Response mechanism of meiofaunal communities to multi-type of artificial reef habitats from the perspective of high-throughput sequencing technology

Minpeng Song, Jiahao Wang, Yuxin Wang, Renge Hu, Lu Wang, Zhansheng Guo, Zhaoyang Jiang*, Zhenlin Liang*

Marine College, Shandong University, Weihai, Shandong 264209, China

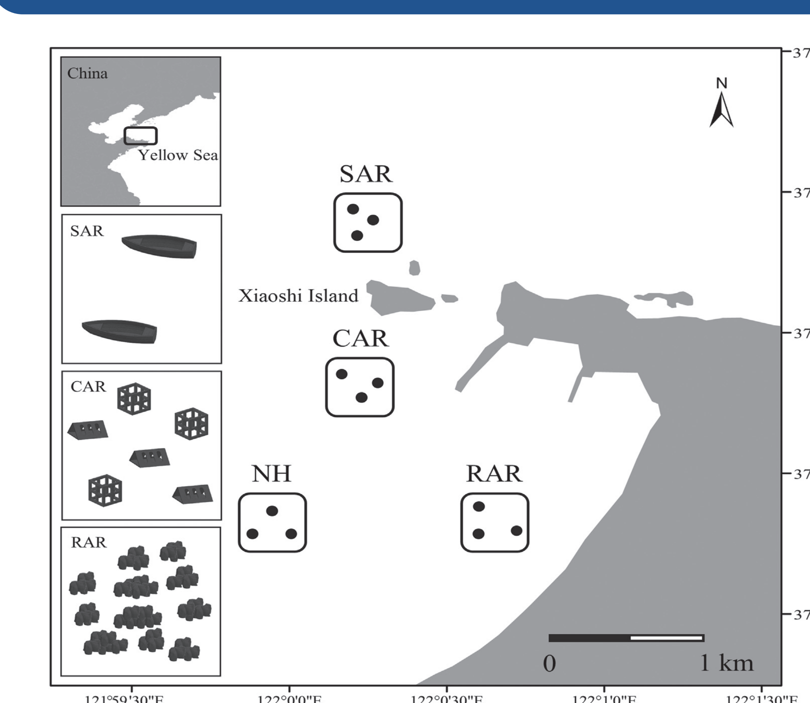
Key Laboratory of Modern Marine Ranching Technology of Weihai, Weihai, Shandong 264209, China

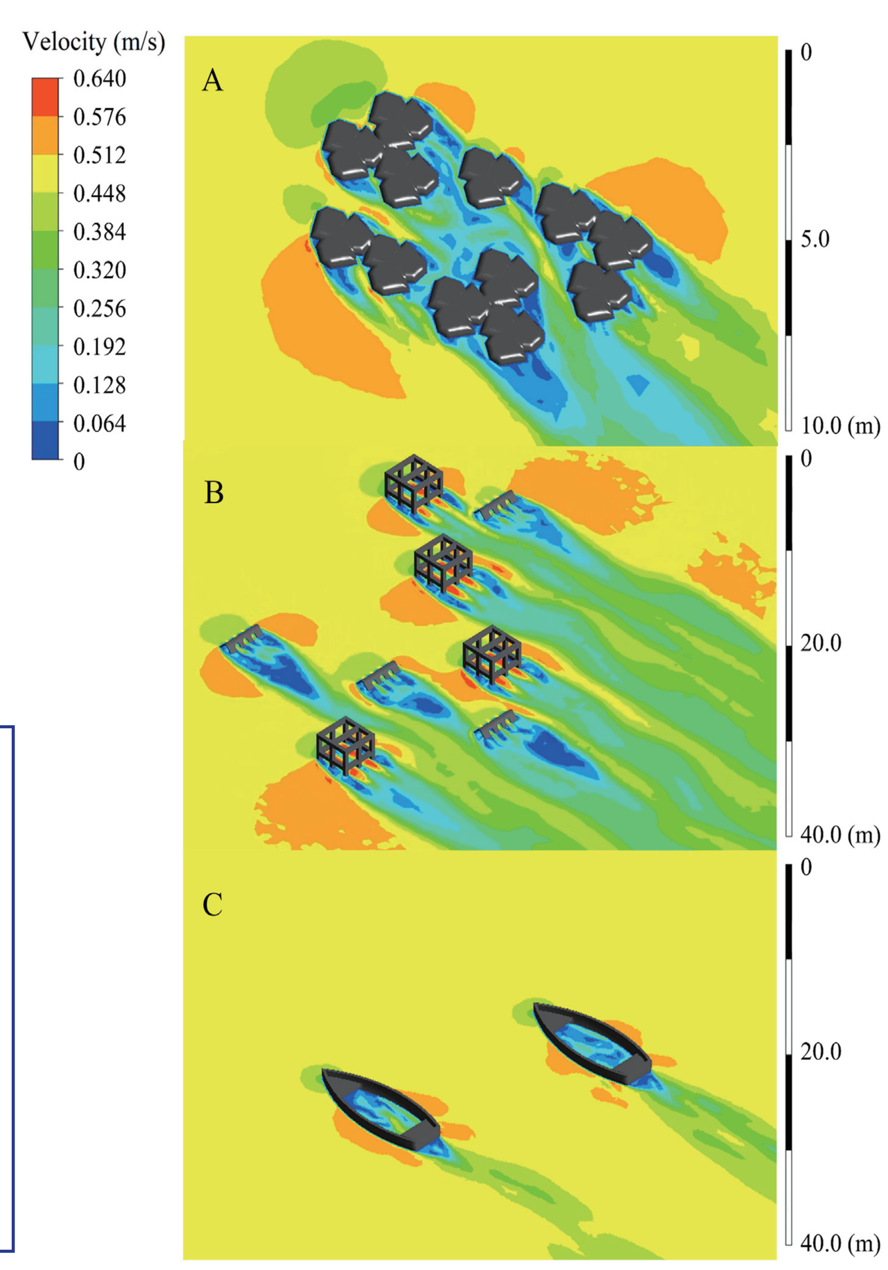
1. Introduction

Background: Habitat loss and degradation are widespread in terrestrial and aquatic systems. Artificial reef is often placed on sea floor to emulate the biological and physical influence of natural reefs on marine living resources and habitats in order to restore the ecological environment. Multiple types of artificial reefs have been widely deployed in the coast of northern Yellow Sea. Meiofauna plays important ecological roles in marine ecosystem, but the response mechanism of meiofaunal community to different types of artificial reef is still poorly understood.

Objective: This research attempts to explore the influence of the construction of different types of artificial reefs on the diversity, structure, composition, dominant taxa and co-occurrence pattern of meiofaunal community.

2. Study area





Four types of habitats were selected as research objects, including concrete artificial reef zone (CAR), rocky artificial reef zone (RAR), ship artificial reef zone (SAR) and natural habitat (NH).

3. Results and analysis

3.1. Impacts of artificial reefs on sediment environmental parameters

Environmental factors of CAR, RAR, SAR and NH. Values are shown with mean ± se.

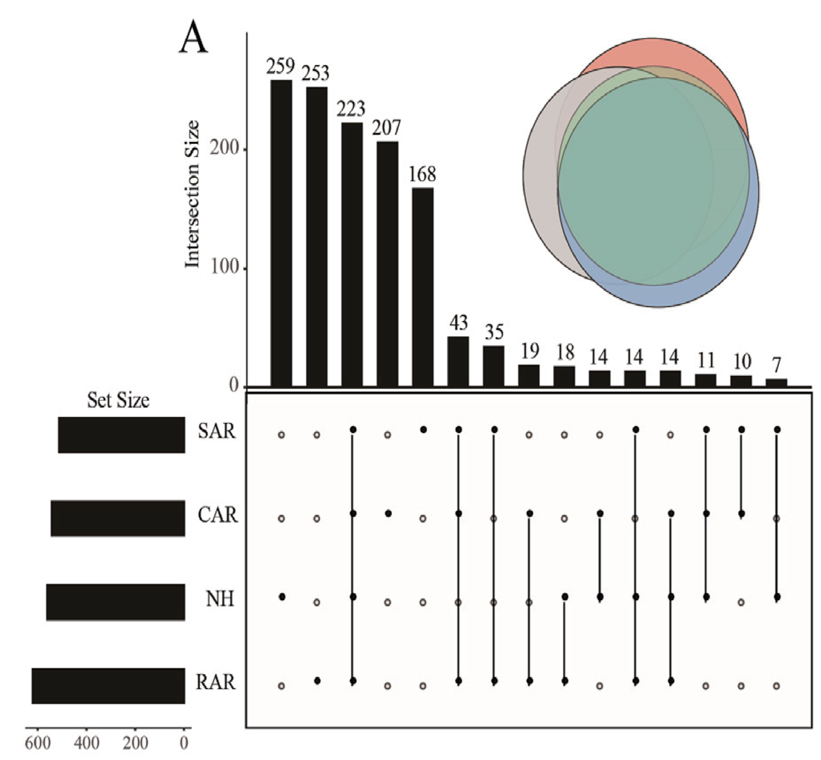
Season	Habitat	T (°C)	DO (mg/L)	pH	Sal (‰)	GZ (μm)	Chl a (μg/g)	TOC (%)	TN (mg/g)	TP (mg/g)	DIN (mg/g)	DIP (mg/g)
Winter	CAR	0.663 ± 0.018	10.344 ± 0.011	8.151 ± 0.003	31.063 ± 0.018	36.200 ± 5.626	2.243 ± 0.337	0.099 ± 0.009	0.098 ± 0.015	0.042 ± 0.002	0.008 ± 0.002	0.014 ± 0.003
	RAR	0.663 ± 0.018	10.330 ± 0.005	8.153 ± 0.002	31.063 ± 0.018	76.438 ± 11.907	3.024 ± 0.230	0.103 ± 0.008	0.266 ± 0.022	0.040 ± 0.002	0.017 ± 0.003	0.014 ± 0.003
	SAR	0.650 ± 0.019	10.345 ± 0.009	8.153 ± 0.002	31.113 ± 0.013	34.825 ± 8.018	1.373 ± 0.278	0.091 ± 0.007	0.183 ± 0.013	0.038 ± 0.002	0.027 ± 0.002	0.024 ± 0.003
	NH	0.656 ± 0.018	10.322 ± 0.005	8.153 ± 0.003	31.133 ± 0.017	38.338 ± 6.713	2.564 ± 0.466	0.090 ± 0.005	0.169 ± 0.012	0.034 ± 0.005	0.011 ± 0.002	0.019 ± 0.004
Spring	CAR	9.286 ± 0.014	8.646 ± 0.007	8.199 ± 0.004	32.100 ± 0.038	31.629 ± 4.324	2.297 ± 0.328	0.105 ± 0.005	0.239 ± 0.027	0.036 ± 0.003	0.020 ± 0.003	0.020 ± 0.005
	RAR	9.267 ± 0.017	8.648 ± 0.009	8.217 ± 0.001	32.078 ± 0.028	56.111 ± 6.917	1.622 ± 0.215	0.116 ± 0.005	0.141 ± 0.013	0.049 ± 0.004	0.028 ± 0.002	0.027 ± 0.004
	SAR	9.271 ± 0.018	8.663 ± 0.006	8.216 ± 0.007	32.086 ± 0.026	33.957 ± 4.211	2.416 ± 0.241	0.103 ± 0.005	0.193 ± 0.035	0.030 ± 0.004	0.008 ± 0.001	0.019 ± 0.004
	NH	9.278 ± 0.015	8.649 ± 0.009	8.190 ± 0.010	32.022 ± 0.015	39.489 ± 2.511	2.889 ± 0.337	0.100 ± 0.006	0.212 ± 0.043	0.026 ± 0.003	0.016 ± 0.003	0.017 ± 0.003
Summer	CAR	18.744 ± 0.018	5.151 ± 0.009	8.220 ± 0.003	32.044 ± 0.024	22.433 ± 1.802	1.539 ± 0.233	0.136 ± 0.009	0.229 ± 0.042	0.048 ± 0.004	0.023 ± 0.002	0.013 ± 0.003
	RAR	18.756 ± 0.018	5.169 ± 0.008	8.223 ± 0.002	32.011 ± 0.035	40.333 ± 8.330	2.168 ± 0.249	0.140 ± 0.004	0.312 ± 0.030	0.059 ± 0.008	0.010 ± 0.002	0.012 ± 0.003
	SAR	18.743 ± 0.020	5.137 ± 0.009	8.203 ± 0.006	32.086 ± 0.014	23.957 ± 2.587	1.204 ± 0.187	0.122 ± 0.007	0.265 ± 0.034	0.052 ± 0.005	0.021 ± 0.004	0.022 ± 0.004
	NH	18.743 ± 0.020	5.140 ± 0.012	8.224 ± 0.002	32.057 ± 0.020	20.829 ± 1.931	1.697 ± 0.131	0.120 ± 0.007	0.221 ± 0.013	0.045 ± 0.005	0.030 ± 0.002	0.024 ± 0.004
Autumn	CAR	21.475 ± 0.005	6.233 ± 0.015	8.188 ± 0.036	30.838 ± 0.018	22.788 ± 1.325	2.373 ± 0.272	0.132 ± 0.007	0.201 ± 0.032	0.048 ± 0.004	0.017 ± 0.003	0.031 ± 0.003
	RAR	21.478 ± 0.017	6.231 ± 0.014	8.213 ± 0.002	30.833 ± 0.017	35.411 ± 3.587	1.404 ± 0.226	0.126 ± 0.009	0.135 ± 0.018	0.043 ± 0.001	0.028 ± 0.002	0.024 ± 0.003
	SAR	21.467 ± 0.017	6.237 ± 0.007	8.180 ± 0.016	30.844 ± 0.018	23.233 ± 1.211	1.616 ± 0.348	0.124 ± 0.006	0.233 ± 0.037	0.045 ± 0.003	0.013 ± 0.003	0.015 ± 0.003
	NH	21.467 ± 0.017	6.229 ± 0.007	8.203 ± 0.009	30.856 ± 0.018	24.011 ± 1.169	1.578 ± 0.196	0.117 ± 0.007	0.175 ± 0.025	0.050 ± 0.003	0.022 ± 0.003	0.012 ± 0.003

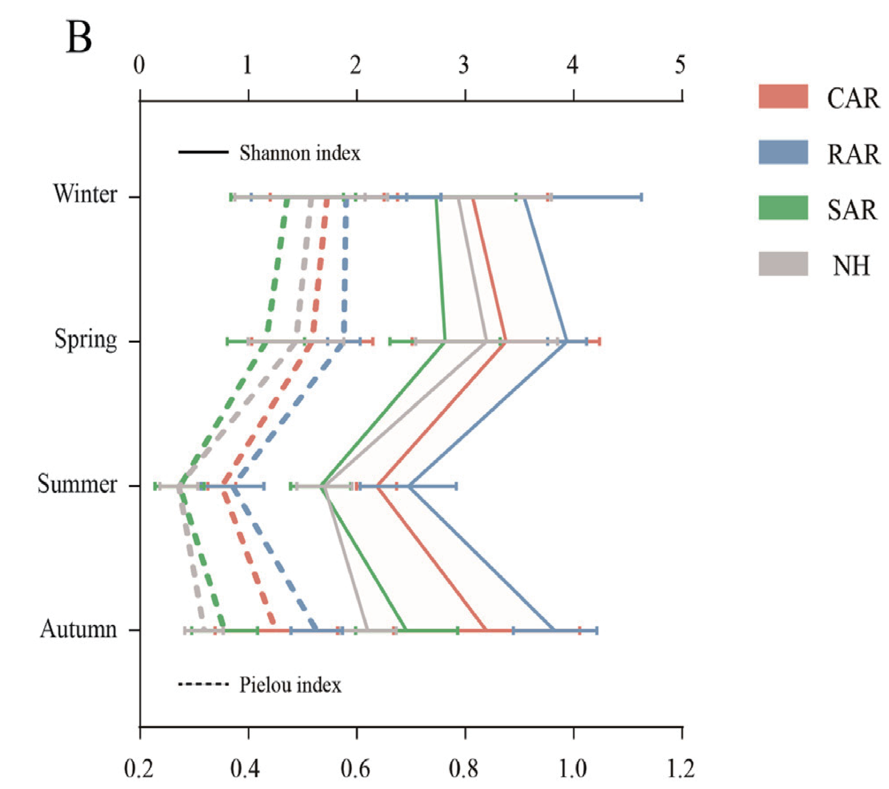
T: water temperature; DO: dissolved oxygen; Sal: salinity; Chl a: chlorophyll *a*; TOC: total organic carbon; GZ: median grain size; TN: total nitrogen; TP: total phosphorus; DIN: dissolved inorganic nitrogen; DIP: dissolved inorganic phosphorus.

The deployment of artificial reefs modified the sediment environmental parameters.

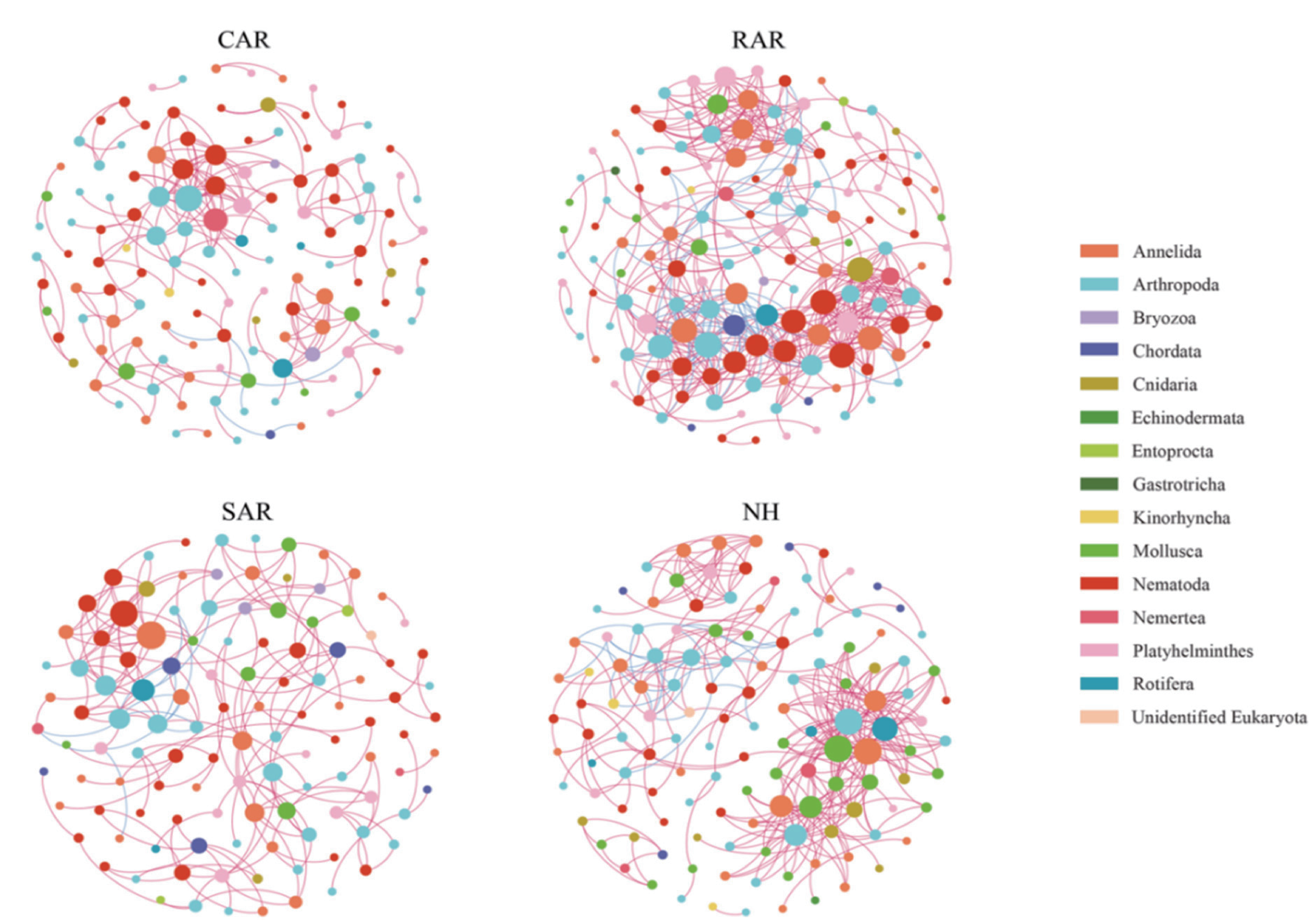
3. Results and analysis

3.2 Diversity and spatial-temporal patterns of meiofaunal communities





Meiofaunal communities responded to different types of artificial reef habitats.



The analysis of co-occurrence network revealed the differences in the symbiosis patterns of different habitats. The stability of faunal communities in SAR and CAR was significantly stronger.

4. Conclusions

The results showed that all types of artificial habitats could significantly change the physicochemical parameters of the surrounding sediments, such as GZ and TOC, through the flow field effect and the biological effect. The alteration of the sediment environment caused the cascade effect of meiofaunal communities, and it could be superimposed over the normal seasonal effects.

Acknowledgments

This work was supported by the National Natural Science Foundation of China (42176150 and 41771544) and the Key Laboratory of Modern Marine Ranching Technology of Weihai.