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## **ECOLOGICAL SYSTEM: NORTHERN ATLANTIC COASTAL PLAIN TIDAL SALT MARSH**

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**Summary:** This system encompasses the mesohaline to saline intertidal marshes of the North Atlantic Coastal Plain, ranging from Chesapeake Bay north to Cape Cod, Massachusetts, and sporadically to the southern Maine coast. It includes a number of different broad vegetation types including salt pannes, salt marshes, and salt shrublands. This system occurs on the bay side of barrier beaches and the outer mouth of tidal rivers where salinity is not much diluted by freshwater input. The typical salt marsh profile, from sea to land, can be summarized as follows: a low regularly flooded marsh strongly dominated by *Spartina alterniflora* (saltmarsh cordgrass); a higher irregularly flooded marsh dominated by *Spartina patens* (saltmeadow cordgrass) and *Distichlis spicata* (saltgrass); low hypersaline pannes characterized by *Salicornia* (saltwort) spp.; and a salt scrub ecotone characterized by *Iva frutescens* (maritime marsh-elder), *Baccharis halimifolia* (groundsel-tree), and *Panicum virgatum* (switchgrass). Salt marsh "islands" of slightly higher elevation also support *Juniperus virginiana* (eastern red-cedar). This system also includes the rare sea-level fen vegetation, which occurs at the upper reaches of the salt marsh where groundwater seepage creates a freshwater fen.

**Range:** This system is found from the southern Maine coast south to the Chesapeake Bay. United States: CT, DE, MA, MD, ME, NH, NJ, NY, RI, VA

### **Delaware Estuary Associations:**

- Brackish Meadow
  - Eastern Reed Marsh
  - Mid-Atlantic High Salt Marsh
  - North Atlantic High Salt Marsh
  - Reed-grass Tidal Marsh
  - Salt Panne Pool
- Cattail Brackish Tidal Marsh  
Maritime Red-cedar Woodland  
Mid-Atlantic Maritime Salt Shrub  
North Atlantic Low Salt Marsh  
Salt Panne (Salicornia Type)

### **CLASSIFIERS FOR NORTHERN ATLANTIC COASTAL PLAIN TIDAL SALT MARSH**

**Primary Division:** 203

**Land Cover Class:** Herbaceous Wetland

**Spatial Scale & Pattern:** Large patch

**Required Classifiers:** Natural/Semi-natural; Vegetated (>10% vasc.); Wetland

**Diagnostic Classifiers:** Tidal / Estuarine; Graminoid; North Atlantic Coastal Plain

**Non-diagnostic Classifiers:** Herbaceous

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### **BRACKISH MEADOW**

*Panicum virgatum* - *Spartina patens* Herbaceous Vegetation

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**Range:** This association occurs from New Hampshire to Delaware. It occurs in Delaware and New Jersey in the Delaware Estuary.

**Environmental Description:** This association occurs at the upland border of salt marshes on moist, sandy, shallow peat over glacial till or quartzite sand. This is the highest elevation within the salt marsh; it is irregularly flooded by tides, high spring tides and storm tides, but is freely drained. It is also subject to salt spray. Soil salinity is low (oligohaline to mesohaline, 0.5-18 ppt). Similar vegetation can occur on anthropogenic dredge spoils where similar environmental conditions are created. Small patches of this



Photo by Linda Kelly

association may also occur around coastal salt ponds.

**Vegetation Description:** This association is a tall grassland occupying brackish meadows at the upland border of high salt marshes. Vegetation is dominated by *Panicum virgatum* (switchgrass) and occasionally codominated by *Spartina patens* (saltmeadow cordgrass). Common associates include *Schoenoplectus americanus* (chairmaker's bulrush), *Solidago sempervirens* (seaside goldenrod), *Teucrium canadense* (American germander), *Distichlis spicata* (saltgrass), *Carex silicea* (beach sedge), and *Juncus* (rush) spp. (*Juncus gerardii* (black-grass) in the north, *Juncus roemerianus* (black needlerush) in the south). Shrubs may occur sporadically, especially *Baccharis halimifolia* (groundsel-tree), *Morella pensylvanica* (northern bayberry), *Prunus maritima* (beach plum), and *Iva frutescens* (maritime marsh-elder). Vegetation can be quite diverse and is a mixture of freshwater and brackish species. In addition to the common associates, other graminoids can include *Setaria parviflora* (yellow foxtail grass), *Elymus virginicus* (Virginia wild rye), *Panicum amarum* (bitter panicgrass), *Cladium mariscoides* (twig-rush), *Cyperus polystachyos* (many-spike flatsedge), *Cyperus dentatus* (bulblet flatsedge), *Schoenoplectus pungens* (common threesquare), and *Fimbristylis castanea* (chestnut fimbry), and other forbs can include *Polygala verticillata* (whorled milkwort), *Solidago sempervirens* (seaside goldenrod), *Euthamia caroliniana* (slender goldentop), *Agalinis maritima* (saltmarsh false foxglove), *Artemisia campestris* ssp. *caudata* (tailed wormwood), *Sabatia stellaris* (rose-of-Plymouth), *Sabatia dodecandra* (marsh rose-gentian), and Asteraceae spp.

**Characteristic Species:** *Panicum virgatum* (switchgrass)

**Dynamics/Successional Trajectory:** This association generally forms as a band of vegetation between high salt marsh and upland vegetation. It is best developed in salt marshes with a gradual elevation gradient that lend themselves to vegetation zonation. In the northern part of the geographic range, this band gets progressively narrower as the transition to the upland border is more abrupt. With more frequent flooding, the community likely transitions to high salt marsh. Where salt spray and salinity influence decreases, shrubs tend to invade or the community can transition to maritime grasslands. Where tidal flooding becomes ponded, vegetation is classified as an interdunal swale. Vegetation can be more sparse, grading into sand flats.

**Management Concerns:** *Phragmites australis* (common reed) invades this ecotonal association. Sea level rise may play a role in the ecology of this community. Marshes may be drowned or experience increases in salinity that could influence the vegetation composition of this type.

**Reference Sites:** Fort Mott, NJ; Cape May Point, NJ

**Global and State Conservation Ranks and Reasons:** GNR (1-Dec-1997). DE: S3?, NJ: S2S3.

**VegBank Link for Plot Data:** [http://vegbank.org/natureserve/element\\_global.2.688411](http://vegbank.org/natureserve/element_global.2.688411)

**References:** Bowman 2000, Breden 1989, Breden et al. 2001, Clancy 1996, Dowhan and Rozsa 1989, Eastern Ecology Working Group n.d., Edinger et al. 2002, Enser 1999, Fender 1937, Harrison 2001, Harrison 2004, Heckscher et al. 1995, Higgins et al. 1971, Hill 1986, Hunt 2000, Johnson 1985b, Lundgren et al. 2000, Metzler and Barrett 2001, Nixon 1982, Rawinski 1984, Sperduto 2000b, Swain and Kearsley 2001

MOST ABUNDANT SPECIES		
STRATUM	LIFEFORM	SPECIES
Herb (field)	Graminoid	<i>Panicum virgatum</i> (switchgrass)

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## CATTAIL BRACKISH TIDAL MARSH

*Typha angustifolia* - *Hibiscus moscheutos* Herbaceous Vegetation

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**Range:** This association occurs along the Atlantic coast from Maine to Virginia and possibly to South Carolina. It occurs in Delaware and New Jersey in the Delaware Estuary.

**Environmental Description:** This association occurs in oligohaline to mesohaline areas of tidal marshes (0.5-18 ppt). In estuarine systems, it can occur in the uppermost zone of brackish marshes where there is freshwater influence; it receives diurnal tidal flooding of brackish water. In salt marshes behind barrier beaches, it can occur in the upper reaches of larger tidal creeks within brackish areas and also at the upland border where there is significant freshwater input from the adjacent upland; here it receives irregular tidal flooding only during high spring tides. Substrate is muck or peat, and there is often an accumulation of *Typha* (cattail) litter.



Photo by Linda Kelly

**Vegetation Description:** The vegetation of this tall graminoid vegetation instead is a mixture of freshwater and saltmarsh species dominated by *Typha angustifolia* (narrowleaf cattail). *Phragmites australis* (common reed), *Typha latifolia* (broadleaf cattail), *Spartina cynosuroides* (giant cordgrass), or *Schoenoplectus pungens* (common threesquare) can codominate. The *Phragmites australis* (common reed) component is the native strain (Saltonstall 2002). Common associates include *Hibiscus moscheutos* (eastern rosemallow), *Schoenoplectus pungens* (common threesquare), *Impatiens capensis* (orange jewelweed), *Amaranthus cannabinus* (water-hemp), *Peltandra virginica* (green arrow-arum), and *Bidens* (beggarticks) spp., plus *Spartina cynosuroides* (giant cordgrass) in the south. Other infrequent associates include *Mikania scandens* (climbing hempvine), *Pluchea odorata* (sweetscent), *Polygonum punctatum* (dotted smartweed), *Eleocharis* (spikerush) spp., and *Schoenoplectus robustus* (alkali bulrush), plus *Schoenoplectus americanus* (chairmaker's bulrush) farther south. Species from adjacent high salt marsh may also be present.

**Characteristic Species:** *Hibiscus moscheutos* (eastern rosemallow), *Typha angustifolia* (narrowleaf cattail)

**Dynamics/Successional Trajectory:** Brackish marsh complexes commonly occur as mosaics of patches dominated by a single graminoid species. Patches dominated by *Typha angustifolia* (narrowleaf cattail) tend to occur where there is more freshwater influence near the upper reaches of estuaries or at the upland border of high salt marshes where there is freshwater input from the surrounding upland. As the marsh becomes more brackish, *Schoenoplectus pungens* (common threesquare) or *Spartina patens* (saltmeadow cordgrass) can become dominant. As the marsh becomes less brackish, *Peltandra virginica* (green arrow-arum), *Pontederia cordata* (pickerelweed), *Acorus calamus* (sweetflag), *Schoenoplectus tabernaemontani* (softstem bulrush), and *Zizania aquatica* (Indian wild rice) can become more prevalent. The pattern of alternating dominance between *Typha angustifolia* (narrowleaf cattail) and *Phragmites australis* (common reed) that can occur in these environmental settings may reflect disturbance history of the site and of the surrounding watershed.

**Management Concerns:** Sea level rise may pose a threat to these marshes by increasing salinity levels, and thereby potentially initiating a shift in vegetation composition to more salt-tolerant species. This community is threatened by pollution and by encroachment of *Phragmites australis* (common reed).

**Reference Sites:** widespread, DE; Hancock Bridge on Alloway Creek, Salem County, NJ; Supawna Meadows NWR (North bank of Mill Creek), NJ

**Global and State Conservation Ranks and Reasons:** G4G5 (19-Jan-2006). DE: S4, NJ: S4. This common small-patch community occurs in the estuarine areas of up to 13 northeastern states, several of which rank this vegetation as S4.

**VegBank Link for Plot Data:** [http://vegbank.org/natureserve/element\\_global.2.683268](http://vegbank.org/natureserve/element_global.2.683268)

**References:** Bowman 2000, Breden 1989, Breden et al. 2001, Cahoon and Stevenson 1986, Coulling 2002, Dowhan and Rozsa 1989, Eastern Ecology Working Group n.d., Edinger et al. 2002, Ferren et al. 1981, Fleming 2001, Fleming and Moorhead 1998, Fleming et al. 2001, Gawler 2002, Good and Good 1975b, Harrison 2001, Harrison 2004, Hill 1986, Klotz 1986, MENHP 1991, McCormick and Ashbaugh 1972, Metzler and Barrett 1992, Metzler and Barrett 2001, Odum et al. 1984, Rawinski 1984, Reschke 1990, Saltonstall 2002, Schafale 2000, Schafale 2003b, Schafale and Weakley 1990, Shreve et al. 1910, Sperduto 1994, Sperduto 1997a, Sperduto 2000b, Steury 1999, Swain and Kearsley 2001

MOST ABUNDANT SPECIES		
STRATUM	LIFEFORM	SPECIES
Herb (field)	Semi-shrub	<i>Hibiscus moscheutos</i> (eastern rosemallow)
Herb (field)	Graminoid	<i>Schoenoplectus pungens</i> (common threesquare)
Herb (field)	Graminoid	<i>Typha angustifolia</i> (narrowleaf cattail)
Submerged aquatic	Aquatic herb (floating & submergent)	<i>Pontederia cordata</i> (pickerelweed)

## EASTERN REED MARSH

*Phragmites australis* Eastern North America Temperate Semi-natural Herbaceous Vegetation

**Range:** This reed marsh type is found across the east-temperate regions of the United States and Canada, ranging from Maine west to the eastern Dakotas and Manitoba, south to Texas and east to Florida. It occurs in all three states in the Delaware Estuary.

**Environmental Description:** Stands occur in semipermanently flooded marshes, ditches, impoundments, etc. that have often been disturbed by human activity.

**Vegetation Description:** The vegetation is often variable, as *Phragmites australis* (common reed) will often invade into existing natural or semi-natural communities present on the site. Once firmly established, this community is usually strongly dominated by *Phragmites australis* (common reed), with few or no other vascular plants present.



Photo by Linda Kelly

**Characteristic Species:** *Phragmites australis* (common reed)

**Dynamics/Successional Trajectory:** This community is strongly influenced by anthropogenic disturbances such as ditches and impoundments that freshen marshes and also dry them out. The biology of *Phragmites* (reed) also perpetuates the drying out of marshes because the plant has the ability to grow rapidly in one season and produce a considerable amount of biomass litter, which adds more organic matter to the marsh and thereby effectively creates higher and drier microsites that are favorable to the plant. *Phragmites* (reed) typically excludes the establishment of other species as it consumes available rooting space through dense underground rhizomes and also shades out understory species.

**Management Concerns:** This is a naturalized type that arises from human disturbance. *Phragmites australis* (common reed) is invasive globally, and the formation of these extensive monocultures are often considered fire hazards.

**Reference Sites:** Bombay Hook NWR, DE; Supawna Meadows NWR, NJ

**Global and State Conservation Ranks and Reasons:** GNA (invasive) (23-Nov-1997). DE: SNA, NJ: SNA, PA: SNA. Although almost always occurring as a naturalized type that arises from human disturbance, some stands in northern Minnesota and further north in Canada may be native. If so, they should be tracked as a separate type.

**VegBank Link for Plot Data:** [http://vegbank.org/natureserve/element\\_global.2.685380](http://vegbank.org/natureserve/element_global.2.685380)

**References:** Bailey 1997, Bailey 1998, Clancy 1993b, Harris et al. 1996, INAI unpubl. data, Metzler and Barrett 1992, Metzler and Barrett 2001, Nelson 1986, Rawinski 1984, Schafale and Weakley 1990, Schotz pers. comm., Southeastern Ecology Working Group n.d., Swain and Kearsley 2001

MOST ABUNDANT SPECIES		
STRATUM	LIFEFORM	SPECIES
Herb (field)	Graminoid	<i>Phragmites australis</i> (common reed)

## MARITIME RED-CEDAR WOODLAND

*Juniperus virginiana* var. *virginiana* / *Morella pensylvanica* Woodland

**Range:** This association occurs along the North Atlantic coast from Delaware to Massachusetts.

**Environmental Description:** This maritime woodland community occurs on sand dunes, the upper edges of salt marshes, and less commonly on rocky headlands. It also occurs on islands in salt marshes (relict of post-glacial forest before sea level rise). It is influenced by onshore winds and salt spray, plus infrequent sand deposition and tidal overwash from severe storms.

**Vegetation Description:** *Juniperus virginiana* (eastern red-cedar) may form pure stands but



Photo by Robert Cox

more often grows in association with *Pinus rigida* (pitch pine), *Quercus stellata* (post oak), *Prunus serotina* (black cherry), *Amelanchier canadensis* (Canada serviceberry), *Ilex opaca* (American holly), or *Quercus velutina* (black oak), which tend to have low percent cover. In the southern portion of the range, *Pinus taeda* (loblolly pine), *Quercus falcata* (southern red oak), *Diospyros virginiana* (eastern persimmon), and *Quercus phellos* (willow oak) can be infrequent canopy associates. A shrub layer may be well-developed where the canopy is more open and include *Morella pensylvanica* (northern bayberry), *Morella cerifera* (wax-myrtle) (at the southern end of the range), *Baccharis halimifolia* (groundsel-tree), *Iva frutescens* (maritime marsh-elder), or *Vaccinium corymbosum* (highbush blueberry). Vines can be dense in the shrub layer and extend into the canopy; species include *Toxicodendron radicans* (eastern poison-ivy), *Smilax rotundifolia* (roundleaf greenbrier), *Smilax glauca* (whiteleaf greenbrier), and *Parthenocissus quinquefolia* (Virginia creeper). Herbs are usually patchily distributed in openings and include many species from the surrounding dune associations, among others. They include *Opuntia humifusa* (eastern prickly-pear), *Dichanthelium ovale* (eggleaf rosette grass), *Schizachyrium scoparium* (little bluestem), *Deschampsia flexuosa* (wavy hairgrass), *Cyperus grayi* (Gray's flatsedge), *Polygonella*

*articulata* (coastal jointweed), *Hieracium gronovii* (queendevil), *Panicum amarum* var. *amarulum* (coastal panicgrass), *Solidago sempervirens* (seaside goldenrod), *Panicum virgatum* (switchgrass), *Spartina patens* (saltmeadow cordgrass), and *Lechea intermedia* (round-fruit pinweed).

**Noteworthy Associated Plant and/or Animal Species:** *Ruellia caroliniensis* (Carolina wild petunia)

**Characteristic Species:** *Juniperus virginiana* var. *virginiana* (eastern red-cedar)

**Dynamics/Successional Trajectory:** The physiognomy of this association is variable, ranging from dense tall-shrub thickets to open woodlands; trees are generally shorter than 4 m. Canopy trees are stunted and salt-pruned.

**Management Concerns:** The habitat is threatened by many of the same threats common to coastal dune systems: dune stabilization, commercial and residential development. This community is further threatened even on "protected" lands in some cases by a lack of recognition that this vegetation is a unique community.

**Reference Sites:** Broadkill Beach, Sussex County, DE; Fowlers Beach south to Lewes, Sussex County, DE; Fortesque NWR, NJ; Mad Horse Creek WMA, NJ; Dias Creek NWR, NJ; Higbee Beach, NJ; Cape May, NJ

**Global and State Conservation Ranks and Reasons:** G2 (18-Nov-1997). DE: S1, NJ: S1. This maritime woodland community is naturally restricted to major coastal dune systems. An estimated maximum of 30 occurrences exist, ranging in size from less than an acre up to a maximum of 100, with an average size of less than 10 acres.

**VegBank Link for Plot Data:** [http://vegbank.org/natureserve/element\\_global.2.689256](http://vegbank.org/natureserve/element_global.2.689256)

**References:** Bowman 2000, Breden 1989, Breden et al. 2001, Clancy 1996, Eastern Ecology Working Group n.d., Edinger et al. 2002, Fleming et al. 2001, Greller 1977, Harrison 2004, Lundgren 2000, Martin 1959b, Rawinski 1984, Reschke 1990, Swain and Kearsley 2001

MOST ABUNDANT SPECIES		
STRATUM	LIFEFORM	SPECIES
Tree canopy red-cedar)	Needle-leaved tree	<i>Juniperus virginiana</i> var. <i>virginiana</i> (eastern red-cedar)
Shrub/sapling (tall & short)	Broad-leaved evergreen shrub	<i>Morella pensylvanica</i> (northern bayberry)
Shrub/sapling (tall & short)	Vine/Liana	<i>Toxicodendron radicans</i> (eastern poison-ivy)
Herb (field)	Graminoid	<i>Schizachyrium scoparium</i> (little bluestem)

## MID-ATLANTIC HIGH SALT MARSH

*Spartina patens* - *Distichlis spicata* - *Juncus roemerianus* Herbaceous Vegetation

**Range:** This association occurs along the Atlantic coast from Delaware to Florida. It occurs in New Jersey and possibly Delaware in the Delaware Estuary.

**Environmental Description:** This high salt marsh association generally occurs behind barrier beaches, but also in the outer reaches of estuaries, occupying the zone extending from mean high tide landward approximately to the limit of high spring tides. They are often adjacent to low salt marshes dominated by *Spartina alterniflora* (saltmarsh cordgrass) (tall form), which are regularly flooded by diurnal tides. *Spartina patens* (saltmeadow cordgrass)-dominated high marshes form very dense peat with high organic matter content. Peat forms over sand, silt or bedrock.

**Vegetation Description:** This high salt marsh is dominated by *Spartina patens* (saltmeadow cordgrass) with *Distichlis spicata* (saltgrass) occurring as a common associate or a codominant species. Associated species that generally occur in low abundance can include *Limonium carolinianum* (Carolina

sea-lavender), *Agalinis maritima* (saltmarsh false foxglove), *Salicornia virginica* (pickleweed), *Sabatia stellaris* (rose-of-Plymouth), *Borrchia frutescens* (seaside oxeye), *Lythrum lineare* (saltmarsh loosestrife), *Juncus roemerianus* (black needlerush), *Solidago sempervirens* (seaside goldenrod), *Pluchea odorata* (sweetscent), *Hibiscus moscheutos* ssp. *moscheutos* (eastern rosemallow), and/or *Atriplex prostrata* (hastate orache). Shrub seedlings of *Baccharis halimifolia* (groundsel-tree), *Iva frutescens* (maritime marsh-elder), and/or *Morella cerifera* (wax-myrtle) may occur sporadically.

**Characteristic Species:** *Distichlis spicata* (saltgrass), *Spartina patens* (saltmeadow cordgrass)

**Dynamics/Successional Trajectory:** Vegetation of this association occurs as a shifting mosaic of patches dominated by single graminoid species. Species composition results from hydroperiod, nutrient availability, salinity gradients, soil oxygen, concentrations of growth inhibitors in the soil, and interspecific competition. As sedimentation increases marsh elevation, vegetation shifts to upland border communities dominated by *Panicum virgatum* (switchgrass) and *Juncus gerardii* (black-grass). Local disturbance, i.e., from ice scouring, can cause invasion by *Spartina alterniflora* (saltmarsh cordgrass), or can lead to the formation of salt pannes.

**Management Concerns:** Sea level rise may lead to the drowning of these marshes and/or a shift to low marsh species depending on the dynamics of the specific marsh. Ditching, dredging and filling, mosquito spraying, and other activities threaten these marshes.

**Reference Sites:** Prime Hook NWR, Sussex County, DE?; Great Marsh, Sussex County, DE?

**Global and State Conservation Ranks and Reasons:** G4G5 (13-May-2002). DE: S4, NJ: SNR. Although widespread on the eastern seaboard, examples of this community that have not been impacted by ditching, dredging and filling, mosquito spraying, and other activities are relatively uncommon.

**VegBank Link for Plot Data:** [http://vegbank.org/natureserve/element\\_global.2.684204](http://vegbank.org/natureserve/element_global.2.684204)

**References:** Adams 1963, Bowman 2000, Clancy 1993b, Clancy 1996, Cooper 1974, Cooper and Waits 1973, Eastern Ecology Working Group n.d., Fleming 2001, Fleming et al. 2001, Harrison 2001, Harrison 2004, Higgins et al. 1971, Hill 1986, Nelson 1986, Peet et al. unpubl. data 2002, Penfound 1952, Schafale 2000, Schafale 2003b, Schafale and Weakley 1990

MOST ABUNDANT SPECIES		
STRATUM	LIFEFORM	SPECIES
Herb (field)	Graminoid	<i>Spartina patens</i> (saltmeadow cordgrass)

## MID-ATLANTIC MARITIME SALT SHRUB

*Baccharis halimifolia* - *Iva frutescens* / *Spartina patens* Shrubland

**Range:** This association ranges from Massachusetts to South Carolina. It occurs in Delaware and New Jersey in the Delaware Estuary.

**Environmental Description:** This maritime shrubland of the mid-Atlantic states occurs in association with salt marshes. It forms an ecotone between the high salt marsh and adjacent upland vegetation. It also occurs in patches on areas of slightly higher elevation within the salt marsh or on spoil mounds adjacent to ditches. This shrubland occurs above mean high tide but can be flooded by storm tides. Substrate is organic peat over glacial till, sand, or sandy loam.

**Vegetation Description:** This tidal shrubland is dominated by *Iva frutescens* (maritime marsh-elder) and *Baccharis halimifolia* (groundsel-tree). Other associated shrubs include *Morella pensylvanica* (northern bayberry) in the northern portion of the range, while *Borrchia frutescens* (seaside oxeye), *Morella cerifera* (wax-myrtle), and *Juniperus virginiana* var. *silicicola* (coastal red-cedar) are frequent associates in the southern part of the range. *Spartina patens* (saltmeadow cordgrass) is a characteristic and usually

abundant grass; other common herbaceous associates include *Distichlis spicata* (saltgrass), *Hibiscus moscheutos* (eastern rosemallow), *Toxicodendron radicans* (eastern poison-ivy), *Teucrium canadense* (American germander), *Festuca rubra* (red fescue), *Limonium carolinianum* (Carolina sea-lavender), and in the south, *Setaria parviflora* (yellow foxtail grass). This community often forms an abrupt transition from salt marsh to upland reflecting the relatively higher elevation and less frequent tidal flooding. Shrub cover in this situation tends to be fairly dense, and herbs are sparsely distributed. Where the topographic relief is more gradual, the community is characterized by an open and relatively evenly spaced shrub stratum with a well-developed herbaceous layer, reflecting an intergrading of this community with the adjacent high salt marsh.

**Characteristic Species:** *Baccharis halimifolia* (groundsel-tree), *Iva frutescens* (maritime marsh-elder), *Spartina patens* (saltmeadow cordgrass)

**Dynamics/Successional Trajectory:** This association occurs above mean high tide but can be flooded by storm tides. Heavy salt spray and tidal flooding from severe storms can cause die-back in the shrub layer. Seaward, this association grades into high salt marsh dominated by herbaceous vegetation. Landward, shrub cover becomes more dense.

**Management Concerns:** Sea level rise may influence the dynamics of this community in the future.

**Reference Sites:** Hansey Creek WMA, NJ; Dias Creek NWR, NJ; Moore's Beach and Thompson Beach, NJ

**Global and State Conservation Ranks and Reasons:** G5 (1-Dec-1997). DE: S5, NJ: S2S3.

**VegBank Link for Plot Data:** [http://vegbank.org/natureserve/element\\_global.2.686210](http://vegbank.org/natureserve/element_global.2.686210)

**References:** Barry 1980, Bartgis 1986, Berdine 1998, Boule 1979, Bowman 2000, Breden 1989, Breden et al. 2001, Clancy 1996, Coulling pers. comm., Daiber et al. 1976, Dowhan and Rozsa 1989, Eastern Ecology Working Group n.d., Edinger et al. 2002, Enser 1999, Fleming 2001, Fleming et al. 2001, Fleming pers. comm., Good 1965, Harrison 2004, Harrison and Stango 2003, Harrison pers. comm., Higgins et al. 1971, Hill 1986, Klemas et al. 1973, Klotz 1986, Martin 1959b, Metzler and Barrett 2001, Rawinski 1984, Reschke 1990, Schafale 2000, Schafale and Weakley 1990, Sneddon et al. 1995, Swain and Kearsley 2001, TNC 1995c, Tiner 1984, Tiner 1985a, Tiner 1985b, VDNH 2003

MOST ABUNDANT SPECIES		
STRATUM	LIFEFORM	SPECIES
Short shrub/sapling	Broad-leaved evergreen shrub	<i>Baccharis halimifolia</i> (groundsel-tree)
Short shrub/sapling	Semi-shrub	<i>Iva frutescens</i> (maritime marsh-elder)
Herb (field)	Graminoid	<i>Spartina patens</i> (saltmeadow cordgrass)

## NORTH ATLANTIC HIGH SALT MARSH

*Spartina patens* - *Distichlis spicata* - (*Juncus gerardii*) Herbaceous Vegetation

**Range:** This high salt marsh association occurs from the Canadian maritime provinces south to Delaware. It occurs in both New Jersey and Delaware in the Delaware Estuary.

**Environmental Description:** This high salt marsh association generally occurs behind barrier beaches, but also in the outer reaches of estuaries, occupying the zone extending from mean high tide landward approximately to the limit of spring tides. They are often adjacent to low salt marshes dominated by *Spartina alterniflora* (saltmarsh cordgrass) (tall form), which are regularly flooded by diurnal tides. *Spartina patens* (saltmeadow cordgrass)-dominated high marshes form very dense peat with high organic matter content. Peat forms over sand, silt or bedrock.

**Vegetation Description:** Vegetation of this marsh community occurs in mosaics of patches generally dominated by a single graminoid species, such as *Spartina patens* (saltmeadow cordgrass), *Distichlis spicata* (saltgrass), or *Juncus gerardii* (black-grass). Other characteristic associates that occur in low abundance include *Symphyotrichum tenuifolium* (saline aster), *Limonium carolinianum* (Carolina sea-lavender), *Solidago sempervirens* (seaside goldenrod), *Symphyotrichum subulatum* (seaside American-aster), *Polygonum ramosissimum* (yellow-flower knotweed), *Atriplex patula* (halberd-leaf orache), *Lythrum lineare* (saltmarsh loosestrife), and *Panicum virgatum* (switchgrass).

**Characteristic Species:** *Distichlis spicata* (saltgrass), *Juncus gerardii* (black-grass), *Spartina patens* (saltmeadow cordgrass)

**Dynamics/Successional Trajectory:** Vegetation of this association occurs as a shifting mosaic of patches dominated by a single graminoid species. Species composition at a particular site results from the interaction of hydroperiod, nutrient availability, salinity gradients, soil oxygen, concentrations of growth inhibitors in the soil, and interspecific competition. As sedimentation increases marsh elevation, vegetation may shift to upland border communities dominated by *Panicum virgatum* (switchgrass) and *Juncus gerardii* (black-grass). Local disturbance, i.e., from ice scouring, can cause invasion by *Spartina alterniflora* (saltmarsh cordgrass), or can lead to the formation of salt pannes.

**Management Concerns:** Sea level rise may influence this community through increased salinity levels that could alter the vegetation composition.

**Reference Sites:** Woodland Beach WMA, Kent County, DE; Jake's Landing WMA, Cape May County, NJ; Dennis Creek WMA, NJ

**Global and State Conservation Ranks and Reasons:** G5 (1-Dec-1997). DE: SNR, NJ: S5.

**VegBank Link for Plot Data:** [http://vegbank.org/natureserve/element\\_global.2.689496](http://vegbank.org/natureserve/element_global.2.689496)

**References:** Bertness et al. 1992, Breden 1989, Breden et al. 2001, Coulling pers. comm., Dowhan and Rozsa 1989, Eastern Ecology Working Group n.d., Edinger et al. 2002, Enser 1999, Fleming 2001, Gawler 2001, Gawler 2002, Harrison 2001, Hill 1923, Metzler and Barrett 2001, Nixon 1982, Rawinski 1984, Reschke 1990, Sperduto 2000a, Sperduto 2000b, Swain and Kearsley 2001

MOST ABUNDANT SPECIES		
STRATUM	LIFEFORM	SPECIES
Herb (field)	Graminoid	<i>Distichlis spicata</i> (saltgrass)
Herb (field)	Graminoid	<i>Spartina patens</i> (saltmeadow cordgrass)

## NORTH ATLANTIC LOW SALT MARSH

*Spartina alterniflora* / (*Ascophyllum nodosum*) Acadian/Virginian Zone Herbaceous Vegetation

**Range:** This association occurs along the Atlantic coastline from Nova Scotia and New Brunswick south to Cape Hatteras, North Carolina.

**Environmental Description:** This low salt marsh community occurs in the regularly flooded intertidal zone, approximately from mean high tide to mean sea level; they are diurnally flooded by tides and are classified as polyhaline (18-30 ppt). This low marsh occurs in areas sheltered from direct wave action, such as behind barrier beaches, as pocket marshes at the heads of bays, or in the outer reaches of estuaries. Low salt marshes occur landward of intertidal flats and subtidal communities and seaward of high salt marsh communities.



Photo by Keith Clancey

Low salt marshes dominated by *Spartina alterniflora* (saltmarsh cordgrass) generally occur on mucky silt to silty coarse fibrous peat, often with high organic matter content. However, peat in the low marsh is generally less dense than farther landward (Bertness 1988). Peat depth ranges from a few feet, if the community formed over a mud flat, to 80 feet in drowned river valleys at the mouths of estuaries.

**Vegetation Description:** This community is a tall grassland dominated by *Spartina alterniflora* (saltmarsh cordgrass) occurring in regularly flooded intertidal zones. *Spartina alterniflora* (saltmarsh cordgrass) dominates this physically stressful zone due to limited competition and its ability to tolerate salinity and flooding. It also requires moderately high levels of iron (7-15 ppm) (Adams 1963). *Spartina alterniflora* (saltmarsh cordgrass) is strongly dominant, forming a nearly monotypic tallgrass layer. There is little variation in vascular plant composition across the range. Tall-form *Spartina alterniflora* (saltmarsh cordgrass) occurs adjacent to saltwater and colonizes unvegetated flats. This association also grades into short-form *Spartina alterniflora* (saltmarsh cordgrass) landward where tidal range is more restricted. Common associates, occurring in low abundance, include *Limonium carolinianum* (Carolina sea-lavender), *Salicornia virginica* (pickleweed), *Salicornia bigelovii* (dwarf glasswort), *Spergularia maritima* (satin-flower), *Spergularia canadensis* (Canada sandspurry), and *Suaeda maritima* (herbaceous seepweed). *Distichlis spicata* (saltgrass), *Agalinis maritima* (saltmarsh false foxglove), *Symphytotrichum tenuifolium* (saline aster), and *Spartina patens* (saltmeadow cordgrass) can also sporadically occur but are more common in high salt marsh. Brown algae can form extensive mats at the bases of the grass culms, especially *Ascophyllum nodosum*, *Fucus vesiculosus*, and *Ulva* spp. *Enteromorpha* spp. can occur early in the growing season. Macroalgae associates may be sparse or absent at the southern edge of the range. Microscopic algae, especially diatoms, can be abundant on the marsh surface (Teal 1986). In New Jersey, *Bassia scoparia* (mexican fireweed) (waif) occurs on the upper edge of this low salt marsh.

**Characteristic Species:** *Spartina alterniflora* (saltmarsh cordgrass)

**Dynamics/Successional Trajectory:** Salt marshes are dynamic habitats. *Spartina alterniflora* (saltmarsh cordgrass) readily colonizes soft sediments off the seaward edge of the salt marsh (Bertness 1988). Grass culms and algal mats trap sediments brought in by the tides and begin the process of marsh peat accumulation. As peat development raises marsh elevation, low marsh succeeds to high marsh communities; *Spartina alterniflora* (saltmarsh cordgrass) performance declines as peat accumulates and becomes more dense. Flotsam and jetsam brought in by tides can smother local patches of vegetation and form unvegetated to sparsely vegetated pannes, a phenomenon that occurs regularly on high marshes. Tidal creeks form sinuous patterns throughout the low marsh draining the diurnal tides.

**Management Concerns:** Sea level rise may influence the dynamics of this marsh through drowning and/or increasing salinity levels.

**Reference Sites:** widespread in DE and NJ; Hansey Creek WMA, NJ

**Global and State Conservation Ranks and Reasons:** G5 (1-Dec-1997). DE: S5, NJ: S5.

**VegBank Link for Plot Data:** [http://vegbank.org/natureserve/element\\_global.2.689365](http://vegbank.org/natureserve/element_global.2.689365)

**References:** Adams 1963, Bertness 1988, Bowman 2000, Breden 1989, Breden et al. 2001, Chapman 1937, Clancy 1993b, Clancy 1996, Cowardin et al. 1979, Eastern Ecology Working Group n.d., Edinger et al. 2002, Enser 1993, Enser 1999, Fleming et al. 2001, Gawler 2001, Gawler 2002, Gosner 1979, Harrison 2001, Harrison 2004, Higgins et al. 1971, Hill 1986, MENHP 1991, Metzler and Barrett 1992, Metzler and Barrett 2001, Moul 1973, Rawinski 1984, Reschke 1990, Schafale 2000, Schafale 2003b, Schafale and Weakley 1990, Sperduto 1994, Sperduto 2000a, Sperduto 2000b, Stalter 1979, Swain and Kearsley 2001, Teal 1986

MOST ABUNDANT SPECIES		
STRATUM	LIFEFORM	SPECIES
Herb (field)	Graminoid	<i>Spartina alterniflora</i> (saltmarsh cordgrass)

## REED-GRASS TIDAL MARSH

*Phragmites australis* Tidal Herbaceous Vegetation

**Range:** This community has a broad geographic range, including coastal areas of the eastern and southeastern United States and Canada. It occurs in Delaware and New Jersey in the Delaware Estuary.

**Environmental Description:** This community is a dense tall grassland indicative of disturbance. It occurs in a range of tidal wetland habitats from fresh to brackish in salinity.

**Vegetation Description:** Spreading in large colonies, *Phragmites* (reed) eventually dominates disturbed areas at coverage up to 100%. More typically though, scattered individuals of other species may occur, such as sparse *Morella cerifera* (wax-myrtle) shrubs, *Kosteletzkya virginica* (seashore mallow), *Calystegia sepium* (hedge false bindweed), *Boehmeria cylindrica* (small-spike false nettle), *Typha angustifolia* (narrowleaf cattail), *Apocynum cannabinum* (Indian-hemp), *Rosa palustris* (swamp rose), *Polygonum* (smartweed, knotweed) sp., and *Mikania scandens* (climbing hempvine). Vines of *Toxicodendron radicans* (eastern poison-ivy) are also frequent but typically occur at low cover.



Photo by Kathleen Strakosch Walz

**Characteristic Species:** *Phragmites australis* (common reed)

**Dynamics/Successional Trajectory:** This community is a broadly defined reed marsh. It is characterized by dense stands of *Phragmites australis* (common reed), a species which tends to grow in colonies of tall, stout, leafy plants often to the exclusion of all other vascular plant species. Associated species are highly variable, depending on the community that has been invaded.

**Management Concerns:** *Phragmites australis* (common reed) is invasive globally, and the formation of these extensive monocultures are often considered fire hazards.

**Reference Sites:** Supawna Meadows NWR, NJ; Mad Horse Creek WMA, NJ

**Global and State Conservation Ranks and Reasons:** GNA (invasive) (22-Nov-1997). DE: SNA, NJ: SNA, PA: SNA.

**VegBank Link for Plot Data:** [http://vegbank.org/natureserve/element\\_global.2.688034](http://vegbank.org/natureserve/element_global.2.688034)

**References:** Bowman 2000, Breden 1989, Clancy 1993b, Edinger et al. 2002, Fleming 1998, Harrison 2001, Metzler and Barrett 1992, Metzler and Barrett 1996, Metzler and Barrett 2001, Nelson 1986, Niering and Warren 1977, Odum et al. 1984, Rawinski 1984, Saltonstall 2002, Schafale and Weakley 1990, Schotz pers. comm., Southeastern Ecology Working Group n.d., Swain and Kearsley 2001

MOST ABUNDANT SPECIES		
STRATUM	LIFEFORM	SPECIES
Herb (field)	Graminoid	<i>Phragmites australis</i> (common reed)

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## SALT PANNE (SALICORNIA TYPE)

*Salicornia (virginica, bigelovii, maritima)* - *Spartina alterniflora* Herbaceous Vegetation

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**Range:** This association occurs along the Mid- and North Atlantic Coast from the Canadian maritime provinces south to North Carolina. It occurs in New Jersey and Delaware in the Delaware Estuary.

**Environmental Description:** Vegetation of this association tends to develop in shallow depressions in salt marshes where drainage is poor. They tend to occur more frequently on the high marsh but occur within low marsh as well. Pannes form in depressions that range from 2-30 cm lower than the elevation of the marsh. The depressions are regularly to irregularly flooded by tides, and as the water evaporates during low tide, the salinity concentration increases forming "salt pannes." Substrate is soft, silty muck or peat of variable density.



Photo by Kathleen Strakosch Walz

**Vegetation Description:** This association includes tidally flooded hypersaline flats or very shallow depressions (pannes) dominated by halophytic herbs. Total vegetative cover is quite variable in pannes, from near total absence of vascular plants to a dense cover of *Salicornia virginica* (pickleweed), *Salicornia bigelovii* (dwarf glasswort), *Salicornia maritima* (sea saltwort), *Sarcocornia perennis* (woody glasswort), or *Spartina alterniflora* (saltmarsh cordgrass) (short form). Common associates include *Limonium carolinianum* (Carolina sea-lavender), *Plantago maritima* var. *juncoides* (seaside plantain), *Triglochin maritima* (seaside arrow-grass), *Suaeda maritima* (herbaceous seepweed), and *Atriplex* (saltbush) spp. Algal mats are characteristically present, visible even in densely vegetated pannes. Blue-green algae are an important component of these mats, in some cases contributing significantly more biomass to the community than do vascular species. The following algae were noted to occur in association with *Spartina alterniflora* (saltmarsh cordgrass) in the littoral zone of a Massachusetts salt marsh: *Oscillatoria subuliformis*, *Oscillatoria amphibia*, *Lyngbea* spp., *Microcoleus chthonoplastes*, *Nodularia harveyana*, *Hydrocoleum lyngbyaceum*, and *Symploca* spp. (Webber 1967).

**Characteristic Species:** *Salicornia bigelovii* (dwarf glasswort), *Salicornia maritima* (sea saltwort), *Salicornia virginica* (pickleweed), *Sarcocornia perennis* (woody glasswort)

**Dynamics/Successional Trajectory:** Salt pannes are part of the shifting mosaic of plant communities of the salt marsh complex. They tend to occur more frequently on the high marsh but are present in the low marsh as well. Pannes are variable in shape and likely variable in origin. Formation can result from ice-scouring or rafting flotsam that scrapes away or smothers existing vegetation, or from peat compaction, mosquito ditch levees, or tidal creekbank erosion that blocks or impedes drainage. Lack of vegetation decreases local sedimentation, which also maintains lower micro-relief (Redfield 1972). Evaporation from these poorly drained shallow depressions leads to hypersaline conditions (Niering and Warren 1980, Bertness et al. 1992). Gradients of salinity and standing water depth and duration correlate to vegetative cover and composition. The lowest portions of pannes tend to be wetter and more saline and can have little or no vegetation. As duration of wetness and salinity decreases across the micro-relief, forb-dominated species assemblages tend to dominate, followed by mixed graminoid-forb assemblages at the outer higher edges (Redfield 1972). Pannes can be ephemeral features on the marsh, and vegetation cover and composition can vary from year to year. Unvegetated, soft-bottomed pannes generally have plentiful worm and crab burrows (Godfrey et al. 1978).

**Management Concerns:** This community may be susceptible to sea level rise and potential drowning.

**Reference Sites:** Great Marsh, Sussex County, DE; Hansey Creek WMA, NJ

**Global and State Conservation Ranks and Reasons:** G5 (1-Dec-1997). DE: S3, NJ: S3S4.

**VegBank Link for Plot Data:** [http://vegbank.org/natureserve/element\\_global.2.686149](http://vegbank.org/natureserve/element_global.2.686149)

**References:** Bartgis 1986, Baumann 1978b, Berdine 1998, Bertness et al. 1992, Bowman 2000, Breden 1989, Breden et al. 2001, Clancy 1993b, Clancy 1996, Clovis 1968, Conard 1935, Dowhan and Rozsa 1989, Eastern Ecology Working Group n.d., Edinger et al. 2002, Enser 1999, Fleming 2001, Fleming et al. 2001, Gawler 2001, Gawler 2002, Godfrey et al. 1978, Good 1965, Harrison 2004, Harvill 1965, Higgins et al. 1971, Hill 1986, Klotz 1986, Metzler and Barrett 1992, Metzler and Barrett 2001, Miller and Egler 1950, Nichols 1920, Niering and Warren 1980, Peet et al. unpubl. data 2002, Rawinski 1984, Redfield 1972, Reschke 1990, Schafale 2000, Schafale and Weakley 1990, Sperduto 2000b, Swain and Kearsley 2001, VDNH 2003, Webber 1967

MOST ABUNDANT SPECIES		
STRATUM	LIFEFORM	SPECIES
Herb (field)	Semi-shrub	<i>Salicornia virginica</i> (pickleweed)
Herb (field)	Semi-shrub	<i>Sarcocornia perennis</i> (woody glasswort)
Herb (field)	Forb	<i>Salicornia bigelovii</i> (dwarf glasswort)
Herb (field)	Graminoid	<i>Spartina alterniflora</i> (saltmarsh cordgrass)

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## SALT PANNE POOL

*Ruppia maritima* - *Schoenoplectus maritimus* Herbaceous Vegetation

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**Range:** This association is currently described in New England from New Hampshire to Connecticut. It also occurs in New Jersey.

**Environmental Description:** This type occurs in permanently or semipermanently flooded salt pools or pannes within high and low salt marshes.

**Vegetation Description:** Vegetation is characterized by *Ruppia maritima* (beaked ditch-grass). Associated species can include *Stuckenia pectinata* (sago pondweed), *Zannichellia palustris* (horned pondweed), and purple-sulfur bacteria. *Schoenoplectus maritimus* (saltmarsh clubrush) borders the standing water in the northern portion of the range. (Note: *Schoenoplectus maritimus* (saltmarsh clubrush) is ranked SH (state historic) in New Jersey.)

**Noteworthy Associated Plant and/or Animal Species:** *Schoenoplectus maritimus* (saltmarsh clubrush)

**Characteristic Species:** *Ruppia maritima* (beaked ditch-grass)

**Reference Sites:** Sea Breeze, NJ

**Global and State Conservation Ranks and Reasons:** GNR (14-Apr-1998). NJ: SNR.

**VegBank Link for Plot Data:** [http://vegbank.org/natureserve/element\\_global.2.687881](http://vegbank.org/natureserve/element_global.2.687881)

**References:** Eastern Ecology Working Group n.d., Edinger et al. 2002, Godfrey et al. 1978, Metzler and Barrett 2001, Miller and Egler 1950, Niering and Warren 1980, Sperduto 2000b, Swain and Kearsley 2000, Thayer et al. 1984

MOST ABUNDANT SPECIES		
STRATUM	LIFEFORM	SPECIES
Submerged aquatic	Aquatic herb (floating & submergent)	<i>Ruppia maritima</i> (beaked ditch-grass)