WHAT'S UP?

Annapolis

JULY 2012

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CUTTING-EDGE RESEARCH AT THE INSTITUTE FOR MARINE AND ENVIRONMENTAL TECHNOLOGY COULD UNLOCK DOORWAYS TO SUSTAINABLE FOOD AND FUEL.

↑ **Institute for Marine and Environmental Technology** is located at Baltimore's Inner Harbor, where 150 University of Maryland faculty members—mostly scientists in a range of fields—conduct innovative research.

By BARBARA PASH || Photography by CHERYL NEMAZIE

Dr. Yonathan Zohar talks to fish. "Hello, how are you today," he greets a tank of sea bream. "Would you like some food," he asks, tossing in handfuls of fish pellets while the fish jump and splash and look as happy as fish can look.

In his laboratory in the basement of the Columbus Center, in downtown Baltimore City, Zohar and his team are at the forefront of aquaculture. They are not alone. The building houses University of Maryland faculty doing pioneering research on everything from the genetics of fin fish, shellfish, and crustaceans to the bacterial biofouling of ships.

Even among the handful of elite marine and terrestrial research institutions around the country, the Institute for Marine and Environmental Technology (IMET) stands out. It is a strategic alliance involving scientists at the University of Maryland Center for Environmental Science, the University of Maryland Baltimore and the University of Maryland Baltimore County. Scientists are engaged in cutting-edge research in microbiology, genetic analysis and biotechnology, using marine life to develop new drug therapies, alternative energy and other innovations to improve public health and economic opportunities.

"All 150 faculty members of IMET work on the molecular level," says Dr. Russell Hill, a professor at the University of Maryland Center for Environmental Science who is currently serving as interim director of IMET.

"Each of the three research partners has its own focus," he says. "It's a unique arrangement."

Following are two examples.

FISH STORY

They lived in the Gulf of Mexico. Then one day, they were caught, put on a truck, and transported to Baltimore, where they now swim in a temperature-controlled, day/night-simulated and seasonal-replication tank.

"They're interacting with us," Zohar, professor and chair of the department of marine biotechnology at the University of Maryland Baltimore County at IMET, says of the sleekly silver Greater Amberjacks, a species of yellowtail, that do indeed seem to pause as they circle past a window in their 5,000-gallon tank.

The world's crop of commercial seafood is declining at an alarming rate. Some species are on the brink of extinction. The answer is aquaculture, but not, in Zohar's opinion, the standard method of fish farms, aka floating net pens in coastal waters, which are neither environmentally sustainable nor economically feasible in the long run.

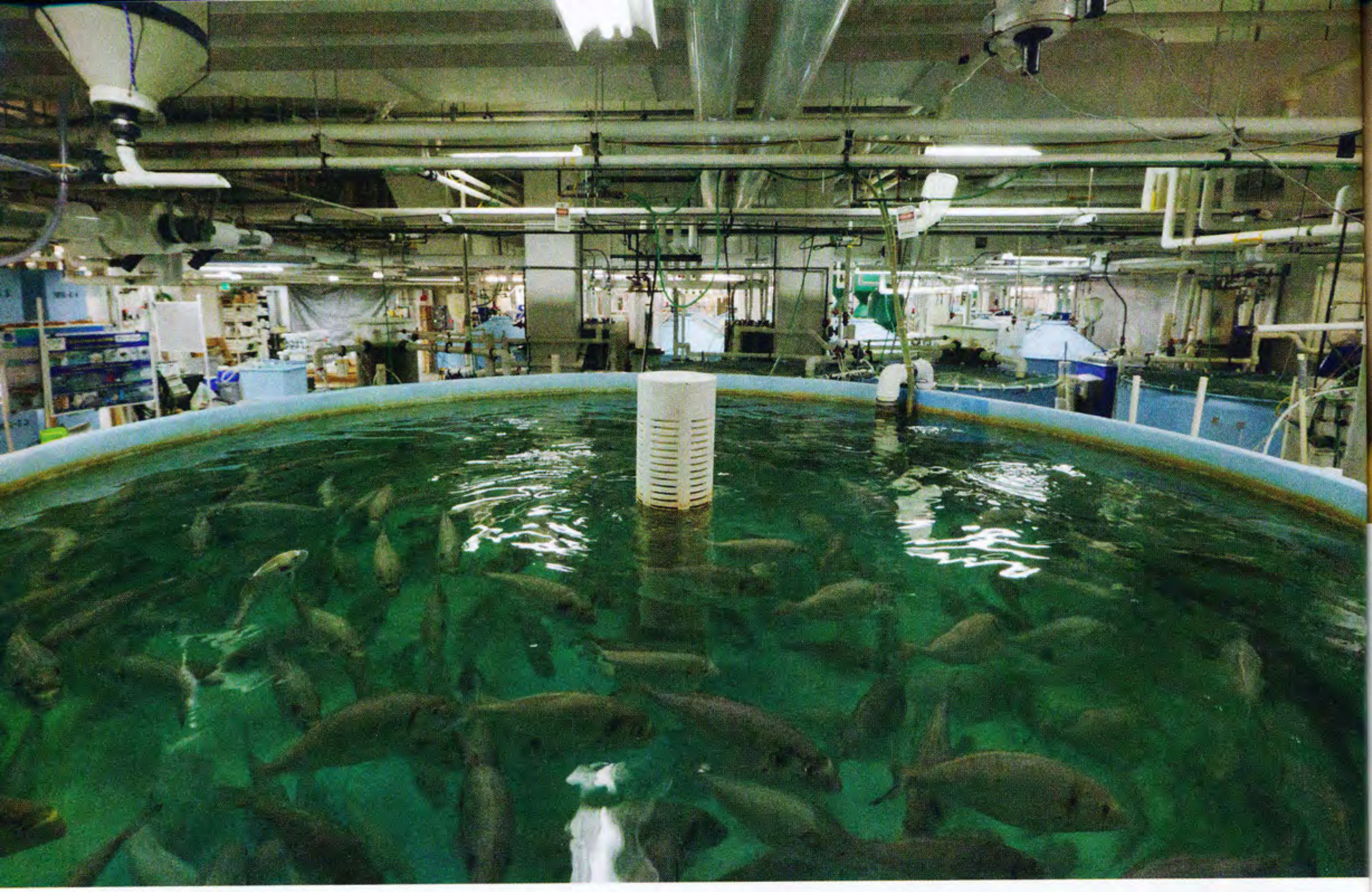
Instead, he and his team have developed a land-based, closed-loop system that not only allows for a greater density of fish but a faster growth rate as well. In his method, sea bream reach one-pound market size in about nine months versus 16 to 18 months in net pens.

His laboratory is a model of how the system works. It is an 18,000square foot maze of fish tanks, water purification cylinders, and overhead pipes, all overlaid with a faint fishy odor.

"From the fish's point of view, it's an optimal environment," he says. "There are no diseases and no pollutants in the water. You can tailor conditions like water temperature, salinity, and lighting for best performance."

Zohar studies fin fish, crabs and oysters. In fin fish, he focuses on high-value commercial species, currently: cobia, Chesapeake Bay rockfish, gilthead sea bream, Greater Amberjack, and Mediterranean sea bass (bronzini).

Interim Director of IMET and professor at the University of Maryland Center for Environmental Science, Dr. Russell Hill oversees research partners that are developing biotech-based solutions to protecting marine ecosystems.



The research conducted within the 18,000-square-foot maze of fish tanks at IMET—each tank holding 5,000 gallons—could hold the key to sustainable aquaculture.

"THE GOAL IS TO MAKE MARYLAND'S AQUACULTURE SUSTAINABLE AND COMMERCIALLY ATTRACTIVE."
—DR. YONATHAN ZOHAR

"The key word is diversity," he says of the species he studies in order to understand their life cycle, breed in captivity, and grow to market size.

In Maryland's aquaculture industry, there's been great progress in shellfish, less so in fin fish despite efforts by state agencies to encourage the latter's development.

That makes Zohar's research particularly important, says Karl Roscher, assistant director of fisheries service, state Department of Natural Resources. "He works not only in aquaculture but in reproductive studies." His rockfish breed stock, for example, and can produce fingerlings that are then sold to producers to grow to market size.

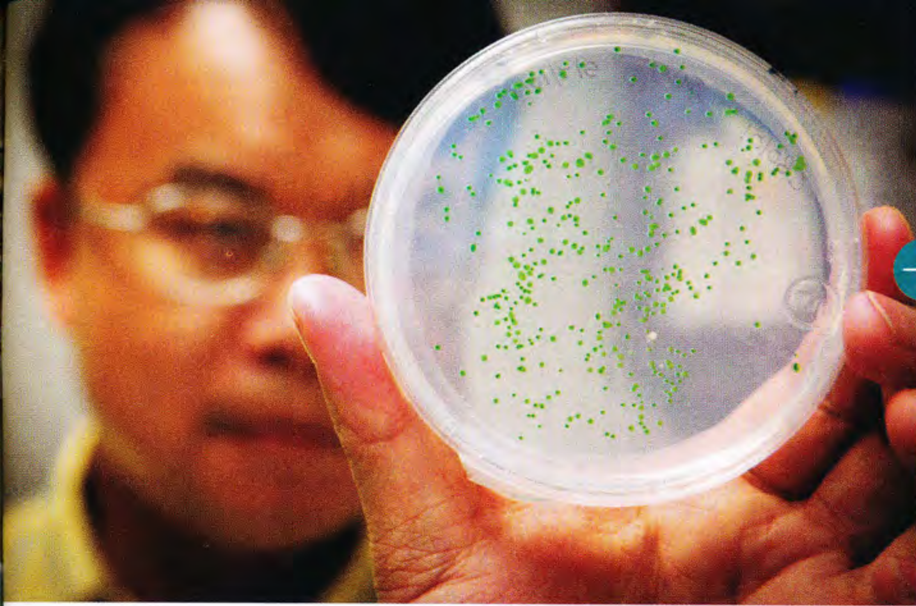
Zohar's research depends on grants from federal and state agencies, foreign governments and industry sources, from $300,000 to $1 million total in any given year.

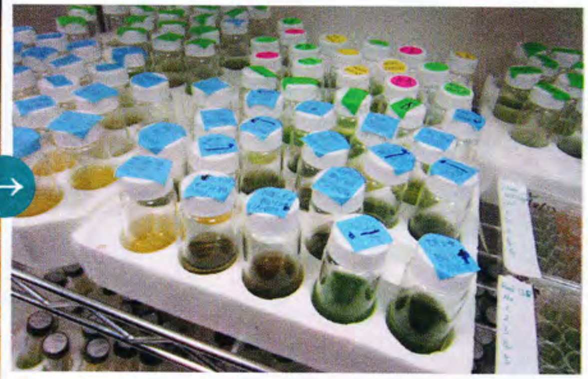
He is talking to Norway about a grant to study salmon. The federal National Oceanic and Atmospheric Administration's funding on cobia and Greater Amberjack totals $1.1 million over a period of years, and includes the first-ever effort in the U.S. to breed the latter in captivity. He has industrial funding to study tuna, the king of fish.

Dr. Yonathan Zohar and his team are currently developing an advanced sustainable method of fish farming by use of a land-based, closed-loop system that not only allows for a greater density of fish but a faster growth rate as well. He is holding a silver Greater Amberjack.

In 2010, the University of Maryland Baltimore County issued the first commercial license of the aquaculture technology. A company in Baltimore City is in the process of seeking funds to raise and sell sea bream and sea bass in a warehouse.

To Zohar, it's the first of many contracts to come. "The goal is to make Maryland's aquaculture sustainable and commercially attractive," he says.





Upwards of 500 strains of algae, collected from around the world, are grown and monitored by Dr. Feng Chen. An ideal single strain of algae could be used to break down and eat carbon emissions from burned fossil fuels, leaving a zero-carbon footprint.

CLEAN ENERGY

Dr. Feng Chen has seen the future of clean energy and it is algae.

In his laboratory in the Columbus Center, Chen, associate professor at the University of Maryland Center for Environmental Science grows 400 to 500 different strains in a temperature- and light-controlled room. They've been collected from around the world, among them Florida and Mexico, the Chesapeake Bay, and the California coast.

Chen, a compact, friendly man, sits in his office and does his best to translate the chemical formulas and complex scientific data of his research into layman-friendly terms.

"Algae need light, carbon dioxide, and water to grow. They can grow in seawater or municipal waste water," says Chen, who is currently working on an environmental project that has revolutionary implications.

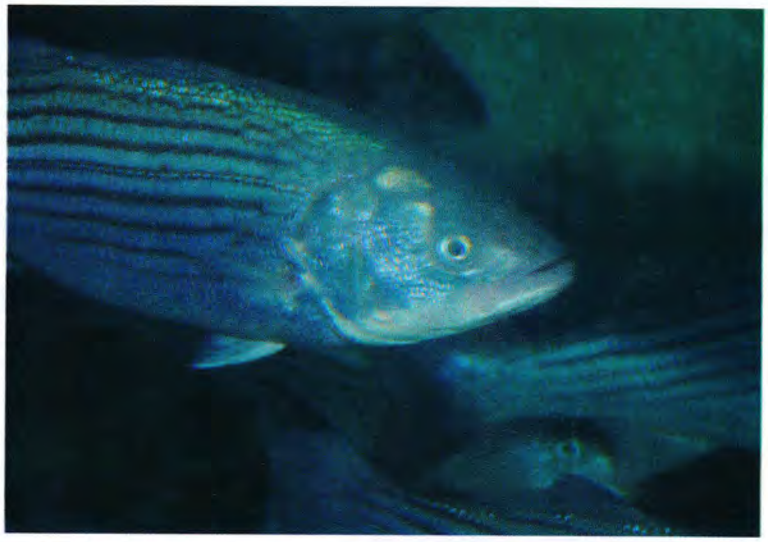
A first in Maryland, the project is taking place at the Back River Waste Water Treatment Plant, located in Baltimore County's Edgemere community and operated by and for Baltimore City. HY-TEK Bio, a start-up company, has built four bioreactors at the site.

The Back River Plant has a power plant on the premises that burns methane gas. Starting this summer, instead of the exhaust from the power plant's flue being released into the air, it will be vented into the bioreactors, where the algae will break it down and absorb the carbon dioxide.

Moreover, the algae will be used to absorb nutrients like nitrogen from the waste water before it is released into the Chesapeake Bay. And, the algae will produce quantities of biomass that can be harvested and sold for a number of purposes, including pharmaceuticals, animal feed, and biofuels.

"The crux is that you can burn any fossil fuel with no emissions—a zero carbon footprint," Bob Mroz, HY-TEK's president and CEO, says of its patent-pending technology.

"This is being done in labs, but this [Back River Plant] will be one of the few in the world using algae, waste water, and flue gas on an industrial scale."



Rockfish breed stock, shown here in IMET fish tanks, can produce fingerlings that are then sold to producers to grow to market size.

For the project, Chen had to find the right algae, one that could survive, and grow, in a high level of carbon dioxide. "As carbon dioxide increases, many species die," says Chen, who spent six months screening over 1,000 strains before finding one that worked.

Funding comes from several different sources. Maryland Industrial Partnership (MIPS), a University of Maryland facility that partners with industry to bring faculties' research to market, contributed $81,000 for each of two years, with HY-TEK adding $9,000 per year to the MIPS grant for Chen's research. At the Back River Plant itself, Baltimore City is spending $250,000 via federal stimulus dollars; HY-TEK, $200,000.

"HY-TEK came to us. We were interested in the project. We look for good science and application to business," says Martha Connelly, MIPS director, adding that another goal for the projects it backs is to create jobs for Marylanders. An added bonus in this situation is the reduction of nutrients into the Chesapeake Bay.

Says Chen, "The project in Maryland is moveable. It can be used in other power plants." ■

Baltimore-based writer Barbara Pash is a frequent contributor to What's Up? Media, covering environmental and political topics.