This presentation provides an update on management of the Research Natural Area (RNA) within Dry Tortugas National Park and fisheries research in and around the region. Staff is requesting Commission action to offer its continued concurrence with the National Park Service’s (NPS) Special Regulations prohibiting fishing and anchoring in the RNA. The presentation also includes a discussion on the timeframe for the next review of the regulations and on-going research efforts in the area.

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Unless otherwise noted, images throughout the presentation are by FWC.
In 1992, the Dry Tortugas National Park (DRTO, Park) was established. In 2007, a no-fishing marine reserve known as the Research Natural Area (RNA) was created within the park by the National Park Service (NPS) to protect shallow-water habitats.

Multiple authorities claim jurisdiction in DRTO. The State of Florida, through the Board of Trustees of the Internal Improvement Fund (Trustees) claims jurisdiction over the majority of the sovereignty submerged lands within the park, as they fall within state waters. In addition, FWC claims jurisdiction of regulatory authority over fishery resources within those same state waters. The NPS also claims regulatory authority over the submerged lands and waters of the park.

In order to address these jurisdictional disagreements, the State of Florida and NPS entered into a Submerged Land Management Agreement in 2005. This agreement acknowledged the multiple claims of jurisdiction, and required all entities to concur with NPS’s Special Regulations for the RNA and any subsequent regulatory changes.

Other regulatory entities also have jurisdiction within portions of DRTO and in nearby waters of the Dry Tortugas region. Due to the park’s location (see map on next slide), the Florida Keys National Marine Sanctuary (FKNMS) and the South Atlantic and Gulf of Mexico Fishery Management Councils have additional authorities within the region.

Staff is requesting Commission action to provide continuing FWC concurrence with the fishing and anchoring restrictions established in the RNA in 2007.
As previously stated, the regulatory structure that provides for fisheries management in DRTO and the Dry Tortugas region is complex. FWC regulations apply throughout state waters of the region, and federal fishing regulations established by the Fishery Management Councils apply throughout the region’s federal waters. In addition to those regulations, the NPS has established fishing regulations that apply in all waters of DRTO, including prohibitions throughout the park on: commercial fishing, spearfishing, harvest of lobster, and harvest of Marine Life (tropical ornamental) species. Within the RNA (shown in cross-hatch on the map above), fishing and anchoring are prohibited entirely, per NPS Special Regulations. Additionally, in an effort to protect the coral reef and spawning aggregations located in the Dry Tortugas region, two Tortugas Ecological Reserves were created in 2001 through the FKNMS process. These areas were identified through the FKNMS process as containing high coral cover and important fish spawning aggregation sites such as Riley’s Hump, a multi-species aggregation site located within the Tortugas South Ecological Reserve. All fishing is prohibited within these areas.

While the regulatory structure in the region is complex, the management of fisheries in the Dry Tortugas region provides an excellent example of coordination among government entities toward conservation of our natural resources.

The rest of this presentation will provide historical information about management of the region and the results of scientific research documenting the conservation benefits of the RNA together with the rest of DRTO and the Tortugas Ecological Reserves.
The Tortugas: A Network of Special Places

- Remote location: approximately 70 miles west of Key West
- Near-pristine coral reef ecosystem
- Best water quality throughout the Florida coral reef tract
- High live coral cover and species diversity
  - Some sites within the RNA as high as 30% live stony coral cover

The Dry Tortugas is remotely located nearly 70 miles west of Key West. The RNA, Tortugas Ecological Reserves and other managed areas in the region constitute a network of special places from a fisheries perspective.

This network of special places is home to a near-pristine coral reef ecosystem. Because of its remoteness, it also boasts the best water quality throughout the entire Florida reef tract. It has high live coral cover and a diversity of coral species, with more than 30% live stony coral cover in some areas of the RNA. DRTO is also home to rare and threatened corals, including ESA-listed species like elkhorn coral (*Acropora palmata*), staghorn coral (*Acropora cervicornis*), and their hybrid (*Acropora prolifera*).

In addition to conserving rare and threatened corals, the network of fishing and other regulations that apply in the DRTO region provides for conservation of fishery resources both within and beyond these species places.
Another special characteristic about the Dry Tortugas region is that it is historically known as a spawning aggregation location for a diversity of species, including many economically important species such as mutton snapper, gray snapper, yellowtail snapper, black grouper, and permit. Based on the ocean currents that flow northward to the east or west from the Tortugas, the larvae that are spawned from these aggregations are believed to supply new fish recruits throughout the entire Keys and both coasts of Florida.

Research information gathered in the years since the RNA was implemented regarding species that aggregate for spawning within the Tortugas South Ecological Reserve (Riley’s Hump) will be presented during the research overview portion of this presentation.
The FKNMS was created in 1990, with the designation of DRTO following shortly thereafter in 1992. The creation of the RNA began with a stakeholder working group process convened by the FKNMS and the NPS. This process began in 1998 and brought together scientists, managers, and stakeholders, with the goal of creating an ecological reserve in the Dry Tortugas that balanced the need to protect the biological resources of the region while continuing to provide ample opportunities for marine-related stakeholder activities. The working group received extensive scientific information regarding finfish and spiny lobsters, ocean currents, and locations of well-developed coral reefs. Members of the fishing industry provided information regarding preferred locations for their fishing activities. In 2001, the process resulted in the creation of two deep-water Ecological Reserves in the FKNMS. The working group also recommended creating the RNA to protect shallow-water habitats within the Park. However, because of uncertainty regarding the regulatory authority relating to the ownership of the sovereignty submerged lands between the NPS and the State of Florida, the RNA was not implemented at that time.

The sovereignty submerged lands issue was addressed in August 2005 by the Submerged Land Management Agreement between NPS and Trustees. That agreement stipulated that “the service shall submit for review to the FWC any proposed NPS Special Regulations or amendments thereto.” At the December 2005 Commission meeting, the Commission was briefed on the Management Agreement and the proposed Special Regulations related to the RNA, which included a prohibition on fishing and anchoring. At its February 2006 meeting, the Commission concurred with those regulations.

The Commission also directed staff to create an MOU between FWC and NPS to cooperatively develop and implement a science plan to evaluate the effectiveness of the RNA toward its stated goals. The Commission further stipulated that FWC staff, in cooperation with NPS, draft a three-year interim, and five-year final report summarizing the results of the science plan. This initial MOU was finalized in February 2007 and set to expire in 2012.

In 2012, the Commission re-concurred with the special regulations of the RNA, and the previous MOU was updated and re-signed in 2013. Today, staff are requesting the Commission renew its concurrence with the Special Regulations for the RNA based on the five year timeframe.
The original (2007) MOU was established between FWC and NPS to develop a joint research program within the RNA. The goal of the MOU was to facilitate the management of resources within DRTO. This MOU identified six specific areas of RNA performance to be evaluated. These areas were: 1) to quantify changes in abundance and size-structure of exploited finfish species within the RNA relative to adjacent areas; 2) to monitor the immigration and emigration of targeted finfish species in the RNA; 3) to monitor changes in species composition and catch rates of exploited fish species throughout the surrounding region; 4) to evaluate the effects of the RNA on the bottom habitat; 5) to assess the reproductive potential of exploited fish species; and 6) to incorporate social sciences into the research and monitoring program. As part of the MOU, FWC was to provide a report to the Commission on the status of the RNA every five years.
The RNA Science Plan

- Developed in 2007 to identify, develop, and prioritize projects to satisfy the MOU
- Development included two facilitated meetings with scientists and managers
- Public workshop convened and attended by agency scientists and managers, non-governmental organizations, and stakeholders
- Results of comprehensive 5-year report presented to Commission in 2012
  - Report showed substantial benefits to reef fish biomass, spawning, and nursery habitats

The RNA Science Plan was developed during early 2007 to develop and prioritize specific projects related to the performance topics set forth in the MOU. To ensure that the Science Plan’s activities would be best suited to address those performance topics, the FWC and the NPS facilitated two science coordination meetings that included scientists and managers from the FWC, NPS, the FKNMS, and the United States Geological Survey (USGS). The initial draft of the Science Plan was distributed to agency scientists and to the public for a 30-day review period. Following that review period, a public meeting was held during May 2007 that was attended by agency scientists and managers, representatives of non-governmental organizations, and stakeholders. The comments and the cooperating agencies responses to those comments were included in the final Science Plan document.

As required by the MOU, a summary of a comprehensive five-year report of the Science Plan was presented to the Commission in 2012, which summarized substantial benefits to reef fish biomass, spawning, and nursery habitats.
2012 Commission Direction

- Commission renewed concurrence with the Special Regulations established for the RNA
- Commission directed a new MOU be drafted
  - Continue evaluating performance topics in the Science Plan
  - Requested an additional 5-year report (10 years after the RNA was established) that summarizes research and progress toward the stated goals
- MOU was signed by FWC in April 2013
  - MOU expires in April of 2018
  - Research overview in the next several slides

At the five-year review in 2012, the Commission supported the continuation of the Special Regulations established for the RNA by offering its renewed concurrence. At that time, the Commission also directed a new MOU to be drafted to continue evaluating performance topics in the Science Plan, as well as requested another five-year report summary. That MOU was signed by the FWC in March 2013, and expires in April of 2018. The following slides present an overview of research findings relevant to the performance of the RNA.
Research Report Overview

- This update to the 5-year report focuses on two RNA performance topics:
  - **RNA Topic 1**: Quantify changes in the abundance and size-structure of exploited species within the RNA relative to adjacent areas
    - Status of reef fish populations
  - **RNA Topic 2**: Monitoring the immigration and emigration of targeted species in the RNA
    - Species movement patterns

The RNA Science Plan was developed in 2007 with the goals of evaluating the success of the RNA following its creation. The intent of the Science Plan was to develop long-term studies and monitoring to document existing baseline conditions and analyze how natural resources will respond to the protection provided. The Science Plan called for these studies to be evaluated every five years. Therefore, in 2012, a five-year report provided the first evaluation of the performance of the RNA. The 10-year report summarized in the following slides provides an update for two of the six topics on RNA performance. The selected topics are evaluated using long-term monitoring projects being conducted within the park. The other four topics not addressed in this report, were previously evaluated in the 2012 report that summarized the first 5 years of RNA performance. The selected topics are: 1) quantifying changes in the abundance and size-structure of exploited species within the RNA relative to adjacent areas and 2) monitoring the immigration and emigration of targeted species in the RNA.
This map provides an overview of fishing regulations for management zones found within the Dry Tortugas region. The following slides will present the status of reef fish populations in these management zones.
Spatial abundance maps for three commercially and recreationally important species were created to examine the change in their abundance throughout the Dry Tortugas region over time. The long-term fishery-independent dataset from the reef visual census monitoring program allows us to examine the change in fish populations before and after the implementation of the various protected areas within the Dry Tortugas region. The information shown in these maps only includes the legal-sized fish for each species.

The first species examined is mutton snapper. Mutton snappers are an important recreational and commercial fishery. These maps show the spatial density of mutton snapper from before the implementation of the Tortugas North Ecological Reserve (TNER) (far left) to the most recent surveys in 2016 (far right). Following the implementation of the no-take areas (TNER and RNA), mutton snapper density within the TNER and DRTO (RNA and NCZ combined) has been greater than each respective zone’s baseline value.

The increase in legal-sized mutton snapper density in the TNER and DRTO has coincided with the re-formation of a spawning aggregation located on Riley’s Hump within the Tortugas South Ecological Reserve (TSER). Riley’s Hump and its importance to fisheries in the region will be discussed further, later in this presentation.
Yellowtail snapper also support an economically important fishery in the Florida Keys. Yellowtail snapper exhibited a significant increase in density and occupancy rate after the implementation of the TNER in 2001 and the RNA in 2007. The abundance of legal-sized yellowtail snapper increased first in the TNER and DRTO (RNA and NCZ), and then subsequently increased in adjacent areas that are open to commercial and recreational fishing. The surveys with the highest yellowtail snapper density within the area open to commercial and recreational fishing are located along the boundaries to the TNER and DRTO. This provides evidence of the spillover effect, where nearby fishing locations benefit from fishery conservation measures in adjacent no-fishing zones. An upcoming slide showing yellowtail snapper movement patterns demonstrates that they routinely cross management boundaries in the region.
The hogfish population in the Florida Keys and off east Florida was recently found to be overfished and undergoing overfishing. While the Dry Tortugas are located within this area, the density of legal-sized hogfish has generally increased throughout DRTO (including the RNA) since the implementation of the TNER and RNA. The shallow-water reef habitat within DRTO has typically had the largest densities of legal-sized hogfish, and the 2016 surveys also indicated a large increase in hogfish density within the TNER.

The density of legal-sized hogfish in areas outside of DRTO that are open to commercial and recreational fishing has declined over this same time period, with the most recent surveys indicating that density has decreased below 2000 baseline levels. While recreational hook and line fishing is allowed in the NCZ/HAU, the prohibition of spearfishing in those areas likely contributes to the increasing density of hogfish in that management zone. Spearfishing is allowed in the areas open to commercial and recreational fishing, where densities continue to decline.

Hogfish in DRTO and throughout the region are subject to the recent Gulf and South Atlantic marine fishery councils and FWC regulatory changes intended to end overfishing and rebuild the fishery throughout the range of the stock.
Reef Fish: Hogfish Size Structure

- Hogfish length frequency inside DRTO assessed for three time periods:
  - Pre-implementation of the RNA (2004-2006)
  - Post-implementation of the RNA (2008-2010)
  - Most recent surveys (2014-2016)
- Size structure has shifted toward more legal-sized hogfish following RNA establishment
  - Note: minimum size limit was 12 inches (fork length) during this study, but is now 16 inches
- The RNA provides a special area for hogfish to grow to larger sizes and to reproduce without disruption

The length frequencies of hogfish are pictured, showing the change within the RNA (closed to all fishing) and the NCZ/HAU (recreational hook and line fishing allowed) from pre-implementation of the RNA to the most recent surveys. The proportion of hogfish that were legal-sized has steadily increased within the RNA and the NCZ/HAU. The protection provided by the RNA and NCZ has resulted in the recovery of large hogfish, which likely has increased reproductive output. Hogfish form harems with one male patrolling a small territory with 7-15 females. Hogfish also have high site fidelity, so the no-take zones may be providing stability of these harems. Outside of the protected areas, spearfishing can disrupt the reproductive output of a hogfish harem by continuously removing the large males.

Given that currents in the region likely distribute hogfish larvae to areas north of DRTO, the recovery of hogfish within DRTO (RNA and NCZ) may be an important factor for rebuilding this overfished stock.
In order to understand how fish populations move throughout the greater Dry Tortugas region and to monitor the immigration and emigration of important species in the RNA, an array of 84 underwater listening stations covering approximately 800 km² was deployed throughout the region in cooperation with Mote Marine Lab and the United States Geological Survey. This network can detect fish tagged with acoustically pinging transmitters as they swim nearby. These detections are then used to analyze fish movement patterns and the connectivity between different management areas.
Eighteen yellowtail snapper were tagged with acoustic transmitters during 2008-2009. Of the 18, six yellowtail snapper had enough data to be analyzed. This animation shows an example of the movements of a tagged yellowtail snapper during the summer as it moves across management boundaries. The yellow circle represents a tagged yellowtail snapper. This snapper moved along the reef edge habitat throughout the summer, crossing into areas open to commercial and recreational fishing three times. The areas that this yellowtail snapper frequented the most, the home range, included multiple management zones. All six fish exhibited similar movement behavior along the reef edge habitat and crossed between the RNA and areas open to fishing.
To examine movement patterns of mutton snapper, 55 mutton were acoustically tagged within the Dry Tortugas region from 2008 to 2010. Of the 55, 21 mutton snapper swam repeated migratory tracks to Riley’s Hump within the TSER, with many of these fish making this migration at least twice per year.

This figure shows the movements of one of these mutton snapper from its home site within the RNA to the spawning aggregation in the TSER over the course of one spawning season. The legend at the top of the animation shows how the movements are timed with full moons. These fish appear to stay at the spawning aggregation site for approximately seven days before returning to their home site (which in the case of the fish shown here, was the RNA).
Regional Connectivity of Mutton Snapper

- Of the 21 fish that made repeated migratory trips to the TSER, 12 of them had home sites within the RNA.
- These movements show the complementary nature of the marine reserve network within Dry Tortugas.

Twelve of the tagged mutton snapper had home sites within the RNA. Four of these fish are depicted here. During the time they were tracked, these fish made multiple migrations to the spawning aggregation site in the TSER with one individual making the trip six times over multiple spawning seasons. The blue lines indicate the maximum extent of where the fish was tracked. These fish reside at their home site and spawning site (shaded areas at the end of the migratory route) 95% of the time they were detected.

These movements from the RNA to the spawning aggregation site in the TSER demonstrate a critical ecological link between different management zones in the Dry Tortugas region. These results demonstrate the importance of the need for shallow foraging habitats and deep spawning habitats in the life history of mutton snapper, and demonstrate how this network of marine reserves in the DRTO region provides conservation of the various life history stages of mutton snapper.
Riley’s Hump is a submerged seamount located in the TSER. Since 2008, FWC scientists have been collaborating with researchers from the National Oceanic and Atmospheric Administration, University of Puerto Rico, Florida Atlantic University, National Park Service, Mote Marine Lab, and the Florida Keys National Marine Sanctuary to monitor patterns of fish habitat use within the TSER. Scientists have complemented conventional scuba surveys with specialized tools including remotely operated vehicles, technical divers, wave gliders, splitbeam and multibeam sonars, stereo cameras, and passive acoustic hydrophones to determine how different fish species use the area. Evidence of aggregations of numerous species located within the TSER have been collected using these visual, remote, and acoustic survey techniques.

Research within the DRTO region has documented that several recreationally and commercially important species aggregate in the TSER for the purpose of spawning. These species include mutton snapper, cubera snapper, dog snapper, black grouper, scamp, yellowmouth grouper, and ocean triggerfish.
For the past ten years, researchers have documented aggregations for several species within the TSER. These videos were taken at Riley’s Hump within the TSER. Mutton snapper and ocean triggerfish aggregations were filmed at 100 feet by divers during the full moon. The cubera snapper aggregation was filmed at 200 feet using fixed stereo cameras during the summer spawning season.
Dry Tortugas as a Mating Ground for Nurse Sharks

- Female sharks visit Dry Tortugas every 2-3 years and stay through the winter
- Male nurse sharks annually migrate to DRTO to mate
- Some sharks traveled over 200 miles in 16 days
- Migration patterns suggest that DRTO is a vital mating site on a regional scale

Since 2007, Mote Marine Laboratory has tagged 57 nurse sharks while in the Dry Tortugas region during the months of June and July when mating takes place.

This study revealed migratory behavior that was not previously known for this species. Male sharks visit the mating grounds every year, and leave immediately after mating season. Females visit every two to three years and overwinter in the Dry Tortugas following the mating season. Nurse sharks traveled long distances when they leave the Dry Tortugas. These movements occurred quickly, usually taking a little over two weeks.

This animation shows the movements of two female and one male nurse shark to and from the Dry Tortugas courtship and mating grounds.

These migration patterns and extreme mating site fidelity suggests that the DRTO protects vital mating grounds for nurse sharks.
The RNA and network of reserves in the Dry Tortugas region play a critical role in protecting the future of Florida’s reef fish fisheries. Density and size of many reef fish has increased. The mutton snapper spawning aggregation in the region has recovered. Additional aggregations of species have been discovered. Hogfish spawning potential is increasing. A critical mating site for nurse sharks is protected here.
The key to the success of the Tortugas RNA is enforcement, which is done primarily by FWC.

In addition to the many jurisdictional boundaries in the area, the long distance from the mainland and often rapidly changing weather create additional enforcement challenges in the area. Effective enforcement in the Tortugas often requires extended trips on large vessels. FWC’s patrol vessels boast long range and adverse weather capabilities. The local officers are highly trained, and well versed in the multiple jurisdictions and regulations within the region.
The current MOU between FWC and the NPS will expire in April 2018, but multi-agency research and monitoring efforts will continue in DRTO. If desired by the Commission, a new MOU or general management agreement could be drafted.

According to the Management Agreement between the State of Florida and the NPS, the Trustees require an update from NPS every five years on the status, activities, and conditions of the submerged lands. In anticipation of this report to the Trustees, the FWC is to review any Special Regulations NPS has established. Given the fact that NPS has not proposed any changes to the Special Regulations since they were originally implemented in 2007, and due to the fishery benefits and stability clearly documented in the five- and ten-year research reports, staff propose the Commission increase the time period under which FWC review the on-going research in the RNA and Dry Tortugas region to every 20 years. Staff would return to the Commission sooner for an additional review if the NPS proposes any regulatory changes that require FWC concurrence.
Staff Recommend continuing to concur with the Special Regulations established for the RNA that prohibit fishing and anchoring within the area. Staff also recommend the Commission continue to support the collaborative research conducted by the FWC and NPS to evaluate the performance of the RNA.

Finally, staff recommend increasing the time period for FWC review of the RNA performance to every 20 years.

If the Commission would like to do so, staff recommend a general MOU be signed between the FWC and NPS, instead of another science MOU.