BOEM
Bureau of Ocean Energy Management

Science Notes
Science for Informed Decisions

March 16, 2021

Dear Reader,

Genomics – the science of mapping and sequencing genomes and analyzing their structure and function – holds a fundamental key to understanding the world around and within us. While we may hear the letters DNA more frequently these days in connection with COVID-19 testing, BOEM has been using genomic techniques in its Environmental Studies Program (ESP) for several years to improve the quality of ecological research and help detect cryptic or invasive species offshore.

Working in partnership with the Smithsonian, BOEM has used DNA barcoding to better understand the ocean's biological resources, specifically the marine invertebrates collected from ESP-sponsored research in all four U.S. Outer Continental Shelf (OCS) regions. BOEM supports scientific research on behalf of the American people and in the spirit of marine conservation.

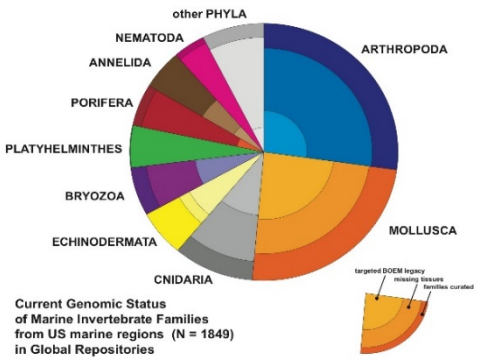
BOEM used these techniques in a recent study with the Smithsonian National Museum of Natural History's Invertebrate Zoology (NMNH/IZ) Department. This study helps fill gaps about the biological diversity of marine invertebrates from U.S. waters by providing genetic barcodes of marine invertebrates in the cryogenic (frozen) and preserved tissue collections housed at the museum's research center.

The goal is to produce a more robust understanding of invertebrate families and marine invertebrate genera in federal waters. Scientists are incorporating genomics research on BOEM's specimens into the Smithsonian's larger contribution to the Global Genome Initiative (GGI), a worldwide initiative to preserve and understand the genomic diversity of life on Earth.

While the technical summary contains more details, I would like to mention the sampling effort because it yielded several important results. The study:

- Generated a list of all marine invertebrate families and genera occurring in U.S. federal waters across BOEM's four OCS regions.

- Provided a gap analysis identifying those taxa that are unrepresented in the museum's collections or tissue repository and without a reference DNA barcode in public databases.



Gap analyses of US marine invertebrate families as of 2020. The outer ring represents fully curated families with vouchers, tissues and DNA barcodes. The inner ring represents vouchered families in NMNH collections without genomic assets. The middle ring represents known, but missing, marine invertebrate families.

- Increased the number of fully curated marine invertebrate families in publicly available repositories from 12% to 31%. These repositories are the Smithsonian's Natural History voucher collections (known by its former name, the U.S. National Museum or USNM), the National Institutes of Health's GenBank database of sequence records, and the Global Genome Biodiversity Network tissue records.

- Added 40 new families to U.S. federal water registries, and

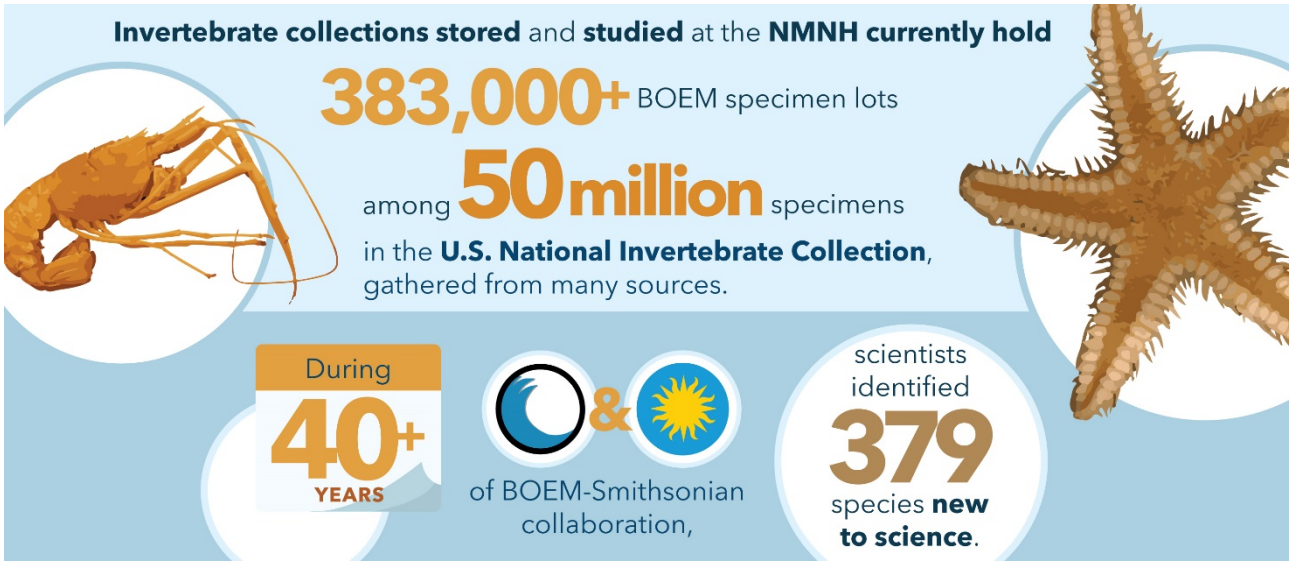
- Documented and curated 72 additional genera.

Today's exciting research and archival resources have come a long way since the BOEM-Smithsonian Natural History partnership began in 1979. Back then, taxonomic identification relied on visual inspection of specimens with rulers, microscopes, and subsequent chemical storage in jars to preserve the fine-scale morphological characteristics important to species identification.

The invertebrate collections are stored and studied at the NMNH's Museum's Support Center in Suitland, Maryland. The center currently holds more than 383,000 BOEM specimen lots among the 50 million specimens in the U.S. National Invertebrate Collection, gathered from many sources. During the 40-year BOEM-Smithsonian collaboration, scientists have identified 379 new species.

BOEM's plan for moving forward with specimen collections is to use the lessons learned during this genomic expansion to help us strategically fill the considerable knowledge gap in families and genera to better preserve this OCS genetic heritage.

BOEM's ultimate goal is to continue adding viable genetic samples to further characterize, discover, and preserve the genetic codes of OCS invertebrates. By contributing to this knowledge, BOEM is helping to conserve and manage the ocean's biodiversity.



I invite you to learn more about the BOEM-Smithsonian collaboration by visiting BOEM's partnership page and the Environmental Studies Program Information System (ESPIS) for new studies and reports as they are posted online. As always, we welcome your feedback, so please send your comments to BOEMPublicAffairs@boem.gov.

Sincerely,

William Y. Brown
BOEM Chief Environmental Officer