

# TRACING NITROGEN FROM THE ARROYO COLORADO INTO THE LOWER LAGUNA MADRE

Hudson DeYoe, Center for Subtropical Studies and Biology  
Dept at University of Texas-Pan American, Edinburg,  
and

Warren Pulich, River Systems Institute, Texas State University,  
San Marcos, TX and UTPA Center for Subtropical Studies,  
Edinburg

# The Lower Laguna Madre and the Arroyo Colorado

- LLM contained around 53 % of the total seagrass in Texas in 1998
  - ▣ Seagrass is the keystone species for the LLM
  - ▣ Many marine animals depend upon it
- The Arroyo Colorado is a highly eutrophic distributary that drains the Lower Rio Grande Valley
  - ▣ Arroyo nutrients come from municipal wastewater treatment plants, urban runoff and agricultural drainage

# Nutrients in estuaries

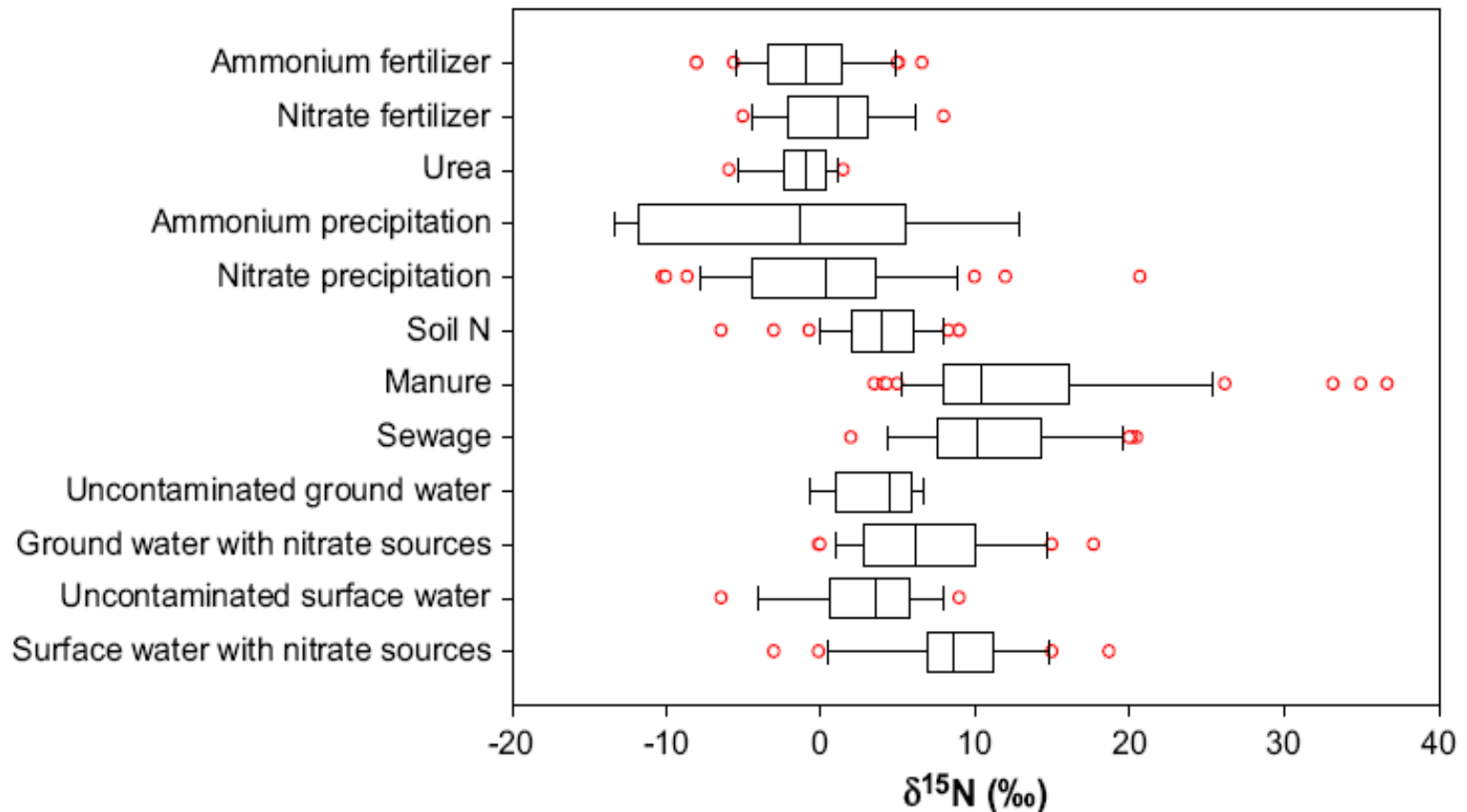
- Nutrients are necessary for growth of primary producers such as phytoplankton, macroalgae, seagrass and seagrass epiphytes
- In moderation, nutrients have beneficial impact but in excess can produce nuisance or harmful quantities of algae sometimes leading to decline of seagrass (shading, smothering)
- Bacterial transformations can remove nitrogen from the system through denitrification

# Questions and Approach

- Is excess nitrogen getting into the LLM from the Arroyo?
  - ▣ If so, where is it going?
- Approach: Use naturally occurring isotopes of nitrogen ( $^{14}\text{N}$ - common,  $^{15}\text{N}$ - rare) to follow it from Arroyo Colorado into the LLM
  - Nitrogen sources can have distinctive isotopic signatures
- ▣ Biologically-mediated reactions (enzymes) discriminate between N isotopes resulting in significant differences between reactants and products

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

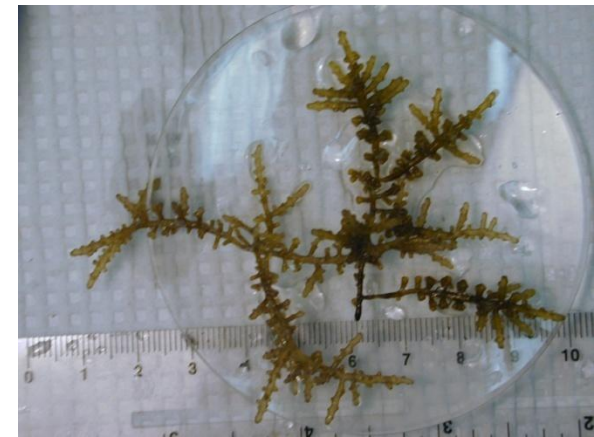
WATER RESEARCH 43 (2009) 1159-1170



- 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  $\text{N}_2$ .

# Our plan

- Collect biological samples at 27 sites north, south and east of the confluence of the Arroyo Colorado and Lower Laguna Madre.
- At each site, where available, collect seagrass, drift algae and epiphyte samples and analyze for isotopic N.
- In addition to the above, archived seagrass and drift algal samples from previous studies were also analyzed.



*Palisada poiteauii*

# Sampling Sites Aug, 18, 2011



Samples collected with help from Mark Lingo and John Lopez of TPWD

Arroyo Colorado



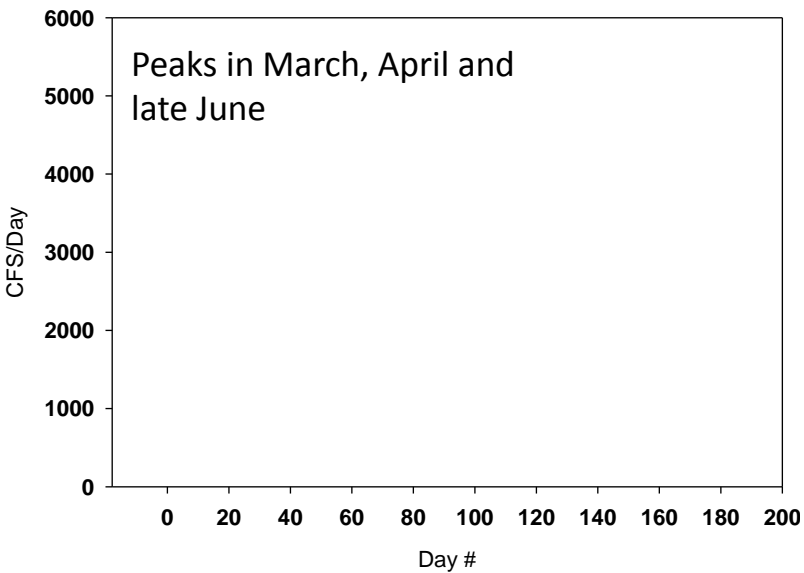
Red- samples analysed  
Black- samples collected but not analysed

ARCHIVED SAMPLE DATA

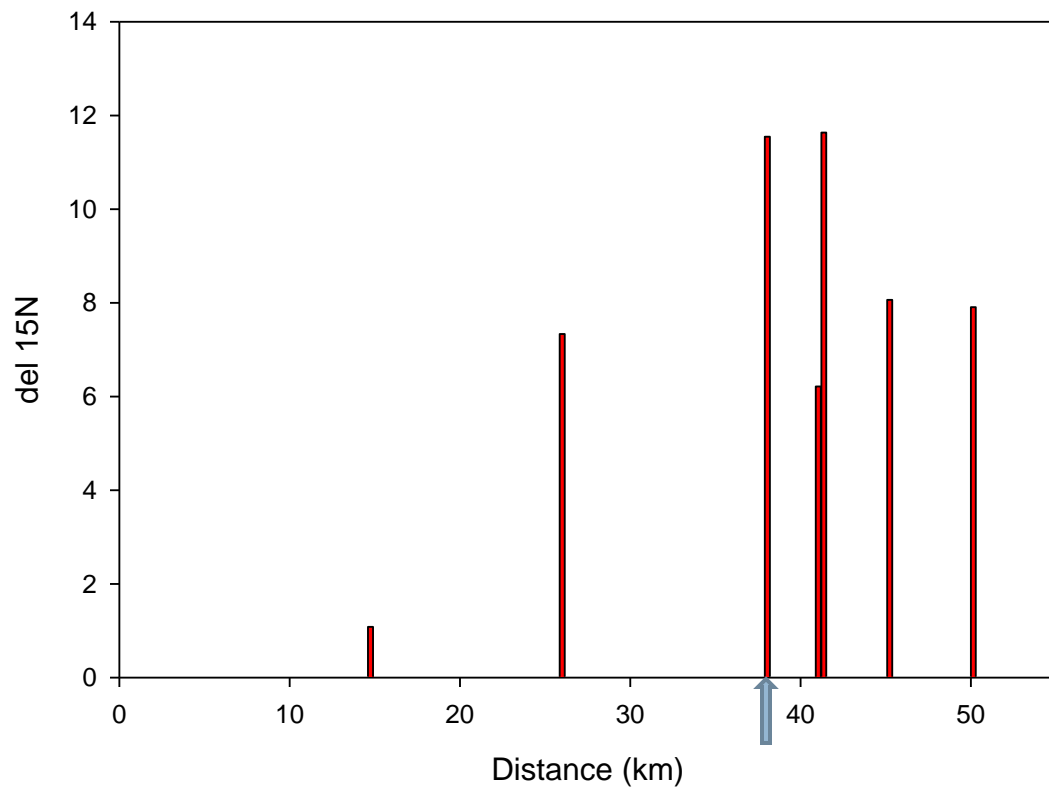




Arroyo Colorado Flow at Harlingen, Jan-Jun 2004

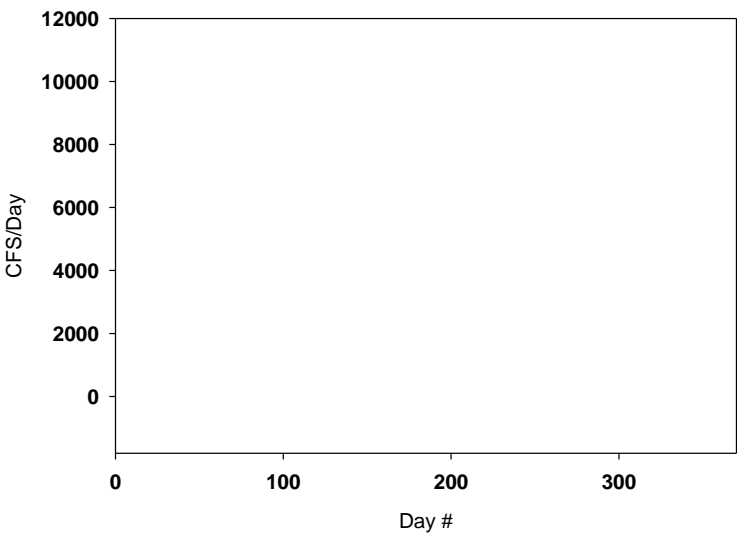


del 15N values for the drift algae, *Palisada* in LLM, May 21, 2004

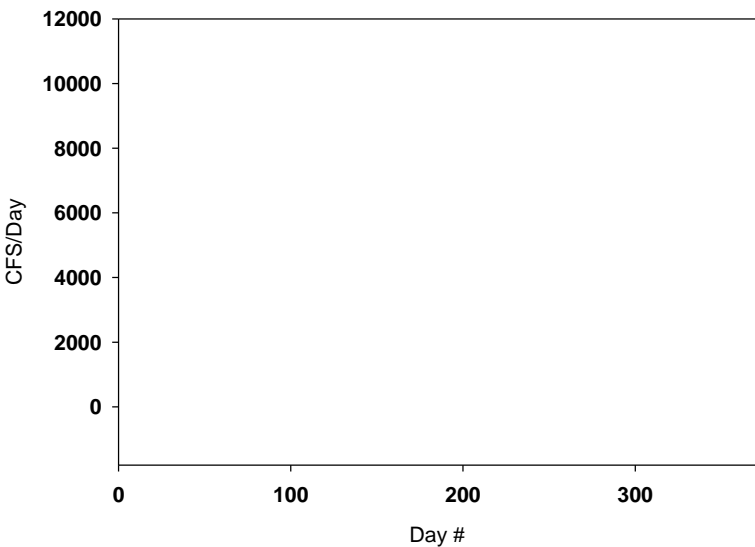


Arroyo Colorado is at 39 km.

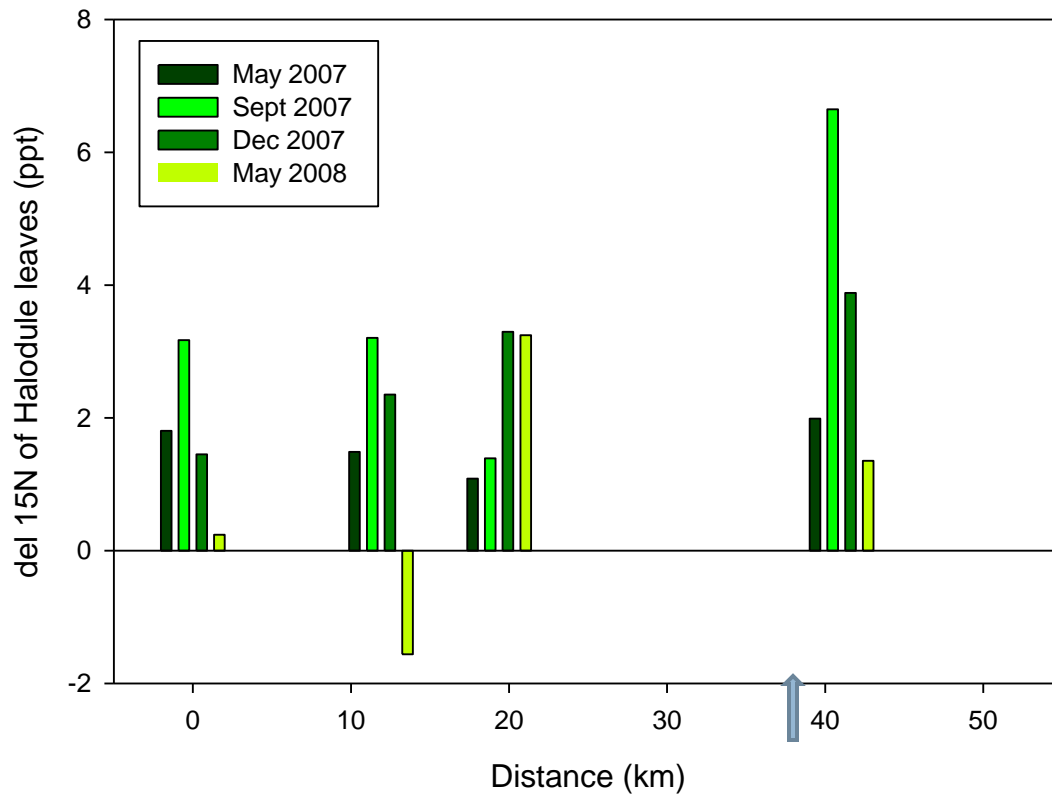
Arroyo Colorado Flow at Harlingen, 2007



Arroyo Colorado Flow at Harlingen, 2008

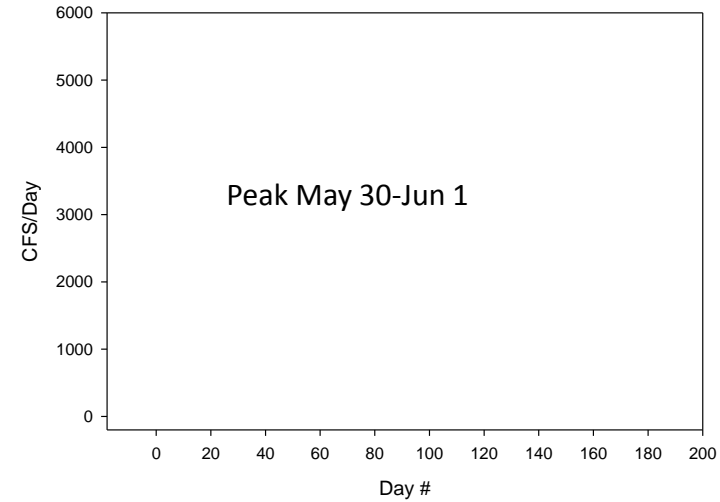


del 15N of *Halodule* leaf tissue in LLM, 2007-8

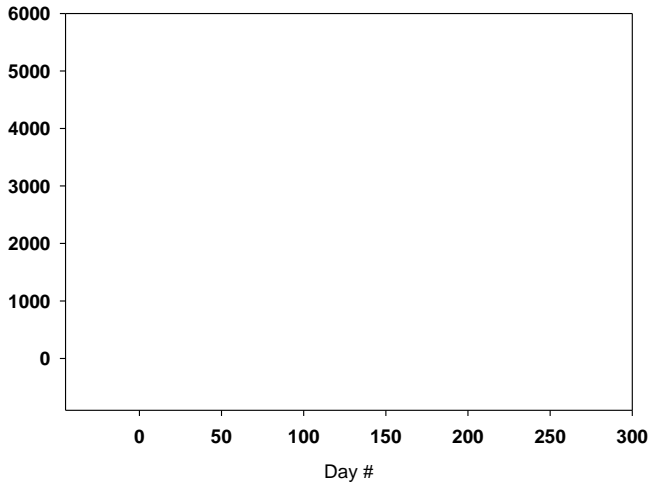


Arroyo Colorado Flow at Harlingen, Jan-Jun 2005

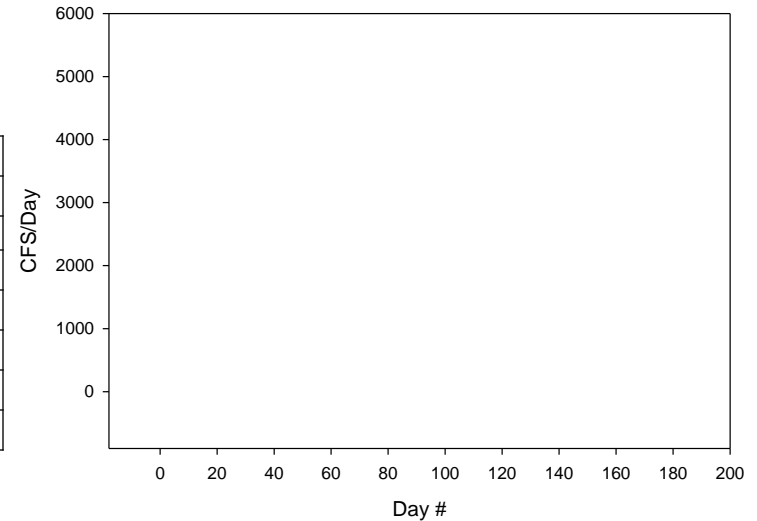
Site	Distance		Species	Wetness	15N
Green island	41.038	5/21/2005	Thalassia	Avg	5.45
Bay West	19.375	6/1/2005	Thalassia	Avg	2.61
ABC-2	14.754	5/21/2005	Thalassia	Avg	1.12



Arroyo Colorado Flow at Harlingen, Jan-Aug 2002



Arroyo Colorado Flow at Harlingen, Jan-Jun 2003

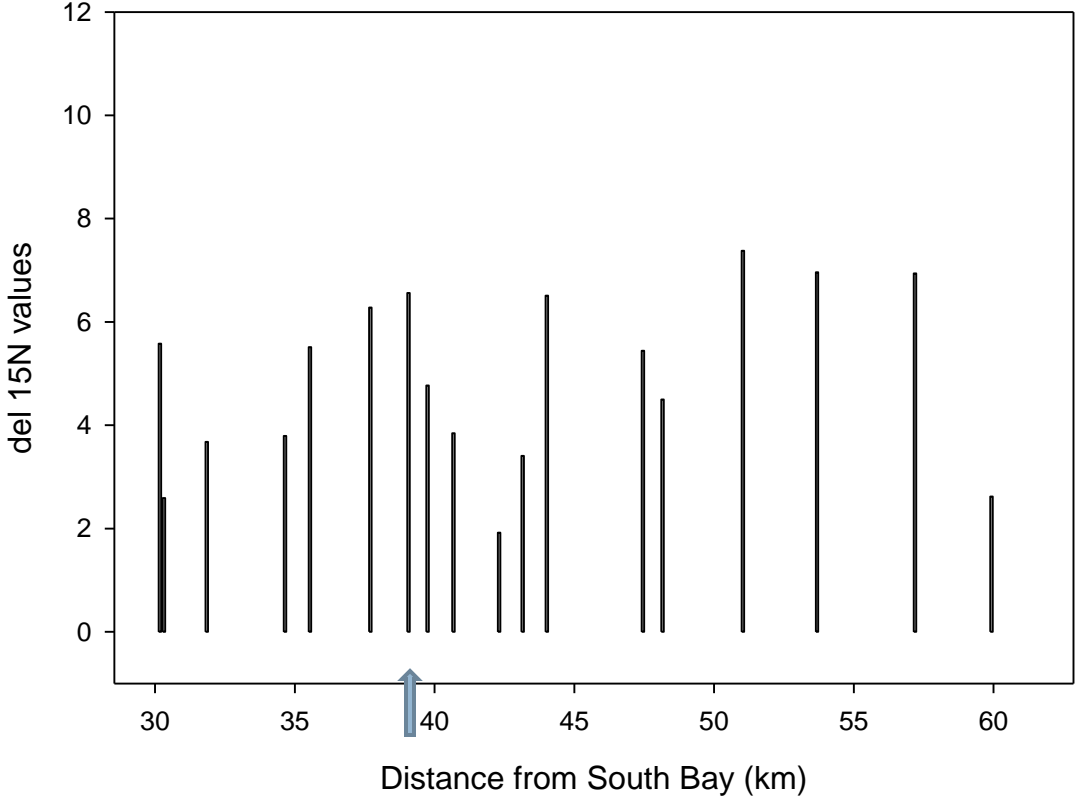


Site	Distance		Species	Wetness	15N
North trans deep	50.661	8/24/2002	Palisada	Avg	6.26
Arroyo trans deep	38.892	8/17/2002	Palisada	Avg	6.40
SPI trans medium	14.754	8/31/2002	Palisada	Avg	1.61
Green island	41.038	6/18/2003	Palisada	Wet	2.86
ABC	14.754	6/18/2003	Palisada	Wet	2.21
Green island	41.038	6/24/2003	Palisada	Wet	3.82
ABC	14.754	6/24/2003	Palisada	Wet	2.50

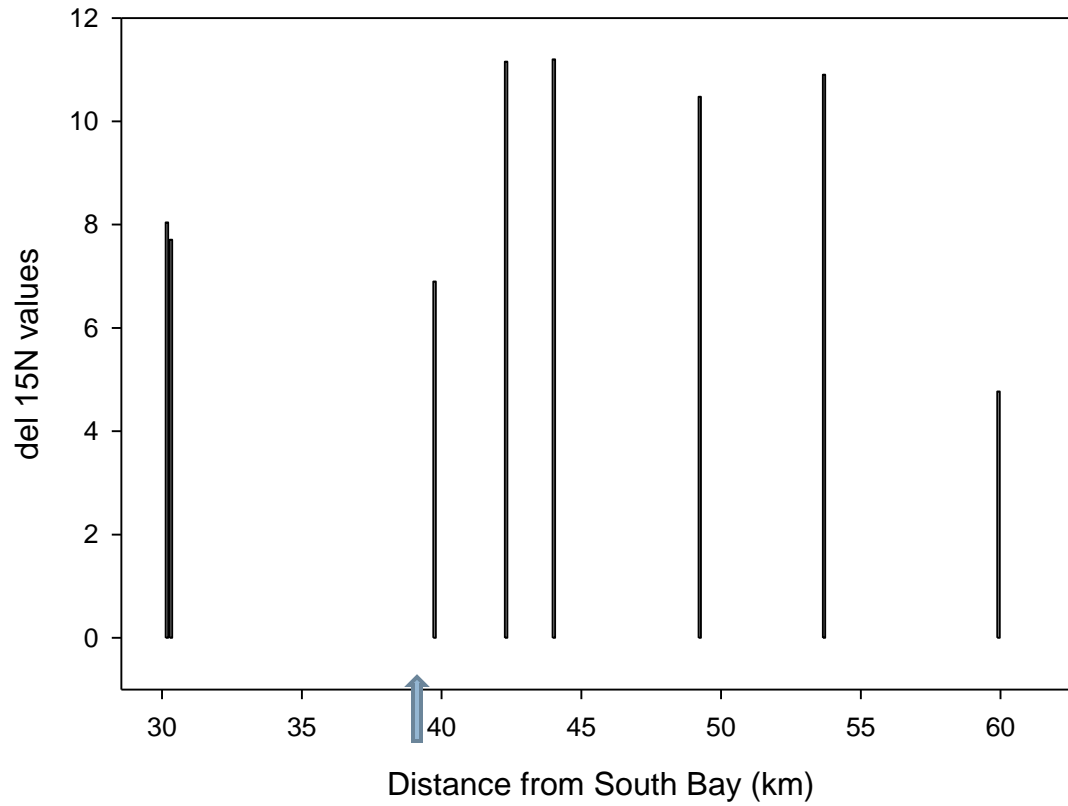
# AUGUST 2011 DATA



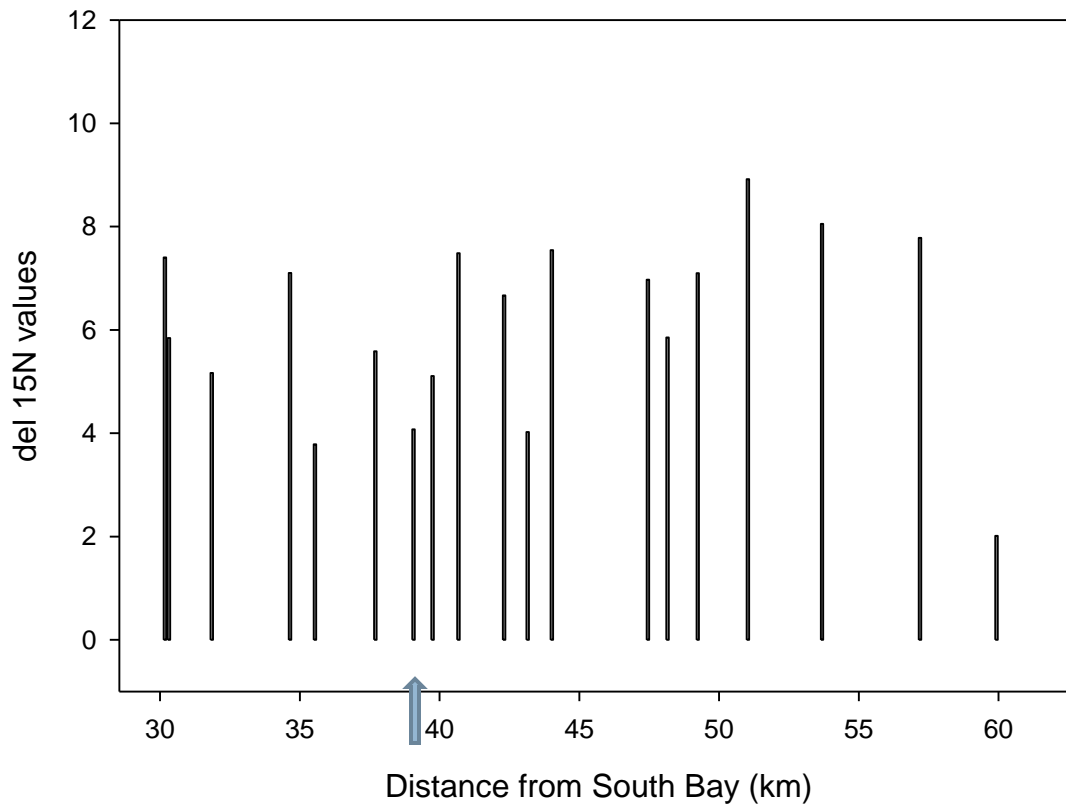
15N values for *Halodule* in LLM, Aug 2011



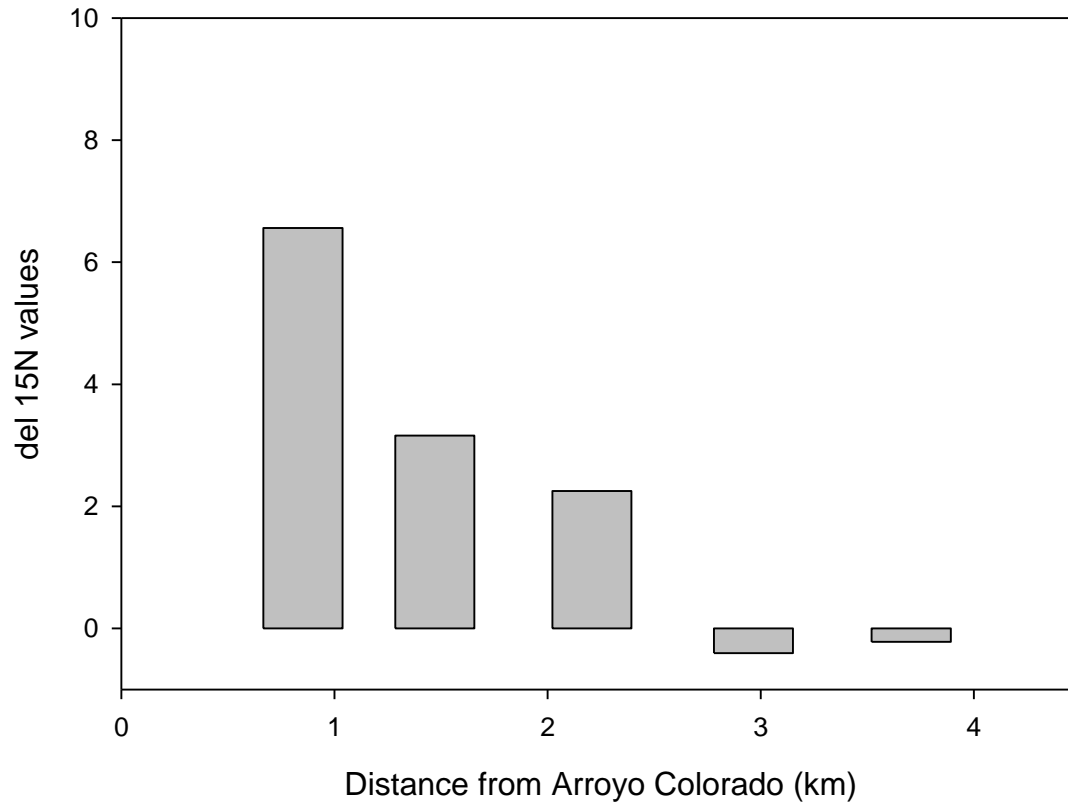
del 15N Values for *Palisada* in LLM, Aug 2011



del 15N values for *Halodule* epiphytes in LLM, Aug 2011

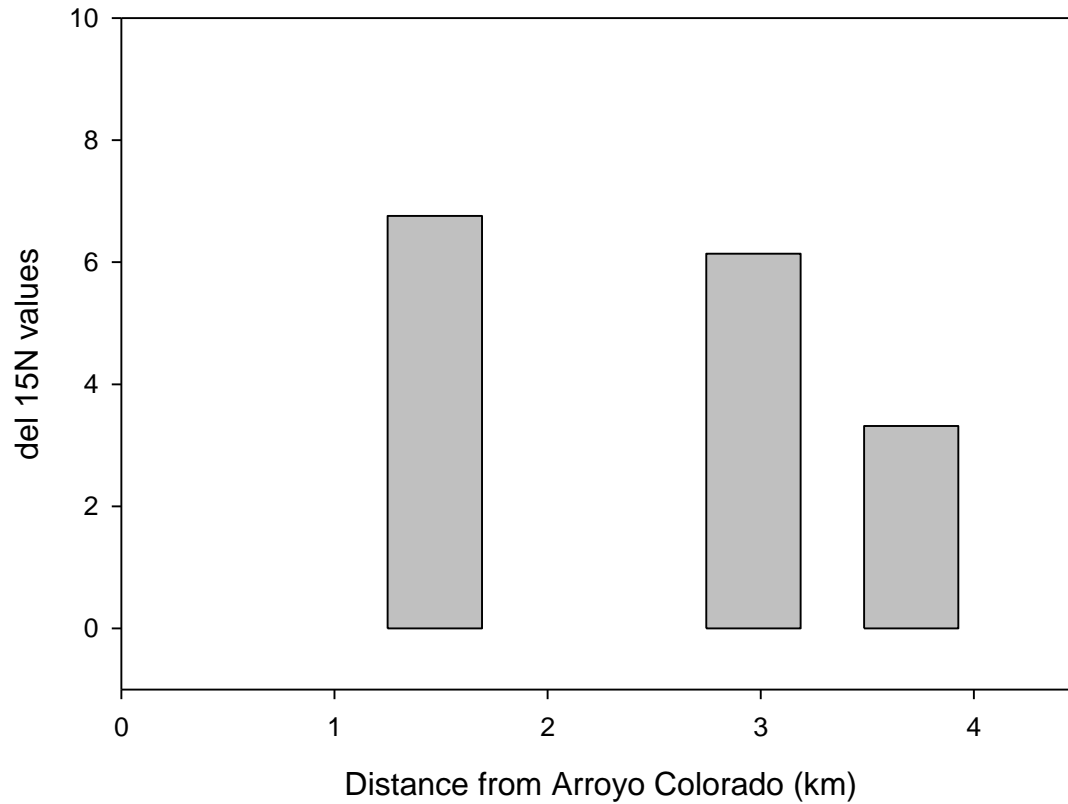


del 15N values for *Halodule*, east transect, LLM, Aug 2011

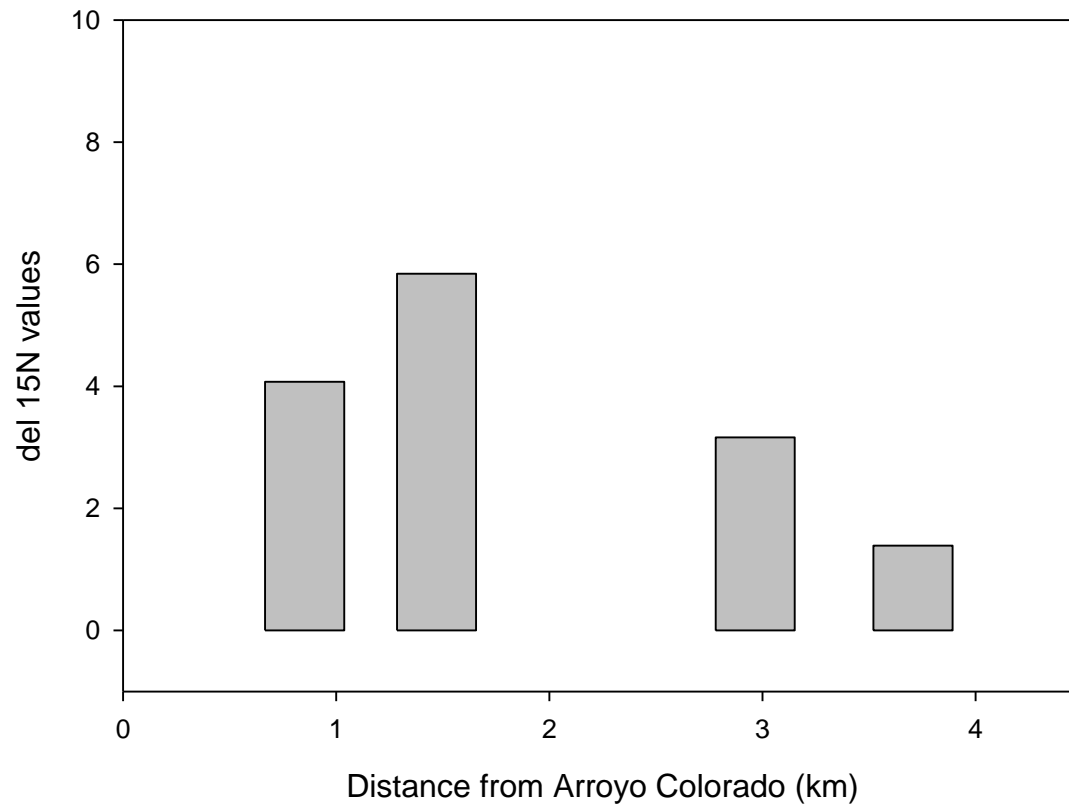




del 15N values for *Palisada*, east transect, LLM, Aug 2011



del 15N values for *Halodule* epiphytes, east transect, LLM, Aug 2011



# Conclusions

- N isotopic signature at the same location varies with type of primary producer
- For one species, seasonal variation occurs at a site
- Differences among primary producers (epiphytes, drift algae, seagrass) may reflect differences in longevity, biomass and metabolic rate
  - ▣ May be useful to detect events of differing duration
- Despite the above, N isotopes detected clear instances of AC nitrogen being incorporated by primary producers

# Acknowledgements

- Thanks to Texas Parks and Wildlife for assisting with sample collection
- Thanks to John Garcia for processing samples
- This project was funded by TWDB in support of the development of a freshwater inflows recommendation for the LLM