

# Use of N isotopes to track N in the LLM

Hudson DeYoe and Warren Pulich

# Why is nitrogen important?

- It is typically the nutrient limiting primary production in marine waters
  - Leads to increases in primary production
- Worldwide DIN export to coasts is expected to increase
  - Locally, LRGV population growth will likely increase leading to more N loading to the coastal waters



# N sources: The Arroyo Colorado

- Loadings from the Arroyo Colorado (at the confluence with the Laguna Madre ) derived from HSPF Arroyo Colorado watershed simulation 1/1/89-12/31/99:
  - Nitrate 1,447,902 kg/yr
  - Ammonia 132,994 kg/yr
  - Organic N 94,084 kg/yr
  - Total P 207,223 kg/yr

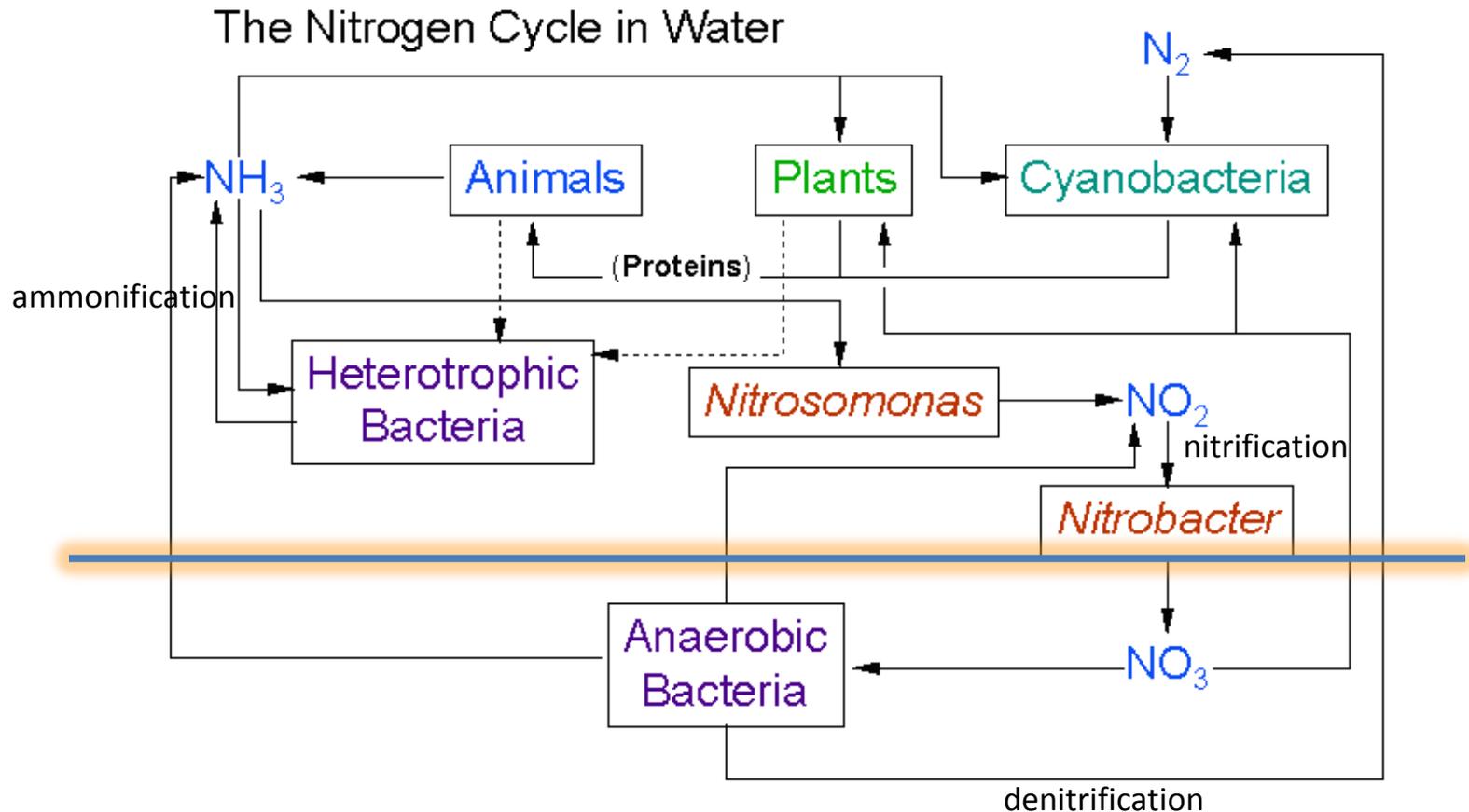
# Other nitrogen sources

- LLM sediments
- Runoff from surrounding land
- Sewage treatment plants that empty directly into the LLM (SPI, Port Isabel, Laguna Vista)
- Wind tidal flats algal mats
- Atmospheric deposition
- Gulf of Mexico
- Relative importance of the different sources is not known at this time.

# Where does all this N go?

- Out to Gulf of Mexico
- Incorporated by primary producers
  - Phytoplankton
  - Epiphytes
  - Drifting macroalgae
  - Seagrass
  - Benthic microalgae
- Bacterial transformations

# Simplified Nitrogen Cycle

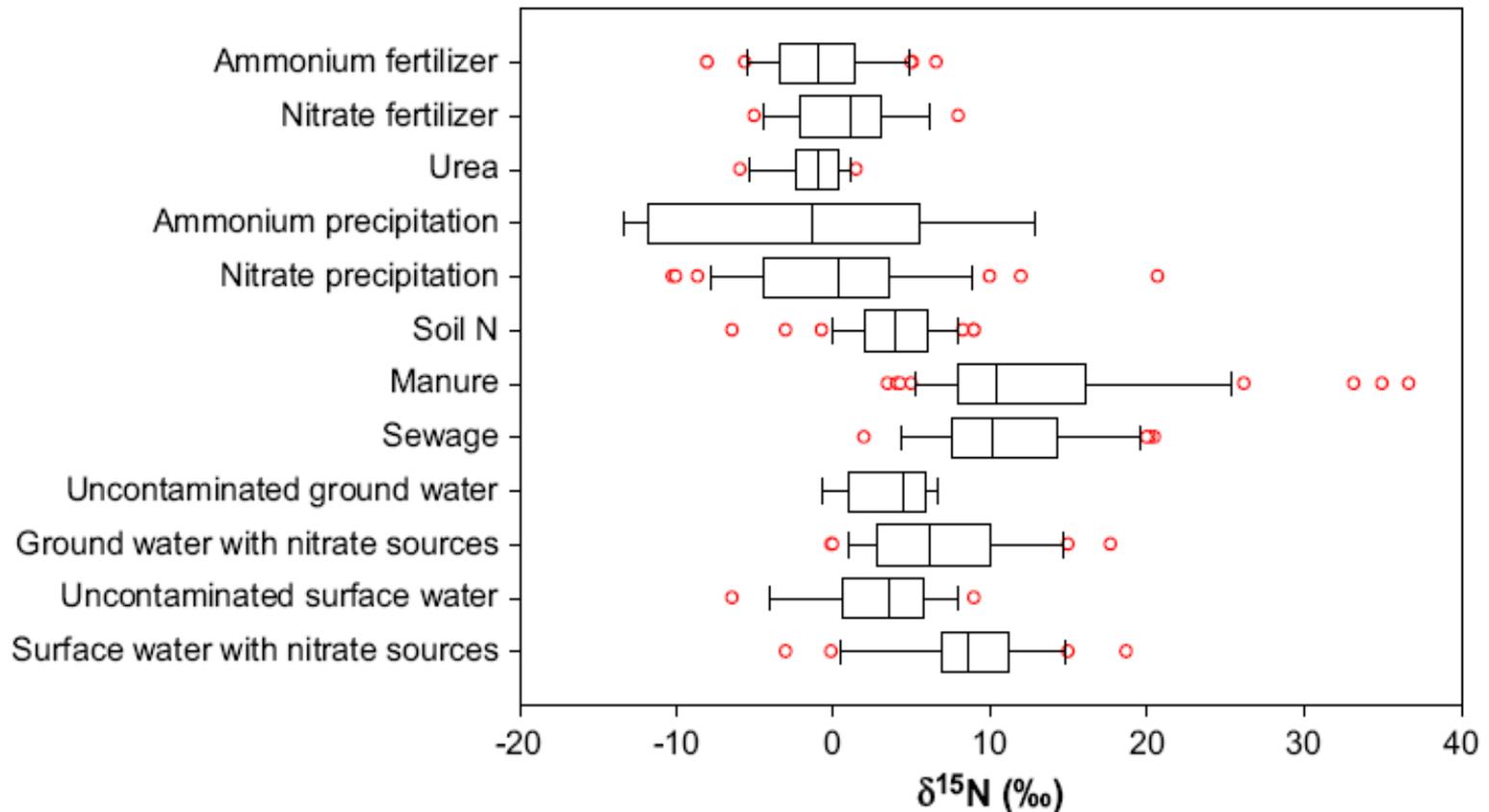


# Use of isotopes

- Uses naturally occurring isotopes
  - $^{14}\text{N}$  (common),  $^{15}\text{N}$  (rare)
  - $^{12}\text{C}$  (common),  $^{13}\text{C}$  (rare),  $^{14}\text{C}$  (radioactive)
- Biologically mediated reactions (enzymes) fractionate isotopes resulting in significant differences between reactants and products
  - Lighter isotopes generally have faster reactions kinetics so that products can be enriched in the lighter isotope

# $\delta^{15}\text{N}$ of various N sources

WATER RESEARCH 43 (2009) 1159-1170



- Box plots of  $\delta^{15}\text{N}$  values from various sources. Box plots illustrate the 25th, 50th and 75th percentiles; whiskers indicate the 10th and 90th percentiles; circles are outliers.  $\delta^{15}\text{N}$  (‰) =  $\left[ \frac{R_{\text{sample}} - R_{\text{standard}}}{R_{\text{standard}}} \right] \times 1000$  where R is the isotope ratio  $^{15}\text{N}/^{14}\text{N}$ . N standard is atmospheric  $\text{N}_2$ .

# N isotope approach has been used in a variety of situations

- A new approach for detecting and mapping sewage impacts. Costanzo et al. 2001.
- Distribution and trophic importance of anthropogenic nitrogen in Narragansett Bay: An assessment using stable isotopes. Oszkowski et al. 2008.
- Using  $\delta^{15}\text{N}$  values in algal tissue to map locations and potential sources of anthropogenic nutrient inputs on the island of Maui, Hawai'i, USA

153°00'

Data from Costanzo et al. 2001



Caboolture R.

Deception Bay

Pine R.

Moreton Bay

Bramble Bay

**Sewage Outfall Sites**  
**Total N (tonnes/yr)**



0 - 100



100 - 200



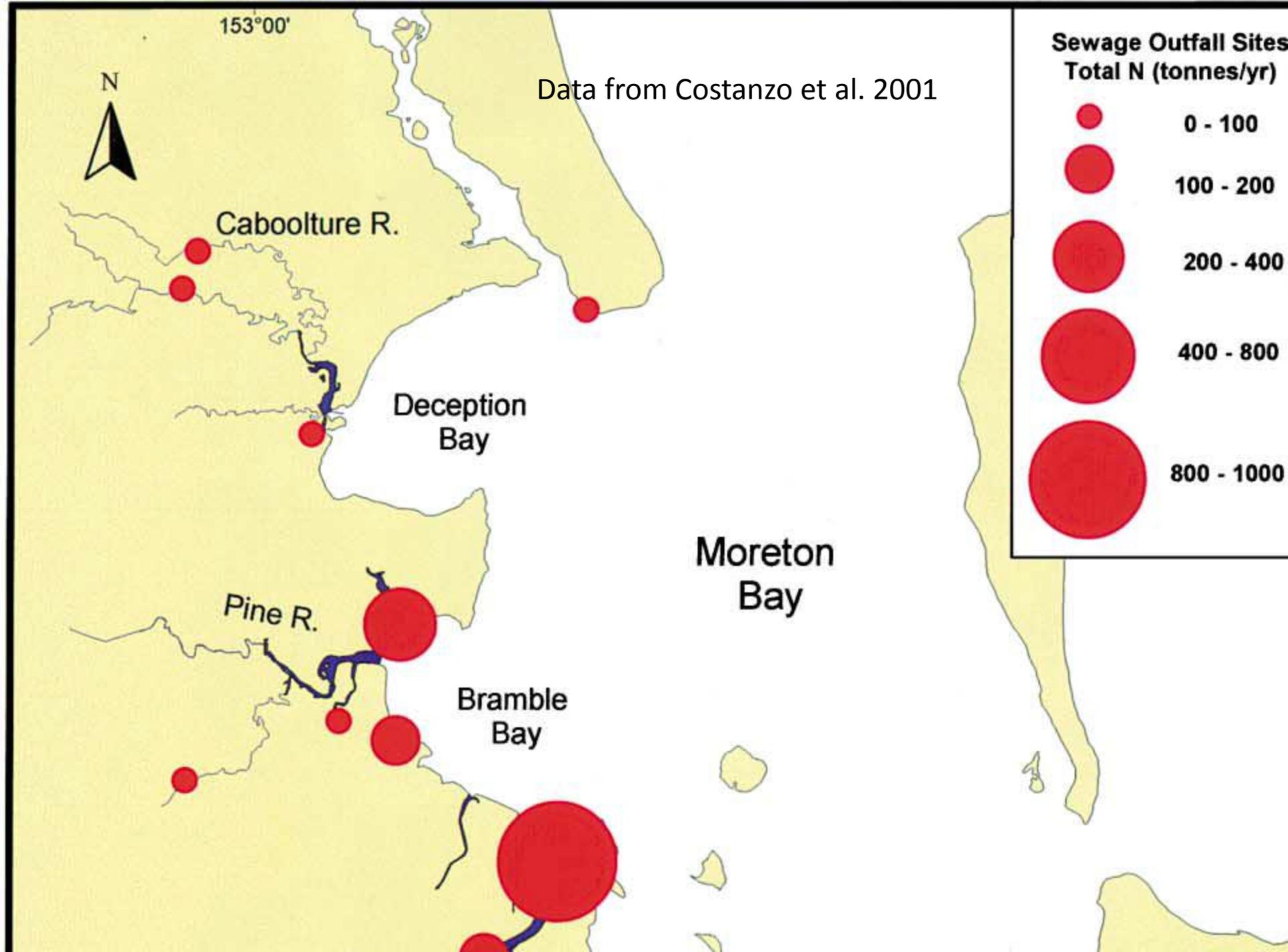
200 - 400



400 - 800



800 - 1000



153°00'

153°30'



Caboolture R.

12.2

3.9

Data from Costanzo et al. 2001

● 3.8

Deception Bay

Pine R.

▲ 11.1

▲ 11.3

Bramble Bay

Moreton Bay

Moreton Is.

■ 2.2

■ 1.6

■ 5.1

▲ 5.0

■ 9.1

● 8.7

● 6.7

● 2.5

● 2.4

Delta 15N (ppt)

● Seagrass

■ Mangrove

▲ Macroalgae

# Our plan

- Collect samples at 9 sites with one site being in the Arroyo Colorado and eight sites being north, south and east of the confluence of the Arroyo Colorado and Lower Laguna Madre.
- At each site, where available seagrass, drift algae and seston samples will be collected.
- In addition to the above, water samples will be collected at selected sites for quantification of the isotopic nitrate.
- In addition to the above, select archived seagrass and drift algal samples collected by Dr. DeYoe in previous studies will prepared for isotopic analysis also.