

RED GROUPE: AN ENGINEERING MARVEL

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Photo courtesy of Bryan Fluech, Florida Sea Grant.



Red grouper is an economically important species of the southeast United States and in particular the Gulf of Mexico. Red grouper are highly territorial and often remain at the same site for long periods of time. We now know Red grouper are also engineering marvels for their ability to modify habitat through excavation. A recently published paper by a group of researchers led by Dr. Felicia Coleman of Florida State University evaluated the architectural activities of red grouper and concluded that red grouper help enhance biodiversity by creating and maintaining structural habitat for other marine life.

Red Grouper are often associated with karst (limestone) environments and in particular “solution holes”. Solution holes were formed thousands of years ago when sea level was lower, and freshwater dissolved holes in the limestone surface. When sea level rose to its present state, these solution holes filled with sediment. Red grouper are commonly associated with these limestone solution holes, but scientists were never able to demonstrate they actually helped create and maintain them.

Coleman and her colleagues observed and documented red grouper removing the sediment from these holes, and restructuring the flat bottom into a three dimensional structure. Much like beavers

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who construct dams, red grouper act as ecosystem engineers that modify their environment and create habitat for themselves and other species. They remove sand with their mouths and fan away sediments with their fins, exposing the limestone bottom that can be colonized by other marine life such as corals, anemones, and sponges as well as the organisms that depend on them. The study also showed that commercially important species such as spiny lobster, black grouper, red porgy and vermillion snapper among others, benefited from the red grouper's engineering abilities.

Red grouper also benefit from digging the holes. "Watching these fish dig holes was amazing enough, Dr Coleman noted, "but then we realized that the sites served to attract mates, beneficial species such as cleaner shrimp that pick parasites and food scraps off the resident fish, and a variety of prey species for the red grouper. So it's no surprise that the fish are remarkably sedentary. Why move if everything you need comes to you?"

Researchers observed excavating behaviors in both juvenile red grouper in shallow waters of the Florida Keys and in adults offshore in marine reserves in the Gulf of Mexico. Dr. Coleman noted, "We found through a series of experiments that they not only dug the holes, but maintained them by carrying mouthfuls of sediment from the center of the pit to the periphery and expelling them through their gills and mouths and then brushing off the rocks with their tail fins."

In one experiment, researchers placed juvenile red groupers in bottomless cages over sediment-filled holes and observed them. Within 48 hours each grouper excavated enough sediment to accommodate its entire body. One grouper escaped by digging under the cage wall. A second experiment evaluated whether red grouper maintain their excavated holes. In this experiment, non toxic aquarium grade charcoal was placed in 13 active grouper holes. Using video cameras, researchers observed red grouper removing the charcoal within two hours of it being placed there, and most was completely removed from all sites within 24 hours.

In a final study, researcher used submarines and remotely operated video camera to document species diversity and abundance associated with red grouper holes. Active grouper holes had greater species diversity and abundance than inactive or sandy bottom sites. In one of the offshore study locations, most of the exposed rock was encrusted in sponges as well as soft and hard corals. Certain species such as sea urchins were only found at maintained grouper holes.

The study entitled, "*Benthic Habitat Modification through Excavation by Red Grouper, Epinephelus morio, in the Northeastern Gulf of Mexico,*" is published in the most recent issue of the journal [The Open Fish Science Journal](#). To learn more about Dr. Coleman's research and to view video of red grouper excavating a grouper hole visit: http://www.bio.fsu.edu/coleman_lab/red_grouper.php



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