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# Using industry ROV videos to assess fish associations with subsea pipelines

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A B S T R A C T

Remote Operated Vehicles are routinely used to undertake inspection and maintenance activities of underwater pipelines in north-west Australia. In doing so, many terabytes of geo-referenced underwater video are collected at depths, and on a scale usually unobtainable for ecological research. We assessed fish diversity and abundance from existing ROV videos collected along 2–3 km sections of two pipelines in north-west Australia, one at 60–80 m water depth and the other at 120–130 m. A total of 5962 individual fish from 92 species and 42 families were observed. Both pipelines were characterised by a high abundance of commercially important fishes including: snappers (Lutjanidae) and groupers (Epinephelidae). The presence of thousands of unidentifiable larval fish, in addition to juveniles, sub-adults and adults suggests that the pipelines may be enhancing, rather than simply attracting, fish stocks. The prevalence and high complexity of sponges on the shallower pipeline and of deepwater corals on the deeper pipeline had a strong positive correlation with the fish abundance. These habitats likely offer a significant food source and refuge for fish, but also for invertebrates upon which fish feed. A greater diversity on the shallower pipeline, and a higher abundance of fishes on both pipelines, were associated with unsupported pipeline sections (spans) and many species appeared to be utilising pipeline spans as refuges. This study is a first look at the potential value of subsea pipelines for fishes on the north-west shelf. While the results suggest that these sections of pipeline appear to offer significant habitat that supports diverse and important commercially fished species, further work, including off-pipeline surveys on the natural seafloor, are required to determine conclusively the ecological value of pipelines and thereby inform discussions regarding the ecological implications of pipeline decommissioning.

## 1. Introduction

Large-scale marine infrastructure is a feature of industrial activity in many of the World's inshore seas. Much of this infrastructure is associated with the oil and gas extraction industries, with significant numbers of large static structures, including platforms (rigs), jackets, pipelines, and associated constructions such as well-heads and subsea mattresses, being positioned around the margins of almost all continents. Inevitably, this infrastructure has an impact on the local marine ecology: both positive and negative. A full understanding of any potentially positive ecological value of marine infrastructure becomes particularly salient towards the end of their operational lives as decommissioning and removal are planned and implemented. These activities are costly, difficult, and may in themselves have significant environmental impacts that need to be considered alongside the potential, often long term, impacts of structures if they are to remain in the water.

There are a number of international treaties that govern the disposal of waste at sea which includes the management of decommissioned offshore structures, but there are no international guidelines or regulations that apply specifically to the removal of pipelines (Oil and Gas UK 2013, 2016). Currently, pipeline decommissioning is under national legislation resulting in variable standards (e.g. Standards Australia AS2885, 2008, The Norwegian Petroleum Activities Act, 1996). In all cases, however, decisions to remove or retain structures are most rationally determined by a cost/benefit approach: although unnatural, and having potentially significant negative environmental impacts that need to be understood and mitigated, many underwater structures, including pipelines and platforms, have also been shown to provide potential benefits, including to marine organisms. The benefits of retaining decommissioned marine structures in the sea are perhaps best exemplified by the implementation of 'rigs to reefs' programs (e.g. Macreadie et al., 2011, 2012; Gourvenec and Techera, 2016) in which decommissioned platform jackets are retained *in situ* in the sea because of recognized and acknowledged net benefits. In the case of rigs to reefs programs, benefits include benthic habitat conservation, enhanced fishery resources, and cost savings for the oil and gas industry. Identifying, describing, and accurately measuring the magnitude of putative benefits (and rejecting anecdotally perceived 'benefits' that prove to be erroneous) is, however, essential.

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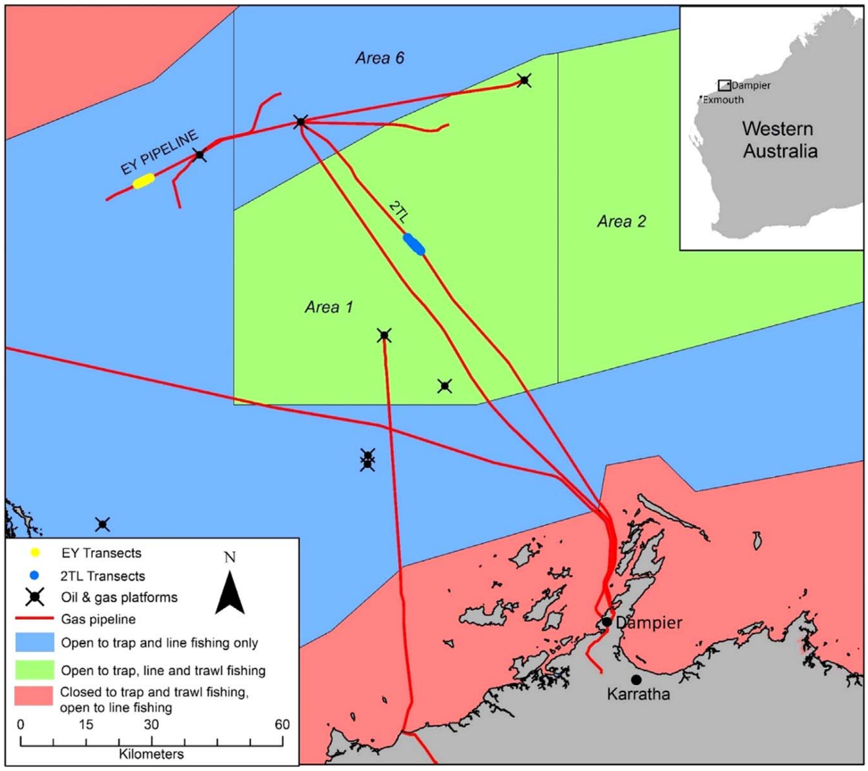


**Fig. 1.** Location of the surveyed section of each pipeline on the north-west shelf of Western Australia. Main commercial fishery areas are indicated and can be viewed in further detail in Newman et al. (2015). The Pilbara Line Fishery can operate throughout Pilbara waters.

A significant component of this evidence-led cost/benefit approach is the assessment of the potential value of marine structures to fishes. Fishes have particular ecological and societal value; their presence is not only indicative of environmental state and stability, but is also (depending on species) of direct value as a human food source. Fishes have been shown to be affected by the presence of artificial marine structures and human activities, with affects being both negative (e.g. McDonald et al., 2008) or positive (e.g. Claisse et al., 2014), depending on circumstances. In addition, geographical variation in marine oceanography and hydrology (including disparity in basic but key variables such as temperature, currents, tides and waves) combine with local organismal diversity to make knowledge and understanding of one marine locale difficult to transfer directly to another. It is thus not possible to predict either positive or negative effects of marine structures on fishes *a priori* with absolute certainty: instead, local observations and measurements are required to provide evidence to inform best practice in any one geographical region.

Despite such caveats, there is widespread evidence that fish populations often benefit from the presence of large marine structures. This phenomenon is well known for sunken ships (e.g. Arena, 2011) and purpose-deployed artificial habitats (e.g. Seaman, 2007), as well as for oil and gas platforms and associated infrastructure (e.g. Macreadie et al., 2011; Claisse et al., 2014; Pradella et al., 2014; Fowler et al., 2015). Few of these observations, however, have been made in the area of interest of this study: the North West Continental Shelf (NWS) of Western Australia (WA). Nevertheless, one study from this area described a diverse range of fish taxa, including ten commercially-fished species found to be living in association with oil and gas structures in water 85–175 m deep (Pradella et al., 2014). Another showed that at least one fish species native to this region appears to live in association with such structures for a considerable part of its whole life history (Fowler and Booth, 2012). In the Santa Barbara Channel of Southern California, Love and York (2005) showed, by submersible transect survey, that the abundance of some fish species was 6–7 times higher in close proximity to pipelines than over the adjacent sea floor.

In the NWS region of WA few, if any, formal studies have collated and analysed data about fish living in association with pipelines (but see Chevron Australia Pty Ltd, 2015). Anecdotally, however, local commercial and recreational fishers report increased fish-take close to pipelines (D. Gibson pers. com.). Despite anecdotal evidence of higher catches close to pipelines, the value of pipelines to fishes and fisheries is unknown but immediately relevant as oil and gas projects near completion and questions arise regarding the removal or decommissioning of these structures.

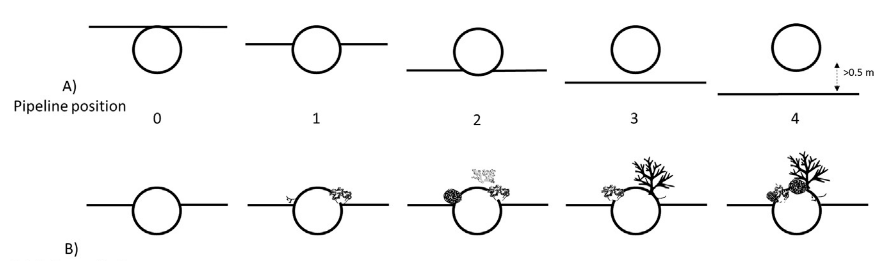


**Fig. 2.** Method of assessing pipeline position (A) with 0=buried, 1=more than half buried, 2=resting on seafloor, 3=span < 0.5 m and 4=span > 0.5 m and (B) habitat complexity with 0=none, 1=low and sparse, 2=moderate height and medium density, 3)=high height and medium density, 4)=high height and dense coverage.