

Spartina invasion of Pacific coast estuaries in the United States: implications for shorebird conservation

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Over the past century, exotic *Spartina* species have invaded parts of the Pacific coast of N America, particularly at Willapa Bay in the state of Washington, one of the most important shorebird sites in the region. The plants grow on the tidal flats in dense monospecific stands and reduce the area available to shorebirds for feeding. In recent years, the area covered by *Spartina* in Willapa Bay has increased rapidly and may pose a serious threat to the birds. There is an urgent need to take appropriate conservation measures to restore affected tidal flats and to prevent invasion of *Spartina* to other important estuaries.

INTRODUCTION

Cordgrass *Spartina* spp. is a common feature of many estuaries along the Atlantic coast of North America. Of the 13 species found in North America, only *S. foliosa* is native to the Pacific coast, where it occurs in California (Mobberley 1956). Unfortunately, four species of invasive *Spartina* now are found on the northern Pacific Coast of the United States. The presence of cordgrass is considered a detriment to shorebird populations in regions where it is exotic, having spread beyond its normal range. *Spartina* grows in dense monospecific stands and effectively captures and accumulates sediment, potentially giving rise to increased elevation of the intertidal mud flats (Ranwell 1964). Although the influence of *Spartina* on invertebrate communities is neither consistent nor well documented (Daehler & Strong 1996), the dense mats of vegetation reduce the foraging area available to shorebirds, and this has been identified as a possible cause of decreases in shorebird populations (Goss-Custard & Moser 1988). The removal of cordgrass from marine estuaries in the region has been identified as a high priority management activity (Buchanan in press).

The cordgrass, *S. alterniflora*, has invaded Washington and has become a problem in some estuaries. Here I describe the invasion of *Spartina* at Willapa Bay and discuss (a) the potential impacts to shorebirds, (b) ongoing efforts to remove cordgrass, and (c) potential implications of continued invasion through the coastal areas of Washington and other estuaries of the northern Pacific coast of North America.

WILLAPA BAY, WASHINGTON

Spartina was first recorded in Willapa Bay, an estuary on the southern coast of Washington with an area of over 400 km², in 1894, but was not generally recognized as a potential problem until 1942 (Mumford *et al.* 1991). For nearly a century the species' distribution expanded very slowly. When shorebird counts were conducted from a small airplane

between 1991 and 1995 (Buchanan & Evenson 1997), the typically circular clumps of cordgrass were clearly visible, primarily in the southern part of the bay and to a much lesser extent in scattered localities elsewhere. The area covered by cordgrass was only about 810 ha in 1994 (Kyle Murphy, pers. comm.), but between 1994 and 2002, it had more than tripled (Fig. 1).

The increase in the numbers and distribution of *Spartina* in Willapa Bay during the 1990s was particularly disconcerting because the spread was rapid and the areas covered were important sites for shorebirds. The surveys conducted between 1991 and 1995 found that although *Spartina* already covered part of the tidal flats at the mouth of the Bear River in southern Willapa Bay, the site still supported the greatest numbers of shorebirds in the whole bay with estimated highs of 27,260 Dunlins *Calidris alpina* in winter and 36,900 Western Sandpipers *C. mauri* in spring (Buchanan & Evenson 1997). There are no count data for this site from the period prior to *Spartina* invasion.

Eleven sites or regions in the bay were included in the aerial surveys. The top six for wintering Dunlins (median = 8,475, range = 3,915–27,260) and four of the top six for spring migrant Western Sandpipers (median = 14,470, range = 9,600–36,900; Buchanan & Evenson 1997) have been invaded by *Spartina* since 1995. Cordgrass has been partially removed at one of these sites, but the core areas of two sites are now completely or largely covered, and five other sites have substantial areas of *Spartina*. Neither aerial nor ground-based counts of Willapa Bay have been conducted in winter or spring since 1995, so the response of shorebirds to these invasions is not known. Two of the individual sites within Willapa Bay meet the criteria established by the Western Hemisphere Shorebird Reserve Network (WHSRN; see Harrington & Perry 1995) for regionally important sites; Willapa Bay, as a whole, meets the criteria of an internationally important site (Drut & Buchanan 2000).

The total area of *Spartina* coverage in Washington is now estimated at about 3,035–3,116 ha (Kyle Murphy, pers.



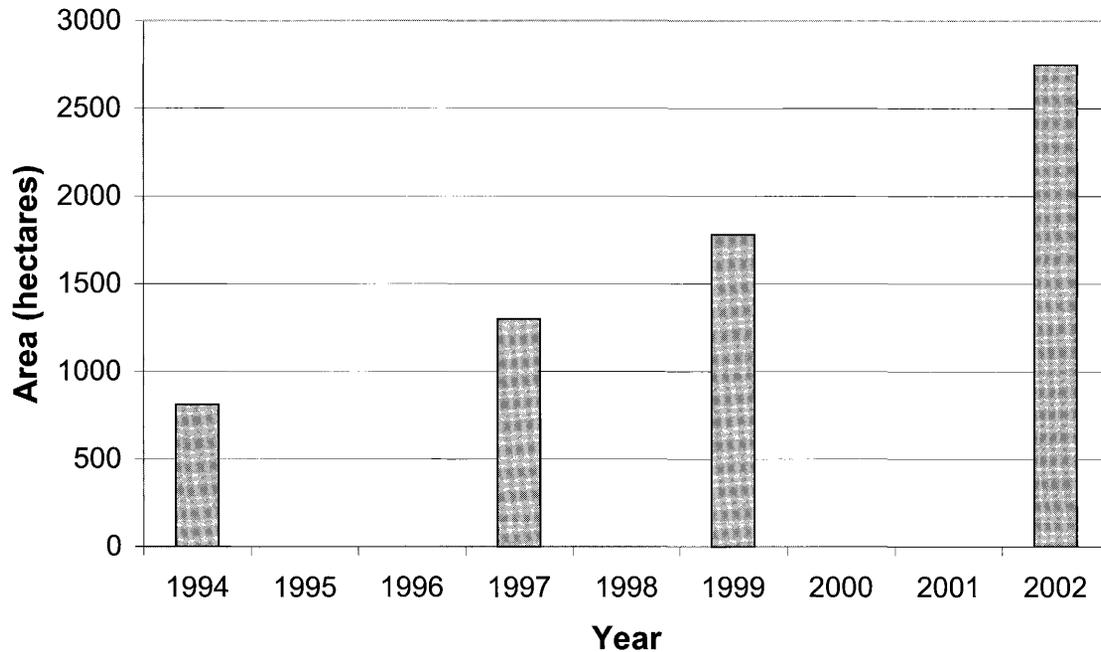


Fig. 1. Amount of tidal flat area covered by *Spartina alterniflora* in Willapa Bay, Washington, between 1994 and 2002. Data from Washington Department of Natural Resources database and Kyle Murphy (pers. comm.).

comm.). Most of it is found in Willapa Bay, but perhaps 200–400 ha exists elsewhere, primarily in northern Puget Sound where *S. alterniflora*, *S. anglica*, *S. densiflora* and *S. patens* have been reported (Daehler & Strong 1996). Puget Sound is a large complex of both large and small estuaries that have collectively supported 52,000–83,000 wintering shorebirds between 1990–91 and 1995–96, and perhaps 83,000–125,000 spring migrant shorebirds in 1991–94 (Evenson & Buchanan 1997). *Spartina* has also been reported in Grays Harbor, the site of the highest recorded number of spring migrant shorebirds in Washington: an estimated one million birds were present in 1981 (Herman & Bulger 1981), and 200,000+ have been reported in other years (J. Buchanan, unpublished data).

A simple model to assess the vulnerability of Pacific coast estuaries to invasion by *Spartina* was developed by Daehler & Strong (1996). The model indicated that 17 sites along the northern Pacific Coast, from Humboldt Bay, California, to Puget Sound, Washington, were vulnerable to invasion. Sites were considered vulnerable to invasion if they were both tidally influenced and protected from wave action. These criteria typify essentially all of the major marine estuaries used by shorebirds along the northern Pacific coast in the United States. Although not identified as a vulnerable estuary by Daehler & Strong (1996), the Fraser River delta in SW British Columbia, Canada, is also likely to be a vulnerable site. This is a particularly valuable shorebird site that supports very large numbers during the non-breeding season (Butler & Campbell 1987, Butler 1994).

THE OUTLOOK

Without systematic survey data, it is impossible to assess the potential influence of the current spread of *Spartina* on shorebirds. A number of the shorebird species that migrate

along the Pacific Flyway are thought to have experienced population declines (Morrison *et al.* 2001). Relationships between these suspected declines and the presence or extent of *Spartina* in Pacific coast estuaries have not been established. If restoration efforts prove to be largely successful in the near future, the likelihood that any impacts to shorebirds would be more than short-term in nature would be reduced.

The coverage of *Spartina* in Willapa Bay is extensive enough that management efforts involving its removal should be referred to in terms of restoration rather than control. Efforts to remove *Spartina* through mechanical tilling have been successful and shorebirds have returned to forage in restored areas. Mechanical tilling is expensive, however, and the level of management necessary to make the transition from the restoration to a control phase may take many years. It is therefore essential that substantial funding be made available until the restoration is complete. A control program may be needed after restoration to minimize the likelihood of significant reinvasion.

The effectiveness of management activities in Willapa Bay may have little impact on other estuaries in the region. Willapa Bay is a large estuary with several units of a national wildlife refuge and an extensive area of commercial shellfish beds. In a sense, it is a rather contained area where various interest groups have forged partnerships to address concerns about *Spartina* management. The presence and spread of *Spartina* in Puget Sound may present something of a different challenge. Many of the estuaries there are small and isolated, and despite their small size collectively support 22–48% of the over-wintering shorebirds in Puget Sound in some years (Evenson & Buchanan 1997). A small number of these estuaries contain protected tidal flats (i.e., a refuge of some sort) and a few support local shellfish growers. Widespread invasion of *Spartina* in Puget Sound may be



difficult to reverse because of the widely spread areas of economic value (i.e., shellfish beds) or refuge status. In addition, moving mechanical tillers among the multiple smaller estuaries may pose logistical constraints and require that other removal techniques be used. Government agencies and local citizens have begun to monitor a number of Puget Sound estuaries for indications of *Spartina* presence. These efforts may prove crucial to preventing the establishment of new areas of invasion.

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Development of *Spartina* meadow on formerly open mud flats at Willapa Bay, Washington, USA. Photo by Blain Reeves.

