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Assessment of Bioaccumulation in San Diego Bay

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EXECUTIVE SUMMARY

Sediment-borne bioaccumulative contaminants have the potential to impair most of the designated beneficial uses for San Diego Bay. However, the ability to assess bioaccumulation-related impacts within the Bay is constrained by limited data availability and uncertainty in the approach to use for assessment and cleanup projects. Tissue contamination data for key elements of the San Diego Bay food web, matched with sediment data, are needed to develop an improved understanding of bioaccumulation relationships within the Bay and to provide updated information needed to assess the impacts of sediment contamination on wildlife and human health.

In 2012, the California Regional Water Quality Control Board, San Diego Region (SDRWQCB), the Southern California Coastal Water Research Project (SCCWRP), and the United States Fish and Wildlife Service (USFWS), Carlsbad Fish and Wildlife Office (CFWO) developed a plan to address the bioaccumulation data needs for San Diego Bay. Funding to conduct these studies was received from the Water Board in May 2014 and January 2015. The overall goal of this project was to conduct integrated food web studies within three regions of San Diego Bay. Compilation and analysis of data from multiple studies, as well as additional sampling conducted under this project were used to accomplish three primary study objectives:

Describe bioaccumulation among key components of the San Diego Bay food web. Two major contaminant exposure pathways were evaluated in the study: bioaccumulation related to feeding on sediment-dwelling organisms (benthic pathway) and bioaccumulation related to uptake of contaminants in water column-dwelling organisms (pelagic pathway).

Evaluate risk to wildlife from contaminant exposure. Contaminant concentrations in the eggs and diet of five species of seabirds were examined: California least tern, Caspian tern, double-crested cormorant, western gull, and surf scoter (diet only).

Assess potential risk to human health resulting from consumption of San Diego Bay fish. Tissue contamination data for several popular sport fish, including spotted sand bass, California halibut, and pacific chub mackerel, were compared to consumption advisory levels developed by OEHHA (Office of Environmental Health Hazard Assessment).

Sediment and tissue samples were obtained from three coordinated studies. Sampling was conducted in 2013 as part of the Southern California Bight Regional Monitoring Program (Bight ’13) in coordination with the Regional Harbor Monitoring Program (RHMP). The Bight ’13 survey also included the collection of seabird eggs from five locations around the Bay. Additional sediment and tissue samples were collected in 2014 as part of a shallow water habitat (SWHB) survey designed to complement the 2013 sample collections. The SWHB samples were collected from water depths of 3 m or less in order to provide information on contamination and bioaccumulation patterns in areas frequently used as bird foraging areas and fish nursery

grounds. Samples of five species of sport fish were collected for the study through a combination of targeted fishing and contributions from the public during a novel fishing derby.
The analyses were based on sediment contamination data from 65 stations in the Bay, randomly selected and representing three geographical regions: North, Central, and South. Additional sampling for biota was conducted at a subset of these stations in order to obtain samples of key food web components: plankton, benthic infauna, and forage fish. A total of 209 tissue samples were analyzed for a suite of contaminants that included mercury, PCBs, DDTs, chlordanes, dieldrin, and contaminants of emerging concern (PBDE flame retardants and perfluorinated compounds).
The key findings from the study are summarized below by study objective:
Bioaccumulation among Food Web Components

- Biomagnification among food web components was evident for all major contaminant types evaluated: PCBs, DDTs, PBDEs, chlordanes, and mercury. Similar patterns among food web components were evident for most contaminant types, with the lowest concentrations occurring in the lowest trophic levels of plankton and benthic infauna (crustaceans, mollusks, polychaetes).

- The greatest bioaccumulation potential from sediment was observed for PCBs and DDTs, where all food web components had median wet weight-based concentrations above bay-wide sediment dry weight-based means.

- Median tissue mercury concentrations were below sediment levels for all trophic levels. However, the influence of sediment contamination on mercury bioaccumulation could not be determined due to differences in mercury speciation between sediment and tissue.

- Sediments in the North region of the Bay contained higher average concentrations of chlordanes, mercury, and PCBs. The concentrations of sediment DDTs were similar in the North and South, which were 2-3x higher than the concentration in the Central Bay.

- Tissue contamination in infauna did not appear to follow trends in sediment concentration for PCBs and DDTs, with the exception of PCBs in crustaceans.

- Within the same species, median total PCB concentrations in fish tissue were generally highest in the Central Bay, and lowest in the South. This pattern differed from the trend seen for sediment, where the highest median concentration of PCBs was measured in the North.

- The highest median PCB concentration (359 ng/g) was measured in six samples of deepbody anchovy from the Central Bay.

- Total DDT concentrations in fish were generally about ten-fold lower than PCBs. Median concentrations of DDTs were generally similar in the North and Central, which were approximately two-fold higher than the South.

- All fish samples contained detectable levels of mercury, but there was little variation in concentration among regions. The highest median concentrations were measured in spotted sand bass, barred sand bass, and deepbody anchovy.

- Seabird eggs contained similar concentrations of DDTs and PCBs. Caspian tern eggs contained the highest median concentration of most contaminant types.

- There was little difference between regions in contaminant concentrations in California least tern eggs.

Risk to Wildlife (Birds)

- Elevated concentrations of mercury in seabird diets and eggs warrant further study, but the likelihood of observing measureable adverse impacts is low. Risk to seabird adults via the diet is somewhat greater than potential impacts on embryos from egg contamination.

- Total DDT concentrations in seabird eggs exceed thresholds for adverse impacts on embryos of sensitive species for eggshell thinning and reduced nest productivity. Risk to adults from dietary exposure to DDTs is less. Waterbirds (seabirds and waterfowl) have intermediate sensitivity to DDTs, so the chance of detecting measurable impacts in the studied species is low.

- Total PCB concentrations in eggs indicate greater potential risk to embryos of sensitive species, relative to adults (from dietary exposure). Further monitoring is warranted, but there is a low likelihood of observing measureable effects in waterbirds.

- Risk from exposure to PBDEs, chlordanes, and PFCs was less than the other contaminants evaluated, and below levels of potential concern.

- Some risk of adverse effects from exposure to PAHs was indicated for birds that forage on benthic invertebrates.

Risk to Human Health

- Potential human health risk from seafood consumption was evaluated for five species of locally-caught sport fish: California halibut, pacific chub mackerel, round stingray, spotted sand bass, and topsmelt.

- PCBs are the dominant trace organic contaminant of sport fish in the Bay. DDTs, while still prevalent in fish, were usually present at much lower concentrations.

- Pacific chub mackerel and spotted sand bass tended to have the highest concentrations of mercury and PCBs among the species analyzed.

Mercury contamination in the fish samples evaluated in this study posed the greatest potential risk to human health, with most of the regional mean concentrations falling in the range where consumption of no more than one meal per week is advised for sensitive populations (children and women 18-45). PCBs were also associated with relatively high potential health risk.

Full Text

http://ftp.sccwrp.org/pub/download/DOCUMENTS/TechnicalReports/953_SDBay_Bioaccum.pdf