Management Information on *Spartina alterniflora*

Preventative measures: Daehler and Strong (1996) report that, "With *Spartina* spp. invasions, a simple but very effective strategy is to identify introduced propagules early through surveying (by air or by shore) the vulnerable sites. Identified propagules can then be eliminated prior to spread at minimal cost. This strategy was successful in eliminating *S. alterniflora* from Humbolt Bay, CA (K. Kovacs, pers. comm.) and will probably succeed with *S. patens* in Puget Sound (J. Civille, pers. comm.)."

Physical: Intertidal collection by pole spear (poles with a long nail on the end to spike the target species), dip netting or by hand is species specific, the collector has to be educated in the identification of the target species. This method can be used in marine protected areas with little impact on the environment. Physical removal through burning or digging is destructive to the environment and has been used on intertidal mudflats to control *Spartina* spp. but without much success. (McEnnulty et al. 2001)

"Spartina rhizomes and roots grow to a depth of three metres and eradication attempts have included physical removal. Mechanical excavation may be effective in areas where suitable access is permitted (and substrate is stable enough). In the UK, physical disturbance was investigated as a possible control method. This involved disturbance of the sediments by a lightweight tracked vehicle until the Spartina clumps were dislodged and buried with the sediment. There was no evidence of impacts to the infauna and the method was thought to be an appropriate for Spartina control in tidal flats. Preliminary experiments using mowing as a control method for *Spartina anglica* and *S. alternifolia* using sickle bar mowers or weed eaters in Washington, USA had variable success depending of the time of year ". (McEnnulty et al. 2001)

"The use of exclusion barriers has met with limited success. Nets are also used in as a barrier in waterways to prevent the active drift of vegetative fragments of aquatic weeds created during mechanical harvesting ". (McEnnulty et al. 2001)

"Smothering as a method of control of *Spartina* spp. has met with limited success. Smothering kills plants by inhibiting photosynthesis and in addition in the intertidal areas raised temperatures result in cooking of the plants by solarisation. This has been used successfully in field experiments to control rice grass (*Spartina* spp.). Smothering of *Spartina* spp. intertidally requires an extended period (up to 6 months) and is limited to small areas (<1 hectare) ",(McEnnulty et al. 2001).

Chemical: Use of the herbicide Rodeo? which has glyphosate as its active compound in the control of *S. alterniflora* has met with success in Washington estuaries; the herbicide mixed with a surfactant was aerially applied to mudflats (Simenstad et al. 1996). Investigations of *S. alterniflora* in New Jersey, USA found the plants to have the ability to survive in highly polluted estuaries and that they were relatively tolerant of copper compound so this is not recommended as a chemical control option (Waddell and Kraus 1990). (McEnnulty et al. 2001)

Biological: Grevstad et al. (2003) reports that, "In 2000, the Washington State Department of Agriculture approved the introduction of a delphacid planthopper *Prokelisia marginata* (Van Duze) into Willapa Bay, Washington as a biological control agent against *S. alterniflora.* The author later states that, "This biocontrol project was encouraged by earlier work by Daehler and Strong (1997) demonstrating a high degree of vulnerability in Willapa Bay of *S. alterniflora* to *P. marginata.* In greenhouse experiments, all *S. alterniflora* clones collected from Willapa Bay were severely stunted or killed after two growing seasons with *P. marginata.* In contrast, *S. alterniflora* from Florida, Maryland, and San Francisco Bay were tolerant of even high densities of the planthopper".
The marsh snail *Littoraria irrorata* is one of the most abundant grazers of live salt marsh cordgrass, *S. alterniflora* present in the salt marshes along U.S. southeast coasts. The snail occurs at densities ranging from 40 to 500 individuals per m². The snails whilst grazing do not consume leaf tissue directly, instead they feed on senescent material around the wounds they create and maintain on the leaves with their radulae. Microscopic examination of injured leaves indicates that fungi (ascomycete) dominate the microbial communities on the injured cordgrass leaves. Field studies have shown that the marsh snail promotes fungal growth on the plants through grazing activities and deposition of fecal pellets on the wounds it creates and maintains on the leaves. (Silliman and Newell, 2005).

The authors of the study (Silliman and Newell, 2005) conclude from results of fungal removal experiments that "Littoraria’s unique grazing behavior suppresses Spartina growth and that snail consumption accounts for <5% of biomass reductions", they further hypothesize that "the primary mechanism of snail control of plant growth is tissue death caused by the facilitation of fungal invasion" and that "grazers can exert top-down control of marine plant production".