The U.S. Army Combat Capabilities Development Command (DEVCOM) leads in the discovery, development and delivery of technology-based capabilities to enable Soldiers to win our nation's wars and come home safely. DEVCOM is a major subordinate command of the U.S. Army Futures Command. The DEVCOM Chemical Biological Center is the Army's principal research and development center for chemical and biological defense technology, engineering and field operations. The DEVCOM Chemical Biological Center is headquartered at Aberdeen Proving Ground, Maryland.

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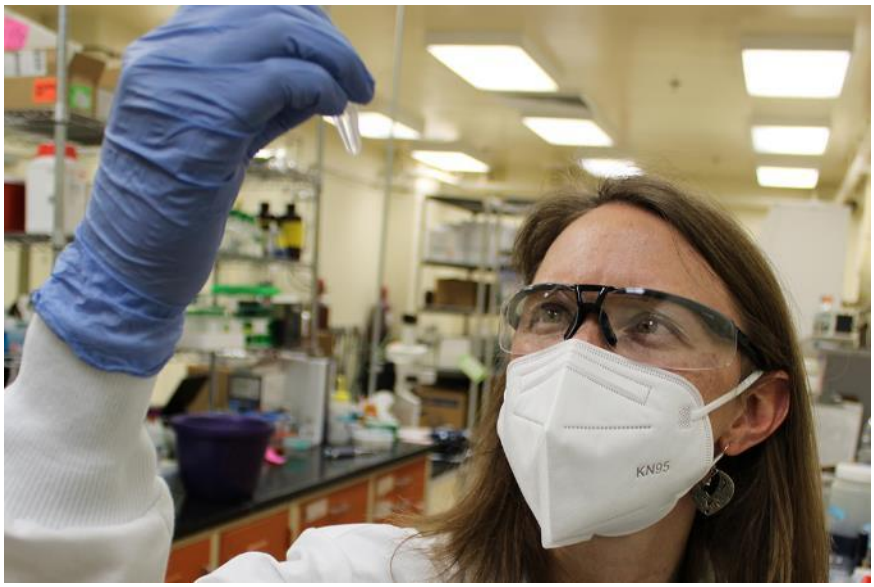
Army Scientists Seek Capability against Waterborne Toxins
Harmful algae blooms may present threat to warfighters in the field

By Richard M. Arndt

U.S. military forces train to fight and win in any domain. Since water covers 71 percent of the Earth's surface, warfighters face numerous threats in that environment. With that thought in mind, scientists at the U.S. Army Combat Capabilities Development Command Chemical Biological Center (DEVCOM CBC) are researching methods of protecting Soldiers by detecting waterborne biological threats.



DEVCOM CBC biologist Alena Calm examines a purified sample of freshwater algae DNA before submitting it for genomic DNA analysis to determine exactly what organisms the sample contains.

Among those biological threats are toxins produced by microalgae. According to DEVCOM CBC biologist Alena Calm, large stretches of coastline, lakes and ponds around the globe are closed to commercial and recreational activity each year due to dangerous levels of toxin resulting from naturally occurring microalgae blooms. "Our Soldiers are deployed to about 150 countries around the world, and many of these areas will experience harmful algae blooms," Calm said. "We need to know the potential toxins in any given area, how to detect them, and how to protect our Soldiers from potential exposure."

Calm emphasized that warfighters don't have to come in contact with the water to be exposed to

waterborne toxins. For example, a harmful microalgae bloom (often referred to as a red tide) occurs nearly every summer along Florida's Gulf Coast. The toxins created by this microalgae aerosolize and can cause symptoms ranging from itchy eyes, skin rash and minor respiratory issues to severe breathing difficulty for people with preexisting respiratory conditions. "Depending on the concentration of the organisms and the atmospheric conditions, these toxins can pose a threat to warfighter deployed to coastal areas or aboard watercraft," Calm said.

The first step in building a capability to detect, identify, and protect against these toxins is building a repository of the microalgae that produce them. Once the microalgae repository is in place, it will be able to provide microalgae samples to researchers at the Center and other Department of Defense laboratories. A team of Center researchers began the process of planning the project, including lab design and in-depth research, in March of 2020 just as the COVID-19 pandemic hit. After several months of remote collaboration, the team came together on-site at the CBC laboratory space in July 2020.

DEVCOM CBC researchers are analyzing samples from microalgae blooms across the American West and Southwest in order to identify and catalogue algae that produce harmful toxins.

Today, with funding from the Joint Program Executive Office for Chemical, Biological, Radiological and Nuclear Defense, Calm is working with Dr. C.J. Howard and Dr. Natalie Robinett in the Center's BioTechnology Branch to grow cultures of unknown microalgae from samples collected from different freshwater algae blooms across the American West and Southwest. Those algae are being identified by their DNA to determine which ones could produce harmful toxins. Cultures of each algae identified are added to the repository so that they can later be grown and provided in support of future research into waterborne biological threats. As the program progresses, additional samples from both freshwater and marine sources around the world will be collected and identified in order to build a repository that represents the global environment into which Soldiers could be deployed.

"Once we have a functional repository of stains, we will make them available to other service labs so they can work toward protecting the warfighter in the field from the threat of environmental exposure to waterborne toxins," Calm said.

The team at DEVCOM CBC is currently laying the foundations for an aquaculture capability that will eventually allow researchers to provide the warfighter with tools to anticipate and detect the presence of waterborne toxins and protect themselves while conducting missions in such environments.

DEVCOM CBC biologist Alena Calm pours off liquid from a microalgae DNA sample while preparing it for sequence analysis.

Microalgae require special growth conditions because they are photosynthetic and grow very slowly. "It's been a bit of an adjustment in terms of project timeline management," Calm explained. "Whereas I could do an entire experiment in a single day with the bacteria E. coli, that very same experiment could take three weeks using microalgae."

Studying a class of biological threats as diverse as toxic microalgae requires a wide range of aquaculture techniques that Center biologists are still learning, but building the repository will pave the way for a useful suite of capabilities that will help researchers better understand these existing and emerging biological threats, Calm said. "CBC labs have already been integral in fielding detection kits for Soldiers, and I could see those detection kits being expanded to include a panel of waterborne toxins."

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For more information about the DEVCOM Chemical Biological Center, visit https://cbc.DEVCOM.army.mil