Appendix 2
Vegetation Management of Tidal Marsh Edges

Photo-illustrated Weed List and Guide
For Tidal Marsh Edge Vegetation, Western San Francisco Estuary

The following guide is a list of widespread, common non-native invasive plant species (weeds) found in the tidal marsh-terrestrial ecotones of the San Francisco Estuary. Representative photographs are provided for recognition of most species, emphasizing the earlier life-history stages (vegetative to flowering, prior to seed set that are most likely to be observed during weed control activities. Nomenclature generally follows 2008 taxonomic treatments of Flora of North America (www.efloras.org). For diagnostic keys to species and genera, refer to state, regional, or county floras. Selected relevant information on field recognition characters and habitat, geographic distribution, for non-technical identification purposes, is provided. Plants are listed in alphabetical order by botanical name for ease of reference with text, and are divided into broad-leaf weeds and grass weeds.

BROAD-LEAF WEEDS


Bassia hyssopifolia
Bassia
Chenopodiaceae (Amaranthaceae), amaranth family (formerly goosefoot family)

Annual erect forb, invasive on levee crests, disturbed alkali or subsaline soils. Seldom persist in competition with dense vegetation. *Narrow gray-green pubescent leaves.*


Beta vulgaris
Wild beet, wild Swiss chard
Chenopodiaceae (Amaranthaceae), Amaranth family (formerly goosefoot family)

Minor shoreline weed, short-lived perennial, of disturbed high tide drift-lines, mostly central and south SF Bay.


***Brassica nigra*, black mustard**. Brassicaceae, mustard family.

Abundant annual on levees, paths, disturbed soils above tide line.

Cakile maritima
Sea-rocket
Brassicaceae, mustard family

Minor shoreline annual to perennial weed, mostly Central Bay, sandy shorelines.

Succulent lobed hairless leaves.

Carduus pycnocephalus
Italian thistle
Asteraceae, aster family

Noxious annual weed of levees, grasslands, disturbed soils, throughout estuary. *Gray-green downy and spiny leaves and stems.*

Carpobrotus edulis* x *chilensis
Iceplant
Aizoaceae, purslane or carpetweed family

Noxious perennial succulent shrub, most invasive in foggy microclimates, Central and North Bay, above and below high tide line.

Centaurea solstitialis
Star-thistle
Asteraceae, aster family

Noxious annual to biennial weed of grasslands, disturbed soils, levees, throughout estuary; most abundant in North Bay, Suisun Bay areas.

Spiny seed-heads, gray-green hairy leaves.


Chenopodium ambrosioides
Mexican-tea
Chenopodiaceae (Amaranthaceae), Amaranth family (formerly goosefoot family)

Occasional annual or perennial weed of levees, disturbed soils. *Aromatic, slightly fleshy dark green leaves.*


Cirsium vulgare
Bull thistle
Asteraceae, aster family

Locally abundant in disturbed grasslands, seasonal wetlands. *Coarse spiny leaves in clumps.*



Conium maculatum
Poison-hemlock
Apiaceae, carrot family

Noxious robust annual weed of levees, disturbed soils with late-spring moisture; often in extensive stands. *Purple-blotched stems, fetid scented dissected fern-like foliage. Highly toxic if ingested; toxins in sap may be absorbed through skin*.

Convolvulus sepium
Bindweed
Convolvulaceae, morning-glory family

Prostrate clonal perennial forb, hard-packed levee soils, paths with sparse cover. *White to pinkish small morning-glory flowers.*

Dipsacus sativus
Teasel
Dipsacaceae, teasel family

Occasional weed of disturbed grasslands, seasonal wetlands. *Distinctive comb-like seedhead.*

Dittrichia graveolens
Stinkwort, stinkweed
Asteraceae, aster family

Highly invasive summer-green resinous annual forb, spreading on levee roads, paths, disturbed subsaline or alkali soils, grasslands, mostly in southern San Francisco Bay; rapidly spreading elsewhere. *Strong camphor scent, linear sticky glandular leaves, regularly branched erect plant. Fall-flowering.*



Foeniculum vulgare
Fennel
Apiaceae, carrot family

Highly invasive tall, robust perennial of levees, dry soils, often in dense or dominant stands. *Anise-scented foliage, flowers, seeds; highly dissected feathery, fern-like leaves with thread-like segments.*


Genista monspessulana
French broom
Fabaceae, pea family

Noxious invasive shrub, often dominant in extensive stands. Abundant, persistent seed banks. Occurs in estuary primarily above tide line, Marin County.


Hypochaeris radicata
Cat's-ear
Asteraceae, aster family

Widespread, locally common to abundant, but seldom dominant in grasslands, disturbed soils, and levees above tide-line.



Lepidium latifolium
Perennial pepperweed, broadleaf pepperweed
Brassicaceae, mustard family

Highly invasive clonal perennial, sprouting from creeping roots. Forms large colonies on levees, high tide lines, brackish marsh plains, and alkali or subsaline seasonal wetlands throughout the estuary. Most abundant in southern San Francisco Bay, Suisun and Martinez marsh areas, and northern San Pablo Bay. *Large, fleshy taproots have strong scent of horseradish.*




Limonium ramosissimum **Mediterranean sea-lavender**
Richardson Bay – *L. r.* ssp. *confusum* (?)
San Francisco Peninsula – *L. r.* ssp. *provinciale*, Algerian sea-lavender (?)
Plumbaginaceae, leadwort family

Low-growing, dwarf branching rosettes with very small, succulent leaves (blunt – ssp. *confusum*; acute – ssp. *provinciale*) forming dense mats in the high tide line, but capable of spreading below and above the high tide line. Do not confuse with native sea-lavender, which has broad, large, wavy-margin leaves on mostly unbranched, stout, tall plants.

Lotus corniculatus
Bird's-foot trefoil
Fabaceae, pea family

Taprooted perennial weed, low-growing weed of seasonal wetlands, upper edges of brackish marshes, levees. *Bright yellow pea flower, green foliage May-summer.*

Malva neglecta
Cheeses, mallow
Malvaceae, mallow family

Low-growing annual weed, disturbed soils; seldom persisting in dense vegetation. *Fruits resemble cheese rounds.*

Do not confuse with similar native gray pubescent species, alkali-mallow (*Malvella leprosa*)

***Medicago* species**
Bur-clovers
Fabaceae, pea family

Low-growing annual minor weeds of disturbed soils. *Most species have bur-like fruits.*

White sweet-clover, melilot
Melilotus alba
Fabaceae, pea family

Annual tall weed of disturbed soils, levees, paths; seldom persisting in competition with dense perennial or shrub vegetation.

Melilotus indica
Yellow sweet-clover, small melilot
Fabaceae, pea family

Annual weed of disturbed soils, levees, paths; seldom persisting in competition with dense vegetation. *M. officinalis* is similar, with smaller flowers and broader, slightly toothed leaves.

Mesembryanthemum nodiflorum
Annual iceplant
Aizoaceae, purslane or carpetweed family

Succulent annual, abundant to dominant weed only on interior slopes of salt ponds with sparse vegetation; minor weed of tidal marsh edges, levees. *Nearly cylindrical succulent leaves; plants bright red during and after flowering.*

Nicotiana glauca *[see photo, preceding page]*
Tree-tobacco
Solanaceae, nightshade family

Moderately invasive soft-wooded tree, often sprouting from suckers on disturbed alkali flats, levees; mostly southern San Francisco Bay, occasionally elsewhere. *Glaucous gray-green slightly fleshy leaves; clusters distinctive tubular yellow flowers on mature plants.*

Oxalis pes-caprae
Bermuda-buttercup
Oxalidaceae, oxalis family

Invasive from clonal spread of seed-like bulbils (bulbs formed instead of seeds in mature flowers) and below-ground bulbs on fleshy roots. Emerges in fall, flowers in winter. Forms extensive, dense colonies, usually in disturbed soil with imported fill near residential areas.


Picris echioides
Bristly ox-tongue
Asteraceae, aster family

Widespread coarse erect annual, moderately invasive in disturbed soils; seldom persistent in dense perennial vegetation. *Flowerheads like dandelions; harsh bristly broad leaves with raised bristly bumps..*

Plantago coronopus
Buck's-horn plantain
Plantaginaceae, plantain family

Locally abundant in disturbed high tide lines, usually in wave-eroded but well-drained saline soils. *Hairy, cut-edged or lobed leaves in a low rosette of leaves from crown of taproot.*

Plantago lanceolata
Lance-leaf plantain

Plantaginaceae, plantain family

Usually a minor weed of levees, disturbed grasslands, soils above tide line. *Narrow leaves in a rosette on top of a taproot.*

Raphanus sativa
Wild radish
Brassicaceae, mustard family

Widespread, often dominant taprooted annual (or weakly perennial in moist soil) on levees and disturbed high tide lines or high tidal marsh, mostly North Bay; occasional in disturbed soils at and above tide line throughout the estuary. *Flowers may be white to lavender or dull yellow or brownish-yellow. Leaves lobed, rough.*

Rumex crispus
Curly dock
Polygonaceae, buckwheat family

Widespread, common perennial forb; abundant in seasonal wetlands, moist grasslands, occasional in levees.

In brackish marshes, do not confuse this with the native western dock, *R. occidentalis*, which lacks the inflated papery sac in the dry fruit around the seed.


***Salsola soda*, Mediterranean saltwort**
Chenopodiaceae (Amaranthaceae)

Highly invasive annual weed of high tide lines and high tidal marsh, especially in drift-lines with debris or disturbed saline soils. *Succulent leaves and stems, nearly cylindrical; stems redden (often dark-striped) by mid-summer or under physiological stress. Seedlings have opposite leaves; mature plants have alternate leaves.*

Senecio vulgaris
Common groundsel
Asteraceae, aster family

Minor annual weed of disturbed soils, paths; often on levees.


Sonchus oleraceus (left) **, *S. asper*** (right)
Sow-thistle
Asteraceae, aster family

Minor annual weed of grasslands, levees, disturbed soils. *Jagged, lobed leaves, milky sap; blowball" seed-heads. S. asper is similar, with prickly leaves and rounded leaf bases.*


Tetragonia tetragonioides
New Zealand spinach
Aizoaceae, purslane or carpetweed family

Fleshy, spreading perennial plant of high tide lines, lower slopes of levees. Locally abundant; edible when tender.

GRASS WEEDS


Agrostis avenacea
Australian bentgrass, oat bentgrass
Poaceae, grass family

Highly invasive in seasonal pond beds, seasonal wetlands, ditches; at least moderately invasive on levees, upper edges of tidal marshes below high tide line. Range is expanding rapidly in North Bay. *Thread-like branches of seed-heads detach and blow in flossy "tumbleweed" masses that accumulate on vegetation, ditch beds, fences.*


Avena sativa
Wild oat
Poaceae, grass family

Widespread, often abundant or dominant annual tall grass of well-drained to arid terrestrial grasslands, levees, disturbed soils. *Plants are often over 3 feet tall, spikelets ("seeds") with long awns*

Bromus diandrus
Ripgut brome
Poaceae, grass family

Highly abundant, widespread invasive annual grass: grasslands, levees, disturbed soils. Often dominant. *Long awns (stiff projections of grass fruit) stick in fur, ears, clothing.*

Cortaderia jubata
Jubata grass
Poaceae, grass family

Invasive massive clump-forming grass of levees, seasonal wetlands; highly invasive on marine bluffs, outer coast. *Feathery, reed-like seed-heads, long, stiff leaves with harsh saw-like edges. Similar to Pampas grass (C. selloana), which has whiter seed-heads and hairless leaf sheath-bases.*

Ehrharta erecta, **erect veldtgrass**

Poaceae, grass family
Highly invasive perennial clump-forming grass with matted growth habit and tenacious roots, abundant small seeds, and exceptional tolerance to many physiological stresses (drought, shade, wind) and competition. Resembles superficially some woodland species of melic-grass (*Melica torreyana, Melica* spp.). Spreading from established Central Bay populations in Marin, San Francisco, San Mateo, and Berkeley-Oakland shorelines.

H. murinum ssp. gussoneanum

H. brachyantherum ***(native)***

Hordeum murinum* ssp. *gussoneanum
Wild barley
Poaceae, grass family

Annual grass often dominant in marginally saline seasonally wet or flooded soils; levees, grasslands [*Caution: do not confuse nonnative wild barley with native meadow barley, Hordeum brachyantherum, above; meadow barley has long, lax, slender spikes, usually purplish-brown when mature*]


Lolium multiflorum
Italian ryegrass
Poaceae, grass family

Widespread, invasive in moist grasslands, seasonal wetlands, levees, especially in North Bay, Suisun and Martinez Marshes. Often forms extensive stands mixed with native salt tolerant species. Similar species L. perenne lacks long awns in seedhead.


Parapholis incurva
Sicklegrass
Poaceae, grass family

Annual, clump-forming grass of saline soils, strongly curved leaves and stems. Usually a minor weed, occasionally abundant near the high tide line. Similar to salt-tolerant grass weed *Hainardia cylindrica*, which has straight seedheads.


Phalaris aquatica
Harding grass
Poaceae, grass family

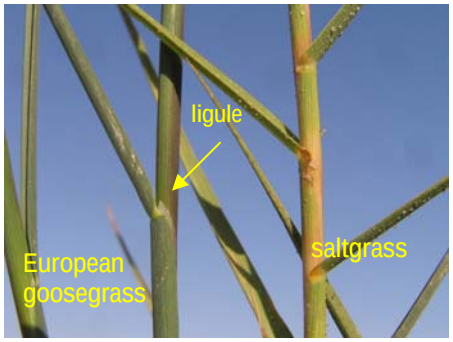
Highly invasive clump-forming tall perennial grass, invading both dry and wet soils; green throughout summer except in highly arid sites.


Piptatherum mileaceum (syn. *Oryzopsis mileaceum*)
Smilo grass
Poaceae, grass family

Bunchgrass with stolon-like layering culms, often with “mops” of vegetative shoots at nodes of the culms. Levees, bayshores, disturbed riparian habitats.

Polypogon monspeliensis
Rabbit's-foot grass
Poaceae, grass family

Primarily weed of seasonal wetlands and disturbed or winter-ponded depressions brackish tidal marshes; also minor weed on levees. *Long soft awns of seedhead/flowerhead form "rabbit's foot".*



Puccinellia maritima European goosegrass

Mat-forming or lax, spreading clump-forming perennial grass with above-ground runners, similar to saltgrass, but lacking salt crystals on leaves, and bearing translucent membrane (ligule) protruding from top ends (collar) of leaf sheath. Found mostly in high marsh.

Appendix 1, Table 1.

List of Widespread Nonnative Weeds of Terrestrial-tidal Marsh Ecotones, San Francisco Estuary

Summary representative list of widespread nonnative weeds of tidal marsh-terrestrial ecotones, San Francisco Estuary, with assessments of invasive status and ranks of abundance. based on author's observations 1991-present. Nomenclature follows Hickman (1993), with synonyms provided for major taxonomic revisions. Selected highly invasive species (strongly dominant where present or severe management problem where established) are named in bold typeface.

Species	common name	family	invasive status	abundance
Acacia melanoxylon	blackwood acacia	Fabaceae	Invasive, but uncommon; spreading from plantings	locally abundant, hillslopes bordering tidal marsh (Newark, Novato)
Agrostis avenacea	**Australian or oat bentgrass**	Poaceae	Highly invasive, range expansion in North Bay, esp. in or near ditches, seasonal ponds; levees	Abundant to dominant in brackish seasonal wetlands; also on levees, moist grassland
Atriplex semibaccata	Australian saltbush	Chenopodiaceae (now placed in Amaranthaceae)	Moderately invasive	Seldom dominant, locally common
Avena barbata	bearded oat	Poaceae	Invasive	Abundant to locally dominant, levees, disturbed soils
Bassia hyssopifolia	bassia	Chenopodiaceae (Amaranthaceae)	Invasive, widespread; primarily on levees, edges of roads or trails	Locally abundant to dominant
Beta vulgaris	wild beet	Chenopodiaceae (Amaranthaceae)	Slightly invasive or negligibly so	Seldom if ever abundant, shorelines
Briza maxima	rattlesnake grass	Poaceae	Invasive, widespread	Abundant locally some years, primarily North Bay
Briza minor	small rattlesnake grass	Poaceae	Invasive	Locally abundant
Bromus diandrus	ripgut brome	Poaceae	Invasive, widespread, especially on levees	Abundant to dominant above high tide line
Bromus hordeaceus	soft brome	Poaceae	Invasive in seasonal wetlands, levees	Commonly abundant
Cakile maritima	sea-rocket	Brassicaceae	Negligibly invasive	Local, shoreline; minor species, gravel or sand shores.
Carduus pycnocephala	Italian thistle	Asteraceae	**Highly invasive,** grasslands, levees	Local, often dominant where present
Carpobrotus edulis (C. edulis* x *chilensis)	**iceplant**	Aizoaceae	Invasive to highly invasive, mostly in cool, fog-influenced microclimates	Local, but dominant or highly abundant clonal spread where present
Centaurea melitensis	**Napa starthistle**	Asteraceae	**Highly invasive**	Local, disturbed soils
Conium maculatum	**Poison-hemlock**	Apiaceae	Highly invasive, widespread	Local dominant, primarily North Bay and Suisun Bay areas
Cortaderia jubata	jubata grass	Poaceae	**Highly invasive,**	Widespread, locally

			primarily in fog influence, cool microclimates or seasonal wetlands	abundant, but not common in tidal marsh edges
Cortaderia selloana	Pampas grass	Poaceae	**Highly invasive,** primarily in fog influence, cool microclimates or seasonal wetlands	Uncommon in tidal marsh edges; occasional, diked baylands
Dittrichia graveolens	**stinkweed**	Asteraceae	Highly invasive, primarily on levees (road or trail edges), alkali grassland; early stages of regional invasion	Locally dominant to abundant, south San Francisco Bay;
Ehrharta erecta	**erect veldtgrass**	Poaceae	Highly invasive, primarily in fog influence, cool climates; spreading from Central Bay area	Early stages of invasion outside established populations Marin, San Mateo, San Francisco, and Berkeley
Elytrigia pontica ssp. *pontica*	Russian wheatgrass	Poaceae	Invasive; potentially highly invasive (early stages of regional invasion?); spreading from old stabilization plantings	Locally abundant to dominant, but not widespread: Coyote Creek, Mare Island
Ficus carica	fig	Moraceae	Slightly invasive (eastern Suisun Marsh to Delta)	Locally abundant (eastern Suisun Marsh to Delta)
Foeniculum vulgare	fennel	Apiaceae	**Highly invasive** on levees, disturbed soils	locally abundant,
Genista monspessulana	French broom	Fabaceae	**Highly invasive, primarily on coastal bluffs, hillslopes; locally on levees, Marin County**	locally dominant, hillslopes, some levees near seed sources
Hainardia cylindrica		Poaceae	Moderately invasive, saline seasonal wetlands, disturbed saline soils	Locally common but seldom abundant
Hordeum murinum ssp. *gussoneanum*	foxtail barley	Poaceae	Invasive, primarily in seasonal wetlands	widespread
Hordeum murinum ssp. *leporinum*	foxtail barley	Poaceae	Invasive	Widespread
Hypochaeris glabra, H. radicata	cat's-ear	Asteraceae	Invasive	Widespread but seldom dominant; locally abundant, levees
Juncus gerardii	black rush	Juncaceae	highly invasive, brackish high marsh plain; possibly higher marsh edges with seeps	local (2008), Southhampton Marsh and Point Pinole
Lepidium latifolium	**perennial pepperweed**	Brassicaceae	Highly invasive, levees, sandy shorelines, especially bordering brackish wetlands	Widespread, abundant to dominant
Limonium	**Algerian sea-**	Plumbaginaceae	Highly invasive in	SF peninsula,

ramosissimum	**lavender**		high marsh and adjacent terrestrial ecotone	Hayward, and Richardson Bay (2008)
Lolium multiflorum, L. perenne	Italian and perennial ryegrasses	Poaceae	Moderately invasive, mostly disturbed or wet soils	Common, grassland
Madia sativa	tarweed	Asteraceae	Locally invasive, usually ephemeral in succession to annual grasses; levees, disturbed soils	Locally abundant to dominant, North Bay
Medicago polymorpha	bur-clover	Fabaceae	invasive	Minor,
Medicago indica	Yellow sweet-clover	Fabaceae	Moderately invasive following disturbance; seldom persisting	Minor
Melilotus alba	White sweet-clover	Fabaceae	Moderately invasive following disturbance; seldom persisting	Locally abundant
Melilotus indica	yellow sweet-clover	Fabaceae	Moderately invasive, disturbed sites	Minor, disturbed soil
Mesembryanthemum nodiflorum	Annual iceplant	Aizoaceae	Locally invasive only on interior slopes of salt pond levees; slightly invasive in disturbed tidal marsh edges	Locally abundant on hypersaline, arid dredge spoils; minor weed in competition with terrestrial vegetation
Oxalis pes-caprae	Bermuda-buttercup	Oxalidaceae	Highly invasive but localized clonal spread from fill	Locally abundant, but colonies relatively rare on levees
Parapholis incurva	sicklegrass	Poaceae	Moderately invasive	Locally common seldom abundant, disturbed saline seasonal wetland soils bordering tidal marsh
Phalaris aquatica	**Harding grass**	Poaceae	Highly invasive and persistent, range increasing; levees, grasslands	Locally abundant to dominant, especially on levees, low grasslands
Piptatherum mileaceum	smilo grass	Poaceae	Invasive, disturbed shorelines	Spreading (2008) S and E SF Bay
Phoenix canariensis	Canary Islands date palm	Arecaceae	Persisting or locally spreading from plantings; slightly invasive	Very localized mature stands, mostly North Bay near residential or old homestead areas
Picris echioides	bristly ox-tongue	Asteraceae	Widespread, disturbed soils, levees	Locally abundant, but seldom over extensive areas
Plantago coronopus	buck's-horn plantain	Plantaginaceae	Invasive, levees, seasonal wetlands, disturbed subsaline soils	Occasionally abundant
Plantago lanceolata	English plaintain	Plantaginaceae	Invasive, levees, seasonal wetlands	Seldom dominant or abundant
Polygonum arenastrum	doorweed, knotweed	Polygonaceae	Moderately invasive, mostly disturbed soils	Seldom abundant or dominant
Prunus domestica cv. undet.	plum	Rosaceae	Noninvasive, persisting from cultivation	Local, minor
Prunus cerasifera cv.	cherry	Rosaceae	Noninvasive, persisting from cultivation (clonal	Local, minor

			root-sprouts)	
Puccinellia maritima	European goosegrass	Poaceae	Highly invasive, high marsh	local (2008), central San Francisco peninsula
Raphanus sativa	**wild radish**	Brassicaceae	**Invasive to highly invasive,** especially levees, disturbed soils	Often stable dominant or occurring as persistent extensive single-species stands
Rubus armeniacus (R. discolor)	Himalayan blackberry	Rosaceae	**Invasive (highly invasive on levees in fresh-brackish estuary)**	Abundance greatest in brackish reaches of estuary, especially Suisun Bay and east; local dominant
Rumex acetosella	sheep-sorrel	Polygonaceae	Invasive, widespread but seldom abundant	Minor (grassland)
Rumex crispus	curly dock	Polygonaceae	Invasive primarily weed of seasonal freshwater to brackish wetlands	Seldom dominant except in seasonal wetlands
Salsola soda	**Mediterranean saltwort**	Chenopodiaceae (Amaranthaceae)	Invasive,	Dominance above marsh plain is usually limited to high tide lines (drift-lines)
Senecio vulgaris	common groundsel	Asteraceae	Invasive, mostly disturbed soils	Minor weed
Silene gallica	windmill pink	Caryophyllaceae	Invasive, mostly disturbed soils	Minor weed of grasslands
Silybum marianum	milk-thistle	Asteraceae	Invasive, mostly disturbed soils; occasional	Locally abundant,
Sisymbrium officinale	hedge mustard	Brassicaceae	Invasive, mostly disturbed soils, levees	Minor
Spartina densiflora	Chilean cordgrass	Poaceae	Invasive, upper intertidal zone	Formerly locally abundant, Corte Madera and Point Pinole vicinity; declining under regional eradication program (2006)
Stellaria media	chickweed	Caryophyllaceae	Invasive, mostly disturbed soils	Minor weed
Sonchus oleraceus, S. asper	sow-thistles	Asteraceae	Invasive, mostly disturbed soils	Usually minor but frequent weed, disturbed levees, grasslands
Tetragonia tetragonioides	New Zealand spinach	Aizoaceae	Invasive, widespread	Locally abundant or dominant but seldom extensive

Appendix 1, Table 2. Recent highly invasive non-native plants established in tidal marsh edges, with localized current regional distribution, San Francisco Estuary.

Agrostis avenacea, Australian bentgrass
Dittrichia graveolens, stinkwort
Ehrharta erecta, tall veldtgrass
Elytrigia pontica ssp. *pontica*, Russian wheatgrass
Limonium ramosissimum, Mediterranean sea-lavender
Puccinellia maritima, European goosegrass