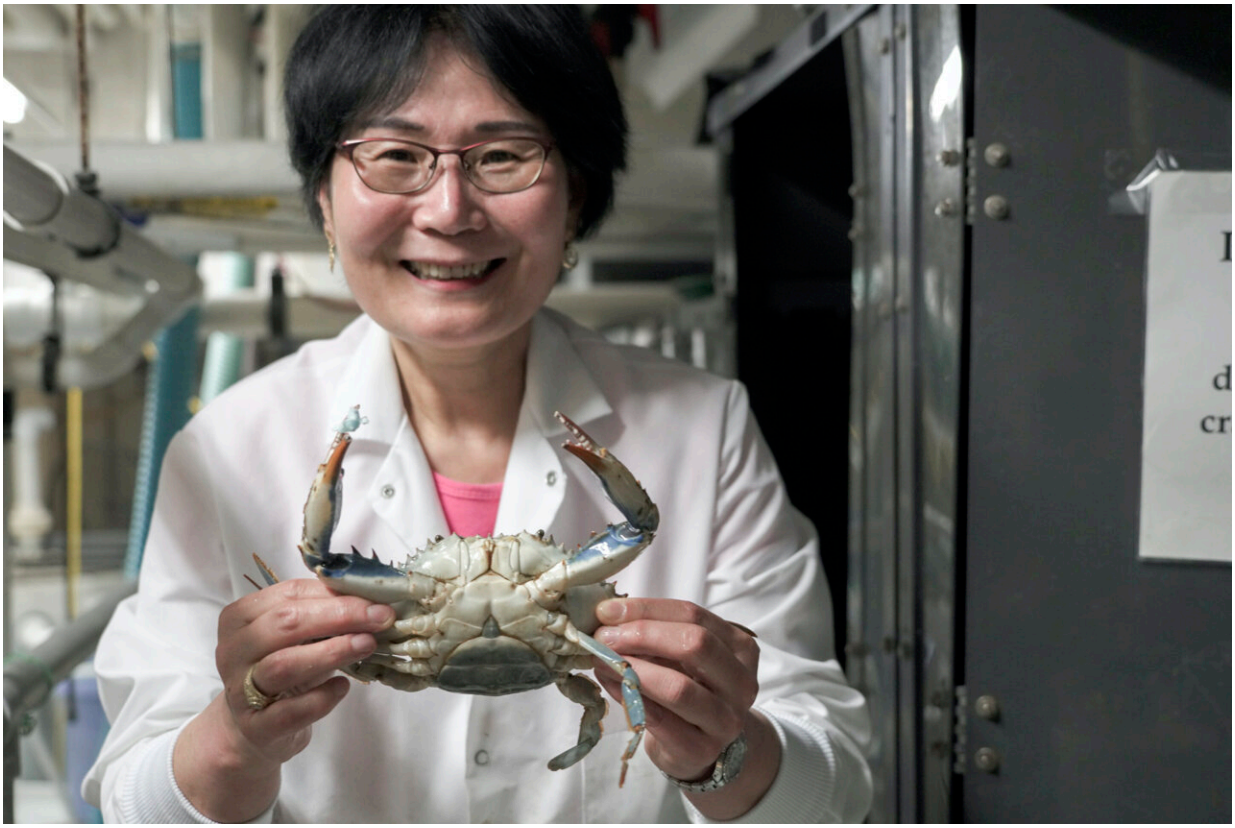
Cracking the blue crab's genetic code

October 4 2021



University of Maryland Center for Environmental Science Professor Sook Chung, an expert in crab biology, led the project to sequence the blue crab at the Institute of Marine and Environmental Technology in Baltimore. Credit: University of Maryland Center for Environmental Science/Cheryl Nemazie

Scientists at the University of Maryland Center for Environmental Science have sequenced the genome of the blue crab. The best way to

understand an organism is to understand its genetic makeup, also known as its genome. Once the code is understood, it reveals many secrets of how the organism works. Researchers plan to investigate the genetics of growth and reproduction, and the genome will be made publicly available so that scientists anywhere can study different aspects of the blue crab.

"What makes crabs successful is located in the chromosomes," said University of Maryland Center for Environmental Science Professor Sook Chung, an expert in crab biology who led the project at the Institute of Marine and Environmental Technology in Baltimore. "Knowing the full genome, we are several steps closer to identifying the genes responsible for growth, reproduction, and susceptibility to disease."

Researchers determined that the blue crab had between 40 and 50 chromosomes, which is nearly double the amount found in humans. However, these chromosomes were very short, resulting in a genome that is approximately one third the length of the human genome, in terms of bases. Despite its relatively diminutive size, the blue crab genome is rich in gene diversity, containing approximately 24,000 genes, slightly more than the amount identified in humans.

Understanding how likely crabs are to reproduce successfully could aid in fisheries policies in places like Maryland's Chesapeake Bay, helping to maintain a healthy ecosystem and economy. Breeding particularly fertile females could help enable the production of blue crabs in aquaculture. The genome could also potentially be used for food source tracking to determine if the lump crab meat in the market came from Venezuela or Maryland's coastal bays.

The genome is the DNA sequence of the chromosomes that give the instructions for how an organism grows and develops. Once the code is

understood, it reveals many secrets of how the organism works. Once you understand the "blueprint" of an organism, you can understand what genetic traits make some crabs particularly successful at reproducing or others more adapted to changing water temperatures fueled by climate change.

Since the genome within a species varies by individual, any genome mapping project begins with choosing the best possible sample organism. In late October 2018, Chung went out on the Chesapeake Bay on a crabber's boat and collected dozens of young female blue crabs to breed in the Institute of Marine and Environmental Technology's Aquaculture Research Center (ARC). One female grew to adulthood, mated, and successfully produced offspring, proving she had good genes for reproducing. Scientists isolated DNA from this crab's daughter for sequencing.

The sequence of the genetic code determines how an organism will grow and develop. When the genetic code is sequenced, it is initially jumbled up from its proper order. The process of correctly ordering the code, or "assembly," required a special computer running night and day for over six months.

"Imagine you take several volumes of an encyclopedia and you have a hundred copies of each volume. You put them all through a paper shredder and then you have to use that to reconstruct the original volumes of the encyclopedia," said Associate Research Professor Tsvetan Bachvaroff, who was responsible for assembling the blue crab genome. "Once the encyclopedia, or genome, is back in the correct order, you can begin to identify genes and use it like a reference book, looking up genes to answer questions."

The team of researchers led by Professor Sook Chung, a comparative molecular endocrinologist, included bioinformaticist and Associate

Research Professor Tsvetan Bachvaroff; population geneticist and Associate Professor Louis Plough, and Associate Research Scientist Ryan McDonald, completed the project in four years.

"Sequencing an entire genome in just four years with four scientists was a major scientific feat," said Russell Hill, executive director of the Institute of Marine and Environmental Technology. "The genome will be made publicly available so that scientists anywhere can use it, and it will fuel decades of research on the blue crab and other crustaceans."

The paper was published in *G3: Genes | Genomes | Genetics*.

More information: Tsvetan R Bachvaroff et al, Chromosome-level genome assembly of the blue crab, Callinectes sapidus, *G3 Genes|Genomes|Genetics* (2021). DOI: 10.1093/g3journal/jkab212

Provided by University of Maryland Center for Environmental Science