

Vulnerability of the Coquí Ilanero, *Eleutherodactylus juanariveroi*, Habitat to Sea Level Rise



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Coquí llanero

Eleutherodactylus juanariveroi



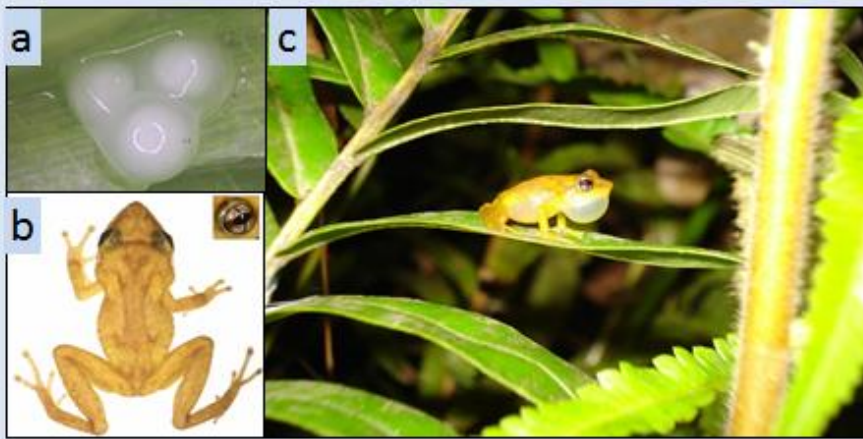


Figure 1. Images of the coquí llanero, *E. Juanariveroi*. (a) egg clutch, (b) dorsal view, (c) calling.

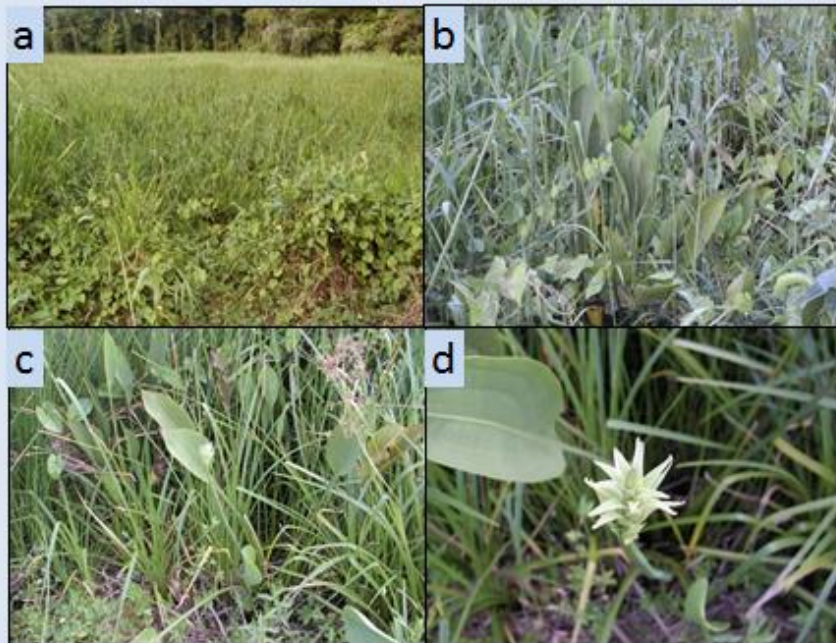


Figure 3. Images of *E. juanariveroi* habitat. (a) Freshwater Marsh, (b, c, d) views of vegetation.

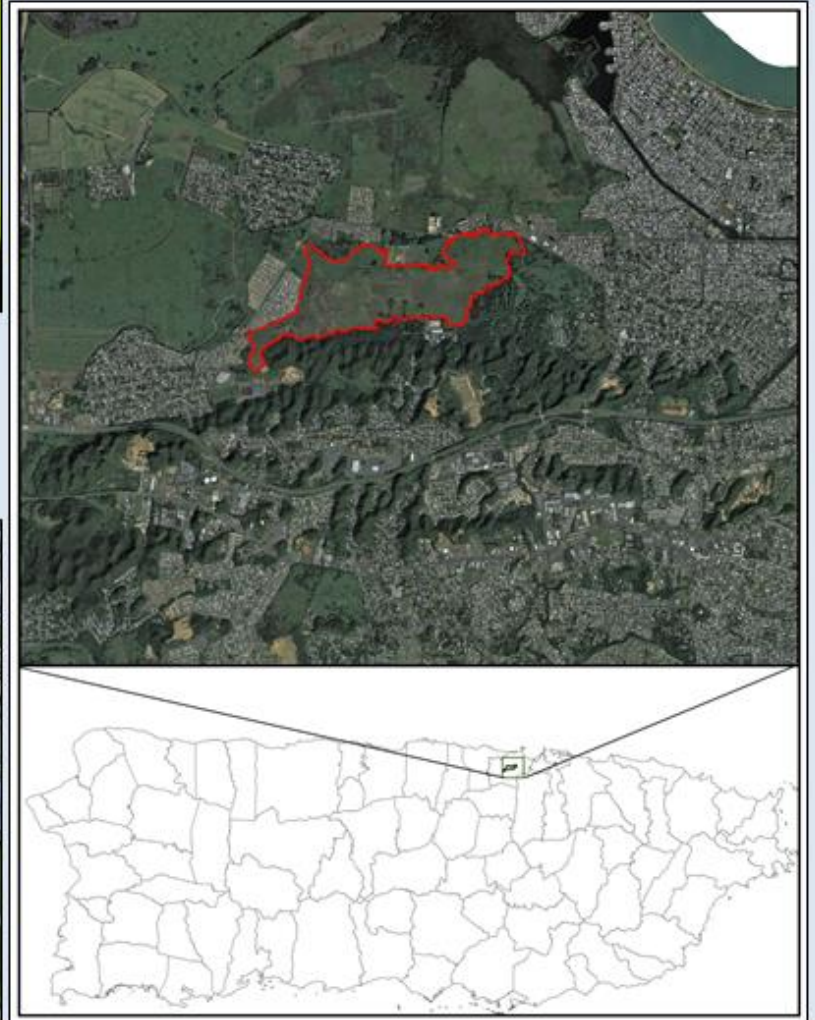


Figure 2. Location of *E. juanariveroi* habitat in the Municipality of Toa Baja, Puerto Rico





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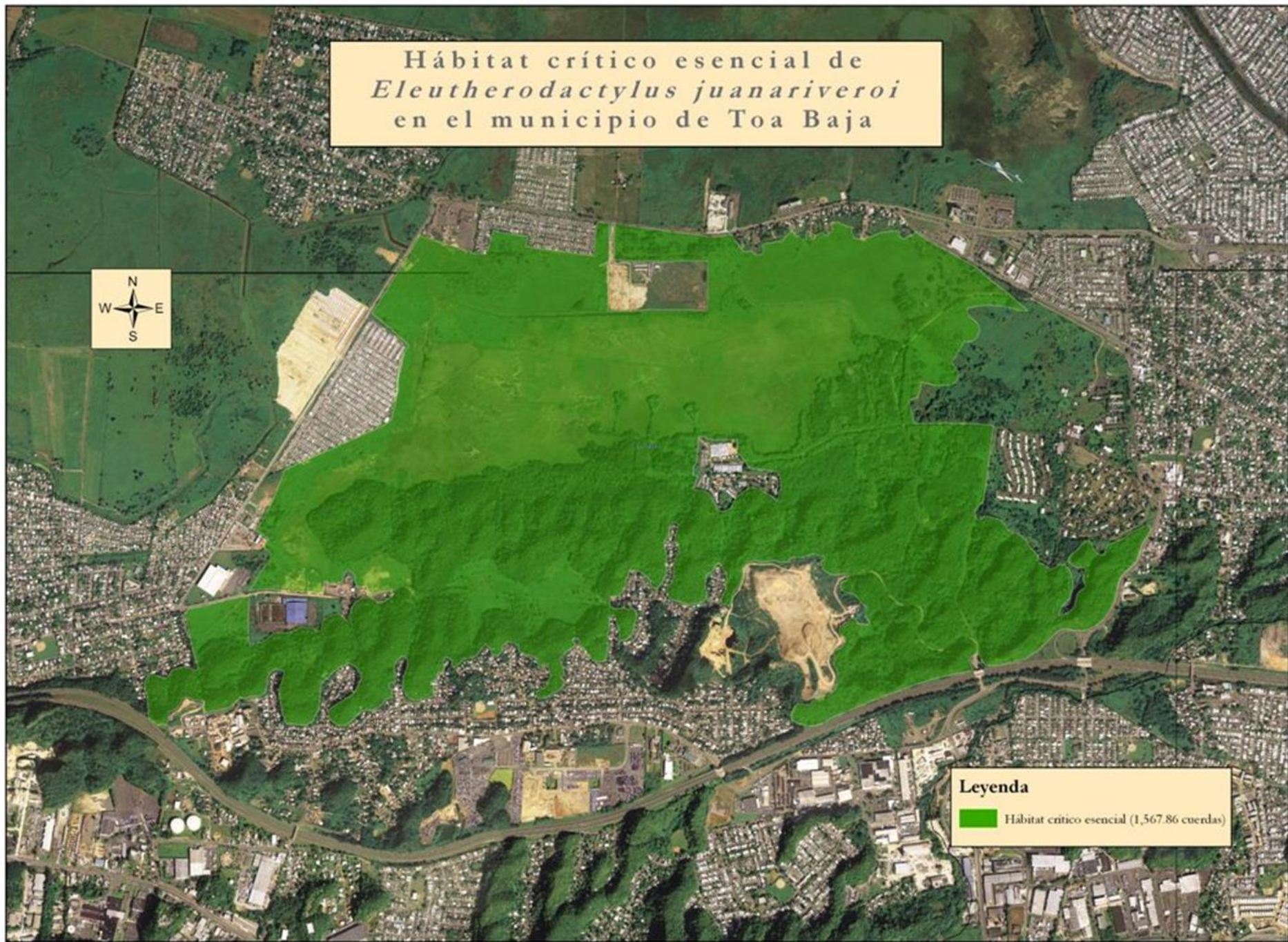


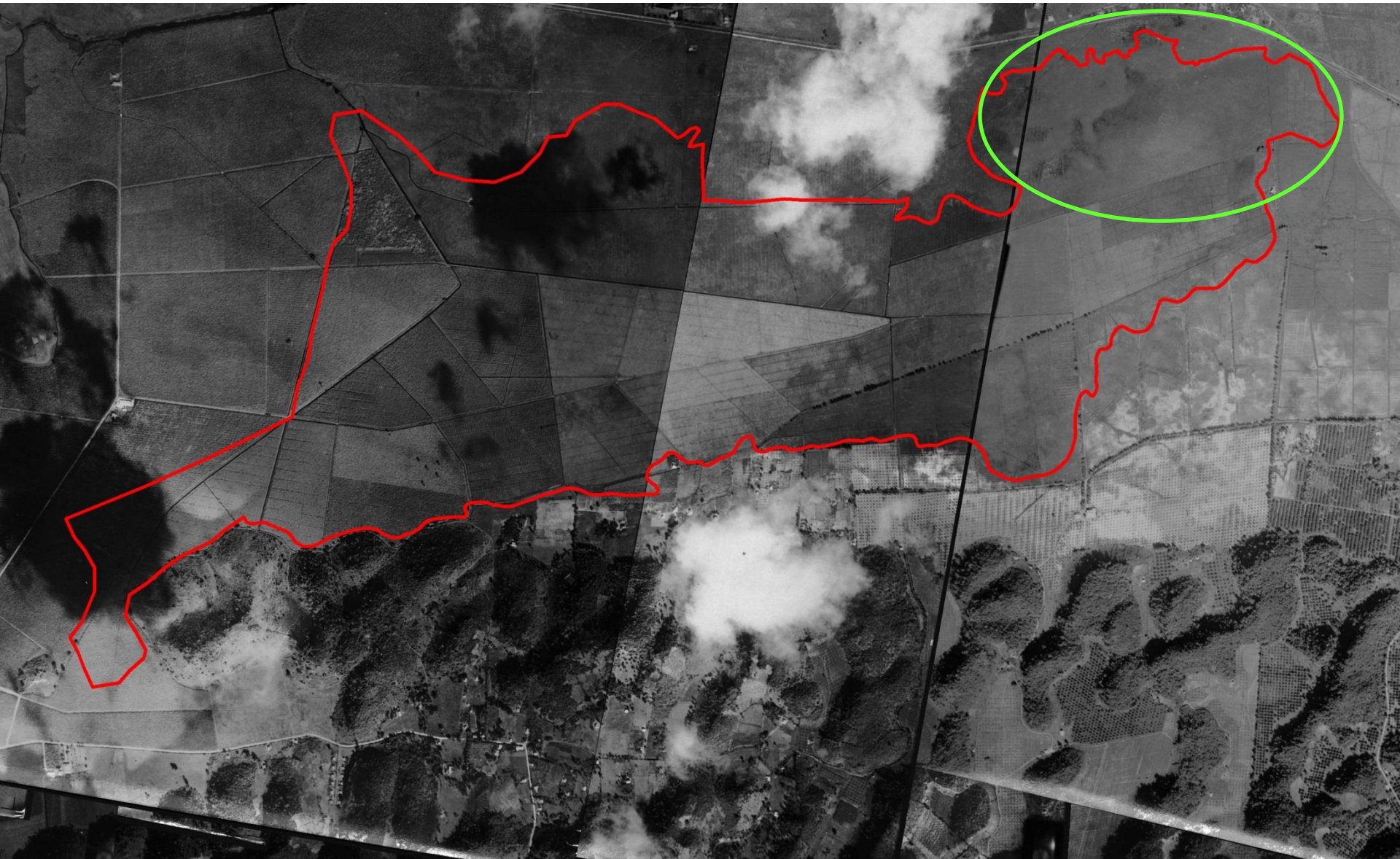
Hábitat crítico esencial de
Eleutherodactylus juanariveroi
en el municipio de Toa Baja

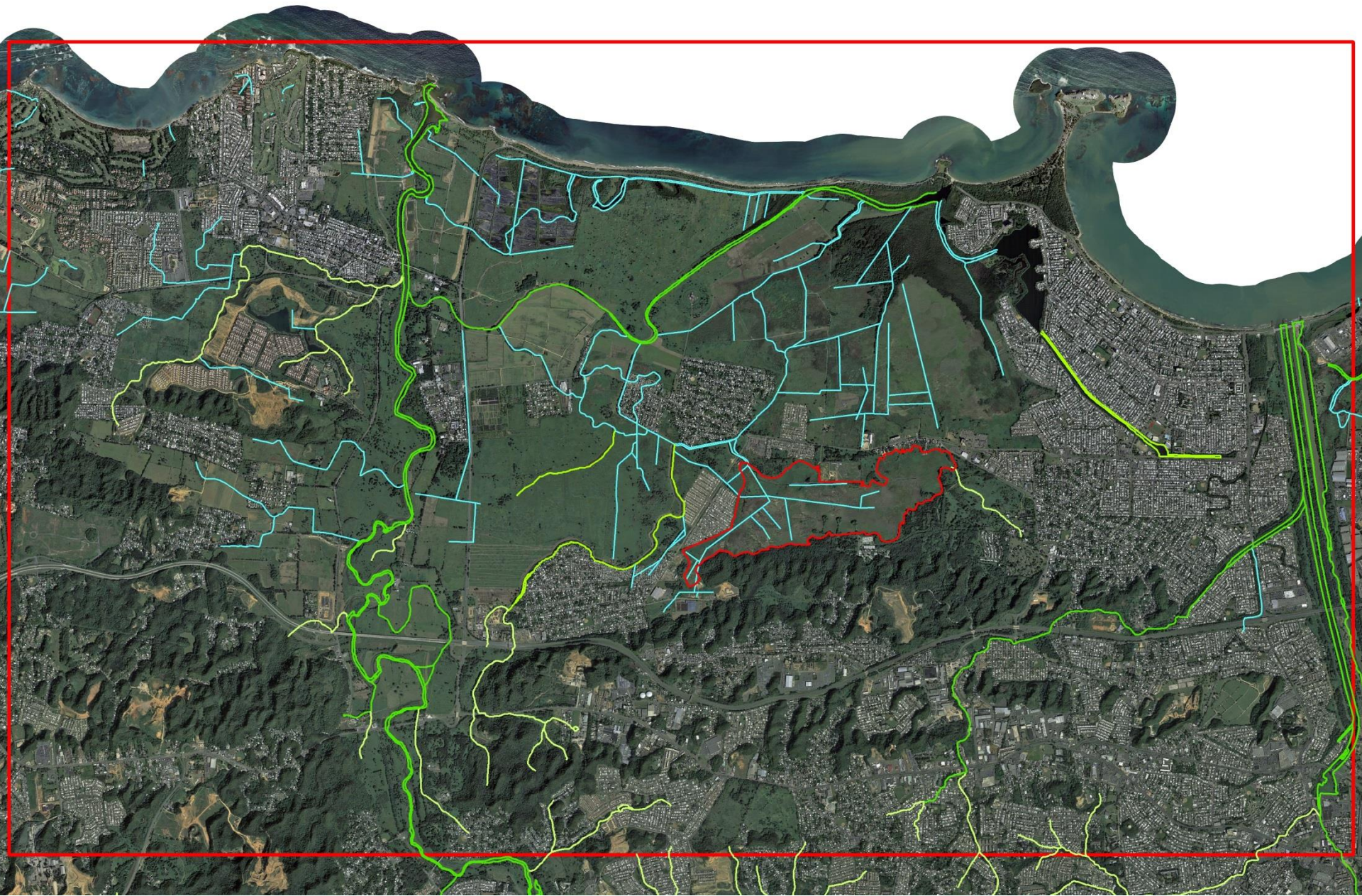


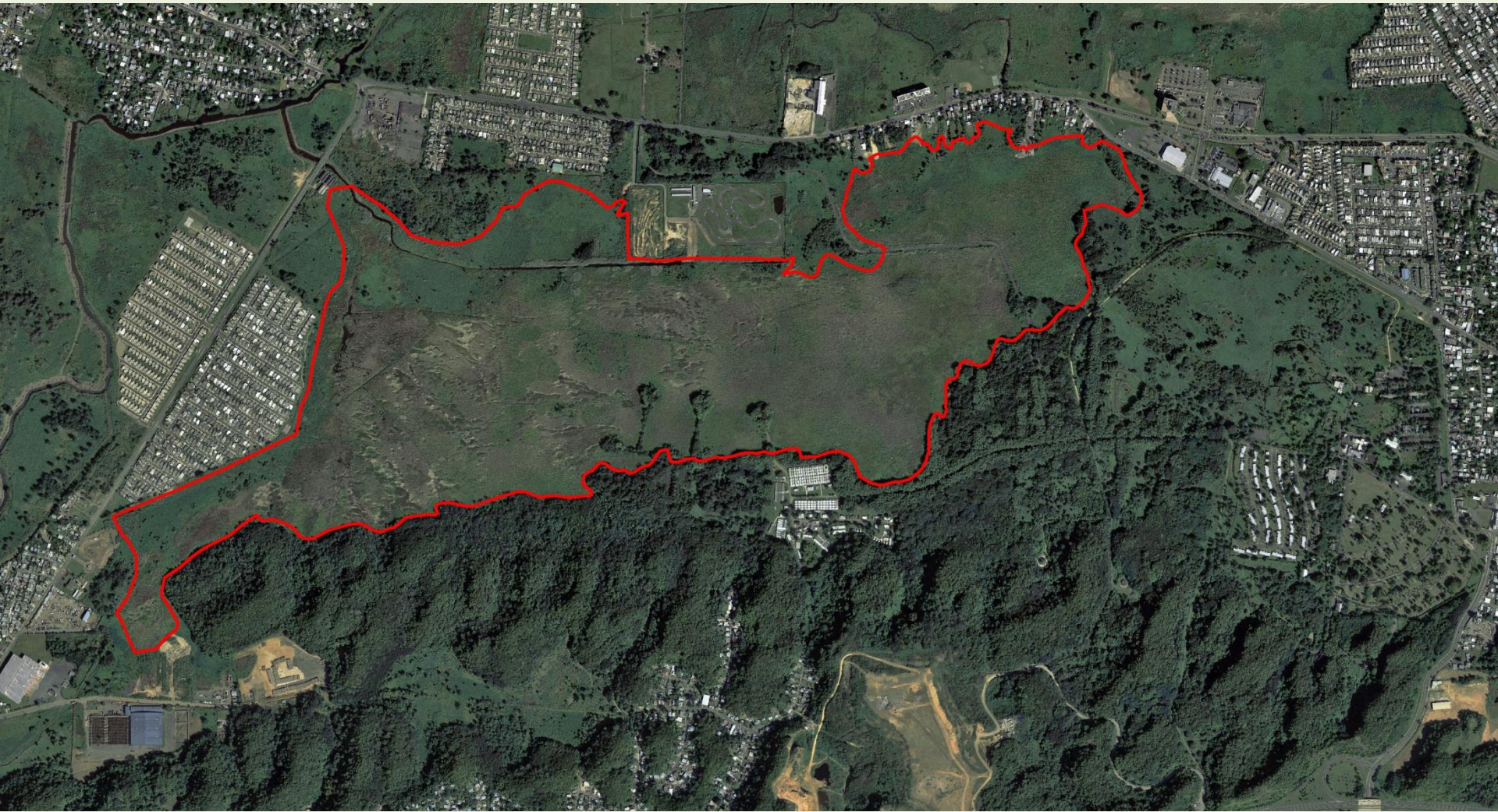
Leyenda

 Hábitat crítico esencial (1,567.86 cuerdas)





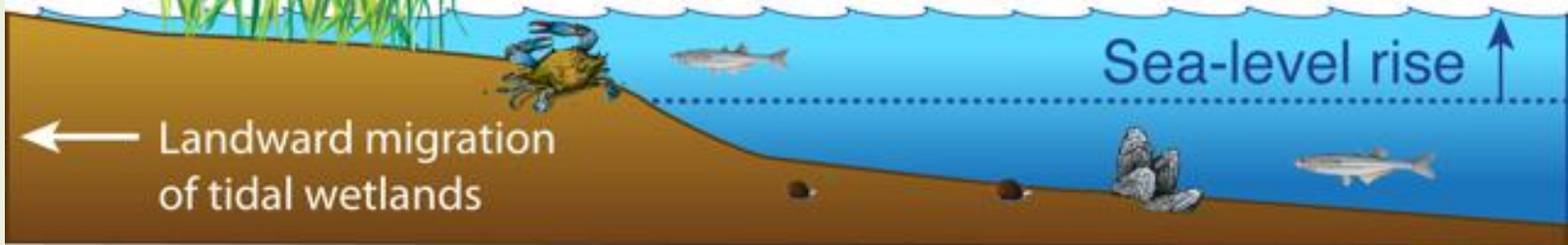




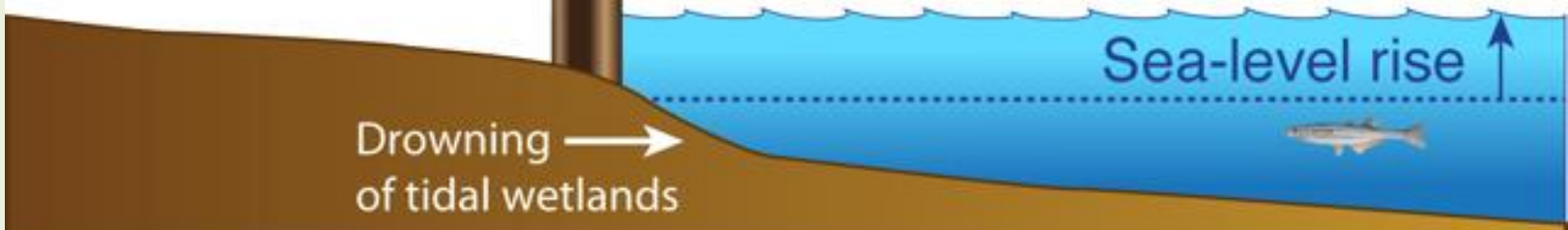
Before



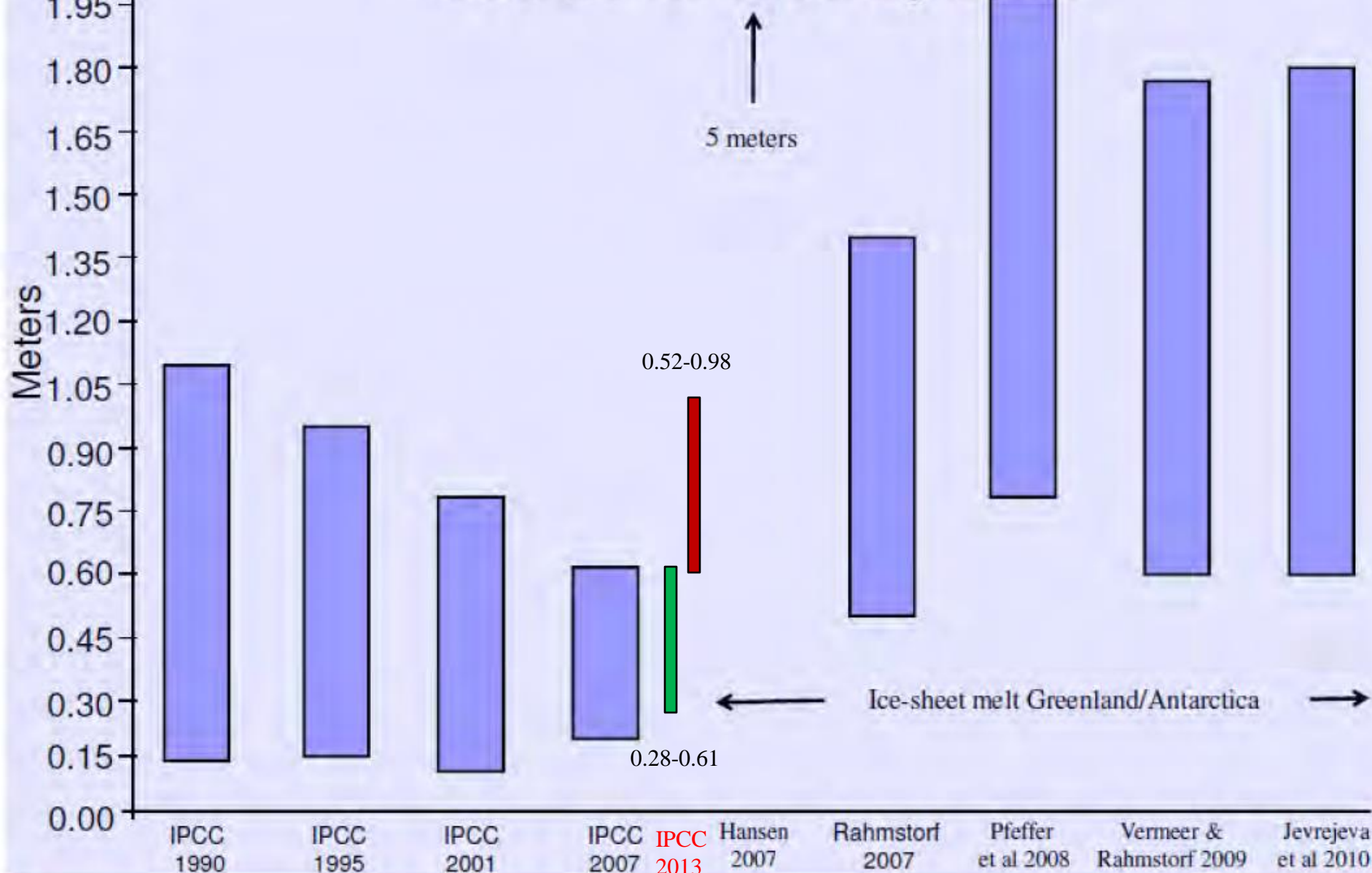
After



After with bulkhead



Sea Level Rise By 2100



IPCC
1990

IPCC
1995

IPCC
2001

IPCC
2007

IPCC
2013

Hansen
2007

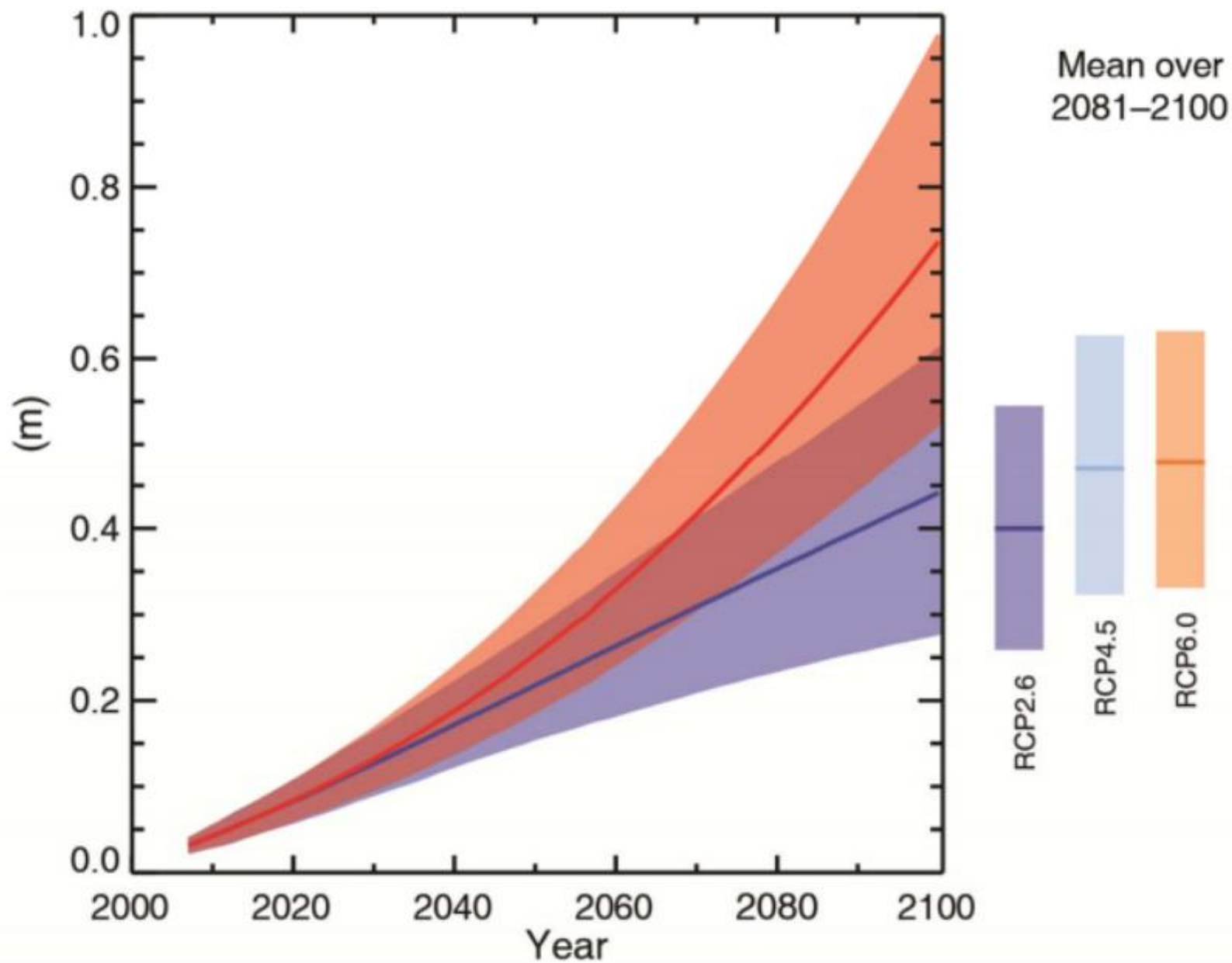
Rahmstorf
2007

Pfeffer
et al 2008

Vermeer &
Rahmstorf 2009

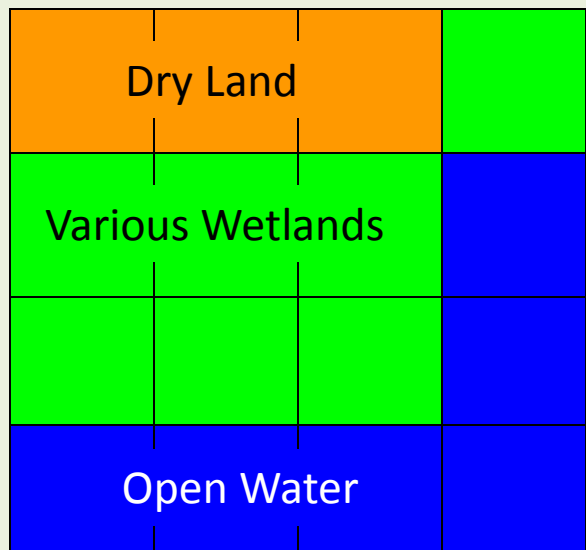
Jevrejeva
et al 2010

Global mean sea level rise

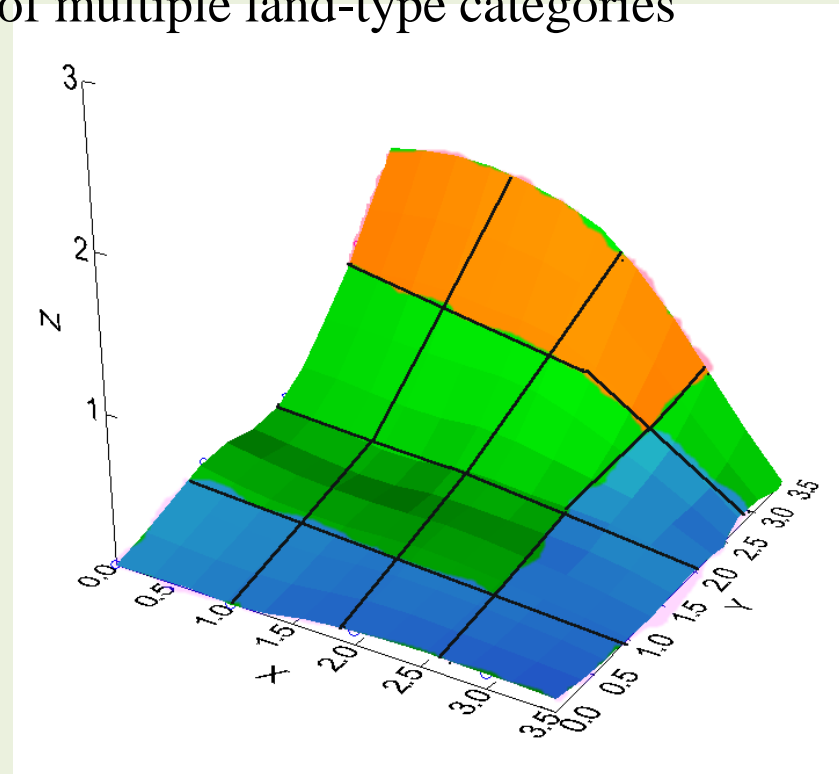


SLAMM

- The Sea Level Affecting Marshes Model, SLAMM, simulates the dominant processes involved in the conversion of wetlands and coasts as well as the long-term changes caused by sea level rise (Clough et al, 2010).
- Cells with elevation, slope, wetland type
 - Same cell size
 - Cell size can be variable (30 meter DEM or LIDAR derived DEM)
 - Cells will track movement of multiple land-type categories

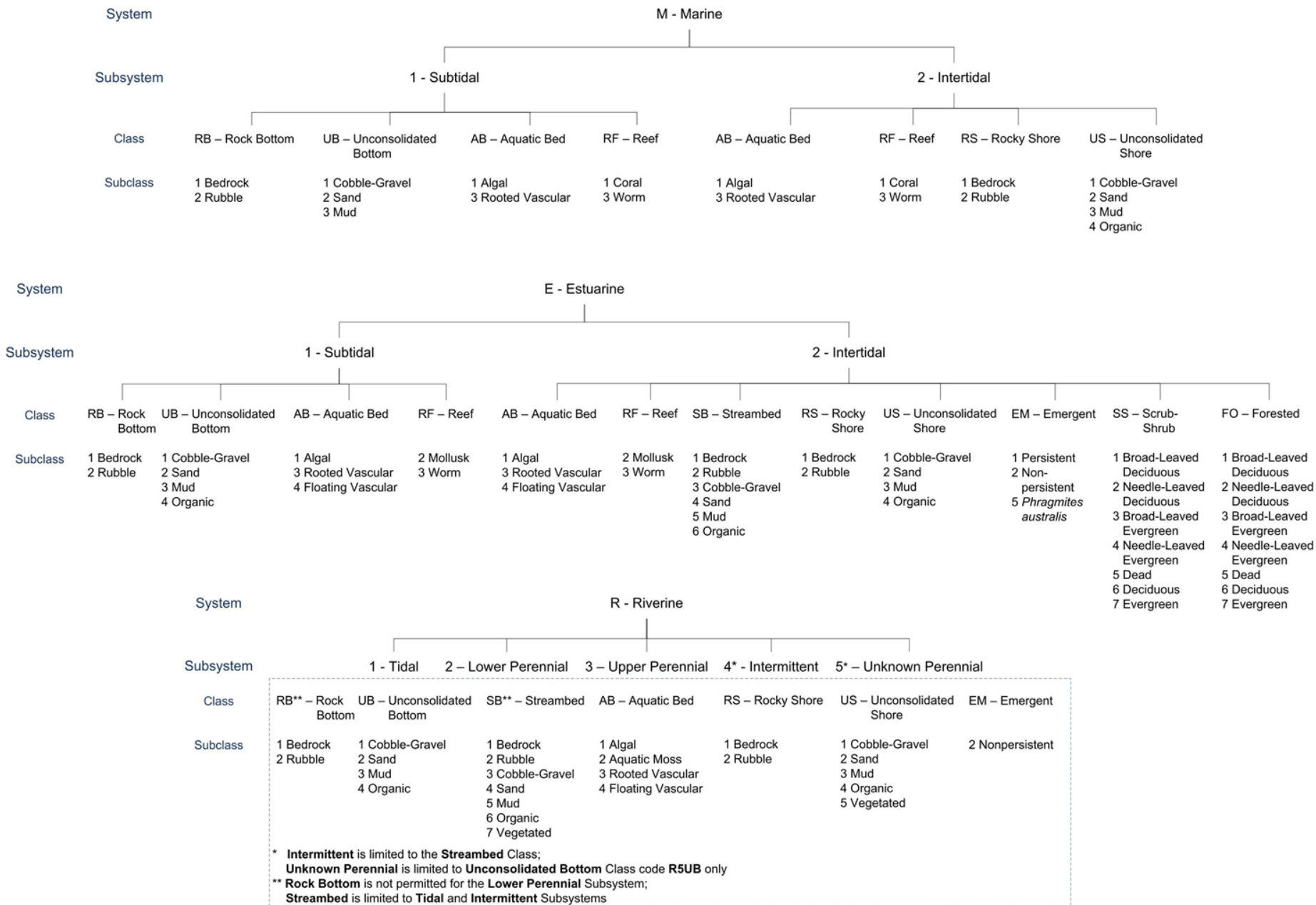


2D Representation

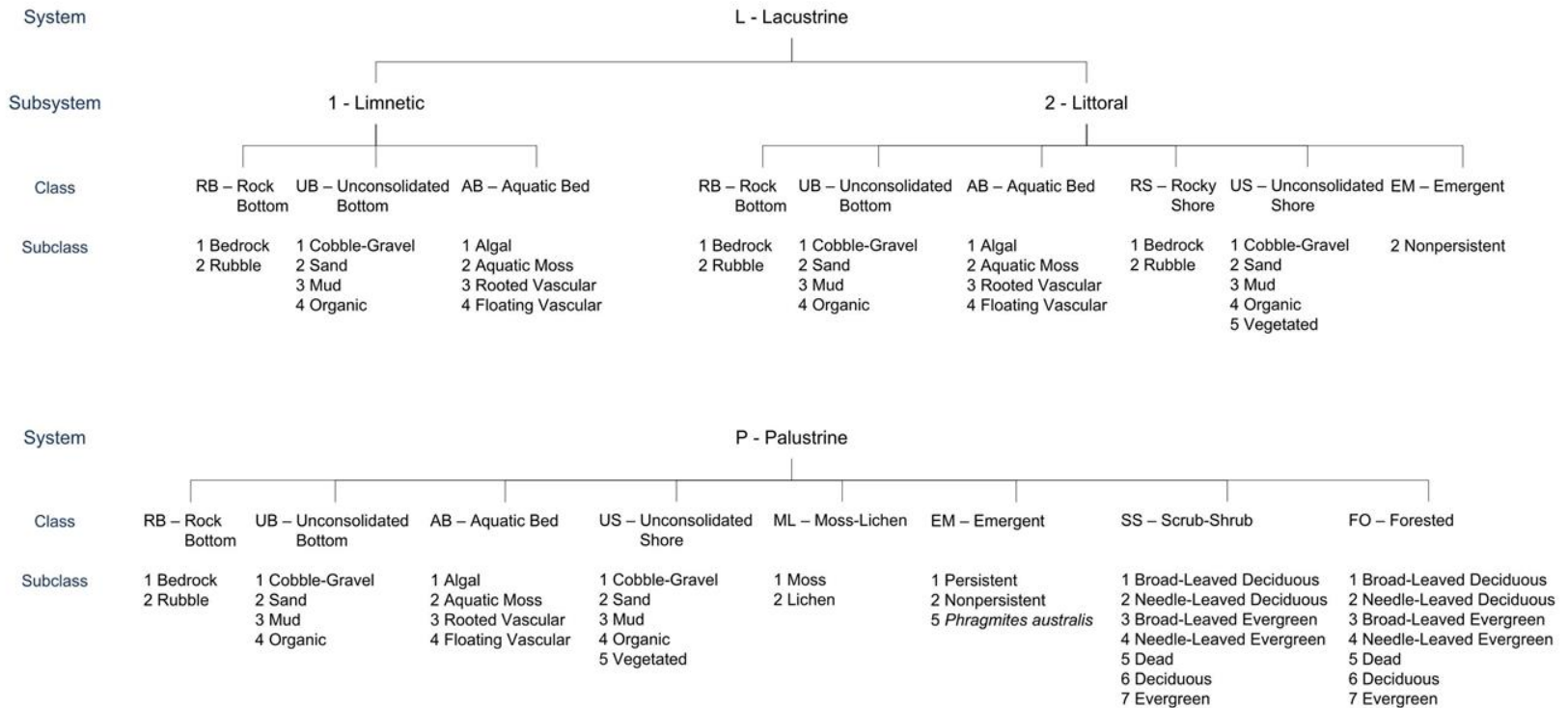


3D Representation

WETLANDS AND DEEPWATER HABITATS CLASSIFICATION



WETLANDS AND DEEPWATER HABITATS CLASSIFICATION



MODIFIERS							
In order to more adequately describe the wetland and deepwater habitats, one or more of the water regime, water chemistry, soil, or special modifiers may be applied at the class or lower level in the hierarchy. The farmed modifier may also be applied to the ecological system.							
Water Regime			Special Modifiers	Water Chemistry			Soil
Nontidal	Saltwater Tidal	Freshwater Tidal		Coastal Halinity	Inland Salinity	pH Modifiers for all Fresh Water	
A Temporarily Flooded	L Subtidal	S Temporarily Flooded-Tidal	b Beaver	1 Hyperhaline	7 Hypersaline	a Acid	g Organic
B Saturated	M Irregularly Exposed	R Seasonally Flooded-Tidal	d Partly Drained/Ditched	2 Euhaline	8 Eusaline	t Circumneutral	n Mineral
C Seasonally Flooded	N Regularly Flooded	T Semipermanently Flooded-Tidal	f Farmed	3 Mixohaline (Brackish)	9 Mixosaline	i Alkaline	
E Seasonally Flooded/ Saturated	P Irregularly Flooded	V Permanently Flooded-Tidal	h Diked/Impounded	4 Polyhaline	0 Fresh		
F Semipermanently Flooded			r Artificial	5 Mesohaline			
G Intermittently Exposed			s Spoil	6 Oligohaline			
H Permanently Flooded			x Excavated	0 Fresh			
J Intermittently Flooded							
K Artificially Flooded							

SLAMM Land Categories

Dry Land: Developed and Undeveloped

Swamp: General, Cypress, & Tidal

Transitional Marsh: Occasionally Inundated, Scrub Shrub

Marsh: Salt, Brackish, Tidal Fresh, Inland Fresh, Tall Spartina

Mangrove: Tropical

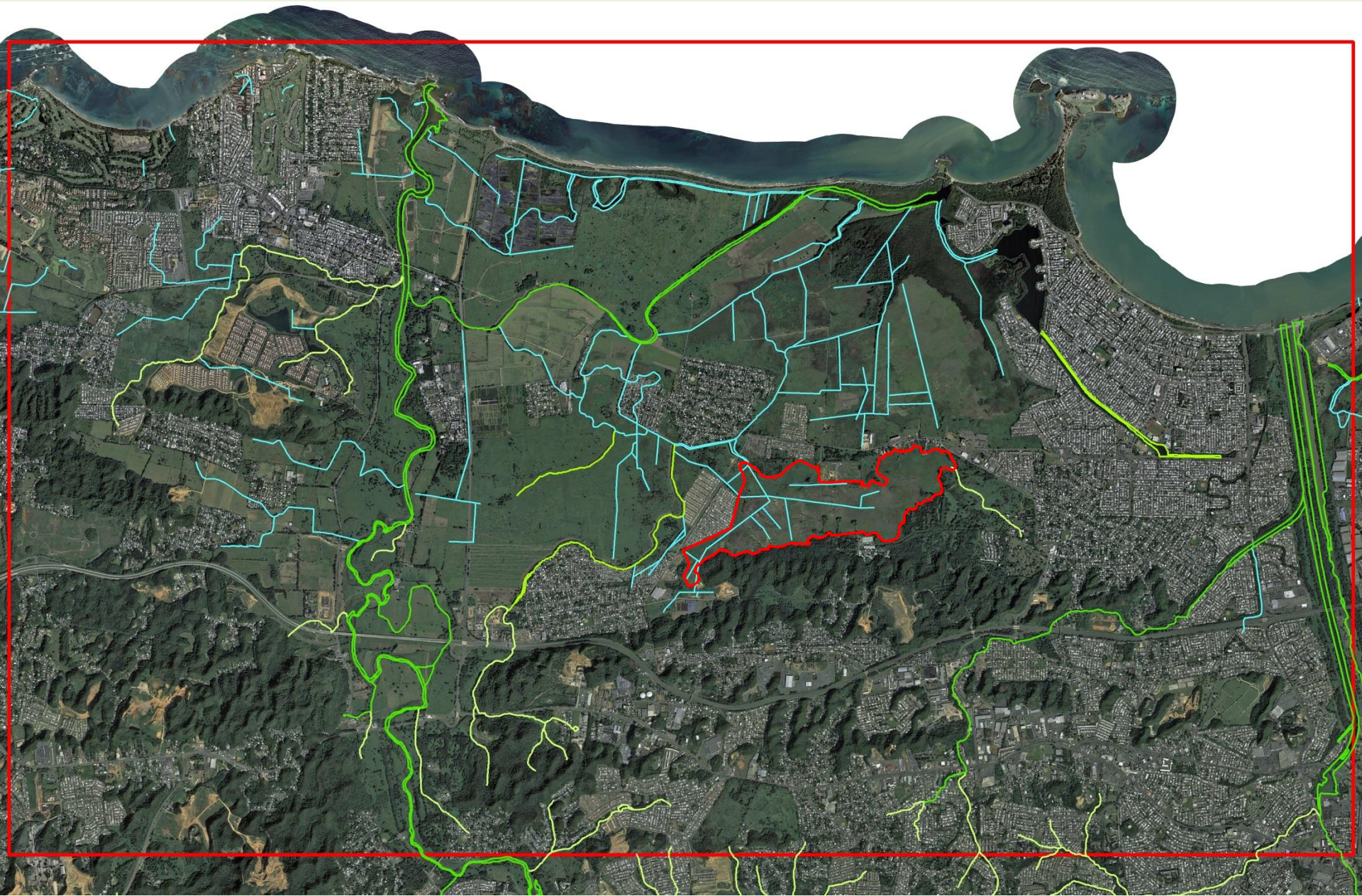
Beach: Estuarine, Marine, Rocky Intertidal

Flats: Tidal Flats & Ocean Flats

Open Water: Ocean, Inland, Riverine, Estuarine, Tidal Creek

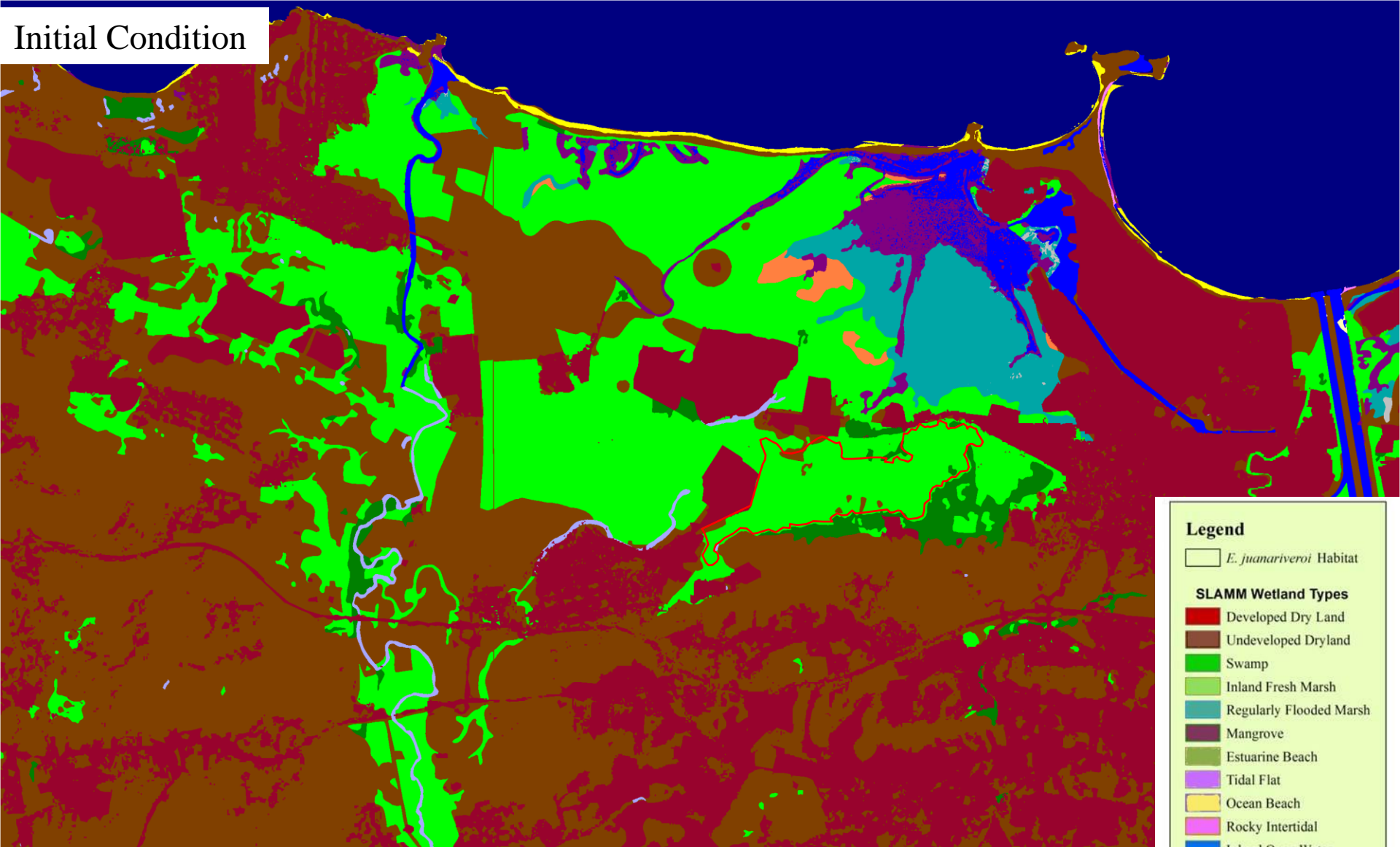
NWI Classes to SLAMM Classes

1.	DevDryland	U	Upland-Developed
2.	UndDryland	U	Upland-Undeveloped (categorized by percent impervious)
3.	Swamp	PFO, PFO1, PFO3-5, PSS	Palustrine forested (living or dead), and scrub shrub.
4.	CypressSwamp	PFO2	needle-leaved deciduous
5.	InlandFreshMrsh	L2EM, PEM[1&2] ["A"- "I"] , R2EM	Lacustrine, Palustrine, and Riverine emergent
6.	TidalFreshMarsh	R1EM, PEM["K"- "U"]	Riverine tidal emergent
7.	Scrub Shrub	E2SS1, E2FO	Estuarine intertidal scrub-shrub broad-leaved deciduous
8.	Salt marsh	E2EM, [no "P"]	Estuarine intertidal emergent
9.	Mangrove	E2FO3, E2SS3	Estuarine intertidal forested and scrub-shrub broad-leaved evergreen
10	Estuarine Beach	E2US2 or E2BB (PUS"K")	Estuarine intertidal unconsolidated shore sand or beach-bar, includes salt pans
11.	TidalFlat	E2US[N,3,4] E2FL, M2AB,	Estuarine intertidal unconsolidated shore mud/organic flat
12.	Ocean Beach	M2US2, M2BB/UB/USN	Marine intertidal unconsolidated shore sand
13.	OceanFlat	M2US3or4	Marine intertidal unconsolidated shore mud or organic
14.	RockyIntertidal	M2RS, E2RS, L2RS, [E,M]2AB1[N,P]	Marine intertidal rocky shore
15.	InlandOpenWater	R3-UB R2-5OW L1- 2OW, POW, PUB, R2UB, (L1-2, UB, AB) PAB, R2AB	Riverine, Lacustrine, and Palustrine open water and aquatic beds
16.	RiverineTidalOpenWater	R1OW	Riverine tidal open water
17.	EstuarineOpenWater	E1, (PUB"K" no "h")	Estuarine subtidal
18.	TidalCreek	E2SB, E2UBN	Estuarine intertidal stream bed
19.	OpenOcean	M1	Marine subtidal
20.	BrackishMarsh	E2EM[1-5]P	Irregularly Flooded Estuarine Intertidal Emergent
21.	TallSpartina	N / A	2M buffer automatically added to Salt Marsh fringe
22.	InlandShore	L2UD, PUS, R[1..4]US/RS	shoreline not pre-processed using Tidal Range Elevations
23.	TidalSwamp	PSS, PFO"K"- "V"/EM1"K"- "V"	Tidally influenced Swamp.




1m SLR, 2100

Initial Condition



Legend

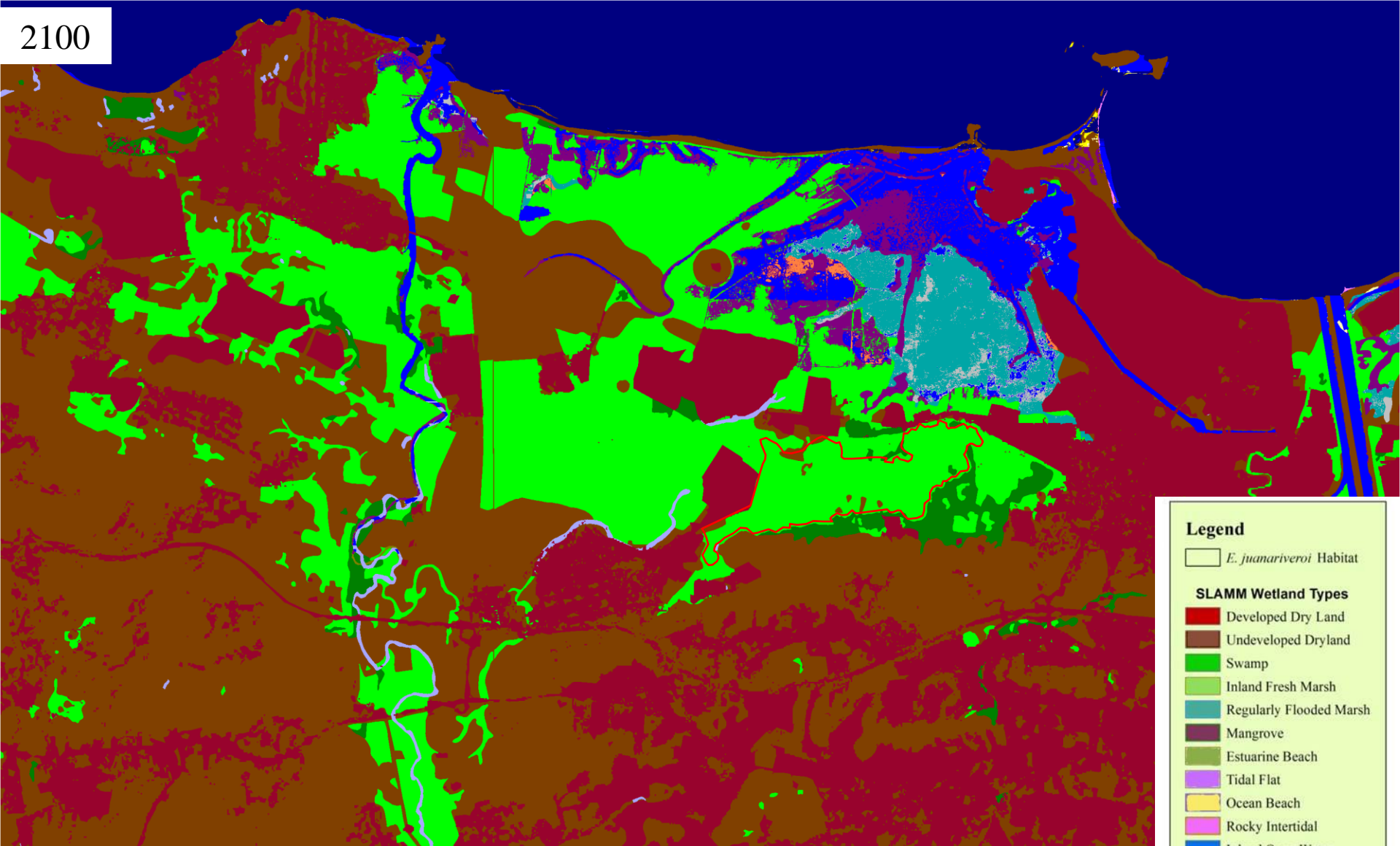
 *E. juanriveroi* Habitat

SLAMM Wetland Types

-  Developed Dry Land
-  Undeveloped Dryland
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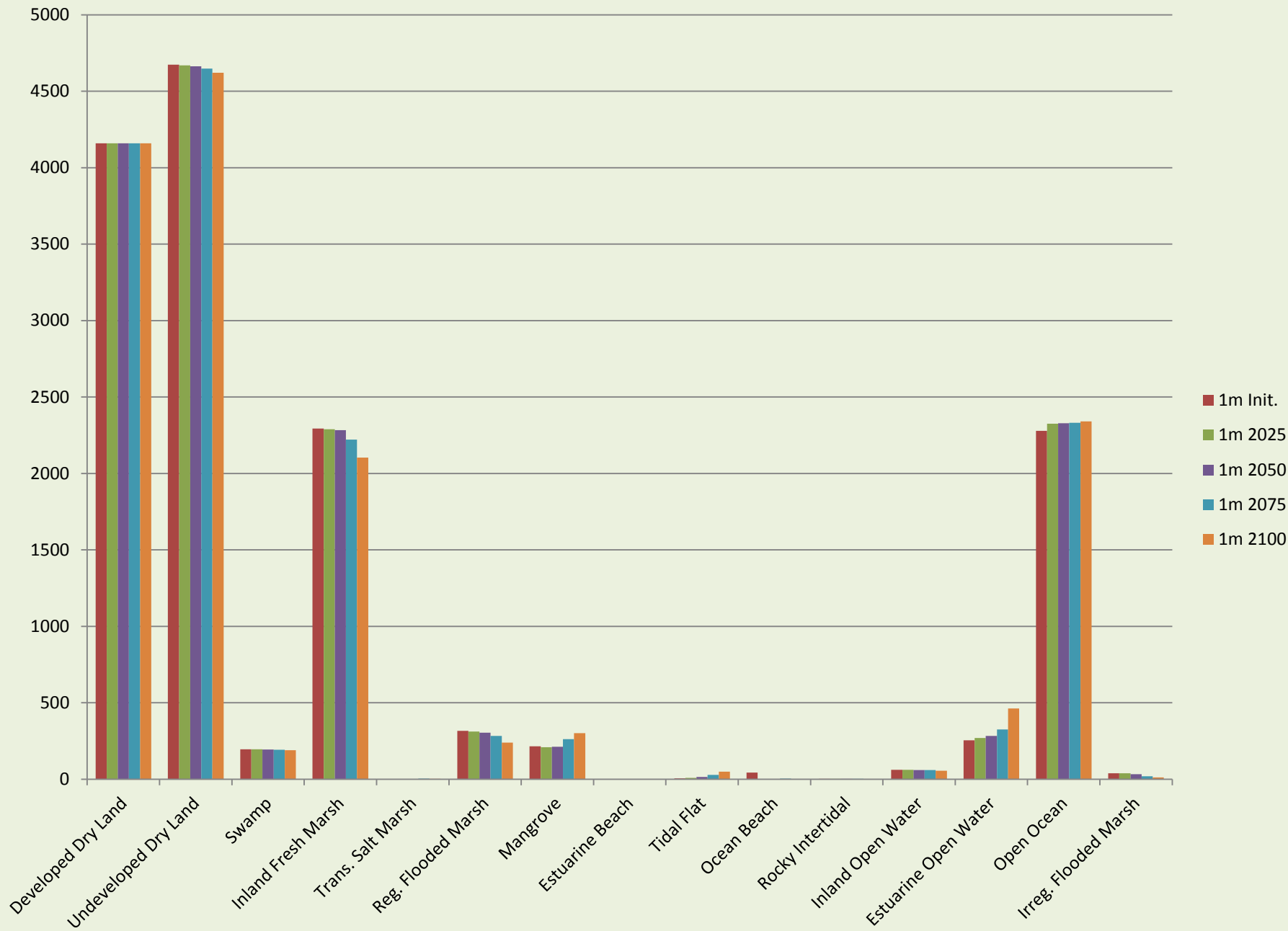
1m SLR, 2100

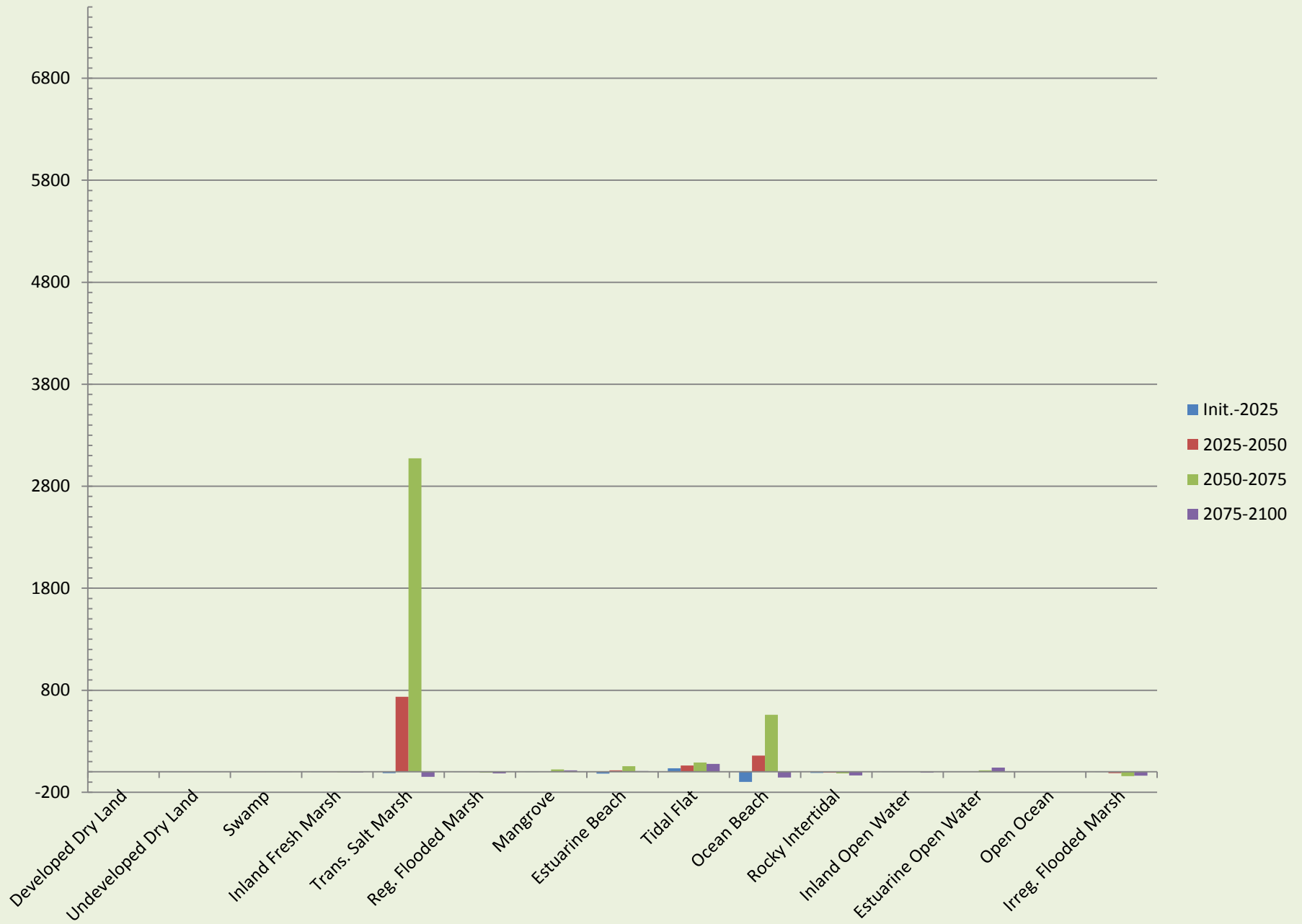
2100



Legend

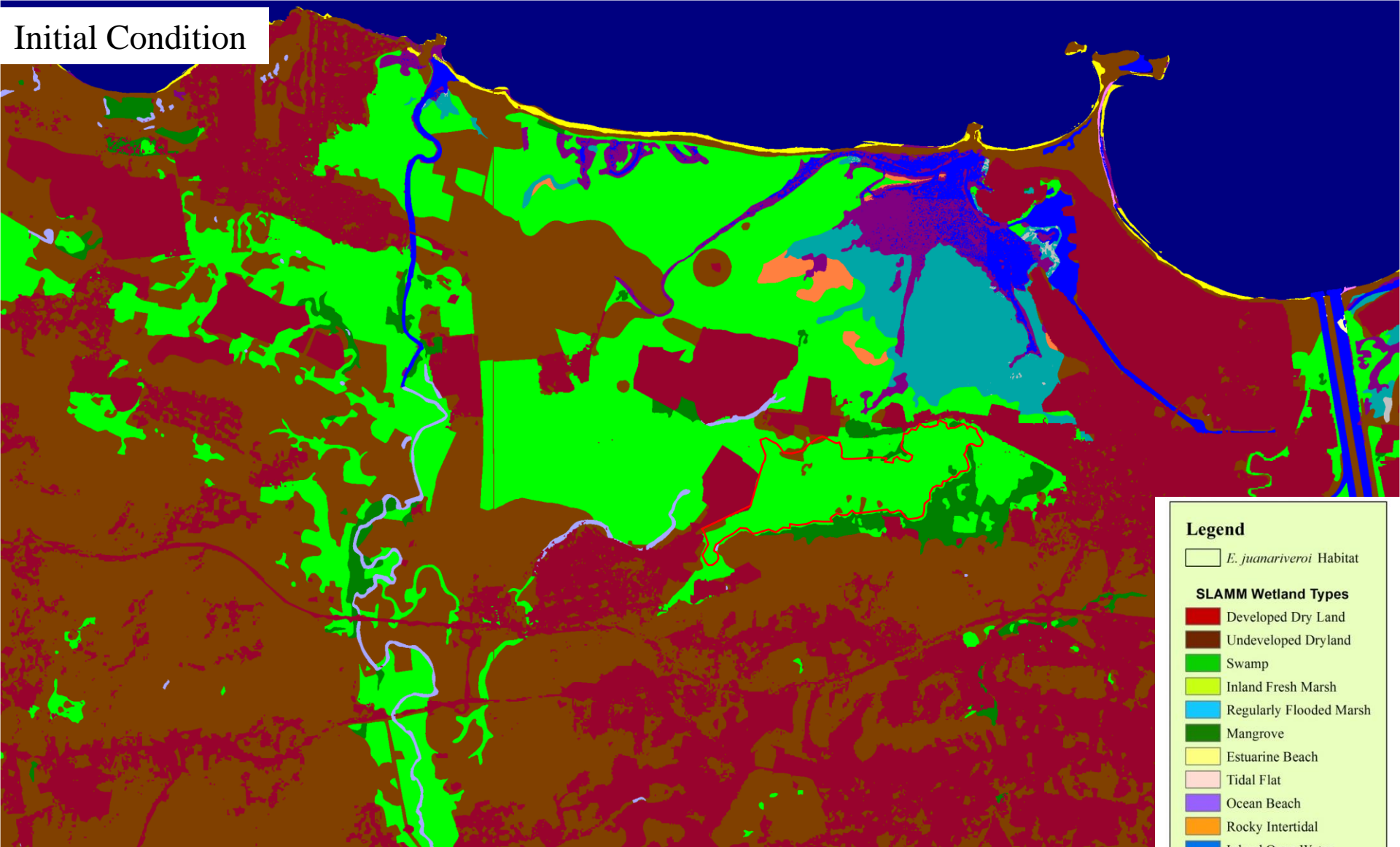
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1.5m SLR, 2100

Initial Condition

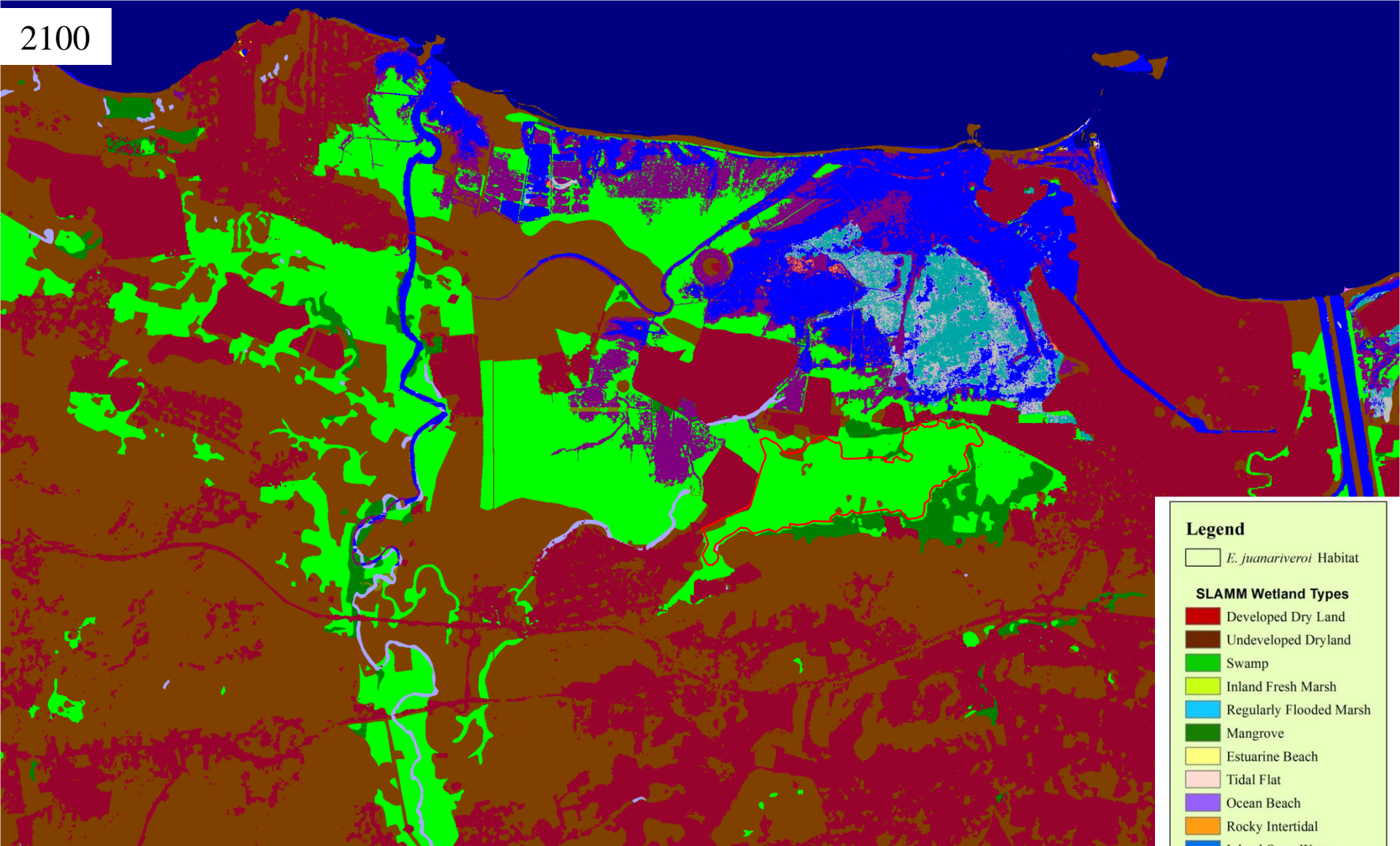


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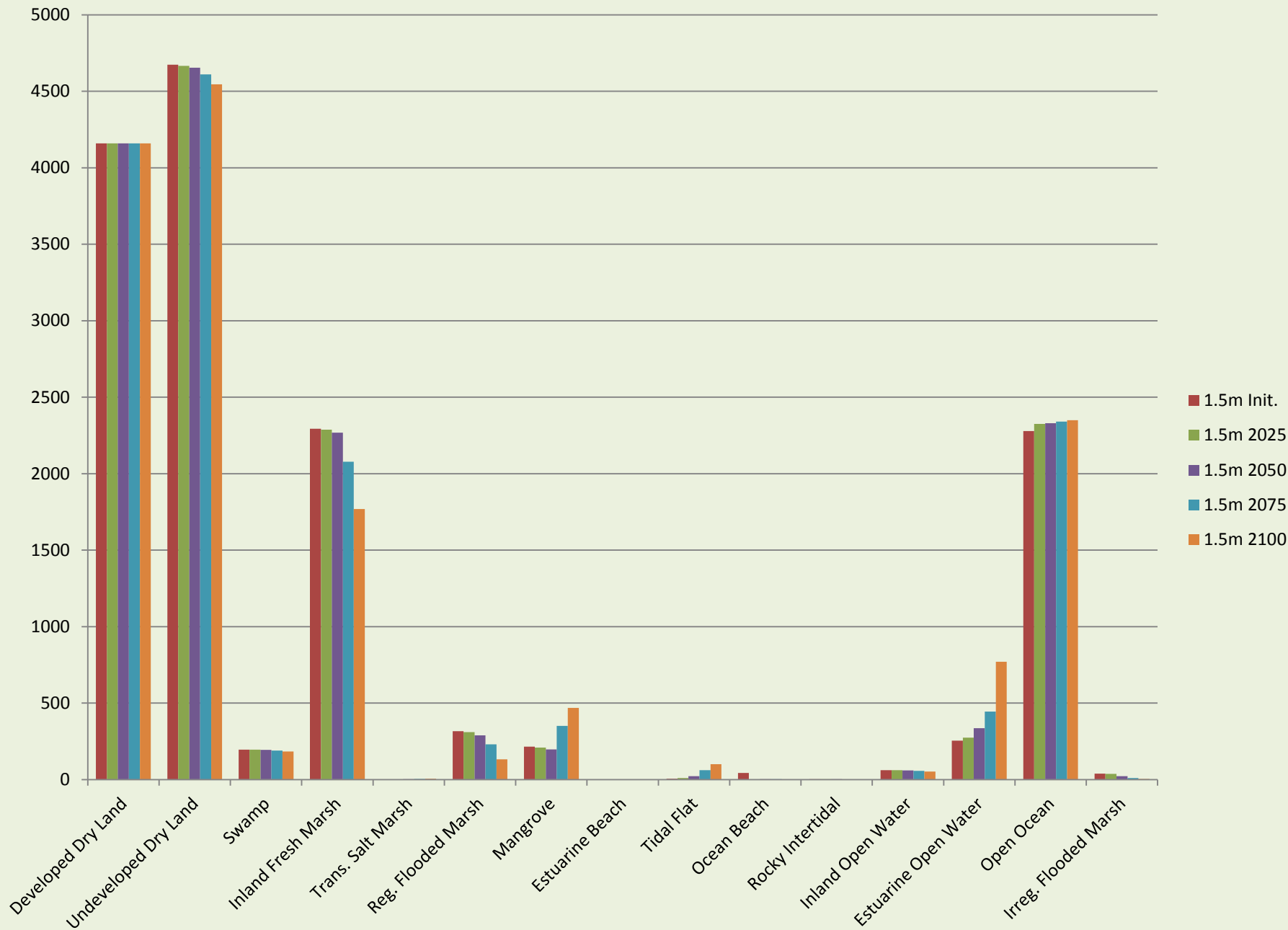
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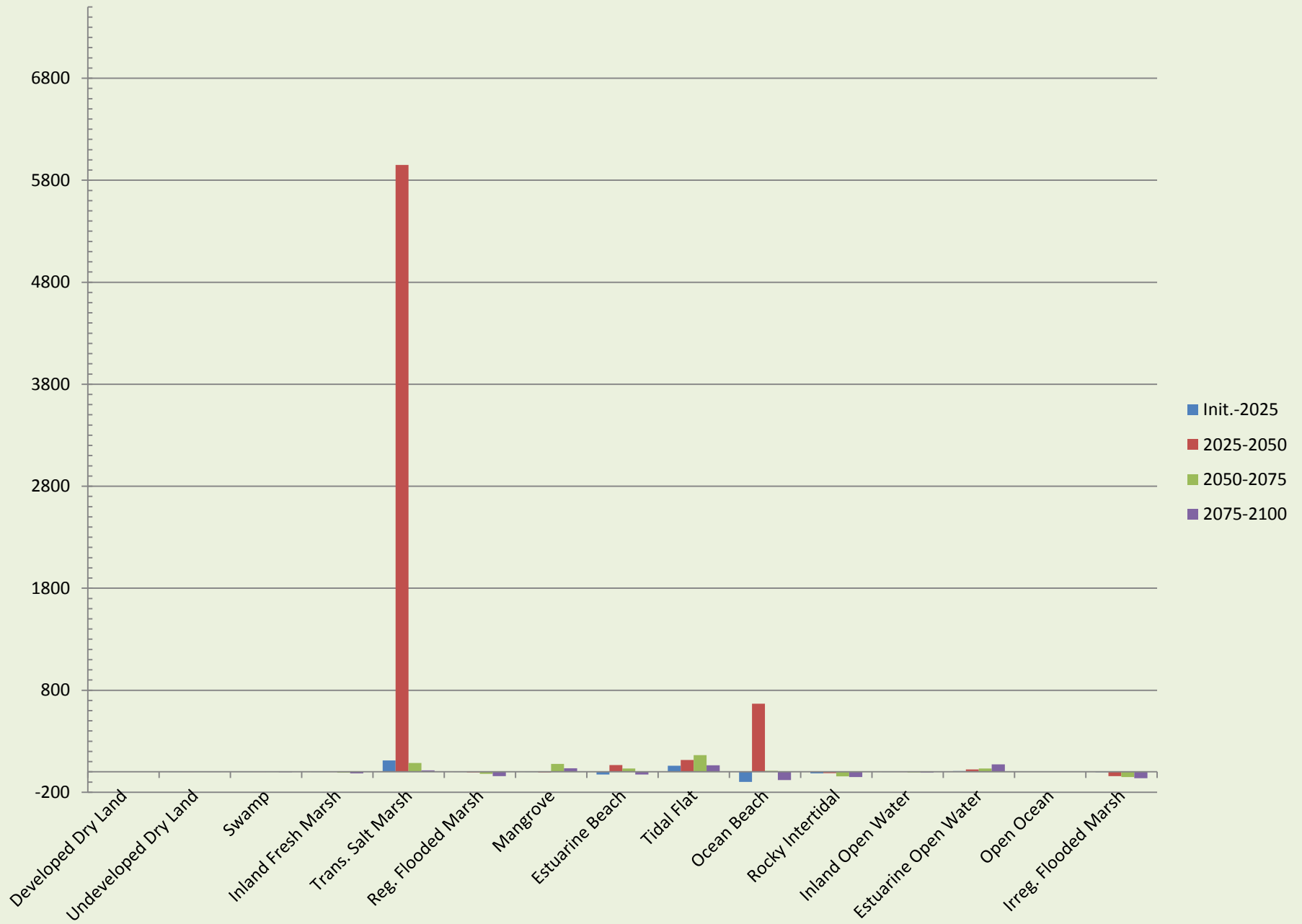
1.5m SLR, 2100

2100



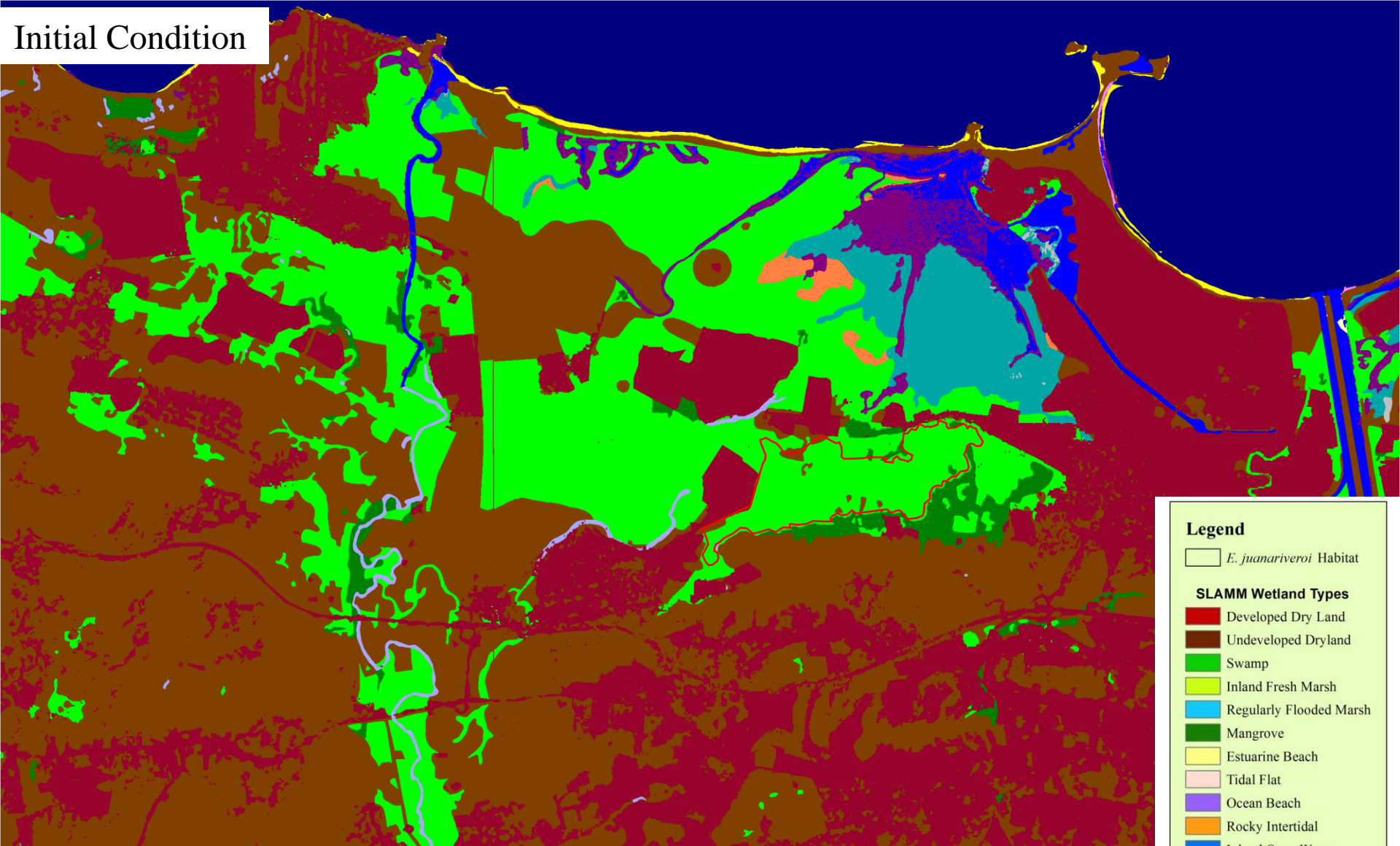
- Legend**
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2m SLR, 2100

Initial Condition

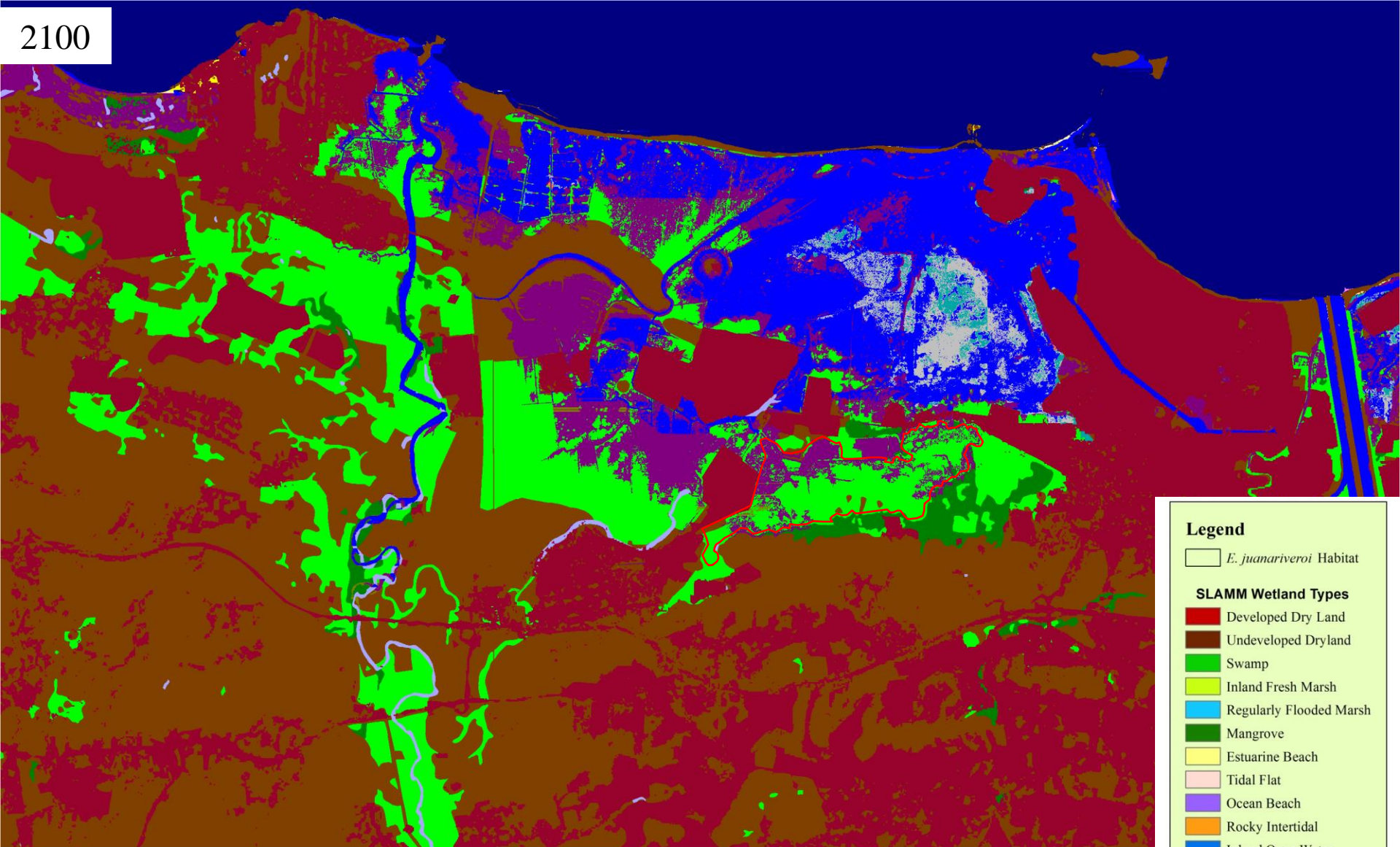


Legend

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2m SLR, 2100

2100

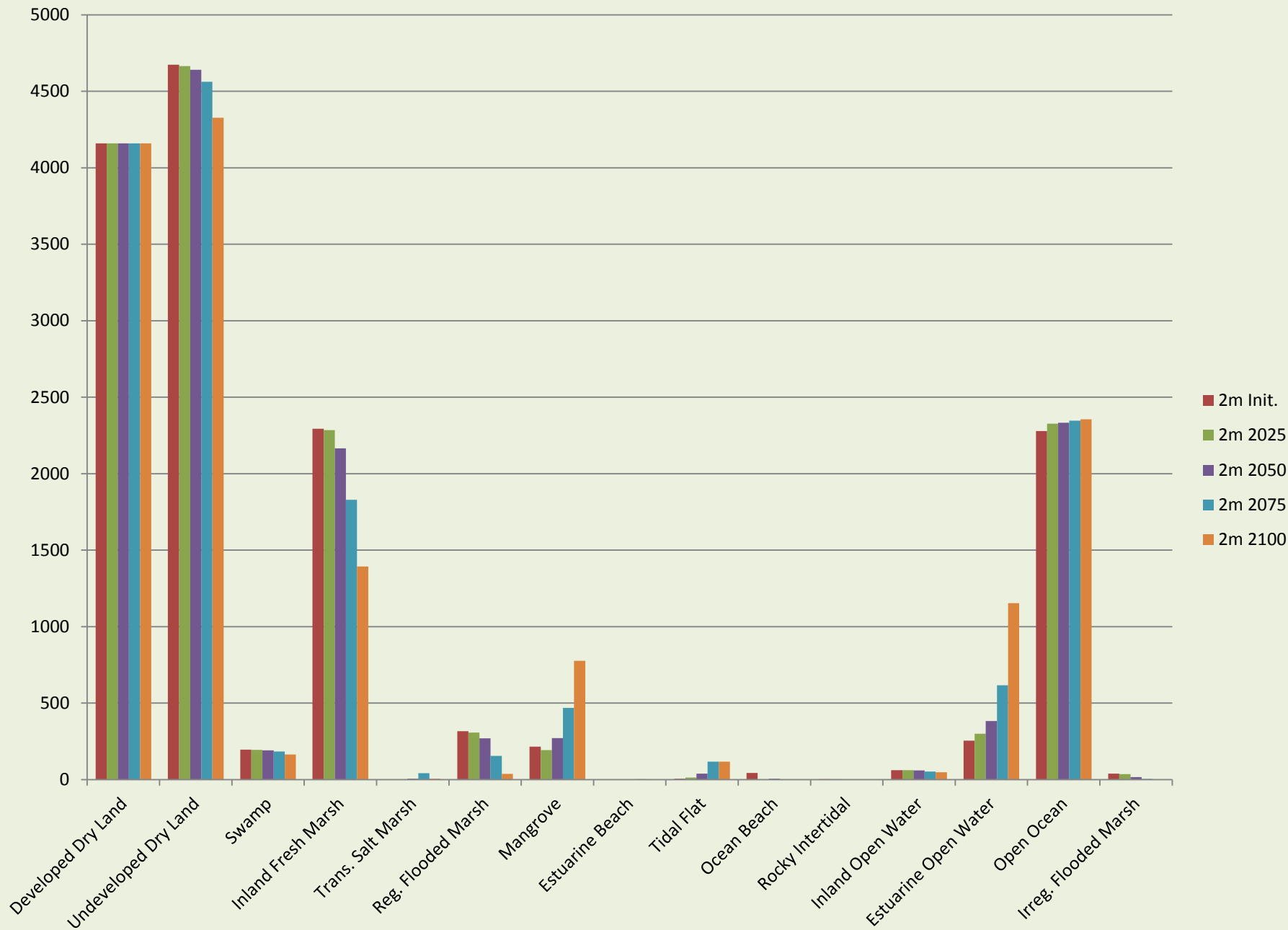


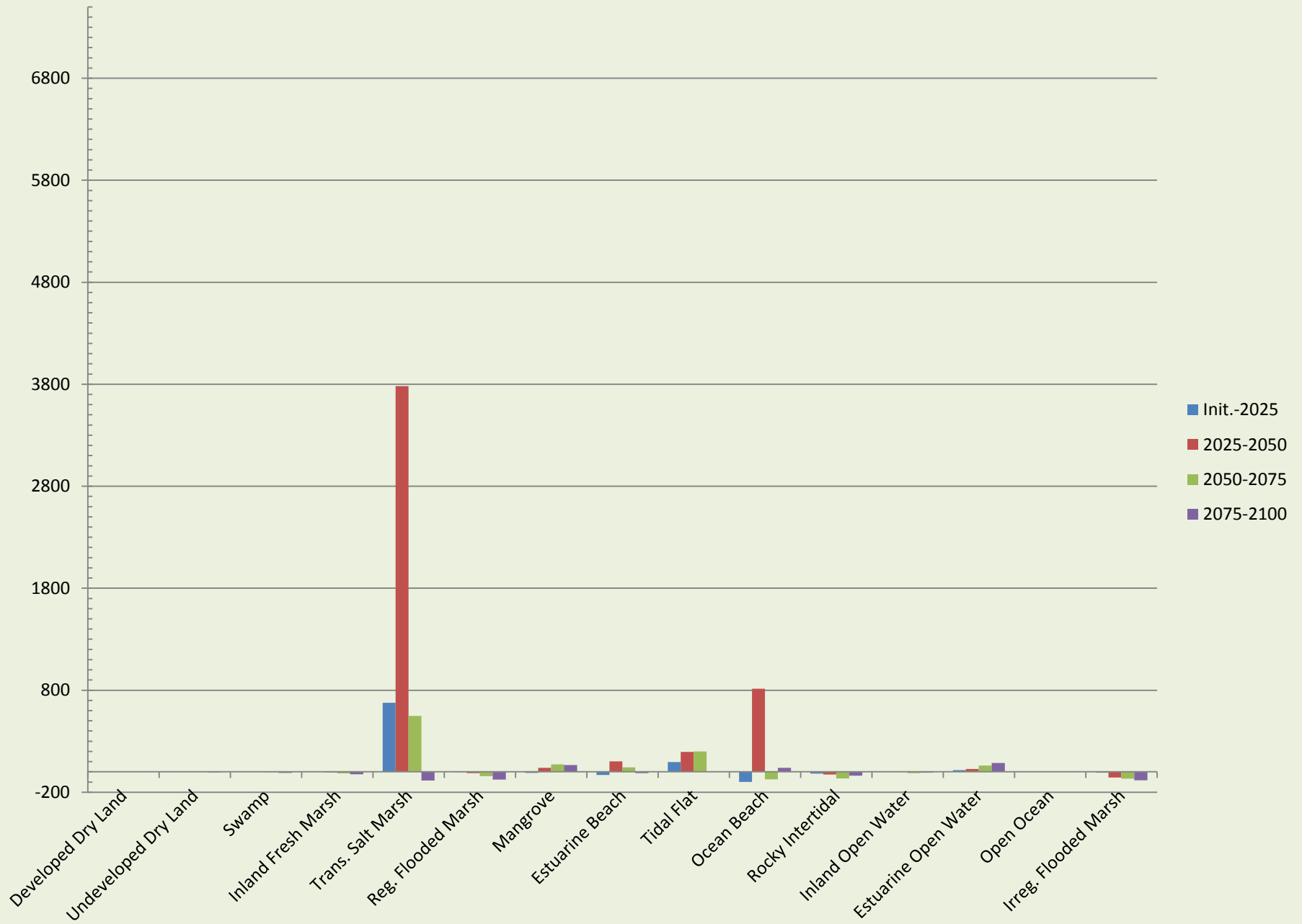
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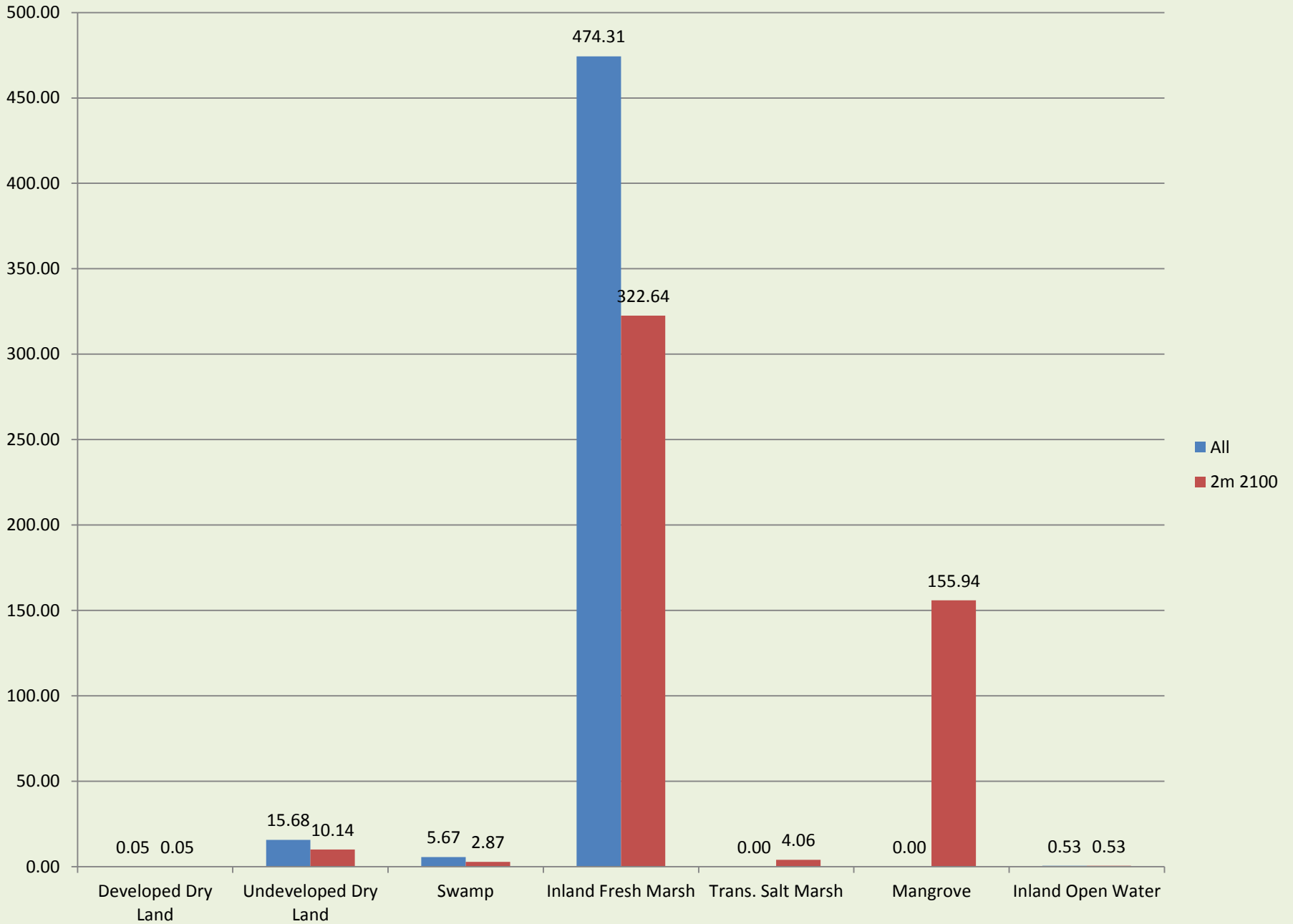
 *E. juanariveroi* Habitat

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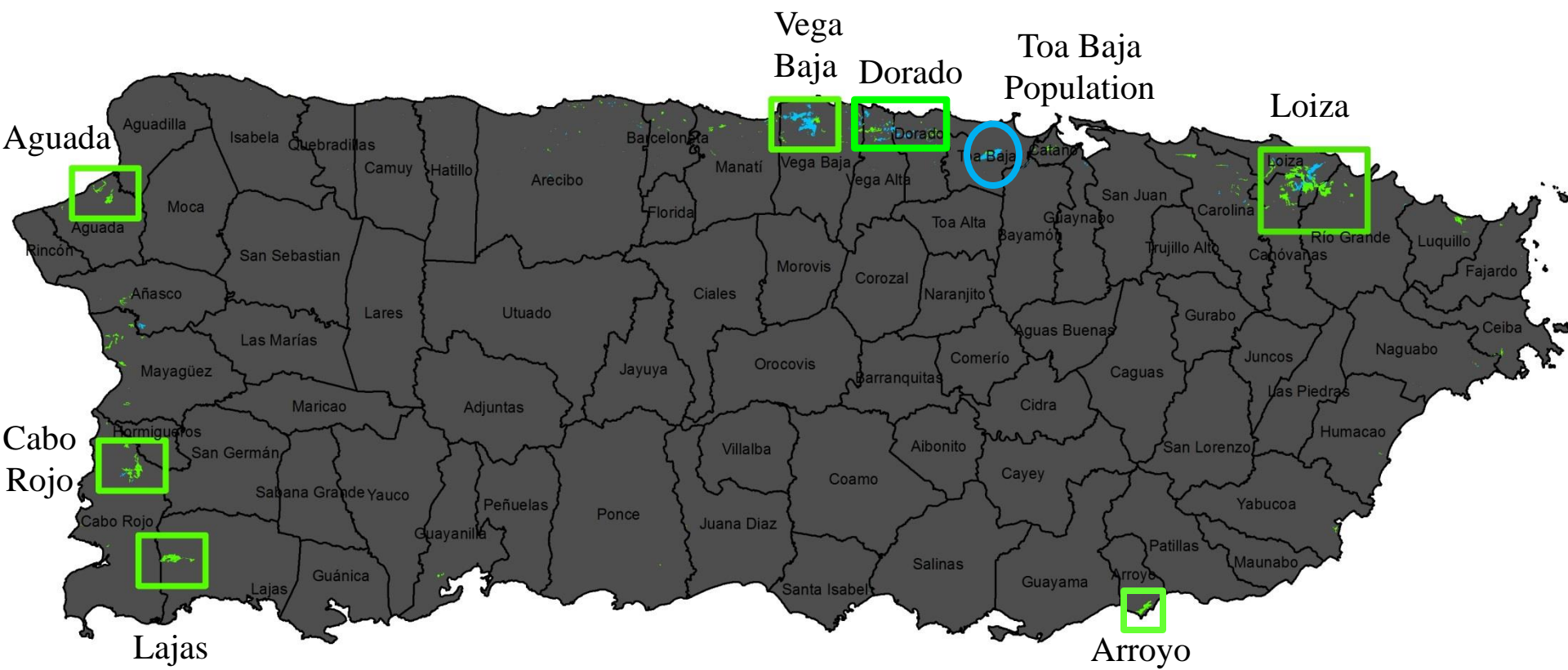




Potential Habitat for New Coquí Llanero Populations

Potential Habitat Identification

- The NWI classifies the coquí llanero habitat as a Palustrine (P), Emergent (EM), Persistent (1), permanently flooded (H), wetland (PEM1H).
- We included a second nontidal modifier, intermittently exposed (G), PEM1G



Arroyo



Lajas



Cabo Rojo



Aguada



Vega Baja



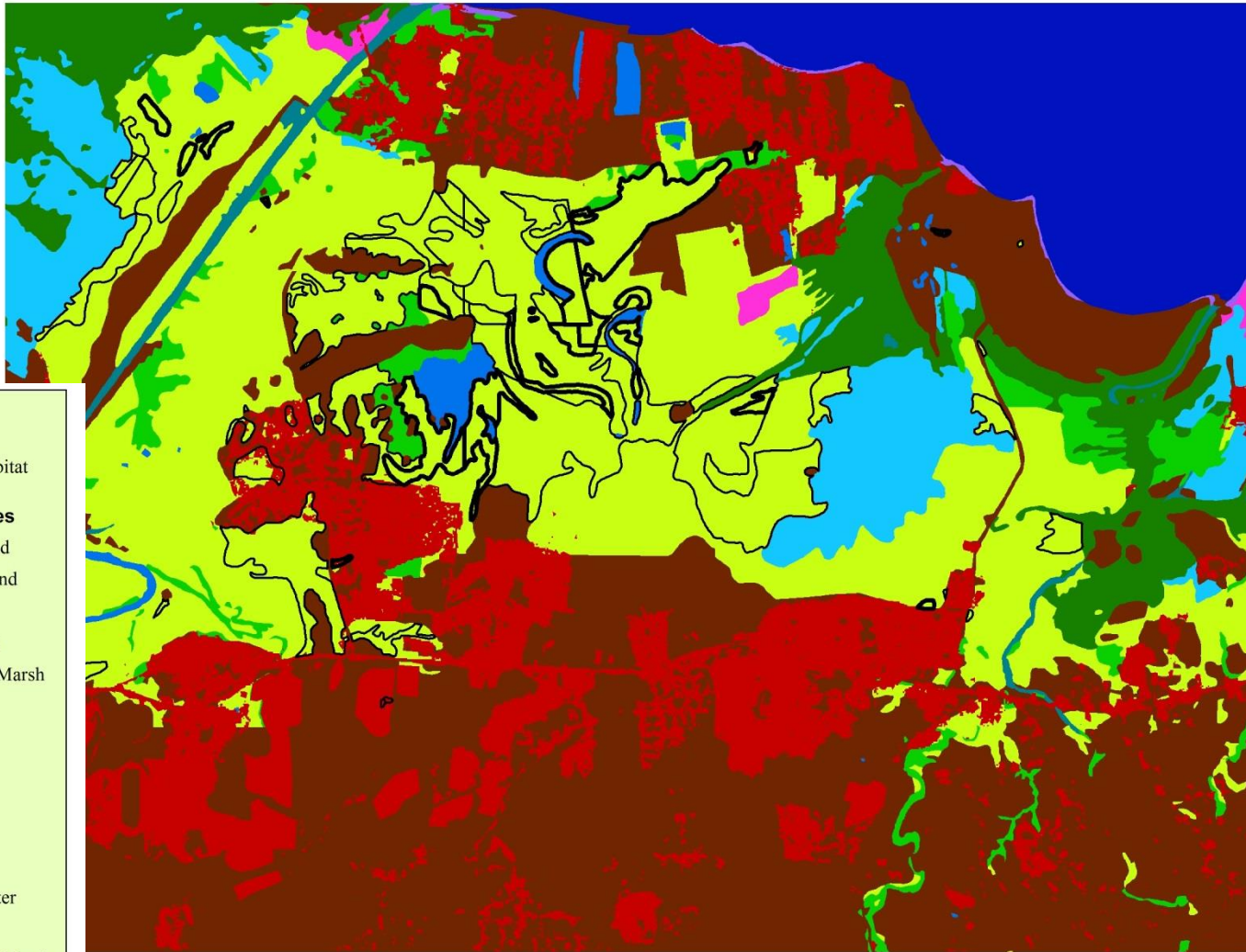
Dorado




Loiza



Initial Condition



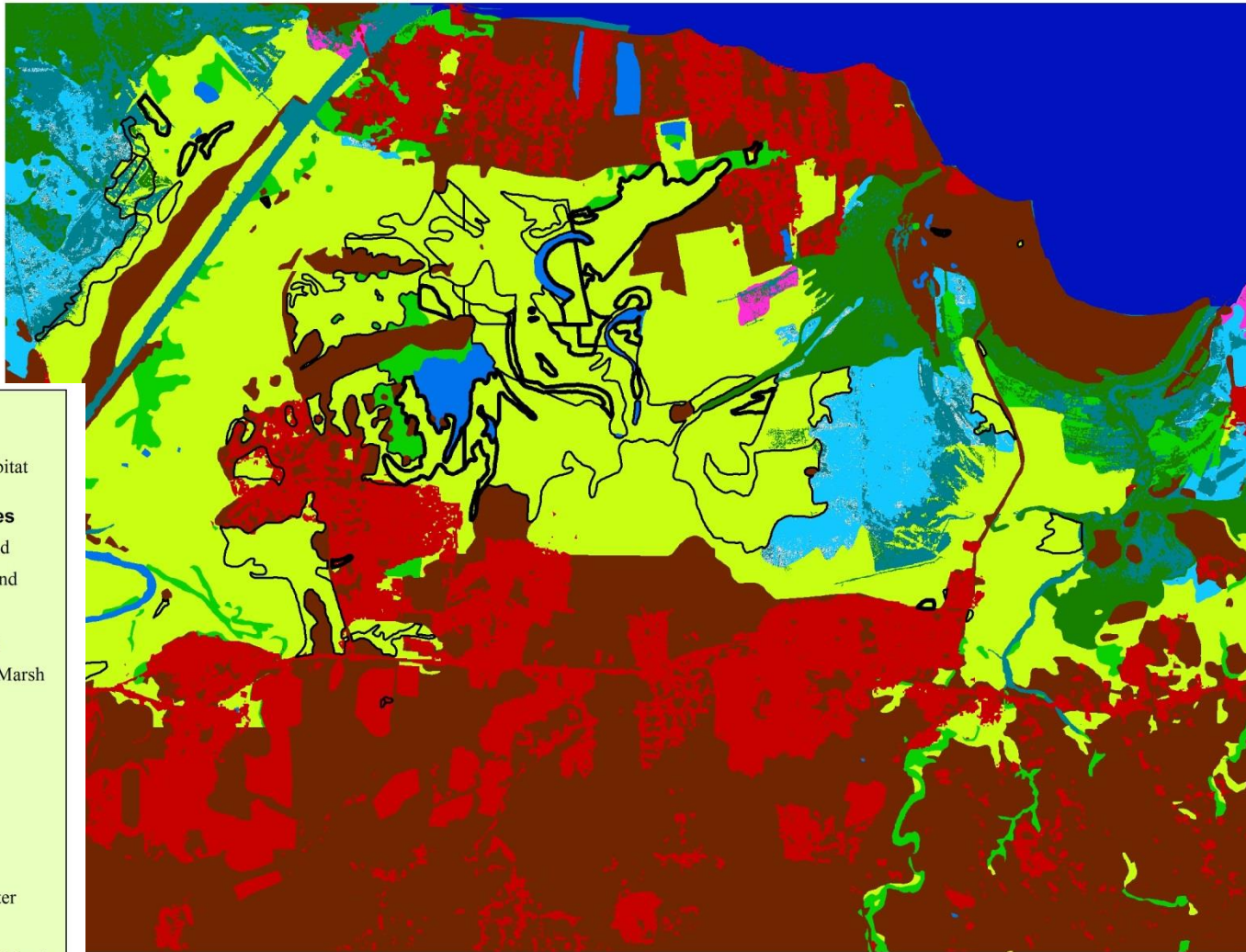
Legend

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1m SLR, 2100



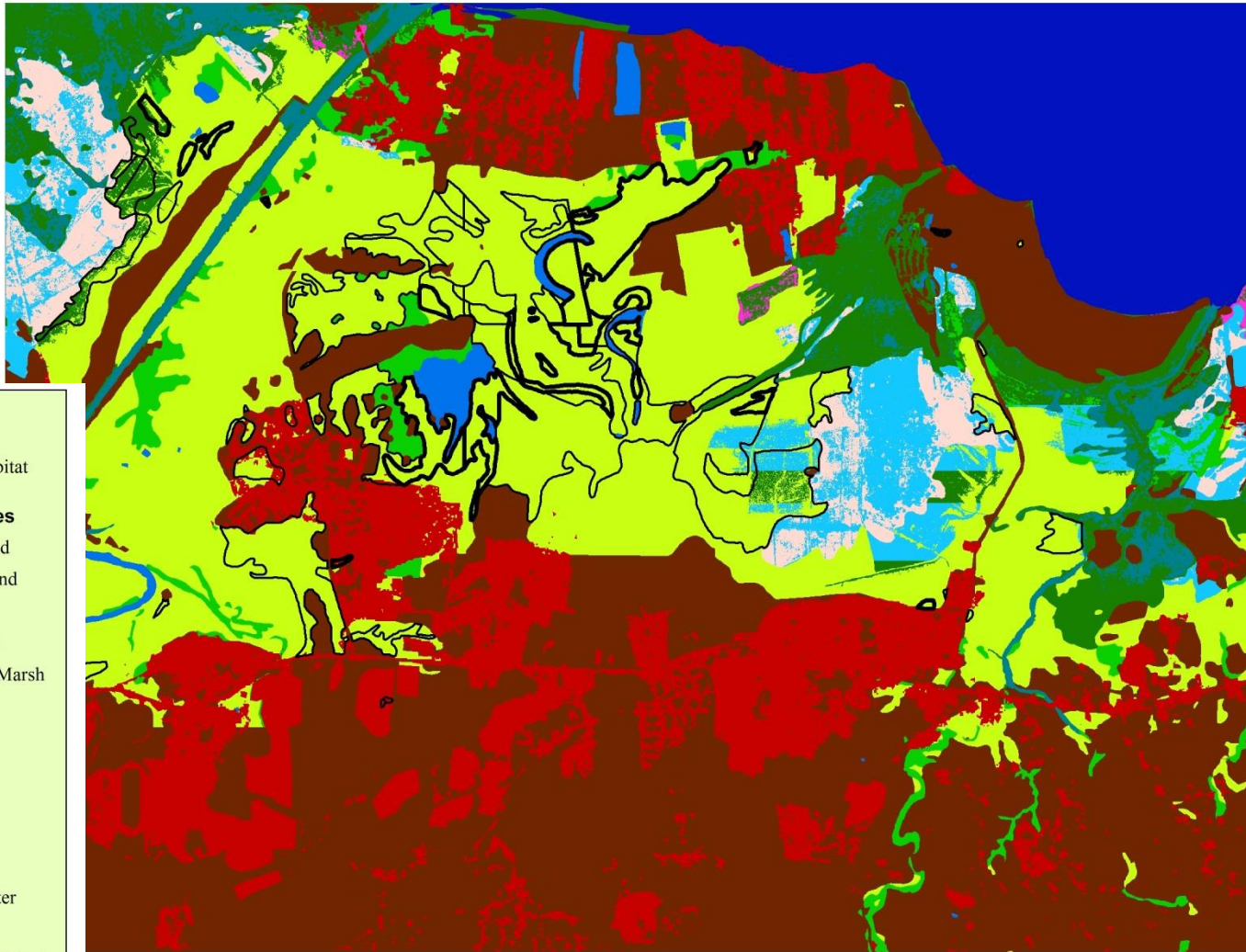
Legend

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1.5m SLR, 2100



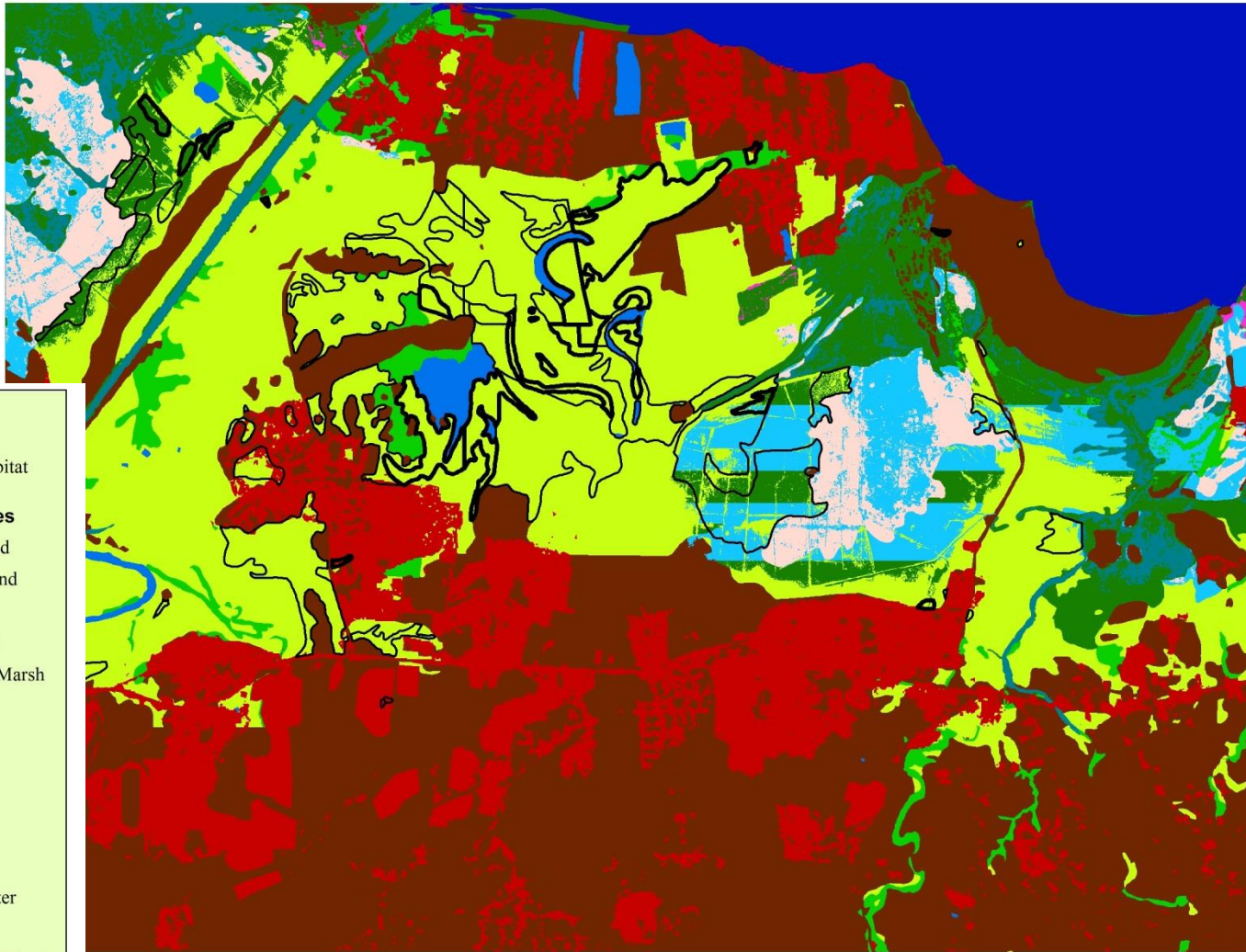
Legend

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2m SLR, 2100



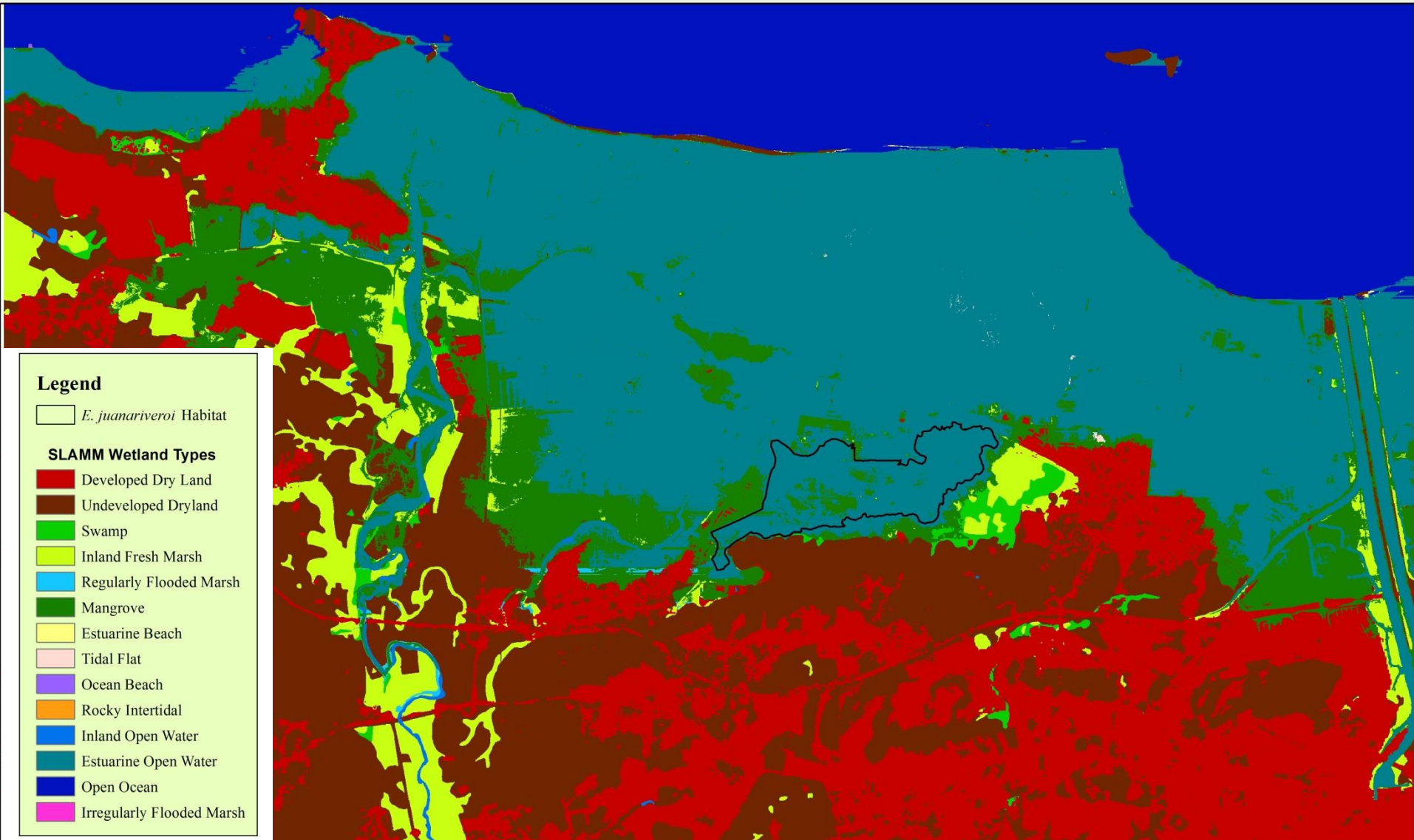
Legend

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5m SLR, 2100





Questions
are
guaranteed in
life;
Answers
aren't.