Dredging and Filling the Ocean for Beach Renourishment

*Many game fish, including pompano **(L)** and snook **(R)**, rely on infauna as their primary source of food.* Photos courtesy of Ken Lindeman/Environmental Defense

Ed note: This is the final installment of a five part series on beach ecology. This month's article was submitted by Dr. Ken Lindeman, Senior Scientist for Environmental Defense

Although they don't have the appeal of baby sea turtles or food fishes such as pompano, invertebrates such as mole crabs, coquina clams and reef-building worms are just as important to the nearshore system as reptiles and food fishes. Hundreds of invertebrate species provide forage food and habitat for shorebirds and economically important fishes, as well as other invertebrates like ghost crabs. Coquinas (Donax spp) and mole crabs (Emerita spp) are two of the most common examples of the suite of beach critters known as "infauna" which rely on shifting inter-tidal sands for their habitat. Many other species occur in nearby submerged areas as well. These organisms are not only connected biologically, but also by man's temporary efforts to stabilize naturally dynamic beaches.

For example, several different ecosystems across the shelf are affected by the large dredge and fill projects that are used for beach renourishment. Each system has its own characteristics (see Surfrider's The Beach is Alive materials) and can respond to dredging in different ways. Most projects involve the excavation and dumping of 1-2 million cubic yards of sediments and are completed in one to three months with 24 hour dredging, pumping, and bulldozing operations. It is useful to think of the biological impacts from the beginning of the dredging operations to the end.

Dredging most often occurs between depths of 20-50 feet. Cutterhead dredges dig straight down, deep into the seafloor. The resulting large craters are called borrow pits, though the same sediments rarely return to these sites. A different system, hopper dredging, trails a suction device across the upper layer of the bottom with reduced depth compared to cutterheads. Direct mortality to a wide array of bottom organisms (crabs, worms, mollusks, etc.) occurs with both systems. Despite occasional buffer zones between dredges and reefs (there are no consistent standards), both types of dredges and associated equipment (e.g., discharge pipelines, mooring chains) can directly damage reefs or other areas.

Because of the excavation and hydraulic pumping of hundreds of thousands of cubic yards of sediment during offshore dredging, turbidity clouds (sediments in the water) are created that extend both downstream and across the shelf for miles. Turbidity may be most concentrated at the dredge excavation site or at the site of slurry overflow for hopper dredge barges. Heavier sediments settle out, stressing corals and other bottom-dwelling animals that provide food and shelter for fishes. Frequent wind- and wave-induced resuspension of fine-grained dredge sediments may occur for years after a series of projects. Divers, surfers and fishermen often comment on how the water "turns to milk" with prolonged wind near frequently dredged areas, such as Jupiter Island, Florida, the site of approximately ten renourishment projects over 25 years. The responses of differing plants and animals to reductions in water quality from chronic turbidity may operate at time scales of hours to decades, with effects ranging from immediate death to masked impacts (e.g., lowered growth and therefore lessened reproduction) that may be cumulatively large through time. Pipelines of 24 to 36-inch diameter are often used to transport hydraulically-pumped fill from the mid-shelf dredge sites across the shelf to the nearshore dump sites. These pipelines are sometimes laid directly across reefs. On the beach, literally at the end of the pipe, the slurry of sediment and water is blown out and then bulldozed directly out into the ocean for hundreds of feet. Impacts at this end of the operation occur on the exposed beachface, where many existing beach fauna are buried, and in nearshore waters where a somewhat different fauna is also directly buried or at least exposed to extremely high turbidity.

*Mole crabs **(top)** and coquinas **(bottom)** are integral parts of the near shore food chain.* Photos: Gilbert Grant/Photo Researchers and Robert Hermes/Photo Researchers.

The most immediate and direct impact to beach infauna is burial and mortality of organisms, which results in an immediate drop in abundance in the months following a replenishment project (Rakozinski, 1996; Peterson et al., 2000). Recovery to pre-replenishment numbers can occur anywhere from months to a year after sand placement (Reilly and Bellis, 1983; Peterson et al., 2000), but that depends on a number of factors: the geographic range of the project; the seasonal timing, duration and frequency of replenishment; location of sand placement within the beach profile; and most importantly, compatibility of the mined sand with what's already on the beach (Hackney et al., 1996; Rakocinski et al., 1996; Peterson et al., 2000).

As if direct mortality weren't enough, there are numerous indirect impacts of beach fill projects to beach invertebrates. Increased amounts of fine-grained sediments and alteration of the beach profile can impact the infaunal community structure; in other words, the types of species may change as a result of these projects, and recovery to a "pre-project" state may be delayed (Reilly and Bellis, 1983; Rakocinski et al., 1996). Localized increases in turbidity from deposit of the dredged material in a water and sediment mix can impair the feeding efficiency of invertebrates, as well as visually-feeding surf zone fish. Mole crabs, for instance, collect food particles from "hairy" antennae that they stick into the surf; the high levels of fine material can clog up the antennae and result in decreased growth and mortality (Reilly and Bellis, 1983).

Immediately offshore, sandy or reef bottoms are also buried from 100-200 feet out. In Florida, shallow nearshore reefs that are federally designated as Essential Fish Habitats are still directly buried. Over 325 species of invertebrates alone have been identified on nearshore reefs buried by renourishment dredging. This includes living colonies of star corals, fire corals, and large numbers of other attached or cryptic species. In terms of fishes, the numbers at a south Florida site where 12 acres of reef were buried decreased by 95%. The abundance declines at the burial site were present 18 months after impact. Eighty percent of the individuals were early life stages, indicating that the buried nearshore reefs are nursery habitats for small life stages that can't simply swim away when their habitat is buried. These and other studies have now identified over 200 species of fishes associated with nearshore reefs of southeast Florida. In total, over 500 species of marine animals are known to use the reefs buried by renourishment projects.

All recent federal expert reports conclude that our coastal areas have lost too much habitat and are too overfished. These reports, including the US Commission on Ocean Policy Report, repeat the need for precautionary and ecosystem-based management. In most areas, the short-term effects of large dredging projects upon nearshore plants, invertebrates, and the fisheries they support are poorly known and the long-term effects are unknown. What we do know and what independent scientists most logically hypothesize is clearly not benign. Beach renourishment projects have a role in coastal management, but it is time for substantially more independent research and scientifically-based enhancement of environmental review procedures.