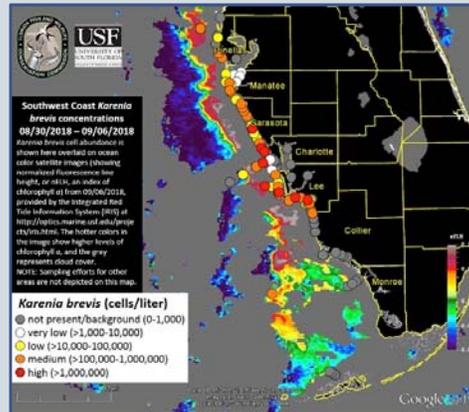


Red Tide Update



Review and Discussion
September 26, 2018



Florida Fish and Wildlife Conservation Commission

Review and discussion of red tide bloom in the Gulf of Mexico that began in November 2017.

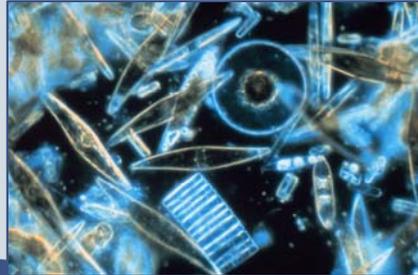
Outline

- What is red tide?
- Ongoing efforts
- Current red tide
- Monitoring and tracking
- Fish and wildlife impacts
- Moving forward and management of red tide
- Staff recommendation



Marine Algae (Phytoplankton)

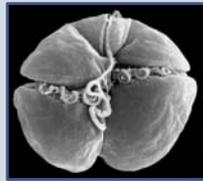
- Form the base of the food web
- Produce half of all the oxygen we breathe
- All require light, nutrients, and species-specific environmental conditions
- Harmful algal blooms form when certain algae become unusually abundant
 - Produce toxins
 - Decaying blooms create low dissolved oxygen conditions



Marine algae are fundamentally important to marine food webs and life on earth. While all algae require light and nutrients, certain environmental conditions can favor one species or type of algae over another.

What is Red Tide?

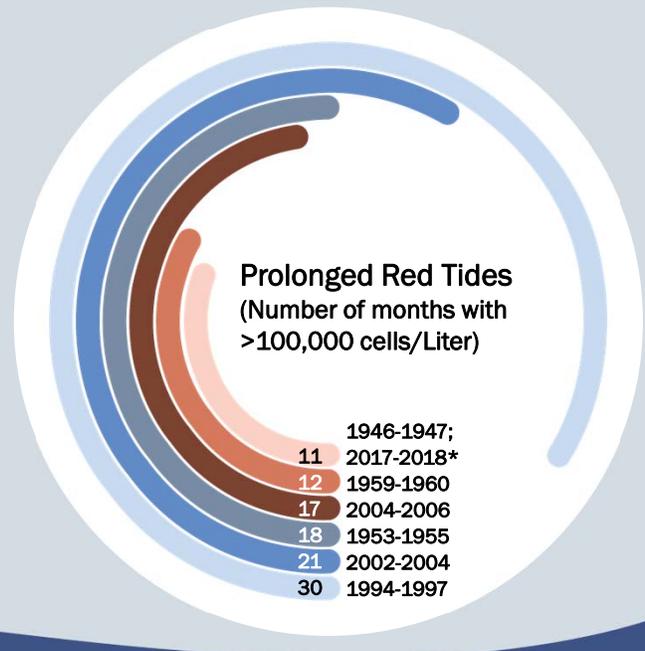
- Produces toxins that kill fish, birds, sea turtles, manatees, dolphins
- Filter feeding shellfish (clams, oysters, mussels) accumulate toxin and can cause Neurotoxic Shellfish Poisoning (NSP) in humans
- Toxin is carried in aerosol form in sea spray and causes respiratory irritation in humans
- Large fish kills on beaches create aesthetic problems, economic losses, and high clean up costs



Red tide is a bloom of a particular marine algae known as *Karenia brevis*. Red tide blooms produce toxins that kill fish, birds, sea turtles, manatees, and dolphins. Filter feeding shellfish (clams, oysters, mussels) accumulate toxin and can cause Neurotoxic Shellfish Poisoning (NSP) in human consumers. Toxin is carried in aerosol form in sea spray and causes respiratory irritation in humans on beaches and near the coast. Massive fish kills on beaches create aesthetic problems, economic losses and high clean up costs

Red Tide History

- Red tide is a natural event that occurs nearly every year
- Anecdotal reports from Spanish explorers in 16th century
- First documented in Florida in 1844
- Prolonged red tides less frequent



*Event in Progress

Red tides are a naturally occurring event. They happen almost every year in Florida. Severe prolonged red tides are less common.

Marine Blooms: Red Tide

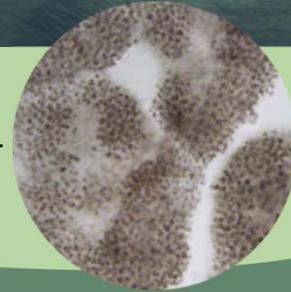
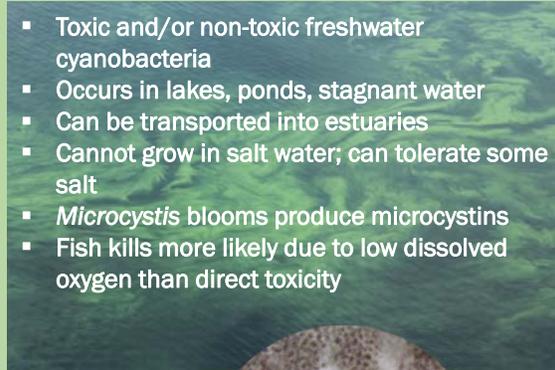
- Starts 10-40 miles offshore
- Occurs in estuaries, along coasts, and offshore in the Gulf of Mexico
- Cannot grow in freshwater; can tolerate brackish conditions
- Produces suite of neurotoxins called brevetoxins
 - Known impacts on marine wildlife
 - Human respiratory impacts
 - Shellfish harvest areas closures



Toxic marine dinoflagellate
Karenia brevis

Freshwater Blooms: Blue-green algae

- Toxic and/or non-toxic freshwater cyanobacteria
- Occurs in lakes, ponds, stagnant water
- Can be transported into estuaries
- Cannot grow in salt water; can tolerate some salt
- *Microcystis* blooms produce microcystins
- Fish kills more likely due to low dissolved oxygen than direct toxicity

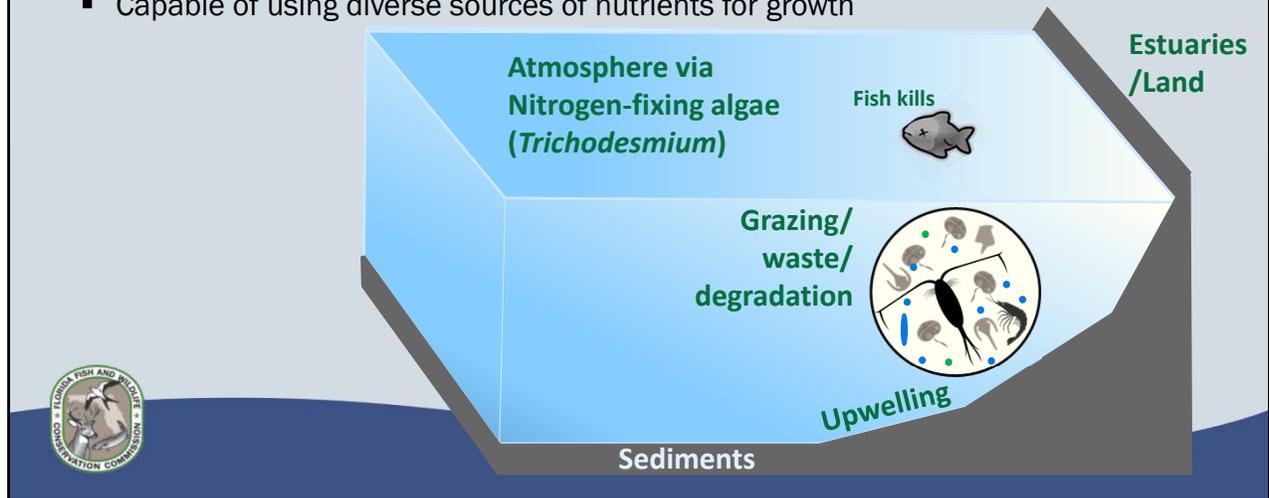


Toxic freshwater cyanobacterium
Microcystis

Red tide and blue green algae blooms do not occur in the same waters but some of their impacts are similar.

Red Tide is Ecologically Flexible

- Broad salinity and temperature tolerance
- Cannot live in freshwater
- Capable of using diverse sources of nutrients for growth



Red tide (*Karenia brevis*) is an opportunistic species capable of using multiple nutrient sources in complex ways. Blooms of *Karenia brevis* initiate near the ocean bottom in areas on the mid West Florida Continental Shelf and are transported to the coastal ocean via bottom waters. On the inner shelf, cells migrate to the surface and are transported nearshore through physical forces (winds, currents, waves). Throughout bloom development on the shelf, multiple sources of nitrogen and phosphorus nutrients are available to cells.

Where Does Red Tide Occur in Florida?

- Initiate offshore in the Gulf of Mexico, deep waters
- Transported inshore with upwelling and winds
- Most common in southwest Florida
- Atlantic can be impacted if blooms are transported to the east coast
- Other Gulf states and Mexico can also be affected



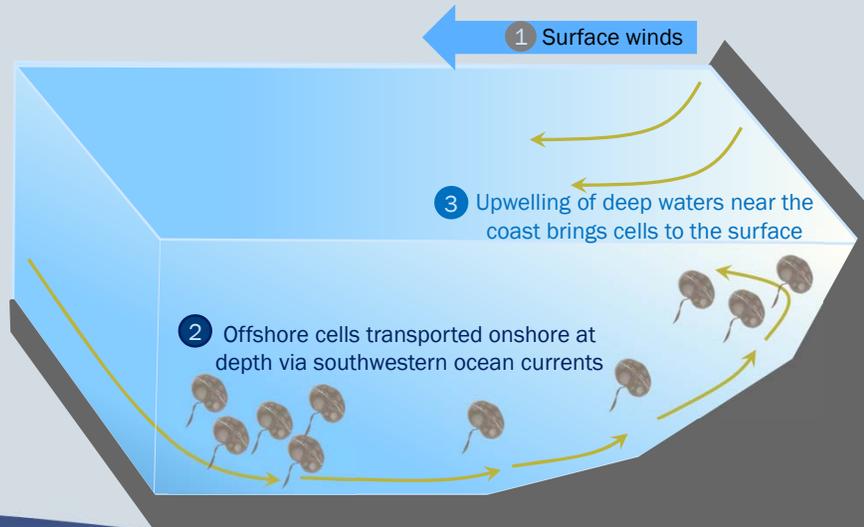
Number of years with documented blooms (≥100,000 cells/L) since 1953 (66 years)



Red tides form offshore in the Gulf of Mexico. They are most common in Southwest Florida where they occur almost every year. They are less common on the Atlantic Coast since this only occurs when red tide blooms are transported out of the Gulf by currents to the east coast.

Initiation of Red Tides

- Blooms initiate 10-40 miles offshore at depth
- Position and intensity of offshore currents during summer/fall play a roll



Although coastal blooms occur nearly every year in Southwest Florida, red tide blooms are most common offshore. An initiation zone 10-40 miles offshore, is hypothesized to feed red tide blooms. This schematic shows the processes involved with bloom initiation. Surface winds and southwest currents at depth create upwelling conditions that transport red tide cells to the surface.

Ongoing Efforts

- Scope and scale of bloom is a tremendous challenge
- Ongoing work to develop possible treatment approaches at small scales (e.g., ozone, clay, hydrogen peroxide, enzymes)
- Will work with partners to continue to explore ways to mitigate
 - Mitigate effects by monitoring, protecting public health, and reducing economic losses



Well established red tides can occur over very large areas, making treatment and control options impractical. Several options are being explored to treat and control the effects of red tide at smaller scales.

Roles and Responsibilities



- Monitoring of water and shellfish, daily reporting to stakeholders and public, fish and wildlife impacts



- Water quality monitoring; control and mitigation techniques; support for counties on clean-ups



- Shellfish harvesting area closures (formal partnership with FWC through Biotxin Contingency Plan)



- County & state levels: sampling, signage, coordination of health related actions, information dissemination



Multiple state agencies are involved in red tide response.

Roles and Responsibilities



- Routine & event response monitoring, partnership between FWC and Mote (cooperative program)
- Control and mitigation options
- NOAA Harmful Algal Bloom Operational Forecasting System (NOAA HAB OFS) – reports likelihood of respiratory irritation for FL counties based on FWC data
- USF College of Marine Science Center for Prediction of Red Tides (CPR) – forecasts of bloom movement
- Optical Oceanography Laboratory – satellite images to detect surface blooms



FWC has a number of key partners in red tide response

Current Red Tide

Nov. 2017: Began in southwest Florida

- Persisted mainly in Charlotte and Lee counties until May 2018

June-July 2018: High concentrations spread south to Collier and north to Sarasota and Manatee counties

Aug. 2018: Gov. Scott declared state of emergency for red tide in southwest Florida

Aug.-Sept. 2018: High concentrations detected from Collier to Pinellas counties

Blooms are patchy and there is local variation in red tide severity and effects



Sequence of red tide concentrations from November 2017-September 2018. Several factors likely have contributed to this bloom persisting as long as it has. Strong cross-shelf and vertical fronts have contributed to bloom maintenance and north/south transport, rather than dispersion, of cells.

Current Red Tide

Nov. 2017: Began in southwest Florida

- Persisted mainly in Charlotte and Lee counties until May 2018

June-July 2018: High concentrations spread south to Collier and north to Sarasota and Manatee counties

Aug. 2018: Gov. Scott declared state of emergency for red tide in southwest Florida

Aug.-Sept. 2018: High concentrations detected from Collier to Pinellas counties

Blooms are patchy and there is local variation in red tide severity and effects



Sequence of red tide concentrations from November 2017-September 2018. Several factors likely have contributed to this bloom persisting as long as it has. Strong cross-shelf and vertical fronts have contributed to bloom maintenance and north/south transport, rather than dispersion, of cells.

Current Red Tide

Nov. 2017: Began in southwest Florida

- Persisted mainly in Charlotte and Lee counties until May 2018

June-July 2018: High concentrations spread south to Collier and north to Sarasota and Manatee counties

Aug. 2018: Gov. Scott declared state of emergency for red tide in southwest Florida

Aug.-Sept. 2018: High concentrations detected from Collier to Pinellas counties

Blooms are patchy and there is local variation in red tide severity and effects



Sequence of red tide concentrations from November 2017-September 2018. Several factors likely have contributed to this bloom persisting as long as it has. Strong cross-shelf and vertical fronts have contributed to bloom maintenance and north/south transport, rather than dispersion, of cells.

Current Red Tide

Nov. 2017: Began in southwest Florida

- Persisted mainly in Charlotte and Lee counties until May 2018

June-July 2018: High concentrations spread south to Collier and north to Sarasota and Manatee counties

Aug. 2018: Gov. Scott declared state of emergency for red tide in southwest Florida

Aug.-Sept. 2018: High concentrations detected from Collier to Pinellas counties

Blooms are patchy and there is local variation in red tide severity and effects



Sequence of red tide concentrations from November 2017-September 2018. Several factors likely have contributed to this bloom persisting as long as it has. Strong cross-shelf and vertical fronts have contributed to bloom maintenance and north/south transport, rather than dispersion, of cells.

Current Red Tide

Nov. 2017: Began in southwest Florida

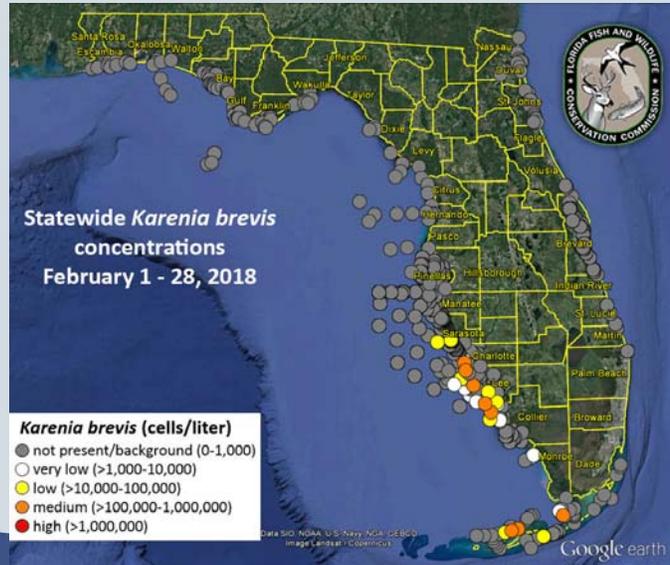
- Persisted mainly in Charlotte and Lee counties until May 2018

June-July 2018: High concentrations spread south to Collier and north to Sarasota and Manatee counties

Aug. 2018: Gov. Scott declared state of emergency for red tide in southwest Florida

Aug.-Sept. 2018: High concentrations detected from Collier to Pinellas counties

Blooms are patchy and there is local variation in red tide severity and effects



Sequence of red tide concentrations from November 2017-September 2018. Several factors likely have contributed to this bloom persisting as long as it has. Strong cross-shelf and vertical fronts have contributed to bloom maintenance and north/south transport, rather than dispersion, of cells.

Current Red Tide

Nov. 2017: Began in southwest Florida

- Persisted mainly in Charlotte and Lee counties until May 2018

June-July 2018: High concentrations spread south to Collier and north to Sarasota and Manatee counties

Aug. 2018: Gov. Scott declared state of emergency for red tide in southwest Florida

Aug.-Sept. 2018: High concentrations detected from Collier to Pinellas counties

Blooms are patchy and there is local variation in red tide severity and effects



Sequence of red tide concentrations from November 2017-September 2018. Several factors likely have contributed to this bloom persisting as long as it has. Strong cross-shelf and vertical fronts have contributed to bloom maintenance and north/south transport, rather than dispersion, of cells.

Current Red Tide

Nov. 2017: Began in southwest Florida

- Persisted mainly in Charlotte and Lee counties until May 2018

June-July 2018: High concentrations spread south to Collier and north to Sarasota and Manatee counties

Aug. 2018: Gov. Scott declared state of emergency for red tide in southwest Florida

Aug.-Sept. 2018: High concentrations detected from Collier to Pinellas counties

Blooms are patchy and there is local variation in red tide severity and effects



Sequence of red tide concentrations from November 2017-September 2018. Several factors likely have contributed to this bloom persisting as long as it has. Strong cross-shelf and vertical fronts have contributed to bloom maintenance and north/south transport, rather than dispersion, of cells.

Current Red Tide

Nov. 2017: Began in southwest Florida

- Persisted mainly in Charlotte and Lee counties until May 2018

June-July 2018: High concentrations spread south to Collier and north to Sarasota and Manatee counties

Aug. 2018: Gov. Scott declared state of emergency for red tide in southwest Florida

Aug.-Sept. 2018: High concentrations detected from Collier to Pinellas counties

Blooms are patchy and there is local variation in red tide severity and effects



Sequence of red tide concentrations from November 2017-September 2018. Several factors likely have contributed to this bloom persisting as long as it has. Strong cross-shelf and vertical fronts have contributed to bloom maintenance and north/south transport, rather than dispersion, of cells.

Current Red Tide

Nov. 2017: Began in southwest Florida

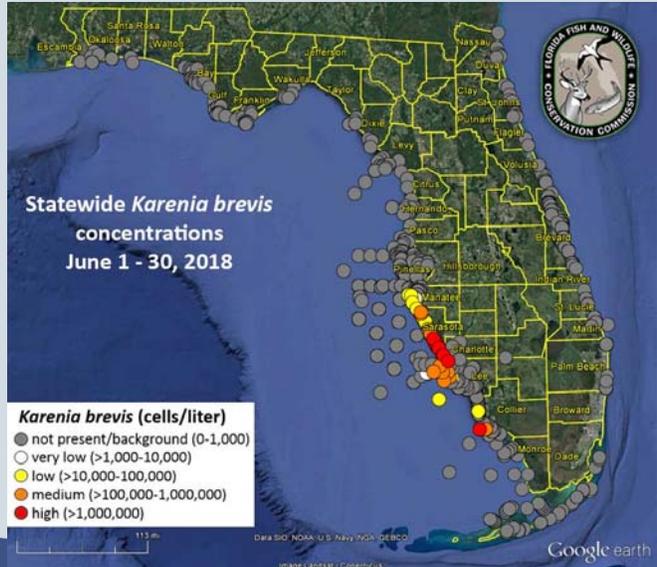
- Persisted mainly in Charlotte and Lee counties until May 2018

June-July 2018: High concentrations spread south to Collier and north to Sarasota and Manatee counties

Aug. 2018: Gov. Scott declared state of emergency for red tide in southwest Florida

Aug.-Sept. 2018: High concentrations detected from Collier to Pinellas counties

Blooms are patchy and there is local variation in red tide severity and effects



Sequence of red tide concentrations from November 2017-September 2018. Several factors likely have contributed to this bloom persisting as long as it has. Strong cross-shelf and vertical fronts have contributed to bloom maintenance and north/south transport, rather than dispersion, of cells.

Current Red Tide

Nov. 2017: Began in southwest Florida

- Persisted mainly in Charlotte and Lee counties until May 2018

June-July 2018: High concentrations spread south to Collier and north to Sarasota and Manatee counties

Aug. 2018: Gov. Scott declared state of emergency for red tide in southwest Florida

Aug.-Sept. 2018: High concentrations detected from Collier to Pinellas counties

Blooms are patchy and there is local variation in red tide severity and effects



Sequence of red tide concentrations from November 2017-September 2018. Several factors likely have contributed to this bloom persisting as long as it has. Strong cross-shelf and vertical fronts have contributed to bloom maintenance and north/south transport, rather than dispersion, of cells.

Current Red Tide

Nov. 2017: Began in southwest Florida

- Persisted mainly in Charlotte and Lee counties until May 2018

June-July 2018: High concentrations spread south to Collier and north to Sarasota and Manatee counties

Aug. 2018: Gov. Scott declared state of emergency for red tide in southwest Florida

Aug.-Sept. 2018: High concentrations detected from Collier to Pinellas counties

Blooms are patchy and there is local variation in red tide severity and effects



Sequence of red tide concentrations from November 2017-September 2018. Several factors likely have contributed to this bloom persisting as long as it has. Strong cross-shelf and vertical fronts have contributed to bloom maintenance and north/south transport, rather than dispersion, of cells.

Current Red Tide

Nov. 2017: Began in southwest Florida

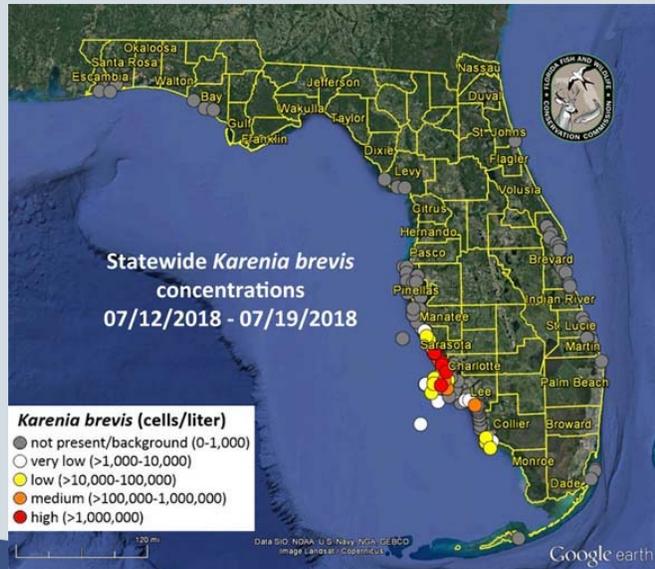
- Persisted mainly in Charlotte and Lee counties until May 2018

June-July 2018: High concentrations spread south to Collier and north to Sarasota and Manatee counties

Aug. 2018: Gov. Scott declared state of emergency for red tide in southwest Florida

Aug.-Sept. 2018: High concentrations detected from Collier to Pinellas counties

Blooms are patchy and there is local variation in red tide severity and effects



Sequence of red tide concentrations from November 2017-September 2018. Several factors likely have contributed to this bloom persisting as long as it has. Strong cross-shelf and vertical fronts have contributed to bloom maintenance and north/south transport, rather than dispersion, of cells.

Current Red Tide

Nov. 2017: Began in southwest Florida

- Persisted mainly in Charlotte and Lee counties until May 2018

June-July 2018: High concentrations spread south to Collier and north to Sarasota and Manatee counties

Aug. 2018: Gov. Scott declared state of emergency for red tide in southwest Florida

Aug.-Sept. 2018: High concentrations detected from Collier to Pinellas counties

Blooms are patchy and there is local variation in red tide severity and effects



Sequence of red tide concentrations from November 2017-September 2018. Several factors likely have contributed to this bloom persisting as long as it has. Strong cross-shelf and vertical fronts have contributed to bloom maintenance and north/south transport, rather than dispersion, of cells.

Current Red Tide

Nov. 2017: Began in southwest Florida

- Persisted mainly in Charlotte and Lee counties until May 2018

June-July 2018: High concentrations spread south to Collier and north to Sarasota and Manatee counties

Aug. 2018: Gov. Scott declared state of emergency for red tide in southwest Florida

Aug.-Sept. 2018: High concentrations detected from Collier to Pinellas counties

Blooms are patchy and there is local variation in red tide severity and effects



Sequence of red tide concentrations from November 2017-September 2018. Several factors likely have contributed to this bloom persisting as long as it has. Strong cross-shelf and vertical fronts have contributed to bloom maintenance and north/south transport, rather than dispersion, of cells.

Current Red Tide

Nov. 2017: Began in southwest Florida

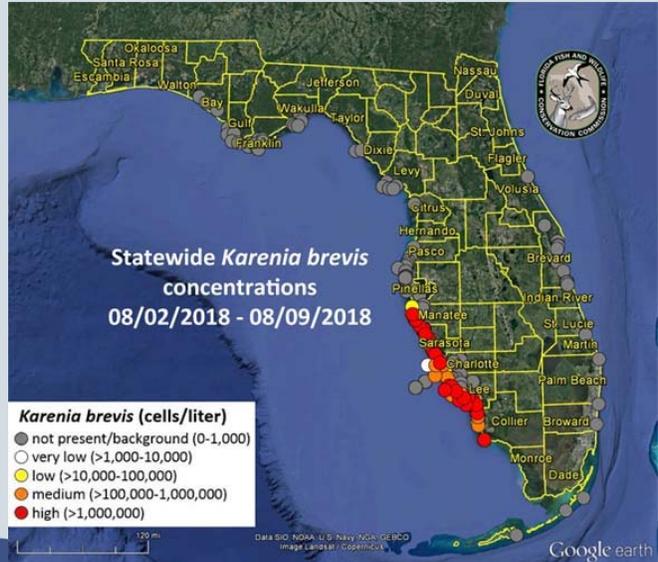
- Persisted mainly in Charlotte and Lee counties until May 2018

June-July 2018: High concentrations spread south to Collier and north to Sarasota and Manatee counties

Aug. 2018: Gov. Scott declared state of emergency for red tide in southwest Florida

Aug.-Sept. 2018: High concentrations detected from Collier to Pinellas counties

Blooms are patchy and there is local variation in red tide severity and effects



Sequence of red tide concentrations from November 2017-September 2018. Several factors likely have contributed to this bloom persisting as long as it has. Strong cross-shelf and vertical fronts have contributed to bloom maintenance and north/south transport, rather than dispersion, of cells.

Current Red Tide

Nov. 2017: Began in southwest Florida

- Persisted mainly in Charlotte and Lee counties until May 2018

June-July 2018: High concentrations spread south to Collier and north to Sarasota and Manatee counties

Aug. 2018: Gov. Scott declared state of emergency for red tide in southwest Florida

Aug.-Sept. 2018: High concentrations detected from Collier to Pinellas counties

Blooms are patchy and there is local variation in red tide severity and effects



Sequence of red tide concentrations from November 2017-September 2018. Several factors likely have contributed to this bloom persisting as long as it has. Strong cross-shelf and vertical fronts have contributed to bloom maintenance and north/south transport, rather than dispersion, of cells.

Current Red Tide

Nov. 2017: Began in southwest Florida

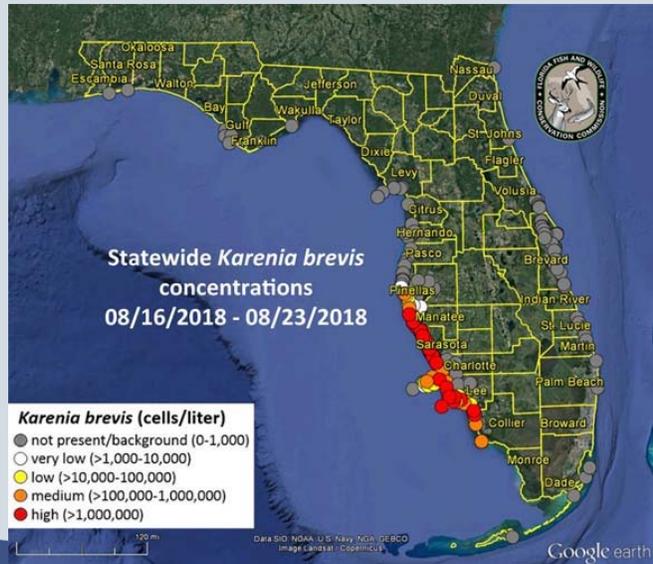
- Persisted mainly in Charlotte and Lee counties until May 2018

June-July 2018: High concentrations spread south to Collier and north to Sarasota and Manatee counties

Aug. 2018: Gov. Scott declared state of emergency for red tide in southwest Florida

Aug.-Sept. 2018: High concentrations detected from Collier to Pinellas counties

Blooms are patchy and there is local variation in red tide severity and effects



Sequence of red tide concentrations from November 2017-September 2018. Several factors likely have contributed to this bloom persisting as long as it has. Strong cross-shelf and vertical fronts have contributed to bloom maintenance and north/south transport, rather than dispersion, of cells.

Current Red Tide

Nov. 2017: Began in southwest Florida

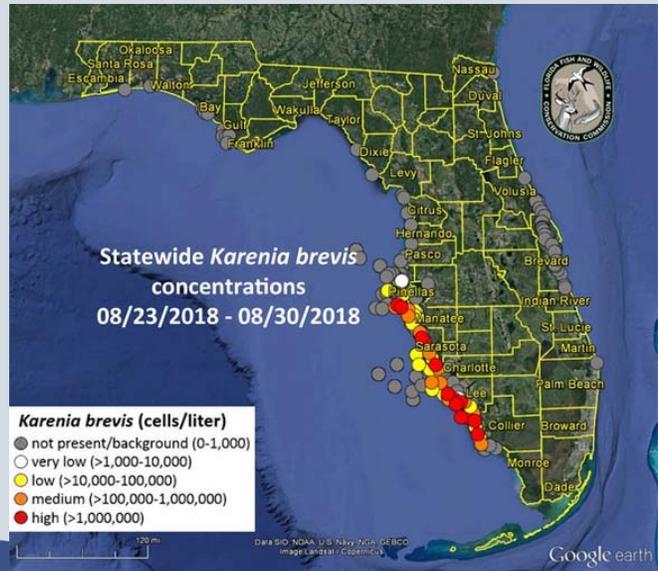
- Persisted mainly in Charlotte and Lee counties until May 2018

June-July 2018: High concentrations spread south to Collier and north to Sarasota and Manatee counties

Aug. 2018: Gov. Scott declared state of emergency for red tide in southwest Florida

Aug.-Sept. 2018: High concentrations detected from Collier to Pinellas counties

Blooms are patchy and there is local variation in red tide severity and effects



Sequence of red tide concentrations from November 2017-September 2018. Several factors likely have contributed to this bloom persisting as long as it has. Strong cross-shelf and vertical fronts have contributed to bloom maintenance and north/south transport, rather than dispersion, of cells.

Current Red Tide

Nov. 2017: Began in southwest Florida

- Persisted mainly in Charlotte and Lee counties until May 2018

June-July 2018: High concentrations spread south to Collier and north to Sarasota and Manatee counties

Aug. 2018: Gov. Scott declared state of emergency for red tide in southwest Florida

Aug.-Sept. 2018: High concentrations detected from Collier to Pinellas counties

Blooms are patchy and there is local variation in red tide severity and effects



Sequence of red tide concentrations from November 2017-September 2018. Several factors likely have contributed to this bloom persisting as long as it has. Strong cross-shelf and vertical fronts have contributed to bloom maintenance and north/south transport, rather than dispersion, of cells.

Current Red Tide

Nov. 2017: Began in southwest Florida

- Persisted mainly in Charlotte and Lee counties until May 2018

June-July 2018: High concentrations spread south to Collier and north to Sarasota and Manatee counties

Aug. 2018: Gov. Scott declared state of emergency for red tide in southwest Florida

Aug.-Sept. 2018: High concentrations detected from Collier to Pinellas counties

Blooms are patchy and there is local variation in red tide severity and effects



Sequence of red tide concentrations from November 2017-September 2018. Several factors likely have contributed to this bloom persisting as long as it has. Strong cross-shelf and vertical fronts have contributed to bloom maintenance and north/south transport, rather than dispersion, of cells.

Current Red Tide

Nov. 2017: Began in southwest Florida

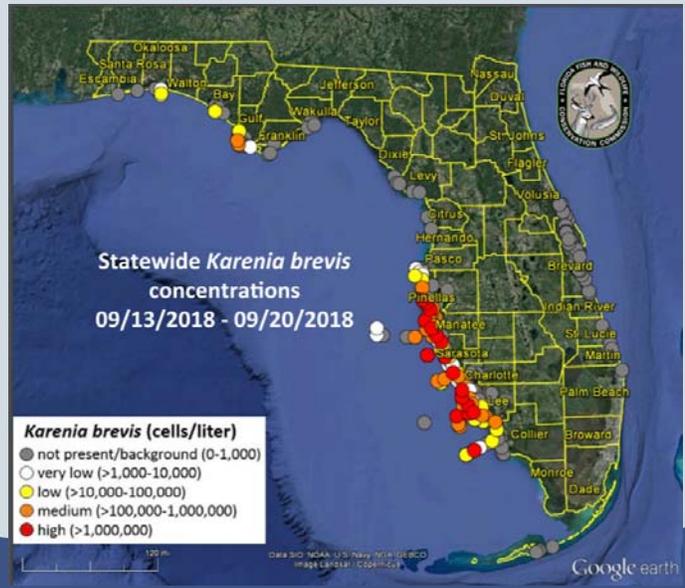
- Persisted mainly in Charlotte and Lee counties until May 2018

June-July 2018: High concentrations spread south to Collier and north to Sarasota and Manatee counties

Aug. 2018: Gov. Scott declared state of emergency for red tide in southwest Florida

Aug.-Sept. 2018: High concentrations detected from Collier to Pinellas counties

Blooms are patchy and there is local variation in red tide severity and effects

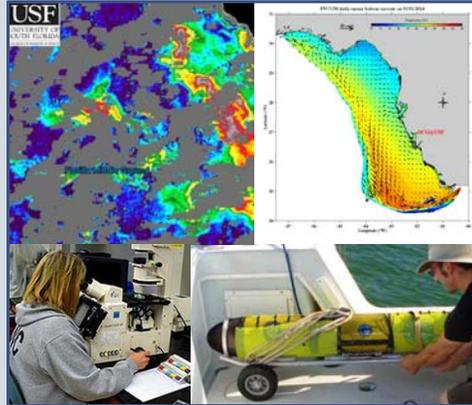


Sequence of red tide concentrations from November 2017-September 2018. Several factors likely have contributed to this bloom persisting as long as it has. Strong cross-shelf and vertical fronts have contributed to bloom maintenance and north/south transport, rather than dispersion, of cells.

Monitoring and Tracking Red Tide

Multipronged monitoring approach

- Cell counts (*FWC and many partners and volunteers*)
- Documenting fish and wildlife impacts (*FWC*)
- Overflights to map bloom, fish kills and fish spawning aggregations (*FWC*)
- Satellite imagery (*USF Optical Oceanography Lab*)
- Glider (*USF College of Marine Science*)
- Predictions (*Collaboration for Prediction of Red Tides*)



Multiple techniques are used to monitor and track red tides.

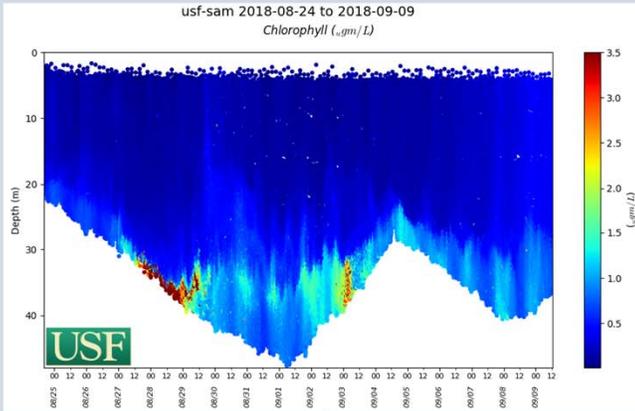
Current Red Tide Sampling

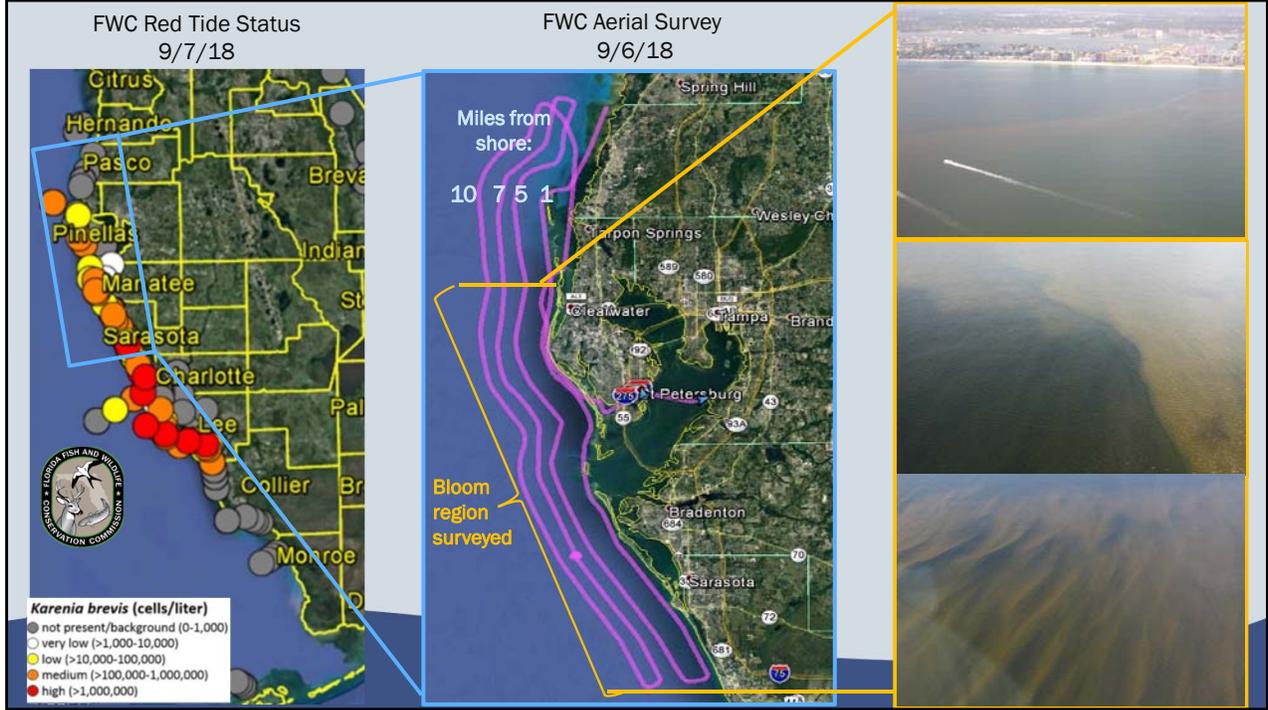
- Since Nov. 1, 2017 more than 9,025 water samples processed via microscopy



Gliders

- Offshore sampling provides insight into subsurface features





Trichodesmium Can Supply Nitrogen



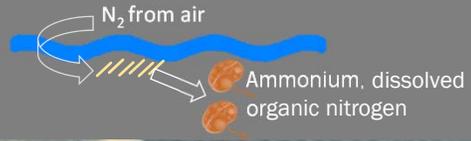
Karenia brevis -
red tide

Iron dust



Trichodesmium -
marine cyanobacterium

Trichodesmium bloom

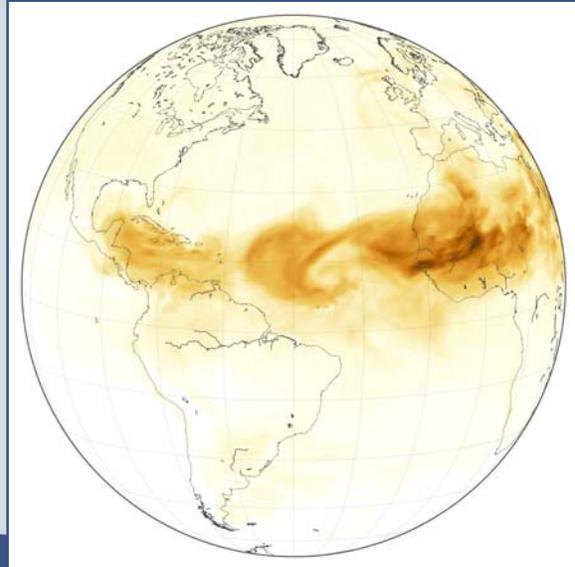


Karenia brevis -
red tide

Trichodesmium, whose growth can be stimulated by atmospheric dust, converts nitrogen in the atmosphere to a form that can be used by red tide.

June 28, 2018 Satellite Image

- A massive plume of Saharan dust appeared across the North Atlantic in June 2018
- Each year over 100 million tons of Saharan dust transported across the Atlantic
- June 2018 level highest seen in 15 years



A massive plume of Saharan dust appeared across the tropical North Atlantic Ocean in June of 2018. This Saharan Air Layer forms over the Sahara Desert during late spring, summer and early fall, and typically moves westward over the tropical Atlantic Ocean. Each year, over one hundred million tons of Saharan dust gets blown across the Atlantic.

Fish and Wildlife Impacts

- Can cause direct mortality and indirect illness or mortality (e.g., through diet)
- Can alter behavior and distribution patterns, which may affect reproductive success
- Timing and patchiness of blooms can result in widely varying impacts
- Impacts from the current bloom have been more severe due to its persistence inshore



Wildlife Impacts

- Documented mortalities for manatees, sea turtles, and bottlenose dolphins
 - Primary exposure through diet
- Sea turtle mortalities highest for a red tide event
- Manatee mortalities recorded from Manatee to Collier counties
- Bottlenose dolphin mortalities recorded from Pinellas to Collier counties
- FWC and DEP provided \$100,000 to Mote Marine Laboratory to support efforts to rescue distressed marine animals



Since November 2017, there have been 461 sea turtle strandings (213 loggerheads, 202 Kemp's ridleys, and 46 green turtles) due to red tide. 58 of these turtles were found alive. This is the largest number of stranded sea turtles we have attributed to a single red tide event. The next largest group was documented during 2006, when we attributed 345 stranded sea turtles to a red tide.

As of September 17, at least 152 manatee mortalities have been attributed to the current red tide bloom between Manatee and Collier counties since December 6, 2017. This number will increase when necropsies and toxin analyses are completed. This is the second highest mortality total tied to a red tide event. In 2013, 277 manatee deaths were attributed to red tide.

To date, 62 bottlenose dolphins have stranded during this event.

Manatee Rescues

- FWRI manatee staff rescued 12 manatees with signs of red tide exposure in 2018
 - The red tide toxin affects the manatee's nervous system
 - Signs include seizures and paralysis
 - Manatees are mainly exposed through ingestion of toxins on seagrass
- Rescued manatees were transported to SeaWorld Orlando for rehabilitation
 - Clearwater Marine Aquarium assisted with transports



If rescued and transported to treatment facilities in time, manatees can recover from red tide exposure. To date, 12 manatees have been rescued and transported to facilities for treatment. The main route of exposure for red tide for manatees is through their diet. Ingestion of toxins on seagrass can impact manatees for several months after a bloom has dissipated in an area.

Red Tide Fish Kills

- Fish kills have been extensive in multiple counties in southwest Florida
- Over 1,200 calls to Fish Kill Hotline
- More than 100 species affected
- Hundreds of tons of fish cleaned up by counties
- Gov. Scott directed \$13 million in grant funding to assist local communities impacted by red tide
 - \$750,000 to Manatee County
 - More than \$190,000 to Collier County
 - \$1.5 million to Sarasota County
 - \$3.9 million to Lee County
 - \$1.3 million to Pinellas County

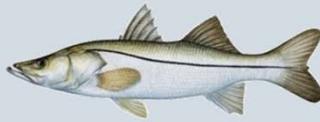


Photo (bottom) courtesy of Meaghan Faletti

Fish kills have been common and extensive in multiple counties in Southwest Florida and Bay County. There have been over 1200 calls to Fish Kill Hotline. Counties have collected hundreds of tons of dead fish and debris. More than 100 species have been affected. Where information on a specific stock is lacking, for example goliath grouper, FWC is obtaining samples from carcasses whenever possible. To date FWC has obtained otoliths from 44 goliath grouper for aging purposes.

Impacts to Snook and Red Drum

- Tampa Bay and Charlotte Harbor
- More than 20 years of monthly sampling in these systems provides an excellent baseline to compare abundances
- Reproductive characteristics and life history important to consider
- Past experience with red tide helps in assessing likely impacts



Snook

Moderately resilient

- Protandric hermaphrodites (male to female transition)
- Mature: age 1, maximum age ~20 years
- Spawn multiple batches ~April through November
- Life cycle
 - Use both rivers and estuarine habitats
 - Migrate to passes and barrier islands to spawn
 - Fairly diverse spawning sites
- In previous red tides, known to seek refuge in low salinity habitats



Snook Abundance Trends

- Adults can use low salinity habitats as refuges
- Juveniles already moved into low salinity habitats
- Abundance during July – Aug. 2018 compared to historic abundance (>20 year period)

	Tampa Bay	Charlotte Harbor
Adults	Comparable	Higher
Juveniles	Higher	Comparable



Red Drum

Less resilient

- Mature: ~age 3, maximum age ~35 to 50 years
- Spawn multiple batches mid-September through mid-November
- Life cycle
 - Estuarine-dependent as juveniles (to age 3-4)
 - Offshore as adults
 - Form large spawning aggregations in coastal habitats near passes in the fall



Impacts to Red Drum

- Reduced abundance of larger juveniles likely not red tide related
- Note that young red drum from this spawning season will not be present until October – December
- Juvenile abundance in both Tampa Bay and Charlotte Harbor already low due to two closely spaced low recruitment years
- Inshore abundance during July – Aug. 2018 compared to historic abundance (>20 year period)

	Tampa Bay	Charlotte Harbor
Larger Juveniles	Below	Below
Younger Juveniles	Comparable	Comparable



Red Drum Spawning Aggregations

- Spawning aggregations >10,000 fish at the surface have occurred off Tampa Bay in past
- An estimated 200,000 fish spawn off Tampa Bay
- Fewer aggregations in Tampa Bay during 2005 red tide
- No aggregations off Charlotte Harbor in 2012 when there was a red tide
- Multiple reports of dead, large red drum offshore received in 2018



Directed aerial survey flights to map spawning aggregations during Fall 2018



Management of Impact to Fish Populations

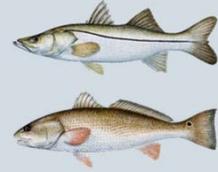
- Large quantities of dead fish observed since red tide event began in Nov. 2017
- Stakeholder concerns about long-term impacts to red drum and snook fisheries
- Extent of impacts to fish populations unknown



Photo (right) courtesy of Andrew Herzog

Part of Ongoing Efforts

- Community engagement and responsiveness
 - FWC and DEP leadership visited affected areas, meeting with community leaders, fishing guides, and local anglers
- Partnerships for hatchery
 - Mote, CCA, and FWC – Snook
 - CCA, Duke Energy, EOG, and FWC – Redfish
- Management actions
 - Executive Order for cleaning up dead fish
 - Executive Order making snook and redfish catch and release only



As part of ongoing efforts to respond to the needs of local communities, FWC and DEP leadership visited areas affected by red tide, meeting with local government and community leaders, fishing guides, and local anglers to better understand how local communities have been impacted.

To help local fish populations recover, FWC is also working with Mote Marine Laboratory, Coastal Conservation Association (CCA) Florida, and Duke Energy to raise and release snook and redfish to waters of southwest Florida once the bloom has ended. In addition, Governor Scott has directed an additional \$1.2 million to FWC to increase stock enhancement research, production, and stocking of redfish at the FWC's Stock Enhancement Research Facility at Port Manatee. This additional funding is anticipated to allow FWC to produce six times the amount of redfish for stocking in southwest Florida.

At Gov. Rick Scott's direction, the FWC has mobilized all available resources to mitigate naturally occurring red tide, and executive director Eric Sutton has waived rules through an executive order to expedite the removal of dead fish – regardless of applicable bag, size, or possession limits or of season or area closures – from shoreline, inshore or nearshore areas in Collier, Lee, Charlotte, Sarasota, Manatee, Hillsborough and Pinellas counties.

The FWC has also implemented temporary changes to make the redfish and snook fisheries catch-and-release-only in a portion of Manatee through Collier counties to help reduce potential long-term impacts to local redfish and snook populations.

Past Severe Red Tide Events

- Fisheries have been impacted from red tide in past
- 2005 red tide impacted broad array of species
 - Severely affected red grouper and gag grouper recruitment
 - Also impacted red drum and snook
 - Large-scale goliath grouper mortality affected recruitment in subsequent years
- 2015-2016 red tide severely impacted bay scallop fishery in Gulf County
 - Local management changes and restoration to help rebuild fishery
 - 2016: Reduced season length and bag limits, began restoration
 - 2017 and 2018: Shorter and later seasons, continued restoration



This approach has not been used for finfish species before



Short-term Changes for Red Drum and Snook

- Conservative, proactive approach
 - Executive Order (EO) to make red drum and snook catch and release only in areas where red tide-related fish kills most prevalent
 - Short-term change
 - Reduce pressure on stressed fish populations
 - Implemented prior to Sept. 1 opening of snook season
 - Expires Oct. 12, 2018



These temporary changes apply in:

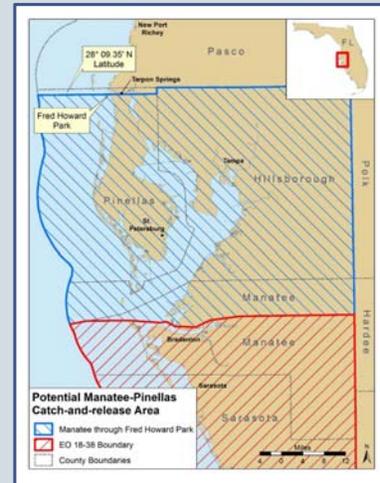
All waters of Manatee County south of a line drawn from Emerson Point west to the northernmost point of Anna Maria Island and west to the intersection of the Manatee – Hillsborough county line including the Manatee and Braden rivers;

All waters of Sarasota, Charlotte, and Lee counties; and

All waters of Collier County north of the south bank of Gordon Pass south of Naples.

Moving Forward

- Consider longer-term options for red drum and snook
 - Monitor recruitment for signs of rebuilding
 - Some recruitment information available March 2019
 - Review at May 2019 Commission meeting to inform next steps
- Bloom has moved north into Pinellas County and has caused additional fish kills since EO implemented
 - Consider expanding catch-and-release area north to include Tampa Bay and Pinellas County
 - Consider extending catch-and-release EO until May 10, 2019



Direction requested

While the extent of the impacts of this ongoing red tide event on the local red drum and snook fisheries are not currently known, staff are asking you to consider a longer-term option. Evaluating impacts will take some time. Staff will monitor recruitment for local red drum and snook populations for signs of rebuilding and expect to have some recruitment information available for analysis in March 2019. This information will be available to review at the May 2019 Commission meeting to inform if additional management changes are needed.

Since the last Executive Order was issued in late August, the bloom has moved north into Pinellas County and has caused additional fish kills outside of the area where these temporary changes currently apply. Staff recommends considering expanding the catch-and-release area north to include Tampa Bay and Pinellas County, and consider extending these temporary changes until May 10, 2019.

Staff is suggesting including all waters of Hillsborough County, and all waters of Pinellas County south of the northernmost point of Fred Howard Park. Fred Howard Park is approximately 1.17 miles south of the Pinellas – Pasco county line near Tarpon Springs. This would also allow a person to transit through the Anclote River to Tarpon Springs with a red drum legally harvested north of the expanded catch-and-release area.

Partners Contributing to Recovery

- Mote Marine Laboratory, CCA Florida, and Duke Energy partnering with FWC to support recovery of redfish and snook in southwest Florida
- CCA Florida and Duke Energy partnering to release hatchery-reared redfish
 - Goal to release 200 adults and 10,000 juvenile redfish
 - Manatee through Collier counties
- Mote Marine Laboratory and CCA Florida partnering to release hatchery-reared snook
 - Two-year initiative will begin April 2019
 - Goal to raise and release 10,000 juvenile snook



Next Steps

- Florida's world class fisheries are still open to fishing
- Continue to monitor red tide and respond to fish kills
 - Monitor effects on redfish and snook recruitment
- Continue to work with partners and community leaders
- Continue to work with Visit Florida and industry on economic recovery
 - Gov. Scott directed \$500,000 to Visit Florida to create emergency grant program to assist local tourism development boards in counties affected by red tide
 - Gov. Scott directed Dept. of Economic Opportunity to activate Emergency Bridge Loan Program to support small businesses affected by impacts from red tide



Staff Recommendation

- Modify catch-and-release EO for redfish and snook
 - Expand area to include Tampa Bay and Pinellas County
 - Extend expiration to May 10, 2019
- Return with update at May 2019 Commission meeting

