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Selenium Concentrations in Surf Scoter and Greater Scaup from the San Francisco Estuary

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Abstract

High selenium (Se) concentrations in the water and sediment of San Francisco Estuary are of potential health concern for both humans and wildlife. Results from 2002 bird tissue analysis showed that Se concentrations from Suisun Bay for surf scoter and greater scaup were significantly higher than tissue concentrations in San Pablo or South Bays. Most of the 2002 Se concentrations, except 2002 Suisun Bay scaup, were significantly lower than the peak year Se tissue concentrations that occurred during the late 1980s. There is, however, high inter-annual variation in the data. Additional sampling and data are neccessary to see any long term trends in tissue accumulation. Surf scoter gut content in Suisun Bay was 100% Potamocorbula amurensis. Gut content for Scoter at other sites included mussels, clams and barnacles.

Methods

In late winter of 2002 surf scoter *(Melanitta perspicillata)* and greater scaup *(Aythya marila)* were collected in Suisun Bay (n=10 each), San Pablo Bay (n=10 and n=7, respectively) and South Bay (n=10 each) (Figure 1). Male and female, adult and juvenile birds were collected by shotgun with bismuth shot. Breast muscle tissue without skin was prepared and each sample analyzed individually. Tissue samples were ashed and then analyzed by HGAAS. Food items from the esophagus-proventriculus of scoters were rinsed over a 0.5-mm screen, sorted by taxon, oven-dried to constant weight, and then weighed. Data were analyzed utilizing the non-parametric Kruskal-Wallis test. Chemical analysis of 2002 and historical data was performed by the California Department of Fish and Game.

Results

Surf Scoter (see Figure 2)

- 2002 Se tissue concentration for Suisun Bay was significantly higher than both San Pablo and South Bay concentrations (p=0.004).
- Suisun Bay 2002 Se tissue concentrations were significantly less than 1989 concentrations (p<0.0005).
- San Pablo 2002 Se tissue concentrations were significantly less than 1990 concentrations (p<0.0005).
- South Bay 2002 Se tissue concentrations were significantly less than 1990 (p<0.0005).

Greater Scaup (see Figure 3)

- 2002 Suisun Bay Se tissue concentrations were significantly higher than both South and San Pablo Bay concentrations (p=0.001).
- 2002 Suisun Bay Se concentrations were significantly higher than 1987 concentrations (p=0.006).
- 2002 San Pablo Bay Se tissue concentrations were significantly less than 1988 concentrations (p<0.0005).
- 2002 South Bay Se concentrations were significantly less than 1987 (p<0.0005).

Surf Scoter Gut Content (see Figure 4)

- 100% of gut content in Suisun Bay scoters was the invasive clam *Potamocorbula amurensis.*
- 25% of gut content in San Pablo Bay scoters was *P. amurensis* and 75% was the soft shelled clam, *Mya arenia.*
- 77% of gut content in South Bay scoters was the mussel, *Musculista stenhousia* and 23% were barnacles of the *Balanus* family.

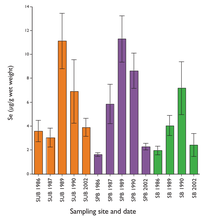

Figure 2. Selenium tissue concentrations in Surf Scoter 1986 – 2002. SUB=Suisun Bay, SPB=San Pablo Bay, SB=South Bay. Columns represent the average concentration, bars represent the 95% confidence limits.

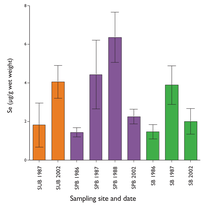

Figure 3. Selenium concentrations in greater scaup tissue 1986 - 2002. SUB=Suisun Bay, SPB=San Pablo Bay, SB=South Bay. Columns represent the average concentration, bars represent the 95% confidence limits.

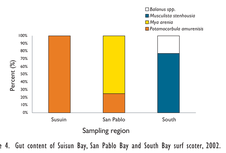

Figure 4. Gut content of Suisun Bay, San Pablo Bay and South Bay surf scoter, 2002.

Discussion

The 2002 data show that Se concentrations in Suisun Bay surf scoter and greater scaup are significantly higher than tissue concentrations in San Pablo Bay and South Bay (Figures 2 and 3). Se concentrations in Suisun Bay scoter may be higher due to a diet high in *Potamocorbula amurensis* (Figure 4). *P. amurensis* encompassed 100% of Suisun Bay scoter diet, 25% of San Pablo Bay scoter diet and no trace in South Bay scoter diet. There is evidence that *P. amurensis* accumulates higher concentrations of Se than other benthic bivalves (Linville et al. 2002). Higher levels of bird tissue Se concentrations might be expected at locations where birds prey predominantly on *P. amurensis.*

Se concentrations in 2002 are lower in most regions of the Estuary, for both species, than the peak concentration years of the late 1980s. Due to the 12-year data gap it is not known whether the relatively low Se concentrations observed in 2002 are indicative of a long-term decline. However, loading of Se from Bay-Delta oil refineries has decreased since the original CDFG studies (1986-1990) (Luoma and Presser, 2000). The SFBRWQCB implemented mandatory reductions in Se discharged to the Estuary by oil refineries beginning in 1998. A full understanding of Se cycling in the Estuary is necessary to determine the factors that control the accumulation of Se in both predator and prey. Developing a long-term data set of Se tissue concentrations is needed to see how the Estuary is responding to management actions and if further regulation is required.

Figure 1. 2002 diving duck sampling regions.

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Acknowledgements

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