National Oceanic and Atmospheric Administration

Center for Coastal Fisheries and Habitat Research

Habitat, Fisheries at the Forefront in NOAA Lab's Second Century of Science

PIVERS ISLAND - In the stark underwater scene on the computer screen, a branch of gray staghorn coral seems to be the only sign of marine life - if, indeed, it is alive.

"There's a whole generation coming up that thinks this is what a reef should look like," says David Johnson, director of the Center for Coastal Fisheries and Habitat Research (CCFHR) near Beaufort.

> ***"We are planning for our next 105 years...."***
> ***David Johnson***

The next slide shows the same background, but seagrasses and sea urchins flourish in the sand, and many fish of varied size and color swim around the orange coral.

"This is how a healthy reef looks," Johnson says. "That many fish, that many species."

The center's aim is to assure that the second scenario – a vibrant and diverse marine community – is more common than the first. The National Oceanographic and Atmospheric Administration (NOAA) marine laboratory researches, monitors, protects and restores marine habitats such as coral reefs, seagrass beds, salt marshes, oyster beds and estuarine areas, and the fish and marine life that depend upon them.

The NOAA complex on Pivers Island has been a community landmark and an important federal marine laboratory since 1899, though its name, governing agencies and departments have varied. Since 1999, the laboratory has been one of five centers in the newly created National Centers for Coastal Ocean Science under the National Ocean Service.

In the laboratory's long history, its tasks have ranged widely, including propagating diamond-backed terrapins and assessing the effects of radiation on invertebrates.

Some of the multitude of its current habitat and fisheries projects take researchers to the other side of the world; some to their own backyard. The center collaborated with its only neighbor on Pivers Island, Duke University Marine Laboratory (DUML), to restore a marsh where a bulkhead had been.

With nets hung from the island's bridge, the center has been monitoring the movement of menhaden and other fish through Beaufort Inlet since 1985. The nets catch a representative sample of fish and larvae as the tide ebbs and flows between the inlet and the Newport River and its estuaries. The findings, combined with a similar data set in New Jersey, help scientists predict distribution throughout the year.

Continuing a long history of research critical to management decisions, fisheries researchers grow fish through their entire life cycle. Using that information and other techniques, they assess current fish stocks and predict future population numbers.

"Part of management is knowing how big the population is," Johnson says. "People here are providing that information."

The National Marine Fisheries Service component at the laboratory also conducts extensive research into marine mammals and sea turtles, and the effects of human activities on their populations.

The laboratory recently developed more aquaculture facilities for fisheries research, including a greenhouse that duplicates the native habitats of marine fish. Researchers are studying whether raising fish in a more natural environment, rather than in tanks, increases survival rates when released into nature, thereby also increasing the success of restocking efforts.

Ecosystem Stressors

CCFHR researchers have been studying the function, fragility and reconstruction of marine habitats for decades. A recent series of Congressional acts has made such work a national priority.

CCFHR scientists scrutinize how human activities and natural events stress these habitats and the larger marine ecosystems. By examining past and current conditions, they are increasingly able to predict - and when people cause the problem, perhaps change – the future of these complex and increasingly vulnerable webs of underwater life.

"Say a boat runs aground in the Florida Keys," Johnson says. "We provide the research and the protocol which allow people to assess how much damage was done and assign a monetary figure to it."

As North Carolinians well know, nature itself can render dramatic alterations. Just as forecasters could estimate how a hurricane's storm surge might affect coastal communities, CCFHR strives to predict what a specific hurricane will do to specific ecosystems. Concentrations of some fish species, for example, diminish after hurricanes with certain

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Established: 1899
Staff: 101 federal and contract
Mission: The mission of CCFHR is to provide the science needed to help managers understand and respond to ecosystem change in the coastal and marine environment.

characteristics, information useful to fisheries managers and commercial fishermen.

On a larger scale, NOAA is assembling a comprehensive ocean observation and forecasting system, using measurements of the physical characteristics of seawater and its movement.

"It will take much of the guesswork out of what is going on in the ocean," Johnson says. On an island and within sight of the sea, the center could be important in the system's development.

> ***"We focus on top-to-bottom science, basic research and detailed application for managers..."***
> ***Mark Fonseca***

CCFHR also researches invasive species that are disrupting ecosystems worldwide, including North Carolina. Paula Whitfield of CCFHR determined that lionfish, typically found in tropical oceans, have been thriving off the state's coast since 2000. The lionfish's venomous spines can inflict severe pain on divers or fishers in accidental encounters.

"In summer months, if there is a reproducing population offshore, we may get these fish inshore," Johnson says. Researchers are examining what conditions the fish favor and what their expanded range means to other species.

Climate change and resulting sea level rise are another ecosystem stressor under study. Some predictions say the water could be a foot or more higher within 50 years. On North Carolina's flat coast, a small increase can bring big changes; higher flood insurance rates among them.

"In addition, sea level rise will affect oyster beds and seagrass beds, which in turn will affect other species," Johnson says.

Pollution is a major contributor to harmful algal blooms that present problems for fish and shellfish or their food sources. Some toxic algae can cause human health problems.

Under the direction of Pat Tester, staff members sample the water and the algae when a bloom occurs to assess factors that caused it. They recently tested a new "Autonomous Underwater Vehicle," a self-powered device capable of documenting conditions in shallow estuarine waters, where blooms are especially problematic.

Molecular probes coded to specific organisms are among the latest tools in the difficult task of identifying algae. Using the probes, CCFHR biologist Mark Vandersea determined a common water mold likely causes many of the lesions on fish that were previously attributed to Pfiesteria, an alga subject to much debate. The mold apparently gets under fish skin through small sores or openings, and spreads throughout the tissues.

Restoration Groundwork

Some of its work is based in North Carolina, but CCFHR's focus is nationwide. It administers another laboratory at Kasitsna Bay near Seldovia, Alaska. University of Alaska-Fairbanks students and staff, state and federal researchers and students from high schools and other academic institutions use the laboratory.

CCFHR monitors and researches natural processes and interrelationships, human impacts and restoration efforts in marine sanctuaries and protected areas coastwide. Similar activities are underway in National Estuarine Research Reserves (NERR), which NOAA oversees.

In all its efforts, CCFHR intends its work to be translated into action.

"We focus on top-to-bottom science, basic research and detailed application for managers," says Mark Fonseca, a research ecologist.

Fonseca and his colleagues worked with the state of Florida on a pilot program to hold boaters financially accountable for injuring habitats when they run aground in marine sanctuaries. The program assessed boaters over $500,000 in restitution in the first year, Fonseca says, but that represents only a fraction of the damage.

"We've taken our knowledge of the recovery dynamics of each plant in the coral community, and used them to guide restoration and build a program that will only be successful if it's no longer needed," he says.

Researchers at CCFHR began to establish the ecological worth of marine habitats long before the federal protection initiatives of the last 15 years.

> ***"We really got the ball rolling in the '60s and '70s on salt marsh and seagrass research and the value of these habitats to fisheries ecology..."***
> ***Gordon Thayer***

"We really got the ball rolling in the '60s and '70s on salt marsh and seagrass research and the value of these habitats to fisheries ecology," says Gordon Thayer, CCFHR Deputy Director.

Researchers at the laboratory built the foundation for many of the restoration efforts now being implemented nationwide. Thayer himself played a lead role in establishing restoration guidance and syntheses, and laboratory staff members have been among the leading researchers in seagrass restoration approaches. Thayer conducted a symposium for scientists and federal legislators in 1989, and edited a significant reference book, *Restoring the Nation's Marine Environment,* that resulted. He also co-organized NOAA's Restoration Center, established soon after.

He is the senior author on Volume One of *Science-Based Restoration Monitoring of Coastal Habitats*, a recently completed guidance document on measuring the success of restoration efforts. Other CCFHR staff members, Thayer says, continue to play important roles in all of these restoration-related efforts. Fonseca and his team of researchers, for example, currently are developing models to predict the recovery of seagrasses and corals from natural and human impacts.

Research from this laboratory in Beaufort, the second oldest federal marine laboratory in the nation, is known for its staying power in many other areas, and there is more to come. Johnson is working with DUML on a master plan for Pivers Island.

That includes NOAA's first new building in 45 years. It will house a teaching laboratory, an auditorium and space for NERR state offices, among other things. The building is part of Johnson's modernization plan to better support center efforts at confronting the environmental challenges of today, and of the future.

"We are planning for our next 105 years," he says.