NOAA Deeper Dive Into Coral Bleaching Emergency media call

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Victor (operator):

Welcome and thank you for standing by. At this time, all participants will be on the listen only mode until the question and answer session of today's meeting. At that time, to ask a question from the phone line, please press *1 and record your name and media outlet when prompted. This call is being recorded. If you have any objections, please disconnect at this time. I would now like to turn the call over to your host, Monica Allen. You may begin.

Monica Allen:

Hi. Good afternoon everybody, and thank you so much for joining this special media call to take a deeper dive into the coral bleaching event that is unfolding in and along Florida's Coral Reef. I'm Monica Allen with NOAA Communications and I'll be facilitating the call today. If you have additional questions after the conclusion of today's call, please email me at Monica.Allen@NOAA.gov, or my public affairs colleagues who've been assisting with this, Kate Silverstein at Katherine.sliverstein@noaa.gov, or John Jones-Bateman at nesdis.pa@noaa.gov. Today's update will begin with opening remarks from Dr. Steve Thur, NOAA assistant administrator for Oceanic and Atmospheric Research. Dr. Thur has a long history with Coral serving as the director of the coral program at NOAA's National Ocean Service. Dr. Thur took the helm as NOAA assistant administrator for research last year.

Following Dr. Thur's remarks, you will also hear from our experts. And this is the panel of experts that you will hear from. You will hear from Dr. Derek Manzello, the coordinator of the NOAA Coral Reef Watch Program, Dr. Ian Enochs, research ecologist at NOAA's Atlantic, Oceanographic, and Meteorological Laboratory, Dr. Andy Bruckner, coordinator at NOAA's Florida Keys National Marine Sanctuary. A copy of the slide deck presentation for our speakers can be downloaded now, if you haven't done it already, from this link. Go to this link: research.noaa.gov and you'll be able to scroll down and see a story titled Media Resources: Deeper Dive into Coral Bleaching, and at the top of that you will see a link to view slides or to download them. So I encourage you to do that because our speakers will be referring to those slides, telling you which page they're on, and it'll be easier for you to understand the presentations. Following our four speakers, we will have a Q&A for the media. With that, I would like to turn the mic over to Dr. Steve Thur.

Steve Thur, Ph.D.:

Good Day everyone. My name is Steve Thur and I am the assistant administrator for Oceanic and Atmospheric Research. Today we're very pleased to present a panel of coral experts from across different components of NOAA who will help you to understand this summer's coral bleaching event affecting one of our nation's largest coral reefs, which is located mostly within the Florida Keys National Marine Sanctuary. Coral reefs in Florida and around the world

are vitally important to human and natural communities. They're also on the front lines of climate change impacts. Teaming with diverse marine life, coral reefs provide nurseries for valuable fisheries that feed millions and provide jobs to those in our coastal communities, they draw tourists to boost our economy, they're important to the cultural heritage of communities on our coast, and they protect coastal areas by reducing the power of waves hitting the coast during hurricanes and severe storm.

The science and stewardship activities needed to understand and protect our amazing marine resources, including coral reefs, is conducted across NOAA. Earlier in my career, I managed NOAA's Coral Reef Conservation Program, which supports some of the work that you will hear about in this call. Coral reef science and conservation is deeply personal to me, and I've been associated with coral reef research since I was an undergraduate student 25 years ago. I am truly sobered by the impacts of the current marine heatwave on Florida's reefs. During my 20 years with NOAA's National Ocean Service, I was fortunate to work with dedicated coral scientists to develop the National Coral Reef Monitoring Program.

That was the first nationwide effort to integrate physical, biological, and human community monitoring to help us understand a clearer picture of coral status and the threats they face. The work that's been undertaken in the Florida Keys over the past couple of decades allows us to place the scale and impact of this current event into a broader context. As climate change continues to impact our marine ecosystems and the communities that rely on them, the work that NOAA does across the agency and with a wide variety of partners from government, academia, the private sector, and non-governmental organizations is more important than ever. Now I'd like to turn this over to Dr. Derek Manzello, our first speaker.

Derek Manzello, Ph.D.:

Thank you very much, Dr. Thur. I'm going to be starting on slide number two, and today I'm going to highlight the current coral bleaching level heat stress patterns in Florida, as well as the wider Caribbean and Eastern Pacific. First, let me orient you to the map and graphs on slide two. The map of Florida and the top right is showing you our bleaching alert area product for the region. The bleaching alert area product simplifies our coral bleaching prediction algorithm such that all light red areas are where there is heat stress that is known to elicit significant coral bleaching, and the dark reds are where there is sufficient heat stress to cause severe bleaching and coral mortality. The light red corresponds to an alert level one and the dark red corresponds to an alert level two. I will refer to these alert levels multiple times. As you can see, all of the Florida Keys and most of southeast Florida is experiencing alert level two conditions.

The plots in the bottom right summarize the data from our Florida Keys and Southeast Florida regional virtual stations. These plots are showing two things. First, the multiple different colored lines at the top are the daily average sea surface temperatures for every year in the satellite record. Second, the lines at the bottom of the plot show the accumulation of degree heating weeks for each year. Degree heating weeks are our primary metric from estimating bleaching level heat stress. There are two dashed horizontal lines that indicate the degree heating week values whereby an alert level one and two are generated. The black lines are the data from 2023. Some key points about these plots: daily average temperatures have been record setting for both regions. In the Florida Keys, sea temperatures broke the previous record for the highest value ever measured by satellite on July 9th, and temperatures have been higher than the prior records, for 28 of the past 37 days.

You can see this pattern in both graphs, as the 2023 black line of sea temperatures is clearly much higher than anything ever recorded. The onset of this heat stress started earlier than ever before. We need to bear in mind that there have already been eight mass coral bleaching events that have impacted the Florida Keys since 1987. During past events, temperatures didn't reach bleaching level heat stress and bleaching wasn't observed until mid-August. If you look at the bottom of these plots, it's clear that the accumulation of heat stress started earlier than ever before on

record. The Florida Keys virtual station has been at an alert level two since July 16th and hit an alert level one on July 6th. What this means is that this bleaching event started a full five to six weeks earlier than the previous eight mass bleaching events that have impacted Florida.

In summary, we hear the word unprecedented thrown around all the time, but allow me to qualify that word with the facts. First, Florida's corals have never been exposed to this magnitude of heat stress. Second, this heat occurred earlier than ever before. A big concern is that temperatures are reaching their seasonal peak right now, so this stress is likely to persist for at least the next month. Thus, these corals will experience heat stress that is not only higher than ever before, earlier than ever before, but for longer in duration than ever before. This is a key point, because the impacts to corals is a function of how high the heat stress is and how long it lasts. Moving on to slide number three, unfortunately, Florida is just the tip of the iceberg and it's just one location that is being impacted by this large scale heat stress event that is impacting coral reefs in both the eastern tropical Pacific and Atlantic oceans. In the top left is the year to date bleaching alert area product for the Caribbean region and Eastern Pacific.

As you can see, large areas of Eastern tropical Pacific have experienced alert level two conditions. In the bottom left, you can see an image of a completely bleached reef off of the Mexican Pacific, as well as the multi-year temperature and degree heating leak data for this site. Again, there is a similar pattern to Florida and that heat stress began accumulating earlier than ever before and has reached values that have never before been achieved. Now let's look at the data from Bocas del Toro, which is on the Caribbean side of Panama. Multiple investigators began observing severe bleaching here in early July and began sending us pictures and reports. In the picture here is acropora cervicornis, or staghorn coral, which is listed as threatened under the Endangered Species Act. Unfortunately, all the non-white bleach portions of these colonies are recent heat driven mortality. Finally, the top right shows data specific to the coral reef climate change sentinel monitoring site in the Florida Keys that Ian Enoch will discuss later. Moving on to slide four, we have confirmed bleaching in five countries bordering the Eastern Pacific, off Mexico, El Salvador, Costa Rica, Panama, and Columbia. In the Atlantic there is confirmed bleaching in at least seven countries and territories. That includes Florida, both sides of the Yucatan Peninsula off Mexico, Belize, Cuba, Panama, Puerto Rico, and the US Virgin Island.

Moving on to slide five, not only does Coral Reef Watch monitor heat stress in near real time, but we also produce a four-month coral bleaching outlook product. This forecast is model-based and utilizes NOAA's climate forecast system to provide weekly updates about possible future heat stress. The outlook product predicts that the Caribbean will continue to warm, such that the majority of the Caribbean is predicted to experience alert level conditions within the next one to two weeks. Alert level two conditions are predicted to occur for the entire Caribbean by mid-September and persist through October. For Florida in particular, the heat stress is not expected to dissipate until mid to late September or early October. This means we may be looking at an additional month of heat stress in Florida. I will add one caveat here. This is not a prophecy written on stone tablet. Things can change. Specifically, the outlook product does not do a good job at predicting hurricanes and tropical storms.

Tropical cyclones do a very good job at dissipating and redistributing the heat in the ocean and may cause significant cooling of coral reef environments. Thus, if Atlantic hurricane activity starts spinning up, these predictions may change. Moving on to slide six, the key take home points are as follows. There is a large scale heat stress and coral bleaching event underway spanning two ocean basins and multiple countries. These surface temperatures in the Atlantic are currently as high or higher than they've ever been in the satellite record, and heat stress has accumulated earlier than ever before. Unfortunately, Florida appears to be the location that is being most severely impacted by this large scale marine heatwave. Pretty much every coral in Florida is experiencing alert level two conditions. Some sites in the Florida Keys are experiencing accumulated heat stress that is two times greater than when we expect mortality to begin. Unless we have significant changes in weather patterns and development of tropical storms and hurricanes,

we are marching towards a Caribbean wide heat stress event within a matter of days to weeks. I'd now like to turn over the floor to Dr. Ian Enoch.

Ian Enochs, Ph.D.:

Thank you, Derek. And before I begin, Monica Allen has asked that I make a minor correction. The location of the materials to follow along, slides to follow along are at research.noaa.gov. That's research.noaa.gov. With that, I'd like to focus really on move to ... well one slide, slide seven, and also to Cheeca Rocks, which is within the Florida Keys National Marine Sanctuary. And this is a patch reef off of the coast of Islamorada. Please move to slide eight. This is a particularly resilient site historically, we've seen with high coral cover. It has been selected as one of NOAA's climate monitoring sites as part of the National Coral Reef Monitoring Program. And associated with that, we have been, with some frequency, measuring the concentration of carbon dioxide in the water and atmosphere, as well as the temperature, as well as the various ecological and physiological responses to those parameters. And we've been doing this really for more than a decade, collecting those data, producing ultimately numerous scientific publications that have advanced our understanding of how reefs respond to climate, but also pushing our understanding forward in terms of management scenarios that can be used to address these issues.

This reef has also been selected as one of the seven sites selected as part of the mission Iconic Reefs as a restoration site. And I mention all of these things to you because I think they really highlight the importance and value of this reef, both from a societal and economic perspective, but also an ecological, biological, biodiversity perspective, and also really from a scientific perspective in terms of all of the understanding that we've taken from this. Please move to slide nine. So with that background I want to show you these data here of really how high the temperature has been. As Derek mentioned very well, we have been very much above the bleaching threshold of this site. These data come from a climate monitoring buoy that we have at the site. You can see that we reached a peak of roughly 93 degrees Fahrenheit, which is well in excess of, as Derek mentioned, what corals are normally able to deal with.

As a result, you can see this photo on the right with nearly complete bleaching of the corals that are there. This is not what a reef is supposed to look like. Please move to slide 10. Now, as part of the National Coral Reef Monitoring Program, one of the things we do, like I said, is to really monitor these reefs quite closely. And while these may look like individual images, these are actually three-dimensional constructions from thousands of digital images each. And these allow us to monitor the health and growth of individual corals. And we've been doing this for over 10 years, so we have a really good understanding of what these corals have dealt with through time. On June 30th, you can see here on the left a healthy coral reef, lots of color, lots of beautiful corals present there. And roughly three weeks later on July 24th, here on the right, you can see it's an entirely different scene. So much bleaching, so much paling. Now I'd like to move to slide 11, please.

This is a closeup, if you will, from those same images. The dark blue arrows on the left point to healthy coral cover. These are the corals that provide all of the structure, all of the habitats, all of the ecosystem services that Dr. Thur was mentioning earlier. And on the right, again, you can see them bleached stark white or paling. The light blue arrows below actually points to soft corals. These are sea fans and sea whips that also have numerous ecological services and ecosystem services associated with them. On the left, again, we see healthy individuals. And on the right, they're unfortunately already dead. Many are disintegrating and falling apart, even with the conditions that they're already experiencing. I'd like to move to slide 12 now, please. So the Atlantic Oceanographic and Meteorological Laboratory and the coral program there is focused on several solution driven science and technology research tracks. So we are looking at performance assessment, whereby we look at the various capabilities of different coral individuals. We want to know what these individuals are capable of dealing with so we can make informed decisions about where we place them on the reef based on what types of stress and degree -

Ian Enochs, Ph.D.:

We place them on the reef based on what types of stress and degrees of stress that they're able to deal with. We're also developing technologies associated with automating various restoration approaches of specifically coral farming, so that we can hopefully increase the efficiency of these efforts and decrease the overall costs. And finally, we're also working on stress hardening, using natural mechanisms to help coral individuals be able to deal with greater degrees of stress for longer. And with that, I'd like to move the mic over to Dr. Andy Bruckner. Thank you.

Andy Bruckner, Ph.D.:

Thank you, Ian. Hello everyone. My name is Andy Bruckner. I am the research coordinator with NOAA's Florida Keys National Marine Sanctuary. And what I want to do now is provide more of a brief overview of what we're seeing on the reefs throughout the Florida Keys, and talk a little bit about some of the actions the sanctuary and our partners are taking to minimize the impacts of this event. For those of you that are not familiar with the Florida Keys, please refer to slide 13.

Florida Keys National Marine Sanctuary covers an area of about 3,800 square miles and it extends 180 miles from Biscayne Bay to south of Miami to the Dry Tortugas. The sanctuary is home to over 6,000 species of marine organisms, and it contains the only barrier coral reef in North America. This bank barrier reef system supports thousands of jobs, it provides key sources of food, as well as revenue for tourism and fisheries, and it forms an important barrier that protects the shoreline from the full brunt of the storms.

If you could move now to slide 14. In 2019, the Florida Keys National Marine Sanctuary kicked off Mission Iconic Reefs, which is one of the world's largest and most comprehensive coral restoration program. This program aims to reestablish about 500,000 reproductively mature corals on the seven iconic reefs that are shown in the illustration up in the top right. While thousands of corals have already been returned to the reef, as you're all aware these corals are witnessing the most severe temperature stress event ever observed in Florida.

If you now go to slide 15 last week, the sanctuary embarked on a sanctuary wide research expedition to conduct a comprehensive bleaching assessment within the plots of restored elkhorn and staghorn corals throughout the seven iconic reefs. The intent of this work is to compare the bleaching severity and coral survival among regions, reefs, habitats the age of these outplants, the restoration method, as well as various biological attributes such as their genotype or genetic strain.

So our surveys to date have really shown how variable the impacts on bleaching have been and how quickly the status of corals is changing. The first signs of stress were noted on these reefs in May and June when severe disease outbreaks began emerging within our shallow nurseries and also on the reef. By the end of June, there were some reefs that had also begun to bleach. Since this time, the extent of bleaching has increased throughout the sanctuary with some reef locations and nursery sites witnessing bleaching followed by near total mortality of corals and other locations exhibiting high levels of bleaching, but much less mortality. And still there are some hope spots. There are some locations date that have exhibited very minimal signs of bleaching and little or no mortality. The other important point to note is that bleaching severity has varied by species with many of the boulder corals such as the Orbicella colony shown in the top right, resisting bleaching, or only experiencing slight paling.

The difference in bleaching that's been observed between reefs have tracked closely with the amount and duration of heat stress. If you look at the figure in the center, this graph illustrates the total number of consecutive days when the water temperature has remained above 88 degrees, that's the first set of bars, and then there's a series of four bars showing how many days each of those reefs the temperatures exceeded anywhere from 86 to 93 degrees. And this is for five locations spread throughout the upper, middle and lower Keys.

Overall, the highest temperatures and the longest duration of temperature above the bleaching threshold has been recorded at the site Ian just mentioned Cheeca Rocks, and this is followed by sites in the middle Keys around Sombrero and Marathon. While Carysfort Reef, which is an offshore location in the upper Keys, it has actually remained cooler than other sites and has seen much less mortality. And the final thing I want to draw your attention to on this slide is that elkhorn coral that's shown in the lower right. Corals often show signs of partial bleaching, and typically what'll happen is the upright portions of that coral that are exposed to the highest levels of light bleach first, while the undersides of these corals may retain their algae and their pigmentation. So ultimately, these top surfaces of these corals may die, and we've seen that in a lot of cases, but then the sides and the bases can survive, and those could actually re-sheet over that dead skeleton or continue growing as long as the temperature stress subsides.

So moving now to slide 16. Over the last three weeks... Oh, I'm sorry, my slides actually got reversed. Slide 17 somehow got moved to before 16. So if you referred to slide 17 first. Over the last three weeks, NOAA has been working with our restoration partners to relocate thousands of corals from shallow water nurseries. The first component is shown by a number one in the figure, involved a genetic rescue where approximately 150 elkhorn coral and 300 staghorn coral fragments. This represents every remaining unique genotype or genetic strain of these species that's known to exist in Florida. These were relocated to Mote Aquaculture Park and the Reese Institute for Gene Banking. A second component involves relocating large branches of elkhorn coral to spawning facilities at Florida Aquarium, basically to increase the genetic diversity of their spawning stocks.

At the same time, the practitioners have been moving a substantial amount of their production stocks from their in-water nurseries to land. So far Mote has moved about 10,000 corals from 4 of their in-water nurseries and CRF has moved about 4,000 corals from one of their in-water nurseries in Tavernier. And fourth, we have another restoration partner, Reef Renewal USA, which has taken a different approach. They've relocated about 2,800 corals from their shallow Tavernier nursery to an offshore location that's in about 70 feet depth, where water temperatures currently are about two degrees cooler than the shallow reefs.

So from my last slide, which on this deck is number 16, I want to just provide a few comments on other activities that we are exploring to understand and address temperature stress. First, it's important to note that our partners are not relocating every single coral from their shallow water nursery, representative genetic strains or genotypes of every species are being maintained in these shallow water nurseries basically to better understand how they perform, how the different genetic individuals perform under periods of high temperature.

Second, the research crews that I mentioned is going to be repeated in February 2024 to basically evaluate patterns of recovery to help identify sites that may be more resilient or less resilient to temperature stress, and also to identify those corals that resisted bleaching with the intent of collecting some of these to use in future propagation and restoration efforts.

Then I just want to just briefly mention a little bit about what Ian discussed in terms of other research. Our federal, state and academic partners are continuing to conduct research to identify and produce resilient corals for a variety of mechanisms such as selective breeding, stress hardening, and symbiont shuffling. While many of these studies are showing promise, the largest challenge we face with this work right now is scaling this up so that we can produce enough resilient corals to meet our goals for restoration.

And then finally, the Florida Keys National Marine Sanctuary and our partners are conducting some pilot interventions this year to both reduce the stress to corals. This includes things like trialing some small scale shading experiments, focus removal of coral predators from out planted corals and improvements of habitat quality, both through the removal of nuisance species that compete with these corals and the reintroduction of herbivorous sea urchins and crabs.

And so I just want to conclude by emphasizing this has been a Herculean effort for what's been done to date, and it's been very, very collaborative in nature. The engagement and the hard work of the dozens of partners has demonstrated the commitment, I think, of the Florida Keys community in working together to save Florida's beautiful coral reefs. And with that, I'm going to pass the microphone back to Monica.

Monica Allen:

Thank you Andy, and to our other speakers as well, a big thanks. Now joining us for the Q&A portion of the call are some additional NOAA experts, and I'm going to give you their names right now. Jennifer Koss, that's K-O-S-S, and Jennifer is the director of the NOAA Coral Reef Conservation Program. Dana Wusinich-Mendez, and Dana's last name is spelled W-U-S-I-N-I-C-H-M-E-N-D-E-Z. And Dana is the Atlantic and Caribbean team lead for the NOAA Coral Reef Conservation Program. Dr. Mark Ladd, who is the coral reef ecologist at the Southeast Fishery Science Center. Dr. Michael Jacox, a research oceanographer at the Southwest Fishery Science Center. Jamison Gove, research oceanographer at the Pacific Islands Fisheries Science Center. And Gerald Hoff, fisheries biologist at the Alaska Fisheries Science Center.

We will now take specific questions from our call participants from journalists. Please be sure to identify yourself by name and your outlet. And also if you want the question to go to a specific person, let us know. Operator, please remind the call participants how they can ask a question and then please queue up the first question.

Operator:

Absolutely.

Monica Nation:

While we are waiting for the question to come in, I'd like to turn the mic over to Jennifer Koss with the Coral Reef Conservation Program to give us some important insight about NOAA's big picture conservation strategy. Jennifer.

Jennifer Koss:

Thank you very much, Monica, and thank you Steve, Derek, Ian, and Andy for capturing the immediacy and urgency of this event so well. It's hard to come up with a perfect analogy to put situations like this into context, but if you'll indulge me, we could think of NOAA's response to this marine heatwave and bleaching event as a battle that is part of a larger campaign to conserve and recover these valuable resources. In addition to these emergency actions, NOAA conducts many more research and management activities every day for the betterment of our nation's coral reefs. NOAA's Coral Reef Conservation Program efforts are part of a very well-designed and well-thought out conservation strategy led by the conservation program using a cross NOAA approach that takes full advantage of the agency's considerable scientific and management expertise. NOAA also works in close partnership with us, coral reef state and territorial agencies, academic and nonprofit partners throughout the Coral Reef Conservation program.

NOAA's theory of change for resilient reefs and successfully managed reefs includes strategies to address local threat reduction, for example, limiting nutrient and sediment pollution and ending unsustainable fishing practices in order to improve water quality in coastal areas. We conduct research on coral reefs to inform and improve management actions. We conduct research to improve in-water coral restoration practices focused on resilient corals and maintaining ecosystem functions. We work closely with our partners to increase capacity at the local government and community levels. All of this is underpinned with what we call resilience based management. That is conservation actions and strategies designed to make sure corals can bounce back and recover from multiple stressors and threats across both short and long timescales. Thank you so much.

Monica Allen:

Thank you, Jennifer. Now we'll open up the line to our first question.

Operator:

Thank you. Our first question comes from Max Chesnes with Tampa Bay Times. Your line is open.

Max Chesnes:

Hi there. Good afternoon. This is Max Chesneshere with Tampa Bay Times. In terms of quantifying the scale of the bleaching event happening now, is there a percentage value or perhaps a square mileage of just the sheer amount of coral that we are seeing that are either bleach now or will be bleached by the end of this event? And that is open to any expert. Thank you.

Monica Allen:

Is that something that you could handle, Derek?

Derek Manzello, Ph.D.:

Hey, Derek Manzello here. I mean, I can speak to the scale of the heat stress, but I unfortunately cannot speak to what is actually going on in the water.

Monica Allen:

Do we have any estimates like that, Andy, or is that something that's going to be part of a future analysis?

Andy Bruckner, Ph.D.:

Yeah, so this is Andy Bruckner. I will try to answer that. So there's a whole series of monitoring that's going on throughout the Florida Reef Track, both in southeast Florida, the Florida Keys National Marine Sanctuary, and the Dry Tortugas that we have something that's called Disturbance Response Monitoring program. This is through, we have a program called the Florida Reef Resilience Program, and this was established prior to the 2014 bleaching event where every year in August and September and October, we do surveys throughout the Florida Reef Track to get a sense of if bleaching occurs, when it first starts, what species are affected, how severe it is.

Then based on the outcome of that, if we have a very bad year like this year, what we then do is we do follow-up cruises to reassess those sites in the winter or spring after the temperatures have cooled and the corals that survive have started to regain their color color. And so we will go back this year and hit sites throughout Florida as well. Now, we don't look at every coral. What you have to do is you try to hit representative sites. We basically have a sampling strategy, which subdivide all the reef system into different regions, different locations in terms of how close it is to shore, so near shore, mid channel, offshore sites, and then specific reefs throughout that system. And we do representative transects. And so based on that, we can get a sense overall of the percent of the reefs that have bleached. But I mean, I think because talking millions of corals, you'll never know the total number, you just have a sense of how severe that event is.

And the last thing I just want to say about that is it's really, really important to remember that a coral can bleach and it can recover if the temperature cools down. And so what our hope is if this heat wave continues as long as what the predictions are, what Derek presented, it could be quite severe. But if we get lucky and we get a hurricane that comes

through or some event that cools this down, those corals that right now are pale to bleached could potentially recover. And really that's what the intent is of our winter, springtime surveys, is to get a better sense of what was the pattern of losses and how many of these corals survived and what sort of direction is the reef going in? And I hope that answers your question. Sorry, that was kind of long.

Max Chesnes:

Thank you.

Monica Allen:

We're ready for our next question.

Operator:

Our next question comes from Amy Green, Inside Climate News. Your line is open.

Amy Green:

Hi, good afternoon. Could you explain the bleaching process and the role of algae in that process of bleaching and death for the corals? And yeah, I was going to ask the same question as Max, which is, if you don't have data that can convey the scope or the scale of this calamity, anecdotally, could you paint a picture for readers and listeners illustrating the scope of this disaster for the corals?

Monica Allen:

Ian, why don't you start with that question?

Ian Enochs, Ph.D.:

Yeah, certainly. I'll address the first part. So it's important when you look at a photo of a coral to understand that it's not just the coral animal, it's actually a whole bunch of things living together. And most importantly, perhaps in that relationship is a symbiosis or the direct relationship of the coral animal with an algae called zooxanthellae. And that zooxanthellae photosynthesizes, just like plants do on land, and in turn provides food to the coral animal. And so that relationship is really sensitive to temperature. So when waters get a bit too warm, that relationship breaks down and the algae leaves the coral and the coral is ultimately compromised. So if this is why Andy was just speaking about if this happens for too long, if it's bleached for too long, if it doesn't get other sources of nutrition, that it can ultimately lead to death.

Ian Enochs, Ph.D.:

... that it can ultimately lead to death. And I'll let someone else address the second question.

Monica Allen:

The second part of the question ... Would you repeat that again, the second part of the question?

Speaker 3:

[inaudible], I'm trying to get a sense of the scope or scale of the disaster, and if data is not available yet to illustrate that anecdotally, could you paint a picture for readers or listeners, how widespread or what the scale of these losses are?

Monica Allen:

Derek or Andy, would you like to handle that one?

Andy Bruckner, Ph.D.:

I'll jump in quickly and then maybe Derek can add a little bit to this.

Speaker 2:

That's Andy Bruckner.

Andy Bruckner, Ph.D.:

Sorry, sorry. Yes, Andy Bruckner. Within the Florida Keys anyways, we are seeing signs of bleaching pretty much everywhere throughout the Reese system. We are trying to characterize how severe that is because as what I indicated before, colonies can start to bleach but not completely lose their pigmentation and they may not die. And so what our hope is, is by the time we finish our surveys in January, February, March timeframe, we will understand how many reefs were hit really hard and we have a lot of mortality versus those reef systems where they fared a little better and we have higher survival of individual corals, certain species or certain genotypes. And so really by next spring, we will have a sense of how severe the impacts were from this event.

But right now, other than the fact that we're seeing bleaching pretty much everywhere throughout all the reef system, we don't have a lot more information than that at this point in time.

Derek Manzello, Ph.D.:

Hey, Derek Manzello here. Two things. So the scale of this event is very alarming. So this started in Eastern Tropical Pacific in early June, and we have confirmed reports of severe bleaching now from southern Mexico around Oaxaca, all the way down through Columbia. So we're talking about thousands of miles of bleaching-level heat stress with confirmed bleaching reports. And then things really started getting hot, severely hot in the Caribbeans in about late June, early July. Again, and we have confirmed reports of bleaching from colleagues, partners, scientists in the field who are very well versed on this topic and providing this data from locations in Panama, Belize, Mexico, both sides of the Yucatan, Florida, The Bahamas, Southeastern Cuba, Guantanamo Bay, and bleaching has already begun in Puerto Rico and the US Virgin Islands.

So we're talking about thousands upon thousands of miles of coral reefs undergoing severe bleaching heat stress. And I do want to add one additional point to the mechanism and the response of corals to bleaching. So it is absolutely true that corals can recover from bleaching if temperatures decline soon enough and they're not exposed to heat stress for too long. But I do want to point out that there are lasting physiological impacts to the coral even when they're able to recover. So it has been very well documented at this point that coral calcification rates decline, reproduction declines to the point where corals can become nearly sterile for upwards of two to four years after recovery from bleaching.

Furthermore, corals become increasingly susceptible to disease after they go through a heat stress event. Now one of the things Andy talked about was that disease levels were very, very high in Florida before this heat stress event even

started. And this could potentially be due to the fact that there was a moderate-to-minor coral bleaching event that impacted the entirety of Florida's coral reef all the way from southeast Florida down through the Dry Tortugas last year.

Now, mortality was low associated with that event, but it's potentially likely that the very high levels of disease that were observed before the bleaching started could have very well been a hangover from the thermal stress event that took place last year.

Monica Allen:

We'll take the next question when you're ready, operator.

Speaker 5:

Our next question comes from Allison Chinchar with CNN. The line is open.

Allison Chinchar:

Hi there. So my question is for either experts, but it's really focused on slides four and five of the presentation today. I know the focus is really on Florida, but I noticed on both of those graphics that there are plenty of other alert level-two areas globally. So my question is what other countries or specific regions are of particular concern, and are there any other areas that have reached similar unprecedented levels like Florida has, but on a global standpoint?

Monica Allen:

We'll put that question over to Derek.

Derek Manzello, Ph.D.:

Yep, thanks, Monica. So, Derek Manzello here. So you're absolutely correct that ... So I will say that I believe Florida right now is experiencing the worst of it, but there are certainly other locations that are experiencing very extreme thermal stress. So off of Southern Mexico, off of the Oaxaca area and the [inaudible] Heat Reef Tract, this site is experiencing heat stress that has never been experienced before. And I was on a call two days ago with members of the Global Coral Reef Monitoring Network for the Eastern Tropical Pacific, and they were discussing some very, very interesting phenomenon that they're seeing on these reefs. In particular, off Mexico, not only are the corals severely bleached, but they're also seeing other ecosystem impacts from this heat stress. One of the things that has been very noticeable to them is that sharks have disappeared.

And the reason for this is because this is normally a higher productivity environment, and when you have an El Nino event, that thermal client gets very, very deep. So you have very low nutrients in the surface waters, and productivity goes way down. So the food sources for the sharks are going away. And also we need to consider the fact that when waters are warmer, there's less oxygen. The sharks, as we know, always need to be swimming around constantly because they have a high oxygen demand. So essentially what you have is a situation where sharks have moved out these areas in the Mexican Pacific because it's basically just too hot for them.

And the other thing they're reporting from Mexico, which is very interesting, is that a species of wrass that's very common throughout the entire Eastern Pacific from Mexico all the way to the Galapagos is currently starting to feed on bleached corals. And this is very weird because this species of wrass in the genus Thalossoma normally is not a coral [inaudible]. Furthermore, there are certain species of sea stars that have totally disappeared from these reefs. So

we even also consider the fact that corals are not the only organisms that are suffering as a result of this heat. There are many other locations in the Eastern Pacific and the Caribbean that are experiencing extreme heat stress.

For instance, the Eastern Pacific part of Panama is experiencing very extreme heat stress that it's never experienced before. Also, off of the Yucatan Peninsula and Mexico, particularly on the western side of the Yucatan, they started seeing coral mortality taking place very early in, I believe it was June. And again, the reports that came in were the kind of things we've seen in the Keys and some of the Acroporas, and that they experienced rapid tissue loss. What this means is they got hit by such an acute heat shock that they skipped bleaching altogether and their tissue just sloughed off, and they died.

So again, this heat stress event is spanning thousands of miles. And unfortunately, I believe it is just beginning because all of the data we have at our disposal right now is suggesting that this event is going to become Caribbean-wide in the next days to weeks. And again, it's all going to depend on just how hot it gets in these locations and how long it lasts. And one of the main cooling mechanisms that can happen to ameliorate these impacts would be hurricanes and tropical storms. But as of right now, the Atlantic Ocean has been pretty conspicuously silent in terms of development of hurricanes and tropical storms. So right now, we are marching toward a Caribbean-wide event unless we have some very significant changes in weather patterns. Thank you.

Monica Allen:

One quick question to follow up on. Derek, you said a species of ... I wasn't sure what the species of that was feeding off the coral, and I didn't hear it well, but maybe others also didn't.

Derek Manzello, Ph.D.:

So this is a type of wrass, it's spelled W-R-A-S-S. So these are small little fish. They're very common on coral reefs all over the world.

Monica Allen:

Okay.

Derek Manzello, Ph.D.:

And this particular species of RAs and they Eastern Pacific is really conspicuous all throughout the region. And normally, it does not feed on coral. But for whatever reason, after this mass ditching started taking place, our colleagues in Mexico are reporting that it has started to feed on coral tissues, which is a very interesting observation.

Speaker 2:

Thanks, Derek.

Speaker 5:

Our next question comes from Catrin Einhorn with the New York Times. Your line is open.

Catrin Einhorn:

Hi, thank you so much for this. I guess we're hearing two things, right? We're hearing about this sort of terrifyingly unprecedented situation that corals are dealing with in Florida and perhaps more broadly. And we're also hearing

about these Herculean efforts to continue restoring the Florida reef despite how degraded it already is. And I wonder if it would be easy for journalists to take away, well, things are really bad, but we're doing all these things to make sure that it's going to be okay, and kind of so you don't have to worry. And is that the takeaway that you want us to have? What's the takeaway that you want us to have?

Andy Bruckner, Ph.D.:

So this was Andy Bruckner, I'll jump in first and other folks can add to this, and I'd say, no, we do need to worry. We are conducting this restoration. We recognize that there's these stresses. When we planned Mission: Iconic Reefs, we also knew that it's very likely that we are going to have some of these disturbances, like this particular bleaching event or a hurricane, or there's a number of things that can cause setbacks in our progress of restoration. That said, we're not doing it in a vacuum. The whole key thing about Mission: Iconic Reefs is that we are taking into account a lot of these other factors like this heatwave event and looking at strategies that we can start implementing in our restoration to ensure that the corals are better able to adapt and tolerate the changing environmental conditions. We expected from day one that we would lose some of these corals, but as we're going along, we're learning and advancing. And so there's sort of two pieces here.

One of them is that we have made an effort to ensure that we don't lose the genetic stock that we have. We've gone through and characterized what's remaining. We've characterized, we're starting to characterize the biology and physiology of these corals and understand how within one species there's individual genetic strains that have different tolerances to different sorts of stresses. There are certain ones that may be more tolerant to disease or resist disease, there are certain ones that can tolerate higher temperatures, and there's a lot more to it than that, the symbiance that Ian was mentioning and everything else.

And so the whole intent here is that we're trying to protect the genetic resources that we have, put them back on the reef, but do other actions at the same time so that we improve the overall condition of that reef system. So we have a whole other management plan that we're currently working on revising to look at things like water quality and the other stresses that are affecting these corals. So we know that overall we need to, as a global society, address CO2 emissions. But what we're really trying to do is we're more or less buying time, and we're trying to build a self-sustaining reef by putting more of these corals that can better tolerate these changes out onto the reef system.

Ian Enochs, Ph.D.:

This is Ian Enochs, if I can add to that, please. I would say that myself and my colleagues have become quite calloused to stress on coral reefs, unfortunately, because we've seen unfortunately decline in the health of these ecosystems. But speaking with many of them, as I have over the last several weeks, we are all quite concerned and worried and stressed about this event because it is happening earlier and then more extreme temperatures than we have been used to seeing. Going to that site, which I said I'd been going to for more than 10 years, and seeing literally everything bleached, it's not a normal thing. And it affects all of us.

Also, to your point, I would say that people that are involved with restoration and from developing these technologies and to working on all of these things are some of the most committed and hardworking, and passionate people that I've ever met, and are doing as much as they can. But none of them, none of them think that they are absolutely doing enough and have this entirely solved. It is really clear that we need to keep doing what we're doing, but do it more of it, do it at a bigger scale if we're really hoping to try to address the scale of the problem as we're seeing it unfold. Thank you.

Derek Manzello, Ph.D.:

Hey, this is Derek Manzello. I'd like to jump in and just add a little bit to that. So one of the things that concerns me right now, so as Andy mentioned, we're learning a heck of a lot right now as this is unfolding, and the Herculean effort by state, local, and federal and government and non-governmental organizations in Florida has been awe-inspiring. I mean, I had been just in awe of what has taken place, but as this continues and it starts spreading throughout the Caribbean, one of my big concerns right now is we don't have the resources in place to fully document what is going to happen and what we're going to lose and how we're going to lose it. And what I mean by that is we don't have the resources to do the surveys at the level of resolution that we need to go out and get before data points, during-event data points, and post-event data points.

And the reason that's so crucial is because with that information then we will be able to know exactly what species die first from the heat, what species can survive the heat, what species might be able to survive the heat, but then they go on to die from disease. And all of this information is vital. If we really hope to make a dent in restoring the coral reefs of Florida Keys. I mean we really, really need this information. Right now there's just no funding in the entire world to gather the information we need to really document what is lost, how it's lost, and what is actually really killing the corals. Is it the heat directly, is it secondary infections and coral disease? I mean, all of this information can be utilized by restoration practitioners.

For instance, during the next bleaching event, if they had all that information, they would know, okay, species A, we got to get that out of the water right now. However, species B is probably going to survive, but we need to do something to ameliorate any increased disease risk for that species moving forward. So these are the kinds of things that need to be done, and unfortunately, we're going to have a huge information bottleneck, and we're just not going to be able to gather enough information to understand what is truly being lost and how it's being lost as a result of the heat stress event.

And this is evidenced by the fact of what we've seen in the key so far. A lot of the staghorn and [inaudible] corals where it's been the hottest, have experienced rapid tissue loss. They didn't even bleach, they just died. And the other thing that's happened in Florida that's really shocking to me is that a lot of places soft corals have just immediately died. And throughout the entire Caribbean, soft corals up until now have been a winner. Their populations have either been sustained or have actually increased throughout the entire Caribbean as the hard corals have declined. So I was completely shocked by the fact that soft corals essentially just were dropping dead in Florida as a result of the heat shock.

So just to kind of wrap it all up, my soapbox feature is that the resources we need to really do our jobs and to really put a dent in the climate crisis that is impacting coral reefs, we just don't have them right now, and it's really unfortunate.

Jennifer Koss:

This is Jennifer Kross. I'd love to jump in too and just say that I echo everything that everyone has said before. It is devastating. People are anxious, they're depressed, but at the same time, they're pitching in and doing everything that they can because we all know this is not a resource we can afford to lose. We cannot stop afford to lose coral reefs. The ecosystem and societal values that they provide to coastal communities, particularly Florida along the southeastern and the Keys, is critical to sustaining economies and the safety ...

Jennifer Koss:

... in the Keys. It's critical to sustaining economies and the safety of the people that live there. As horrible as it is, we're in it and we're going to fight to the death. Figure out how to make sure corals can buy enough time to withstand this event.

Speaker 6:

Is it possible for me to just ask one quick follow-up question?

Monica Allen:

We've got quite a few questions still waiting, and we're running out of time.

Speaker 6:

Okay. You come back to me at the end, if there's time-

Monica Allen:

Yeah, and also we can help you later too.

Speaker 6:

Thank you.

Operator:

Our next question comes from Jenny Staletovich with WLRN. Your line is open.

Jenny Staletovich:

Sorry, can you hear me?

Operator:

Yes.

Jenny Staletovich:

You can hear me?

Operator:

Yep.

Monica Allen:

I can hear you.

Jenny Staletovich:

Okay.

Monica Allen:

Yep.

Jenny Staletovich:

Okay, so sorry about that. My question goes back to the scale of the problem, and Derek might be able to answer this, which is we've had eight bleaching events about in Florida. You talk about this being Caribbean wide, seven in the Pacific, five in the Atlantic. Has that ever happened before? How would you measure this compared to past events that were broad enough to cover the whole system? Then the second part of that is we know things don't stay put in the ocean. If you start losing reefs all around the system, what happens?

Derek Manzello, Ph.D.:

Great question. One of the things that I think maybe people fail to realize is that mass coral bleaching, driven by climate change, has been impacting coral reefs for 40 years. The first mass coral bleaching event that took place that impacted an entire region happened during the 1982, '83 El Nino event, in the eastern tropical Pacific. Coral reefs were impacted from Mexico down to Panama, Columbia, and through the Galapagos Islands. There was about 75% mortality in Panama for the corals. But in the Galapagos there was about 95% to 99% mortality. Then mortality was so great that all the branching coral [inaudible] reef structures in the Galapagos were rapidly bioeroded, and completely lost in about 10 years time. Now, since this first mass coral bleaching event took place 40 years ago in the Eastern Pacific, what we have seen throughout the world is that coral bleaching has increased in severity, magnitude, and duration.

In 1998, we experienced our first global coral bleaching event, which means corals bleached in the Indian Pacific and Caribbean seas. Since then, we've experienced two more global bleaching events. There was a global bleaching event in 2010. The most severe global bleaching event took place in 2014 through 2017. This again was on the back of a very strong El Nino. What is concerning us now is that again, we are right on the cusp of a very strong El Nino. What is happening right now is exactly what happened during the last global bleaching event. Now, it's still way too early to predict whether or not there will be a global bleaching event, but if we compare what is happening right now to what happened in the beginning of the past global bleaching event, things are worse now than they were in 2014 to 2017.

To put the 2014-2017 event into context, more than 75% of the world's coral reefs experienced bleaching level heat stress, and more than half of the world's coral reefs experienced multiple bleaching events. There is a big concern among the coral reef science community right now that we are potentially walking into another global bleaching event, based on what we know and what history has taught us in the past. This is a very serious event, and again, Florida is just the tip of the iceberg. As things progress, we're very closely monitoring what is happening throughout the world's oceans, because again, as I said, Florida is just the tip of the iceberg.

Jenny Staletovich:

Thank you. Can you talk a little bit about what would be lost if these reefs start to collapse?

Monica Allen:

We're going to have to move to the... we've got a few more questions.

Jenny Staletovich:

Okay. Sorry about-

Monica Allen:

We're going to try to take all the questions we have right now, and then we're going to... if you want to do further interviews, you can get in touch with me, or my colleagues, and we'll try to set something up for you. Operator, please take the next questions and we'll go to hear from those folks who've been waiting.

Operator:

Certainly. Our next question comes from Alex Harris with the Miami Herald. Your line is open.

Alex Harris:

Hi there. I was wondering if you could share more about the pilot shading programs, and if that's a scalable idea for all of Southeast Florida and the Keys reefs, or if it only works in some scenarios, and how much if you know, degree difference does that make?

Andy Bruckner, Ph.D.:

This is Andy Bruckner. I will start on that and other folks can jump in on this. Shading has been... shading is something we use all the time, for instance, on land-based coral production facilities, basically to keep down the amount of light. We know that it's a critical piece. It's not necessarily intended to reduce the temperature in that area. It's actually trying to reduce the amount of light, because what we've seen is when these corals are exposed to really high temperature stress, if there is the compounding impact from high light level, that tends to make bleaching much more severe. That said, we know that shading works the best if you get out there and shade corals early in the event. When you have maybe three to six degree heating weeks, it's been shown to be very effective in some small scale pilots that have been tried on the Great Barrier Reef and in a few other locations, and it's been used in coral nurseries very, very effectively.

We also do know that when corals do bleach, when you shade them and if you supplement them then with food and things like that, that can actually make them recover quickly. In terms of scalability of this, there's a lot of challenges to doing this, and all we're trying to do this year is really just to demonstrate proof of concept, because it really hasn't been tried a lot on the reefs. It's been used more in confined areas like coral nurseries. Our intent is just to try to find suitable materials to figure out different ways to deploy it, and then to start measuring how these different materials affect the amount of light and the temperature underneath those areas. We'd love to scale this up, but any of these interventions, you have to remember that they're really challenging. Realistically, where I see where we could go with shading is for certain really high value areas, you would potentially be able to shade those in an event like this, but not the entire reef system.

Monica Allen:

Next question, please, operator.

Operator:

Certainly. Our next question comes from Tim O'Hara with the Key West Citizen. Your line is open.

Tim O'Hara:

Yeah. My first question, I just would like to ask two fairly quick questions, I would think. My first one's for Andy. About a year ago, Andy, you said at a Sanctuary Advisory Council meeting when they kicked off the Restoration Blueprint, that the Keys reef is at a tipping point, and it could be the first major US ecosystem collapse this century. Have we surpassed that tipping point, and are we seeing that collapse now, do you think? Then also you guys were talking

about funding. There's been a huge effort put into moving corals to deeper water, shading, all of these things. What is the government doing federally and state to pitch in here? How much is this cost, let's say moat and reef renewal, the Sanctuary, and moving all of this stuff, and doing it? Do you have any costs on that? Are any requests in right now to the federal government to bring extra funding into the Sanctuary itself, or into grants to help this cover all of these costs that a lot of it are being born out of pocket by the Sanctuary and the local groups?

Andy Bruckner, Ph.D.:

Okay, this is Andy Bruckner. I'll try to answer that. Yes, I mean, I still think that we are near a tipping point, and how this event unfolds will tell us a little more when we're there, but I still don't think that it's too late. I mean, I think that as long as we take the actions we have. We've demonstrated over the last three years that in some of the sites we've been very, very successful at restoring the coral. Prior to this event, we had areas where there were thickets of elkhorn coral, and staghorn coral, again, that had been reestablished, and we were starting to see some of the other community members coming back in those spots. Given where our technology is and everything that we've done, as well as the new measures we're proposing in our Restoration Blueprint to address other stresses that are affecting these reefs, I think that as long as we really dedicate a lot of efforts, and we continue to make progress here, that we still have a while before we would say that these reefs are too far gone, that they won't come back.

In terms of the funding, I can't provide you with exact dollar amounts, but what I can tell you is this whole rescue effort has been a collaborative effort. Each of the restoration practitioners are focusing on their corals. We've brought in other folks, both the sanctuary divers from our buoy team and our science team, have been out with them, helping them set up new ropes, move the corals onto land to establish new moorings, and doing a lot of that work. Then the other really positive thing is through NOAA's Coral Reef Conservation Program, and I think Jen Koss can probably speak more about this, but there's some NFWF emergency funding that's coming out to support the efforts that all of the practitioners, and our partners are doing to help support the costs of moving these corals, the infrastructure needs. There's other costs as well. You have maintenance costs once they're on land. You need people that are good in husbandry to take care of the corals.

Yes, the federal government is providing a lot of funding for that. I just don't know, because it's too early yet. We really don't know what the costs are.

Monica Allen:

Thanks, Andy. We'll go to our last question.

Operator:

Our final question comes from Cat Clifford with CNBC. Your line is open.

Cat Clifford:

Hi, can you hear me?

Monica Allen:

We hear you fine. Yep.

Cat Clifford:

Okay, super. Thank you so much. Outside of the inherent importance of the biodiversity in keeping these coral reefs alive, can you speak to the implications of why coral reefs are important? Again, putting the importance of every creature and such aside, which I recognize, but what are the other implications? What are the cascading implications? Why is it so important to keep these coral reefs alive? Thank you.

Ian Enochs, Ph.D.:

I can take this one. This is Ian Enochs.

Monica Allen:

Great.

Ian Enochs, Ph.D.:

I think it's really important to recognize you're speaking to some NOAA scientists here, which we are all within the Department of Commerce, so we can be really clear about all of the ecosystem services, all the economic benefits, all the commerce that coral reefs support. Coral reefs obviously support fisheries and food to coastal economies, and also recreation. There's scuba divers, if people go out to reefs to go fishing. Also, all of the other things that are associated with that as well, Hotels, restaurants, whatnot. Reefs are also really important for buffering storm energy and hurricane wave action that would otherwise pummel our shorelines, and our coastal infrastructure. They are living walls that break that energy from hitting our shores. Maybe Andy has the number better than I do, but I know that billions of dollars of economic value are ascribed to coral reefs throughout the Keys on a yearly basis.

If we look wider throughout reefs throughout the Caribbean, and throughout the rest of the world, it's incredibly high value from all of these different ecosystem services. Again, there are a whole bunch of economic benefits, but that's really not the only thing. I really want to come back to that just inherent absolutely amazing value of just all of the different species and beauty that these natural ecosystems provide, and that really cannot be discounted, as well.

Monica Allen:

Thank you so much, Andy... I mean, thank you so much, Ian, and thank you so much Andy, and thank you so much, Derek, for your great answers, and Jennifer Koss, as well. We have no further questions, and we're going to wrap up the call. First, I'd like to also thank all the journalists who hung in there for the little extra bit so we could get everyone's questions in, and then also to Steve Thur and all our speakers. Because the coral event is ongoing, and NOAA's Mission: Iconic Reefs is currently doing an assessment, we look forward to keeping the media updated when we have those assessment results, and other info to share. Also, I encourage you to go to research.noaa.gov for media resources, including photos, videos, and stories, and lots of background that you can use in your stories. Lastly, an audio file of this call will be posted on noaa.gov, the noaa.gov/media-advisories, and on that resource page on research.noaa.gov later today. If you have any further questions, or you need more interviews, please email me at monica.allen@noaa.gov, or my colleagues katherine.silverstein@noaa.gov, or nesdis.pa.noaa.gov. Thank you very much.

Operator:

That does conclude today's conference. Thank you for your participation. You may disconnect your lines at this time.

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