Algorithmically Speaking

Is South Carolina leading the world in 'eco-forecasting'?

BY BENJAMIN SCHLAU

Is it possible that South Carolina — often portrayed as a backwater state filled with racists, spousal abuse, and the worst SAT scores in the nation (see story on page 11) — is the home of the most advanced DNA technology in the world used to analyze the genetic response of marine organisms to environmental stress? Technology that could one day be used to predict the future of marine environments?

Yes it is, according to population geneticist Dr. Bob Chapman of the S.C. Department of Natural Resources (DNR).

"It's absolutely astonishing that this happened in South Carolina," says Chapman.

And, astonishingly, it wouldn't have been possible without something many South Carolinians are very bad at: math.

Using mathematics to predict the future was once something found only in science fiction novels. But, as with so many other things like submarines, space travel, and cloning, it has become reality.

To a degree.

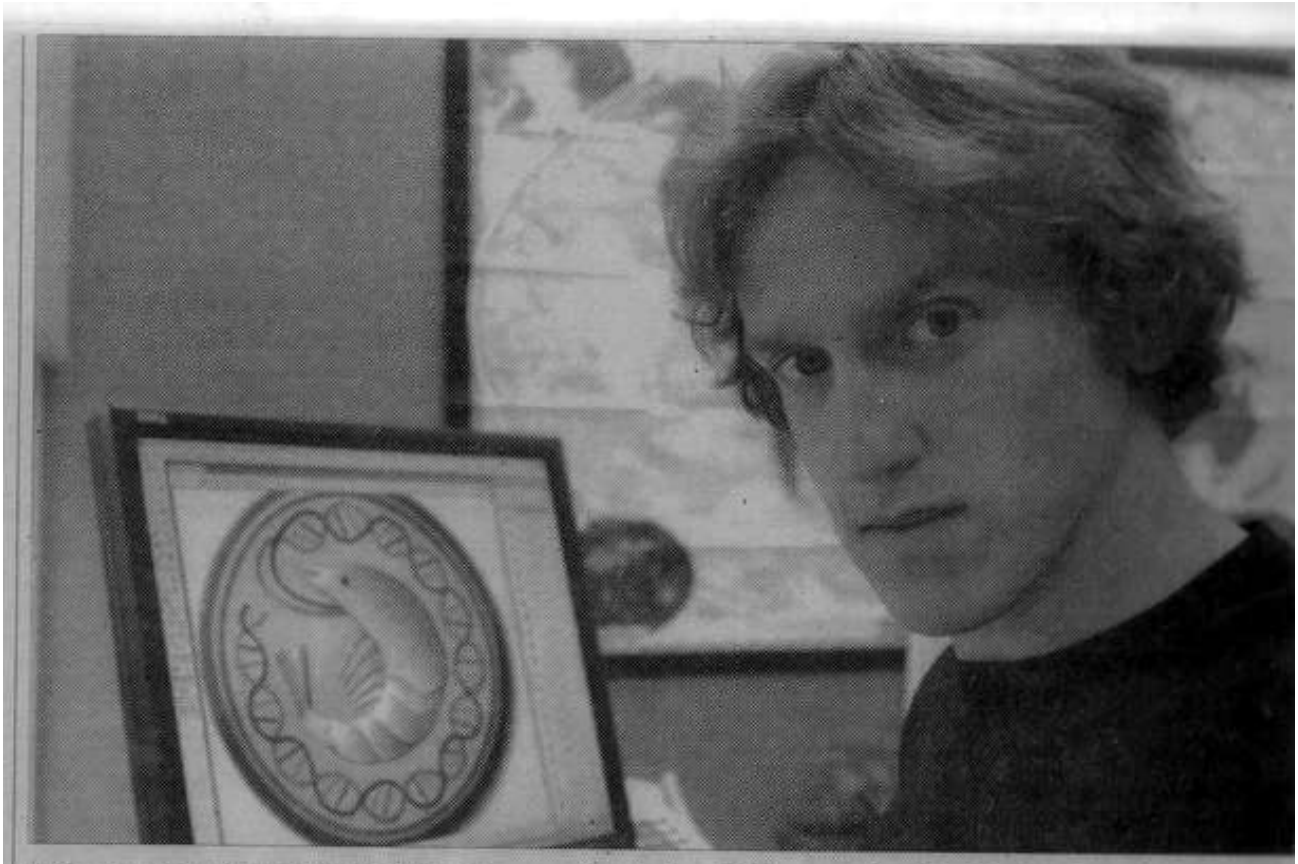
Satellites use intricate mathematical computations called algorithms for weather forecasts. *The Wall Street Journal* reports that marketing firms use algorithms to figure out how much money passengers will pay for tickets, and movie studios utilize these types of equations in an attempt to predict the popularity of new films.

One day, Chapman says algorithms, using variables gathered from the DNA of marine organisms, will be used in the emerging field of "eco-forecasting" to predict changes in the environment and effects on marine life. And "eco-forecasting" would not have become a reality without the Marine Genomics Project, which was developed right here in Charleston.

Built on the Human Genome Project, which maps the DNA sequence of humans, the Marine Genomics Project is the culmination of years of work by scientists and mathematicians at the Medical University of South Carolina (MUSC) and the DNR.

In actuality, the marine project is an internet site: www.marinegenomics.org. More than that, the website allows biologists from all over the world to send DNA samples of sub-aquatic critters to the Hollings Marine Lab on James Island so that their DNA can be mapped and various genetic responses to environmental factors compared using software available through the website that also relies on, you guessed it, algorithms.

Not only can diseases and environmen-



Irishman scientist David McKillen is mapping shrimp DNA as part of the Marine Genomics Project

tal contamination in marine populations be monitored, but pollution levels in the sample species' habitat can be measured as well.

One day, Chapman says algorithms can be applied to the data to predict future environmental conditions and how organisms will respond — hence the term "eco-forecasting."

Chapman is confident scientists will be able to use algorithms to predict the future of marine life, adding that he already uses the equations to predict the monthly shrimp harvests within 5 percent of the actual catch.

Chapman sees even more promise in the application of DNA sequencing to marine biology.

"Given the track record with human health, you can see how useful it will be to marine science," Chapman says, pointing out that knowledge gained from the Human Genome Project is now used in diagnosing cancer and predicting how a patient will respond to certain medical treatments.

But it is expensive.

Mapping the human genome ate up about $1 billion in funding, he says. Work has been slower in applying this new science to marine life.

"No one's going to give us a billion dollars to sequence a shrimp's DNA," he says.

But there is hope. As one of the project's mathematicians, Jonas Almeida, puts it: "My biggest surprise is how far sheer persistence will get you, even when the funds are scarce. Marine biology is just one of those fields that gets people excited beyond what public funding would let you anticipate."

Almeida worked with a team of biologists and mathematicians at MUSC that was led by molecular biologist and computer scientist David McKillen from Ireland. For those feeling inadequate just reading McKillen's job title, factor in this: he just turned 28 last week.

McKillen says the overall purpose of the marine project is to create a research resource to allow marine biologists from all over the world to focus on how organisms might react to different environmental stress.

McKillen uses shrimp in an example. He says that with their website, a biologist could compare how shrimp respond genetically to pollution from a factory. A scientist could then take shrimp samples downstream from the pollution, meaning they would be exposed to that particular environmental stressor, and take shrimp samples from upstream before the shrimp are exposed. Then, using the website, the scientist could compare what genes were activated in response to the pollution.

Like Chapman, McKillen believes their project is the most advanced in the world.

"Nobody has really gotten to the level we're at," McKillen says. They both say that biologists from all over the world already rely on the project to analyze genetic activity.

Another project developer and user of the website is Mathew Jenny, who expects to earn a doctoral degree in molecular biology for his research at MUSC in about a month.

He says their work goes beyond the well-being of marine life because human health and our economy depend so much on the hardiness of the oceans. Jenny foresees that if the oceans collapse, not only will the fishing industry deteriorate, so will tourism.

Currently, Jenny is involved in collecting DNA from pristine oysters in South Carolina's ACE Basin nature preserve. Later, he will examine Charleston oyster beds to compare the genetic effects due to environmental contamination caused by human activities.

Jenny says his research is of ever-increasing importance because the growing number of roads and parking lots are not allowing the ground to absorb pollutants before rainwater carries contaminants into waterways.

He adds that he could not do his work without the project's website because of the immense amount of data needed to be analyzed.

"One reason we developed the website is to handle that much info," Jenny says.

As can be seen, the project is not just for marine biologists. The website is even open for public browsing, but we here at the *City Paper* recommend brushing up on your knowledge of molecular biology before diving in. CP