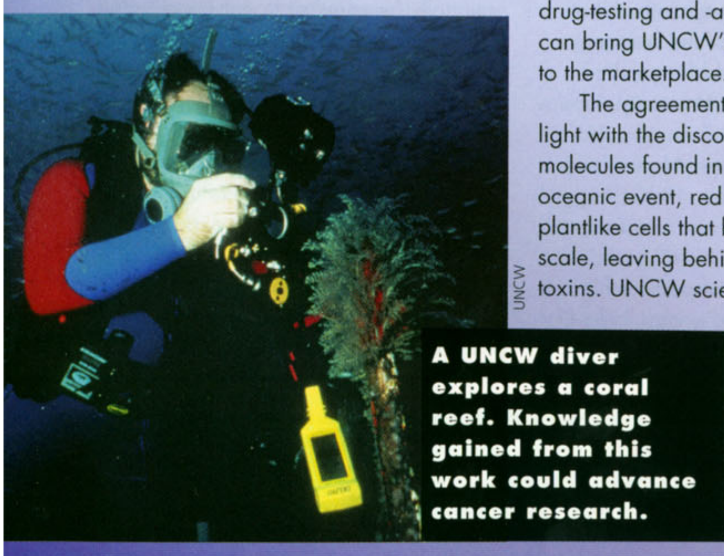
Exploring a deep sea of knowledge

Research at the Center for Marine Science could lead to innovations that advance drug development and feed the world.

Before humans embark on missions to discover whether life ever existed on Mars, we should consider the abundant life undiscovered in the Earth's oceans. So says Daniel Baden, director of the Center for Marine Science at the University of North Carolina at Wilmington. The extent of marine biodiversity is staggering — 32 of the 34 animal phyla live in oceans. The case for marine research is even more compelling when you consider that only 2% of oceanic life has been investigated. "The great unknown is not in outer space," Baden says. "It's right here in the oceans."

UNC Wilmington's Center for Marine Science is the state's most prominent marine-science facility. Research in the Myrtle Grove-based center cuts across multiple disciplines, including marine biology, marine chemistry, physical oceanography and ocean geology. Increasingly, research there is leading to innovations that could save lives, advance pharmaceutical discovery and feed the world. Recent center research has discovered techniques for detecting harmful bacteria that could be used in clinical labs or in the food industry. It's also discovered organic chemicals that serve as antidotes for toxins in shellfish.



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A UNCW diver explores a coral reef. Knowledge gained from this work could advance cancer research.

Growing renown for UNCW's marine research led to a partnership in 2002 between the university and Wilmington-based aaiPharma Inc. The drug company — with its expertise in the drug-testing and -approval process — can bring UNCW's scientific discoveries to the marketplace.

The agreement's potential came to light with the discovery of a series of molecules found in red tides. A common oceanic event, red tides are caused by plantlike cells that bloom on a massive scale, leaving behind a trail of chemical toxins. UNCW scientists are researching the microscopic components within these blooms, molecules that can mitigate some symptoms associated with cystic fibrosis. And since red-tide algae can be cultured in a laboratory, source material can be in ready supply.

The oceans cover 70% of the Earth's landmass. Into this vast expanse, the search continues for scientific discoveries with broad marketplace applications.

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Under the sea, it's the sponges vs. the coral, and the sponges seem to have the upper hand. Not many people keep up with territorial battles among invertebrate organisms, but Joseph Pawlik, a UNCW professor of marine biology, has made such study his life's work. He and other scientists ply the coral reefs around the Bahamas on research boats, observing the battle between competing invertebrates. Knowledge gained from this could advance cancer research.

The oceans are teeming with invertebrates, a diverse animal phylum that includes mollusks, jellyfish, clams, snails, octopuses and starfish. The competition between the sponges and coral might best be understood as a long-running territorial dispute. "I call it chemical warfare that's been going on for 600 million years," Pawlik says.

The "chemicals" are toxins that sponges harbor, compounds called allelopathogens. When coral absorb them, whole reefs begin to die off.

In scuba-diving gear beneath the ocean's surface, Pawlik studies the tissue responses of coral to the sponges' toxins. The growing knowledge about

UNCW student-researchers take a water sample searching for the algae that form red tides, which when cultured in the lab may have pharmaceutical benefits.

allelopathogens has led to intriguing questions. How is it that a sponge can generate toxins that kill off another species while doing no harm to itself? And can this immunity be replicated in lifesaving pharmaceuticals for humans?

The question is significant for drug companies developing cancer-fighting treatments, including chemotherapy, which introduce toxins into the body to kill cancerous cells. Since sponge-produced allelopathogens are harmless to a host organism but lethal to rivals, understanding these invertebrate toxins could lead to new chemotherapy treatments.

New advances in cancer treatment could be years away, but the idea that his marine research could eventually save lives, Pawlik says, is even more incentive to plumb the ocean's depths for new discoveries.

If you think raising children is tough, try raising sea bass or flounder. As newborns, they're finicky eaters, and as adults, they need inducements to spawn.

Wade Watanabe, a UNCW research professor, is meeting this fish-rearing challenge. In a state better known for its "Tobacco Road" agriculture, Watanabe and a team of UNCW scientists are putting aquaculture on the map.

Aquaculture is farming sea life for food production. Around the globe, scientists are noting depletions in fish stocks due to overfishing, including sea bass and flounder populations off the North Carolina coast. Coastal states increasingly face a choice, Watanabe says. "Do we want to see these fishing industries die out as the fish stocks are diminished, or will we learn how to raise them?"

Seafood production is big business for North Carolina. According to the state's Division of Marine Fisheries, during 2002 state fishermen harvested more than 160 million pounds of catch, worth nearly $95 million. Successful fish farming could eventually mean more exportation of North Carolina aquaculture products, Watanabe says. "We've got a gold mine swimming under the sea, but we've got to learn how to effectively mine it."

Working out of the Marine Science Center's aquaculture facility in Wrightsville Beach, researchers raise fish species that have proved resistant to controlled breeding in large tanks. It is no small feat to meet the nutritional needs of wild fish species accustomed to open aquatic spaces, Watanabe says. Both sea bass and flounder go from newly hatched larvae to pinkie-sized fingerlings. At this tiny stage, they can only feed on live plankton, microscopic organisms "grown" with sophisticated equipment.

Growing fish through juvenile stages is problematic, and trying to spawn mature fish brings another set of challenges. In UNCW research labs, scientists sometimes inject egg-bearing gravid fish with hormones and let them loose in a tank with hundreds of their kind. Equally effective in inducing underwater ardor has been the use of lighting and temperature controls. But even when spawning is induced in tanks, commercial viability is not ensured, since considerable risks still exist throughout the fish's delicate life cycle. Sustainable stocks for both sea bass and flounder are still years — and multiple spawning rounds — away.

The end result of all of Watanabe's research will be millions of dollars of economic exports for state fishermen and seafood companies. In the meantime, the scientist has fingerlings to nurture, persnickety juveniles to monitor and mature fish that require lighting ambiance before "the mood" finally sets in.

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