History

Bivalves (mussels, clams, and oysters) have been used as biosentinels of water quality in a number of monitoring efforts worldwide. Bivalves are filter feeders and can ingest and accumulate environmental contaminants like organochlorine pesticides (i.e. DDTs, chlordanes, dieldrin), butyltins, polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), and trace metals (i.e. lead, silver, copper, mercury, and zinc). They are especially effective bioindicators of exposure to certain pollutants like PAHs that are metabolized by species at higher trophic levels. In addition to serving as bioindicators of organic contaminants and trace metals exposure, bivalves can serve as bioindicators of accumulated algal toxins (domoic acid, cyanotoxins) that may pose risks to human health and marine life that consume contaminated shellfish. Monitoring bivalves for organic contaminants, trace metals and harmful algal toxins, can help regulators identify sources, and help assess the bioavailability of contaminants at specific locations.

In California, three primary long-term monitoring programs have implemented bivalves to monitor contaminant bioavailability in coastal environments. The history and current status of these programs (SMW, RMP, and NMW) are described above. Data from SMW, RMP, and NMW have provided evidence of significant decreases in concentrations of contaminants like lead, silver, organochlorine pesticides, butyltins, and PCBs since monitoring efforts began. The declines in these pollutants are likely the result of a combination of: chemical bans, increased regulations, increased source control, and improved wastewater treatment. For example, DDT was banned in 1972 and since the 1980s, 90 percent of SMW stations, all six of the RMP stations, and 20 of 35 NMW stations reported significant reductions of DDTs in mussels.

In addition to looking at long-term pollution trends, the Mussel Watch data can be used to identify specific locations in the state where contaminants have declined and other sites where pollutants continue to be problematic. For example, data from NMW identified Crescent Point and Humboldt Bay had the lowest total butyltins (TBTs) concentration, whereas locations like San Pedro Harbor and San Diego Bay Harbor Island had some of the highest TBT concentrations in the state. Additionally, some of the most dramatic TBT declines were seen at Eureka Samoa Bridge, Monterey Bay Point Santa Cruz, San Francisco Bay, Marina Del Rey, Royal Palms, and Mission Bay. These state-wide reductions in TBT tissue concentrations coincide with the phaseout of TBT-based paints that started in the late 1980s.

TBT was widely used in paint for boat hulls, docks, fishnets, buoys, and cooling water systems as an anti-fouling agent. Studies have reported TBT has negative impacts on human health and aquatic ecosystems. Immunosuppression and imposex in snails and bivalves are some of the most documented effects of TBT on marine organisms. The decline in TBT concentration at many locations statewide is a good indicator that the regulations and bans have had a positive effect on preventing TBTs from entering coastal environments. Regulators can look at TBT, and other contaminants, on a site by site basis to identify regions where regulations are working and other areas that may need to implement additional strategies to meet water quality standards.

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