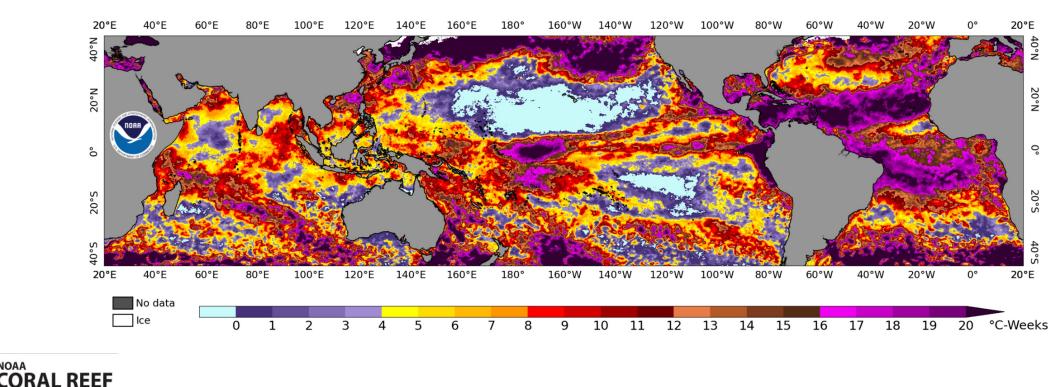
### The 4<sup>th</sup> Global Coral Bleaching Event (GBE4): 2023 - ?

Derek Manzello, Ph.D. NOAA Coral Reef Watch

NOAA Coral Reef Watch 5km Degree Heating Week Maximum (v3.1) 1 January 2023 - 31 August 2024





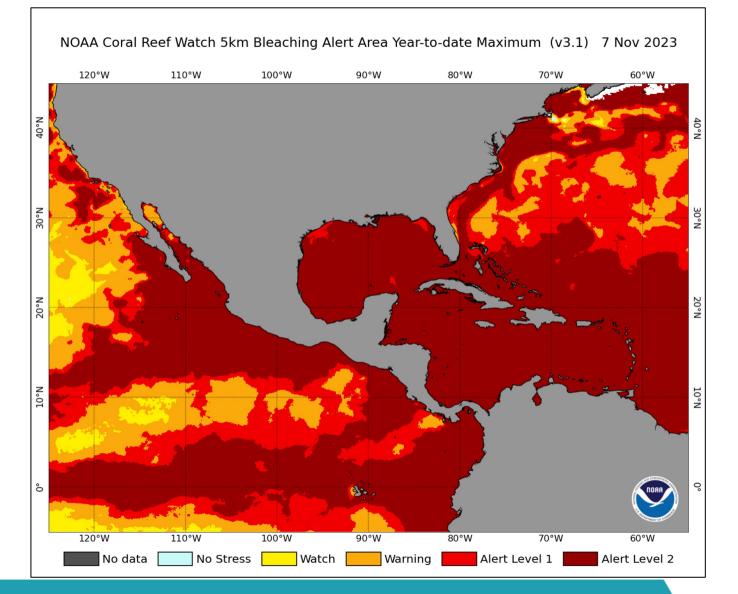
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# Bleaching Alert Levels: A New Reality

Bleaching Alert Level 1 (4 < DHW < 8) Significant Bleaching Likely

Bleaching Alert Level 2 (DHW > 8) Severe Bleaching and Significant Mortality Likely





## **New Bleaching Alert Levels**

Bleaching Alert Level 1 (4 < DHW < 8) <u>Reef-Wide Bleaching</u>

Bleaching Alert Level 2 (8 < DHW < 12) Reef-Wide Bleaching with Mortality of Heat-Sensitive Corals

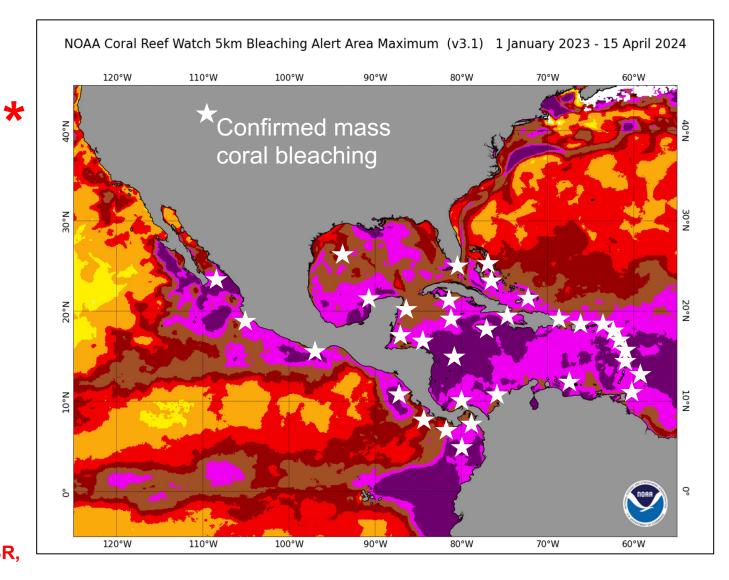
Bleaching Alert Level 3 (12 < DHW <16) Multi-Species Mortality

Bleaching Alert Level 4 (16 < DHW < 20) <u>Severe, Multi-Species Mortality</u> (> 50% of corals)

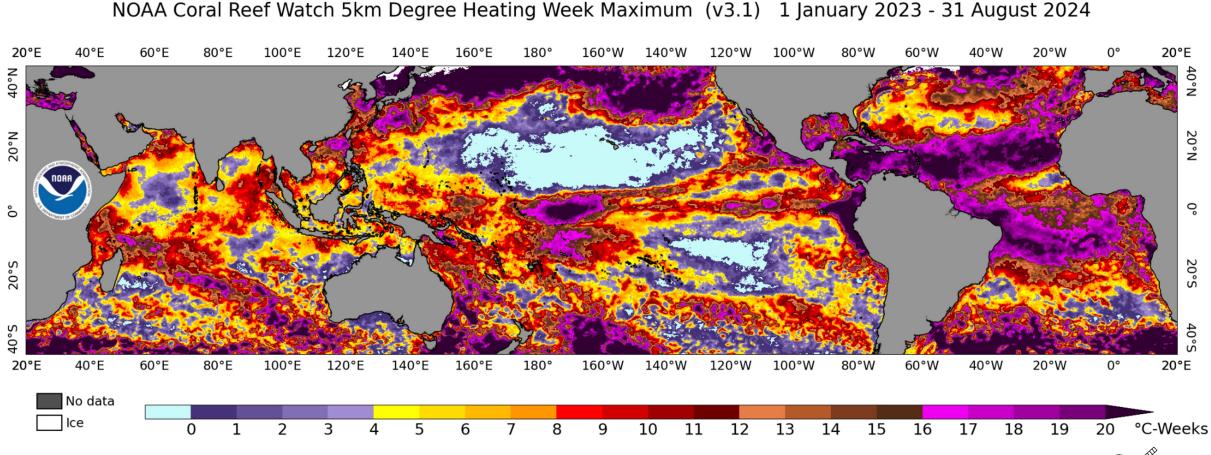
Bleaching Alert Level 5 (DHW > 20)

Near Complete Mortality (> 80% of corals)
★ Severe coral mortality can occur at AL2: -for heat sensitive species (*Acropora*) -when a reef experiences 1st event (e.g., NGBR,





# Max Degree Heating Weeks: 2023 - 2024



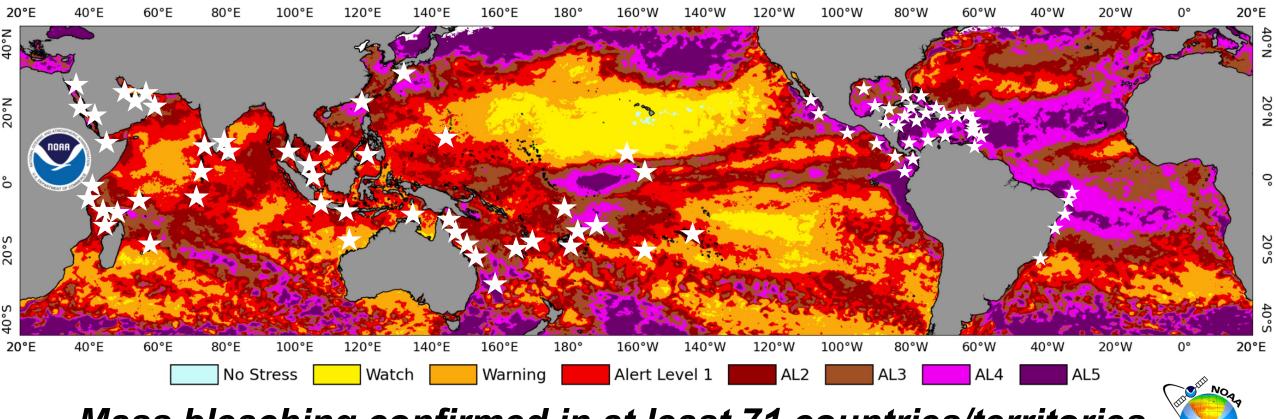




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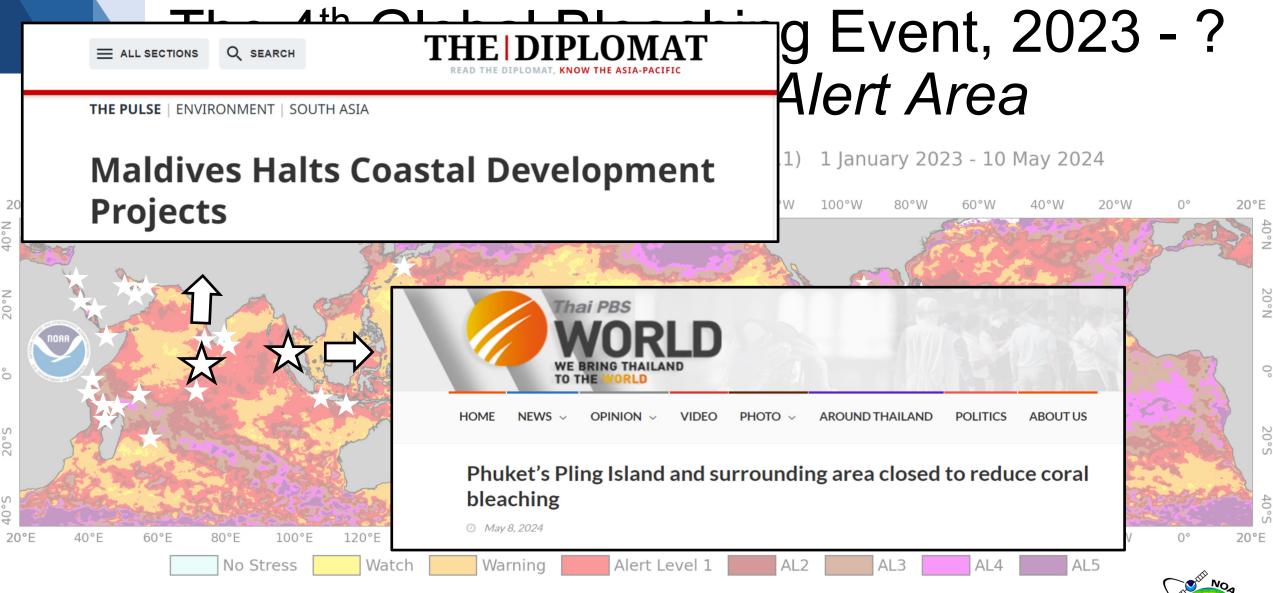
## The 4<sup>th</sup> Global Bleaching Event, 2023 - ? Max Bleaching Alert Area

NOAA Coral Reef Watch 5km Bleaching Alert Area Maximum (v3.1) 1 January 2023 - 31 August 2024



### Mass bleaching confirmed in at least 71 countries/territories



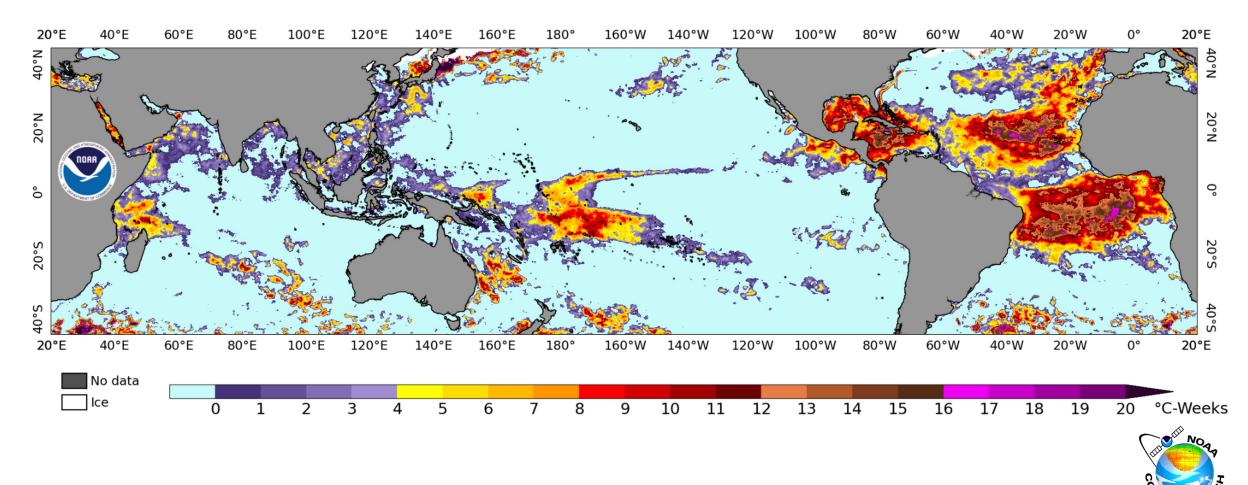


### Mass bleaching confirmed in at least 71 countries/territories



## **Record-Setting Heat Stress**

### $\Delta DHW = (Max DHW_{2023-2024}) - (Max DHW_{1985-2022})$





## Ranking the 4 Global Coral Bleaching Events

#### **Global Bleaching Event Index\***

Event	Years	Peak % Reef Area Impacted
GBE1	1998	20%
GBE2	2010	35%
GBE3	2014-2017	56.1%
GBE4	2023-?	73.1% and increasing

From 1 Jan 2023 to 31 August 2024, 76.5% of world's reef area has experienced bleaching-level heat stress

### **Resultant Impacts**

- 8% of world's corals died in 1998
- 14% further loss from 2009-2018

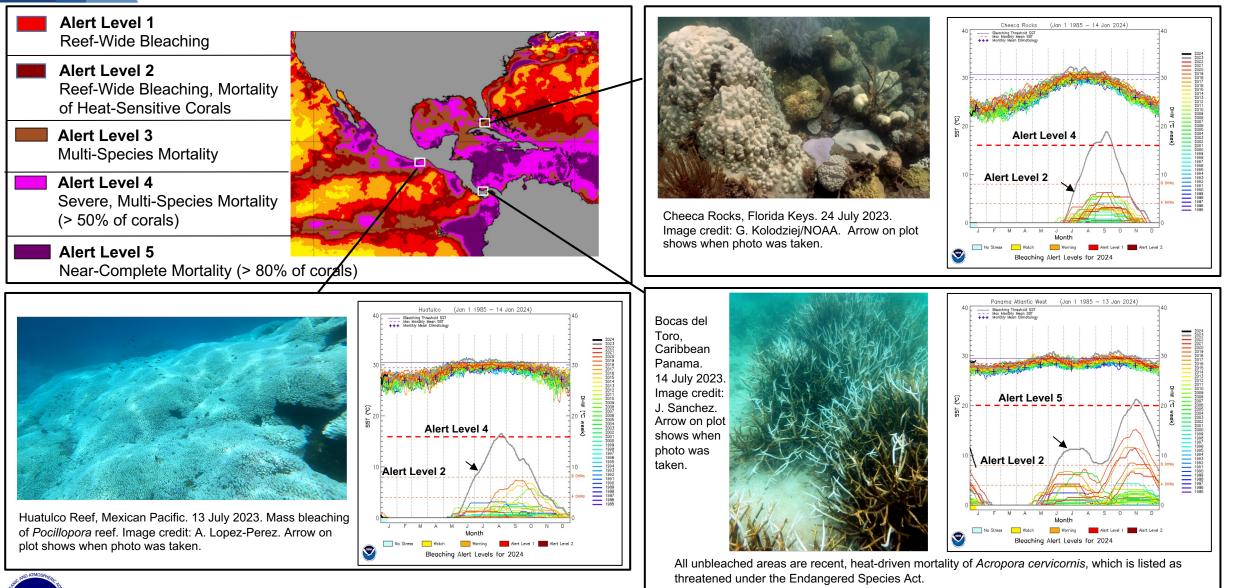
Source: Status of Coral Reefs of the World: 2020

99.9% of Atlantic reef areas have experienced bleaching-level heat stress within past year





## 2023 Max Bleaching Alert Area



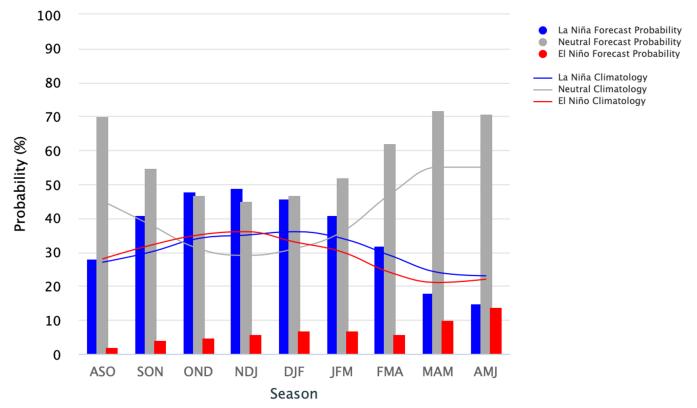
# Good Riddance, El Niño!

-ENSO-neutral

-"Borderline" La Niña may develop in Nov 2024 – Jan 2025

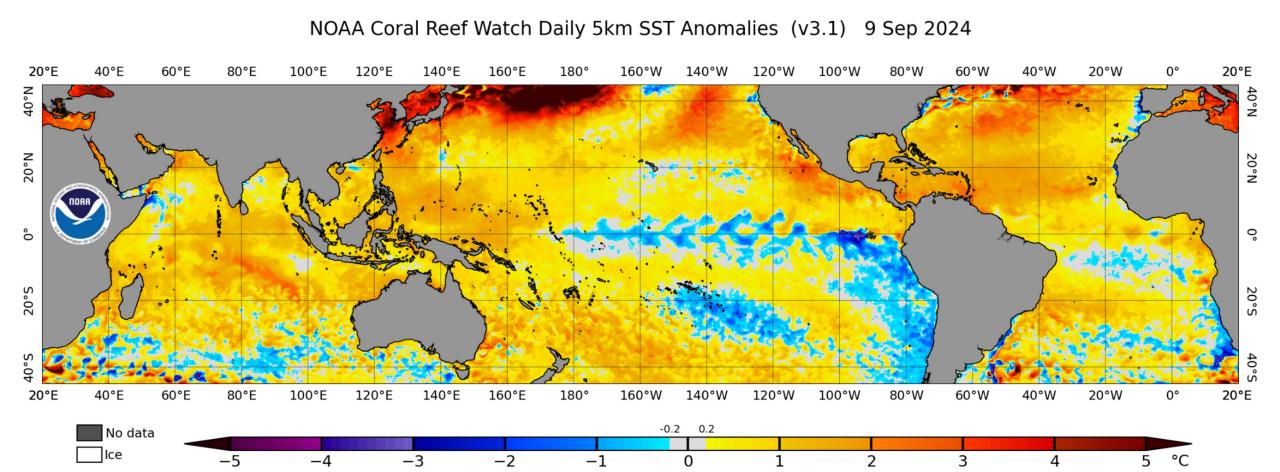
-Remergence of ENSO-neutral in early 2025 Mid-August 2024 IRI Model-Based Probabilistic ENSO Forecasts

ENSO state based on NINO3.4 SST Anomaly Neutral ENSO: -0.5  $^{\circ}\mathrm{C}$  to 0.5  $^{\circ}\mathrm{C}$ 





# ...But, the ocean is still running a serious fever...



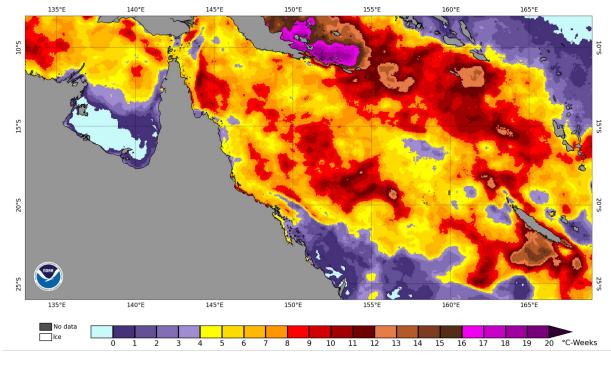


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# ...and mass bleaching is now occurring during all phases of ENSO...

- First mass bleaching event on the Great Barrier Reef during La Niña in 2022 (Spady et al. 2022, *F1000*)
- Ocean temps have warmed to where large-scale bleaching now occurs out of phase with El Niño

NOAA Coral Reef Watch 5km Degree Heating Week Annual Maximum(v3.1) 2022



Max 2022 DHW for GBR

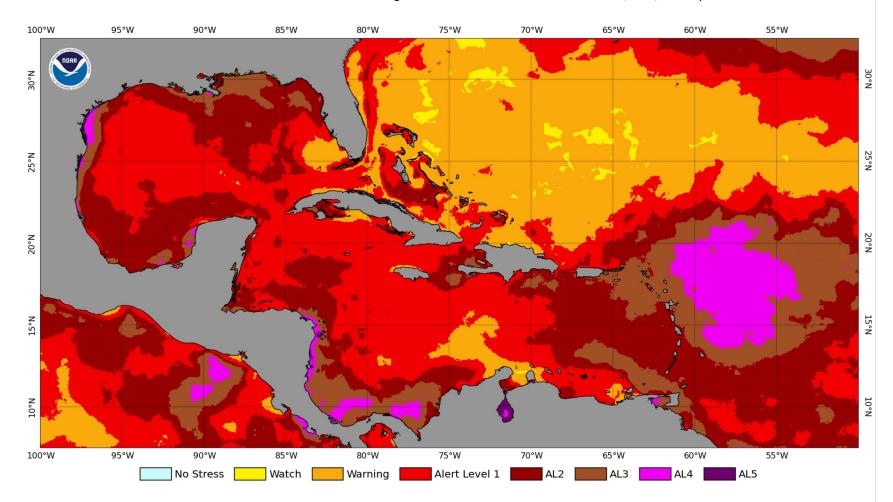


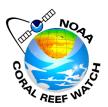


## Another Very Hot Year for Caribbean

NOAA Coral Reef Watch 5km Bleaching Alert Area Year-to-date Maximum (v3.1) 9 Sep 2024

Max 2024 Bleaching Alert Levels

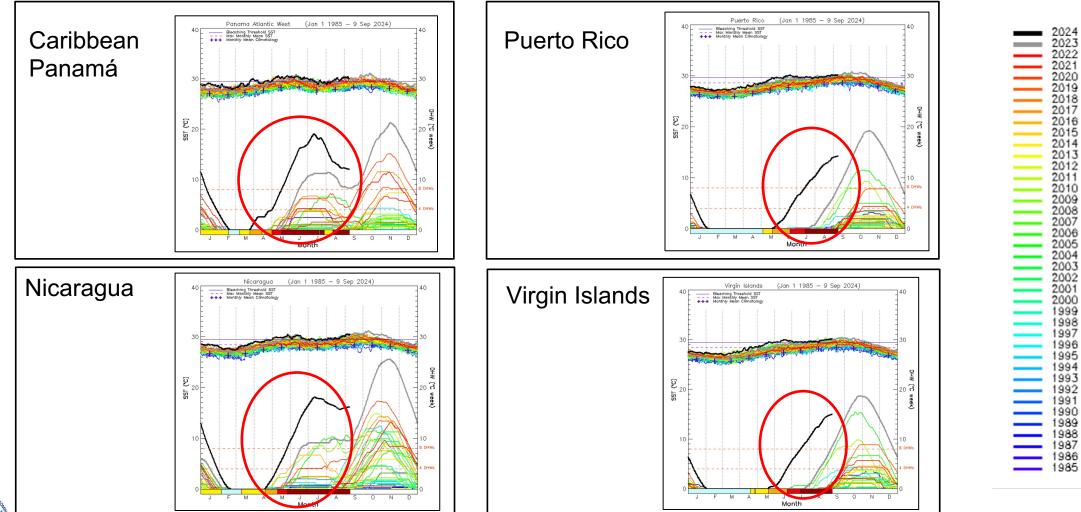






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# Unprecedented Caribbean heat stress patterns in 2024, yet again....





# Now what?

Coral Reefs (2009) 28:925–937 DOI 10.1007/s00338-009-0531-7

REPORT

# Coral disease following massive bleaching in 2005 causes 60% decline in coral cover on reefs in the US Virgin Islands

J. Miller · E. Muller · C. Rogers · R. Waara · A. Atkinson · K. R. T. Whelan · M. Patterson · B. Witcher

 Post-bleaching disease outbreak for two years after heat stress stopped led to 60% decline in coral cover

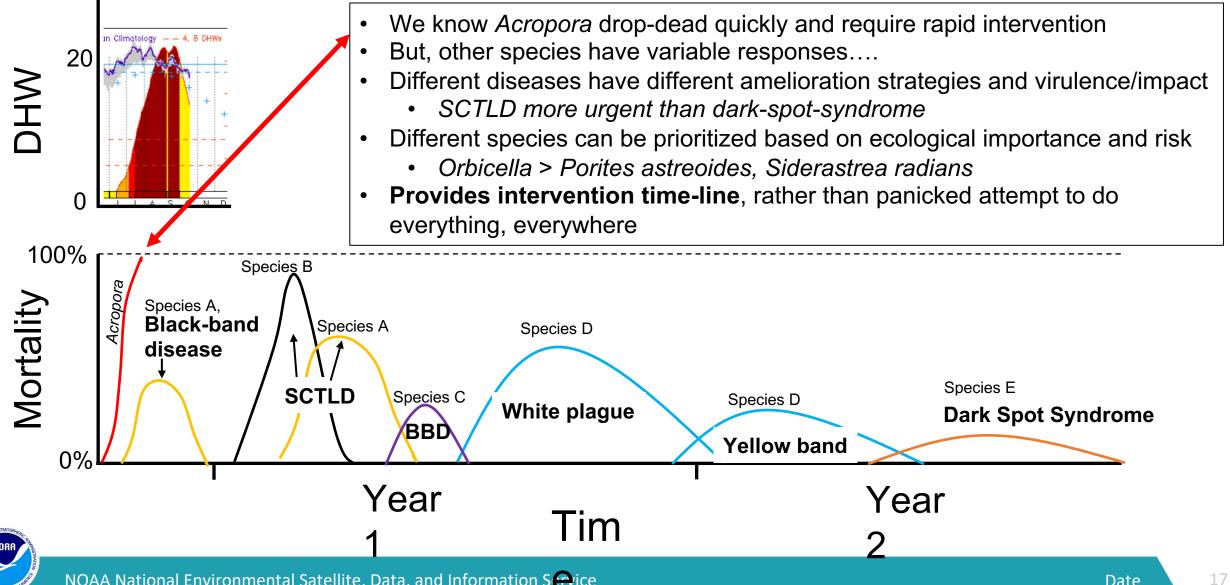


### The Importance of Post-Bleaching Monitoring: *Corallivory*

- Coral-eating snails can form aggregations and decimate the survivors!
  - Indo-Pacific *Drupella* form aggregations on corals that resisted bleaching (Bruckner et al. 2017)
  - Caribbean Coralliophila specifically target Acropora colonies with damage or disease (Bright et al. 2015)
- Removing corallivores is a well-known, viable intervention to save corals recovering from bleaching (e.g., Williams et al. 2014; Shaver et al. 2018; Rogers and Plagányi 2022)

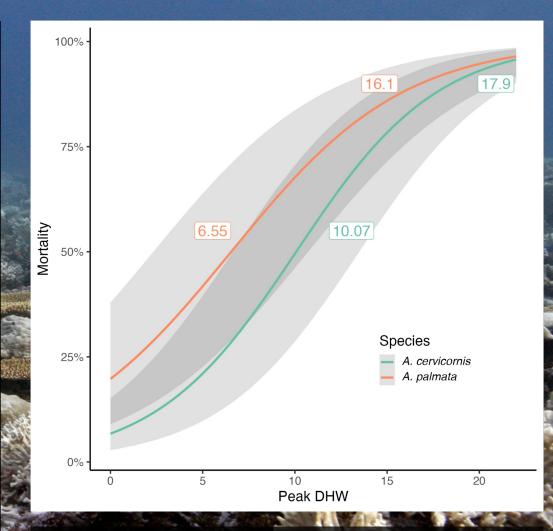


## **Knowledge is Power** Hypothetical Community Response to Heat



## Bleaching Monitoring: What is it good for?

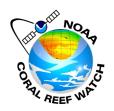
- Establish Intervention Timelines
  - Taxa-specific bleaching/mortality curves
  - Is the timing of disease and corallivore outbreaks predictable?
- Other Key Benefits
  - Allows identification of Refugia, Heattolerant Genotypes, and possible acclimatization
  - We need to document what is lost and needs to be restored
  - Establish bleaching severity mortality relationships (e.g. GBR)



Relationship between max DHW and mortality of *Acropora palmata* (APAL) and *Acropora cervicornis* (ACER) from Florida.

## Summary and Conclusions

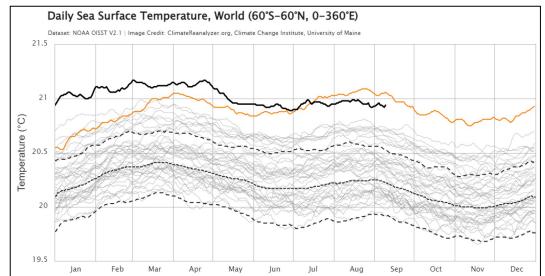
- The world is experiencing it's 4th Global Coral Bleaching Event
- Since February 2023, coral bleaching reported in 71 countries/territories spanning all ocean basins
  - 76.5% of world's reef area impacted since Jan 2023
- There is a dearth of bleaching monitoring data! This is not good!
- Monitoring needed during bleaching and <u>1-2 years after</u> heat stress subsides!
  - Allows identification of resilient reefs, species, and genotypes
  - Provides blueprint for how to save corals during the next, inevitable coral bleaching event
- Impacts from this event will take 1-2 years to fully understand
  - We do know there were severe impacts to Acropora in wider Caribbean
  - First publication from Mex Pac 50-93% mortality (Lopez-Perez et al. 2024, Oceans)

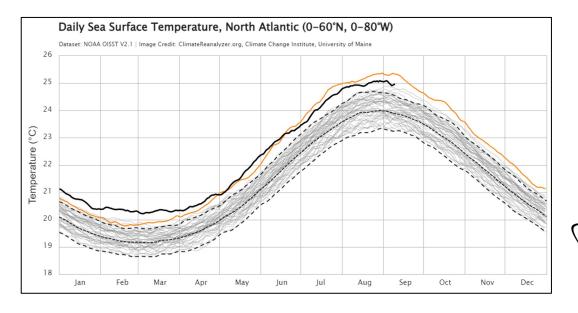




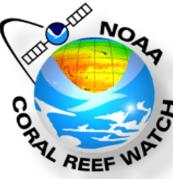
# Summary and Conclusions II

- These are "strange days" for global ocean temps
- The end of El Niño is good news...
  - ...but ocean still running a serious fever
- Important to understand the timing of subsequent disease and corallivore outbreaks
  - Many corals can survive bleaching, but later die from disease or predation
  - Preventing a local extinction could be as simple as picking snails off recovering corals!!









#### Thank you from the **NOAA Coral Reef Watch Team!!**





Federal Coordinator

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