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TITLE: An End-to-End DNA Taxonomy Methodology for Benthic Biodiversity Survey in the Clarion-Clipperton Zone, Central Pacific Abyss

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ABSTRACT:

Recent years have seen increased survey and sampling expeditions to the Clarion-Clipperton Zone (CCZ), central Pacific Ocean abyss, driven by commercial interests from contractors in the potential extraction of polymetallic nodules in the region. Part of the International Seabed Authority (ISA) regulatory requirements are that these contractors undertake environmental research expeditions to their CCZ exploration claims following guidelines approved by the ISA Legal and Technical Commission (ISA, 2010). Section 9 (e) of these guidelines instructs contractors to " . . . collect data on the sea floor communities specifically relating to megafauna, macrofauna, meiofauna, microfauna, nodule fauna and demersal scavengers". There are a number of methodological challenges to this, including the water depth (4000-5000 m), extremely warm surface waters (~28 °C) compared to bottom water (~1.5 °C) and great distances to ports requiring a large and long seagoing expedition with only a limited number of scientists. Both scientists and regulators have recently realized that a major gap in our knowledge of the region is the fundamental taxonomy of the animals that live there; this is essential to inform our knowledge of the biogeography, natural history and ultimately our stewardship of the region. Recognising this, the ISA is currently sponsoring a series of taxonomic workshops on the CCZ fauna and to assist in this process we present here a series of methodological pipelines for DNA taxonomy (incorporating both molecular and morphological data) of the macrofauna and megafauna from the CCZ benthic habitat in the recent ABYSSLINE cruise program to the UK-1 exploration claim. A major problem on recent CCZ cruises has been the collection of high-quality samples suitable for both morphology and DNA taxonomy, coupled with a workflow that ensures these data are made available. The DNA sequencing techniques themselves are relatively standard, once good samples have been obtained. The key to quality taxonomic work on macrofaunal animals from the tropical abyss is careful extraction of the animals (in cold, filtered seawater), microscopic observation and preservation of live specimens, from a variety of sampling devices by experienced zoologists at sea. Essential to the long-term iterative building of taxonomic knowledge from the CCZ is an "end-to-end" methodology to the taxonomic science that takes into account careful sampling design, at-sea taxonomic identification and fixation, post-cruise laboratory work with both DNA and morphology and finally a careful sample and data management pipeline that results in specimens and data in accessible open museum collections and online repositories.

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