Goliath Groupers

Text and photos
by Walt Stearns

Goliath grouper, or *Epinephelus itajara*, are the subject of strong opinions and divided emotions. Divers love to see these mammoth fish; underwater hunters denounce them as competitors, or covet them as outsized trophies; fishermen are just itching for a policy change that allows harvest; and regulatory bodies seem constantly poised to rescind long-term protection in favor of short-term exploitation. Opinions abound, and the rhetoric can get heated when interest groups clash. But when cooler heads prevail, the facts emerge and paint a picture of a species that has come back from the brink in the U.S. state of Florida but is still very much in need of our protection.

The Gathering

As the summer reaches its zenith, so begins a spectacle that divers and underwater photographers will not find anywhere else on the planet except here in Florida. The event I speak of is the opportunity to dive with 40 to 90 plus giant groupers massed together for the purpose of propagation. Spawning season here in Florida for the Atlantic goliath groupers is nearly two months long, beginning around mid-August through to the end of September, or the first of October.

Why they are called goliaths is quite obvious. Measuring up to 7ft (2.13m) in length, with a large robust body the width of a barrel weighing over 450 lbs (204kg), goliaths are the largest of all bony reef fish found in tropical reef environments.

Atlantic goliath groupers are capable of growing to extremely large sizes. Having grown up here in Florida, I have heard more than my share of monster goliath grouper tales, with the

Diver with goliath grouper, known to grow up to 7ft (2.13m) and over 450 lbs (204kg)

Groupers

behemoths weighing in excess of 1,000 lbs (454kg). Yet, I have never met one this big. Nor have I seen one as large as the 680-pound (308kg) IGFA (International Gamefish Association) all tackle record grouper that was caught by sportfisherman off Fernandina Beach, Florida, back in 1961.

However, when you come face-to-face with one even half the size of that IGFA fish underwater for the first time, it will be an encounter you will never forget. Throw in the magnification factor created by water's effect on a diver's facemask, the perspective to just how big that fish is, can be amplified enough to make a 6ft (2m) long brute with a girth equal in diameter to an oil drum appear as big as a compact car.

Record IGFA goliath catch, 680 lb (308kg), in Florida, 1961

Where and when

The most favorable location for encountering these giants happens between two natural and four artificial reef sites along Florida's Palm Beach County Coast. From mid August to the end of September/early October, these six key sites play host to the only goliath grouper spawning aggregations known to take place off Florida's east coast. Interesting, in that all of these take place less than five miles from shore. Where as the rest (approximately seven in all) take place in the southern Gulf of Mexico, 25 to 40 miles offshore of Florida's west coast.

For underwater photographers on Florida's east coast, the timing and length of these huge spawning aggregations, combine with often highly favorable conditions like underwater clarity in the 60 to 90ft (18-27m) range, tropical water temperatures and calm seas, make it easy for them to capture images that defy words.

In comparison to most other grouper species, this romance period these fish follow is more like a marathon than a 50-meter dash. While these concentrated annual gatherings don't really get going till mid-August, the journey for some actually begins as early as mid-July. More recent studies have found, following tagged fish, some of the distances traveled to reach one specific spawning aggregation site have been recorded greater than 300 miles (483km).

Spawning

Having followed these fish since the first spawning aggregation reappeared after a three-decade-long hiatus on a local site off Jupiter called the Hole-in-the-Wall back in 2001, I can pretty well describe the process by which it typically takes place.

Around the timing of the first full moon of August, the bulk of the spawning fish have completed their journey, swelling the ranks on a single aggregation site from a dozen big behemoths to a herd

Spawning aggregate of goliath groupers off the coast of the U.S. state of Florida

Spawning aggregation of goliath groupers off coast of Florida (left); Underwater photographers will enjoy encounters with the giant fish from mid-August to early October, when vis is 60-90ft (18-27m) (below)

topping 40 to 60 fish.

Typically the first to see these numbers first are wrecks in Northern Palm Beach, off Jupiter called the Zion Train/ Esso Bonaire wreck trek and neighboring MG-111 and Hole-in-the-Wall. In a short span of a week or two, a similar number, comprised 50 to 60 fish have descended on a second set of wrecks, *Mizpah* and *Danny,* a few miles south off West Palm Beach. By early September, another wreck further south off Boynton Beach named the *Castor* completes the scene with the arrival of another 50 to 60 individuals.

In the last two consecutive seasons, we have seen surprising twist where the *Castor* wreck received the lion's share around the later part of September. Both times, as the spawning season was near the end, number of fish present swelled to around 100 fish in 2013, with the 2014 season peaking out with nearly 150, the majority of which were fish that had pulled up or moved down the coast from both the Jupiter and West Palm Beach sites.

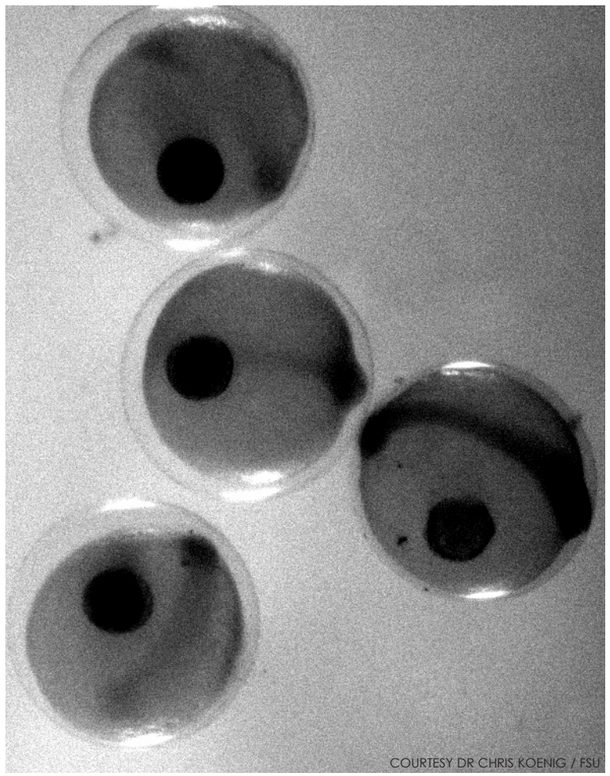
The first shift in preferred locations may have been influenced by a string of cold-water upwelling's that plagued the first half of the 2013 season. Considering goliaths are not fans of cold water, the upwelling's (an event that takes place time to time along the Palm Beach Coast) may have pushed a number of fish off the Jupiter/West Palm Beach sites farther south than normal. It just so happens that in addition to Boynton Beach being Florida's east coast most southern spawning site, water temps were less affected by the upwelling's.

The 2014 season was a different matter. While the upwelling's were less apparent, the presence of the Gulf Stream was also less apparent, leaving most of the summer months with little to no current. Perhaps, these fish knew something we didn't.

Witnessing this spectacle could cause some to believe the fish are no longer threatened, and have successfully made a comeback. To call it such may be as premature as calling a herd of American buffalo in game reserves a full recovery for the species.

Long road back

Twenty-five years ago, encounters with just one of these reef giants off Florida's east coast was a considerable rarity. Around the rest of the state, the situa-



COURTESY DR CHRIS KOENIG / FSU

Goliath grouper eggs

Groupers

tion was not all that much different.

Once highly abundant, particularly on distant wrecks far off shore in the southern Gulf of Mexico, the fish began to be beaten back by aggressive fishing practices during the mid 1980s. In a short few years, the fishery was so badly in decline, the federal government under the Magnuson-Stevens Fisheries Act, began work to close the fishery on goliath grouper completely.

By the time these protective measures were fully enacted in 1990, there were so few large goliaths left it would be some eight years (1998) before the first documented spawning aggregation would reappear in the southern Gulf of Mexico. And another three years (August 2001) before the first spawning aggregation comprised of 27 fish off Jupiter, Florida, would be seen again for the first time on the east coast in nearly three decades.

But appearances can be deceiving, as a major portion of the entire regional population taking part in this ritual behavior is represented between this one zone off Florida's east coast and a key number of sites in the southern Gulf of Mexico.

Add to that the reality that at one time, the Atlantic goliath grouper were once highly abundant in not only Florida, but also along the entire Central and South American Continental Shelf as far south as the southern edge of Brazil. Their historical range even spanned the entire Bahamas and Caribbean to as far away as Western Africa in the Gulf of Guinea.

Our planet's ever expanding human population and today's highly efficient means to harvest fish from the oceans has made it more difficult than ever to keep fish stocks the world over from being pushed to complete collapse. The most heavily impacted are the dominant predators of the tropical reefs—namely the groupers, with goliath grouper taking the heaviest toll.

While our own management measures may have stopped the progression of the U.S. population of goliath grouper toward extinction, relentless fishing pressure elsewhere in their range alerted the International Union for the Conservation of Nature (IUCN) to list goliath grouper as "critically endangered."

The same year the fish was placed under its new protected status, the job of monitoring the recovery of this species was put into the hands of scientists at both the National Marine Fisheries Service (NMFS) and Florida State University (FSU). FSU's Research Ecologist, Dr Chris Koenig, and his colleagues, began a detailed study of the fish's natural history.

Understanding an enigma

Unraveling the story behind what makes these fish tick has led to remarkable discoveries. Like most reef dwelling species, including groupers, goliaths are broadcast spawners where a female releases a quantity of unfertilized eggs into the water at the same time sperm is released by one or more males; the result is fertilization.

This behavior is typically nocturnal. Which is why during daylight hours on any given spawning aggregation site, divers commonly see the fish formed up in either one comprehensive group idly hanging close to one another, or arranged in three to five moderately

Once abundant along the coasts, historically, goliaths groupers in the western hemisphere used to range from the Bahamas and the Caribbean, to the coasts of Central America, and as far south as Brazil; Goliath grouper with school of silversides on wreck (top left)

SOUTH FLORIDA SFUPS UNDERWATER PHOTOGRAPHY SOCIETY

SFUPS INTERNATIONAL GOLIATH GROUPER UNDERWATER PHOTO COMPETITION 2015

In an effort to raise awareness of the plight of the endangered Atlantic goliath groupers in Florida, an organization of local underwater photographers in Fort Lauderdale called SFUPS—the South Florida Underwater Photography Society—is holding the first international photo competition featuring goliath groupers.

Be part of something extraordinary!
Goliath grouper, the largest bony fish, can grow to a size as big as a fridge. Florida is one of the few places on Earth where divers can witness spawning aggregations and swim with these gentle giants.

CONTEST DATES: August through October 2015 in Palm Beach County

PRIZES: Contest categories and prizes will be announced this spring 2015. (Past SFUPS contest prizes have included liveaboard dive packages, underwater photo equipment and courses, dive charters and scuba equipment, with a combined worth in the thousands of dollars—just to get an idea of contest sponsorship.)

SPONSORS: The contest is sponsored by Reef Photo & Video, the Florida State Department of Environmental Protection, Palm Beach County Diving Association, and Ocean Arts Media.

FOR MORE INFORMATION: Join the SFUPS mailing list to receive information on contest categories and prizes, travel iterary, and local discount assistance by going to: **goliath.sfups.org**

Goliath groupers like to take refuge in certain wrecks of the Florida wreck trail

spaced subgroups milling about between their neighbors.

Nassau groupers (*Epinephelus striatus*), for example spawn collectively together in a massive unit under a full moon. Unlike their closest kin, the actual mating ritual for goliaths does not take place by the light a full moon.

Based on the data collected by Koenig and his research team from FSU, the highest amount of evidence points to spawning taking place during the new moon cycle rather then the full moon. How much of a role the moon phase plays is not exactly clear-cut.

Through years of on-site data collection using specialized nets to capture fertilized egg on spawning sites to using hydrophones to listen in on various day and nighttime activates, Koenig and his research team from FSU have narrowed the event down to commencing shorty after sunset.

Also something of interest, which Koenig has found: instead of happening one night, the event period encompasses a succession of nights beginning four to five nights before the new moon, with another three to four nights after it.

Adding to this grand enigma is what precisely takes place when actual spawning is in motion. Rather than spawning as a collective group like Nassau groupers, they might—as claimed by a handful of diver eyewitness accounts—instead break from the main group in pairs or perhaps very small groups of three to four males and one female at a time.

Together, with the likelihood of working in the dark without any illumination of the moon has thus far made any documentation out of reach, much to the frustration of many underwater photographers and fish biologists who would love to have captured it on camera.

What is certain is that the fish always remain on or near aggregation sites in force through the last new moon cycle of September. After that, the fish slowly begin their journey back home.

Humble beginnings

After the eggs are released during spawning, those that are fertilized will drift for a short period of time before they hatch, emerging first as free swimming pelagic larvae supported by a yolk-sac until

Goliath groupers under ledge in Hobe Sound (left) and at Hole-in-the-Wall site (below), off Jupiter, Florida

Groupers

they grow large enough to feed themselves.

By this time the tiny fry are still smaller than a grain of rice, but now large enough to be seen by other—although small—predators. From here, their existence is at its most perilous, until currents from incoming tides deliver them inside coastal river mouth or inshore brackish water estuaries.

This explains why the likelihood of encountering an adolescent, much less a juvenile goliath on a reef is highly unlikely. That is because their life cycle is far different than most reef-dwelling fish.

Estuarine habitats play a pivotal role in the juvenile development of these fish, as mangroves' tangled roots provide the necessary shelter from predators until five to six years of age. By this time they have reached a sub-adult size, around 4ft (1.2m) in length and better equipped to begin their new life in deeper water.

How big do they get?

A goliath's growth rate begins to slow after the first eight years. From there, it may take as long as another seven to 15 years before they actually exceed 400 lbs (181kg).

Goliaths can live a surprisingly long time. The, the oldest specimen on record was 37 years old, which opens speculation that they could live well beyond 50 years of age. Through all that time, they will continue to grow, although quite slowly, until they are too old to effectively fend for themselves. This of course begs the question: how big does a goliath get?

Atlantic goliath is capable of growing to extremely large size. As I said earlier, having grown up here in Florida, I have heard more then my share of monster goliath grouper tales with the behemoths weighing in excess of 1,000 lbs (454kg). While the 680lb (308kg) fish from Fernandina Beach, Florida, still remains the most incontrovertible, I have also found photos of a reported, but unconfirmed 10ft (3m), 790 lbs (360kg) behemoth that was supposedly landed in Brazil.

While stories of this fish and others of equal and larger persist, Koenig and his team of researchers have yet to come across a single fish past the 500 lb (227kg)mark since the study began in 1990. "It's not that I don't think there were fish of that size," Koenig points, "it's that for a fish to get that size, it requires an extreme amount of time to do it, which I feel they no longer have."

It's amazing to think this giant started out at a size smaller than a head of a pin.

Home bodies

Surprisingly, for a big fish, goliaths favor shallow water. While we think of them on structures like wrecks, caves and large undercut ledges on a reef, they also have a propensity for taking up residence beneath large piers and bridges inside intercostal waterways along Florida's coast.

The most consistent places both divers and fishermen will find goliath groupers are on wrecks and

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THIS PAGE: Florida Sate University researchers measure and tag goliath grouper

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Researcher shows fishing line removed from stomach of goliath grouper

Groupers

large artificial reefs. One of these steel structures can harbor anywhere from one to more than a dozen of these giant groupers.

To understand why they prefer these man-made structures over most natural reef habitats, ask yourself which would you prefer to live in: a mansion or a tent?

While these big fish find artificial structures more suitable, they also favor reefs with high profiles affording deep undercut ledges. If neither is readily available for homesteading, in some cases, goliaths will excavate the sand from around the base of a limestone formation. By doing so, they expose and enlarge the space beneath a ledge that was buried in the sand.

One such example is a small reef off Hobe Sound just north of Jupiter, which I have known about and visited many times over the years. The reef is home to 15-16 resident goliaths, along with a wide assortment of fish, including gag grouper, snook, snapper, jacks, grunts and spadefish.

The most interesting feature of the reef is a series of ledges high enough for a diver to pass under, with one overhang wide enough for a car. Originally, the highest part of the reef was 4ft (1.2m) high. None of the features I spoke of existed until the first two goliaths moved in seven years ago. Over time, as more adult fish moved in, more and more of the bottom was excavated, leaving giant depression around the reef.

Since its beginning in the early 1990s, part of FSU's Goliath Grouper Recovery Study involved placing tags in both juvenile and adult fish. To more effectively track their movements, a large number of adult fish were also fitted with small transmitters surgically implanted in the body cavity. Each time one of these fish would come within 100 meters of a specific listening receiver mounted on the sea floor, that fish's transmitter indentification would be logged in.

What the study has revealed, once the fish have established a home base on a suitable site (be it a wreck, reef, pier or bridge), is that eight out of ten mature fish rarely roam more than a kilometer from it. Those who do move about, usually pay a short visit to a neighboring location where food is likely more abundant.

Getting to the spawn on time

The one exception to this stay-at-home behavior is romance. When mating season rolls around, goliaths will pack up and swim considerable distances to join a spawning aggregation.

Part of the FSU's Goliath Grouper Recovery Study includes surgically implanting small transmitters in adult fish. The process also includes the placement of specialized underwater receivers designed to log every transmittered fish that passes within a 100m of it.

Between FSU, NMFS, FWC and other universities and research entities, there are now several hundred such receivers in place up and down the Florida coast. Through the array, biologists that are part of the cooperative network are able to tap into information on not only their fish, but also everyone else's, which are carrying similar tags.

Within the past three years, the migra-

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LEFT TO RIGHT: Groups of goliath groupers in wrecks off Florida coast; Goliath grouper in mangroves of Florida; Spawning aggregation of goliaths

COURTESY OF DON DEMARIA

tory behavior portion of FSU's study carried out by Ph.D. candidate, Robert Ellis, has revealed two of the August/September regulars to the Zion Train aggregation site off Jupiter, Florida, came from an area just north of Cape Canaveral, which lies some 200km to the north. One of the fish made this journey in ten days.

The most compelling evidence of just how far some of these fish will travel to spawn comes from a very large adult fish, which, for two years in a row, made a 560km trip from its home near Cumberland Island in southern Georgia to the waters off Jupiter. Once there, they spend the next two months (August and September) selecting spawning sites that best suit them in one area off Palm Beach County.

In addition to placing acoustic tags in fish to study their movements, a large part of Koenig's research involved collecting data on what the approximated ages were among the population, what the they ate and how often, to what natural, as well as continued man-made threats they faced.

To answer this involved capturing a large number of both adult and sub-adult size fish on Florida's east and west coast. Whenever a fish is brought aboard, Koenig's team would quickly go to work extracting fin ray samples for age determination and DNA cataloging, checking stomach contents, attaching visual tags to even implanting acoustic tags in the fish to track its movements before releasing it back into the wild. With each year, an extensive amount of new data is collected revealing even more information about this fish that challenges almost everything we previously knew about it.

Here's where things get interesting, as well as a little disturbing.

Slow growth equals high mercury

Trace amounts of mercury are found in just about every species of fresh and saltwater fish in the world. With most, these trace amounts are seldom high enough for concern. But, with others—such as swordfish, tuna, King mackerel and tilefish to name a few—the fish have the concentration levels for which we hear warnings issued by U.S. agencies like the Food and Drug Administration (FDA) and Environmental Protection Agency (EPA). They strongly advise women of child-bearing age, nursing mothers, and young children to completely avoid eating these fish.

The FDA's "action level" (for which the FDA may prohibit sale of fish) is 1.0 ppm. In comparison, the Natural Resources Defense Council (NRDC) considers .5 ppm as the "very high" threshold for human consumption.

Methylmercury is particularly nasty stuff, as absorption of this toxin through ingestion is accumulative in muscle and fatty tissues of both animals and humans. When enough of it is absorbed into our bodies, really bad things happen.

Mercury poisoning

Classic mercury poisoning includes tingling in the extremities, sensory impairment (vision, hearing, speech). As more neuronal cells are destroyed, the damage is irreversible, taking the form of more pronounced neurological disorders like diminishing muscle coordination, or control, to kidney damage, even coma and death. Mercury poisoning risks are five to ten times greater for children under six and those in the womb, where underlying perils include reduced immune system response and brain damage.

As mentioned earlier, goliaths are a slow growth species, taking seven or more years to reach sexual maturity. Their slow growth rate and surprisingly long life spans of 30 plus years make this species especially prone to exposure to highly toxic organic compounds, namely methylmercury.

Working in conjunction with Koenig's research, research biologists Douglas H. Adams and Christian Sonne were carrying out their own study of mercury levels in the fish.

As part of their research, 56 Florida goliath groupers where sampled, with muscle, liver, kidney, gonad and gill tissue samples extracted from live fish and brain tissue biopsies harvested from dead fish.

In 2013, they presented their paper on mercury and histopathology regarding goliath groupers. What Adams and Sonne found, which includes a complete histology (microscopic anatomy of cells and tissues) of key organs to determine the depth of the contamination was pretty frightening.

Spawning aggregation of goliath groupers, with school of silversides

The greatest amount concentrated mercury found in those fish was in the liver, with mean mercury range from 2.87 µg/g to some containing as much as 22.68 µg/g in the tissue. Following the liver, brain tissue samples revealed concentration levels between 0.37 µg/g and 0.89 µg/g, with muscle tissue falling with a mean level of 0.63 µg/g.

Mean mercury concentrations observed in those goliaths were not only within the range known to cause direct health effects in fish after long-term exposure, the presence mercury induced lesions, and histological changes were also observed in the liver, kidney, and gills belonging to several of the fish sampled.

Granted, the human body is capable of removing a fraction of the mercury that might be ingested from one serving of fish, but the process takes an exorbitant amount of time as the "half-life" of mercury in your system is about 60 days. What that means is this: your body absorbs two "units" of mercury from a fish you ate; after 60 days—provided no additional mercury is ingested—half of what was taken in (e.g. one "unit") would still remain.

One way to visualize the accumulative process of mercury contamination is think of each trace amount of mercury as a drop of water falling into an empty bucket. Now think of that same empty bucket continually receiving one drop after another. With enough time, the accumulative process will eventually fill the bucket entirely.

Now think of that same bucket as a sexually mature goliath grouper (sexual maturity is seven to eight years of age). One could easily argue that adult goliath grouper, in any form, should never be considered safe for human consumption.

Conclusion

While this recent discovery of mercury levels adds a new wrinkle in the argument against reopening the fish for commercial or recreational harvest, it does not underscore the fact that goliath populations are still in trouble.

Using the Palm Beach County coast as a benchmark, it's taken more than 25 years to bring these fish back to where they are today. Furthermore, while the southwestern regions of Florida's Gulf coast and a section of Florida's east coast have shown the greatest signs of the goliath grouper's comeback, the rest of the state has not seen an equivalent rebound. On Florida's southeast coast, from Fort Lauderdale and Miami, through to the Florida Keys and Key West, the number of adult size fish is still very sparse.

Looking back at the goliath's historical range—which includes the Bahamas and the Caribbean as well as the Central American coasts down to Brazil—fishing pressure has pushed stocks to complete collapse in over 90 percent of that range—Hence the reason for the IUCN's decision to "Red List" them as a critically endangered species.

As to what the future holds for the reef's biggest fish, only enough concerned citizens will be able to answer that question, as the FWC (Florida Wildlife Conservation Commission) will be once again placing this fish up for review in September 2015 to determine whether they should remain under protection in U.S. waters or reopened to fishing. ■

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Text by Walt Stearns

WALT STEARNS

The older the fish, the higher production of eggs. In the world of broadcast-spawning fish, it's all a numbers game in who will survive and who will not. To better the odds of survival of the species, adult female fish must produce a large quantity of fertilizable eggs, likewise with sperm from males. The purpose for this is larval mortality (from egg to fry) is extremely high, as they are cast into highly variable ocean currents and preyed upon by a wide variety of fish and invertebrates.

In terms of a fish's fecundity (the ability produce a large volume of fertilizable eggs), the older the fish, the more prolific it will be at producing viable eggs for fertilization. Unlike people and other mammals, reproductive output increases with age and size in fish. For a goliath, the height of fecundity is achieved around 13 to 15 years of age.

Gender bender

Most grouper species are protogynous hermaphrodites, meaning that individuals first mature as females, changing sex to become males later in life. Thus, the vast majority of large individuals in protogynous species are male.

Goliaths are a bit more complicated, as they don't exactly follow that rule. FSU researchers have found some males at small sizes—as small as the size of sexually maturity—and some at the largest sizes, but females are abundant among older age groups, a pattern unlikely to occur in typical protogynous species.

The bigger surprise is that they have found specimens that had both fully functional male and female capabilities in the same individuals. This new finding has led Koenig to surmise that these individuals are bisexual hermaphrodites, capable of functioning as a male at one time and a female at another.

Starting out

It was not until four years after the closure that a discernible number of juveniles started to reappear in regions like the Ten Thousand Islands in southwestern Florida. From the data collected by Koenig and his colleagues during the first phase of the distribution, a regional density and habitat study revealed the vast majority of juvenile fish sampled between 1994 and 1997 just started to exceed 400mm (15-16 inches) in length. While most were in the one to three-year age group, only a few fell in the four to six-year bracket.

But life here can also be quite harsh as coastal mangrove and sea grass habitats are constantly subjected to environmental shifts in water salinity and temperature.

During heavier than normal rainy seasons and when severe cold snaps in winter are fast and sudden, juvenile mortality can become excessively high. In addition to natural shifts in nature, the constant growth rate of human habitation in Florida has also had a harmful effect on coastal estuaries through construction of sea walls, docks and piers. If that isn't enough, there is also the issue of runoff carrying pollutants like pesticides and herbicides from urban areas every time it rains.

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One of the worst natural environmental shifts on record to affect juvenile goliaths since the study began in 1990 took place the first week of January 2010 when a massive cold front pushed inshore water temperatures (recorded by the Everglades National Park) to as low as 5°C (41°F).

The sudden plunge in water temperature had such a detrimental affect on marine life in the shallow mangrove and sea grass beds, that it triggered a wide-scale fish kill up and down the Florida coast, essentially wiping out six full years of juvenile goliath development in one night.

What does a goliath grouper eat?

While their mouth is quite large and well-adapted for sucking in prey whole, their teeth are quite small for their size. Don't let their relatively slow swimming mannerism fool you. Goliaths are capable of powerful short bursts for overtaking slow-moving prey. But it is also this same physical appearance that has led many fishermen to assume these big fish are continuous, indiscriminate, eating machines, further fueling an inaccurate reputation that the goliaths are out of control on wrecks and reefs.

Goliath groupers, like many other large predators (sharks, barracuda, groupers, snappers, etc.) in the ocean are opportunistic feeders; meaning, if they encounter another fish—including another species of grouper in a distressed state (struggling on the end of a line or spear)—they will literally seize the moment. Of course when fishermen encounter such blatant thievery, snatching their catch on the end of their lines, you can somewhat understand their point of view.

Contrary to what some believe, grouper and snapper are not a normal part of the goliath's diet. Koenig, along with his research team, have examined the stomach contents of over 500 adult size fish; half (230) of the captured fish stomachs were empty while the prey species predominately found in the remaining adult fish were crabs.

While a large goliath might not pass up a large meal when the opportunity is right, they are not constant eaters. This is because a goliath's metabolism is not hyper-tuned, like tuna, mackerel, jacks, and dolphin fish, which have a hyper growth rate but also have to go far and fast for their meals. Instead, the goliath's daily metabolic requirement is low, allowing even the smallest meal to go a long way, leaving the impression among divers that big fish are lazy. ■

REFERENCES:
WWW.EDF.ORG/ARTICLE.CFM?CONTENTID=3951
WWW.EPA.GOV/OST/FISH
WWW.EPA.GOV/WATERSCIENCE/FISH
EMEDICINE.MEDSCAPE.COM/ARTICLE/813869-PRINT
WWW.FDA.GOV/FOOD/FOODSAFETY/PRODUCT-SPECIFICINFORMATION/SEAFOOD/FOODBORNEPATHOGENSCONTAMINANTS/METHYLMERCURY/UCM088794.HTM
WWW.YOUTUBE.COM/WATCH?V=P0F8X4I5GYE&FEATURE=RELATED