CONTAMINANTS IN WINTERING CANVASBACKS AND SCAUPS FROM SAN FRANCISCO BAY, CALIFORNIA

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(Received 25 June 1996; accepted 14 December 1996)

Abstract. Organochlorines, metals, and trace elements were measured in liver, kidney, or whole-body tissues of canvasbacks (Aythya valisineria), lesser scaups (A. affinis), and greater scaups (A. marila) collected from San Francisco Bay and three coastal areas of California during the winter of 1986–1987. Potentially toxic concentrations of mercury (mean $\leq 10.4$ μg/g, dry weight) and selenium (mean $\leq 32.7$ μg/g, dry weight) were found in livers of scaups and canvasbacks from several San Francisco Bay sites. These elements varied spatially, temporally, and between species, with the highest concentrations found in late winter. Mean concentrations of mercury, selenium, and cadmium were generally higher in scaups than in canvasbacks. Of all the organochlorines included in the analyses, only $p,p'$-DDE and total PCBs were detected in all samples in this study. Mean whole-body concentrations of DDE and PCBs from San Francisco Bay ducks collected in late winter varied spatially and between species, but the concentrations were not considered toxic. Causes for inter-specific differences are unclear, but may be attributable to differences in diet, movement, or physiology.

Key words: canvasbacks, greater scaups, lesser scaups, metals, organochlorines, San Francisco Bay

1. Introduction

San Francisco Bay, the largest estuary on the west coast of the continental United States (Conomos et al., 1985), has been greatly modified by human activity (Nichols et al., 1986). Over the past century, more than 85% of the tidal wetlands that once surrounded the Bay have been lost to agricultural and industrial development (Nichols et al., 1986). Loss of habitat has contributed substantially to declines in waterbirds and other wildlife species. For example, numbers of canvasbacks overwintering in San Francisco Bay have decreased about 50% over the past 25 years (USFWS, unpubl. data). Nevertheless, the Bay is a major wintering and feeding area for many species of waterfowl and shorebirds, including several

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endangered species. The open bay waters and salt evaporation ponds in and adjacent to San Pablo Bay (Figure 1) support more wintering canvasbacks than any other location in the western United States (USFWS, unpubl. data). As many as one million shorebirds have been observed on San Francisco Bay during spring migration (Stenzel and Page, 1988).

Besides lost habitat, wildlife has been exposed to a wide range of potentially hazardous pollutants discharged into the Bay (Phillips, 1987). Threats associated with the input of contaminants into southern San Francisco Bay (South Bay) from wastewater treatment plants and non-point sources are compounded by poor flushing due to low tidal exchange and low freshwater flows (Conomos, 1979). Concentrations greater than background levels of metals and trace elements have been measured in water (Cutter, 1989), sediments (Luoma and Cloern, 1982), and bivalves of south San Francisco Bay (Luoma et al., 1985). At least one of these bivalves, *Macoma balthica*, is a primary food for canvasbacks in the Bay (White et al., 1988).

Although flushing of contaminants by freshwater flows is greater in the North Bay, this region also receives large quantities of municipal, industrial, and agricultural discharges (Gunther et al., 1987). In recent studies, concentrations of trace elements were elevated above background in bivalves from North San Francisco Bay and Suisun Bay (Luoma et al., 1990).

A few studies have addressed the potential threats of contaminants to migratory waterfowl in San Francisco Bay. Elevated concentrations of mercury (Hg), cadmium (Cd), and selenium (Se) were found in greater scaups and surf scoters (*Melanitta perspicillata*) from San Francisco Bay in 1982 (Ohlendorf et al., 1986c). In 1985, mean concentrations of Se, Hg, and Cd in scoters collected from the North Bay differed from scoters collected from the South Bay (Ohlendorf and Fleming, 1988; Ohlendorf et al., 1991). Se was found to accumulate in diving ducks wintering in the Bay to levels toxic to other species (White et al., 1988). DDE and other organochlorines (OCs) were also found to accumulate in surf scoters during the winter (Ohlendorf et al., 1991).

The present study was conducted to investigate waterfowl exposure to contaminants in San Francisco Bay. Specific objectives were to measure organic and inorganic contaminant residues in scaups and canvasbacks wintering in San Francisco Bay and at sites on the California coast, assess geographic differences in contaminant concentrations in these species from these sites, and document contaminant accumulation by ducks wintering in the Bay.

### 2. Materials and Methods

#### 2.1. Study Areas

The California Department of Fish and Game (CDFG) collected canvasbacks, greater scaups, and lesser scaups during the winter of 1986–1987 from five sites...