

# Oyster Pond: Concentrations, effects, and sources of groundwater nutrients



Carrie Soltanoff, Lukas Cheney, and Megan Mach

**Boston University Marine Program**  
**Marine Biological Laboratory**  
**Woods Hole, Massachusetts, 02543**

# Coastal Ecosystems

- Nutrient loading has increased with extensive development
- Productivity in coastal estuaries is nutrient limited
- Causes eutrophication, which leads to low dissolved oxygen levels and poor habitat quality



# Questions to be Answered

1. What are the nutrient concentrations and loads in Oyster Pond's groundwater?
2. Are there inter-annual increases in nutrient concentrations?
3. What are the sources of nitrogen?
4. Where are septic system plumes entering the pond?
5. How does urbanization affect nitrogen loads?

# Questions to be Answered

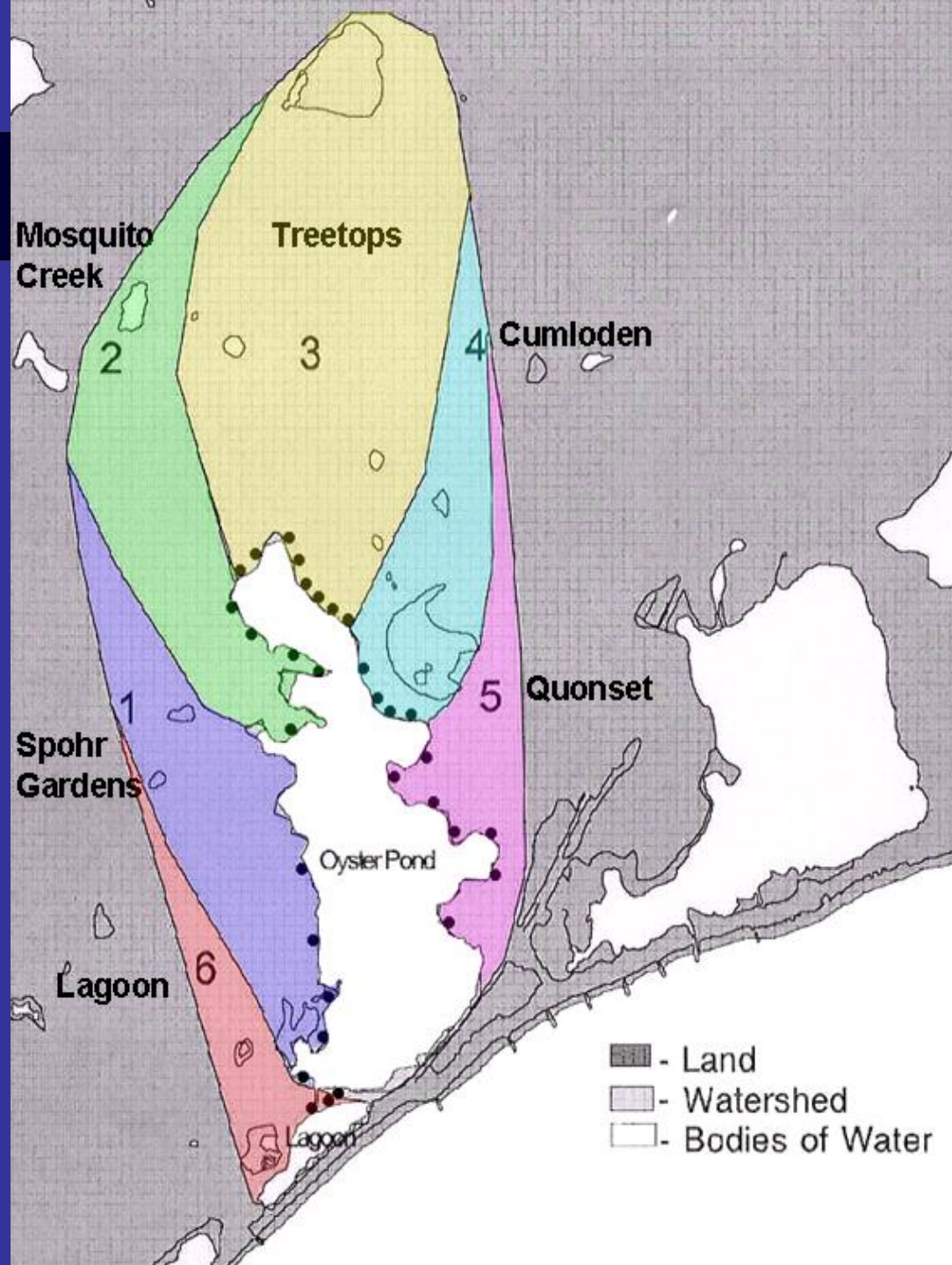
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# Oyster Pond

and its watershed

- To compare different areas, the watershed is split into six sub-watersheds
- Collected groundwater samples at 32 sites
- Analyzed samples for concentrations of nutrients

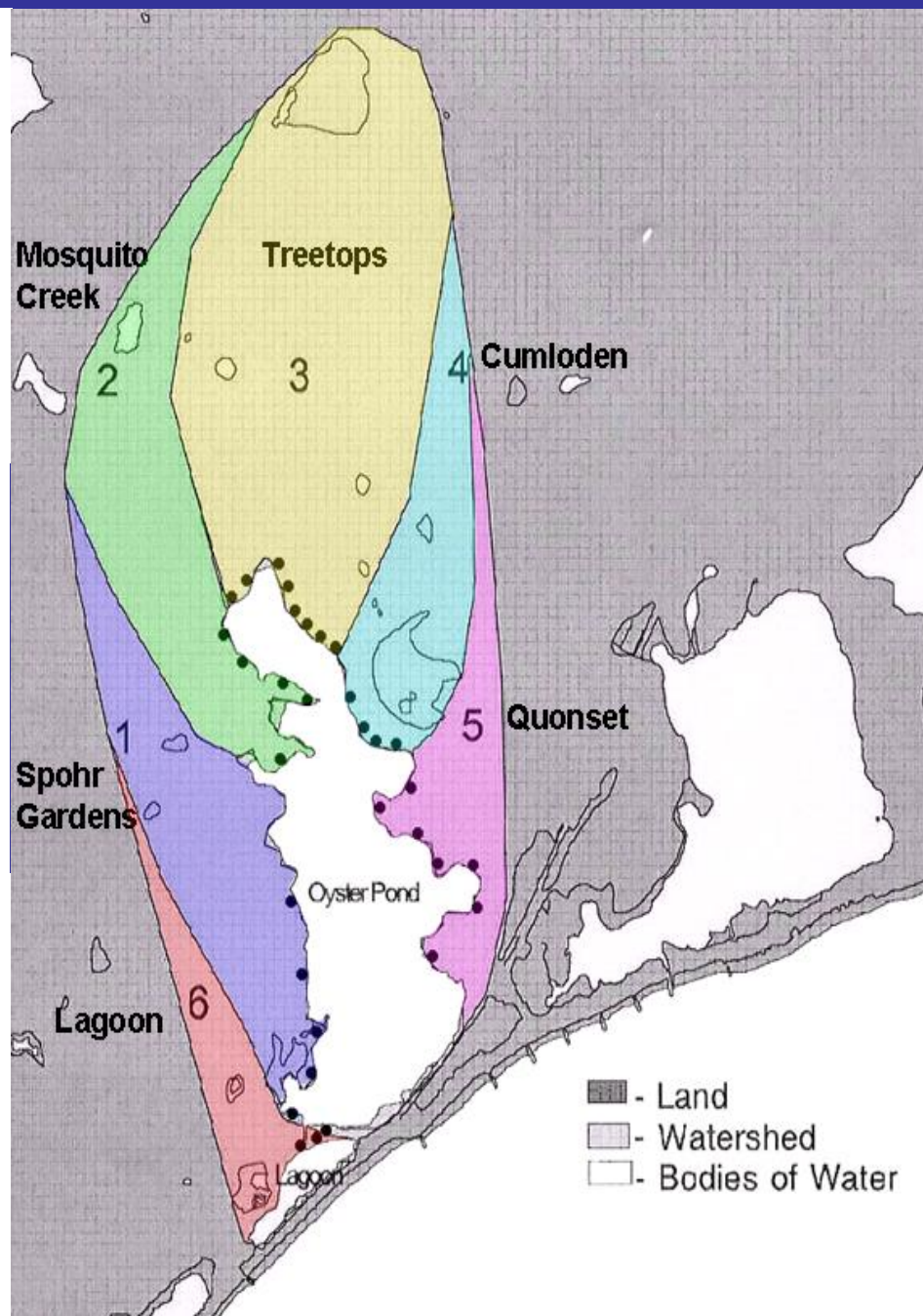
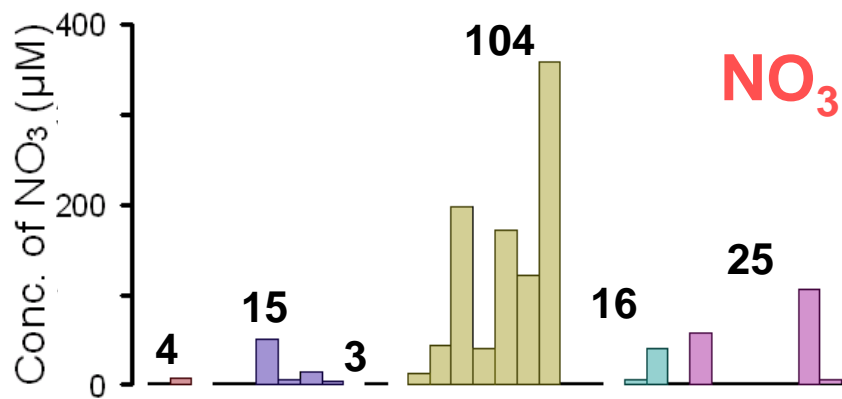
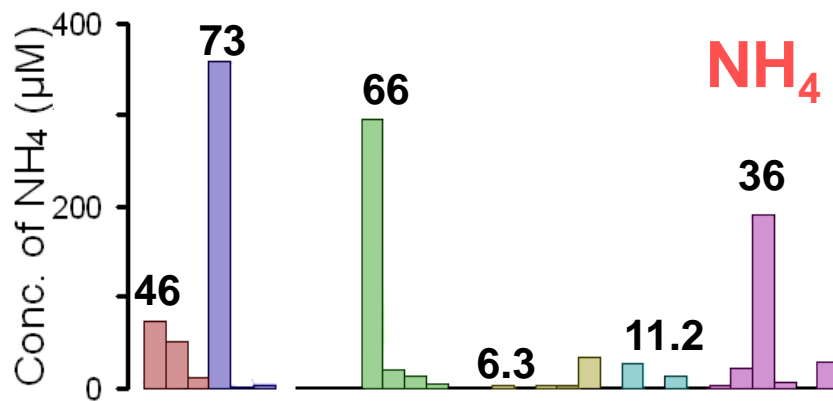
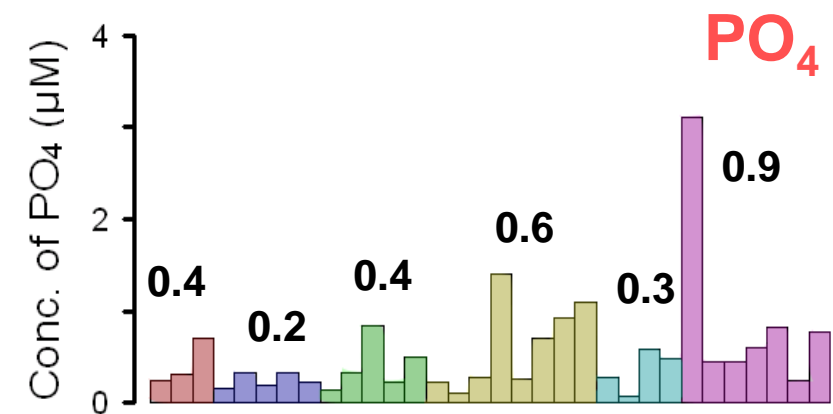




# Methods



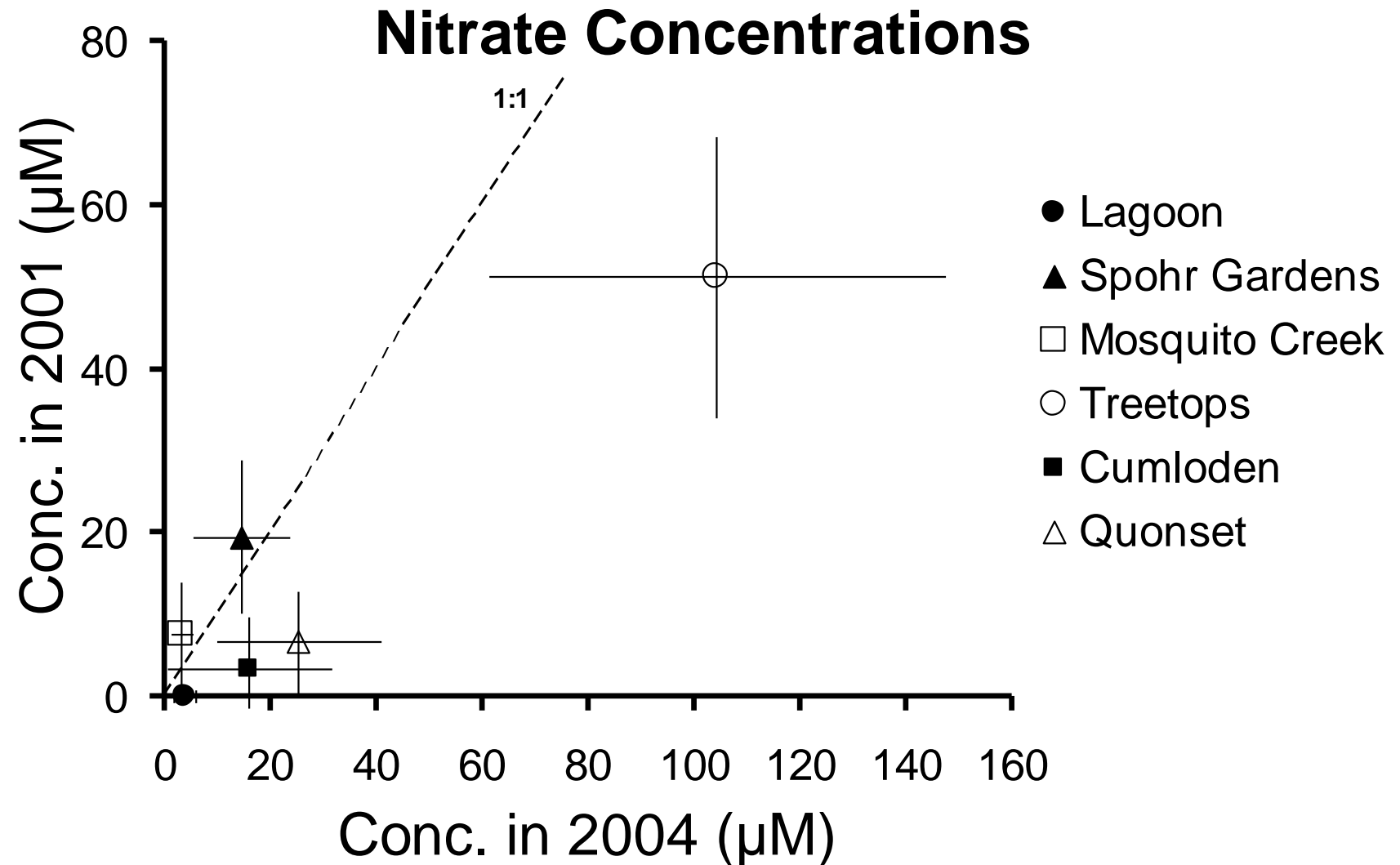




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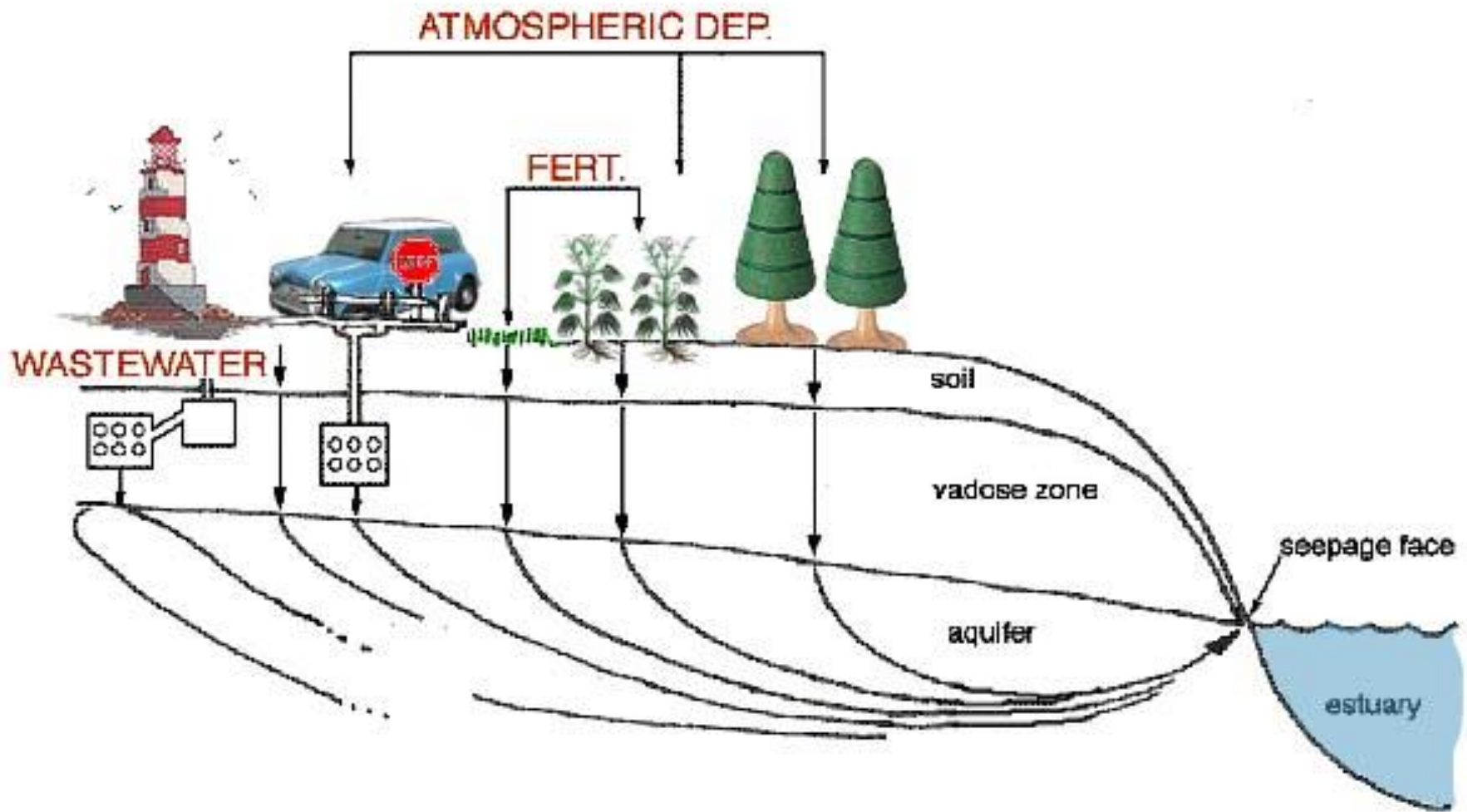


- $\text{NO}_3$  concentrations significantly higher in Treetops
- $\text{NH}_4$  and  $\text{PO}_4$  concentrations not significantly different

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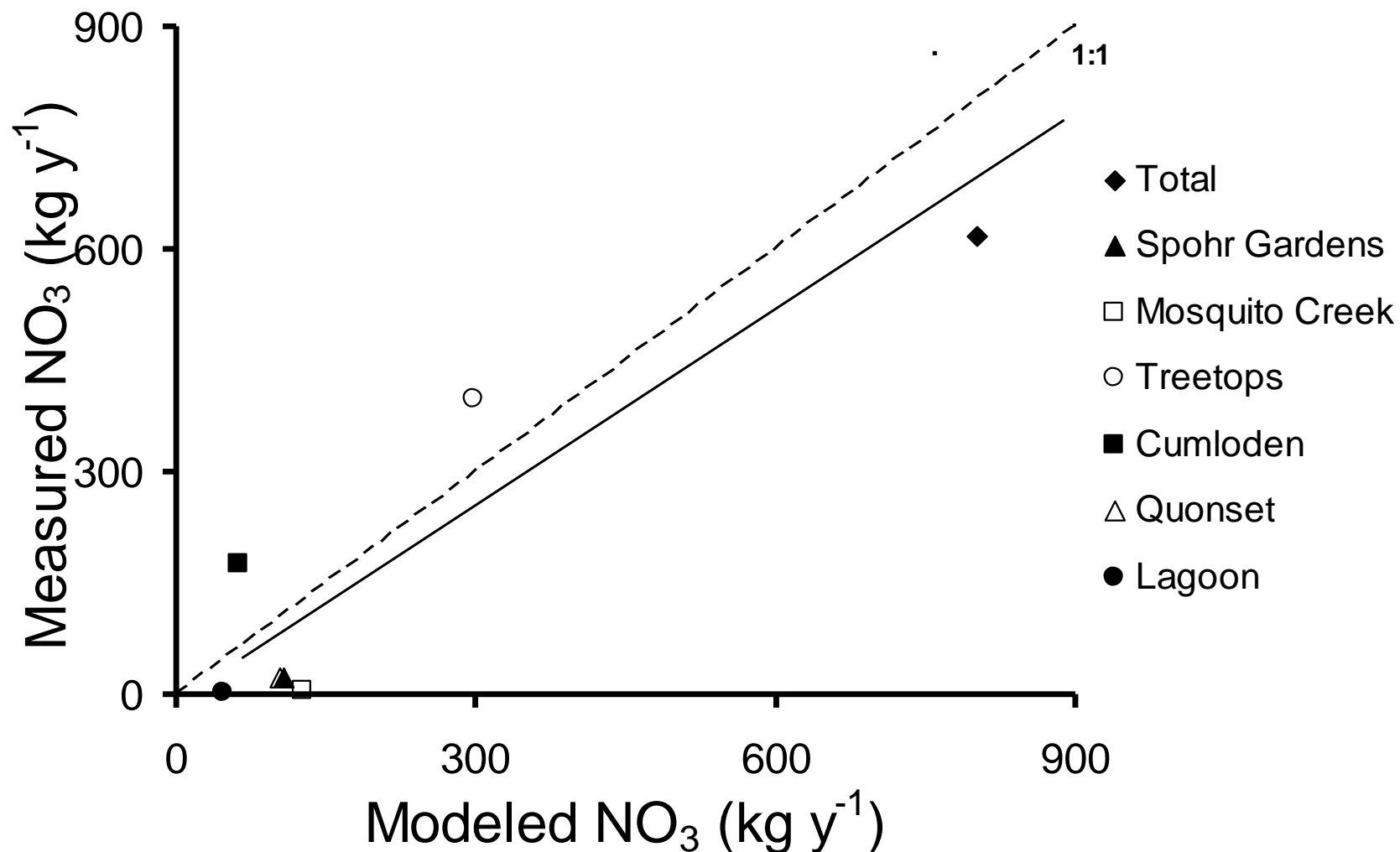
Wastewater run off carries nitrogen from the atmosphere, fertilizers and septic systems



New England watershed (Adapted from Valiela et al. 1997 Ecol. Appl.)



# Measured vs. Modeled\*



\* Caraco and Cole model

# Nitrogen Loading Model\*

	Nitrogen from different sources				
	Total N load		Wastewater	Atm. Dep.	Fertilizer
Sub-watersheds	kg N yr <sup>-1</sup>	%	%	%	%
Spohr Gardens	136	14.4	69.7	23.0	7.3
Mosquito Creek	151.4	16.0	66.7	24.0	9.4
Treetops	390.6	41.3	71.0	21.4	7.7
Cumloden	71.8	7.6	54.2	39.5	6.3
Quonset	139.2	14.7	81.2	10.6	8.2
Lagoon	55.7	5.9	63.3	30.0	6.9
Total	988.8	100			

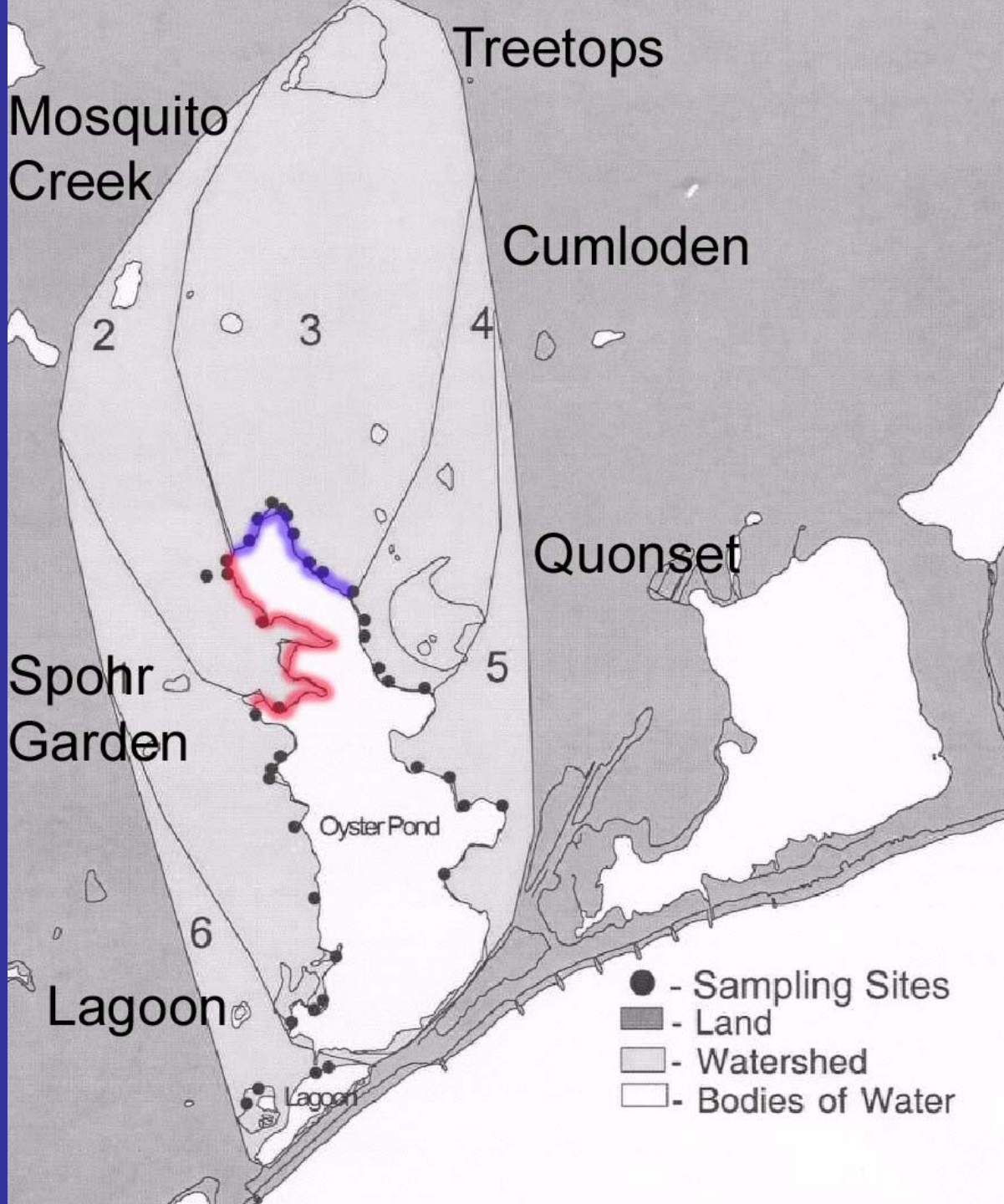
\* Valiela et al 1997

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# Septic Leachate Detector\*



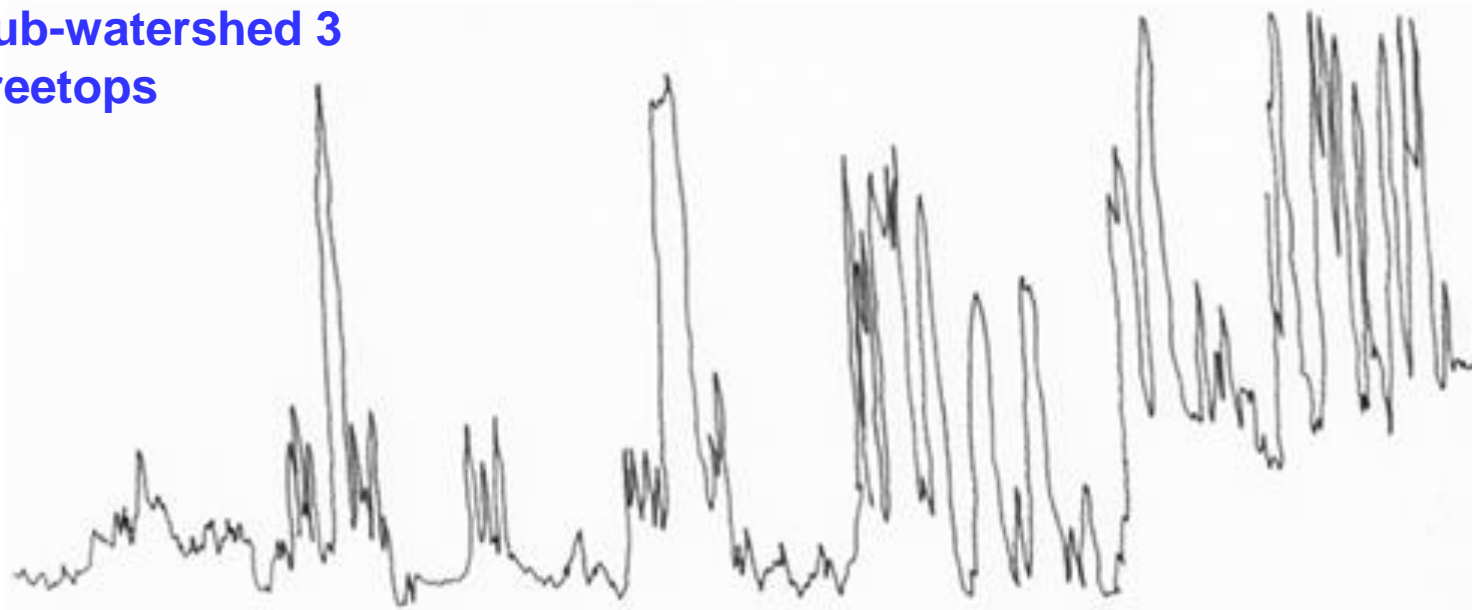
\*Kerfoot and Skinner 1981

# Leachate Results

**Sub-watershed 2**  
**Mosquito Creek**



**Sub-watershed 3**  
**Treetops**



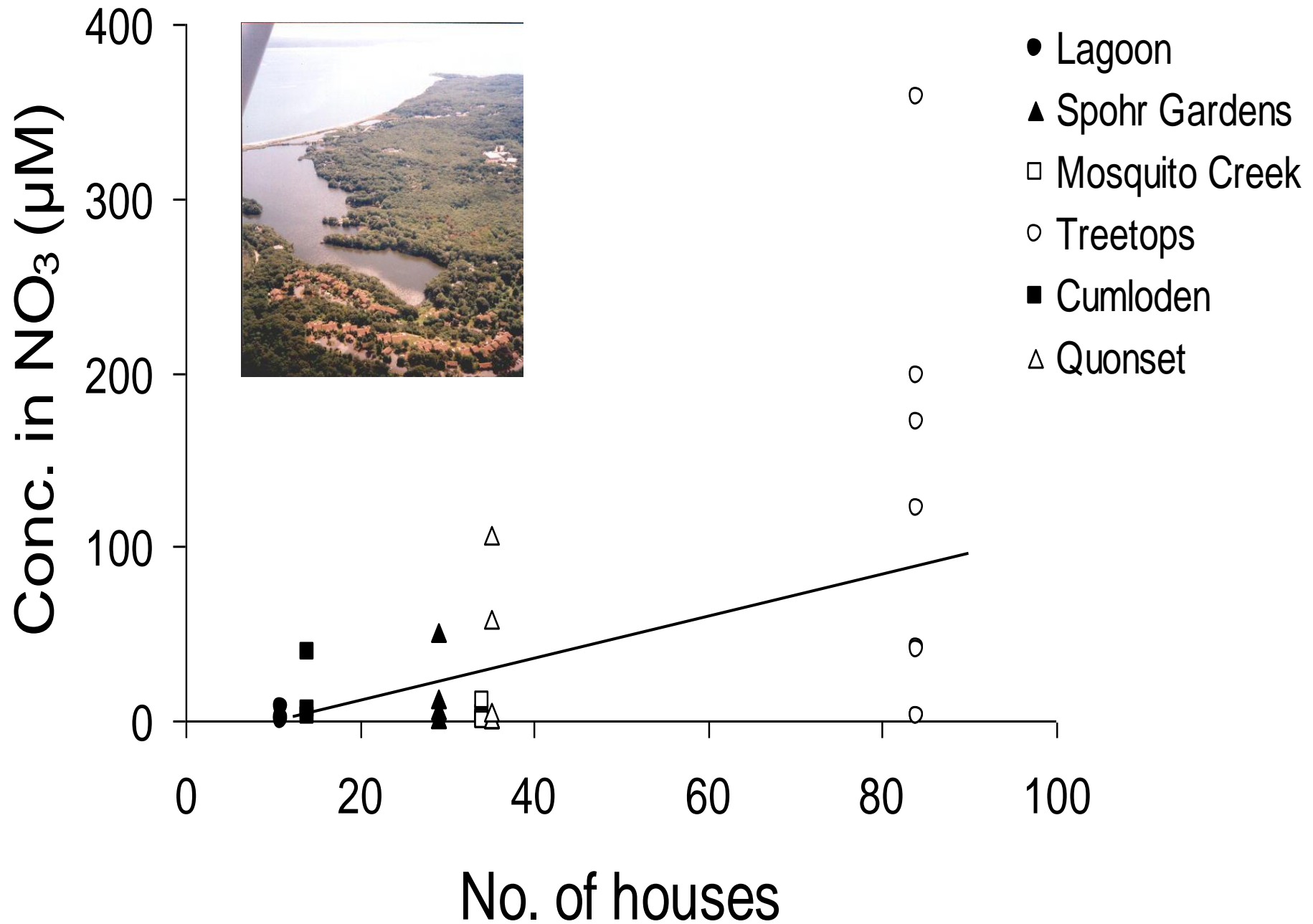
# Septic System Plumes

	Sub-watersheds	
	Mosquito Creek	Treetops
<b>No. of septic system plumes</b>	6	23
<b>No. of housing units in sub-watershed</b>	34	84
<b>No. of housing units on lots directly bordering pond</b>	8	61 (31 septic tanks)



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# Current Treetops Septic System vs. RUCK Septic System

Treetops Sub-watershed					
		Wastewater		Total N load	
Septic System	% Nitrogen efficiency	kg N y <sup>-1</sup>	% within sub-watershed	kg N y <sup>-1</sup>	% of total watershed
Conventional	40	280	70	390	40
RUCK®	60-90	80-200	40-65	190-310	25-35
Change	20-50	80-200	5-30	80-200	5-15

# Answers

1.  $\text{NO}_3$  concentrations in groundwater are higher at Treetops than the other sub-watersheds.
2. There were no inter-annual increases in groundwater nutrient concentrations in the sub-watersheds, except Treetops where nitrate concentrations increased.
3. Nitrogen comes mainly from wastewater and Treetops contributes the most nitrogen to total watershed N-load.

# Answers

4. A larger number of septic plumes are found from tanks bordering the pond in a more highly developed sub-watershed.
5. Concentrations of nitrate increase with the number of houses in a sub-watershed. The RUCK<sup>®</sup> septic system would reduce the amount of nitrogen in Treetops' wastewater from 280kg y<sup>-1</sup> to an average of 140kg y<sup>-1</sup>.



# Thank You

- Oyster Pond Residents
- Bill Kerfoot
- Falmouth Town Planning Office
- BUMP/MBL
- Jen 'Bosox' Bowen
- Our persnickety professor, Ivan Valiela
- Jack

