Spartina Eradication Program 2008 Progress Report

Washington State Department of Agriculture

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Photos provided by Justin Haug, Dave Heimer, Les Holcomb (WDFW), Wendy Brown (DNR), Kevin D. Anderson and Tanner Ketel (WSDA).

Cover Photos: Nahcotta Washington on the Long Beach Peninsula
before treatment in 2005
and in the fall of 2008.

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PROGRESS OF THE 2008 *SPARTINA* ERADICATION PROGRAM

January 2009

Washington State Department of Agriculture

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Acronyms used in this report:

ALEA	Aquatic Lands Enhancement Account
ATV	All Terrain Vehicle
DNR	Department of Natural Resources, Washington State
GPS	Global Positioning System
NPDES	National Pollutant Discharge Elimination System
PSP	Puget Sound Partnership
TNC	The Nature Conservancy
USFWS	U.S. Fish and Wildlife Service
WSDA	Washington State Department of Agriculture
WDFW	Washington State Department of Fish and Wildlife
WSU	Washington State University

Executive Summary

Spartina, commonly known as cordgrass, is an aggressive noxious weed that severely disrupts the ecosystems of native saltwater estuaries in Washington State. *Spartina* outcompetes native vegetation and converts mudflats into monotypic *Spartina* meadows, destroying important migratory shorebird and waterfowl habitat, increasing the threat of flooding, and severely impacting the state's shellfish industry.

Since 1995, the Washington State Department of Agriculture (WSDA) has served as the lead state agency for the eradication of *Spartina*. In this role, WSDA facilitates the continued cooperation of local, state, federal, and tribal governments; universities; interested groups; and private landowners.

Over the past six years, the combined statewide effort to eradicate *Spartina* from the marine waters of Washington State has been extremely successful. WSDA estimates that the effort has successfully reduced the overall statewide infestation from a high of more than 9,000 solid acres in 2003 to fewer than 120 solid acres projected in 2009. This is an unprecedented statewide reduction of more than 98%.

With the success of the past six years, and the large reductions of *Spartina* continuing throughout the state, continued funding and support are more important than ever. The effort has shown that large reductions of *Spartina* are possible and that eradication is an attainable goal. Figure 1 is a projection of *Spartina* reduction within Washington State over the next four years with sustained funding.

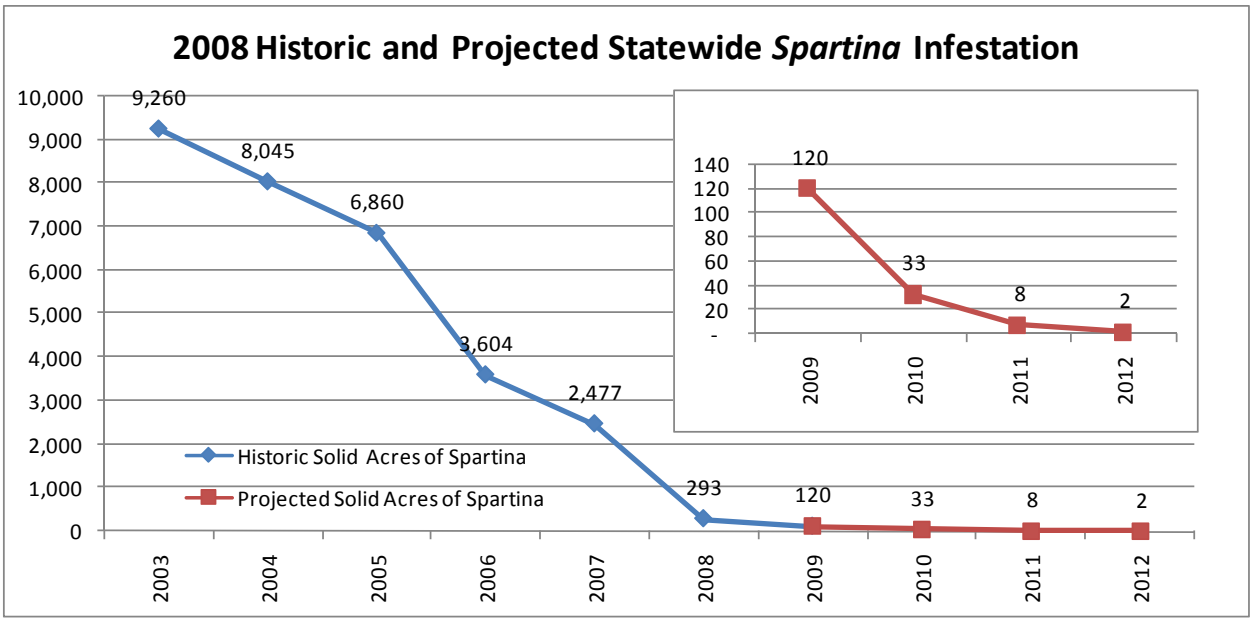

Figure 1: Solid acres of *Spartina* by year statewide based on WSDA estimates. The blue line represents historic *Spartina* infestation since 2003. The red line indicates the projected *Spartina* infestation level through 2012.

Willapa Bay

The 2008 Willapa Bay treatment program was successful. All known infestations were treated and some of the greatest reductions in program history were achieved. Monitoring of the program's 2008 Willapa Bay effort indicated that fewer than 250 solid acres of *Spartina* remained. This was an unprecedented 89% reduction from approximately 2,310 solid acres in Willapa Bay during the 2007 season. In 2008, the program completely evolved from large-scale treatments of meadows to treatments of scattered infestations. WSDA estimates fewer than 100 solid acres of *Spartina* will be present in Willapa Bay during the 2009 treatment season.

Grays Harbor

2008 was a successful year for *Spartina* survey and eradication in Grays Harbor. WSDA, Washington Department of Fish and Wildlife (WDFW) and the US Fish and Wildlife Service (USFWS) continued to work together to treat all known infestations. All potential *Spartina* habitat within Grays Harbor was surveyed three times during the 2008 season, with a total of 0.445 solid acres of *Spartina* treated. Of the 0.445 acres treated in Grays Harbor, 0.279 solid acres were *S. alterniflora* and 0.166 solid acres were *S. densiflora*. Additionally, 38 miles of coastline were surveyed, stretching from Cape Shoalwater to the Moclips River, yielding no new *Spartina* finds. WSDA estimates that fewer than 0.25 solid acres of *Spartina* will remain in Grays Harbor during the 2009 treatment season.

Puget Sound

Less than 43 solid acres of *Spartina* remained in Puget Sound, the Strait of Juan de Fuca, and Hood Canal in 2008. This is a 75% reduction from the 164 solid acres found in 2007. WSDA estimates that fewer than 20 solid acres of *Spartina* will remain in 2009. Increased effort and cooperation between partner groups made this reduction possible. Continued surveys revealed new infestations in the Strait of Juan de Fuca and Whatcom County. Further cooperation between partners and emphasis on control, survey, and outreach will ensure the continued success of the Puget Sound *Spartina* program.

2008 Trends

The above successes are a result of the continued level of state funding provided to WSDA, WDFW, and the Department of Natural Resources (DNR), as well as federal funding provided to USFWS. Central to this success is continued cooperation of WSDA, WDFW, DNR, and other state agencies, universities, USFWS, counties, tribes, private organizations and private landowners.

With the largest of the state's infestations now coming under control, the effort continues to evolve into a 'survey and eradicate' model focused on finding and treating the remaining individual plants and scattered infestations that exist throughout the previously infested area. This requires significant personnel on the ground to give individual attention to the same areas that helicopters or large machines were previously able to cover in a relatively short amount of time. The amount of herbicide needed to treat the infestations has declined, bringing herbicide costs down. However, the number of personnel needed has increased labor costs. As a result, to meet the program's goal of eradicating *Spartina*, continued funding is imperative over the next four years. Figure 2 illustrates the current distribution of *Spartina* in Washington State.

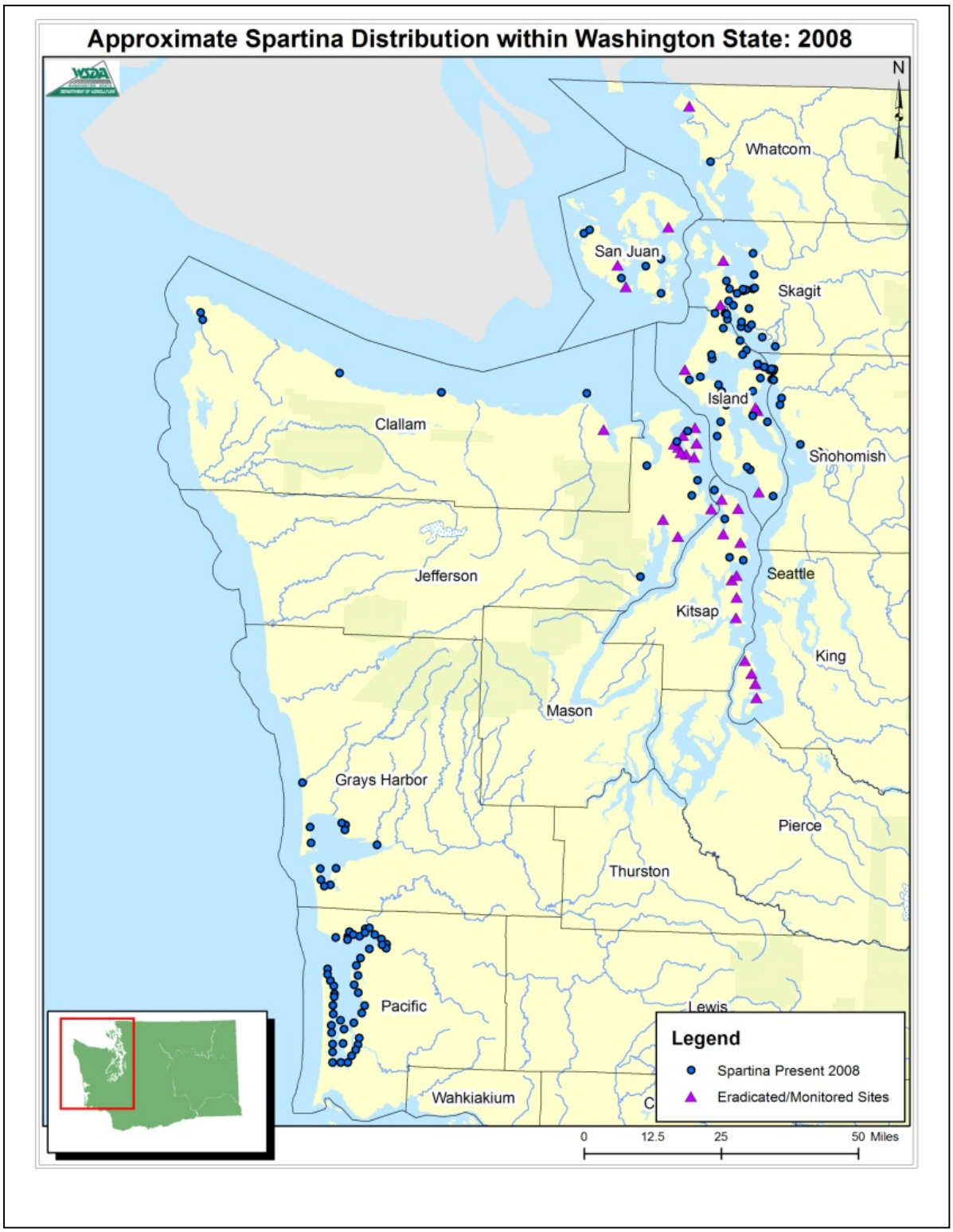

Figure 2: Distribution of *Spartina* in Washington. The blue circles represent locations with *Spartina* present in 2008. The triangles represent sites where *Spartina* has been eradicated or requires further monitoring before eradication can be declared.

Spartina Eradication Program

WSDA *Spartina* Program

In 2008, the WSDA *Spartina* Eradication Program worked collaboratively with partner agencies to continue *Spartina* eradication.

WSDA hired, equipped and coordinated a crew to treat infestations in Clallam, Jefferson, and Kitsap counties; assisted the Swinomish, Suquamish, Makah and Tulalip tribal communities and the noxious weed control boards in San Juan, Clallam, and Jefferson counties with eradication work; worked cooperatively with Washington Department of Fish and Wildlife (WDFW) and the U.S. Fish and Wildlife Service (USFWS) in Grays Harbor; and worked cooperatively with the Department of Natural Resources (DNR), WDFW, USFWS, The Nature Conservancy (TNC), The Shoalwater Tribe, Pacific County, the aquaculture industry, University of Washington and Washington State University on infestations in Willapa Bay.

WSDA continued to work cooperatively with the Department of Ecology to administer the National Pollutant Discharge Elimination System (NPDES) general permit for aquatic noxious weed control, facilitating the control programs of federal, state and local governmental agencies and other entities.

WSDA provided resources through interagency agreements, contracts and cost-share to state and local government agencies and private landowners. WSDA organized and facilitated the exchange of *Spartina* eradication information through regional planning and informational meetings, and continued to explore more efficient and cost-effective ways to eradicate *Spartina* with partner agencies.

In 2008, WSDA continued to allocate funding for resources and *Spartina* work crews in counties with the majority of the infestations. In Willapa Bay, $100,000 was provided to Pacific County to continue the transition toward greater county involvement and $80,000 of herbicide was provided to the cooperators. In the Puget Sound, WSDA provided resources totaling $150,000 by entering into agreements with the noxious weed control boards in Skagit, Island and Snohomish counties, the Swinomish Tribe and WDFW. WSDA staff participated in field activities throughout the control season and facilitated coordination meetings to ensure contract priorities were adequately addressed. During the 2008 season, WSDA continued working with WDFW, DNR, WSU and USFWS to explore the potential for restoration of once-infested tidelands back to functioning shorebird and waterfowl habitat.

An additional development during 2008 was the West Coast Governors' Agreement on Ocean Health, the Governors of Washington, California, and Oregon committed to work cooperatively to eradicate non-native *Spartina* on the western U.S. coast by 2018. An Action Coordination Team was formed with representatives from the three states, federal government, tribal governments, non-governmental organizations, and the Province of British Columbia. Continued intergovernmental cooperation should aid ongoing eradication efforts and enhance future efforts.

Budget

WSDA allotted $1.79 million of its appropriation from the Aquatic Lands Enhancement Account (ALEA) for statewide *Spartina* activities during the 2007-2009 biennium. Additionally, $65,000 from the state General Fund was appropriated for FY09 in Pacific County. Table 1 describes where WSDA allocated funds to conduct *Spartina* eradication activities throughout Western Washington.

Table 1: WSDA Budget Activity by Area – FY08 and FY09

Activity	Puget Sound/ Olympic Peninsula		Willapa Bay		Grays Harbor		Total
	FY08	*FY09*	*FY08*	*FY09*	*FY08*	*FY09*	*FY08&09*
[1]WSDA Eradication & Coordination Activities	$160,000	$220,000	$370,000	$340,000	$80,000	$100,000	$1,270,000
[2]Cost Share & Herbicide Purchases	$15,000	$12,000	$75,000	$80,000	$2,500		$184,500
[3]Purchased Services							$400,000
Pacific Co.				$100,000			
Skagit Co.	$30,000	$30,000					
Island Co.	$50,000	$50,000					
Snohomish Co.	$50,000	$50,000					
Swinomish Tribe	$10,000	$10,000					
WDFW	$10,000	$10,000					
Total	**$325,000**	**$382,000**	**$445,000**	**$520,000**	**$82,500**	**$100,000**	**$1,855,000**
Biennial Total		**$707,000**		**$965,000**		**$182,500**	

Notes for Table 1:

1. WSDA Eradication and Coordination Activities: Expenses include WSDA eradication, survey, restoration activities, salaries and benefits, herbicide, equipment, travel, legal fees, public notification expenses and other goods and services.
2. Cost Share & Herbicide Purchases: Costs of herbicide and equipment purchased to support WSDA's cooperators.
3. Purchased Services: WSDA interagency agreements and intergovernmental agreements to accomplish *Spartina* eradication goals.

WSDA and other agencies received additional funding for *Spartina* activities during the 2007-2009 biennium. This funding was provided from ALEA, federal agreements, grants and other sources. Table 2 describes where these funds were allocated.

Table 2: Other Agency Budget Activity by Area – FY08 and FY09

Agency	Puget Sound/ Olympic Peninsula		Willapa Bay		Grays Harbor		Total
	FY08	*FY09*	*FY08*	*FY09*	*FY08*	*FY09*	*FY08&09*
WSDA					$36,000	$25,000	$61,000
WDFW	$275,000	$110,000	$230,000	$140,000	$236,000	$105,000	$1,096,000
DNR			$350,000	$350,000			$700,000
[1]USFWS			$1,100,000	$990,000	$50,000	$34,000	$2,174,000
TOTAL	**$275,000**	**$110,000**	**$1,680,000**	**$1,480,000**	**$322,000**	**$164,000**	**$4,031,000**
Biennial Total		**$385,000**		**$3,160,000**		**[1]$486,000**	

Note for Table 2:

1. USFWS received additional federal funding for work in Grays Harbor of which $402,000 was budgeted for use by WDFW and WSDA and $84,000 was budgeted for activities conducted by USFWS.

Spartina Eradication Effort in Willapa Bay

For programmatic purposes, this geographic region includes the mouth of Willapa Bay, Willapa Bay, and all rivers, streams and creeks that feed into the Bay.

Extent of the Infestation in Willapa Bay

All infestations within Willapa Bay were treated during the 2008 season and most were treated two or more times. This season the program completely evolved from large-scale treatments of meadows to efforts aimed at eradicating the scattered infestations and individual plants remaining throughout the Bay.

WSDA estimates that, during the 2008 season, approximately 225 solid acres of *Spartina* were treated in Willapa Bay. This estimate is based on a compilation of the treatment data reported by each of the cooperators. Table 3 identifies areas of the Bay treated and the entity which conducted the treatments.

At the final two 2008 Technical Committee meetings the cooperators discussed an increase in late season *Spartina* emergence. Surveys and treatments conducted towards the end of the season revealed unexpected numbers of new plants sprouting and growing. The quantity of *Spartina* present in past years possibly masked or made identifying late emergence difficult. This season the partners noted new plants emerging in September and October. Some of the *Spartina* observed emerging late in the season was treated, however, many plants emerged in areas that had received their final treatments for the year. Late season *Spartina* emergence was consistent across the program with similar observations made by both the Puget Sound and Grays Harbor cooperators. No late emerging plants were observed producing seed.

WSDA estimates fewer than 250 solid acres of *Spartina* were present in Willapa Bay over the course of the 2008 treatment season. This estimate is derived from treatment acreages reported by the cooperators (225) and includes an additional 10% to compensate for late season emergence, survey misses and other contributing factors.

Table 3: Summary of 2008 Willapa Bay *Spartina* Eradication Effort

Site	*Estimated Solid Acreage Treated*	*Approximate Affected Acres Treated*	*Entity Conducting Treatment*
North Willapa Area			
North Cove / Toke Point	8.72	700	USFWS
Toke Point / Cedar River	5.93	1,000	WDFW
Cedar River / Smith Creek	1.57	1,000	WDFW
Smith Creek / Willapa Meadow	30.05	2,000	WDFW - USFWS
Mailboat Slough	5.41	400	USFWS
South Bend / Raymond	.74	500	USFWS
S. Willapa River / Rose Ranch	1.66	750	DNR
Rose Ranch / Stony Point	1.27	600	DNR
Ellan Sands	.65	1,000	USFWS
Bone River NAP / South Stony Point	.46	200	DNR
Wilson Point	.88	300	DNR
Niawiakum NAP	6.12	650	DNR
Bay Center / Palix	14.97	1,500	USFWS
Nemah Beach	6.83	750	USFWS - Private
North Nemah	1.58	1,500	USFWS
South Willapa Area			
South Nemah / Seal Slough	3.89	500	DNR - USFWS
Naselle	2.21	2,000	DNR - TNC
East Long Island / Stanley Point / Pot Shot	5.65	1,000	USFWS
Kaffee Lewis Slough	7.01	1,000	USFWS
West Long Island	4.45	750	USFWS
South Long Island	.38	50	USFWS
O'Meara Cove	1.6	100	USFWS
O'Meara Point / Bear River	1.01	250	USFWS
Porters Point / Tarlatt Slough	10.52	3,000	USFWS
Long Beach Peninsula	101.92	2,500	DNR – County – Private - WSDA – USFWS
Total	**225.5**	**24,200**	

WSDA = Department of Agriculture, WDFW = Department of Fish and Wildlife, DNR = Department of Natural Resources, , USFWS = U.S. Fish and Wildlife Service, TNC = The Nature Conservancy, ST = Shoalwater Tribe

Roles of Willapa Bay Cooperators in 2008

- **WSDA** – Continued cooperation with the Department of Ecology to ensure NPDES coverage was available to qualified applicators. Provided resources, equipment and herbicide to WDFW, DNR and private property owners to ensure proper treatment of all sites. Conducted eradication activities, including coordinating private property owner consent on the Long Beach Peninsula in cooperation with Pacific County, DNR, and USFWS. Administered the Landowner Incentive Program grant for eradication activities in Tokeland.

- **DNR** – Conducted control work in South Nemah, Naselle River, Rose Ranch, Stony Point, South Willapa River and the Natural Area Preserves. DNR also cooperatively treated the Long Beach Peninsula with Pacific County, USFWS and WSDA. Expanded restoration and monitoring activities in cooperation with WDFW.

- **WDFW** – Conducted control operations in cooperation with USFWS from Toke Pt. to the Willapa River Meadow. Expanded restoration and monitoring activities in cooperation with DNR, Western Washington University and WSU.

- **USFWS** – Conducted control work in North Bay in cooperation with WDFW. Treated Ellan Sands, Long Island, all areas from the Niawiakum River Bridge south to the Seal Slough/South Nemah, and the Stanley Point area south to the northern boundary of the Tarlatt Slough treatment area. The Seal Slough/South Nemah area was treated in cooperation with DNR. Conducted eradication activities on Long Beach Peninsula in cooperation with Pacific County, WSDA and DNR.

- **Pacific County –** Conducted eradication activities on the Long Beach Peninsula in cooperation with DNR, WSDA, USFWS, and property owners. Worked closely with the cooperators in Advisory and Technical Committee meetings. Participated in a late season surveys of *Spartina* in Willapa Bay. Provided staff time to conduct Class B Select Noxious Weed compliance activities for *Spartina alterniflora*.

- **Shoalwater Tribe –** Worked closely with state and federal partners. Provided staff time to evaluate previous treatments and consult regarding 2008 activities. Allowed USFWS to conduct all necessary surveys and treatments to tribal-owned lands and lands within the reservation boundaries.

- **University of Washington Olympic Natural Resources Center (UW-ONRC) –** Continued to develop tidal elevation maps of various treatment sites to predict the dry time that plants receive on specific days. Organized a late season survey of *Spartina* in Willapa Bay.

- **Washington State University (WSU) –** Continued research to improve efficacy and efficiency of control tools. Continued research on impacts of *Spartina* to shorebirds and waterfowl.

- **The Nature Conservancy (TNC) –** Worked closely with the cooperators in the Advisory and Technical Committees. Cooperated with DNR to treat Ellsworth Slough in the Naselle River.

Highlights of the 2008 Season in Willapa Bay

In 2008, the cooperative *Spartina* eradication effort resulted in treatment of plants totaling approximately 225 solid acres, throughout the 24,000 affected acres of Willapa Bay.

During the winter and spring of 2008, WSDA worked cooperatively with WDFW, DNR, USFWS, Shoalwater Tribe, TNC, WSU, UW and the Willapa Bay/Grays Harbor Oyster Growers Association (WBGHOGA) to develop a 2008 work plan focusing on detailed re-treatment of the previous years' treatment sites.

Over the past six years, the combined effort in Willapa Bay has been extremely effective and has reduced the overall infestation from a high of about 8,500 solid acres in 2003 to fewer than 250 solid acres in 2008. This is an overall reduction of 97% achieved in five treatment seasons. If the 2008 treatment season meets expectations and achieves an overall efficacy of 60% or greater, then fewer than 100 solid acres of *Spartina* are expected in Willapa Bay during the 2009 treatment season. This would be a reduction of more than 98% in six treatment seasons.

A significant new development in 2008 has been the increased role of the Pacific County Noxious Weed Board in the day to day field operations. This expanded role in the program proved to be quite valuable. It has encouraged further sharing of resources, crews and knowledge of the Bay.

Cooperation between the various agencies and entities involved has continued during the 2008 season. WSDA, USFWS and DNR combined efforts to ensure thorough treatment of the Long Beach Peninsula. Also, WDFW, USFWS and DNR combined efforts and resources to ensure thorough treatment of the entire North Willapa Bay area. The 2009 plan, if successful, will result in the continued treatment of all infestations in Willapa Bay with emphasis placed on conducting multiple rounds of survey and treatment utilizing the most effective control techniques. The effort also continues to focus on restoration potential for successfully eradicated sites. Ongoing research will help managers evaluate potential restoration projects in the Bay.

WSDA is confident that reductions will continue in 2009 and that eradication is attainable in Willapa Bay.

Figures 3 and 4 are maps of North Willapa Bay and South Willapa Bay respectively, including treatment area names.

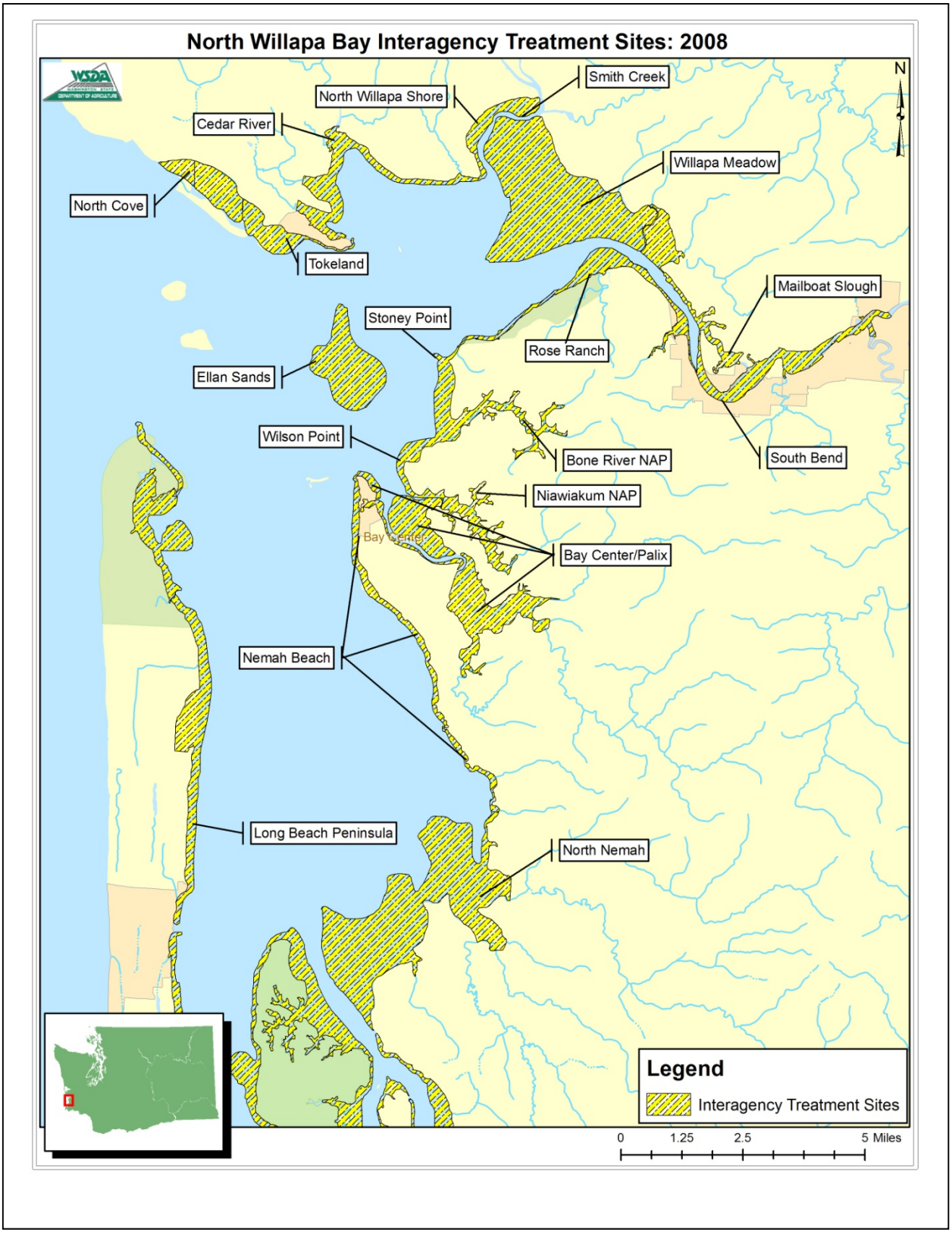

Figure 3: 2008 North Willapa Bay Interagency *Spartina* Treatment Sites.

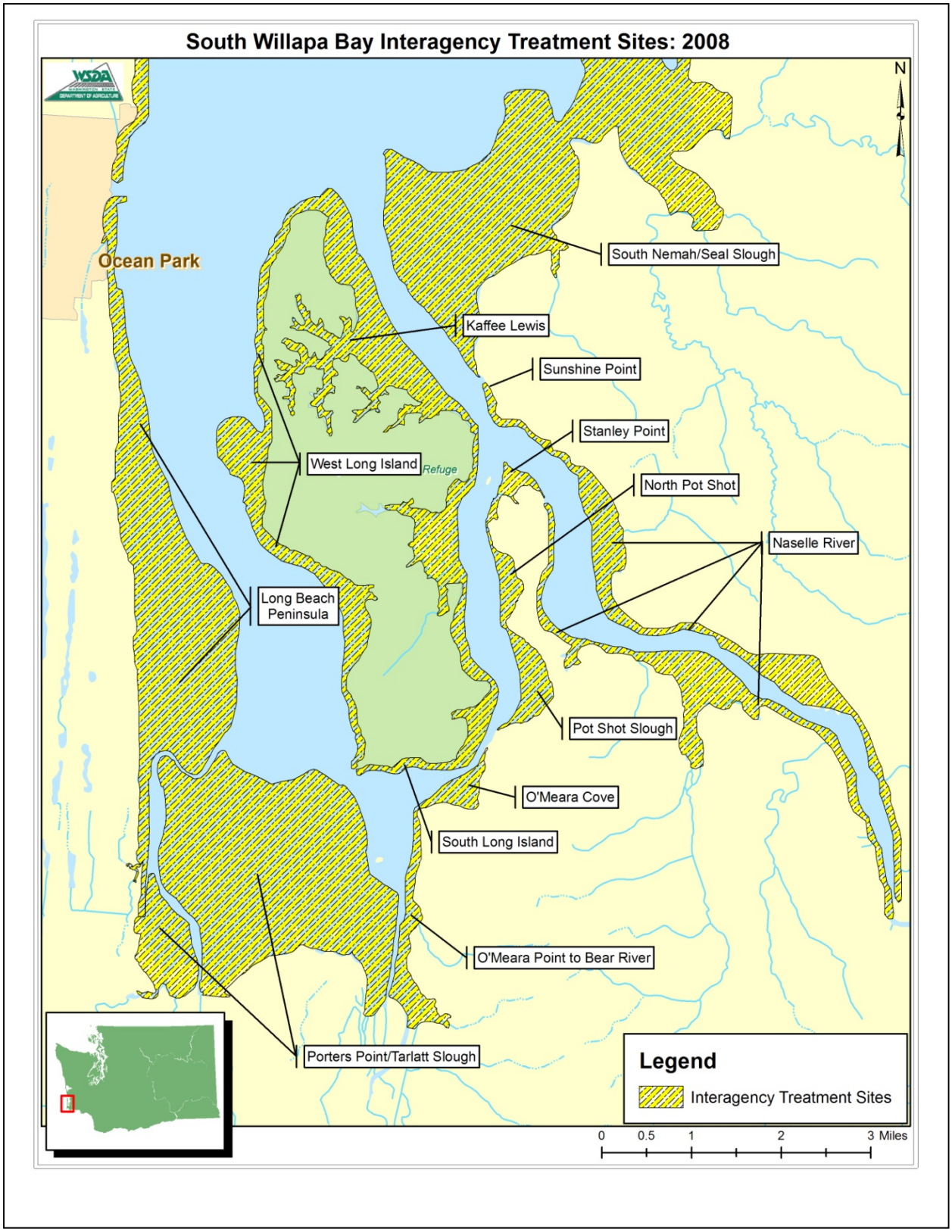

Figure 4: 2008 South Willapa Bay Interagency *Spartina* Treatment Sites.

Recommendations for the Future

With the successes of the past six years and the sizable reductions of *Spartina* in Willapa Bay, continued support and funding are more important than ever. In 2008, the Willapa Bay *Spartina* Eradication Program continued the evolution from large-scale treatments of meadows to smaller-scale treatments of scattered infestations and individual plants found throughout the Bay. This transition has required an increase in the numbers of personnel on the ground to give individual attention to the same areas that helicopters or large machines were previously able to cover in a relatively short amount of time. As the large meadows have broken up into small, scattered plants under the pressure of eradication, the amount of herbicide needed to treat the infestation has declined. This programmatic shift has resulted in lower herbicide costs and increased labor costs. Under this regime, WSDA anticipates the overall cost of re-treating scattered infestations in the coming biennium will not significantly differ from the cost of conducting the recent large-scale applications.

Starting in 2009, the USFWS Willapa Refuge will no longer conduct *Spartina* control activities outside of Refuge lands. The cooperators are pursuing additional funding sources to accommodate these new responsibilities.

WSDA estimates fewer than 100 solid acres of *Spartina* will be present in Willapa Bay during the 2009 treatment season. With the successful eradication of over 8,000 solid acres of *Spartina* in Willapa Bay over the past six years, it is critical that program continuity is maintained. Figure 5 is a projection that *Spartina* can be largely eradicated from Willapa Bay over the next four seasons with sustained funding.

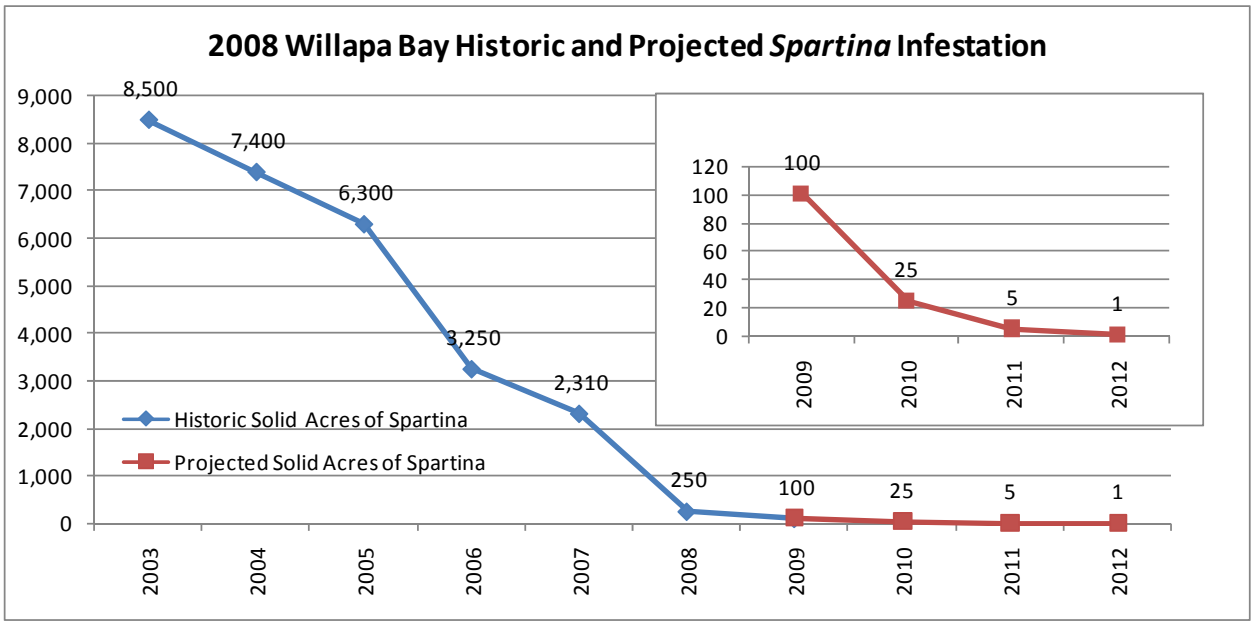

Figure 5: Solid Acres of *Spartina* in Willapa Bay by year, based on WSDA estimates. The blue line represents the historic area of *Spartina* since 2003. The red line represents the projected *Spartina* area through 2012. Projected area assumes sustained funding.

Spartina Eradication Effort in Grays Harbor

For programmatic purposes this geographic area includes Grays Harbor, its surrounding tributaries, and the coast from Cape Shoalwater to Cape Flattery.

Two species of *Spartina* exist in Grays Harbor. The most prevalent species in Grays Harbor during the 2008 season was *Spartina alterniflora* which made up roughly 63% of the infestation. The remaining 37% was *Spartina densiflora*, a species that blends in well with the native flora, and tends to grow higher in the intertidal zone.

Extent of the infestation in Grays Harbor

During the 2008 season, approximately 25,000 acres of intertidal lands in Grays Harbor and its tributaries, with the potential for *Spartina* infestation, was surveyed. This acreage was surveyed three or more times during the course of the treatment season. The 3,900 affected acres were found to contain either *S. densiflora* or *S. alterniflora* (Figure 6).

Survey and control work has existed in Grays Harbor in 1995. However, due to the overwhelming size of the *Spartina* infestation in Willapa Bay, resources to conduct a comprehensive survey in Grays Harbor were not available until 2005. An aerial survey in late summer of 2005 located an estimated 10 solid acres of *Spartina* and spurred an effort to undertake a more thorough survey and treatment program.

Of the 10 acres located through the aerial survey, WDFW treated 6.5 solid acres during the remainder of the 2005 season. WDFW also treated 3.5 solid acres, including all known infestations during the 2006 season. The experience gained during the 2005 and 2006 treatment seasons led project partners to conclude that more aggressive efforts would be needed to achieve eradication in Grays Harbor.

As a result, in 2007 staff from WSDA, U.S. Fish and Wildlife Service and WDFW combined forces to achieve the most thorough survey and treatment regime in the harbor to that point. Three treatment laps were conducted in 2007 with a total of 2.51 solid acres of *Spartina* treated.

In the 2008 treatment season, the Grays Harbor crew treated 0.445 solid acres of Spartina. Of the 0.445 acres treated in Grays Harbor, 0.279 solid acres were *S. alterniflora* and 0.166 solid acres were *S. densiflora*.

Highlights of the 2008 Season in Grays Harbor

Continued federal funding through the Nisqually National Wildlife Complex enabled the cooperators to develop three major goals for the 2008 treatment season:

1) Conduct at least two comprehensive rounds of survey and treatment throughout Grays Harbor, treating all known infestations.
2) Survey coastal sites that may harbor unknown *Spartina* infestations.
3) Incorporate digging of *S. densiflora* plants where practical.

The first goal was achieved and staff from WSDA, U.S. Fish and Wildlife service, and WDFW continued to work in joint crews throughout the season, completing three treatment laps while treating 0.445 solid acres of *Spartina*.

Along with three survey and treatment laps in the main Grays Harbor water body including the surrounding tributaries, the Grays Harbor crew also accomplished the second goal, and surveyed 38 miles of the outer coastline. This survey was conducted by foot and all terrain vehicle stretching from Cape Shoalwater to Westport and then from Southwest Ocean Shores to Moclips River, yielding no new *Spartina* infestations.

The third goal was met when in southeast Ocean Shores on May 29th, 1,200 *S. densiflora* plants were dug with the aid of crew members from the Washington Conservation Corp.

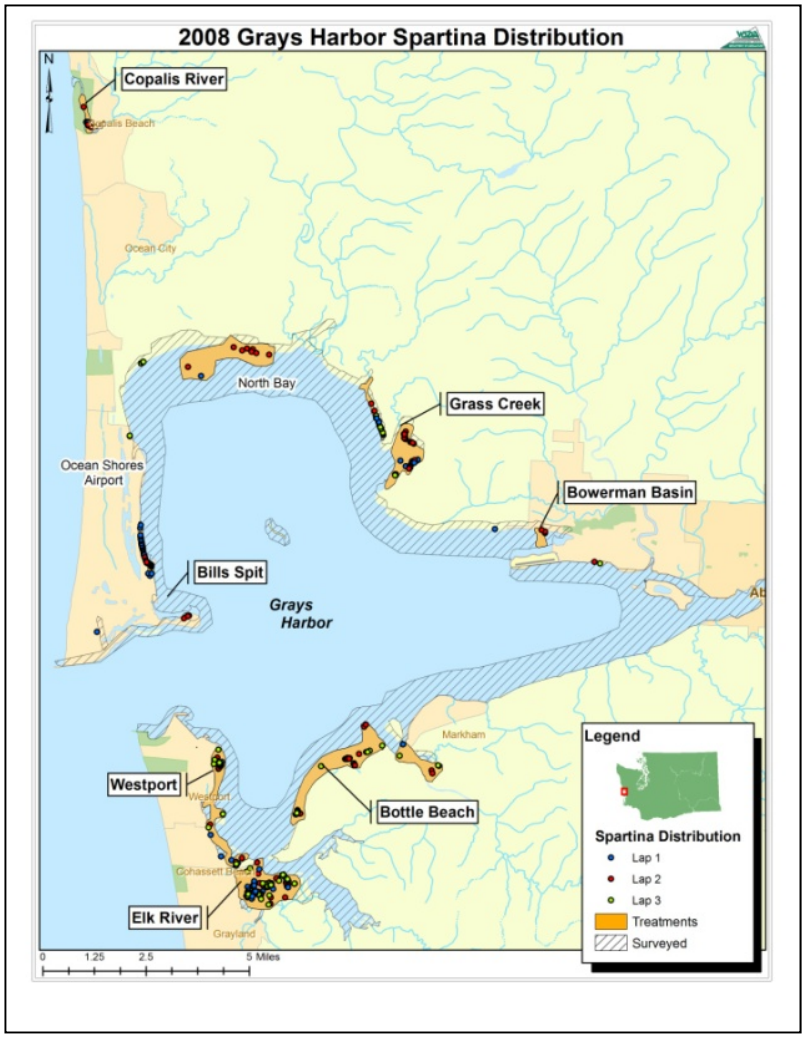

Figure 6: Illustrates the surveyed, infested, and points of *Spartina* infestation in Grays Harbor.

Conversely, in 2007, a coastal aerial survey turned up a 0.7 acre infestation in Grass Creek and also a relatively large infestation just South of Cape Flattery. Both infestation areas were *S. alterniflora,* and treated in the 2007 and 2008 seasons with great results.

The reduced size of the 2008 Grays Harbor infestation caused a change in herbicide application methods. In 2007, either high-pressure systems mounted on airboats or four gallon low-pressure backpack sprayers were typically used. In 2008 the crew usually used half-gallon low-pressure sprayers which were adequate for the reduced numbers of plants. This was a positive sign indicating a significant reduction in *Spartina*.

Of the 0.445 solid acres of *Spartina* located and treated in Grays Harbor during 2008, 0.21 acres were treated in the first round. Round two resulted in 0.13 solid acres of *Spartina* treated. During round three 0.115 solid acres of *Spartina* were located and treated resulting in a harbor wide reduction of 82.2% from the 2007 treatment season.

Table 4: Sites and areas (acres) of *Spartina* treated in 2007, along with area treated in 2008 with percent reduction between the two years.

Site	*Acres Treated in 2007*	*Acres Treated in 2008*	*Percent Reduction*	*Spartina Species*
Bill's Spit	0.085	0.14016	-64.89 *	*S. densiflora*
Bottle Beach	0.015	0.01125	25.00	*S. alterniflora*
Bowerman Basin	0.02	0.01375	31.25	*S. alterniflora*
Chenois Creek	0.015	0.00	100.00	*S. alterniflora*
Copalis River	0.095	0.00563	94.07	*S. alterniflora*
Damen Point	0.06	0.00313	94.78	*S. alterniflora*
Elk River	0.83	0.08969	89.19	*S. alterniflora*
Grass Creek	0.8125	0.10063	87.62	*S. alterniflora*
Humptulips River	0.03023	0.00	100.00	*S. alterniflora*
John's River	0.155	0.025	83.87	*S. alterniflora*
North Bay	0.145	0.0125	91.38	*S. alterniflora/densiflora*
Ocean Shores	0.06	0.025	58.33	*S. densiflora*
Point Brown	0.0051	0.005	01.97	*S. alterniflora*
Rennie Island	0.00125	0.00	100.00	*S. alterniflora*
Westport (Fire Cr. Pt.)	0.17823	0.01375	92.29	*S. alterniflora*
Total Acres Treated	**2.50731**	**0.44546**	**82.23**	

*Denotes an increase in solid acres treated of *Spartina densiflora*.

Spartina densiflora Concerns

Grays Harbor hosts the largest infestation of *Spartina densiflora* in Washington State. *S. densiflora* is a South American species of *Spartina* that was discovered in Grays Harbor in 2001. As indicated in Table 4 areas in the harbor infested with *S. alterniflora* typically showed high levels of reduction, however, the two areas infested with *S. densiflora* (Bill's Spit / Ocean Shores) did not (Figure 8).

Along with the "reasons for poor efficacy" discussed in Appendix 3 – "*Spartina densiflora* Treatment Study", this increase in *S. densiflora* could also possibly be attributed to the following factors:

1) *S. densiflora* may be more tolerant of the herbicide mixture used than *S. alterniflora.*
2) The longevity of the seed bank of this species is in question (some sources suggest longer than 1 year).
3) Seedlings of *S. densiflora* are cryptic (i.e. tending to be camouflaged) and blend in with the surrounding salt marsh grasses.

Historically, *S. densiflora* was found in Grays Harbor on the eastern side of the Ocean Shores Peninsula. Two primary sites were Bill's Spit and east of the Ocean Shores airport. However, this season crews noticed the Bill's Spit infestation had increased in both number of sites and size of the infestation, with scatterd plants extending about a mile to the north. Crews also found *S. densiflora* in North Bay for the first time, extending from Campbell Slough west, roughly 3.5 miles. Approximately 25 plants were found and treated in North Bay during the 2008 season. The cooperators believe that *S. densiflora* treatments could surpass *S. alterniflora* treatments in 2009.

A survey targeting *S. densiflora* is planned in the early spring months of 2009. *S. densiflora* does not senesce (i.e. experience a dormant period) in the winter like most native plants. This early survey should make locating cryptic *S. densiflora* easier due to the senesced surrounding vegetation. Crews could then flag infested areas and return at a later date during the treatment season.

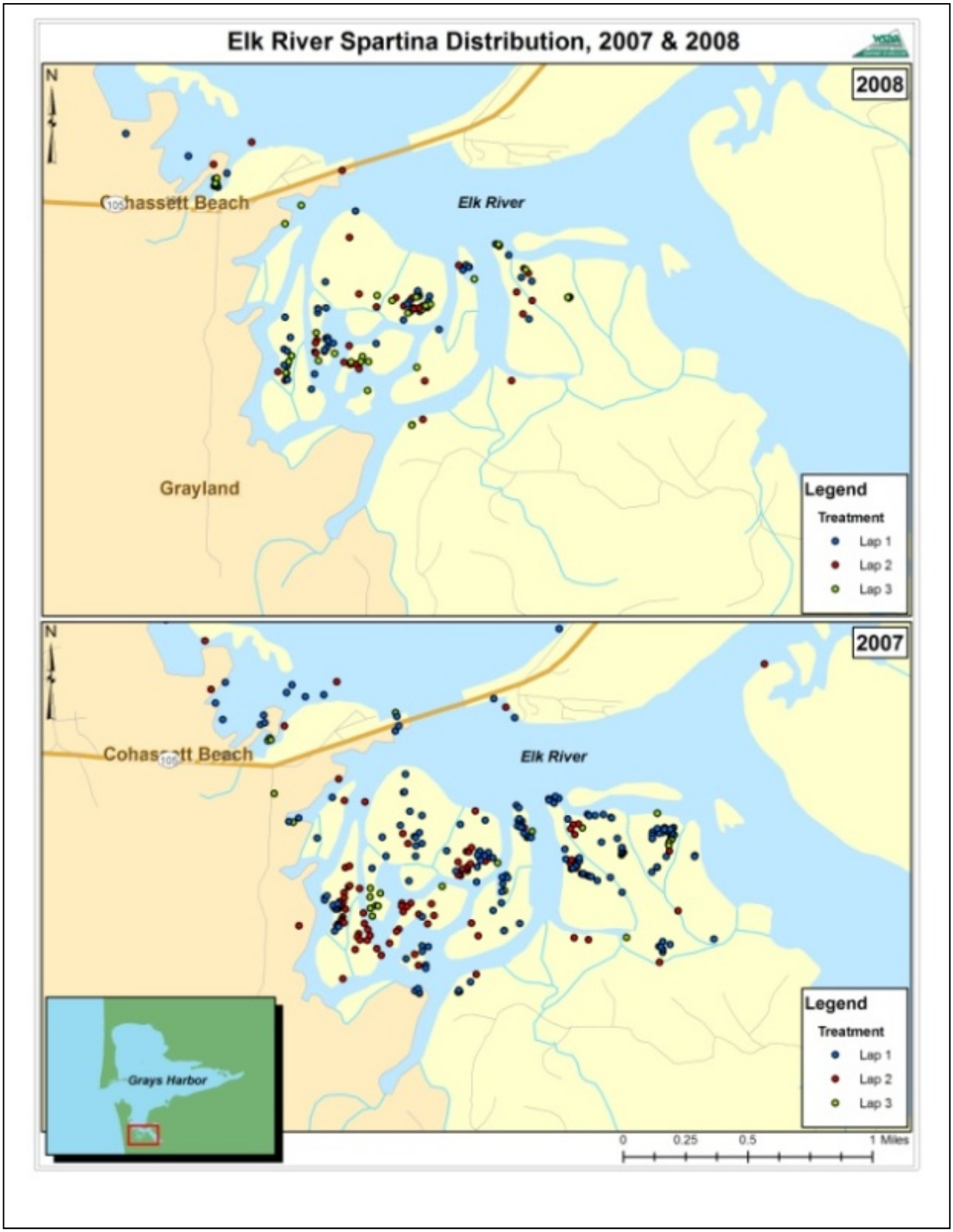

Figure 7: Comparative reduction of *S. alterniflora* in Elk River from 2007 to 2008.

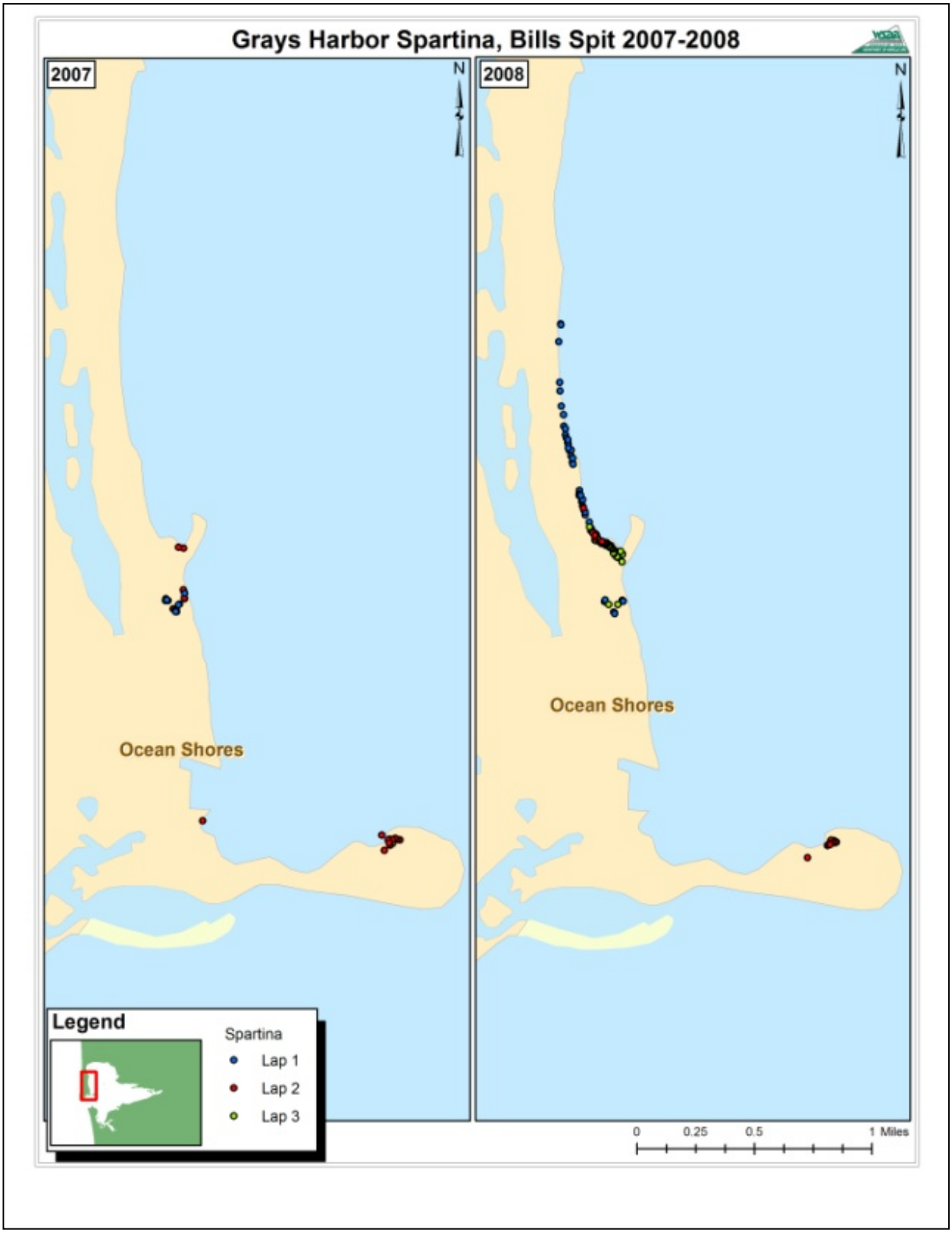

Figure 8: Comparative increase in *S. densiflora* density at Bill's Spit from 2007 to 2008.

Recommendations for the Future

The 2008 survey and treatment season in Grays Harbor was successful. The cooperators aligned the resources needed to conduct a detailed survey and treatment program during the 2008 season. As previously noted, three survey laps were completed with all known *Spartina* infestations treated.

After the success of the 2008 season, WSDA projects that less than 0.25 solid acres of *Spartina* will be present in Grays Harbor during the 2009 treatment season.

Specific Recommendations for the 2009 Grays Harbor survey and treatment season include:

1) Hire a Grays Harbor *Spartina* crew lead by February to provide ample time for GPS training, herbicide application license preparation, *S. densiflora* survey work, and a general knowledge of Grays Harbor.
2) Include *S. densiflora* flagging in early spring before the competing vegetation becomes too high making locating *S. densiflora* seedlings difficult.
3) Continue to perform coastal surveys as well and extend the Grays Harbor survey well inland of the salt marsh to insure that no outliers are missed.
4) Complete a minimum of two comprehensive rounds of survey and treatment throughout Grays Harbor.
5) Implement a new consent process in the affected areas of Grays Harbor County.

Figure 9 is a projection that *Spartina* can be largely eradicated from Grays Harbor over the next four seasons with sustained funding.

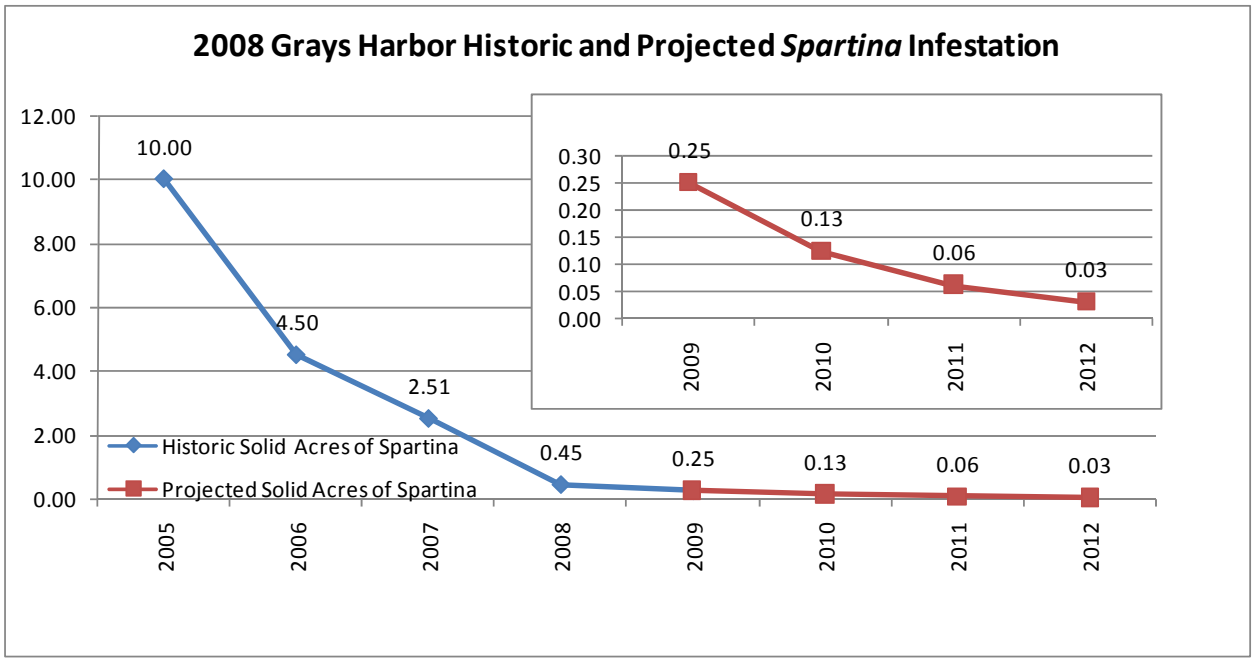

Figure 9: Solid Acres of *Spartina* in Grays Harbor by year, based on WSDA estimates. The blue line represents the historic area of *Spartina* and the red line represents the projected area of *Spartina*. Projected area assumes sustained funding.

Spartina Eradication Effort in Puget Sound, Hood Canal, and the Strait of Juan de Fuca

Overview

For programmatic purposes, this geographic region ranges west to Neah Bay, north to Whatcom County and south to the South Puget Sound. This region includes all of the waters in the Puget Sound basin. There are more than 2,400 miles of shoreline in these waters. Along the Puget Sound's shores, four species of *Spartina* are found: *Spartina anglica, Spartina alterniflora, Spartina densiflora, and Spartina patens*. Of these four species, *S. anglica* is the most abundant and accounts for more than 99% of the infestation. *S. anglica* was introduced to Snohomish County in 1961 and the infestation increased in size to a peak of more than 1000 acres by 1997. *S. alterniflora, S. densiflora* and *S. patens* are limited in distribution and extent; combined, these three species account for less than one solid acre throughout the Puget Sound.

In 2008, WSDA estimates that there were approximately 43 solid acres of *Spartina* controlled throughout this region. This is a 75% reduction in the amount of Spartina remaining in the Puget Sound from the 164 acres controlled during 2007. Figure 11 shows the approximate extent and distribution of *Spartina* control sites in the Puget Sound region. WSDA estimates that fewer than 20 solid acres of *Spartina* will remain in 2009. WSDA predicts with sustained funding and *Spartina* will be largely eliminated from the Puget Sound region by 2012. Figure 10 illustrates the decline in solid acres of *Spartina* in the Puget Sound since 2003 and projected decreases through 2012.

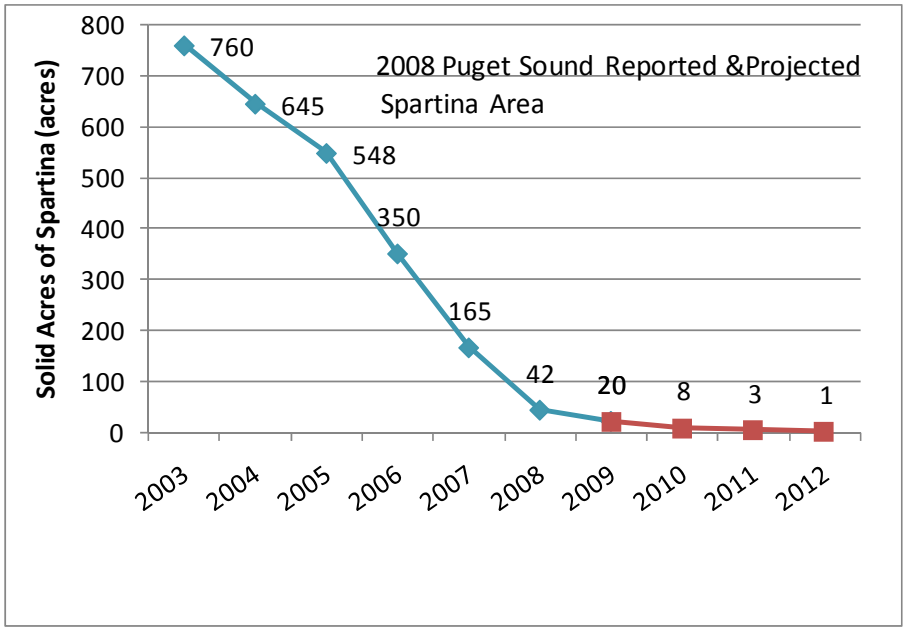

Figure 10: Reported area of *Spartina* in the Puget Sound and projected area of *Spartina* in the Puget Sound region. All areas are reported in solid acres and are based upon WSDA records and those of cooperator groups. The blue line represents the reported area of *Spartina* and the red is the projected area of *Spartina* based on WSDA estimates.

The 2008 control season was successful; favorable weather and efficient cooperation between partner groups facilitated high levels of control. Highlighted below are some achievements in *Spartina* eradication for 2008. Following these brief highlights are more detailed reports on a regional basis. Table 5 shows the estimated area of *Spartina* controlled this season by county.

- 42.1 acres of *Spartina* treated throughout the region during the 2008 season; a 75% reduction from the amount of *Spartina* present in 2007.
- Large scale cooperative treatments in Turner's Cove, one of the last remaining seed producing stands of *Spartina* in the North Puget Sound.
- More than 300 miles of shoreline surveyed for potential infestations.

In addition to progress toward the eradication of *Spartina*, 2008 saw inroads to other areas of the management of this noxious weed species. Volunteer interest in *Spartina* related projects in the Puget Sound increased in 2008. Local kayak clubs, WSU Beachwatchers, People for Puget Sound and other concerned groups partnered to augment agency survey efforts throughout the region. A stronger partnership between Canadian *Spartina* cooperators and the *Spartina* cooperators of WSDA was forged through a series of meetings to disseminate technical information and experiences eradicating *Spartina*.

Table 5: Estimated Solid Acres of *Spartina* in 2008 by county as reported by WSDA and records from *Spartina* cooperators.

County	***Estimated Solid Acres of Spartina***
Snohomish	21.34
Island	15.375
Skagit	6.24
Clallam	0.18*
San Juan	0.11
Kitsap	0.06
Jefferson	0.01
Whatcom	<0.01
Total	**43.325**

***Includes infestations on Makah Tribal Lands.

Island County

In 2008, Island County contained the second largest infestation of *Spartina* in the Puget Sound. The Island County Noxious Weed Control Board (ICNWCB), WDFW, and WSDA conducted the *Spartina* eradication work in Island County. A total of approximately 15.4 acres of *Spartina* were treated in this control season. WSDA provided ICNWCB with $50,000 to eradicate *Spartina* within Island County.

WDFW conducted large scale treatments in Triangle Cove, Emerick's, and Price's meadows, treating approximately 11.75 acres this year in these three areas. These historically large sites are the focus of ongoing eradication activities. In 2007, more than 90 acres of *Spartina* were controlled in these areas.

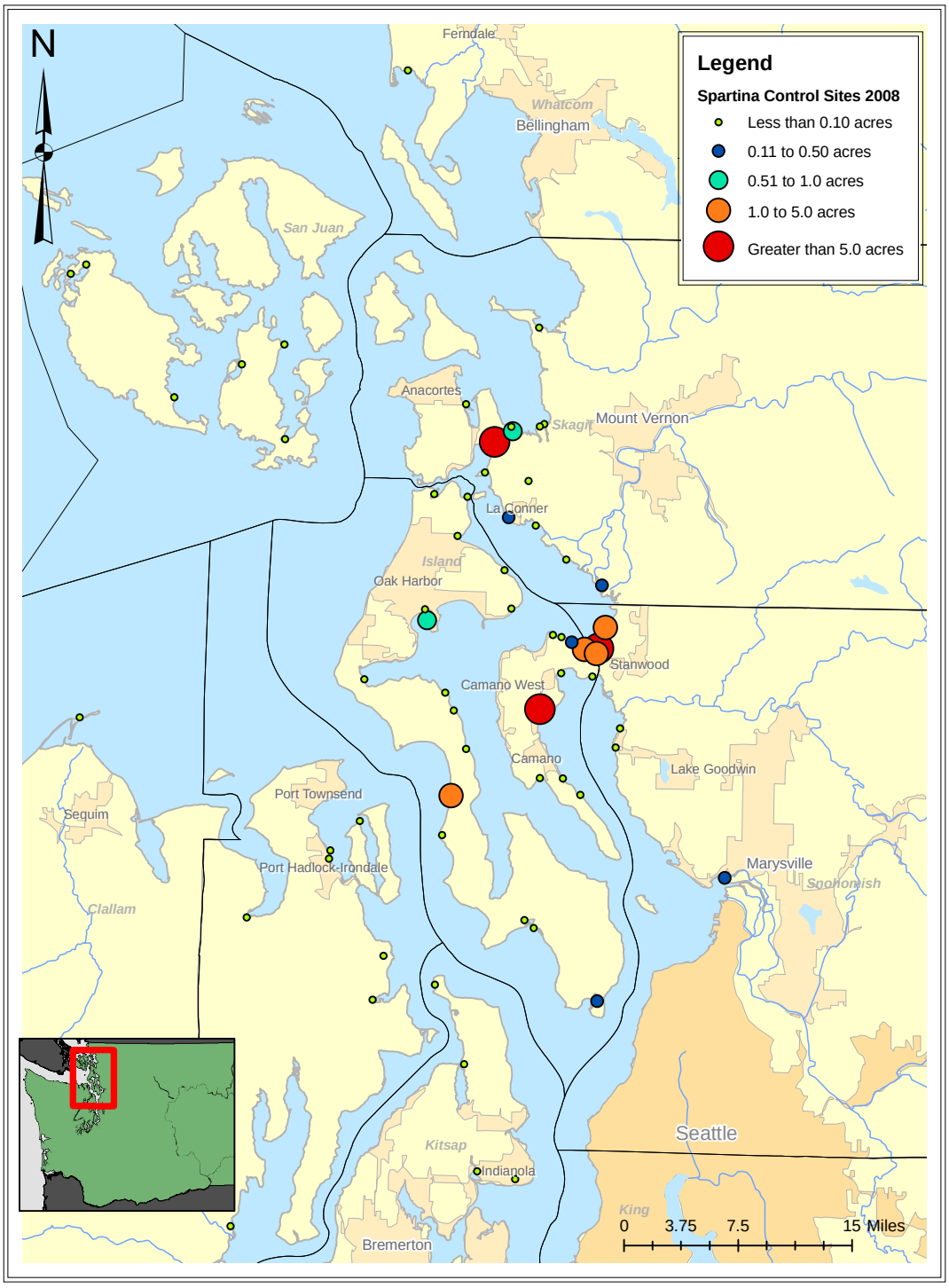

Figure 11: Extent and distribution of *Spartina* control sites in the Puget Sound. For clarity on the map, some of the smaller infestations have been combined. The largest infestations remain near the original introduction site of *S. anglica* in Snohomish County

ICNWCB and its contractor Wildlands Management (WM) controlled the major *Spartina* infestations and seed sources on Whidbey Island in 2008. Priority sites were identified at coordinating meetings and treated early in the control season. Through cooperation, Lake Hancock and other areas missed in 2007 were able to receive treatments during the 2008 control season.

Approximately 15.4 acres of *Spartina* and all major infestations were treated in Island County during 2008. The total area of *Spartina* present and treated in Island County reduced 85% from 2007 to 2008. Table 6 summarizes the Island County *Spartina* eradication effort in 2008. With continued funding and effort, WSDA expects large seed producing infestations to decline in size during the next four years. During this period, eradication of the small outlier populations in Island County is a primary goal. Figure 12 highlights the remaining infestations in Island, Snohomish, and Skagit Counties.

Snohomish County

Currently, Snohomish County has the largest *Spartina* infestations in the Puget Sound and is a center for large scale eradication activities. The Snohomish County Noxious Weed Control Board, WDFW, Tulalip Tribes, and The Nature Conservancy (TNC) worked in concert to treat *Spartina* in Skagit Bay and Port Susan. Approximately 20.35 acres and all known sites were treated in Snohomish County in 2008. WSDA provided support to cooperators to eradicate *Spartina*. In addition to augmenting labor for cooperative *Spartina* projects, WSDA contributed funding to cooperators for *Spartina* eradication. In 2008, WSDA supplied $50,000 to Snohomish County Noxious Weed Control Board to control *Spartina*.

The major focus within Snohomish County was treating the major populations in SE Skagit Bay. WDFW conducted surveys and treatments on WDFW owned and managed lands in Snohomish County. Much of this work focused on Leque Island and Mystery Island. Historically, these sites had more than 200 solid acres of *Spartina*. During 2008, WDFW crews located and treated only 4.2 acres of *Spartina* on these sites. *Spartina* control activities also progressed northwards to the southern reaches of the Skagit Delta. Previously no surveys or treatments had occurred in this area however, during 2008, more than 2 solid acres of *Spartina* were found and treated. WDFW continued as a major logistical supporter of the *Spartina* management effort in Snohomish County in 2008.

In 2007, TNC increased *Spartina* control effort on its 4,000 acre Port Susan Preserve. TNC treated 1.89 solid acres of *Spartina* in Port Susan in 2007; during 2008 less than 0.25 acres of *Spartina* were found and controlled within the Port Susan Preserve. Snohomish County Noxious Weed Control Board continued treating *Spartina* in SE Skagit Bay and the Stillaguamish channel system in 2008. Snohomish County was able to treat *Spartina* in areas previously untreated in Skagit Bay through continued partnership with landholders and cooperative efforts.

Table 6: Summary of 2008 *Spartina* eradication effort in Island County.

Site	*Estimated Solid Acreage Treated*	*Entity Conducting Treatment*	*Treatment Method*
Triangle Cove/ Barnum Point	6.55	WDFW, WM, & WSDA	Herbicide
Emrick's/Price	5.2	WDFW	Herbicide
Hancock Lake	1.65	WDFW, WM, & WSDA	Herbicide
Maylor's Marsh	0.7	WM	Herbicide
English Boom	0.425	WM	Herbicide
Cultus Bay	0.25	WM	Herbicide
Livingston Bay/Iverson/Juniper Beach	0.235	WM & WDFW	Herbicide
Sandy Hook	0.06	WM	Herbicide
Elger Bay	0.04	WM	Herbicide
Arrowhead Beach	0.04	WM	Herbicide
Sunny Shores	0.03		Herbicide
Twin Lagoons, Kennedy Lagoon	0.022	WM	Herbicide
Nelson's Lagoon	0.02	WM	Herbicide
Oak Harbor	0.02	WM	
Deer Lagoon	0.017	WM & IC	Herbicide
Glenwood Lagoon	0.015	WM	Herbicide
Sunlight Beach	0.015	WM	Herbicide
Ala Spit	0.01	WM	Herbicide
Dugualla Bay	0.01	WM	Herbicide/Dig
Race Lagoon	0.01	WM	Herbicide
Lagoon Pt.	0.01	WM	Herbicide
Mariner's Cove	0.005	WM	Herbicide
Cornet Bay-	0.005	WM	Herbicide
Eagle Tree	0.005	WM	Herbicide
El Capitan Lagoon	0.005	WM	Herbicide
Harrington's Lagoon	0.005	WM	Herbicide
Strawberry Pt.	0.005	WM	Dig
Fawn Bluff	0.005	WM	Dig
Holme's Harbor	0.003	WM	Dig
Mt. View Lagoon	0.002	WM	Herbicide
Honeymoon Bay	0.002	WM	Herbicide
Monroe's Landing	0.002	WM	Herbicide
Blower's Bluff	0.001	WM	Dig
Crescent Harbor	0.001	WM	Dig
Total Solid Acres Treated	**15.375**		

IC = Island County Noxious Weed Control Board, WM = Wildlands Management, WDFW = Washington Department of Fish & Wildlife,

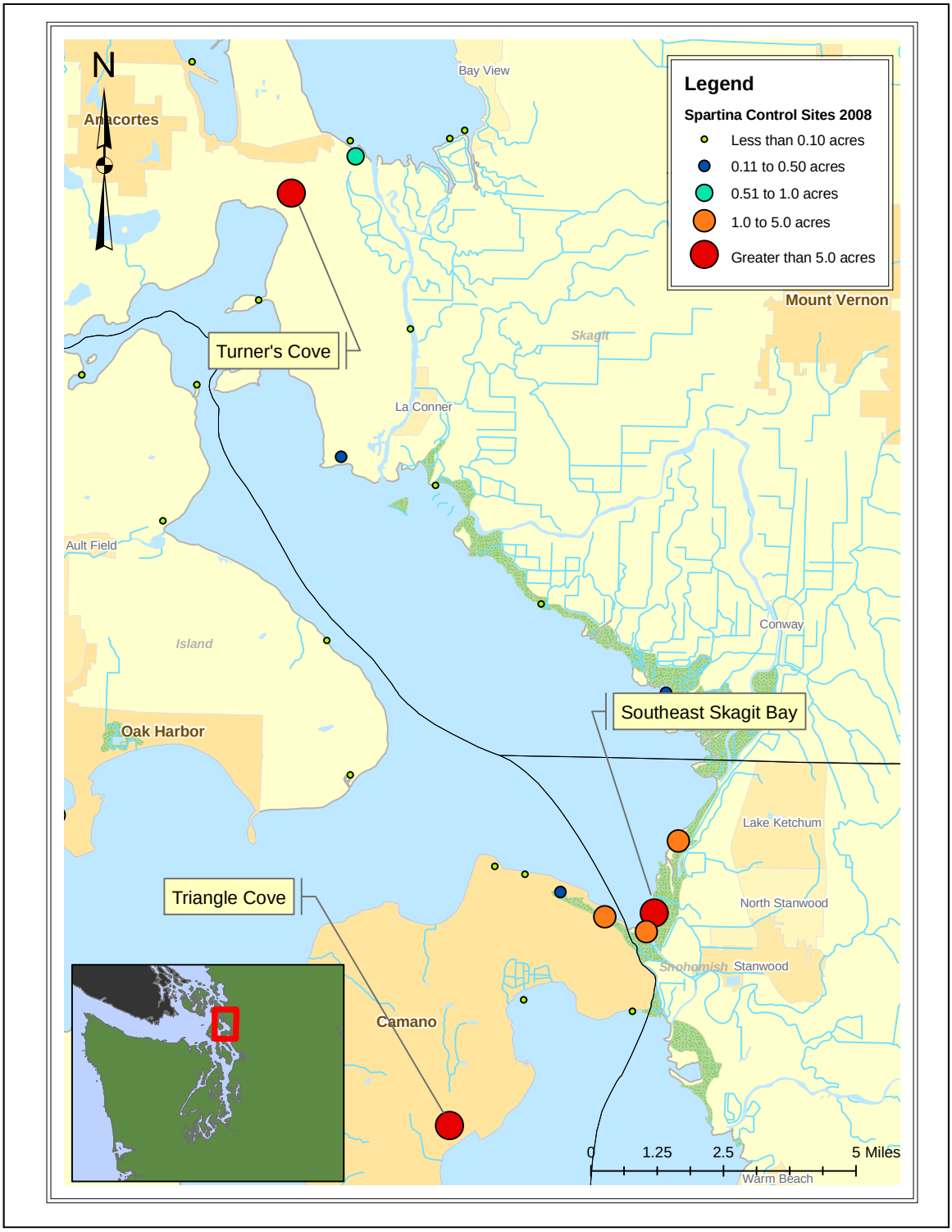

Figure 12: Detailed map showing the major infestation areas receiving treatment in the 2008 Control season. For clarity, some of the smaller infestation sites have been combined. Triangle Cove, Turner's Cove, and SE Skagit Bay remain the focus of intense management activities.

Table 7: Summary of 2008 *Spartina* eradication Effort in Snohomish County.

Site	*Estimated Solid Acreage treated*	*Entity Conducting Treatment*	*Treatment Method*
Southeast Skagit Bay	12.19	SC,WDFW, WSDA	Herbicide
Leque Island	3	WDFW	Herbicide
North of Big Ditch	2.2	WDFW & SC	Herbicide
Mystery Island	1.7	WDFW, SC	Herbicide
Stillaguamish River Channels	1.22	SC & WSDA	Herbicide
Davis Slough	0.43	WDFW & SC	Herbicide
Big Flats	0.36	WDFW, WSDA, SC & TT	Herbicide
Port Susan	0.24	TNC, WDFW, & WSDA	Herbicide
Harborview Park & Water Treatment Facility	0.01	SC	Dig & Herbicide
Total Solid Acres Treated	**21.35**		

SC = Snohomish County Noxious Weed Control Board, TNC = The Nature Conservancy, TT = Tulalip Tribe, WDFW = Washington Department of Fish & Wildlife

The Snohomish County control effort in 2008 was successful due to continued coordination between partner groups. Table 7 shows the summary of the 2008 control season with the areas treated, methods used and cooperators conducting the control. If overall effort levels are maintained in Snohomish County, the large populations will diminish, resulting in near eradication within four years.

Skagit County

Within the Puget Sound, Skagit County has the third largest infestations of *Spartina* after Island County and Snohomish County. Skagit County Noxious Weed Control Board (SCNWCB), the Department of Ecology, WDFW, and the Swinomish Tribal Community controlled approximately 6.24 acres of *Spartina* in Skagit County in 2008. WSDA provided $30,000 for Skagit County's *Spartina* control effort and $10,000 for the Swinomish Tribal Community's *Spartina* eradication projects.

The SCNWCB had staff in the field at the start of the control season and was able to treat areas that did not receive treatment in the prior year. The SCNWCB reported large reductions in the amount of *Spartina* treated in the traditional areas of their work.

In its seventh year of partnership with WSDA, the Swinomish Tribal Community actively engaged in *Spartina* control on their lands. In 2008, the tribe allowed the use of herbicide to eradicate *Spartina* on their lands. This allowed for the first complete treatment of Turner's Cove. Turner's Cove is the largest single infestation in Skagit County and the focus of intense management activity. In 2007, tribal staff used geotextiles and mowed seed heads in Turner's Cove to control *Spartina*. These measures proved ineffective in preventing the spread of *Spartina* within Turner's Cove. In 2008, 5.1 solid acres of *Spartina* were controlled in Turner's Cove using herbicide.

Additionally the Swinomish tribe partnered with People for Puget Sound and other concerned groups to organize a community *Spartina* dig event at Swadabs Park, located on the Swinomish Chanel, this effort successfully removed approximately 110 square feet of *Spartina*. The Swinomish Tribal Community's continued cooperation is essential to eliminate *Spartina* from Skagit County.

Since 1996, the Department of Ecology (DOE) has controlled Spartina on their Padilla Bay Estuarine Research Reserve. Padilla Bay contains two species of *Spartina*, *S. anglica* and *S. alterniflora*. During this control season DOE staff treated 0.007 acres of *Spartina* on the Reserve and all known infestations. This is a large reduction from the maximum of 17 acres reported in the Reserve during 1997. In 2008, Dike Island had the only known population of *S. alterniflora* in the Puget Sound, totaling fewer than 65 square feet. DOE staff expects to eradicate the *S. alterniflora* infestation during the next four years and will remain active in preventing new infestations of S. *anglica.*

Skagit County benefited from cooperation between the project cooperators and the subsequent eradication efforts by these groups. Table 8 summarizes this effort by site. Through planning and coordination, any sites missed in 2008 will receive treatment early in the 2009 control season. Over the next four years WSDA expects significant reductions in the size of the Skagit County infestation.

Table 8: Summary of the 2008 *Spartina* Eradication Effort in Skagit County.

Site	***Estimated Solid Acreage Treated***	***Entity Conducting Treatment***	***Treatment Method***
Turners Cove	5.1	WDFW, SW, SK, PPS & WSDA	Mowing & Herbicide
Rawlings Rd. South	.05	SK	Herbicide
Casino Lagoon/ Casino Beach	0.51	SK	Herbicide
Gallups South	0.13	SK	Herbicide
Padilla Bay/Alice Bay/Samish Bay	0.053	SK, DOE, WDFW	Dig, Mow & Herbicide
Eagle's Nest	0.26	SK	Herbicide
Swinomish Channel	0.04	SK, SW, PPS	Herbicide & Dig
Sands Island	.02	SK	Herbicide
Kraft Island	.04	SK	Herbicide
Kiket Island	.04	SK	Herbicide
March Point	.001	SK	Dig
Total Solid Acres Treated	**6.18**		

DOE = Department of Ecology, PPS = People for Puget Sound, SK = Skagit County Noxious Weed Control Board, SW = Swinomish Tribal Community, WDFW = Washington Department of Fish & Wildlife

Clallam, Jefferson, Kitsap, King, San Juan and Whatcom Counties

In 2008, WSDA continued to work with the Noxious Weed Control Boards of Clallam, Jefferson, King, San Juan, and Whatcom Counties as well as the U.S. Navy, State Parks, Vashon Maury Land Trust, Suquamish Tribe and U.S. Fish and Wildlife Service (USFWS) to conduct surveys and control *Spartina*. These cooperators provided logistical aid in surveying estuaries in their areas for outlying populations of *Spartina*. Table 9 summarizes the *Spartina* eradication effort in Clallam, Jefferson, Kitsap and King Counties.

In Kitsap County, WSDA and the Suquamish Tribe worked together to treat the largest known infestation in the Central Puget Sound at Doe-Kag-Wats. Since 2006, the herbicide Imazapyr has been utilized at the site. In 2008, approximately 0.06 acres (2,600 square feet) of *Spartina* were treated at Doe-Kag-Wats. By comparison, in the 2007 control season, 0.50 acres were treated at the site. This is an 88% reduction in the infestation size. The difficulty with this site is the shifting driftwood in the marsh. Each winter, storms move driftwood and expose new plants and cover other plants. Effective control of this site will require repeated visits in the coming years.

During 2008, WSDA assisted the San Juan County Noxious Weed Control Board in a shoreline survey and treatment program. Surveys were conducted by boat due to the extensive shoreline and limited access. WSDA staff also conducted two additional surveys in San Juan County and treated populations discovered in 2007. Infestations controlled in San Juan County during 2008 totaled 0.11 acres and are now priority sites for future control.

WSDA crews have substantially reduced all known infestations in Clallam, Jefferson, Kitsap and King Counties. With the exception of Dosewallips State Park, all known sites were surveyed twice and all finds were treated during the 2008 control season. After completing extensive surveys of *S. patens* in Dosewallips State Park, WSDA was unable to treat the infestation due to inclement weather and poor tides. This site will be a priority for early season treatment in 2009. A complete list of historic *Spartina* sites surveyed this season is listed in Table 10. This season over 300 miles of shoreline were surveyed in areas adjacent to known infestation sites. As the amount of *Spartina* decreases, the amount of surveys for *Spartina* has increased in the Puget Sound. Surveys are important to detect any outlier infestations before they become problematic.

Recommendations for the Future

Continuous control and the elimination of major seed producing populations in the Puget Sound have resulted in significant decreases in the total amount of *Spartina*. The *Spartina* management paradigm in the Puget Sound has shifted from aerial treatments, boom sprayers and large scale mechanical control towards a more labor intensive effort that uses fewer material resources and less herbicide. Treating these diffuse populations is more labor intensive and consequently requires alternative survey and treatment strategies.

The 2008 field season confirmed that continued cooperation and coordination is essential to the future success of the *Spartina* program in the Puget Sound. Increased labor and pooled resources will be needed to successfully eradicate the remaining diffuse infestations of *Spartina*. With the continued cooperation between the partner groups in the region and sustained funding this effort should continue to succeed.

Table 9: Summary of *Spartina* Eradication Effort in Clallam, Jefferson, Kitsap, King, San Juan and Whatcom Counties.

Site	*Estimated Solid Area (square feet)*	*Entity Conducting Treatment*	*Treatment Method*
San Juan County			
Fisherman Bay & Mud Bay	50	SJC/WSDA	Dig
Spencer Spit	20	SJC/WSDA	Dig
Low Point	2,600	WSDA	Herbicide
White Point	2,100	WSDA	Herbicide
Clallam County			
Salt Creek	10	CC	Dig
Pysht River Estuary	4,030	WSDA	Herbicide
Dungeness Spit NWR	10	USFWS/WSDA	Dig
Jefferson County			
Dosewallips State Park	800	WSDA	Not treated
Discovery Bay	15	WSDA	Dig
North Indian Island	25	WSDA/Navy	Dig
Kala Point	5	WSDA	Dig
Mata Mats Bay	5	WSDA	Dig
Port Ludlow	25	WSDA	Dig
Kitsap County			
Foulweather Bluff	50	WSDA	Dig
Doe-Kag-Wats	2,400	WSDA/ST	Herbicide
Point Julia	5	WSDA	Dig
Whatcom County			
Red River Mouth	5	WC, WDFW, and PPS	
Total Solid Area Treated	**12,155 sq feet (0.279 acre)**		

CC = Clallam County Noxious Weed Control Board, SJC = San Juan County Noxious Weed Board, ST = Suquamish Tribe, USFWS = United States Fish & Wildlife Service, WC = Whatcom County Noxious Weed Control Board, PPS = People for Puget Sound

Table 10: Historic *Spartina* sites in the Puget Sound with no *Spartina* recorded in 2008. Eradicated sites are locations with no *Spartina* recorded for two years. Monitor sites are locations with no *Spartina* recorded during the current year.

Site	*Status*	*Site*	*Status*
San Juan County		**Kitsap County**	
Buck Bay	Monitor	Eglon	Eradicated
Clallam County		Murden Cove	Eradicated
Gibson Spit	Eradicated	Kingston	Monitor
Jefferson County		Manzanita	Monitor
Bywater Bay	Eradicated	Miller Bay	Monitor
Port Hadlock	Eradicated	Point Monroe	Eradicated
Mystery Bay	Eradicated	Port Gamble	Monitor
Chimicum Creek	Monitor	**King County**	
Fort Flagler	Monitor	Fern Cove	Eradicated
Oak Bay	Monitor	Gorsuch Road	Eradicated
S. Indian Island	Monitor	Point Heyer	Eradicated
Thorndyke Bay	Monitor	Port Blakely	Eradicated
Tarboo Bay	Monitor	Rabb's Lagoon	Eradicated
Scow Bay	Monitor	**Whatcom County**	
Whalin Point	Monitor	Birch Bay	Monitor

Appendices

Appendix 1 - *Spartina* in Washington State

Why is *Spartina* a problem?

The invasive noxious weed *Spartina* is found in various intertidal areas of Washington State. *Spartina* can modify the hydrology of estuaries, causing increased flooding. It out competes native vegetation, forming monotypic meadows that accumulate sediment. This disturbance can lead to reduced plant diversity, elevated intertidal areas and displacement of invertebrates, which are a major food source for shorebirds and juvenile salmon. *Spartina* can destroy valuable shorebird, waterfowl and salmon habitat. *Spartina* also has the ability to threaten both the natural and commercial shellfish beds that are important to the economy of Washington State.

Which species of *Spartina* occur in Washington State?

There are currently four species of non-native *Spartina* known to occur in Washington. *Spartina alterniflora* is most widely found in Willapa Bay, with fewer than 100 solid acres currently infesting the Bay. *Spartina alterniflora* is also known to occur in Skagit, Clallam, Jefferson and Grays Harbor counties.

Spartina anglica is present in Skagit, Snohomish and Island counties. It has also been found in San Juan, Whatcom, King, Kitsap, Clallam and Jefferson counties in small infestations. It currently infests approximately 15 solid acres in the Puget Sound region.

Spartina patens is known to occur at only one location in the state: Dosewallips State Park in Jefferson County. This infestation is controlled by surveys, digging and herbicide applications, as needed. The current infestation size is less than one solid acre.

Spartina densiflora is a South American species that was discovered in 2001 in Grays Harbor County and in Island County. The species currently infests less than a quarter solid acre in Grays Harbor.

Figure 13 shows each of the four species.

How was *Spartina* introduced into Washington State?

Spartina alterniflora was unintentionally introduced to Willapa Bay as packing material for oysters shipped from the east coast during the late 1800's. In Puget Sound, various landowners introduced *Spartina alterniflora* in an effort to stabilize shorelines. *Spartina anglica* was similarly introduced into Puget Sound at a farm located in Port Susan in the early 1960's to serve as bank stabilization and as a potential source of feed for cattle. The modes of introduction for both *Spartina patens* and *Spartina densiflora* are unknown.

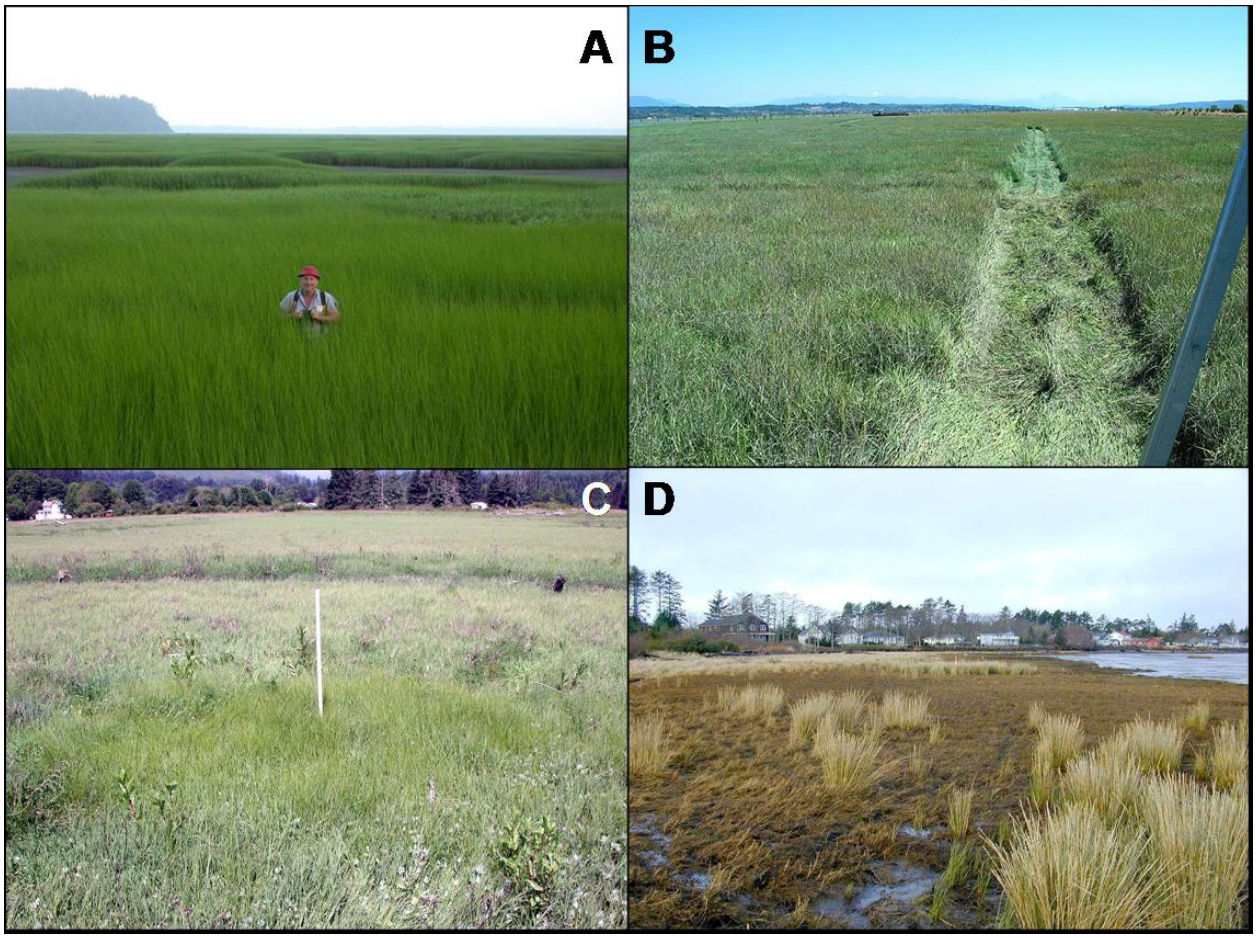

Figure 13: The four species of *Spartina* present in Washington. A) A meadow of *S. alterniflora* in Willapa Bay, B) A meadow of *S. anglica* in Skagit Bay (2003), C) *S. patens* at Dosewallips (2001), and D) clones of *S. densiflora* in Grays Harbor County.

How do we eradicate *Spartina*?

Spartina spreads quickly and is difficult to eradicate. A successful eradication program involves four steps:

1) Preventing an existing infestation from producing seed;
2) Treating an existing infestation for several consecutive years using integrated pest management (IPM) techniques (including mechanical, chemical or manual control, or a combination of these methods);
3) After eradication is achieved, monitoring the area and removing new seedlings to ensure no re-establishment occurs; and
4) Continuing to survey shorelines, educate the public, and follow-up on possible sightings of new infestations.

Appendix 2 - Recent Surveys/Early Detection Rapid Response in Action

Contributed by Kevin Anderson, WSDA

With significant reductions in the solid acreage of *Spartina*, there is an increased focus on finding and eliminating outlying infestations. During of the 2007 and 2008 field seasons, WSDA and its cooperators have made survey a priority. The following portion of the report details the survey activities and finds of the past two field seasons.

Throughout the course of the control season, when time and tides permitted, WSDA and cooperators participated in shoreline surveys in ten counties in Washington State. This concerted effort utilized staff from WSDA, WDFW, county weed boards, People for Puget Sound, and numerous private citizens volunteering their time. Surveys were conducted with watercraft, various types of rough terrain vehicles, and helicopter observation. Stretches of shoreline were selected for survey based upon an "outside to inside" strategy. Lengths of shoreline were identified in areas with potential *Spartina* habitat and surveyed.

In 2007 and 2008, 775 miles of shoreline were surveyed statewide (Figure 3). During 2007, 373 miles of shoreline were surveyed statewide. A large portion (273 miles) consisted of helicopter surveys along the outer coast. A USFWS grant funded the aerial survey activities. In addition, 40 miles of shoreline were surveyed in the Puget Sound region in 2007.

During 2008, survey activities increased in the Puget Sound region. A total of 363.9 miles of shoreline were surveyed in the Puget Sound. Areas of Whatcom County, San Juan County, and portions of the South Puget Sound were surveyed by boat. People for Puget Sound (PPS) organized volunteer surveys in San Juan, Whatcom, Island, and Skagit Counties; with volunteers, PPS surveyed more than 53 miles of shoreline.

Table 11: Summary of shoreline surveyed for cordgrass infestations in 2007 and 2008 *Spartina* control seasons

Region	***2007***	***2008***	***Total***
Puget Sound	40	363.9	403.9 miles
Open Coast	333.1	38	371.1 miles
			775 miles

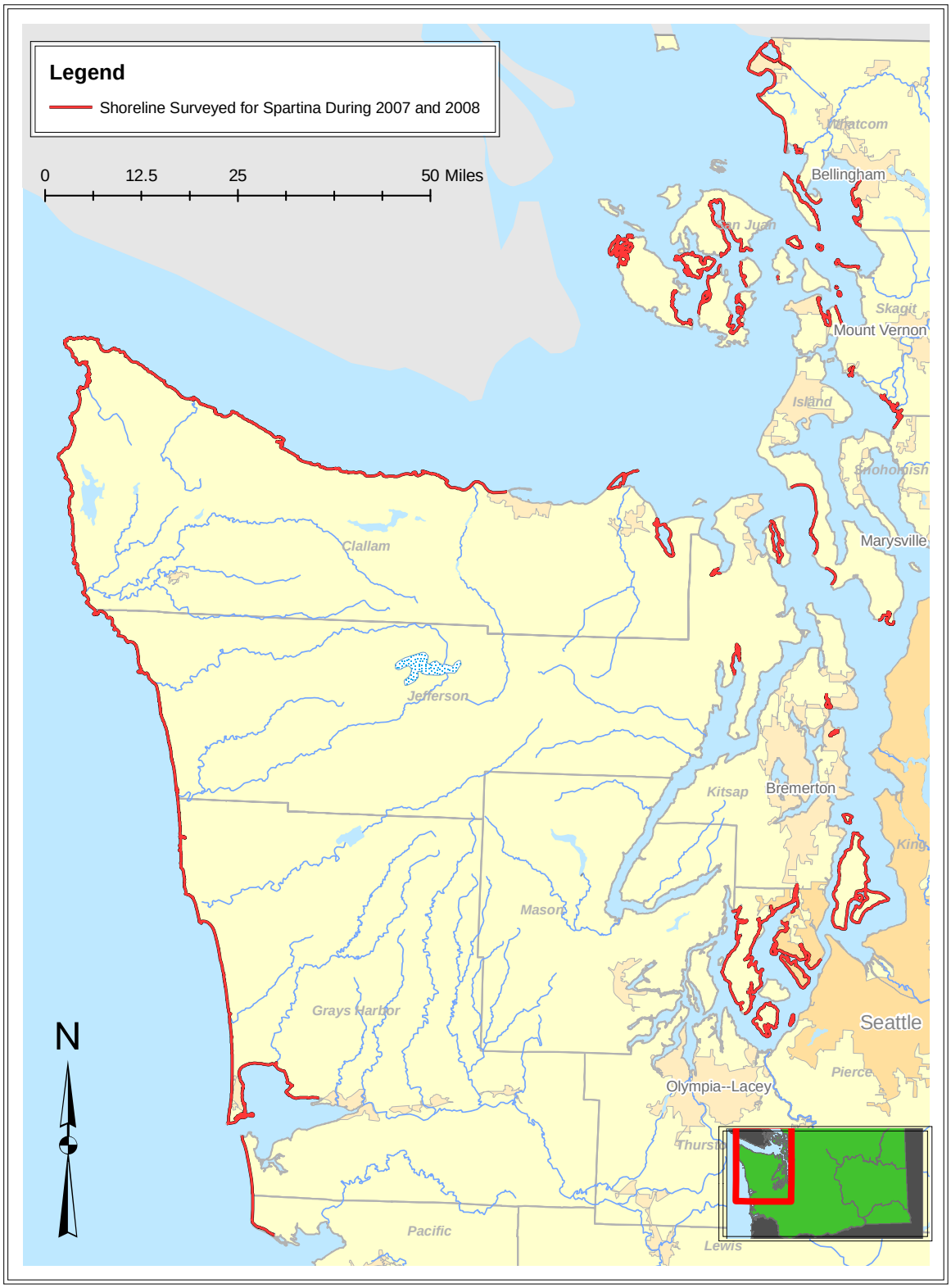

Figure 14: Shoreline surveyed for *Spartina* infestations during 2007 and 2008. Red lines are tracks that surveys followed. A total of 775 miles of shoreline were surveyed during this period.

Results

The past two years of survey yielded several previously unknown finds in the Strait of Juan de Fuca, Neah Bay area, and Puget Sound. An infestation of *S. alterniflora* was discovered by aerial survey in the Waatch and Sooes River estuaries on Makah Tribal lands. Ground based surveys detected *S. anglica* infestations in the Pysht River Estuary, at Salt Creek, and on Dungeness Spit in Clallam County. Boat surveys in San Juan County revealed infestations of *S. anglica* on Low Point and White Point located on San Juan Island. In late 2008, a volunteer survey lead by People for Puget Sound discovered an infestation of *S. anglica* at the mouth of the Red River in Whatcom County. Subsequent to discovery, all of these sites were the focus of targeted management efforts. The total solid acreage of these finds is less than one solid acre (1 acre) total. Though these sites are relatively small, their discovery and subsequent management are important in preventing the spread of *Spartina* within the region.

Appendix 3 - Grays Harbor - *Spartina densiflora* Treatment Study

Contributed by Dave Heimer, WDFW

On August 8th, 2008, one hundred and ninety-nine *Spartina densiflora* plants were marked using numbered flags at Bill's Spit in Grays Harbor, Washington. Each of these plants had been treated once by field crews with backpack sprayers using a mixture of imazapyr, glyphosate, Agridex, and dye during June and July. Plants that were flagged were mostly small, less than a foot, multi-stemmed and were exhibiting the effects of herbicide damage.

On October 31st, 2008, a minimum of 102 days post-treatment, the *S. densiflora* plants at the site were revisited and plant vigor was assessed. A total of 169 marked plants were relocated at the site. Each plant that could be associated with a flag was given a rating of: Alive (showing at least one completely green stem), Marginal (showing some green on a stem), or Dead (no green on any stems) (Table 4).

Table 12: Results of *S. densiflora* treatment assessment. Alive plants showed at least one green stem, marginal plants has partially green stems and dead plants had no photosynthetic tissues.

S. densiflora Assessment	*Number of Plants Counted*	*Percent of Total Counted*
Alive	43	25.44
Marginal	56	33.14
Dead	70	41.42
Total	169	100

Of the *S. densiflora* plants counted, 41% exhibited mortality three months after treatment and 25% were alive. These figures are concerning because *S. densiflora* plants that were treated would have received thorough herbicide coverage and their location in the highest part of the intertidal would have also allowed adequate dry time. The reasons for the poorer than expected efficacy may be attributed to the canopy architecture, biochemistry, or phenology of *S. densiflora* whose bunchgrass growth form and South American origin is much different than *S. alterniflora* and *S. anglica*.

It is possible that the mortality will increase over the winter if some of the Marginal plants die, but steps should be taken to improve the lower than desired efficacy in 2009. These steps would

include continued digging of green plants in the spring and using the maximum labeled herbicide rate during the treatment season. Herbicide treatment earlier in the season has the added benefit of preventing seed production, as very few *S. densiflora* plants were seen flowering in 2008. The unexpected number of small plants at the site may be attributed to seedling emergence and a seed bank. The longevity of seeds is unknown and should be examined. The 2009 treatments of *S. densiflora* will be monitored and that information will be used to improve the eradication program in Grays Harbor.

Appendix 4 - Late Season Cooperative Willapa Bay Survey

Contributed by Tim Crose, Pacific County Noxious Weed Control Board

A detailed survey of the status of *Spartina* eradication efforts in Willapa Bay was completed in November under a cooperative project sponsored by the Coastal Resources Alliance (a local non-profit organization), the Pacific County Noxious Weed Control Board, the University of Washington's Olympic Natural Resources Center, the Willapa National Wildlife Refuge, Pacific County and WSDA. Ed Darcher, a longtime *Spartina* crew supervisor hired by CRA and Tim Crose, Pacific County Noxious Weed Coordinator, surveyed all the tidal sloughs and visit all infested mudflats to document the *Spartina* that remained in October and early November 2008. It was understood that some of the *Spartina* that remained green had been treated and that the effects of recent treatments would not be visible.

The survey crew used two GPS-equipped cameras to take over 3,000 photos. Each photo includes embedded in it the GPS location of the camera when the photo was taken. Most of the photos also included a compass bearing. In addition, the survey crews noted their observations throughout the Bay. The photos and notes were transferred for analysis and compiled by the University of Washington Olympic Natural Resource Center. Each image was analyzed to assess the size of the *Spartina* patch. A bay wide map was then generated showing the location of each image and the size of each patch at that location. This data will be available to all agencies involved in the eradication program and to others who are interested.

Appendix 5 - Restoration of *Spartina*-Impacted Nearshore Habitat

Contributed by Dave Heimer, WDFW

The Washington State Legislature clearly recognized the environmental and economic threat that *Spartina* poses to the remaining nearshore habitat and, in response, has funded a vigorous *Spartina* eradication effort. Agencies are eliminating record amounts of *Spartina*. However, many questions remain concerning the long-term ecological recovery of previously infested areas following eradication of *Spartina* meadows.

The agencies secured modest grant funding (through the Landowner Incentive Program, National Fish and Wildlife Foundation, and Washington Wildlife and Recreation Program) to establish a set of interrelated research projects that monitor sediment dynamics, vegetation change, invertebrate change, and bird and fish use to gauge the effectiveness of different restoration methods. The long-term goal of this project is to restore previously treated *Spartina* meadows and return ecological functionality to this highly altered mudflat where dense root masses and accreted

sediment remain. Restoration activities focused on techniques for breaking up the dense root masses and monitoring the ecological response.

Vegetation Change: The obvious change in vegetation has been the dramatic decrease in the cover and abundance of *Spartina* within the intertidal zone of Washington. Native plants and some introduced species (e.g. *Cotula coronopifolia, Zostera japonica*) have reestablished in niches vacated by *Spartina*, especially in the higher intertidal zone. In Puget Sound, species richness in some controlled areas is approaching un-invaded, low salinity mudflats. Lower intertidal areas that historically did not support vegetation have been colonized due to accretion that occurred as a result of *Spartina* invasion. It is unclear whether this colonization is temporary and what the value of this vegetation is to the system. Interestingly, the distribution of *S. anglica*, in the form of seedlings, remains unchanged over a five year time period.

Bird Usage: Research conducted in Willapa Bay finds bird usage within large untreated *Spartina* meadows, regardless of species, is virtually non-existent. In Puget Sound, dunlin, a migratory shorebird, also did not utilize intact *Spartina* stands, but did use adjacent mudflat where *Spartina* had been eliminated. Control of the *Spartina* meadows has resulted in increased use by shorebirds and waterfowl. The level of bird usage appears to be related to the amount of vegetative cover on the site. For example, sites that had no standing *Spartina*, like mud flats and tilled meadows, had higher bird densities than areas with *Spartina*.

Fish Usage: In Puget Sound, fish sampling work by the Skagit River System Cooperative on a *Spartina* restoration project indicates that juvenile salmon utilized habitat within treated *Spartina* marshes. Juvenile chum and Chinook salmon were captured in both reference (flooded mudflat, blind tidal channels within native marshes) and treated *Spartina* marsh (flooded and blind channel) habitats. However, comparison of fish density results suggests that juvenile salmon may prefer reference habitats associated with native marsh. In addition, the sampling showed that other fish species utilize habitat within treated *Spartina* marshes including these dominant nearshore species: surf smelt, shiner perch, and staghorn sculpin.

Invertebrate Change: For invertebrates in Puget Sound, data collected in this study suggest that invasion by *S. anglica* produces long-lasting effects on invertebrate communities, even after the plants have been removed. The above-ground portions of *Spartina* reduce water flow, increasing sedimentation; the compact below-ground root matrix consolidates the sediments and may inhibit habitat use by burrowing invertebrates.

Control efforts remove the *Spartina*, but the results indicate that recovery to pre-invasion conditions occurs slowly. For instance, there was no significant difference between the invertebrate communities in disked and undisked (a form of mechanical tilling) *S. alterniflora* meadows 2-3 months after treatment. Removing the above-ground plants does not eliminate the root mass; organic content of sediments remains high even in areas from which *S. anglica* has been removed for two to three years. The invertebrate community in control mudflats (i.e. pristine mudflats) is distinctly different from that in the *S. anglica*-impacted areas. Removal of the *Spartina* has not yet restored the community to that seen in the mudflats, but there are indications that progress is being made. Sites that have received mechanical treatment, but still hold some *S. anglica* continue to resemble the *S. anglica*-covered areas. Where the *Spartina* has been removed for several years (i.e., in the near-eradication area), the communities are becoming similar to the

mudflat samples and moving away from the *S. anglica*-covered areas. This suggests that, in general, removal of the *Spartina* is allowing the community to move back toward the natural mudflat condition.

It is clear that infestation of intertidal mudflats by *S. anglica* strongly affects invertebrates on and below the surface. Eradicating *Spartina* allows the habitat to begin moving back to the natural condition, but the process is slow, probably due to persistent plant material in the sediments. Further study will be necessary to see if the system converges on the mudflat condition or settles into some alternate state.

These examples of restoration and monitoring demonstrate how agencies are beginning to transition to the next phase in the *Spartina* effort.

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