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## Energy and Environment - Paper Presentation

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### Vertical zonation and functional diversity of fish assemblages revealed by ROV videos at oil platforms in The Gulf

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About one third of the oil and gas extracted worldwide comes from offshore sources. There is currently thousands of large-scale oil and gas platforms spread across the seas and coastal oceans, from the North Sea to the seas of South Asia. Although their primary purpose is not related to enrichment of biodiversity, gas and oil platforms can act as large and complex artificial marine habitats for a wide range of marine organisms, including sessile invertebrates and fishes. These structures have shown to enhance ecosystem function, especially secondary fish production, relative to adjacent natural reefs, besides being among the most productive marine fish habitats globally. Indeed oil platforms constitute important fish aggregating devices, especially in areas subjected to a range of environmental perturbations. Hard substratum availability combined with exclusion zones around these structures allows for the development of diverse fish assemblages. We carried out the first assessment of vertical distribution, diel migration, taxonomic and functional diversity of fishes at offshore platforms in the Arabian Gulf. Video footages were recorded at the Al Shaheen Oil Field, between 2007 and 2014 using a Remotely Operated Vehicle (ROV). Indeed diving and snorkeling are strictly forbidden in the exclusion zone around offshore platforms, precluding conventional monitoring techniques such as underwater visual census, collection of sessile organisms, etc. Routine inspection and maintenance surveys, however, are conducted to monitor the state of underwater structures using ROVs. A total of 4,510 video files, containing 120 hours of underwater video recordings,

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were provided by Maersk Oil Qatar A/S. These videos were recorded over six years (2007, 2009, 2010, 2011, 2012 and 2014), during day and night, at the 9 platform locations (A-I) within the Al Shaheen Oil Field using a ROV of the model SAAB Seaeye Surveyor Plus 229. To assess the local fish community, a total of 242 videos amounting to twenty-one hours of observation were selected randomly, however, if no fish appear in a selected video a new video was randomly selected from the list. This work represents the first assessment of reef fish communities inhabiting oil and gas platforms in the Arabian Gulf. A total of 12,822 fish, belonging to 83 taxonomic groups were recorded around the platforms. Among them, two species are first recorded for Qatari waters: *Cylichthys orbicularis* and *Lutjanus indicus*. In addition two chondrichthyes, one endangered (*Stegostoma fasciatum*) and a vulnerable species (*Taeniurops meyeri*), were also observed across the platforms. Several trends were found in the vertical distribution of the fish community, most species were observed between 20 and 50 m depth and higher fish abundance recorded in the upper layers, down to 40 m depth and decreasing with depth. Vertical variation, however, in fish diversity was generally not accompanied by differences in vertical movements. The vertical variation, however, in fish diversity was not accompanied by differences in vertical movements of the fish. These results suggest that the vertical zonation pattern does not change, or only changes slightly, on a daily basis. The mean centers of mass of the most abundant fish species did not overlap, likely due to potential competition or niche differences. The dominant trophic groups were carnivores and invertivores, being well represented at each depth range (each spanning 10 m) from surface to seabed. Diel vertical movement was observed only for *Acanthopagrus bifasciatus*, which was concentrated at shallow depths during the daytime but migrated to deeper layers at night. The functional indices showed no significant differences between water depths or diel cycles (day / night). Besides the temperature variation, the reduced light penetration due to platform structures makes difficult the algal growth necessary for browsing herbivorous fish. Thereby, the effect of sunlight penetration may be reflected in the vertical distribution of herbivorous fish, which are rare in deeper layers. Planktivores are densely grouped within and just below the thermocline, which is located around 18 m during summertime. The study demonstrates that oil platforms represent a hotspot of fish diversity and interesting sites for studying fish communities, abundance and behaviour.