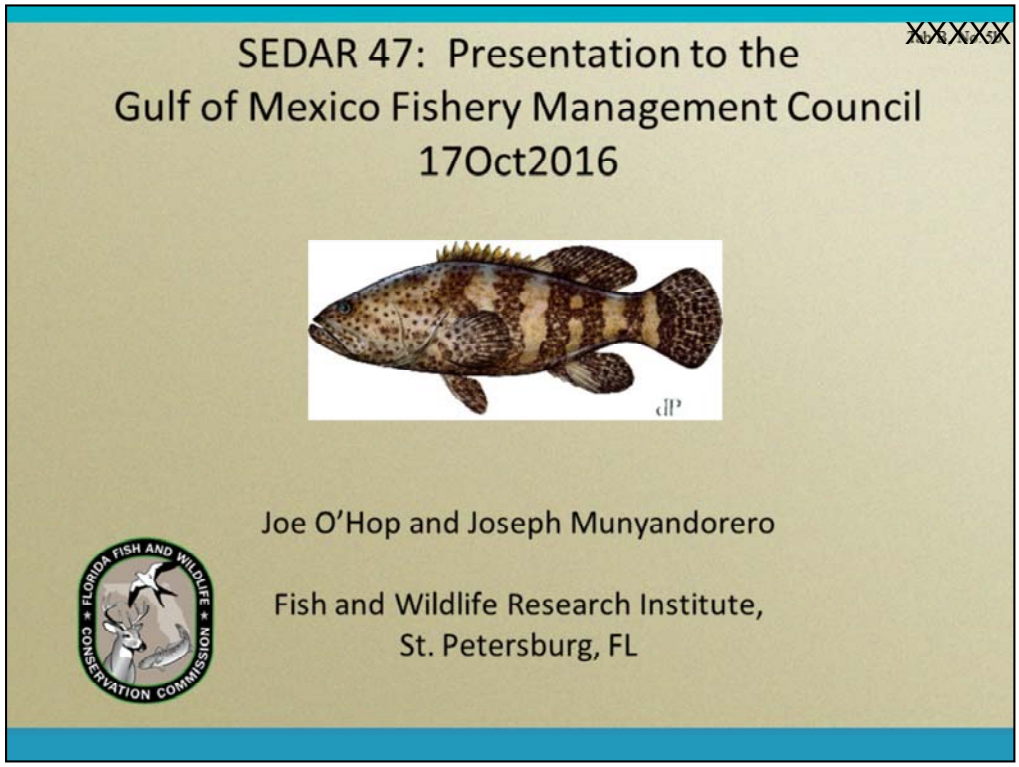
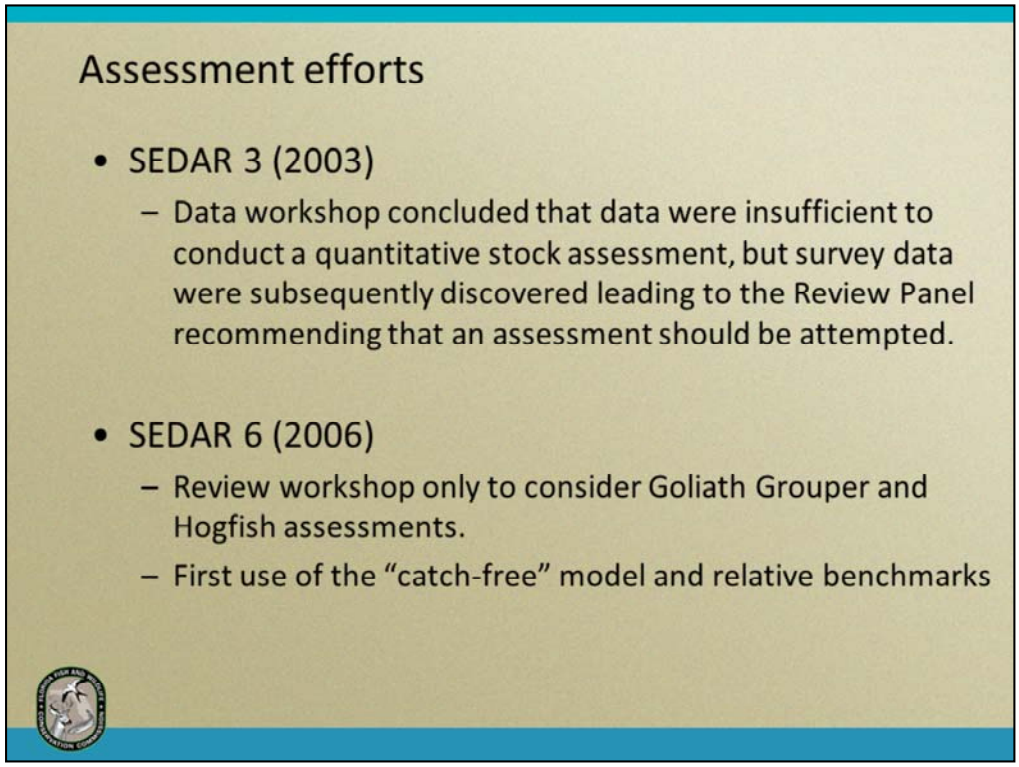
Tab B, No. 5a - with presenter notes



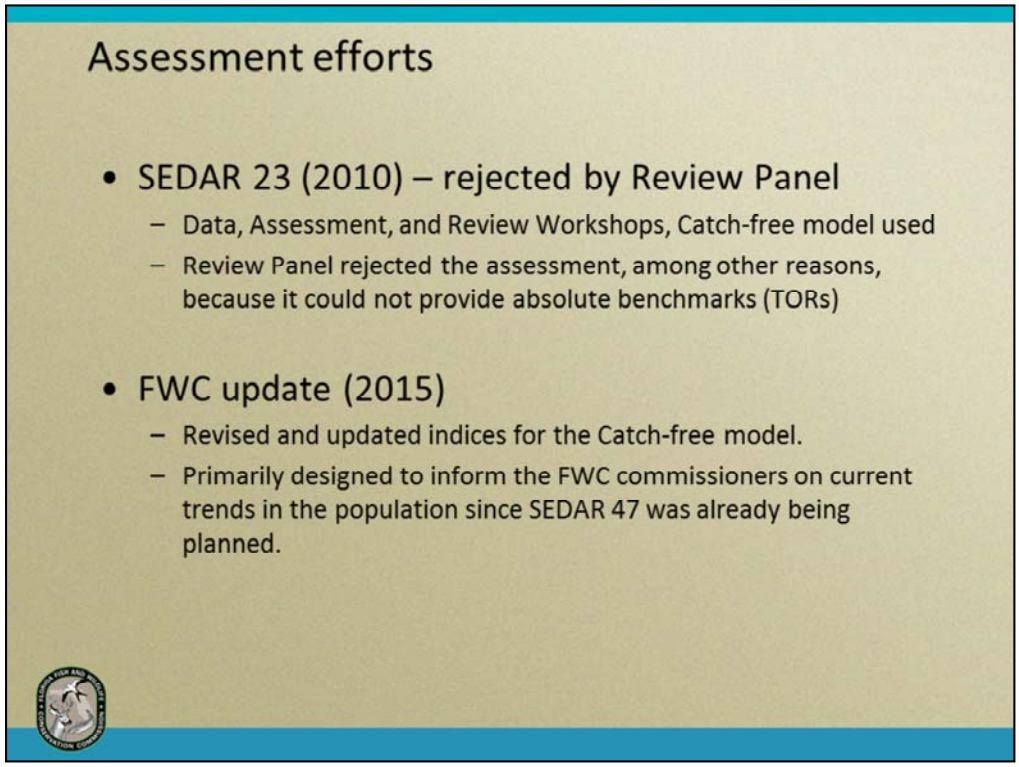
SEDAR 47 attempted an assessment of population status of the Goliath Grouper in Southeastern U.S. waters. The SEDAR 47 Review Workshop met during May 17-19, 2016 to consider the assessment results.

Adult Goliath Grouper aggregating at the MG111 barge wreck off of Jupiter, FL in 65 feet of water. Photo by Mr. Walt Stearns, Underwater Journal (http://www.waltstearns.com/underwaterjournal.html)

After testimony by fishermen and divers about alarming declines in Goliath Grouper numbers in the Gulf of Mexico, the Florida Marine Fisheries Commission (now combined into the FWC) and both the Gulf of Mexico and the South Atlantic Fishery Management Councils took precautions and prohibited the retention of Goliath Groupers in 1990. Since that time, observations made by divers and research studies have documented increasing numbers and signs of population recovery of this species in southern Florida.



There have been four data workshops devoted to Goliath Grouper. The first held during SEDAR 3 concluded that existing data were insufficient to allow an assessment to proceed. Following that workshop, additional information came to light and the SEDAR 3 Review Panel recommended that an assessment should be attempted. This new assessment formed part of SEDAR 6, and was the first use (and acceptance) of the Catch-free model (Porch et al. 2006) which delivered relative benchmarks for guiding management advice. While the result of the assessment was that the spawning biomass for this species was still overfished, the population (numbers and biomass) showed significant signs of improvement after the prohibition in 1990.

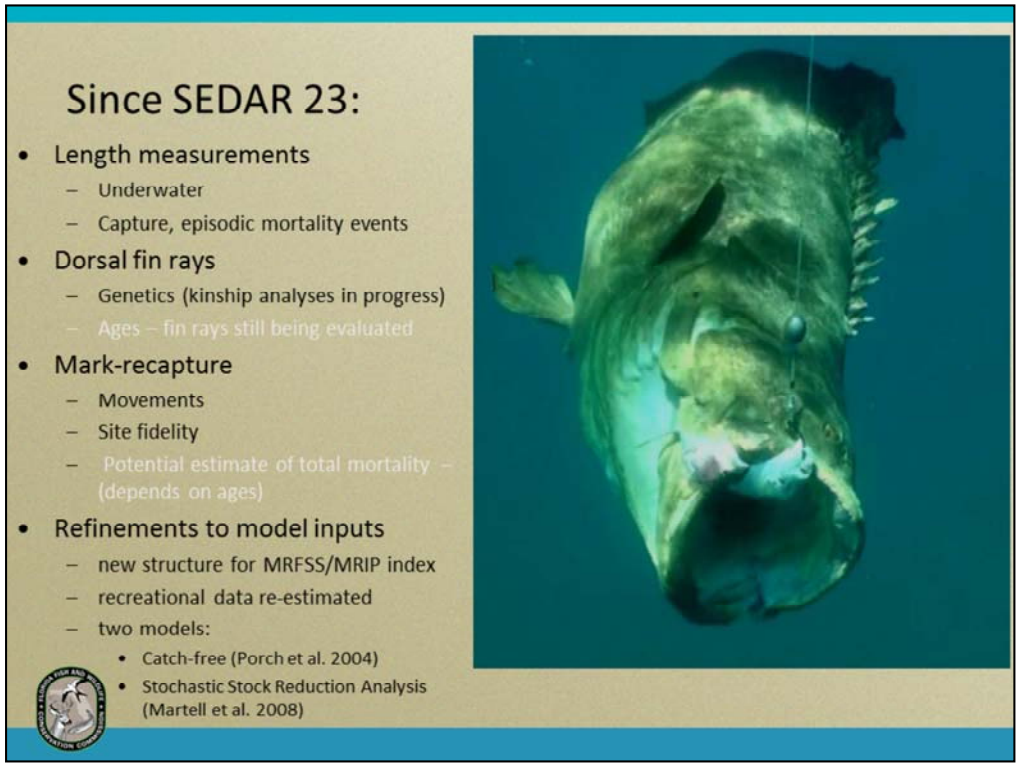


SEDAR 23, in 2010, held data and assessment workshops in part for Goliath Grouper. The "Catch-free" model was again used as the primary model, and we attempted to reconstruct landings data to be used in a surplus production model. This assessment was rejected by the Review Panel because it could not provide the absolute benchmarks need for management advice, but there were also concerns about the measures of abundance used in the models. While the surplus production model was not presented as an alternative to the reviewers, they encouraged further development of the data inputs suitable for this model.

The FWC requested an update on Goliath Grouper in 2015, and indices were re-constructed and updated for the Catch-free model. Primarily, this update was for informational purposes rather than advice to management since SEDAR 47 was in the planning stages.

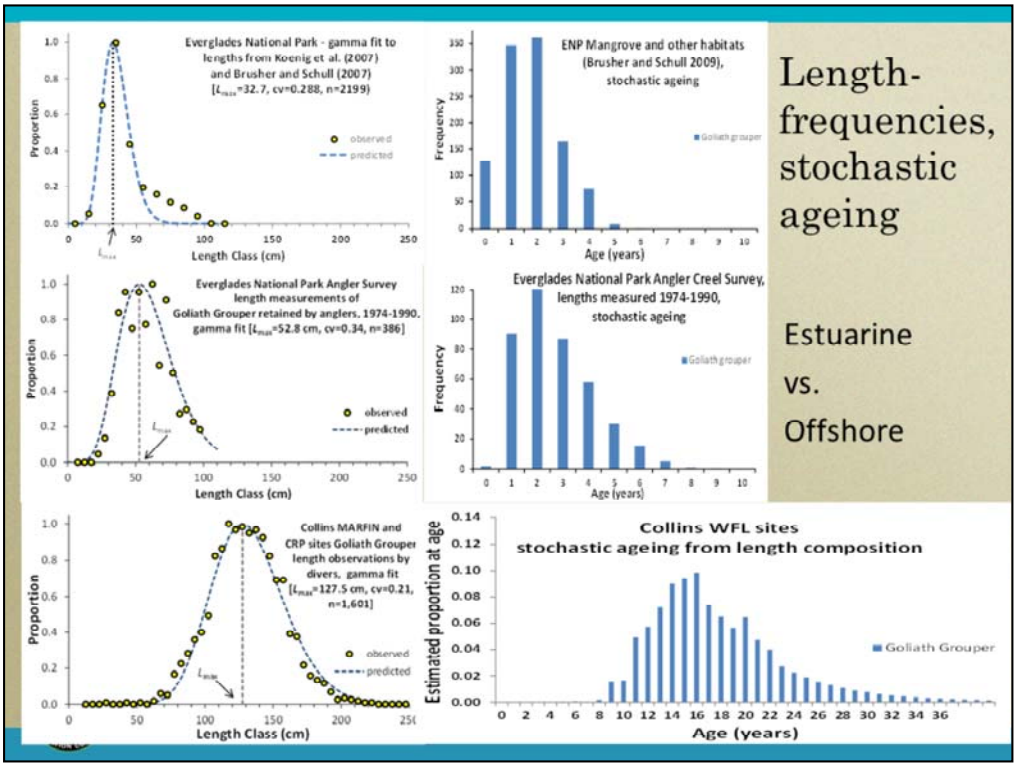
Assessment efforts

- In planning the analyses for SEDAR 47, data sources were considered to determine whether new types of data suitable for the assessment had become available.
  - Research studies had been conducted on estuarine and offshore portions of the population
    - Good information on sizes of individuals, movements, site fidelity, genetics, potential for nursery habitat identification, mercury levels, and other aspects of its life history.
    - Some potential information on age composition of offshore fish available, but still undergoing evaluation and was not available for the SEDAR 47.
  - Without new data suitable for the assessment, we did not hold data or assessment workshops
    - We used the recommendations from SEDAR 23 to structure data inputs for this assessment.



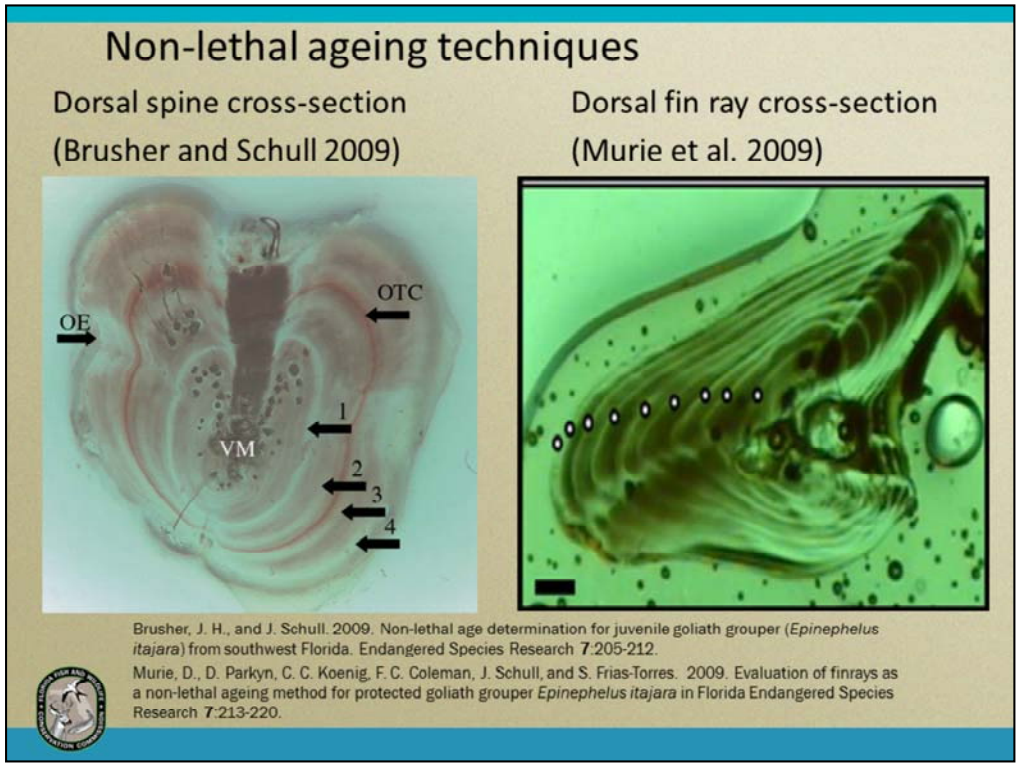
So, to recap, we have some basic data from the original study on the biology of this species (Bullock et al. 1992), and additional length measurements from underwater observations and non-lethal research captures, from dead specimens collected after episodic events (cold kills, red tide), bridge demolitions, and from other mortality. From the research captures, we gain samples for genetics, possibly ages from fin rays, other biological data (e.g., stomach contents, reproductive samples, mercury and other elements, etc.), and specimens may be marked with acoustic and/or visual tags to track movements.

We have also made new estimates of recreational removals (historical and recent, and that portion of the fish which die after being released). There is also information on commercial releases, but the data are not yet suitable for estimating releases.

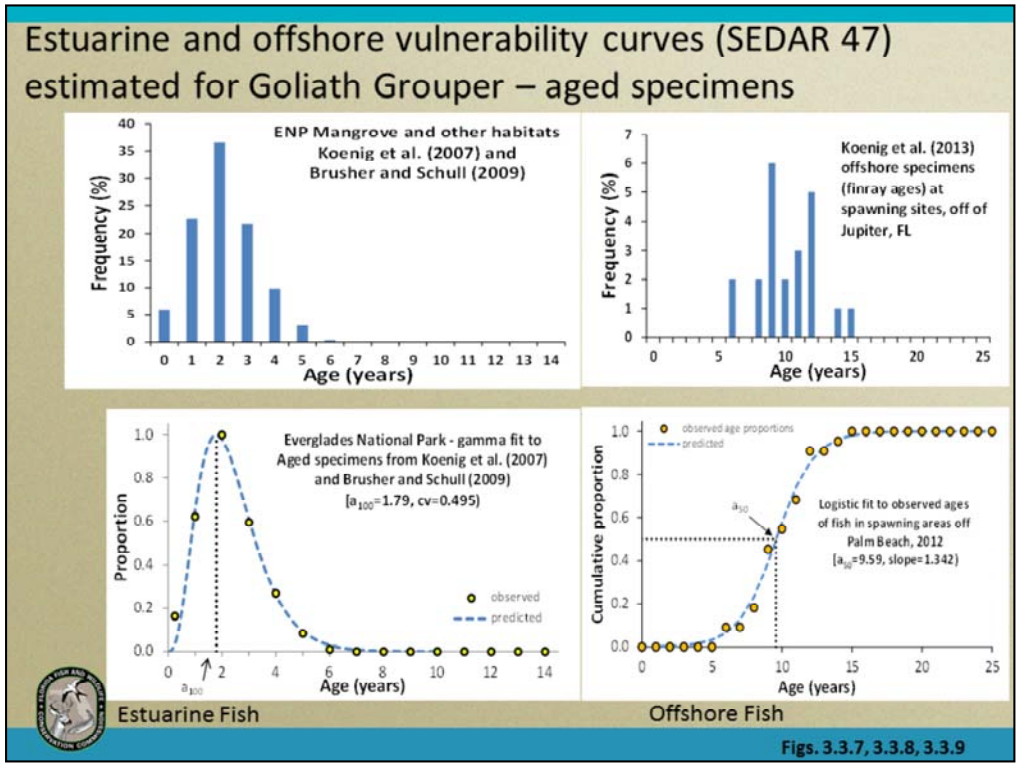


There is limited data on the size and inferred age structure of Goliaths from catches in the Everglades National Park Angler Survey (most measurements were from 1974-1977, with a few additional measurements until 1990). There are very few measurements of sizes from the MRFSS/MRIP survey over the 1981-1990 period when retention was still permitted.

ENP research studies in estuarine areas by Koenig et al. (2007) and Brusher and Schull (2009) provided additional length measurements and ages (mostly from dorsal fin spines and from a few otoliths). Research studies in offshore areas (Collins, 2015) provided information on observed sizes in offshore areas of West Central Florida. We can use the measured sizes of individuals to estimate ages, but there is considerable uncertainty especially in the offshore areas.

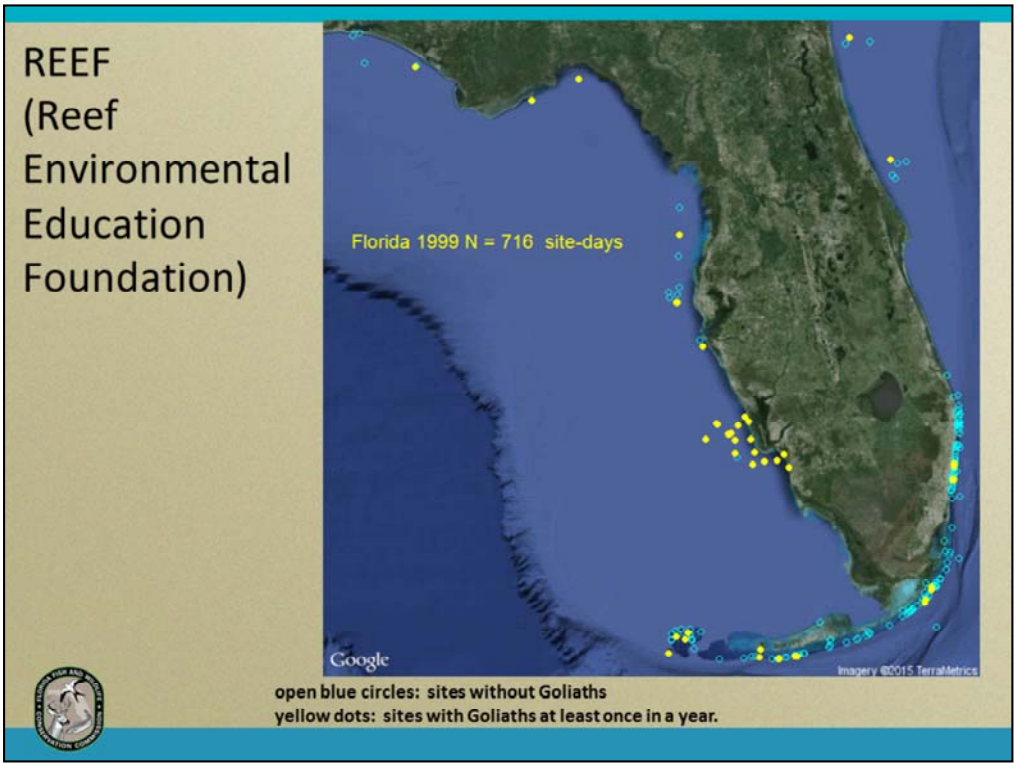


Usually, age determinations for groupers and many other reef fish are made using otoliths but this involves killing the specimen to remove this structure for analysis. Other ageing techniques that do not kill the specimen include removal of spines or soft rays from the dorsal fin. These techniques have been applied to ageing Goliath Grouper. Dorsal spines showed promise for ageing juvenile Goliaths, but there is some uncertainty associated with the technique. Currently, dorsal finrays are being evaluated for ageing Goliaths from offshore areas. Depending upon the outcome of the evaluation, finrays may be a viable structure for ageing older Goliaths (perhaps within an age range).



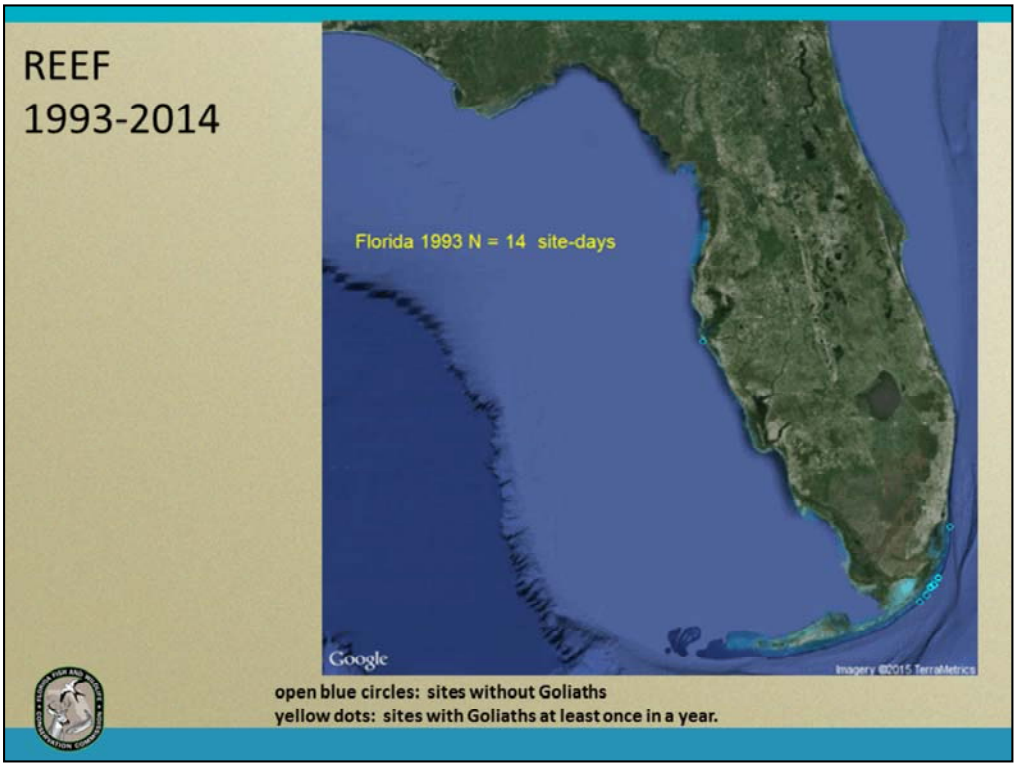
Alternatively, the observed ages of fish can be used without resorting to the more indirect stochastic ageing technique. At present, there is more confidence with the ageing of the estuarine specimens of Goliaths. The sample size was reasonably large and the research studies estimating age-at-length were in reasonable agreement, fishery samples of fish lengths from the Everglades were reasonably similar, and the life history of Goliaths indicates that they are spending the first 5 to 6 years of their life in the estuary before moving offshore.

For the offshore portion of the population, and at the time SEDAR 47 was reviewed, only a few provisional “ages” derived from fin ray sampling were available, and the effectiveness of this technique is still undergoing validation (grant report expected in November, 2016). If the technique proves useful, there may be several hundred ages from specimens available from offshore of Palm Beach and possibly more from central West Florida offshore areas. In conjunction with the Palm Beach tag/recapture study, there may be enough information available for estimating total mortality rates over several years for that area. However, tag losses in this study will have to carefully examined.



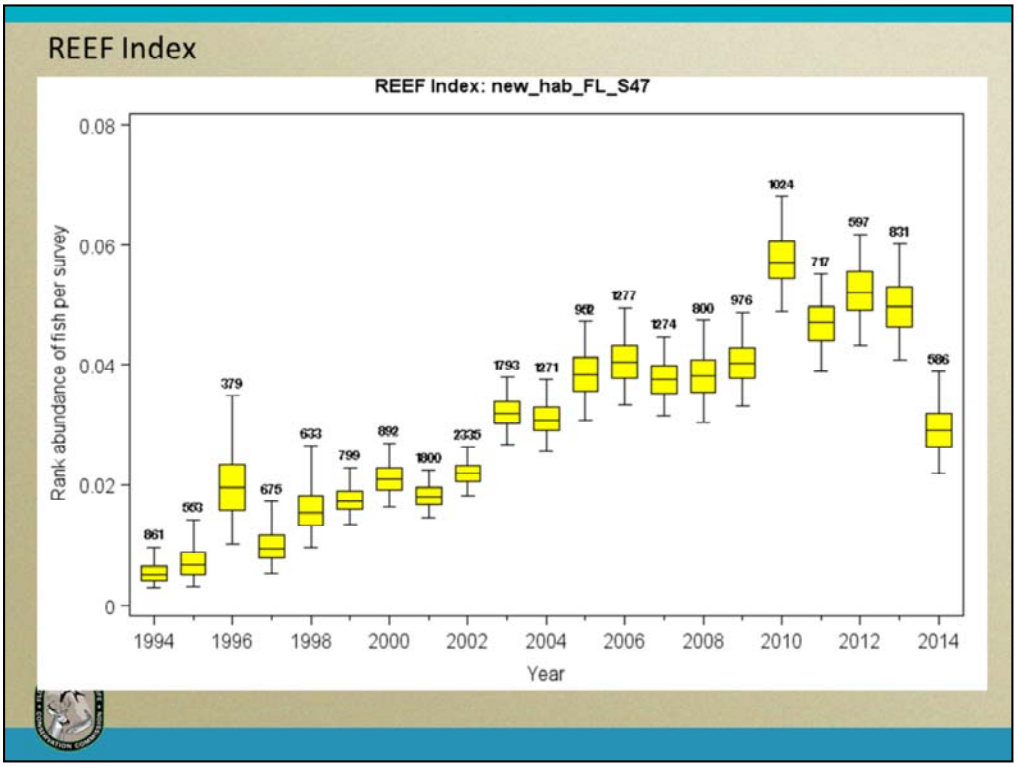
Underwater observations

REEF has provided a voluntary way for divers to contribute data on fish assemblages that they observe. Divers are qualified through training with REEF on survey methods and fish identification. Information from their dives are contributed to REEF as either presence/absence or ranked abundance data. In the Florida Keys, the first REEF surveys were recorded in 1993. Dive sites are totally up to the volunteers. REEF serves as the repository of the information.

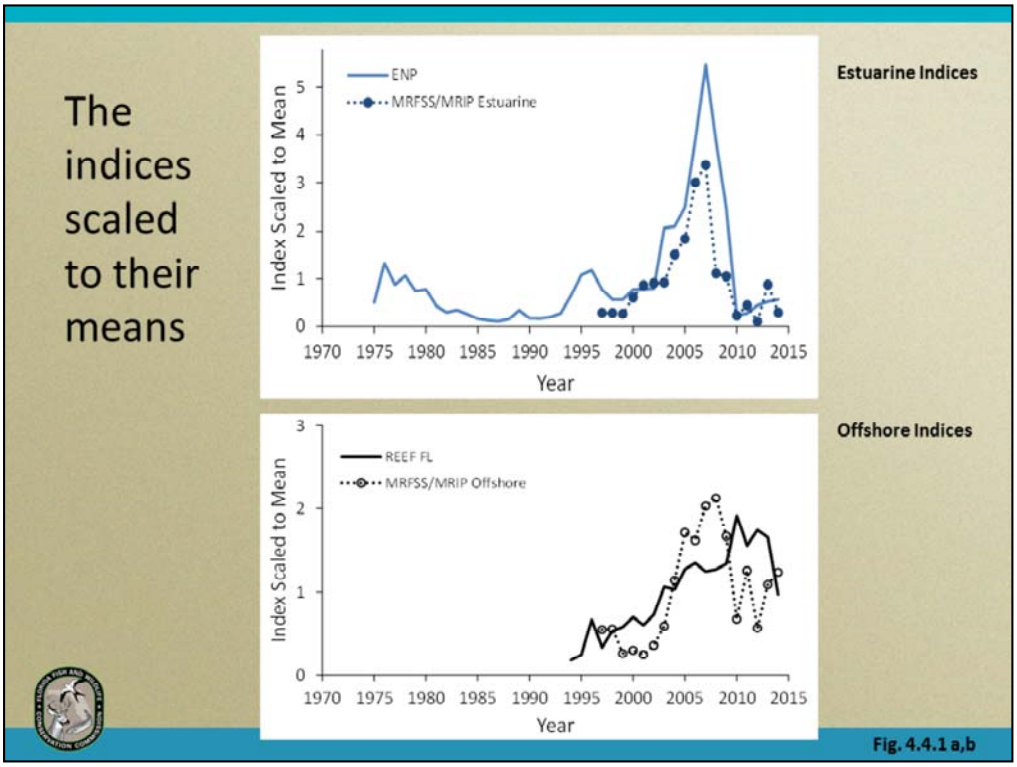


Underwater observations – ranked abundances

You can get an idea of the survey coverage with this animation of sites with and without Goliath Grouper from 1993 to 2014. The open blue circles are sites without Goliaths, while the yellow dots are sites where Goliaths were observed at least once during the year. Note the expansion of survey sites over time, and changes to the distribution of surveys through the years. The Southeastern Florida sites tend to have much higher coverage through the years than West Florida sites.



Even with the coverage issues associated with REEF, we attempted to use the ranked abundance data to construct an index of abundance. In REEF, abundance is represented as: 0 (none observed), 1 (1 fish), 2 (2-10 fish), 3 (11-100 fish), and 4 (over 100 fish). With Goliath Grouper, we felt that there were few (if any) species identification issues, they are usually easy to see due to their size (but water clarity may make counting difficult), and they are not usually timid around divers. The index, which combines data from sites from Southeastern Florida, Florida Keys, and West Florida, shows a generally increasing trend over time to 2013, but has a worrisome decline in 2014.

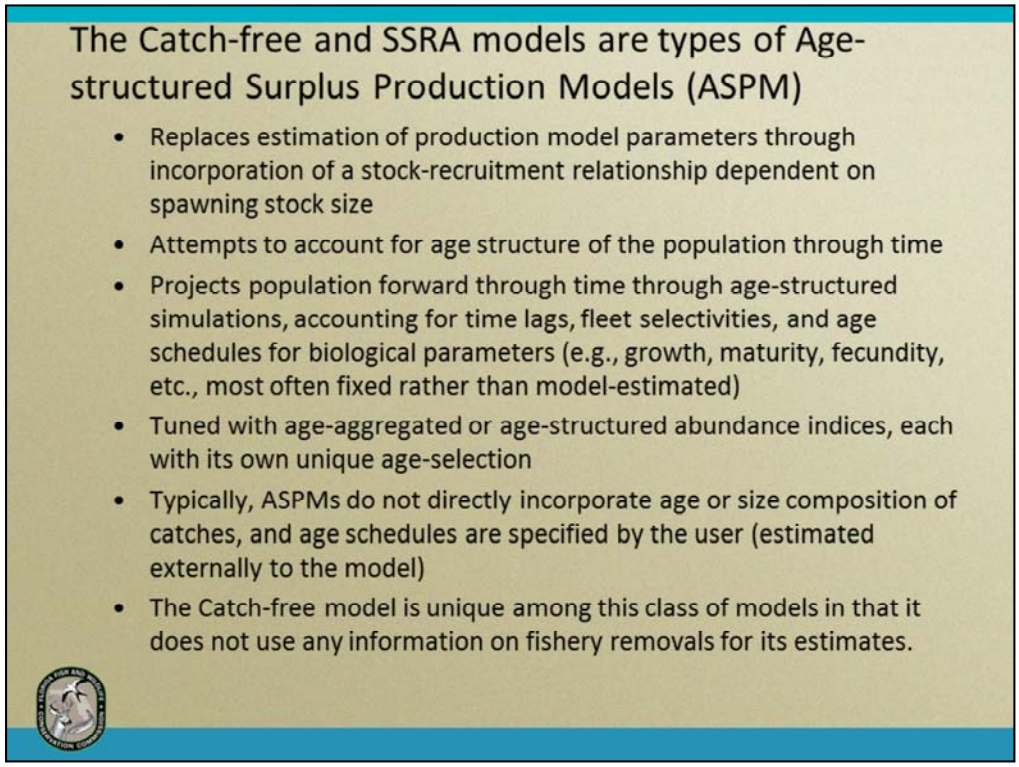


Additional indices of abundance were made from fishery dependent sources for SEDAR 47. For this assessment, the recreational fishery from the national survey (MRFSS/MRIP) was stratified into estuarine and offshore indices which should correspond to the known life history of Goliaths. Juvenile Goliaths spend their first 5-6 years in mangrove areas, and afterward move offshore where they mature in a year or two.

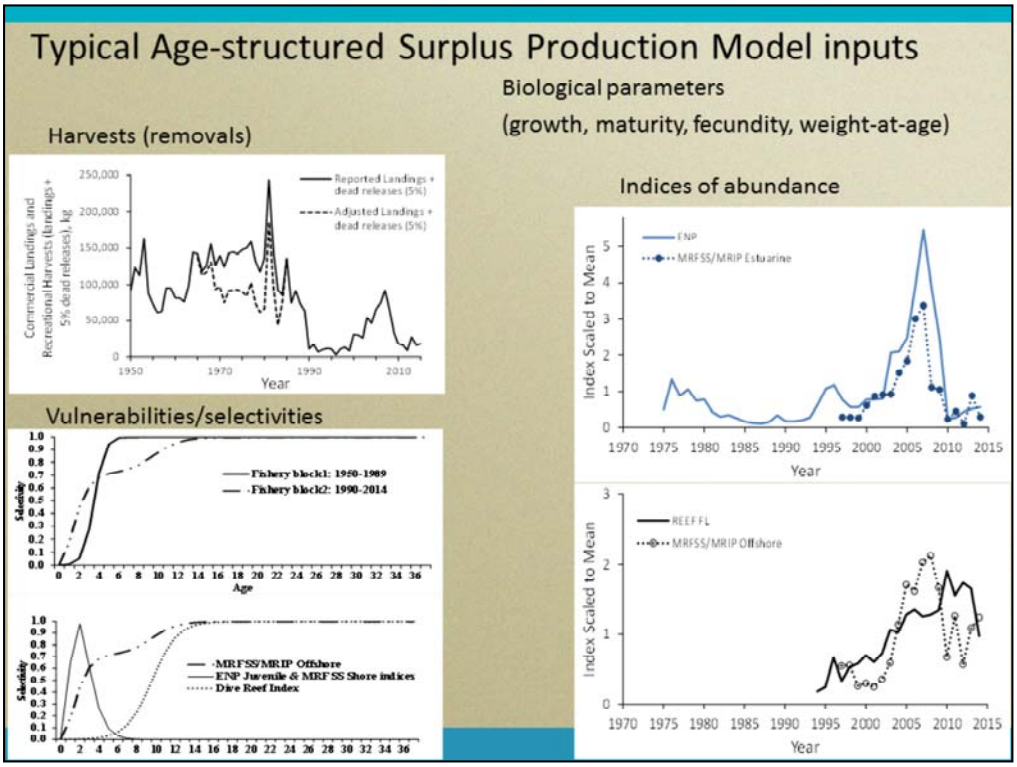
Note the concordance of the Estuarine indices, and that the ENP index is the longest time series available and covers before and after the prohibition on retention took effect in 1990. The large declines in the estuarine indices are associated with the cold kills in 2008 and 2010. The trends in these indices after 2010 may be indicative of low recruitment. The offshore indices are also in agreement, but to a lesser extent. This may be due to differences in the vulnerabilities/selectivities represented by these indices. But, the selectivities of the recreational offshore catch are not known, and the age structure of the offshore adults is based on a smaller number of aged specimens from a research study in a small area over a limited number of years. In any case, the declines in the offshore indices in the later portion of the time series are a concern.

We couple the indices with age compositions that we infer from the size or age data from the research studies to inform the assessment model with the appropriate

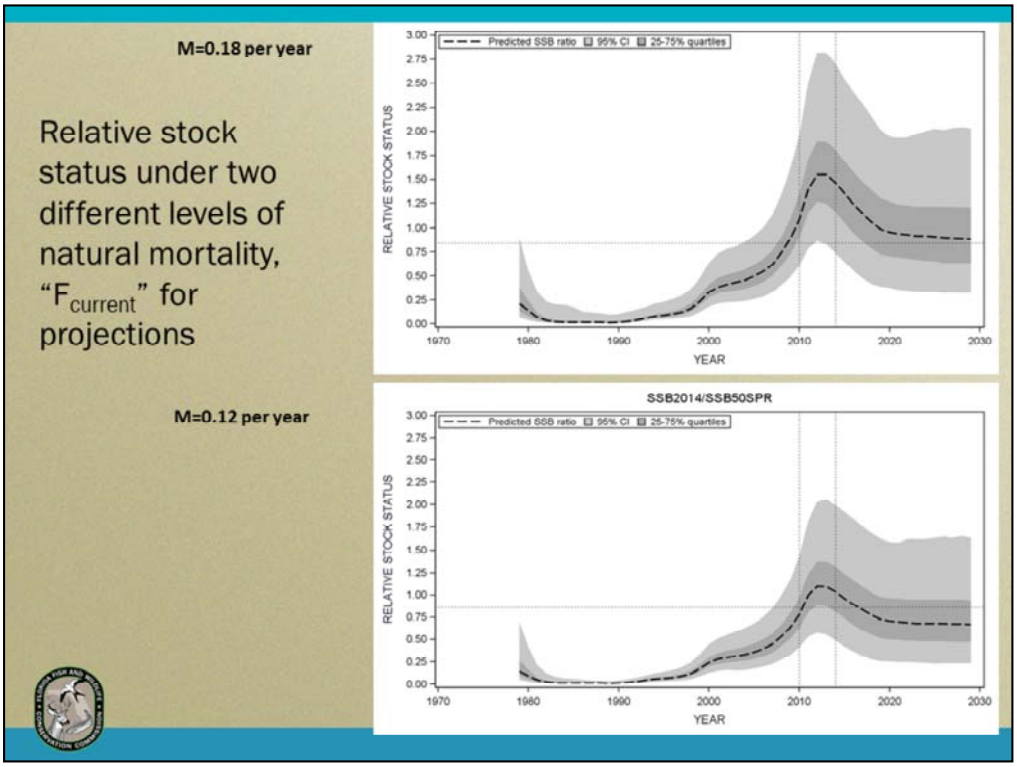
ages to be applied to each index, and this allows the model to estimate the changes in the proportions at age for the reconstructed population.



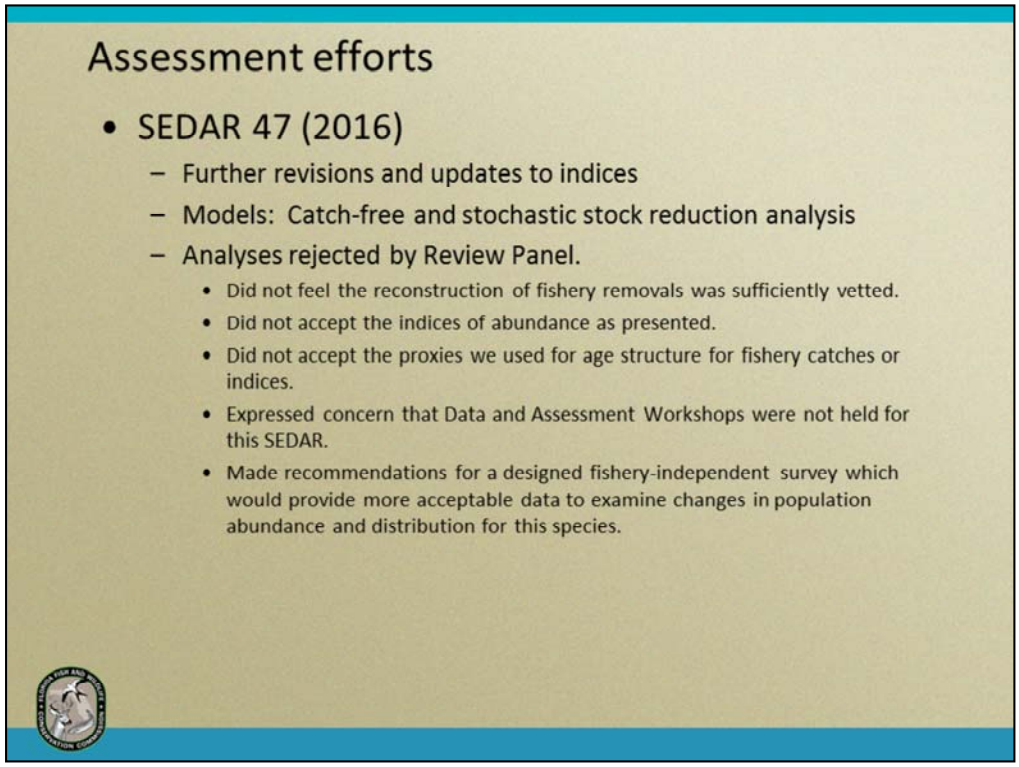
The modeling approaches used in SEDAR 47 are classified as Age-Structured Surplus Production. ASPMs attempt to account for removals by estimating how large the stock (including recruitment) must have been to account for the observed time series of catches and the observed changes in relative abundance (i.e., indices). Historical catches and abundance indices are key inputs to these models.



Typical inputs to age-structured surplus production models like Stochastic Stock Reduction Analysis include a time series for harvest removals (for example: landings, dead discards, estimated mortality after release) by the fishery, a schedule of fishery removals by age (vulnerabilities to fishing gear), time series for abundance measures (indices), and a suite of life history/biological parameters including a growth function, maturity-at-age, fecundity-at-age, and weight-at-age. The Catch-free model is an unusual ASPM in that it includes all of the inputs above except a time series of fishery harvest removals. All of the model predictions of harvest are derived from the biological parameters, vulnerabilities, and indices of abundance.



Uncertainty in the $SSB_{2014}/SSB_{50\%SPR}$ ratio by MCMC runs generated by the Catch-free model at two input levels for the natural mortality rate. The results generally describe the stock status as not "overfished", with declines in spawning stock biomass (SSB) predicted shortly after 2010 plausibly related to the 2010 cold kill. The projections after 2014 from this model predict a decline in SSB, but this is largely an artifact of the way the Catch-free model solves for the fishing mortality rate since the prohibition on retention in 1990. The output of the other model, SSRA, indicated the stock was not overfished nor was overfishing occurring. In any case, since the Review Panel has rejected the assessment results from both models, thus the above results should not be used to provide management advice.



In 2016, SEDAR 47 built upon the new structure of the indices to use in the Catch-free model and attempted to reconstruct commercial and recreational fishery removals to enable a stochastic stock-reduction analysis. Both models were presented to the review panel, and the analyses were not accepted for management purposes.