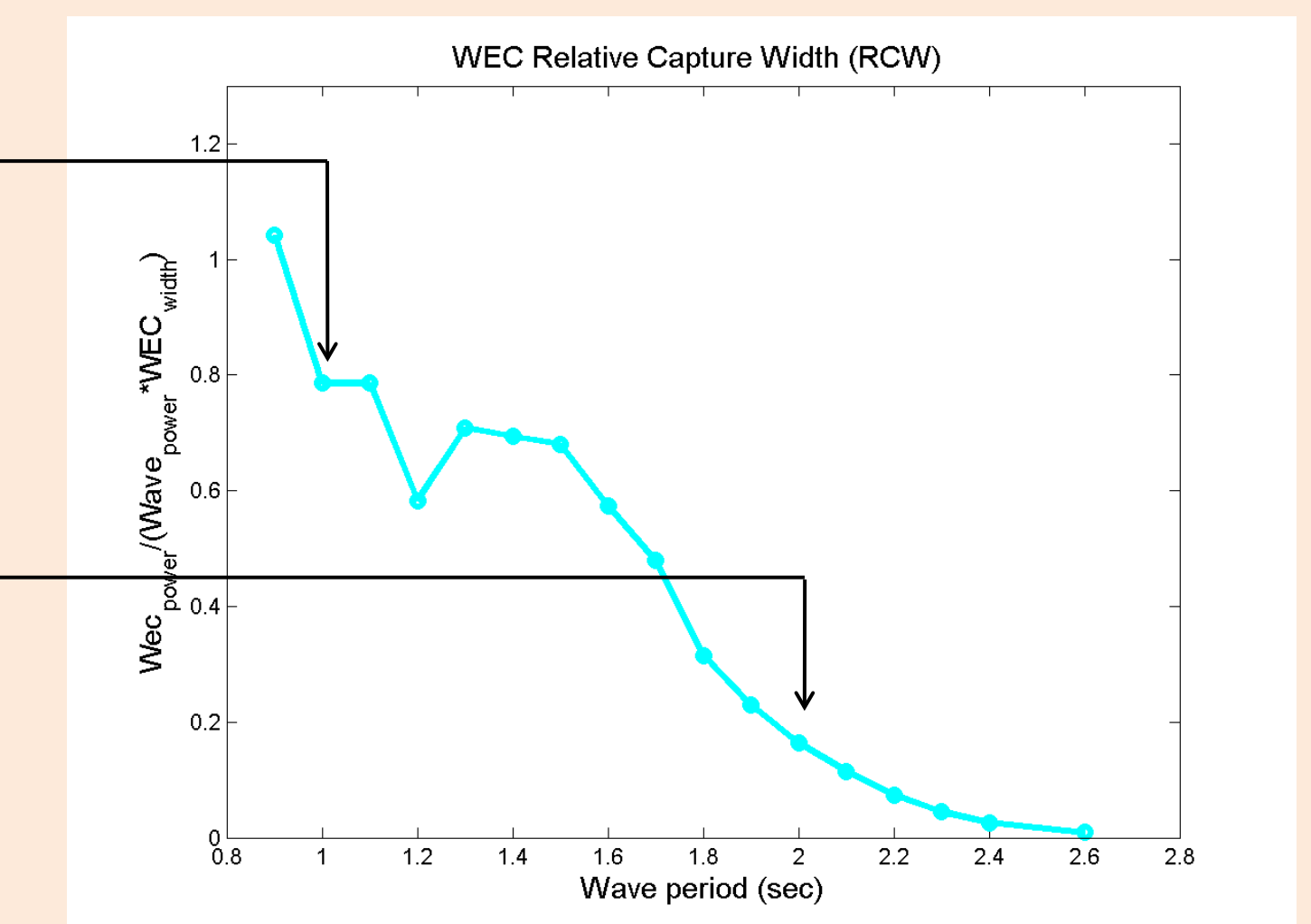
H ₀ (m)	T ₁ (s)	T ₂ (s)	T ₃ (s)	T ₄ (s)	T ₅ (s)	T ₆ (s)
2.0	5.75	6.9	8.0	9.2	11.5	
3.0	5.75	6.9	8.0		11.5	14.9
4.0			8.0		11.5	14.9
5.0					11.5	14.9

*Note: these were not the only conditions tested, just the only conditions analyzed so far.

Results

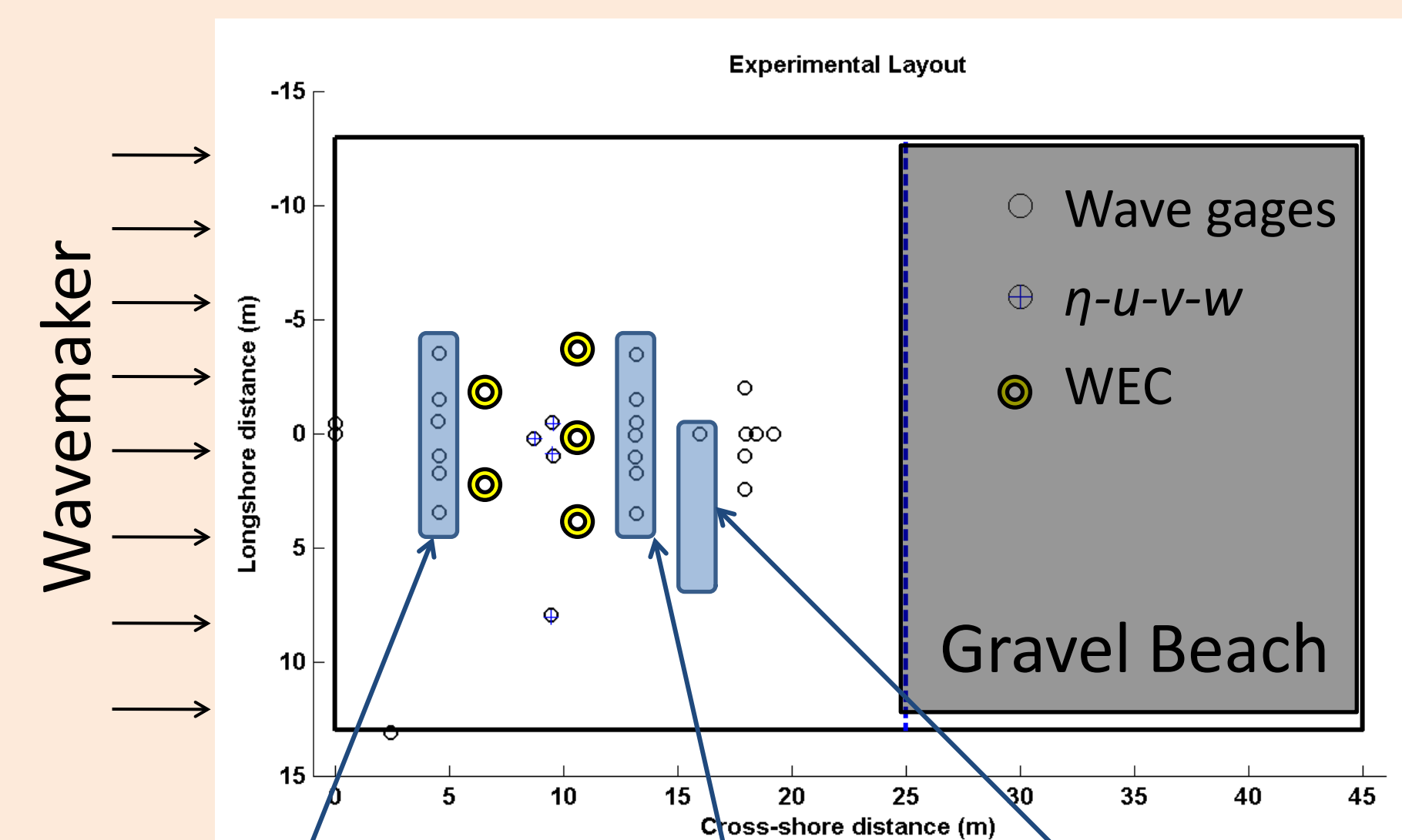


The green, red, and black lines demonstrate the varying wave conditions in the lee of a 1/3/5-WEC array, respectively.



The relative capture width of a single WEC decays with wave period above 0.8 seconds (shown above). The corresponding decrease in wave shadowing with wave period is evident in the figures to the left.

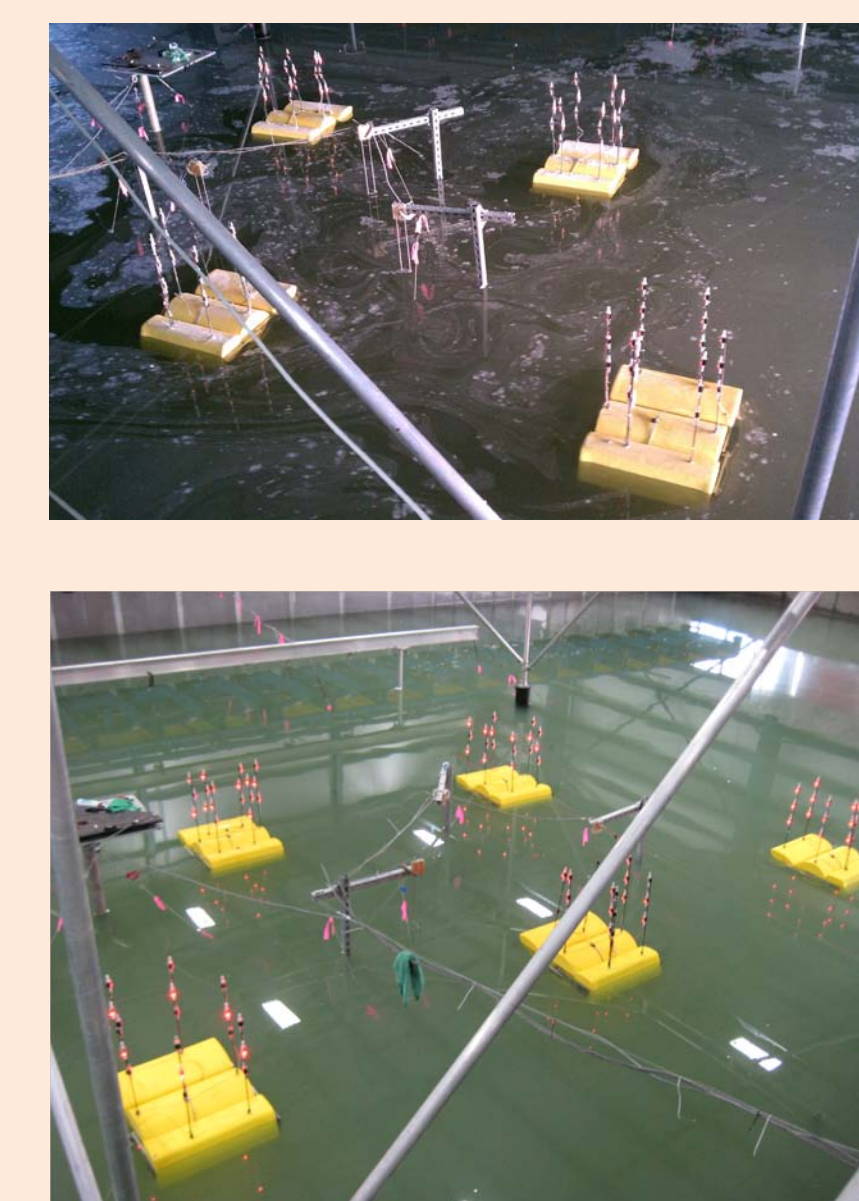
Experimental Facility



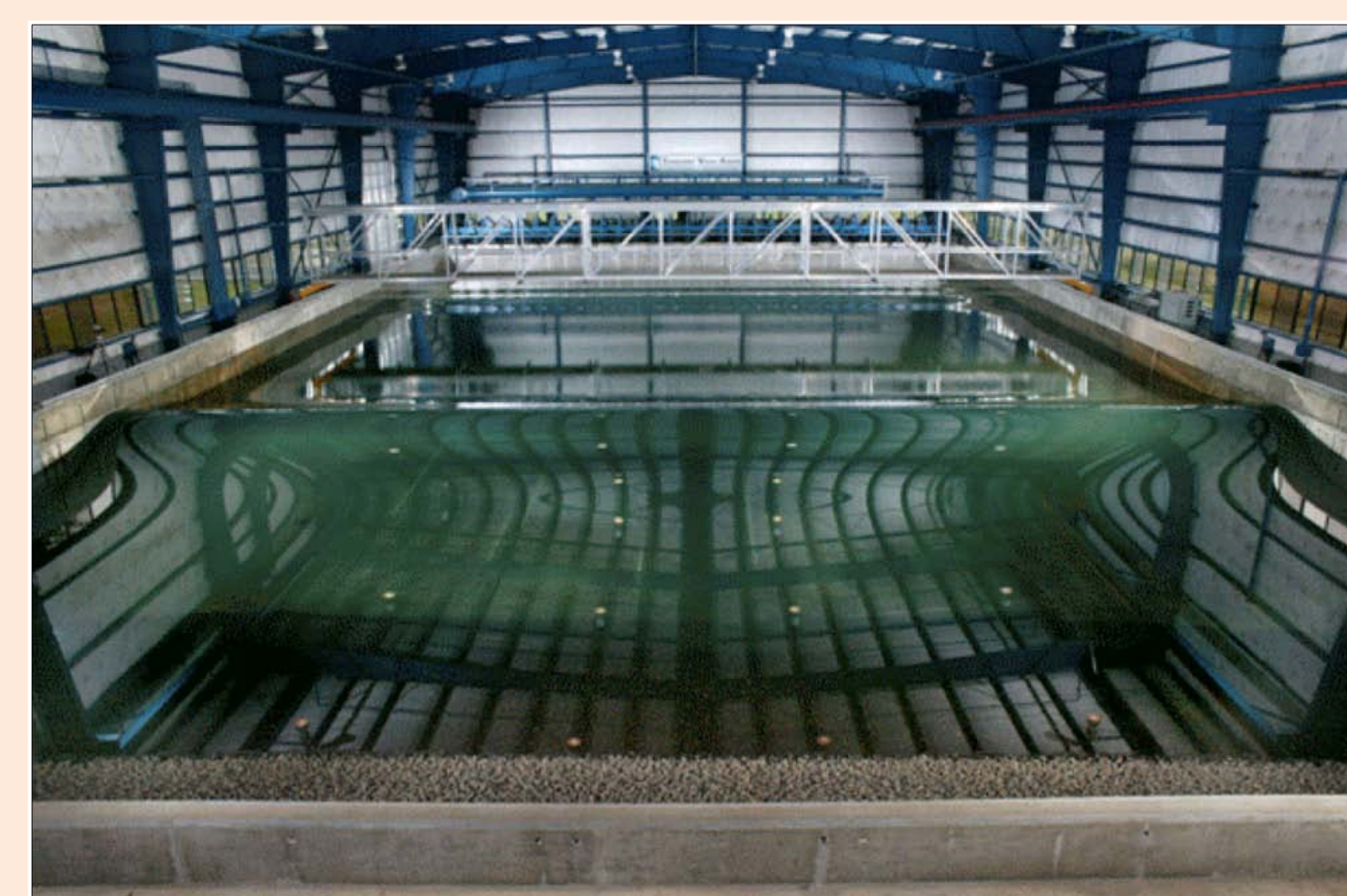
1:33 scale



Five 1:33 scale “Manta” Wave Energy Converters (CPT) were used in the experiments



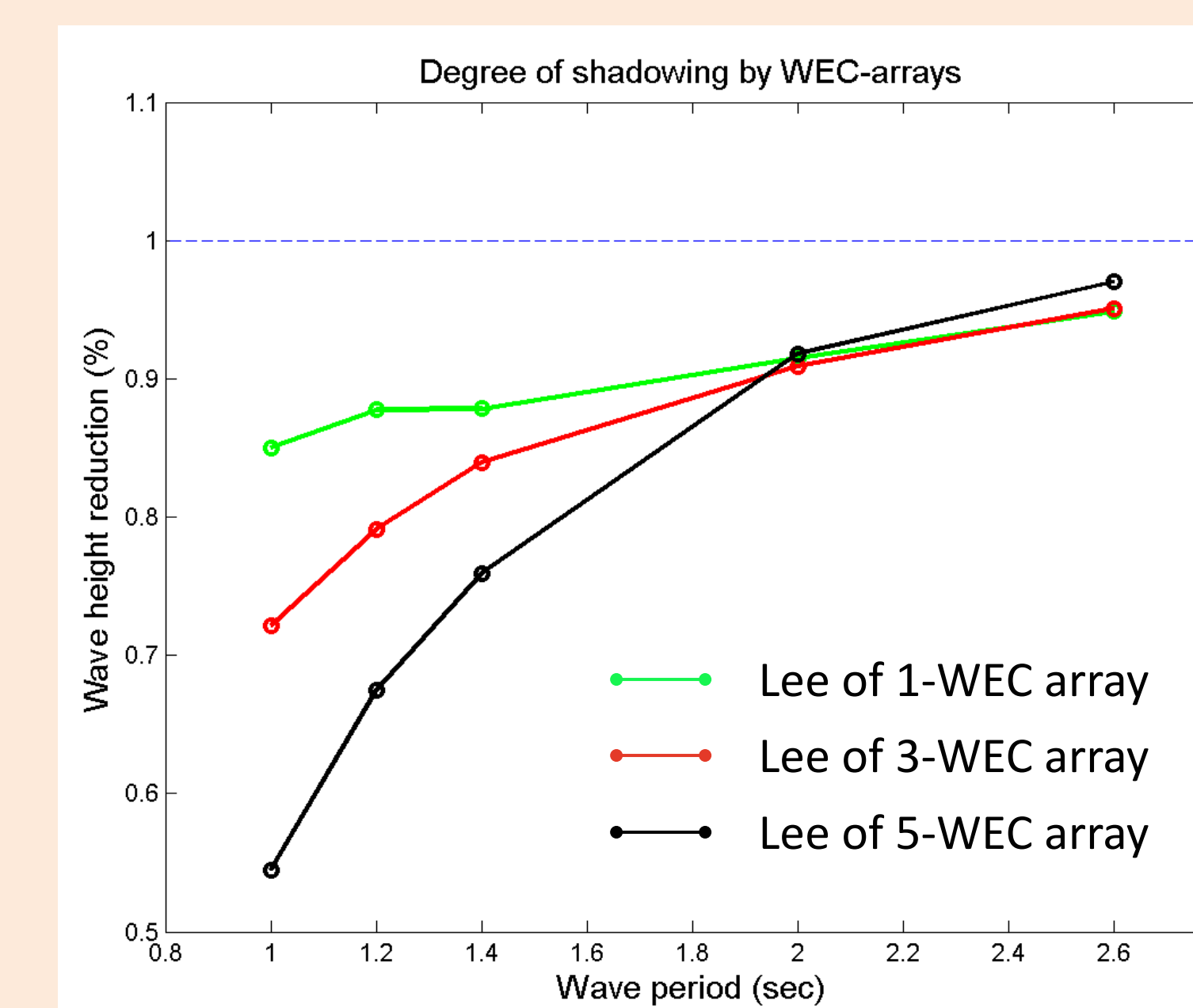
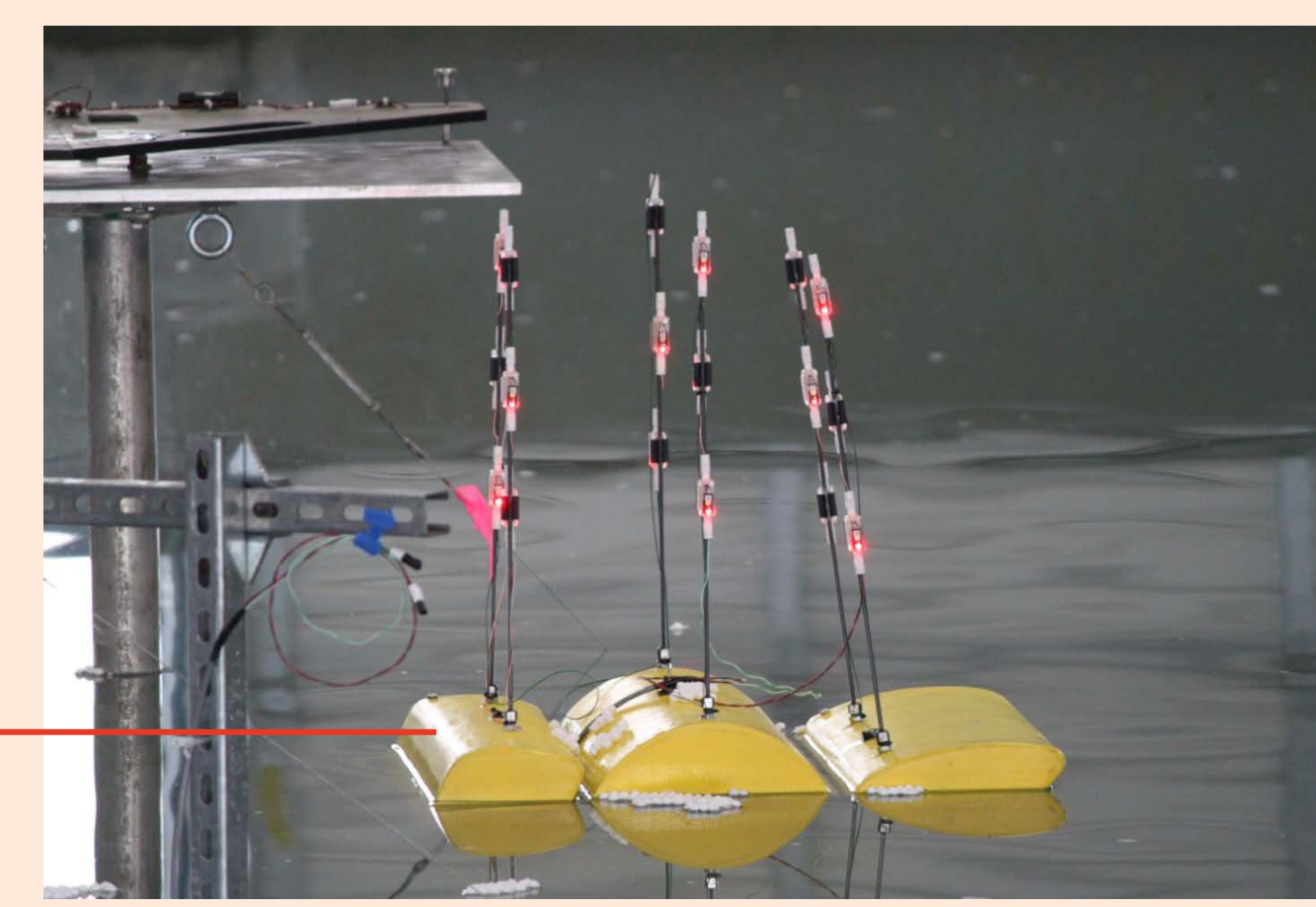
WECs were arranged in 1/3/5 WEC-array configurations



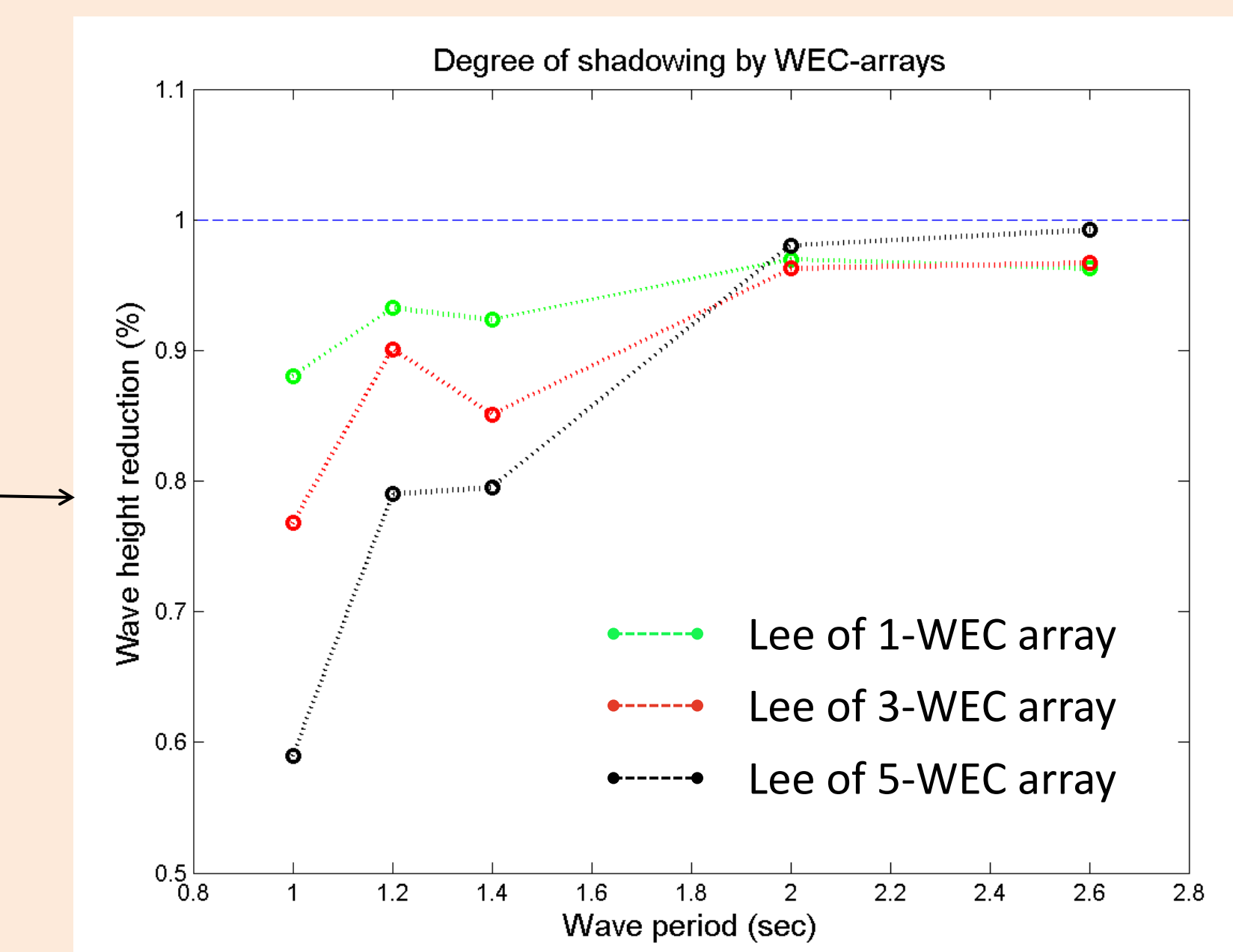
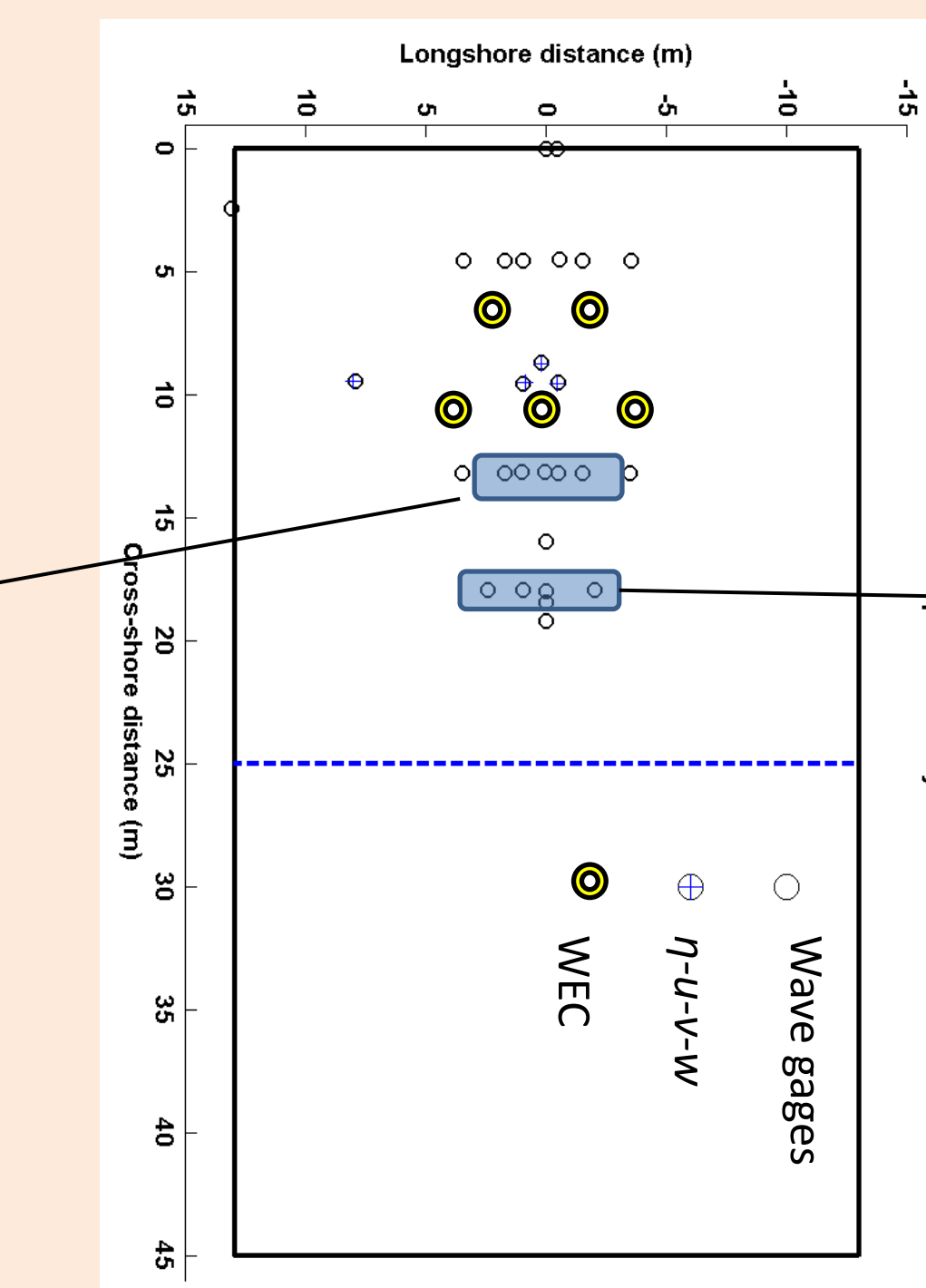
Tsunami Wave Basin (49 m x 26.5 m x 2.1 m)
Oregon State University



Observations included PhaseSpace© motion capture system for WEC performance analysis and stereo video for 3D water surface reconstruction.



Percent wave height reduction in the lee of the array, as a function of WEC-array size.



Percent wave height reduction in the far-field of the array, as a function of WEC-array size.

Acknowledgements

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