MARINE EASY CLEAN

The Science of TWC (The Water Cleanser): How Bacillus Controls Cyanobacteria and Restores Ecosystem Balance

The Water Cleanser (TWC) is a biologically driven water remediation technology designed to stimulate the natural growth of native Bacillus species in aquatic environments. It achieves this by providing a stable surface for colonization and creating favorable microzones of nutrients, enabling Bacillus to thrive. In laboratory conditions, adding TWC results in Bacillus bacteria doubling every 20 to 30 minutes instead of every 46 minutes, meaning a single cell can theoretically multiply to over 8 million in just ten hours. This exponential growth enhances their ecological role as key players in breaking down organic matter, processing nutrients, and regulating microbial communities.

How TWC Works in Aquatic Environments

Organic Matter Breakdown

In nutrient-rich environments, aquatic systems often accumulate excess organic matter due to runoff, decaying plant material, and algal die-off. As this matter decomposes, it produces ammonia—a compound that contributes significantly to oxygen depletion (hypoxia) through aerobic microbial activity.

Bacillus Stimulation

When TWC is introduced, the stimulated Bacillus populations rapidly degrade this organic load, thereby reducing the production of ammonia at the source. Uniquely, these bacteria also utilize facultative anaerobic respiration, allowing them to process ammonia even under low-oxygen conditions.

Oxygen Conservation

This helps conserve dissolved oxygen for nitrifying bacteria, which convert ammonia to nitrate—a more stable and non-toxic nutrient readily taken up by beneficial organisms such as diatoms, aquatic plants, and non-toxic algae. This reestablishes the nitrogen cycle in a way that removes the competitive edge cyanobacteria often enjoy.

Breaking Down Oils and Improving Oxygen Exchange

Another factor contributing to cyanobacterial blooms is the accumulation of natural oils and lipids from decomposing material. These oils increase the water's surface tension, limiting oxygen exchange from the atmosphere and creating an oxygen-starved environment that favors cyanobacteria.

The enzymes secreted by Bacillus—particularly lipases and proteases—break down these oils into amino acids and fatty acids, which are then repurposed as energy for beneficial microbial life. As these oils are degraded, surface tension decreases, allowing more oxygen to dissolve into the water, which further supports aerobic bacterial activity and disrupts the energy reserves cyanobacteria rely on for bloom persistence.

Ecological Dominance and Microbial Balance

As Bacillus becomes ecologically dominant, it occupies physical space through biofilm formation, preventing cyanobacteria from colonizing key surfaces. It also competes directly for essential nutrients such as phosphate and nitrogen. Importantly, Bacillus can secrete antimicrobial compounds, including lipopeptides, that inhibit the growth of cyanobacteria and other harmful microbes. Additionally, these beneficial bacteria interfere with quorum sensing—the chemical communication system cyanobacteria use to synchronize bloom events—further destabilizing their presence.

Rather than eradicating cyanobacteria, TWC shifts the microbial balance in favor of non-toxic, ecologically valuable species. Over time, a more diverse and stable microbial community emerges, dominated by Bacillus, diatoms, and nitrifiers. When used alongside best-practice watershed management strategies—such as reducing nutrient runoff and reestablishing native vegetation buffers—TWC accelerates the natural recovery of degraded aquatic ecosystems, restoring clarity, balance, and biodiversity.

Understanding Cyanobacteria and Phytoplankton

The Double-Edged Role of Cyanobacteria. Example: Nodularia spumigena

Cyanobacteria such as Nodularia spumigena are capable of surviving in saline environments and possess a unique ability to fix atmospheric nitrogen. This allows them to generate their own nutrients, giving them a competitive edge in nitrogen-depleted waters by outcompeting other organisms.

However, Nodularia spumigena can also produce a potent liver toxin called nodularin, which poses serious health risks to both humans and animals. Exposure to contaminated water can lead to significant health issues, particularly affecting liver function. As a result, when blooms of this cyanobacterium occur, public health authorities often issue warnings and restrict water access until the risk subsides.

What's the Difference Between Cyanobacteria and Phytoplankton?

Phytoplankton and cyanobacteria are both microscopic organisms that inhabit aquatic environments and perform photosynthesis — the process of using sunlight to create energy. The key distinction lies in their classification:

Cyanobacteria

Commonly referred to as blue-green algae, are not algae at all. They are photosynthetic bacteria that have existed for billions of years. Found in oceans, lakes, soil, and even extreme environments like hot springs, cyanobacteria played a foundational role in shaping Earth's early atmosphere by producing large amounts of oxygen.

Phytoplankton

A broader category that includes any microscopic, photosynthesizing organisms in the water. This group encompasses various types of algae as well as cyanobacteria.

In short, while cyanobacteria are a type of phytoplankton, not all phytoplankton are cyanobacteria.

Though cyanobacteria are critical to life on Earth, contributing to global oxygen production and supporting aquatic ecosystems, some species — like Nodularia spumigena — can become hazardous under certain conditions. Harmful algal blooms, often driven by nutrient imbalances and warm temperatures, can lead to widespread environmental and public health issues. Beaches and waterways may be closed due to these blooms, primarily when toxic cyanobacteria are present.

Cyanobacteria are a reminder of nature's complexity — essential for life, yet potentially dangerous when environmental conditions allow them to dominate.

How using The Water Cleanser Technology Creates Ecosystem Balance and Controls Toxic Cyanobacteria by increasing Bacillus Bacteria

The Water Cleanser (TWC) technology works by promoting the growth of beneficial Bacillus bacteria in waterways. Bacillus species are naturally occurring, non-toxic, and play a critical role in maintaining a healthy microbial balance in aquatic environments. Here's how boosting their numbers helps control harmful organisms like toxic cyanobacteria:

1

Competition for Resources

Bacillus bacteria consume the same basic nutrients (like nitrogen, phosphorus, and organic matter) that toxic cyanobacteria and harmful bacteria need to grow.

By increasing the Bacillus population, you create direct competition for these nutrients, making it harder for cyanobacteria and bad bacteria to find the resources they need to bloom and dominate.

2

Biofilm Formation and Microbial Territory Control

Bacillus bacteria form biofilms — thin, sticky layers on underwater surfaces.

These biofilms physically occupy space and make it harder for harmful organisms to attach, grow, and establish large colonies. Essentially, Bacillus "locks up" valuable real estate in the waterway, preventing opportunistic species from taking hold.

3

Production of Natural Antimicrobial Compounds

Some Bacillus strains naturally produce mild antimicrobial substances (such as bacteriocins and enzymes) that inhibit the growth of harmful bacteria and cyanobacteria.

These substances don't harm fish or plants but can selectively suppress or limit the expansion of unwanted pathogens.

4

Improved Decomposition of Organic Waste

Excess organic matter (such as decaying leaves, algae, or fish waste) can fuel harmful blooms if left untreated.

Bacillus bacteria efficiently break down organic material, keeping nutrient levels lower and reducing the fuel source that toxic cyanobacteria and bad bacteria rely on.

5

Restoration of Natural Ecological Balance

In a healthy waterway, microbial communities are diverse and balanced.

When beneficial bacteria like Bacillus dominate, they help stabilize the ecosystem, making it resilient against invasions by harmful organisms.

By restoring this natural microbial balance, TWC prevents the environmental triggers (such as high nutrient loads and stagnant conditions) that allow toxic cyanobacteria to explode.

Summary

By using The Water Cleanser to increase Bacillus bacteria, you are essentially crowding out harmful species, removing their food sources, physically blocking their colonization, and creating a healthier, more stable ecosystem.

Instead of using chemicals to kill harmful blooms after they appear, this method prevents the problem biologically — through balance, not eradication.

How Bacillus Works Against Disease-Causing Bacteria

These principles also work against disease-causing (pathogenic) bacteria, and here's how:

Competitive Exclusion

Just as Bacillus competes with cyanobacteria for nutrients and space, it also outcompetes harmful bacteria (like Aeromonas, Vibrio, E. coli) by colonizing surfaces and using up available resources.

Result: Pathogens have less opportunity to grow and spread.

Antimicrobial Compound Production

Certain Bacillus strains produce:

- Bacteriocins
- Lipopeptides (e.g., surfactin, iturin)
- Enzymes that disrupt pathogen cell walls

These naturally inhibit or kill many disease-causing bacteria without harming fish or beneficial microbes.

Biofilm Barrier Effect

Bacillus forms beneficial biofilms that act like a microbial shield, making it harder for pathogens to adhere to surfaces (e.g., gills, filters, pond linings).

This also limits the formation of harmful biofilms by bacteria like Pseudomonas or Vibrio.

Immunostimulant Effects (in aquaculture)

In fish and shrimp farming, Bacillus probiotics are used to:

- Boost innate immune responses
- Improve gut microbiota
- Reduce mortality from infections

Water Quality Improvement

Many pathogens thrive in polluted or organic-rich water.

Bacillus breaks down excess organic waste (e.g., uneaten feed, fish waste), lowering ammonia and improving oxygen levels — making conditions less favorable for pathogens.

How Bacillus Suppresses Harmful Bacteria

The same natural processes that make Bacillus effective against cyanobacteria also help it suppress disease-causing bacteria in aquatic environments. Through a combination of biological competition, antimicrobial activity, and habitat modification, Bacillus plays a crucial role in maintaining microbial balance and protecting aquatic health.

One of the primary mechanisms is competitive exclusion. Bacillus rapidly colonizes surfaces and consumes available nutrients, making it difficult for harmful bacteria such as Aeromonas, Vibrio, and E. coli to establish themselves. By occupying ecological space and depleting the resources pathogens need to grow, Bacillus reduces their opportunity to spread and cause disease.

Bacillus also produces natural antimicrobial compounds that directly inhibit or destroy pathogenic bacteria. These include bacteriocins, which target and kill competing bacterial strains, as well as lipopeptides like surfactin and iturin, which disrupt bacterial membranes. Additionally, Bacillus secretes enzymes that break down the cell walls of harmful microbes, weakening them without affecting fish or beneficial microbial communities.

Another key function is the formation of beneficial biofilms. These protective microbial layers coat surfaces such as fish gills, pond linings, and filtration systems, making it harder for pathogens to adhere and form harmful biofilms of their own. This microbial barrier significantly limits the ability of opportunistic bacteria like Pseudomonas and Vibrio to take hold in aquatic systems.

In aquaculture, Bacillus acts as an immunostimulant, helping fish and shrimp build stronger innate immune responses. By improving gut microbiota and supporting overall health, Bacillus supplementation has been shown to reduce mortality rates from infections, contributing to more resilient livestock.

Finally, Bacillus improves water quality — a critical factor in disease prevention. Many pathogens thrive in organic-rich, polluted conditions. By breaking down excess organic matter such as uneaten feed and fish waste, Bacillus reduces ammonia concentrations and increases oxygen availability. This creates a cleaner, more stable environment that is less conducive to the growth of harmful bacteria.

In all of these ways, Bacillus supports a healthier aquatic ecosystem by naturally suppressing disease-causing organisms without the need for harsh chemicals or antibiotics.

Cyanobacteria Control Supporting Published Papers

1

Ndlela, L.L., Oberholster, P.J., Van Wyk, J.H., & Cheng, P.H. (2017)

Title: An overview of cyanobacterial bloom occurrences and research in Africa over the last decade

Journal: Harmful Algae, 68, 199–209

Key Point: Discusses the potential of Bacillus species as biological control agents against cyanobacteria like Microcystis.

2

Pal, M., Ghosh, S., & Das, A. (2023)

Title: Microbial management of algal blooms: emerging perspectives on eco-friendly control strategies

Journal: Journal of Environmental Management, 343, 117776

Key Point: Highlights Bacillus spp. as part of probiotic consortia that reduce harmful algal blooms through competition and nutrient cycling.

3

Zhao, Y., Xue, W., & Li, Y. (2020)

Title: Bioremediation of eutrophic water by Bacillus subtilis and its effect on microbial communities

Journal: Ecotoxicology and Environmental Safety, 190, 110077

Key Point: Demonstrates how Bacillus subtilis can improve water quality, inhibit algae, and shift microbial populations toward beneficial balance.

4

Liu, W., et al. (2021)

Title: Application of microbial remediation technology for the control of harmful algal blooms: a review

Journal: Ecological Engineering, 160, 106162

Key Point: Reviews microbial bioremediation strategies, emphasizing the role of Bacillus in controlling cyanobacteria via biofilms and antimicrobial compounds.

5

Zhu, M., et al. (2022)

Title: A review on the biotechnological potential of Bacillus spp. in aquaculture and aquatic ecosystems

Journal: Aquaculture Reports, 24, 101123

Key Point: How Bacillus supports water quality, suppresses pathogenic microbes, and reduces harmful blooms in aquaculture ponds.

Supporting Studies

- Zhou et al. (2009) – Bacillus reduced Aeromonas hydrophila infections in carp.
- Verschuere et al. (2000) – Bacillus species as effective biocontrol agents in aquaculture.
- Farzanfar (2006) – Bacillus probiotics reduce disease incidence in fish farming.

Summary:

Yes, increasing Bacillus via The Water Cleanser can reduce not only toxic cyanobacteria but also disease-causing bacteria — by shifting the entire microbial ecosystem toward beneficial, protective species.