Triclosan

TIER 2
LOW CONCERN

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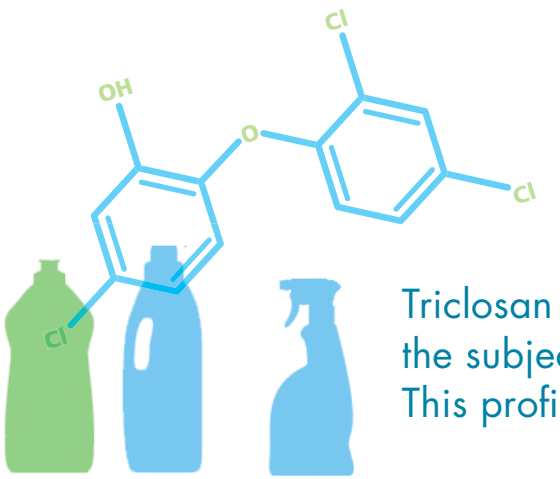
Quick Summary

Triclosan is an antimicrobial chemical used widely in personal care products, such as liquid hand soaps. Triclosan accumulates in Bay sediment. The concentrations observed have been well below effect thresholds, but potential risks are not fully understood. Doubts about the efficacy of triclosan in some of its uses and concern for its potential impacts on water quality call into question whether its uses should be curtailed.



What Is It?

- Synthetic chlorinated chemical that is a broad-spectrum antimicrobial agent.
- Kills or inhibits the growth of microorganisms, including bacteria and fungi.
- Structurally similar to triclocarban, another popular antimicrobial that is found in bar soaps and is also a concern in aquatic environments.

What Is It Used For?

- Antimicrobial used since the early 1960s in thousands of consumer and industrial products, including antibacterial liquid hand soaps (0.1-0.3% by weight), body washes, cosmetics, mouthwash, toothpaste, detergents, deodorants, and other products including furniture, cutting boards, sports equipment, floors, and carpets.
- Microban®, a slow release product that sometimes contains triclosan, is also incorporated into plastics used in children's toys, kitchen utensils, and other consumer and industrial products, and Biofresh®, another triclosan product, is embedded in some clothing.
- Estimated annual use of more than 300,000 kg/yr in the US (Halden and Paull 2005).
- The American Medical Association has not endorsed the necessity or efficacy of triclosan and other antibacterial agents in personal care products (WMI 2006). Physicians indicate that the best germ fighting measure continues to be the actual act of hand washing with regular soap, or for extra assurance, alcohol-based hand sanitizers.
- According to the US Food and Drug Administration, the only evidence of effectiveness is in toothpaste in preventing gingivitis (http://www.fda.gov/forconsumers/consumerupdates/ucm205999.htm).

How Is It Getting Into the Bay?

- Municipal wastewater treatment plant effluent is probably the major pathway to the Bay, although more information is needed on other potential pathways.
  - Over 95% of triclosan uses are in consumer products that are disposed of in residential drains, resulting in transport to municipal wastewater treatment plants.
  - Removal efficiencies in treatment plants typically range from 60% to >99.5%, depending on the type of treatment used.
  - Given the incomplete removal in treatment plants, triclosan is commonly detected in treatment plant effluent.
  - Concentrations in effluent from a Bay Area treatment plant in 2006 (ranging from <500 to 900 ng/L) (Jackson and Sutton 2008) were comparable to effluent concentrations observed in other studies.
  - Average concentrations in sewage sludge from two Bay Area treatment plants in 2008 (15-20 ppm) were similar to the nationwide average of 16 ppm (USEPA 2009 Targeted National Sewage Sludge Survey).
- Urban stormwater, which flows directly into the Bay untreated, is another potential pathway due to the use of triclosan-containing products for activities such as exterior cleaning and car washing.

Triclosan is a personal care product ingredient of particular interest that was the subject of a RMP fact sheet (www.sfei.org/news_items/factsheet-triclosan). This profile presents an update of the information in the fact sheet.

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What Happens to It in the Bay?

General Properties

- The fate of triclosan in the Bay has not been studied, but predictions can be made based on information from other studies.
- Upon entry into the Bay, triclosan is expected to be quickly removed from the water column through binding to sediment particles, photodegradation, and biodegradation. Some of the degradation products are problematic, however (more on this below).
- Triclosan is expected to accumulate primarily in sediment (due to its high affinity for organic matter and sediment particles) where it can be taken up by sediment-dwelling organisms and passed up the food chain.
- Triclosan can persist in sediments with a half-life as long as 540 days and resists biodegradation under low oxygen conditions when it is associated with sediments (Halden and Paull 2005).
- Other degradation products include chloroform, chlorophenoxyphenols, chlorophenols (e.g., 2,4-dichlorophenol and 2,4,6-trichlorophenol), and 2,8-dichlorodibenzo-p-dioxin; some of these chemicals are probable human carcinogens. Triclosan is suggested as the largest source of lower chlorinated dioxins to aquatic environments (Buth et al. 2010).
- One transformation product, methyl triclosan, is more persistent than triclosan and has been found to accumulate in fish (Leiker et al. 2009).

Patterns of Occurrence in the Bay and in Other Aquatic Ecosystems

- In a 2008 Bay sediment survey, concentrations ranged from < 5 to 40 ppb (FIGURE 1) (unpublished data).
- In a 2010 RMP Bay survey, triclosan was not detected in surface water (< 60 ng/L) or sediment (< 62 ppb); however, typical concentrations in estuaries are below these detection limits (<1 to 26 ng/L in water and from below detection to 86 ppb in sediment). A more sensitive method would be needed to detect triclosan in Bay water.
- Triclosan was not detected in mussels collected from the Bay in 2010 (< 33 ng/g wet weight) (unpublished data).
- Sediment concentrations are comparable among the US estuaries that have been studied, including San Francisco Bay.
- Studies in other parts of the US indicate concentrations are generally highest in water and sediment near municipal wastewater treatment plant outfalls or waters with known inputs of raw wastewater (Glassmeyer et al. 2005).
- Triclosan was one of the most frequently detected wastewater contaminants in a 1999-2000 survey of US stream waters – detected at 58% of sites nationwide (Kolpin et al. 2002).
- Though few studies have investigated triclosan bioaccumulation, triclosan has been detected in the US and Europe in algae, fish tissues (bile, plasma), marine mammals (plasma), and humans (milk, blood, urine).

Trends in the Bay and Nationally (PAGE 3)

- No trend data are available for the Bay.
- Data from other parts of the US suggest that sediment concentrations were highest in the 1960s and 1970s, declined significantly with the adoption of activated sludge wastewater treatment, but may have recently begun rising (Cantwell et al. 2010).

Is There a Risk of Harm in the Bay?

- Laboratory studies have suggested that triclosan can act as an endocrine disruptor in fish and mammals, but concentrations in the environment are generally much lower than the exposure concentrations used in these studies.
- Algae appear to be the most sensitive to triclosan exposure (acute toxicity threshold 200 ng/L) (Chalew and Halden 2009).
- Most of the toxicity threshold data currently available are from acute effects studies, which are not indicative of the potential effects due to long-term, chronic exposure to concentrations that are typically found in aquatic environments.
- In chronic toxicity studies, effects on the endocrine system in amphibians and the structure and function of algal communities have been observed at concentrations occurring in the environment (Veldhoen et al. 2006; Wilson et al. 2003).
- Additional concerns include the potential for indirect effects on algal and aquatic plant grazers due to the toxicity of triclosan to algae and the combined effects of persistent antimicrobial compounds, such as triclosan and triclocarban, on microbial communities.
- Some of triclosan's transformation products are probable human carcinogens.

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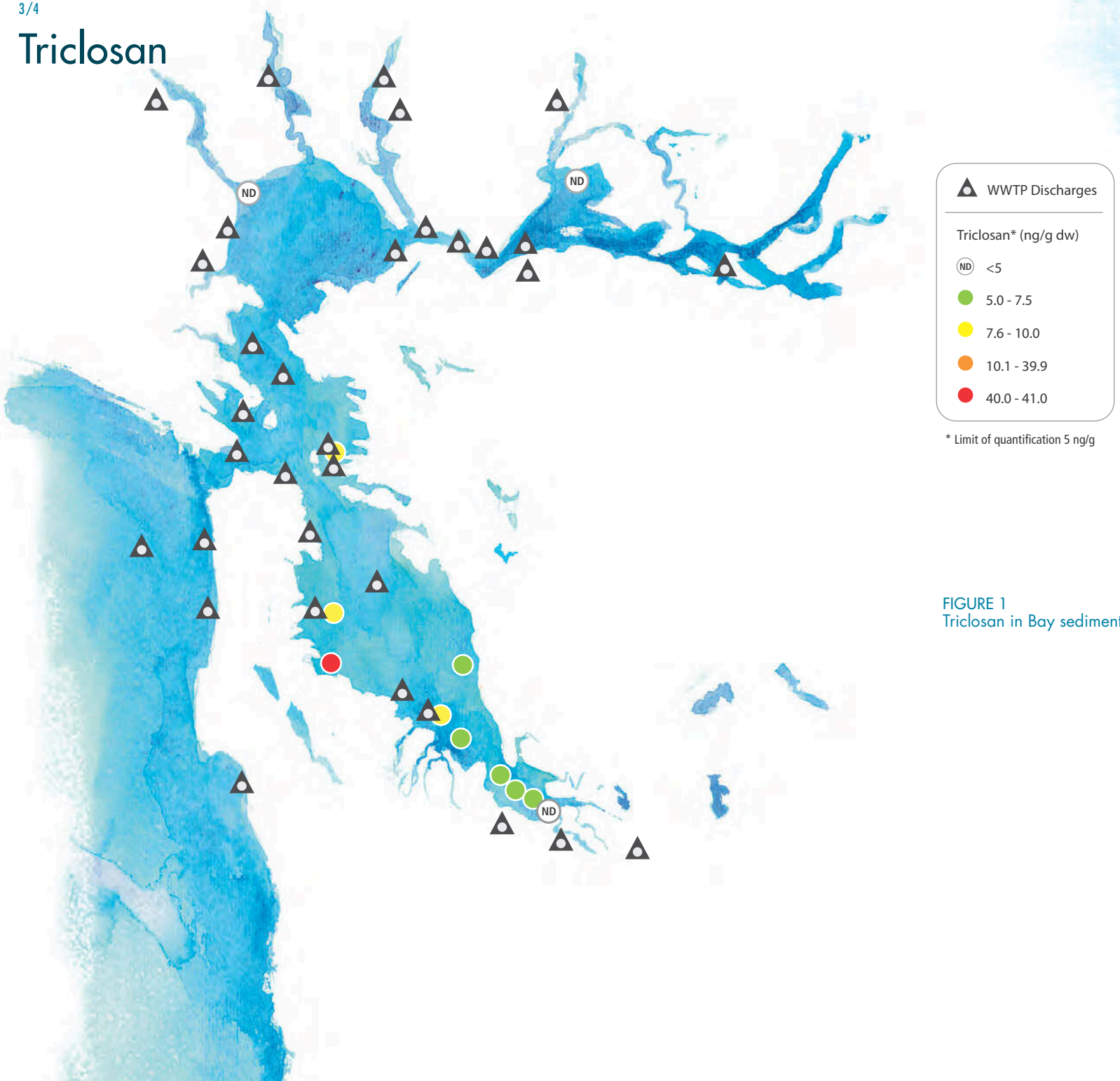

FIGURE 1
Triclosan in Bay sediment, 2008.

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Key Information Gaps

- Relative contributions of stormwater runoff and municipal wastewater as pathways of triclosan to Bay surface waters.
- Potential chronic effects on algae and microbes due to long-term exposure to concentrations of triclosan and other antimicrobials that are typically found in aquatic environments.
- The potential for transfer of triclosan and methyl triclosan through the food web to act as a source of exposure to wildlife.
- Concentrations in sediment and biota influenced by Bay Area treatment plant outfalls, where exposures are anticipated to be highest.
- Potential development of widespread antimicrobial resistance due to the presence of triclosan in aquatic environments.
- The occurrence of potentially toxic degradation and transformation products in the Bay.
- The identity, extent of use, and potential environmental health impacts of chemicals used as replacements for triclosan.

Management Timeline