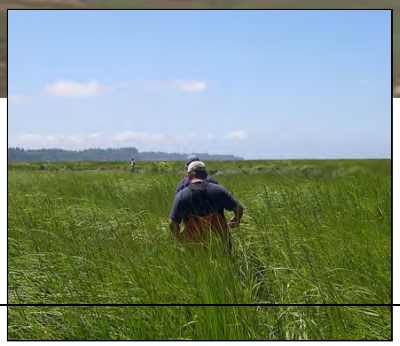
Spartina Eradication Program 2004 Progress Report

Valoria H. Loveland, Director



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AGR PUB 850-132 (N/1/05)

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Photos provided by Dave Heimer and Justin Haug (WDFW),
Dr. Kim Patten (WSU), and Hector Beltran (Pacific Shellfish Institute).

Extreme care was used during the compilation of the maps in this report to ensure accuracy. However, due to changes in data and the need to rely on outside sources of information, the Department of Agriculture cannot accept responsibility for errors or omissions, and, therefore, there are no warranties which accompany this material.

REPORT TO THE LEGISLATURE

PROGRESS OF THE 2004 *SPARTINA* ERADICATION PROGRAM

December 15, 2004

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Executive Summary

2004 Progress Report of the *Spartina* Eradication Program

Spartina, commonly known as cordgrass, is an aggressive noxious weed that severely disrupts the ecosystems of native saltwater estuaries in Washington state. It out competes 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. *Spartina* spreads by both seed production and below ground root growth. In 2003, at the height of its invasion in Washington state, *Spartina* infested more than 8,500 acres spread over 20,000 acres.

Since 1995, the Washington State Department of Agriculture (WSDA) has served as the lead state agency for the eradication of *Spartina*. This report details the progress of the eradication program in 2004.

2004 *Spartina* Eradication Season Accomplishments

For the first time in the history of the eradication program, WSDA can report an overall decline in the size of the infestation statewide -- from 8,500 acres to 7,500 acres -- as a result of the unprecedented amount of control work carried out in 2003, when an estimated 7,000 acres was treated. 2004 was another solid year for *Spartina* control. An estimated 5,700 solid acres of *Spartina*, approximately 80% of the infestation, was treated in Willapa Bay. This is the second year of a greatly increased overall effort in Willapa Bay. In Puget Sound, an estimated 528 solid acres of *Spartina*, approximately 82% of the infestation, was treated.

This work was a result of the continued financial commitment of the state to eradication efforts and continued cooperation of WSDA, other state agencies, universities, U.S. Fish & Wildlife Service, counties, tribes, private organizations and private landowners. A significant development of the 2004 season was the addition of a new, more effective eradication tool. The herbicide imazapyr (Habitat®) was approved for use in spring 2004 and used for the majority of the herbicide treatments during the 2004 season.

Continued Funding

WSDA allotted $1.76 million of its initial appropriation from the Aquatic Lands Enhancement Account (ALEA) for Spartina activities during the 2003-2005 biennium. Though less than the amount appropriated in the 01-03 biennium, this lower funding did not substantially impact the overall success of the program as WSDA pre-purchased herbicide for the 2003 control season at the end of the 2003 fiscal year. This allowed WSDA to save a majority of the money allotted for herbicide purchases until the beginning of the 2004 treatment season, which allowed for the more expensive imazapyr to be purchased and more acreage to be treated.

As in 2003, WSDA supplied the majority of the herbicide needs for other state agencies and for Snohomish, Skagit, and Island counties in 2004. WSDA did not provide any additional

herbicide to the U.S. Fish & Wildlife Service; however, USFWS had glyphosate remaining from the 2003 season and was able to supply the remainder of its herbicide needs through its federal funding.

The FY 04 supplemental budget included $85,000 in additional one-time ALEA funds for Spartina eradication efforts in Willapa Bay and Grays Harbor during the 2004 control season. WSDA used these funds and a substantial amount of its initial funding to purchase herbicide and conduct aerial applications to three of the largest meadows in Willapa Bay. The majority of the vast clone fields and several small adjacent infestations were also successfully treated from the air.

Other agencies have significant funding committed to *Spartina* eradication. The Department of Fish & Wildlife (WDFW) and the Department of Natural Resources (DNR) budgets include $1.09 million for spartina eradication in the 03-05 biennium; USFWS has received about $1 million annually in federal funds.

Cooperation and Coordination Activities

Continued cooperation of local, state, federal and tribal governments, universities, interest groups and private landowners was a critical factor in the 2004 control season. Besides having the right tools to get the job done, having a committed group of individuals and organizations cooperating is absolutely essential for a program like this to be successful.

Willapa Bay Cooperative Efforts

Cooperation was again key in the 2004 effort in Willapa Bay. WSDA continued to coordinate the Technical Committee meetings as well as the Advisory Committee meetings, which focused on developing an overall work plan for the 2004 season, as well as ensuring open communication and coordination throughout the treatment season.

Other notable areas of cooperation in Willapa Bay were the continued large-scale cost share effort undertaken by WSDA and the Oyster Growers Association. It is important to note that the USFWS also took part in this effort during the 2004 season, assisting in follow-up treatment of the 2003 large-scale cost share site at South Nemah/Seal Slough.

WSDA, WDFW and DNR also continued to conduct small-scale cost share work along the Long Beach Peninsula, and other areas of the Bay in a cooperative approach.

Puget Sound Cooperative Efforts

The effort in Puget Sound continued to see excellent cooperation from all entities involved. The Nature Conservancy (TNC) became even more involved in the North Puget Sound effort this season by hiring a large field crew to control all infestations on its Port Susan Bay nature reserve. Several cooperative treatment efforts also took place during the 2004 season. One in particular was an effort in Port Susan, which involved every major partner in the North Puget Sound effort: Skagit, Island and Snohomish counties, the Swinomish Tribe, WSDA, WDFW and TNC. Several cooperative efforts also took place on Island County as well.

The Swinomish Tribal Community continued to utilize a fully implemented integrated pest management strategy to eradicate infestations on its land. The Tribe worked closely with Skagit County by allowing the county to conduct all herbicide applications to tribal land.

In Kitsap County, WSDA worked closely with the Suquamish Tribe to test the efficacy and non-target impacts of the new herbicide. The Suquamish Tribe owns about half of an infested marine-influenced wetland near the small town of Indianola. With the permission of the Tribe, WSDA has spent many years conducting manual and mechanical control operations at this site with no visible reductions. With this in mind the tribe approached WSDA to begin testing the use of herbicides on the infestation. The results of the test will be evaluated in the spring of 2005, at which time the Tribe will make a decision on the use of herbicides on this infestation.

Continued Efforts to Improve Control Tools, Restore Tidelands

The Spartina Eradication Program uses Integrated Pest Management (IPM), a coordinated decision-making and action process that uses the most appropriate pest control methods and strategy in an environmentally and economically sound manner to meet pest management objectives. Entities involved in Spartina eradication use a wide range of control tools, including ground and aerial herbicide applications, various mechanical tools, biological control using the insect *Prokelisia marginata*, and manual control involving digging seedlings in areas where an infestation has not taken hold.

The biggest advance in *Spartina* control tools came about in spring 2004. For nearly 10 years WSU researchers have been studying the efficacy of an herbicide, imazapyr, on *Spartina alterniflora* in Willapa Bay. Research has shown imazapyr to be more effective in killing spartina than glyphosate, the other approved herbicide.

In early 2004, the necessary ecological risk assessment of imazapyr by WSDA was completed, the U.S. Environmental Protection Agency registered the herbicide, and the Department of Ecology approved its use as an aquatic herbicide in Washington. With the aquatic pesticide permit (NPDES permit) allowing the use of imazapyr in place, all entities involved in *Spartina* control in Washington state began using imazapyr in June 2004.

With the extensive research that has been conducted, managers are optimistic that the areas treated with imazapyr during the 2004 season will yield very effective results. The cost of using imazapyr, however, is $180 per acre, more than double the cost of using glyphosate at $81 per acre.

There were several other significant activities in this area in 2004.

- Several new surfactants were also approved for use during the spring of 2004. Through the same state approval process which imazapyr went through, a series of less toxic surfactants were approved. The two used most widely for *Spartina* applications were Agri-dex® and Competitor®.
- The University of Washington-Olympic Natural Resources Center (UW-ONRC) continued to provide tide prediction maps for chemical herbicide applications. The modeling uses LIDAR (Light Detection And Ranging) data to predict dry times of various applications at sites

throughout Willapa Bay. Spartina must be dry a certain amount of time to give the herbicide time to affect the plant. This modeling helps ensure the maximum efficacy possible of herbicide applications.

- State and Federal partners tested applications with imazapyr at various rates and tank mixes to determine maximum efficacy and cost efficiency.
- Washington State University continued its search for more effective herbicide application techniques.
- UW-ONRC continued to work on improving efficacy of biological control through investigation of different biocontrol agents.

Other Noteworthy 2004 *Spartina* Eradication Program Activities

Second Year of Water Quality Sampling Conducted

As required by the aquatic pesticide permit, WSDA conducted water quality monitoring for the second year in a row.

During the 2003 season, WSDA tested several sites for concentrations of the herbicide glyphosate during the next incoming high tide after applications were completed. To supplement the 2003 monitoring, in 2004 WSDA tested areas adjacent to treatment sites for off-site movement of glyphosate, as well as concentrations through time at treatment sites.

WSDA also conducted water quality testing for the new herbicide imazapyr in 2004. WSDA tested for imazapyr concentrations at treatment sites, as well as off-site movement and concentrations through time.

Grant Funding Received for *Spartina* Specific Projects

In spring 2004, two private tideland owners worked with WSDA to apply for a grant through the WDFW Landowner Incentive Program. The two landowners, Taylor Shellfish and Bay Center Mariculture, submitted a proposal that would provide $100,000 for *Spartina* eradication work in the Bay Center area of Willapa Bay. The proposal's plan called for the grant money to be spent on herbicide, coordination activities and monitoring. The goal of the plan is to successfully eradicate the 600-acre Palix meadow over a five-year period, with a restoration component also being conducted.

In September 2004, WSDA received confirmation from WDFW that the grant was approved and all necessary consultations with USFWS were complete. Given that WSDA conducted the initial treatment of the meadow in August 2004, the grant funding will be used to ensure that proper re-treatments are conducted and the meadow is successfully eradicated.

WSDA will work closely with the landowners to adjust the plan now that the initial, and probably most expensive, application has already been conducted. This will probably allow for the funding to go a little farther, providing more follow-up control work and monitoring. WSDA will provide in-kind contributions to the grant by conducted pre-treatment site preparation and restoration work.

Summary of 2004 Statewide Spartina Eradication Activities

Spartina Eradication in Willapa Bay

2004 was a highly successful year for *Spartina* eradication in Willapa Bay. In 2004, 12,000 affected acres were treated, 2,000 more acres than the previous year. Of the 10,000 affected acres treated in 2003, monitoring data and follow-up treatments indicate that the 2003 treatments resulted in an approximate 2,000-acre reduction in affected acres. The total solid acreage treated during the 2004 season is estimated at 5,700 acres.

Of special note is the use of the new herbicide imazapyr during the 2004 season. Imazapyr was used on approximately 90% of the acreage treated during 2004. Relying heavily on efficacy data gathered over many years of research, WSDA feels confident that the treatments using imazapyr, especially the ground and aerial broadcast applications, will be much more effective than the same treatments using glyphosate.

Spartina Eradication in Grays Harbor

Ongoing surveys in Grays Harbor continue to turn up new infestations of *Spartina*. All identified plants are treated each year, and upon return inspections, the treated plants show a high level (90 – 95%) of control. Due to the lack of any large seed-producing infestation in Grays Harbor, it is assumed that the new infestations are due to increased seed dispersal from Willapa Bay. With the increased effort in Willapa Bay, managers hope to see a decrease in new infestations in Grays Harbor over the next several years.

Spartina Eradication in Puget Sound and Hood Canal

An estimated 528 solid acres of *Spartina* were treated in Puget Sound and Hood Canal in 2004, approximately 82% of the estimated 645-acre infestation. The Puget Sound infestation, estimated at 1,000 solid acres in 1997, has been reduced by about 35%.

- **Snohomish County**

In Snohomish County, 350 solid acres of *Spartina* were treated in 2004, just up slightly from the 343 acres treated in 2003. For the second consecutive season, all meadows in southeast Skagit Bay, Leque Island and Mystery Island were treated in their entirety. These sites are home to three of the largest infestations in Puget Sound. As past research has indicated, consistent yearly treatment of entire sites is necessary for eradication to be successful. The combined size of these three infestations is now approximately 285 solid acres. Managers expect the decline at these sites to increase as consistent treatment continues. These three sites constitute about 80% of the overall infestation in Snohomish County and 45% of the infestation in Puget Sound.

- **Island County**

In Island County, 164 solid acres of *Spartina* were treated in 2004, about half as many as the 325 acres treated in 2003. This reduction in the total amount treated is due to the reduction in the infestation at several sites in the county. Island County and its subcontractor surveyed and treated every infestation on Whidbey Island. About ten new infestations were discovered, all less than 1 solid acre; most were seedlings along the shoreline. All sizeable infestations in Island County had been identified in previous years. On Camano Island, WDFW continued to do mechanical control at the two largest infestations: Triangle Cove and the Emerick/Price site. At

Triangle Cove, mechanical control has result in a 90% reduction of the treated areas. Managers expect similar results at the Emerick/Price site.

The entire Livingston Bay infestation was again treated in 2004. After six successful years of treatment, including the 2001 season in which herbicide was not allowed for use, this infestation has decreased from approximately 100 solid acres to an estimated 4.5 solid acres, a decrease of 95.5%. Only one known infestation in Island County did not get treated during the 2004 season; this is down from six in 2003.

- **Skagit County**

In Skagit County, 13.5 solid acres of *Spartina* were treated in 2004 compared to 26 acres in 2003 and 36 acres in 2002. This reduction in treated acreage is due to the reduction in the overall infestation in Skagit County. All known *Spartina* infestations were treated with the exception of one 10.5-acre infestation on Swinomish tribal land, which is being tested as a biological control release site. The overall infestation in Skagit County, estimated at 100 solid acres in 1997, has been reduced by about 76%, to 24 solid acres in 2004.

- **San Juan, Clallam, Jefferson, Kitsap, King Counties**

WSDA crews have substantially reduced all known infestations in Clallam, Jefferson, Kitsap and King counties during the past six years. All sites were treated entirely at least twice and are nearing eradication. During the 2004 season, four new infestations were identified, all less than 1/8 of an acre in size. These new discoveries were due in part to a more thorough survey by WSDA field crews. These infestations were most likely a result of seed movement from the larger infestations in Island and Snohomish counties, which highlights the importance of eradicating those sites in order to keep the infestation from spreading to other areas of Puget Sound. Infestations in San Juan County continue to be controlled and surveyed by the San Juan County Noxious Weed Control Board. One new infestation was discovered in San Juan County in 2004. A more extensive survey will be conducted next summer to identify any additional unknown infestations.

Table 1 illustrates the total solid acres and estimated solid acres treated by county from 1997 through 2004.

Table 1. Acres of *Spartina* treated in Washington state – 1997 through 2004

County	*Spartina* Present at Start of 2004	*Spartina* Treated, 1997 - 2004	2004 Treatment Methods
Pacific (Willapa Bay)	~ 7,000 solid acres spread over > 18,000 acres	‘97 - approx. 742 solid acres ‘98 - approx. 450 solid acres ‘99 - approx. 600 solid acres ‘00 – approx. 800 solid acres ‘01 – approx. 900 solid acres ‘02 – approx. 1,804 solid acres ‘03 – approx. 6,000 solid acres **‘04 – approx. 5,700 solid acres**	Mow/herbicide, herbicide, seedling removal, various mechanical controls
Snohomish	Approx. 370 solid acres spread over > 4,500 acres	‘97 - approx. 89 solid acres ‘98 - approx. 126 solid acres ‘99 - approx. 90 solid acres ‘00 – approx. 158 solid acres ‘01 – approx. 75 solid acres ‘02 – approx. 238 solid acres ‘03 – approx. 343 solid acres **‘04 – approx. 350 solid acres**	Mow/herbicide, herbicide, seedling removal, dig, mechanically crush, mow
Island	Approx. 250 solid acres spread over >1,000 acres	‘97 - approx. 250 solid acres ‘98 - approx. 160 solid acres ‘99 - approx. 155 solid acres ‘00 – approx. 130 solid acres ‘01 – approx. 72 solid acres ‘02 – approx. 300 solid acres ‘03 – approx. 325 solid acres **‘04 – approx. 164 solid acres**	Mow/herbicide, herbicide, seedling removal, mechanically crush, mow
Skagit	Approx. 24 solid acres spread over > 2,000 acres	‘97 - approx. 91 solid acres ‘98 - approx. 57 solid acres ‘99 - all treated ‘00 – approx. 60 solid acres ‘01 – approx. 33 solid acres ‘02 – approx. 37 solid acres ‘03 – approx. 26 solid acres **‘04 – approx. 13.5 solid acres**	Mow/herbicide, herbicide, seedling removal, dig, mow
Grays Harbor	Scattered clones and seedlings 2.8 acres in size	‘97 - all treated ‘98 - all treated ‘99 - all treated ‘00 – all treated ‘01 – all treated ‘02 – all treated ‘03 – all treated **‘04 – all treated**	Herbicide, seedling removal, mow
Kitsap	8 infestations - approx. 1 solid acre total	‘97 - all but 2 tribal sites ‘98 - all treated ‘99 - all treated twice ‘00 – all treated ‘01 – all treated ‘02 – all treated twice ‘03 – all treated twice **‘04 – all treated twice**	Mow, mow/herbicide, dig, seedling removal
Jefferson	14 infestations – approx. 0.01 solid acres total	‘97 - all treated ‘98 - all treated twice ‘99 - all treated twice ‘00 – all treated three times ‘01 – all treated three times ‘02 – all treated three times ‘03 – all treated twice **‘04 – all treated twice**	Mow, mow/herbicide, dig, seedling removal
Clallam	1 infestation < 0.001 acres in size	‘97 - treated twice ‘98 - treated three times ‘99 - treated twice ‘00 – treated four times ‘01 – treated four times ‘02 – treated four times ‘03 – treated three times **‘04 – all treated twice**	Dig
King	2 infestations – single clones and a few seedlings	‘97 - monitored ‘98 - all treated ‘99 - all treated ‘00 – all treated twice ‘01 – all treated twice ‘02 – all treated twice ‘03 – all treated twice **‘04 – all treated twice**	Dig
San Juan	Re-growth found at one site. 2 other sites clean for four consecutive years	‘97 - all treated ‘98 - all treated ‘99 - monitored ‘00 – all treated ‘01 – all treated ‘02 – all treated ‘03 – all treated **‘04 – all treated twice**	Survey, dig

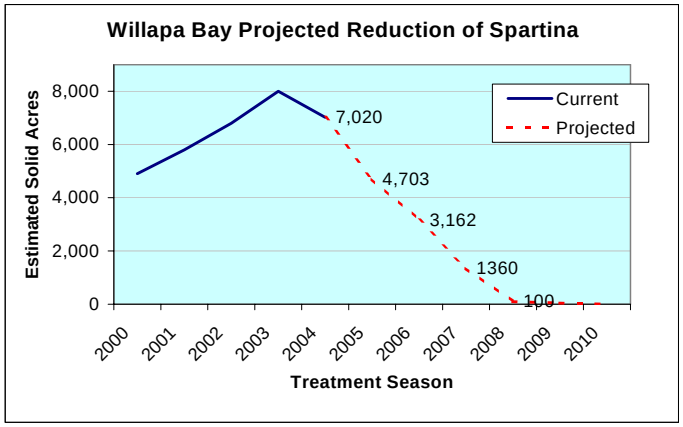
Recommendations for the Future

An unprecedented amount of control work was carried out in 2003, resulting in the first overall decline in the size of the Spartina infestation in Washington. The 2004 control season built on that achievement by treating as much acreage as possible in both Willapa Bay and Puget Sound and by using the new, more effective herbicide. 2004 was another very successful year in terms of acreage treated, and there is a renewed sense of optimism about the ability to achieve the overall goal of eradication. To continue to build on the achievements of the past two years, it is important to use the best control methods and treat as much acreage as possible. The cost of using imazapyr, however, is $180 per acre, more than double the cost of using glyphosate. The one downside to using the more effective herbicide was that WSDA has no funding available for herbicide for the last month of the biennium. WSDA has submitted a request for $122,000 for the FY 05 supplemental budget to treat 500 solid acres of Spartina with imazapyr in June 2005, the first, and arguably the most effective, month of the control season. Unless supplemental funding is provided, WSDA will have to wait to conduct any substantial applications until July, when the new biennium begins.

With the increased effort that has taken place over the past several years, it has become more and more important to take advantage of the entire treatment season and to ensure that the maximum amount of acreage is treated during the best months to treat. The activities of the 2004 control season illustrate the importance of sustained funding, continuing cooperation, and continued development of IPM tools. Graph 1 illustrates the current projection that Spartina can essentially be eradicated from Willapa Bay in five years. This projection assumes that:

- The 2004 treatments result in a 50% overall reduction.
- WSDA receives $122,000 supplemental funding for June 2005 herbicide needs.
- WSDA funding continues at the same levels as the 2003-2005 biennium.
- WDFW and DNR funding continues at the same levels as the 2003-2005 biennium.
- USFWS continues to receive $1,000,000 per year in federal funding for *Spartina* control.
- Through continued large-scale IPM, the effort will eradicate 2,000 solid acres per year in 2005 and 2006.
- The Spartina infestation has a growth rate of 17% (based on previous calculations from DNR), which is added in before the yearly reductions are subtracted.

Graph 1. Projected solid acres of *Spartina* with sustained funding



In Grays Harbor, extensive surveys are required to ensure all infestations are identified and treated. If the current level of activity continues in Grays Harbor and in Willapa Bay, Grays Harbor can continue to be protected from a major infestation.

Experience in central and southern Puget Sound shows that continuous control and monitoring of infestations, coupled with the elimination of nearby seed-producing meadows, can eradicate infestations and limit re-infestation. Substantial use of the new herbicide imazapyr may result in higher efficacy and faster declines in the overall infestation in Puget Sound. Continued funding and support is needed to keep up this successful effort in Puget Sound.

Spartina Eradication Program

Introduction

Why is *Spartina* a problem?

The invasive noxious weed *Spartina* is found in the marine intertidal areas of Washington state. *Spartina* out competes and displaces beneficial native vegetation. It destroys migratory shorebird and waterfowl habitat in Willapa Bay, one of the most important estuaries on the West Coast migratory route. It also threatens to severely impact a shellfish industry that is extremely important to the economy of Washington state.

What species of *Spartina* occur in Washington state?

There are currently four species of non-native *Spartina* known to occur in Washington state. *Spartina alterniflora* is most widely found in Willapa Bay with over 7,000 solid acres currently infesting the Bay. *Spartina alterniflora* is also known to occur in Skagit County within Padilla Bay, Clallam County within Sequim Bay, Jefferson County within Thorndyke Bay and at several sites within Grays Harbor. Figure 11 *(see pg. 48)* shows *Spartina alterniflora* invading a mudflat in Willapa Bay.

Spartina patens is known to occur at only one location, Dosewallips State Park in Jefferson County. This infestation is controlled with yearly surveys, digging and herbicide applications as needed. Figure 12 *(see pg. 48)* shows the largest of the *Spartina patens* clumps found in 2001.

Spartina anglica is present in Skagit, Snohomish and Island counties. It has also been found in San Juan, King, Kitsap and Jefferson counties. Figure 13 (*see pg. 49*) shows a *Spartina anglica* clone in Puget Sound. It currently infests approximately 645 acres in Puget Sound and Hood Canal.

Spartina densiflora is a South American species that was discovered in 2001 in the northwest portion of Grays Harbor and within Race Lagoon in Island County. Figure 14 (*see pg. 49*) shows *Spartina densiflora* in northwest Grays Harbor.

How was *Spartina* introduced into Washington state?

Spartina alterniflora was unintentionally introduced to Willapa Bay as packing material for east coast oysters that were dumped into the bay during the late 1800's. In Puget Sound, various landowners intentionally introduced *Spartina alterniflora*, planting it to stabilize shorelines. *Spartina anglica* was also intentionally introduced. It was planted at a farm located in Port Susan in the early 1960's to serve as bank stabilization and potential feed for cattle. The modes of introduction for both *Spartina patens* and *Spartina densiflora* are unknown.

In all, there are ten counties in western Washington with one or more infestations of *Spartina alterniflora*, *Spartina anglica*, *Spartina patens* or *Spartina densiflora*. These include Clallam, Grays Harbor, Island, Jefferson, King, Kitsap, Pacific, San Juan, Skagit and Snohomish counties.

Spartina infestations range from one infestation in Clallam County measuring only a few square feet to more than 7,000 solid acres (if contiguous) spread throughout Willapa Bay in Pacific County. All totaled, *Spartina* infests over 7,500 solid acres spread over more than 20,000 total acres.

How do we eradicate *Spartina*?

Spartina spreads quickly and is extremely 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 IPM (methods include 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.

WSDA *Spartina* Program

In 2004, the WSDA *Spartina* Eradication Program worked collaboratively with partner agencies to continue *Spartina* control; hired, equipped and coordinated a crew to treat all infestations in Clallam, Jefferson, Kitsap and King counties; assisted the Swinomish and Suquamish tribal communities with control work on their property; and worked cooperatively with WDFW, DNR, USFWS and the aquaculture industry on infestations in Willapa Bay.

WSDA continued to work cooperatively with the Department of Ecology to administer the NPDES permit for aquatic noxious weed control, extending NPDES coverage to numerous federal, state and local governmental agencies and private entities for herbicide applications to both marine and freshwater environments.

WSDA provided funding through interagency agreements, personal services contracts and direct cost-share to state and local government agencies and private landowners. WSDA also provided over $200,000 in equipment and herbicide to WDFW, DNR, USFWS, Skagit, Island and Snohomish counties and the Willapa Bay/Grays Harbor Oyster Growers Association for work in both Willapa Bay and Puget Sound. WSDA organized and facilitated the exchange of *Spartina* eradication information through regional planning and informational meetings; and continued to explore with partner agencies more efficient and cost-effective ways to eradicate *Spartina.*

***Spartina* Budget**

WSDA allotted $1.76 million of its initial appropriation from the Aquatic Lands Enhancement Account (ALEA) for Spartina activities during the 2003-2005 biennium. Though $400,000 less than the amount appropriated in the 01-03 biennium, the lower funding did not substantially impact the overall success of the program. WSDA pre-purchased herbicide for the 2003 control season at the end of the 2003 fiscal year, which allowed WSDA to save a majority of the money

allotted for herbicide purchases until the beginning of the 2004 treatment season. This allowed for the more expensive imazapyr to be purchased and more acreage to be treated. WSDA also received an additional $85,000 in ALEA funds for Spartina eradication efforts in Willapa Bay and Grays Harbor during the 2004 control season in the FY 04 supplemental budget. Table 2 illustrates how WSDA has budgeted its appropriation.

Table 2. Budget Activity by Area – FY04 and FY05

	Puget Sound/Oly. Peninsula		Willapa Bay		Total	
Activity	*FY04*	*FY05*	*FY04*	*FY05*	*FY04*	*FY05*
[1]WSDA Coordination and control activities	$181,517	$181,518	$181,518	$181,518	$363,035	$363,036
[2]Large-scale cost share and IPM	0	$33,000	$180,774	$468,386	$180,774	$501,386
[3]Purchased Services					$220,000	$220,000
Skagit Co.	$40,000	$40,000				
Island Co.	$50,000	$50,000				
Snohomish Co.	$50,000	$50,000				
Swinomish Tribe	$10,000	$10,000				
WDFW			$60,000	$60,000		
Other	$5,000	$5,000	$5,000	$5,000		
Total WSDA Budget	**$33517**	**$369,518**	**$427,292**	**$714,904**	**$763,809**	**$1,084,422**
[4]Other State Agency Operational Budgets						
WDFW	$113,284	$84,915	$172,755	$141,425	$286,039	$226,340
WDNR			$291,000	$291,000	$291,000	$291,000
TOTAL State Agency Budgets	**$449,801**	**$454,443**	**$891,047**	**$ 1,147,329**	**$1,340,848**	**$1,601,762**

Notes for Table 2:

1. WSDA Coordination and Control Activities: These expenses include program coordination and control costs including salaries and benefits, travel, attorney fees, public notification expenses and other goods and services.
2. Large-scale cost share and IPM: These are the costs of aerial applications to approximately 2,300 acres (three sites) in Willapa Bay and cost-share to oyster growers for ground applications. Includes additional one-time funding of $85,000 for 2004 control season.
3. Purchased Services: WSDA has written two-year Interagency Agreements with Skagit, Island and Snohomish counties, an Interagency Agreement with WDFW to conduct work in Pacific County, and an Intergovernmental Agreement with the Swinomish Tribal Community to conduct work on its property in Skagit County.
4. These figures represent the Spartina eradication operational funds available to the Washington Department of Fish & Wildlife and the Washington Department of Natural Resources. This funding is separate from WSDA's Spartina funding.

The budget table does not include the amount of funding provided by the USFWS for eradication activities. USFWS reports it received $956,713 for the 2004 control season.

County Activities

In 2004, WSDA continued to allocate funding for resources for *Spartina* work crews in those counties with the majority of the infestations. WSDA allocated these resources by way of interagency agreements with the Skagit, Island and Snohomish County Noxious Weed Control

Boards and WDFW in Pacific County. WSDA also provided all necessary herbicide under these agreements. WSDA staff conducted field audits throughout the control season and facilitated coordination meetings to ensure contract priorities were adequately addressed.

Cost Share Program

As directed by RCW 17.26.007, WSDA offered financial assistance to private landowners for *Spartina* control and eradication in 2004. With the issuance of NPDES permits for herbicide applications, WSDA was able to provide cost share assistance in the form of purchasing herbicide for licensed private applicators as well as providing control for private landowners through county and state crews.

Table 3. WSDA Cost Share Options

Eradication/Control Method	WSDA Contribution	Landowner Contribution
County or state work crews mow and/or apply herbicide	WSDA grants county funds to treat priority areas	Must treat once during the season or agree to pay herbicide costs
Direct cost share - Landowner applies herbicide	100% of herbicide costs	100% labor & equipment
Direct cost share - Landowner covers or digs up infestation	100% of pre-approved materials	100% labor
Direct cost share - Landowner uses WSDA pre-approved contractor	50% of contractor cost	50% of contractor cost

Because private landowners most often request the services of the state or county work crews, WSDA allocates the majority of cost share funding for this option (through interagency agreements). However, during the 2004 season, WSDA provided over $10,000 in direct cost share to 35 landowners in Willapa Bay. With the new availability of imazapyr, the number of landowners requesting cost share increased by approximately 50%. WSDA was able to provide cost share for approximately 95% of the requests for the 2004 season. In 2005, WSDA will attempt to provide cost share assistance to every landowner on the Long Beach Peninsula, with the overall goal of treating all *Spartina* on the Peninsula.

For the second year in a row, WSDA conducted the large-scale cost share project with the Willapa/Grays Harbor Oyster Growers Association, resulting in treatment of about 1,460 acres of infestation. WSDA provided over $45,000 in herbicide, equipment and resources directly to the association for this effort as well as coordinating and conducting an aerial application to the identified cost share site at an overall cost of approximately $350,000.

Management Plans

As a requirement of the NPDES permit, WSDA developed a Statewide IPM Plan for the 2004 season. The Statewide IPM Plan was a compilation of the five regional IPM work plans.

WSDA has been developing regional work plans since 1998. Copies of the 2004 statewide management plan as well as the 2004 regional plans are available by contacting the WSDA

Statewide *Spartina* Eradication Program Coordinator. WSDA will update all IPM work plans prior to the 2005 control season.

2004 Highlights

In 2004, WSDA, state and federal partner agencies, local governments, tribal entities, and commercial and private landowners treated approximately 6,200 solid acres of *Spartina* throughout Puget Sound, Grays Harbor and Willapa Bay. There are many positive highlights in 2004. Several are discussed below.

Imazapyr

The biggest advance in *Spartina* control in Washington state came about in 2004. For nearly 10 years WSU researchers have been studying the efficacy of an herbicide, imazapyr, on *Spartina alterniflora* in Willapa Bay. Throughout the course of the research, imazapyr has been shown to be very effective and consistent. Not only was the efficacy improved over that of glyphosate, the other approved herbicide, but also the amount of herbicide needed per acre was far less.

In early 2004, the necessary ecological risk assessment of imazapyr by WSDA was completed, the U.S. Environmental Protection Agency registered the herbicide, and the Department of Ecology approved its use as an aquatic herbicide in Washington. With the aquatic pesticide permit (NPDES permit) allowing the use of imazapyr in place, all entities involved in *Spartina* control in Washington state began using imazapyr in June 2004.

Prior to any applications taking place, WSDA, WSU and BASF, (the manufacture of the imazapyr product) sponsored two full-day training courses on the proper use and application of imazapyr. The training consisted of both classroom and field training. Participants were given the opportunity to test several different types of application equipment commonly used in the eradication of *Spartina*. One course was conducted in Pacific County and the other was in Snohomish County.

With the extensive research that has been conducted, managers are optimistic that the areas treated with imazapyr during the 2004 season will yield very effective results. The cost of using imazapyr, however, is $180 per acre, more than double the cost of using glyphosate at $81 per acre.

Imazapyr was used almost exclusively on all broadcast applications to meadows treated during the 2004 season. Only about 300 acres of meadow were treated with glyphosate due to the costs factors involved with using imazapyr. Many agencies also utilized imazapyr for hand-held applications, either by itself or tank mixed with glyphosate.

The Puget Sound effort also began using imazapyr on a large scale. Managers in Puget Sound were especially interested in trying imazapyr in an attempt to accelerate the overall decline in infested acreage. Though no imazapyr research or testing has been done on *Spartina anglica*, managers are hoping for similar results as on *Spartina alterniflora*. Early indications point to this new herbicide being very effective on *Spartina anglica* as well, although true efficacy data will not be able to be collected until spring 2005.

LIP Grant Awarded to Bay Center Mariculture and Taylor Shellfish

Preliminary planning of the 2004 season by the Willapa Bay *Spartina* Advisory Committee included the initial treatment of the North Nemah and Palix meadows, two of the largest meadows in Willapa Bay that had never been treated. As the plan progressed, and the efficacy of 2003 treatments and the need for substantial re-treatments became clear, it appeared that WSDA funding was not going to be sufficient for both meadows to receive treatments.

Knowing this, WSDA began looking for other funding to ensure that both meadows would be treated and eradication in Willapa Bay would proceed as fast as possible. Staff with the WDFW *Spartina* program suggested the Landowner Incentive Program (LIP), which awards grants to private landowners restoring lands to the benefit of fish and wildlife.

In early spring, WSDA met with two of the major tideland owners in the Bay Center area of Willapa Bay: Taylor Shellfish and Bay Center Mariculture. WSDA and the two-tideland owners developed a plan for the Bay Center area and completed the grant application. The application requested approximately $100,000 for up to five years, to help eradicate the Palix meadow and other infestations around the Bay Center area.

The grant was approved by WDFW in early June, but still needed final approval from the USFWS in Olympia. Funding for LIP grants comes from USFWS with administration of the grant program by WDFW. By early September, final approval had come through and the extra funding was in place.

The original plan called for a majority of the funding to be spent on the treatment of the meadows during the 2004 season. However, since the funding did not come through until late, WSDA partnered with the WDFW *Spartina* program to treat the meadows in August. WSDA will work with the Taylor Shellfish and Bay Center Mariculture to revise the plan for the LIP grant to ensure it is used on the Palix meadow and surrounding area to ensure eradication is successful.

Second year of large-scale cost share with growers

In 2003, WSDA partnered with the Willapa Bay/Grays Harbor Oyster Growers Association (Growers Association) to conduct a large-scale cost share project in the South Nemah/Seal Slough area of Willapa Bay. This effort proved to be a success in terms of building partnerships, and in using a cost-share approach for these types of treatment sites.

During the 2004 season, the partnership was expanded to not only include the re-treatment of the South Nemah/Seal Slough site, but also the Bay Center area, including the 600-acre Palix meadow.

At the South Nemah/Seal Slough site, USFWS joined the cost share partnership and conducted the follow-up re-treatment to approximately 200 affected acres of the solid meadow that was aerially treated in 2003. The remainder of the meadow and much of the clone field was treated aerially by WSDA using imazapyr. The Growers Association treated the remaining clones.

In the Bay Center area, WSDA treated the entire Palix meadow and many of the smaller meadows downstream from the Niawiakum and Palix River bridges. The aerial application also included the treatment of much of the small clone field spreading out from the main meadow. The Growers Association treated the remaining clones as well as much of the infestation found in tidal channels adjacent to Bay Center. DNR also took part in the Bay Center cost share treatments. DNR crews treated much of the infestation on the north side of the Niawiakum River west of the bridge. These were areas were aerial application wasn't feasible.

Once again, this effort proved to be a success. The Growers Association crews possess such an immense knowledge about the bay and are able to quickly and efficiently treat the small clones and infestations that are not feasible for WSDA to treat from the air. WSDA and the Growers Association will again consider the option of a large-scale cost share effort in 2005.

Second Year of Water Monitoring Conducted

As required by the NPDES permit, WSDA conducted water quality monitoring for the second consecutive year.

During the 2003 season, WSDA tested several sites for concentrations of glyphosate during the next incoming high tide after applications were completed. Testing sites were located in Puget Sound, Grays Harbor and Willapa Bay. The monitoring plan for 2004 was modified to sample for not only concentrations of glyphosate at the treatment location during the next incoming high tide, but also to test for concentrations throughout time and for concentrations away from the treatment site.

In 2004, WSDA also conducted water quality testing for imazapyr as well. WSDA tested for imazapyr concentrations at treatment sites, as well as off-site movement and concentrations through time.

All samples were collected using standard water quality sampling techniques to ensure no sample contamination. Anatek Labs in Moscow Idaho, fully accredited by the Department of Ecology, processed the samples. The results indicate that very low to non-detectable levels are present immediately after applications are complete and, as time elapses, the amounts quickly diminish to non-detectable levels. The results for off site transport also indicated that non-detectable levels were found not too far from the treatment sites.

Program Results by Geographic Area

Spartina Eradication Efforts in Willapa Bay

The water body of this geographic area includes the mouth of Willapa Bay, Willapa Bay, and all the rivers, streams and creeks that feed into the Bay.

Extent of the Infestation in Willapa Bay

In September 2003, DNR conducted an aerial infrared photography survey of the entire Willapa Bay. This survey allows DNR to identify the *Spartina* separate from all other vegetation and calculate a fairly accurate infested acreage figure. The infrared photography is able to identify the unique color signature of *Spartina* among the various other plants that occur in the area. For this to work, however, the *Spartina* has to be actively growing.

Because the survey was conducted at the end of the treatment season, photos of many of the treated areas did not yield accurate acreage numbers because the plants were no longer actively growing.

We do know, however, the approximate amount of acreage that was treated during the 2003 season. By using the 2003 treated acreage data together with the infrared photography data and then comparing it with information on solid acres treated in 2004, the agencies estimate there was approximately 7,020 solid acres of *Spartina* at the beginning of the 2004 treatment season.

This is a reduction of approximately 1,000 solid acres, or 12%, based on the estimated acreage at the beginning of the 2003 treatment season. This is the first time we have seen an actual decline in the solid acreage in Willapa Bay. With the use of a new, potentially more effective herbicide, and continued funding, we should start to see an even greater decline next year.

Roles of Participating State and Federal Agencies in 2004

In 2004, the participating agencies pursued the use of various herbicide application systems and mechanical control tools to combat the spread of *Spartina*. The following list outlines the role each agency assumed in Willapa Bay during the 2004 control season.

- **WSDA –** Continued to work with the Department of Ecology to ensure NPDES coverage was extended to all qualified applicators. Provided resources, equipment and herbicide to WDFW, DNR, USFWS and the Growers Association. Worked cooperatively with WDFW to control North Willapa Bay meadow, conducted cost share control activities with WDFW and DNR on private land on the Long Beach Peninsula and the North East side of Willapa Bay, continued to operate mechanical control tools on North Long Beach Peninsula. Conducted all aerial applications.

- **DNR –** Conducted control work in Pot Shot, Stanley Point and Naselle River as well as Natural Area Preserves. Managed the infrared aerial photography and mapping program. Implemented a *Spartina* control-monitoring program in cooperation with WSU. Provided

staff time and airboat assistance for UW-ONRC biocontrol program. Assisted WSDA with cost share on the Long Beach Peninsula.

- **WDFW** – Conducted control operations in cooperation with WSDA in North Bay priority area, conducted control work with WSDA on private property in Northeast Willapa Bay and assisted University of California-Davis in collecting data for research that may help to improve *Spartina* control. Collected data for control monitoring program. Cooperated with WSDA on aerial broadcast applications in North Bay.

- **USFWS** – Operated ground broadcast application equipment, conducted control work in South Bay, South Long Beach Peninsula, Long Island Slough, North Long Island, Ellsworth Slough and the South Nemah/Seal Slough area. Provided airboat support for *Spartina* researchers.

- **UW-ONRC** – Continued to manage the biological control release program. Continued to develop tidal elevation prediction maps of various treatment sites to predict the dry-time plants will receive on specific days.

- **WSU** – Continued research to improve efficacy and efficiency of control tools. Began researching the potential of various mechanical tools for restoration at successfully eradicated sites.

Highlights of the 2004 Season in Willapa Bay

In 2004, the cooperative *Spartina* eradication effort resulted in treatment of approximately 5,700 solid acres spread throughout the nearly 13,000 affected acres of Willapa Bay. The acreage treated encompassed about 75% to 80% of the overall solid infestation. This is up from 2003 when about 65% to 70% of solid acres were treated. Figure 1 shows the approximate location of all treatment sites. Table 4 identifies the areas of the bay treated, who conducted treatment, and what kind of treatment was done. Figures 2 and 3 are maps of North Willapa Bay and South Willapa Bay treatment areas, respectively.

Building on the success of the 2003 season, WSDA feels that the 2004 treatments will result in sizable reductions in Spartina bay wide, the second consecutive year of overall decline in Willapa Bay. With the extensive use of the new herbicide imazapyr, WSDA is confident that the efficacy achieved as a result of the 2004 applications will exceed those resulting from the 2003 season, when only glyphosate was used.

The first priority of the 2004 work plan for Willapa Bay was to ensure that all sites treated during the 2003 season received full re-treatment. Research conducted in both Willapa Bay and Puget Sound have highlighted the importance of consistent multi-year treatments to sites to ensure eradication proceeds at the most effective and efficient pace. During the 2004 season, this priority was met. All sites treated during the 2003 season received treatment in 2004. Approximately 90% of the re-treatments were conducted using the new herbicide imazapyr, hopefully ensuring more effective and consistent reductions.

The second priority of the 2004 work plan was for initial treatments of several areas of the bay, including the North Nemah meadow, the Palix meadow, Wilson Point, and the section of infested shoreline from North River to Cedar River. This priority was also met. Both the North Nemah and Palix meadows, a combined 1,300 solid acres, were treated using imazapyr applied by air. The other areas were treated with imazapyr, glyphosate, a combination of both, or by mechanical control methods.

In North Willapa Bay, WSDA and WDFW re-treated all areas treated during the 2003 season, including approximately 150 solid acres of the North Willapa meadow by air. The remainder of the North Willapa meadow was re-treated with a combination of mechanical crushing and hand-held herbicide applications. Figure 15 (*see pg. 50*) shows a portion of the North Willapa meadow before any treatments. Figure 16 (*see pg. 50*) shows the same site after one year of mechanical crushing, with herbicide applications to the re-growth. WSDA and WDFW also re-treated the meadows at Stoney Point and Bruceport (previously know as the Disney site). WDFW conducted initial applications to the stretch of shoreline between the Bruceport site and the Rose Ranch site, as well as the stretch of beach from the mouth of the North River to the mouth of the Cedar River. Finally, WDFW and DNR treated the various infestations within, and around the mouth of the Bone River. These included the clones adjacent to the mouth of the Bone River and the meadow on the north side of Wilson Point.

In Central Willapa Bay, WSDA conducted aerial applications to the entire Palix meadow in the Bay Center area as well as the North Nemah meadow. Treatments to both meadows totaled just over 1,300 solid acres. Originally, about 50% of the treatment of the Palix meadow was going to be paid for by the LIP grant approved by WDFW. However, the necessary federal approval did not come through in time, so the WDFW *Spartina* program provided $30,000 to ensure the application could proceed. As well as the aerial application that took place in the Bay Center area, DNR and the Growers Association treated the remaining infestations in the area west of both the Niawiakum and Palix River bridges. WDFW and DNR conducted several cooperative treatments to the section of beach between the North Nemah infestation and the Bay Center area, however, due to lack of time and money, the entire stretch did not get treated.

In South Willapa Bay, USFWS conducted the majority of the treatments, from the tip of Long Island south through Long Island Slough, Porters Point, and up to the very southern end of the Long Beach Peninsula. The Naselle River, Stanley Point, and Pot Shot Slough were treated by DNR. The South Nemah/Seal Slough area was re-treated through a cooperative effort between WSDA, the Growers Association and USFWS. WSDA mechanically crushed 200 acres in the spring with a follow-up ground broadcast treatment conducted by USFWS. The remaining 860 acres of solid meadow and large clones were treated aerially by WSDA in June. Figure 17 (*see pg. 51*) shows the helicopter conducting the application; Figure 18 (*see pg. 51*) shows the site three months after the application. Figure 19 (*see pg. 52*) shows the Porters Point site after glyphosate applications in 2003. Figure 20 (*see pg. 52*) shows the same site after imazapyr applications in 2004. In the South Willapa Bay area, all treatments sites were initially treated during the 2003 season.

Figure 1. Approximate Location of 2004 Interagency Willapa Bay Treatment Sites

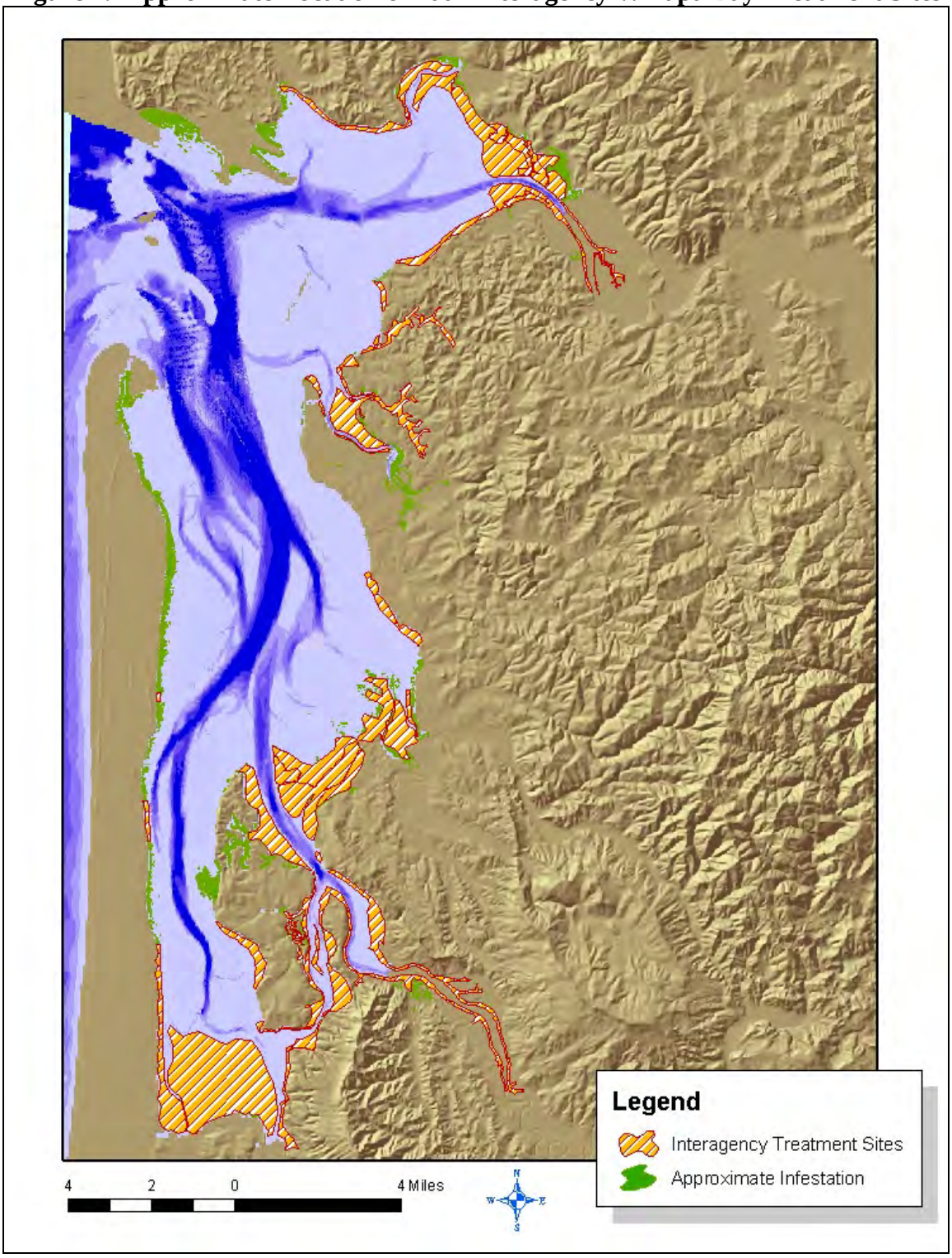


Table 4. Summary of 2003 Willapa Bay *Spartina* Eradication Effort

Site	Estimated Solid Acreage Treated	Approximate Affected Acres Treated	Entity Conducting Treatment	Treatment Method Used
North Willapa Area				
North Willapa Meadow/Smith Creek	680.7	1661	WDFW, WSDA	Herbicide, Crush
North Shore	150.0	430	WDFW, WSDA	Crush, Herbicide
Bruceport to Rose Ranch	57	167	WDFW	Herbicide
S. Willapa River/ Rose Ranch	196.2	458	WDFW, WSDA	Herbicide, Crush
Mailboat Slough	13.3	96	WDFW	Herbicide
Niawiakum NAP	11.7	70	DNR	Herbicide
Bone River NAP	9.5	93	DNR	Herbicide
South Stoney Point	25	40	WDFW	Herbicide
Wilson Point	64	64	WDFW	Crush
Bay Center	573	625	WSDA/WBOGA/DNR	Herbicide
Nemah Beach	25.5	34	DNR, WDFW	Herbicide
North Nemah	860	860	WSDA	Herbicide
South Willapa Area				
North Pot Shot	50.6	83.3	USFWS, DNR	Herbicide
O'Meara Pt. to Bear R.	3.3	177	USFWS	Herbicide
O'Meara Point	56	103	USFWS	Herbicide
Pot Shot	26	223	DNR	Herbicide
South Long Island	5	36	USFWS	Herbicide
Sunshine Point	15.5	15.5	DNR	Herbicide
Smokey Hollow	1	20	WSDA, DNR	Herbicide, Seedling Dig
East Long Island/ Middle Isl. Reserve	244.5	362	USFWS	Herbicide
Ellsworth/Naselle/ Chetlo Harbor	193	803	DNR, USFWS, TNC	Herbicide, Rototill
Porters Point/Tarlatt Slough	844	3348	USFWS	Rototill, Herbicide
Stanley Point	87.5	114	DNR	Herbicide
Kaffee Lewis Slough	440.3	650	USFWS	Herbicide
South Nemah/Seal Slough	945	1668	WSDA/WBOGA, USFWS	Herbicide, Crush
Long Beach Cost Share	100	209	WSDA, DNR, WDFW	Herbicide
Total	**5,677.6**	**12,734.8**		

Figure 2. 2004 North Willapa Bay Interagency Treatment Sites

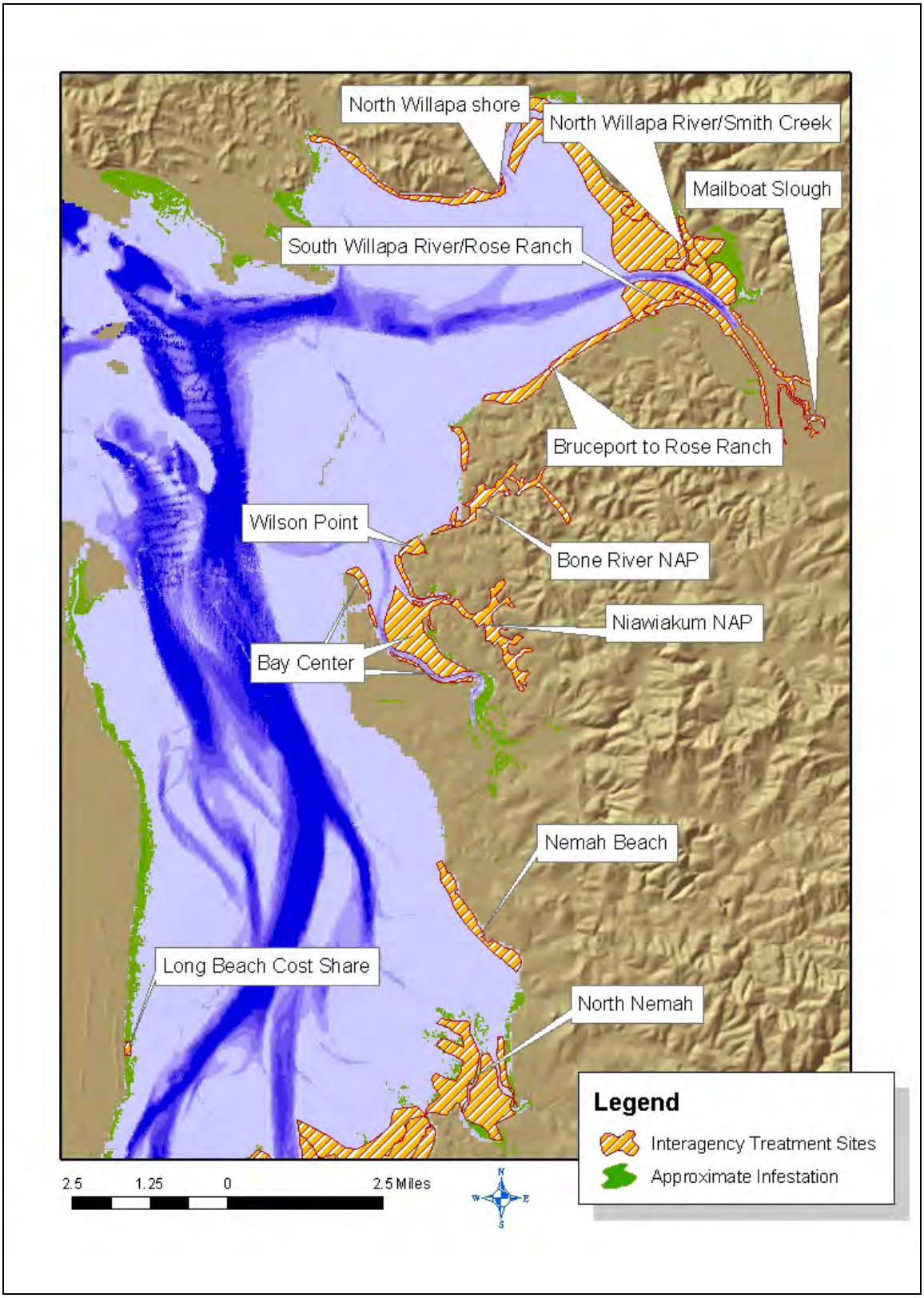
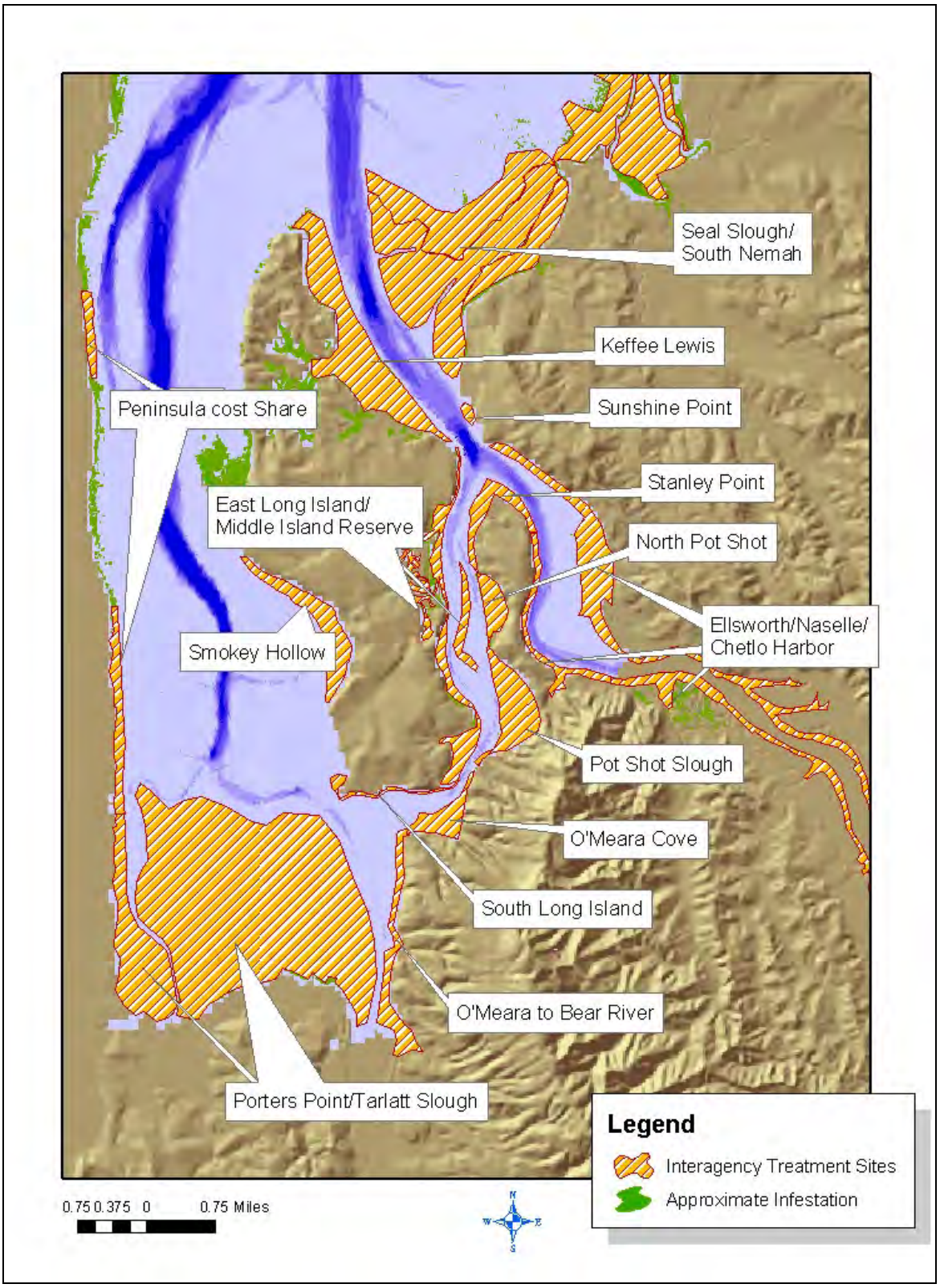


Figure 3. 2004 South Willapa Bay Interagency Treatment Sites



2004 *Spartina* Eradication Monitoring Program, Willapa Bay

The Willapa Bay *Spartina* monitoring program was continued this year, building on the 2003 efforts. The monitoring program allows managers to understand the effectiveness of treatment methods at different sites and then to use that information, along with acres treated, to determine how much *Spartina* was killed each year. It also provides information about how effective the overall control approach is, as well as effectiveness of individual treatments. Data generated from the program are also used for adaptive management purposes–to improve and make future adjustments to the control strategy.

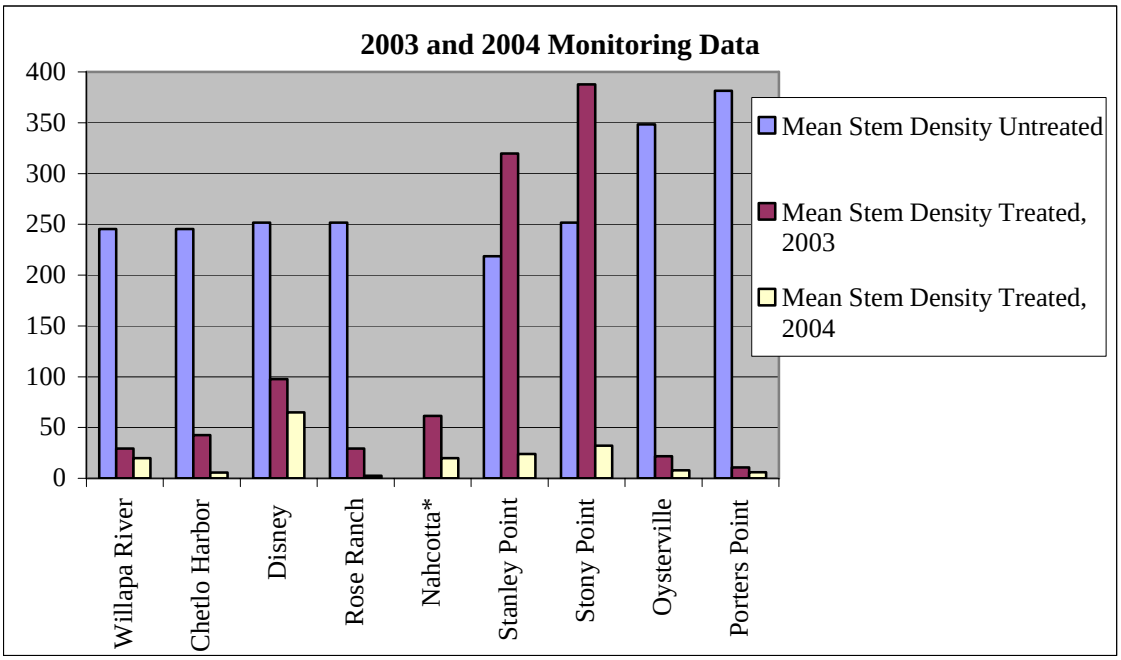
Monitoring sites were selected in areas where chemical and mechanical control have been previously conducted, as well as at untreated sites. The treated sites vary in substrate type and method and timing of mechanical treatment. Untreated sites serve as a reference for comparison to the sites where control has taken place. The sites included in the monitoring program are as follows:

Site	Treatments
Stanley Point	Crushed winter 2002/spring 2003, sprayed 2003
Willapa River	Crushed summer 2001, 2002 and 2003
Chetlo Harbor (Naselle River)	Crushed winter 2001 and fall 2002, sprayed 2003
Stoney Point	Crushed fall 2002, sprayed summer 2003
Disney Property	Crushed fall 2002 and 2003
Rose Ranch	Crushed winter 2002 and spring/summer 2003
Nahcotta	Crushed summer 2002 and summer 2003
Oysterville	Hand-held spray, summer 2002, 2003
Porters Point	Ground broadcast spray, summer of 2002, 2003

At each site, 100 samples were collected from treated areas and 25 samples were collected from an untreated area (the reference site). The samples were collected along randomly located transects at one-meter intervals. A 0.5 x 0.5 m^2 sampling unit, or quadrat, was placed along the transects and the number of stems (stem density), number of flowering stems, and percent native vegetation cover were recorded.

As shown in Graph 2, the monitoring data show significant reductions in average stem density in all of the sites. The most dramatic differences in stem density appeared at the two sites that showed increases in stem density the year before: Stanley Point and Stoney Point. In 2004, following chemical treatments at the end of the 2003 control season, the mean stem density declined 93 percent and 92 percent, respectively. Other sites showing quite substantial reductions between 2003 and 2004 include Chetlo Harbor (87 percent), Rose Ranch (91 percent), and Nahcotta (67 percent). The remaining four sites (Willapa River, Disney Property, Oysterville and Porters Point) also had reductions in stem density but to a lesser degree.

Graph 2. 2004 monitoring data - Stem density



* No reference site data available for Nahcotta.

Further analysis of the data is planned to provide insight on the change in flowering stem density at the sites, as well as the proportion of sample quadrats containing 0 to 10 stems. This information, together with the stem density data, will be used to evaluate the efficacy of the treatments and to adjust our management approach and plan for future control work.

Monitoring at all sites will continue in 2005 to assess the amount of *Spartina* growing back after herbicide applications and additional mechanical control. The expectation in 2005 is to see *Spartina* eradicated from several of the monitored sites and then to focus major control efforts in new areas.

Biological Control

The *Spartina* biological control program using the planthopper, *Prokelisia marginata*, is continuing to make progress. Several populations of this insect are now well established and expanding. Over the past four years, University of Washington researchers have determined the characteristics of habitats in which *P. marginata* has the highest summer reproduction and winter survival. Released populations are now more likely to make it through the critical establishment phase and form permanent, growing populations. Until this year, the source of *P. marginata* for introduction into Washington was San Francisco Bay, California. Due to low wintering survival of this ecotype, *P. marginata* has now been introduced from the northeast coast of the United States with the expectation that it will have better survival and therefore build more rapidly to high densities over large areas as needed to suppress the *Spartina* population.

Currently there are three areas where *P. marginata* populations are well established and expanding in Willapa Bay. These include Leadbetter Marsh, North Cove, and Tarlatt Slough. Other releases from previous years are tentatively established with lower densities. These include upper Palix River and Parpala Road. In April and May, about 275,000 *P. marginata*

were released at 32 new locations in Willapa Bay (see Table 5). Most of these releases were of the East Coast ecotype. This was the largest number of *P. marginata* released in a year since the start of the biocontrol program. The releases were made into areas that were not slated for control by other methods in the near term. As of September, *P. marginata* was recovered at all of the new release sites. At some sites, the insects were abundant enough that the plants were showing signs of stress.

Table 5. New Releases in 2004 - Willapa Bay

Site	Date	Source	Number released
Leadbetter (1)	4/8/2004	CA	5,000
Leadbetter (1)	4/8/2004	RI	5,000
Leadbetter (1)	4/8/2004	VA	5,000
Leadbetter (1)	4/8/2004	GA	5,000
North Cove	4/14/2004	CA	5,000
North Cove	4/14/2004	RI	5,000
North Cove	4/14/2004	VA	5,000
North Cove	4/14/2004	GA	5,000
Grassy Island	4/15/2004	CA	5,000
Grassy Island	4/15/2004	RI	5,000
Grassy Island	4/15/2004	VA	5,000
Grassy Island	4/15/2004	GA	5,000
Tokeland	4/23/2004	CA	5,000
Tokeland	4/23/2004	RI	5,000
Tokeland	4/23/2004	VA	5,000
Tokeland	4/23/2004	GA	5,000
Leadbetter (2)	4/27/2004	CA	3,000
Leadbetter (2)	4/27/2004	RI	3,000
Leadbetter (2)	4/27/2004	VA	3,000
Leadbetter (2)	4/27/2004	GA	3,000
Niawiakum Bridge	5/6/2004	Mix	6,000
Tokeland S-curve	5/11/2004	Mix	7,000
Tokeland Tide gate	5/11/2004	Mix	4,000
South Leadbetter (new site)	5/19/2004	Mix	9,000
Jenson Spit	5/20/2004	Mix	14,700
Tokeland Golf Course	5/20/2004	Mix	9,000
Upper Palix 2	6/2/2004	Mix	10,000
South Leadbetter (old site)	6/8/2004	Mix	21,000
Tokeland Southside (1)	5/25, 8/10	Mix	26,500
Tokeland Southside (2)	6/9/2004	Mix	10,000
Leadbetter Extra South	6/15/2004	Mix	15,000
Lower Palix tidal slough	6/17/2004	Mix	7,000
Terramar	7/8/2004	Mix	12,500
Tarlatt (2)	4/21- 7/28	Mix	31,500

CA=California, RI=Rhode Island, VA=Virginia, GA=Georgia

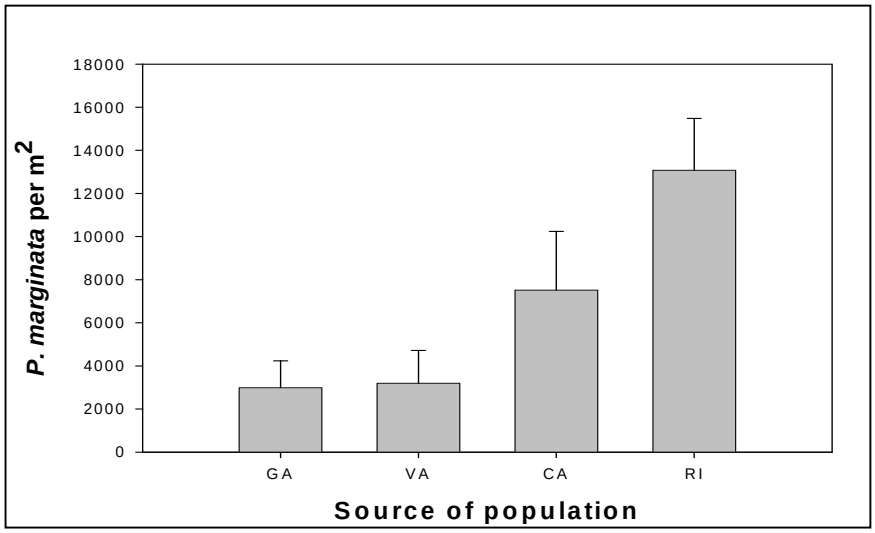
In Puget Sound, about 57,000 *P. marginata* were released at three new sites in 2004: Turners Cove (2), Turners Channel, and West Pass Dike. The insects released were primarily the East Coast ecotypes. As of September 2004, all three of these new populations were doing very well. At another site (Turners Cove (1)) where the California ecotype was released in 2003, the insects were present but very sparse.

Table 6. New Releases in 2004 – Puget Sound

Site	Date	Source	Number released
Turners Cove (2)	4/21/04	Mix	14,000
West Pass Dike	4/21/04	Mix	30,000
Turners Channel	5/3/04	Mix	13,000

Twenty of the releases that were made in Willapa Bay this year were set up as an experiment to compare the performance of the different geographic source populations of *P. marginata*. At each of five sites, 5,000 individuals of each of four source populations were simultaneously released. Each release was separated by at least 100 meters. Over the next two years, these populations will be monitored carefully to determine which population has the highest reproduction, winter survival, and phenological match to Washington's seasons. So far, Rhode Island insects are the best performers, attaining mean fall density that is approximately double that of *P. marginata* introduced from California and four times the densities of populations from Virginia and Georgia (Graph 3).

Graph 3. Mean densities of different source populations of *P. marginata*, September 2004



Each bar represents the mean of five replicate releases.

Even though progress with *P. marginata* is going well, the use of additional biocontrol agent species could improve the overall success of the biocontrol program. Multiple biocontrol agents can provide added stress to the plant. Moreover, added agent species will help ensure that biocontrol is effective in a variety of habitat types. Initial survey work for additional biocontrol agent species in the native range of Spartina has already been completed. More than two dozen

herbivorous insects were found that appear to specialize on Spartina. About ten of these have good potential for impacting invasive Spartina if introduced on the West Coast. Host specificity testing and risk assessment of these agents is needed to determine whether they would be safe to introduce into the new environment. This could be accomplished in two to three years with adequate funding.

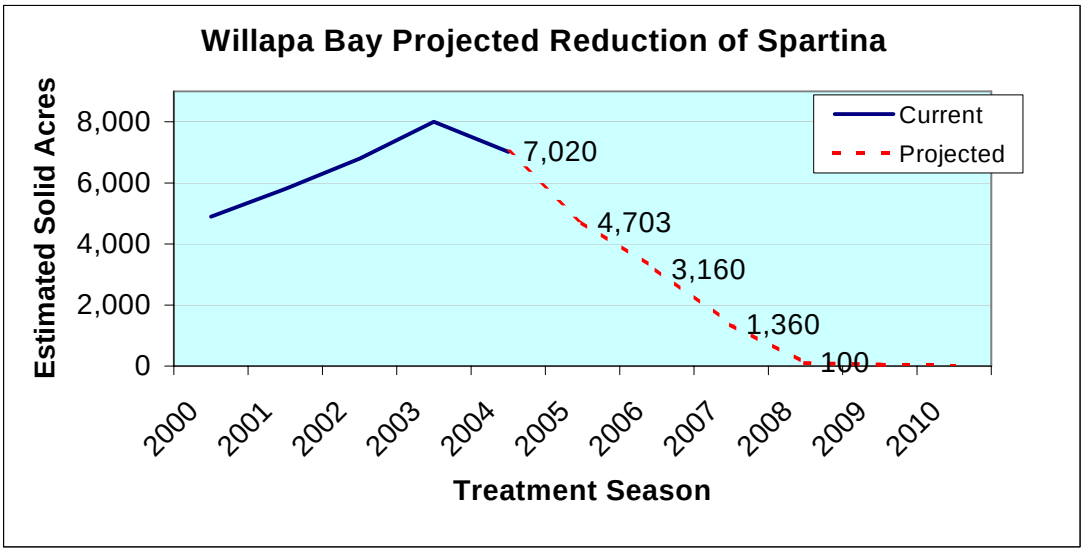
Recommendations for the Future

An unprecedented amount of control work was carried out in 2003, resulting in the first overall decline in the size of the Spartina infestation in Washington. The 2004 control season built on that achievement by treating as much acreage as possible in both Willapa Bay and Puget Sound and by using the new, more effective herbicide. 2004 was another very successful year in terms of acreage treated, and there is a renewed sense of optimism about the ability to achieve the overall goal of eradication. To continue to build on the achievements of the past two years, it is important to use the best control methods and treat as much acreage as possible. The cost of using imazapyr, however, is $180 per acre, more than double the cost of using glyphosate. The one downside to using the more effective herbicide was that WSDA has no funding available for herbicide for the last month of the biennium. WSDA has submitted a request for $122,000 for the FY 05 supplemental budget to treat 500 solid acres of Spartina with imazapyr in June 2005, the first, and arguably the most effective, month of the control season. Unless supplemental funding is provided, WSDA will have to wait to conduct any substantial applications until July, when the new biennium begins.

With the increased effort that has taken place over the past several years, it has become more and more important to take advantage of the entire treatment season and to ensure that the maximum amount of acreage is treated during the best months to treat. The activities of the 2004 control season illustrate the importance of sustained funding, continuing cooperation, and continued development of IPM tools. Graph 4 illustrates the current projection that Spartina can essentially be eradicated from Willapa Bay in five years. This projection assumes that:

- The 2004 treatments result in a 50% overall reduction.
- WSDA receives $122,000 supplemental funding for June 2005 herbicide needs.
- WSDA funding continues at the same levels as the 2003-2005 biennium.
- WDFW and DNR funding continues at the same levels as the 2003-2005 biennium.
- USFWS continues to receive $1,000,000 per year in federal funding for *Spartina* control.
- Through continued large-scale IPM, the effort will eradicate 2,000 solid acres per year in 2005 and 2006.
- The Spartina infestation has a growth rate of 17% (based on previous calculations from DNR), which is added in before the yearly reductions are subtracted.

Graph 4. Projected solid acres of *Spartina* with continued same level funding



Spartina Eradication Effort in Grays Harbor

This water body includes the mouth of Grays Harbor, Grays Harbor, and all the rivers, creeks and streams that run into Grays Harbor and the Copalis River drainage. Figure 4 shows the approximate locations of the 2004 treatment sites in Grays Harbor.

Extent of the Infestation in Grays Harbor

Due to the magnitude of the problem in neighboring Willapa Bay, property managers and landowners in Grays Harbor have long been concerned about the potential for invasion of *Spartina*. This threat was validated in 1992 with the discovery of one large *Spartina* clone in Grays Harbor by DNR staff. This was the only known infestation in Grays Harbor at the time, and the DNR crew mowed it repeatedly throughout the growing season.

In 1995, WDFW began conducting yearly surveys and control work in Grays Harbor. At the beginning of the 1995 season there were approximately 2 solid acres of known *Spartina* within the Grays Harbor management area.

Between 1995 and 2002, WDFW and the Grays Harbor County Noxious Weed Control Board conducted regular surveys of the harbor. WDFW conducted yearly control work on any infestations found during the surveys.

In 2002, WDFW, WSDA and DNR continued to put strong emphasis on preventing *Spartina* establishment in Grays Harbor. Specifically, all known infestations were treated by the end of the 2002 season, including the newly discovered *Spartina densiflora*.

Extensive control and survey efforts continued in Grays Harbor during the 2004 treatment season. WDFW again controlled all infestations and continued to find new small infestations. Of interest is a recent research study of drift cards released at the mouth of Willapa Bay. After the first release of drift cards at the mouth of the Willapa Bay, many of the cards turned up on the shorelines around the mouth of Grays Harbor, lending more evidence to the theory that the infestation in Grays Harbor is directly related to the infestation in Willapa Bay. This highlights the need to continue eradication efforts in Willapa Bay to keep Grays Harbor clean.

Recommendations for the Future

The size of the Grays Harbor treatments has fluctuated since 1992 from as much as the 3 solid acres controlled this season to as little as 0.25 acres controlled during the 2001 season. Every year new infestations are found in the bay. New research indicates that the Grays Harbor infestation is a result of seeds coming from Willapa Bay. This demonstrates the importance of continued funding not only to conduct surveys and control work in Grays Harbor, as well as for future reductions in the Willapa Bay infestation.

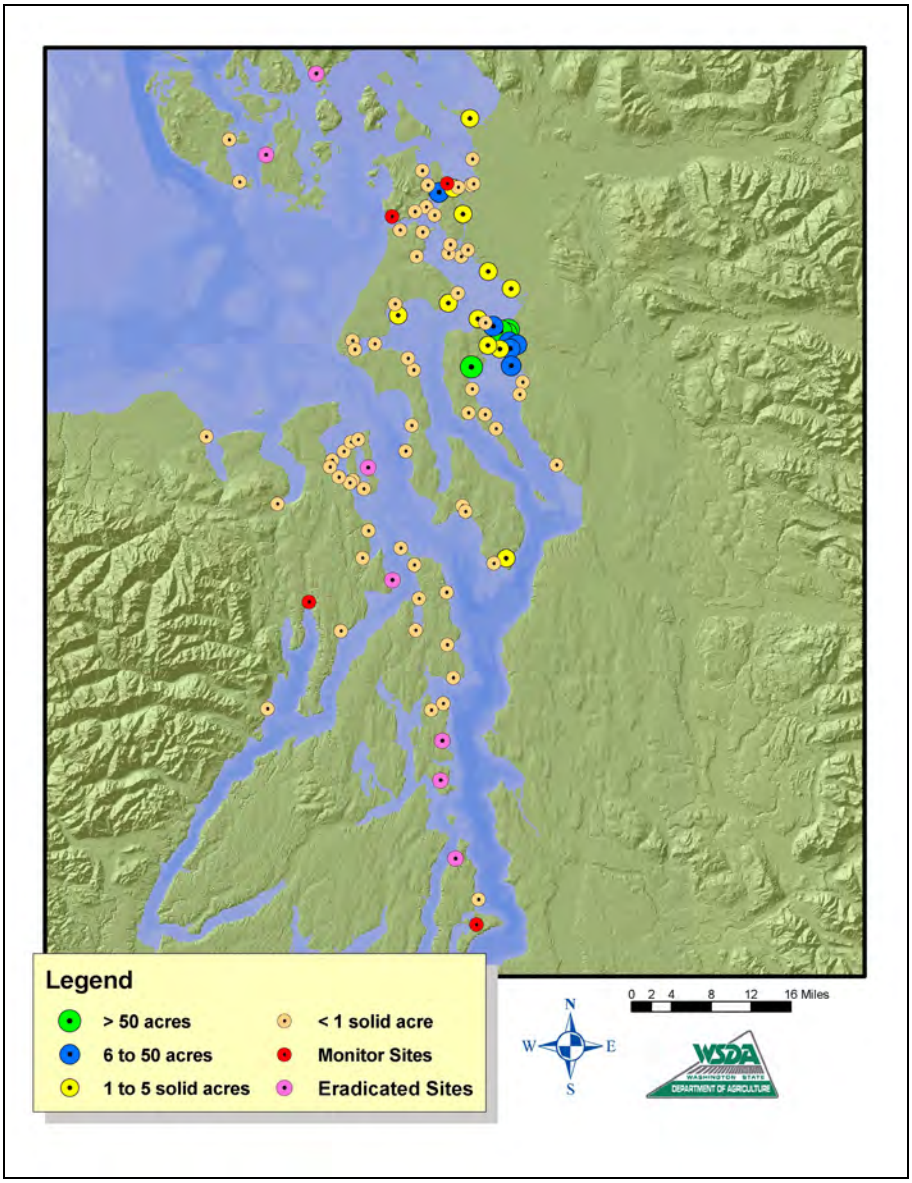
If the current level of activity continues in Willapa Bay, Grays Harbor can continue to be protected from a major infestation. Extensive surveys in Grays Harbor are required to ensure all infestations are identified and treated.

Figure 4. Approximate Locations of WDFW Grays Harbor Treatment Sites, 2004

Spartina Eradication Effort in Puget Sound and Hood Canal

For purposes of the WSDA *Spartina* Program, Puget Sound and Hood Canal refers to San Juan, Skagit, Island, Snohomish, Clallam, Jefferson, Kitsap and King counties. Figure 5 shows approximate locations and sizes of all known *Spartina* infestations in Puget Sound and Hood Canal. Figure 5 also shows locations of monitor sites, which are defined as sites of previous infestation at which no re-growth was found during the current season, and eradicated sites; at which no re-growth was found for at least the past two years. During the 2004 treatment season, an estimated 528 solid acres were treated.

Figure 5. Locations and Sizes of Known Puget Sound and Hood Canal *Spartina* Infestations



Extent of the Infestation in Puget Sound and Hood Canal

At the end of the 2003 field season, the North Puget Sound *Spartina* Task Force re-evaluated the total solid acreage in Puget Sound at 760 solid acres prior to the 2003 treatment season. After the completion of the 2004 season, treatment data, coupled with site surveys and monitoring data from sites were reductions where gained, has led managers to estimate the solid acreage remaining in Puget Sound at 645 acres. This is a 125-acre reduction from the 2003 figure and an overall acreage reduction of 35% from 1997.

Snohomish County

WSDA provided $50,000 to the Snohomish County Noxious Weed Control Board for *Spartina* eradication activities in 2004. On top of this funding, WSDA provided all the necessary herbicide to the county. WDFW and Wildlands Management also conducted a substantial amount of control work in Snohomish County during the 2004 season. This work was focused mainly on WDFW-managed lands on Leque Island. The herbicide for these treatments was also provided by WSDA.

In total, 350 solid acres of *Spartina* were treated in Snohomish County in 2004. Table 7 shows the solid acres treated, who did the treatment, and the treatment methods used on every site in Snohomish County. Figure 6 identifies the approximate location of the infestations.

For the second consecutive season, all meadows in Southeast Skagit Bay, Leque Island and Mystery Island were treated entirely. These sites are home to three of the largest infestations in Puget Sound and account for about 65% of the total infestation. The treatments were made possible through the successful cooperative efforts of WSDA, WDFW and Snohomish County. The combined size of these three infestations is approximately 280 solid acres. This constitutes about 80% of the overall infestation in Snohomish County.

Although the infestation in Southeast Skagit Bay is not being reduced as rapidly as managers had hoped, there are small reductions being seen to the infestation. On top of this, a second consecutive year of complete treatment should again substantially reduce the amount of seed coming from the infestation and potentially being transported throughout Puget Sound.

WDFW, for the second consecutive season, treated the entire infestations at Leque Island and Mystery Island; the combined size of these infestations is over 146 solid acres. Both infestations showed small declines in overall size. During the 2004 season, both infestations were treated with a combination of the new herbicide imazapyr and glyphosate. Early indications are promising and managers are confident that large declines will result from this season's work.

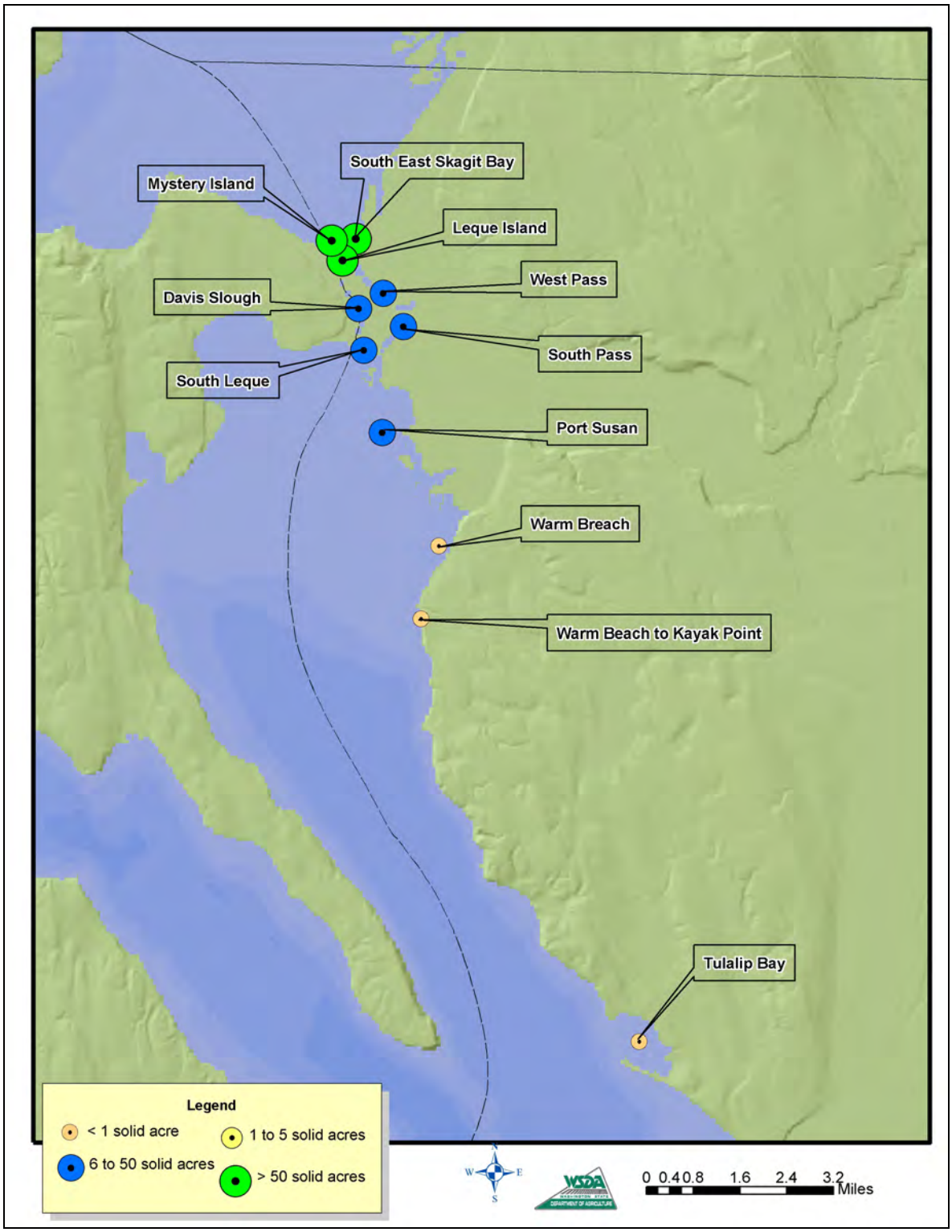
The Nature Conservancy (TNC) continued to be a major on-the-ground contributor during the 2004 season. With grant funding through the NOAA Fish America Foundation and a private donor, TNC hired an Americorps field crew to conduct extensive surveys and control work in Port Susan. Overall, TNC was able to treat every known *Spartina* plant in Port Susan with either imazapyr or a combination of imazapyr and glyphosate. The increased effort by TNC resulted in a larger amount of *Spartina* being found at the expansive site. With continued surveys and control work by TNC, and continued reduction and seed suppression to the nearby large infestations, this site will quickly near eradication.

Table 7. Summary of 2004 *Spartina* Eradication Effort in Snohomish County

Site	Estimated Solid Acreage treated	Entity Conducting Treatment	Treatment Method used
Port Susan	37*	TNC	Herbicide, Dig
South east Skagit Bay	138.5*	SC, WDFW	Herbicide, Crush
Davis Slough	7.5	WDFW	Herbicide
Mystery Island	59*	WDFW	Herbicide
Leque Island	87.25*	WDFW	Herbicide, Crush
South Leque	3	WDFW, WM	Herbicide
Warm Beach	0.018*	SC	Herbicide
West Pass	11.75	SC, WDFW	Herbicide
Kayak Point to Warm Beach	0.0001*	PFPS	Mow,Dig
South Pass	5.8	SC, WDFW	Herbicide
Tulalip Bay	0.25*	WSDA, SC, TT	Mow, Dig
Total Solid Acres Treated	**350.068**		

*Denotes entire site treated
SC = Snohomish County, WDFW = Department of Fish and Wildlife, WM = Wildlands Management, TT = Tulalip Tribe

Figure 6. Approximate Locations of all 2004 Snohomish County *Spartina* Treatment Sites



Island County

WSDA provided $50,000 to the Island County Noxious Weed Control Board for *Spartina* eradication activities in 2004. Island County sub-contracted the majority of its *Spartina* eradication work to a private company, Wildlands Management (WM). In addition, WDFW conducted a large amount of control work in Island County during the 2004 season. WSDA provided all necessary herbicide to both Island County and WDFW.

In total, 164 solid acres of *Spartina* were treated in Island County in 2004. Table 8 shows the solid acres treated, who did the treatment and the treatment methods used. Figure 7 shows the approximate locations of the treatment sites.

During the 2004 season, the effort enlisted more of a two-pronged approach to the eradication effort in Island County. Not only was worked focused on the last remaining large seed producing meadows in Island and Snohomish counties, but an extremely extensive survey was conducted of the entire shoreline of Whidbey Island and much of the shoreline of Camano Island. This survey turned up a handful of new infestations; all but one was less than half an acre in size. Most of the new infestations appeared to be one-or two-year-old seedlings. Wildlands Management and Island County carried out this large effort.

Wildlands Management and WDFW also continued to attack the remaining infestation in Livingston Bay. This site is one of the great success stories in North Puget Sound *Spartina* eradication. In 1999, the infestation in Livingston Bay was estimated at approximately 100 solid acres. WDFW and Wildlands Management began treating this infestation in 1999 using a combination of herbicide and mechanical control tools. After six successful years of treatment, including the 2001 season in which herbicide was not allowed for use, the overall infestation is now estimated at only 4.5 solid acres. This is an overall decrease of 95%. The remaining 4.5 solid acres were treated during the 2004 season with a combination of glyphosate and imazapyr.

WDFW and WSDA continued to focus on the infestations in Triangle Cove and the Emerick/Price meadow with mechanical control tools. During the winter and spring of 2004, substantial crushing and disking operations were underway on the main areas of the infestations. The only parts of the infestations that were not treated in this fashion were the edges of the many small channels that wind their way through the sites. Figure 21 (*see pg. 53*) shows the Emerick/Price meadow before mechanical treatments began in 2003. Figure 22 (*see pg. 53*) shows the same site after multiple treatments with mechanical control tools.

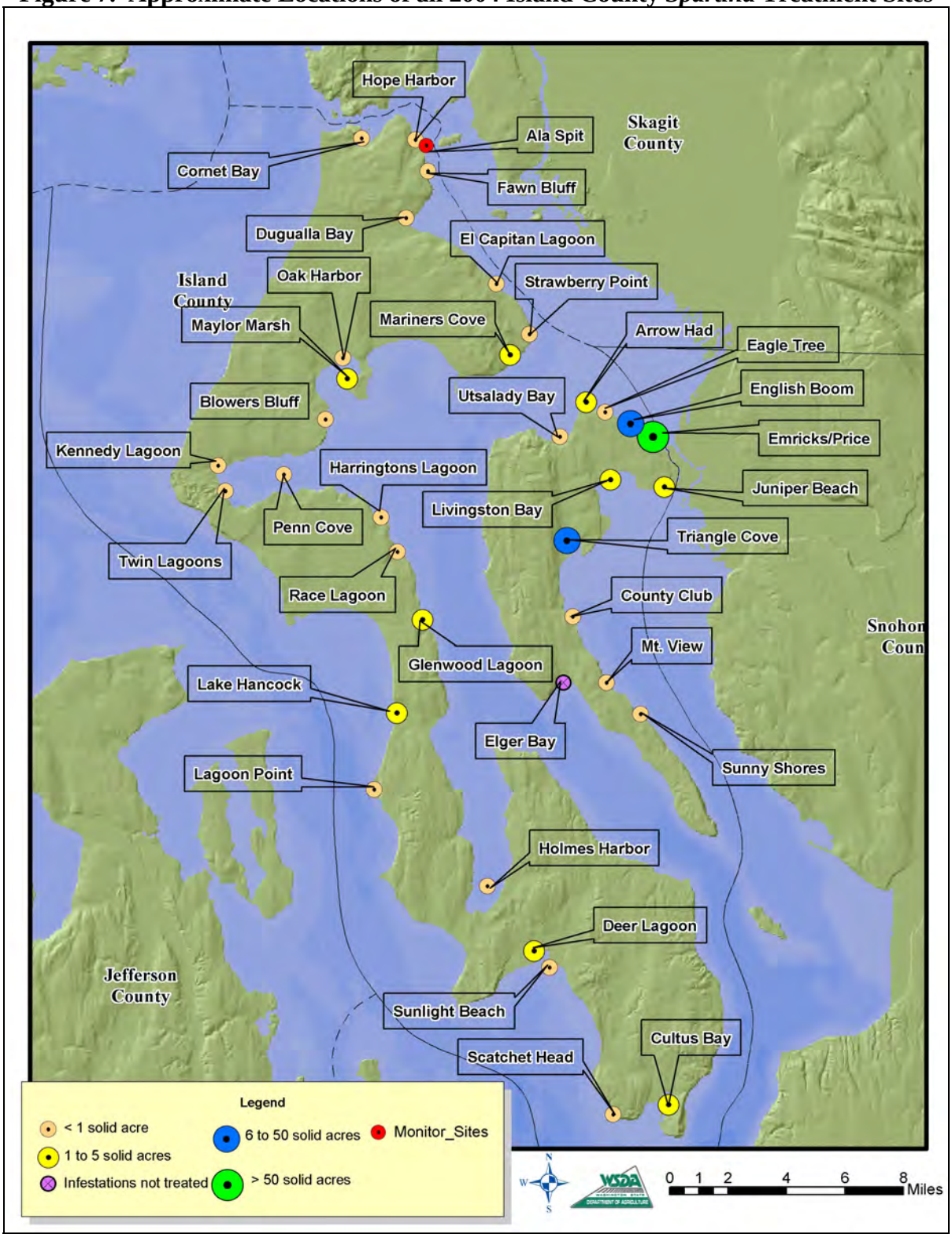
Post-treatment monitoring of the Triangle Cove site conducted by WDFW indicates that the mechanical control has resulted in a 90% reduction of the infestation in the treated areas. What remains to be treated at this site is small-scattered regrowth in the mechanical control areas and the edges of the channels, which will likely be treated entirely during the 2005 season. With the 90% reduction to the main body of the Triangle Cove infestation, this site is now estimated at only 65 solid acres, down from an estimated 180 solid acres in 1997. Figures 23 and 24 (*see pg. 54*) are before and after photos, respectively, of the Triangle Cove meadow. This site has only been treated using mechanical control.

Table 8. Summary of 2004 *Spartina* Eradication Effort in Island County

Site	Estimated Solid Acreage Treated	Entity Conducting Treatment	Treatment Method
Hope Harbor	0.25*	WM	Herbicide
Ala Spit	0	WM	Monitor
Cornet Bay	0.025*	WM	Herbicide
Dugwalla Bay	0.3*	WM	Herbicide
Race Lagoon	0.65*	WM	Herbicide
Arrowhead Beach	1.5*	WM	Herbicide
Utsalady Bay	0.02	WM	Herbicide
Livingston Bay	4.45*	WM, PFPS	Herbicide, Dig
Emrick/Price	60.0*	WM, WDFW	Crush
Deer Lagoon	1.325*	PFPS	Dig, Seed Removal
Cultus Bay	1.5*	WSDA, WDFW, WM	Herbicide, Dig
Scatchet Head	0.025*	WM	Herbicide
English Boom	7.5*	WM	Herbicide
Mt. View Lagoon	0.01*	WDFW	Herbicide
County Club	0.01 *	WDFW	Herbicide
Sunny Shores	0.75*	WDFW	Herbicide
Eagle Tree	0.25*	WM	Herbicide
Sunlight Beach	0.75*	WM	Herbicide
Juniper Beach	1*	WDFW	Herbicide, Dig
Triangle Cove	75.00	WDFW, WSDA	Crush
Penn Cove/Twin Lagoons, Kennedy Lagoon	0.7*	WSDA, WM, IC	Herbicide
Blowers Bluff	0.025*	WM	Herbicide
El Capitan Lagoon	0.5*	WM	Herbicide
Fawn Bluff	0.15*	WM	Herbicide
Harrington's Lagoon	0.175*	WM	Herbicide
Glenwood Lagoon	1.5*	WM	Herbicide
Holmes Harbor	0.4*	WM	Herbicide
Mariner's Cove	1.5*	WM	Herbicide
Lagoon Point	0.075*	WM	Herbicide
Strawberry Point	0.1	WM	Herbicide
Oak Harbor	0.01	WM, IC	Herbicide, Dig
Maylor Marsh	2.25	WM, WDFW	Herbicide
Hancock Lake	1.65	WM, WDFW	Herbicide
Total Solid Acres Treated	**164.35**		

*Denotes entire site treated
WM = Wildlands Management, WDFW = Department of Fish and Wildlife, IC = Island County
WSDA = Department of Agriculture, DNR = Department of Natural Resources.

Figure 7. Approximate Locations of all 2004 Island County *Spartina* Treatment Sites



Skagit County

WSDA provided $40,000 to the Skagit County Noxious Weed Control Board and $10,000 to the Swinomish Tribal Community during the 2004 control season. The Swinomish Tribe, WDFW and the Department of Ecology also allocated resources towards *Spartina* eradication activities in Skagit County.

In total, 13.5 solid acres of *Spartina* were treated in Skagit County in 2004 compared to 26 in 2003 and 36 in 2002. This reduction in the total amount treated is due to the overall reduction in the infestation in Skagit County. All known *Spartina* infestations were treated with exception of a 10.5-acre infestation on Swinomish tribal land. Table 9 shows the solid acres treated, who did the treatment, and the treatment methods used on every site in Skagit County. Figure 8 shows the approximate locations of all Skagit County 2004 treatment sites.

For the third year in a row the Swinomish Tribal Community worked cooperatively with WSDA, Skagit County and others to conduct *Spartina* eradication activities following an integrated pest management approach. Through an agreement between WSDA, the Swinomish Tribal Community and Skagit County, the Tribe has agreed to allow Skagit County to control all the infestations on Tribal land with the exception of the Turners Cove infestation, which is were the Tribe is experimenting with a release of the biological control agent, *Prokelisia marginata*.

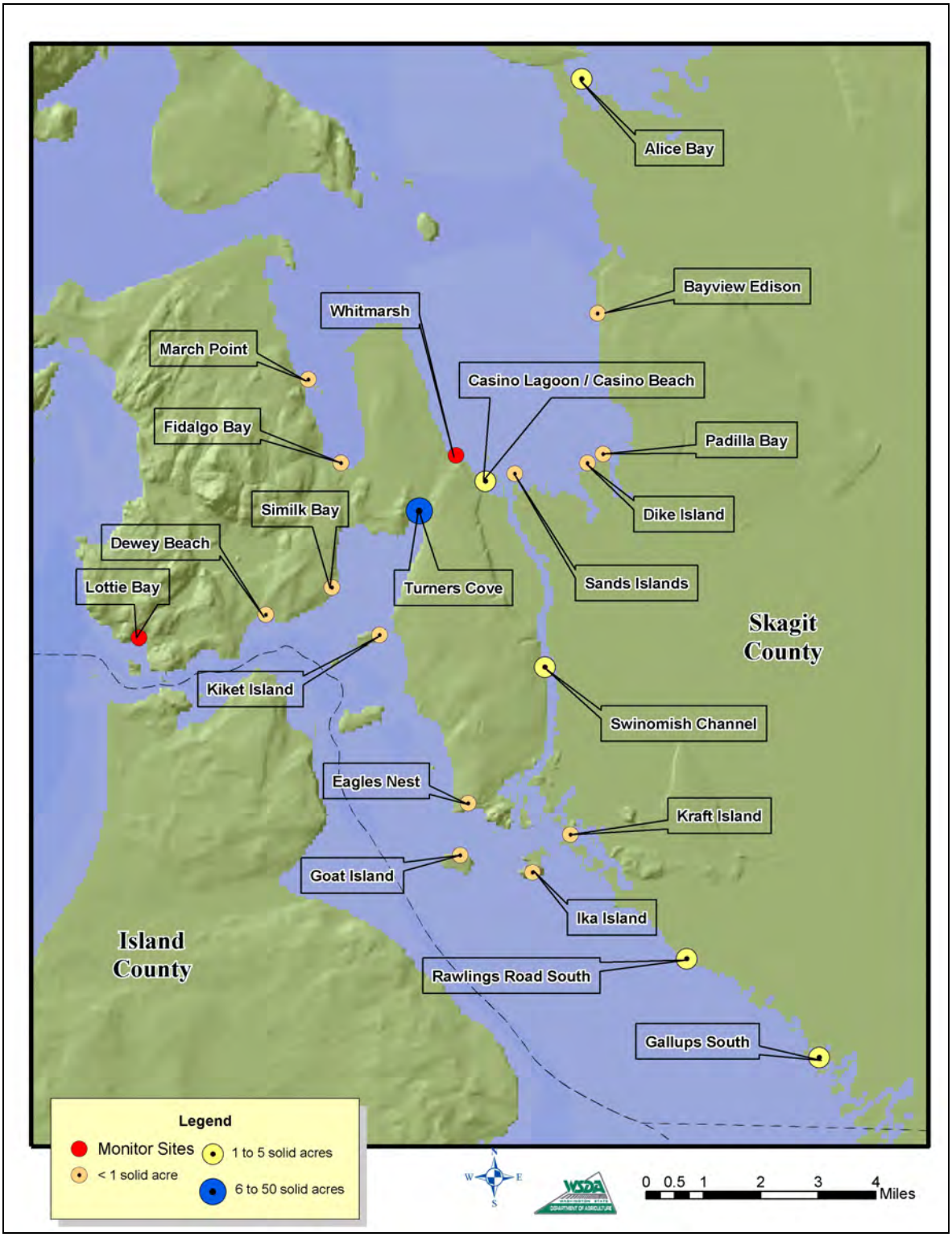
The overall effort in Skagit County continues to be extremely successful. The overall infestation in Skagit County, estimated at 100 solid acres in 1997, has been reduced by about 75% to 24 solid acres in 2004. With the continued use of an IPM approach for controlling infestations on Swinomish Tribal property, the effort in Skagit County will continue its progress towards eradication.

Table 9. Summary of 2004 *Spartina* Eradication Effort in Skagit County

Site	Estimated Solid Acreage Treated	Entity Conducting Treatment	Treatment Method
Gallups South	2.372*	SK	Dig, Herbicide
Rawlings Rd. South	1.5*	SK	Mow, Herbicide
Kiket Island	0.09*	SK	Monitor
Sands Island	0.09*	SK	Herbicide
Kraft Island	0.64*	SK	Herbicide
Ika Island	0.001*	SK	Dig
Dike Island	0.04*	WM, WDFW	Herbicide
Padilla Bay	0.003*	DOE	Dig
Similk Bay	0.001*	SK	Dig
Bayview Edison	0.0002*	DOE	Dig
Eagle's Nest	3.28*	SW, PFPS	Dig
Alice Bay (Samish Island)	0.5	WDFW, DOE	Herbicide
Turners Cove	1	SW	Mow, Dig, Biocontrol release
Lottie Bay	0	SK	Monitor
Goat Island	0.1*	SK	Herbicide
Dewey Beach	0.001*	SK	Monitor, Dig
Fidalgo Bay	0.03*	SK	Dig
March Point	0.001*	SK	Dig, Herbicide
Whitmarsh	0	SK	Monitor
Casino Lagoon/ Casino Beach	1.86*	WDFW, WSDA, SW, PFPS	Mow, Dig, Herbicide
Swinomish Channel	2.09*	SK, SW, WSDA,WDFW, PFPS	Dig, Herbicide
Total Solid Acres Treated	**13.50**		

*Denotes entire site treated
SK = Skagit County, WM = Wildlands Management, DOE = Department of Ecology,
WSDA = Department of Agriculture, WDFW = Department of Fish and Wildlife,
SW = Swinomish Tribal Community, PFPS = People for Puget Sound

Figure 8. Approximate Locations of all 2004 Skagit County *Spartina* Treatment Sites



San Juan, Clallam, Jefferson, Kitsap, King Counties

In 2004, WSDA worked with the San Juan County Noxious Weed Control Board, U.S. Navy, State Parks, Vashon/Maury Island Land Trust, Suquamish Tribe, and North Olympic Salmon Coalition to conduct control work in San Juan, Clallam, Jefferson, Kitsap, and King counties. San Juan County conducted survey and control efforts at all known sites and one newly discovered infestation at Jakle's Lagoon. Figure 9 shows where surveys and control work took place in San Juan County. The U.S. Navy assisted the WSDA crew with control work and surveys on Indian Island by providing access to sites on naval property and providing logistical support. WSDA also worked with State Parks to conduct control work at Dosewallips State Park in Jefferson County. The North Olympic Salmon Coalition provided volunteers to conduct control work at the Chimicum Creek site. Figure 10 shows the locations of all 2004 WSDA treatment sites. WSDA conducted several site surveys of Vashon and Maury Island cooperatively with the Vashon/Maury Island Land Trust. Table 10 shows the solid acres treated, who performed the treatment, and the treatment methods used at every site in San Juan, Clallam, Jefferson, Kitsap and King counties.

Of special note in Kitsap County during the 2004 season was the continued partnership WSDA has with the Suquamish Tribe. This partnership has been ongoing for many years and continues to provide many benefits to the control effort. During the course of this partnership, WSDA and the Tribe have worked closely to find eradication techniques that are agreeable to the Tribe. After many years of mechanical and manual control techniques, the infestation appears to not be getting any smaller, and is still producing seeds that can potentially spread to other areas of Puget Sound. With this in mind, the Tribe and WSDA began several small-scale tests of the new herbicide imazapyr on infested land directly adjacent to the Tribal land. If the tests prove successful and the Tribe feels comfortable with this type of control, WSDA may begin using herbicide on the entire site during the 2005 season.

WSDA crews have substantially reduced all known infestations in Clallam, Jefferson, Kitsap and King counties during the past five years. It is important to note that, with the exception of the Doe-Kag-Wats site in Kitsap County, all sites were treated entirely at least twice. Again, with the exception of the Doe-Kag-Wats infestation which is on the Suquamish Reservation, all sites are nearing eradication and will continue to progress towards that end with yearly surveying and control.

Recommendations for the Future for Puget Sound

The results of continuous control and monitoring of these sites, coupled with the elimination of major nearby seed-producing meadows, is reflected in the small size and the low re-infestation rate of central and southern Puget Sound infestations. With continued funding for all agencies involved, this same success will be achieved in the rest of Puget Sound. Substantial control took place for the second consecutive year at the three largest infestations in Puget Sound. Great progress was made this season and these infestations are much closer towards eradication. Continued funding and support is needed to keep up this successful effort in Puget Sound.

Figure 9. Approximate Locations of 2004 San Juan County *Spartina* Treatment/Survey Sites

Figure 10. Approximate Locations of all 2004 Clallam, Jefferson, Kitsap and King county *Spartina* infestations

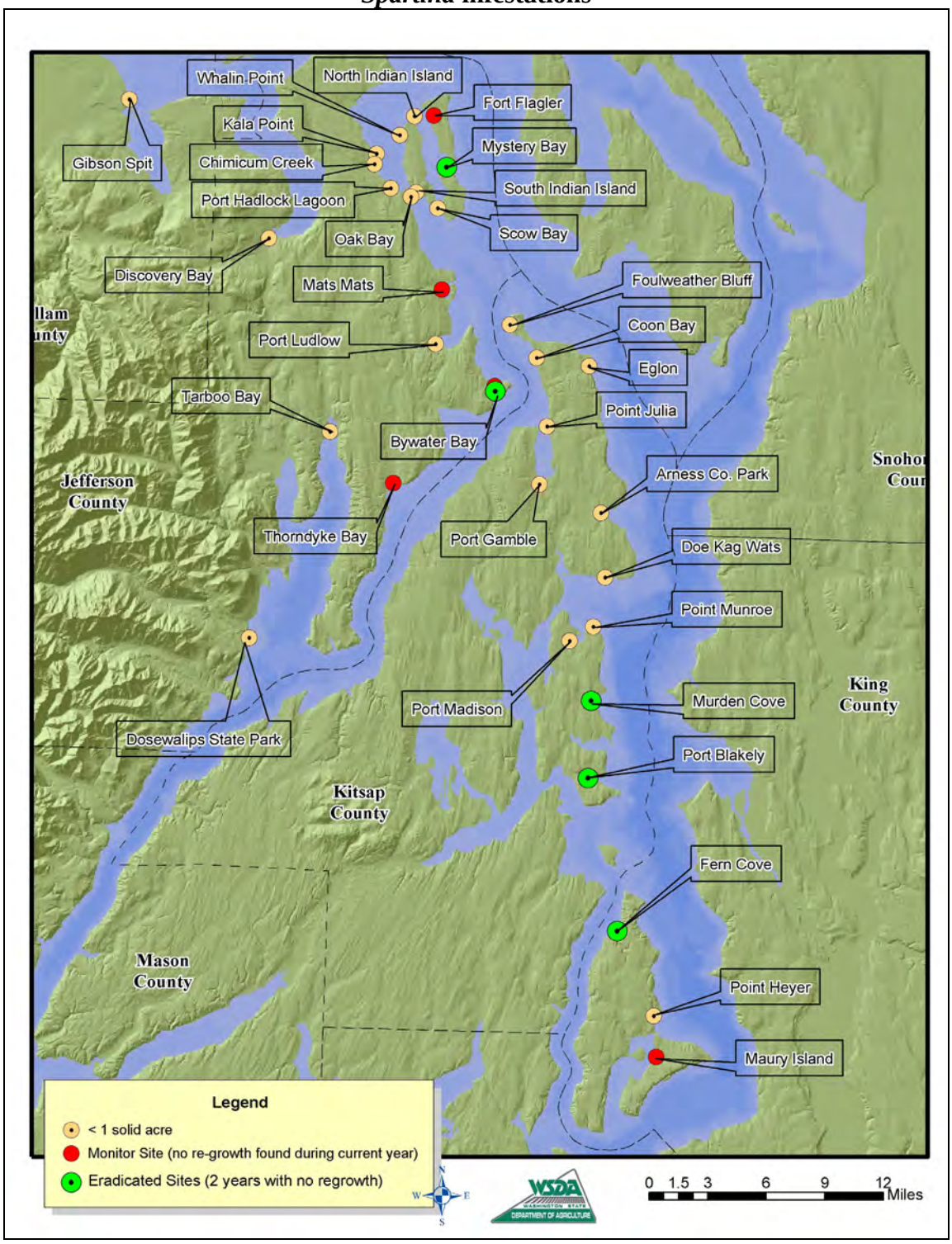


Table 10. Summary of 2004 *Spartina* Eradication Effort in San Juan, Clallam, Jefferson, Kitsap and King Counties

Site	Estimated Solid Acreage Treated	Entity Conducting Treatment	Treatment Method
➢ **San Juan County**			
Argyle Lagoon	0.0006*	SJC	Dig
Fisherman Bay & Buck Bay	0	SJC	Eradicated
Jakle's Lagoon#	0.0001*	SJC	Dig
➢ **Clallam County**			
Gibson Spit	0.0001*	WSDA	Dig
➢ **Jefferson County**			
Dosewallips State Park	0.005*	WSDA	Dig, Herbicide
Thorndyke Bay	0	WSDA	Monitor
Tarboo Bay	0.0001	WSDA	Dig
Oak Bay	0.0004*	WSDA	Dig
Port Hadlock Lagoon#	0.0006*	WSDA	Dig
Mats Mats	0	WSDA	Monitor
Scow Bay	0.0001*	WSDA	Dig
Whalin Point	0.001*	WSDA/Navy	Dig
Kala Point	0.0001*	WSDA	Dig
Bywater Bay & Mystery Bay	0	WSDA	Eradicated
Chimicum Creek#	0.003*	WSDA/NOSC	Dig
Discovery Bay	0.003*	WSDA	Dig
South Indian Island	0.0004*	WSDA	Dig
North Indian Island	0.0001*	WSDA/Navy	Dig
Fort Flagler	0	WSDA	Monitor
Port Ludlow	0.0001*	WSDA	Dig
➢ **Kitsap County**			
Murden Cove & Port Blakely	0	WSDA	Eradicated
Point Monroe	0.0001*	WSDA	Dig
Foulweather Bluff	0.0007*	WSDA	Dig
Point Julia#	0.015*	WSDA	Dig
Coon Bay	0.0001*	WSDA	Dig
Port Gamble	0.0001*	WSDA	Dig
Doe-Kag-Wats	1*	WSDA	Mow, Dig, Herbicide
Eglon#	0.0005	WSDA	Dig
Arness Park/Kingston Ferry	0.0001*	WSDA	Dig
Port Madison	0.0003*	WSDA	Dig
➢ **King County**			
Fern Cove	0	WSDA	Eradicated
Maury Island	0	WSDA	Monitor
Point Heyer	0.0001*	WSDA	Dig
Total Solid Acres Treated	**1.0317***		

*Denotes entire site treated # Denotes a newly discovered site

WSDA = Washington State Department of Agriculture, SJC = San Juan County Noxious Weed Control Board, Navy = United States Navy

Figure 11. *Spartina alterniflora* in Willapa Bay, Pacific County, Washington, Aug. 2000

Figure 12. *Spartina patens* at Dosewallips State Park, Jefferson County, Washington July 2000

Figure 13. *Spartina anglica* invading mudflat in Livingston Bay, Island County, June 1999

Figure 14. *Spartina densiflora* located in Grays Harbor near Damon Point, Dec. 2002

Figure 15. North Willapa meadow before any treatments, May 2002

Figure 16. NorthWillapa meadow after one crushing treatment and one handheld herbicide application (red arrow indicates same point on both photos). Sept, 2004

Figure 17. Aerial application to the South Nemah/Seal Slough meadow. Aug. 2003

Figure 18. South Nemah/Seal slough meadow 3 months after application, Sept. 2004

Figure 19. Porters Point after glyphosate application, Sept. 2003

Figure 20. Porters Point after imazapyr application, Sept. 2004

Figure 21. Emerick/Price Meadow before treatment, June 2003

Figure 22. Emerick/Price meadow after herbicide and multiple mechanical applications, October 2004.

Figure 23. Triangle Cove before mechanical control, Summer 2002

Figure 24. Triangle Cove after two years of mechanical control, Summer 2004