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Conservation and Human Impact Awareness
Through Historical Pictures

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http://cmbc.ucsd.edu/Research/student_research/Earth_Altered/
Concept Development

The world is a changing place, and it’s easy to go about daily life and not notice some of these changes, or to deny that they exist. But our impact on Earth is immense and undeniable. My capstone features a compilation of “then” and “now” images, paired together to show locations the way they used to be, and how it they currently are after human impact. Although the evidence presented is anecdotal, each photo pair is accompanied by research that supports the seen change. This photo essay demonstrates what science has told us for some time, that human populations have greatly changed our planet, and both we and the natural world are dealing with the consequences.

Humans are visual creatures, and photography has always been used to excite emotions, elicit responses, and cause change. Throughout time many pictures have been influential in our world, and had a drastic impact (Sullivan, 2003). The phrase “A picture is worth a thousand words” is well known due to its truth – a picture often can say something in a way that words cannot express. This capstone project was created to express this concept, and use the power of imagery to raise awareness, and promote change.
“With the knowledge of science we can solve resource limitations, cure diseases, and make society work happily – but only if people can figure out what in the world scientists are talking about and why they should care” (Olson, p. 5, 2009).

The disconnect between the scientific community and mainstream American society grows steadily wider and the effective communication of science is an issue that persists in this field, with possible disastrous consequences (Mooney and Kirshenbaum, 2009). The audience is always changing, and there exists today a new media environment that needs to be adapted to. Scientists are well known to be poor storytellers, and to share their knowledge or research in ways that does not capture an audience's attention, or that the audience often cannot understand. In order to communicate a message effectively, the audience needs to be aroused and fulfilled, to understand the message, and to be enticed to care (Olson, 2009). With this photo essay, an attempt was made to communicate science in a different way, and to tell a story that all people will be intrigued with, comprehend, and be provoked to care about.

**Data Collection**

The image pairs were collected from a variety of resources.

- An email listserv was sent to Scripps Institution of Oceanography as well as NOAA Southwest Fishery Science Center was sent out, and responses were received from scientists, teachers, and employees. Images submitted were either images representative of their work or research, or of places studied
that have exhibited change that then photographic representation of that change could be found.

- The San Diego and La Jolla Historical societies were used and their many boxes of pictures were examined. In addition, local references were obtained that provided historical examples of fishing and coastline use. Quite a few stunning “then” images were compiled to compare to current images of those same places.

- Published research that uses repeat photography in its methods was investigated, and then the photos featured in these research papers were used.

- Several image databanks were used and their photo collections sifted through.

- Permission was granted from two noted environmental photographers. Gary Braasch – a well-known environmental photographer who particularly takes image pairs that demonstrate climate change. And Howard Hall – the cinematographer who wrote, directed, and filmed Under the Sea IMAX 3D, among other accomplishments.

- Images taken by NASA, USGS, and the US Coast Guard were utilized.

- Images featured on the Shifting Baselines website.

- Google Earth was used in some cases to get a current aerial image of a landscape.
**Final Product**

The final product is a compilation of 50 image pairs that demonstrate both global and local references of environmental change due to anthropogenic causes. The images were sorted into three categories that best represented the main topics represented with the image pairs: Transformed Landscapes, Overfishing, and Climate Change.

*Transformed Landscapes* features images showing how so many places on Earth look completely different from how they used to. Displayed in this section are images of water depletion, coastal development, degraded environments, and other ways that humans have altered our world’s landscapes.

*Overfishing* features images of historical fishing, including depleted fisheries, decreasing catch size, banned species that used to be fished, and the destructive nature of some fishing methods.

*Climate change* features examples of sea level rise, coral reef bleaching and loss, the destructive nature of storms (that are expected to increase in intensity), and image pairs of glacial retreats.

**Website Development and Promotion**

After all image pairs had been compiled, a website was created to feature these image pairs and make sure they are accessible by anyone who wants to view them. This website was entitled *Earth Altered – Photographic Evidence of Human Impacts*. On the home page of this website is a brief description of the project, and what is to be found on subsequent pages inside. In addition there are
definitions of each of the three categories, as well as links to additional information on the topics. These definitions follow:

**Transformed Landscapes**
There are approximately 6.8 billion people living on Earth, and this number is increasing at a rapid rate. Human presence is transforming the way our planet looks and functions. This section features a collection of these impacts.

**Overfishing**
Overfishing occurs when commercial and non-commercial fishing catches so many adult fish that not enough remain to breed and replenish the population. This section features global changes that have occurred due to overfishing, including fishery collapse, decrease in fish catch size, and the destructive nature of some of our fishing tactics methods.

**Climate Change**
Science has confirmed that the carbon dioxide produced by burning fossil fuels is causing a rise in global temperatures. As our planet warms, there are many consequences affecting both humans and the environment that both will have to deal with. This section captures some of these consequences.

From the homepage, a visitor can click to one of the three different categories and view all the image pairs featured in that section. Displayed on the top of the page within the category is the headline and location of the image pair featured, followed by the image pair prominently placed on the screen with the dates taken. The option is available to click the image to expand it and get a better look, as well as an option to download the image full size. Following each image pair is a caption explaining the change seen in the pictures. To write these captions, many different sources were used to find current research or published materials that explain the change, or explain the phenomenon that is occurring. Definitions of scientific terms and general descriptions were used in these captions, to ensure that anyone visiting this website, despite their background, can understand the change they see on the screen. The sources used to write the captions were also listed as a hyperlink, so
that if a viewer is interested in the topic, they can click on the source to read more about the topic featured in the images. Underneath the images are thumbnails of the different image pairs featured in this section, as well as “next” and “back” tabs at the top of the page, to allow easy navigation throughout the site. Finally, there is an email address listed so that viewers of the website can comment and contribute photos, to make this an ever growing resource.

**Earth Altered** will be promoted on a variety of different websites in order to maximize exposure and ensure as many people view it as possible to increase its effect. Earth Altered is going to be featured on the Center for Marine Biodiversity and Conservation home page, as well as on the Shifting Baselines and Birch Aquarium websites. It is also going to be linked to from Marine Photobank, an image database that is working to advance ocean conservation through imagery.

Finally, the images pairs and the concepts they cover are a good resource for teachers to use in order to introduce topics and begin discussions. The website is to be included in the Ocean Discovery Institute curriculum packet for next year, as well as emailed to the San Diego Science Teacher List Serve of the Birch Aquarium, including a breakdown of how each topic covered best aligns with the California State Science Content Standards, divided by grade, so teachers can easily understand how to best utilize this resource.

**Conclusion**

**Earth Altered** and the images it features were created to raise awareness and inspire change and action among its viewers. In addition, it is to be used as a
good resource for teachers, to show the younger generation some of the impacts we have had on our planet and inspire them to want to protect it. The Center for Marine Biodiversity and Conservation at Scripps Institution of Oceanography is going to keep this website live, so that it can provide an ever growing resource of then and now image comparisons.

Using the power of images to show, not tell the changes going on in our planet, a different approach to communicating science was taken. This approach allows viewers to view photographic evidence of human impacts and see these changes for themselves, without being told so by scientists. Images provoke reactions in people, and those reactions cause change to happen. When faced with an image we have a choice, we can look away, or we can address the image. This capstone was created in hopes that people will see these images, and be provoked to address them.

**Website Content**

Following are all of the captions for the image pairs featured on the Earth Altered website. Listed by category and the order they are featured on the website.

**TRANSFORMED LANDSCAPES**

**Ever More Aral Sea**  
**Kazakhstan & Uzbekistan - 1989, 2008**

Once the fourth largest lake in the world, now 75% of the Aral Sea is a desert with only ghost ships sitting in the sand. In the 1960's water was diverted from the lake to irrigate cotton crops and increase rice production in Central Asia. This caused a dramatic drop in water which pushed the salt content to increase, thereby causing the Aral Sea to become a hostile marine environment, killing all known 20 fish species that used to live there. This led to over 60,000 fishermen losing their jobs, and available drinking water decreasing dramatically as the remaining water is contaminated by toxic chemicals from pesticides and bacteria and viruses that cause people to become ill.
And that's not the end of it. The Aral Sea used to absorb summer heat and keep winters mild, but now that the sea has decreased so much the climate has altered dramatically, with longer summers and colder winters. The Aral Sea provides an extreme example of how when humans harshly alter the environment, the damage to both environment and the people that depend on it can be equally as harsh.

**Vanishing Nesting Sea Turtles**  
*Rancho Nuevo, Mexico – 1947, 2009*

These images display a mass-nesting event of the Kemps Ridley Sea Turtle, called an Arribada. The first image is captured from a film taken in 1947 in Rancho Nuevo beach in Tamaulipas, Mexico (main nesting beach for the species) where is approximated that 40,000 turtles came ashore to nest.

The second image shows a large arribada that occurred on the same beach in 2009. It was estimated that during the two-day time period up to 5,000 Kemp’s Ridleys came ashore to lay their eggs. The reason the large aggregations from the first image do not occur anymore is due to the near extinction of this species. From the 1940’s-70’s, poaching of the nesting turtles and their eggs decimated the population.

**Smothering Sediment Runoff**  
*Puerto Rico – 2009, 2010*

The first image shows what this part of the coastline of Puerto Rico typically looks like. In the second image, you can see massive terrestrial runoff from the land into the ocean.

This major form of ocean pollution can bring harmful nutrients from the land into the sea, and also the sediment you can see that travelled down this river and poured into the ocean can smother out huge areas, particularly hurting ecosystems such as coral reefs.

**Mangroves Protect Coasts From Tsunami**  
*Indonesia – 2004, 2004 after tsunami*

In the first areal image you can areas cleared of the native mangrove ecosystem to make way for shrimp farms in Indonesia. In the second image, you can clearly see that after the Asian Tsunami of 2004 hit, the areas that still had the native mangrove...
vegetation were shielded from the storm, however the areas where the mangroves had been cleared were completely decimated.

This demonstrates what science has shown, that mangroves and coastal vegetation provide a protective buffer for severe storms and hurricane activity.

Image: Public Domain/Marine Photobank

**Irrigation Drains Lake**
**New Mexico - 1991, 2001**
The drastic reduction of water in this lake is due to the fact that the water from this reservoir is used for irrigation purposes in New Mexico, Texas, and northern Mexico, and so much water has been drained from it that the shoreline has even been drastically altered. In addition, recently there has been increasingly more drought in the western states and therefore less water runoff to the reservoir.

Image: Susan Glover
Source: Shifting Baselines

**Paving La Jolla Shores**
**San Diego, CA – 1917, 2010**
This image demonstrates the impact that coastal development can have on a native landscape.

More than ½ of the nations population lives and works within 50 miles of an ocean coastline, but coastal areas only account for 11% of the nations land area. The vast amount of people that inhabit these coastal areas leads to the intense development of our oceans coastal habitat.

Image: La Jolla Historical Society, Shannon Yee & Jessica Wiseman
Source: NOAA Year of the Ocean

**Mission Bay – Once A Wetland**
**San Diego, CA – 1918, 2008**
Mission bay was once a wetland that consisted of a labyrinth of mudflats, salt marshes and tidal channels (as seen in image one), which served as a feeding and nesting habitat for migratory and resident birds, among other plants and animals. In the 1950s and 60s however, the river was channelized and the bay was dredged and natural areas filled in to create Mission Bay Park (image two). As this area developed, the major alterations made to the land and water caused most of the wetland to be eliminated.

Image: San Diego Historical Society, Google Earth
From Hillsides to Hotels
La Jolla Cove, San Diego, CA – 1897, 2010
This image once again demonstrates coastal development, and shows the popular La Jolla cove in San Diego, CA. The modernization and development around this once natural landscape is extreme.

Image: La Jolla Historical Society, Shannon Yee & Jessica Wiseman
Source: NOAA Year of the Ocean

Cannery Closes, Kelp Forest Returns
Monteray Bay, CA – 1932, 2008
Monteray Bay, CA was once a booming fishing port known for their many sardine canneries. With time, severe overfishing mixed with oceanic conditions led to the collapse of the fisheries. Although this collapse was an environmental and economic catastrophe, it had an unexpected positive effect in a different arena.

In the 1932 version of this picture, you can see a lot of scum on the water from the huge canneries and many gulls waiting for offal. In 2008 you can clearly see the return of the native kelp forest to the area after the pressure from the pollution and run off from the canneries was removed.

Image: Stephen Palumbi, Stanford
Source: Cannery Row

Lighthouse Loses it’s Island
Morris Island, SC – 1876, 2009
The Morris Island lighthouse was constructed in 1873 in South Carolina. Shortly after construction was complete, the city of Charleston began building jetties at the entrance to its harbor to increase its depth. Although the jetties succeeded in this, they also altered sand transport around the area, and it quickly became evident that Morris Island was losing large amounts of sand.

In 1880, the lighthouse stood tall on the island 2,700 feet from the water. By 1938, the lighthouse was at the water's edge, and today the lighthouse stands in the middle of the ocean, roughly 1,600 feet offshore.

Image: US Coast guard
Source: Lighthouse Friends

Gulf of Mexico Oil Spill
2009- 2010
In the first image, you can see the Gulf of Mexico on a normal day. In the second image however, you can see a white swirl off the coast of New Orleans.
Unfortunately this isn’t a cloud, its oil from the oil spill that resulted from an explosion that occurred on April 20, 2010, on the Deepwater Horizon rig.

At the time this website was written, this oil spill is on pace to be "worse than Exxon Valdez and is pumping at least 12,000 barrels of oil a day - that’s over 500,000 gallons - into the biologically diverse and commercially productive Gulf of Mexico. Thousands of sea birds, dolphins, whales, sea turtles, and other animals are threatened by the ever growing plume of toxic sludge." This massive oil slick threatens tremendous amounts of ocean habitat and life, as well as coastal environments and the people that reside there as it makes its way to shore.

Image: NASA Earth Observatory
Source: NASA Earth Observatory, Oceana

**The Trampling of the Great Barrier Reef**
**Stone Island, Australia- 1895, 1994**

These images are of Stone Island in the Great Barrier Reef. You can see that the coral cover that once dominated this reef-flat (shallowest part of the reef, here exposed at low-tide) is now non-existent and has been replaced with coral rubble and algae.

There has been widespread concern that the coral reefs of the Great Barrier Reef have suffered severe degradation from anthropogenic (human) influences since European settlement in Australia. "This concern has developed particularly in more recent times, as the human population has increased. Part of the evidence used to support this contention has come from comparisons between old photographs of reef-flats exposed at low tide and the same reef-flats as they are today," after the influx of humans to the Great Barrier Reef.


**Shifting Reef Flats**
**Great Palm Island, Great Barrier Reef Australia – 1880, 1995**

Another exposed reef-flat in the Great Barrier Reef where you can see that although some of the same types of corals have remained, many of the massive corals are gone and there has been significant algal growth on the reef flat.

Reef Landscape Altered
Daydream Island, Great Barrier Reef, Australia – pre 1950, 1995
These images show the exposure of the reef-flat in Daydream Island in the Great Barrier Reef. In this location there remains dominance by the same type of coral, however the community has shifted and the size of the coral decreased with time.

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Squid Spawning Decline – A Personal Tale
La Jolla, San Diego, CA – 1970s, 2009
These images come along with a first hand story from Howard Hall, a noted underwater cinematographer that wrote, directed, and filmed IMAX Under the Sea 3D among other accomplishments:

This pair shows "the bottom off La Jolla Shores, CA, covered with squid eggs in the late 1970's. Today you seldom see patches of squid eggs there larger than the one shown in image number two". This is due to the fact that the fishery for Market Squid has grown exponentially, which has led to their decreased abundance.

Image: Howard Hall
Source: Howard Hall, Market Squid Status of the Fishery

OVERFISHING

Shrinking Trophy Fish
Florida Keys, FL – 1957, 2007
These images were taken from the same display board, from the same dock, from the same recreational fishery in Key West, Florida. The board displays the largest trophy fish that were caught that day. You can clearly see that with time, the "largest" caught fish get significantly smaller and smaller.
A study by McClenachan that analyzed photos like these found that in the 50 year period studied, the average length of trophy fish declined from 91.7 to 42.4 cm, and the average weight declined from 19.9 to 2.3 kg. In addition to the obvious change in size, there was also a major shift in species composition, and the average length of sharks declined by over 50%. These images demonstrate that the fishing pressure we are putting on our environment throughout time causes drastic shifts in the ocean environment, particularly in regard to fish size.

Image: Loren McClenachan  

**Trawling Levels Seamount**  
**Tasmania – Natural, Trawled**  
These images are of a seamount at about 1000 m depth off the coast of Tasmania. The first image shows a natural seamount, which is an underwater mountain rising from the ocean floor and having a peaked or flat-topped summit below the surface of the sea. It is on this summit that many unique species call home, as you can see on the first image.

However this diversity of life attracts fishing, and in the second image the seamount has been heavily fished and you can even see the trawl marks left behind in the sand as they raked across the top of the seamount, removing everything in its path.

Image: CSIRO Marine & Atmospheric Research, Australia, courtesy of Tony Koslow  

**Reef to Rubble**  
**North Atlantic Lophelia Reef – Natural, Trawled**  
Deep sea trawling is a form of fishing that is particularly destructive in that in rakes across the bottom of the ocean, destroying anything in its path. This image pair shows a pristine deep sea Lophelia reef from the North Atlantic, and one that has been damaged from trawling, with part of a fishing equipment entangled in the destroyed coral left behind.

Image: M. Roberts, Scottish Association for Marine Science  

**Vanishing Giants**  
**San Diego Marlin Club -1950s, 2009**  
This image from the 1950s features a Marlin caught at the Marlin Club in San Diego. The board states that this marlin is 203lbs, and the largest recorded marlin weighed at the Marlin Club in 1954 was 243.5lbs.
In 2009, the average marlin caught at the Marlin Club was 122 lbs, and the largest caught was 153 lbs. The image on the right is of a marlin that weighs approximately 120 lbs, the average size of the fish caught last year at the Marlin Club. You can see the size of the fish in comparison to the men standing next to them.

This is a general trend that many recreational fishers that catch large game fish have been noticing. As time passes, fishing pressures are causing the average size of fish caught to decrease.

Image: San Diego Historical Society
Source: Marlin Club

**Fishing Giant Sea Bass – Now Off Limits**
**San Diego, CA – 1920s, 2009**
This image features a massive catch of Giant Sea Bass off the coast of San Diego. In 1981, a law was passed that prohibited the take of giant sea bass for any purpose.

Why? Commercial landings of this fish peaked in the 1930s, but then over the next few decades they quickly crashed. This fish grows slowly and matures at a relatively old age, which makes it particularly susceptible to overfishing since it takes so long for the stock to replenish itself. In 1981 the numbers had dwindled down so low that the ban was passed.

Currently, Giant Sea Bass have become a tourist attraction for divers, who travel to dive in their habitat in hopes of seeing the gentle giants.

Image: San Diego Historical Society, Underwater Photography Guide
Source: Pfleger Institute of Environmental Research; Fishery of the Giant Sea Bass

**Tuna Industry Gone For Good**
**San Diego, CA – 1940s, 2010**
The Tuna industry once dominated the San Diego waterfront, and for many years the area was known as the "tuna capitol of the world." In 1903, a large tuna canning industry began and boomed, until in the 1950s foreign competition threatened the traditional hook-and-line pole caught tuna fishing, and the industry had to switch to seiners which used large nets to corral entire schools of tuna. Although this method of fishing increased catch size, it also increased controversy in that it caught anything else that was around the nets, including sharks and dolphins.

Foreign competition and decreasing catches eventually caused all of San Diego’s tuna canneries to close down by the early 1980s. Now in a park where the tuna cannery workers used to take their lunch breaks, all that remains of this once flourishing fishery is a dedicated statue.

Image: San Diego Historical Society, Jessica Wiseman
From Whaling to Whale Watching
San Diego, CA – 1941, 2009
This over 60 ft Finback Whale was caught in the 1940s in the waters off of San Clemente island, straight off the coast of San Diego. Whale’s used to be hunted at an extreme rate, until their numbers dwindled down so low that in 1985 the International Whaling Commission (IWC) placed a moratorium (ban) on commercial whaling.

The second image shows a whale watching boat in which San Diego tourists pay high prices to go and see whales in the same habitat that the whale in the first image was captured. The booming ecotourism industry has created a way of profitable conservation, and demonstrates that humans can benefit from the environment without always having to extract from it.
Image: San Diego Historical Society, Birch Aquarium
Source: International Whaling Commission

Soup to Science
San Diego, CA – 1920, 2008
This image shows that a catch of sea turtles being unloaded to be turned into turtle soup at the San Diego Soup Factory.

Currently these Green Sea Turtles are listed as Endangered, which means they have a high risk of extinction in the wild. Due to this status, the turtles that remain in the San Diego area are closely tracked and monitored by scientists at NOAA, to examine their health and aid in the survival of the species.

Image: San Diego Historical Society, NOAA
Source: San Diego Historical Society, IUCN Red List: Green Sea Turtle

Beachload to Basketload
Rosarito, Mexico – 1915, 2009
This lobster dump is on Rosarito beach in Mexico. Spiny lobsters used to be in such abundance that a quantity that filled an entire beach could be caught. At that time, spiny lobsters weighed between 3.5 and 4 lb on average, and were so abundant that a single person could catch 500 lb in just two hours.

However as time has gone by, concern for this fishery has led to a closed season and a size limit that has been instituted, and take of egg-bearing females is prohibited. These regulations have allowed the fishery not to completely collapse, but numbers certainly have dwindled from a time where you could fill an entire beach with your catch.
**San Diego Cannery Crashes**

**San Diego, CA – 1920s, 2010**

San Diego once was home to booming Tuna canning factories. This image shows these canneries at work, packing massive quantities of fish every day. However, in the 1980s, the last of San Diego’s canneries closed due to shortages in fish and foreign competition.

Although all the canneries have shut down, San Diego is still the corporate headquarters for tuna giants Bumblebee Tuna and Chicken of the Sea. Although the canneries have closed and the fish have dwindled, the businesses remain as a reminder of industry that once dominated the sea front.

**Blue Shark Dramatic Decline – A Personal Tale**

**California**

These images represent the eradication of blue sharks from California water. They come along with a first hand story from Howard Hall, a noted underwater cinematographer that wrote, directed, and filmed IMAX Under the Sea 3D, among other accomplishments:

"Prior to 1978 we could go out any day of the year and attract between 20 and 100 blue sharks with a little bait. Today most attempts result in no blue sharks attracted. A good day would be three. In 1978 California initiated the drift gill net fishery. Just prior to that they closed the inshore gill net fishery with much publicity. Most Californians think gill nets have been banned in California. The drift net fishery includes hundreds of miles of drifting net that every night kill nearly everything that swims into them - whales, pinnipeds (seals and sea lions), sting rays, blue sharks, jellyfish, etc." Image two features a blue shark killed in a drift net.

**CLIMATE CHANGE**

**From Beachfront To Actual Beach**

**Cape Hatteras, SC – 1999, 2004**

In just five years, this house in Cape Hatteras, North Carolina, experienced such high erosion to the dunes that it now sits in the surf, awaiting destruction. The cape is
currently losing 12 feet a year due to erosion and sea level rise, which is a product of rising global temperatures.

This image serves as a warning of how sea level rise can affect humanity, given the massive amount of people that reside on coastal property.

Image: Gary Braasch  

High Tide Threatens House  
Tuvalu – low tide, high tide  
High tides surround a house in Tuvalu, a small island in the Pacific. This island is only a few meters above sea level and is flooded several times a year by rising tides. The entire island is threatened with being eliminated if the sea level continues to rise.

Image: Gary Braasch  

Spruce Beetle Demolished Forest  
Alaska - healthy forest, forest after spruce beetle  
The Spruce Beetle has devastated these Spruce trees in Alaska. This plant eating insect has been on the rise recently, devouring and destroying more Spruce trees every year.

It has been shown that these beetles are susceptible to changes in CO2 in the atmosphere, and that they will benefit from a warmer climate and will reproduce in ever-increasing numbers if temperatures rise, thus ever increasing the destruction of these ancient forests.

Image: Gary Braasch  
Source: The Spruce Beetle. Forest Insect and Disease Leaflet

Coral Reef Bleaching  
Fiji – 1999, 2000  
The first image shows a healthy coral reef in Fiji 1999. The second image shows the same reef after a bleaching event in 2000, in which the majority of corals in Fiji died.

Corals are colonies of animals called polyps, and are highly sensitive to ocean temperature. Bleaching is caused by environmental stress, particularly increased temperatures, and is the loss of the microscopic pigmented algae (zooxanthellae) that lives within a coral colony. "Large-scale bleaching events have been linked to increases in sea surface temperature and have increased in incidence and severity over the last 25 years corresponding with global warming trends."
Bleached coral loses its pigment and appears white, as seen here, and bleaching often leads to death of the colony.

Image: Howard Hall
Source: Howard Hall, Coral Reef Bleaching

**From Coral Reef to Seaweed Reef**
**Cocos Island, Costa Rica – 1997, 1997 6 months later**
The first image shows the reef off of Cocos Island just after it bleached in the mass-bleaching event in 1997 in which many of the world's coral reefs bleached. Six months later, the second image was taken in the same spot and you can see that the coral is dead and covered in algae. This shift has negative repercussions for the entire ecosystem.

Image: Howard Hall
Source: Howard Hall, Coral Reef Bleaching


**Giant Corals to Seaweed Mats**
**Barbados – 1978, 1980**
The first image shows a healthy coral reef in Barbados, complete with an abundance of Staghorn and Elkhorn corals. The second image shows the same reef in 1980 when it has been completely degraded and overgrown with seaweed.

A study found that Barbados reefs remained very much the same over a period of almost 100,000 years before humans appeared there. However modern day reefs are now vastly different and dominated by completely different species compared to anything seen in their past. In the past you would have seen an overwhelming dominance of Elkhorn, a staple of Caribbean reefs in the past but now Elkhorn has virtually disappeared and the same reefs are now dominated by algae and seaweed.

Image: ARC Centre of Excellence for Coral Reef Studies/Marine Photobank


**Seaweed Overtakes Reef**
**Discovery Bay, Jamaica – 1960s, 2009**
This image of Discovery Bay shows some of the most structurally complex reefs of all time. A hurricane tore through Jamaica in 1980 and destroyed most of the coral in Discovery Bay, however at the time scientists thought that storms had always destroyed coral reefs so the reef would bounce back, but they got it wrong.
If you notice in the first picture, although the reef is in tact, there are no fish present. The combination of overfishing, pollution and other human stresses caused this reef to not return to its old state.

The second image shows the same reef over grown with seaweed. A mass-mortality event of a local grazing sea urchin, coupled with humans fishing out too many of the herbivorous fish caused these reefs to turn into seaweed mats, since all the species that ate the seaweed and kept it under control had disappeared.

Image: Phillip Dustan Ph.D. FLS, College of Charleston, SC
Source: Macroalgal Overgrowth of Fringing Coral Reefs at Discovery Bay, Jamaica

Carysfort Reef Melting
Florida Keys - 1975, 2004
These images taken from the same vantage point show the decline of this largest and most luxurious reef of the Florida Keys. Carysfort Reef has lost over 92% of it's living coral cover from global warming, pollution, disease, and physical damage.

Image: Phillip Dustan Ph.D. FLS, College of Charleston, SC

500 Year Old Coral Head Bleaches and Dies
Key West, FL - 1996, 1997, 2000, 2005
1996 - Healthy
1997 - Bleached
2000 - Dead
2005 - Overgrown with Algae

The 500-year-old coral above is part of an expansive coral reef off Key West, Florida. In 1996, the coral head appeared healthy. "By the following year, elevated water temperatures resulted in the bleaching and, ultimately, the death of 80% of this coral head. Since then, much of the outlying coral reef colony has died and become overgrown with algae."

Image: Craig Quirolo, Reef Relief/Marine Photobank
Source: Marine Photobank, Coral Reef Bleaching


Yellow Band Disease Kills Coral
Key West, FL - 1994, 2005
Other than bleaching, another large threat to corals is disease. This image pair shows yellow band disease slowly killing this coral in Key West, Florida. The 1994
image is the very first documentation of yellow band disease ever, and before this
time the disease had not yet been described. You can see how ultimately in 2005 the
disease has killed the coral and it is covered with algae.

Coral that has been subject to environmental stress such as warmer temperatures
and nutrient and sediment runoff has been proven to be more susceptible to
disease, and there has been a significant documented increase of disease in corals in
the last 10 years, most likely due to the increasing amount of stress and
temperature to coral reef ecosystems.

Image: Craig Quirolo, Reef Relief/Marine Photobank
Life and Death of Coral Reefs. New York: Chapman and Hall. pp.114-139. Major Reef-
building Coral Disease. NOAA’s Coral Reef Information System.

Gigantic Coral Head Death
Florida – 1959, 1988, 2005
The black and white photo taken in Florida in 1959 shows a composite head
consisting of two species of brain coral and one star coral. In 1988 the star coral at
left has eroded away and by 1998, this giant head of coral is dead.

Image: E.A. Shinn, USGS
Source: Shifting Baselines, Coral Reef Bleaching

Deforestation by Cyclone
Queensland, Australia – 2006, 2006 after cyclone
These images are of Maria Creek in Queensland, Australia, before and after cyclone
Larry hit. Even down in the low-lying river bank the wind blew all the leaves off the
trees.

Many studies have shown that the frequency and intensity of cyclones and other
storms are supposed to increase as global temperatures rise.

Image: Julie McGowan, 2006/Marine Photobank
Source: Mooney, Chris. Storm World: Hurricanes, Politics, and the Battle Over Global
Warming. Houghton Mifflin Harcourt. 2007

Strong Cyclones Shred Trees
Queensland, Australia – 2005, 2006
This driveway in Queensland Australia shows the extreme damage of category five
cyclone Larry.

Many studies have shown that the frequency and intensity of cyclones and other
storms are supposed to increase as global temperatures rise.
Image: Julie McGowan, 2006/Marine Photobank

**Melting of the Muir Glacier**
**Alaska – 1941, 2004**
This Alaskan glacier has retreated to less than half of its size in the past 100 years.

Image: William O. Field 1941, Bruce Molnia 2004
Source: American Geographical Society/World Data Center-A for Glaciology, National Snow and Ice Data Center/World Data Center for Glaciology, U.S. Geological Survey.

**Asthabasca Glacier Retreats**
**Canada – 1919, 2005**
Over the last 100 years, this glacier has shrunk to 2/3 of its size in 1870 volume

Image: Gary Braasch

**Carroll Glacier Disappears From View**
**Alaska – 1906, 2004**
The 2004 photograph shows that the Carroll Glacier has changed to a stagnant, debris-covered glacier that has significantly thinned and retreated from its 1906 position.

Image: Wright, Charles Will 1906, Bruce Molnia 2004
Source: USGS Photo Library, National Snow and Ice Data Center, U.S Geological Survey

**McCall Glacier Now A Necklace of Snow**
**Alaska – 1958, 2004**
A 2002 study of 67 Alaskan glaciers found that most are melting at a rapid rate, shrinking by an average of more than a foot each year from the 1950s to the 1990s, and some nearly 6 feet a year from the mid-1990s to 2001

Image: Austin Post 1958, Matt Nolan 2004
Source: USGS Photo Library, National Snow and Ice Data Center/World Data Center for Glaciology

**McCarty Glacier Now A Lake**
**Alaska – 1909, 2004**
The McCarty glacier retreated about 20km in this time period in which these two images were taken, and now is no longer visible

Image: Ulysses Sherman Grant 1909, Bruce Molnia 2004
Mendenhall Glacier Gone
Alaska – 1894, 2004
Since just 1946, this glacier, which flows into suburban Juneau, has retreated 580 m.

Image: National Snow and Ice Data Center Collection, NOAA, Gary Braasch
Source: Global Glacial Retreat Overview

Retreat of the Pasterze Glacier
Austria – 1875, 2004
Austria's longest glacier was about two kilometers longer in the 19th century but is now completely out of sight from this overlook. Now a dammed artificial lake is in the place where the glacier terminus was in 1875. The glacier is now about eight Km long and loses about 15 meters per year.

Image: Braasch, Gary

Portage Glacier Out Of Sight
Alaska – 1914, 2004
This glacier from near Anchorage Alaska has "steadily retreated across the lake and by the turn of the twenty-first century had pulled back far into the valley". This large tourist attraction built a visitor center in 1986 with a clear view of the glacier, but now ice is no longer visible from the visitor center.
Image: NOAA, Braasch, Gary

Tourist Town Loses Main Attraction
Rhone Glacier, Switzerland – 1859, 2001
This tiny town in Switzerland was built at the foot of the glacier as a place where travelers would pass through to cross below the glacier snout. However over the years the glacier has pulled away so far that it is now a mile and a half away from the town and 1,400 feet higher.
Image: Gary Braasch

Mount Hood No Longer Hooded
Oregon – 1984, 2006
This is Oregon's highest peak, a dormant volcano. In 1984, at the end of summer it was draped with eleven glaciers and the ice fields here are crucial for summer water supply and irrigation. In 2006 you can see that the ice has visibly shrunk, and glaciologists have calculated that the ice has shrunk by 34% since the beginning of the 20th century.
References*


*Sources used for website captions are listed under the caption

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