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Data Descriptor

Multi-Attribute Ecological and Socioeconomic Geodatabase for the Gulf of Mexico Coastal Region of the United States

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Abstract: Strategic, data driven conservation approaches are increasing in popularity as conservation communities gain access to better science, more computing power, and more data. High resolution geospatial data, indicating ecosystem functions and economic activity, can be very useful for any conservation expert or funding agency. A framework was developed for a data driven conservation prioritization tool and a data visualization tool. The developed tools were then implemented and tested for the U.S. Gulf of Mexico coastal region defined by the Gulf Coast Ecosystem Restoration Council. As a part of this tool development, priority attributes and data measures were developed for the region through 13 stakeholder charrettes with local, state, federal, and other non-profit organizations involved in land conservation. This paper presents the measures that were developed to reflect stakeholder priorities. These measures were derived from openly available geospatial and non-geospatial data sources. This database contained 19 measures, aggregated into a one km^2 hexagonal grid and grouped by the overarching goals of habitat, water quality and quantity, living coastal and marine resources, community resilience, and economy. The developed measures provided useful data for a conservation planning framework in the U.S. Gulf of Mexico coastal region.

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Keywords: land conservation; geodatabase; Gulf of Mexico; conservation planning

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1. Summary

In response to the Deepwater Horizon Oil Spill in 2010, the United States government authorized the Resources and Ecosystems Sustainability, Tourist Opportunities and Revived Economies of the Gulf Coast States Act (RESTORE Act) in order to develop and implement a comprehensive strategy for restoration and protection of the Gulf Coast Region (GCR) of the United States. The RESTORE Act established the Gulf Coast Ecosystem Restoration Council (Restore Council), which is responsible for implementing protection and restoration of the GCR as described by their initial comprehensive plan. The Strategic Conservation Assessment of Gulf Coast Landscapes (SCA) Project, funded under the Restore Council's council selected restoration component (Bucket 2), is intended to: (1) collate existing plans and priorities within an ecological and socio-economic framework proposed by the

Restore Council's initial comprehensive plan [1]; (2) develop tools and templates that can evaluate and strengthen existing land conservation proposals; and (3) develop spatial data layers that can be used to identify potential areas for land conservation projects. To accomplish the three objectives, the SCA project is developing a suite of three tools where users can explore a catalog of existing conservation plans and projects across the GCR (Catalog Tool) [1], evaluate and strengthen conservation proposals (Conservation Prioritization Tool), and explore areas within the GCR based on conservation priorities (Conservation Visualization Tool). The SCA tool suite is available to individuals and organizations who are interested in maximizing conservation benefits across the GCR within an environmental, social, and economic context. The backbone of the SCA tool suite is the geospatial database presented in this paper.

This geodatabase of 19 ecological and socioeconomic measures for the Gulf Coast Region of the United States was compiled to assess the ecological and socioeconomic benefits that may be associated with the protection of different landscapes. The measures are aggregated within a single hexagonal grid layer, with a resolution of one km^2. The geodatabase was developed by the SCA project for use in the Conservation Prioritization Tool (CPT) and the Conservation Visualization Tool (CVT). The CPT, currently in beta testing, is an online tool where users can explore and compare ecological and socioeconomic benefits of land conservation actions throughout the Gulf Coast Region (GCR) of the United States. To assess the value of lands being considered for conservation, the CPT uses the geodatabase of 19 measures within a multi-criteria decision analysis framework. The CPT provides the user with summaries of geospatial raw data and utility values that may support conservation actions in identified project areas. The upcoming CVT will use the geodatabase to allow users to visualize where land conservation may achieve conservation objectives throughout the GCR.

2. Data Description

The geodatabase contains five categories of data, reflecting the five goals (Table 1) that the Gulf Coast Ecosystem Restoration (Restore) Council declared in their initial comprehensive plan [2]. The data cover the SCA region of interest, which aligns with the RESTORE Act identified GCR, an area of approximately 700,000 km^2 (Figure 1). The GCR encompasses coastal parts of AL, LA, MS, and TX, and all of FL. This geographic extent was created using the coastal management zone area in the five Gulf states, plus a 40.2 km inland buffer. Each measure, reflected by a dataset within the geodatabase, is described in Table 2. More detailed information about each measure can be found in Appendix A.

Table 1. Goals identified in the Gulf Coast Restoration Council [2]. RESTORE, Resources and Ecosystems Sustainability, Tourist Opportunities and Revived Economies of the Gulf Coast States.

	RESTORE Goal [1]	Definition
1	Restore and Conserve Habitat (HAB)	Restore and conserve the health, diversity, and resilience of key coastal, estuarine, and marine habitats.
2	Restore Water Quality and Quantity (WAQ)	Restore and protect the water quality of the Gulf Coast region's fresh, estuarine, and marine waters.
3	Replenish and Protect Living Coastal and Marine Resources (LCMR)	Restore and protect healthy, diverse, and sustainable living coastal and marine resources.
4	Enhance Community Resilience (CRES)	Build upon and sustain communities with capacity to adapt to short and long term changes.
5	Restore and Revitalize the Gulf Economy (GEC)	Enhance the sustainability and resiliency of the Gulf economy.

[1] In the remainder of the manuscript, RESTORE goals will be referenced by the defined acronyms.

Table 2. Description of each measure, organized by the RESTORE goal that is available for use in the geodatabase.

	RESTORE Goal	Measure [1]	Unit	Data Sources [2]
1	HAB	Threat of Urbanization	Index	SLEUTH (Slope, Land use, Exclusion, Urban extent, Transportation and Hillshade) cellular automaton model 3.0 beta [3–6]
2	HAB	Connectivity to Existing Protected Area	Index	PAD-US 2.0 [7]
3	HAB	Structural Connectivity	Percentage	EsriIntact Habitat Cores [8]
4	HAB	Composition of Natural Lands	Percentage	Gap Analysis Program (GAP) [9]; Florida Cooperative Land Cover (FL CLC) [10]; Texas Ecological Mapping Systems (TX EMS) [11]
5	WAQ	303D: Impaired Watershed Area	Percentage	EPA 303(d) list [12]; NHDPlusV2 [13]
6	WAQ	Hydrologic Response to Land Use Change	Percentage	NLCD 2016 [14]; SSURGO [15]; NHDPlusV2 [13]
7	WAQ	Stream Abundance	Kilometer	NHDPlusV2 [13]
8	LCMR	Biodiversity Index	Index	U.S. protected lands mismatch biodiversity priorities [16]
9	LCMR	T&E Species Area	Percentage	USFWS Threatened and Endangered Species [17]
10	LCMR	T&E Species Counts	Count	USFWS Threatened and Endangered Species [18]
11	LCMR	Light Pollution Index	Index	The New World Atlas of Artificial Night Sky Brightness [19]
12	CRES	National Registry of Historic Places	Count	NPS National Register of Historic Places [20]
13	CRES	National Heritage Area	Percentage	NPS National Heritage Area [21]
14	CRES	Proximity to Socially Vulnerable Communities	Binary	NOAA Social Vulnerability Index [22,23]
15	CRES	Community Threat Index	Index	NFWF Coastal Resilience Evaluation and Siting Tool [24]
16	GEC	Working Lands: High Priority	Percentage	GAP [9]; Florida Cooperative Land Cover (FL CLC) [10]; Texas Ecological Mapping Systems (TX EMS) [11]
17	GEC	Commercial Fishing Reliance	Index	NMFS Social Indicators [25,26]
18	GEC	Recreational Fishing Engagement	Index	NMFS Social Indicators [25,26]
19	GEC	Access and Recreation: Number of Access Points	Count	Florida Fish & Wildlife Conservation Commission [27]; Alabama Dept. of Conservation & Natural Resources [28]; Mississippi Dept. of Marine Resources [29]; Louisiana Dept. of Wildlife & Fisheries [30]; Texas Parks and Wildlife Dept. [31]; PAD-US 2.0 [7]; TIGER/Lines 2019 [32]

[1] Refer to the Appendix A for the definitions of each measure, as well as the steps followed to represent them in a hexagonal grid. [2] Acronyms from the table are defined: SLEUTH, Slope, Land use, Exclusion, Urban extent, Transportation and Hillshade; PAD-US, Protected Areas Database of the United States; Esri, Environmental Systems Research Institute; EPA, Environmental Protection Agency; NHDPlusV2, National Hydrography Dataset Plus Version 2; NLCD, National Land Cover Database; SSURGO, Soil Survey Geographic Database; USFWS, U.S. Fish and Wildlife Service; T&E, threatened and endangered; NOAA, National Oceanic and Atmospheric Administration; NFWF, National Fish and Wildlife Foundation; NMFS, National Marine Fisheries Service; TIGER, Topologically Integrated Geograph Encoding and Referencing.
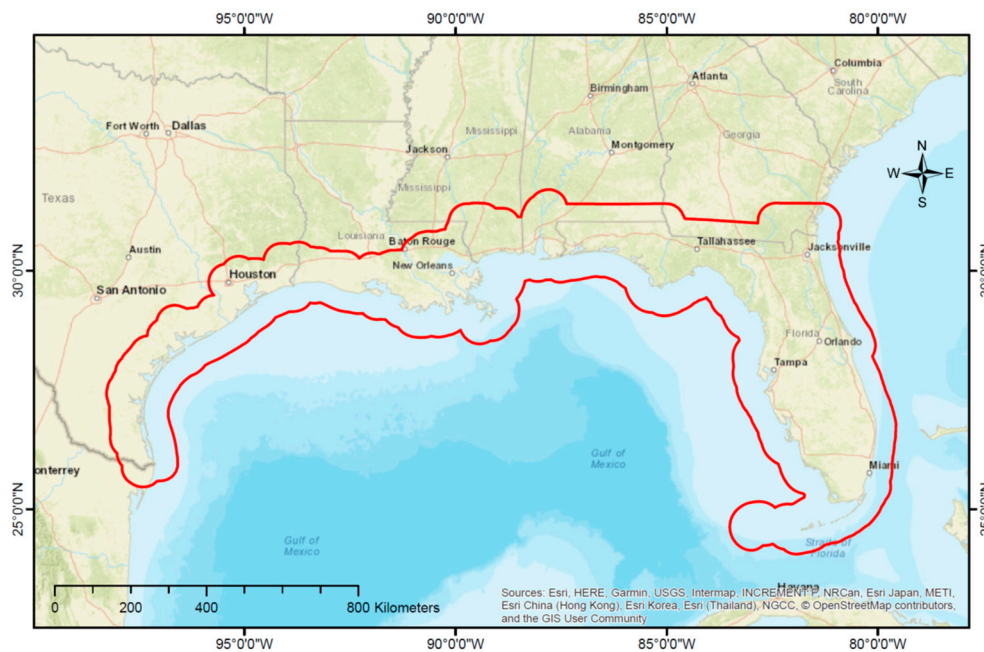
Figure 1. Overview of the Gulf of Mexico Coastal Region (GCR) along the U.S. Gulf of Mexico. The GCR includes the coastal management zone area of all the Gulf Coast states (i.e., Texas, Louisiana, Mississippi, Alabama, and Florida), plus 40.2 km inland of the coast including the barrier islands, as shown in the red outline.

3. Methods

The geodatabase was compiled with 19 measures that were developed either directly from existing datasets or by building datasets from the analysis of GIS data. All measures included in the geodatabase were identified from charrettes that the SCA project held across the GCR from March to May 2018 with land conservation stakeholders, which included representatives from various RESTORE member and partner agencies and organizations that engage in conservation actions. In total, 13 charrettes were conducted within the GCR (Austin, Corpus Christi, and Galveston, Texas; New Orleans, Louisiana; Biloxi, Mississippi; Mobile, Alabama; St. Mark's and St. Petersburg, Florida) where a total of 176 stakeholders were in attendance.

Throughout the charrettes, a total of 46 priority attributes were proposed by the stakeholders that they felt were important to land conservation in the GCR. Priority attributes were defined as key features that more specifically define conservation goals and can be quantified through measures. Stakeholders were asked to define priority attributes for land conservation within the framework of the five RESTORE goals (Table 1) and to suggest ways to measure each priority along with relevant sources of data. Stakeholders then ranked each attribute to indicate their priority for land conservation (highest to lowest). In total, a list of 260 tentative measures was developed from stakeholder identified priority attributes. Suitable data sources for each measure were then located by consultation of experts in geospatial analysis and large scale conservation planning. For a measure to be included in the database, it had to have Gulf-wide data availability and had to have relevance to land conservation. Following expert consultation and data exploration, the SCA project approved 19 measures for inclusion in the database. Data were then derived for measures from the openly available geospatial and non-geospatial data sources listed in Table 2.

Each measure was then processed to a 1 km^2 hexagonal grid using ArcGIS and the leaflet package within program R [33–35]. A total of seven distinct methods was used to process the data into measures, depending on the data type from the source (i.e., raster or vector) and the type of measure being created (i.e., index, binary, percentage, count, length). See Section 3.2 for more information regarding data processing.

3.1. Hexagon Grid

Characterizing and comparing heterogeneous data types on the fly across a large geographic scale such as the SCA region required subdividing the region into finer and relatively homogenous sub-regions. Through subdividing, the variations in the data were minimal and the subdivision was relatively easy for interpretation and processing. In the literature, this process of subdividing is often referred to as zone mapping [36]. Zone mapping can be achieved by either using some criteria such as natural delineations (example: watershed, land cover), geopolitical delineations (example: county, city), or by using a fixed grid system. The method of subdividing geospatial data with a fixed grid system has unique advantages over other methods especially when it comes to undertaking any decision analysis as it coarsely represents the underlying data without the complexities of data size.

In this work, the SCA region (Figure 1) was partitioned into an equal area hexagonal grid (side length of 0.61 km and area of 1 km^2 see Figure 2). Hexagonal grids are preferred over other geometrical shapes (e.g., square or triangle) because they are characterized by elements that do not have gaps or overlaps and the center-to-center distances between neighboring cells are almost equal [36]. Furthermore, hexagonal cells have a topology that is symmetric, invariant, and of equal area and can be recursively partitioned into smaller divisions of grids if or when required to represent higher resolution data types.
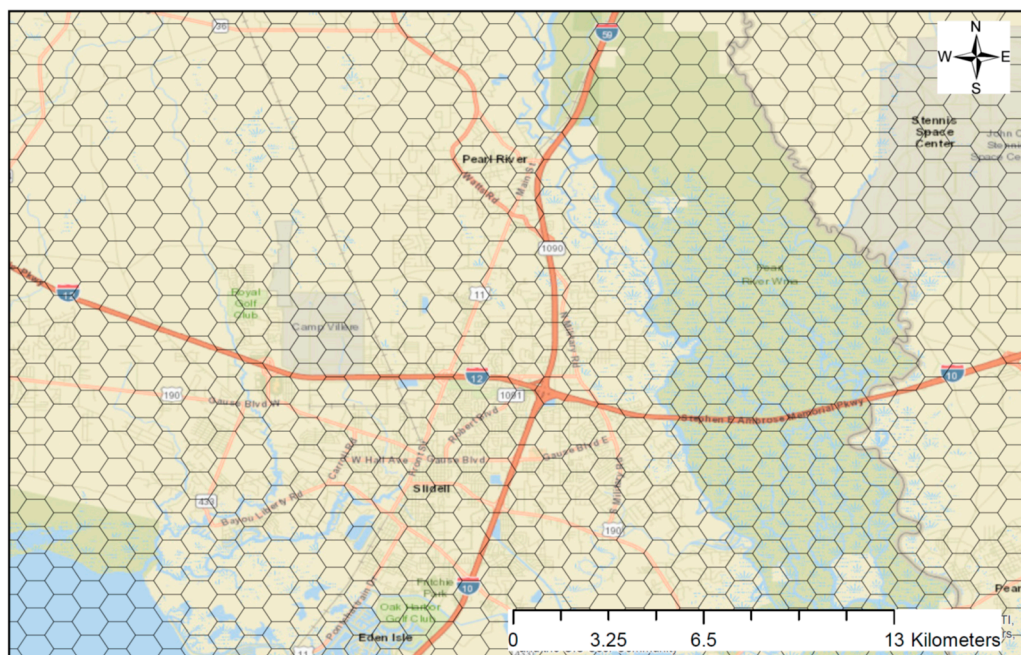
Figure 2. Snapshot of the 1 km^2 hexagonal grid overlaid on a base map showing parts of coastal Mississippi and Louisiana.

The geodatabase was included within the hexagonal grid as an Esri Shapefile that stored nontopological geometry and attribute information for the spatial features in the dataset. An ESRI shapefile consists of a main file (.shp), an index file (.shx), a dBASE table (.dbf), a projection file (.prj), and a metadata file (.xml) that is compliant with the Federal Geographic Data Committee [37]. These data can be read in commercial GIS tools such as ArcMap and open source programs such as QGIS, R, and Python. The Esri Shapefile can also be converted into other file formats such as GeoJSON using open source tools.

3.2. Data Processing Workflow

The methods used to process each measure were dependent on the type of source data (i.e., vector or raster) and the type of measure unit (i.e., index, binary, percentage area, count, or length). See Table 3 for a more detailed summary of the source data type and measure unit type for each of the 19 measures. Figures 3 and 4 provide a visualization of the general workflow used to produce measures from vector and raster source data, respectively. Appendix A provides more detailed steps for how we produced each measure.

Table 3. Summary of source data type and measure unit type for each measure.

| Source Data Type	Measure Type	Measure
Vector to Measure	Index (0–1)	Commercial fishing reliance
		Recreational fishing engagement
	Binary (0/1)	Connectivity to existing protected area
		Proximity to socially vulnerable communities
	Percentage Area (%)	303(d) impaired watershed area
		Hydrologic response to land use change
		T&E species area
		National heritage area
	Count (#)	T&E species count
		National register of historic places
		Access and recreation
	Length (km)	Stream abundance
Raster to Measure	Index (0–1)	Threat of urbanization
		Biodiversity index
		Light pollution index
		Community threat index
	Percentage Area (%)	Structural connectivity
		Composition of natural lands
		High priority working lands
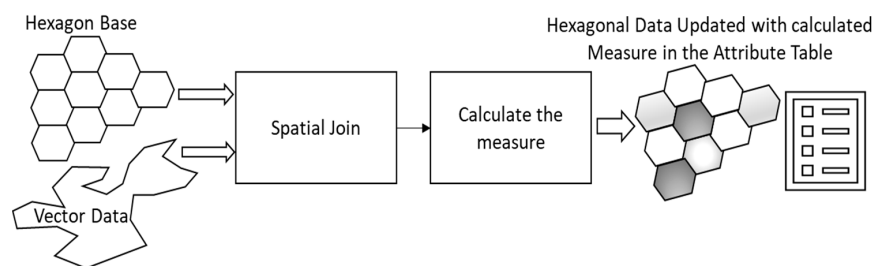
**Figure 3.** Visual aid of the steps involved to convert vector source data into a measure.
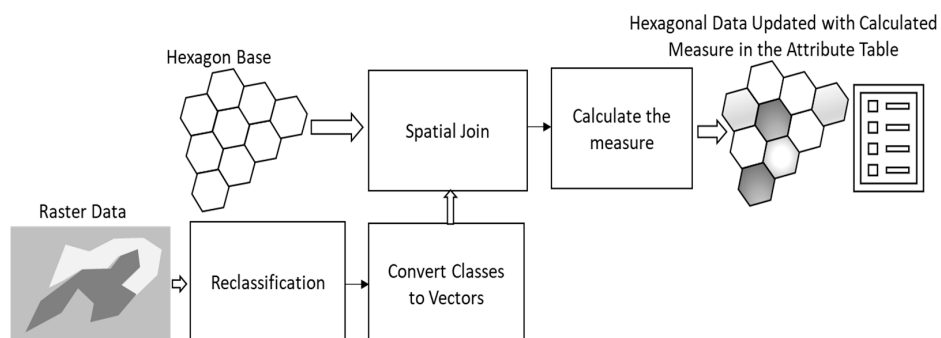
Figure 4. Visual aid of the steps involved to convert raster source data into a measure.

3.3. Data Overview

Figure 5a–e illustrate the five different types of data measures in preprocessed states (i.e., index, binary, percentage area, count, and length) that are present within the database. Figure 6a,b illustrate the two types of source data (i.e., vector and raster) that were utilized in processing the database measures.
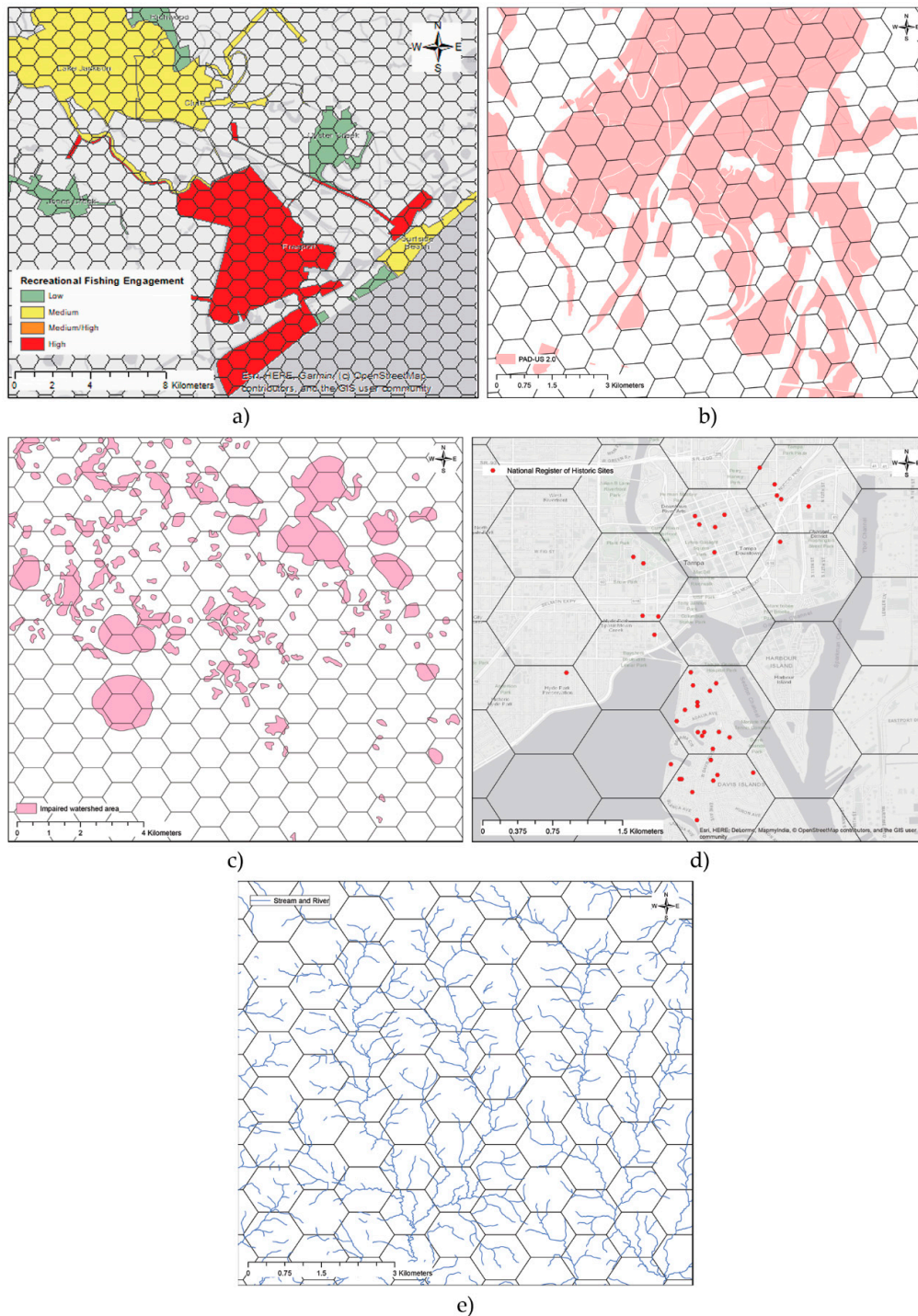
Figure 5. Measure types included within the geospatial database. (**a**) An example of an index measure using recreational fishing engagement. (**b**) An example of a binary measure using connectivity to existing protected area. (**c**) An example of a percentage area measure using 303(d) impaired watershed area. (**d**) An example of a count measure using the National Register of Historic Places. (**e**) An example of a length measure using stream abundance.
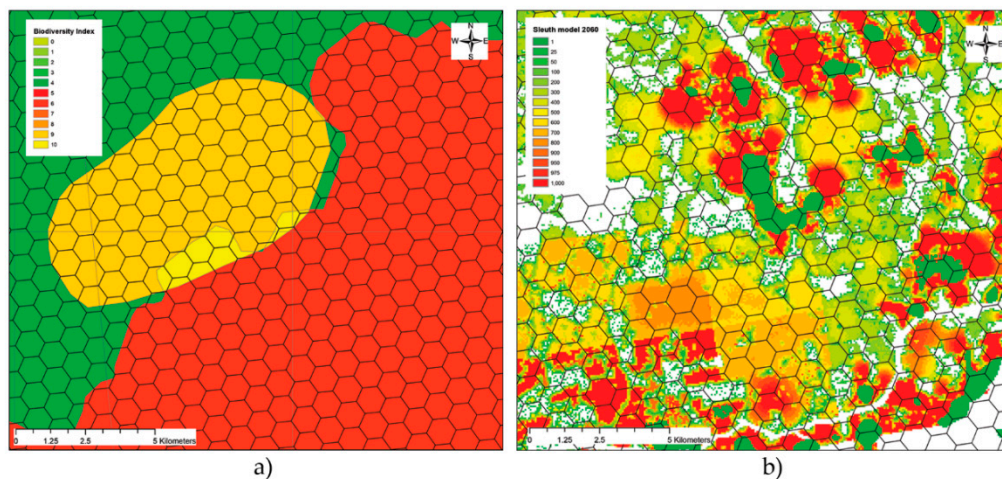
Figure 6. Source data types: (**a**) An example of vector data using the biodiversity index [16]. (**b**) An example of raster data using the SLEUTH model [3–6].

4. User Notes

There are two potential sources of uncertainty that need to be considered with the use of this database. First is the time lag between source data production and when the database was created, which will depend on each measure. As time progresses, the accuracy of each measure will inevitably decline, but the database used the most recent version of each source datum to minimize any error induced by time lag. A second potential source of uncertainty came from the 1 km^2. resolution that was used for the hexagonal grid. Since the measures were defined to describe general features of an area for conservation considerations and most lands conserved in this region were roughly 1 km^2, the data resolution was adequate for assessments of the land conservation value. Caution should thus be noted if using this database for purposes other than the land conservation value.

The geodatabase is available at Scholar's Junction, an institutional repository for Mississippi State University as a shapefile. A readme file is available for download along with the database where the user can find instructions for how to convert the database from GeoJSON to other formats. The codebase of the SCA project is available through github and the details of the project can be found at Landscope webpage both provided as Supplementary Materials.

Appendix A. Definition and Implementation of Database Measures

Appendix A.1. Threat of Urbanization

Definition: Threat of urbanization (ToU) indicates the likelihood of the given project area or area of interest (AOI) being urbanized by the year 2060. A ToU score of zero indicates the AOI is already urbanized. A ToU score of one indicates that there is absolutely no threat of urbanization. A ToU score between zero and one indicates the predicted likelihood of threat in decreasing order. Source data came from the SLEUTH model [3–6].

Workflow:

1. Reclassify raster values from 0–1000 in 16 classes (1 to 1000), where A_i represents the area of the *i*th class within a hexagon).
2. Convert individual classes to vectors.
3. Crop the vector classes to hexagon boundaries, and perform spatial joins to obtain areas of each vector class within hexagons.
4. ToU is then calculated as shown in Equation (A1).

$$
\begin{aligned}
\text{ToU} = 1 - \ & (0.025A_{25} + 0.05A_{50} + 0.1A_{100} + 0.2A_{200} + 0.3A_{300} + 0.4A_{400} \\
& + 0.5A_{500} + 0.6A_{600} + 0.7A_{700} + 0.8A_{800} + 0.9A_{900} + 0.95A_{950} \\
& + 0.975A_{975} + 1.0A_{1000} + 1A_1)
\end{aligned}
\tag{A1}
$$

Appendix A.2. Connectivity to Existing Protected Area

Definition: Connectivity to existing protected area indicates if the proposed conservation area is close to an area classified as protected by Protected Areas Database of the United States (PAD-US) 2.0 data [7]. Protected areas included International Union for Conservation of Nature (IUCN) Categories Ia-VI and U.S. Geological Survey Gap Analysis Program (GAP) Status 1–4 areas. A binary attribute represents the spatial relationship between a hexagon and a protected area within PAD-US 2.0. Any hexagon that directly intersects or is within a 1 km distance of a protected area would count as one, otherwise, zero.

Workflow:

1. Create a 1 km buffer around PAD-US 2.0 data.
2. Perform spatial overlay of the PAD-US 2.0 buffer with hexagon boundaries
3. Classify the hexagons as connected (one) or not connected (zero) based on the overlap between a hexagon and the buffer

Appendix A.3. Structural Connectivity

Definition: A percent attribute that stands for the proportion of area classified as a hub or corridor, according to the Intact Habitat Cores layer from Esri's Green Infrastructure Initiative [8]. This attribute prioritizes large protected areas and critical corridor connections.

Workflow:

1. Convert the Intact Habitat Cores layer to vector format.
2. Merge Hub and Connectivity layers.
3. Perform spatial join with hexagon boundaries to extract areas.

Appendix A.4. Composition of Natural Lands

Definition: This attribute prioritizes rare habitat types and those that have been identified as conservation priorities in state and regional plans. Scores reflect the proportion (%) of each area of

interest that is covered by a priority land cover. Source data came from USGS GAP (2011) [9], Florida Cooperative Land Cover 3.3 by the Florida Fish & Wildlife Conservation Commission (FWC) [10], and Texas Ecological Mapping Systems (TX EMS) by the Texas Parks & Wildlife Department (TPWD) [11].

　　　Workflow:

1. Mosaic TX, FL, and GAP data together.
2. Compile appropriate classes within assigned categories.
3. Resample TX to 30 m resolution.
4. Rank classifications of landcover within the hexagons (see Table A1).

Table A1. Categorization (tier) of landcover classes for ranking in the composition of natural lands.

Tier 1	State Wildlife Action Plan (SWAP) Tier 1 habitats Gulf Coast Vulnerability Assessment ecosystems: mangrove tidal emergent marsh oyster reef barrier islands LCC priority habitats: GCP LCC, GCPO LCC, PF LCC Other prioritized natural lands not overlapping with Tier 1
Tier 2	managed pine rangelands hay crop lands low density residential
Tier 3	urban commercial barren open water

Appendix A.5. 303(d): Impaired Watershed Area

　　　Definition: A percent attribute that stands for the proportion of impaired watershed within each hexagon. The watershed data are analyzed based on the 12-digit hydrologic unit code (HUC-12) level. Any HUC-12 watershed that contains an Environmental Protection Agency (EPA) 303(d) listed impaired waterbody would be considered impaired [12].

　　　Workflow:

1. Clip the impaired watershed boundary layer with hexagon boundaries.
2. Perform spatial join to calculate the proportion of each hexagon that contains an impaired watershed.

Appendix A.6. Hydrologic Response to Land Use Change

　　　Definition: A percent attribute that stands for the change in peak flow during a 24 h 1 rainfall event of an HUC-12 watershed at its currently developed state relative to its hypothetical pre-developed state. The pre-developed state was created by replacing all anthropogenic land cover with the most dominant natural land cover found within the HUC-12 watershed. All land cover used in this measure came from the National Land Cover Database (NLCD) 2016 [14].

　　　Workflow:

1. Perform spatial join of the vector data with hexagon boundaries.
2. Compute mean of percent change in peak flow values within each hexagon.

Appendix A.7. Stream Abundance

Definition: A numerical attribute that quantifies the length of streams (km) found within a hexagon. Stream data came from the National Hydrography Dataset Plus Version 2 (NHDPlusV2)-NHD Snapshot [13].
Workflow:

1. Clip the NHD Snapshot stream vectors to the hexagon boundaries.
2. Calculate the length of all streams within each hexagon.

Appendix A.8. Biodiversity Index

Definition: The biodiversity index is on a continuous zero-to-ten range representing prioritized species richness for more than 1200 endemic mammals, birds, amphibians, reptiles, freshwater fish, and trees in the U.S. An index of zero indicates the lowest under-protected (vulnerable) biodiversity. An index of 10 indicates the highest under-protected biodiversity. Source data came from the U.S. protected lands mismatch biodiversity priorities, by Jenkins et al. [16].
Workflow:

1. Classify the raster into 10 classes.
2. Vectorize 10 classes.
3. Perform spatial join with the hexagon boundaries.
4. Compute the mean of biodiversity values within each hexagon.

Appendix A.9. Threatened and Endangered Species Critical Habitat Area

Definition: The attribute is based on the U.S. Fish and Wildlife Service designated T&E critical habitat [17]. The value in each hexagon is the cumulative % area of critical habitats for all T&E species.
Workflow:

1. Exclude the species not found in the SCA region and the areas of critical habitat not contained in the SCA region.
2. For each species *i*, calculate the proportion of critical habitat for species in the SCA region contained within a hexagon (*Asi*) using Equation (A2).
3. Calculate T&E percent area using Equation (A3).

$$A_{S_i} = \frac{\text{Area of critical habitat for species } i \text{ that intersects with the hexagon}}{\text{Total area of critical habitat for species } i} \tag{A2}$$

$$T\&E \; Percantage \; Area = \sum_i A_{S_i} \tag{A3}$$

Appendix A.10. T&E Species Counts

Definition: This attribute measures the number of threatened and endangered (T&E) species that have habitat ranges identified within each hexagon. The source data came from the U.S. Fish and Wildlife Service designated T&E habitat ranges [18].
Workflow:

1. Perform spatial join of the data with hexagon boundaries.
2. Obtain the counts within each hexagon.

Appendix A.11. Light Pollution Index

Definition: An index that measures the intensity of light pollution within each hexagon. A score of zero indicates that the sky above the hexagon is already polluted/bright, and a score of 0+ to 1 indicates light pollution (LP) in decreasing order. Source data came from Falchi et al. [19].

Workflow:

1. Reclassify raster values from 0–30 to zero (Z), low (L), medium (M), and high (H) as per the thresholds shown in Table A2 below.
2. Convert Z, L, M, and H classes to vectors.
3. Crop the vector classes to hexagon boundaries and perform spatial joints to obtain areas (A_Z, A_L, A_M, and A_H).
4. The LP index is then calculated as shown in Equation (A4).

Table A2. Description of discretized values used to calculate Light Pollution Index.

Class	LP Score
A_Z	0
A_L	1–10
A_M	11–20
A_H	21–30

$$Light\ Pollution\ Index = 1 - (0.33A_L + 0.66A_M + A_H) \tag{A4}$$

Appendix A.12. National Register of Historic Places

Definition: A numeric attribute that represents the counts of historic places within each hexagon. The data were based on the U.S. National Park Service's National Register of Historic Places Program [20].
Workflow

1. Perform spatial join of the data with hexagon boundaries.
2. Obtain the counts within each hexagon.

Appendix A.13. National Heritage Area

Definition: A percent attribute that stands for the proportion of heritage area within each hexagon. The heritage data were based on the U.S. National Park Service's National Heritage Area layer [21].
Workflow:

1. Clip the national heritage area data to hexagon boundaries.
2. Perform spatial join to obtain the area within each hexagon.

Appendix A.14. Proximity to Socially Vulnerable Communities

Definition: This measure indicates the proximity to communities that are socially vulnerable according to the National Oceanic and Atmospheric Administration's (NOAA) Social Vulnerability Index. This is a binary attribute that represents the spatial relationship between a hexagon and areas that have been identified by NOAA as having medium or higher social vulnerability. Any area of interest that directly intersects or is within a 1 hex (1 km^2) distance of a socially vulnerable community would score a one, and areas of interest not within a 1 km^2 distance of a socially vulnerable community would score a zero. Source data came from the Social Vulnerability Index of Coastal Communities, from NOAA's Office of Coastal Management [22,23].
Workflow:

1. Clip NOAA's Social Vulnerability Index to hexagon boundaries.
2. Perform spatial join to obtain the Social Vulnerability Index within 1 km of each hexagon.

Appendix A.15. Community Threat Index

Definition: The Community Threat Index (CTI) comes from the Coastal Resilience Evaluation and Siting Tool (CREST), by the National Fish and Wildlife Foundation (NFWF) in collaboration with National Oceanic and Atmospheric Administration (NOAA), U.S. Army Corps of Engineers (USACE), and NatureServe [24] and includes datasets that show coastal flood and severe storm hazards on the landscape. The Threat Index is a raster based model (30 × 30 meters) with a cumulative scoring of inputs, which include: storm surge scenarios, sea level rise scenarios, flood prone areas, soil erodibility, impermeable soils, areas of low slope, and geologic stressors (i.e., landslide susceptibility and land subsidence).

Workflow:

1. Transform the CTI raster data to a vector shapefile.
2. Perform spatial join to obtain the CTI within each hexagon.

Appendix A.16. Working Lands: High Priority

Definition: The percentage area of pine, cropland and pasture/hay classes from the National Land Cover Database (NLCD) 2016 classification map [14] excluding the areas that are already protected according to the Protected Areas Database of the United States (PAD-US) 2.0 [7].

Workflow:

1. Extract the target layers from NLCD 2016 to a new raster file.
2. Transform the raster data to a vector shapefile.
3. Perform spatial join to calculate the percent area within each hexagon.

Appendix A.17. Commercial Fishing Reliance

Definition: Commercial fishing reliance measures the presence of commercial fishing through fishing activity as shown through permits and vessel landings relative to the population of a community. A high rank indicates more reliance. The data source for this measure came from the Social Indicators of Fishing Community Vulnerability and Resilience, by the National Marine Fisheries Service (NMFS) [25,26]. More information can be found at st.nmfs.noaa.gov/humandimensions/social-indicators/.

Workflow:

1. Clip the Commercial fishing reliance data to hexagon boundaries.
2. Perform spatial join to obtain the commercial fishing reliance data within each hexagon.

Appendix A.18. Recreational Fishing Engagement

Definition: Recreational fishing engagement measures the presence of recreational fishing through fishing activity estimates, including charter fishing pressure, private fishing pressure, and shore fishing pressure. A high rank indicates more engagement. The data source for this measure came from the Social Indicators of Fishing Community Vulnerability and Resilience, by the National Marine Fisheries Service (NMFS) [25,26]. More information can be found at st.nmfs.noaa.gov/humandimensions/social-indicators/.

Workflow:

1. Clip the recreational fishing engagement data to hexagon boundaries.
2. Perform spatial join to obtain the recreational fishing engagement data within each hexagon.

Appendix A.19. Access and Recreation: Number of Access Points

Definition: This measure indicates the number of points within a 25 km buffer radius of a hexagon, where the public can access places to engage in outdoor recreation, including boat ramps and access

points to parks, wildlife management areas, wildlife refuges, and national estuarine research reserves. Besides boat ramps, access points to protected areas were identified by intersections between roadways and protected areas listed under the Protected Areas Database for the United States (PAD-US) 2.0 [7]. Roadways were acquired from the Topologically Integrated Geographic Encoding and Referencing (TIGER)/Line Shapefile by the United States Census Bureau (USCB) [32]. Public boat ramps were obtained from the Florida Fish & Wildlife Conservation Commission (FWC) [27], Alabama Dept. of Natural Resources (ALDNR) [28], Mississippi Dept. of Marine Resources (MDMR) [29], Louisiana Dept. of Wildlife & Fisheries (LDWF) [30], and Texas Parks & Wildlife Dept. (TPWD) [31].

Workflow:

1. Clip the access points data to hexagon boundaries.
2. Create a 25 km buffer around the centroid of each hexagon.
3. Obtain the counts of access points that intersect with the 25 km buffer of each hexagon.

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