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Data Report on a Reconnaissance- level Assessment for Avian Injury in Commencement Bay

Commencement Bay, Washington



Prepared for
The Commencement Bay Natural Resource Trustees

U.S. Fish and Wildlife Service
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Data Report on a Reconnaissance-level Assessment for Avian Injury in Commencement Bay

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By

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Executive Summary

In 1995, the U.S. Fish and Wildlife Service (FWS) initiated an investigation in association with an ongoing natural resource damage assessment (NRDA) to preliminarily assess the potential for injury to bird species exposed to contaminants in the Commencement Bay area. The purpose of this report is to provide the co-trustees of the damage assessment with a summary of the reconnaissance-level assessment and its major findings.

From June 1995 to May 1997, the FWS: (1) collected and analyzed eggs from four species of birds known to reside, feed, and nest in the Commencement Bay environment; (2) collected additional contaminant exposure information from surf scoters as they began and ended their wintering residence in Commencement Bay; and (3) observed the feeding behavior of great blue herons (i.e. forage site selection) at the Dumas Bay and Hylebos colonies.

The major findings of this preliminary assessment are:

1. Total TCDD Toxic Equivalency Quotients (TEQs) in the eggs of the Canada goose, glaucous-winged gull, great blue heron and mallard duck collected in Commencement Bay ranged from 6.57 ppt to 598 ppt. Mallard and heron eggs scored the highest TEQ values overall with polychlorinated biphenyls (PCBs) being the greatest contributor in the TEQ value for all species analyzed except Canada goose.
2. DDE and metal residues detected in the eggs of the four species analyzed were not above critical values associated with mortality or impaired reproductive success.
3. Mean concentrations of mercury (measured in liver and kidneys) and chromium (measured in liver) were significantly higher in surf scoters collected in the late winter sample group than the fall sample group.
4. Observations recording arrival and departure data from the Dumas Bay and Hylebos Waterway great blue heron colonies indicated that nearly one-half of the birds in each colony were selecting forage sites located in or near the industrial waterways of Commencement Bay.
5. Levels of productivity from the Dumas Bay great blue heron colony continue to be consistently below that which would be necessary for the colony to maintain itself.

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Table of Contents

| | |
|-------------------------------|----------|
| Executive Summary | iv |
| Acknowledgments | v |
| List of Abbreviations | xii |
| 1.0 Introduction | 1 |
| 1.1 Background | 1 |
| 1.2 Location | 1 |
| 1.3 Summary of Impacts | 1 |
| 1.4 Study Objectives | 3 |

Avian Egg Collection and Analysis

| | |
|---|-----------|
| A2.0 Methods | 4 |
| A2.1 Collection | 4 |
| A2.2 Processing | 4 |
| A2.3 Lab Methodology and Analysis | 7 |
| A3.0 Results | 10 |
| A3.1 Dibenzodioxin, Dibenzofuran, and Biphenyls | 10 |
| A3.2 TCDD Equivalents (or TEQs) | 17 |
| A3.3 Metals | 26 |
| A3.4 Pesticides, Butyltins, and other analytes | 29 |

Surf Scoter Collection and Analysis

| | |
|---|-----------|
| B2.0 Methods | 32 |
| B2.1 Objectives | 32 |
| B2.2 Collection and Processing | 32 |
| B2.3 Statistical Analysis | 34 |
| B3.0 Results | 34 |
| B3.1 Tissue and Bile Chemistry | 34 |
| B3.2 Cytochrome P450, Blood and Histology | 35 |

Great Blue Heron Colony Monitoring

| | |
|---------------------------|-----------|
| C2.0 Methods | 36 |
|---------------------------|-----------|

| | |
|--|-----------|
| C2.1 Objectives | 36 |
| C2.2 Tasks | 36 |
| C3.0 Results | 37 |
| C3.1 Dumas Bay Colony | 39 |
| C3.2 Hylebos Colony | 43 |
| C3.3 Comparison Colonies at Auburn and Nisqually | 45 |
| References | 46 |

Appendices

| | |
|---|-----|
| A. Morphological measurements of eggs | A-1 |
| B. Data validation report avian tissue analysis | B-1 |

List of Tables

| | | |
|------------------|--|----|
| Table 1. | Compiled bird list and selected species for 1995 and 1996 egg collection in Commencement Bay using Hylebos Waterway Christmas Bird Count Data, 1977-1982. | 05 |
| Table 2. | Summary information on eggs collected in 1995 and 1996 in Commencement Bay. | 07 |
| Table 3. | Methodologies used by contracted labs for analyzing constituents in avian eggs collected in Commencement Bay in 1995 and 1996. | 08 |
| Table 4. | Avian toxic equivalency factors (TEFs) used to calculate TCDD-equivalents in avian egg tissues collected in Commencement Bay in 1995 and 1996. | 09 |
| Table 5. | Total PCBs in ng/g (ppb) wet weight in avian egg tissues collected in Commencement Bay in 1995 and 1996. | 10 |
| Table 6. | Congener specific mean and range values in pg/g (ppt) wet weight and their corresponding TEF/TEQ value for Canada goose and glaucous-winged gull eggs collected in Commencement Bay in 1995. | 11 |
| Table 7. | Congener specific mean and range values in pg/g (ppt) wet weight and their corresponding TEF/TEQ value for great blue heron and mallard duck eggs collected in Commencement Bay in 1996. | 12 |
| Table 8. | Lowest observable adverse effect levels ($\mu\text{g/g}$ or ppm wet weight) of total polychlorinated biphenyls (PCBs) in bird eggs from the Great Lakes region (modified and adapted from USFWS December 2, 1996 letter to EPA). | 17 |
| Table 9. | Total TEQs in pg/g (ppt) wet weight and percent fraction between Dioxins/Furans and PCBs in avian egg tissues collected in Commencement Bay in 1995 and 1996. | 23 |
| Table 10. | Field studies measuring exposure in eggs and effects in TCDD-equivalents and 2,3,7,8 -TCDD values (ppt) for selected species (modified and adapted from Hoffman <i>et al.</i> 1996). | 24 |

| | | |
|------------------|---|----|
| Table 11. | Mean and range values for trace metals in $\mu\text{g/g}$ (ppm) dry weight; butyltins in $\mu\text{g/kg}$ (ppb) dry weight ; phthalates, phenols, and PAHs in $\mu\text{g/kg}$ (ppb) wet weight; and percent lipid, percent moisture, and wet weight conversion factors in avian egg tissues collected in Commencement Bay in 1995 and 1996. | 27 |
| Table 12. | Mean and range values for pesticides in $\mu\text{g/kg}$ (ppb) wet weight in avian egg tissues collected in Commencement Bay in 1995 and 1996. ... | 30 |
| Table 13. | Comparisons between selected analytes and surf scoter sampling sets collected from Commencement Bay in 1995 and 1996 (Mercury and Chromium values are mean concentrations in ppm). | 34 |

List of Figures

| | | |
|-------------------|--|----|
| Figure 1. | Map of the Commencement Bay Nearshore/Tideflats Superfund Site and surrounding area. | 02 |
| Figure 2. | Map of egg collection locations in Commencement Bay in 1995 and 1996 | 06 |
| Figure 3. | Congener-specific comparison between avian species for dibenzodioxins in pg/g (ppt) wet weight in egg tissues collected in Commencement Bay in 1995 and 1996. | 13 |
| Figure 4. | Congener-specific comparison between avian species for dibenzofurans in pg/g (ppt) wet weight in egg tissues collected in Commencement Bay in 1995 and 1996. | 14 |
| Figure 5. | Congener-specific comparison between avian species for non ortho-chlorinated biphenyls in pg/g (ppt) wet weight in egg tissues collected in Commencement Bay in 1995 and 1996. | 15 |
| Figure 6. | Congener-specific comparison between avian species for mono ortho-chlorinated biphenyls in ng/g (ppb) wet weight in egg tissues collected in Commencement Bay in 1995 and 1996. | 16 |
| Figure 7a. | Percent fraction of total TCDD-equivalents in Canada goose eggs collected in Commencement Bay in 1995. | 19 |
| Figure 7b. | Percent fraction of total TCDD-equivalents in glaucous-winged gull eggs collected in Commencement Bay in 1995. | 20 |
| Figure 7c. | Percent fraction of total TCDD-equivalents in great blue heron eggs collected in Commencement Bay in 1996. | 21 |
| Figure 7d. | Percent fraction of total TCDD-equivalents in mallard duck eggs collected in Commencement Bay in 1996. | 22 |
| Figure 8. | Comparison of TCDD-equivalent contributions in pg/g (ppt) in eggs collected in Commencement Bay in 1995 and 1996 between avian species and between dibenzodioxins, dibenzofurans, and biphenyls. . . | 25 |
| Figure 9. | Comparison of trace metal values in $\mu\text{g/g}$ (ppm) dry weight between avian species egg tissues collected in Commencement Bay in 1995 and 1996. | 28 |

| | | |
|-------------------|--|----|
| Figure 10. | Comparison of 4,4' -DDT, -DDD, -DDE residue values in $\mu\text{g}/\text{kg}$ (ppb) wet weight and tributyltin residue values in $\mu\text{g}/\text{kg}$ (ppb) dry weight between avian species egg tissues collected in Commencement Bay in 1995 and 1996. | 31 |
| Figure 11. | Surf scoter collection and telemetry locations in 1995/1996, and collection site utilized in 1984-1985 by Henny <i>et al.</i> (1991) in Commencement Bay. | 33 |
| Figure 12. | Great blue heron colony locations in and near Commencement Bay in 1997 and historically. | 38 |
| Figure 13. | Primary summer foraging sites utilized by great blue herons observed in Commencement Bay in 1997. | 40 |
| Figure 14. | Nesting observations from the Dumas Bay, Nisqually, and Auburn great blue heron colonies, 1984-1997. | 41 |
| Figure 15. | Productivity of the Dumas Bay, Nisqually, and Auburn great blue heron colonies by numbers of young per successful nest and numbers of young per active nest, 1984-1997. | 42 |
| Figure 16. | Arrival and departure data results from the Dumas Bay (B) and Hylebos (C) great blue heron great blue heron colony in 1997. | 44 |

List of Abbreviations

| | |
|----------|--|
| AHH | Aryl Hydrocarbon Hydroxylase |
| DOI | Department of the Interior |
| MFO | Mixed-Function Oxygenase |
| NPL | National Priorities List |
| NRDA | Natural Resource Damage Assessment |
| PCB | Polychlorinated Biphenyl |
| PSAMP | Puget Sound Ambient Monitoring Program |
| TCDD-Eq. | Tetrachlorodibenzodioxin Equivalent (=TEQ) |
| TEF | Toxic Equivalency Factor |
| TEQ | Toxic Equivalent (=TCDD-Eq.) |

1.0 Introduction

1.1 Background

As part of an ongoing Natural Resource Damage Assessment (NRDA) in Commencement Bay, Washington, the U.S. Fish and Wildlife Service (FWS) was tasked with the responsibility to assess injury specific to avian species potentially exposed to contaminants present in the Commencement Bay area.

A Preliminary Natural Resource Survey performed by the FWS in March 1984 stated there was a high probability that waterfowl, shorebirds, fishes and a federally-classified threatened species (bald eagle) may be affected by releases in Commencement Bay (U.S. Department of the Interior 1984, U.S. Fish and Wildlife Service 1984). In 1991, the Commencement Bay Natural Resource Trustees' (Trustees) performed a Preassessment Screen which concluded that available data support the conclusion that contaminants have adversely affected natural resources in the Commencement Bay environment and a damage assessment may be undertaken at a reasonable cost (The Natural Resource Trustees 1991).

1.2 Location

Listed on the National Priority List (NPL) in 1981, the *Commencement Bay Nearshore/Tideflats Superfund Site* (Site), located near Tacoma, Pierce County, Washington, consists of approximately 15 square miles of estuarine habitat, industrial waterways, and uplands (**Figure 1**). Industrialized development in the estuary began in the 1920's and has included many activities including: shipping, pulp and paper production, oil and chemical production, railroad operations, and metal smelting. These activities have resulted in the acute and chronic release of numerous hazardous substances over time. Environmental contaminants released at the Site include chlorinated organic compounds, aromatic hydrocarbons, trace metals, dioxins, furans, and phenols. Concentrations 100 to 1,000 times reference conditions were measured for 28 contaminants or contaminant groups (Tetra Tech 1985).

1.3 Summary of Impacts

Documented adverse impacts from the contaminants include depressed or altered benthic organism populations, high mortality rates in benthic microfauna and macrofauna, tumors, growth and reproductive impacts in fish, elevated levels of contaminants in fish and shellfish resulting in human consumption advisories, and toxic sediment conditions as demonstrated in laboratory bioassays. Studies conducted on fish, crab, and shrimp in

¹U.S. Department of the Interior: Fish and Wildlife Service and Bureau of Indian Affairs; U.S. Department of Commerce: National Oceanic and Atmospheric Administration; State of Washington: Departments of Ecology, Fish and Wildlife, and Natural Resources; Muckleshoot Indian Tribe; and Puyallup Tribe of Indians.

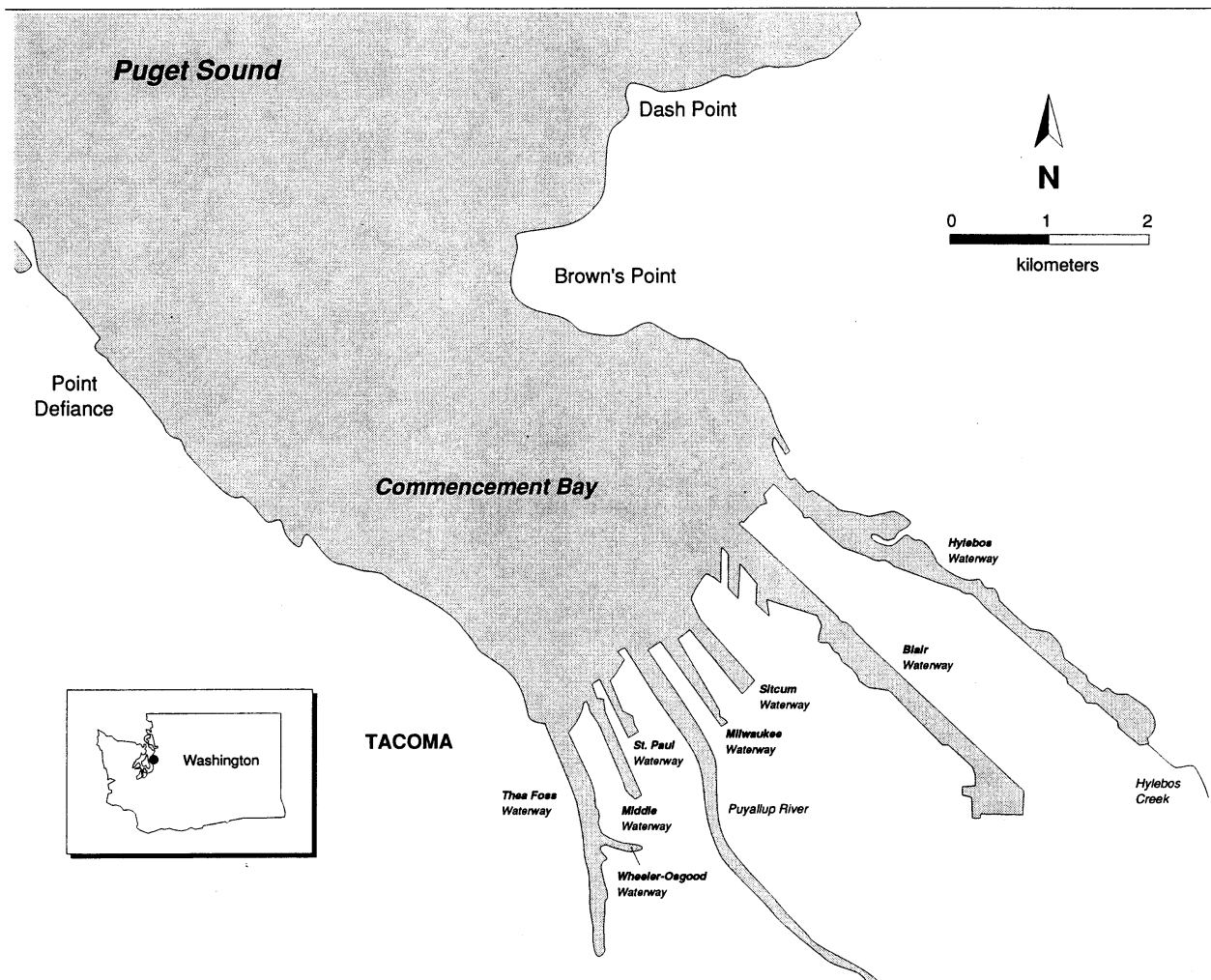


Figure 1. Map of the Commencement Bay Nearshore/Tideflats Superfund Site and surrounding area.

Commencement Bay have revealed elevated concentrations of organics and heavy metals in muscle tissues, elevated incidences of fin erosion and tumors, and abnormal tissue damage to internal organs (Malins *et al.* 1982, 1984; Tetra Tech 1985; McCain *et al.* 1990; Varanasi *et al.* 1993; Stein *et al.* 1992, 1995).

Information regarding contaminant exposure to higher trophic levels such as birds in the Commencement Bay area is generally limited, dated, or statistically inadequate. Eggs collected from a great blue heron (*Ardea herodias*) colony near Commencement Bay in 1984 and 1988 indicated that exposure to polychlorinated biphenyls (PCBs) had occurred and at concentration levels known to cause reproductive failure (e.g. egg lethality, embryonic deformities) in several waterfowl species (Speich *et al.* 1992; Block 1992; Giesy *et al.* 1994). The results of a productivity study funded and directed by the Trustees in 1994 suggested that this particular heron colony also exhibited lower productivity than other regionally

located colonies (EVS Environmental Consultants 1995).

Data collected from six glaucous-winged gull (*Lams glaucescens*) colonies in 1984 indicated incidences of histopathological impairment (e.g. liver disease), traumatic lesions, and egg-shell thinning in the Commencement Bay colony (Riley *et al.* 1983; Calambokidis *et al.* 1985; Speich *et al.* 1992). Analysis of western grebes (*Aechmophorus occidentalis*) and surf scoters (*Melanitta perspicillata*) in Commencement Bay indicated that significant amounts of PCBs, organochlorines and metals were being accumulated by the overwintering birds during 1985-1986 (Henny *et al.* 1990, 1991).

1.4 Study Objectives

To preliminarily assess injury to avian species residing in or utilizing the Commencement Bay area, the FWS designed and implemented a three-pronged reconnaissance assessment and approach designed to address and update our current knowledge of the extent, severity, and trend of contaminant exposure to birds from hazardous substances released into the Commencement Bay environment. The three components of the assessment are divided into separate overview sections in the report:

Avian Egg Collection and Analysis - Determine contaminant concentrations in the eggs of several different avian species known to reside, feed and nest in the Commencement Bay environment.

Surf Scoter Collection and Analysis - Utilize and expand upon an existing contaminant monitoring program (the Puget Sound Ambient Monitoring Program) and collect additional contaminant exposure information from surf scoters as they begin and end their wintering period in Commencement Bay.

Great Blue Heron Colony Monitoring - Observe feeding behavior of great blue herons at the Dumas Bay and Hylebos colonies in Commencement Bay.

This report presents the culmination of iterative steps taken between June 1995 and May 1997 investigating the potential for avian injury in Commencement Bay.

A2.0 Methods

To better understand the extent of chemical exposure, eggs were selected from birds with different feeding strategies and food preferences in Commencement Bay. Egg residues in general are a preferred medium to analyze for contaminants because of their high potential to biomagnify and accumulate specific chemicals known to cause injury.

A list of birds was generated from known observation data generated in part by Christmas Bird Count data and Appendix A from the Commencement Bay Programmatic Environmental Impact Statement Volume 1 (Commencement Bay Natural Resources Trustees 1997). Four species from this list were then selected based on: 1) whether or not the bird was known to nest in or near the Commencement Bay Site; 2) the likelihood of readily obtaining the egg samples; and 3) residence time and general abundance (**Table 1**). The four species selected were: Canada goose (*Branta canadensis*); glaucous-winged gull (*Lams glaucescens*); mallard duck (*Anas platyrhynchos*); and great blue heron (*Ardea herodias*).

A2.1 Collection

Collection took place during the Spring of 1995 and 1996. One egg was randomly collected from each nest of the four species. When possible, nests with three or more eggs visible were selected for collection. Four eggs were collected from the nests of Canada geese near the Hylebos and Blair Waterways and from glaucous-winged gull nests located on the roof of the Simpson Tacoma Kraft Mill in 1995. In 1996, five eggs were collected from nests of the great blue heron colony in Dumas Bay and 2 eggs were obtained from mallard nests located in between the Hylebos and Blair Waterways (**Figure 2**). The original intent of collecting five eggs from each species could only be accomplished for the great blue heron (**Table 2**). Searches for nesting duck species in the Commencement Bay area proved to be time-intensive and problematic.

A2.2 Processing

The contents of each egg collected in 1995 (goose and gull) were removed on site and placed (blown) into chemically clean I-CHEM[®] jars. Samples were placed in a cooler with cold packs and then frozen prior to shipment for analysis. Eggs collected in 1996 (heron and mallard) were collected and stored in paper cartons on cold packs until storage in a refrigerator. The eggs were then wrapped in nanograde acetone rinsed aluminum foil and transferred to another refrigerator prior to arrival to the lab facilities at the FWS Western Washington Office in Olympia. These eggs were then processed using procedures consistent with FWS Standard Operating Procedure (SOP) for avian egg harvesting and residue analysis (U.S. Fish and Wildlife Service 1990). Recorded information included: general condition, whole egg weight, length, width, volume, content weight, and shell