Friends of Herring River

Will tidal restoration in Herring River wetlands produce odors?

Foul odors from wetlands are usually caused by the release of hydrogen sulfide gas into the atmosphere – the "rotten egg" odor. Sulfide is produced by the decomposition of organic matter by microbes in the absence of oxygen. These conditions are common in wetlands, where the sediments are both rich in organic matter and saturated with water, driving out air and, thus, oxygen. However, most sulfide never reaches the atmosphere, and few wetlands produce bad odors, because sulfides are precipitated (immobilized) by iron, which is naturally abundant in Cape Cod soils and wetland sediments. Sulfides and iron combine to form very stable minerals that remain inert provided that the marsh remains waterlogged by periodic tidal flooding.

At Herring River, much of the original marsh has not remained waterlogged, but has been drained by diking and creek channelization since 1909. This has allowed air to enter the marsh peat. When this happens the newly available oxygen reacts with previously stable iron-sulfide minerals. The sulfide oxidizes to sulfuric acid, which flows out to acidify surface waters and kill aquatic life, while the iron converts to iron oxides, which are solids and therefore remain in the peat.

Importantly, retention of these iron oxides above the dike makes the Herring River especially resistant to sulfide accumulation and the release of foul odors once tidal seawater is restored. Although return of the tides will re-establish the natural conditions that promote sulfide production (and incidentally relieve the acidity problem), the wetland's rich deposits of iron oxides will capture and immobilize sulfides before they can enter the atmosphere to cause foul odors.

That said, there are some portions of the flood plain that were not successfully drained by the diking, mainly because 1) they have always been very low and 2) drainage has caused the peat to shrink and subside. These waterlogged peats may have less iron available to remove sulfides. Therefore, with tidal restoration, these areas could produce odors, especially if they do not drain well during regular low tides. Here monitoring will indicate whether adaptive management, perhaps including restoration of the creek system, is needed to encourage low-tide drainage and consequent peat aeration and natural sulfide removal during the restoration process.

It's important to realize that even healthy salt marshes commonly produce a sweet and subtle sulfidic odor (more a fragrance): this is *dimethyl sulfide* given off by salt marsh plants, seaweeds, phytoplankton, even fresh fish (it's the aroma of a fresh fillet). It's also the smell of the sea: familiar "salt air" is not just scented by salt, but also by dimethyl sulfide emitted by millions of marine organisms.