



Padilla Bay

National Estuarine Research Reserve

Technical Report No. 16

**SURVEY FOR PESTICIDES ON THE PADILLA BAY
NATIONAL ESTUARINE RESEARCH RESERVE
DEMONSTRATION FARM, 1993**

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and

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**Survey for Pesticides on the Padilla Bay National Estuarine
Research Reserve Demonstration Farm, 1993**

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ABSTRACT

Bulthuis, D.A. and W.C. Anderson. 1996. Survey for pesticides on the Padilla Bay National Estuarine Research Reserve Demonstration Farm, 1993. Washington State Department of Ecology, Padilla Bay National Estuarine Research Reserve Technical Report No. 16, Mount Vernon, Washington. 15pp.

Sediment samples were collected from fields on the Padilla Bay National Estuarine Research Reserve Demonstration Farm, from surface ditches that drained the farm, and from No Name Slough that flows through the farm. The concentration of chlorinated pesticides was determined in all samples, and the concentration of metals, total organic carbon, and grain size analysis determined in ditch and slough samples. Only two chlorinated pesticides (beta-BHC and 4, 4'-DDE) were detected. They were just above the detection limit in one ditch sample. The concentration of metals in sediments from the ditches and slough reflected the influence of seawater and the silt and clay composition of the sediments. There was no indication of high concentrations of chlorinated pesticides or heavy metals in the fields or ditches of the Padilla Bay National Estuarine Research Reserve Demonstration Farm.

INTRODUCTION

The Padilla Bay National Estuarine Research Reserve purchased a farm located on the southern shore of Padilla Bay and within the proposed boundaries of the Reserve in 1993 (Fig. 1). Prior to purchase of the farm, a study was conducted by Washington State University in order to examine the potential use and management of such a farm by Padilla Bay National Estuarine Research Reserve (DePhelps *et al.* 1993). DePhelps *et al.* (1993) summarized the recent cropping history on the farm which included a typical Skagit Valley cropping rotation involving cucumbers, peas, potatoes, seed crops (spinach, cabbage, red beet), cauliflower, corn, mustard, and wheat as a cover crop. Strawberries may have been raised on two of the fields in the past. Various pesticides were applied in association with these crops. The concentration of pesticides that may have accumulated in the fields or in the sediments of the slough draining the fields was not known and had not been measured.

The purpose of this study was to measure the background concentration of a broad range of chlorinated pesticides in soil from the fields on the Demonstration Farm, in sediments from two ditches draining the farm and from No Name Slough.

METHODS

Composite samples of the soils were collected from two fields on the Demonstration Farm and from three sites near the mouth of No Name Slough in June 1993 for analysis of the concentration of chlorinated pesticides. Ancillary measurements on the sediments from the slough included grain size, total organic carbon and an ICP scan for metals.

Soil samples from two fields (North Field and South Field, Fig. 2) were a composite of several samples taken within each field on June 11, 1993. Samples were homogenized, dried, and sent to Washington Department of Ecology, Manchester Environmental Laboratory on June 16.

Sediment samples of the top 4-5 cm from the slough were collected at three sites (North Ditch, Central No Name, and South Ditch, Fig. 3). The North Ditch site was fifty feet north of the northernmost of three tide-gates that control the flow of No Name Slough into Padilla Bay. Four grab samples were taken from the center of the ditch. The Central No Name site was located midstream immediately north of the central tide-gate where three grab samples were composited. The South Ditch site was located about 8 m south of the pump station for No Name Slough under a wooden bridge that crosses the South Ditch, at which location four grab samples were composited. At sites North Ditch and Central No Name, the surface of the sediments had a thin aerobic layer (≈ 1 mm) that was underlain with black, anaerobic sediment. At South Ditch the surface of the sediments as well as the underlying sediments were black and apparently anaerobic. All samples smelled strongly of hydrogen sulfide. Sediment samples were stored in a cooler with ice and sent the same day (June 16) to Manchester Environmental Laboratory for analyses.

Chlorinated pesticides were measured with the Gas Chromatography Electron Capture Detection method by Sound Analytical Services; sediment grain size was determined using Puget Sound Estuary Program (1986) protocols by Soil Technology Laboratory; metal concentration was determined with an ICP (Inductively Coupled Plasma Atomic Emissions Analysis) Scan with limited quality control by Manchester Environmental Laboratory; and total organic carbon determined by Weyerhaeuser Technology Center, Analytical Chemistry Laboratories using the Puget Sound Estuary Program Protocols (Puget Sound Estuary Program 1986).

RESULTS

Chlorinated pesticides

No chlorinated pesticides were detected in the soil samples from the north or south fields (Table 1). Two chlorinated pesticides, beta-BHC and 4, 4'-DDE were detected just above the detection limit in the sediment sample from the North Ditch (Table 1). No other chlorinated pesticides were detected in sediments from the sloughs. The nature of the slough sediments caused analytical problems for chlorinated pesticides, with some recoveries from surrogates outside the quality control limits. As a result, the laboratory reports for chlorinated pesticides indicate that the concentration of the

detected pesticides are estimates and that non-detected pesticides were not detected at or above the estimated result.

Metals

The concentration of metals in the sediments of No Name Slough and the ditches flowing into No Name Slough are presented in Table 2. Iron, aluminum, sodium, magnesium and calcium were the most abundant metals detected in all three samples. For most of the metals, concentrations were highest in the South Ditch and lowest in No Name Slough.

Grain Size

Sediments in No Name Slough were almost half sand (45%) whereas sediments in the ditches were only 31% and 11% sand (Table 3, Figs. 4 & 5). South Ditch was particularly muddy with 64% silt and 25% clay.

Total Organic Carbon

Total organic carbon was 2.1% in sediments from No Name Slough, but more than twice that percentage (4.1%) in the South Ditch (Table 3).

DISCUSSION

These results indicate that chlorinated pesticides have not accumulated to high levels on the Demonstration Farm, nor in the ditches draining the farm, nor in No Name Slough that receives the drainage from the farm as well as from a 1,050 hectare watershed (Entranco Engineers and Nelson 1989). These results are consistent with the study by Mayer (Mayer 1989, Mayer and Elkins 1990) that indicated little movement of pesticides from farms in the Padilla Bay watershed into the sloughs or bays. Chlorinated pesticides (such as DDT) have been phased out of most agricultural uses and concentrations in many farm soils have declined to environmentally insignificant concentrations.

The concentrations of metals in the sediments of the ditches appear to reflect salt water influence (note the relative abundances of metals in these sediments compared to the hydrosphere, Table 2). Skagit Valley soils have a high concentration of iron and

aluminum which is also reflected in the sediments of the slough and ditches. For most metals there is a noticeable trend of increasing concentration from No Name Slough to North Ditch to South Ditch. This may be caused by the increasing concentration of silt and clay (Table 3). Metals tend to be absorbed and bound to silt and clay particles.

SUMMARY

This preliminary survey of sediments from fields, ditches and No Name Slough indicates that there are no unusual or high accumulations of chlorinated pesticides or metals on the Padilla Bay National Estuarine Research Reserve Demonstration Farm.

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Table 1. Results of analyses for selected organic pesticides in soil samples from fields, ditches and No Name Slough at the Padilla Bay Demonstration Farm. Units are $\mu\text{g}/\text{Kg}$ (dry weight). Data qualifier definitions: u - Compound was not detected at or above the reported result; uj - Compound was not detected at or above the reported estimated result; j - The associated numerical result is an estimated quantity.

Pesticide	North Field	South Field	No Name Slough	North Ditch	South Ditch
alpha-BHC	10 u	9.8 u	22 u	28 uj	33 uj
beta-BHC	10 u	9.8 u	22 u	35 j	33 uj
delta-BHC	10 u	9.8 u	22 u	28 uj	33 uj
gamma-BHC (Lindane)	10 u	9.8 u	22 u	28 uj	33 uj
Heptachlor	10 u	9.8 u	22 u	28 uj	33 uj
Aldrin	10 u	9.8 u	22 u	28 uj	33 uj
Heptachlor epoxide	10 u	9.8 u	22 u	28 uj	33 uj
Endosulfan I	10 u	9.8 u	22 u	28 uj	33 uj
Dieldrin	10 u	9.8 u	22 u	28 uj	33 uj
4,4'-DDE	10 u	9.8 u	22 u	53 j	33 uj
Endrin	10 u	9.8 u	22 u	28 uj	33 uj
Endosulfan II	10 u	9.8 u	22 u	28 uj	33 uj
4,4'-DDD	10 u	9.8 u	22 u	28 uj	33 uj
Endosulfan sulfate	10 u	9.8 u	22 u	28 uj	33 uj
4,4'-DDT	10 u	9.8 u	22 u	28 uj	33 uj
Methoxychlor	20 u	20 u	43 u	57 uj	66 uj
Endrin ketone	10 u	9.8 u	22 u	28 uj	33 uj
Endrin aldehyde	10 u	9.8 u	22 u	28 uj	33 uj
alpha-Chlordane	1000 u	980 u	2200 u	2800 uj	3300 uj
gamma-Chlordane	1000 u	980 u	2200 u	2800 uj	3300 uj
Toxaphene	1000 u	980 u	2200 u	1800 uj	3300 uj

Table 2. Concentration of metals (mg/kg dry weight) in sediments at the mouth of No Name Slough and in two ditches near the mouth of the slough. Blanks indicate that the concentration was below the detection limit; concentrations in italics were above the instrument detection limit but below the established minimum quantitation limit. Elements are arranged in order of their abundance in the marine hydrosphere (after Goldberg 1957).

	No Name Slough Central Tide Gate	North Ditch	South Ditch
Sodium	7,970.	13,500.	20,300.
Magnesium	7,190.	10,100.	12,500.
Calcium	4,040.	4,910.	8,180.
Potassium	1,750.	2,500.	3,330.
Strontium	48.6	77.	106.
Boron	25.2	35.9	42.
Iron	19,300.	25,900.	36,300.
Aluminum	15,200.	24,400.	22,300.
Zinc	77.7	122.	131.
Molybdenum	2.	1.3	1.9
Barium	25.5	37.1	45.6
Selenium			
Lead	7.3	11.	15.
Copper	27.6	39.6	42.3
Arsenic	13.	17.	16.
Manganese	167.	213.	269.
Vanadium	43.4	52.9	65.9
Titanium	720.	737.	832.
Nickel	35.7	57.6	62.
Cobalt	8.6	14.9	15.9
Antimony			3.4
Silver			
Cadmium	0.4	0.5	1.2
Chromium	32.6	46.5	53.8
Thallium			
Beryllium	0.4	0.8	0.7

Table 3. Total organic carbon (%) and percent composition of sand, silt and clay of sediments from mid-stream near the mouth of No Name Slough and in two field ditches flowing into No Name Slough. Location of sample sites shown in Figure 2.

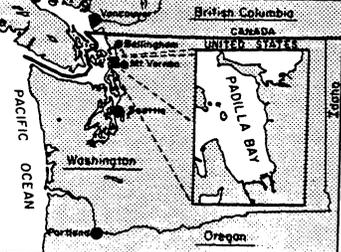
	Total Organic Carbon (%)	Sand (%)	Silt (%)	Clay (%)
No Name Slough	2.1	45	38	17
North Ditch	3.5	31	48	21
South Ditch	4.5	11	64	25



Figure 1. Padilla Bay and the Padilla Bay Demonstration Farm

N
 Soundings in fathoms below Mean Lower Low Water
 Height in feet above Mean Sea Level
 Contour interval 50 Feet

0 1000 METERS
 0 3000 FEET



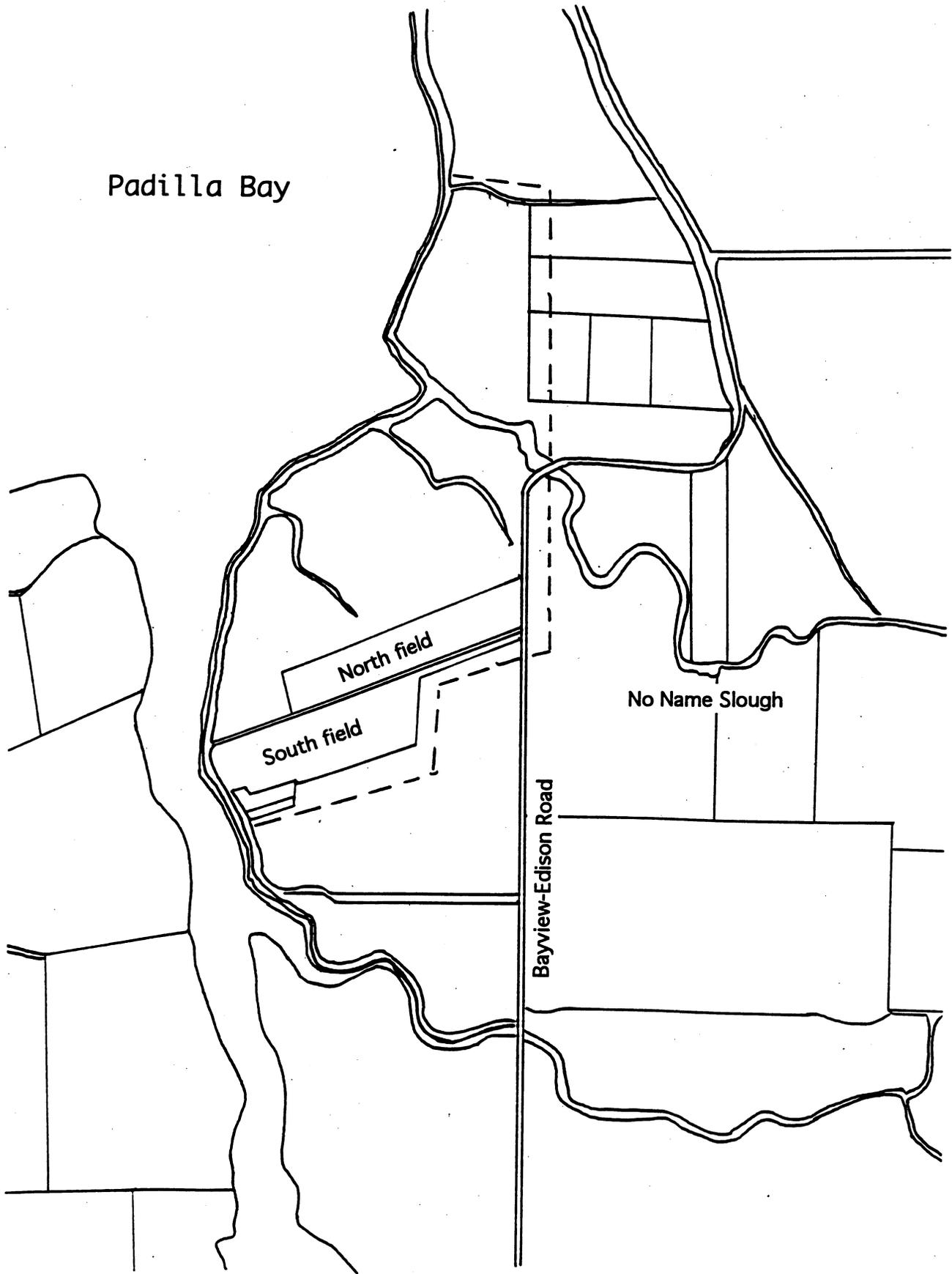


Figure 2. Padilla Bay Demonstration Farm (outlined with dashed lines) and the North and South Fields from which soil samples were collected for analyses of chlorinated pesticides.

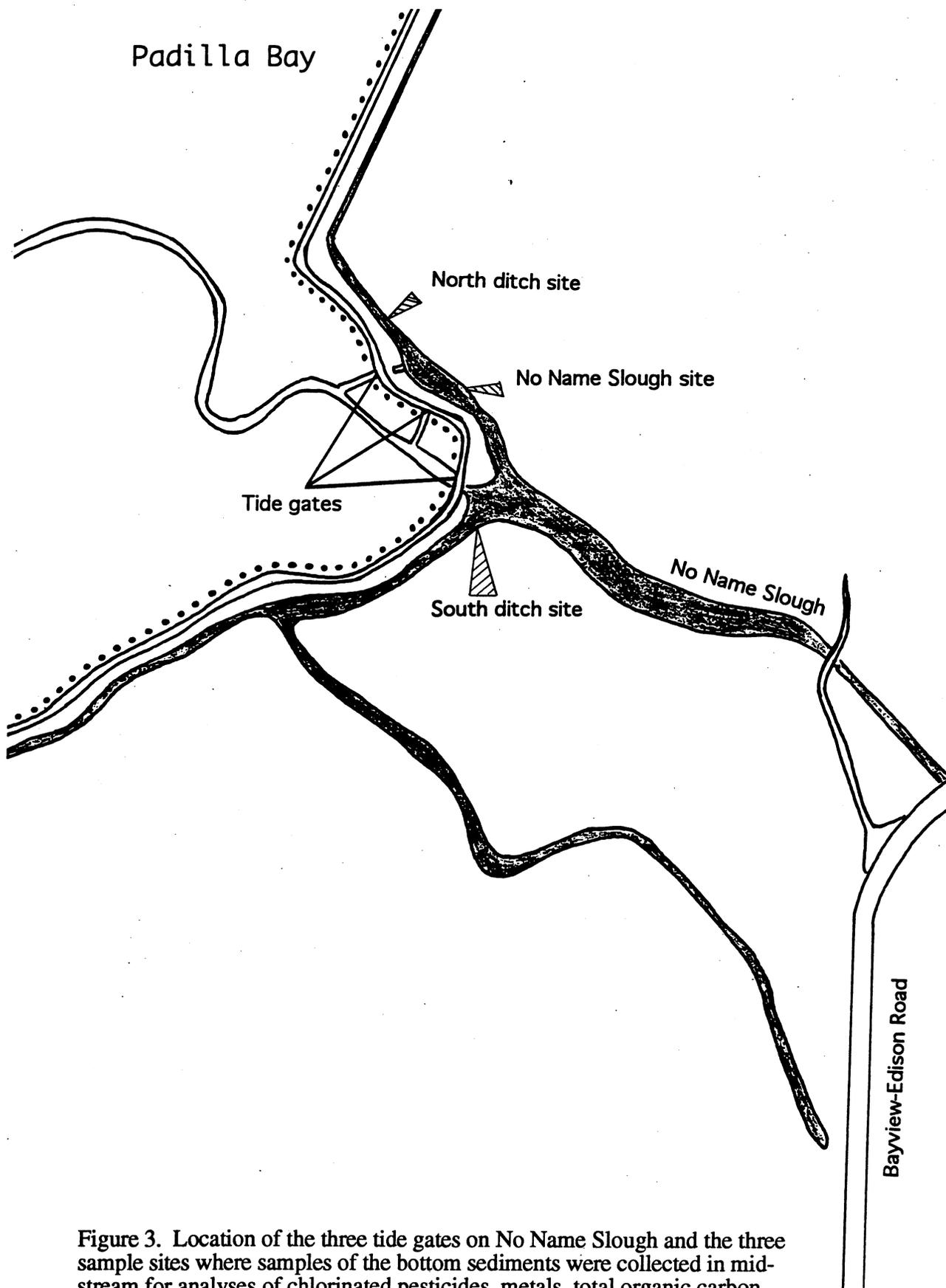


Figure 3. Location of the three tide gates on No Name Slough and the three sample sites where samples of the bottom sediments were collected in mid-stream for analyses of chlorinated pesticides, metals, total organic carbon, and particle size.

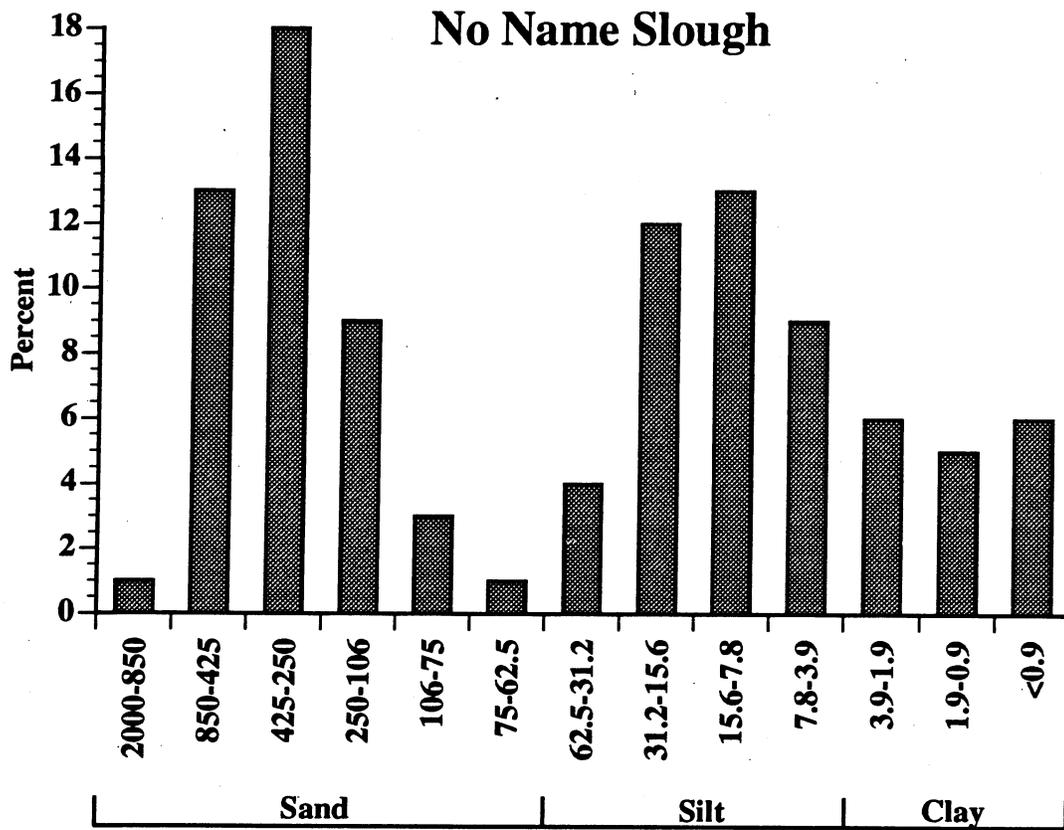


Figure 4. Grain size (μm) of sediments from the center of No Name Slough near the mouth of the slough.

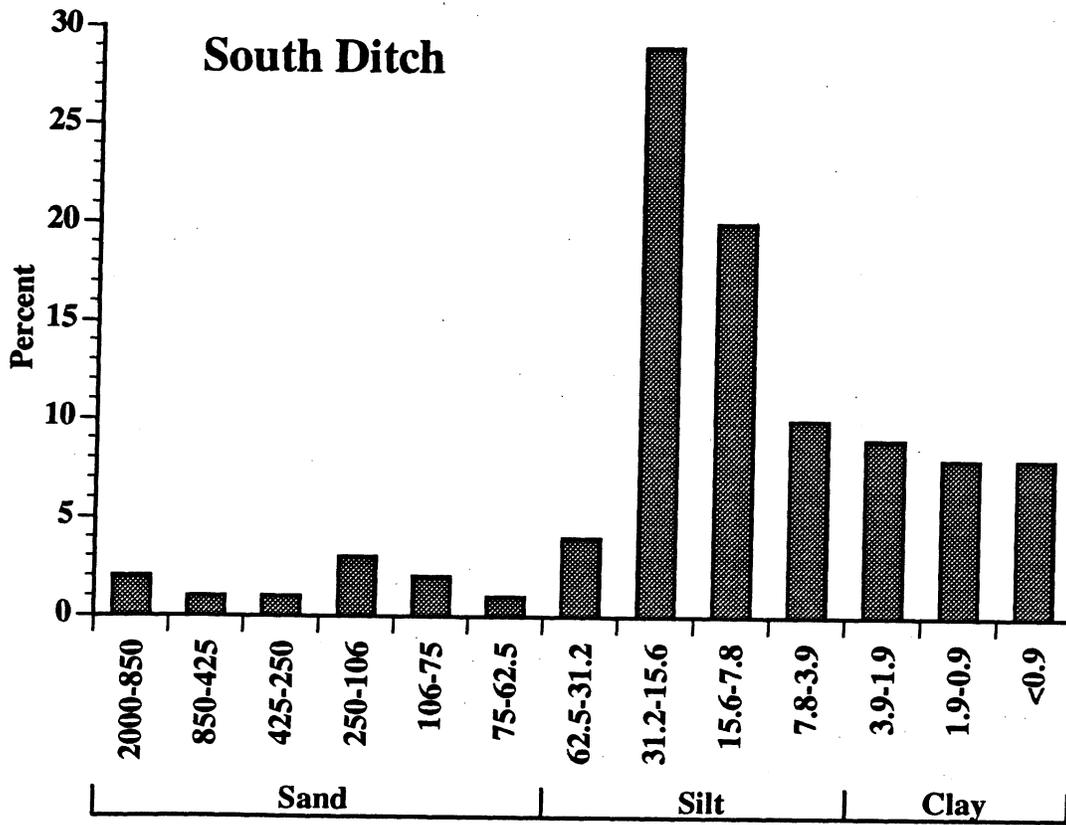
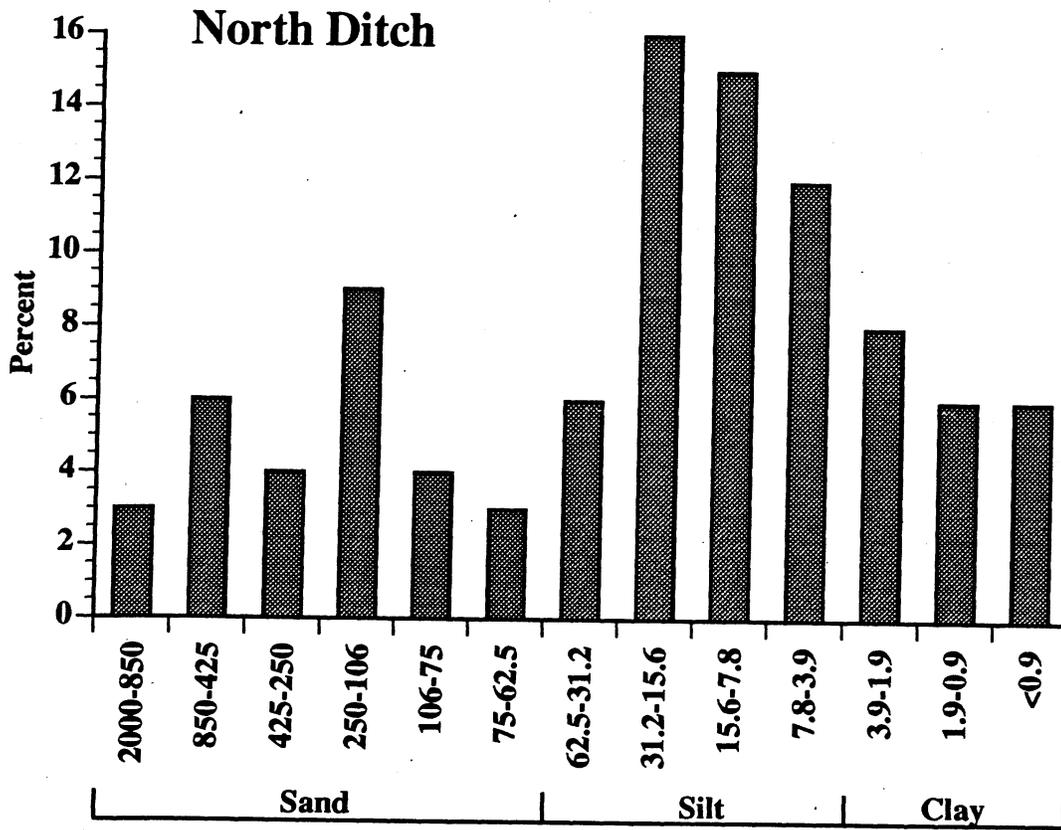


Figure 5. Grain size (μm) of sediments near the center of two field ditches draining into No Name Slough near its mouth.

