

# **GREEN TIDE IN FAUNTLEROY COVE**

## **BACKGROUND, IMPLICATIONS, AND COMMUNITY ACTIONS**

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#### **BACKGROUND**

Hydrogen sulfide gas (H<sub>2</sub>S or "sewer gas") is often produced when bacteria break down organic matter. In Puget Sound and many other locations around the world, it is a byproduct of algal blooms in saltwater. Excess nutrients fuel an over abundance of seaweed that accumulates on the beach as the tide recedes and rots there. Thus, this phenomenon is often referred to as "green tide."

In Fautleroy Cove and other beaches in Central Puget Sound, nutrients (including nitrogen and fecal coliform from non-human sources) collude with high summer temperatures to encourage exceptional growth of *Ulva expansa*, a species of seaweed that thrives in enriched saltwater. Huge, deep mats of it accumulate near the shoreline; when strands break free, it washes ashore. In full bloom, production in Fautleroy Cove has been documented to be as much as 1.6 tons per day.<sup>1</sup>

Since 1980, the Fautleroy community in West Seattle has been under summer seige by this noxious gas. At first, it was thought to be associated with wastewater from ferries serving the Washington State Ferry System terminal in the cove. The state modified sewage holding tanks on the ferries, which reduced odors from the sewage pump station near the toll booth. After exceptional effort by Metro to control sewage odors, the beach odor persisted and researchers determined seaweed rotting on the beach to be the source of the problem.

#### **IMPLICATIONS FOR HUMANS**

Air-quality monitoring has documented varying levels of H<sub>2</sub>S throughout the "bowl" formed by hills on the north, east, and south sides of Fautleroy Cove. The greatest area of impact has been south of the ferry pier, near the beach.

Gas levels experienced by residents depend on the amount of rotting seaweed, wind velocity, and terrain. Because H<sub>2</sub>S is a heavy gas, it tends to settle in low-lying areas. Consequently, the residents most often and most severely affected are those living closest to the cove. On a warm day between early July through September, at low tide with moderate winds, the gas reaches scores of homes, compelling residents to close their windows despite the heat, use fans to clear rooms, stay indoors, and (during the worst episodes) leave the house.

H<sub>2</sub>S is a health concern because it can affect several systems in the body. Exposure to episodic low levels can cause eye irritation, sore throat, and cough. Long-term, low-level exposure can result in fatigue, loss of appetite, headaches, dizziness, and nausea.

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<sup>1</sup> Ronald M. Thom, *An Oceanographic Analysis of Odorous Beach Conditions in Fautleroy Cove, West Seattle*, 1985.

Consequently, H<sub>2</sub>S is listed by the Environmental Protection Agency and other federal agencies, as well as the State of Washington, as a hazardous air pollutant.

In the report of its 1990 investigation of odors at Fauntleroy Cove,<sup>2</sup> the Washington State Department of Health stated, "Hydrogen sulfide not only presents a nuisance due to its obnoxious odor but can also present health concerns." The report goes on to back the anecdotal record with solid numbers:

Hydrogen sulfide occurs in nature as part of the sulfur cycle. It is produced by bacteria which decompose dead plant or animal material when oxygen is not present. In addition to its obnoxious smell, hydrogen sulfide has toxic effects. At concentrations in the 10 ppm (parts per million) range, it can cause eye and respiratory irritation. It can also cause headache, interference with sleep, and nausea, which may be due primarily to the strength of the odor. At very high concentrations (500 to 1000 ppm or greater), hydrogen sulfide has neurotoxic and respiratory effects that are very hazardous. The odor detection limit for hydrogen sulfide is in the range of 0.003 to 0.02 ppm. Previous investigations had measured concentrations at the beach at Fauntleroy that were in the 10 ppm range, and the 1990 investigation was initiated to deal with the problem because of potential health concerns, as well as the nuisance aspect of the odor.

State-established safety limits for worker exposure to air contaminants (WAC 296 307 62625) are 15 ppm of continuous H<sub>2</sub>S exposure over a 15-minute period and 10 ppm of continuous exposure over an 8-hour period. National Institute for Occupational Safety and Health standards are a bit lower: 10 ppm for 10 minutes.

Monitoring during the course of the state's 1990 study routinely found readings in excess of 10 ppm on the beach close to seaweed accumulations, spiking to 40 to 50 ppm in late July and August. Readings at a residence away from the beach occasionally reached 10 ppm for a few minutes at a time. (Follow-up monitoring was done in 1998 at various locations in the community but, for want of funding for analysis, that data has never been reported.)

As reported by the Puget Sound Water Quality Action Team in 2000, residents along both east and west shores of Central Puget Sound and the islands between have experienced or are experiencing this sickening gas.<sup>3</sup> Since that report, the list has lengthened to include Shilshoal<sup>4</sup> in north Seattle and Dumas Bay in Federal Way.<sup>5</sup> The phenomenon is no longer restricted to coves; residents along Beach Drive, a nearly straight shoreline between Lowman Beach and Alki Point in West Seattle, have in recent years been subjected to H<sub>2</sub>S.<sup>6</sup>

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<sup>2</sup> *Fauntleroy Cove Odor Investigation*, Washington State Department of Health, 1990.

<sup>3</sup> *Blooms of Ulvoids in Puget Sound*, Puget Sound Water Quality Action Team, 2000.

<sup>4</sup> Personal communication with David Anderson, PhD, Envirotest Research, 2006.

<sup>5</sup> Personal communication with Daniel Smith, Surface Water Management, City of Federal Way, 2007.

<sup>6</sup> Personal experience and communication with residents, 2006.

## **IMPLICATIONS FOR JUVENILE SALMON**

The decomposition of seaweed uses all the dissolved oxygen in the water, leaving the nearshore habitat - where juvenile salmonids migrate and feed - a dead zone devoid of oxygen. The less oxygen available for the many aquatic species that use the cove to mature and thrive, the more unhealthy the habitat.

The report of a multiyear study of juvenile fish in the cove found that Chinook salmon (an endangered species) and coho salmon are among the species affected by nearshore habitat degradation.<sup>7</sup> Some of the coho juveniles are from Fauntleroy Creek, which discharges into the cove. The Chinook juveniles are documented as coming from as far away as the Duwamish River in order to feed between Fauntleroy Cove and Vashon Island.

## **IMPLICATIONS FOR BOATERS**

As in freshwater, seaweed blooms in saltwater interfere with boating. Air-quality specialist David Anderson, PhD, has been involved with "the stench" here since the 1980s. He notes that, in the height of boating season, Fauntleroy Cove can have a seaweed mat the size of a football field.<sup>8</sup> Boaters who unwittingly pull in here (or another infested area) will find themselves in a pea soup of prop-binding strands. Should they wish to come ashore, they'll find the beach covered in rotting, stinking seaweed.

## **COMMUNITY ACTIONS TO DATE**

The Fauntleroy Community Association has taken the lead to carry out what strategies we could devise to counter green tide. In chronological order, we have

- worked with then Senator Phil Talmadge in 1990 to secure \$10,000 in state funding to monitor air quality, harvest seaweed off the beach, haul floating mats of it out to mid channel by seine net and tug, and provide data for a study report. The project included a hotline for residents to call to report incidents of gas. Participating agencies were the State Department of Ecology, State Department of Health, Seattle-King County Public Health, Metro, Seattle Drainage and Wastewater Utility, and the State Department of Transportation.
- cooperated with the State Department of Health to produce a comprehensive report, edited by Harriet Ammann, in 1990.
- worked with then County Councilman Greg Nickels in 1998 to secure county funding for a second air-quality monitoring of the neighborhood. Envirotest, an air-quality consulting firm, did the monitoring. Funding was insufficient, however, to compile and analyze the data.
- initiated coverage by *The Seattle Times* in 1998, resulting in contacts from other communities on Puget Sound similarly impacted.
- worked with then Senator Mike Heavey in 1999 to secure \$30,000 in state funding for use over two years to harvest and haul out seaweed from the cove. The first harvest/haul-out netted some 90 tons of seaweed; the second, in 2000, netted some 60

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<sup>7</sup> *Juvenile Salmon Composition, Timing, Distribution, and Diet in Marine Nearshore Waters of Central Puget Sound in 2001-2002*, King County Department of Natural Resources and Parks, 2004

<sup>8</sup> Personal communication, David Anderson, Envirotest Research, 2009.

tons. This funding paid for Envirotec to continue to collect data on air quality in the neighborhood.

- worked with Adopt-a-Beach and King County Wastewater Management between 1999 and 2001 to provide written information about H<sub>2</sub>S to beachfront owners and ways they could reduce nutrients in the cove. Seattle-King County Public Health again provided a telephone hotline for residents to report H<sub>2</sub>S incidents.
- provided initial input in 2006 to the new Puget Sound Partnership's science committee to get green tide on a Sound-wide agenda. Given the committee's broad workplan, it will not begin to address specific problems for at least another year.
- advocated with health and air-quality agencies, neither of which saw H<sub>2</sub>S as part of its workplan.
- explored the possibility of patching together agency resources for a comprehensive outreach program to beachfront owners, a promising plan stymied by inadequate agency budgets to work with small groups.
- successfully advocated for legislative funding for the 2006-2008 biennium to devise a removal process, secure permits, and do test removal by vacuuming up floating seaweed before it could reach the beach. The State Department of Ecology coordinated this project and, with supplemental local funding, was able to include Dumas Bay in Federal Way. Pilot removal was done there in summer 2008 but cooler weather tempered *Ulva* growth in Fauntleroy Cove, such that no removal could be done.

## **MAJOR QUESTIONS**

The above experiences, together with increasing sea-lettuce blooms around the Sound, have expanded our list of concerned jurisdictions, citizens, and researchers and spotlighted two major questions:

- To what extent are excess nutrients coming from the urban environment? In other words, if landscape chemicals, yard waste left on the beach, stormwater runoff, and airborne chemicals went away, would water and air quality be restored?
- To what extent is a natural process contributing? Are nutrient-rich currents in the Sound at play? Are incremental changes in water temperature over time encouraging the process?