II. ESTUARINE SYSTEM

The estuarine system consists of deepwater tidal habitats and adjacent tidal wetlands that are usually semienclosed but have open, partly obstructed, or sporadic access to open ocean or tidal fresh waters, and in which ocean water is at least occasionally diluted by freshwater runoff. The limits extend from the upstream limit of tidal influence seaward to an imaginary line closing the mouth of a river or bay. Salinity is usually less than 30.0 parts per thousand (ppt) ocean-derived salts.

A. ESTUARINE SUBTIDAL

This subsystem includes the area below the lowest tide; the substrate is permanently flooded with tidal water; it is continuously submerged.

1. Tidal river: the aquatic community of continuously flooded substrates that support no emergent vegetation. Within the river there are two zones; the deepwater zone includes areas where substrates are usually over 6 ft (2 m) deep at low tide, the shallows zone includes submerged areas less than 6 ft (2 m) deep at low tide that lack rooted aquatic vegetation. In the river there is a vertical salinity gradient, with a surface layer of fresh water (salinity less than 0.5 ppt) floating over a deeper layer of brackish water (salinity between 0.5 and 18.0 ppt). Salinities at any one place in the river may fluctuate as the tides flow in and out because the "salt wedge" of brackish water alternately rises and falls with the tides. Characteristic fishes include year-round residents as well as seasonal migrants or anadromous species that enter the river as adults to spawn and return to the ocean afterwards. The progeny of these anadromous fishes occupy the river as a nursery area for the remainder of the year or longer. Characteristic fishes of the deepwater include Atlantic tomcod (*Microgadus tomcod*), hogchoker (*Trinectes maculatus*), and rainbow smelt (*Osmerus mordax*). Characteristic fishes of the shallows include striped bass (*Morone saxatilis*), American shad (*Alosa sapidissima*), banded killifish (*Fundulus diaphanus*), spottail shiner (*Notropis hudsonius*), tesselated darter (*Etheostoma olmstedi*), and pumpkinseed (*Lepomis gibbosus*). Fishes that occur in both deepwater and shallows include bay anchovy (*Anchoa mitchilli*), blueback herring (*Alosa aestivalis*), white perch (*Morone americana*), and alewife (*Alosa pseudoharengus*).

Distribution: in the Hudson Valley and Coastal Lowlands ecozones.

Rank: G4 S3

Example: the Hudson River, from New York City to Troy

Source: Gladden et al. 1988.

2. Tidal creek: the aquatic community of a continuously flooded creek that drains the tidal waters of a coastal salt marsh. The water is brackish to saline (salinity between 0.5 and 30.0 ppt). Water levels fluctuate with the tides; the creek bottom is permanently flooded, but the banks are exposed at low tide. Most tidal creeks flow in a very sinuous pattern through the salt marsh. Although the vertical banks of the creek are regularly eroded and slump into the creek bottom, the position of the creek bed in the marsh is fairly stable and oxbows are rare. The sinuous meanders of the creek are not formed by recent erosion of the marsh, rather they are thought to be relicts of the drainage channels that were active in the tidal flats when the salt marsh grasses first became established. Characteristic plants include widgeon-grass (*Ruppia maritima*), and several cyanobacteria including *Hydrocoleum lyngbaceum*, *Anabaena torulosa*, and *Agmenellum quadruplicatum*. Several fishes that are resident in tidal creeks at low tide also use the low salt marsh when it is flooded by high tide. Characteristic fishes that have this distribution pattern include Atlantic silverside (*Menidia menidia*), mummichog (*Fundulus heteroclitus*), striped killifish (*Fundulus majalis*), sheepshead minnow (*Cyprinodon variegatus*), fourspine stickleback (*Apeltes quadracus*), threespine stickleback (*Gasterosteus aculeatus*), and American eel (*Anguilla rostrata*). Tidal creeks are also utilized as nursery areas for several important marine fishes, including winter flounder (*Pseudopleuronectes americanus*), black sea bass (*Centropristis striata*), bluefish (*Pomatomus saltatrix*), and striped bass (*Morone saxatilis*).

Distribution: in salt marshes along the seacoast in the Coastal Lowlands ecozone, and along the Long Island Sound in the Manhattan Hills ecozone.

Rank: G4 S3S4

Examples: Hubbard Creek Marsh, Suffolk County; Northwest Harbor, Suffolk County.

Sources: Redfield 1972; Teal 1986; Webber 1967.

3. Brackish subtidal aquatic bed: the aquatic community of continuously flooded substrates with rooted aquatic vegetation. The water is brackish (salinity between 0.5 and 18.0 ppt) and the water is usually less than 6 ft (2 m) deep at low tide. Characteristic species are waterweed (*Elodea nuttallii*), coontail (*Ceratophyllum demersum*), naiad (*Najas guadalupensis*), sago pondweed (*Potamogeton pectinatus*), horned pondweed (*Zannichellia palustris*), and widgeon grass (*Ruppia maritima*). A common weedy exotic is Eurasian milfoil (*Myriophyllum spicatum*).

Distribution: along the Hudson River from New York City to Newburgh, in the Hudson Valley and Triassic Lowlands ecozones; may also occur in the Coastal Lowlands ecozone.

Rank: G4 S3S4

Example: Piermont Marsh, Rockland County.

Sources: Metzler and Rosza 1982; Muenscher 1937; Senerchia-Nardone et al. 1985.

4. Freshwater subtidal aquatic bed: the aquatic community of continuously flooded substrates with rooted aquatic vegetation. The water is fresh (salinity less than 0.5 ppt) and the water is usually less than 6 ft (2 m) deep at low tide. Characteristic species are waterweeed (*Elodea nuttallii*), tapegrass (*Vallisneria americana*), naiads (*Najas guadalupensis*, and *N. minor*), and pondweed (*Potamogeton perfoliatus*). Two exotic weeds, Eurasian milfoil (*Myriophyllum spicatum*) and water-chestnut (*Trapa natans*), are common in the Hudson River aquatic beds.

Distribution: along the Hudson River from Newburgh to Troy, in the Hudson Valley ecozone.

Rank: G4 S3

Sources: Metzler and Rosza 1982; Muenscher 1937.

B. ESTUARINE INTERTIDAL

This subsystem includes the area between the highest tide level and the lowest tide level; the substrate is periodically exposed and flooded by semidiurnal tides (two high tides and two low tides per tidal day). Some areas are only irregularly exposed at low tide, while other areas are only irregularly flooded at high tide. Semidiurnal submergence, warm water, copious deposits of mud, and varying salinity make the intertidal estuarine communities extreme and specialized habitats (Fassett 1928).

1. Salt shrub: a shrubland community that forms the ecotone between salt marsh and upland vegetation. Salinity levels are generally lower here than in the salt marsh; and the elevation is higher. Periodic disturbance associated with storms causes die-back of shrubs. Characteristic shrubs are groundsel-tree (*Baccharis halimifolia*), saltmarsh-elder (*Iva frutescens*), and pasture rose (*Rosa carolina*); salt-meadow grass (*Spartina patens*), and switchgrass (*Panicum virgatum*) are typical herbs. A characteristic animal is marsh wren (*Cistothorus palustris*). This community is usually present as a linear feature at the upper edge of a salt marsh; where local topography is nearly level, an extensive shrubland or meadow sometimes occurs.

Distribution: in sheltered areas of the seacoast in the Coastal Lowlands and Manhattan Hills ecozones.

Rank: G5 S4

Examples: Hubbard Creek Marsh, Suffolk County; Northwest Harbor, Suffolk County.

Sources: Clark 1985; Clark 1986a; Conard 1935; Nixon 1982; Redfield 1972; NHP field surveys.

2. High salt marsh: a coastal marsh community that occurs in sheltered areas of the seacoast, in a zone extending from mean high tide up to the limit of spring tides. It is periodically flooded by spring tides and flood tides. High salt marsh typically consists of a mosaic of patches that are mostly dominated by a single graminoid species. The dominant species in many large areas are either salt-meadow grass (*Spartina patens*) or a dwarf form (6 to 12 in. tall) of cordgrass (*Spartina alterniflora*); also common are large areas dominated by spikegrass (*Distichlis spicata*), black-grass (*Juncus gerardi*), or a mixture of salt-meadow grass and cordgrass. Characteristic species of the upper slope of the high marsh (the area that grades into salt shrub) are black-grass, switchgrass (*Panicum virgatum*), sea-lavender (*Limonium carolinianum*), and slender saltmarsh aster (*Aster tenuifolius*). Characteristic animals include salt marsh mosquitoes (*Aedes* spp.), greenhead flies (*Tabanidae*), coffeebean snail (*Melampus bidentatus*), sharp-tailed sparrow (*Ammodramus caudacutus*), marsh wren

(*Cistothorus palustris*), eastern meadowlark (*Sturnella magna*), clapper rail (*Rallus longirostris*), and American black duck (*Anas rubripes*).

High salt marsh is one zone within a coastal salt marsh ecosystem; it occurs in a complex mosaic with several other communities. Other communities in a salt marsh ecosystem include salt shrub at the upland border of the high marsh; low salt marsh at the seaward border of the high marsh and along the edges of tidal creeks that drain the high marsh; and salt pannes in shallow depressions within the marsh.

Distribution: in sheltered areas of the seacoast in the Coastal Lowlands and Manhattan Hills ecozones.

Rank: G4 S3S4

Examples: Hubbard Creek Marsh, Suffolk County; Northwest Harbor, Suffolk County.

Sources: Clark 1985; Clark 1986a; Conard 1935; Nixon 1982; Redfield 1972; NHP field surveys.

3. Salt panne: a shallow depression in a salt marsh where the marsh is poorly drained. Pannes occur in both low and high salt marshes. Pannes in low salt marshes usually lack vegetation, and the substrate is a soft, silty mud. Pannes in a high salt marsh are irregularly flooded by spring tides or flood tides, but the water does not drain into tidal creeks. After a panne has been flooded the standing water evaporates and salinity of the soil water is raised well above the salinity of sea-water. Soil water salinities fluctuate in response to tidal flooding and rainfall. Small pond holes occur in some pannes; the pond holes are usually deeper than the thickness of the living salt marsh turf, and the banks or "walls" of the pond holes are either vertical or they undercut the peat. Characteristic plants of a salt panne include the dwarf form (6 to 12 in. tall) of cordgrass (*Spartina alterniflora*), glassworts (*Salicornia europaea* and *S. virginica*), marsh fleabane (*Pluchea odorata*), salt marsh plantain (*Plantago maritima* ssp. *juncoides*), arrow-grass (*Triglochin maritimum*), and salt marsh sand spurry (*Spergularia marina*). Widgeon-grass (*Ruppia maritima*) grows in the pond holes; fishes that may be permanent residents in large pond holes include mummichog (*Fundulus heteroclitus*) and sheepshead minnow (*Cyprinodon variegatus*).

Distribution: in salt marshes along the seacoast of the Coastal Lowlands ecozone.

Rank: G3G4 S3

Examples: Hubbard Creek Marsh, Suffolk County; Northwest Harbor, Suffolk County.

Sources: Nixon 1982; Redfield 1972; NHP field surveys.

4. Low salt marsh: a coastal marsh community that occurs in sheltered areas of the seacoast, in a zone extending from mean high tide down to mean sea level or to about 6 ft (2 m) below mean high tide. It is regularly flooded by semidiurnal tides. The vegetation of the low salt marsh is a nearly monospecific stand of cordgrass (*Spartina alterniflora*), a coarse grass that grows up to about 10 ft (3 m) tall. A few species of marine algae can form dense mats on the surface sediments between the cordgrass stems, including knotted wrack (*Ascophyllum nodosum*) and rockweed (*Fucus vesiculosus*); sea lettuce (*Ulva* spp.) and green algae in the genus *Enteromorpha* can be abundant, especially in early summer. Other plants that are present in very low numbers include glasswort (*Salicornia europaea*), salt marsh sand-spurry (*Spergularia marina*), and lesser sea blite (*Suaeda maritima*). Characteristic animals include clapper rail (*Rallus longirostris*), willet (*Catoptrophorus semipalmatus*), marsh wren (*Cistothorus palustris*), seaside sparrow (*Ammodramus maritimus*), fiddler crabs (*Uca pugilator* and *U. pugnax*) nesting along creek banks, and at high tide mummichog (*Fundulus heteroclitus*) and several other small fishes that live in the tidal creeks at low tide.

The low salt marsh is one zone within a coastal salt marsh ecosystem; it occurs in a mosaic with several other communities. Low salt marsh grades into high salt marsh at slightly higher elevations, and it grades into intertidal mudflats at slightly lower elevations. Tidal creeks that drain the salt marsh flow in a sinuous pattern through the marsh, and a narrow band of low marsh lines the banks of the tidal creeks. Shallow depressions or pannes may also occur in the low marsh.

Distribution: in sheltered areas of the seacoast in the Coastal Lowlands and Manhattan Hills ecozones.

Rank: G4 S3S4

Examples: Hubbard Creek Marsh, Suffolk County; Northwest Harbor, Suffolk County.

Sources: Clark 1985; Clark 1986a; Conard 1935; Nixon 1982; Redfield 1972; NHP field surveys.

5. Coastal salt pond: a community inhabiting marine shoreline lakes or ponds formed by sandspits that close off a lagoon or bay. The water is brackish or slightly brackish. Occasionally the barrier beach is broken by hurricanes and the pond becomes saline until the sandspit closes the pond again. Some ponds have permanent (natural or artificial) inlets. Characteristic species are dwarf spikerush (*Eleocharis parvula*), switchgrass (*Panicum virgatum*), salt-meadow grass (*Spartina patens*), reedgrass (*Phragmites australis*), saltmarsh fleabane (*Pluchea odorata*), three-square (*Scirpus americanus*), rose-mallow (*Hibiscus moscheutos*), pigweeds (*Chenopodium* spp.) and mock bishop's-weed (*Ptilimnium capillaceum*).

Distribution: along the seacoast in the Coastal Lowlands ecozone.

Rank: G4 S1S2

Examples: Oyster Pond, Suffolk County; Island Pond, Fisher's Island, Suffolk County.

Source: NHP field surveys.

6. Brackish tidal marsh: a marsh community that occurs where water salinity ranges from 0.5 to 18.0 ppt, and water is less than 6 ft (2 m) deep at high tide. This community consists of a mixture of salt marsh and freshwater tidal marsh species, with no species attaining dominance over extensive areas (although some species are locally abundant in patches). The vegetation in a brackish tidal marsh is dense and dominated by tall graminoids. Characteristic plants are narrowleaf cattail (*Typha angustifolia*), arrowleaf (*Peltandra virginica*), pickerel-weed (*Pontederia cordata*), water smartweed (*Polygonum punctatum*), reedgrass (*Phragmites australis*), marsh fern (*Thelypteris palustris*), wild rice (*Zizania aquatica*), soft-stem bulrush (*Scirpus tabernaemontanii*), river bulrush (*S. fluviatilis*), dwarf spikerush (*Eleocharis parvula*), arrowhead (*Sagittaria latifolia*), lilaeopsis (*Lilaeopsis chinensis*), rose-mallow (*Hibiscus moscheutos*), yellow iris (*Iris pseudacorus*) and saltmarsh fleabane (*Pluchea odorata*). Purple loosestrife (*Lythrum salicaria*) is a common weed in brackish marshes. Characteristic birds inlcude red-winged blackbird (*Agelaius phoeniceus*), swamp sparrow (*Melospiza georgiana*), marsh wren (*Cistothorus palustris*), yellow warbler (*Dendroica petechia*), common yellowthroat (*Geothlypis trichas*), song sparrow (*Melospiza melodia*), Virginia rail (*Rallus limicola*), American goldfinch (*Carduelis tristis*), and eastern kingbird (*Tyrannus tyrannus*).

Brackish marshes are best developed on large river systems characterized by gentle slope gradients coupled with tidal influence over considerable distances. The downstream limits of the community begin where cordgrass (*Spartina alterniflora*) no longer dominates tidal creek or river banks, and the upstream limits extend to where the green seaweed *Enteromorpha intestinalis* can no longer be found. Brackish tidal marshes can be distinguished from freshwater tidal marshes by the lack of species restricted to freshwater, such as spatterdock (*Nuphar luteum* ssp. *macrophyllum*), sweetflag (*Acorus americanus*), and blue flag (*Iris versicolor*), and a decrease in cover of sedges (*Carex* spp. and *Cyperus* spp.).

Distribution: along the seacoast of the Coastal Lowlands ecozone, and along the Hudson River from New York City to Newburgh in the Triassic Lowlands and Hudson Valley ecozones.

Rank: G4 S3S4

Examples: Constitution Marsh, Putnam County; Iona Island, Rockland County; Piermont Marsh, Rockland County.

Sources: Metzler and Rosza 1982; Muenscher 1937; Odum et al. 1984; Senerchia-Nardone et al. 1985; Swift 1987; NHP field surveys.

7. Brackish intertidal mudflats: a sparsely vegetated community, characterized by low-growing, rosette-leaved aquatics. The community occurs on exposed intertidal mudflats where water salinity ranges from 0.5 to 18.0 ppt. This community is best developed where mudflats are nearly level so that broad expanses are exposed at low tide. The rosette-leaved aquatics are completely submerged at high tide, and they are usually coated with mud. Characteristic species are spongy arrowhead (*Sagittaria calycina* var. *spongiosa*), strap-leaf arrowhead (*Sagittaria subulata*), mudwort (*Limosella australis*), three-square bulrush (*Scirpus americanus*), and tapegrass (*Vallisneria americana*).

Distribution: along the Hudson River from New York City to Newburgh in the Triassic Lowlands and Hudson Valley ecozones; may also occur in the Coastal Lowlands ecozone.

Rank: G3G4 S1S2

Examples: Piermont Marsh, Rockland County; Constitution Marsh, Putnam County.

Sources: Muenscher 1937; NHP field surveys.

8. Brackish intertidal shore: a community of the intertidal gravelly or rocky shores of brackish tidal rivers and creeks where water salinity ranges from 0.5 to 18.0 ppt. This community is usually sparsely vegetated. More data on this community are needed.

Distribution: along the seacoast of Long Island in the Coastal Lowlands ecozone, and along the Hudson River from New York City to Poughkeepsie in the Triassic Lowlands and Hudson Valley ecozones.

Rank: G3G4 S1S2

Example: Hands Creek, Suffolk County.

Source: NHP field surveys.

9. Freshwater tidal swamp: a forested or shrub-dominated tidal wetland that occurs in lowlands along large river systems characterized by gentle slope gradients coupled with tidal influence over considerable distances. The swamp substrate is always wet and is subject to semidiurnal flooding by fresh tidal water (salinity less than 0.5 ppt). The characteristic trees are green ash (*Fraxinus pennsylvanica*), black ash (*F. nigra*), red maple (*Acer rubrum*), slippery elm (*Ulmus rubra*) and American hornbeam (*Carpinus caroliniana*; northern white cedar (*Thuja occidentalis*) is a distinctive associate in at least one example in the Hudson Valley. Common shrubs and vines are alders (*Alnus serrulata, A. rugosa*), spicebush (*Lindera benzoin*), arrowwood (*Viburnum recognitum*), silky dogwood (*Cornus amomum*), red-osier dogwood (*C. sericea*), gray dogwood (*C. foemina* ssp. *racemosa*), Virginia creeper (*Parthenocissus quinquefolius*), and poison ivy (*Toxicodendron radicans*). Characteristic groundlayer species are rice cutgrass (*Leersia oryzoides*), sensitive fern (*Onoclea sensibilis*), clearweed (*Pilea pumila*), spotted jewelweed (*Impatiens capensis*), common monkeyflower (*Mimulus ringens*), knotweeds (*Polygonum hydropiper, P. hydropiperoides, P. sagittatum*), skunk cabbage (*Symplocarpus foetidus*), hog peanut (*Amphicarpea bracteata*), groundnut (*Apios americana*), wild yam (*Dioscorea villosa*), sedge (*Carex grayi*), Jack-in-the-pulpit (*Arisaema triphyllum*), and swamp milkweed (*Asclepias incarnata*).

Distribution: along the Hudson River from Newburgh to Troy, in the Hudson Valley ecozone.

Rank: G2G3 S1

Examples: Roger's Island, Columbia County; Catskill Marsh, Greene County.

Sources: DeVries and DeWitt 1986; McVaugh 1958; Westad and Kiviat 1985; NHP field surveys.

10. Freshwater tidal marsh: a marsh community that occurs in shallow bays, shoals, and at the mouth of tributaries of large tidal river systems, where the water is usually fresh (salinity less than 0.5 ppt), and less than 6 ft (2 m) deep at high tide. The vegetation in dominated by aquatics that are emergent at high tide. Typically there are two zones in a freshwater tidal marsh: a low-elevation area dominated by short, broad-leaf emergents bordering mudflats or open water, and a slightly higher-elevation area dominated by tall graminoids.

Characteristic plants of the low-elevation, broad-leaf emergent zone include spatterdock (*Nuphar luteum* ssp. *macrophyllum*), pickerel-weed (*Pontederia cordata*), arrowleaf (*Peltandra virginica*), and fowl mannagrass (*Glyceria striata*). Under the canopy of emergents (or between clones) there may be a sparse understory of rosette-leaved aquatics such as narrow-leaved arrowheads (*Sagittaria subulata, S. graminea,* and *S. rigida*), and mud-plantain (*Heteranthera reniformis*).

Characteristic plants of the slightly higher, graminoid zone inlcude narrowleaf cattail (*Typha angustifolia*), river bulrush (*Scirpus fluviatilis*), bur-reed (*Sparganium eurycarpum*), wild rice (*Zizania aquatica*), and blue flag (*Iris versicolor*).

Other characteristic plants that occur in both zones include arrowhead (*Sagittaria latifolia*), rice cutgrass (*Leersia oryzoides*), water-hemp (*Amaranthus cannabinus*), spotted jewelweed (*Impatiens capensis*), estuary beggar-ticks (*Bidens bidentoides*), sweetflag (*Acorus americanus*), softstem bulrush (*Scirpus tabernaemontanii*), sedges (*Carex hystericina, C. lacustris*), and cyperus (*Cyperus* spp.). Purple loosestrife (*Lythrum salicaria*) and reedgrass (*Phragmites australis*) are common exotics in this community.

Some marshes include small areas of sandflats, often dominated by one or a few

species. Characteristic plants of sandflats include three-square bulrush (*Scirpus americanus*), water horsetail (*Equisetum fluviatile*), Pennsylvania bittercress (*Cardamine pensylvanica*), mud-hyssop (*Gratiola neglecta*), water smartweed (*Polygonum punctatum*), and an exotic, black mustard (*Brassica nigra*).

Characteristic birds include marsh wren (*Cistothorus palustris*), red-winged blackbird (*Agelaius phoeniceus*), swamp sparrow (*Melospiza georgiana*), Virginia rail (*Rallus limicola*), song sparrow (*Melospiza melodia*), yellow warbler (*Dendroica petechia*), least bittern (*Ixobrychus exilis*), American goldfinch (*Carduelis tristis*), willow flycatcher (*Empidonax traillii*), and common yellowthroat (*Geothlypis trichas*).

Distribution: along the Hudson River from Newburgh to Troy, in the Hudson Valley ecozone.

Rank: G3G4 S2

Examples: Stockport Creek Marshes, Columbia County; Catskill Marsh, Greene County.

Sources: DeVries and DeWitt 1986; Metzler and Rosza 1982; Muenscher 1937; Odum et al. 1984; Swift 1987; NHP field surveys.

11. Freshwater intertidal mudflats: a sparsely vegetated community characterized by low rosette-leaved aquatics. This community occurs on exposed intertidal mudflats where the water is fresh (salinity less than 0.5 ppt). This community is best developed where mudflats are nearly level so that broad expanses are exposed at low tide. The plants are completely submerged in 3 to 4 ft (0.9 to 1.2 m) of water at high tide; and they are usually coated with mud. Characteristic species are strap-leaf arrowhead (*Sagittaria subulata*), mud-plantain (*Heteranthera reniformis*), grass-leaf arrowhead (*Sagittaria graminea*), stiff arrowhead (*Sagittaria rigida*), three-square bulrush (*Scirpus americanus*), golden club (*Orontium aquaticum*), and wild rice (*Zizania aquatica*).

Distribution: along the Hudson River from Newburgh to Troy, in the Hudson Valley ecozone.

Rank: G3G4 S2

Examples: Stockport Creek Marshes, Columbia County; North Tivoli Bay, Dutchess County.

Sources: Muenscher 1937; NHP field surveys.

12. Freshwater intertidal shore: a community of the intertidal gravelly or rocky shores of freshwater tidal rivers and creeks, sometimes occurring at the base of cliffs. The vegetation may be very sparse. Characteristic species are heartleaf plantain (*Plantago cordata*), estuary beggar-ticks (*Bidens bidentoides*), water-hemp (*Amaranthus cannabinus*), smartweed (*Polygonum hydropiperoides*), cardinal flower (*Lobelia cardinalis*), Pennsylvania bittercress (*Cardamine pensylvanica*), mud-hyssop (*Gratiola neglecta*), golden club (*Orontium aquaticum*), and an exotic, black mustard (*Brassica nigra*).

Distribution: along the Hudson River from Newburgh to Troy, in the Hudson Valley ecozone.

Rank: G3G4 S2S3

Examples: Tivoli Bays, Dutchess County; Inbocht Bay, Greene County.

Sources: McVaugh 1958; Muenscher 1937; NHP field surveys.

C. ESTUARINE CULTURAL

This subsystem includes communities that are either created and maintained by human activities, or are modified by human influence to such a degree that the physical conformation of the substrate, or the biological composition of the resident community is substantially different from the character of the substrate or community as it existed prior to human influence.

1. Estuarine channel/artificial impoundment: the aquatic community of an estuarine channel or bay that was created or modified by a barrier or dam which obstructs the outflow of water; an artificial estuarine deepwater community.

Distribution: in the Hudson Valley, Hudson Highlands, Manhattan Hills, and Coastal Lowlands ecozones.

Rank: G5 S5

2. Estuarine ditch: the aquatic community of a ditch or narrow channel excavated in an estuarine marsh for the intended purpose of reducing mosquito populations. These ditches have not been very effective in reducing mosquito populations; the ditches have probably done more harm to the salt marsh vegetation than is justified

by the effectiveness of the mosquito control efforts.

Distribution: along the seacoast of the Coastal Lowlands and Manhattan Hills ecozones.

Rank: G5 S5

3. Estuarine impoundment marsh: a marsh community that occurs in a wetland created or modified by a barrier or dam that obstructs the outflow or inflow of water, and which has a biological composition significantly different from the composition of a natural estuarine marsh. This community is characterized by an abundance of weedy species such as purple loosestrife (*Lythrum salicaria*), reedgrass (*Phragmites australis*), or water-chestnut (*Trapa natans*).

Distribution: in the Hudson Valley, Hudson Highlands, Manhattan Hills, and Coastal Lowlands ecozones.

Rank: G5 S5

4. Estuarine dredge spoil shore: the wetland community of a constructed estuarine shore in which the substrate is composed of dredge spoils. This is a community with minimal vegetative cover and relatively low species diversity.

Distribution: in the Hudson Valley, Hudson Highlands, Manhattan Hills, and Coastal Lowlands ecozones.

Rank: G5 S5

5. Estuarine riprap/artificial shore: the wetland community of a constructed estuarine shore in which the substrate is composed of broken rocks, wooden bulkheads, or concrete placed so as to reduce erosion. Vegetative cover and species diversity are low compared to natural estuarine shores.

Distribution: in the Hudson Valley, Hudson Highlands, Manhattan Hills, and Coastal Lowlands ecozones.

Rank: G5 S5