Deep–Sea Research II 201 (2022) 105097

Contents lists available at ScienceDirect

Deep-Sea Research Part II

journal homepage: www.elsevier.com/locate/dsr2

Dynamic change in an ocean desert: Microbial diversity and trophic transfer along the 110 °E meridional in the Indian Ocean

Eric J. Raes [a,b,*], Cora Hörstmann [c], Michael R. Landry [d], Lynnath E. Beckley [e], Maxime Marin [f], Peter Thompson [g], David Antoine [h], Amaranta Focardi [i], James O'Brien [i], Martin Ostrowski [i], Anya M. Waite [j]

[a] Flourishing Oceans, Minderoo Foundation, PO Box 3155, Broadway, Nedlands, WA, 6009, Australia
[b] Dept. of Biology, Dalhousie University, Halifax, NS, B3H 4R2, Canada
[c] Ecological Chemistry, Alfred Wegener Institute Helmholtz Center for Polar and Marine Research, Bremerhaven, Germany
[d] Scripps Institution of Oceanography, University of California at San Diego, La Jolla, CA, 92093-0227, USA
[e] Environmental & Conservation Sciences, Murdoch University, 90 South Street, Murdoch, WA, 6150, Australia
[f] Institute of Marine and Antarctic Science, University of Tasmania, Hobart, Tasmania, Australia
[g] Oceans and Atmosphere, Commonwealth Scientific and Industrial Research Organisation, Hobart, TAS, 7001, Australia
[h] Remote Sensing and Satellite Research Group, School of Earth and Planetary Sciences, Curtin University, Perth, WA, 6845, Australia
[i] Climate Change Cluster, University of Technology Sydney, Sydney, NSW, Australia
[j] Ocean Frontier Institute, Dalhousie University, Halifax, NS, B3H 4R2, Canada

ARTICLE INFO

Keywords:
16S rRNA
18S rRNA
Bacteria
Eukaryotes
Function
Indian Ocean
Isotopes
HPLC
Food web
Mixotrophy
Zooplankton
IIOE-2

ABSTRACT

The eastern Indian Ocean is among the most oligotrophic regions in the world and has been described as an ocean desert. Limited information exists on microbial community profiles from marker gene data, and an open question in this system is how energy is transported from the base of the food web to higher trophic levels. Here we show that, along a 3300 km long transect in the ultra-oligotrophic eastern Indian Ocean, both alpha and beta diversity metrics for prokaryotic and eukaryotic trophic groups revealed remarkably strong latitudinal trends. The latitudinal Shannon diversity pattern for autotrophic eukaryotes furthermore aligned with the isotopic $\delta^{13}C$ ratios of particulate organic carbon, fractionated zooplankton and hand-picked fish larvae, suggesting a close trophic linkage between autotrophic eukaryotes and higher trophic levels. Our data also showed an increasing contribution of eukaryotic mixotrophs and a high contribution of heterotrophic eukaryotes towards warmer waters. These findings highlight that not only the recycling of organic matter via bacterial regeneration is important in this system but that mixo- and heterotrophic eukaryotes play a major role in redistributing energy within the marine food web of these oligotrophic waters. Our data provide a baseline to understand how environmental changes such as warming surface waters might impact the open-ocean food web in this oligotrophic basin.

1. Introduction

Sea surface temperature in the tropical Indian Ocean (IO) has increased by an average of about 1 °C from 1950 to 2015 (Roxy et al., 2020) and is predicted to warm further under varying future emission scenarios (Zhongming et al., 2021). Ocean warming has been shown to enhance stratification (Hood et al., 2006) and reduce nutrient fluxes across the pycnocline (Boyd et al., 2016), and is predicted to alter nitrogen (N) budgets on time scales of decades (Huesemann et al., 2002). Additional expected effects are declining magnitudes of primary productivity and carbon sequestration to deeper waters, with cascading effects on genetic and evolutionary traits of organisms (Boyd et al., 2010). Our study seeks to develop a deeper understanding of how community and trophic structures respond to physicochemical variability in open-ocean oligotrophic conditions along 110 °E. The aims are to provide a baseline and mechanistic framework for the food web structures (including NO_3^- fluxes over the pycnocline, stable isotope plankton stoichiometry and microbial community observations) for future studies.

The photic zone of the Indian Southern Subtropical Gyre (ISSG,

* Corresponding author. Flourishing Oceans, Minderoo Foundation, PO Box 3155, Broadway, Nedlands, WA, 6009, Australia.
E-mail address: eraes@minderoo.org (E.J. Raes).

https://doi.org/10.1016/j.dsr2.2022.105097
Received 11 January 2022; Received in revised form 1 April 2022; Accepted 1 May 2022
Available online 5 May 2022