Supplementary Materials

Exploring the Spatial Relationship between the Ecological Topological Network and Carbon Sequestration Capacity of Coastal Urban Ecosystems: A Case Study of Yancheng City, China

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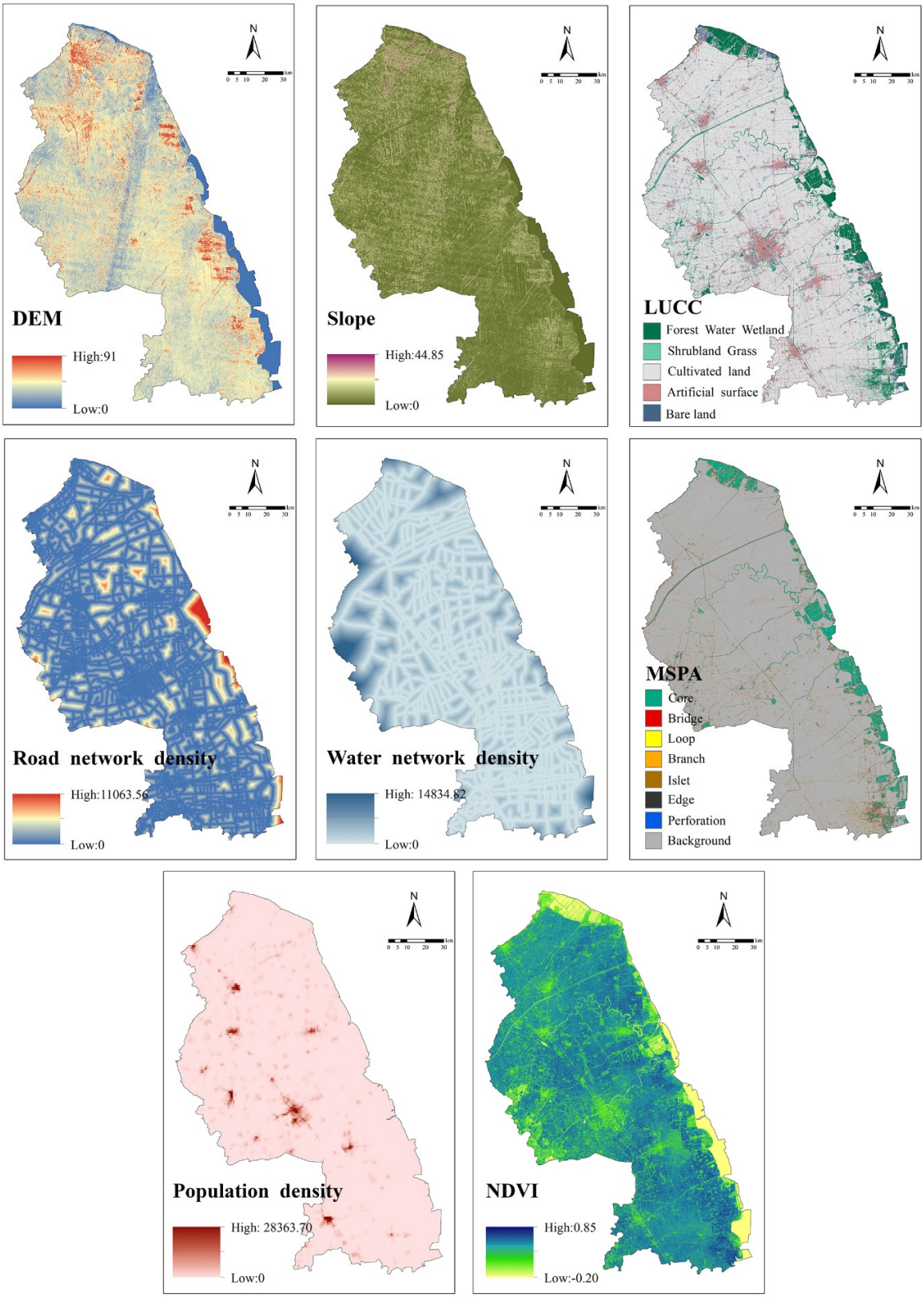

Figure S1. Results of front resistance surfaces.

Table S1. Definition and ecological implication of landscape types in MSPA.

Landscape Type	Definition	Ecological Implication
Core	The set of foreground pixels whose area is greater than the specified threshold.	The core is a spatially distinguishable nonlinear large natural patch that can be distinguished as the 'source' of various ecological processes, which is of great significance for the protection of biodiversity. It is usually identified as ecological source in the study of ecological network.
Bridge	Long-narrow patch with at least two points connected to different cores.	Bridge is a narrow area between connected cores, which is a channel for species migration and energy exchange between regions.
Loop	Long-narrow patch with at least 2 points connected to the same core.	Loop is a channel that connects to the same core. As a shortcut for material flow in the same area, loop is small in scale and has low connection with the surrounding natural plaques.
Branch	Long-narrow patch with only one side connected to another type of plaque.	Branch is an ecological patch that has only one section of connection with other ecological regions.
Islet	The patch that is not connected to any other foreground areas, and the area is less than the threshold of core.	Islet is an isolated, fragmented small natural patch that is clearly distinct from the surrounding landscape elements and is not connected to each other. It is often difficult to communicate with surrounding patches. However, as a small green space in the built area, it has great ecological potential.
Edge	The outer edge transition zone of the set of foreground pixels.	Edge is the transition zone between the core and the non-core area, which has the edge effect. Adjacent patches penetrate, connect and distinguish each other through edge, so it has characteristics of both itself and adjacent patches.
Perforation	The internal edge transition zone of the set of foreground pixels.	Perforation is a transition zone between the non-core area within core. Similar to Edge, it also has an edge effect.

Table S2. Expert rating of resistance factors based on the AHP.

Resistance Factor	EXPERT										Average
	1	2	3	4	5	6	7	8	9	10	
DEM	0.1283	0.1869	0.1556	0.0689	0.0808	0.1211	0.1248	0.1070	0.1336	0.1186	0.1243
Slope	0.0497	0.0769	0.0508	0.0608	0.0600	0.0867	0.0724	0.0923	0.0741	0.0672	0.0713
LULC	0.2208	0.1414	0.2781	0.2837	0.1719	0.1781	0.1580	0.1670	0.1445	0.2697	0.2110
NDVI	0.1118	0.1241	0.0893	0.1135	0.1494	0.0968	0.1690	0.1056	0.1099	0.1083	0.1121
MSPA	0.1696	0.1543	0.1731	0.1844	0.2105	0.1569	0.1285	0.1959	0.2129	0.1460	0.1762
Population density	0.1440	0.1021	0.0973	0.0934	0.1298	0.1633	0.1583	0.1500	0.0970	0.0726	0.1167
Distance from water network	0.0957	0.0999	0.0968	0.1051	0.1140	0.0866	0.0942	0.0737	0.0965	0.0893	0.0931
Distance from main road network	0.0800	0.1145	0.0591	0.0902	0.0837	0.1104	0.0947	0.1085	0.1316	0.1283	0.1023

Table S3

Comprehensive resistance evaluation index system.

Resistance Factor	Weight	Value	Classification Index	Factor	Weight	Value	Classification Index
[a]DEM/m	0.12	1	0-4	LULC	0.21	1	Forest, Water, Wetland
		20	4-8			20	Shrub, Grass
		60	8-12			60	Cultivated land
		80	12-19			80	Artificial surface
		100	19-91			100	Bare land
[a]Slope/°	0.07	1	0-1.11	[a]Population density	0.12	1	0-667
		20	1.11-2.30			20	667-2892
		60	2.30-3.97			60	2892-7786
		80	3.97-7.67			80	7786-15572
		100	7.67-44.85			100	15572-28364
[a]NDVI/%	0.11	1	55.72-84.94	[b]Distance from water network/m	0.09	100	＜100
		20	43.38-55.72			80	100-500
		60	26.50-43.38			60	500-1000
		80	-0.25-26.50			20	1000-1500
		100	-20.00—0.25			1	≥1500
MSPA	0.18	5	Core	[b]Distance from main road network/m	0.10	100	≥2000
		10	Bridge			80	1500-2000
		30	Loop			60	1000-1500
		40	Branch			20	500-1000
		50	Islet			1	<500
		60	Edge				
		70	Perforation				
		100	Background				

Note: Different lowercase letters indicate different grading methods. *a* represents the natural interrupt method, which determines the cutoff value by minimizing the intra-class variance and maximizing the inter-class variance in the iterative calculation; *b* indicates that the isometric method divides the range of attribute values into subranges of equal size.

Table S4. Description of the topological indicators

Type of Indicator	Name of Indicator	Significance of Indicator	Ecological Implications in the Ecological Network
Evaluation of the overall structure of the network	Average degree	Average of the degrees of all ecological nodes in the network	Evaluates the average connectivity of all sources and nodes in the network
	Average clustering coefficient	Average of the clustering coefficients of all nodes in the network	Indicates whether the distribution of ecological nodes in the network tends to be concentrated or decentralized
	Modularity	Each ecological node in the network is assigned to a different community	Evaluates the effect of network community division
Evaluation of nodes of the network	Degree	The number of corridors owned by a node	The number of ecological corridors owned by an ecological source or a node
	Betweenness centrality	The normalized index of the proportion of all the shortest paths in the network that pass through a node	Indicates the proportion or degree to which an ecological node exists on the shortest path of any two nodes in the network
	Closeness centrality	The reciprocal of the sum of the shortest distances from a node to all other nodes multiplied by the number of other nodes	Indicates the distance between ecological node and other nodes through the shortest path; at the same time, quantifies the position of ecological nodes in the geometric center
	Clustering coefficient	The ratio of the number of corridors actually existing between the neighboring nodes of a node to the maximum number of corridors that may exist	Indicates the proportion of connectivity between neighboring nodes
	Eigenvector centrality	Each node is assigned a relative score; connections to nodes with high scores are weighted more than connections to nodes with low scores	The more important the node connected to node A, then the more important node A is; this indicator is used to evaluate the importance of nodes
	PageRank	The importance of nodes	Rank of the importance of ecological nodes

Table S5. The description and calculation formulas of the robustness indicators

Name of Indicator	Significance of Indicator	Ecological Implications in the Ecological Network	Calculation Formula
Average degree	Average of the degrees of all ecological nodes in the network	Evaluates the average connectivity of all sources and nodes in the network	$K = \frac{1}{n}\sum_{n=1}^{n} k_n$
Efficiency	The shortest path between any two nodes in a network	Represents the efficiency of energy flow between network nodes	$E = \frac{1}{n(n-1)}\sum_{i=1}^{n}\sum_{j=1(i\neq j)}^{n} H_{ij}$
Connectivity robustness	The relative size of the maximum connected subgraph during network fragmentation under attack	Directly reflects the extent of network damage	$G = \frac{P^*}{P}$

Note: K is the average degree, n is the number of nodes in the network, K_n is the degree of node n, E is the efficiency of the network, H_{ij} is the reciprocal of the shortest path between nodes i and j, G is the relative size of the maximum connected subgraph, P^* is the size of the maximum connected subgraph, and P is the size of the initial network connectivity.

Table S6. Interaction matrix based on the gravity model.

Importance	Source 1	Source 2	Source 3	Source 4	Source 5	Source 6	Source 7	Source 8	Source 9	Source 10	Source 11	Source 12	Source 13	Source 14	Source 15	Source 16
Source 1	—	1.97	3.73	1.42	3.08	0.95	3.55	0.98	9.68	3.56	0.87	1.20	34.73	0.88	1.33	3.05
Source 2		—	17.41	65.65	33.38	11.17	3.20	15.31	5.19	21.55	9.79	3.37	0.85	11.00	10.70	1.39
Source 3			—	7.34	214.26	3.23	9.58	3.69	21.65	631.76	2.89	3.18	1.42	3.06	7.20	2.32
Source 4				—	11.03	28.35	1.93	50.82	3.07	8.56	24.14	2.41	0.64	29.44	6.26	1.00
Source 5					—	4.22	7.86	4.98	13.41	452.77	3.77	3.36	1.22	4.03	10.74	2.21
Source 6						—	1.09	182.55	1.71	3.62	313.69	1.49	0.45	325.45	3.11	0.68
Source 7							—	1.17	11.01	10.71	0.98	1.73	1.44	1.02	2.37	4.17
Source 8								—	1.88	4.24	195.17	1.70	0.46	397.51	3.85	0.74
Source 9									—	18.73	1.60	1.91	3.01	1.66	3.07	4.88
Source 10										—	3.35	3.79	1.43	3.56	9.81	2.75
Source 11											—	1.56	0.43	1278.40	3.35	0.70
Source 12												—	0.77	1.58	18.63	3.64
Source 13													—	0.46	0.83	2.24
Source 14														—	3.49	0.71
Source 15															—	3.21
Source 16																—

Note: Red, yellow and green respectively indicated that there may be common ecological corridors, secondary important ecological corridors, and important ecological corridors between two ecological sources.