

# Coral Reef Health Report

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## Introduction

Welcome to our journey into the world of coral reefs! This report explores the health of coral communities across various monitoring stations, focusing on how much space stony corals cover, the variety of coral species, the number of soft octocorals, and the living tissue of corals. Our goal is to understand what's happening to these underwater wonders over time and predict what might happen in the next five years. Think of this as a health check-up for the ocean's gardens, helping us decide how to keep them thriving for future generations!

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## Key Findings

### 1. How Stony Coral Coverage Has Changed Over Time

We looked at how much of the reef floor is covered by stony corals at different stations. Imagine the reef as a colorful carpet—some areas, like those in the Upper Keys (UK), are losing threads fast (up to 2.6% less cover each year), while Middle Keys (MK) are holding steady or even growing a bit (1.1% more per year). This shows a mixed picture across stations, like different patches of a garden doing better or worse.

### 2. Trends in Coral Species Variety

We counted the types of stony corals at each station, like checking the variety of flowers in a garden. Most stations are seeing fewer types over time, with an average loss of about half a species per year across all areas.

### 3. Changes in Soft Coral (Octocoral) Numbers

Soft corals, or octocorals, are like the bushes among the flowers. Their numbers vary by station—some MK stations are gaining a few more bushes (0.05 per square meter per year), while others stay the same or drop.

### 4. Differences in Coral Health Across Sites

We measured the living tissue area (LTA) of corals, like checking how much of a plant is still green and healthy. Our tests show clear differences between stations ( $p\text{-value} < 0.05$ ), meaning site conditions matter a lot.

### 5. Where Coral Species Are Found and How It Changes

We mapped where different coral species live across stations over time. Over the years, some species are fading in UK stations, while others pop up elsewhere, showing a shifting landscape under the sea.

### 6. Connections Between Coral Cover and Variety

We found that stations with more coral cover tend to have more species (correlation  $\sim 0.65$ ). A healthy carpet of coral helps keep variety alive.

### 7. Links Between Soft Corals, Temperature, and Water Conditions

Warmer water seems to stress soft corals, reducing their numbers in some stations (correlation  $\sim -0.45$ ).

## 8. Comparing Regions

UK stations show the steepest losses (cover down 2.6% per year, richness down 0.22 species/year), while MK holds steady with cover up 1.1% and richness down 0.6 species/year. LK falls in between.

## 9. What Affects Coral Health

Disease (DSD) and rising temperatures are major stressors. Disease reduces coral cover and variety (correlations of -0.68 and -0.88), while heat mainly affects variety (-0.56).

## 10. Early Warning Signs

More disease and warmer water are early indicators of coral stress—like yellowing leaves in a garden.

## 11. Looking Ahead to 2029

Without intervention, coral cover may hover around 6.1–6.2%, species richness around 90–91, and soft corals at 2.5 colonies/m<sup>2</sup> by 2029. Minor improvements are seen with stable temperatures or halved disease levels, but larger action is needed.

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## In-Depth Analysis

### 1. Coral Cover Evolution

UK stations are losing cover quickly (2.6%/year), while MK is slightly improving (1.1%/year). This highlights the need for area-specific interventions.

### 2. Species Richness Trends

Loss of 0.5 species/year, especially in MK (-0.6), suggests a decline in biodiversity.

### 3. Octocoral Density

Some MK stations show positive growth (+0.05/m<sup>2</sup>/year), but others show declines, reflecting uneven resilience.

### 4. Living Tissue Area Differences

Significant site differences ( $p < 0.05$ ) imply that location-specific factors affect coral health.

### 5. Spatial Patterns

Species distribution changes highlight ecological shifts, with UK losing species while others relocate.

### 6. Cover vs. Richness

A strong positive relationship (correlation ~0.65) reinforces the importance of maintaining coral cover.

### 7. Octocoral and Temperature

Negative correlation (-0.45) with temperature indicates vulnerability of soft corals to warming seas.

### 8. Regional Differences

UK is declining, MK is more stable, and LK is intermediate. Tailored strategies are necessary.

### 9. Health Factors

Disease (-0.88) and heat (-0.56) are major threats to coral richness.

## **10. Early Signs**

**Monitoring temperature and disease can offer early warnings for reef decline.**

## **11. Future Outlook**

**Stabilizing temperature or reducing disease has limited effects unless more comprehensive actions are taken.**

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## **Conclusion**

### **Key Takeaways:**

**Coral reefs face serious threats from disease and climate change. UK regions are most at risk, while MK shows resilience.**

### **Actionable Steps:**

- **Remove infected corals and introduce resistant species.**
- **Aim to reduce disease by 75–90%, especially in UK.**
- **Implement localized cooling strategies (e.g., shading) in MK.**

### **Implications:**

**Healthy reefs support biodiversity, tourism, and fisheries. Proactive measures are essential to preserve these ecosystems for future generations.**