Coastal Wetlands of the United States

an overview

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Talk outline

- Introduction
- Pacific Coast
- Gulf of Mexico Coast
- Atlantic coast
  - North Atlantic
  - South Atlantic
  - Chesapeake Bay
- Conclusions

- Geology, soils, hydrology
- Environmental factors (salinity, temperature, tidal range)
- Plant communities
- Fauna

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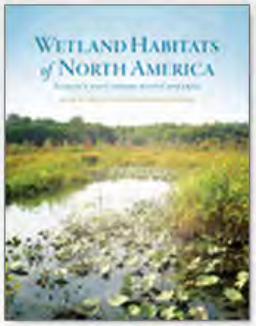

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Wetland Habitats of North America

Ecology and Conservation Concerns

Darold P. Batzer (Editor), Andrew H. Baldwin (Editor)

Available worldwide

A Stephen Bechtel Fund Book in Ecology and the Environment

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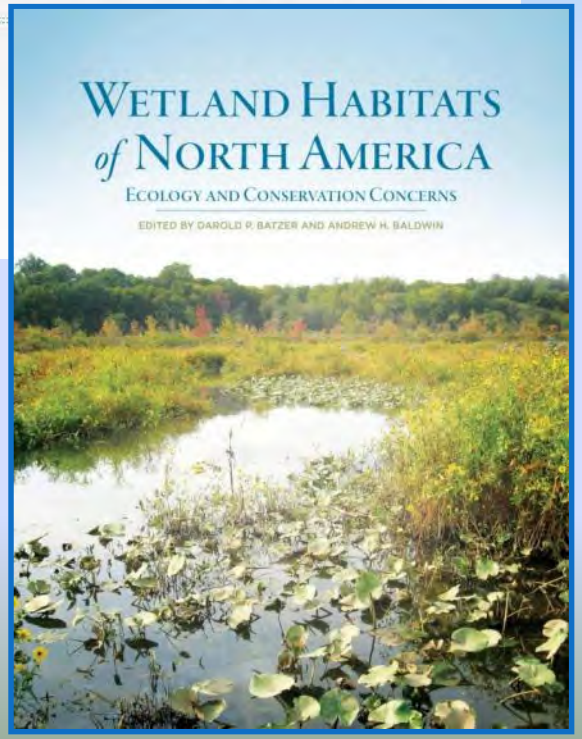

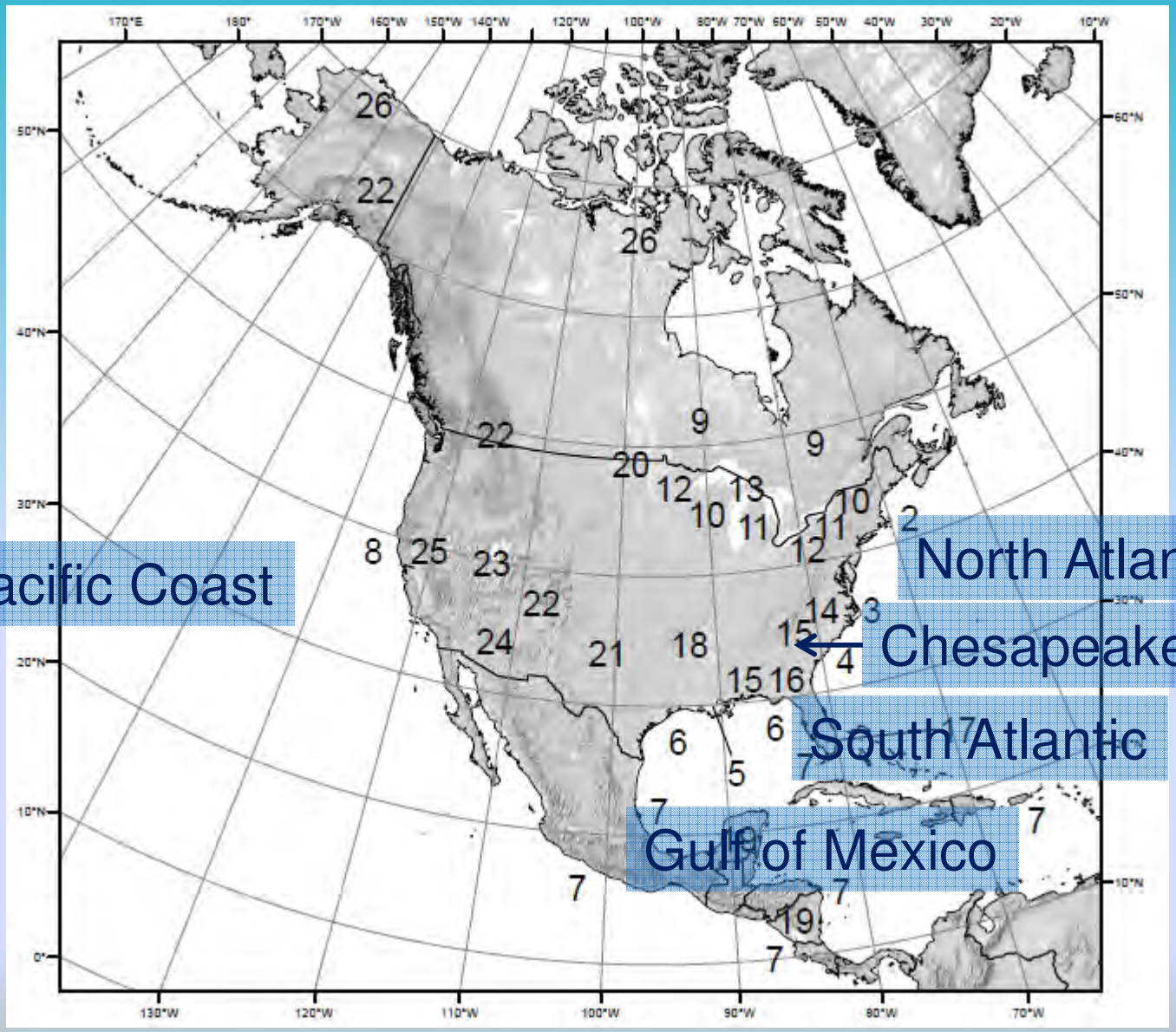

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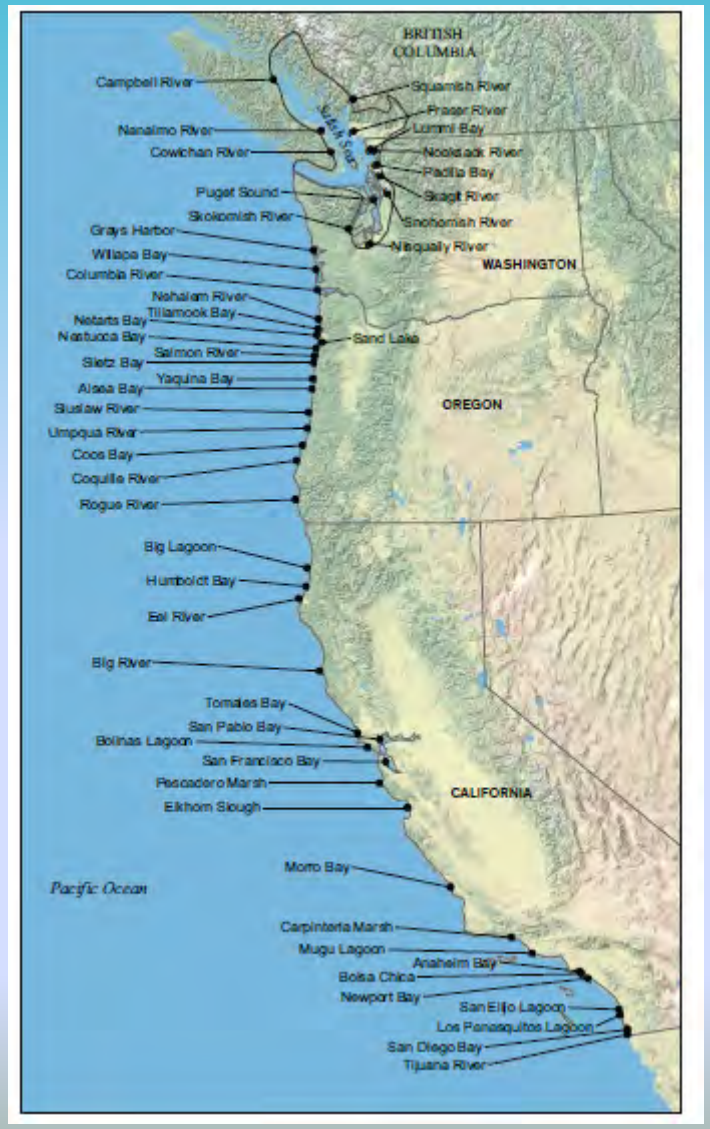
Pacific coast wetlands



- Geomorphology
  - Tectonic subduction zone
  - Small coastal plain; mountains constrain estuary size
    - Exceptions: Columbia R, Puget Sound, San Francisco Bay
  - Steep rock headlands
- Tides
  - Increase south to north
  - <2 m in California, 3-4 m in Washington
- Climate
  - Seasonal variation in precipitation and coastal development influence estuarine salinity

Callaway et al. in Batzer and Baldwin 2012

Plant communities

- Gradient of salt, brackish, and tidal freshwater plant communities proceeding upstream across estuaries

Saline	Brackish	Freshwater
California		
Atriplex triangularis	*Bolboschoenus maritimus*	*Calystegia sepium*
Batis maritima	*Euthamia occidentalis*	*Carex* spp.
Cuscuta salina	*Juncus balticus*	*Cephalanthus occidentalis*[a]
Distichlis spicata	*Lepidium latifolium*[b]	*Cornus sericea*[a]
Frankenia salina	*Potentilla anserina*	*Eleocharis* spp.
Grindelia stricta	*Schoenoplectus acutus*	*Lycopus americanus*
Jaumea carnosa	*Schoenoplectus americanus*	*Persicaria maculata*
Limonium californicum	*Schoenoplectus californicus*	*Phragmites australis*
Sarcocornia pacifica	*Triglochin maritima*	*Rubus armeniacus*[b]
Spartina alterniflora and hybrids	*Typha domingensis*	*Salix lasiolepis*[a]
Spartina foliosa		*Stachys albens*
		Typha latifolia

Callaway et al. in Batzer and Baldwin 2012

Salt marsh community, strait of Juan de Fuca, Washington.
Sarcocornia pacifica and *Distichlis spicata* are common here.

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Tidal freshwater marsh community, San Joaquin-Sacramento Delta, California. *Schoenoplectus acutus* (tule) dominates.

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Delta smelt, *Hypomesus transpacificus*

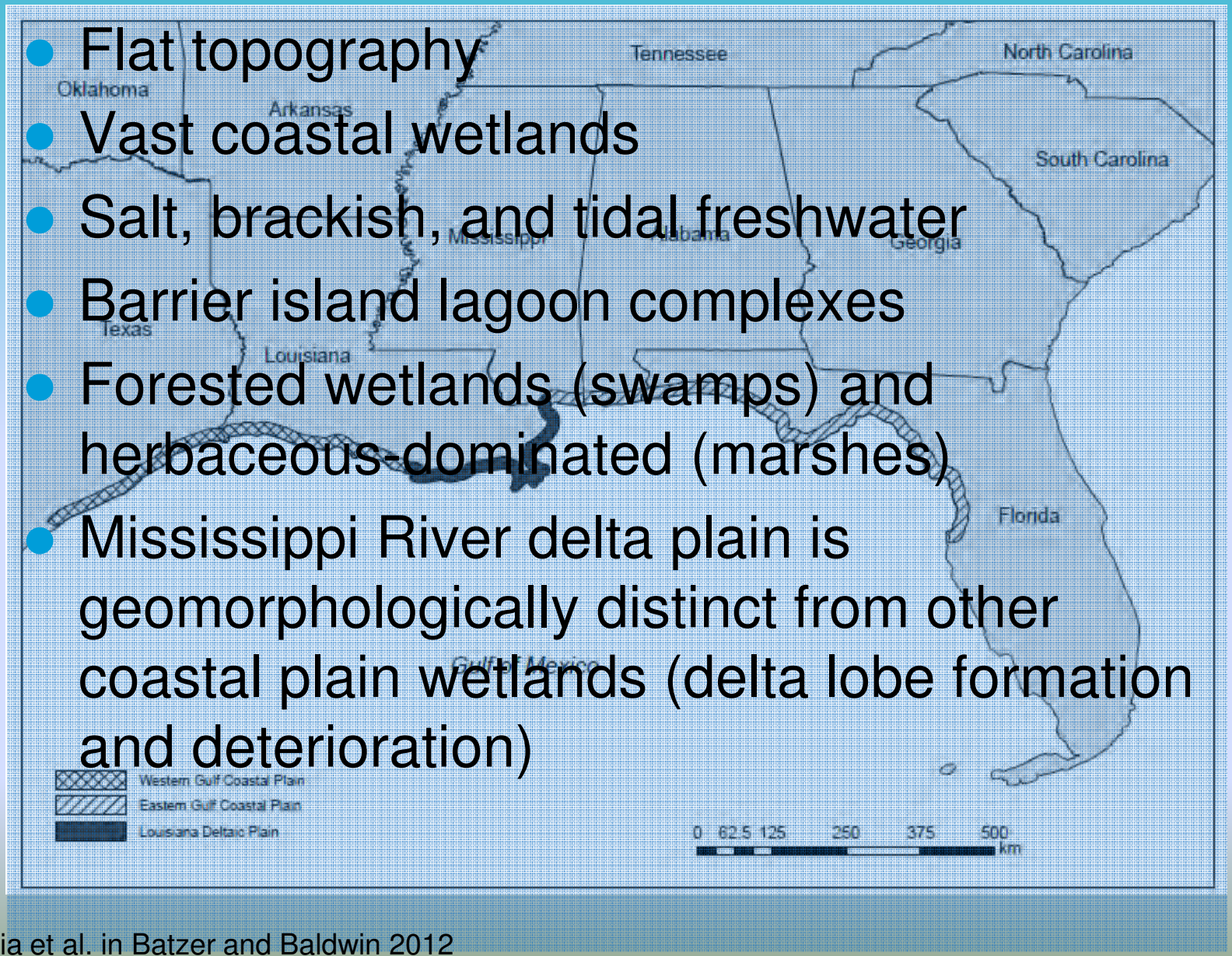
AH Baldwin

Wetland losses

Photo by AH Baldwin

Gulf of Mexico coastal wetlands

- Flat topography
- Vast coastal wetlands
- Salt, brackish, and tidal freshwater
- Barrier island lagoon complexes
- Forested wetlands (swamps) and herbaceous-dominated (marshes)
- Mississippi River delta plain is geomorphologically distinct from other coastal plain wetlands (delta lobe formation and deterioration)



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Coastal wetlands on Western Gulf Coastal Plain. *Juncus roemerianus* and *Spartina alterniflora* are dominants here.

Battaglia et al. in Batzer and Baldwin 2012

Coastal transition on Eastern Gulf Coastal Plain. *Juncus roemerianus* and *Spartina alterniflora* are marsh dominants, and grade into maritime forest.

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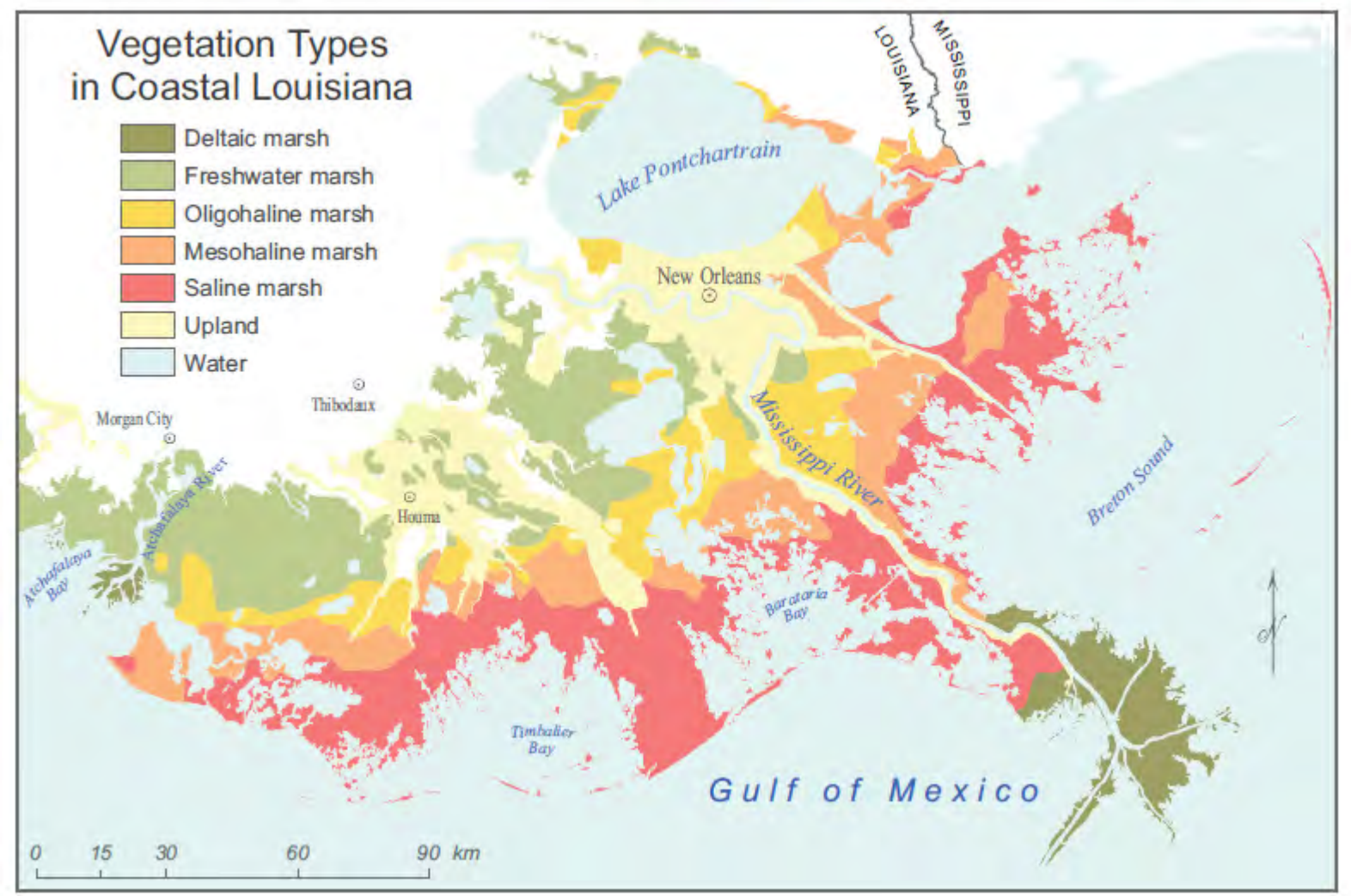
Mississippi River Delta Plain



Louisiana contains about 40% of the coastal wetlands in the 48 contiguous US states

Visser et al in Batzer and Baldwin 2012

TABLE 5.1

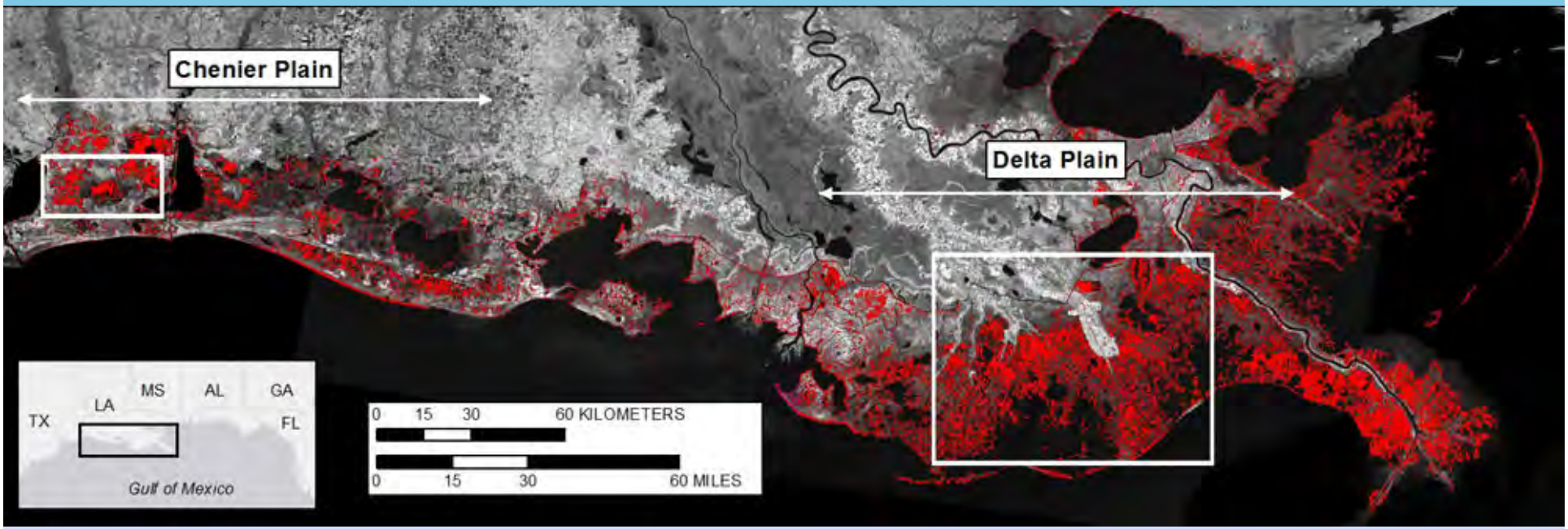
Summary of the different habitats in the Mississippi Deltaic Plain

Habitat type	Present area[a] (ha)	Soil salinity[b] (ppt)	Soil bulk sensity[c] (g cm^{-3})	Soil organic matter[d] (%)
Deltaic marsh	95,862	1.7	1.10	11
Forested wetlands	140,000		0.21	23
Fresh marsh	210,538	1.2	0.09	67
Oligohaline marsh	139,819	4.1	0.08	60
Mesohaline marsh	169,293	7.4	0.14	37
Saline marsh	248,188	10.5	0.29	19

Total of about 1,003,000 ha of coastal wetlands in the Delta Plain alone

Visser et al in Batzer and Baldwin 2012

Historical wetland loss, coastal Louisiana (in red)



Delta Plain: Loss of 2,251 km^2 from 1956-2006

Currently 38.9 +/- 5.6 km^2/yr

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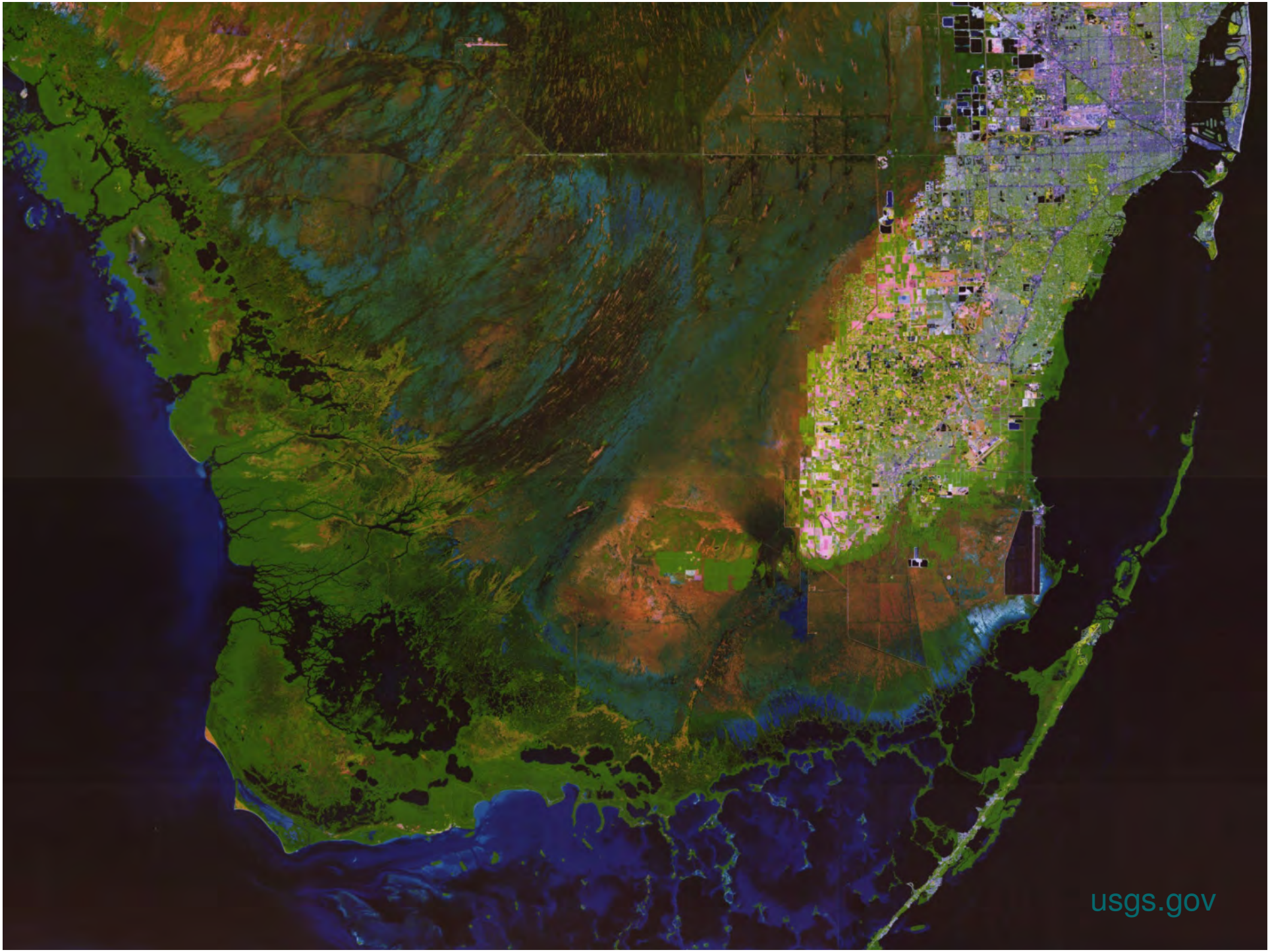
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Mangroves

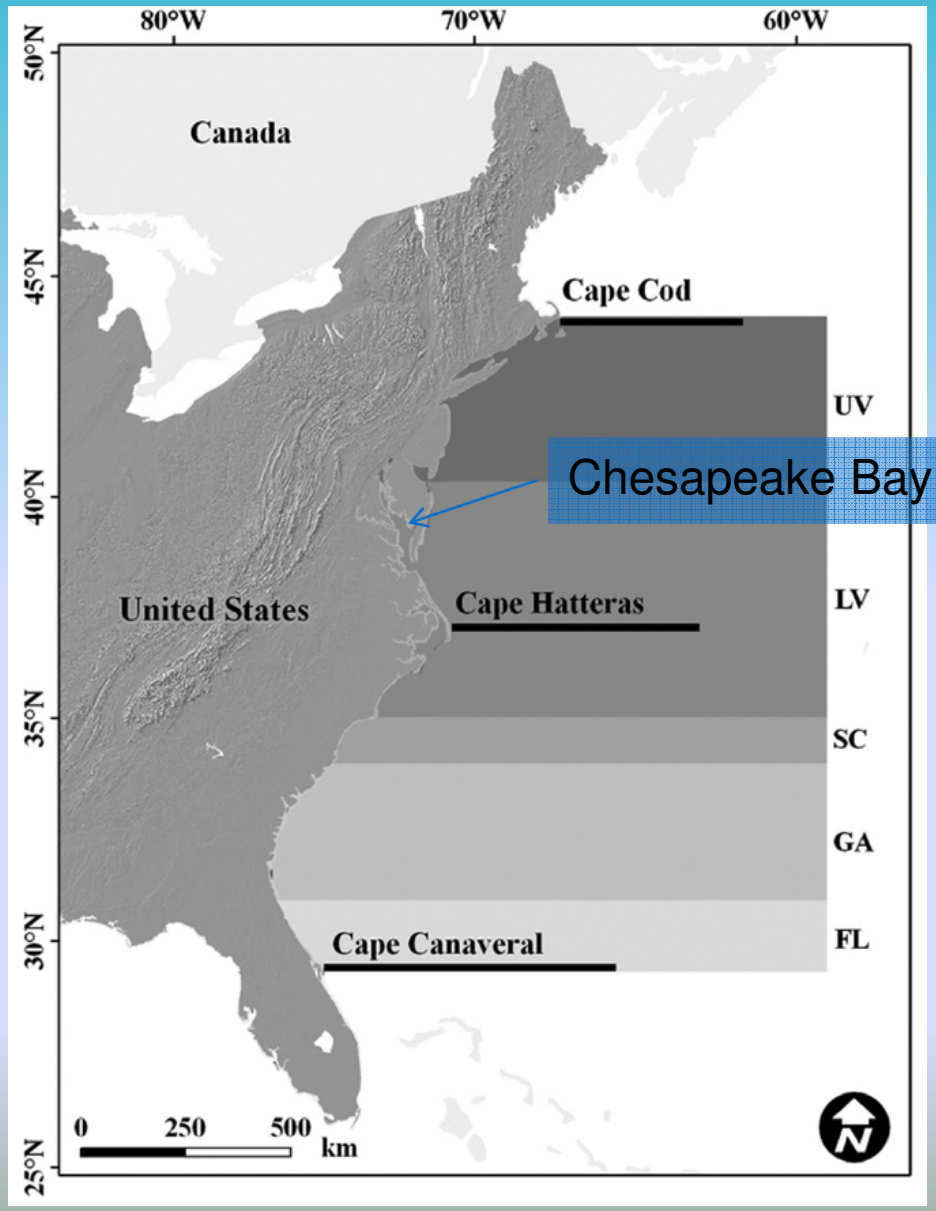
Productivity up to >2,200 g m^{-2} yr^{-1}

McKee in Batzer and Baldwin 2012


A

Atlantic Coast wetlands

- Broad latitudinal gradient
- Located in the coastal plain
- Marshes and swamps
- Tidal freshwater, brackish, and salt



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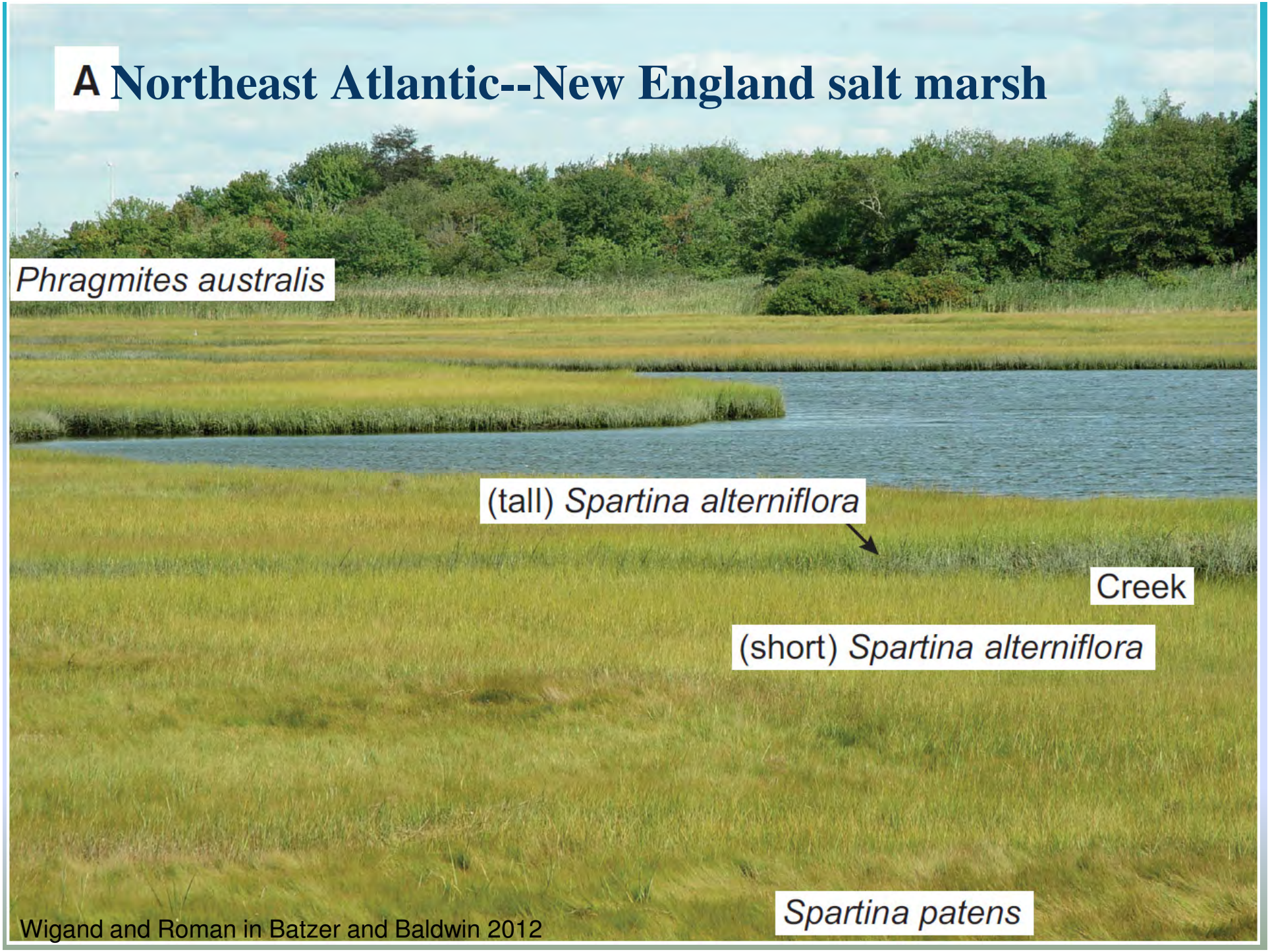

A Northeast Atlantic--New England salt marsh
Phragmites australis
(tall) Spartina alterniflora
Creek
(short) Spartina alterniflora
Spartina patens
Wigand and Roman in Batzer and Baldwin 2012

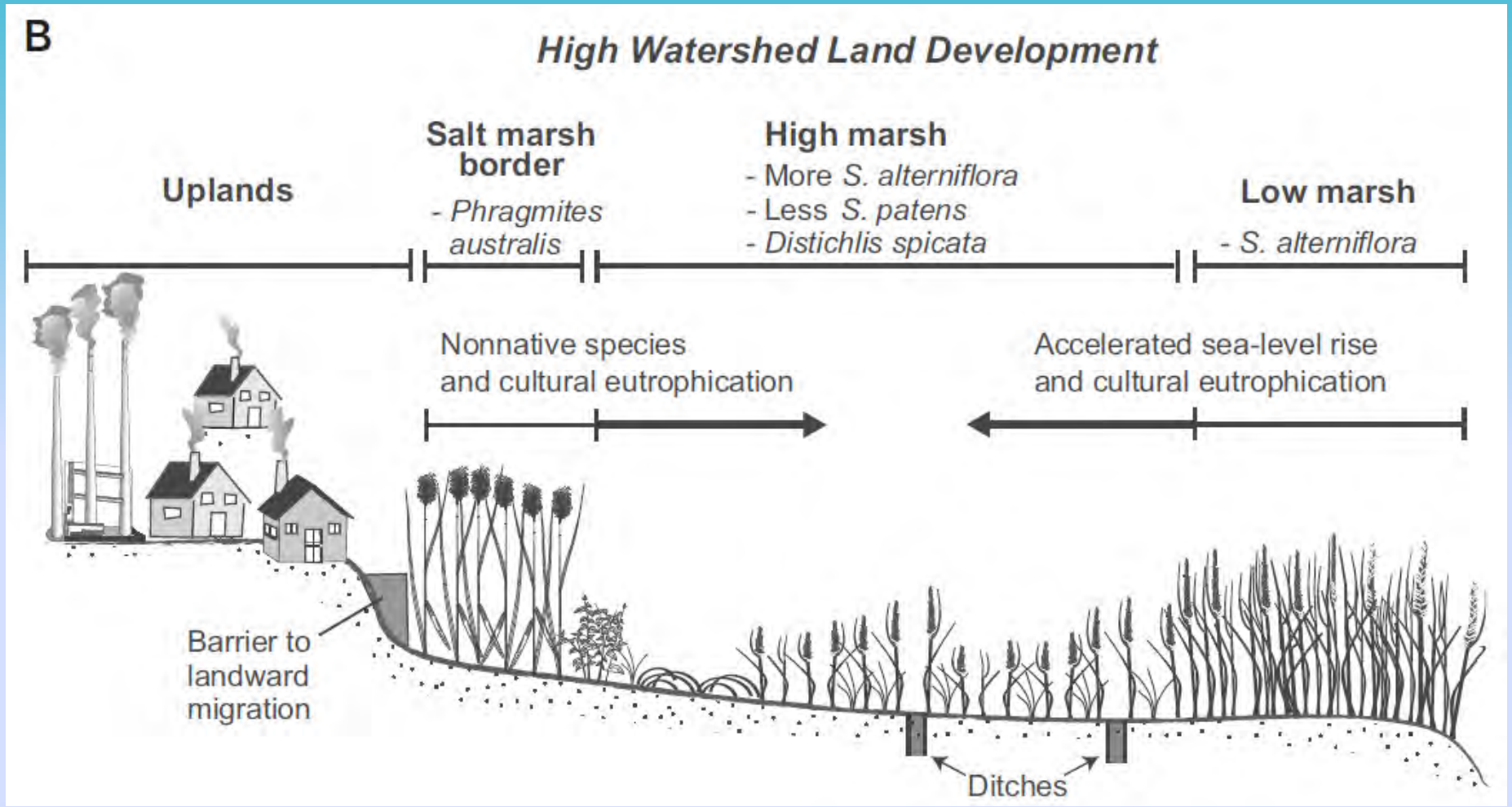
TABLE 2.1

Areal extent and size of the coastal tidal wetlands of the northeastern U.S. states from Delaware Bay to Maine

Northeastern U.S. state	Estuarine intertidal emergent (ha)	Average size (ha)	Estuarine intertidal scrub-shrub (ha)	Average size (ha)	Riverine tidal emergent (ha)	Average size (ha)	Total areal extent (ha)
Delaware[a]	27,471	27.3	236	4.1	4	3.5	27,711
New Jersey	81,665	19.6	646	1.7	267	10.7	82,578
Pennsylvania	0	na	0	na	64	7.1	64
New York	12,319	4.5	346	1.1	4	1.0	12,669
Connecticut	4,846	4.8	23	2.6	68	3.1	4,936
Rhode Island	1,370	1.3	90	0.7	0	na	1,460
Massachusetts	18,176	4.7	412	1.5	2	1.2	18,590
New Hampshire	2,340	7.9	0	na	0	na	2,340
Maine	8,723	2.7	39	0.9	21	1.3	8,783

The northeast US (Delaware to Maine) contains approximately 160,000 ha of coastal wetlands; more than half are in New Jersey

Wigand and Roman in Batzer and Baldwin 2012



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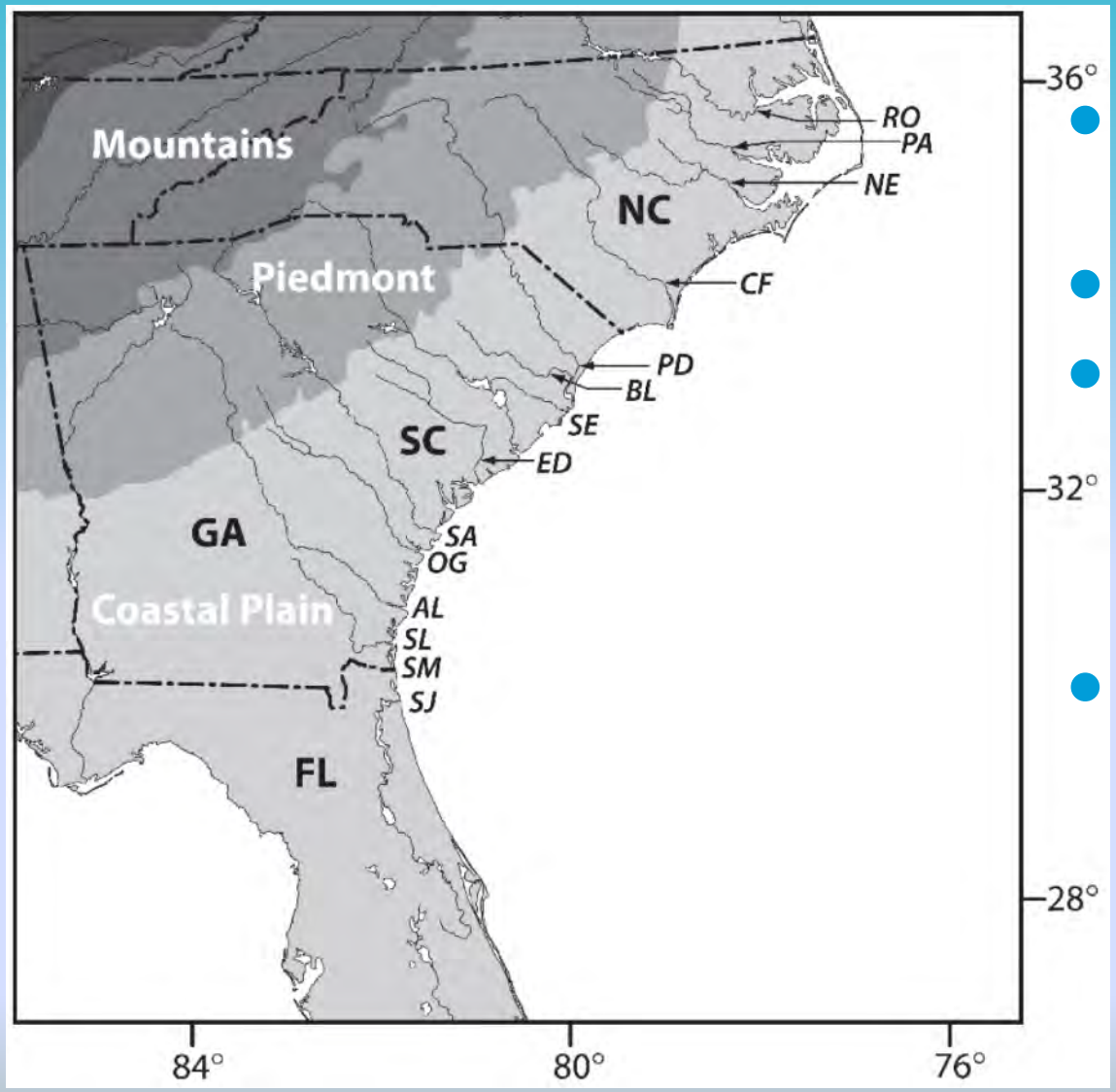
Southeast Atlantic



- Warm and wet climate
- Tidal range of 1-3 m
- Soils have less organic matter than northeast and Gulf Coast wetlands
- Fewer anthropogenic impacts than northeast US Atlantic coast

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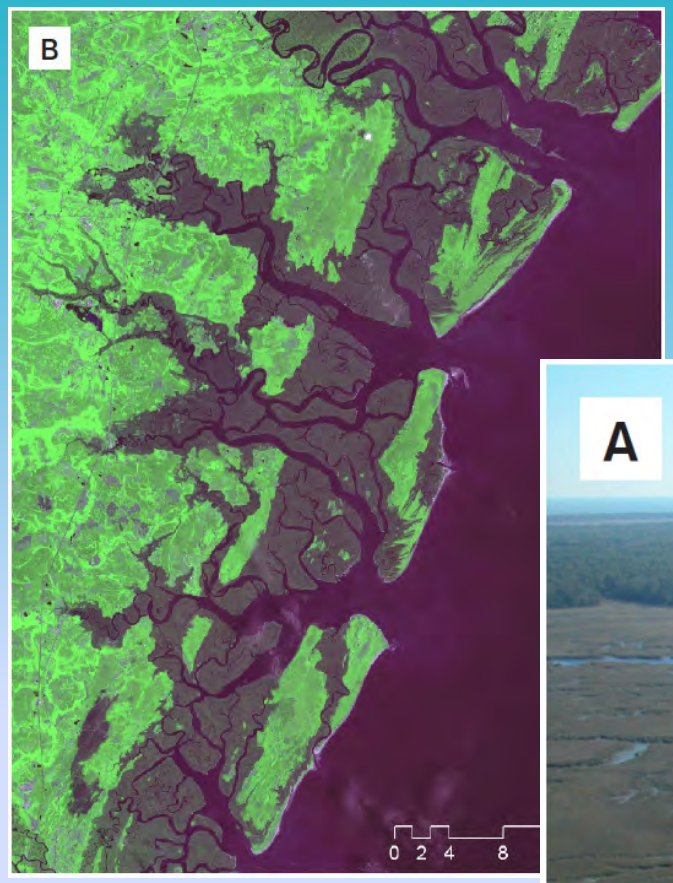
Georgia salt marshes



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E
Spartina alterniflora salt marsh at low tide
Oyster reefs (*Crassostrea virginica*)
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Alligator mississippiensis: The American Alligator

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Littoraria irrorata: The littorine snail

Experiment: *Littoraria* caged at 600 m^{-2} decreased *Spartina alterniflora* biomass by 65-90%

Herbivorous crab, *Sesarma reticulatum*

Both have been implicated in localized marsh die-back

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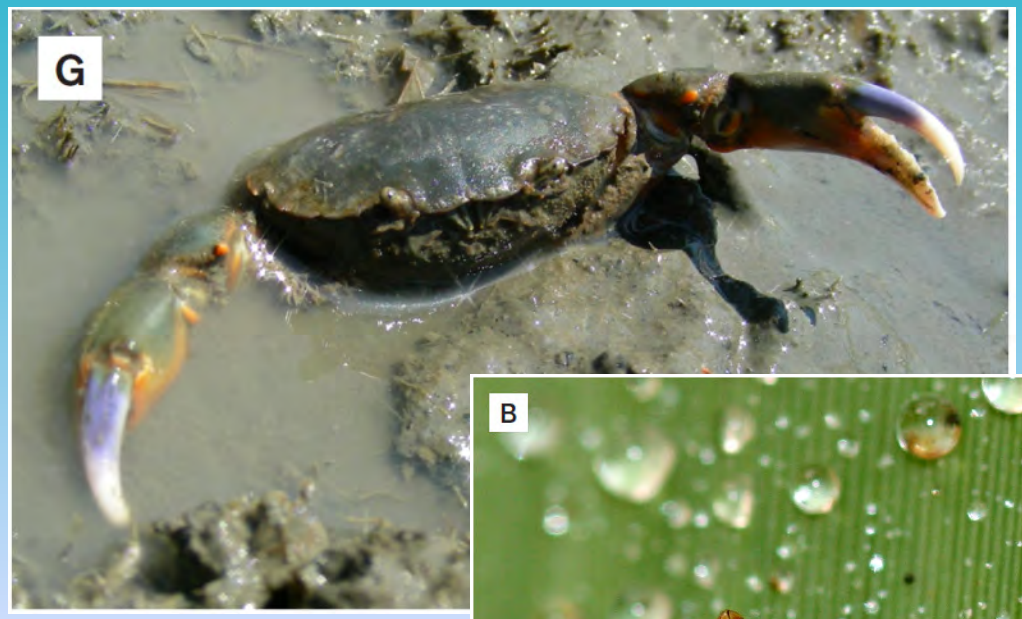
Predatory crab, *Eurytium limosum*



Aphids, *Uroleucon ambrosiae*

Planthopper, *Prolekesia* sp.

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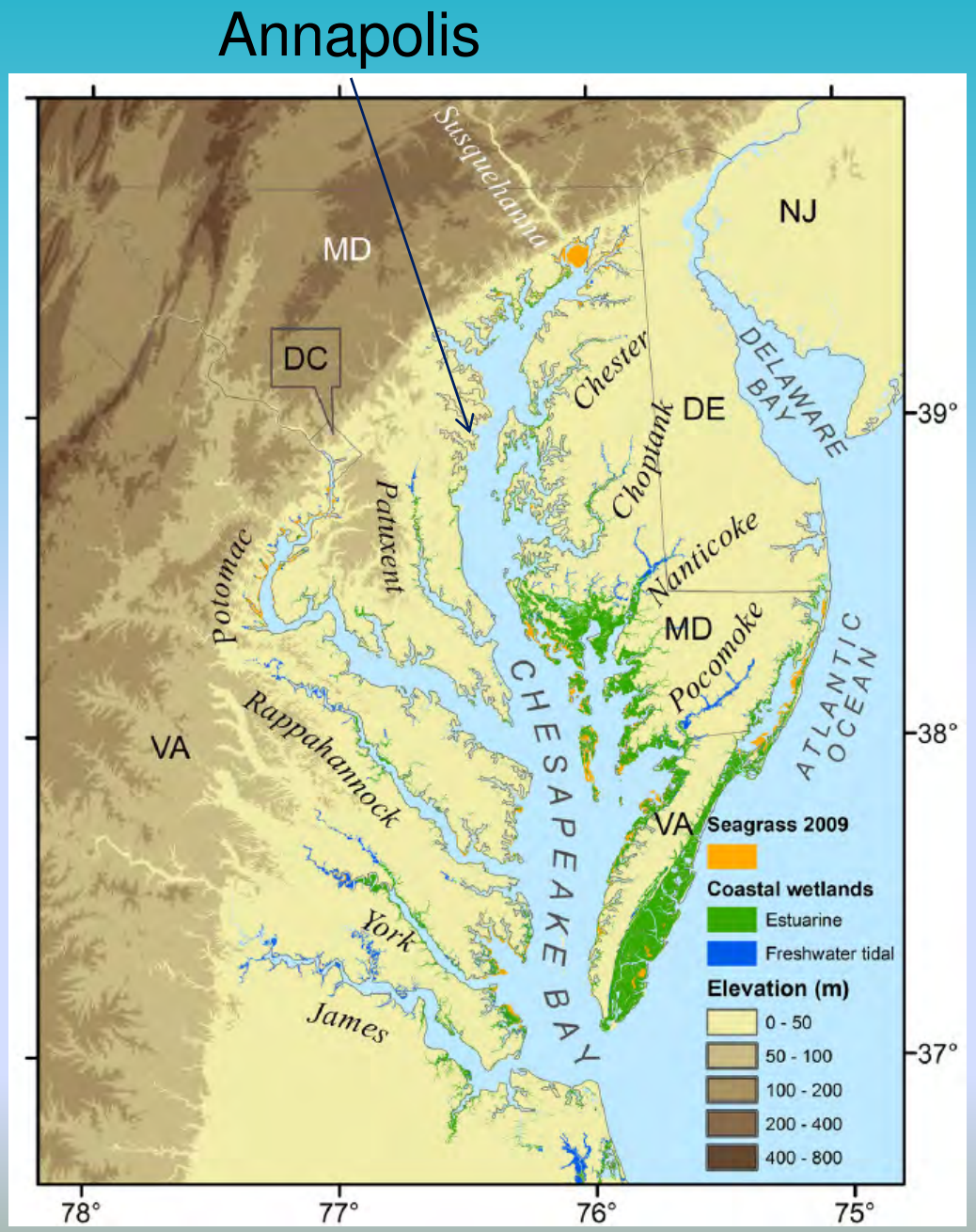
Chesapeake Bay

- 6,400 km shoreline
- About 160,000 ha of coastal wetlands
- Marshes, swamps, seagrass beds, mudflats
- Tidal amplitude generally 0.4-0.9 m
- Soils organic, many >70% organic matter several m deep
- Salinity up to about 25 psu at mouth



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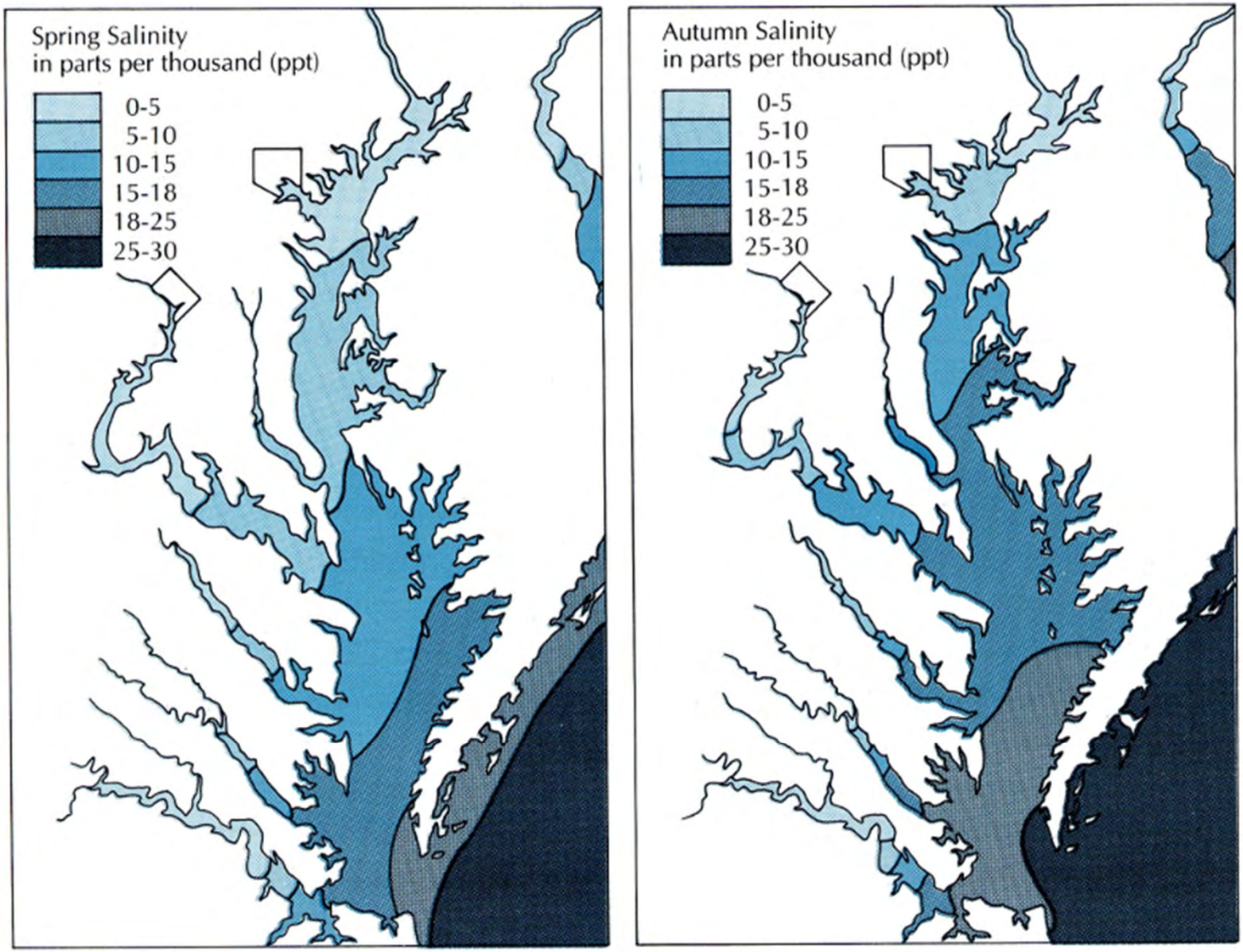

Figure 3. *Isohalines*, or salinity contours, on the maps above mark the salt content of waters at the surface of the Bay. The *salinity gradient* varies with freshwater inflow: fresher during spring rains, saltier during the drier months of autumn (adapted from EPA 1982).

White 1989


A
Tidal freshwater marshes, Patuxent River
Baldwin et al in Batzer and Baldwin 2012

B Tidal freshwater marshes, Patuxent River

Baldwin et al in Batzer and Baldwin 2012

Tidal freshwater swamp, Nanticoke River

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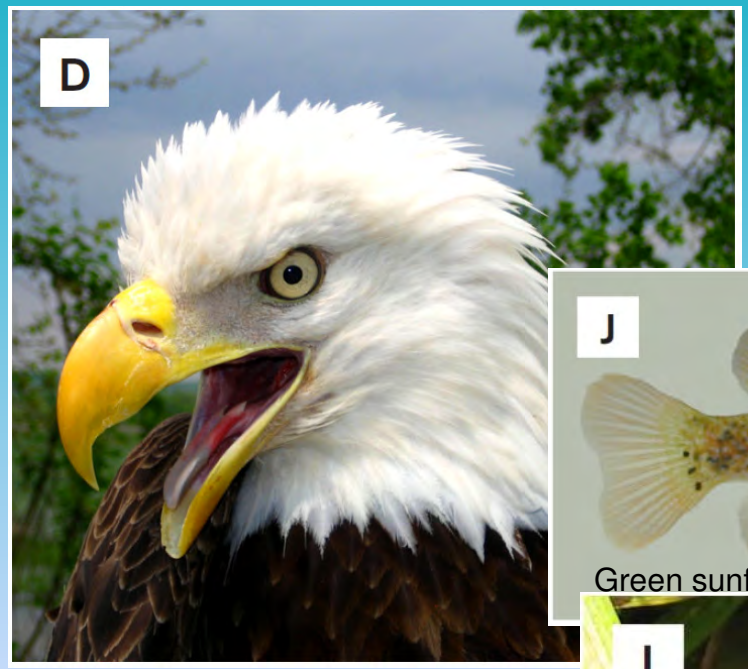
Brackish marsh, Nanticoke River. *Spartina cynosuroides*, *Spartina patens*, *Juncus roemerianus* occur in patches

Baldwin et al in Batzer and Baldwin 2012

Baldwin et al in Batzer and Baldwin 2012

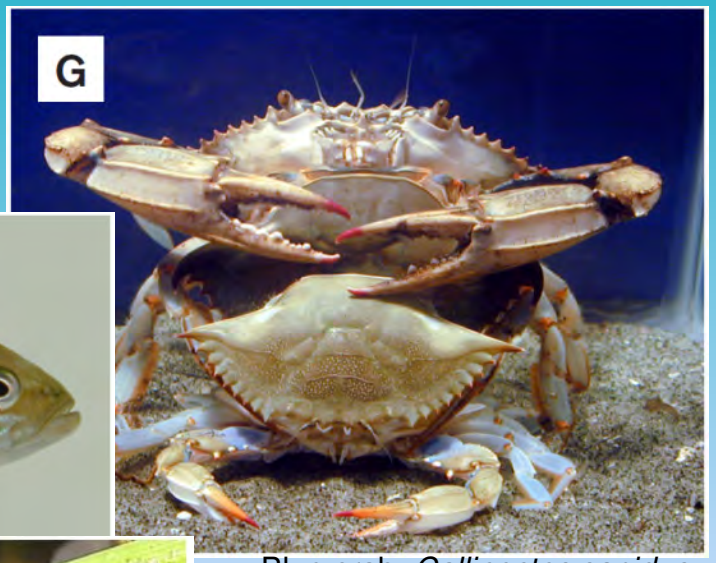
Production and decomposition

- Aboveground production: many wetlands 1000-1500 g m^{-2} yr^{-1}, but…
  - *Peltandra/Polygonum*: 990 g m^{-2} yr^{-1}
  - *Phragmites australis*: 1,990 g m^{-2} yr^{-1}
  - *Spartina cynosuroides*: 2,160 g m^{-2} yr^{-1}
  - *Typha* spp.: 2,340 g m^{-2} yr^{-1}
  - Seagrasses: 60-250 g m^{-2} yr^{-1}
- Decomposition: 45-80% annually



Bald eagle, *Haliaeetus leucocephalus*

Green sunfish, Lepomis cyanellus



Blue crab, *Callinectes sapidus*

Fishing spider,
Dolomedes sp.

Den of muskrat, *Ondatra zibethicus*

Virginia rail, *Rallus limicola*

Baldwin et al in Batzer and Baldwin 2012

Conclusions

- US coastal wetlands occur across a range of climatic and geomorphological environments
  - Pacific, Gulf of Mexico, Atlantic coasts
- Productivity often high, soils often organic
- Diverse plant and animal assemblages
- Sea-level rise poses the greatest threat
  - Eutrophication, hydrologic alteration, and invasive species also important

Thanks!

- Darold Batzer
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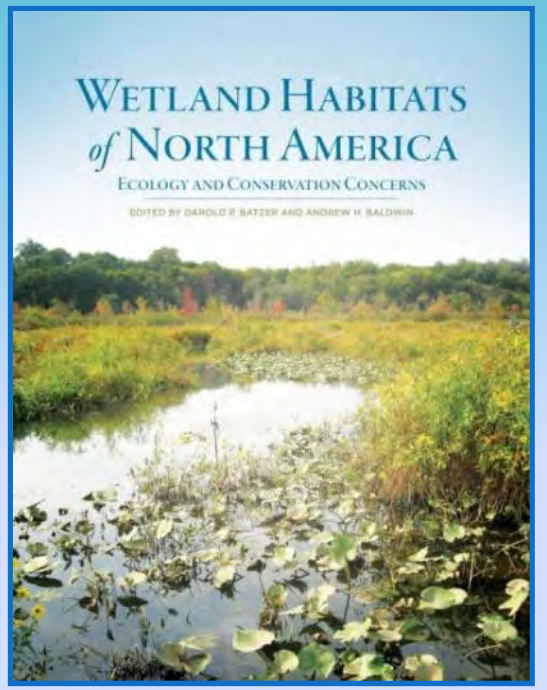
- Chapter authors and reviewers



Supplemental slides

TABLE 2.2

Belowground biomass,[a] densities, and diameters of roots and rhizomes comparing deteriorating (Black Bank) and stable (JoCo) marshes at Jamaica Bay, New York

		Marsh type		
Soil depth	Roots and rhizomes	Stable	Deteriorating	P
0–10 cm	Fine root mass (g m^{-2})	3,975 ± 461	1,697 ± 129	*
	Coarse root and rhizome mass (g m^{-2})	2,757 ± 689	2,858 ± 557	ns
	Rhizome density (# m^{-2})	8,935 ± 654	6,087 ± 387	*
	Coarse root density (# m^{-2})	16,669 ± 1840	6,524 ± 537	*
	Rhizome diameter (mm)	3.59 ± 0.22	4.55 ± 0.14	*
	Coarse root diameter (mm)	1.37 ± 0.004	1.37 ± 0.007	ns
10–20 cm	Fine root mass (g m^{-2})	2,874 ± 373	1,631 ± 206	*
	Coarse root and rhizome mass (g m^{-2})	1,893 ± 56	1,001 ± 128	*
	Rhizome density (# m^{-2})	6,586 ± 914	3,968 ± 352	ns
	Coarse root density (# m^{-2})	17,918 ± 731	3,569 ± 273	*
	Rhizome diameter (mm)	3.00 ± 0.06	4.22 ± 0.07	*
	Coarse root diameter (mm)	1.38 ± 0.005	1.41 ± 0.004	*

Deteriorating salt marshes in NY: lower fine root biomass and (at depth) lower coarse root and rhizome biomass than stable marshes

Wigand and Roman in Batzer and Baldwin 2012

TABLE 4.2

Selected properties of tidal marsh soils (0–30 cm) of the southeast Atlantic coast (North Carolina, South Carolina, Georgia, and Florida) as a function of geomorphic position and location on the salinity gradient

	Sand (%)	Silt (%)	Clay (%)	Bulk density ($g\ cm^{-3}$)	Organic matter (%)	Total N (%)	Total P ($ug\ g^{-1}$)
BARRIER/SEA ISLAND							
Salt marsh[a,b,c,d]	65 ± 8	16 ± 2	13 ± 2	0.94 ± 0.14	4 ± 1	0.19 ± 0.04	690 ± 240
RIVERINE							
Salt marsh[b,c,e–l]	57 ± 10	20 ± 7	11 ± 4	0.56 ± 0.09	12 ± 2	0.36 ± 0.05	530 ± 100
Brackish marsh[e,f,g,k,m]	16 ± 16	29 ± 16	27 ± 27	0.33 ± 0.07	28 ± 7	0.81 ± 0.26	620 ± 10
Tidal freshwater marsh[e,k]	32	41	2	0.23 ± 0.02	25 ± 4	0.73 ± 0.05	740 ± 190
Tidal forest[n]	66	7	1	0.45	26	0.64	490
LAGOONAL							
Brackish marsh[a,b,o,p]	13	30	6	0.17 ± 0.02	51 ± 3	1.58 ± 0.12	860 ± 60

Soils of barrier island and riverine wetlands: 33-65% sand, 4-28% organic matter; lagoonal marshes 13% sand and 51% organic matter

Pennings et al in Batzer and Baldwin 2012