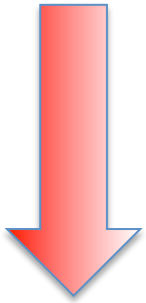
Articulating Nature's Benefits to Improve Decisions

Anne Guerry
Lead Scientist, Natural Capital Project
Northwest BioCarbon Summit, June 2013

people



nature

Food, fuel, fiber

Climate regulation

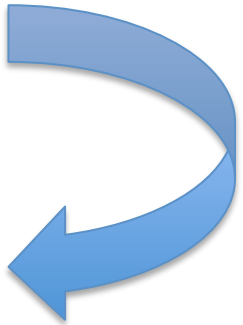
Coastal protection

Clean water

Recreation

people

nature



The Natural Capital Project

natural capital PROJECT

Woods Institute for the Environment Stanford University

WWF Woods Institute for the Environment Stanford University The Nature Conservancy

The Nature Conservancy

Institute on the Environment

University of Minnesota

Driven to Discover℠

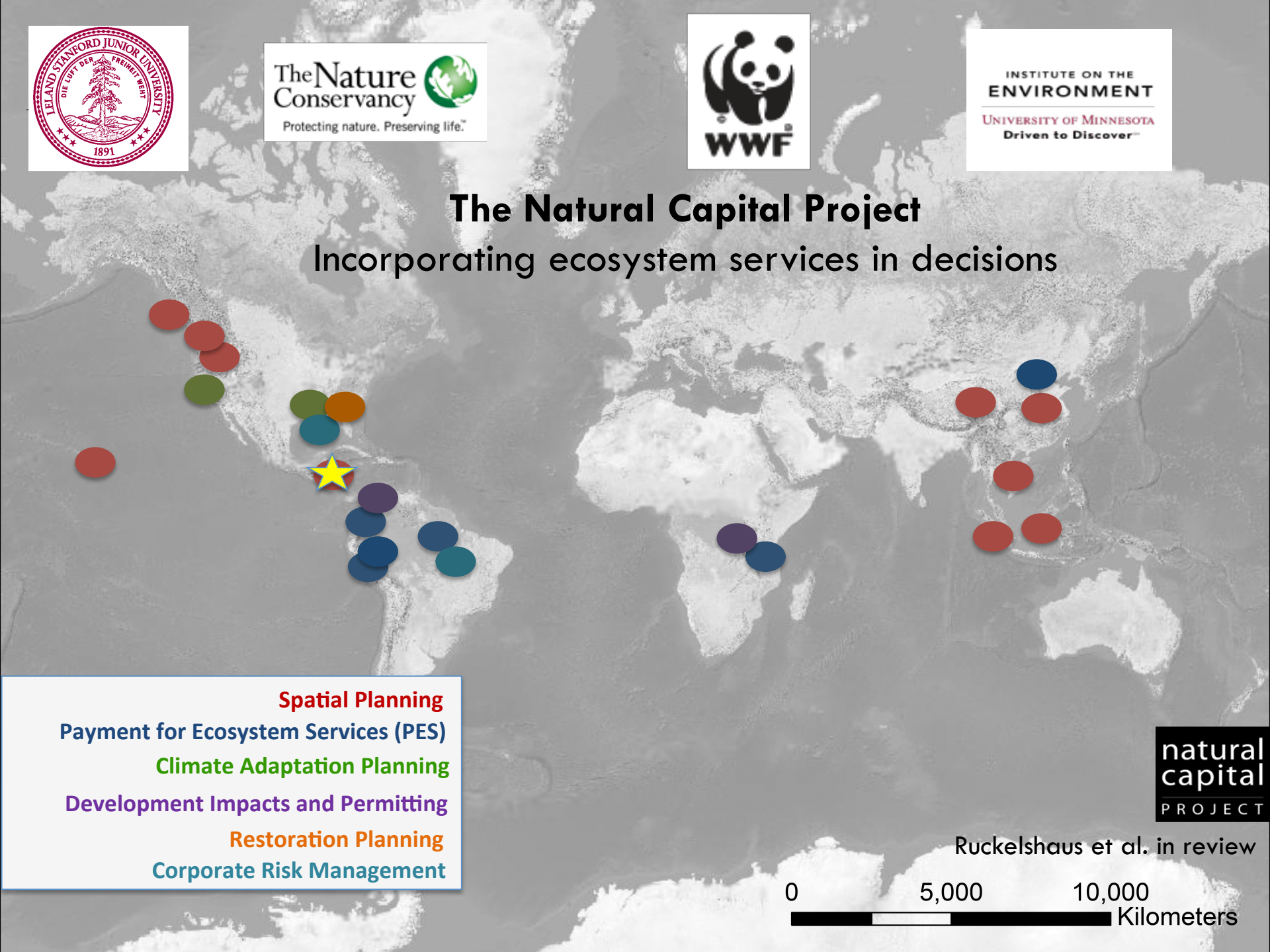
NatCap's mission

- Develop and apply a credible ecosystem service approach to support decision makers with dual development and conservation goals
- Learn what works, train users, and disseminate useful approaches and lessons
- Create an informed community of leaders and practitioners who will enable large-scale policy changes



The Natural Capital Project

Incorporating ecosystem services in decisions



How can we balance sustainable use of the coastal and marine environment for the benefit of Belizeans and the global community?

natural capital PROJECT

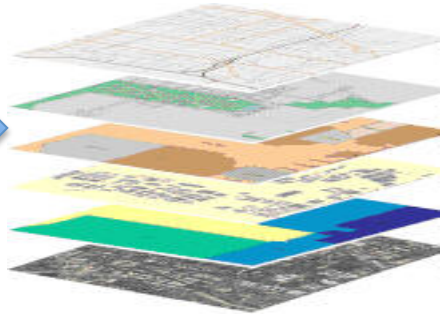
BELIZE COASTAL ZONE MANAGEMENT AUTHORITY & INSTITUTE

1

Define Partnerships, Roles & Objectives

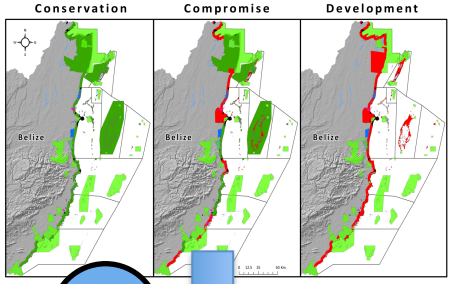
2

Compile Data



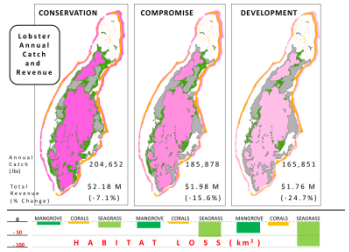
3

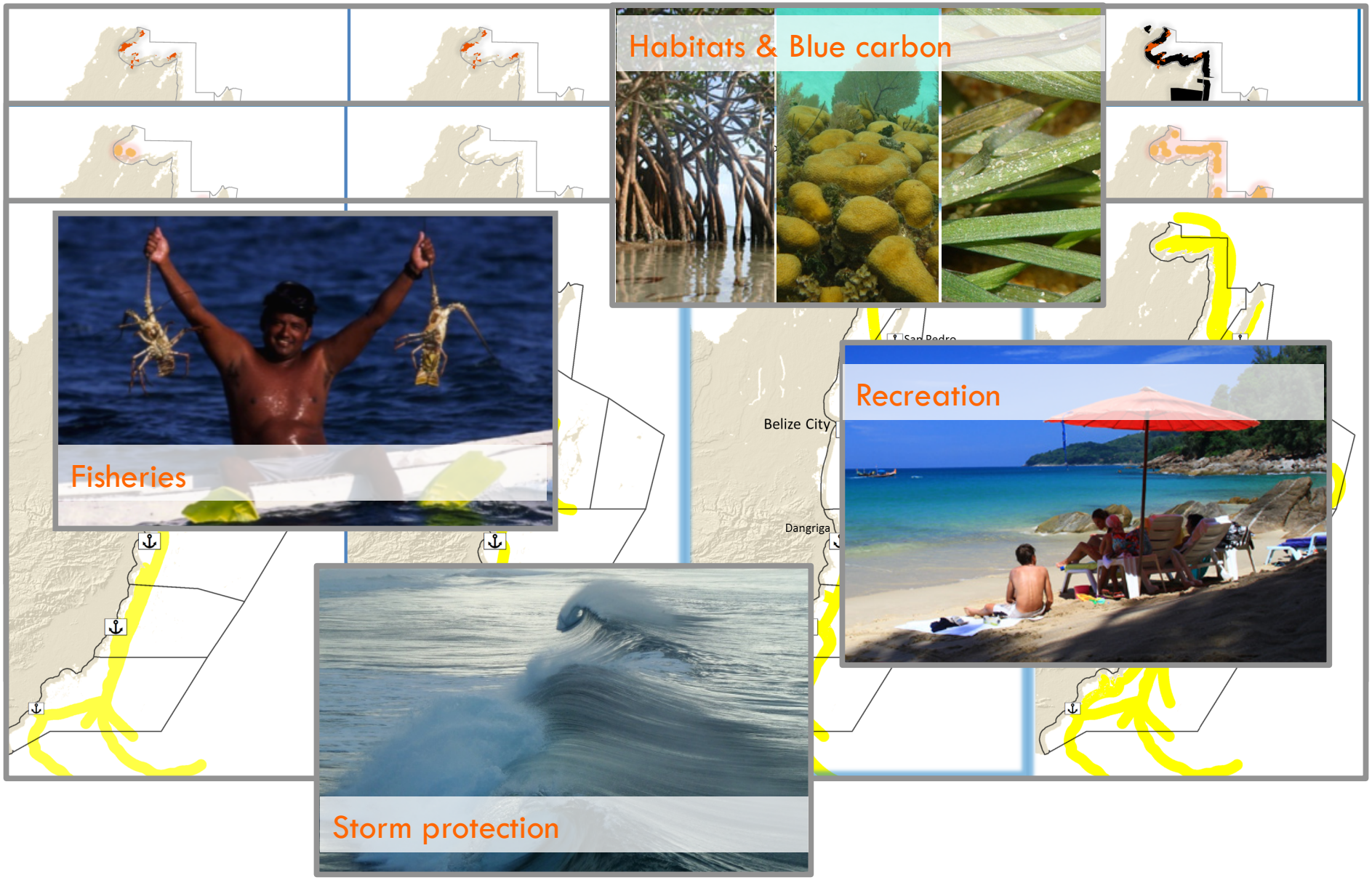
Generate Baseline & Scenarios



4

Assess outcomes




Habitats & Blue carbon
Fisheries
Recreation
Storm protection
Belize City
Dangriga

InVEST

Accounting for nature's benefits

Free. Open source.

www.naturalcapitalproject.org

natural capital PROJECT


THE
WHAT IF
MACHINE
F(a-)
$f_x = \frac{f(x_0 + 1) - f(x_0 - 1)}{2}$
$f_y = \frac{f(y_0 + 1) - f(y_0 - 1)}{2}$
$f_{xx} = \frac{f(x_0 - 1) - 2f(x_0) + f(x_0 + 1)}{4}$

Changes in ecosystem → Changes in ecosystem services and their values



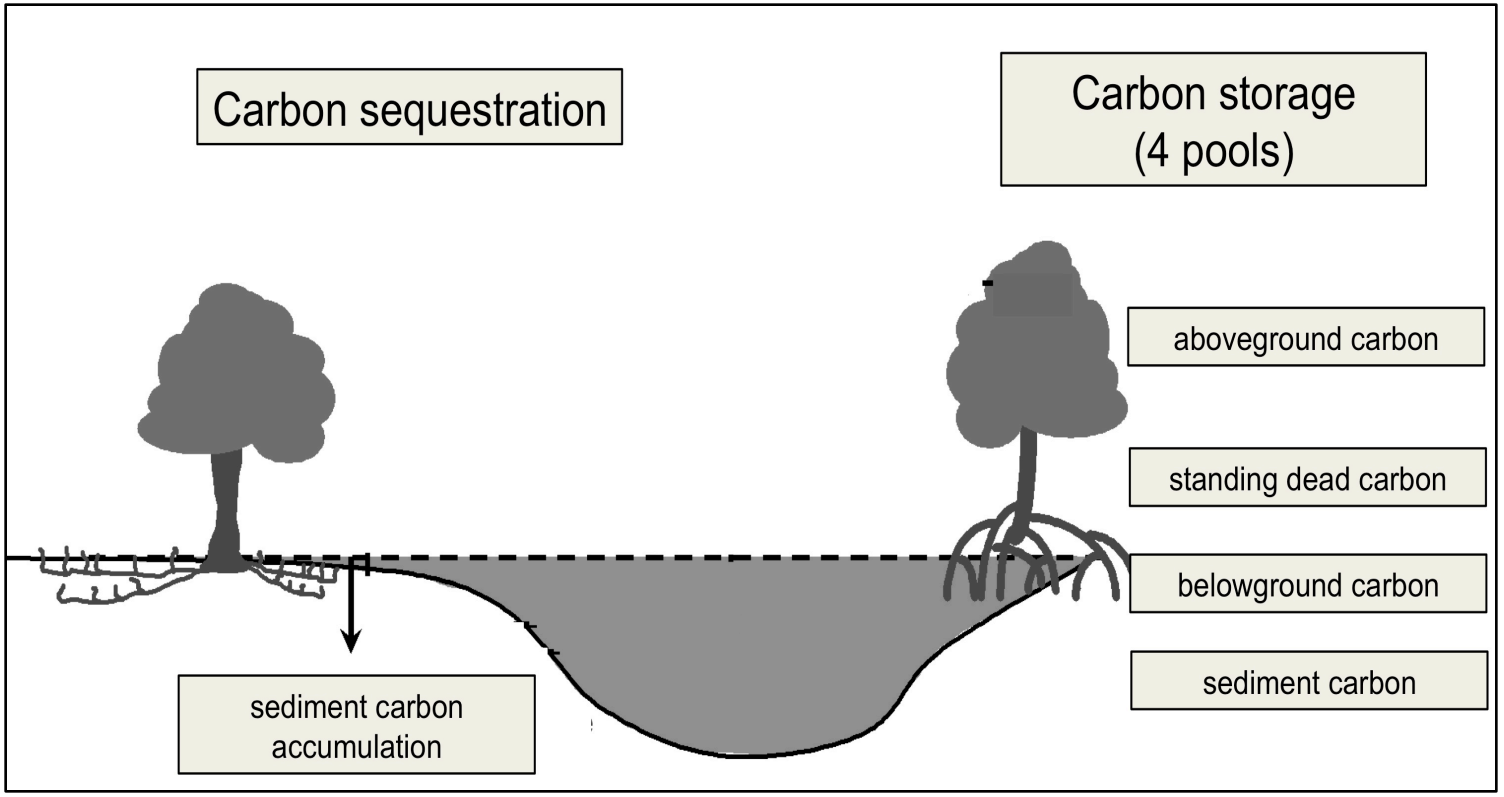

How might coastal development affect
Erosion/flooding from storm events?


How might coastal development affect
Erosion/flooding from storm events?
Coastal and marine recreation?
Nursery habitat for key species?
Fisheries?
Carbon storage and sequestration?

InVEST
integrated valuation of environmental services and tradeoffs

Blue Carbon model

natural capital PROJECT



Estimates:

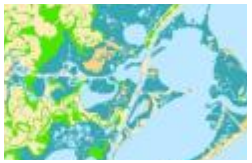
- **How much carbon is stored** in coastal vegetation and sediments
- **Carbon accumulation** in the sediments
- **Economic value (social or market)** of storage and sequestration

Blue Carbon Model

InVEST
integrated valuation of environmental services and tradeoffs

Inputs

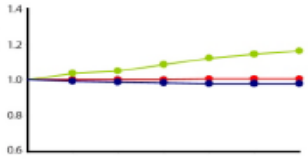
Biophysical



Maps of coastal/marine vegetation

Storage in 4 carbon 'pools'

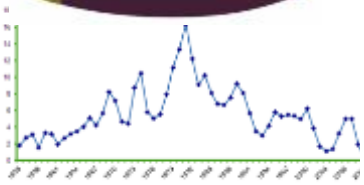
- Aboveground biomass
- Belowground biomass
- Sediments
- Dead organic matter



Rate of carbon accumulation in sediments

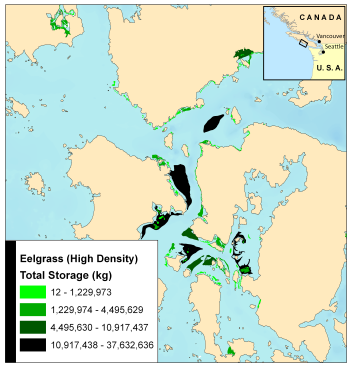
Economic *(optional)*

Market or social value



Annual rate of change and discount rate

Outputs



Carbon storage (Mg C/ha)

Carbon sequestration (Mg C/ha/yr)

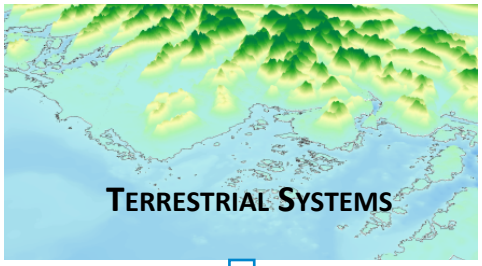
Value of carbon storage and sequestration

Input Data (reflect scenarios)

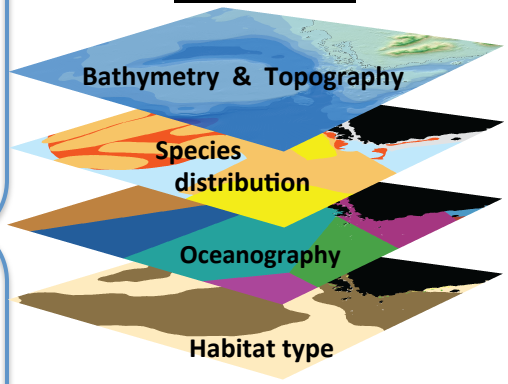
Marine InVEST Models

Model Outputs (ecosystem services & values)

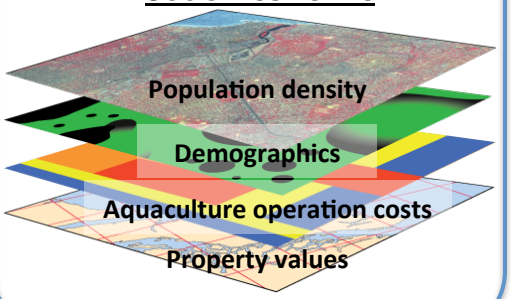
SCENARIOS

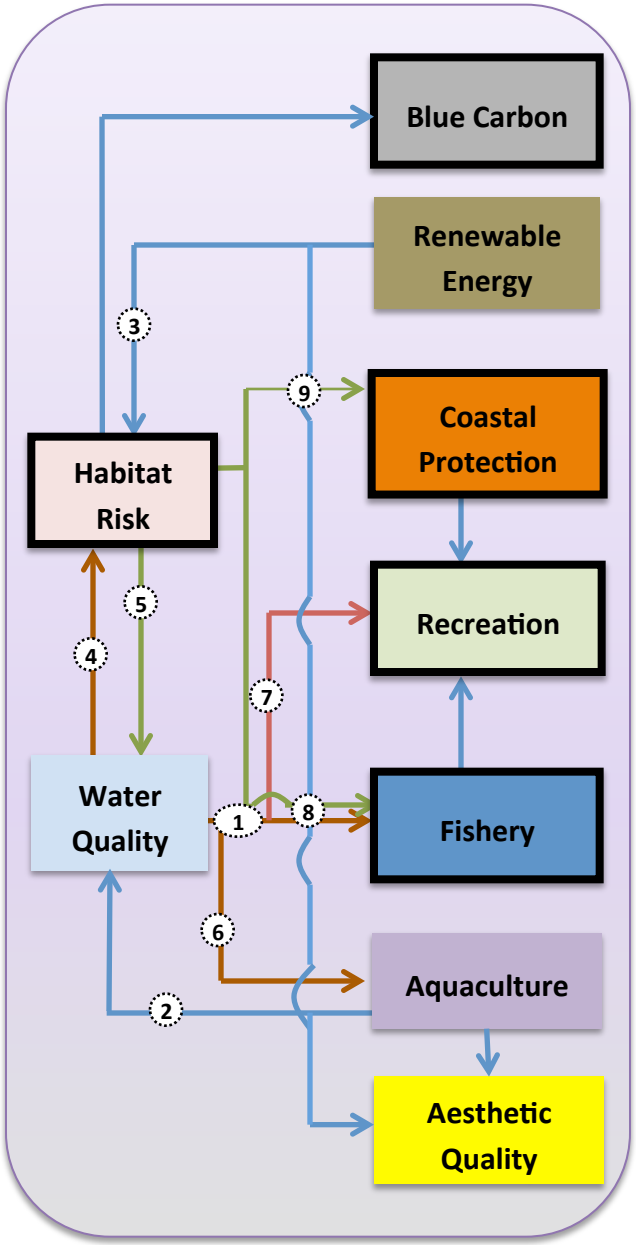


BIO-PHYSICAL



SOCIO-ECONOMIC

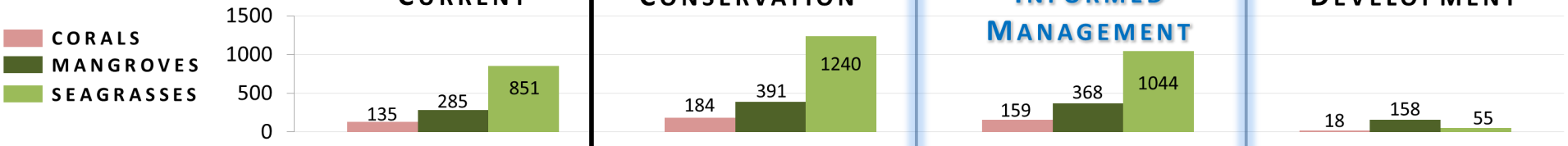




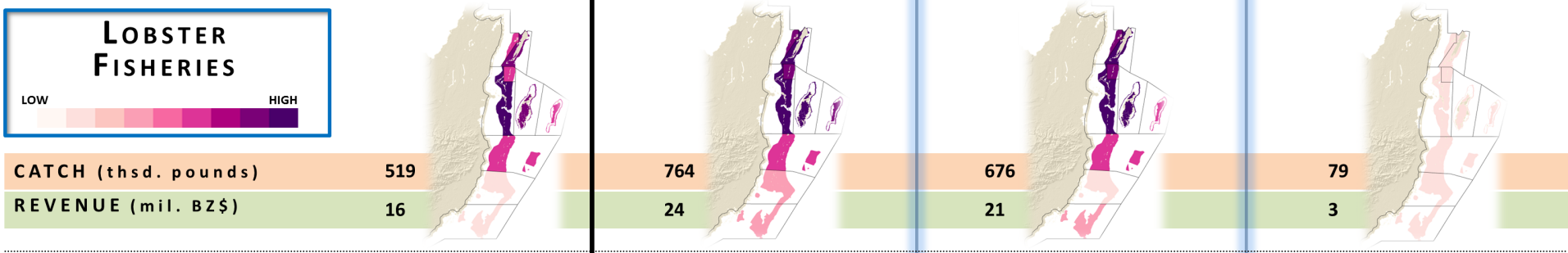
ECOSYSTEM SERVICES	VALUATION e.g.
Carbon Sequestered	*Value of carbon sequestered*
Energy Captured	*Value of captured wave energy*
Avoided Area Flooded/ Eroded	*Value of avoided damages*
Visitation Rates	*Expenditures due to recreation activity*
Landed Biomass	*Net present value of finfish and shellfish*
Harvested Biomass	

Guerry et al 2012

Functional Habitat (km²)

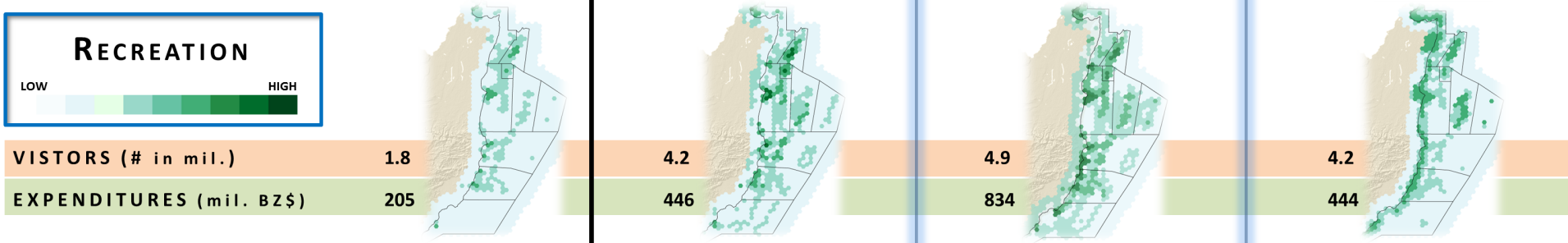


Lobster Fisheries



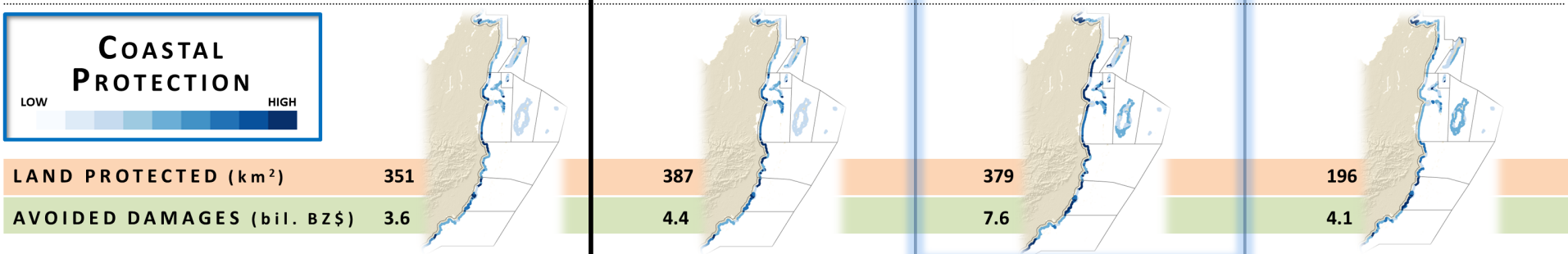
	2010 Current	2025 Conservation	2025 Informed Management	2025 Development
CATCH (thsd. pounds)	519	764	676	79
REVENUE (mil. BZ$)	16	24	21	3

Recreation



	2010 Current	2025 Conservation	2025 Informed Management	2025 Development
VISTORS (# in mil.)	1.8	4.2	4.9	4.2
EXPENDITURES (mil. BZ$)	205	446	834	444

Coastal Protection



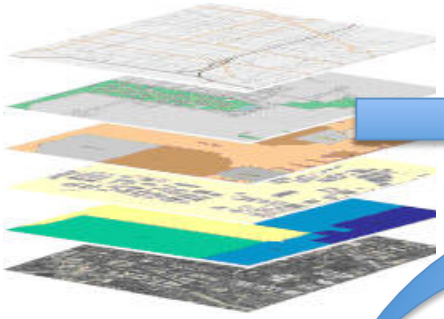
	2010 Current	2025 Conservation	2025 Informed Management	2025 Development
LAND PROTECTED (km²)	351	387	379	196
AVOIDED DAMAGES (bil. BZ$)	3.6	4.4	7.6	4.1

1

Define Partnerships, Roles & Objectives

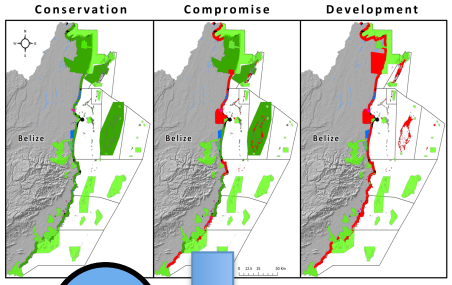
2

Compile Data



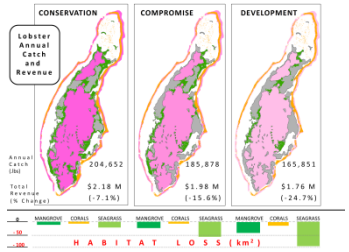
3

Generate Baseline & Scenarios



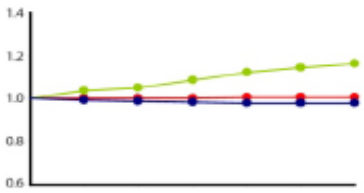
4

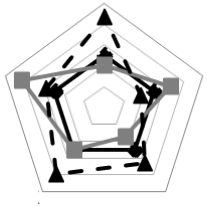
Assess Outcomes

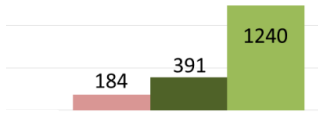


5

Synthesize Results





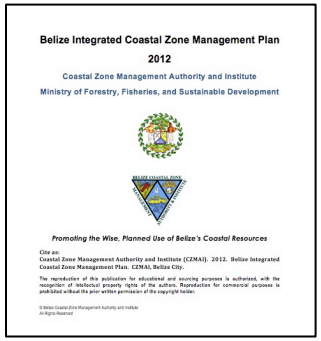


6

Iterate & Build Capacity

7

Inform Decisions



Belize Integrated Coastal Zone Management Plan

2012

Coastal Zone Management Authority and Institute

Ministry of Forestry, Fisheries, and Sustainable Development

Promoting the Wise, Planned Use of Belize's Coastal Resources

Cite as:
Coastal Zone Management Authority and Institute (CZMAI). 2012. Belize Integrated Coastal Zone Management Plan. CZMAI, Belize City.

The reproduction of this publication for educational and sourcing purposes is authorized, with the recognition of intellectual property rights of the authors. Reproduction for commercial purposes is prohibited without the prior written permission of the copyright holder.

© Belize Coastal Zone Management Authority and Institute
All Rights Reserved

Belize Integrated Coastal Zone Management Plan

2012

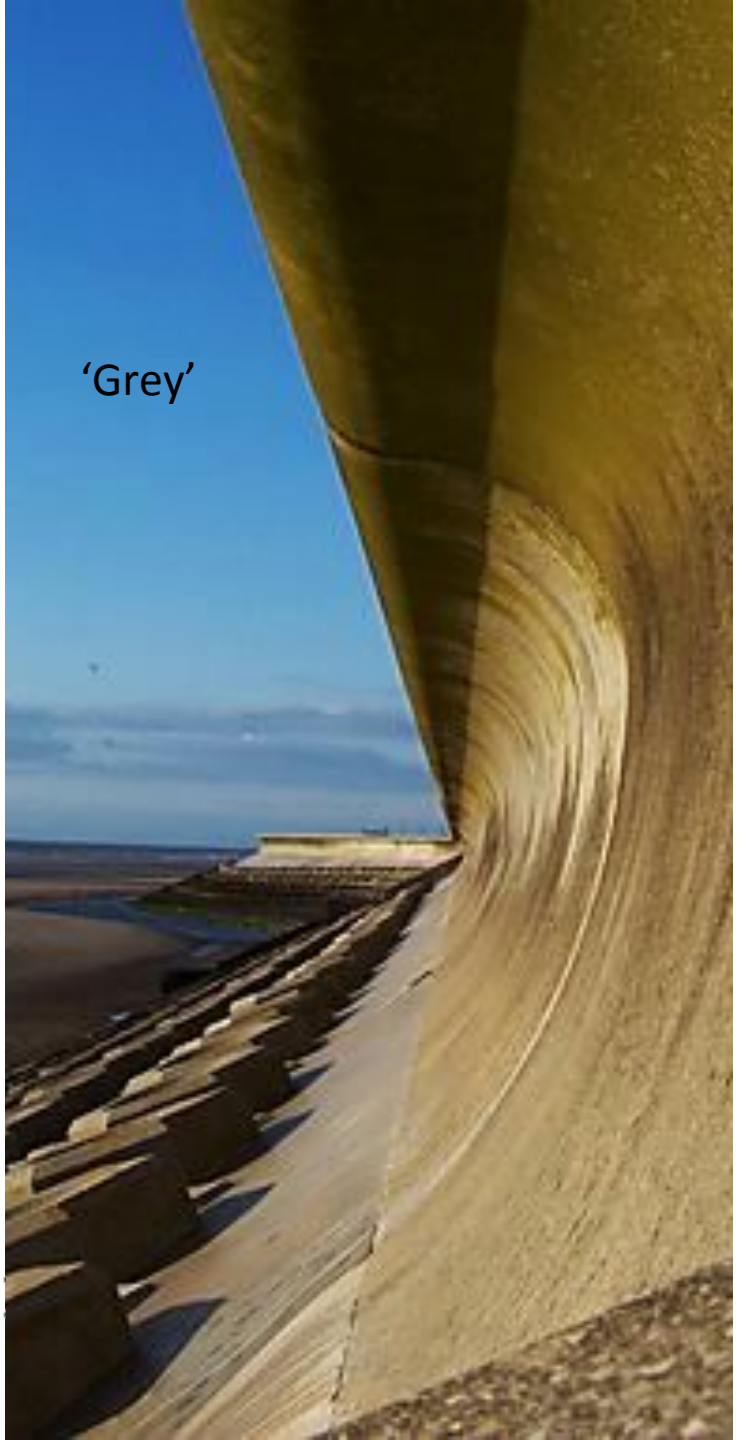
Coastal Zone Management Authority and Institute

Ministry of Forestry, Fisheries, and Sustainable Development

Promoting the Wise, Planned Use of Belize's Coastal Resources

Cite as:
Coastal Zone Management Authority and Institute (CZMAI). 2012. Belize Integrated Coastal Zone Management Plan. CZMAI, Belize City.

What are the costs and benefits of alternative climate adaptation options?



- Value suite of services
- Scenarios for climate change and adaptation options

IDB

Integrated

- Protection of coastal mangroves and littoral forest
- Some restoration of mangroves
- Establishment of MPAs
- Strategic construction of sea walls to avoid undeveloped and conservation areas and beaches that are used for tourism

Reactive

- Construction of sea walls along all coastlines with development
- Some protection of mangroves and littoral forest

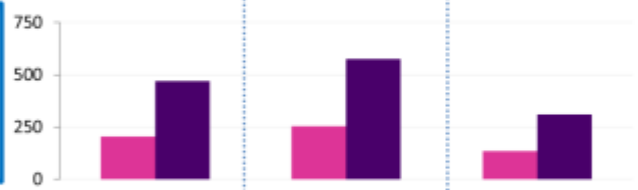
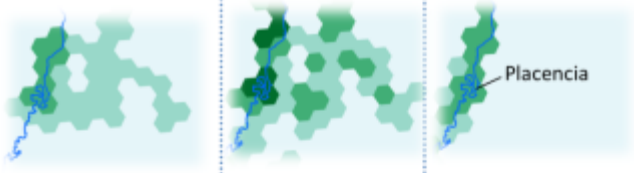
ECOSYSTEM SERVICES & VALUES

SOUTH-CENTRAL PLANNING REGION

natural capital PROJECT

ANNUAL RETURNS (2025 – 2100)

Adaptation >> Scenarios

	NO ACTION	INTEGRATED	REACTIVE
LOBSTER FISHERIES (LOW – HIGH)			
Climate Scenarios >>	INACTION	MITIGATION	
CATCH (thsd. pounds)	19, 44	24, 54	3, 6
REVENUE (thsd. BZ$)	205, 470	253, 576	135, 310
RECREATION (LOW – HIGH)			
VISTOR DAYS (# in thsd.)	441	549	368
EXPENDITURES (mil. BZ$)	47	94	39
CARBON SEQUESTRATION (LOW – HIGH)			
CARBON SEQ. (mil. tons)	3.9	4.1	3.7
VALUE (thsd. BZ$)	-	141	-786

Integrated

- Protection of coastal mangroves and littoral forest
- Some restoration of mangroves
- Establishment of MPAs
- Strategic construction of sea walls to avoid undeveloped and conservation areas and beaches that are used for tourism

$275M greater net benefit

Reactive

- Construction of sea walls along all coastlines with development
- Some protection of mangroves and littoral forest

1) Articulating multiple benefits of natural systems informs planning and improves outcomes for people and the environment
2) Accessible tools and capacity building are critical for scaling up these approaches

Mary Ruckelshaus, Steve Polasky, Gretchen Daily, Peter Kareiva, Taylor Ricketts, Jon Foley, Heather Tallis, Anne Guerry, Becky Chaplin-Kramer, Rich Sharp, Emily McKenzie, Liz Rauer, Brian Robinson, Gail Kaiser, Guy Ziv, Stacie Wolny, Jodie Toft, Katie Arkema, Greg Guannel, Gregg Verutes, Spencer Wood, CK Kim, Joey Bernhardt, James Douglass, Martin Lacayo-Emery, Derric Pennington, Amy Rosenthal, Yonas Ghile, Rob Griffin, Suzanne Langridge, Lula G-Michael, Nasser Olwero, Doug Denu, Nirmal Bhagabati, Bonnie Keeler, Mike Anderson, Kris Johnson, Peter Hawthorne, Shan Ma, Jess Silver, Adrian Vogl, Joe Faries.

Support from:

Gordon and Betty Moore Foundation, David and Lucile Packard Foundation, Rockefeller Foundation, Summit Foundation, MacArthur Foundation, Google/Tides Foundation

NOAA, NSF, DoD, EPA

Private Individuals

TNC, WWF, Stanford, UMN

www.naturalcapitalproject.org

Conceptual Diagram

Scenario example:

No Manage		High Green
t1	2006	
t2	2025	
	2050	
	2075	t1
	2100	t2

Carbon stock over time

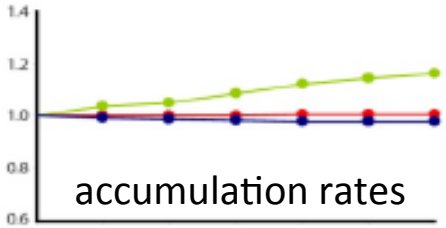
t1 → t2

aboveground biomass

standing and belowground

sediments

growth curves?



Blue Carbon Global Lit Review

natural capital PROJECT

Vegetation included:

- salt marsh
- mangrove
- seagrasses

Values included:

- aboveground biomass
- soil storage in top meter
- sediment accumulation rate
- depth of organic sediments

Location	General Location	Latitude	Longitude	Tonnes CO2e/ha/yr	Study	Year	Citation	Original Article if Cited in Review
Tijuana Slough, Calif.	California	32.50	-117.10	12.58	Chmura et al.	2003	Chmura, G. L., S. C. Anisfeld,	Cahoon et al 1996
Tijuana Slough, Calif.	California	32.60	-117.10	1.58	Chmura et al.	2003	Chmura, G. L., S. C. Anisfeld,	Cahoon unpublished data 1993
Alviso, San Francisco Bay, Calif.	California	37.50	-122.00	14.12	Chmura et al.	2003	Chmura, G. L., S. C. Anisfeld,	Patrick and DeLaune 1990
Bird Island, San Francisco Bay, Calif.	California	37.60	-122.20	1.98	Chmu			90
Ballona Wetlands Los Angeles		33.97	-118.44	1.43	Brevik an			
St. Annaland, Netherlands	Europe	51.50	4.10	10.16	Chmu			
St. Annaland, Netherlands	Europe	51.50	4.10	5.10	Chmu			
Scheldt, Netherlands	Europe	51.50	4.10	21.53	Chmu			988
Scheldt, Netherlands	Europe	51.50	4.10	23.84	Chmu			988
Netherlands	Europe	52.32	4.20	35.09	Cebri			
Netherlands	Europe	52.32	4.20	68.57	Cebri			
Netherlands	Europe	52.32	4.20	56.25	Cebri			
St Marks Florida	Florida	30.06	84.15	2.15	Choi a			
St. Marks, Fla.	Florida	30.10	-84.20	1.61	Chmu			ed data