This is a review and discussion on next steps for goliath grouper research and management. This presentation will include a brief review of state and federal management, including recent FWC discussions; a presentation of current and ongoing research; information on how recent events, such as Hurricane Irma and the 2017-2018 red tide, impacted goliath; and a potential state waters management goal for goliath. Staff will seek direction on adopting a state management goal for goliath grouper and will recommend a stock status update be presented to the Commission in 2022.

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Unless otherwise noted, images throughout the presentation are by FWC.

Outline

- Management history
- Recent FWC discussions
- Proposed state waters management goal
- Recent events impacting stock
- Current FWC research
- Stock status indicators
- Next steps

This presentation will provide a brief review of the goliath grouper management history, recent Commission discussions, recent events impacting the stock, and current research. It will also present potential next steps FWC could take to meet this management challenge, while still allowing stakeholders access to goliath and promoting continued rebuilding.

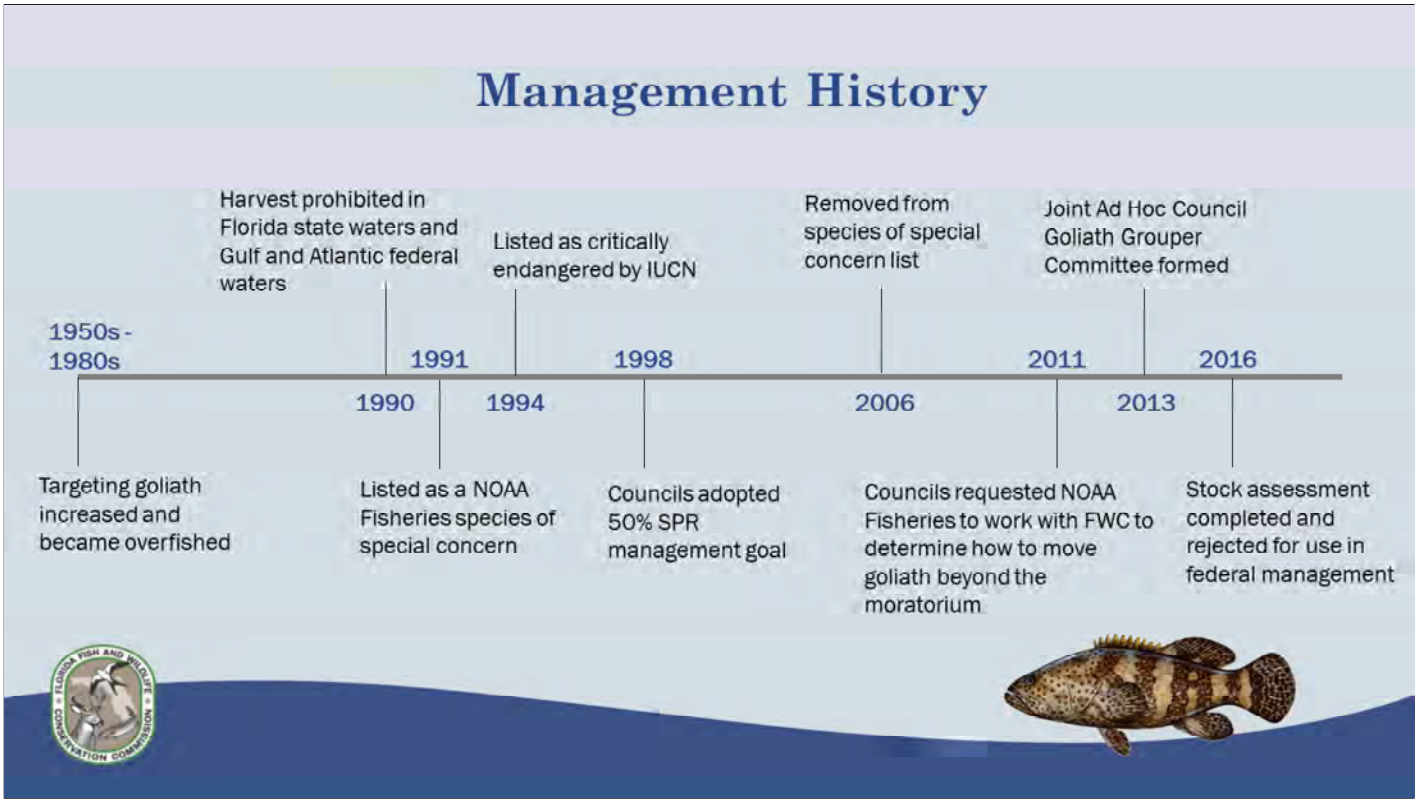
Goliath grouper are one of the largest grouper species on the planet. They are slow growing and long-lived. The oldest documented fish was 37 years old, but they are presumed to live over 40 years. They also exhibit late maturity (3-6 years). Juvenile goliath grouper are dependent on mangrove habitat. Adult goliath are sedentary and gather in large groups to spawn at predictable times and locations.

Historically, the distribution of goliath grouper within the continental U.S. spanned through southeast waters, with the center of abundance in Florida. Multiple decades of overfishing caused a severe decline in goliath grouper abundance that accelerated in the 1980s. Beginning in 1983, the state of Florida and the federal fishery management councils enacted several regulations to rebuild the stock, including prohibiting harvest.

Given the data-poor nature of this fishery (e.g., 28 years of no landings, high uncertainty in historic landings, many life history unknowns), it is difficult to assess the status of the stock and objectively evaluate whether the population is rebuilt. Several stock assessments have been conducted, but each was rejected for use in federal management. However, based on a 2016 FWC assessment, we know goliath grouper abundance in south Florida has increased since the closure.

In 2017, FWC gathered public input on goliath grouper management, including the possibility of a limited state waters harvest, through 17 public workshops throughout the state and an online survey. Stakeholders also had the opportunity to submit comments through an online form, as well as through email, phone calls, and letters. Feedback showed stakeholders have divergent perspectives on goliath. Some desire a robust catch-and-release-only goliath fishery. Other anglers desire a harvest opportunity. And still other anglers consider goliath a nuisance species because they opportunistically remove hooked fish from their line. Members of the dive community want to preserve goliath for ecotourism. There are others who think that goliath should be preserved for their role as a large predator in the marine ecosystem. Many feel that goliath grouper should be a conservation priority of the agency.

Given all these factors, it's clear that management of goliath grouper presents a unique challenge.



Prior to 1983, there were no state or federal regulations for harvest of goliath grouper. During the 1980s, the goliath fishery quickly expanded beyond historic participation and harvest, and the species became overfished. In response to the rapid growth of this fishery, Florida and the federal fishery management councils implemented several regulations between 1983-1989 to protect the species from further overfishing. Ultimately, in 1990, both federal councils and the State of Florida prohibited harvest of goliath because of concern that the stock was more severely depleted than previously thought. Because of goliath's depleted status, the South Atlantic Council noted that goliath had gained greater value for non-consumptive purposes, like dive ecotourism, compared to consumptive value.

Since 1990, other governments throughout the species' range, including Brazil, Puerto Rico, and the U.S. Virgin Islands, have followed suit and prohibited harvest. However, goliath fisheries persist in other parts of the Caribbean (e.g., Honduras, Belize). In 1991, NOAA Fisheries listed goliath grouper as a species of special concern. In 1994, goliath were listed as critically endangered on the International Union for the Conservation of Nature (IUCN), World Conservation Union's Red List of Threatened Species.

In 1998, to address new requirements of the Magnuson-Stevens Act, the federal councils set a management goal of 50% spawning potential ratio (SPR) for goliath. The councils selected this value for goliath to provide for population rebuilding by taking into account its biology and life history, as well as its high non-consumptive value. This management goal remains in place for goliath grouper today. To achieve this goal, federal allowable catch levels have remained at zero.

State and federal management measures have effectively aided goliath rebuilding. In 2006, NOAA Fisheries removed goliath from their Species of Special Concerns list in response to increasing abundance in U.S. waters. In 2011, the councils requested NOAA Fisheries work with the FWC to determine how to move goliath beyond the moratorium. In order to complete this task, the councils formed the Joint Ad Hoc Council Goliath Grouper Committee, which included FWC staff, to consider all available data and determine if another stock assessment could be conducted. FWC took the lead in conducting a new stock assessment that was prepared for the federal Southeast Data Assessment Review (SEDAR) process.

The goliath grouper stock assessment was completed in 2016; however, it was rejected by independent reviewers for use for federal management. When the councils received an update on the assessment they chose to take no action for goliath in federal waters and kept the acceptable biological catch and annual catch limit at zero.

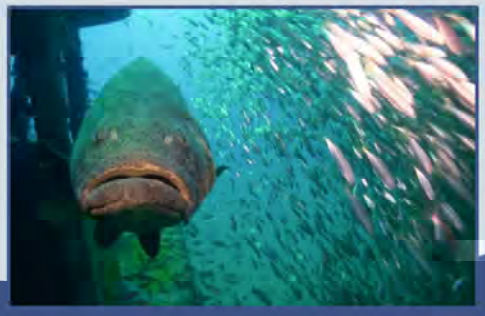
Recent FWC Discussion and Actions

April 2018 Commission Meeting

- Review of public feedback from 2017 workshops
- Commission decided to forego harvest at this time
- Develop next steps for goliath research and management

Today

- Discuss adoption of management goal
- Review ongoing research to support stock status update



At the April 2018 Commission meeting, staff presented a review of stakeholder feedback from 2017 and early 2018. The survey responses and submitted comments were divided between those who supported a limited harvest and those who supported maintaining a catch-and-release-only fishery. The Commission decided not to pursue a limited harvest.

In April, the Commission expressed a desire to continue advancing goliath grouper rebuilding. They directed staff to develop the next steps for goliath grouper research and management.

Adoption of a management goal will be discussed. The presentation will also highlight recent impacts to goliath grouper and review monitoring and research efforts that can address important data gaps and contribute to better understanding of goliath's stock status.

Overarching Management Concepts

Recognize goliath's role in ecosystem

- Important, large predator in Florida's reef ecosystem
- Maintains ecological integrity of reef habitats

Allow users access to goliath while promoting continued rebuilding

- Continue catch-and-release fishing
- Maximize dive viewing opportunities
- Interactions with goliath will increase

FWC management of goliath grouper has operated under two overarching management concepts.

First, FWC recognizes goliath's role in the ecosystem. Goliath is an important and large predator in Florida's reef ecosystem. The presence of goliath grouper on natural reefs maintains the ecological integrity of reef habitats.

Secondly, FWC allows users access to goliath while also promoting continued rebuilding of the population. Although no harvest is allowed in order to progress rebuilding, recreational anglers continue to have the opportunity to enjoy catch-and-release fishing for goliath. Dive viewing opportunities for recreational divers and dive ecotourism is maximized and generates value for these participants. As the population continues to rebuild, interactions with goliath will continue to increase for both anglers and divers.

Currently the management goal for federal waters is 50% spawning potential ratio (SPR).

Standard fisheries management metrics are not suitable for goliath because they are highly vulnerable long lived species and lack the usual data streams used in standard stock assessments. Any type of assessment for goliath can only provide relative stock status at this point in time.

However, alternative management goals for relative stock status could be adopted. There are five points that make up this goal that could be used for state waters. For the long-term our goal would be stable or increasing number of adults and juveniles with broader distribution among areas and habitats. One specific aspect of this goal is to see increased numbers of adult goliath on natural reefs as they are currently found primarily on artificial reefs off Florida. Another part of the goal is an expanded presence of goliath in older age classes. Older fish contribute more to the stocks reproductive potential but have been rare since the moratorium was established in 1990. The final part of the proposed goal would be increased genetic diversity in the population with a low level of inbreeding.

Setting Management Metrics

- Alternative metrics for indicating relative stock status
  - Indices of abundance – long term stability or increase for adults and juveniles
  - Population size – increased abundance in broader areas and habitats
  - Abundance on natural reefs – increased adult density on natural reefs
  - Population age structure – expanded presence of fish in older age classes
  - Genetic diversity – increased genetic diversity, low level of inbreeding

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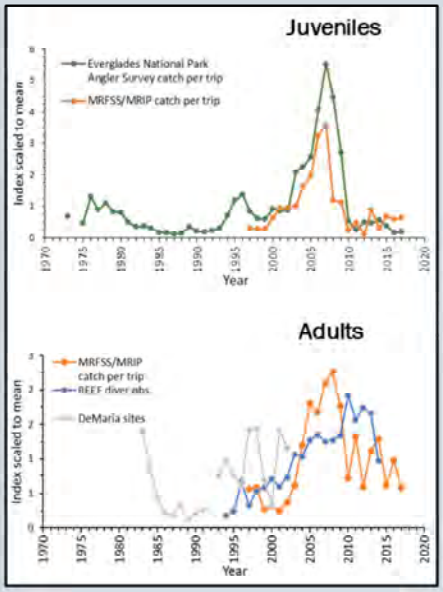
These metrics and goals will be explained further on upcoming slides.

Measuring Stock Status: Relative Abundance Indices

- Juveniles
  - Everglades National Park creel survey
  - MRIP catch per trip
  - Juvenile abundance low due to 2009/2010
  - 2017/2018 red tide impacts expected
- Adults
  - MRIP catch per trip
  - REEF diver observations
- Adult abundance reduced from cold kill and red tides
- Juvenile and adult indices are available annually
  - Indices will be reviewed at least every 3 years for signs of stabilization/increase



Abundance of juvenile goliath grouper will be monitored using the Everglades National Park (ENP) creel survey and the Marine Recreational Information Program (MRIP). Adult abundance will be based on catch rates from MRIP and standardized diver observations obtained through the Reef Environmental Education Foundation (REEF) programs. These programs provide a longer-term perspective on goliath grouper abundance and allow better evaluation of the level when the population reaches an equilibrium, steady-state.

Measuring Stock Status: Absolute Population Size

- Genetic tagging program
  - Non-lethal mark recapture program to estimate population size
  - Accurate estimate will require many more marked (fin clips) fish
  - Goal is to sample at least 400 fish annually through FWC efforts and volunteers
- App-based reporting of goliath to collect distribution information
- Population estimate using genetic tagging possible after 5-7 years

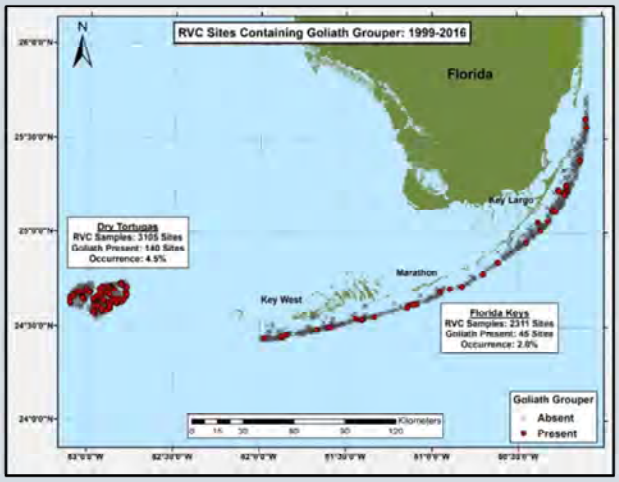
FWC Reporter App

Angler Fin Clip Kit

Besides providing information on genetic structure, movements, and kinship, genetic samples can be used to generate estimates of absolute population size based on mark-recapture techniques. A new goliath grouper reporting module in the FWC Reporter App will provide georeferenced data/photos directly from fishers and divers.

Measuring Stock Status: Abundance on Natural Reefs

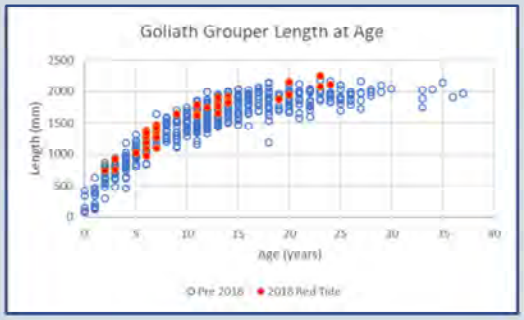
- FWC Reef Visual Census (RVC)
  - Long term dataset since 1999
  - Very low numbers of goliath on natural reefs
  - Higher numbers of goliath on artificial reefs
  - Looking for goliath to recolonize natural reef habitats
  - RVC data collected every other year, will be reviewed at least every 5 years



FWC has conducted a reef visual census (RVC) of fish communities in the Florida Keys and Dry Tortugas for nearly twenty years. The map presented in this slide shows the rate of occurrence of goliath grouper in this survey and includes only stations with medium or high relief (generally >5 feed) habitat, which are preferred by goliath. Throughout the survey, goliath have been relatively rare and the mean occurrence rate for the Keys is 2.0% while the Dry Tortugas is slightly higher at 4.5%. Ninety-five percent of stations where goliath occurred consisted of a single individual. These data confirm that goliath continue to be fairly rare on what we would expect to be suitable natural habitat.

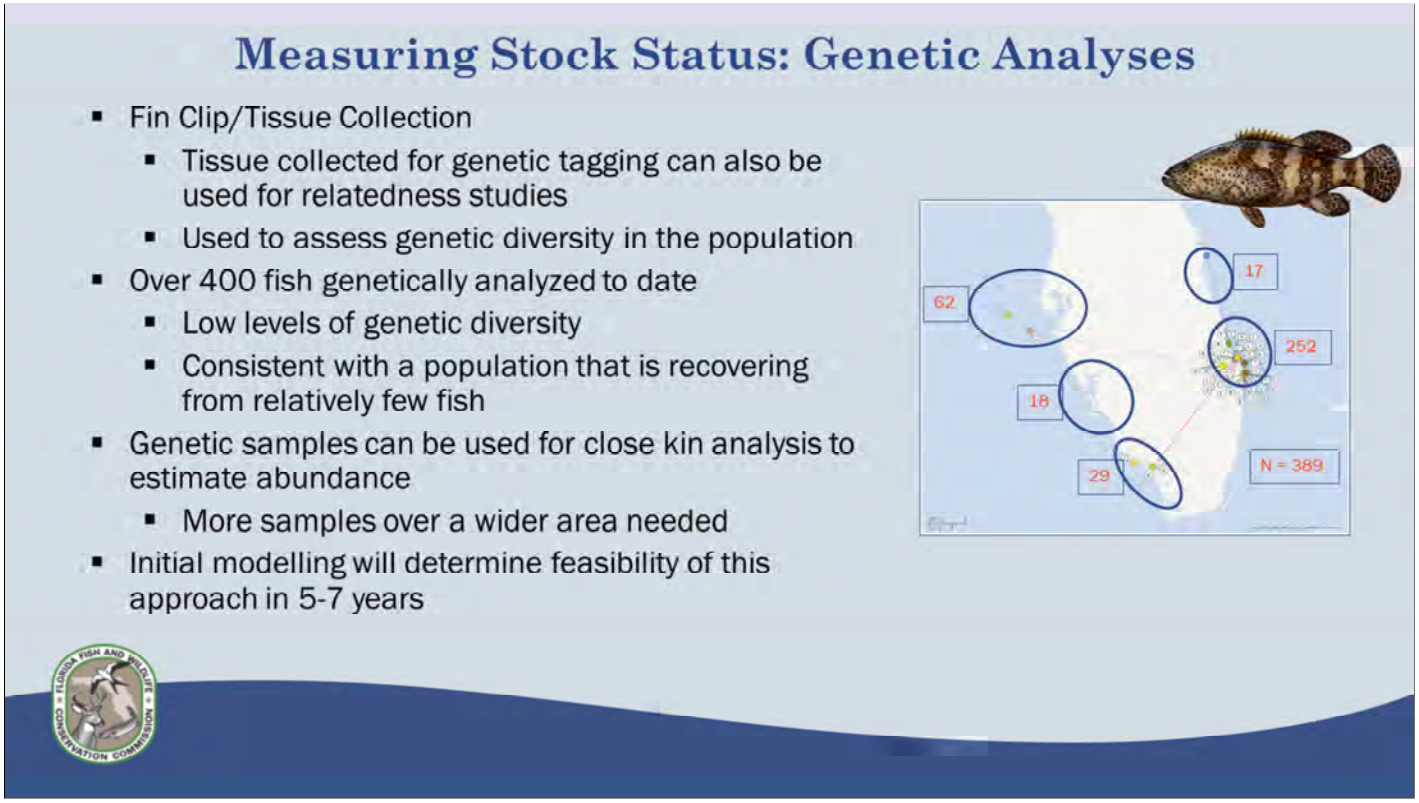
Measuring Stock Status: Population Age Structure

- Long term recovery requires rebuilding of older age classes
  - By 1990 moratorium very few older fish
  - Maximum age 37 years (fish harvested in late 1980s) true maximum age likely higher
  - Fish spawned during year one of the moratorium are only 28 years old today
- Current age structure of population is missing older age classes
  - Even very large goliath killed by 2018 red tide still did not show older ages
- Long term goal is to keep survival high so these older age classes can rebuild over time
- Older age classes will likely not be rebuilt for at least another 10 years



- Only 2 fish collected >25 year old since 1990
- N=535 fish; 44 from 2018 Red Tide

Collection of biological samples allow evaluation of the population age structure. Samples collected around the time the goliath grouper fishery was closed (1990) indicate they live to be at least 37 years of age. Although hundreds of goliath grouper have been aged during the years, only a handful of the ages observed have been over 30 years, and only 2 goliath grouper aged since 1990 have been older than 25 years. This indicates older age classes will likely not be rebuilt for at least another 10 years.

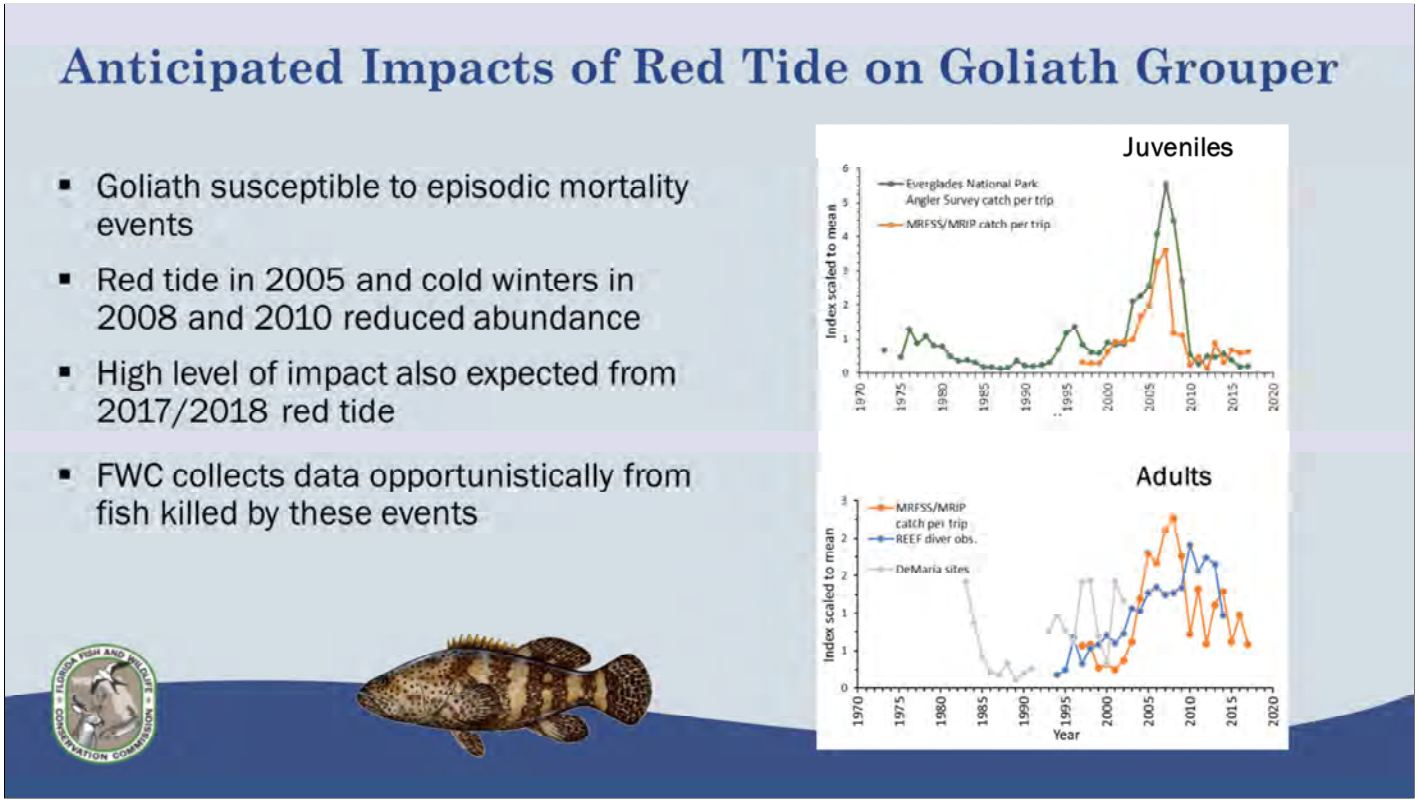


An evaluation of goliath grouper stock structure, spatial distribution, and kinship is based on genetic analyses of samples obtained through a fin clip collection program. Over 400 goliath grouper samples have been analyzed to date. Results indicate low levels of genetic diversity consistent with a population that is recovering. However, more genetic samples from a wider area are needed to further evaluate this issue. FWC is also testing the feasibility of using a non-lethal genetic technique for estimating goliath grouper population abundance. The technique, called Close-Kin analysis, is a novel approach to ecological assessment in circumstances that are not amenable to traditional fishery stock assessments.

Measuring Stock Status: Summary of Metrics

Metric	Goal	Timeframe
Relative indices of abundance	Long term stabilize or increase for both juveniles and adults	Available annually Will be reviewed at least every 3 years
Population size	Increased abundance in a broader range of areas and habitats	Genetic tagging supports population modeling after 5-7 years
Abundance on natural reefs	Increased density on natural reefs	RVC data collected every other year Will be reviewed at least every 5-7 years
Population age structure	Presence of fish in older age classes	Likely no improvement for at least 10 years
Genetic diversity	Increased genetic diversity – low level of inbreeding	Genetic tagging supports modelling after 5-7 years

Summary of metrics, goals, and timeframes for progress updates toward the goal that FWC is using to assess goliath grouper stock status.



Goliath grouper are highly susceptible to episodic mortality associated with severe environmental events (red tides, cold kills, etc.). Noticeable on these abundance graphs is the impact of the 2010 cold-kill event on the goliath grouper population, especially juveniles in shallower, inshore habitats more susceptible to be influenced by abrupt changes in water temperature. Based on reports to the FWC Fish Kill Hotline and other data collected by FWC staff we expect goliath grouper in southwest Florida to have been also impacted by the prolonged and severe 2017-2018 red tide event.

Incidental Carcass Collection

- FWRI collects samples from incidentally-killed goliath
  - Otoliths (aging)
  - Fin clips (genetic analysis)
  - Muscle tissue (Mercury; stable isotopes)
- Sample collection numbers
  - 231 total (2006-2018)
  - Aging = 165 otoliths aged
  - DNA = ~400 fin-clips

Collecting size data and otoliths from red tide-killed Goliath groupers

Through reports to the FWC Fish Kill Hotline and coordination with coastal county agencies FWC conducts ongoing collections of biological samples (ages, sex, sexual maturity, diet, genetics, and level of mercury accumulation) from goliath grouper killed by episodic mortality events such as red tides and cold kills. These samples provide FWC with information to start filling data gaps on goliath grouper life history, biology, and ecology and develop a better idea of the current condition of the stock.

Staff Recommendation

- Adopt alternative stock status indicators for goliath in state waters
- Continue research to fill data gaps
- Report back on stock status in 2022

Staff recommends using alternative stock status indicators as a management goal for goliath in state waters.

Staff recommends the Commission direct staff to work toward the development of a goliath grouper stock status update by continuing research to fill data gaps for the metrics for the 5 management goals.

Results from this effort can be presented to the Commission in 2022.