

## **Progress Report:**

### **Monitoring of Efficacy and Restoration of *Spartina* Eradication in Palix River, Washington**

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#### **Introduction**

The Palix River *Spartina* meadow has spread rapidly. Based on 1993 aerial surveys, the meadow was confined to a few small patches covering less than a few acres. In 2004 the entire intertidal area was solid *Spartina*. Research plots established by WSU from 1997 through 2003 indicated that control of *Spartina* at this site was feasible using the herbicide Habitat. WSDA applied for and received an LIP grant to treat this meadow in 2004.

*Application Background:* WSDA treated the Palix River *Spartina* meadow with Habitat on 8/18/2004 and 8/19/2004 by air. The outer meadow received 6 pt/ac of Habitat + 1% Competitor surfactant and the higher inner meadow received 5 pt/ac + 1% Competitor surfactant. The application had good dry time (all > 12hrs). Plant height was 5-6'; the canopy had fallen over and was lying down in 20 to 30% of the treated area. Plants were at full anthesis, early seed fill. Application conditions were overcast but dry.

*Visual Observations:* Based on visual observation, the overall efficacy at the site was ~ 85 to 90%. The upper region showed excellent control (95%); the low area near the river and channels showed mixed control (50 to 75%), especially along channels. Patchy control corresponded with bridge photos of plants lying down and of areas missed by the boom sprayer. There was regrowth on the edge of some of the sloughs, and the outer edge of the meadow.

#### **Methods**

*Spartina Assessment.* On July 7, 2006, stem, seedling density and native plant data were collected from six transects located along the south and west banks of the meadow and headed inward toward the center of the meadow (Photo 1). These transects were approximately 500' long with 20 quadrats collected per transect (one every 25'); GPS start points and transect directions are noted in Table 1.

*Migratory Shorebird and Waterfowl Survey:* Visual observations of shorebird and waterfowl usage were conducted on two days during peak migration period (April 28, 2006 and May 12, 2006) using a spotting scope at five locations of approximately one hectare each within the meadow. Each site was observed for 10 minute counts, which coincided with tidal periods 0.25-1 hour prior to tidal submergence or after tidal withdraw.

#### **Results and Discussion**

*Spartina* Control: Although the overall control of *Spartina* at this site was good, there was considerable variation in efficacy depending on the location of the transects (Tables 1 and 2). The pre-count stem density at this site based on previous experiments was above 50 to 60 stems per 0.25m<sup>2</sup>. Stem density post treatment ranged from 0.05 to 10 stems per 0.25m<sup>2</sup>. The percentage of *Spartina*-free quadrats ranged from 0 to 100% and averaged 36% in the meadow and 44% along the south river bank. The variability in control resulted from numerous high stem density counts that were collected along the tidal channel banks or where the *Spartina* had lodged or had wrack on top of it.

**Add discussion to bring in 2006 data**

**Table 1.** *Spartina* monitoring assessment of Palix River meadow, June 2005

| Site (GPS / Transect direction)*        | Seedling density (#/0.25m <sup>2</sup> ) | Stem Density (#/0.25m <sup>2</sup> ) | % <i>Spartina</i> - free quadrats |
|---|--|--------------------------------------|-----------------------------------|
| # 1 (N 46.36.912/W123.55.056/Northeast) | 3.6                                      | 2.6                                  | 0                                 |
| # 2 (N 46.61572/W123.92213/Northwest)   | 18.3                                     | 0.84                                 | 0                                 |
| # 3 (N 46.61887/W123.93588/North)       | 1.75                                     | 0.05                                 | 45                                |
| # 4 (100' east of #5/Northeast)         | 0.23                                     | 0.15                                 | 69                                |
| # 5 (N 46.62614/W 123.94058/Northeast)  | 0.45                                     | 0.35                                 | 75                                |
| # 6 (N 46.37.567/W 123.56.433/East)     | 1.8                                      | 8.3                                  | 25                                |
| Average                                 | 4.3                                      | 2.0                                  | 36                                |

**Table 2.** *Spartina* monitoring assessment of Palix River meadow, July 2006



| Site (GPS/Transect direction)*          | Seedling density (#/0.25m <sup>2</sup> ) | Stem Density (#/0.25m <sup>2</sup> ) | % <i>Spartina</i> - free quadrats |
|---|--|--------------------------------------|-----------------------------------|
| # 1 (N 46.36.912/W123.55.056/Northeast) | 0  | 2.05                                 | 80                                |
| # 2 (N 46.61572/W123.92213/Northwest)   | 0  | 3.74                                 | 60                                |
| # 3 (N 46.61887/W123.93588/North)       | 0  | 1.35                                 | 75                                |
| # 4 (100' east of #5/Northeast)         | 0  | 1.2                                  | 90                                |
| # 5 (N 46.62614/W 123.94058/Northeast)  | 0  | 1.35                                 | 80                                |
| # 6 (N 46.37.567/W 123.56.433/East)     | 0  | 2.85                                 | 55                                |
| Average                                 | 0  | 2.09                                 | 73                                |

\* see photo for direction of transect

**Table 3.** Number of native plants found in quadrats in 2005 versus 2006

| Native Plants | Pickleweed | Sea Arrow Grass |
|---------------|------------|-----------------|
| 2005          | 0          | 0               |
| 2006          | 9          | 1               |

*Seed Viability:* Seed germination ranged from poor (0.29%) to excellent (>25%). Not surprisingly, there was a general lack of relationship between lab data on germination and seedling data in the field. Seed transport likely accounts for this difference. The bulk of seedlings observed were along the southern edge of the meadow. This can be expected, based on the movement of pollen with the NW winds toward this section of meadow.

*Native Plants:* No native marsh plants were observed within any of the quadrats during the 2005 survey. In July 2006, native marsh plants were present in site 1 and site 4 (Table 3).

*Bird usage:* Bird usage in the Palix meadow is dramatically lower than pre-*Spartina* infestation (pers. communication Dick Wilson). Ground bird surveys yielded no shorebirds or waterfowl present, while the aerial survey showed a very small number of shorebirds and waterfowl (Table 3). At present, it is still unclear what the most critical factors are driving shorebird usage of tide flats post-*Spartina* control—prey density, prey accessibility, predator avoidance behavior, or other variables. Research on changes in prey density post-*Spartina* control has been inconsistent. Studies in France (Triplet et al. 2002), England (Evans 1986) and Tasmania (Kriwoken and Hedge 2000) indicate reduced invertebrate density post-*Spartina* control, while White (1995) and Rader (1984) reported higher invertebrate densities in areas where *Spartina* had been removed. Studies in Willapa Bay found the presence of *Spartina* reduced the abundance and richness of benthic invertebrates (O’Connell 2002, Zipperer 1996). Regardless of prey density, if tideland sediment is still inaccessible to beak probing after *Spartina* removal, owing to vegetative cover, thick rootmat or dry firm sediment, it is less likely to be utilized for foraging (Stralberg et al., White 1995). For all five areas ground surveyed in the Palix meadow, there was no evidence of shorebird usage in either the live *Spartina* or in areas of dead stubble. Two ground count surveys will be conducted in fall of 2005 to assess shorebird and waterfowl presence in these areas.

**Discussion to include increase in bird usage 2006—as spartina density decreased, bird usage increased (refer to large decrease in % cover spartina by quadrat : quadrats averaged 36 % spartina free in 2005, versus 75% spartina free in 2006)**

**ADD LINE GRAPH (Or other pictorial) to represent bird usage for spring 05, fall 05 and spring 06—will show very nice increase in bird usage.**

**Table 3.** Assessment of birds in the Palix River Meadow in spring 2005.

| Ground Bird Survey |                                 |           |           | Aerial Bird Survey |                  |           |           |
|--------------------|---------------------------------|-----------|-----------|--------------------|------------------|-----------|-----------|
| Date               | Site (GPS)                      | Shorebird | Waterfowl | Date               | Site             | Shorebird | Waterfowl |
| 4/19/2005          | #1<br>N 46.61245<br>W 123.91736 | 0         | 0         | 4/24/2005          | Entire<br>Meadow | 20        | 10        |
| 4/19/2005          | #2<br>N 46.61481<br>W 123.93198 | 0         | 0         |                    |                  |           |           |
| 4/19/2005          | #3<br>N 46.61657<br>W 123.93775 | 0         | 0         |                    |                  |           |           |
| 4/19/2005          | #4<br>N 46.62209<br>W 123.9465  | 0         | 0         |                    |                  |           |           |
| 4/19/2005          | #5<br>N 46.62736<br>W 123.95016 | 0         | 0         |                    |                  |           |           |
| 5/6/2005           | #1<br>N 46.61245<br>W 123.91736 | 0         | 0         |                    |                  |           |           |
| 5/6/2005           | #2<br>N 46.61481<br>W 123.93198 | 0         | 0         |                    |                  |           |           |
| 5/6/2005           | #3<br>N 46.61657<br>W 123.93775 | 0         | 0         |                    |                  |           |           |
| 5/6/2005           | #4<br>N 46.62209<br>W 123.9465  | 0         | 0         |                    |                  |           |           |
| 5/6/2005           | #5<br>N 46.62736<br>W 123.95016 | 0         | 0         |                    |                  |           |           |

## Appendix 2

Raw data on stem density

| Date      | Site              | Quadrats | Seedling Count | Stem Density/0.25m <sup>2</sup> |
|-----------|-------------------|----------|----------------|---------------------------------|
| 6/10/2005 | Palix 1 PS Bank 1 | 1        | 0              | 40                              |
| 6/10/2005 | Palix 1 PS Bank 1 | 2        | 2              | 40                              |
| 6/10/2005 | Palix 1 PS Bank 1 | 3        | 5              | 20                              |
| 6/10/2005 | Palix 1 PS Bank 1 | 4        | 6              | 5                               |
| 6/10/2005 | Palix 1 PS Bank 1 | 5        | 2              | 5                               |
| 6/10/2005 | Palix 1 PS Bank 1 | 6        | 1              | 0                               |
| 6/10/2005 | Palix 1 PS Bank 1 | 7        | 0              | 0                               |
| 6/10/2005 | Palix 1 PS Bank 1 | 8        | 0              | 0                               |
| 6/10/2005 | Palix 1 PS Bank 1 | 9        | 0              | 0                               |
| 6/10/2005 | Palix 1 PS Bank 1 | 10       | 0              | 0                               |
| 6/10/2005 | Palix 2 PS Bank 2 | 1        | 0              | 0                               |
| 6/10/2005 | Palix 2 PS Bank 2 | 2        | 3              | 0                               |
| 6/10/2005 | Palix 2 PS Bank 2 | 3        | 0              | 0                               |
| 6/10/2005 | Palix 2 PS Bank 2 | 4        | 2              | 0                               |
| 6/10/2005 | Palix 2 PS Bank 2 | 5        | 4              | 0                               |
| 6/10/2005 | Palix 2 PS Bank 2 | 6        | 3              | 0                               |
| 6/10/2005 | Palix 2 PS Bank 2 | 7        | 0              | 0                               |
| 6/10/2005 | Palix 2 PS Bank 2 | 8        | 5              | 0                               |
| 6/10/2005 | Palix 2 PS Bank 2 | 9        | 2              | 0                               |
| 6/10/2005 | Palix 2 PS Bank 2 | 10       | 1              | 60                              |
| 6/10/2005 | Palix 3 PS Bank 3 | 1        | 0              | 0                               |
| 6/10/2005 | Palix 3 PS Bank 3 | 2        | 0              | 0                               |
| 6/10/2005 | Palix 3 PS Bank 3 | 3        | 0              | 0                               |
| 6/10/2005 | Palix 3 PS Bank 3 | 4        | 0              | 0                               |
| 6/10/2005 | Palix 3 PS Bank 3 | 5        | 0              | 0                               |
| 6/10/2005 | Palix 3 PS Bank 3 | 6        | 0              | 0                               |
| 6/10/2005 | Palix 3 PS Bank 3 | 7        | 0              | 0                               |
| 6/10/2005 | Palix 3 PS Bank 3 | 8        | 0              | 0                               |
| 6/10/2005 | Palix 3 PS Bank 3 | 9        | 0              | 0                               |
| 6/10/2005 | Palix 3 PS Bank 3 | 10       | 0              | 0                               |
| 6/10/2005 | Palix 4 PS Bank 4 | 1        | 1              | 0                               |
| 6/10/2005 | Palix 4 PS Bank 4 | 2        | 2              | 0                               |
| 6/10/2005 | Palix 4 PS Bank 4 | 3        | 0              | 0                               |
| 6/10/2005 | Palix 4 PS Bank 4 | 4        | 0              | 0                               |
| 6/10/2005 | Palix 4 PS Bank 4 | 5        | 1              | 0                               |
| 6/10/2005 | Palix 4 PS Bank 4 | 6        | 0              | 0                               |
| 6/10/2005 | Palix 4 PS Bank 4 | 7        | 2              | 0                               |
| 6/10/2005 | Palix 4 PS Bank 4 | 8        | 0              | 0                               |
| 6/10/2005 | Palix 4 PS Bank 4 | 9        | 1              | 0                               |

|           |                   |    |     |    |
|-----------|-------------------|----|-----|----|
| 6/10/2005 | Palix 4 PS Bank 4 | 10 | 0   | 0  |
| 6/10/2005 | Palix 5 PS Bank 5 | 1  | 2   | 0  |
| 6/10/2005 | Palix 5 PS Bank 5 | 2  | 4   | 0  |
| 6/10/2005 | Palix 5 PS Bank 5 | 3  | 2   | 0  |
| 6/10/2005 | Palix 5 PS Bank 5 | 4  | 5   | 0  |
| 6/10/2005 | Palix 5 PS Bank 5 | 5  | 2   | 0  |
| 6/10/2005 | Palix 5 PS Bank 5 | 6  | 0   | 0  |
| 6/10/2005 | Palix 5 PS Bank 5 | 7  | 1   | 0  |
| 6/10/2005 | Palix 5 PS Bank 5 | 8  | 5   | 0  |
| 6/10/2005 | Palix 5 PS Bank 5 | 9  | 4   | 0  |
| 6/10/2005 | Palix 5 PS Bank 5 | 10 | 1   | 0  |
| 6/10/2005 | Palix 6 PS Bank 6 | 1  | 2   | 0  |
| 6/10/2005 | Palix 6 PS Bank 6 | 2  | 2   | 0  |
| 6/10/2005 | Palix 6 PS Bank 6 | 3  | 0   | 0  |
| 6/10/2005 | Palix 6 PS Bank 6 | 4  | 4   | 0  |
| 6/10/2005 | Palix 6 PS Bank 6 | 5  | 3   | 0  |
| 6/10/2005 | Palix 6 PS Bank 6 | 6  | 3   | 0  |
| 6/10/2005 | Palix 6 PS Bank 6 | 7  | 2   | 0  |
| 6/10/2005 | Palix 6 PS Bank 6 | 8  | 0   | 0  |
| 6/10/2005 | Palix 6 PS Bank 6 | 9  | 4   | 0  |
| 6/10/2005 | Palix 6 PS Bank 6 | 10 | 0   | 20 |
| 6/10/2005 | Palix 7 PS Bank 7 | 1  | 1   | 0  |
| 6/10/2005 | Palix 7 PS Bank 7 | 2  | 0   | 0  |
| 6/10/2005 | Palix 7 PS Bank 7 | 3  | 0   | 0  |
| 6/10/2005 | Palix 7 PS Bank 7 | 4  | 1   | 0  |
| 6/10/2005 | Palix 7 PS Bank 7 | 5  | 0   | 0  |
| 6/10/2005 | Palix 7 PS Bank 7 | 6  | 0   | 0  |
| 6/10/2005 | Palix 7 PS Bank 7 | 7  | 0   | 0  |
| 6/10/2005 | Palix 7 PS Bank 7 | 8  | 1   | 0  |
| 6/10/2005 | Palix 7 PS Bank 7 | 9  | 0   | 0  |
| 6/10/2005 | Palix 7 PS Bank 7 | 10 | 1   | 0  |
| 6/2/2005  | Palix meadow PLX1 | 1  | 2   | 16 |
| 6/2/2005  | Palix meadow PLX1 | 2  | 3   | 1  |
| 6/2/2005  | Palix meadow PLX1 | 3  | 2   | 10 |
| 6/2/2005  | Palix meadow PLX1 | 4  | 4   | 1  |
| 6/2/2005  | Palix meadow PLX1 | 5  | 10  | 0  |
| 6/2/2005  | Palix meadow PLX1 | 6  | 6   | 0  |
| 6/2/2005  | Palix meadow PLX1 | 7  | 3   | 0  |
| 6/2/2005  | Palix meadow PLX1 | 8  | 4   | 0  |
| 6/2/2005  | Palix meadow PLX1 | 9  | 2   | 0  |
| 6/2/2005  | Palix meadow PLX1 | 10 | 4   | 0  |
| 6/2/2005  | Palix meadow PLX1 | 11 | 0   | 1  |
| 6/2/2005  | Palix meadow PLX1 | 1  | 27  | 0  |
| 6/2/2005  | Palix meadow PLX1 | 2  | >25 | 0  |
| 6/2/2005  | Palix meadow PLX1 | 3  | >25 | 10 |

|          |                   |    |     |   |
|----------|-------------------|----|-----|---|
| 6/2/2005 | Palix meadow PLX2 | 4  | >25 | 1 |
| 6/2/2005 | Palix meadow PLX2 | 5  | 18  | 0 |
| 6/2/2005 | Palix meadow PLX2 | 6  | >25 | 0 |
| 6/2/2005 | Palix meadow PLX2 | 7  | 12  | 0 |
| 6/2/2005 | Palix meadow PLX2 | 8  | 9   | 0 |
| 6/2/2005 | Palix meadow PLX2 | 9  | 4   | 0 |
| 6/2/2005 | Palix meadow PLX2 | 10 | 8   | 0 |
| 6/2/2005 | Palix meadow PLX2 | 11 | >25 | 0 |
| 6/2/2005 | Palix meadow PLX2 | 12 | 15  | 0 |
| 6/2/2005 | Palix meadow PLX2 | 13 | 20  | 0 |
| 6/2/2005 | Palix meadow PLX3 | 1  | 0   | 0 |
| 6/2/2005 | Palix meadow PLX3 | 2  | 6   | 1 |
| 6/2/2005 | Palix meadow PLX3 | 3  | 1   | 0 |
| 6/2/2005 | Palix meadow PLX3 | 4  | 4   | 0 |
| 6/2/2005 | Palix meadow PLX3 | 5  | 1   | 0 |
| 6/2/2005 | Palix meadow PLX3 | 6  | 0   | 0 |
| 6/2/2005 | Palix meadow PLX3 | 7  | 1   | 0 |
| 6/2/2005 | Palix meadow PLX3 | 8  | 0   | 0 |
| 6/2/2005 | Palix meadow PLX3 | 9  | 6   | 0 |
| 6/2/2005 | Palix meadow PLX3 | 10 | 5   | 0 |
| 6/2/2005 | Palix meadow PLX3 | 11 | 1   | 0 |
| 6/2/2005 | Palix meadow PLX3 | 12 | 0   | 0 |
| 6/2/2005 | Palix meadow PLX3 | 13 | 0   | 0 |
| 6/2/2005 | Palix meadow PLX3 | 14 | 2   | 0 |
| 6/2/2005 | Palix meadow PLX3 | 15 | 0   | 0 |
| 6/2/2005 | Palix meadow PLX3 | 16 | 7   | 0 |
| 6/2/2005 | Palix meadow PLX3 | 17 | 0   | 0 |
| 6/2/2005 | Palix meadow PLX3 | 18 | 0   | 0 |
| 6/2/2005 | Palix meadow PLX3 | 19 | 1   | 0 |
| 6/2/2005 | Palix meadow PLX3 | 20 | 0   | 0 |
| 6/2/2005 | Palix meadow PLX4 | 1  | 1   | 0 |
| 6/2/2005 | Palix meadow PLX4 | 2  | 0   | 0 |
| 6/2/2005 | Palix meadow PLX4 | 3  | 0   | 2 |
| 6/2/2005 | Palix meadow PLX4 | 4  | 0   | 0 |
| 6/2/2005 | Palix meadow PLX4 | 5  | 1   | 0 |
| 6/2/2005 | Palix meadow PLX4 | 6  | 0   | 0 |
| 6/2/2005 | Palix meadow PLX4 | 7  | 0   | 0 |
| 6/2/2005 | Palix meadow PLX4 | 8  | 0   | 0 |
| 6/2/2005 | Palix meadow PLX4 | 9  | 0   | 0 |
| 6/2/2005 | Palix meadow PLX4 | 10 | 0   | 0 |
| 6/2/2005 | Palix meadow PLX4 | 11 | 1   | 0 |
| 6/2/2005 | Palix meadow PLX4 | 12 | 0   | 0 |
| 6/2/2005 | Palix meadow PLX4 | 13 | 0   | 0 |
| 6/2/2005 | Palix meadow PLX5 | 1  | 0   | 0 |
| 6/2/2005 | Palix meadow PLX5 | 2  | 0   | 0 |



|          |                   |    |   |    |
|----------|-------------------|----|---|----|
| 6/2/2005 | Palix meadow PLX5 | 3  | 0 | 0  |
| 6/2/2005 | Palix meadow PLX5 | 4  | 0 | 0  |
| 6/2/2005 | Palix meadow PLX5 | 5  | 1 | 2  |
| 6/2/2005 | Palix meadow PLX5 | 6  | 0 | 0  |
| 6/2/2005 | Palix meadow PLX5 | 7  | 0 | 0  |
| 6/2/2005 | Palix meadow PLX5 | 8  | 0 | 2  |
| 6/2/2005 | Palix meadow PLX5 | 9  | 0 | 0  |
| 6/2/2005 | Palix meadow PLX5 | 10 | 0 | 0  |
| 6/2/2005 | Palix meadow PLX5 | 11 | 0 | 0  |
| 6/2/2005 | Palix meadow PLX5 | 12 | 0 | 0  |
| 6/2/2005 | Palix meadow PLX5 | 13 | 0 | 0  |
| 6/2/2005 | Palix meadow PLX5 | 14 | 0 | 1  |
| 6/2/2005 | Palix meadow PLX5 | 15 | 3 | 0  |
| 6/2/2005 | Palix meadow PLX5 | 16 | 5 | 2  |
| 6/2/2005 | Palix meadow PLX5 | 17 | 0 | 0  |
| 6/2/2005 | Palix meadow PLX5 | 18 | 0 | 0  |
| 6/2/2005 | Palix meadow PLX5 | 19 | 0 | 0  |
| 6/2/2005 | Palix meadow PLX5 | 20 | 0 | 0  |
| 6/2/2005 | Palix meadow PLX6 | 1  | 0 | 0  |
| 6/2/2005 | Palix meadow PLX6 | 2  | 3 | 20 |
| 6/2/2005 | Palix meadow PLX6 | 3  | 2 | 0  |
| 6/2/2005 | Palix meadow PLX6 | 4  | 0 | 0  |
| 6/2/2005 | Palix meadow PLX6 | 5  | 2 | 0  |
| 6/2/2005 | Palix meadow PLX6 | 6  | 2 | 10 |
| 6/2/2005 | Palix meadow PLX6 | 7  | 0 | 5  |
| 6/2/2005 | Palix meadow PLX6 | 8  | 3 | 0  |
| 6/2/2005 | Palix meadow PLX6 | 9  | 0 | 0  |
| 6/2/2005 | Palix meadow PLX6 | 10 | 2 | 0  |
| 6/2/2005 | Palix meadow PLX6 | 11 | 4 | 20 |
| 6/2/2005 | Palix meadow PLX6 | 12 | 0 | 10 |
| 6/2/2005 | Palix meadow PLX6 | 13 | 0 | 0  |
| 6/2/2005 | Palix meadow PLX6 | 14 | 2 | 10 |
| 6/2/2005 | Palix meadow PLX6 | 15 | 3 | 10 |
| 6/2/2005 | Palix meadow PLX6 | 16 | 2 | 25 |
| 6/2/2005 | Palix meadow PLX6 | 17 | 1 | 20 |
| 6/2/2005 | Palix meadow PLX6 | 18 | 4 | 15 |
| 6/2/2005 | Palix meadow PLX6 | 19 | 6 | 20 |
| 6/2/2005 | Palix meadow PLX6 | 20 | 0 | 0  |

# Appendix 1

| Stem Monitoring data from 3/2/2005 from the upper Palix meadow |   |  |                         |  |                           |  |                                      |                                  |
|--|---|--|-------------------------|--|---------------------------|--|--------------------------------------|----------------------------------|
| Habitat @ 5pt/ac   |   |  |                         |  |                           |  |                                      | Rodeo 5% since 1997              |
| Site 1   | Site 2  | Site 3   | Site 4                  | Site 5                                       | Site 5                    | Site 6   | Site 7                               |                                  |
| Palix R. E section along bank, just N. of bridge               | Palix R. channel N. bank next to bridge out to 1st slough | Palix meadow just N. of Patten's 2003 imazapyr strip | E. edge of Palix meadow | Upper Palix meadow 300' out from E shoreline | NE corner of Palix meadow | NE Palix meadow to outer S. bank of Niawiakum R. | S. bank of Niawiakum R. W. of Bridge | S. bank of Niawiakum E of Bridge |
| 0  | 0   | 0  | 0                       | 0  | 0                         | 0  | 0                                    | 2                                |
| 0  | 0   | 0  | 0                       | 0  | 0                         | 0  | 0                                    | 10                               |
| 0  | 0   | 0  | 0                       | 0  | 0                         | 0  | 0                                    | 0                                |
| 0  | 0   | 0  | 0                       | 0  | 0                         | 0  | 0                                    | 0                                |
| 0  | 0   | 0  | 0                       | 0  | 0                         | 0  | 0                                    | 0                                |
| 0  | 0   | 0  | 0                       | 0  | 0                         | 0  | 0                                    | 25                               |
| 0  | 0   | 0  | 0                       | 0  | 0                         | 0  | 0                                    | 10                               |
| 0  | 0   | 0  | 0                       | 0  | 0                         | 0  | 0                                    | 50                               |
| 0  | 0   | 0  | 0                       | 0  | 0                         | 0  | 0                                    | 50                               |
| 0  | 0   | 0  | 0                       | 0  | 0                         | 0  | 0                                    | 0                                |
| 0  | 0   | 0  | 0                       | 0  | 0                         | 0  | 0                                    | 10                               |
| 0  | 0   | 0  | 0                       | 0  | 0                         | 0  | 0                                    | 20                               |
| 0  | 0   | 0  | 0                       | 0  | 0                         | 0  | 0                                    | 50                               |
| 0  | 0   | 0  | 0                       | 0  | 0                         | 0  | 0                                    | 3                                |
| 0  | 0   | 0  | 0                       | 0  | 0                         | 0  | 0                                    | 50                               |
| 0  | 0   | 0  | 0                       | 0  | 0                         | 0  | 0                                    | 50                               |
| 0  | 0   | 0  | 0                       | 0  | 0                         | 0  | 0                                    | 50                               |
| 0  | 0   | 0  | 0                       | 0  | 0                         | 0  | 0                                    | 1                                |
| 0  | 0   | 5  | 0                       | 0  | 0                         | 0  | 0                                    | 35                               |
| 0  | 0   | 1  | 0                       | 0  | 3                         | 0  | 0                                    | 1                                |
| 0  | 0   |  | 0                       | 0  | 5                         | 0  | 0                                    | 1                                |
| 0  | 0   |  | 0                       | 0  | 15                        | 0  | 0                                    | 10                               |
| 0  | 0   |  | 0                       | 0  |                           | 0  | 0                                    | 25                               |
| 0  | 0   |  | 0                       | 0  |                           | 0  | 0                                    | 35                               |
| 0  | 0   |  | 0                       | 0  |                           | 0  | 5                                    | 50                               |
| 0  | 0   |  | 0                       | 0  |                           | 0  | 7                                    |                                  |
| 0  | 5   |  | 0                       | 0  |                           | 0  | 2                                    |                                  |
| 0  | 1   |  | 0                       | 0  |                           | 0  | 1                                    |                                  |
| 0  | 20  |  | 0                       | 0  |                           | 0  |                                      |                                  |
| 0  | 50  |  | 0                       | 0  |                           | 0  |                                      |                                  |
| 5  | 50  |  | 0                       | 0  |                           |  |                                      |                                  |
| 2  | 30  |  | 0                       | 10   |                           |  |                                      |                                  |
| 2  | 5   |  |                         | 10   |                           |  |                                      |                                  |
| 4  | 1   |  | 1                       | 10   |                           |  |                                      |                                  |
|  |   |  | 5                       | 10   |                           |  |                                      |                                  |
|  |   |  |                         | 10   |                           |  |                                      |                                  |
|  |   |  |                         | 2  |                           |  |                                      |                                  |
|  |   |  |                         | 2  |                           |  |                                      |                                  |
|  |   |  |                         | 2  |                           |  |                                      |                                  |
|  |   |  |                         | 7  |                           |  |                                      |                                  |
|  |   |  |                         | 50   |                           |  |                                      |                                  |

## Appendix 3 Raw data on bird counts

### Shorebird Usage of Palix Meadow Spring 05 through Spring 2006

| Date      | Site | WESA | DUNL | DOWI | BBPL | peeps | Other | TTL<br>SHSB | GBHE | WF |
|-----------|------|------|------|------|------|-------|-------|-------------|------|----|
| 4/19/2005 | 1    | 0    | 0    | 0    | 0    | 0     | 0     | 0           | 0    | 0  |
| 4/19/2005 | 2    | 0    | 0    | 0    | 0    | 0     | 0     | 0           | 0    | 0  |
| 4/19/2005 | 3    | 0    | 0    | 0    | 0    | 0     | 0     | 0           | 0    | 0  |
| 4/19/2005 | 4    | 0    | 0    | 0    | 0    | 0     | 0     | 0           | 0    | 0  |
| 4/19/2005 | 5    | 0    | 0    | 0    | 0    | 0     | 0     | 0           | 0    | 0  |
| 5/6/2005  | 1    | 0    | 0    | 0    | 0    | 0     | 0     | 0           | 1    | 0  |
| 5/6/2005  | 2    | 0    | 0    | 0    | 0    | 0     | 0     | 0           | 0    | 0  |
| 5/6/2005  | 3    | 0    | 0    | 0    | 0    | 0     | 0     | 0           | 3    | 0  |
| 5/6/2005  | 4    | 0    | 0    | 0    | 0    | 0     | 0     | 0           | 1    | 1  |
| 5/6/2005  | 5    | 0    | 0    | 0    | 0    | 0     | 0     | 0           | 0    | 0  |
| 9/29/2005 | 0    | 55   | 0    | 0    | 0    | 0     | 5     | 60          | 0    | 0  |
| 9/29/2005 | 1    | 0    | 0    | 0    | 0    | 0     | 0     | 0           | 0    | 0  |
| 9/29/2005 | 2    | 0    | 0    | 0    | 0    | 0     | 0     | 0           | 0    | 4  |
| 9/29/2005 | 3    | 0    | 0    | 0    | 0    | 0     | 0     | 0           | 0    | 0  |
| 9/29/2005 | 4    | 0    | 0    | 0    | 0    | 0     | 0     | 0           | 0    | 0  |
| 9/29/2005 | 5    | 0    | 0    | 0    | 0    | 0     | 0     | 0           | 0    | 0  |
| 3/20/2006 | 1    | 0    | 0    | 0    | 0    | 0     | 0     | 0           | 0    | 8  |
| 3/20/2006 | 2    | 0    | 0    | 0    | 0    | 0     | 0     | 0           | 0    | 0  |
| 3/20/2006 | 3    | 0    | 0    | 0    | 0    | 0     | 0     | 0           | 1    | 0  |
| 3/20/2006 | 4    | 0    | 0    | 0    | 0    | 0     | 0     | 0           | 0    | 0  |
| 3/20/2006 | 5    | 0    | 0    | 0    | 0    | 0     | 0     | 0           | 0    | 16 |
| 4/28/2006 | 1    | 0    | 0    | 57   | 0    | 186   | 0     | 243         | 0    | 0  |
| 4/28/2006 | 2    | 0    | 0    | 0    | 0    | 543   | 0     | 543         | 0    | 0  |
| 4/28/2006 | 3    | 0    | 0    | 0    | 0    | 549   | 0     | 549         | 0    | 0  |
| 4/28/2006 | 4    | 0    | 0    | 0    | 0    | 0     | 0     | 0           | 0    | 0  |
| 4/28/2006 | 5    | 0    | 0    | 0    | 0    | 0     | 0     | 0           | 0    | 0  |
| 5/12/2006 | 1    | 0    | 0    | 0    | 0    | 209   |       | 209         | 0    | 0  |
| 5/12/2006 | 2    | 0    | 0    | 0    | 0    | 429   |       | 429         | 0    | 0  |
| 5/12/2006 | 3    | 0    | 67   | 0    | 25   | 0     | 0     | 92          | 0    | 0  |
| 5/12/2006 | 4    | 0    | 0    | 0    | 46   | 60    |       | 106         | 1    | 0  |
| 5/12/2006 | 5    | 0    | 93   | 0    | 0    | 92    | 5     | 190         | 0    | 0  |

### Palix *Spartina* Meadow—Bird Survey Spring 2005

Date—4/19/2005

Started with overview from bridge. Meadow is expansive. Vehicle traffic on bridge is heavy, only able to do quick overview of area from here. Lots of standing dead *Spartina*.

High Tide: 10:54 am/ 7.4 ft

Weather: T 58, clouds: 10, light wind

Area 2/10:25 am: Regrowth/green in foreground. Lots of standing dead *Spartina*. Thick growth is not shorebird friendly. Some smaller areas of accumulated wrack.

**Bird Count: 0**

Area 3/10:40 am: Thick area of *Spartina*. No bare areas. *Spartina* regrowth prevalent

**Bird Count: 0**

Area 4/10:55 am: Same as above.

**Bird Count: 0**

Area 5/11:10 am: Dick Wilson's House. Nice overview of *Spartina* Meadow. Dick said he has seen flocks of Dunlin fly over, but no landings. Too much stubble. Areas of standing dead *Spartina* as well as regrowth.

**Bird Count: 0**

Area 6/11:45 am: Meadow viewed from construction pullout.

**Bird Count: 0**

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**Day 2 5/6/2005**

**High Tide: 13:30/8.0 feet**

**Weather: 60 F Clouds: 9.0**

Area 2/14:55 pm: 1 hour past high tide. Receding tide.

**Bird Count: 0 shorebirds, 1 heron**

Area 3/15:10 pm:

**Bird Count: 0 shorebirds**

Area 4/15:25 pm:

**Bird Count: 0 shorebirds, 3 heron**

Area 5/15:40 pm:

**Bird Count: 0 shorebirds, 1 heron, 1 duck**

Area 6/15:55 pm:

**Bird Count: 0 shorebirds**

## REFERENCES

Daehler, C.C., Strong, and D.R. Mar 1994. Variable reproductive output among clones of *Spartina alterniflora* (Poaceae) invading San Francisco Bay, California: the influence of herbivory, pollination, and establishment site. *American journal of botany*. 81 307-313.