Our Ocean Backyard

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Desalination and the Coastal Ocean

Something I’ve learned from being involved in local environmental issues for over 50 years is that any good environmentalist will bring up every conceivable argument, valid or not, important or insignificant, in order to derail or stop a project.

While facts today don’t settle all or even many arguments, as a scientist I believe that it’s important to learn as much as we can about an issue before reaching a decision or taking a position. As Neil deGrasse Tyson once said, “The wonderful thing about science is that it’s true, whether or not you believe it”.

One issue that is brought up in all discussions about desalination is the potential impact on the marine environment. We love our ocean backyard and a lot of dedication and effort over the years has gone into protecting it.

Any large industrial facility will have some environmental impacts and desalination is no exception. All potential impacts need to be evaluated, understood and mitigated or reduced to an acceptable level through an Environmental Impact Report (EIR) and the permitting process. For a desalination plant, this includes plant siting and operation, and importantly, the effects of pumping large volumes of salt water from the ocean and also any impacts of discharging the salty brine back into the ocean.

Water from the coastal ocean in most places will contain a variety of organisms ranging in size from large marine mammals and fish down to microscopic plankton. The types of organisms and their abundance will vary from place to place depending upon the productivity of the local waters, the time of year, and also with the depth from which water is pumped if taken directly from the ocean.

Intake pipes are normally covered with screens, and the mesh or size of the openings in the screen will determine the organisms that won’t enter the intake, or be caught on the screen (impingement), and those that will pass through and remain (entrainment) in the feed water. Fish and marine mammals will not be trapped with a small screen size, but any plankton that pass through the screens and enter the plant will not survive.

The magnitude of these lethal effects (impingement or entrainment) is dependent upon the volume of water being withdrawn, the source of the water, and therefore the abundance of different types of marine life and their size.

Impingement and entrainment have often been considered as the largest single ecological barriers to desalination plant siting in recent environmental impact assessments. An important perspective should be kept in mind in these assessments, however, and that is the volume of seawater used for cooling existing coastal power plants. Most coastal states have sited their electrical generating stations along the coastline so they can use the very large volumes of easily accessible cold ocean water in the cooling process. California is no exception. The Moss Landing Power Plant has been operating since 1950, withdrawing cooling water from either the adjacent Elkhorn Slough or Monterey Bay at a rate of about 1.2 billion gallons a day.

The proposed desalination plant studied jointly by the Soquel Creek County Water District and the Santa Cruz City Water Department over 10 years ago would have pumped about five million gallons a day from the bay in order to produce about two million gallons a day of fresh water that would have been shared between the two districts depending upon their differing seasonal needs.

While the potential impingement or entrainment effects of this volume of water were raised as concerns, five million gallons a day is 0.4% of the 1.2 billion gallons a day of seawater that has been withdrawn by the Moss Landing power plant for 70 years. This comparison is used simply to compare the volumes of seawater pumped in daily, not to compare the nature of the effluent or water released from each plant, which are clearly different. The common element to both a power plant and a desalination plant is that both would entrain the microscopic plankton in the seawater pumped from the ocean. These would not survive the transit through either facility.

Monterey Bay is a highly productive biological environment that supports a healthy commercial and recreational fishery and is widely known for the diversity and abundance of its marine life. It’s important to know what has been learned from plankton studies. The plankton includes the eggs and larvae of a number of marine organisms including finfish and shellfish, the phytoplankton (the microscopic floating plants like diatoms) and the zooplankton (krill and similar organisms). These vary in their abundance depending upon the specific location, time of year and water depth, although most of the plankton is concentrated in the upper 150 feet of the ocean where light can penetrate for photosynthesis.

A field study done near Mitchell’s Cove along West Cliff, one possible intake site for the proposed Santa Cruz desalination plant, showed that the average percentage entrainment for fish larvae over a 13-month period was 0.02 percent of the larvae present in the area, and for shrimp and crab larvae the average percentage entrainment was 0.007 percent. These are very low values and the consultant’s conclusion was that these do not represent a significant source of mortality for these species.

Most marine organisms lay huge numbers of eggs to ensure some offspring survive, simply because very few reach maturity as they become food for lots of other things swimming around out there. Market squid typically produce 2,000 to 3,000 eggs when they spawn; a lingcod may release 50,000 to 170,000 eggs, and a female Dungeness crab can produce 2.5 million eggs. You can imagine what a successful crab season we would have even 10% of those eggs from a single female made it through to adult size. Egg and larval survival rates in the coastal ocean are very, very low, however, typically less than 0.01%.

Nonetheless, these small and localized entrainment effects can be reduced by using smaller-sized intake screens, by placing intakes in deeper water to avoid most of the plankton that are concentrated in the upper 150 feet of ocean, by using multiple intake ports to reduce flow into any individual pipe, or by using subsurface intake wells beneath the beach or buried in the sand on the seafloor. More to come.