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Epibenthic assemblages on vertical artificial substrates: recruitment and succession patterns in offshore Qatari waters

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Artificial structures get introduced into the marine environment by accident (e.g., shipwrecks) or intentionally, for logistical (i.e., coastal protection), industrial (i.e., oil exploitation) or biological habitat enhancement (i.e., artificial reefs). Similarly to other types of man-made submerged structures, offshore oil and gas platforms provide adequate hard substratum for the development of sessile marine invertebrates and to increase habitat and food availability for fishes and other motile marine organisms (Svane and Petersen, 2001). Furthermore, offshore platforms generally face minimum external interference and are usually located in waters with strong currents, which facilitate larval dispersal and settlement. Despite the fact that there are currently more than 800 offshore oil and gas platforms in the Arabian Gulf (Sheppard et al., 2012), scarce information exists about the biological assemblages associated to these structures (Burt et al., 2012; Stachowitsch et al., 2002). In fact, oil and gas platforms are high-security areas with an exclusion zone of at least 500m around the structures (Kashubsky and Morrison, 2013), which prevents fishing and other human impacts, but also restricts sampling for scientific purposes. Considering the substantial habitat and diversity losses of natural reefs in recent years, the perceived ecological role of these offshore structures is gaining increasing recognition. Several research and industrial programs have tried to promote the transition of decommissioned platforms into artificial reefs (e.g., Rigs to Reefs, Reggio Jr, 1987). It is vital, therefore, to study the community structure in such isolated marine habitats, to assess their structural and functional similarity and connectivity to natural marine ecosystems (Zintzen et al.,

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2008), in order to provide the scientific underpinning to the planning and decommissioning stage of the platforms. These issues are currently being addressed in the framework of the project “Connectivity, diversity and genetic flow between offshore natural coral reefs and oil platforms - NPRP No.: 7-1129-1-201”. In this specific study we aim to understand the recruitment and succession patterns of fouling communities offshore in Qatari waters, using stainless steel plates as artificial substrates, in order to mimic the stainless steel jackets, which generally support offshore oil platform in the Gulf. In October 2016, six vertical structures were deployed in the northeast of the Qatari Exclusive Economic Zone, in an area between the Al Shaheen oil field and natural offshore reefs, to investigate the source of the epibenthic species that colonize these artificial substrates. Each structure supports 30 stainless steel fouling plates (20 x 20 cm), spaced by 1m, at depths ranging between 10m and 45m. Temperature data loggers (Onset TidbiT) were attached to the plate structures, at max and min depth, to investigate how the temperature and depth variations affect recruitment and development of fouling assemblages. All the structures were successfully retrieved during the first assessment, done 15 weeks after deployment, in February 2017. After all the plates were photographed and data downloaded from the temperature loggers, the structures were re-deployed in the same location. This imagery is currently being analyzed using the online platform CoralNet, to assess the percentage cover, abundance and diversity of the fouling assemblages. Preliminary results of this first assessment indicate strong invertebrate recruitment, with almost 100% cover of the plates, at all depths and locations. A clear vertical gradient was, however, apparent, with diversity and cover generally increasing with depth. Barnacles, bivalves, anemones and fenestrate bryozoans were dominant at shallow depths, while other types of macroinvertebrates, such as encrusting sponges, foliaceous bryozoans and hydrozoans, became more dominant as depth increased. As expected, important seasonal variations of seawater temperature (e.g summer-winter) were registered in shallow (< 10m) and deep (> 40m) layers. Variations observed in deep water (>40 m) during autumn and early winter were, however, larger than expected. High variability was found in all locations, with sea temperatures ranging 3-4ºC during one single day. The semi-diurnal and lunar periodicity of these variations strongly suggests they are associated with tidal cycles. The full seasonal time series (one year), which will be available in November 2017, will allow the precise delimitation of the periodicity and magnitude of these temperature variations. The final data analyses will integrate data on temperature with depth and distance among structures to infer on recruitment and succession of sessile and mobile epifauna.ReferencesBurt, J.A., Bartholomew, A., Feary, D.A., 2012. Man-Made Structures as Artificial Reefs in the Gulf, in: Riegl, B.M., Purkis, S.J. (Eds.), Coral Reefs of the Gulf, Coral Reefs of the World. Springer Netherlands, pp. 171–186.Kashubsky, M., Morrison, A., 2013. Security of offshore oil and gas facilities: exclusion zones and ships’ routeing. Aust. J. Marit. Ocean Aff. 5, 1–10. doi:10.1080/18366503.2013.10815725Reggio Jr, V.C., 1987. Rigs-to-reefs. Fisheries 12, 2–7.Sheppard, C., Al-Husiani, M., Al-Jamali, F., Al-Yamani, F., Baldwin, R., Bishop, J., Benzoni, F., Dutrieux, E., Dulvy, N.K., Durvasula, S.R.V., Jones, D.A., Loughland, R., Medio, D., Nithyanandan, M., Pilling, G.M., Polikarpov, I., Price, A.R.G., Purkis, S.J., Riegl, B.M., Saburova, M., Samimi-Namin, K., Taylor, O., Wilson, S., Zainal, K., 2012. Environmental Concerns for the Future of Gulf Coral Reefs, in: Riegl, B.M., Purkis, S.J. (Eds.), Coral Reefs of the Gulf, Coral Reefs of the World. Springer Netherlands, pp. 349–373.Stachowitsch, M., Kikinger, R., Herler, J., Zolda, P., Geutebrück, E., 2002. Offshore oil platforms and fouling communities in the southern Arabian Gulf (Abu Dhabi). Mar. Pollut. Bull. 44, 853–860. doi:10.1016/S0025-326X(02)00085-1Svane, I., Petersen, J.K., 2001. On the Problems of Epibioses, Fouling and Artificial Reefs, a Review. Mar. Ecol. 22, 169–188. doi:10.1046/j.1439-0485.2001.01729.xZintzen, V., Norro, A., Massin, C., Mallefet, J., 2008. Spatial variability of epifaunal communities from artificial habitat: Shipwrecks in the Southern Bight of the North Sea. Estuar. Coast. Shelf Sci. 76, 327–344. doi:10.1016/j.ecss.2007.07.012