Mixing Fresh and Salt Water

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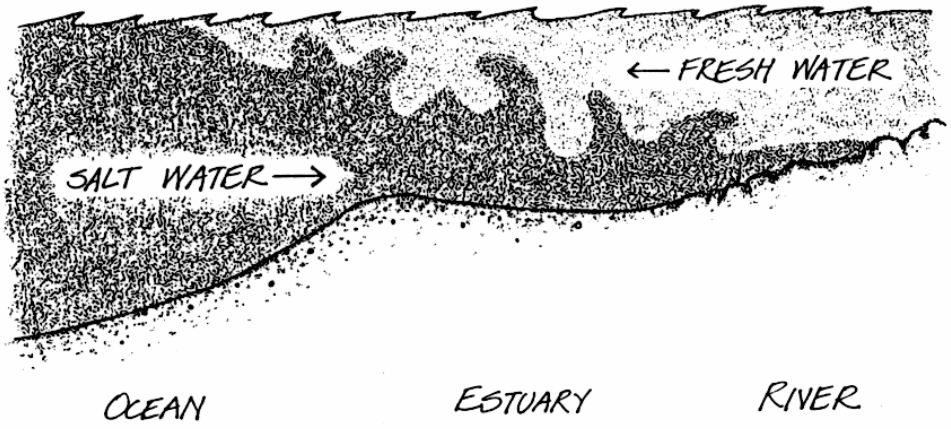

By definition, an estuary is a moving, dynamic body of water where fresh and salt water meet. Because of characteristic differences between salt and fresh water, however, the two don't always easily blend. Sometimes they don't mix at all, but instead stratify or form layers.

Sea water contains about 35 parts per thousand (ppt) dissolved salts, mostly sodium chloride and magnesium chloride, and is denser than fresh water. That is, salt water is heavier than fresh water when the two are at identical temperatures. Salt water is a better conductor of electricity, and light refracts or bends more in salt water than in fresh water.

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In most estuaries, the mixing of fresh and salt water is determined by checking the water's salinity level. This is a relatively easy and inexpensive test, accomplished in one of three ways: by measuring a water sample's density, electrical conductivity, or refraction of light.

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The tides represent the most important force, often causing large-scale turbulence and mixing in the estuary. They are of greatest significance where and when tidal ranges--the differences between high and low tide--are greatest.

Winds are considered to be of lesser importance. They can be a major force, however, where tidal range is small. Winds also have greater effects on shallow estuaries, especially those with large open areas. Winds also create various surface and internal waves, which can contribute to estuarine mixing.

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River water is more buoyant than ocean water. As it flows seaward in the surface layer, and the denser salt water flows landward in the bottom layer, some mixing can occur.

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For example, the monthly cycle of spring and neap tides can greatly alter the character of an estuary where tides are the major mixing force. During spring tides, when tidal ranges are greatest, increased currents and tidal sloshing can speed up the mixing process. During neap tides, on the other hand, tidal ranges are smaller and might have little effect on mixing, resulting in stratification of the estuary.

In a system known as dynamic classification, estuaries can be labeled according to how they circulate and stratify. A Type A estuary is highly stratified; Type B, partly mixed; and Type C, well mixed.

On Coos Bay, where tidal ranges are relatively large, summer winds and winter storms can enhance mixing. Although occasionally in winter the bay is a Type B estuary, most of the time it's a Type C.

Studies have shown that vertical mixing can increase photosynthesis and the production of phytoplankton in the estuary. It also brings nutrients and food particles up from the bottom into the surface zone, and it delivers oxygenated surface waters to the estuary's depths.

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