Pacific County
Noxious Weed Control Board
Vegetation Management

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DATE: **April 9, 2007**

TO: **Washington State Noxious Weed Control Board**
Noxious Weed Committee

FROM: **Pacific County Noxious Weed Control Board**
RE: **Addition of *Spartina alterniflora* to State Noxious Weed A List**

The Pacific County Noxious Weed Control Board requests the addition of smooth cordgrass (*Spartina alterniflora)* to the Washington State Noxious Weed List as a Class A noxious weed.

Common Names: Smooth Cordgrass
Latin Name: *Spartina alterniflora*
Native Range: *S. alterniflora* is native to the US East Coast and Gulf Coast where it is widely distributed.
Escaped/Naturalized: Western Washington's bay and estuaries (Willapa Bay, Grays Harbor, Puget Sound)

Background on the biology and properties of the species

Taxonomy and Distribution of Target Weed:

The taxonomic position of *Spartina alterniflora* is well accepted. It is consistently placed in the tribe Chlorideae in the subfamily Chloridoideae (Gould and Shaw 1983; Dahlgren et al. 1985; Watson and Dallwitz 1992).

Taxonomic position of target weed
Family: Poaceae
Subfamily: Chloridoideae
Supertribe: Chloridae
Tribe: Chlorideae
Genus: Spartina
Species: *S. alterniflora* (Loisel.)

S. alterniflora is native to intertidal salt marshes along the Atlantic Coast of North America from the Gulf of Mexico to Newfoundland (Mobberley 1956; Smart 1982). In these marshes it is often the dominant plant, forming dense and expansive monospecific stands that extend from upper to middle-lower tidal elevations.

On the west coast, *S. alterniflora* has been introduced into San Francisco Bay, and nearby California estuaries, and into Willapa and Padilla Bays in Washington. It has been found occasionally in other Northwest estuaries but was eradicated promptly when found. *S. alterniflora* has also invaded and been environmentally detrimental in other areas of the world including Europe (Marchant 1967; Ranwell 1967), China (Chung 1990), and New Zealand (Asher 1990).

In San Francisco Bay, a vigorous hybrid of *S. alterniflora* and the native *S. foliosa* is spreading rapidly and displacing *S. foliosa* (Ayres et al. 1999). These hybrids do not suffer from heavy infestations of *P. marginata* (Daehler and Strong 1996).

Taxonomy and Distribution of Related Plants:

The *Spartina* genus includes approximately 14 species worldwide (Mobberly 1956). Six of them, including the target species, are native to the Atlantic and Gulf Coasts of North America where the genus is believed to have arisen (Chapman 1977; Daehler and Strong 1996) (Table 1). Only *S. foliosa* is native to intertidal habitats of the Pacific coast of North America. It occurs in upper tidal elevations in estuaries from central California south to the tip of the Baja Peninsula (Mobberley 1956). This species is the only known host of California populations of *P. marginata*. Two species, *S. gracilus* and *S. pectinata*, occur in the central interior of North America, extending as far west as Eastern Washington and Eastern Oregon. *S. gracilus* and *S. pectinata* do not occur west of the Cascade Mountain Range. No *Spartina* species are native to the coasts of Washington, Oregon, or British Columbia.

In addition to *S. alterniflora*, two other non-native *Spartina* spp.—*S. anglica* and *S. patens*---have been introduced into the state of Washington. Both are state listed noxious weeds and are invading Puget Sound, but do not occur in Willapa Bay or other outer coast estuaries. *S. anglica* was introduced from Britain where it arose during the 1800's as a result of hybidization of *S. alterniflora*

and *S. maritima* followed by a doubling of chromosomes (Raybould et al. 1991). It has been invasive in numerous locations in Puget Sound. *S. patens* was established in one location near Hood Canal prior to 1968 (Frankel and Kunze 1984). Like *S. alterniflora*, these species are serious weeds of economic and environmental importance and are the targets of a mechanical and chemical control program that costs the state approximately $575,000 per year (Washington State Department of Agriculture 2006).

With the exception of the introduced *Spartinas*, there are few chloridoid grasses that grow in the Pacific Northwest Coastal climate. The C-4 metabolism that is characteristic of the group restricts most of the subfamily to hotter and drier regions (Jacobs 1986; Shantz and Piemeisel 1927). Only one other species in the Chloridoideae is found in the Willapa Bay area. *Distichlis spicata* is a common saltmarsh grass that has recently been placed in the same supertribe as *Spartina*, but a different tribe, *Aleuropodeae* (Watson and Dallwitz 1992). Its distribution spans the North American continent. In Willapa Bay, it grows adjacent to *S. alterniflora* in the upper saltmarshes.

Table 1. Distributions and origins of *Spartina* species in North America. Compiled from (Daehler and Strong 1996; Brueggeman et al. 1992).

Species	Habitat	Native to	Introduced to
S. alterniflora	Intertidal	Atlantic/Gulf coasts	Willapa Bay, Padilla Bay, Grays Harbor*, WA; San Francisco Bay, Humbolt Bay, CA
S. anglica (*S. alterniflora* x *maritima* hybrid)	Intertidal	Britain	Puget Sound, WA; San Francisco Bay, CA
S. patens	Upper intertidal	Atlantic/Gulf coasts	Suislaw estuary, OR; Hood Canal, WA*
S. densiflora	Upper intertidal	Pacific coast of Southern South America	San Francisco Bay, Humbolt Bay, CA
S. foliosa x *alterniflora* hybrid	Intertidal		San Francisco Bay, CA
S. foliosa	Intertidal	Pacific coast (California to Baja Peninsula)	
S. pectinata	Brackish/terrestrial	Central Interior, Atlantic (not west of Cascade Range)	
S. cynosuroides	Brackish	Atlantic/Gulf coasts	
S. bakeri	Brackish and freshwater lakes	Florida/Georgia	
S. gracilus	Alkaline lakes, stream banks	Central Interior (not west of Cascade Range)	
S. spartinae	Beach, terrestrial	Gulf/Central America	

*populations recently eradicated.

Other chloridoids in Washington include five species in the genus *Eragrostis*, in the tribe Eragrostieae, that occur in Washington but only one of these, *E. hypnoides*, occurs west of the Cascade Range. This species and the other four *Eragrostis* species have wide ranging distributions in the U.S. and already occur near current populations of the candidate biocontrol agent, *P. marginata*. Six species of *Muhlenbergia* (also in the tribe Eragrosteae), 2 *Aristida* spp. (*A. oligantha* and *A. longiseta* in the Aristideae), and *Leptichloa fascicularis* (in the Chlorideae) also range into Eastern Washington, but do not occur west of the Cascades (Hitchcock and Cronquist 1973).

Beckmannia syzigachne was formerly included in the Chlorideae: Chloridoideae, but recent taxonomic evaluations by grass specialists, including genetics work, has resulted in this genus being shifted out of the subfamily Chloridoideae (Travis Colombus, Rancho Santa Anna Botanic Garden, pers. comm). Similar morphological features to Chloridoid species are thought to be examples of convergent evolution.

Description and Life History:

S. alterniflora is a rhizomatous perennial grass that resprouts each year from a dense, persistent root mass. It spreads clonally through underground rhizomes and disperses longer distances by way of broken root fragments and floating seeds. The growing season for this plant spans from April to September. *S. alterniflora* often reaches heights of 2 m but this can vary greatly among years and clones. Each fall, the bulk of the above-ground foliage dies back and only the short young shoots remain green but dormant over the winter. The dead leaf tissue (wrack) accumulates in the upper tidal zones. Flowering occurs from August through October. Clones with medium to tall culms and medium to low shoot density are more likely to flower than the short, dense morphs (Sayce 1988). After 1995, there was a dramatic increase in flowering rates which contributed to a rapid population expansion in Willapa Bay. Viability of seeds tended to be low in Willapa Bay before 1995; Sayce (1988) reports 0.04% viability, but most recent samples showed increased viability (D. Strong, unpublished; Kim Patten, unpublished). Seeds are dispersed from September to November. *Spartina* spp. do not appear to have long-term seed banks. In the laboratory *S. alterniflora* seeds survive for approximately 8 months (Mooring et al. 1971) and in the field seeds of the closely related *S. anglica* have been found to survive only one growing season (Hill 1984).

Spartina spp. thrive in salty environments. One reason for this is their use of the C-4 photosynthetic pathway. In C-4 plants, the first product of carbon dioxide incorporation is a 4-carbon acid rather than the 3-carbon phosphoglyceric acid produced in the more common C-3 plants. With the C-4 pathway, less water is lost through evapotranspiration than in C-3 plants. *Spartina* spp. also have specialized organs on the leaves that secrete excess salt (Thompson 1991).

Invasion by *S. alterniflora* takes on a characteristic pattern. Plants that survive the young seedling stage begin to send out rhizomes to form new shoots. The clone spreads radially outward as a circular patch at a rate of approximately 0.5 m per year (Sayce 1988). The mudflats become dotted with these circular clones of varying sizes (ages) until they eventually merge into a solid meadow (see Figure 1).

Impacts of *S. alterniflora*:

Washington State's official review of the impacts of the *S. alterniflora* invasion was carried out in 1992 and 1993 pursuant to the State Environmental Protection Act (SEPA). All of the state's natural resource agencies took part in that review. The Final Environmental Impact Statement (EIS) was issued in November 1993 by the following Co-leading Agencies: the Washington State Department of Ecology, the Washington State Department of Natural Resources, the Washington State Department of Agriculture, the Washington State Noxious Weed Control Board, the Washington State Parks Department, and the Washington State Department of Fish and Wildlife. The agencies reached consensus that the invasive *Spartina* spp. would have significant deleterious impacts on the environment and economy of Washington and should be controlled. They selected "integrated weed management" (IWM) as the preferred response. A parallel federal environmental review process conducted by U.S. Fish and Wildlife Service reached an identical conclusion. Completed in 1997, the Federal Environmental Assessment (EA) also adopted an "integrated pest management" strategy.

The Washington Legislature in 1995 declared that the *Spartina* infestation had become an environmental emergency, and directed all state agencies to assign a high priority to the control program. The Legislature also specifically exempted *Spartina* control activities from review under the State's Shoreline Management Act, making it clear that the threat was exceptional and control activities should not be hampered by time consuming regulatory procedures.

The distribution, biology, and ecology of introduced *Spartina* species, their impacts on the environment and economy, and the impacts of various control methods have been reviewed in great detail in the EA and EIS. We summarize these impacts here.

As sediment is trapped in dense *S. alterniflora* clones, expanses of flat open intertidal mud are transformed into emergent monotypic marshes (Sayce 1988). Rigorous analysis of the impacts of *S. alterniflora* on the benthic invertebrate assemblages that form the basis of the food web revealed a marked alteration in diversity as "terrestrially associated" invertebates replaced the native assemblage associated with tidal mudflats (Zipperer 1996). Other studies showed that *S. alterniflora* invades and aggressively displaces the native shoreline plant species and the eelgrass and algal communities that make Willapa Bay one of the ten most important wintering and fueling areas of the Pacific Flyway. In addition, the state's estuaries are "critical habitat" for endangered salmonid populations making their transition from freshwater to saltwater and their return to freshwater spawning grounds. Besides the multitude of ecological values, Washington's threatened estuaries are home to economically important commercial marine enterprises. The present day aquaculture industry is one of the leading private sector employers and contributes an estimated $20 million per year to the local economy.

Additional concerns have not been well studied, but are widely regarded as plausible. Among the possible long-term effects are those resulting from sediment trapping, and fundamental changes in the benthic profile. Such fundamental alteration of the hydrology of the watershed could lead to increased winter flooding, already a costly and chronic problem for lowland coastal communities. Another fear concerns the likely increase in summer mosquito populations as *Spartina* marshes spread. Increasingly dependent on tourism, Washington coastal areas are presently free of nuisance levels of biting insects.

Location and infestation information – where, when, and how much

Willapa Bay

In its 2006 Report to the Legislature, WSDA described the infestation in Willapa Bay as follows: "at the beginning of the 2006 season, a total of 3,250 solid acres were infested with *Spartina* in Willapa Bay. This estimate was acquired through the use of 2006 treatment data. The acreage information collected while conducting herbicide applications during the 2006 season provides a reasonably accurate accounting of the total solid acres present in those treated areas. While conducting broadcast applications to sites, the application equipment is calibrated to apply a specific amount of herbicide per treated acre. In addition, most ground-based and all aerial-based broadcast application equipment have the capability of tracking the solid acreage treated through the use of GPS systems on the equipment. While using ground, hand-held application equipment, operators are able to calibrate the amount of herbicide applied per acre as well.

All infested sites were treated during the 2006 season. Managers estimate that fewer than 100 solid acres at these sites went untreated for various reasons during the 2006 season. Adding the acreage information obtained from treatment data to the minimal acreage estimated as not treated provides a reasonably accurate total solid acre estimate for the beginning of the 2006 treatment season.

In 2006, the cooperative *Spartina* eradication effort resulted in treatment of approximately 3,150 solid acres spread throughout more than 25,000 affected acres of Willapa Bay. The acreage treated encompassed over 95% of the overall solid infestation. Of particular note is the increase in overall affected acres treated and decrease in solid acres treated, indicating that the density of the infestation is decreasing. In 2003, approximately 6,000 solid acres were treated over 10,000 affected acres. In 2004, the solid acres treated decreased to 5,700 solid acres while the affected acres increased to almost 13,000 acres. In 2005 approximately 5,000 solid acres were treated in an area encompassing about 20,000 acres. The increase in affected acres treated and the decrease in solid acres treated demonstrates that the overall solid acres in Willapa Bay are being substantially reduced, and that the large meadows are fragmenting."

Grays Harbor

In its 2006 Report to the Legislature, WSDA described the *S. alterniflora* infestation in Grays Harbor as follows: "In 2006, herbicide treatments within Grays Harbor totaled approximately 3.5 acres. There were three primary areas of infestation: the Elk River, North Bay, and Grass Creek. The most challenging ares is the Elk River estuary which contains approximately half the Spartina in Grays Harbor. The difficult terrain required the crews to resort to backpack sprayers and traverse very uneven and hazardous substrate. The North Bay is dominated by clones of all sizes that are also difficult to reach using airboats. Grass Creek is another large infestation (about 1 acre) but, for the most part, is easily accessible with airboats."

Puget Sound

Justin Haug of WDFW estimated in February 2007 that there is less than 100 square feet of *S. alterniflora* present in the entire Puget Sound. The majority of *S. alterniflora* in Puget Sound is located at Dike Island in Skagit County where it was intentionally introduced. He has also found a small infestation at Emrick's Meadow on Northern Camano Island.

Control Methods:

In its 2005 Report to the Legislature, WSDA described methods used to eradicate *S. alterniflora* as follows: "The *Spartina* eradication program uses Integrated Pest Management (IPM), a coordinated decision-making and action process that uses the most appropriate pest control methods and strategy in an environmentally and economically sound manner to meet pest management objectives. Entities involved in *Spartina* eradication use a wide range of control

tools, including ground and aerial herbicide applications, various mechanical tools, biological control using the insect *Prokelisia marginata*, and manual control involving digging seedlings in areas where an infestation has not yet taken hold.

During the 2005 season, the effort relied much more heavily on aerial applications of imazapyr, the herbicide that received federal approval for this use in 2004. Prior to 2004, aerial herbicide applications were used on a relatively small scale. During the 2004 season, approximately 2,000 solid acres were treated aerially with imazapyr. The herbicide appears effective when applied aerially, has extremely low environmental toxicity, and has a lower per acre cost for aerial applications than glyphosate, the other available herbicide.

The biggest benefit of aerial applications is the ability to treat larger areas in a relatively short amount of time. During the 2005 season, approximately 3,500 solid acres were treated aerially over the course of 12 days. This compares to the 2003 work of a cooperating agency that treated season addressed 3,500 solid acres by ground-based methods. This work took five months. The ability to treat large amounts of infestation in a short amount of time has allowed managers to control the majority of the infestations before the plants have produced seeds, thus reducing the chance for spread through seedling dispersal."

Specific change requested

The Pacific County Noxious Weed Control Board requests that the State Weed Board add *S. alterniflora* to the Washington State Class A Weed List.

Reasons for the request

Listing this plant as a Class A noxious weed would impose a clear mandate on all land owners to kill *S. alterniflora* rather than merely control seed and vegetative spread. Under Class B designation, landowners may continue to harbor infestations on their property. Since 1994, roughly $25 million dollars have been spent by federal, state and local agencies in the effort to eradicate *S. alterniflora.* From 2003 when the infestation in Willapa Bay extended over 25,000 acres of intertidal habitat to the present, an enormous amount of progress has been made eliminating *S. alterniflora* from thousands of acres of mudflats that serve as critical habitat for wildlife. This progress can be lost in a very short time, if the eradication program is not completed. Live *S. alterniflora* plants will pose a serious, unnecessary and permanent risk of re-infestation to areas in which it has been eliminated through costly and difficult work.

Of the hundreds of private landowners with *S. alterniflora* infestations on their property, only three have refused to allow agencies to apply cost-effective treatments aimed at eradication. Class B designation allows these few owners to treat for control rather than eradication. Acres of live *S. alterniflora* present an unacceptable long-term risk to the resources and economy of Willapa Bay and other infested estuaries. We cannot let a few uninformed and extremist landowners jeopardize 15 years of work and this enormous investment of tax payer dollars.

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