Journal of the Persian Gulf
(Marine Science)/Vol. 9/No. 34/ December 2018/7/47-53

Issue of Second International Conference on Oceanography for West Asia (RCOWA) 2020

Assessment of Amphipoda communities in Chabahar Bay using species richness and Taxonomic distinctness indices

Farzaneh Momtazi[1*], Roghaieh Zarei[2]

[1] *Iran Iranian National Institute for Oceanography and atmospheric Science (INIOAS), Marine Bioscience Department. Tehran, Iran*
[2] *Department of plant Sciences, Faculty of biological sciences, Alzahra University, Tehran, Iran, Email; r.zarei@alzahra.ac.ir*

Abstract

In most ecological studies, traditional biodiversity indices such as the Shannon have generally been used in assessing species diversity. New taxonomic distinctness indices have been considered phylogenetic relatedness of species and provide more information for ecologists. In the present contribution traditional species richness index along taxonomic distinctness indices were used to evaluate amphipods communities of Chabahar Bay. Sampling was carried out in 19 stations during December 2016. We identified 21 species belong to 14 genera and 12 families. Amplisidae was the most abundant family. Shannon index was 0-2.9 with average value of 1.2. The highest distribution of amphipod communities was on the east, northeast and southwest coasts of the bay. The highest average taxonomic distinctness index (AvTD) was calculated for west, southwest and southeast. Therefore, considering that higher taxonomic distinctness indices indicate more suitable ecological conditions, it can be concluded that the middle part of Chabahar Bay has more unfavourable ecological conditions for amphipods and other macrobenthos.

Keywords: AvTD, VarTD index, Makran Bay, Amphipoda

1. Introduction

The biodiversity and variations in the macrobenthos community are some of the most important indexes in environmental impact assessment studies that could be revealed the habitat health status (Borja et al., 2009; Van Hoey et al., 2010). The amphipod assemblages are one of the main parts of macrobenthos community. The density and composition of amphipod assemblages were affected by environmental conditions, geography and history of distribution (Ellis et al. 2000; Guerra-García & GarcíaGómez 2009). Annually multi environmental impact assessment studies was carried out in the Iranian coastal waters. Usually, traditional biodiversity indices was used for defining the ecological condition of ecosystems.

In the last two recent decades, several formulas have been proposed in the ecological literature to measure species diversity based on the number of species and their relative frequency. One of the main problem of species richness indices (such as Shannon-Wiener, Simpson, Margalf and Brillouin) is the high correlation between them and the sampling size without pay attention to the taxonomic diversity in the community. For example, it is clear that a population with 10 species of one genus has lower biodiversity than a population with 10 species of different

* Corresponding Author name: Farzaneh Momtazi
E-mail address: momtazi.f@inio.ac.ir

genera, but because these indicators are only sensitive to species level of biodiversity, therefor, unable to differentiated two communities (Ashori et al., 2016). Recently, Clark and Warwick (2001) proposed further biodiversity index, based on taxonomic (or phylogenetic) relatedness of species, namely the variation in taxonomic distinctness' (VarTD, Λ+) between every pair of species recorded in a study. It complements the previously defined 'average taxonomic distinctness' (AvTD, Δ+), which is the mean path length through the taxonomic tree connecting every pair of species in the list. VarTD is simply the variance of these pairwise path lengths and reflects the unevenness of the taxonomic tree. However, these indices was used in terrestrial ecology of Iranian studies but generally ignored in marine biodiversity projects.

Chabahar crenulated shape bay (Ω) is part of the Makran area in the southeast of Iran (Oman Sea, north-western part of Indian Ocean). It has 13.5 km wide entrance and 17 km length in south-north direction. Several habitats are found in the Chabahar Bay, including coral reefs, sandy and rocky shores, and mangrove swamps (Maghsoudlou & Momtazi, 2017).

In the present study, for the first time the taxonomic indices associated with traditional indices was used for detecting the biodiversity status of Chabahar Bay.

2. Materials and Methods

Quantitative sampling was done with tree replicates by 0.25 m Ekman grab, in 16 subtidal stations and three intertidal stations in November 2016 (Fig 1). Stations was organized in three transect perpendicular to coastal line. In subtidal stations amphipod community was collected via Van veen grab (0.025 m2) and in coastal stations via quadrate (0.25*0.25 m2) with three replicate. The contents of each grab or quadrate were sieved by 0.5 mm mesh and after relaxing with MgCl2, the material was fixed in 75% ethanol. Macrobenthic organism was sorted and identified with Stereo Microscope (Nikon SMZ 1500) and valuable Intkey (Dallwitz, 2002).

Taxonomic and biodiversity indices was calculated with PRIMER Ver. 6.1.12 and PERMANOVA ver.1.0.2 (Clarke & Gorley, 2006). The results was mapped with Arc GIS 10.6.1 software (Esri & GeoEye, 2018).

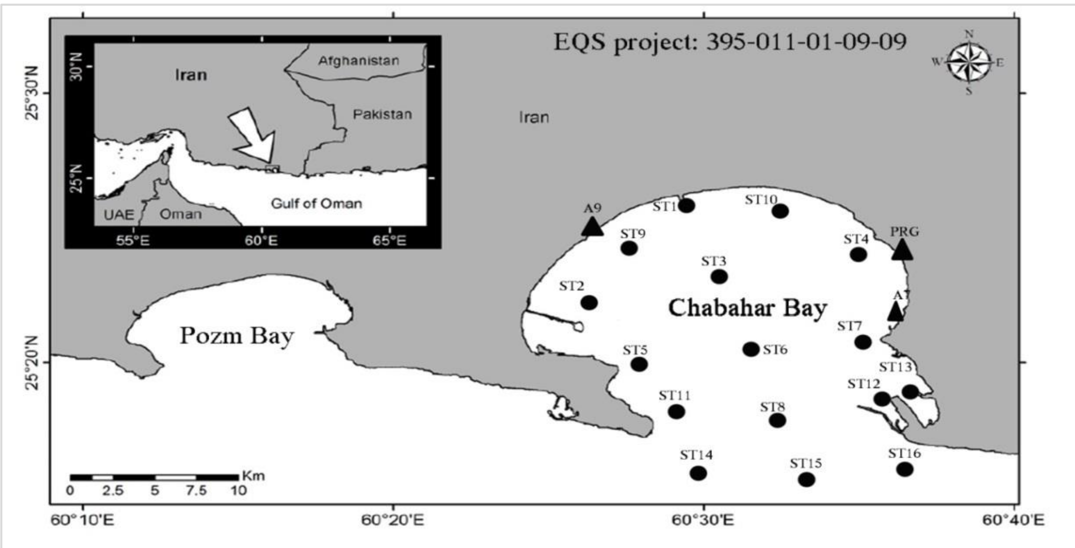

Fig. 1: Map of the study area and locality of different stations.

3. Results and Discussion

The amphipod macrobenthic community in the current study was composed of 21 species belong to 14 genus and 12 family. The most frequent family are Ampeliscidae with eight identified species from 2 genera (Table 1). Also, the most relevant species in the studied area was Ampelisca persicus that was reported from 14 stations.

Table 2: The amphipod assemblages in the Chabahar Bay

	ST1	ST2	ST3	ST4	ST5	ST6	ST7	ST8	ST9	ST10	ST11	ST12	ST13	ST14	ST15	A7	A9	PRG	ST16
Ampelisca cyclops	-	-	-	-	+	+	+	+	-	-	+	-	-	+	+	-	-	-	+
A. Persicus Momtazi, 2020	+	+	-	-	-	+	+	+	+	+	+	+	+	+	+	+	-	-	+
Ampelisca sp.1	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-
Ampelisca sp.2	-	-	-	-	+	+	-	+	+	-	+	+	-	-	+	-	-	-	-
Ampelisca sp.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	+	-	-
Ampelisca sp.4	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-
A .zamboangae	-	-	-	-	-	-	-	+	+	-	+	-	-	-	+	-	-	-	+
Byblis sp.	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ceradocus sp.	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-
Indischnopus herdmani	-	-	-	+	+	-	-	-	-	-	-	-	-	-	+	-	+	+	-
Latigammaropsis sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-
Leptocheirus sp.	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-
Leuchothoe sp.	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Metatiron brevidactylus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-
Monoliropus kazemii	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-
Photis sp.	+	+	+	-	-	-	-	-	-	-	+	-	-	-	+	-	-	-	-
Rhinoecetes brevipodus	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-
Tryphosella sp.	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-
Urothoe grimaldi	-	-	-	-	+	-	-	-	-	-	-	-	-	+	-	+	-	-	-
Urothoe platydactyla	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-
Xenocheria sp.	-	-	-	-	-	-	+	-	-	-	+	-	-	+	+	-	-	-	-

Figure 2 was shown the spatial pattern of total amphipod abundance in the Chabahar Bay. It could be seen the lower frequency of amphipods is in the center of the Bay.

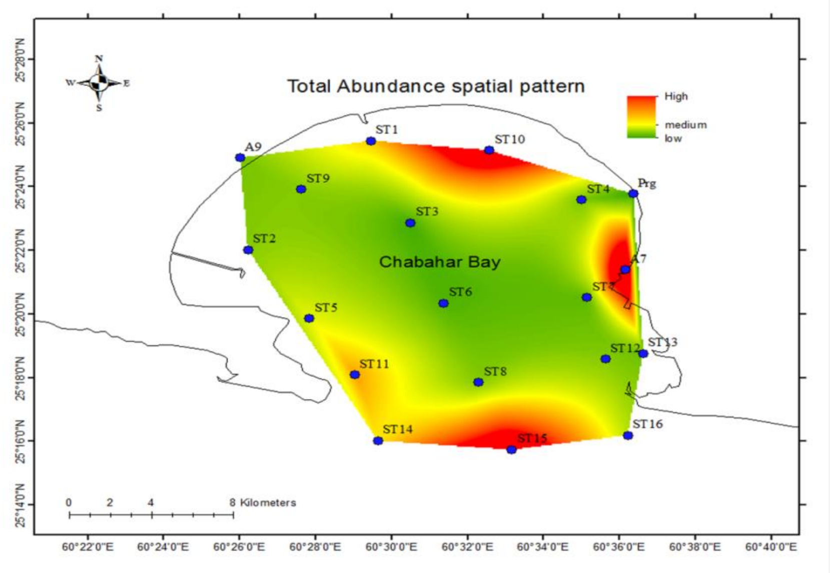

Fig. 2: Spatial distribution of amphipod abundance in Chabahar Bay

The biodiversity indices in this study was shown that Shannon index was different from 0 to 2.9 in the Chabahar Bay. The mean value of Shannon index was 1.2 in the studied area. The results of spatial pattern of calculated Shannon index in each station was observed in the Figure 3. The highest distribution of amphipod communities was on the east, northeast and southwest coasts of the Bay.

The results of Taxonomic distinctness index (AvTD) was mapped in the Figure 4. The highest average taxonomic distinctness index (AvTD) was calculated for west, southwest and southeast. The average taxonomic distinctness was differentiated from 0 to 2.9 with mean 1.2.

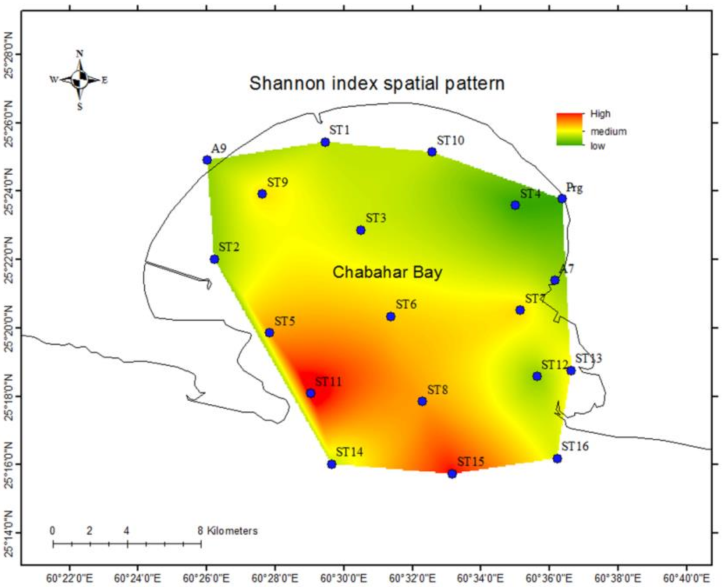

Fig. 3: The spatial pattern of Shannon index in the Chabahar Bay

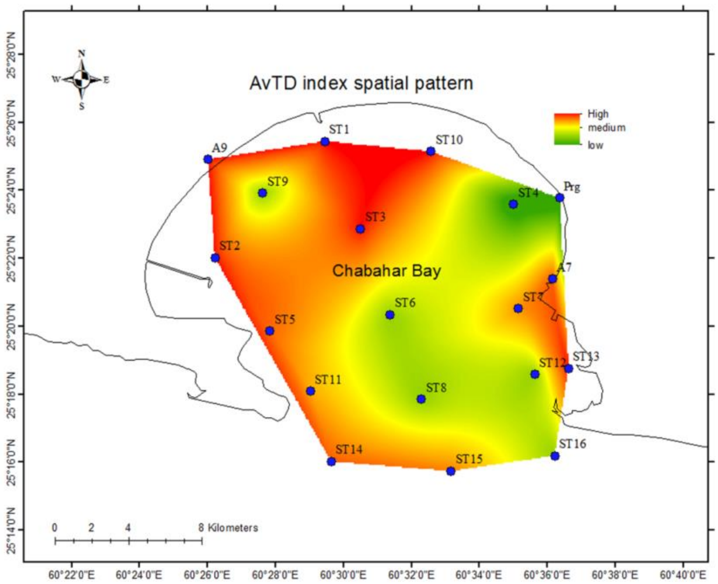

Fig. 4: The spatial pattern of average taxonomic distinctness in the Chabahar Bay

The result of variation taxonomic distinctness was demonstrated in Figure 5. The higher value of Λ+ was recoded in western coast and the southeast of the Bay.

Funnel plots of the Δ+ and Λ+ for the studied stations and the elliptical plot of their combination, based on the presence and absence data, at 95% confidence level (continuous line) and mean value (dashed line), is shown in Fig. 6A–C. As indicated in Fig. 6, except for St16,12, 9, 8, 6, 4 in other stations Δ+ is very close to the community average. The variance of Λ+ is more than Δ+ and all stations show irregular distribution around mean value (dash line).

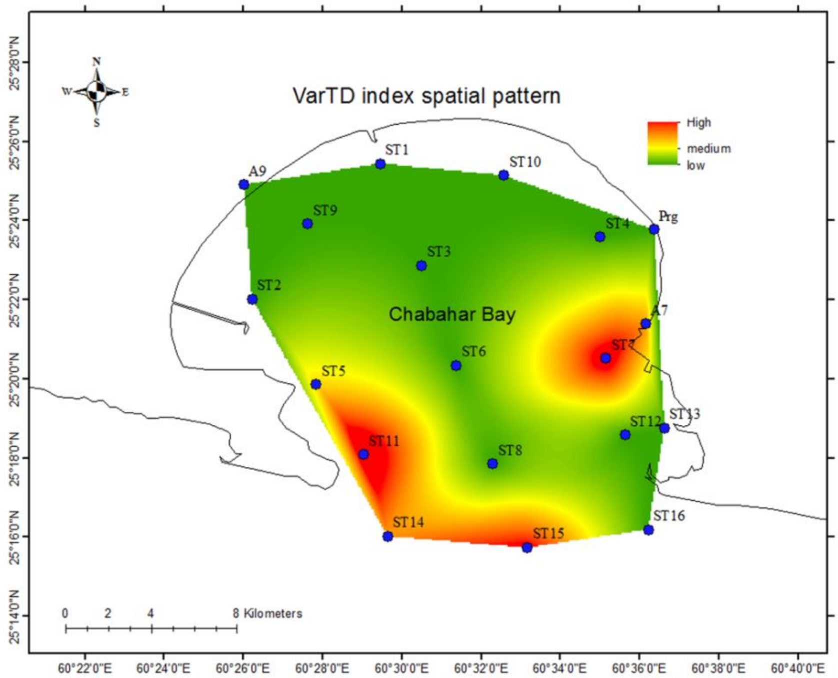

Fig. 5: The spatial pattern of variation in taxonomic distinctness in the Chabahar Bay

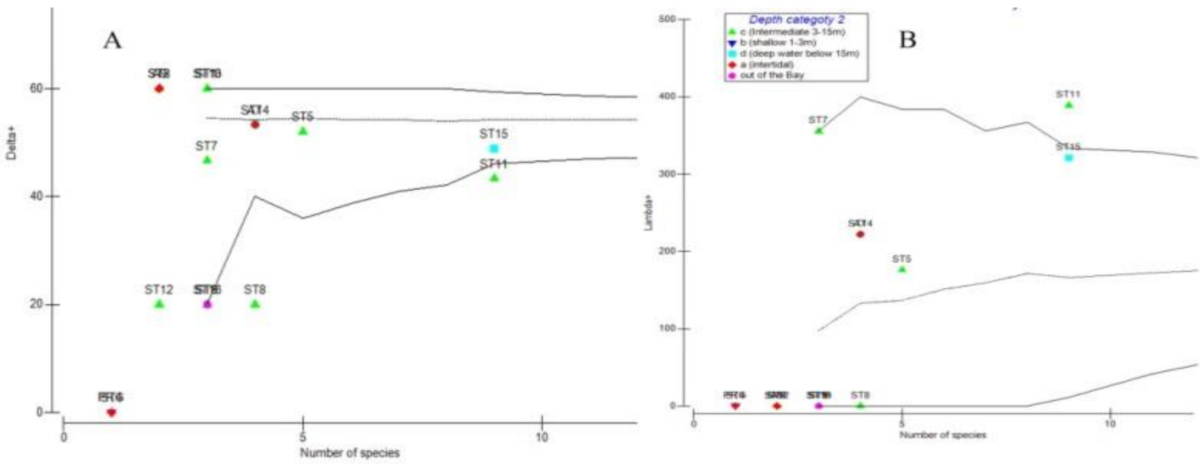

Fig. 6: Funel plot of Average taxonomic distinctness (A) and Variation in taxonomic distinctness (B) in the studied stations

4. Conclusions

The response of species richness index to environmental changes in different habitats is not uniform due to the dependence of these indicators on habitat type and complexity (Warwick, R.M., 2008; Warwick & Clarke 1995;1996;1998).

For example, after an environmental disturbance, most species in a community that all belong to the same genus are replaced by species of different genera but with the same frequency, traditional diversity indices will not be able to detect the effects of environmental disturbances on species diversity (Ashori et al., 2016). Using of phylogenetic relationship could be improve the insight of ecosystem function on disturbance environment (Maghsoudlou et al., 2020).

However, the result of Shannon index in the region represent the low amphipod species diversity in the Chabahar Bay, but the average taxonomic index value show the high diversity expect for stations 16, 12, 9, 8 and 6.

The same results for numbered stations was seen in Λ+ value. Warwick and Clarke (1995) were mentioned that with increase on pollutants in the ecosystem, the variation on taxonomic distinctness decreases. Therefore, stations that located under the mean line in the figure 6 (B) have not a safe ecological conditions. As amphipods known as sensitive organisms to pollution in marine environment (De-la-Ossa-Carretero, 2012), this is the early warning point for managements.

Acknowledgments

The current study was funded by Iran National Science Foundation (INSF, 97004513) and Iranian National Institute for Oceanography and Atmospheric Science (INIOAS) (project grant number "395-011-01-09-09).

References

Asouri, P., Jalili, A., Danekar, A., Zarechahouki, M., & Hamzeh, B. (2016). Evaluation of plant communities using new indices of taxonomic diversity (Case study: rangelands around Tehran province). *Rangeland*, 10(1), 94-108.

Borja, A., Miles, A., Occhipinti-Ambrogi, A., Berg, T., 2009. Current status of macroinvertebrate methods used for assessing the quality of European marine waters: implementing the Water Framework Directive. *Hydrobiologia* 633, 181–196.

Clarke, K. R., & Warwick, R. M. (2001). A further biodiversity index applicable to species lists: variation in taxonomic distinctness. *Marine ecology Progress series*, 216, 265-278.

Clarke, K.R., Gorley, R.N., 2006. Primer. PRIMER-e, Plymouth.

De-la-Ossa-Carretero, J.A., Del-Pilar-Ruso, Y., Giménez-Casalduero, F., Sánchez-Lizaso, J.L. and Dauvin, J.C., 2012. Sensitivity of amphipods to sewage pollution. Estuarine, Coastal and Shelf Science, 96, pp.129-138.

Esri, D., GeoEye, E.G., 2018. CNES/Airbus DS, USDA, USGS, AEX, getmapping,

aerogrid, IGN, IGP, swisstopo, and the GIS user community (2017). ArcGIS world imagery map service. Available online verified232017.

Ellis, J. I., Norkko, A., & Thrush, S. F. (2000). Broad-scale disturbance of intertidal and shallow sublittoral soft-sediment habitats; effects on the benthic macrofauna. *Journal of Aquatic Ecosystem Stress and Recovery*, *7*(1), 57-74.

Guerra-García, J. M., & García-Gómez, J. C. (2009). Recolonization of macrofauna in unpolluted sands placed in a polluted yachting harbour: A field approach using experimental trays. *Estuarine, Coastal and Shelf Science*, *81*(1), 49-58.

Maghsoudlou, A. & Momtazi, F (2017) Biodiversity of subtidal amphipod assemblages from Chabahar Bay, Makran Sea- Iran. *Biodiversity Journal*, 8 (2): 619–620

Maghsoudlou, A., Momtazi, F., & Hashtroudi, M. S. (2020). Ecological Quality Status (EcoQs) of Chabahar sub-tropical bay based on multimetric macrobenthos-indexes approach: Response of bio-indexes to sediment structural/pollutant variables. *Regional Studies in Marine Scienc*e, 40, 101524.

Van Hoey, G., Borja, A., Birchenough, S., Buhl-Mortensen, L., Degraer, S., Fleischer, D., Kerckhof, F., Magni, P., Muxika, I., Reiss, H., Schröder, A., 2010. The use of benthic indicators in Europe: from the Water Framework Directive to the Marine Strategy Framework Directive. *Mar. Pollut. Bull.* 60 (12), 2187–2196.

Warwick, R. M., & Clarke, K. R. (1998). Taxonomic distinctness and environmental assessment. *Journal of Applied ecology*, 35(4), 532-543.

Warwick, R. M., & Clarke, K. R. (1996). New biodiversity measures reveal a decrease in taxonomic distinctness with increasing stress. *Oceanographic Literature Review*, *7*(43), 727.

Warwick, R. M., & Clarke, K. R. (1995). New\'biodiversity\'measures reveal a decrease in taxonomic distinctness with increasing stress. *Marine ecology progress series*, *129*, 301-305.

Warwick, R. M. (2008). Average taxonomic diversity and distinctness. In *Encyclopedia of Ecology* (pp. 300-305). Academic Press Oxford.