**WRITEN FINDINGS OF THE**
**WASHINGTON STATE NOXIOUS WEED CONTROL BOARD**
**Proposed for listing 2003**

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| Scientific Name: | *Spartina densiflora* |
| Common Name: | Dense-flowered cordgrass |
| Family: | Poaceae |
| Legal Status: | WSDA Quarantined plant, Proposed as a Class "A" Weed for Washington State's 2003 Noxious Weed list |

Description and Variation: *Spartina densiflora* is a perennial salt tolerant $C_4$ grass that grows erect in dense, caespitose (tufted) clumps. Leaf blades are narrow, long and inrolled. The blades are tough, grayish in color, and 1/4-1/3 an inch in width. The Stems(culms) range from 27-150 cm in height. The Inflorescence is a 6-30 cm long with dense, compact colorless flowers. *S. densiflora* blooms from April through July. The plant inhabits the upper intertidal zone near the mean high water mark, or just below it on open mud (Daehler and Strong 1996). Unlike other introduced *Spartina* species, *S. densiflora* does not produce rhizomes (Pfauth and Sytsma 1998).

*Spartina* species are geographically centered along the East Coast of North and South America, with outliers on the West Coast of North America, Europe, and Tristan da Cunha. Members of this genus occur primarily in wetlands, especially estuaries (Partridge 1987). *Spartina densiflora* is native to South America and has previously been found in parts of California and Spain (Mobberley 1956). It has also invades areas of the European Mediterranean Coast (Figuerra and Costellanos 1988 in H.T Harvey 1993). In 2001, *S. densiflora* was discovered in two areas in Washington. One infestation being in the North Bay area of Grays Harbor and the other location being on Whidbey Island.

Each year, federal, state, and local governments, as well as private landowners, spend hundreds of thousands of dollars trying to control the three other *Spartina* species (*S. alterniflora, S. anglica,* and *S. patens*) that have been introduced to Washington State. *Spartina* control work is difficult and expensive, because these plants grow in habitats that are hard to access on terrain that is damaging to equipment. Preventing the spread of this plant in Washington will eliminate negative environmental impacts associated with this *Spartina* species and reduce the fiscal resources being spent by agencies and landowners in managing this plant.

Economic Importance:
*Detrimental*: The *Spartina* genus has been noted as being among the most aggressive invaders in the world (Nieva et al. 2001). The impacts of *S. densiflora* are thought to be similar to those of the other *Spartina* species. These detrimental effects include competition with native flora (Kittelson & Boyd 1997), changes to the detrital food web (Adam, 1990), modification of native habitat (Partride 1987), and alterations to estuarine sedimentary dynamics (Long& Mason, 1983).

Native plants species that the *Spartina* genus is known to displace include: *Zostera marina* (seagrass) at lower elevations, and salt marsh species, such as *Salicornia virginica, Triglochin maritimum, Jaumea carnosa*, and *Fucus distichus* at higher elevations (Wiggins and Binney 1987; Simenstad and Thom 1995) destroying important refuge and food sources for fish, crabs, waterfowl, and other marine life (Balthuis and Scott 1993).

*Spartina* species are known to create salt marshes by building up sediment around their rhizomes. Eventually the natural mudflats are replaced by high *Spartina* meadows. In this change, the bottom-dwelling invertebrate communities become replaced by salt marsh species. Studies indicate that populations of invertebrates in the sediments of *S. alterniflora* clones and meadows in Willapa Bay are smaller than populations in intertidal mudflats (Norman and Patten 1994b, O'Connell 2002). As *Spartina* infestations expand, shorebirds and waterfowl could potentially lose important foraging and refuge habitats. Juvenile chum salmon and English sole may lose prey resources and other important attributes of mudflat nurseries. In short, mud- and sandflat communities based on bottom-dwelling microalgae will decline, being replaced by food webs driven by the supply of *Spartina* detritus (Simenstad and Thom 1995).

Changes associated with *Spartina* also impact recreation. There is a loss of beach habitat and navigation routes, reduced water access, and other alterations to the estuarine ecosystems. Therefore, activities, such as fishing, hunting, boating, bird watching, botanizing, and shellfish harvesting, could be negatively impacted by the continued spread of *Spartina* species (Ebasco Environmental 1993).

*Beneficial*: *Spartina* species are highly valued in their native habitats (Simenstad and Thom 1995; Landin 1991). The species is highly productive, exporting approximately 1300 g/m$^2$ of detritus annually to the estuarine system (Landin 1991). *S. alterniflora* is highly regarded for erosion control, as well as fish and wildlife values in its native range (Simenstad and Thom 1995). In these native habitats, some waterfowl and wetland mammals eat the roots and shoots of this plant. In addition, stands of *S. alterniflora* can serve as a nursery area for mangroves, and estuarine fishes and shellfishes. Because of their ability to trap sediment, *Spartina* species have been planted in many parts of the world for estuary reclamation (Partridge 1987). While *S. anglica* has been used more commonly for this purpose, *S. alterniflora* has been planted in some areas, such as the North Island of New Zealand (Although NZ also has a Spartina eradication program) (Partridge 1987). Juvenile chinook salmon have an affinity for salt marsh habitat, so they may benefit from the spread of salt marsh vegetation (Simenstad and Thom 1995). *Spartina anglica* has been planted around the world for a variety of reasons. Because of its ability to trap sediment, navigational interests have used *S. anglica* to stabilize mudflats and reduce the source area for channel silting (Ranwell 1967). The species has also been planted to protect coastlines from erosion (Ranwell 1967; Gray et al. 1991). In addition, agricultural interests have planted *S. anglica* for estuary reclamation (Ranwell 1967; Partridge 1987; Gray et al. 1991). In England, *S. townsendii* is widely used by livestock, and experience from around the world indicates a wide variety of herbaceous mammals will eat *S. anglica* or *S. townsendii* (Ranwell 1967). *S. anglica* is also used as green manure in China; 50 kg of *S. anglica* are approximately equivalent to 0.5 kg of urea (Chung 1982).

Habitat: *Spartina densiflora* grows in the upper intertidal zone, or mid to high marsh zones, near the mean high water mark, or just below it on open mud (Daehler and Strong, 1996). It is native to the South American cost lines and has become established along the California and Mediterranean coastlines (Figueroa and Costellanos 1988).

Geographic Distribution: *Spartina densiflora* is native to South America and has previously been found in parts of California and Spain (Mobberley 1956). It has also invades areas of the European Mediterranean Coast (Figuerra and Costellanos 1988 in

H.T Harvey 1993). Recently *S. densiflora* was discovered in two areas in Washington. One infestation being in the North Bay area of Grays Harbor and the other known location being at Race Lagoon, near Penn Cove, on Whidbey Island.

History: *Spartina densiflora* and *S. anglica w*ere introduced to the San Francisco Estuary in 1976, as part of a marsh restoration project. *S. densiflora*, native to Chile, was transplanted to Humboldt Bay, CA, during the nineteenth century. Researchers believe that it was brought in as solid ballast of lumber trade ships from Chile (Mobberly1956:Spincher and Josselyn 1993).

Growth and Development: In Washington, *Spartina* species can flower as early as April and continue through the summer. Spring through early fall is a time of rapid growth and flowering for *Spartina* species. In late fall, the flowering culms generally die; however, flowering may extend to the following year during mild winters. Monospecific stands generally occur at restoration sites and in disturbed salt marshes (Kittelson & Boyd 1997). Populations have been noted to show higher rates of flowering when surrounded by other competing species in contrast to being surrounded by a plant-free area (Kittelson & Boyd 1997). It is noted that perennial herbs living in a shady environment tend to restrict their flowering (Waller 1988). Establishment and expansion for *S. densiflora* are thought to be governed by salinity and availability of bare soil (Kittelson & Boyd 1997).

Reproduction: Unlike other introduced *Spartina* species, *S. densiflora* does not produce rhizomes (Pfauth and Sytsma 1998). Its reproduction is driven solely by seed production and vegetative growth (Kittelson & Boyd 1997). Expansion is thought to involve both vegetative tiller production and seed germination over a range of salinities. The relative importance of vegetative or sexual productivity is determined by population density (Kittelson & Boyd, 1997). Studies indicate that the germination rate of seeds for *S. densiflora* are inversely related to salinity increases (Kittelson & Boyd 1997).

Control methods and responses of *Spartina densiflora* are thought to be similar to the other *Spartina* Species. The information below is based on the responses of the other three *Spartina* species in the state of Washington.

Response to Herbicide: Rodeo™ (glyphosate) is the only herbicide presently labeled for use on *Spartina* in Washington. Most efficacy studies with Rodeo™ have been conducted with *S. alterniflora* with control results ranging 100 percent (Crockett 1991) to 0 percent (Balthuis and Scott 1993). In most cases, *Spartina* is mowed first, then Rodeo™ is applied to re-growth. Research is currently being conducted on the use of Arsenal to control *Spartina* infestations. Currently Arsenal is not federally registered for aquatics but will hopefully be available for the 2004 season (WSDA, Report to the Legislature 2001).

Response to Cultural Methods: Diking can be used to remove tidal action, thereby inhibiting nutrient flow and oxygen exchange. In addition, dikes can be used to flood areas, which will eventually bring about *Spartina* death. Flooding will also kill other species that cannot tolerate prolonged submersion, therefore it is not commonly recommended.

Response to Mechanical Methods: Spartina seedlings can be pulled out effectively but care must be taken to remove both shoots and roots. Repeated pulling is thought to

eventually kill small infestations However, pulling or digging established clones is difficult and largely ineffectual (Spartina Task Force 1994).

Covering small *Spartina* clones with woven geotextile fabric has been successful in some areas. With this technique, clones are mown to ground level and covered out 3 to 4 feet beyond the edges of the clone. The covering must be anchored in place. To be effective, covering should be left in place for one to two growing seasons. This method is most suitable for small infestations (Spartina Task Force 1994).

Mowing infestations can contain growth, limit seed set, and eventually kill the plants. To be effective, clones must be mowed repeatedly, beginning with initial spring green-up and continued until fall die-back. For clones under 10 feet in diameter, one to three mowings during the growing season may be effective. Larger clones need to be mowed nine to ten times over two seasons for eradication. In some cases, mowing will be required for a third or fourth year (Spartina Task Force 1994).

Biocontrol Potentials: None known at this time for *Spartina densiflora*.

Rationale for Listing: Less than one acre of *S. densiflora* was discovered in two areas in Washington during the 2001 season. One infestation being in the North bay area of Grays Harbor and the other location being near the Penn Cove area on Whidbey Island (Personal contact, Kyle Murphy).

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