Sea Grant
NORTH CAROLINA

Measuring Multifunctionality of Living Shorelines

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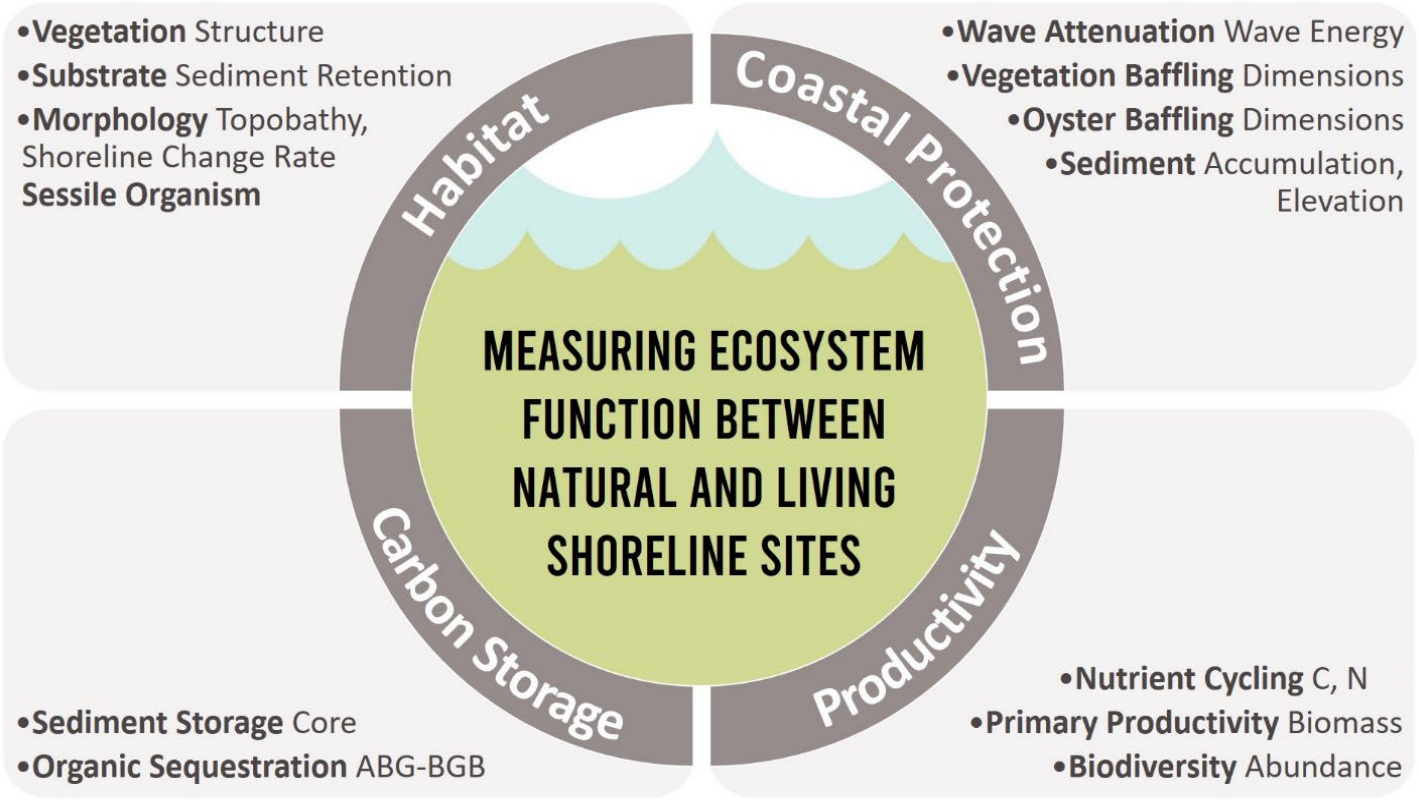
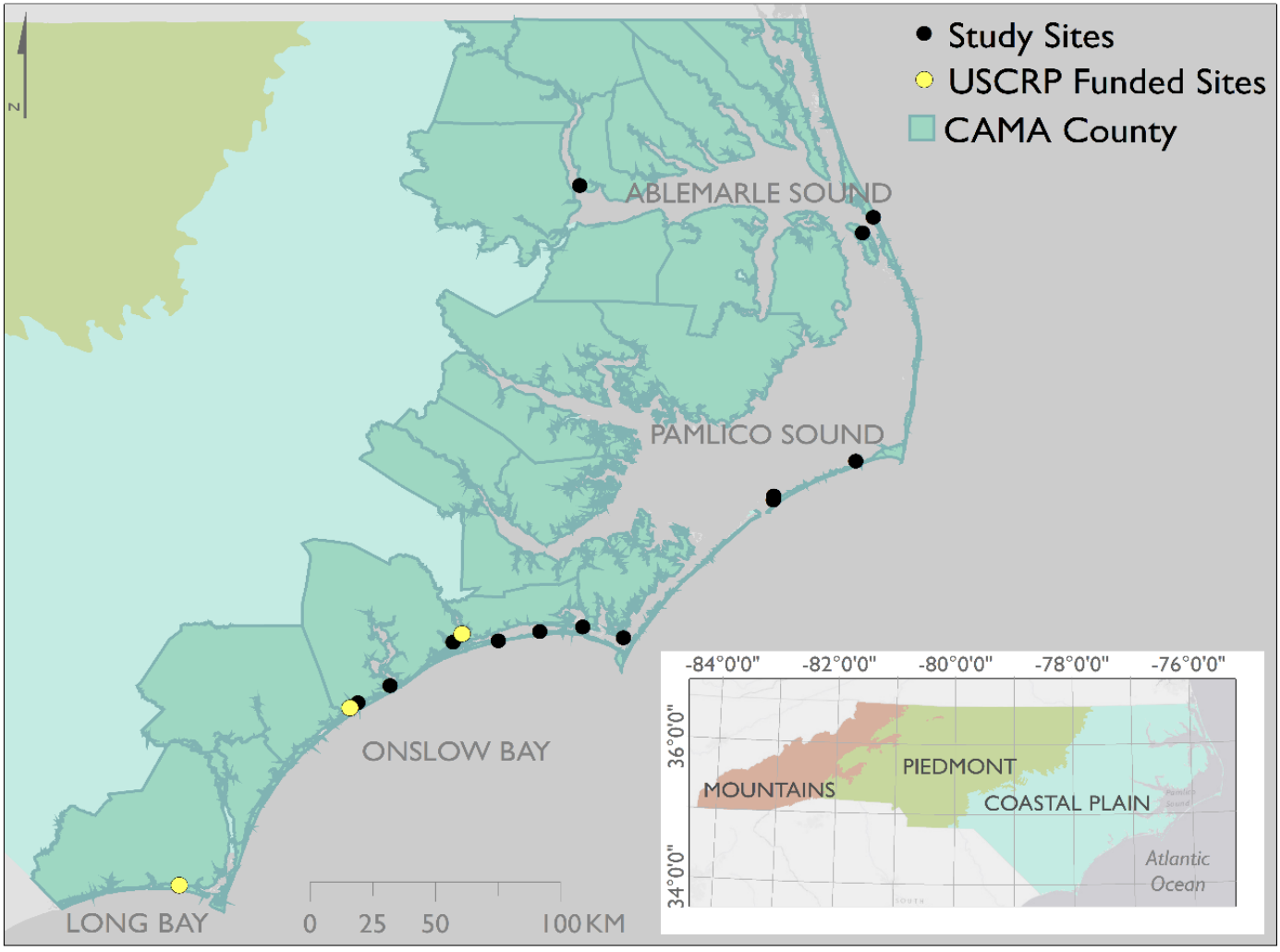
UNCW
Center for Marine Science UNCW
ECU
USCRP
US COASTAL RESEARCH PROGRAM

COMPARE THE ECOSYSTEM SERVICES OF NATURAL MARSH SHORELINES AND SILL LIVING SHORELINES




Study Sites
USCRP Funded Sites
CAMA County
N
ABLEMARLE SOUND
PAMLICO SOUND
ONSLOW BAY
LONG BAY
0 25 50 100 KM
-84°0'0"
-82°0'0"
-80°0'0"
-78°0'0"
-76°0'0"
36°0'0"
34°0'0"
MOUNTAINS
PIEDMONT
COASTAL PLAIN
Atlantic Ocean


Site 1
Est. 2011 (9 years)
Bag Sill


Site 1
Est. 2011 (9 years)
Bag Sill

Site 2

Est. 2005 (15 years)

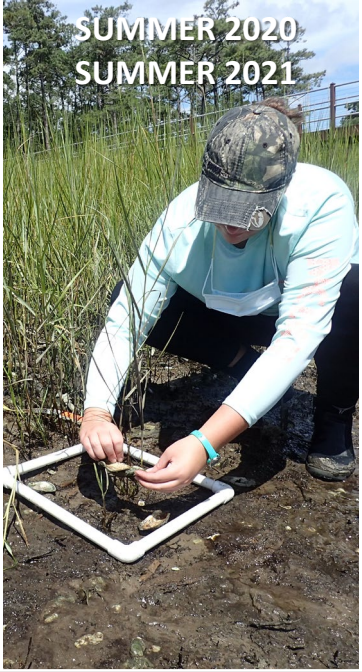
Rock Sill


Site 2
Est. 2005 (15 years)
Rock Sill


Site 3
Est. 2010 (10 years)
Bag Sill


Site 3
Est. 2010 (10 years)
Bag Sill

	Functional Value	Indicator	Method	Adapted from
Coastal Protection	**Wave Attenuation**	Wave energy (height/distance)	RBR sensor in front of and behind structure or in front of marsh at natural sites	
	Ecosystem Engineers	Abundance of *C. Virginica, G. demissa, S. alterniflora* (dimensions/ # individuals/area) Rugosity (Variation/area)	Inventory quadrat plots (0.25 m^2) Terrestrial laser scan	Ridge, Rodriguez, & Fodrie, 2017; Hanke, Posey, & Alphin, 2017
	Shore Position	Shoreline change rate (position/time)	SCR pre-post installation	Polk & Eulie, 2018

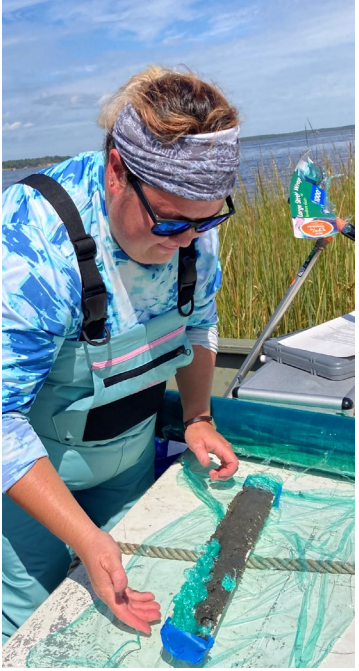


Productivity

Functional Value	Indicator	Method	Adapted from
Species Abundance	Abundance of *C. Virginica, G. demissa, L. irrorate, T. obsolete* (# individuals/area)	Inventory quadrat plots (0.25 m^2)	Harding et al., 2012; Ridge et al., 2016 (*C. Virginica*) Honig et al., 2015 (*G. demissa*) Zengel et al., 2016 (*L. irrorate*) Levinton et al., 1995 (*T. obsolete*)
Benthic infauna	*Abundance (# individuals/area)* *Species richness (species/area)*	*Benthic core*	*Posey, Alphin, & Powell, 1997;*
Nutrient Retention	Nutrients in AGB and BGB (Nutrient concentration)	N and P in plant clipping Sediment core	Wieski et al., 2010; Loomis & Craft, 2010

Habitat	**Plant Structure**	Abundance (# plants/area) Species richness (species/area) Dimensions (height, diameter)	Vegetation inventory plots (0.25 m^2) Count all stems, Measure 10 random stem heights, Diameter at first node of those leaves	Currin, Delano, & Valdes-Weaver, 2007; Morgan, Burdick, and Short, 2009; Meyer et al., 2001
	Species Abundance	Abundance of *C. Virginica, G. demissa* (dimensions/ # individuals/area)	Inventory random plots (0.25 m^2)	Ridge, Rodriguez, & Fodrie, 2017
	Shore Morphology	Physical (elevation, acreage, slope) Vegetation (density, canopy height, acreage, sub-habitat)	Topobathy using terrestrial laser scanner and single beam echosounder Return signal classification	

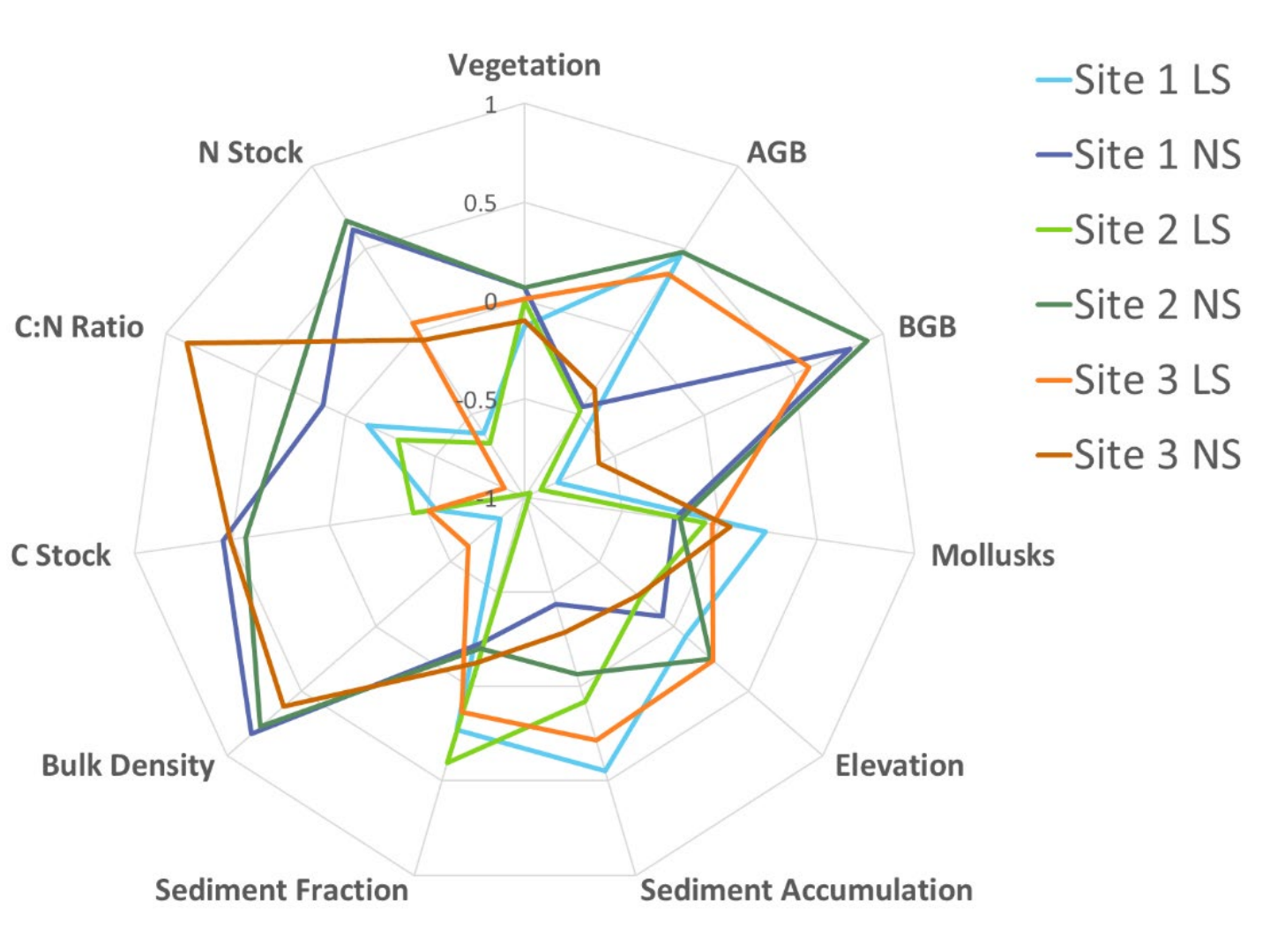
Sediment	**Accumulation**	Sediment depth (depth/time)	Soil horizon markers (1 m^2)	Reed, 1989; DeLaune et al., 1994; Cahoon et al., 2002
		Sediment weight and grain size (mass/area/time)	Sediment Tile (10 cm^2)	Pasternack and Brush 1998; Lagomasino et al.2013

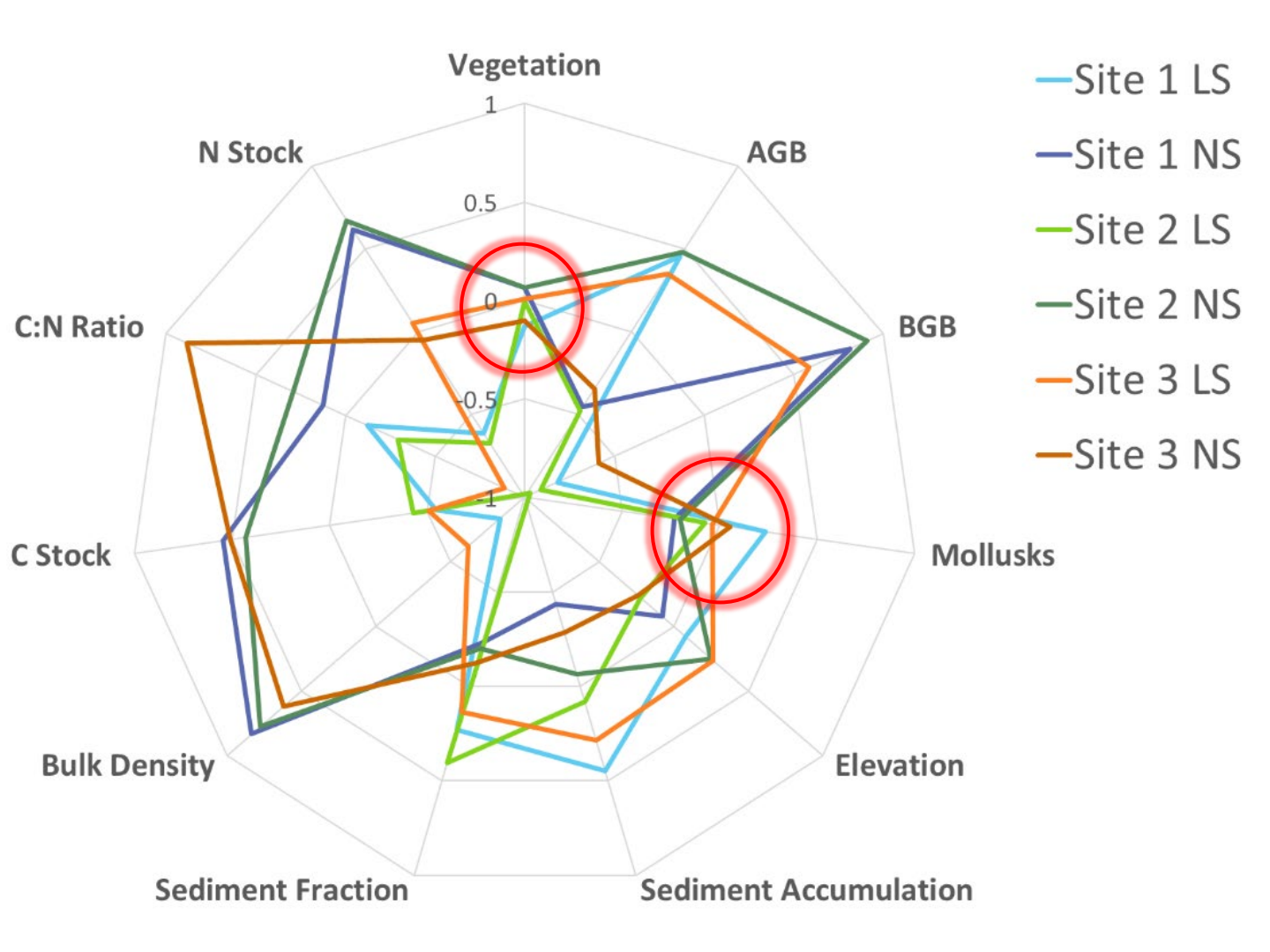


	Functional Value*	Indicator	Method	Adapted from
Carbon Storage	**Primary productivity**	Annual standing crop (biomass /area /time)	Vegetation clip plots (0.25 m^2)	Davis et al. 2015
		Below-ground biomass (biomass /area /time)	Sediment cores LOI	Craft et al., 1991; Davis et al. 2015
	Sediment Storage	C:N and stable isotope analysis of C, N	Sediment cores (20 cm deep, 3.5 cm diameter), live roots and rhizomes separated and dried at 60° C	Wieski et al., 2010; Loomis & Craft, 2010; Davis et al., 2015; Kim et al., 2016

METHODS

AGB live weight	SA avg diameter
AGB dead weight	SA avg height
AGB Total	Mud snail plot Size
BGB Total Weight	Mud Snail Plot density
Bulk Density	Mussels density marsh platform
C Stock	Oysters density marsh platform
C:N Ratio	Periwinkles density marsh platform
N Stock	Periwinkles: 15 m size
Elevation	Periwinkles: 15 m density
JR density	Sediment Accumulation
SA density	Sediment % >2 mm
SP density	Sediment % Sand
	Sediment % Silty/Clay


Vegetation
AGB
BGB
Mollusks
Elevation
Sediment Accumulation
Sediment Fraction
Bulk Density
C Stock
C:N Ratio
N Stock
1
0.5
0
-0.5
-1
Site 1 LS
Site 1 NS
Site 2 LS
Site 2 NS
Site 3 LS
Site 3 NS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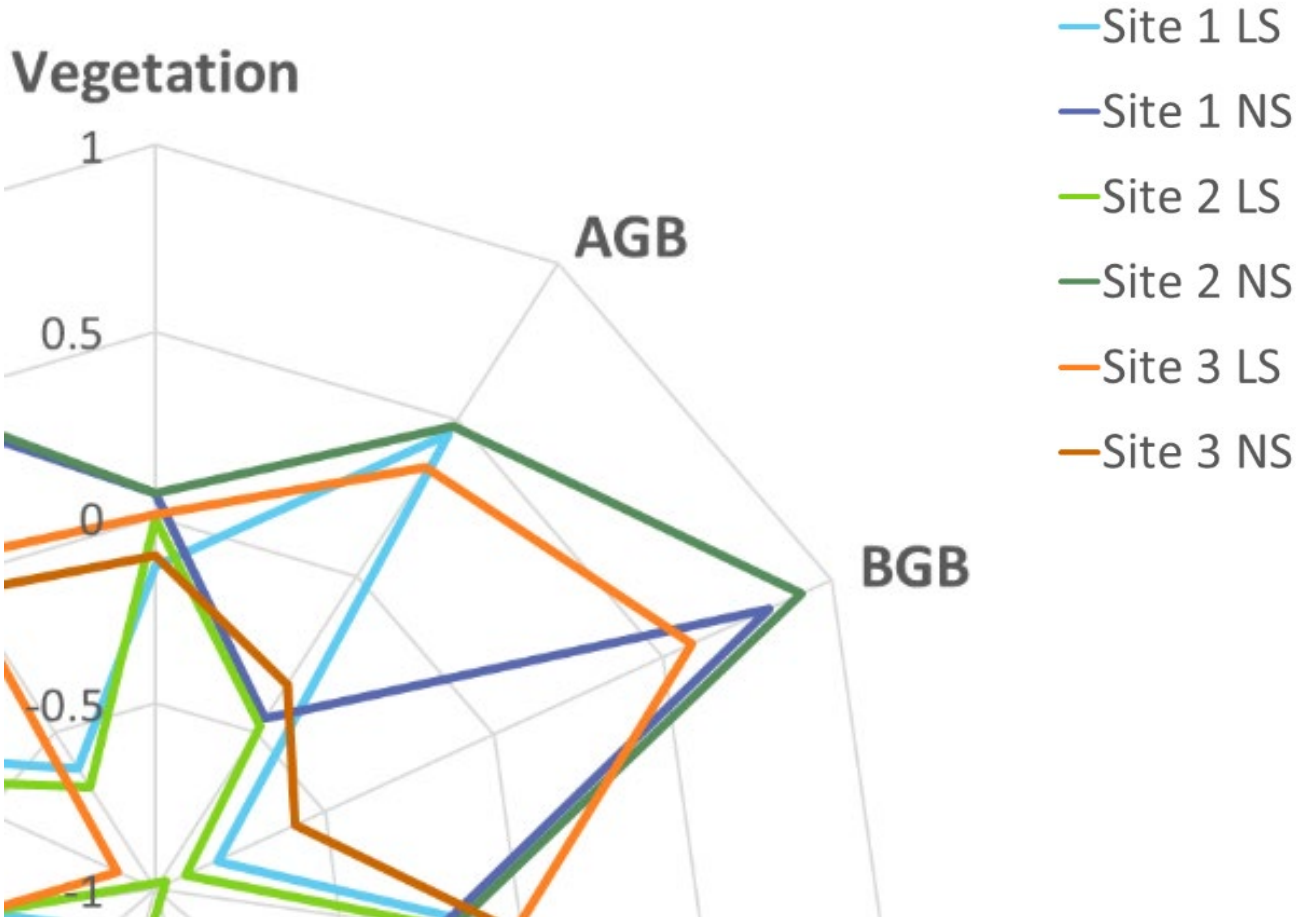
Vegetation
1
0.5
0
-0.5
-1
AGB
BGB
Site 1 LS
Site 1 NS
Site 2 LS
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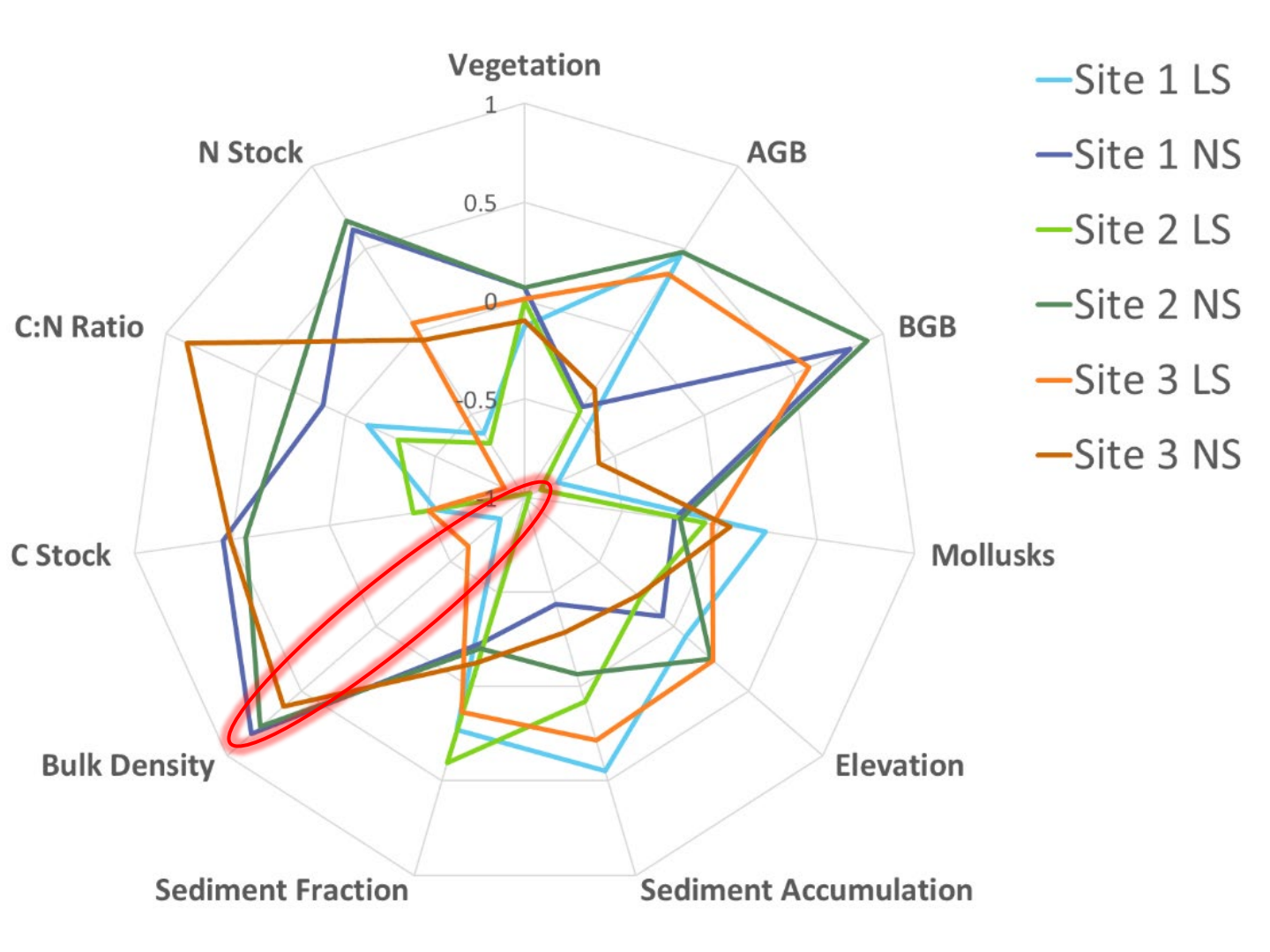
Vegetation
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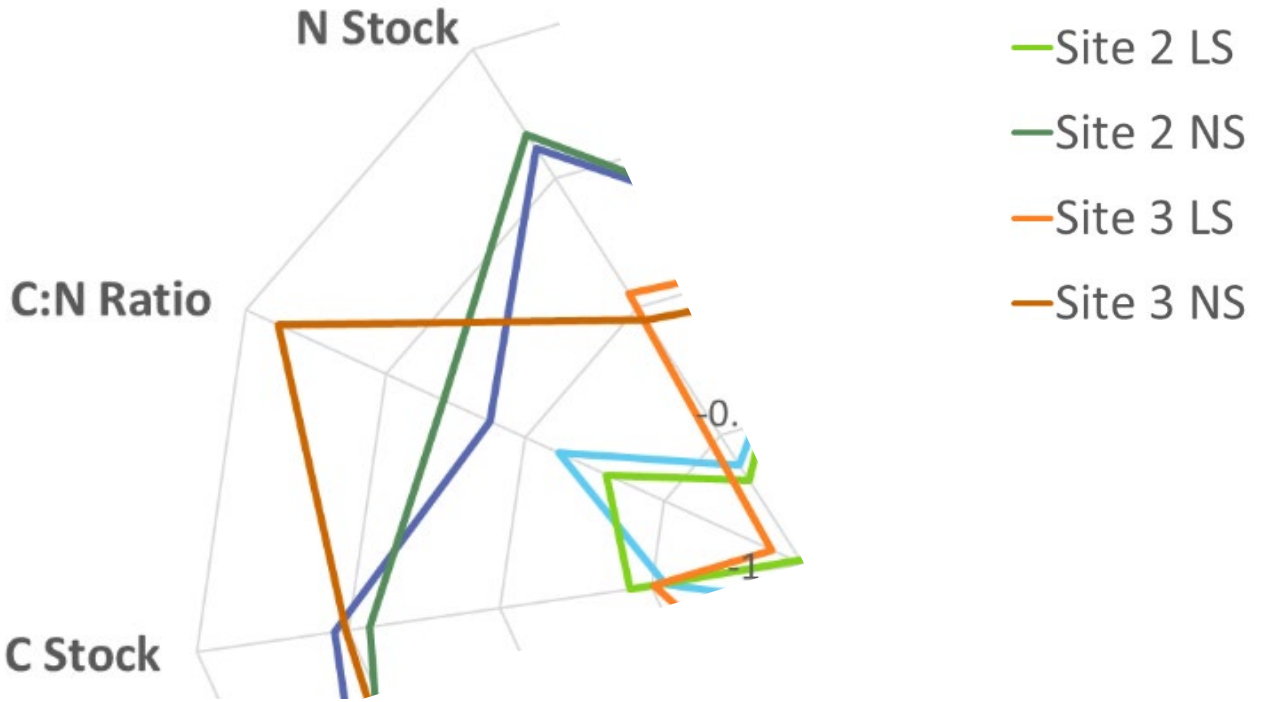
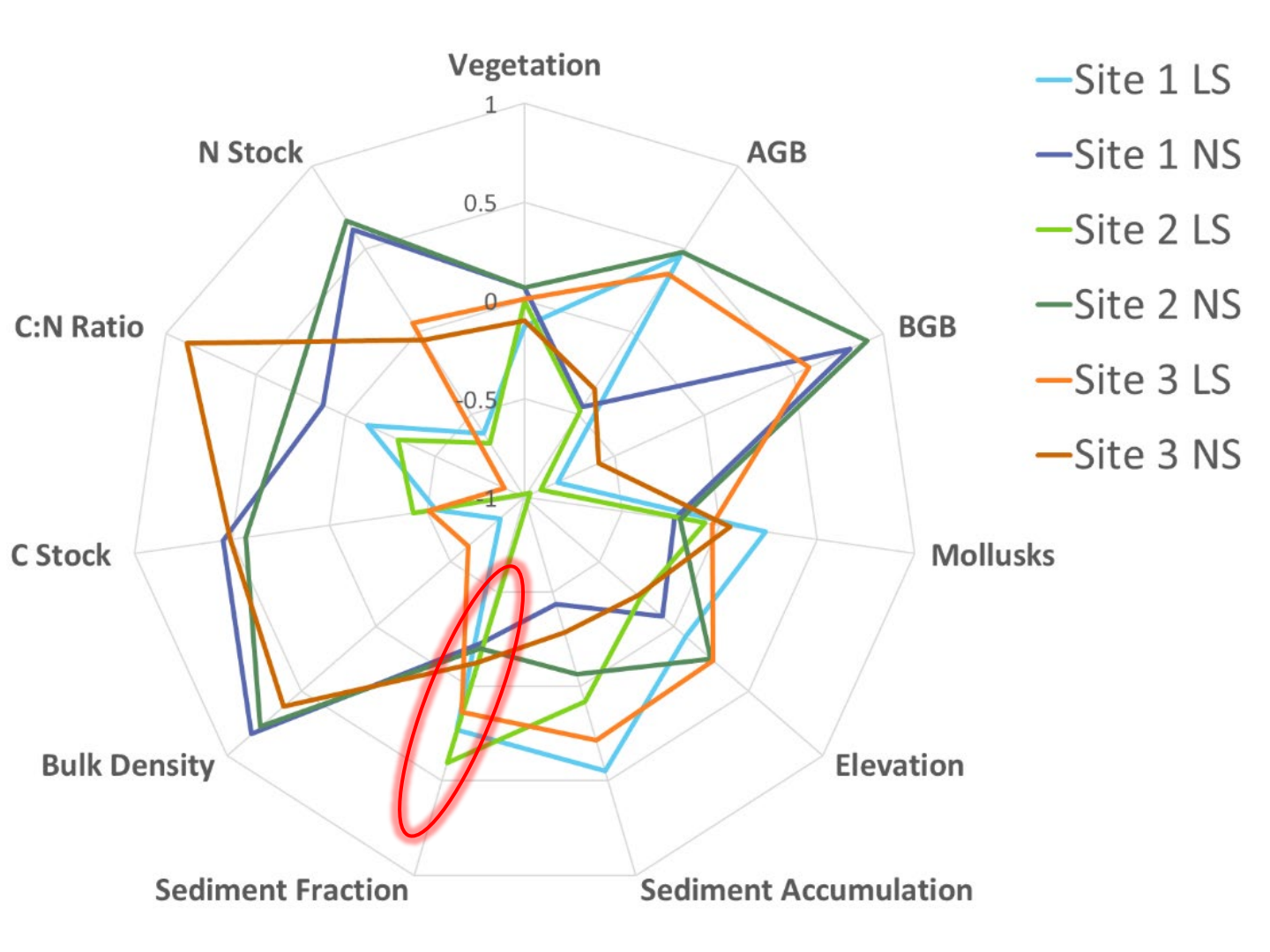

N Stock
C:N Ratio
C Stock
-0.
-1
Site 1 LS
Site 1 NS
Site 2 LS
Site 2 NS
Site 3 LS
Site 3 NS


Vegetation
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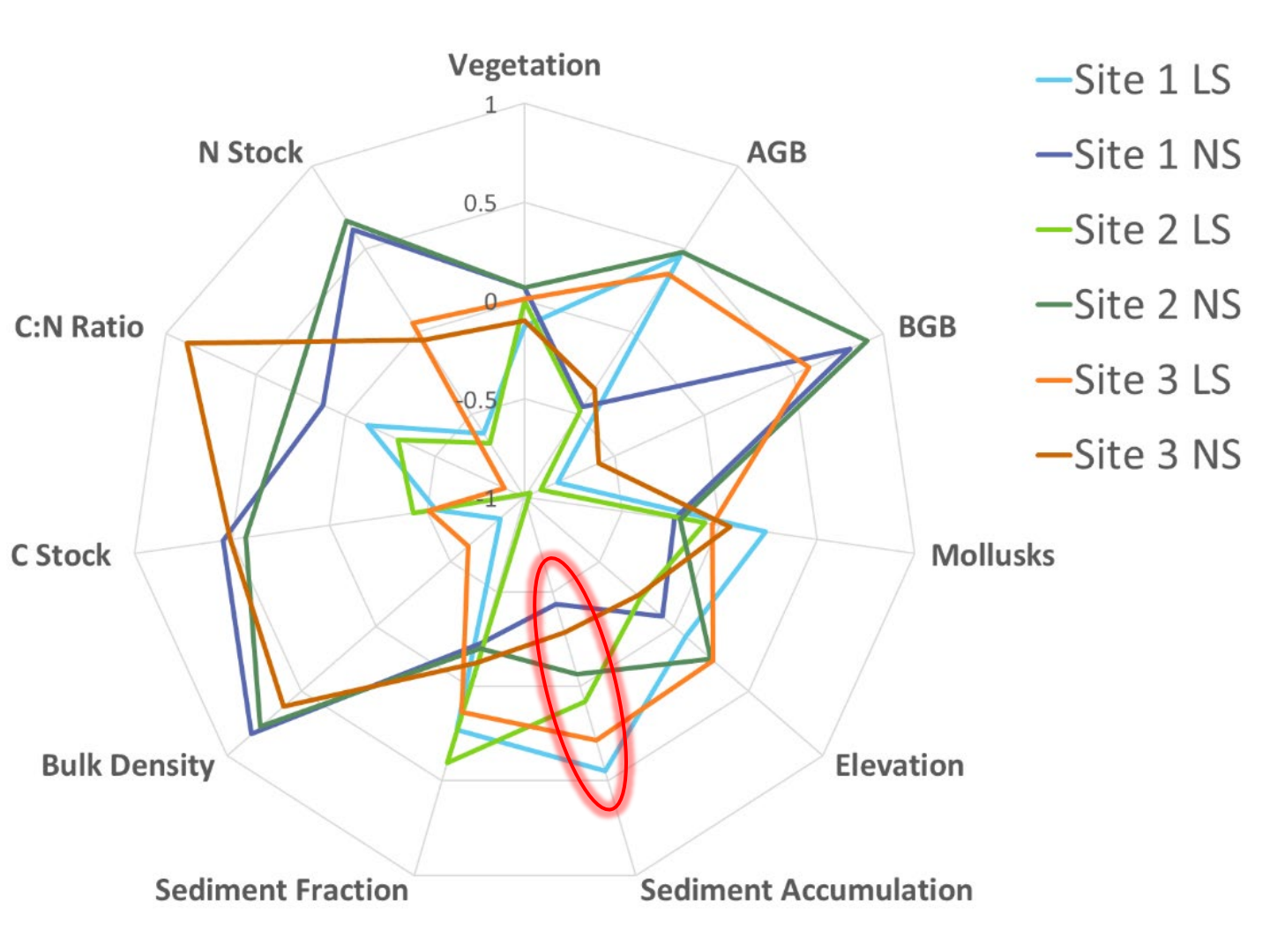
Site 3 NS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0.5
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-1
Site 1 LS
Site 1 NS
Site 2 LS
Site 2 NS
Site 3 LS
Site 3 NS

SUMMARY

Findings suggest **differences in physical functions** with the presence of living shorelines

Biotic functions suggest similar functionality

Take pictures!

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