Sewage From Anchored Ships Is Damaging Spratly Reefs

Analysis By Simularity
July 12, 2021
Phytoplankton and algal blooms are caused by excess nutrients in the water. These are seen primarily along coastlines, with the extra nutrients coming from runoff from fertilized agricultural areas, erosion of riverbanks, land clearing, and sewage effluent.

In the Spratly and Paracel Islands, there are no runoffs from fertilized agriculture, erosion of riverbanks, or land clearing. There is, however, sewage effluent.

Areas of increased nutrients from sewage effluent are seen on satellite images as areas of increased Chlorophyll-a.

Sewage effluent sources in the Spratly Islands include ship wastewater and human habitation without sufficient sewage treatment. When the ships don’t move, the poop piles up.

Image source: unknown ship from Marine Executive
Sewage Leads To Excess Chlorophyll-a

**Excess nutrients** in the water increase the Chlorophyll-a concentration. Chlorophyll-a is produced by plants of all sizes.

**Chlorophyll-a Concentration** can indicate harmful algae activity and is a generally accepted measure of water quality. It can be observed and measured in multi-spectral satellite images.

In water, Chlorophyll-a concentration is a measure of **phytoplankton**. Excess phytoplankton that cannot be consumed by the reef inhabitants dies off and sinks to the sea floor, where it is consumed by bacteria. These bacteria consume oxygen that would normally be available to the fish, creating a “**dead zone**”.

On reefs, Chlorophyll-a concentration is a measure of the amount of **plant material**, such as “**fleshy algae**” on the reef. Excess nutrients can speed the growth of “fleshy algae” that can overtake the coral and **destroy** the reef habitat.
Orientation: Union Banks June 17, 2021

Total Ships In Union Banks On June 17: 236

Imagery credit: European Space Agency – produced from ESA remote sensing data
Anchored Ships Creating Chlorophyll-a Blooms In Union Banks
Detail Of Johnson South Reef June 17, 2021
Chlorophyll-a Concentration

Ships

Shits
Union Banks June 17, 2021, Johnson South Reef
Chlorophyll-a Concentration

Not all ships have chlorophyll trails, possibly due to recent arrival.

Imagery credit: European Space Agency – produced from ESA remote sensing data
Union Banks Reef Damage By Plants and Algae
Johnson South Reef: Chlorophyll-a Concentration

Notice:

- loss of dark areas (where there used to be lack of chlorophyll)
- increasing overall light areas (indicating increased chlorophyll)
- loss of differentiation as plants overtake distinctive reef features

These indicate overgrowth of algae in the last 5 years.
Hughes Reef: Chlorophyll-a Concentration

Notice:

- loss of dark areas (where there used to be lack of chlorophyll)
- increasing overall light areas (indicating increased chlorophyll)
- loss of differentiation as plants overtake distinctive reef features

These indicate overgrowth of algae in the last 5 years.
Lansdowne Reef: Chlorophyll-a Concentration

Notice:

- loss of dark areas (where there used to be lack of chlorophyll)
- increasing overall light areas (indicating increased chlorophyll)
- loss of differentiation as plants overtake distinctive reef features

These indicate overgrowth of algae in the last 5 years.
Ross Reef: Chlorophyll-a Concentration

Notice:

- loss of dark areas (where there used to be lack of chlorophyll)
- increasing overall light areas (indicating increased chlorophyll)
- loss of differentiation, as plants overtake distinctive reef features

These indicate overgrowth of algae in the last 5 years.

May 14, 2016

June 17, 2021

Imagery credit: European Space Agency – produced from ESA remote sensing data
Collins Reef: Chlorophyll-a Concentration

Notice:

- loss of dark areas (where there used to be lack of chlorophyll)
- increasing overall light areas (indicating increased chlorophyll)
- loss of differentiation, as plants overtake distinctive reef features

These indicate overgrowth of algae in the last 5 years.

© Copyright 2021 Simularity. All Rights Reserved

Imagery credit: European Space Agency – produced from ESA remote sensing data
It Gets Worse: Cascades of Reef Damage

Healthy coral reef ecosystems have a delicate balance between the organisms and plants that inhabit the reef. Even small increases in nutrients can tip this balance towards algae. But that’s not all...

Overfishing the waters near coral reefs removes the primary algae-eaters from the environment, allowing populations of fleshy algae to explode. Fishers’ use of rocks as anchors lowers coral cover, giving further competitive advantage to the algae.

Fleshy algae on reefs release copious amounts of nutrients, which microbes eat. These microbes then endanger corals by depleting oxygen from the environment or by introducing diseases. As the corals die off, the algae have even more space to take over, leading to further coral mortality.

Tipping the balance towards algae results in increased acidification of the water, increasing coral erosion. This is in addition to the increased ocean acidification caused by climate change.
And It Gets **Even** Worse: Desperation Does More Damage

With the increased level of effort needed to catch rapidly declining amounts of fish, subsistence fishers are getting desperate. Even though dynamite fishing is outlawed, it is an expedient way to feed one’s family when there are no other options. Dynamite fishing does tremendous damage to reefs, that can take generations to recover from, and hastens the fish stock decline.

Why Does The Health Of The Spratly Reefs Matter?

- Coral reef fishes supply a **major source of protein for about 85% of coastal inhabitants**.
- The **larvae** for the fish that inhabit the South China Sea come largely from its coral reefs. The larvae from the Spratly reefs get distributed around the South China Sea by the winter and summer monsoons.
- Many of the inhabitants of the reefs are **food for the fish** that make up the food supply for the nations that border the South China Sea and support commercial fisheries.
- The Spratly reefs function as a source of food for migratory fish, including tuna, that travel through the South China Sea on their way to the Indian Ocean.
- The **size of the fish stock** in the South China Sea is directly linked to the **health of its reefs**.

Image credit: Monga Bay
The Health Of The Spratly Reefs Impacts All Bordering Nations

These reefs (in blue) in the South China Sea are the “nurseries” that generate the larva that become the adult fish stock that make up the fisheries in Vietnam, The Philippines, Malaysia, Brunei, and Indonesia.

“This emphasizes the value of international partnerships in coral reef management given how these areas share similar regional roles in supplying larvae to the region.”
In Summary

Human activity in the Spratly Islands is **damaging** the coral reefs that supply **food for millions** of people in the region.

1. The hundreds of ships that are anchored in the Spratlys are dumping raw sewage onto the reefs they are occupying. Verified by satellite imagery.

2. The excess nutrients in sewage are causing elevated concentrations of Chlorophyll-a, leading to a cascade of reef damage that can take **decades to recover** from **even with active mitigation**.

3. The damage to the reefs in **just the last 5 years** is visible from space. This time period is **after** and therefore in addition to the well-documented reef destruction wrought by China's giant clam harvesting and artificial island building.

4. Damaging these reefs directly affects the fish stocks of the entire South China Sea and can lead to a **hunger crisis** in coastal regions and a **collapse of commercial fishing** in the South China Sea. This is a catastrophe of epic proportions and we are close to the point of no return.

**This Needs To Stop Immediately!**  #ChinaStopShittingOnTheSpratlys
On offshore atolls and archipelagos in the South China Sea, **coral cover** has declined an average of 67% within the past 10-15 years.

Total **fish stocks** in the South China Sea have declined by 66% to 75% in 20 years.
Methods and Sources

Imagery: All imagery was provided by Sentinel 2 of the European Space Agency, freely available at the ESA’s open access hub.

Algorithm: The Chlorophyll-a Concentrations were determined using the C2RCC algorithm which is supplied with the European Space Agency’s Sentinel Toolbox, SNAP, which is also freely available. Chlorophyll-a concentrations are in mg/m³.

Sources:
1. OneSharedOcean
2. Nutrient pollution disrupts key ecosystem functions on coral reefs – The Royal Society Proceedings
4. Too much algae -- and too many microbes -- threaten coral reefs – National Science Foundation
5. Dissolved organic matter feedbacks in coral reef resilience – National Science Foundation
6. Assessment of Coral Reef Fish Stocks From the Nansha Islands, South China Sea, Using Length-Based Bayesian Biomass Estimation
7. The wicked problem of China’s disappearing coral reefs, Hughes TP, Huang H, Young MA.
8. A Blueprint for Fisheries Management and Environmental Cooperation in the South China Sea, CSIS
9. Hysteresis in coral reefs under macroalgal toxicity and overfishing
10. Larval connectivity patterns of the North Indo-West Pacific coral reefs, Patrick R. Pata, Aletta T. Yñiguez
11. The rising environmental of China’s offshore island grab, Yale School of the Environment
Simularity’s AIADS Software

Simularity is a software company that uses AI and Geospatial data to determine when significant changes have happened to an area. Our software, Automated Image Anomaly Detection System (AIADS), enables us to automate the scanning of large areas, such as the South China Sea, for unusual activity.

Our South China Sea monitoring project helps us demonstrate the value of our software. When new low-cloud Sentinel 2 images of the South China Sea are available, they are automatically downloaded and analyzed by Simularity’s AIADS software.

This anomaly heat map (red squares in the above image) was generated by AIADS. It is shown overlaid onto a European Space Agency Sentinel 2 image. After reviewing the imagery, our analyst then drew the pink polygons around the areas that need further investigation.

A human analyst then reviews the results of the AIADS analysis, an “anomaly heat map” that highlights significant changes in red. By looking at the new image, the anomaly heat map, and historical images, our human analyst determines where there are changes that deserve a closer look. Those are indicated in this report with the red polygons.

Running AIADS on free Sentinel 2 imagery makes it possible for us to inexpensively monitor a very large area.

Please contact us at info@simularity.com to chat about your monitoring project.

Imagery credit: European Space Agency – produced from ESA remote sensing data
Republishe Permissions

Republishe Rights are given to all accredited news agencies as follows:
• Any cropped images from the report can be published with the condition that image credits associated with the images are also published
• Entire pages/slides from the report can be published as is
• Credit for the entire report must be given to Simularity Inc.

For further questions, interview requests, or exclusive report projects please contact info@simularity.com