Mixing genomics and geography yields insights into life and environment

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In an upcoming issue of *Proceedings of the National Academy of Sciences*, Yale researchers used newly developed mathematical models to analyze huge amounts of data on physical characteristics such as temperature and salinity in different ocean habitats and metabolic activity in marine micro-organisms.

They were able to see in unprecedented detail how environment influences molecular changes within living organisms. As the technology dubbed "metagenomics" progresses, scientists might be able to detect environmental change or toxic chemicals not simply by using mechanical sensors or monitoring sensor species, but by examining biological changes within tiny organisms, said Mark Gerstein, the Albert L. Williams professor of biomedical informatics and professor of molecular biophysics & biochemistry and computer science.

"Such biosensors are the modern equivalent of canaries in a coal mine,' Gerstein said.

The research team was headed by computational biology and bioinformatics Ph.D. student Tara A. Gianoulis under the laboratories of Gerstein and Michael Snyder, the Lewis B. Cullman professor of molecular, cellular & developmental biology and professor of molecular biophysics & biochemistry, The team incorporated biochemical and environmental data from the previously published Global Ocean Survey, which catalogued information from 40 different aquatic sites. The GOS data effectively doubled the number of known proteins, and through a

statistical analysis of these data, the Yale team was able to infer microbial adaptations to the environment.

"The genomics world has developed amazing technology that has captured a tremendous amount of information about living organisms, giving rise to an era of big data," Gerstein said. "Meanwhile, you have this explosion of geo-spatial information from satellites and global sensors. When key data sets connect these two disparate worlds, you find a subtle richness of connections."

Through a complex statistical analysis, the study showed that organisms switched energy conversion strategies depending on the environment, used components of membranes differently, and provided evidence that factors such as metals may play a large role in how micro-organisms adapt to their environments.

Source: Yale University