Developing Nitrogen Load-Eelgrass Response Relationships for Small-Medium Sized New England Estuaries

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US EPA Office of Research and Development

Narragansett, RI

A workshop on the Status, Trends, and Conservation of Eelgrass in northeastern United States and Canada
February 24-25, 2009
Regency Hotel in Portland, Maine

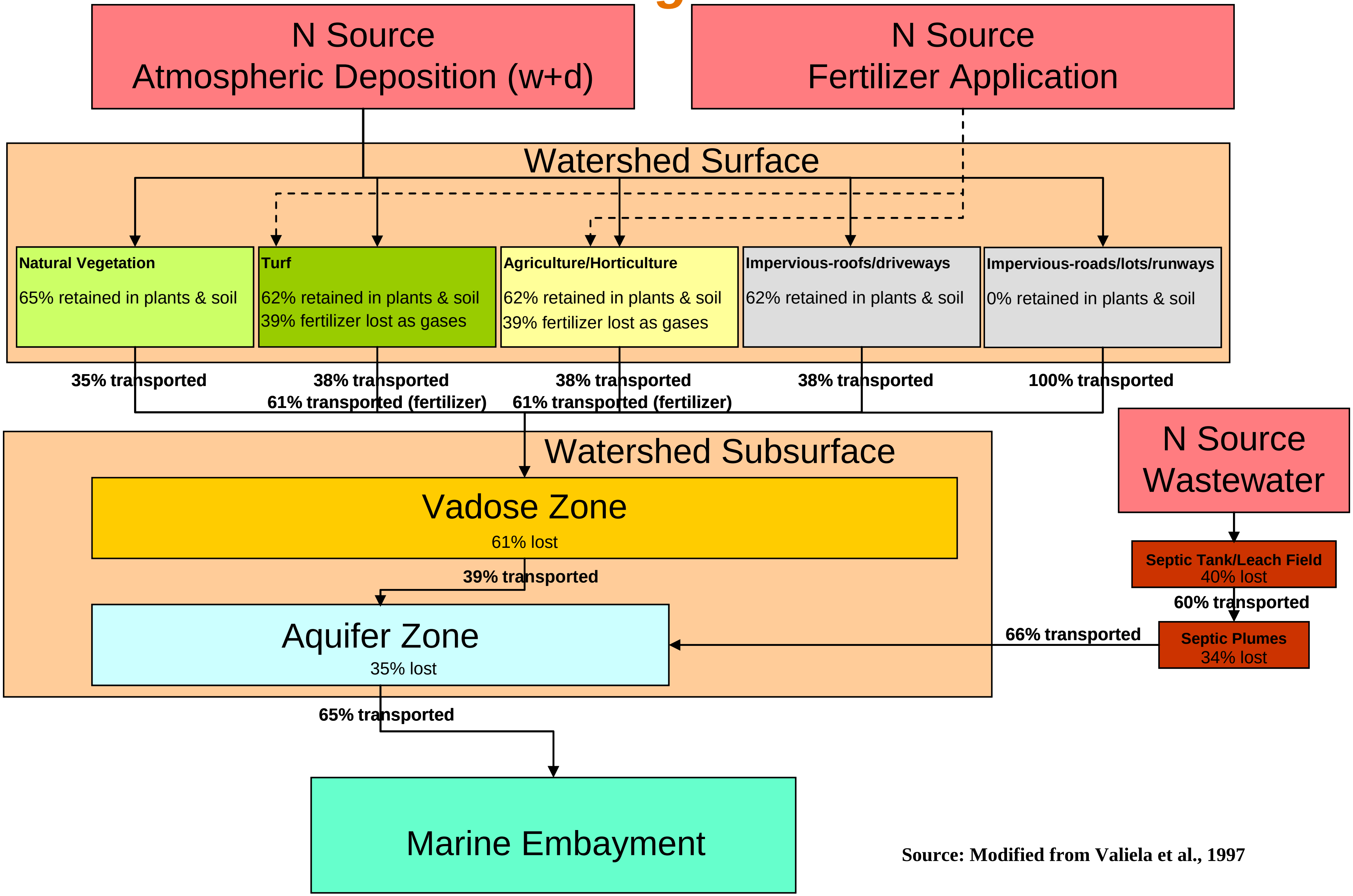
Overall Objective of Research

To construct nitrogen load eelgrass response models for small-medium sized New England estuaries

Specific Tasks

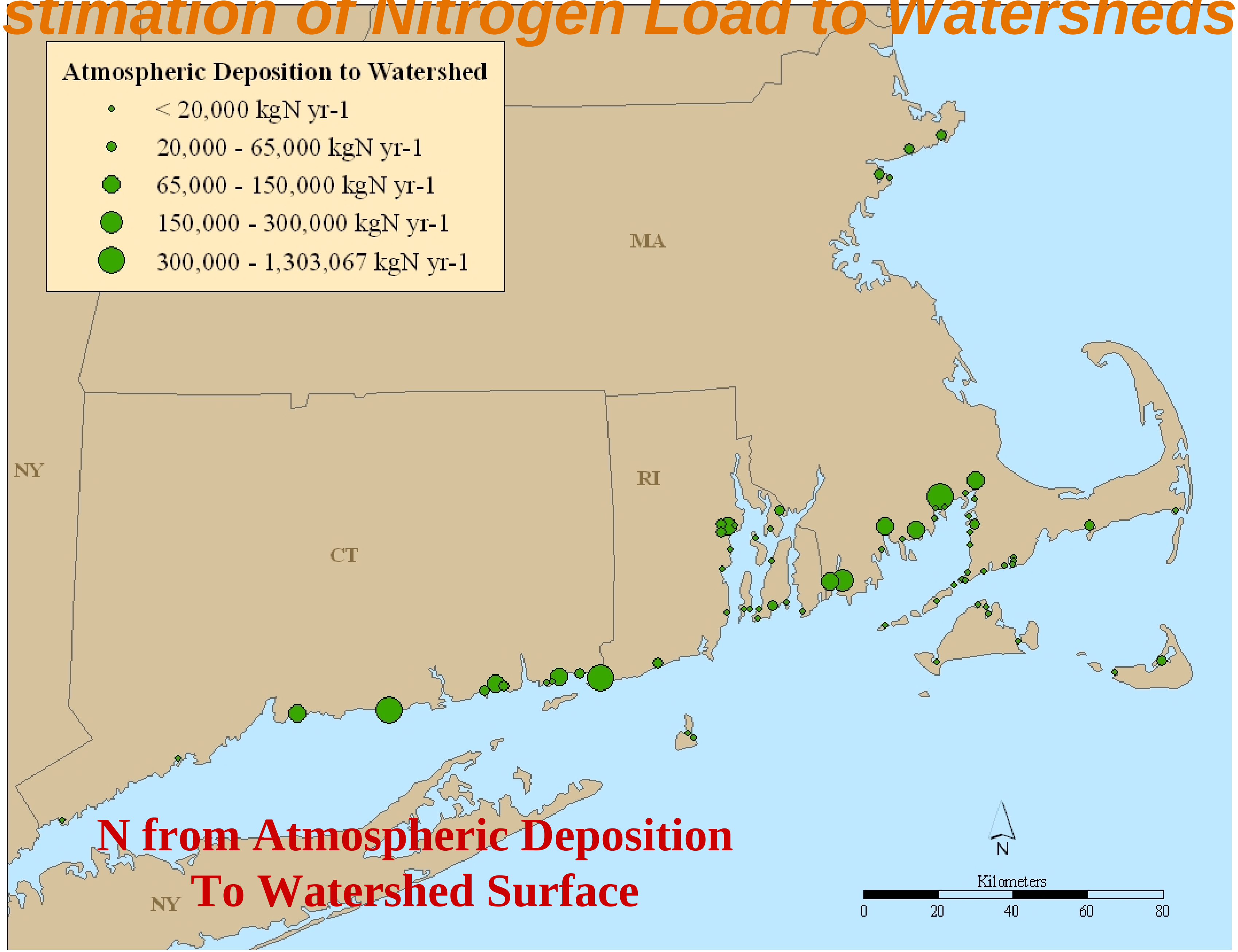
- Estimate nitrogen load to estuaries
- Determine eelgrass extent along N gradient
- Construct nitrogen load-eelgrass response models, including application of appropriate scaling variables

Estimation of Nitrogen Load to Estuaries



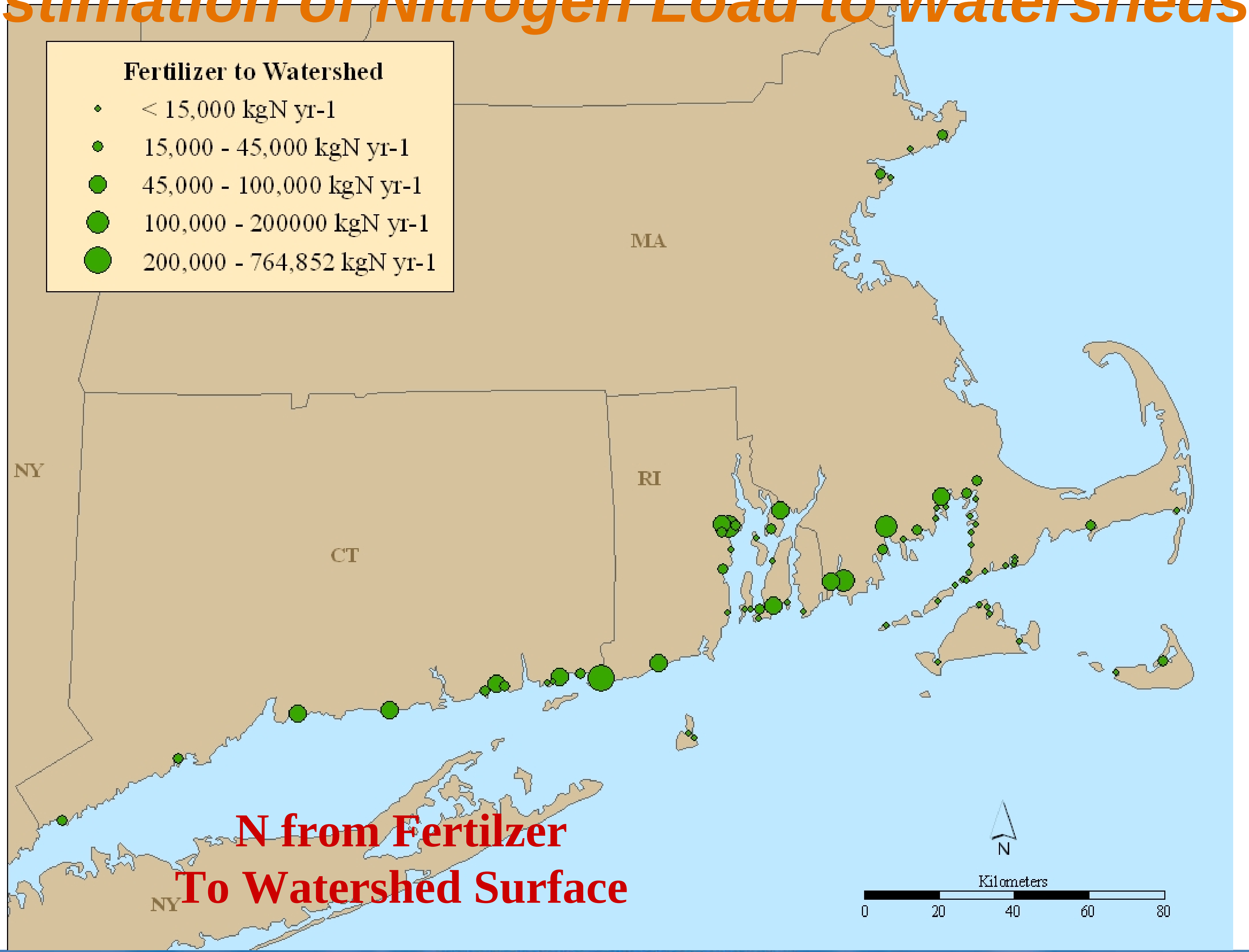
Source: Modified from Valiela et al., 1997

Estimation of Nitrogen Load to Watersheds



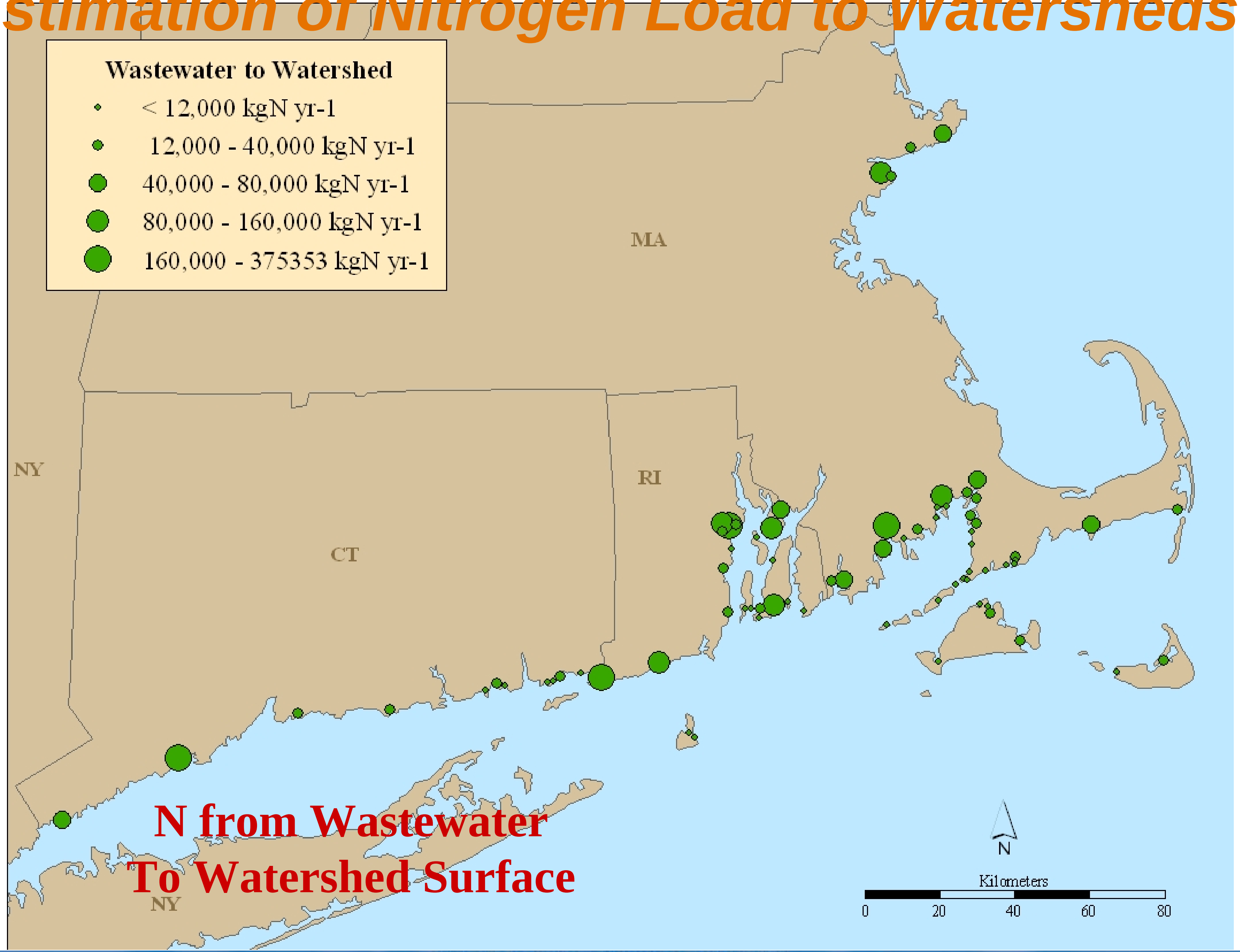
N from Atmospheric Deposition
To Watershed Surface

Estimation of Nitrogen Load to Watersheds



N from Fertilzer
To Watershed Surface

Estimation of Nitrogen Load to Watersheds



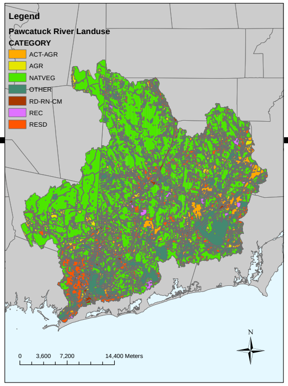
Estimation of Nitrogen Load to Estuaries

Within Watershed Losses (surface and subsurface)

Atmospheric Deposition to Watershed

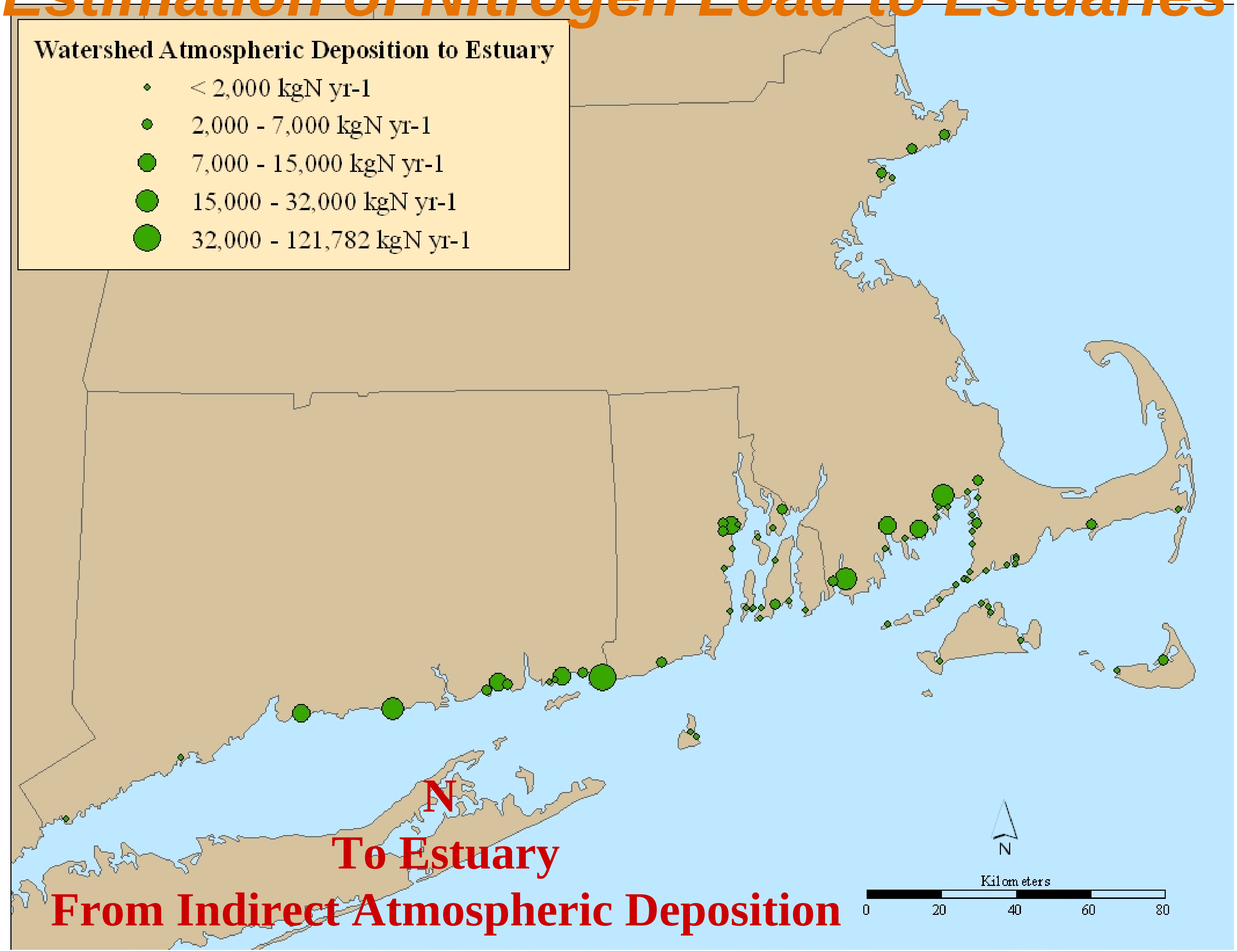
	Input	Natural Vegetation		Turf		Agriculture/ Horticulture		Impervious Roofs/Driveways		Impervious Roads/Lots/Runways	
	ug/L	% retained or transported	ug/L	% retained or transported	ug/L	% retained or transported	ug/L	% retained or transported	ug/L	% retained or transported	ug/L
Atmospheric Deposition (w+d)	100										
Retained on watershed surface		65%	65	62%	62	62%	62	62%	62	0%	0
Transported to Vadose zone		35%	35	38%	38	38%	38	38%	38	100%	100
Watershed Sub - Surface											
Loss in Vadose Zone		61%	21	61%	23	61%	23	61%	23	61%	61
Transported to Aquifer		39%	14	39%	15	39%	15	39%	15	39%	39
Loss in Aquifer		35%	5	35%	5	35%	5	35%	5	35%	14
Marine Embayment											
Transport to Marine Embayment		65%	9	65%	10	65%	10	65%	10	65%	25

Natural Vegetation includes: forests, wetlands and other natural lands
Turf includes: lawns and golf courses
Agriculture/Horticulture includes: croplands
Impervious Roofs/Driveways include: roofs and driveways adjoined by turf
Impervious Roads/Lots/Runways include: roads, runways and parking lots that discharge into catch basins



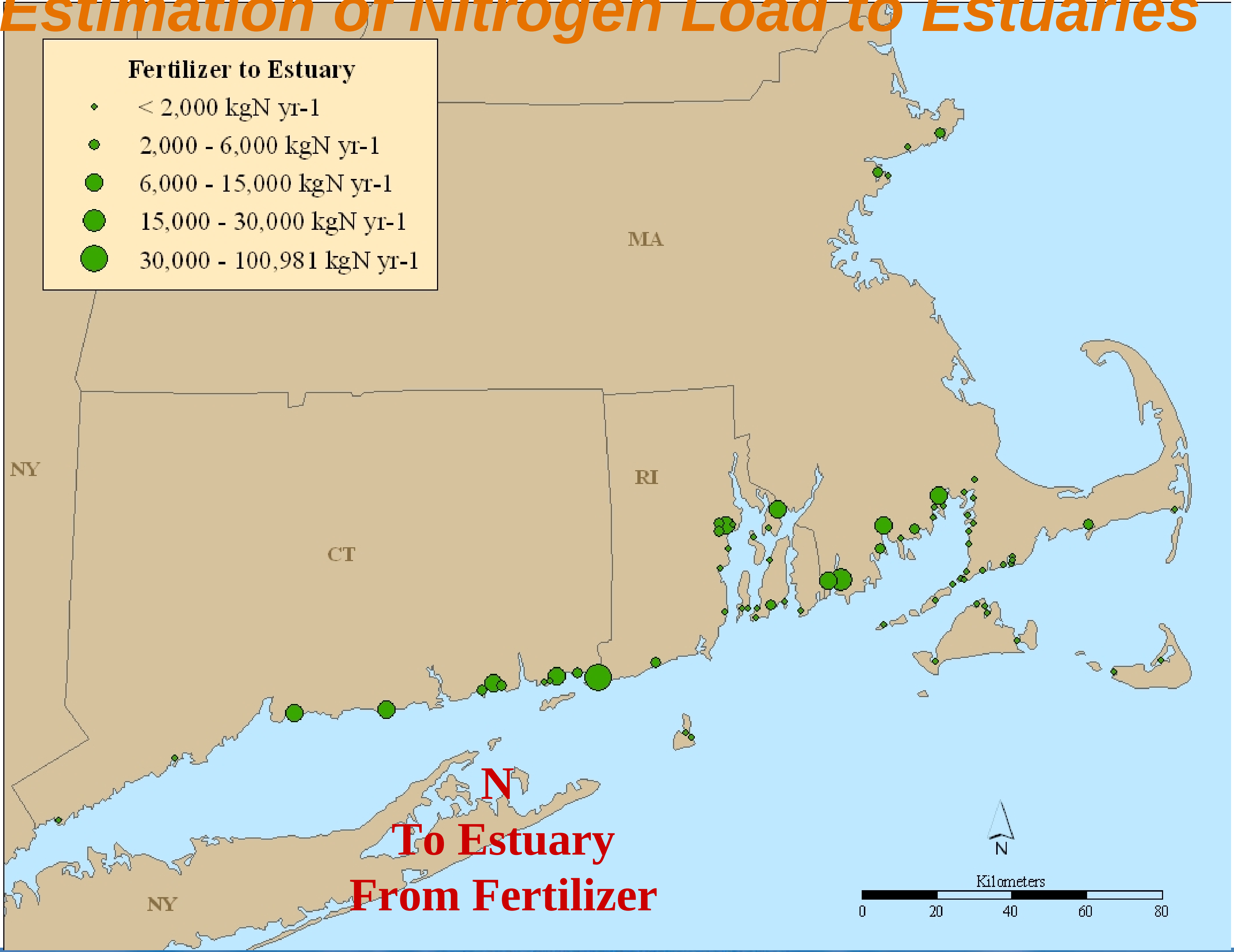
Similar reductions for wastewater and fertilizer nitrogen

Estimation of Nitrogen Load to Estuaries



N
To Estuary
From Indirect Atmospheric Deposition

Estimation of Nitrogen Load to Estuaries



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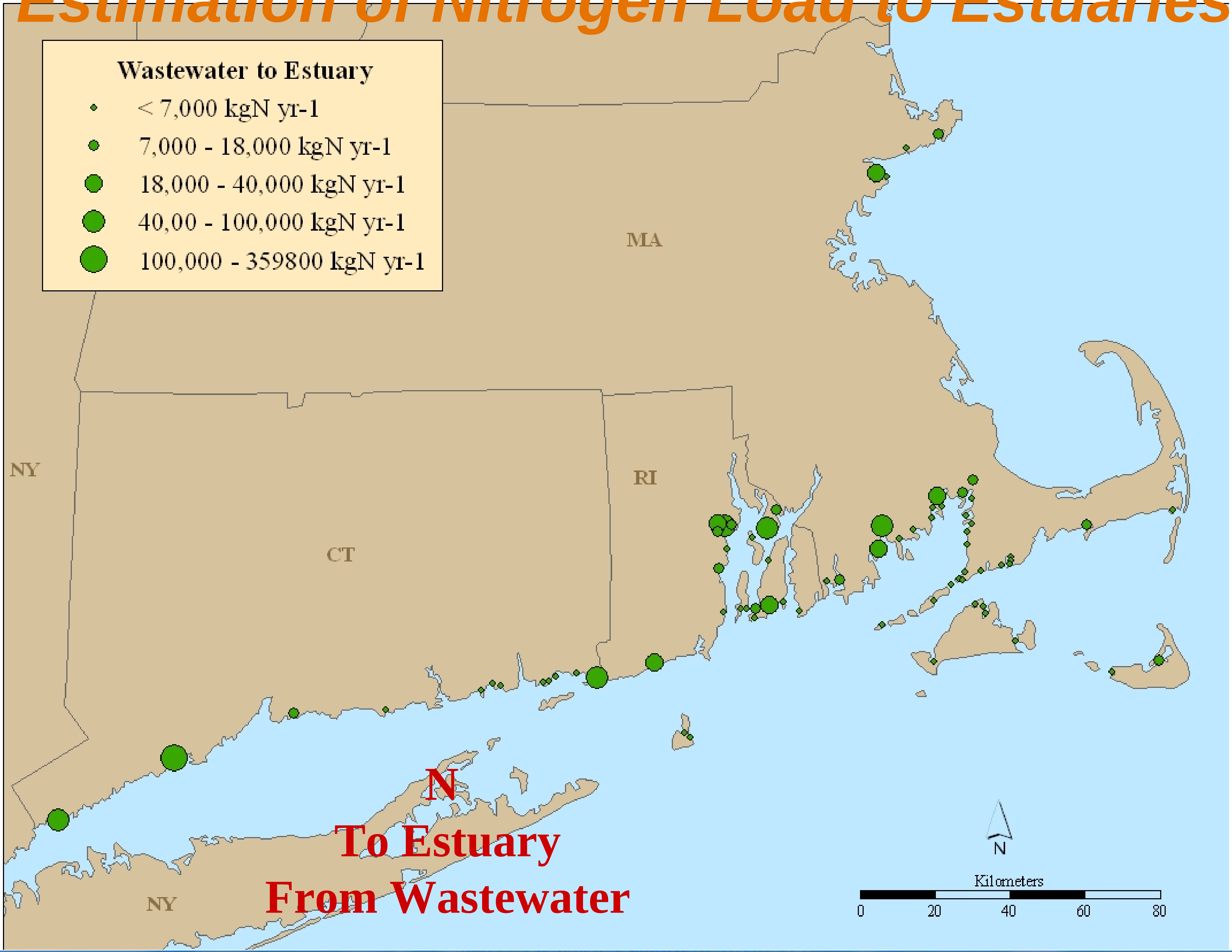

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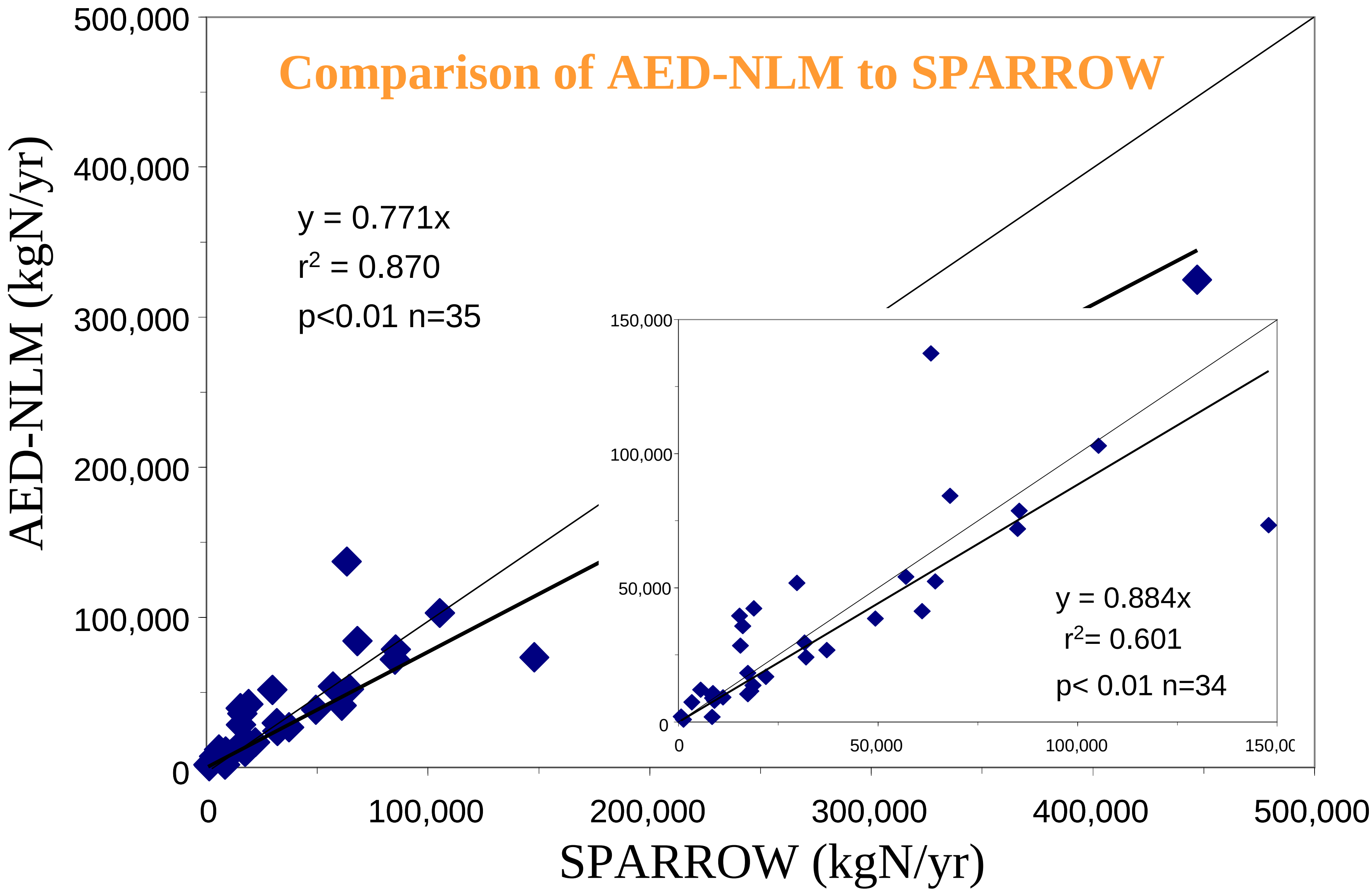

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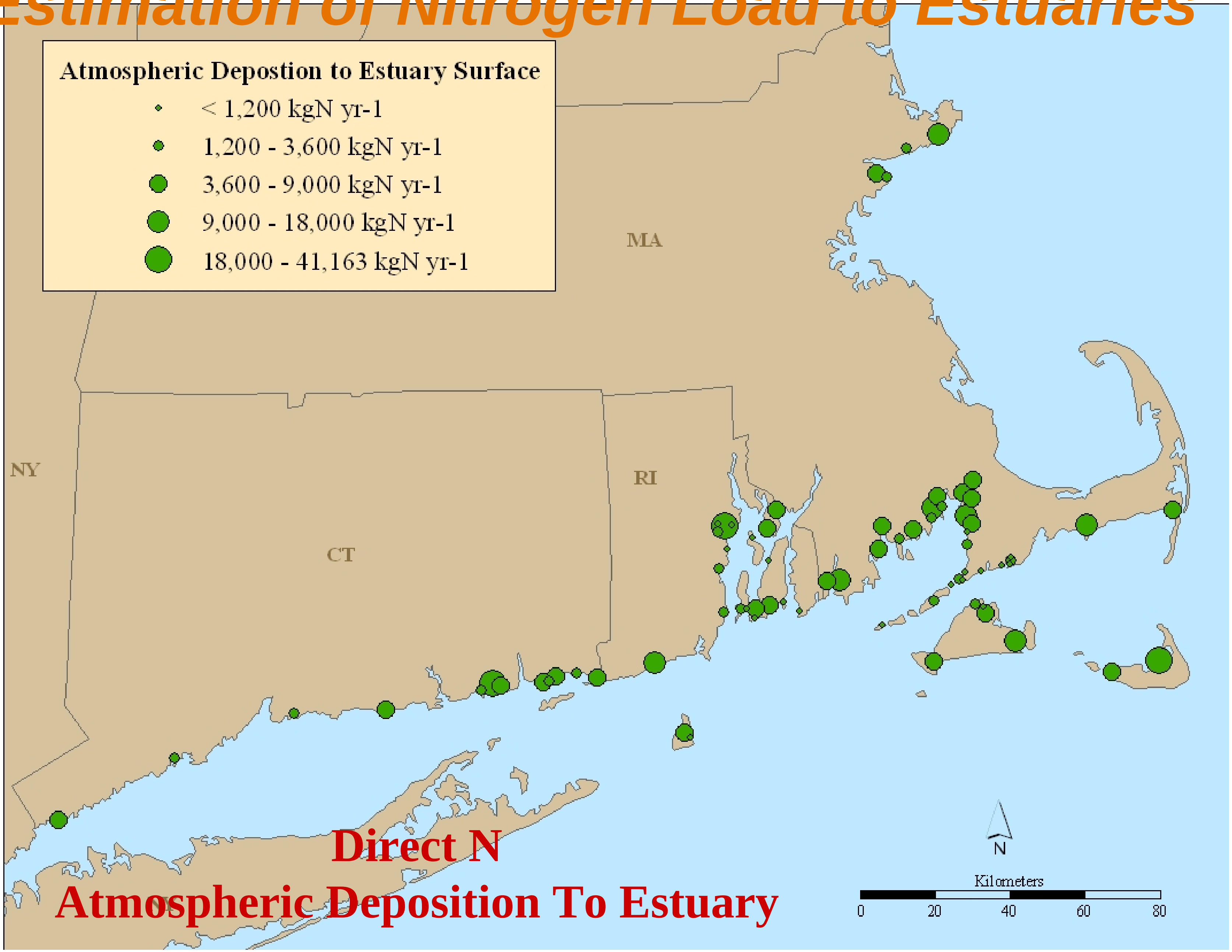

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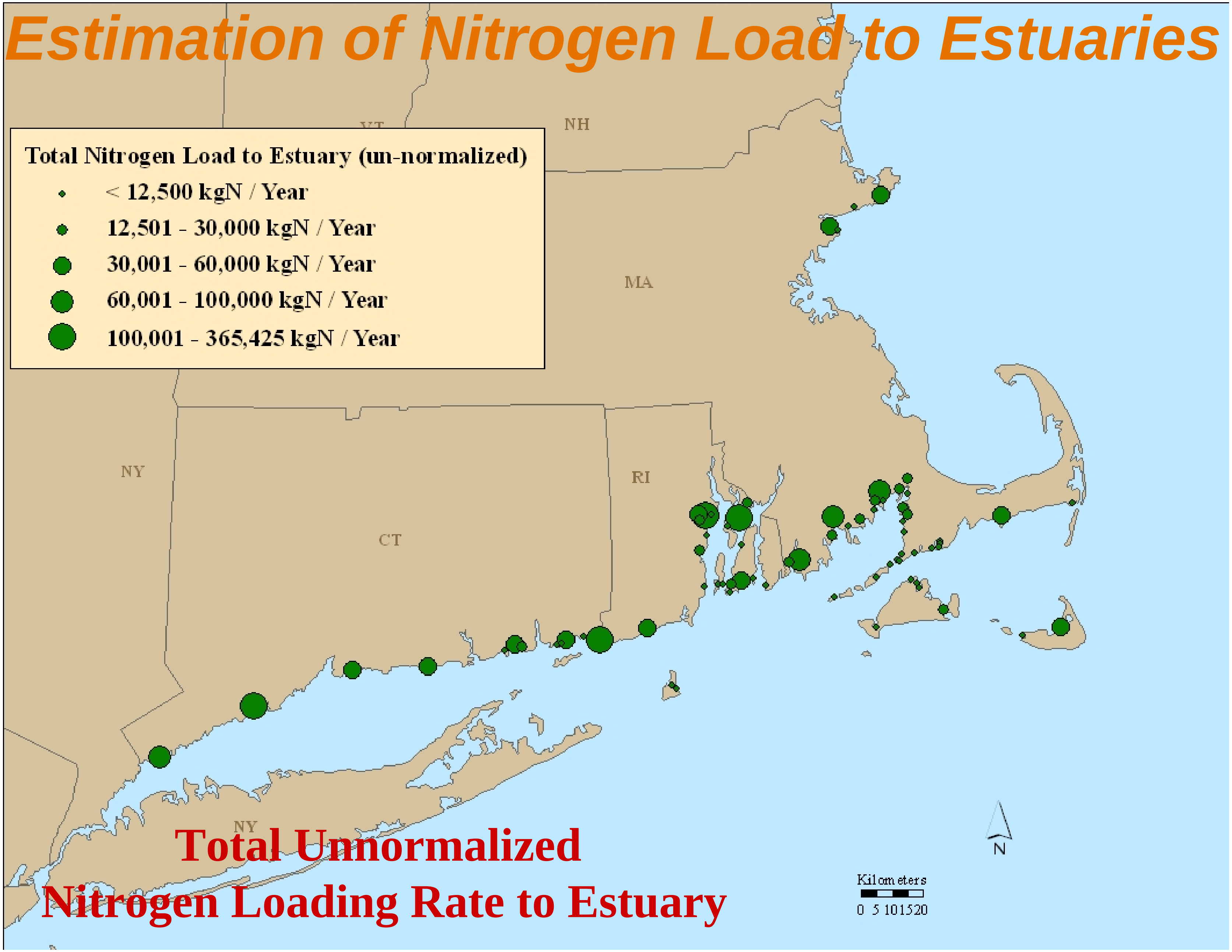
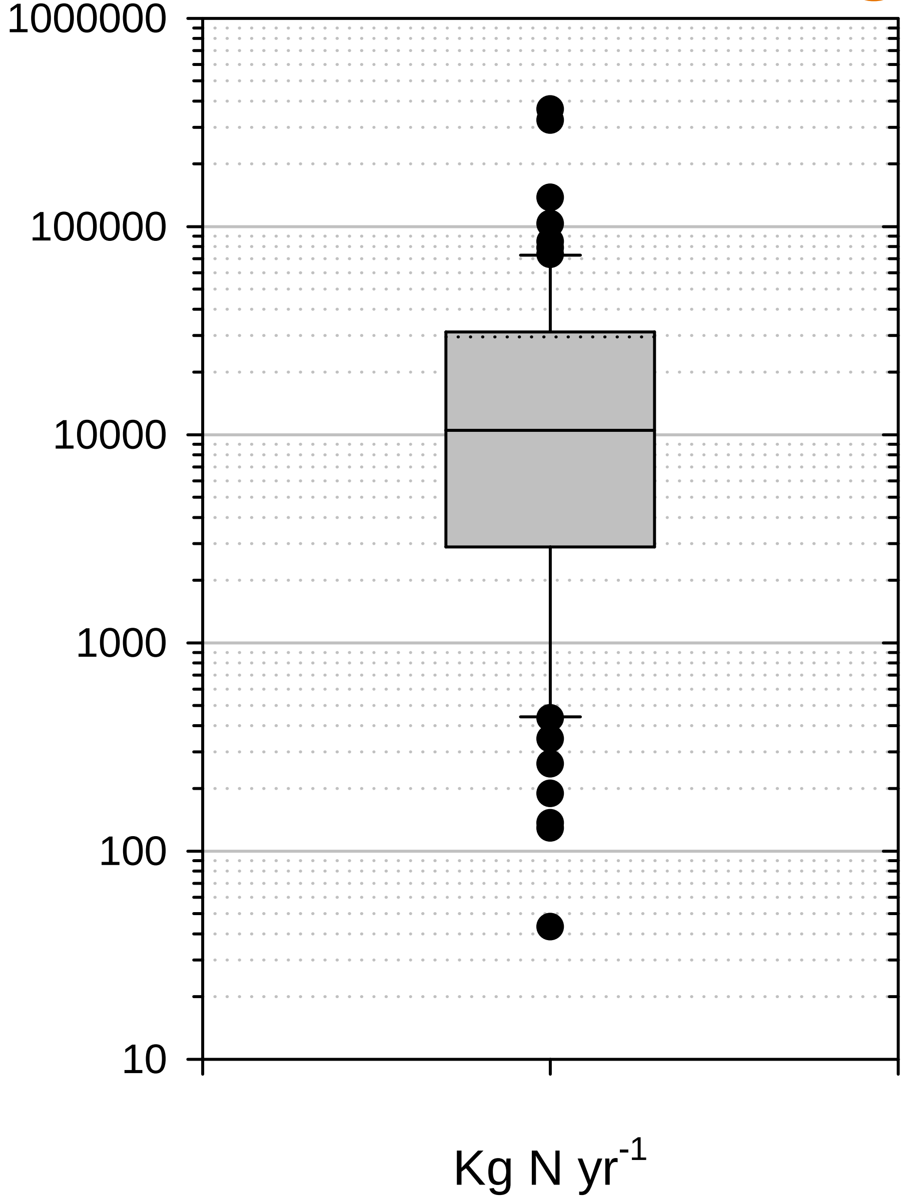


Total Unnormalized

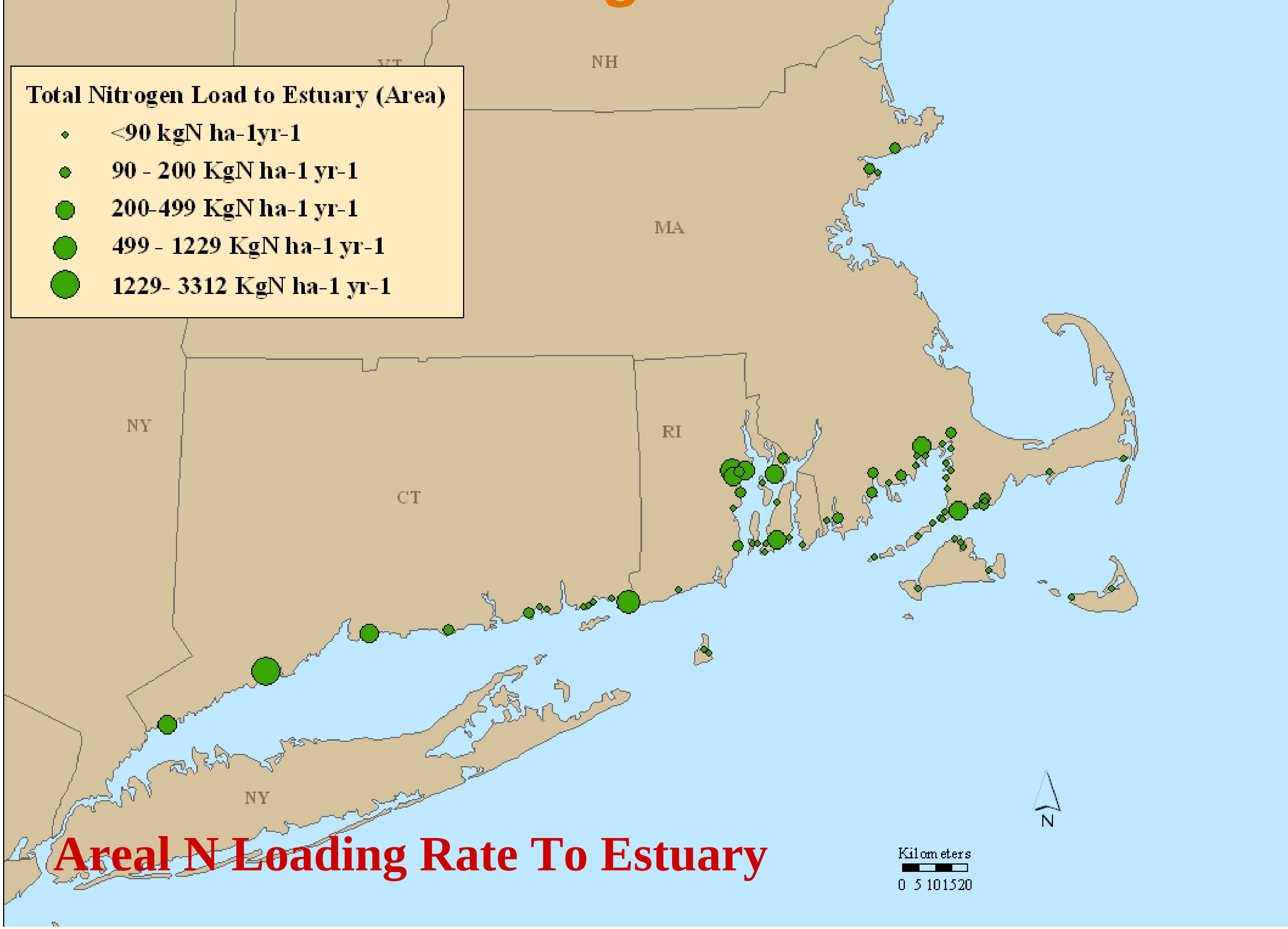
Nitrogen Loading Rate to Estuary

Estimation of Nitrogen Load to Estuaries



Total Unnormalized Nitrogen Loading Rate to Estuary

Estimation of Nitrogen Load to Estuaries



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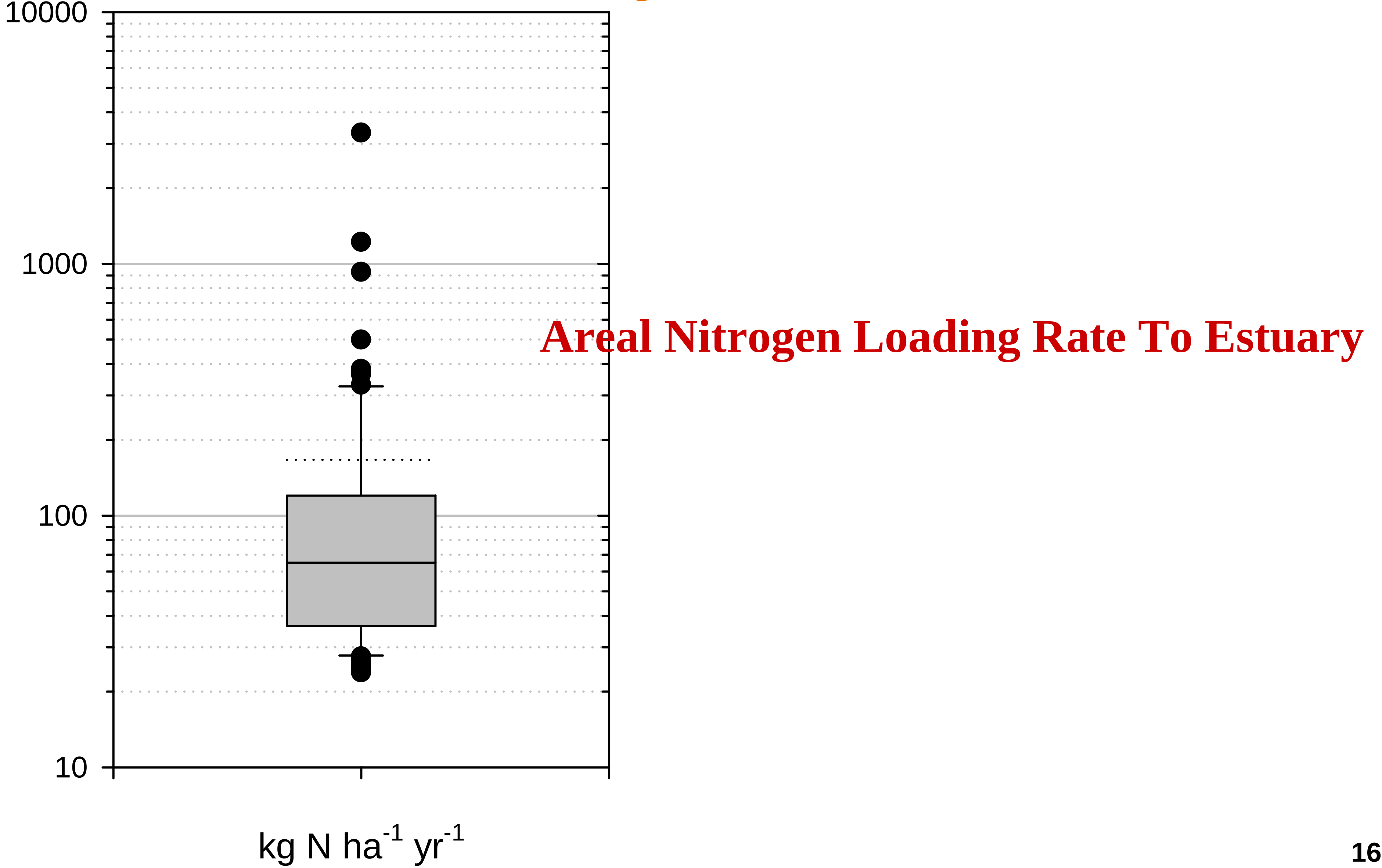

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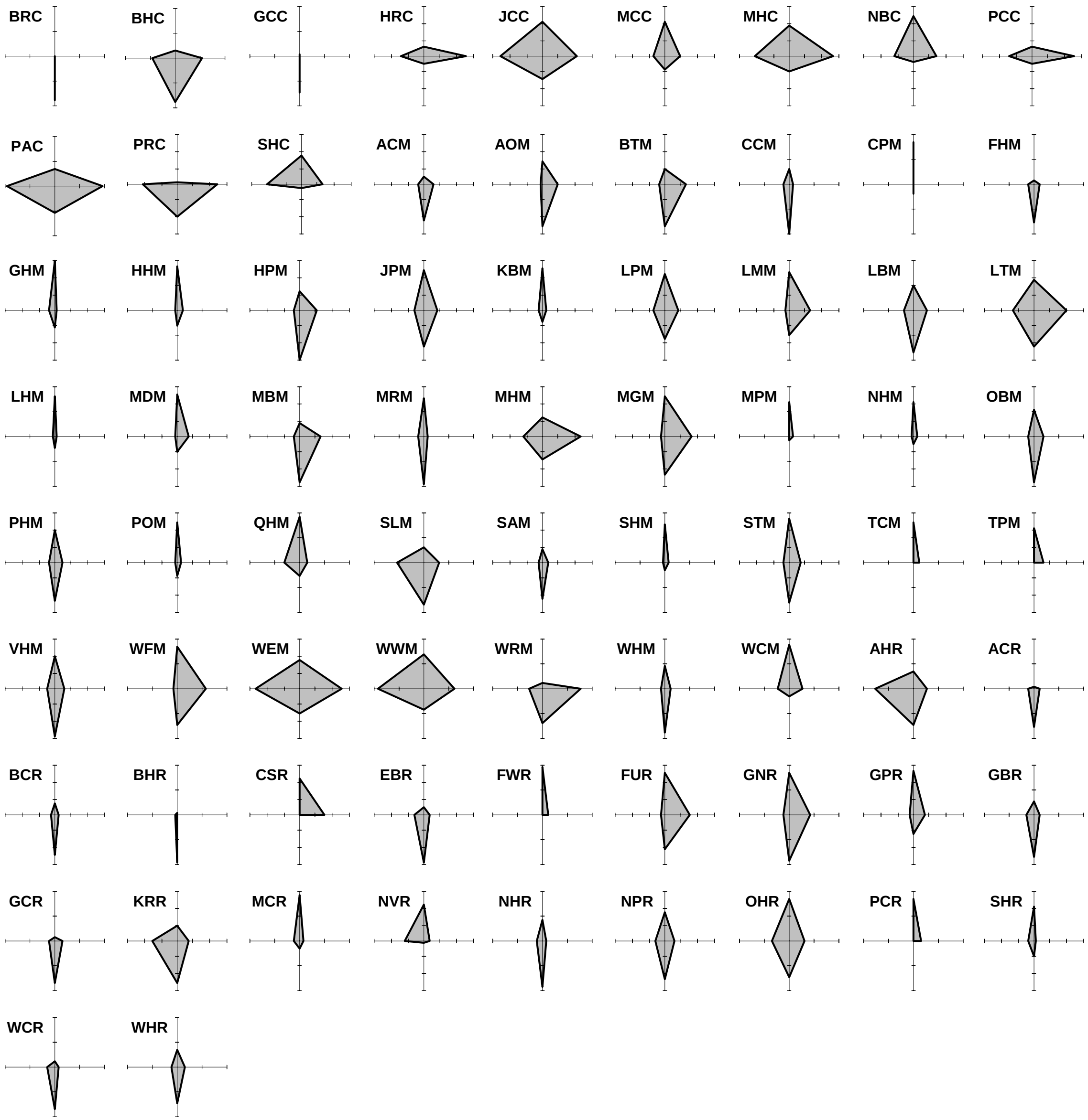
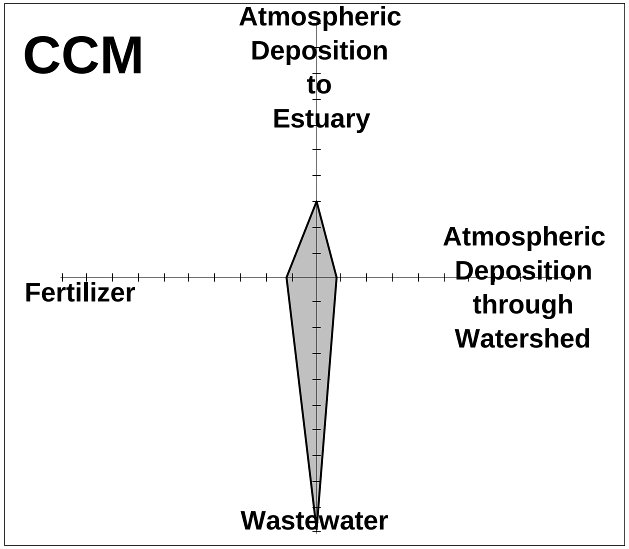


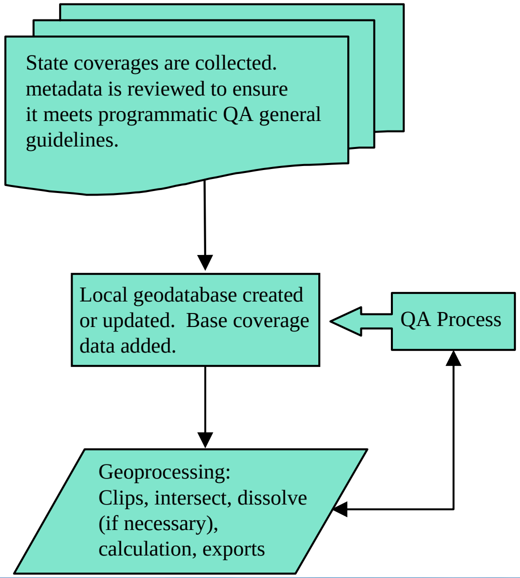


Determine Eelgrass Extent for Each Estuary

Source Data Overview:

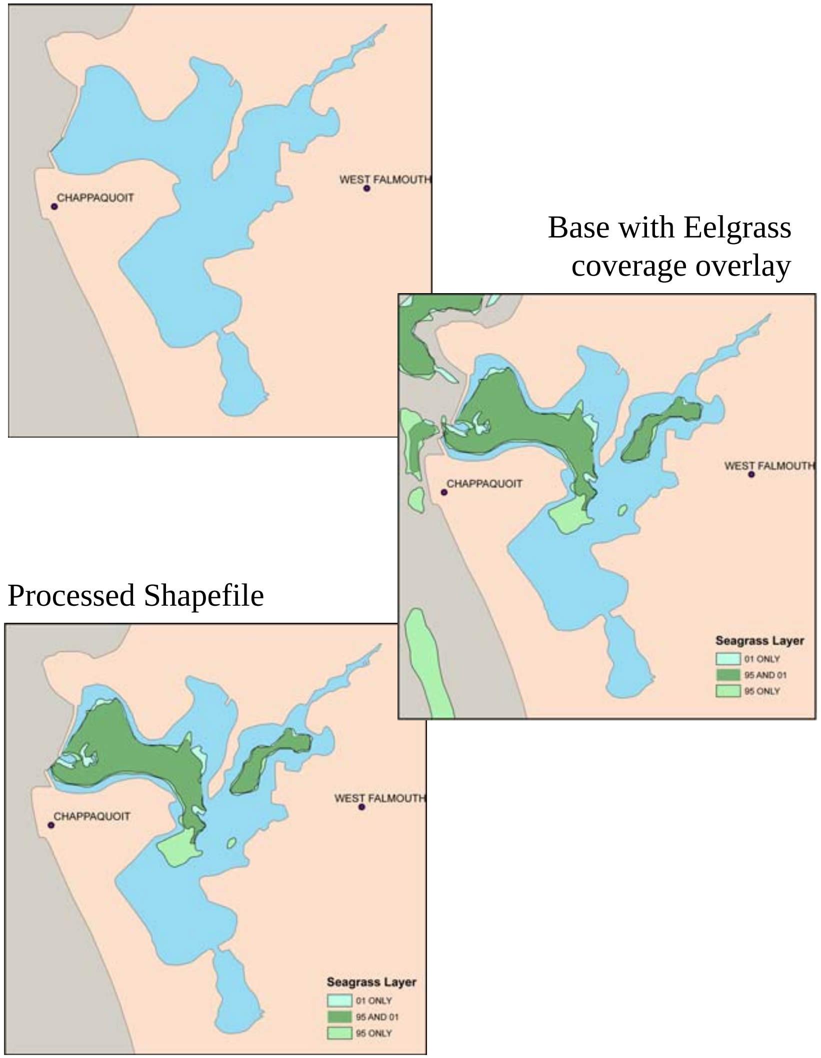
State	Description	Collection Date	Source
MA	Data layer compiled from aerial photography collected in 1995, 2001	1995, 2001	MA-DEP
RI	Delineated from 2006 aerial photography.	Summer 2006	RIGIS
CT	Delineated form 2006 aerial photography of a portion of CT coastline.	Summer 2006	USFWS

Geoprocessing Workflow:

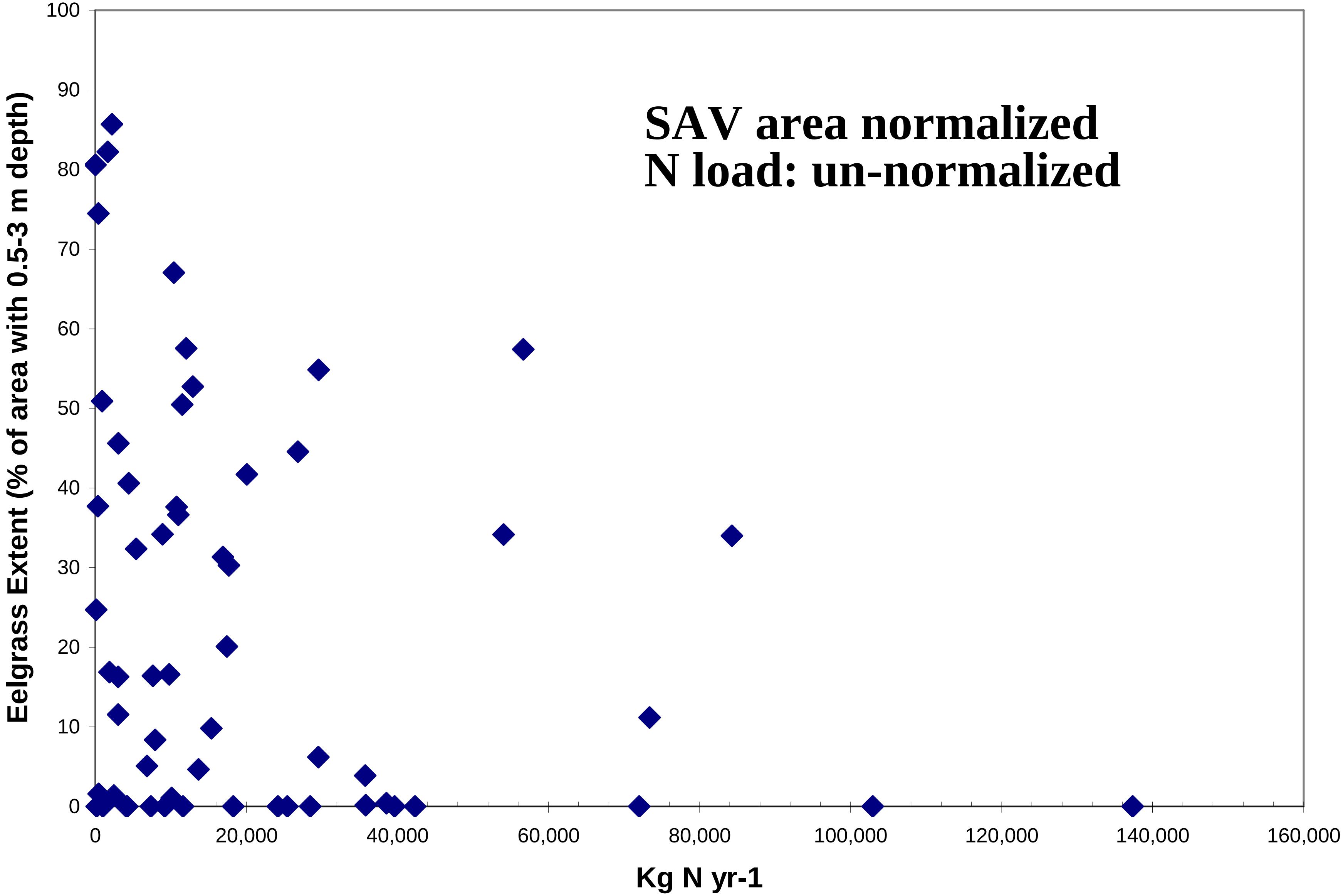


Process Example:

Base Data



Construct N Load-Eelgrass Response Model



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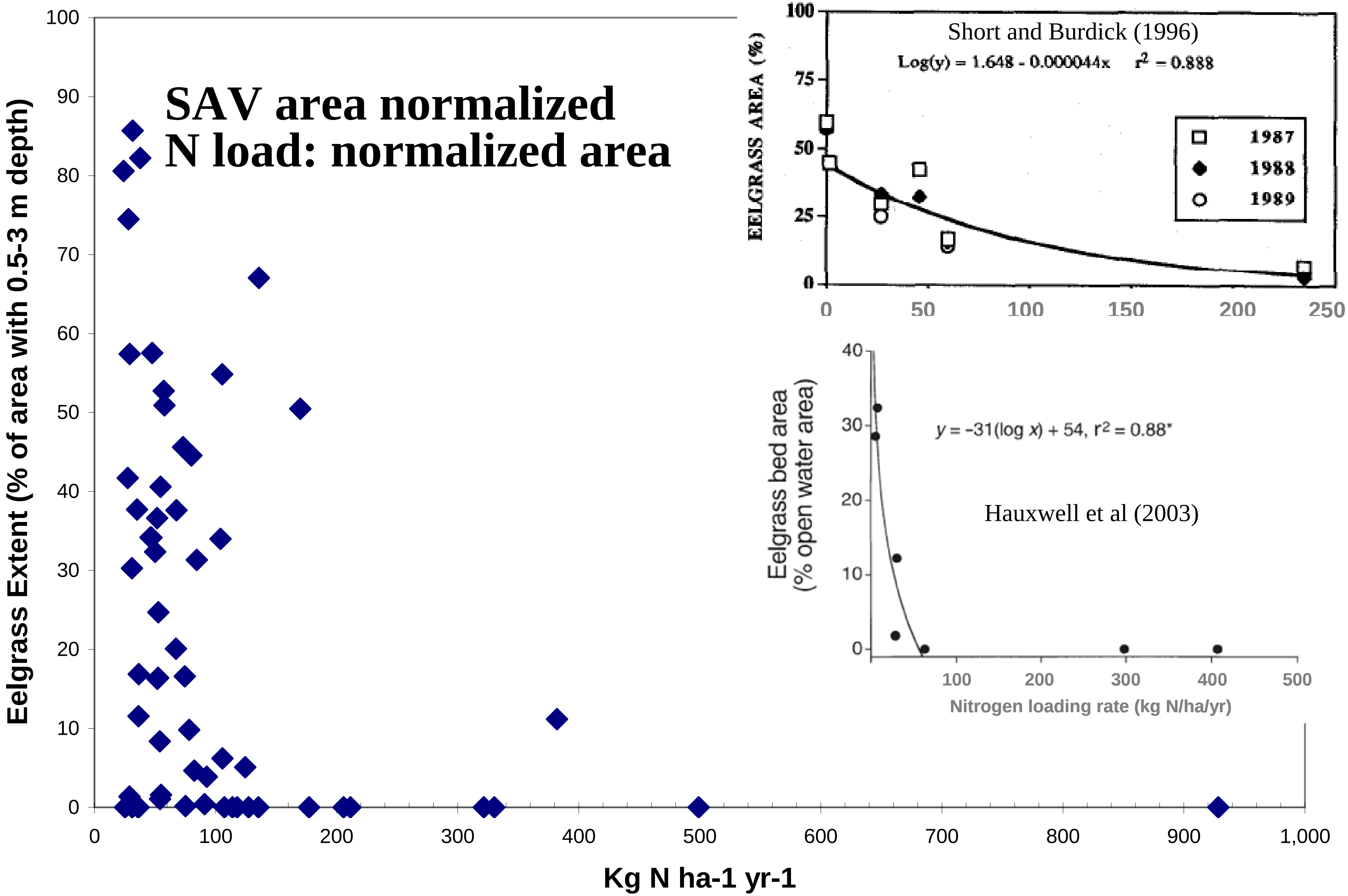

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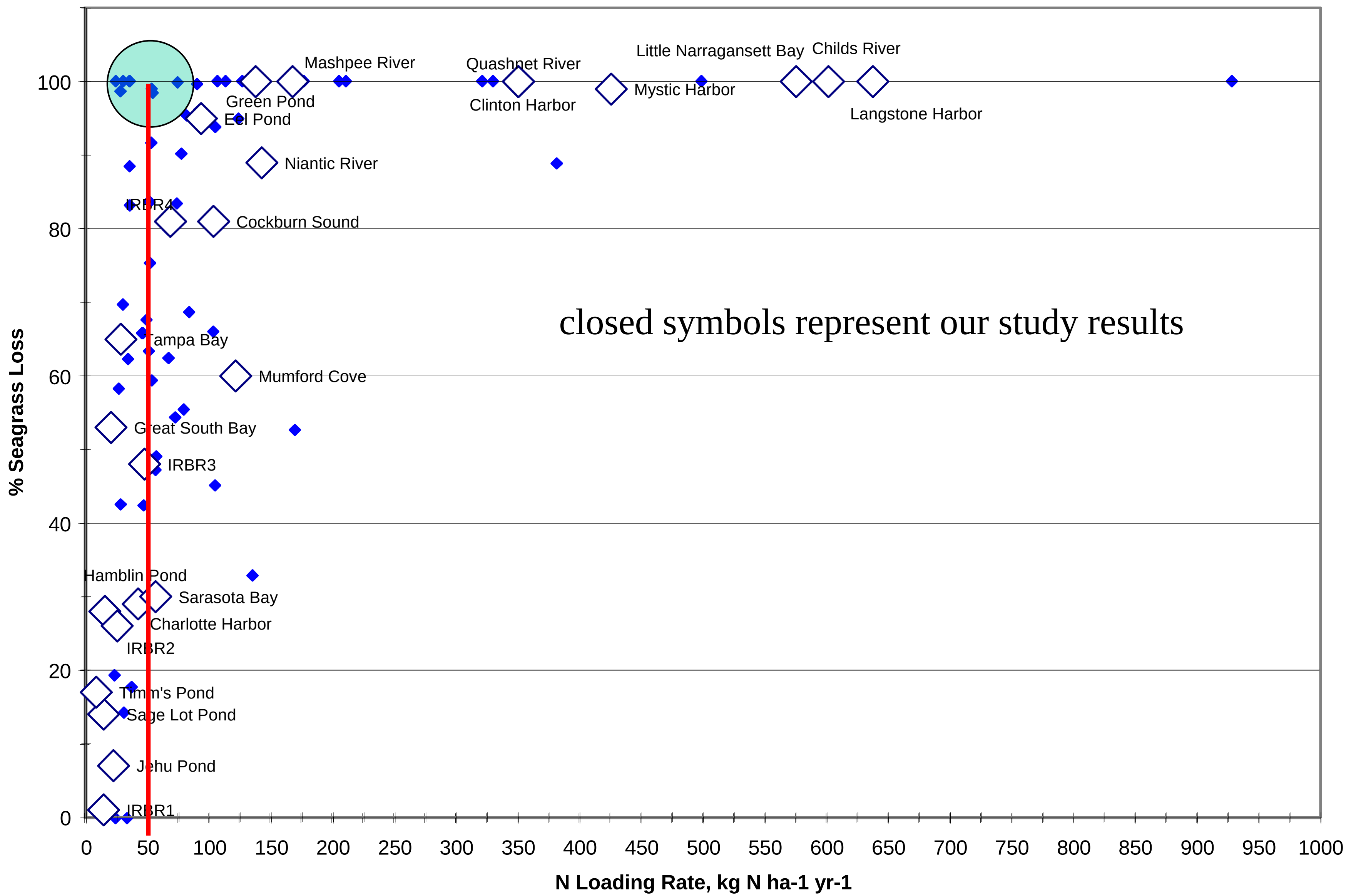

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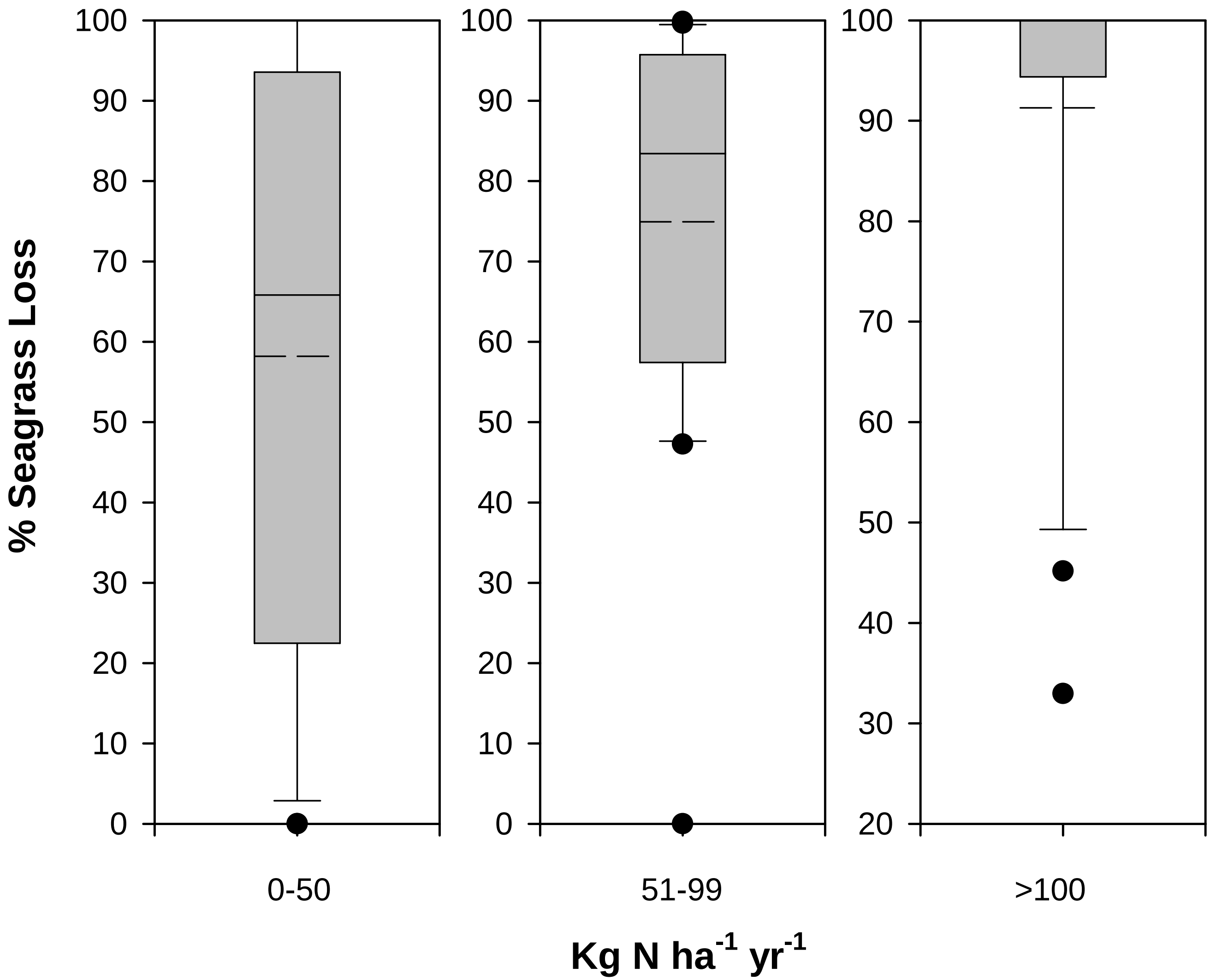
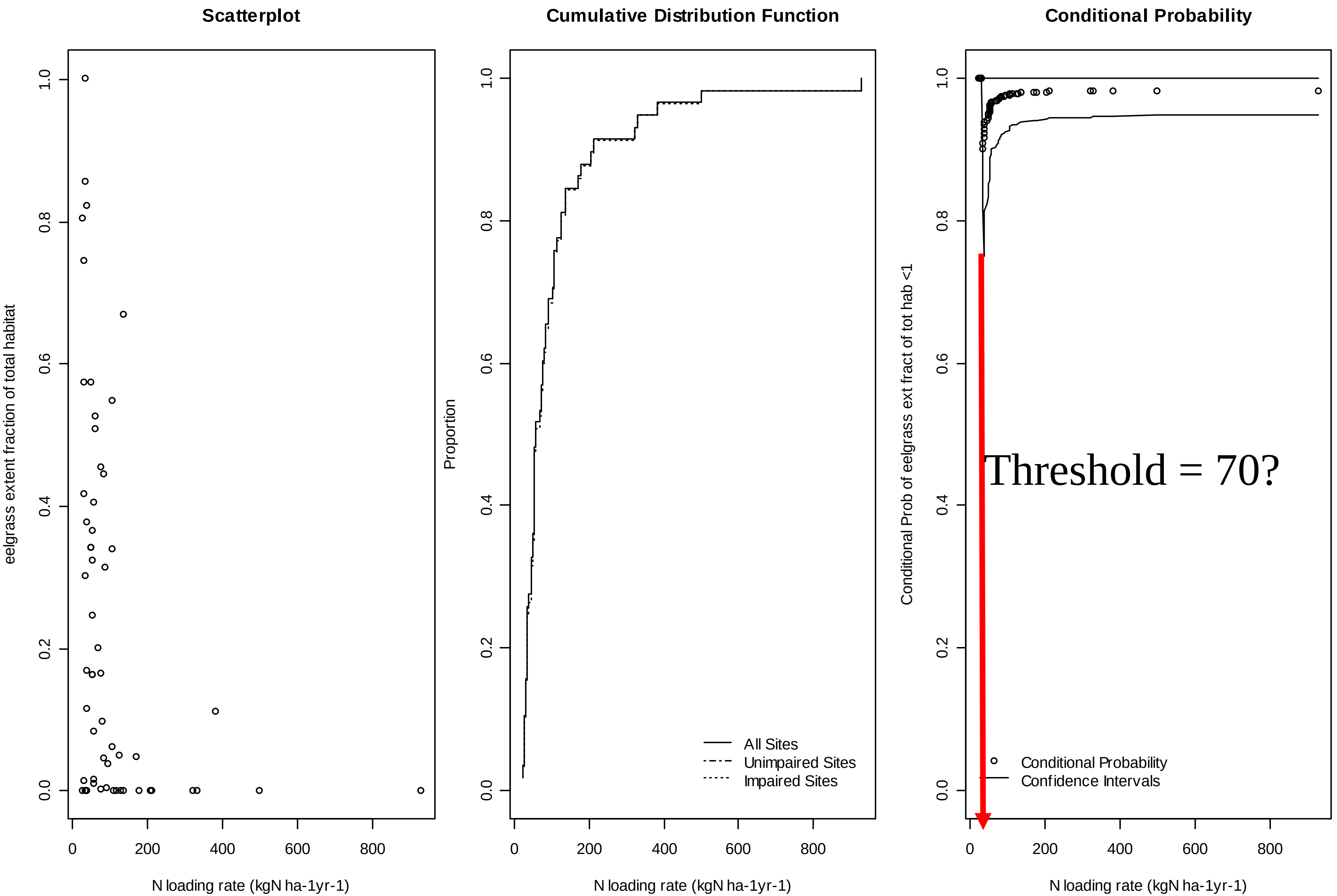
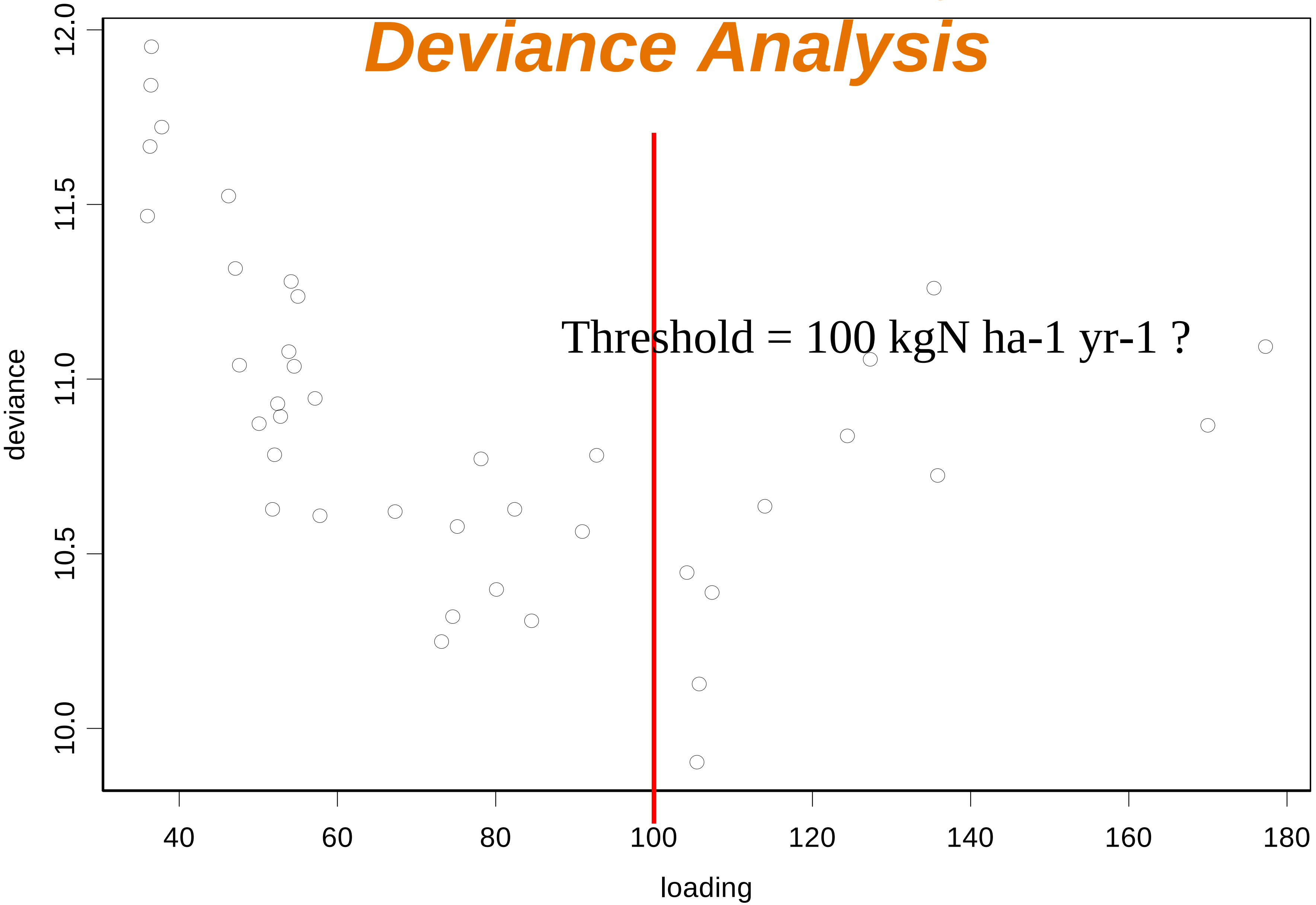


Other Statistical Analyses? (CPA)



Other Statistical Analyses? Deviance Analysis



Next Steps

Nitrogen Loading

- Incorporate watershed sinks (e.g., lakes, ponds)
- Distinguish water edge loading from far-field loading
- Include updated landuse data
- Provide output for wet, dry, and average years
- Include more data comparing AED-NLM with SPARROW or other models

Eelgrass

- Look at data from RI more carefully (low load - low eelgrass)
- Incorporate factors relevant to eelgrass response (water clarity, substrate type, habitat requirements)
- Evaluate *in situ* measures of eelgrass condition or extent along N gradient

Overall: Try to answer the question of how these data and analyses may be used in the context of developing nitrogen loading limits (loading based criteria) for estuaries?