



This is a review and discussion of corals off Florida's coast. This presentation describes FWC efforts to monitor and restore corals, as well as the status of several species of Florida corals that have been listed as threatened under the Endangered Species Act.

FWC research efforts have been important in understanding corals and investigating techniques to help in restoration. Corals and associated reefs are very important to south Florida. Protecting these areas is one of the major focal areas of the Florida Keys National Marine Sanctuary, which will be mentioned in the next presentation.

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Importance of Coral Reefs to Florida

- Support recreational and commercial fisheries
 - Critical habitat for fish and invertebrates
- Support high-value ecotourism
- Protect coastlines from erosion



Florida's coral reefs create habitat to support a high diversity of organisms, including many important recreational and commercial fisheries species like spiny lobster, grouper, and marine life. Coral reefs are also economically important to Florida as a source of ecotourism for SCUBA divers, snorkelers, fishermen, and boaters. Our barrier reef system also protects shorelines from erosion by absorbing wave energy created during hurricanes and storm events. According to the National Oceanic and Atmospheric Administration (NOAA), coral reefs in southeast Florida have an asset value of \$8.5 billion, and generate billions of dollars to the local economy and support 70,400 full and part-time jobs.

FWC Coral Research Program Goals

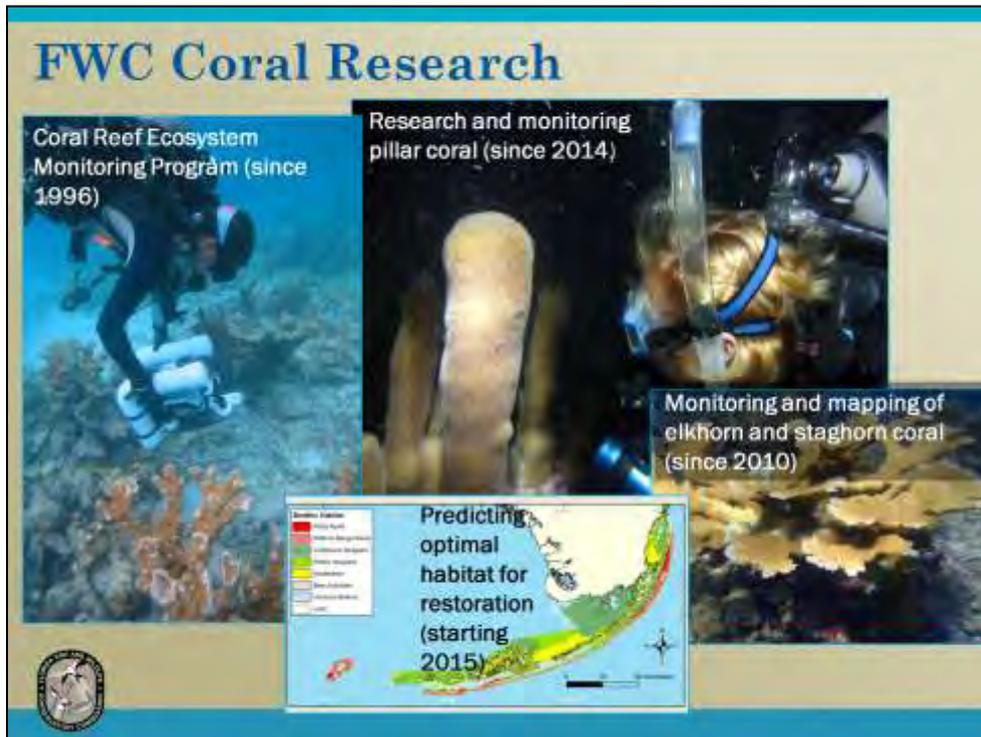
- Annually monitor the coral reef ecosystem to document health and trends
- Conduct research to better understand why corals are declining in Florida



FWC's Coral Research Program annually monitors Florida's coral reef ecosystem to document health and trends, and conducts research to better understand why corals are declining in Florida.

This research includes:

- 1) long-term monitoring of the Florida Reef Tract (from Palm Beach County to Dry Tortugas National Park), and
- 2) targeted research, including documenting population dynamics, spawning, and genetic diversity of Endangered Species Act (ESA) and State of Florida listed coral species; conducting research on a disease that is currently affecting octocorals; and tracking coral recruitment along the Florida Reef Tract.



Our main grant-funded projects include:

- 1) The Coral Reef Evaluation and Monitoring Program (CREMP), which has been surveying the same reef sites along the Florida Reef Tract since 1996,
- 2) Elkhorn and staghorn coral monitoring since 2010,
- 3) Pillar coral monitoring and population genetics projects started this year, and
- 4) A new project to predict optimal habitats for restoration that will begin this winter.

FWC Coral Restoration Program Goals

- Propagating and growing listed corals to enhance existing populations
- Rebuilding reef structure to restore critical fishery habitat
- Restoring habitat of other reef-dwelling species critical to coral reef health



Our present research projects include propagating genetically diverse colonies of staghorn coral, which is listed as threatened under the Endangered Species Act. We are outplanting these corals along the Florida Keys reef tract to identify and refine techniques that will maximize their survival and growth. We are also testing coral outplanting strategies designed to restore both critical fishery habitat and to restore habitat for other reef-dwelling organisms vital to the health of coral reefs. For example, we have started a study to design staghorn coral outplanting techniques to enhance the survival of the long-spined sea urchin. This sea urchin is vital to a healthy coral reef ecosystem because it eats algae that impact corals. Populations of this sea urchin declined dramatically in the 1980s and have not recovered. Using outplanted corals to enhance shelter and survival of this sea urchin will benefit not only these two species, but the health of the entire coral reef ecosystem.

Also, the FWC Coral Reef Restoration Research Program is developing in collaboration with researchers and restoration practitioners a document that will outline a coral reef ecosystem restoration research strategy that will be used by FWC's State Wildlife Grants Program to prioritize coral reef restoration research in the coming years.

FWC Coral Reef Restoration



The photograph on the left of this slide shows our staghorn coral nursery in the middle Florida Keys. These corals are grown on artificial “trees”. When they are large enough, they are moved and attached to the ocean bottom using epoxy. The remaining photographs show some of the different coral outplanting designs we have used and our artificial long-spined sea urchin shelters.

Threats to Florida's Corals

- Disease
- Temperature extremes
 - Bleaching
- Loss of dominant herbivore (urchin)
- Predation on corals
- Direct human impacts
- Water quality/Pollution
- Storms
- Ocean acidification
- Sedimentation



Corals are threatened by a multitude of biological and physical stressors, which have contributed to the severe declines in abundance of ESA Listed Coral species (as much as 98% for species such as elkhorn and staghorn). FWC staff currently collect disease occurrence and temperature-induced bleaching data during coral surveys. Staff are also working to document long-spined sea urchin occurrence as well as conduct research to increase the abundance of this once-dominant herbivore. Certain species of corals, such as elkhorn and staghorn, are experiencing elevated predation rates as coral population numbers have declined. Reefs are also affected by direct and indirect human impacts, such as physical damage from anchors, boat groundings, and traps, as well as polluted water and run-off from shore. Reefs are also threatened by increasingly severe storm events, ocean acidification, and sedimentation from storm events or coastal development.

Management Status of Corals in Florida

- Harvest of corals prohibited in Florida since 1976 and adjacent federal waters since 1982
- 2006 – elkhorn and staghorn corals listed as threatened under Endangered Species Act
- 2014 – five coral species that occur in Florida recently ESA-listed as threatened

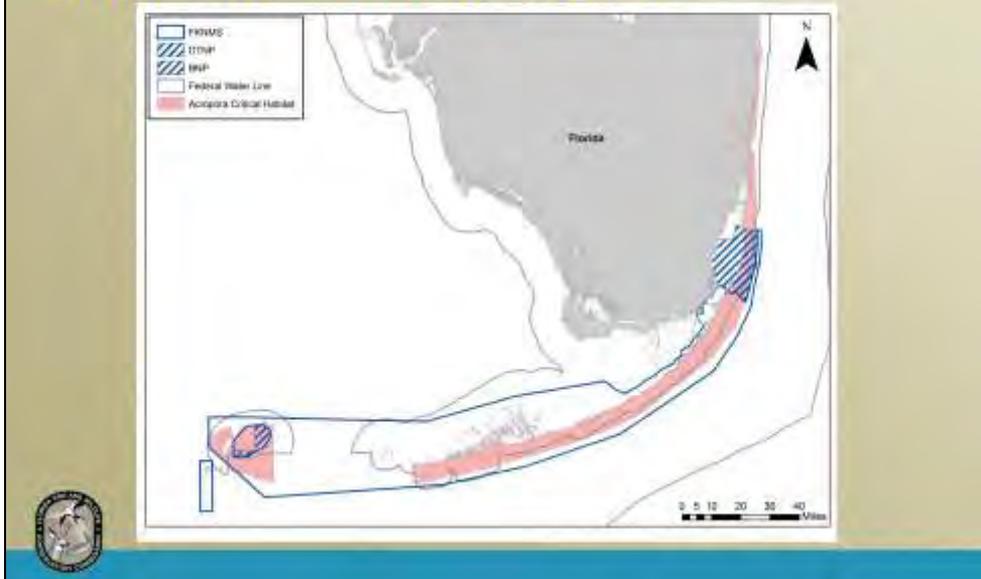


Because of the various threats to coral populations, harvest of corals has been prohibited in state waters since 1976 and adjacent federal waters since 1982. In 2006, elkhorn and staghorn corals (*Acropora palmata* and *Acropora cervicornis*), which occur in Florida and the Caribbean, were listed as threatened under the Endangered Species Act (ESA) in response to population declines. Because these two species are federally listed, they are also included on Florida's imperiled species list. Earlier this year, NOAA listed five additional coral species found in Florida waters as threatened under the ESA:

- Pillar coral (*Dendrogyra cylindrus*)
- Lobed star coral (*Orbicella annularis*)
- Mountainous star coral (*Orbicella faveolata*)
- Boulder star coral (*Orbicella franksi*)
- Rough cactus coral (*Mycetophyllia ferox*)

These listings resulted from NOAA Fisheries' consideration of a petition to list 83 coral species from around the world (seven from the Caribbean/Florida) under the ESA. Reclassification of elkhorn and staghorn corals to endangered status was also considered as part of this listing decision, but these species will remain listed as threatened. Pillar coral is already listed as a state-designated threatened species. Because listing from NOAA does not automatically trigger regulations, it is important to work cooperatively with federal, state, and local entities to accomplish recovery of these species.

All Listed Corals Occur in Both State and Federal Waters



All seven of the listed coral species occur in both state and federal waters off Florida. The pink areas on the map above indicate surveyed areas of the Florida Reef Tract where these coral species are known to occur. These corals also likely occur in waters between Key West and the Dry Tortugas as well as in the Tortugas North and South Ecological Reserves; however, these areas have not been formally surveyed.

The Florida Keys National Marine Sanctuary (Sanctuary) is outlined in blue on this map. The Sanctuary is considering special management areas to protect large stands of these corals that occur within Sanctuary boundaries as part of its regulatory review process.

Next Steps

- Continue FWRI coral ecosystem research and restoration
- Listings may evoke changes in management to protect these important corals
- FWC staff engaging in continued evaluation of federal and state management options
- Federal Councils and Florida Keys National Marine Sanctuary also involved in coral management



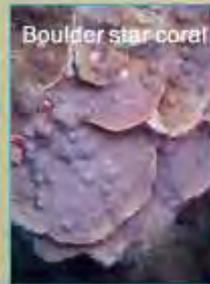
The ESA process for these coral species is just beginning, but FWC staff will stay engaged as it progresses. In the future, additional management actions could be needed at the state and federal levels to limit fishery interactions with corals. The South Atlantic and Gulf Councils, as well as the Florida Keys National Marine Sanctuary will also be involved in this process since these corals occur in their jurisdictions. Staff will keep the Commission apprised of any proposed management changes as they are developed.

The Sanctuary is an important partner and many stakeholders have been working on recommended changes to Sanctuary regulations and zone management, some of which could be helpful in protecting coral ecosystems. The Sanctuary's Superintendent will give a presentation on their ongoing regulatory review process.

The following slides are considered backup material and are not anticipated to be part of the Commission meeting presentation



Corals Federally-listed as Threatened under the ESA



Staghorn & Elkhorn Coral

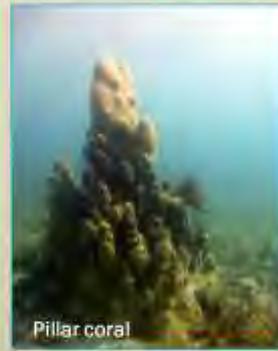
Listed as Threatened under the ESA in 2006

- Occur in shallow reef habitats
 - Staghorn coral - 0-100 ft
 - Elkhorn coral - prefer depths < 20 ft
- Important species for reef growth and fish habitat
- Since 1980, populations have collapsed
 - Staghorn - declines up to 98%
 - Elkhorn - declines of 90-95% where quantified



Pillar Coral

- Occurs on shallow reef habitat 3-80 ft; most commonly 15-50 ft
- Infrequently encountered in FL; population likely declining
- Broadcast spawner with low reproductive potential; no juvenile corals encountered in surveys 1999-2009
- Susceptible to disease and bioerosion
- State-designated Threatened Species



Star Corals

- Occur in shallow and intermediate reef habitat 3-275 ft; most abundant 3-30 ft
- Grow in columns, mounds, or large boulders up to ~5 feet in diameter
- Slow growing, long-lived species
- Broadcast spawners; low recruitment rate
- Life history limits scope of recovery



Rough Cactus Coral



- Occurs at depths from 15-100 ft; more abundant from 30-70 ft
- Particularly sensitive to bleaching; localized mass mortalities from disease and bleaching since the mid-1970s
- Reproduction - a “brooder”
 - Fertilized eggs retained by the parent until they are well developed, usually settle immediately upon release
 - Appear to fair better than broadcast spawning corals during adverse conditions, but limits dispersal

