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Developing a Coastal Health Index for the Northern Gulf of Mexico

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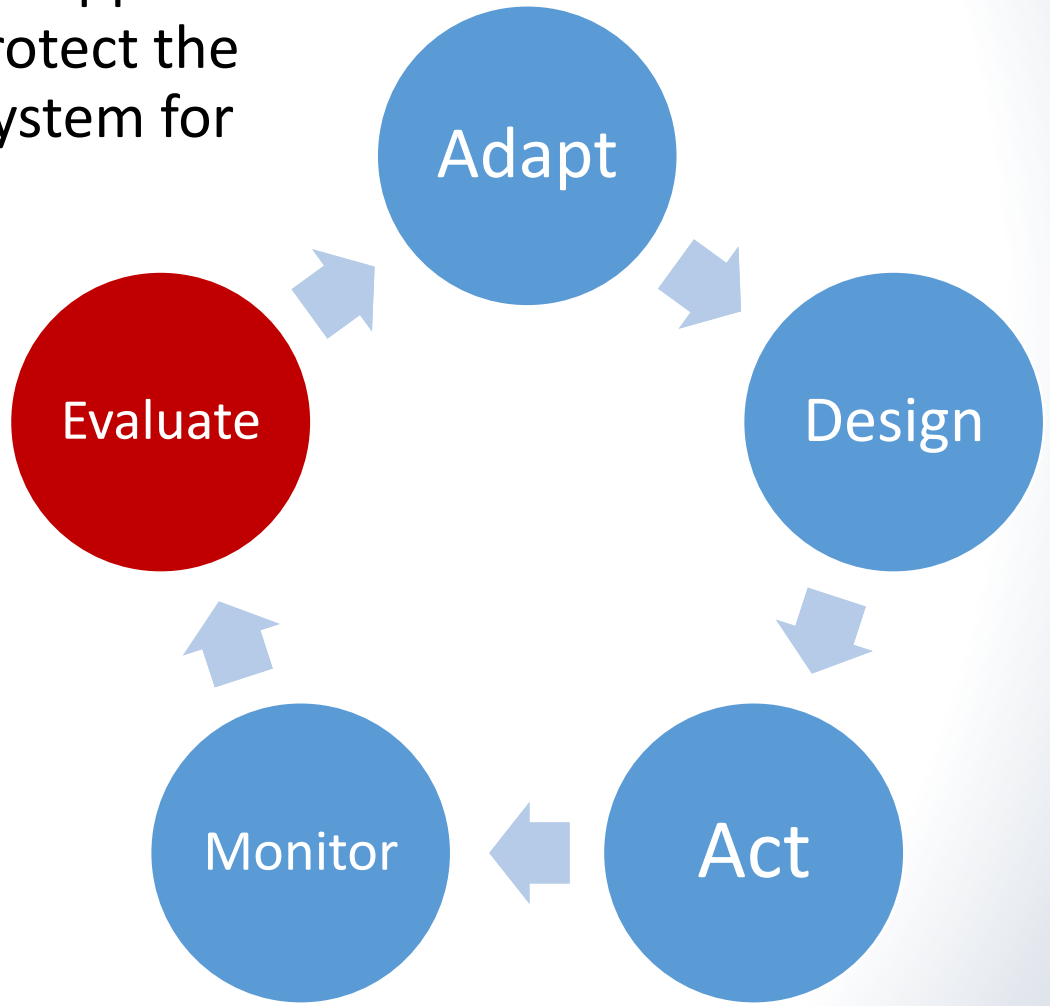
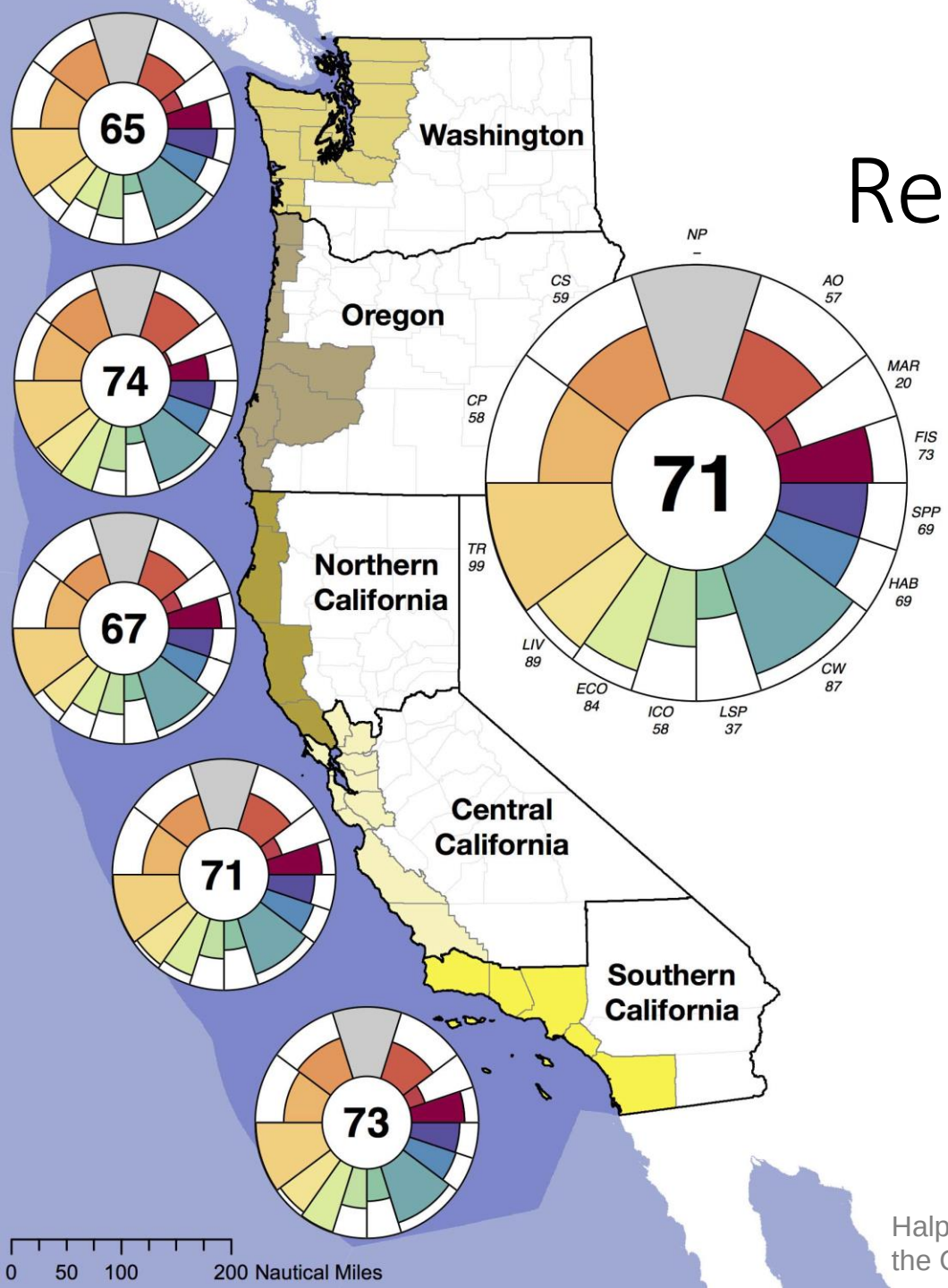
NMC: March 27, 2019

Background

- <u>Ecosystem Based Management:</u> site specific approach to natural resource management that aims to protect the health, function and resilience of an entire ecosystem for the benefit of all organisms.

- Integrate Metrics:
  - Biological
  - Chemical
  - Remotely Sensed
  - Economic
  - Societal





Regional Ocean Health Indices

- Ecosystem-based management
  - Raise public awareness
  - Identify knowledge gaps
  - Prioritize management & research

Halpern BS,, et al. (2014) Assessing the Health of the U.S. West Coast with a Regional-Scale Application of the Ocean Health Index. PLoS ONE 9(6): e98995. doi:10.1371/journal.pone.0098995

Variables	Sub-Variables	Definition
Food Provision (FP)	Fisheries (FIS)	Harvest of sustainabily caught seafood
	Aquaculture (AQA)	Production of sustainably-cultured aquatic food
Artisanal Fishing (AO)		Opportunity to engage in artisanal-scale fishing for subsistence
Natural Products (NP)		Sustainable harvest of renewable natural products other than food provision
Carbon Storage (CS)		Potential of natural habitats to afford long-lasting carbon storage
Coastal Protection (CP)		Status of natural habitats affording protection from storms
Tourism and Recreation (TR)		Economic stability of recreation and tourism supported by a healthy coast
Coastal Livelihoods and Economies (LE)	Coastal livelihoods (LIV)	Jobs and wages from marine-related sectors
	Coastal economies (ECO)	Revenues and Establishments from marine-related sectors
Sense of Place (SP)	Lasting Special Places (LSP)	Cultural or aesthetic connection to the environment afforded by protected places
	Iconic Species (ICO)	Cultural or aesthetic connection to the environment afforded by iconic species
Clean Waters (CW)		Clean waters that meet basic aquatic life use standards
Biodiversity (BD)	Biodiversity of Habitats (HAB)	The existence of biodiversity afforded by the conservation status of habitats
	Biodiversity of Species (SPP)	The existence of biodiversity afforded by the conservation status of coastal species

$$CHI = a_1V_1 + a_2V_2 + \cdots + a_{10}V_{10}$$

Study Area

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Defining ecologically, geographically, and politically coherent boundaries for the Northern Gulf of Mexico coastal region: Facilitating ecosystem-based management

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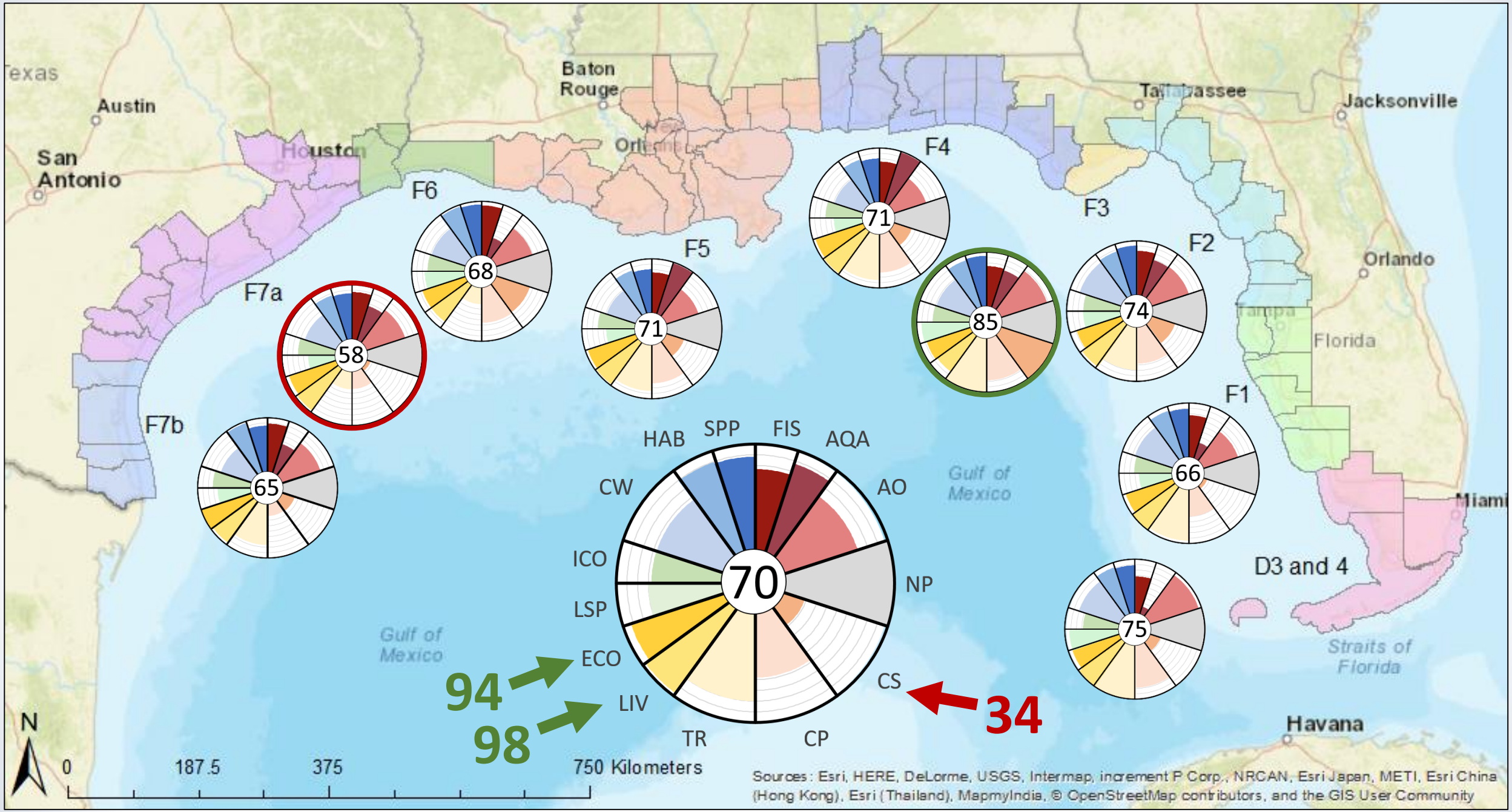

Texas
Austin
San Antonio
Houston
Baton Rouge
Orlando
Tampa
Florida
Jacksonville
Miami
Havana
Gulf of Mexico
Straits of Florida
F1
F2
F3
F4
F5
F6
F7a
F7b
D3 and 4
HAB
SPP
FIS
AQA
AO
NP
CS
CP
TR
LIV
ECO
LSP
ICO
CW
70
71
68
71
85
74
58
65
66
75
94
98
34
N
0
187.5
375
750 Kilometers
Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

CHI Results

Variable	Sub-Variable	Region								
		GOM	F7b	F7a	F6	F5	F4	F3	F2	F1	D3and4
Food Provision (FP)	Fisheries (FIS)	76.5	88.7	86.6	**92.4**	74.7	84.1	74.1	81.1	77.2	**67.9**
	Aquaculture (AQA)	87.5	55.2	65.7	35.3	**98.1**	24.3	71.4	68.8	29.3	**13.6**
Artisanal Fishing (AO)		70.6	72.9	73.5	68.9	**60.9**	80.7	87.8	70.2	65.7	**93.1**
Natural Products (NP)		--	--	--	--	--	--	--	--	--	--
Carbon Storage (CS)		18.0	23.1	6.2	64.0	32.9	26.9	**100.0**	43.8	**5.6**	18.8
Coastal Protection (CP)		58.1	**22.1**	32.3	65.8	71.2	49.7	78.1	67.3	49.9	**78.5**
Tourism and Recreation (TR)		80.2	75.8	33.1	**31.1**	85.4	95.2	**100.0**	79.3	94.9	**100.0**
Coastal Livelihoods and Economies (LE)	Coastal livelihoods (LIV)	96.9	95.4	96.3	85.8	97.5	99.3	**83.6**	96.8	99.3	**99.6**
	Coastal economies (ECO)	92.3	**99.9**	92.8	**85.6**	95.1	97.3	87.1	88.5	93.4	93.7
Sense of Place (SP)	Lasting Special Places (LSP)	70.1	62.8	**51.6**	75.6	54.8	56.2	91.0	70.9	62.7	**93.2**
	Iconic Species (ICO)	67.1	**71.8**	70.4	70.5	70.0	70.0	70.0	70.0	71.7	**67.7**
Clean Waters (CW)		67.1	**61.4**	62.1	68.0	58.0	**82.8**	67.9	82.7	75.1	80.6
Biodiversity (BD)	Biodiversity of Habitats (HAB)	89.5	96.4	86.5	**96.7**	**84.3**	84.8	91.2	86.7	91.7	91.5
	Biodiversity of Species (SPP)	88.2	85.1	84.3	**94.3**	80.6	**83.7**	93.2	90.9	89.2	88.7
Coastal Health Index (CHI)		**69.8**	**64.8**	**58.2**	**68.4**	**70.7**	**70.6**	**85.0**	**74.5**	**66.5**	**75.4**

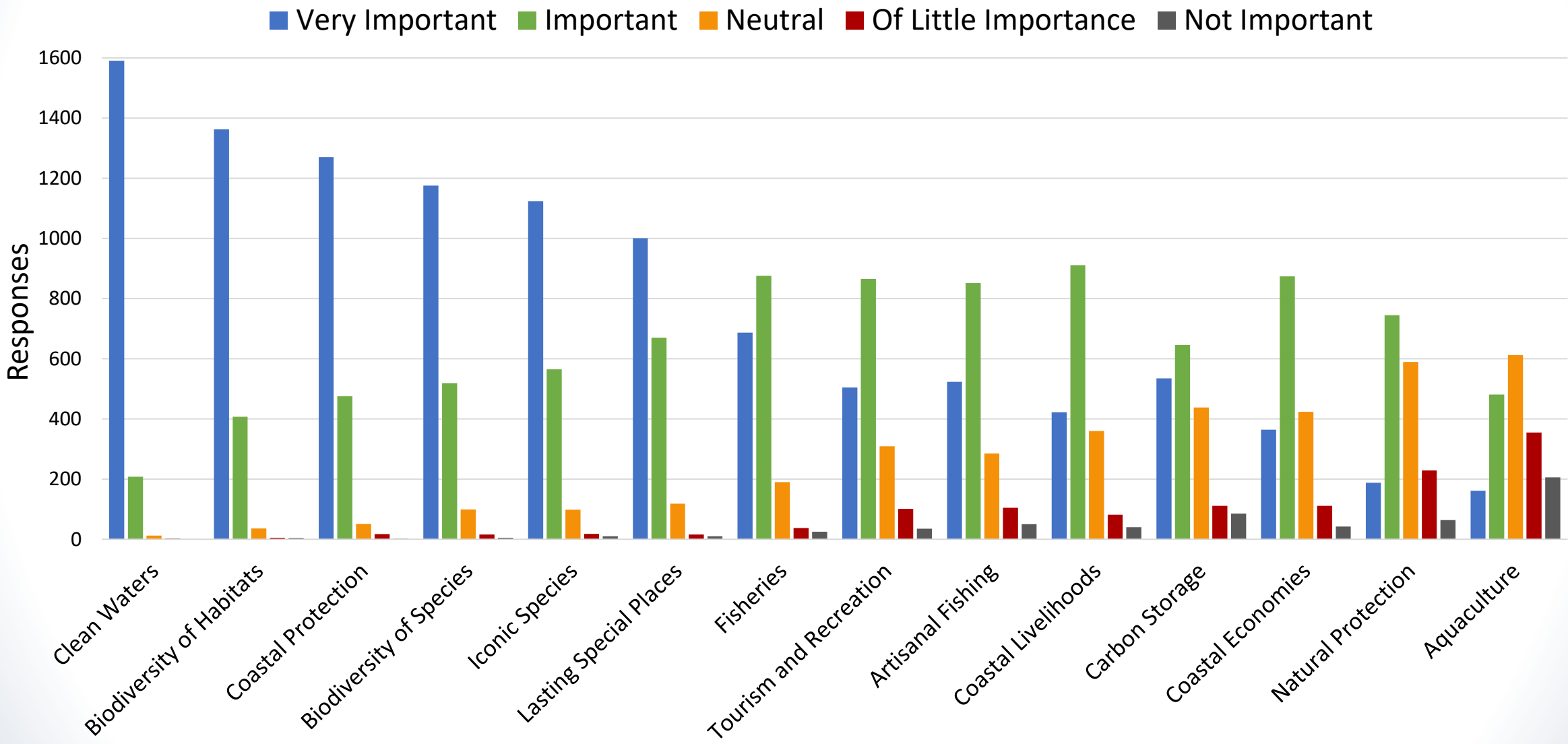
Stakeholder Survey

- Social Media
- Targeted E-mail
- Survey
  - Value importance when determining if a coastal ecosystem is healthy
    - Likert Scale
  - Differentially weight model

Do you live, work, or vacation along the Texas Gulf Coast? Please take a short survey on the health of your coast.
https://www.surveymonkey.com/r/TexasGulfCoast

Stakeholder Survey

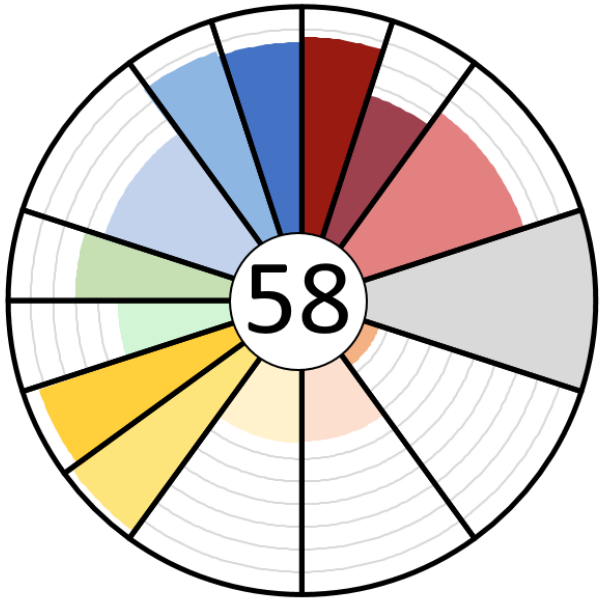
- 2,265 responses = 1,815 complete

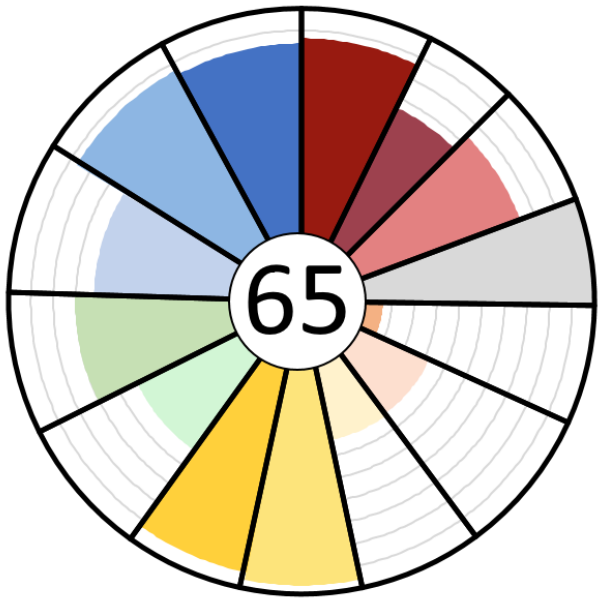


Original Model

Differentially Weighted

F7a





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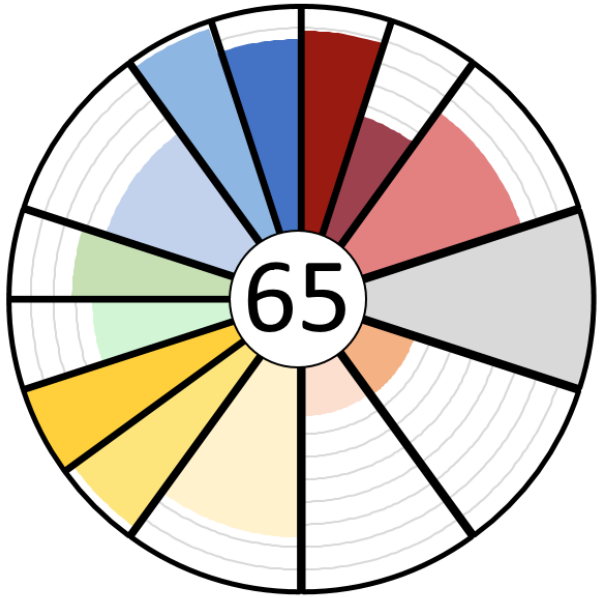

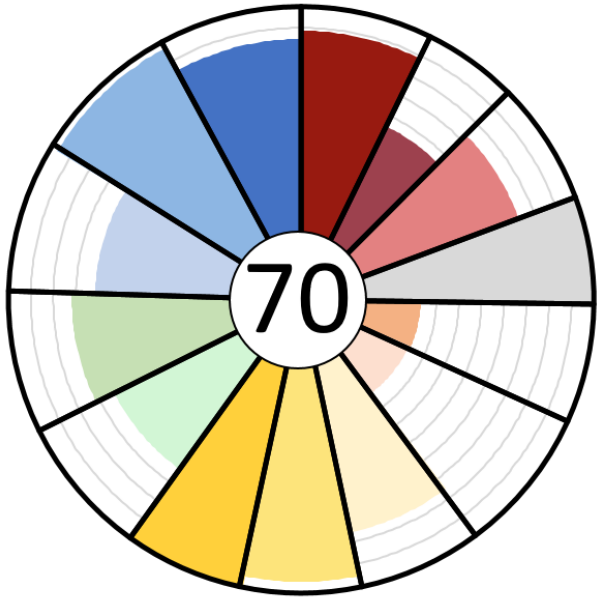

Sub-Variables
Fisheries
Aquaculture
Artisanal Fishing
Natural Products
Carbon Storage
Coastal Protection
Tourism and Recreation
Coastal livelihoods
Coastal economies
Lasting Special Places
Iconic Species
Clean Waters
Biodiversity of Habitats
Biodiversity of Species

Summary of Findings & Other Results

- Heterogeneous health measured by CHI across the Northern GOM.
- Some regions are more stressed than others
  - Research/management focus areas
- Some declining trends in scores through time
- Stakeholders value variables differentially
  - CHI weighted using stakeholder values = higher score
  - Stakeholders demographics significantly influence their perception of variable importance.

Acknowledgements

- Data Sources and Data Managers
  - NOAA (C-CAP, ENOW)
  - EPA (NCCA)
  - State Resource Agencies (TPWD, LDWF, MDWFP, ADCNR, FWC)
  - USDA (NASS)
  - USGS (PAD)
  - Nature Serve
  - Jones and Kammen (2014)
  - US Department of Labor (BLS)
  - IUCN
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  - Texas A&M University, Wildlife and Fishery Science
  - University of Houston-Clear Lake, and EIH
  - Texas Chapter of the American Fisheries Society

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Sub-Variables	Data Source(s)	Data Used
Fisheries	Gulf States Fishery Management Agencies	Annual commercial catch (in lbs/year) per species
Aquaculture	USDA Agriculture Census	Annual aquaculture produced (in lbs/year) by type
Artisanal Fishing	NOAA, Public access fishing site register; U.S. Census, SAIPE; EPA, NCCA	Designated access points and if they charge an access fee; Number of people in poverty; Wild-caught seafood contaminants
Natural Products	Not applicable	Insufficient data/products available for analysis
Carbon Storage	NOAA Coastal Change Analysis Program (CCAP); Jones and Kammen 2012; Literature Review	Aerial cover by habitat type; Total carbon footprint (tCO2e/yr); Carbon storage potential by habitat type (gC/m2/yr)
Coastal Protection	NOAA, CCAP	% cover of wetland habitats compared to wetland potential
Tourism and Recreation	NOAA, Economics National Ocean Watch	Tourism and Recreation sector of total ocean economy; Total coastal economy
Coastal Livelihoods	NOAA, Economics National Ocean Watch	Total ocean economy; Total economy
Coastal Economies	NOAA, Economics National Ocean Watch	Total ocean economy; Total economy
Lasting Special Places	NOAA,CCAP; USGS, Protected Area Database.	Coverage by natural habitat type; Coverage of protected land and level of protection
Iconic Species	IUCN	Number and conservation status of iconic species
Clean Waters	EPA, NCCA	Nutrients, Chlorophyll-a, Dissolved Oxygen, Water Clarity
Biodiversity of Habitats	NOAA, CCAP; USGS, Protected Area Database.	Coverage by natural habitat type; Coverage of protected land and level of protection
Biodiversity of Species	IUCN; NatureServe	Conservation status by species