Spartina Eradication Program 2009 Progress Report

Washington State Department of Agriculture

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Photos provided by Dave Heimer, Les Holcomb (WDFW), Jonathan Still and Tanner Ketel (WSDA).

Cover Photo: **One of the largest newly discovered infestations treated during the 2009 season, located at Baker Bay on the Columbia River near Ilwaco, Washington.**

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PROGRESS OF THE 2009 *SPARTINA* ERADICATION PROGRAM

March 2010

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
NAP	Natural Area Preserve
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

The Washington State Department of Agriculture (WSDA) has served as the lead state agency for the eradication of invasive *Spartina* since 1995. WSDA facilitates the cooperation - of local, state, federal, and tribal governments; universities; interested groups; and private landowners - that is responsible for the tremendous success of the program. From a statewide high of 9,000 solid acres infested in 2003, the program has reduced *Spartina* to fewer than 40 solid acres projected in 2010. This is an unprecedented statewide reduction of more than 99%. These final, solid 40 acres are a collection of individual plants and small clumps spread along thousands of miles of shoreline in the Puget Sound, Willapa Bay and Grays Harbor.

Spartina, commonly known as cordgrass, is an aggressive noxious weed that has severely disrupted the ecosystems of native saltwater estuaries in Washington State. Left unchecked, *Spartina* out competes native vegetation and converts mudflats and estuaries into monotypic *Spartina* meadows. As a result, important migratory shorebird and waterfowl habitat are lost, the threat of flooding is increased, and the state's shellfish industry is severely impacted.

WSDA remains confident that with continued funding the goal of eradication can be reached. The 2009 *Spartina* survey and eradication season proved to be successful with better than expected results. During 2009 project partners surveyed more than 80,000 acres of saltwater estuaries and more than a thousand miles of shoreline for evidence of *Spartina*. Figure 1 is a projection of *Spartina* reduction within Washington State over the next three years assuming sustained funding.

This eradication program is an unprecedented success story; however, the last few acres of *Spartina* will by far be the most difficult to find and eradicate.

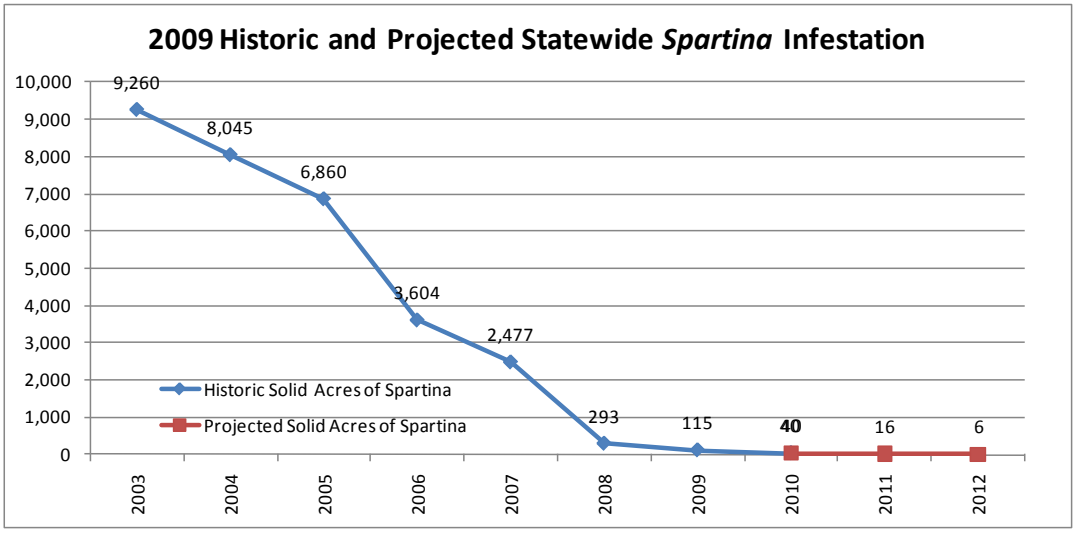

Figure 1: Solid acres of *Spartina* by year statewide based on WSDA estimates. The blue line represents historic *Spartina* infestation since 2003. The red line indicates the projected *Spartina* infestation level through 2012.

Willapa Bay

The 2009 Willapa Bay treatment program was successful. All known infestations were treated and a significant reduction was achieved. Monitoring of the program's 2009 Willapa Bay effort indicated that fewer than 85 solid acres of *Spartina* remained. This was a 66% reduction from approximately 250 solid acres in Willapa Bay during the 2008 season. In 2009, the program completed the evolution from large-scale treatments of meadows to treatments of scattered infestations. WSDA estimates fewer than 25 solid acres of *Spartina* will be present in Willapa Bay during the 2010 treatment season.

Grays Harbor

2009 was a successful year for *Spartina* survey and eradication in Grays Harbor. WSDA, Washington Department of Fish and Wildlife (WDFW) and the United States Fish and Wildlife Service (USFWS) continued to work together to treat all known infestations. The vulnerable habitat of Grays Harbor was surveyed two times during the 2009 season, with a total of 0.54 solid acres of *Spartina* found and treated. Of the 0.54 acres treated in Grays Harbor, 0.26 solid acres were *S. alterniflora* and 0.28 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 0.35 solid acres of *Spartina* will remain in Grays Harbor during the 2010 treatment season.

Puget Sound

In 2009, less than 29 solid acres of *Spartina* were found and treated in Puget Sound, the Strait of Juan de Fuca, and Hood Canal. This is a 33% reduction from the 43 solid acres present in 2008. In an increased effort, WSDA crews surveyed over 400 miles of shoreline in Puget Sound, Hood Canal and the San Juan Islands that had not been previously surveyed. WSDA estimates that fewer than 15 solid acres of *Spartina* will remain in Puget Sound in 2010. Increased effort and cooperation between partner groups made this reduction possible. Further cooperation between partners and emphasis on eradication, survey, and outreach will ensure the continued success of the Puget Sound *Spartina* program.

2009 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 controlled, the effort has evolved 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 and transportation costs. As a result, to meet the program's goal of eradicating *Spartina*, continued funding is imperative during the coming years.

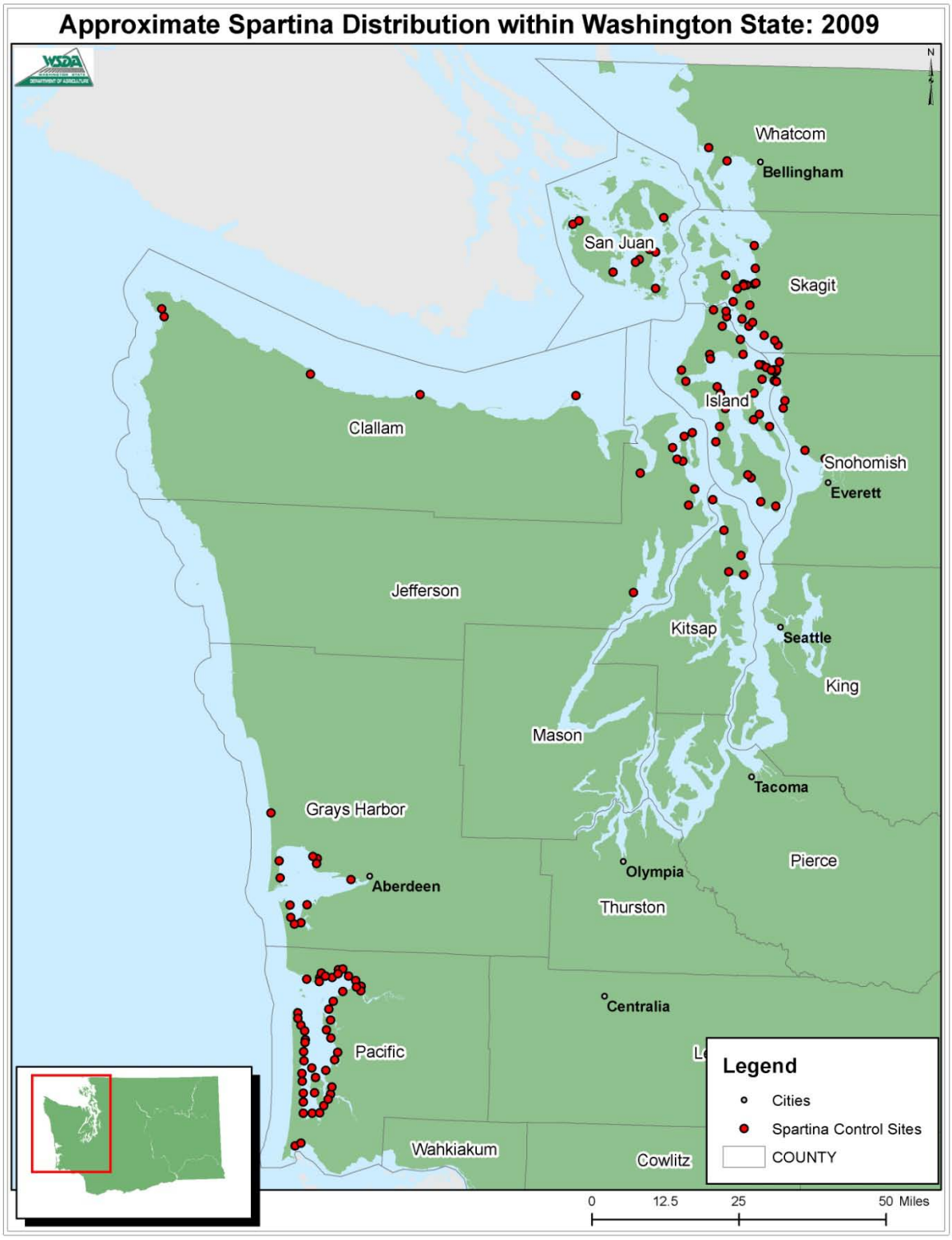

Figure 2: Distribution of *Spartina* in Washington State 2009.

Spartina Eradication Program

WSDA *Spartina* Program

In 2009, 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), Washington Department of Ecology (DOE) and the U.S. Fish and Wildlife Service (USFWS) in Puget Sound and Grays Harbor; 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 state's 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 2009, WSDA continued to allocate funding for resources and *Spartina* work crews in counties with the majority of the infestations. In Willapa Bay, $175,000 was designated for Pacific County to continue the transition toward greater county involvement, and herbicide was provided to the cooperators. In the Puget Sound, WSDA provided resources totaling $162,500 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. WSDA continued working with WDFW, DNR, WSU and USFWS to explore the potential for restoration of once-infested tidelands to functioning shorebird and waterfowl habitat.

During 2009 WSDA participated in ongoing efforts related to the West Coast Governors' Agreement on Ocean Health. In this agreement the Governors of Washington, California, and Oregon committed to eradicate all non-native *Spartina* on the western U.S. coast by 2018. As part of this agreement an Action Coordination Team shares knowledge and developments with representatives from the three states, federal government, tribal governments, non-governmental organizations, and the Province of British Columbia. This continued high level intergovernmental cooperation will aid ongoing eradication programs and enhance future efforts.

Budget

WSDA allotted $2.31 million of the appropriation from the Aquatic Lands Enhancement Account (ALEA) for statewide *Spartina* activities during the 2009-2011 biennium. Table 1 describes where WSDA allocated funds to conduct *Spartina* eradication activities throughout Western Washington.

Table 1: WSDA *Spartina* Budget Activity by Area – FY10 and FY11

Activity	Puget Sound/ Olympic Peninsula		Willapa Bay		Grays Harbor		Total
	FY10	*FY11*	*FY10*	*FY11*	*FY10*	*FY11*	*FY10&11*
[1]**WSDA Eradication & Coordination Activities**	$290,000	$290,000	$270,000	$270,000	$125,000	$125,000	$1,370,000
[1]**Purchased Services**							
Pacific Co.			$175,000	$175,000			$350,000
Skagit Co.	$30,000	$30,000					$60,000
Island Co.	$50,000	$50,000					$100,000
Snohomish Co.	$50,000	$50,000					$100,000
Swinomish Tribe	$7,500	$7,500					$15,000
WDFW	$25,000	$25,000	$70,000	$70,000		$125,000	$315,000
Total	**$452,500**	**$452,500**	**$515,000**	**$515,000**	**$125,000**	**$250,000**	
Biennial Total		**$905,000**		**$1,030,000**		**$375,000**	**$2,310,000**

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. Purchased Services: WSDA interagency agreements and intergovernmental agreements to accomplish *Spartina* eradication goals.

Other agencies received additional funding for *Spartina* activities during the 2009-2011 biennium. This funding was provided from ALEA, federal agreements, grants and other sources. Table 2 describes where these funds were allocated.

Table 2: Other Agencies *Spartina* Budget Activity by Area – FY10 and FY11

Agency	Puget Sound/ Olympic Peninsula		Willapa Bay		Grays Harbor		Total
	FY10	*FY11*	*FY10*	*FY11*	*FY10*	*FY11*	*FY10&11*
[1]**WDFW**	$111,000	$111,000	$180,000	$155,000			$557,000
[2]**DNR**			$323,000	$305,000			$628,000
[3]**USFWS**			$250,000	$250,000	$247,000	$275,000	$1,022,000
TOTAL	**$111,000**	**$111,000**	**$753,000**	**$710,000**	**$247,000**	**$275,000**	
Biennial Total		**$222,000**		**$1,463,000**		[1]**$522,000**	**$2,207,000**

Notes for Table 2:

1. WDFW Willapa Bay FY10 includes $28,000 in restoration grant funding.
2. DNR Willapa Bay FY10 includes approximately $18,000 in restoration grant funding.
3. USFWS funds in Willapa are expended by the Willapa National Wildlife Refuge for eradication efforts on Refuge lands. USFWS funds in Grays Harbor are contracted to WSDA and WDFW to support eradication efforts throughout the 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, and all intertidal areas on the Washington side of the Columbia River.

Extent of the Infestation in Willapa Bay

All infestations within Willapa Bay were treated during the 2009 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 2009 season, approximately 81 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.

WSDA estimates fewer than 85 solid acres of *Spartina* were present in Willapa Bay over the course of the 2009 treatment season. This estimate is derived from treatment acreages reported by the cooperators (81acres) and includes an additional 5% to compensate for late season emergence, survey or application misses and other contributing factors.

Table 3: Summary of 2009 Willapa Bay *Spartina* Eradication Effort

Site	*Estimated Solid Acreage Treated*	*Approximate Affected Acres Treated*	*Entity Conducting Treatment*
North Willapa Area			
North Cove / Toke Point	5.55	700	WDFW - ST - PC
Toke Point / Cedar River	1.93	1,000	WDFW
Cedar River / Smith Creek	1.26	1,000	WDFW
Smith Creek / Willapa Meadow	10.41	2,000	WDFW
Mailboat Slough	3.52	400	PC
South Bend / Raymond	.575	500	PC
S. Willapa River / Rose Ranch	.215	770	DNR
Rose Ranch / Stony Point	.185	630	DNR
Ellan Sands	.4	1,000	PC
Bone River NAP / South Stony Point	.305	940	DNR
Wilson Point	.185	286	DNR
Niawiakum NAP	.89	1065	DNR
Bay Center / Palix / Nemah Beach	3.3875	2,250	DNR - PC
South Willapa Area			
North Nemah / South Nemah / Seal Slough	3.37	2,000	PC
Naselle	2.725	2,235	DNR - TNC
Willapa National Wildlife Refuge	31.685	6,150	USFWS - PC
Long Beach Peninsula	14.6125	2,500	DNR - WSDA - PC
Mouth of Columbia River / Baker Bay	.02	4	WSDA - DNR
Total	**81.225**	**25,430**	

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, PC = Pacific County

Roles of Willapa Bay Cooperators in 2009

- **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, Pacific County and private property owners to ensure proper treatment of all sites. Conducted eradication activities on the Long Beach Peninsula and Columbia River in cooperation with Pacific County and DNR. Administered the Landowner Incentive Program grant for eradication activities in Tokeland. Coordinated private property owner consent process in the Tokeland area in cooperation with WDFW.

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

- **WDFW** – Conducted eradication activities from Toke Point to the Willapa River Meadow. Conducted treatments between North Cove and Toke Point in cooperation with Pacific County and Shoalwater Tribe. Expanded restoration and monitoring activities in cooperation with DNR, Western Washington University and WSU.

- **USFWS** – Conducted eradication activities on Long Island and from the Stanley Point area south to the northern boundary of the Tarlatt Slough treatment area.

- **Pacific County –** Conducted eradication activities on the Long Beach Peninsula in cooperation with DNR and WSDA. Treated Ellan Sands, North Nemah, South Nemah and Seal Slough. Conducted treatments between North Cove and Toke Point in cooperation with WDFW and Shoalwater Tribe. Pacific County also cooperatively treated the Palix River and Bay Center areas with DNR. Provided staff time to conduct Class A 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 2009 activities. Conducted eradication activities on tribal-owned lands between North Cove and Toke Point in cooperation with Pacific County and WDFW.

- **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 of control tools**.** Continued research on impacts of *Spartina* to shorebirds and waterfowl.

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

Highlights of the 2009 Season in Willapa Bay

In 2009, the cooperative *Spartina* eradication effort resulted in treatment of plants totaling approximately 81 solid acres, throughout the 25,500 affected acres of Willapa Bay.

During the winter and spring of 2009, WSDA worked cooperatively with WDFW, DNR, USFWS, Shoalwater Tribe, TNC, WSU, UW and the Willapa Bay/Grays Harbor Oyster Growers Association to develop a 2009 work plan focusing on detailed re-treatment of the previous years' treatment sites.

Over the past seven 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 85 solid acres in 2009. This is an overall reduction of 99% achieved in six treatment seasons. If the 2009 treatment season meets expectations and achieves an overall efficacy of 70% or greater, then fewer than 25 solid acres of *Spartina* are expected in Willapa Bay during the 2010 treatment season.

A significant development has been the increased role of Pacific County in the day to day field operations. Starting in 2009, the USFWS no longer conducted *Spartina* control activities except on Refuge lands. The cooperators secured funding that allowed Pacific County to expand their *Spartina* program to treat much of the lands previously treated by USFWS. This expanded role in the program proved to be quite valuable. It has encouraged further sharing of resources, crews and knowledge of the Bay.

Surveys conducted in the Columbia River estuary during the 2009 season revealed the first known infestation of *Spartina alterniflora* on the Washington side of the river. Treatments to this new infestation located in Baker Bay near Ilwaco occurred in late October. Figure 3 depicts the Columbia River Survey and Treatment area. See appendix 4 for a detailed report.

Cooperation between the various agencies and entities involved has continued during the 2009 season. WSDA, Pacific County and DNR combined efforts to ensure thorough treatment of the Long Beach Peninsula and Columbia River. Pacific County and DNR worked together to treat the Bay Center and Palix River areas. Also, WDFW, Pacific County and the Shoalwater Tribe combined efforts and resources to ensure thorough treatment of the entire North Willapa Bay area. The 2010 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 2010 and that eradication remains an attainable goal in Willapa Bay.

Figures 4 and 5 are maps of North Willapa Bay and South Willapa Bay respectively, including treatment area names.

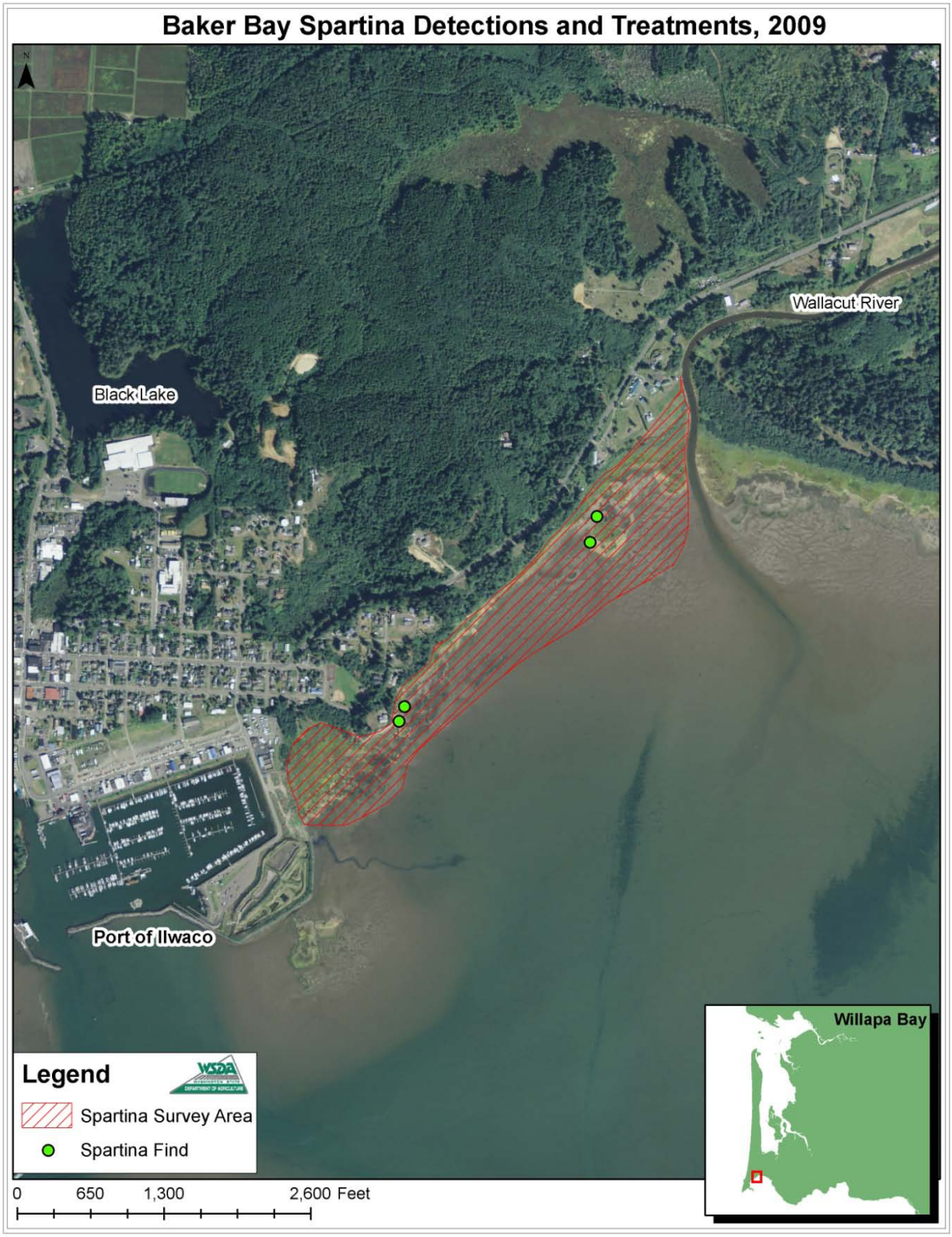

Figure 3: Columbia River survey and treatment areas in Baker Bay

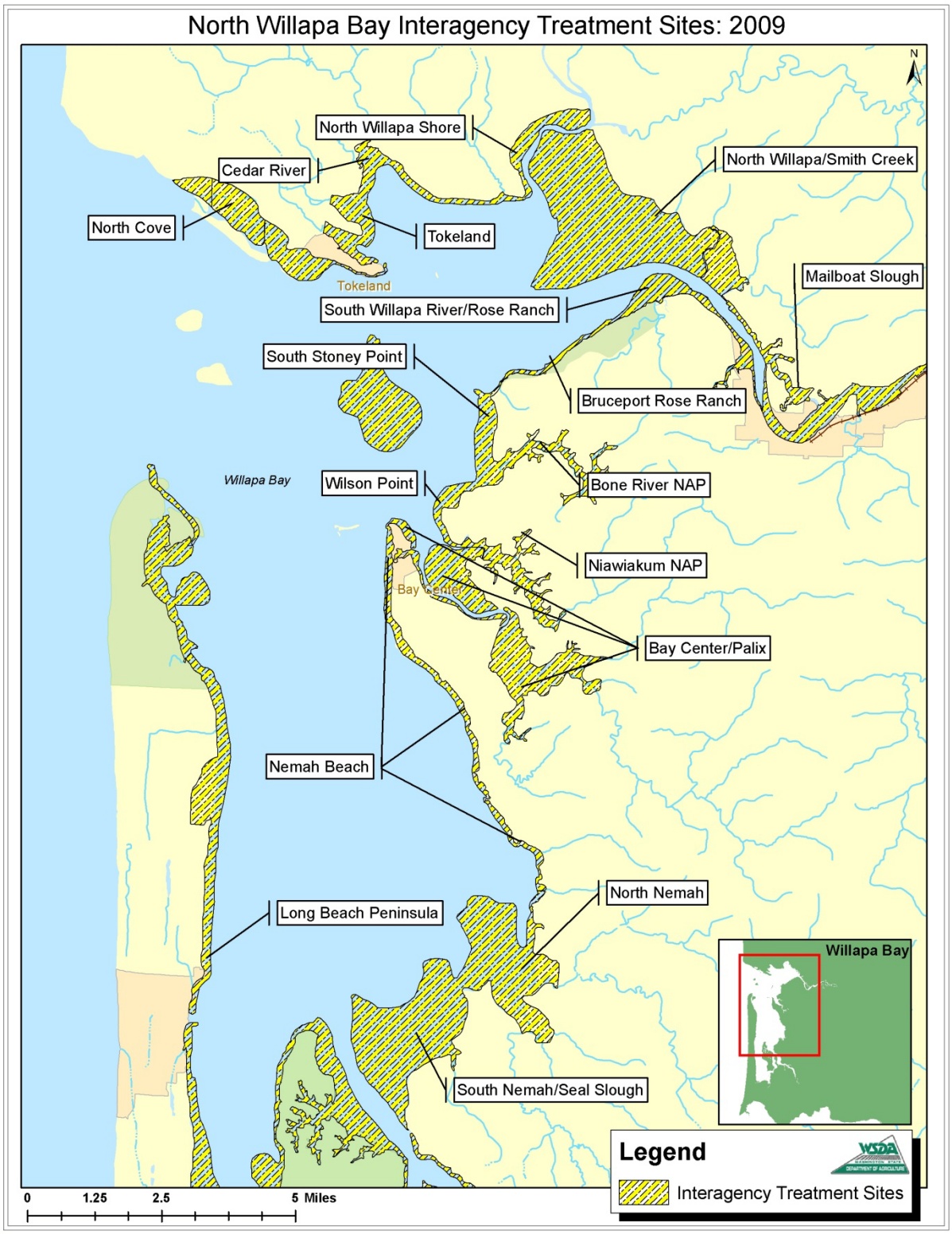

Figure 4: 2009 north Willapa Bay interagency *Spartina* treatment sites.

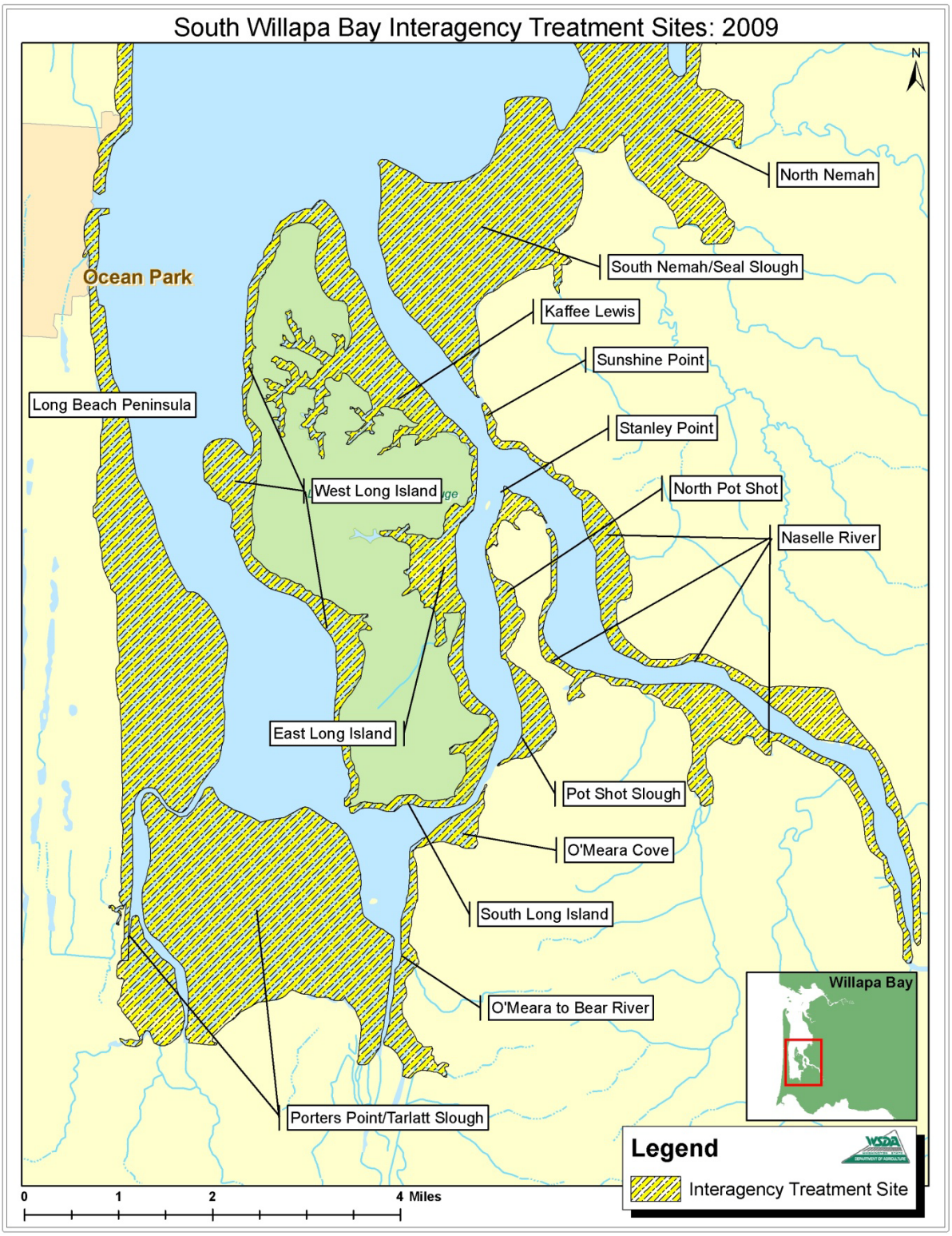

Figure 5: 2009 south Willapa Bay interagency *Spartina* treatment sites.

Recommendations for the Future

With the successes of the past seven years and the massive reductions of *Spartina* in Willapa Bay, continued support and funding are more important than ever. In 2009, the Willapa Bay *Spartina* Eradication Program completed an 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 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 over the next three years will not differ significantly from the cost of conducting the recent large-scale applications.

WSDA estimates fewer than 25 solid acres of *Spartina* will be present in Willapa Bay during the 2010 treatment season. With the successful eradication of over 8,000 solid acres of *Spartina* in Willapa Bay over the past seven years, it is critical that program continuity is maintained. Figure 6 is a projection of *Spartina* reduction within Willapa Bay over the next three years with sustained funding.

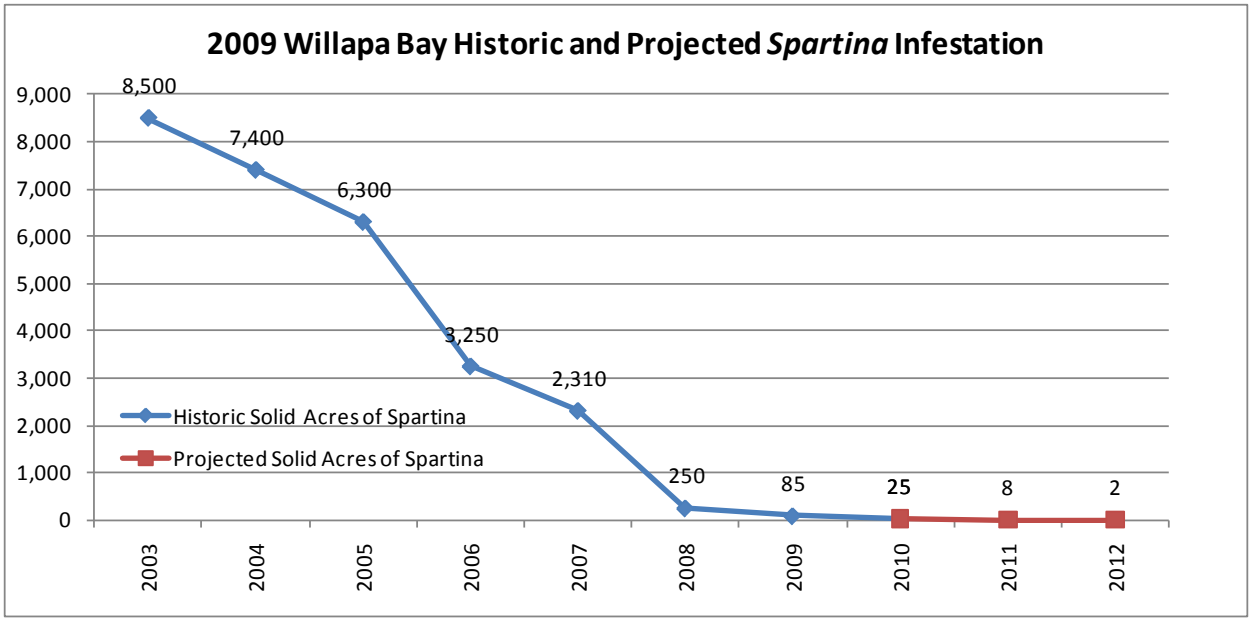

Figure 6: Solid Acres of *Spartina* in Willapa Bay by year, based on WSDA estimates. The blue line represents the historic area of *Spartina* since 2003. The red line represents the projected *Spartina* area through 2012. Projection assumes sustained funding.

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 (Figure 7).

Two species of *Spartina* infest Grays Harbor. The most prevalent species in Grays Harbor during the 2009 season was *Spartina densiflora*, a South American cordgrass species that tends to grow higher in intertidal zones and blends in well with native grasses. *S. densiflora* totaled roughly 51% of the infestation. *S. alterniflora*, though more widespread in terms of affected acreage than *S. densiflora*, totaled 49% of the infestation.

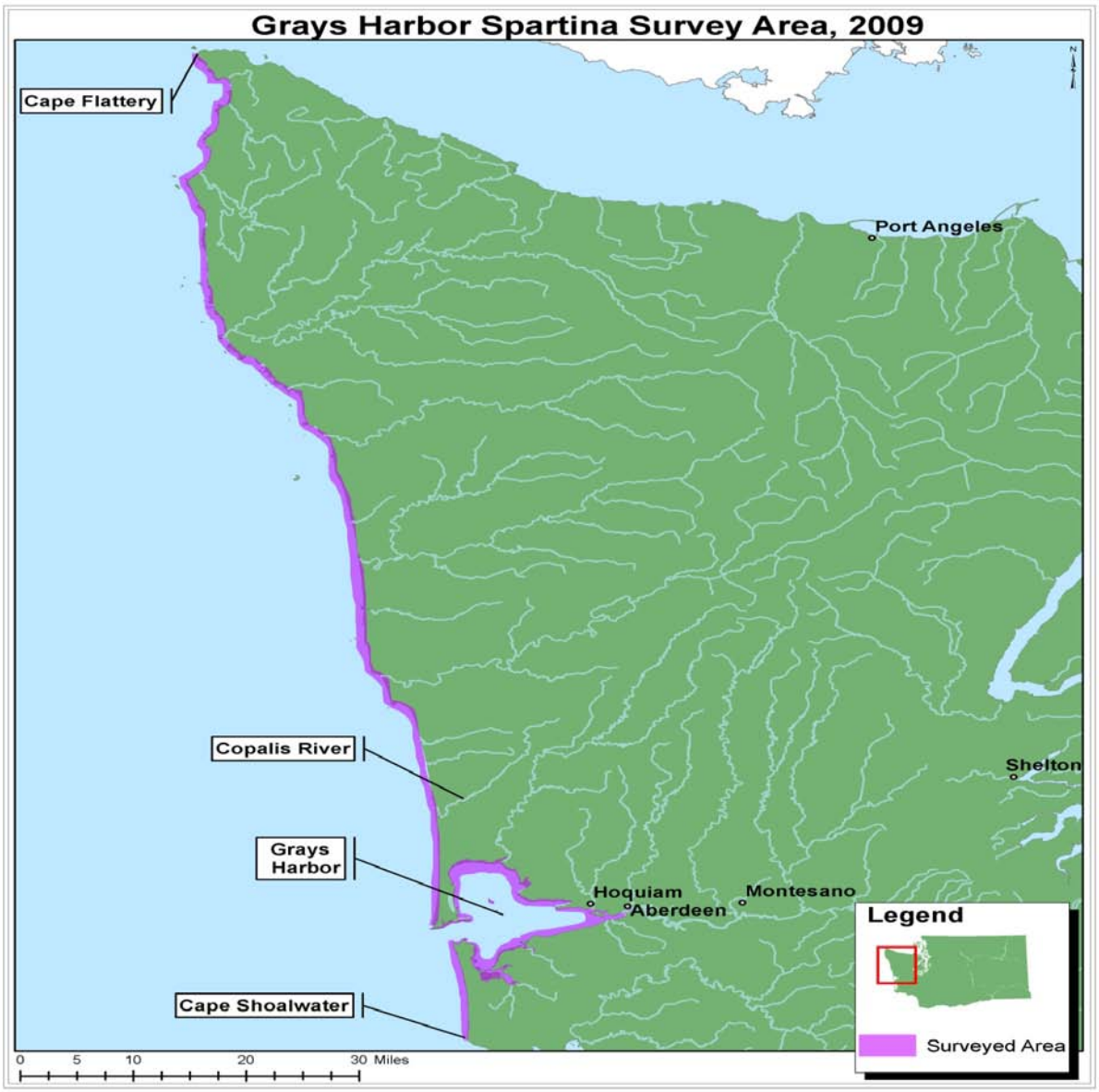

Figure 7. Grays Harbor *Spartina* project area.

Historical Overview of the Grays Harbor Infestation

Survey and control work started in Grays Harbor in 1995. However, due to the overwhelming size of *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 the project partners to conclude that a more aggressive effort was 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. Approximately 25,000 acres of intertidal lands in Grays Harbor and its tributaries with the potential for *Spartina* infestations were surveyed. Additionally, a coastal aerial survey revealed 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. The 2007 season yielded a total of 2.51 solid acres of *Spartina* treated in Grays Harbor and the Copalis River drainage.

While conducting three whole harbor surveys in 2008, Grays Harbor crews found and 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*. A positive sign in 2008 was that half-gallon low-pressure sprayers were adequate to treat the reduced numbers of plants in Grays Harbor.

2009 Survey and Treatment Season in Grays Harbor

With the opportunity furnished by continued federal funding from the USFWS Nisqually National Wildlife Complex, the cooperators developed three major goals for the 2009 treatment season:

1) Achieve at least two comprehensive rounds of survey and treatment throughout Grays Harbor, treating all known infestations with emphasis on high salt marsh area surveys.
2) Survey coastal sites that may harbor undetected *Spartina* infestations.
3) Incorporate *S. densiflora* transect methods in the Bills Spit area. Transect methodology is a systematic survey technique to maximize detection of a target species. (Description and analysis of the results is discussed in appendix 3 of this report).

Grays Harbor surveys continued during the 2009 season where either *S. densiflora* or *S. alterniflora* was found within approximately 3,900 affected acres. *S. alterniflora* was the most widespread and occurred in 3,180 affected acres while *S. densiflora* occurred in 720 affected acres (Figure 8). Notably, *S. densiflora* continues to spread throughout North Bay as evidenced by comparisons between 2008 and 2009 affected acreages and infestation points (Figure 9).

Figure 8: Affected acreage of *S. alterniflora* (yellow) and *S. densiflora* (red) in Grays Harbor, 2009.

Figure 9. Comparison of *S. densiflora* affected areas and infestation points, 2008-2009.

Staff from WSDA and WDFW continued to work in joint crews throughout the June 1 to October 31 treatment season, achieving two whole harbor survey laps and *densiflora* transect laps treating an estimated 0.26 solid acres of *alterniflora* and 0.28 acres of *densiflora*, respectively, for a total of 0.54 solid acres of *Spartina*. The negligible difference between solid acres of *alterniflora* treated from 2008 (0.28)to 2009 (0.26) can be attributed to the finding of large clones in the Grass Creek area, the mouth of Campbell Slough, Johns River, Copalis River and the "Sink" area, located between Ocean Shores Marina and Point Brown.

Along with two survey and treatment laps in the main Grays Harbor water body and surrounding tributaries and two *densiflora* transect laps performed in Bills Spit, the Grays Harbor crew also surveyed 38 miles of the outer coastline. This survey was conducted by foot and all-terrain vehicles, extending from Cape Shoalwater to Westport and continuing north from southwest Ocean Shores to the Moclips River. The coastal surveys yielded no new *Spartina* infestations.

Preliminary *S. densiflora* surveys conducted in April and May of 2009 in the Bills Spit area of North Bay indicated a need for a thorough comprehensive treatment plan, as large quantities of *densiflora* were identified. Therefore, in May, the cooperators discussed the application of transect methods in the heavily infested area of Bills Spit. In consequence, two rounds of transect survey and treatments were completed in the approximate 4 acre area treating an estimated 0.19 solid acres. The transect methods are discussed/analyzed in appendix 3 of this report.

S. densiflora located outside of the transect area inhabited areas from Damen Point, extending north beyond the transect area to the Ocean Shores airport, and to the upper North Bay area near Campbell Slough (Figure 9). Crews treated 0.09 solid acres of *S. densiflora* located outside of the transect area during the two rounds of survey and treatment.

Table 4 identifies the areas in which either *S. alterniflora* or *S. densiflora* occurs and compares the percentage reduction/increase in solid acres treated from 2008-2009. The data clearly shows that *S. densiflora* is increasing in solid acreage. It is important to note that this increase is partially attributed to the systematic approach of the transect methods applied in the Bills Spit area. The increase may also be attributed to meticulous survey efforts in North Bay.

Table 4. Sites and areas (acres) of *Spartina* treated in 2008 and 2009 with corresponding percent reduction/increase between the two years.

Site	*Acres Treated in 2008*	*Acres Treated in 2009*	*Percent Reduction/Increase +/-*	*Spartina Species*
Bills Spit	0.14016	0.20	+43%	*S. densiflora*
Bottle Beach	0.01125	0.016	+42%	*S. alterniflora*
Bowerman Basin	0.01375	0.0052	-38%	*S. alterniflora*
Chenois Creek	0.00	0.005	+100%	*S. alterniflora*
Copalis River	0.00563	0.034	+250%	*S. alterniflora*
Damen Point	0.00313	0.003	0	*S.alterniflora/densiflora*
Elk River	0.08969	0.0845	-1%	*S. alterniflora*
Grass Creek	0.10063	0.037	-72%	*S. alterniflora*
HumptulipsRiver	0.00	0.00	0	*S. alterniflora*
Johns River	0.025	0.03	-39%	*S. alterniflora*
North Bay	0.0125	0.009	-39%	*S.alterniflora/densiflora*
Ocean Shores	0.025	0.09	+190%	*S. densiflora*
Point Brown	0.005	0.03	+250%	*S. alterniflora*
Rennie Island	0.00	0.00	0	*S. alterniflora*
Westport (Fire Cr. Pt.)	0.01375	0.005	-36%	*S. alterniflora*
Total Acres Treated	**0.44546**	**0.5447**	**+23%**	

Recommendations for the Future

The 2009 survey and treatment season in Grays Harbor was successful. Continued cooperation between partner agencies provided the resources needed to achieve detailed surveys and treatments during the 2009 season. Once again, two whole harbor survey and *densiflora* transect laps were completed with all known *Spartina* infestations treated.

After the success of the 2009 season, WSDA expects that less than 0.35 solid acres of *Spartina* will be present in Grays Harbor during the 2010 treatment season (Figure 10). Moreover, since 2005, Grays Harbor has enjoyed a 94.6% overall reduction in *Spartina*. Continued funding is paramount in our efforts to achieve eradication.

Specific recommendations for the 2010 Grays Harbor survey and treatment season include:

1) Conduct a minimum of two comprehensive rounds of survey and treatment throughout Grays Harbor with emphasis in high salt marsh areas.
2) Hire Grays Harbor crews in early spring to conduct transect surveys and flag *S. densiflora* located outside the Bills Spit transect area before the competing vegetation becomes too high. Continue to conduct *densiflora* transects during the treatment season window.
3) Continue to perform coastal surveys and extend the Grays Harbor survey well inland of the salt marsh to insure that no outlying infestations are missed.

Figure 10 is a projection of *Spartina* reduction within Grays Harbor over the next three years with sustained funding.

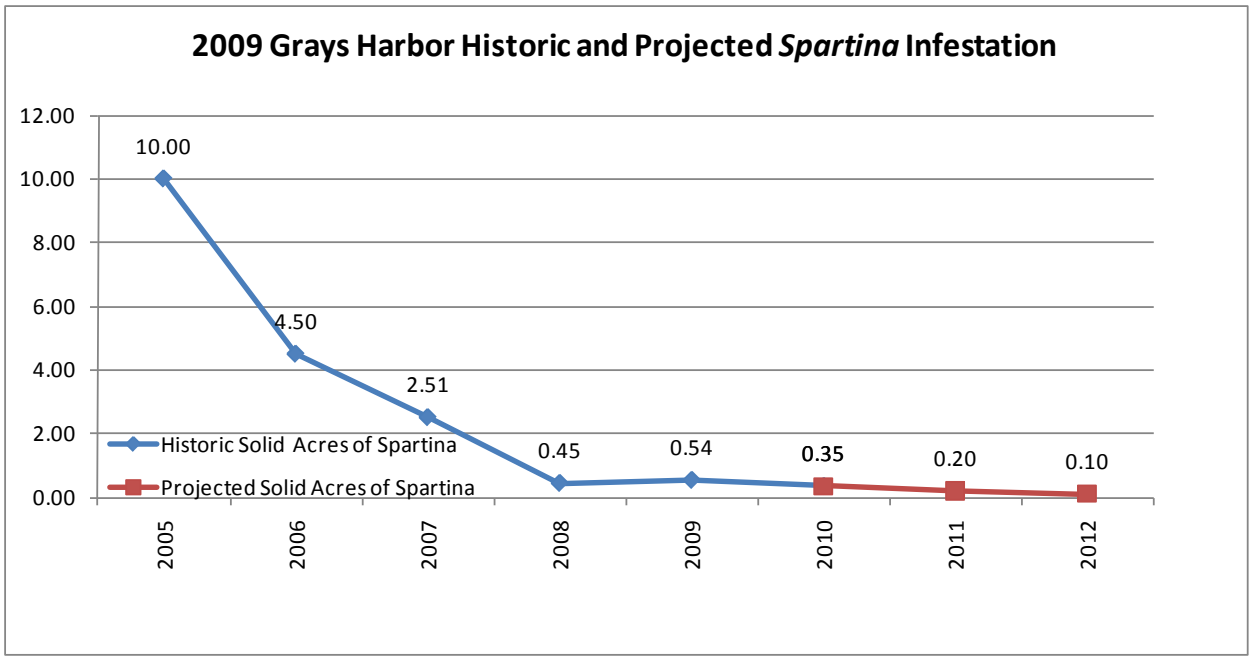

Figure 10: Area (Acres) of *Spartina* in Grays Harbor based on WSDA estimates. The blue line represents the historic area of *Spartina* and the red line represents the projected area of *Spartina*. Projected area assumes sustained funding. All areas are in solid acres.

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 Cape Flattery, north to Whatcom County and south to south Puget Sound. This region includes all waters in the Puget Sound basin. There are more than 2,400 miles of shoreline in these waters. Along the Puget Sounds 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 to a peak of more than 1000 acres by 1997. *S. alterniflora* and *S. patens* are limited in distribution and extent; combined, these two species account for less than 0.1 solid acres throughout Puget Sound. *S. densiflora* has not been located for the last two years. Figure 11 shows the geographic area and distribution of *Spartina* in the Puget Sound region.

The 2009 control season was successful; favorable weather and efficient cooperation between partner groups facilitated high levels of control. Below are some highlights of the 2009 treatment season. Following these brief highlights are more detailed reports on a regional basis.

- 29 solid acres of *Spartina* were located and treated during the 2009 season; a 33% reduction from the amount of *Spartina* present in 2008.
- The Puget Sound program has achieved a 97% reduction in *Spartina* from the peak infestation of more than 1,000 solid acres in 1997.
- WSDA increased the survey effort in Puget Sound, Hood Canal, and San Juan Islands, exploring 409 new shoreline miles and detecting previously unknown infestations. (See appendix 2)

Table 5: Estimated solid acres of *Spartina* in 2009 by county as reported by WSDA and records from *Spartina* cooperators.

County	***Estimated Solid Acres of Spartina***
Island	10.56
Snohomish	13.49
Skagit	4.61
Clallam	0.02
San Juan	0.035
Kitsap	0.055
Jefferson	0.02
Whatcom	0.00
King	0.00
Total	**28.79**

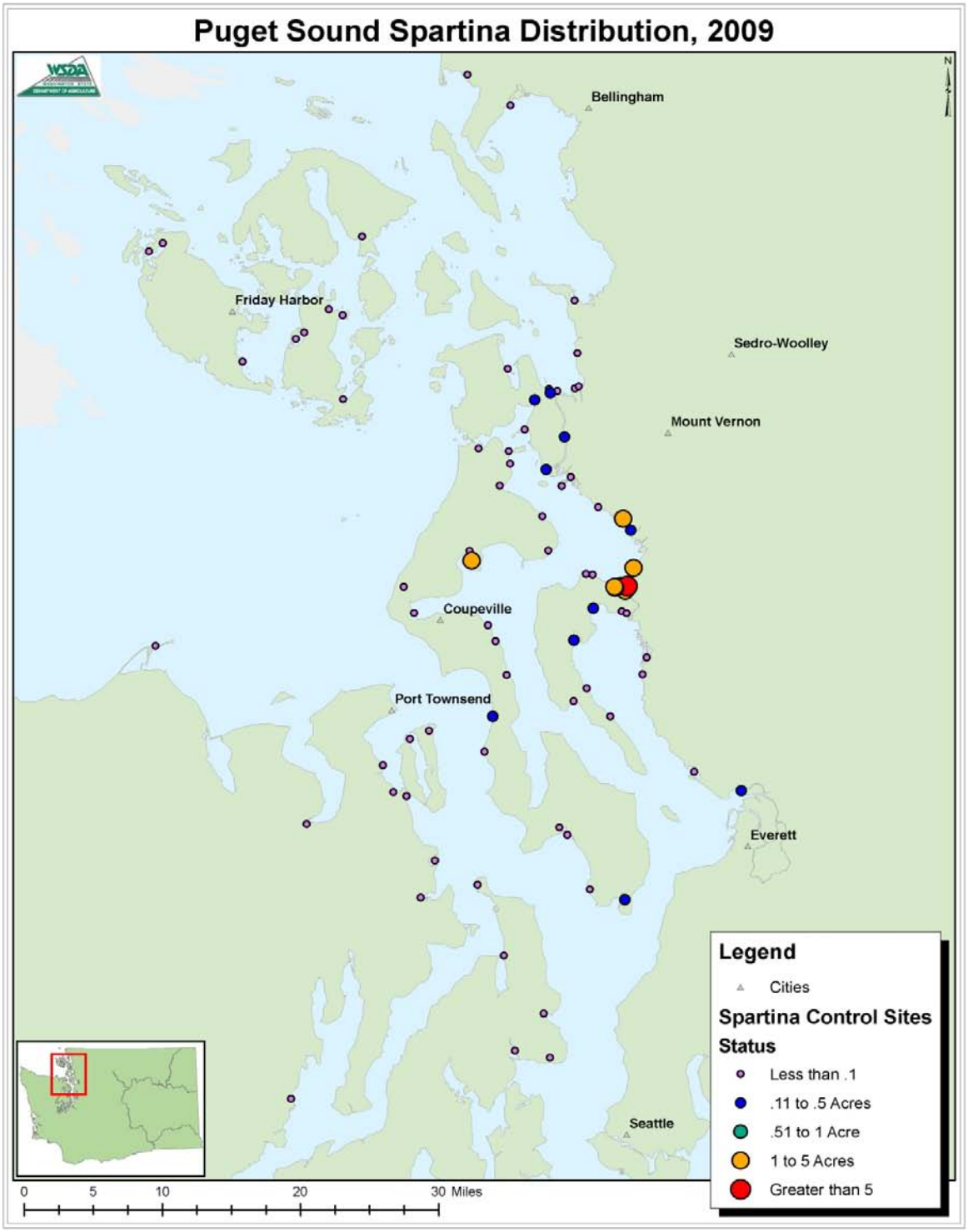

Figure 11: Extent and distribution of *Spartina* control sites in Puget Sound. For clarity on the map, some of the smaller infestations have been combined. The largest infestations remain near the original introduction site of *S. anglica* in Snohomish County

Island County

In 2009, Island County had the second largest infestation of *Spartina* in Puget Sound. The Island County Noxious Weed Control Board and Washington State Department of Fish and Wildlife conducted the *Spartina* eradication work in Island County. A total of approximately 10.56 solid acres of *Spartina* were found and treated in Island County this season. This is a 31% reduction from 2008. Washington State Department of Agriculture provided Island County $50,000 for *Spartina* eradication activities in 2009.

Table 6: Depicts the past and present solid acres of *Spartina* treated as well as percent reductions in Island County

Year	*Spartina* Treated (solid acres)	% Reduction from previous year
2002	300	
2003	325	-8% (net increase)
2004	164	49%
2005	134	18%
2006	99	26%
2007	97	2%
2008	15.4	84%
2009	10.6	31%
	% Reduction from Peak Acreage	97%

Washington State Department of Fish and Wildlife treated a total of 8.22 solid acres in Island County in 2009. Almost all of this acreage was located from Davis Slough heading northwest to English Boom on Camano Island. Only 0.35 solid acres were treated at Hancock Lake in 2009 which is a large reduction from the 1.65 solid acres in 2008. The biggest reduction in Island County came from Triangle Cove. In 2008, 6.55 solid acres of *Spartina* were treated and only 0.42 acres in 2009; a 94% reduction. See figure 12.

Island County Noxious Weed Control Board and its contractor Wildlands Management controlled most of the major *Spartina* infestations and seed sources on Whidbey Island in 2009. 2.34 solid acres of *Spartina* were treated by Wildlands Management throughout Island County in 2009. Due to some logistical difficulties the south end of Whidbey Island did not receive treatment in 2009 and will be a high priority for the 2010 season.

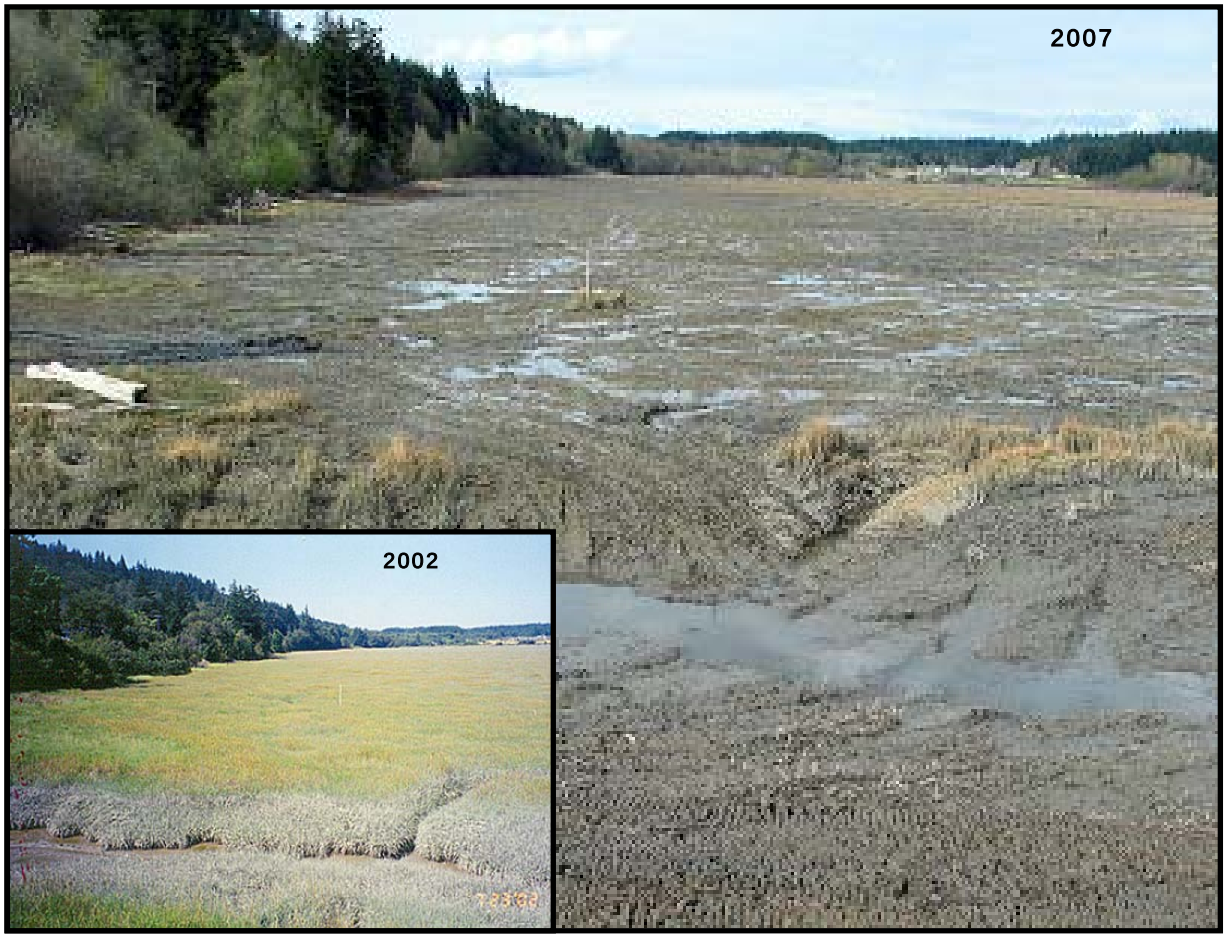

Figure 12: Illustrates Triangle Cove in Island County before and after large scale treatments

Snohomish County

The largest *Spartina* infestation in Puget Sound remains in Snohomish County. The Snohomish County Noxious Weed Control Board, Washington State Department of Fish and Wildlife, The Nature Conservancy and the Tulalip Tribal Nation worked diligently to find and treat 13.49 solid acres of *Spartina* in 2009. This is a 33% reduction from the 20.35 solid acres present in 2008. Washington State Department of Agriculture provided Snohomish County $50,000 for *Spartina* eradication activities in 2009.

The Snohomish County Noxious Weed Control Board (SCNWCB) treated 3.5 solid acres of *Spartina*. Their main focus was in Southeast Skagit Bay where 2.3 solid acres were treated. The SCNWCB Coordinator and crew also performed some late season seed clippings in this area over a 43 acre transect. SCNWCB also treated Warm Beach, Johnson's Dike, and the Davis Slough system.

Washington State Department of Fish and Wildlife (WDFW) focused their efforts on WDFW owned and managed lands in Snohomish County. WDFW treated approximately 7.3 solid acres in Southeast Skagit Bay in 2009. 0.5 of these acres treated were located in south Skagit County.

3.05 solid acres were treated on North Leque Island as well. WDFW also treated 0.1 solid acres of *S. anglica* at Big Flats located on Tulalip Tribal property in 2009.

Between WDFW and SCNWCB, 9.6 solid acres of *S. anglica* were treated in Southeast Skagit Bay in 2009. That is a 21% reduction from the 12.19 solid acres treated in 2008. Although this reduction seems relatively low, considering the difficult work environment SE Skagit Bay presents, a 21% reduction is a great accomplishment.

In 2009, The Nature Conservancy (TNC) mechanically removed approximately 0.08 solid acres of *Spartina* on their 4,000 acre Port Susan Preserve. Island County also contracted Wildlands Management to conduct control work in 2009; 0.12 solid acres were removed. 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.

Table 7: Depicts the past and present solid acres of *Spartina* treated as well as percent reductions in Snohomish County

Year	*Spartina* Treated (solid acres)	% Reduction from previous year
2002	238	
2003	343	-44% (net increase)
2004	350	-2% (net increase)
2005	375	-7% (net increase)
2006	215	43%
2007	60	72%
2008	21.3	65%
2009	13.5	37%
	% Reduction from Peak Acreage	96%

Skagit County

In 2009, Skagit County had the third largest infestation of *Spartina* after Island and Snohomish County in Puget Sound. Approximately 4.61 solid acres of *Spartina* were found and treated in 2009 by Skagit County Noxious Weed Control Board, Department of Ecology, Washington State Department of Fish and Wildlife, WSDA, and the Swinomish Tribal Nation. This is a 26% reduction from 6.24 solid acres treated in 2008. WSDA provided $30,000 to Skagit County Noxious Weed Control Board and $7,500 to the Swinomish Tribal Nation for *Spartina* eradication activities in 2009.

The Skagit County Noxious Weed Control Board started *Spartina* treatments on June 23rd and continued throughout the summer. Prior to treatments, crew conducted extensive surveys and flagged all *Spartina* found. A total of 3.1 solid acres of *Spartina* were treated by Skagit County Noxious Weed Control Board crew in 2009. This solid acreage was found within approximately 2,291 acres within Skagit County shorelines.

In its eighth year of partnership with WSDA, the Swinomish Tribal Nation engaged in *Spartina* control on their lands. In 2008, 5.1 solid acres of *Spartina* were controlled in Turner's Cove using herbicide. In 2009, 0.35 solid acres of *Spartina* were treated in Turner's Cove using two rounds of treatment. This is a 93% reduction from 2008. Two full rounds of treatment were completed by the Swinomish Tribe and partners throughout their land with most sites seeing massive reductions. The Swinomish Tribal Nation's cooperation is essential to eliminate *Spartina* from Skagit County.

The Department of Ecology (DOE) has controlled *Spartina* on their Padilla Bay Estuarine Research Reserve since 1996. Two species of *Spartina* exist in Padilla Bay, *Spartina anglica* and *Spartina alterniflora*. In the 2009 treatment season, DOE treated/dug less than 0.003 solid acres of *Spartina*. Less than 0.001 solid acres were *S. alterniflora*. This *S. alterniflora* infestation on Dike Island is the only known population in Puget Sound. With the minimal amount of *S. alterniflora* remaining, DOE expects to eradicate this species from Padilla Bay within the next few years.

Washington State Department of Fish and Wildlife treated roughly 0.5 solid acres of *Spartina anglica* in south Skagit County in Southeast Skagit Bay.

Table 8: Depicts the past and present solid acres of *Spartina* treated as well as percent reductions in Skagit County

Year	*Spartina* Treated (solid acres)	% Reduction from previous year
2002	37	
2003	26	30%
2004	13.5	48%
2005	10	26%
2006	10	0%
2007	6	40%
2008	6.2	-3% (net increase)
2009	4.6	26%
	% Reduction from Peak Acreage	88%

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

In 2009, WSDA continued to work with the Noxious Weed Control Boards of Clallam, Jefferson, Kitsap, 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 played an important role in all aspects of integrated pest management from consent to control work in the 2009 season.

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. This site has its challenges with the ever shifting driftwood that litters the cove and makes surveying difficult and dangerous. 0.05 solid

acres of *Spartina* were treated using herbicide in 2009 which is a slight reduction from 2008. Eradication of this site will require repeated visits in the coming years.

2009 marked the most extensive boat survey of San Juan County in program history. The majority of shoreline was surveyed by WSDA and San Juan County Noxious Weed Control Board. (See section 2 in appendences) A few new infestations were detected and treated chemically or mechanically before seed set could occur. In total, 0.035 solid acres of *Spartina* anglica were treated in San Juan County. People for Puget Sound also conducted survey work around the San Juan Islands by kayak.

Less than 0.02 solid acres of *Spartina alterniflora/anglica* were treated or removed from Clallam County in 2009. This is an 89% reduction from 2008 treatments. With help from the Clallam County Noxious Weed Control Board, United States Department of Fish and Wildlife, and the Makah Tribal Nation, all known infestations were treated in 2009.

Jefferson County has the only known infestation of *Spartina patens* in Washington State at Dosewallips State Park on Hood Canal. WSDA crew, along with retired Evergreen State College professor Dr. Dave Milne, treated the site using herbicides in early October. This was the first time the site had been treated in two years, and 0.0125 solid acres of *Spartina patens* was sprayed. All together Jefferson County accounted for 0.02 solid acres of *Spartina* treated.

Despite surveying, King and Whatcom Counties did not treat any *Spartina* in 2009. In King County, historic sites were surveyed and no *Spartina* was present. In Whatcom County, a few small clones were discovered on the Nooksack Delta within the Lummi Reservation. These clones could not be treated in 2009 but will be high-priority for the 2010 treatment season.

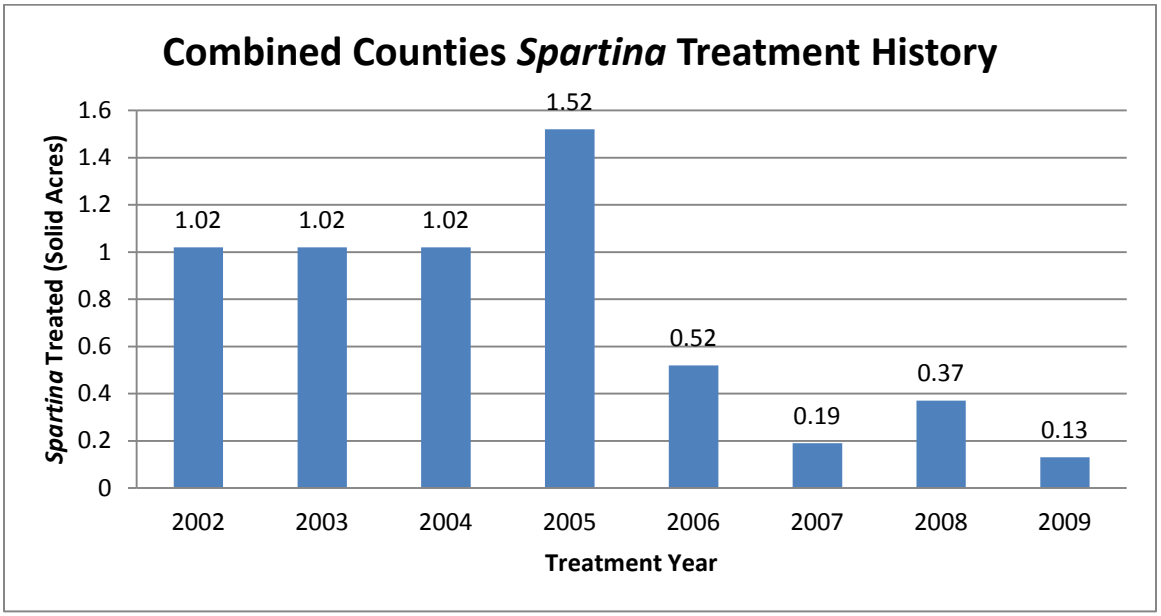

Figure 13: Depicts the past and present solid acres of *Spartina* treated in Clallam, Jefferson, Kitsap, King, San Juan and Whatcom Counties.

Recommendations for the Future

Continuous control and the elimination of major seed producing populations of *Spartina* in Puget Sound have resulted in significant decreases in remaining *Spartina*. Less than 29 solid acres of *Spartina* were found and treated in 2009 throughout Puget Sound, Hood Canal, and the Straits of Juan de Fuca. This is a 97% reduction from the height of the infestation in 1997 at 1,000 solid acres. 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. However, personnel needs on the ground are increasing as the infestations decrease to promote more extensive surveys.

Once again the 2009 field season confirmed that cooperation and coordination is essential to the future success of the *Spartina* program in Puget Sound. Increased survey and pooled resources will be important for eradicating the limited remaining infestations. With the continued collaboration between cooperators in the region and sustained funding, the future success of the Puget Sound *Spartina* program looks bright.

Figure 14 is a projection of *Spartina* reduction within Puget Sound over the next three years with sustained funding.

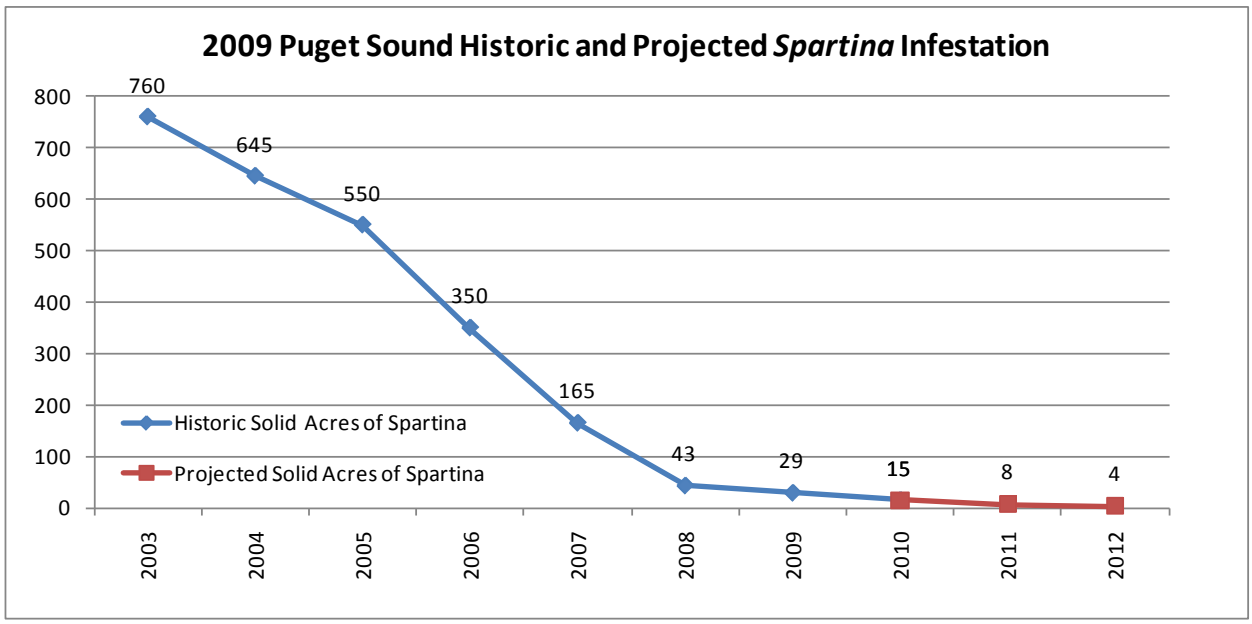

Figure 14: Area (Acres) of *Spartina* in Puget Sound based on WSDA estimates. The blue line represents the historic area of *Spartina* and the red line represents the projected area of *Spartina*. Projected area assumes sustained funding. All areas are in solid acres.

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 25 solid acres currently infesting the Bay. *Spartina alterniflora* is also known to occur in Skagit, Clallam, 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 receives annual surveys and is controlled by digging, covering and herbicide applications as needed. The current infestation size is less than one tenth of an acre.

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

Figure 15 shows each of the four species.

How was *Spartina* introduced into Washington State?

Spartina alterniflora was unintentionally introduced to Willapa Bay along with oysters shipped from the east coast during the late 1800's. In Puget Sound, 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.

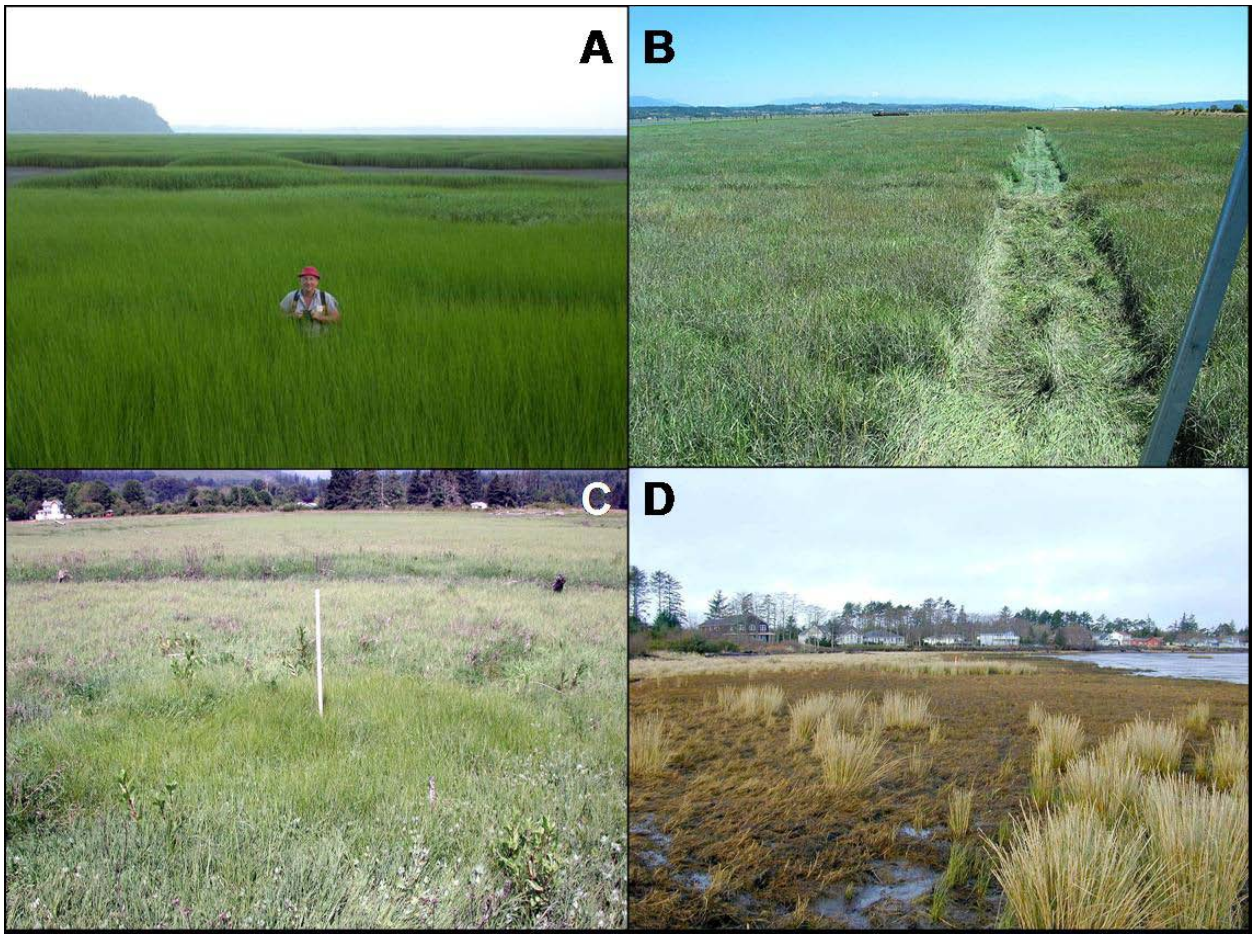

Figure 15: The four species of *Spartina* present in Washington. A) A meadow of *S. alterniflora* in Willapa Bay, B) A meadow of *S. anglica* in Skagit Bay (2003), C) *S. patens* at Dosewallips (2001), and D) clones of *S. densiflora* in Grays Harbor County.

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 to ensure no re-establishment occurs;
4) Continuing to survey shorelines, educate the public, and follow-up on possible sightings of new infestations.

Appendix 2 – Increased WSDA Survey Efforts in Puget Sound, Hood Canal and the Strait of Juan de Fuca

Contributed by Tanner Ketel, WSDA

The goal of the state wide eradication program is the complete removal of all invasive *Spartina* species from Washington State. With significant decreases in solid acreage of *Spartina* achieved in the past seven years, an increase in shoreline survey is more important than ever. Accurate delineation of known infestations and early detection of new populations are key to the success of any eradication program. Since 2007, WSDA and its cooperators have increasingly made survey a priority. The following details the survey activities and finds of the past three field seasons.

Throughout the course of the control seasons when time and tides permit, WSDA and cooperators participated in shoreline surveys in fourteen counties in Washington State. This concerted effort utilized staff from WSDA, WDFW, county noxious 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. Shoreline was identified in areas with potential *Spartina* habitat and surveyed.

During 2007, 373 miles of shoreline were surveyed statewide. A large portion (273 miles) consisted of helicopter surveys along the outer coast funded by USFWS. 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 364 miles of shoreline were surveyed in 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.

In 2009, in addition to the traditional survey/treatment areas in Puget Sound, 454 miles of shoreline were surveyed by foot and boat by WSDA. 93 of these miles were in Puget Sound predominantly around the north end of the Kitsap Peninsula. A seventy-two square foot clone of *S. anglica* in Miller Bay just north of Bainbridge Island was discovered on these surveys.

155 miles of Hood Canal were surveyed focusing on the cryptic species *Spartina patens*. In 2008, the only known infestation of *S. patens* in the state of Washington was not treated at Dosewallips State Park. This spurred the effort to survey Hood Canal for potential outlying infestations. The survey took approximately two weeks to complete and resulted in no new finds. A few miles of shoreline remain un-surveyed in Hood Canal in areas requiring special permission. These areas will be priority sites for the 2010 season.

The partner groups thought a detailed survey of San Juan County was necessary considering the amount of shoreline previously un-surveyed and nearby *Spartina* infestations in British Columbia that could promote seed drift. This summer an extensive boat survey was conducted throughout the islands focusing on previously un-surveyed areas. 161 new shoreline miles were surveyed extensively.

In addition to surveying the traditional sites in the San Juan Islands, the survey discovered multiple new infestations containing mature clones of *S. anglica*. Private landowners were promptly contacted and treatment/removal of the clones was accomplished.

In addition to the San Juan Islands, Parks Canada, Ducks Unlimited Canada, and crew from WSDA worked cooperatively to conduct a survey of 46 miles of shoreline along the Canada-Washington border in the Gulf and San Juan Islands. These surveys primarily took place in areas of prime *Spartina* habitat on Saturna, South Pender, Sydney and Lopez Island. No previously unknown *Spartina* was found in the course of this two day survey. WSDA staff also worked collaboratively across the border in late September when an airboat tour was conducted near Delta, BC. This tour was an opportunity for governmental and environmental representatives from both Washington State and Canada to see the areas infested and at risk near the mouth of the Fraser River. The tour was a success and valuable relationships were established. Figure 16 shows the past and present shoreline monitoring conducted by WSDA within the last three years.

Additionally, in 2009, a total of 103 shoreline miles were surveyed by People for Puget Sound by volunteer kayakers. 0.05 solid acres of *Spartina* were discovered by kayakers including new finds in Skagit and Whatcom Counties.

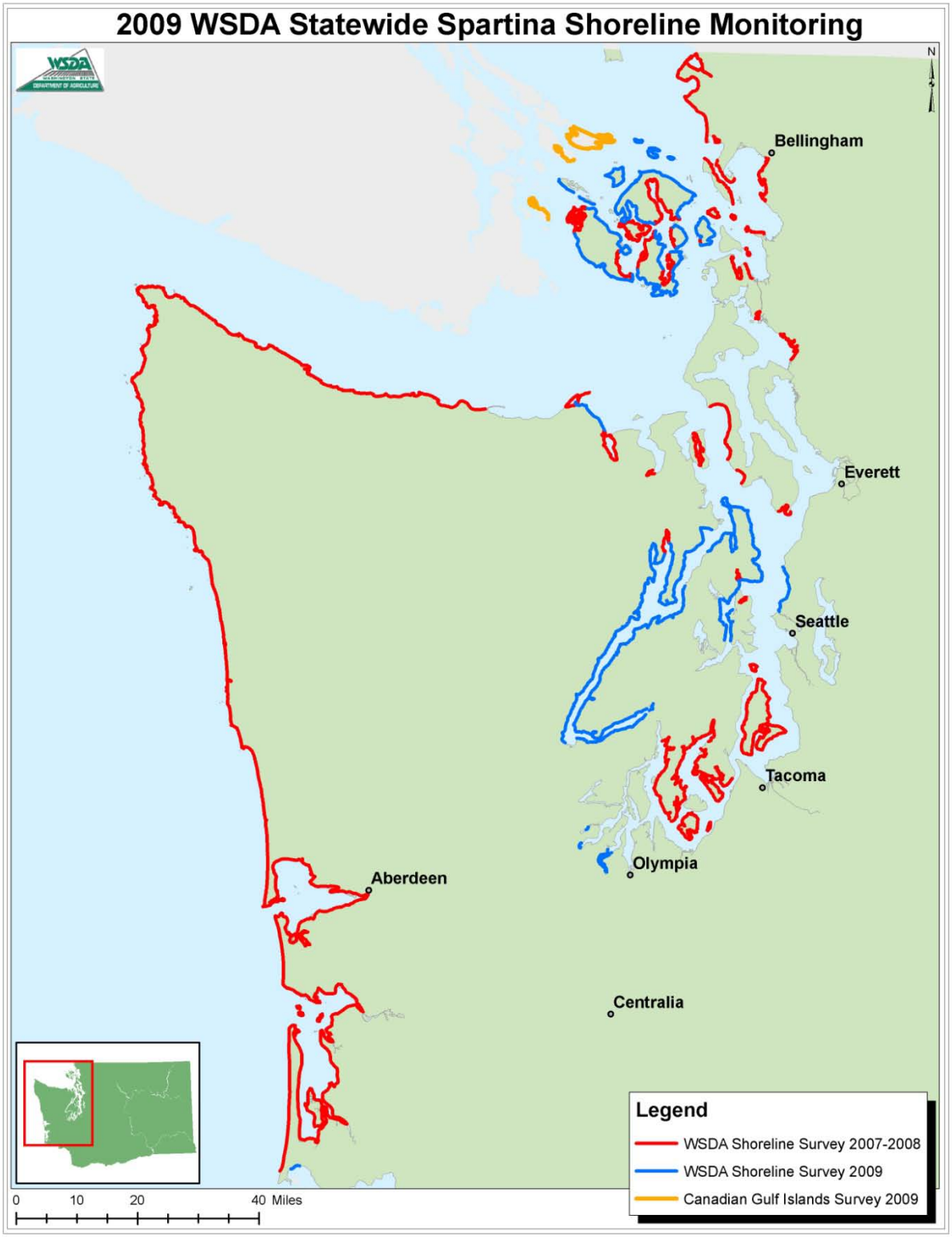

Figure 16: WSDA performed surveys in Puget Sound, Grays Harbor and Willapa Bay.

The past three 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 new infestations of *S. anglica* on Low Point, White Point, and Swifts Bay located on San Juan and Lopez Islands. A volunteer survey lead by People for Puget Sound discovered infestations of *S. anglica* at the mouth of the Red River and Nooksack River Delta in Whatcom County as well as a *S. anglica* find on Dredge Islands at the North end of the Swinomish Channel in Skagit County.

Subsequent to discovery, all of these sites were the focus of targeted management efforts. The total area of these finds is less than one solid acre. Though these sites are relatively small, their discovery and successive management are important in preventing the spread of *Spartina* within the region. WSDA anticipates completing within the next three years a five-year survey of Puget Sound, Hood Canal, and Strait of Juan de Fuca.

Appendix 3 - 2009 Grays Harbor *Spartina densiflora* Transect Study

Contributed by Nels Mikkelsen, WSDA

OVERVIEW

Grays Harbor hosts the largest infestation of *Spartina densiflora* in Washington State. *S. densiflora* is a South American cordgrass species of *Spartina* that was discovered in Grays Harbor in 2001 (Figure 17).

Figure 17. *Spartina densiflora.*

Areas of Grays Harbor infested with *S. alterniflora* typically respond well to eradication treatments and show high levels of reduction from year to year. However, in spite of aggressive treatment efforts, the two areas infested with *S. densiflora* (Bills Spit / North Bay) have shown an increase in affected acres and infestation points from 2008 to 2009 (Refer to Figure 9 page 17).

Historically, *S. densiflora* was found in Grays Harbor on the eastern side of the Ocean Shores Peninsula. The two primary sites were Bills Spit and east of the Ocean Shores airport. However, as in 2008, crews noticed that in 2009 the Bills Spit infestation had increased in both number of sites and solid acreage, with scattered plants discovered about a mile to the north. Crews continue to find *S. densiflora* in North Bay, extending from Campbell Slough west roughly 1.5 miles. As discussed in the 2008 WSDA *Spartina* report, the cooperators believed that more *S. densiflora* could be treated in the 2009 season than *S. alterniflora* in Grays Harbor. This premise has proved to be correct as more *densiflora* was treated (51% of the total *Spartina* infestation) than *alterniflora* (49%) in the 2009 treatment season.

Treatments conducted during the 2008 and 2009 seasons have shown that *S. densiflora* may be tolerant to herbicide application in Grays Harbor. The reasons for the poorer than expected efficacy may be attributed to the canopy architecture, biochemistry, or phenology of *S. densiflora*, as its bunchgrass growth form and South American origin are significantly different than *S. alterniflora*. The annual increase of *S. densiflora* in Grays Harbor could also possibly be attributed to the following factors:

1) The longevity of the seed bank of this species is in question (some sources suggest longer than 1 year).
2) *S. densiflora* plants are cryptic and blend in well with the surrounding salt marsh flora.

In response to this increase, surveys targeting *S. densiflora* were performed in the early spring months of 2009. In Washington State, *S. densiflora* does not senesce in the winter like most of the native plants. Spring surveys make locating *S. densiflora* easier due to the senesced surrounding vegetation. Consequently, in April/May of 2009, large amounts of *densiflora* were identified in the Bills Spit area; therefore, the cooperators agreed that an alternative method of survey and treatment was necessary to achieve eradication. As a result, in late May, the cooperators decided to address the main infestation in Bills Spit with a transect methodology whereby complete coverage could be achieved through meticulous survey and treatment efforts (Figure 18). Transect methodology is a systematic survey technique to maximize detection of a target species (Figure 19).

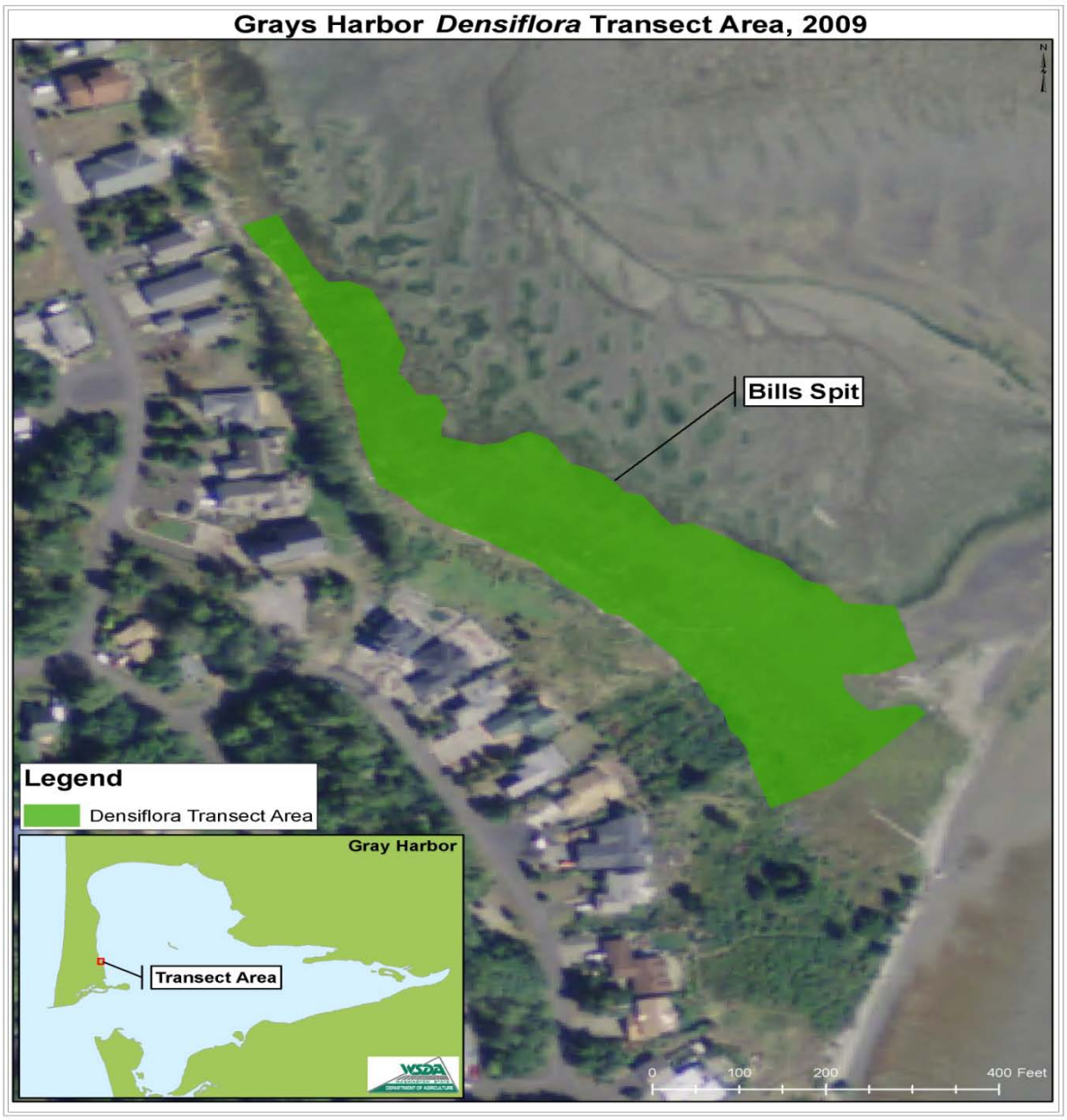

Figure 18. Bills Spit *S. densiflora* infestation area.

TRANSECT GRID SYSTEM

Preliminary discussions between cooperators focused on a grid system where the Bills Spit infestation could undergo a complete and thorough coverage approach. This approach included the tracking of total herbicide mix used and total plant numbers within "cells" of designated transects. Herbicide mix use within a cell could be tracked to more easily stay within the herbicide label rates. Also, plant numbers within a cell could be tracked to provide total cell/transect counts between rounds. The data collected could then be entered into an Excel spreadsheet for tracking purposes, generation of field data gathering sheets and final report writing (Table 9).

Table 9. SAMPLE 2009 Grays Harbor *S. densiflora* Transect Data Sheet															
Transect	A area	A oz.	A#	B area	B oz.	B#	C area	C oz.	C#	D area	D oz.	D#	E area	E oz.	E#
1	1760	1	2	1320	3	2									
2	1760	6	5	1760	82	81									
3	1760	0	0	1760	70	72	1056	38	59						
4	1760	0	0	1760	28	34	1760	105	152	770	66	76			
5	1760	0	0	1760	10	13	1760	94	95	1452	99	102	330	8	8
6	1760	0	0	1760	0	0	1760	29	33	1760	86	122	880	32	23
7	1760	0	0	1760	0	0	1760	15	18	1760	190	136	1452	33	26
8	1760	0	0	1760	0	0	1760	2	3	1760	24	28	1386	0	0
9	1760	0	0	1760	2	2	1760	13	11	1760	52	36	1496	0	0
10	1760	0	0	1760	10	11	1760	84	67	1760	100	74	1408	0	0
11	1760	0	0	1760	4	4	1760	26	25	1760	10	8	1298	0	0
12	1760	0	0	1760	6	6	1760	58	66	1760	47	27	836	0	0
13	1760	0	0	1760	12	12	1760	8	10	1760	0	0	418	0	0
14	1760	0	0	1760	4	4	1760	1	1	1760	4	2	396	0	0
15	1760	0	0	1760	0	0	1760	17	12	1760	51	6	286	0	0
16	1760	0	0	1760	2	1	1760	60	33	1760	18	12	528	0	0
17	1760	1	1	1760	0	0	1760	16	8	1760	30	12	990	0	0
18	1760	0	0	1760	58	65	1760	17	9	1760	69	49	1100	0	0
19	1760	2	3	1760	3	1	1760	3	1	1760	101	64	1606	69	44
20	1760	3	3	1760	3	4	1760	0	0	1760	97	57	1760	34	27
21	1760	0	0	1760	0	0	1760	9	7	1760	16	13	1760	20	16
22	1760	0	0	1760	1	1	1760	0	0	1760	1	1	1760	10	8
Totals	38720	13	14	38280	298	313	32736	595	610	30382	1061	825	19690	206	152
159,808 sq. ft.= 3.67 acres 2,173 oz.= 16.98 gallons 1,914 *densiflora* plants															

Contributing factors to determine cell size included the expanse of the treatment area (approx. 4 acres), tidal influences (survey time), survey crew numbers (3-5 individuals) and allowable herbicide application rates (label rate). Therefore, based upon these variables, 40x44 ft. (1,760 sq. ft.) cells were identified to maximize the efficiency of our field operations in time and space.

To determine the maximum amount of herbicide mix that could be applied to each cell we used the 2009 Grays Harbor mix rate. This rate was derived from calibrated treatment equipment and was set at a maximum application rate of 100 gallons tank mix per acre. Thus, twenty five 40x44 ft. cells (1,760 sq. ft.) equates to one acre (25 cells x 1,760sq. ft.=43,560 sq. ft.= 1 acre), therefore, the 100 gallon maximum rate per acre divided by 25 cells (1 acre) equals a maximum application rate of 4 gallons herbicide mix per cell (512 usable ounces).

Utilizing a cell size with an easily tracked maximum allowable amount of herbicide ensures that all herbicide label rates and applicable federal and state laws are followed. A total of two rounds of survey and treatment were planned as per the preliminary cooperator discussions.

TRANSECT AREA DELINEATION

As discussed, the 2009 April/May surveys in Bills Spit revealed large amounts of *S. densiflora*. Preliminary measurements of the main infestation area were made according to the mudflat to saltwater vegetation transition and the upper salt marsh to upland vegetation transition within the main infestation. The northerly and southerly ends of the transect area served as a "bottleneck" due to the reduced distance between the mudflat and the high marsh. Here, the amount of *densiflora* was reduced in conjunction with reduced suitable habitat. Continuing northerly and southerly away from the transect area the amount of plants found were reduced and scattered. Trimble GPS points were then collected at the northern and southern boundaries. From this data, a linear relative north to south line was established.

This relative north/south linear line was adjusted to effectively cover the boundary of the mudflat to salt marsh vegetation transition. It was also adjusted to contain 22 transects spaced at intervals of 44 feet which were pre-marked for accurate tracking of herbicide mix use totals as per the prior discussion in the "Transect Grid System" section. The 22 transects x 44 feet equaled 968 lineal feet. Stakes were then established at the northern and southern ends with an additional "midpoint" stake established to accelerate daily surveys with a reduced length of line.

With the establishment of the lineal mudflat to salt vegetation transition line it was then necessary to establish the high salt marsh vegetation to upland vegetation "westerly" boundary line and corresponding transect stakes. A compass reading was established at the northern boundary stake to the west to determine the easterly/westerly boundary. This compass reading was subsequently used to determine each easterly/westerly transect line moving north to south along the mudflat to salt vegetation line at the 44 ft mark intervals.

The salt marsh vegetation to upland vegetation transition stakes are curvilinear and conform to the natural vegetation transition. This natural transition area created "partial cells". Partial cells were measured for area and a corresponding maximum herbicide mix application rate was calculated so as not to violate the herbicide label rates. Figure 19 depicts the approximate grid system layout in the Bills Spit area of North Bay.

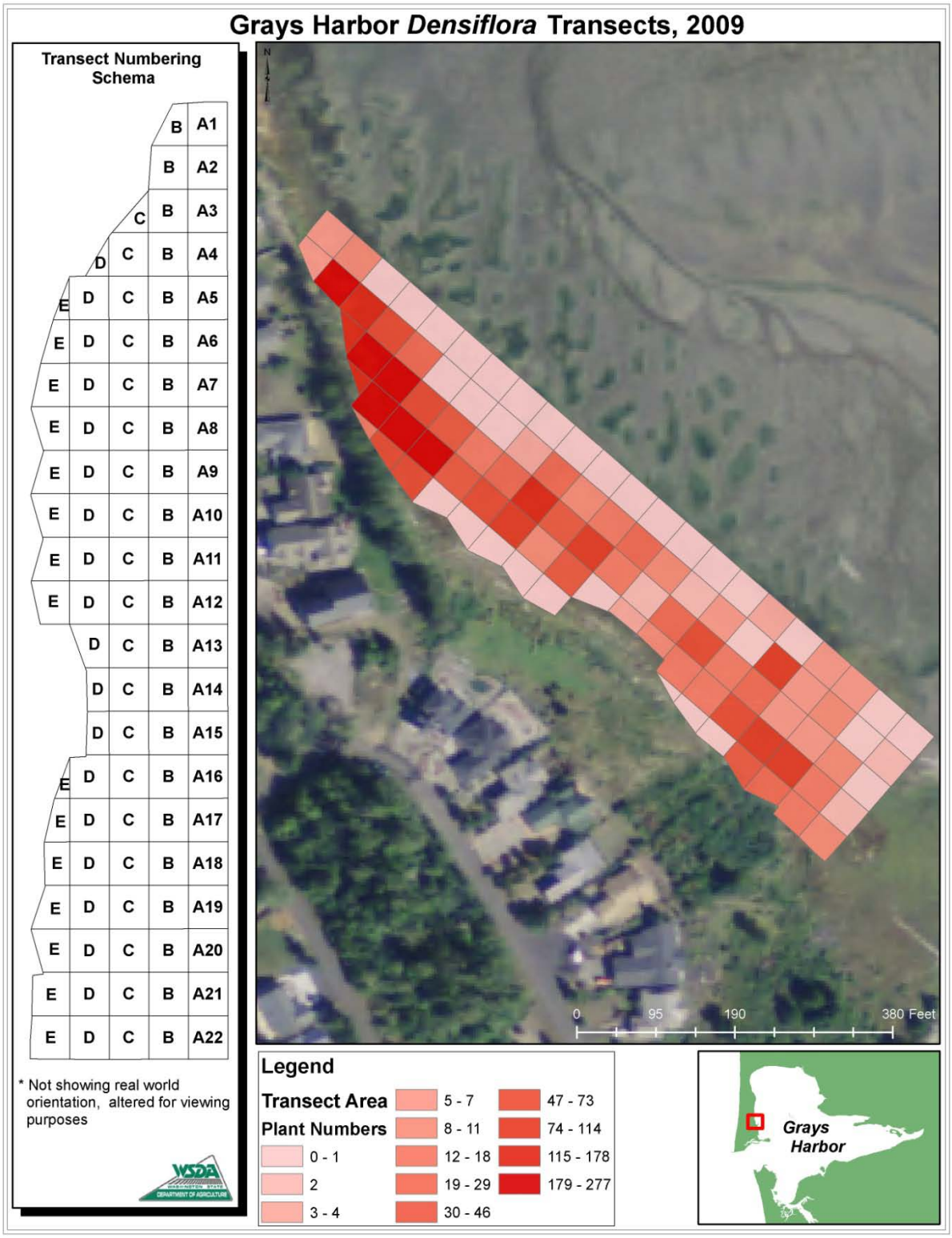

Figure 19: 2009 Grays Harbor transect grid system layout and corresponding plant numbers within cells. Darker shaded areas indicate larger numbers of *densiflora* plants

TRANSECT FIELD APPLICATION

With favorable tides and weather a crew of 3-5 individuals from WDFW and WSDA used heavy ropes to determine transect boundary lines between the mudflat transition line and the upland transition stakes. The ropes were pre-marked at 40 ft. intervals and measuring tapes were used to delineate cell boundaries from rope to rope, thus creating the 40x44 ft. cells. The first cells immediately west of the mudflat transition line were marked as 1A. Continuing west through transect 1, the next cell was 1B, 1C etc (Figure 19). Crew members began surveys at the mudflat transition line (cell A) and moved westerly through the cells equipped with ½ gallon low pressure sprayers marked in increments of 4 ounces and count "clickers". Crew members were spaced equidistant to one another and treated/tallied every *densiflora* plant found. At the completion of each cell crew members provided to the data recorder ounces of herbicide mix used and total plant numbers. These numbers were entered on a field data spreadsheet. Surveys were terminated prior to the minimum 4 hour recommended herbicide mix dry time in accordance with tidal fluctuations. Field data was transferred to Excel spreadsheets at the conclusion of each survey day.

RESULTS

Round 1 survey and treatment operations began in earnest June 12 and were completed on June 29. A total of 9 survey days were needed to complete the 22 transects in round 1, or roughly 2.5 transects completed per survey day. 1,888 individual *densiflora* plants were treated for a total of 0.17 solid acres. Sizes ranged from single stemmed plants a few inches in height to multi-stemmed "bushes" 3-4 ft. high and 3 ft. in diameter.

Round 2 survey and treatment operations began August 24 and were completed on September 15. A total of 6 survey days were needed to complete the 22 transects or roughly 3.5 transects completed per survey day. Crew familiarity with transect operations explain the 1 transect completed per day difference from round 1 to round 2. 1,480 individual *densiflora* plants were treated in round 2. Many of the previously treated plants were re-treated as these plants were still showing "green" stem and or leaves. Plants showing full vigor in round 2 were treated and estimated at 0.02 solid acres. Based upon the ratio of round 1 plant numbers we can estimate the .02 solid acres treated as an additional 200 "green" plants found.

Therefore, the total estimate of vigorous *densiflora* plants found and treated in rounds 1 and 2 are approximately 2,088 and 0.19 solid acres treated. Overall, a 22% decrease in numbers of plants found from round 1 to round 2 was achieved. A survey is planned for the early spring months of 2010 to accurately assess the efficacy of the transect study as it is not clear if plants exhibiting the effects of herbicide damage will ultimately perish or regenerate. Figure 19 depicts the distribution and numbers of *densiflora* plants within cells, rounds 1 and 2 inclusive.

CONCLUSION/DISCUSSION

S. densiflora is an austral cordgrass exhibiting bunchgrass type growth. Methods of growth and reproduction are of tiller action and seed production, respectively. During the last 20 years *densiflora* has been recorded as aggressively invading estuarine environments in the USA, Spain and Morocco (Bortolus, 2006). While this species is one of the three most widely distributed worldwide, it is among the least studied within the *Spartina* genus. Unlike native salt marsh plants in Washington State, this salt tolerant species exhibits a C_4 metabolism which enables it to cope better with local environmental variables and microhabitat conditions (Kittelson & Boyd,

1997; Nieva *et al*., 1999, 2005). Additionally, its morphology lends itself to exhibit cryptic characteristics within native salt marsh flora.

These combined ecological characteristics make survey and potential treatment a difficult task. Furthermore, *densiflora* has shown a tolerance to herbicide application. Its dense multi-stem morphology and reduced leaf surface area may be a factor in its tolerance. Notably, during our transect treatments, the smaller *densiflora* plants have shown a high tolerance, whereas efficacy appears to be higher in the larger multi-stemmed plants, which exhibit more leaf surface area.

The transect effort in Grays Harbor has shown that complete coverage in densely infested areas is possible. While it is not clear that the treated plants exhibiting the effects of herbicide damage will ultimately perish, there may be an associated decrease in seed production. More definitive work is needed to address *densiflora's* tolerance to herbicide application. Suggestions include studies with different surfactants that can penetrate the thick cuticle in order to adequately introduce foliar and systemic herbicide chemicals. In addition, perform a single round of transect methodology, with the herbicide mix applied at the maximum rate per the herbicide label, may prove to increase efficacy results.

A survey is planned in the early spring months of 2010 to assess the numbers of *densiflora* plants present in the transect area. Results will be available in the WSDA 2010 *Spartina* report. With continued funding provided by the cooperators we will continue to apply transect methods in the Bills Spit area of Grays Harbor. Recommendations for the 2010 season include the hiring of Grays Harbor crew members in the early spring months to familiarize with *S. densiflora* identification, perform transect surveys and flag *densiflora* existing outside of the transect area.

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Appendix 4 – Columbia River - *Spartina alterniflora* found in Baker Bay

Contributed by Jonathan Still, WSDA

In the summer of 2008, a significant sized clone of *Spartina alterniflora* was discovered and treated at the mouth of the Skipanon River, Oregon, located approximately 9 miles east of the mouth of the Columbia River.

In response, on July 13th, 2009, WSDA and Clatsop Soil & Water District (OR) conducted an aerial survey of the Columbia River estuary in search of *Spartina.* Evidence of regrowth near the Skipanon clone was observed; however, no new infestations were found. Due to variables and restrictions with regard to safe helicopter operation, aerial surveys were concluded and recommendations for ground surveys on both sides of the Columbia River were discussed.

Accordingly, ground surveys in Baker Bay were performed by crews from the Washington State Department of Natural Resources on September 29th, 2009. Access to the Baker Bay survey area was initiated from the city park in Ilwaco where crews subsequently surveyed the intertidal areas between the Port of Ilwaco and the mouth of the Wallacut River. Survey efforts identified two large clones of *S. alterniflora* located near the mouth of the Wallacut River and the Port of Ilwaco, respectively. WSDA and Pacific County combined efforts to obtain private property owner consent for the affected acres. On October 22nd, 2009, crews from WSDA and DNR conducted eradication activities from the Port of Ilwaco to the mouth of the Wallacut River, treating .02 acres of *S. alterniflora.*

Figure 20: *Spartina alterniflora* in Baker Bay, 2009.

Thorough surveys of all intertidal areas from the mouth of the Columbia River to the Astoria-Megler Bridge are scheduled for the spring of 2010. If needed, eradication activities will be conducted between June and October, 2010. Continued cooperation with the State of Oregon and Clatsop Soil & Water District will be essential to ensure the eradication of *Spartina* in the Columbia River estuary.