

*United Nations Environment Programme
(UNEP)*

*Promoting laws to protect
and aid marine life and
local communities amidst
the rise of marine
heatwaves*



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I. INTRODUCTION

The United Nations Environment Programme (UNEP) was founded in 1972 in Stockholm, Sweden, following the landmark UN Conference on the Human Environment. UNEP was established to track environmental conditions, provide scientific evidence for policy decisions, and organize global environmental crisis responses. Since its founding, UNEP has collaborated closely with its 193 Member States and other key players to mobilize global pledges and coordinated efforts to tackle several urgent environmental issues facing the globe. It also plays a leading role as the docking station for 15 multilateral environmental agreements (UN environmental program, n.d).

The United Nations Environment Programme is the leading global authority on the environment. The goal of UNEP is to encourage, educate, and empower countries and peoples to enhance their standard of living while preserving that of coming generations. For nearly fifty years, UNEP has been working with governments, businesses, civil society, and UN agencies to address critical environmental challenges such as preserving the ozone layer, protecting the world's oceans, and developing a green, inclusive economy by concentrating on the fundamental causes of pollution, biodiversity loss, climate change, and the triple global catastrophe. Their goals are to support nations in their transition to low-carbon and resource-efficient economies, improve environmental legislation and governance, protect ecosystems, and supply fact based data to guide policy choices. UNEP assists its 193 Member States in achieving the Sustainable Development Goals and coexisting with the environment via innovative science, cooperation, and advocacy (UN environmental program, n.d).

UNEP has already taken action in the Promotion of laws to protect and aid marine life and local communities amidst the rise of marine heatwaves. Half of the world's coral reefs have been lost; in 2016, a 400-mile stretch of the Great Barrier Reef was witnessed dead. 31% of fish stocks are being consumed at unsustainable levels, largely due to illegal, unreported or unregulated activities (UN environment program, n.d).

Scientists have introduced the concept of Marine Heatwaves (MHW), characterizing each MHW event as a distinct duration of unusually warm water for a particular area. As a result, MHWs happen when a location's mean Sea Surface Temperature (SST) rises over thresholds in comparison to a baseline period (climatology). The climatology is computed

with respect to the day of the year, often including an 11-day period. MHWs should have definite start and finish dates, a minimum of five days, and no more than two days of downtime in between. With summary statistics, the occurrences may be further described in terms of frequency, intensity, duration, and spatial extent. A combination of atmospheric and oceanic factors, such as altered ocean currents, momentary wind lulls, decreased cloud cover, elevated air and sea temperatures, etc., can cause marine heatwaves. There is also a relationship between the frequency and severity of maritime heatwaves and natural climatic variability. For instance, in the eastern and central Pacific Ocean, "El Niño" phenomena seem to facilitate the development of marine heatwaves (Coblentz et al., 2023).

Marine ecosystems are facing a tipping point due to sudden temperature rises, leading to mass mortality events and affecting species distribution. "In 1999, the Mediterranean experienced a marine heatwave, causing significant mortality among gorgonians and other benthic organisms. In 2022, temperatures rose by +4 to +6°C above average in the Mediterranean. Higher temperatures can cause toxic algae blooms and alter plankton populations. These extreme events could exacerbate climate change by impairing the ocean's mitigation capacity" (Coblentz et al., 2023). Marine heatwaves also alter the ocean carbon cycle, particularly during extreme weather events like El Niño, impacting "blue carbon" ecosystems that capture large amounts of CO₂ (Coblentz et al., 2023). UNEP continues to play a crucial role in the international effort to protect marine life and assist local people impacted by the rising frequency of heatwaves in the sea. UNEP still supports new policies and initiatives, encouraging the creation of marine protected areas and providing support for the development of capacity and knowledge. By addressing current environmental challenges and advancing the long-term Sustainable Development Goals (SDG's), these projects promote ecological, social, and economic advantages and guarantee a more sustainable and healthy future.

II. HISTORY OF THE PROBLEM

One crucial physical characteristic of the world's seas is their sea surface temperature. The surface temperature of the world's oceans can vary with latitude depending if they are closer to the equator or the Arctic and Antarctic regions. Over the past centuries, significant increases have occurred, making incredible and noticeable changes in the different ecosystems around the world (United States Environmental Protection Agency, 2024).

1980 - 2000

During this time, the term Marine Heatwaves was not widely used, but this phenomenon has persisted in history for many years, as the ocean temperatures have been observed and documented. Since the 1970s, melting and heat expansion have contributed to observed sea level rise going into the 20 to 33 inches, making a noticeable consequence of thermal expansion. In the early 1990's, the sea level has been measured from space using radar altimeters; to estimate the observed sea level rise is due to thermal expansion, they measure sea surface temperature they use, drifting buoys, satellites and water samples that are collected by ships (Lindsey, 2023).

Despite the growing frequency and intensity of marine heatwaves during the 1980s and 1990s, the scientific understanding of this phenomenon was still limited. While researchers may have recognized the phenomenon and its potential impacts, the causes and long-term consequences were not fully understood. The factors of climate change, ocean currents, atmospheric patterns, have been heard during this time, but the contributions and effects were still being explored and interpreted. The lack of extensive historical data made it challenging to predict the long term patterns since technology and methods were not fully developed.

Biodiversity is at higher risk as the time passes. The Great Barrier Reef, is one of the most biologically diverse regions in the world which has faced consequences of the rise in temperatures, and continues with the constant threat of climate change. Unusually warm sea temperatures have caused serious damage to more than 16% of the world's coral reefs. The Great Barrier Reef has experienced eight mass bleaching events since 1979; and over 50% of the reefs experienced bleaching during the most extensive outbreaks in 1998 and 2002 (Australian Government, n.d.). There are two significant events that mark this two decades: the "El Niño" phenomenon which was strong, leading to wide spreading marine heat waves across the Pacific Ocean and a significant disruption to ecosystems and fisheries; the Northeast Pacific heatwave, which was a prolonged period of unusually warm waters that contributed to the decline of certain fish populations.

“El Niño” from 1997 to 1998, was one of the biggest and most researched climate events because of its origin, evolution and the intense one in the records. He contributed to the rising temperatures during 1997 (+0.44°) being the highest value registered in the 20th century. For this, meteorologists, climatologists, oceanographers of international scientific institutions such as the International Research Institute for Climate and Society (IRI), SCRIPPS Institute, National Oceanic and Atmospheric Administration (NOAA), and the Mont-Earth Observatory of Columbia University, have researched and worked on this phenomenon (Capel, 1998). One of the most notable impacts was its influence on global weather patterns, causing extreme events such as heat waves, forest fires and tropical cyclones. It led to massive flooding in many regions, such as South America, Australia and parts of the United States; other areas, such as Indonesia and Philippines, suffered droughts. The warm temperatures in the ocean caused coral bleaching and disrupted fish populations, affecting the human economy and industries (Capel, 1998).

Northeast Pacific heatwave, was a significant event with profound effects and impacts on marine ecosystems and fisheries in the region. It was characterized by unusually warm ocean temperatures that lasted several years and had far reaching consequences. The decline in fish population, particularly salmon. The warm temperatures disrupted the food chain because of the migration of some fish species, causing a change in the ecosystems of some areas. The warmer waters led to increased algal blooms, which can drain oxygen levels in the water and harm marine life. It also contributed to the spread of invasive species, disrupting ecosystem balance (Kowano et al., n.d.).

2000-2020

These centuries were a mark of the witnessed significant increase in the frequency, intensity, and duration of marine heatwaves. Sea surface temperatures increase, exceeding the historical averages. From 1925 to 2016, the global average marine heatwave frequency and duration, increased by 34% and 17%, respectively, resulting in a 54% increase in annual marine heatwave days globally (Oliver et al., 2018). The northern Mediterranean Sea in 2003, the coast of Western Australia in 2011, the northwest Atlantic in 2012, the northeast Pacific during 2013–2015, the area off the southeast coast of Australia in 2015–2016, and the entirety of northern Australia in 2016 were all notable locations for noteworthy events. Prolonged loss of kelp forests, coral bleaching, mass mortality of marine invertebrates from

heat stress, rapid shifts in the ranges of long-distance species and the resulting reconfiguration of community structure, fishery closures or quota changes, and even heightened economic tensions between countries were among the significant ecological and economic effects of these events. These effects show how detrimental MHWs are to marine communities and ecosystems, as well as how they affect their sustainability (Oliver et al., 2018).

The coast of California has experienced several marine heatwaves since 2014, being one of the most recorded marine heatwaves or phenomenon related to the increase in temperatures. In 2014 - 2016, a period of warming at the ocean's surface from 2014 to 2015 was called “The Blob”, which combined with ocean warming from the 2015 - 2016 “El Niño”, resulted in the largest marine heatwave on record for the North Pacific. The mortality of species was at risk, as well as the ecosystems that were being directly affected (*What is a [...]*, n.d.).

Sea surface temperatures show variations from year to year, with warmer and cooler temperatures. Since 1980, satellite based climate data records, reveal that areas with temperatures higher than the mean recorded in 1982-2020, have become more frequent, larger and warmer (*Marine heatwave intensification [...]*, n.d.).

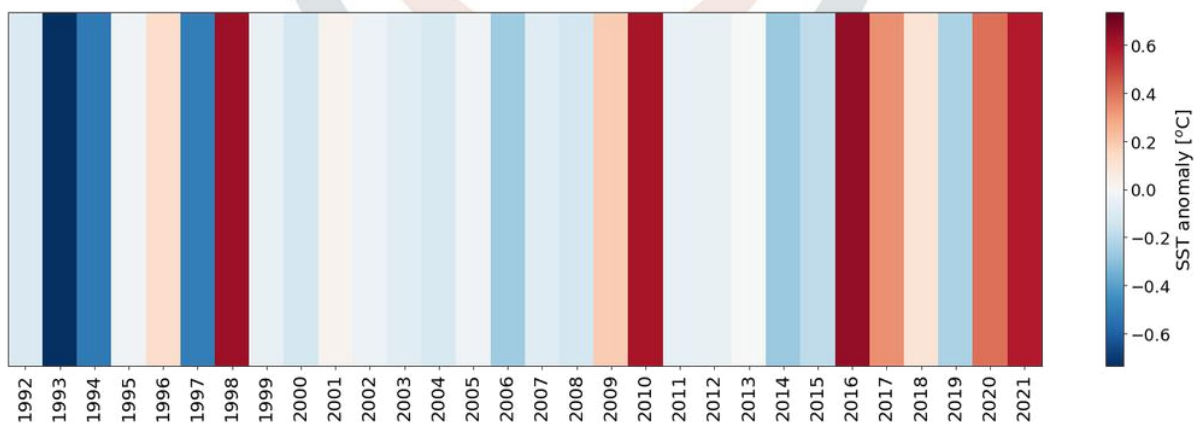


Image 1: (*Marine heatwave intensification [...]*, n.d).

Climate stripes are a way of illustrating the temperature variations. This graphic is a representation of the region around the Great Barrier Reef, and the anomalies apparent during this year.

In the last decades, marine heat waves have become more frequent with higher temperatures each time. It is a threat to the whole world since it is making it vulnerable to some species and making the society suffer these consequences as well. Climate change is something that has progressed over time, however there are people who do not believe the effects until they are affected, and to this day it is something that continues to affect and grow the effects it has on ecosystems, fauna and flora.

III. CURRENT SITUATION

During the last years the problem of the rise of marine heatwaves and the consequences that it has on marine life, has been increasing due to escalating consequences of climate change. Elevated water temperatures have the potential to cause direct mortality in changing ecosystems. The creatures release the algae and become white when the water temperature rises too high. Heat stress induced bleaching in 75% of tropical reefs worldwide between 2014 and 2017, which led to the death of roughly 30% of those reefs. Even profound reefs. Three hundred feet below the surface of the Indian Ocean, researchers discovered coral bleaching (Lohan , 2024). And these are just some of the consequences that can be observed or recorded by scientists.

The yearly cumulative intensity of marine heat waves has grown throughout the displayed period (1982-2023) across the majority of coastal U.S. seas, with the biggest changes occurring in the waters of coast lines of Alaska and the northeast. In The spring and in Alaska in the summer, changes were most noticeable. In the majority of the coastal regions of the United States marine heat waves episodes have increased in frequency and severity in recent years. Changes in frequency, length, and severity at marine protected areas in the Northeast, Alaska and Hawaii are particularly noticeable, as are regional changes in these locations.(EPA, 2024).

Florida's waters were blasted by a maritime heatwave this summer, with one area seeing triple digits in August. Most corals like temperatures between 73 and 84 degrees Fahrenheit. However, temperatures far higher than that resulted in extensive bleaching and reef death in Florida. Thirty percent of marine fish and many other species are at risk of extinction due to the destruction of coral reefs, which also makes coastal towns more vulnerable to storm floods (Lohan , 2024).

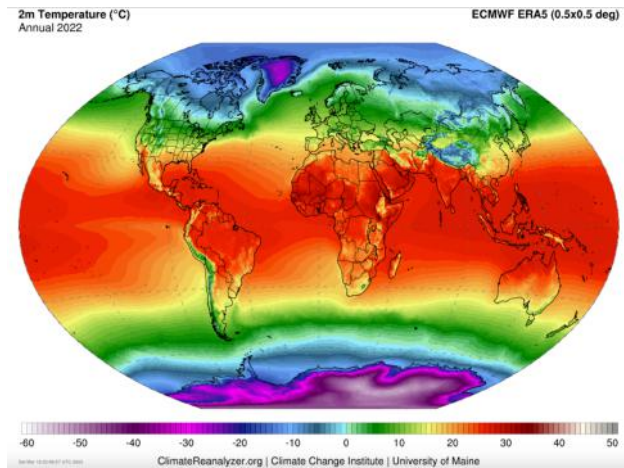


Image 2: (Climate Reanalyzer, 2022)

Since the 1970s, the ocean has been working extra hard, absorbing almost 90% of the extra heat. The year 2023 was the highest on record, and this warmth also extended to the ocean. Global sea surface temperatures reached record monthly highs for five months in a row. August recorded the highest monthly sea surface temperature anomaly in 174 years of NOAA's recordkeeping (Lohan , 2024).

Because of the increasing average sea surface temperature worldwide, marine heat waves are also happening more frequently. The rise of water temperatures above average was credited to a combination of developing “El Niño” in the Pacific Ocean and long-term global change. Elevated sea temperatures have the potential to upset ecological equilibrium, as demonstrated by “The Blob”, a prolonged marine heatwave that occurred in the northern Pacific Ocean from 2013 to 2016. A bloom of toxic algae was encouraged by the warm seas, and as a result, a variety of marine species was poisoned, including sea lions and mussels (Lohan , 2024).

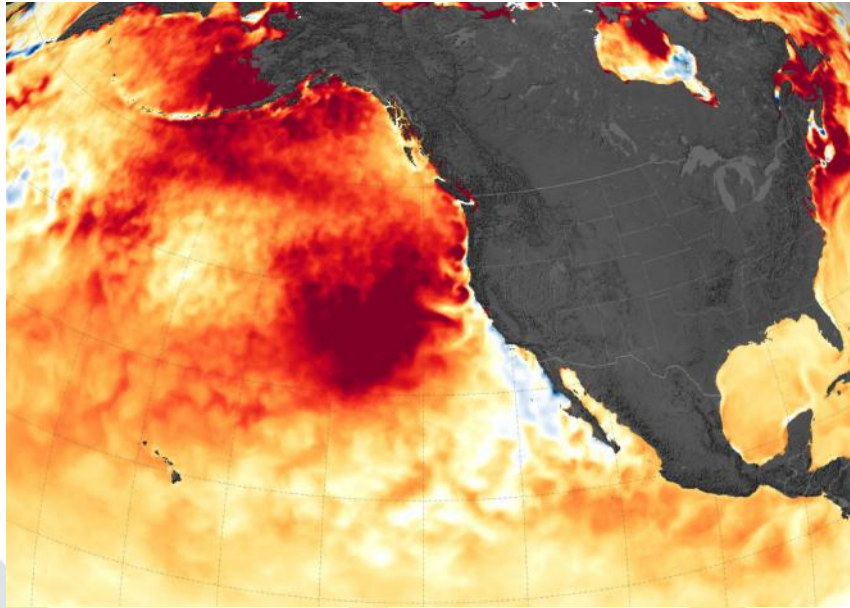


Image 3: (Lohan, 2024)

As the climate is causing the Earth to get warmer, marine heatwaves are becoming longer lasting, more frequent, and more intense. Actually the number of marine heatwaves has doubled since 1982 and recently some extreme events have appeared around the Mediterranean, in the North Atlantic, and Antarctica (National oceanography center n.d.). Some of the main reasons could be: surface heat flux, which is the term used to describe the heating that results from atmospheric high pressure systems being over water for a prolonged amount of time, and advection is the process by which ocean currents bring warm waters into the area. While marine heat waves caused by condensation are deeper and last longer, those caused by surface heat often have a shorter duration. They are important for their occurrence, intensity, and persistence because of oceanic mixing processes (National oceanography center n.d.).

Researchers have been able to investigate marine heatwaves from orbit with the help of satellites that have been tracking sea surface temperatures every day since the early 1980s. When the instruments return to Earth, they are used on permanent ocean observatories and on board ships. Additionally, autonomous robots and floating devices are part of worldwide networks that are constantly gathering data about the ocean throughout the water column. All of these observation systems have shown a general rise in the frequency, severity, and duration of maritime heatwaves. One of the primary causes is the rising mean global

temperature, although other factors include evolving modern systems (National oceanography center, n.d.).

IV. UN ACTIONS

The waters gave rise to life itself. Approximately 72% of the earth's surface, or 140 millions square miles, is made up of the ocean. For as long as there has been documented history, the ocean has supported trade and business, exploration, and adventure in addition to serving as a vital supply of sustenance for the life it helps create. It has caused division as well as unity among people. The majority of people on earth still reside no more than 200 miles from the sea and retain strong ties to it, even in this day and age when the continents have been mapped and their innards made accessible by air, river and road (UN, n.d) The freedom of the seas theory, which was proposed in the 17th century and effectively restricted sovereign rights and jurisdiction over the ocean to a narrow sea belt encircling a country's shore, had long applied to the oceans. The other oceans were proclaimed to belong to no one and to everyone. Although this state of affairs persisted until the middle of the 20th century, there was pressure to expand national claims to offshore resources by the middle of the century. Long distance fishing fleets toll on coastals fish stocks and the potential pollution and waste from transports ships and oil tankers transporting toxic cargoes that traversed international maritime routes were two issues that were causing increasing worry.

United Nations Law of the sea convention (UNCLOS)

This law includes the rights to unrestricted the navigation, to Draw the sea limits that are 12 miles offshore, to establish exclusive economic zones, establish the guidelines for expanding the rights to the continental shelf up to 350 miles offshore and that the international Seabed authority was established additional dispute settlement institutions (such as the UN commission on the Limits of the continental shelf).

Treaty to protect marine environments

Following nearly two decades of intense negotiations, the 193 member states of the United Nations adopted a legally binding agreement on june 19,2023, on marine biodiversity. This agreement covers two thirds of the planet's oceans and aims to create a common wave of conservation and sustainability in the high seas beyond national boundaries.The international conference on marine biodiversity of regions beyond national jurisdiction (BBNJ) approved a

convention with the goal of protecting the ocean for present and future generations. This pact, known as the High Seas Agreement, is compatible with the conventions of the law of the sea (UN n.d).

Protection of marine environment and biodiversity

The United Nations Environment Programme (UNEP), works to safeguard seas and oceans and encourage the sustainable use of marine resources, especially through its regional seas Programme. The sole international legal foundation for regional ocean and sea protection, is found in the regional seas convention and action plans which are agreements among countries sharing a body of water. The global programme of actions for the protection of the marine environment from land based activities was also established by UNEP. It is the only worldwide intergovernmental process that focuses specifically on the relationship between freshwater, coastal, terrestrial, and marine ecosystems. Through the intergovernmental oceanographic commission, the United Nations educational, scientific and cultural organizations (UNESCO) organize programs in marine research surveillance systems, hazard mitigation, and improved management of ocean and coastal areas.

Marine shipping and pollution

The International Maritime Organization (IMO) has established binding energy-efficiency standards to lower greenhouse gas emissions from international shipping as well as rules to address ship emissions of the air pollutants in order to make sure that shipping is cleaner and more environment friendly. Two of these are the international convention for the prevention of pollution of the sea by oil. The 1973 convention for the prevention of pollution from ships, as amended by the 1978 protocol (MARPOL).

Polar Code

The international code for ships operating in polar waters, sometimes known as the polar code, came into effect in 2017. All design, building, equipment, operational, training, search and rescue, and environmental protection issues that are pertinent to ships operating in the icy water around the poles are covered by the polar code. Along with a number of other regulatory improvements pertaining to environmental concerns, supply chain security, and maritime safety, it was a significant regulatory development in the area of trade facilitation and transportation (UN, n,d).

V. POSSIBLE SOLUTIONS

Climate Change is making marine heat waves more frequent and intense, which puts marine ecosystems in threat. Promoting and enforcing regulations that safeguard marine life and assist local communities, is essential to overcoming these obstacles. This may entail establishing marine protected zones, regulating sustainable fishing methods, and offering coastal communities services to help them adjust to shifting ocean conditions. Government, scientist, and local stakeholders may work together to design measures that effectively protect marine biodiversity and human livelihoods. This are the following solutions proposed:

- I. Support marine protected areas. Maritime protected areas (MPAs) safeguard biodiversity, preserve cultural heritage, and promote sustainable maritime resource exploitation.
 - a. Safeguarding teh MPA could function with the help of campaigns and NGOs that are interested in making a change for future generations.
 - b. Participate in beach cleanups and other conservation initiatives to engage with your local community.
 - a. Motivate people to back laws that save our seas. The precise activities allowed in these regions differ based on the MPA's objectives and degree of protection. Participating helps protect marine life and improves the condition of our seas.
- II. Promote laws that establish and protect the ecosystems for a non exploitation source, and support his laws with sanctions and consequences for the ones that do not follow them.
 - a. With the help of NGOs and other organizations, laws can be implemented and safeguard.
 - b. Support the sanctuaries with resources and take care of the place that is being exhibited.

- c. Sanctions can go from monetary sanctions (depending on the event), to prison sanctions with 5 to 15 years depending on the event.

III. Promote the consumption of sustainable food.

- a. Unsustainable fishing practices, and the devastating of ecosystems, pose a global danger to fisheries.
- b. Download the Monterey Bay Aquarium's seafood watch app, and request that the eateries and stores in the desired area purchase seafood from sustainable fisheries. Changing diet will change the environment, personal health and make a change in how we can support climate change and effects. These unsustainable actions all produce greenhouse gasses, which trap solar radiation and cause climate change. Food is a major factor in around one-third of all greenhouse gas emissions created by humans. Land use and agriculture account for the majority of greenhouse emissions associated with food production (National Marine protected Areas, 2009).

IV. Use less plastic. Plastics that wind up in the water as marine trash entangle and kill a great number of marine species in addition to destroying habitats.

- a. Decrease, utilize and recycle. Invest in items that require less packaging and make use of cloth grocery bags and reusable water bottles. Production and extraction: The majority of people are unaware that fossil fuels are the source of plastics. As a matter of fact, the plastics sector contributes around 6% of the world's oil consumption, and by 2025, that percentage is predicted to rise to 20% as a result the energy - intensive producers needed to extract and distill oil result of greenhouse gasses (GHGs) during the plastics production process.
- b. Consumption: The majority of people believe that plastics disappear when they are thrown in recycling bins. However there is no “away” - just 9% of its gear recycled worldwide; the remainder is disposed of in the open air (UN, n.d).

- V. Reducing energy use is a critical step in mitigating MHW, as it helps curb greenhouse gas emissions and slow down global warming, preventing further ocean warming and protecting marine ecosystems.
- a. Energy efficiency: improving energy efficiency in homes, business, and industries can reduce the amount of energy needed to perform some tasks.
 - b. Renewable energy can be a great consideration of energy efficiency.
 - c. Consumer choices are important since they have to make conscious choices as consumers, such as purchasing energy efficient products, reducing waste and contributing to other factors.

VI. COUNTRIES INVOLVED

1. United States of America

Since April 2023, NOAA scientists have seen a continuous rise in ocean temperatures, which is resulting in previously unheard-of heat stress conditions in the Caribbean basin, which includes the waters around Florida and the Gulf of Mexico. Along the Gulf streams route, more isolated maritime heat wave conditions have been seen off the coast of the Northeastern United States. Additionally, a big marine heat wave that has been resting offshore in the northeast pacific (in the gulf of Alaska) since last 2022 has been seen by NOAA. Ninety percent of the surplus heat linked to global warming is absorbed by the ocean. Maritime heatwaves are warming globally as time goes forward. Although the presence occurrence is warmer in absolute terms due to climate change, it most likely would have happened regardless of climate change (NOAA, 2023).

2. Republic of India

The Indian oceans' fast warming has contributed to a rise in marine heatwaves in the tropical indian ocean of up to four times. These maritime heat waves affect the monsoon by decreasing rainfall over the middle Indian subcontinent and increasing it over the southern peninsula in the study published in the journal JGR oceans. The central Indian subcontinent experiences dry weather as a result of marine heatwaves

in the western Indian Ocean and the bay of bengal. In reaction to the heatwaves in the north Bay of Bengal, there is also a notable rise in the southern peninsula of India. These alterations are a result of heatwaves influencing the monsoon winds (CCCR.ITM, n.d).

3. Kingdom of Thailand

Scientists and local populations are concerned as the sea surface temperatures off the Eastern Gulf Coast of Thailand hit record high this month during a regional heat wave, harming aquatic life from fish to coral reefs. About five meters below the surface, the once-vibrant and colorful corals have gone white in a condition known as coral bleaching, which experts believe is an indication that their health was declining as a result of rising water temperatures. In the Eastern Gulf of Thailand, sea surface temperatures have hit 32.73 degrees Celsius earlier this month. However, evidence indicates that underwater readings are slightly warmer, with dive computers registering approximately 33 degrees Celsius (Reuters & VnExpress, 2024).

4. Commonwealth of Australia

This summer, MHWs have affected a large portion of Australia's east coast, from Queensland to Tasmania's southeast. Mass coral bleaching is one of the major effects that these extended oceanic warm water situations may have on marine life. They could even clarify the recent sighting of a marine turtle in the Derwent River in Hobart. Waters below 20°C are rarely home to these turtles. Numerous things, including the introduction of warm water into ocean currents and the warming of the ocean's surface due to atmospheric pressure, might contribute to them. “El Niño”, which was predicted for Australia in 2023, is one example of a climate driver that may affect their frequency, severity, and length (CSIRO, n.d.).

5. People's Republic Of China

Scleractinian coral communities in China's greater bay Area (GBA) in the northern South China Sea (nSCS) underwent an unprecedented bleaching event from July to August 2022, despite the fact that coral communities in this region are frequently regarded as coral thermal refugia because of their high latitude distribution. Coral bleaching was seen at all six locations, which are spread over the primary collar distribution zones of the GBA, according to field studies. In shallow water compared

to deep water, bleaching was more severe, as evidenced by the percentage of bleached cover. Oceanographic data analysis in the three locations investigated revealed the presence of maritime heat waves through the summer, with mean intensities ranging from 1.62 to 1.97 °C and durations ranging from 5 to 22 days. The strong western pacific subtropical high and decreased wind speed, resulted in less mixing between the surface and deep upwelling water, which was the main cause of these MHWs. When the 2022 marine heatwaves were compared to historical oceanographic data, it became clear that they were unprecedented and the frequency, intensity, and total number of MHW days between 1982 and 2022 had significantly increased (ScienceDirect, 2023).

6. State of Palestine
7. People's Republic of Bangladesh
8. Republic of India
9. Kingdom of Thailand
10. Republic of the Union of Myanmar
11. Kingdom of Cambodia
12. Republic of the Philippines
13. Republic of Chad
14. Federal Republic of Somalia
15. Democratic Republic of the Congo
16. Islamic Republic of Afghanistan
17. Republic of Mali
18. Federal Republic of Nigeria
19. Republic of South Sudan
20. Republic of Yemen
21. People's Republic of China
22. Russian Federation

23. State of Israel
24. United Mexican States
25. United States of America
26. Commonwealth of Australia
27. Republic of Peru

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