Gag pack into reef cubes when disturbed.

UF RESEARCHERS ARE CREATING **ARTIFICIAL REEFS** THAT GIVE **YOUNG GROUPER** ROOM TO **GROW**, HELPING TO ENSURE A **HEALTHY POPULATION** LONG INTO THE FUTURE

Joe Richard

Reef Relief

By Joseph Kays

Zy Biesinger, a UF doctoral candidate, installs a submersible data logger on the seafloor as part of an array to record the movement behavior of gag around reefs.

Anybody who's ever wrestled with a grouper on the end of their line knows these monsters don't take well to having a hook in their mouth. But the reward for a half hour of fighting that will leave your arms sore for a week can be a fish that offers some of the best eating in the ocean.

Unfortunately, the growing demand for grouper sandwiches and improved technology like GPS that can put a charter captain right on top of his favorite grouper spots every time have led to concerns this species is being overfished.



Bill Lindberg (left) and Doug Marcinek, research coordinator, rig for research diving.

The gag grouper's growth and maturation rates, penchant to congregate around easily identified seafloor outcroppings and unusual biology — all grouper start life as females and only a fraction change to reproductive males — only adds to the risk that fishing will outstrip their ability to reproduce.

So Bill Lindberg, a UF professor of fisheries and aquatic sciences, and his team are working to give gag a fighting chance by creating more of the habitat they love. The artificial reefs they've created by dropping nearly 3,000 concrete cubes in the waters of the Gulf of Mexico off Florida's Big Bend coast over the past 15 years are meant to ease overcrowding around natural reefs that limits their ability to grow and reproduce.

Gag grouper are born at sea, then carried on the current into the coastal sea grasses, where they spend their first year growing in relative safety. But as young adults, they must make a precarious journey across the mostly flat ocean floor to reach their spawning grounds. It is during this journey that Lindberg theorizes competition for the limited amount of rocky habitat they prefer causes an ecological "bottleneck" in their ability to reproduce.

"Gag place such a premium on finding and staying on habitat that provides shelter from mortality that their densities can cause lower growth rates, which affects subsequent reproductive potential," Lindberg says.

In other words, the more fish crammed onto a reef, the greater the competition for food and the less they will grow. And the less they grow, the fewer babies they will have.

"For grouper, size matters a great deal," Lindberg says. "The number of babies they have is directly proportional to their length."

So the artificial reefs provide a way station, primarily for young females who meet the minimum catch limits, but have not yet reproduced.

"The reef system is intended to enable them to occupy quality shelter at lower densities so they can maximize their growth rates and reproductive potential," Lindberg says.

The reefs also serve as natural laboratories for studying the grouper life cycle and the impact of reef habitats on grouper populations, data that is vital to determining just how many grouper can be fished out of the Gulf of Mexico without causing the species to collapse.

"Artificial reefs have long been popular among recreational fishermen because they increase their catch and create reef fishing sites where there had just been sand bottom," Lindberg says. "But if artificial reefs simply attract fish from elsewhere, making them easier to catch, they don't benefit the grouper population."

Lindberg says this "attraction-production" question has been debated in fisheries management for decades, but became even more important after Congress passed the Sustainable Fisheries Act of 1996, which required the identification and management of essential fish habitat for all federally managed fisheries.

Like so many other fish, demand for grouper has exploded in the last two decades, especially along Florida's west coast. In 2004, west Florida fishers hauled in 7.5 million pounds of gag grouper, up from less than 2 million pounds in 1987.

Historically, fisheries assessments have been based on actual catch as reported by commercial and charter captains, but Lindberg says those numbers can be deceiving.

This so-called "fisheries dependent" data doesn't necessarily take into account what's happening within the grouper population. Only recently, at the urging of scientists like Lindberg, have regulators demanded more "fisheries independent" data of the kind the UF team is gathering.

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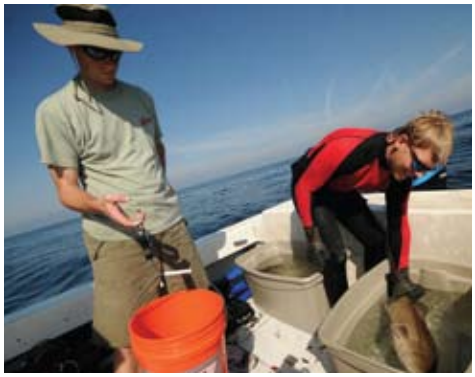


Kristen Bartlett Grace

Zy Biesinger (left) and Doug Marcinek weigh a gag collected for tagging and release.

Lindberg says plugging this data into computer simulations has produced some "pretty scary" scenarios for the grouper fisheries, reminiscent of the collapse of the cod fisheries off New England in the early 1990s.

"Even though the general population may be going down, fishermen can find new spots and maintain their catch," Lindberg says. "As the simulated fishing fleet becomes more precise, the catch rate actually goes up as the population is falling off a cliff. That's a really spooky outcome. The implication is that a grouper fishery such as gag may be vulnerable to the same outcomes cod experienced. Figuring out whether or not that's the reality requires us to have information at a much finer scale of resolution."

GapResearch

Lindberg has been focusing in on the grouper picture his entire career, using new technologies and techniques to get a better understanding of how fish live and how fishing affects their populations.

"I've been scaling-up research projects my whole career," says Lindberg of the research he began as a doctoral student at Florida State University in the late 1970s. "My dissertation at FSU looked at these questions in a small, model system. But there's always a question of how such model systems translate to the much broader natural scale. Relevance of ecology on the small scale to management on the large scale requires someone to work in the gaps."

Since the early 1990s, Lindberg and his team have been filling those gaps by using artificial reefs as experimental treatments to turn the ocean into a natural laboratory.

Between 1991-93 the team constructed the Suwannee Regional Reef System, placing 1,350 one-ton concrete cubes on the ocean floor in a 26-mile-long strip about 20 miles off the coast of Florida's Levy and Dixie counties.

In the second phase started in 2005 — the Steinhatchee Fisheries Management Area — the researchers placed 1,600 cubes in groups of four as a line of standardized reefs that brackets the Big Bend region of Florida. These are sites for fisheries independent monitoring to aid gag stock assessments, and to evaluate the output of "conservation" reefs to be built in a 100-square-mile triangle about 18 miles west of Steinhatchee, Fla.

Florida has more artificial reefs off of its coast than any other state, but Lindberg says the Steinhatchee reefs are

examples of a new approach for Florida's artificial reef program. In the past, the stated goal of artificial reefs was to enhance fishing success. While that's still true, the Artificial Reef Strategic Plan adopted by the state in 2003 also includes an explicit goal of using artificial reefs as a component of ecosystems management.

"Previously, the coordinates of every permitted artificial reef had to be advertised for easy access by fishers," he says. "Now, if a project's objective is fisheries conservation rather than public fishing, such advertisement is not necessary."

Gag lined up in the shelter of a reef designed for research and fisheries conservation.

The specially designed concrete blocks Lindberg's team uses have holes in them where the grouper can sit to await their prey without having to worry about becoming prey themselves.

Fisheries management is a complex and often contentious process in which federal and state regulators try to balance short- and long-term economic and ecological concerns. Often these regulations result in fewer opportunities to catch less fish, and that invariably leaves people unhappy.

For example, the most recent rules approved by the Gulf of Mexico Fishery Management Council in August prohibit gag grouper fishing during February and March, doubling the current one-month spawning season closure. Recreational anglers can keep only two gag grouper a day, down from five. And commercial fishers face a gag grouper quota, which will be 1.32 million pounds in 2009. The quota on red grouper was increased from 5.31 million pounds to 5.75, but if commercial fishers exceed either quota, all grouper fishing must stop for the year because it's impossible to catch one species without catching the other.

UnderTheSea

"Conducting fish conservation research is like tracking butterflies under 80 feet of water," Lindberg says. "It may be straightforward in concept, but difficult to pull off."

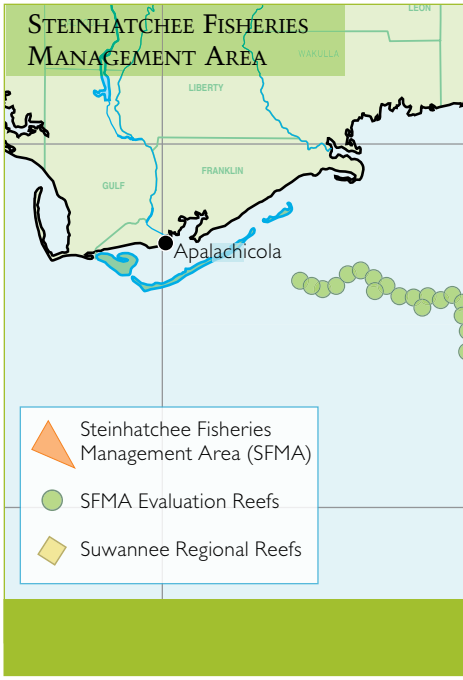
But researchers are able to do things today they couldn't have imagined 20 years ago thanks to technologies like GPS and sonar. These new technologies have enabled researchers to monitor grouper faster, more accurately and more economically.

In an environment where all the landmarks are hidden beneath the waves, Global Positioning System, or GPS, technology has been one of the biggest breakthroughs, Lindberg says.

"In the past we would get in the vicinity of a marker we had put on the seafloor, then do circle searches until we found it," Lindberg says. "Now, with GPS, we can land right on the stake every time. GPS gives us the ability to do more precise positioning of our sampling and mapping of the habitat."

Another new tool is side-scan sonar.

"We don't have the advantage of having aerial photography and satellite imagery like terrestrial ecologists to see the landscape characteristics of the seafloor," Lindberg says. "Twenty years ago we were putting divers in the water to do manual mapping on a very small scale; now we're using hi-resolution, side-scan sonar to collect large amounts of data over a broad area. We're beginning to develop better capabilities for mapping the seafloor in order to get at the questions we need answered."



Lindberg says researchers can "mow the lawn" in 150-meter-wide swaths with the sonar.

"In the past, all we would have is a chart that would show the depth; now we have an actual picture of what the bottom looks like."

In addition to mapping the habitat, new tools allows the researchers to actually track fish as they go about their daily business.

Graduate student Zy Biesinger is using state-of-the-art hydroacoustic telemetry to map how individual fish move about their home range. Receivers placed in the water record data every two seconds from transmitters implanted in fish.

Bill Lindberg records data between research dives.

Kristen Bartlett Grace

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— Bill Lindberg

Every few weeks the researchers retrieve the receivers, bring them back to the laboratory and download data that maps all of the fish's movements during that period.

Because virtually all of the grouper researchers' work involves repeated dives to depths from 50 to 80 feet, UF has become one of the few universities in the country to use sophisticated rebreathing technology instead of SCUBA gear.

"For safety, logistical and scientific reasons, we decided to move from traditional SCUBA to closed-circuit rebreathers," Lindberg says.

Rebreathers essentially act as second lungs, capturing a diver's exhaled air, scrubbing out the carbon dioxide and replenishing the spent oxygen. Because gas is not expelled, there are far fewer fish-scaring bubbles. And, modern systems optimize the breathing gas mix to minimize decompression concerns.

"One day I did 11 dives to 65 feet," Lindberg says. "That kind of up-and-down diving adds a risk factor, but by going to closed-circuit rebreathers, we're actually diving a physiologically safer profile."

And logistically, closed-circuit rebreathers require far less oxygen to be filled and carried on the boat.

"We couldn't carry enough regular SCUBA bottles to supply our whole team on a typical day," Lindberg says. "With the rebreathers, we need just a few small tanks. It saves money, time and wear and tear on the crew. The equipment was expensive, but in all respects it was a justifiable investment."

"We have lots of questions we want to answer, but if you don't have the logistical and technical skills to extract the data, the questions sit on the shelf," Lindberg says. "In recent years we've been able to integrate technologies into our field operations that were unavailable a decade ago, so we are now able to address some questions that we posed a decade ago but didn't have the technology to address."

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