Oil, Gas Platforms Sources for Marine Natural Products?

Summary

Oil and gas platforms have potential as sustainable sources for marine natural products derived from the aquatic invertebrates that live below the platforms. As shown in a study, however, variability in the distribution and recruitment of the invertebrates among platforms points to the need for critical targeting of both culture species and localized culture environments.

The underwater superstructures of oil and gas platforms offer environments for the growth of varied and potentially valuable invertebrates.

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For the past several decades, many have been excited about the discovery and potential commercial application of pharmaceutically important products obtained from marine invertebrates such as sponges, tunicates, and bryozoans. However, a major bottleneck to the development of these marine natural products (MNPs) has been an adequate supply of the organisms.

Typically, drug discovery and development requires large quantities of animals because each individual organism produces only miniscule amounts of the desired product. As a result, the harvesting of sufficient quantities of MNPs for research and commercial production can result in ecological impacts to the natural populations and associated communities.

One potential solution to the supply bottleneck and potentially adverse environmental impacts is the harvest and/or culture of pharmaceutically important species from man-made structures, such as offshore oil and gas platforms.

The structures support an abundant and diverse assemblage of marine invertebrates, including many with potentially important natural products.

Why Oil, Gas Platforms?

Oil and gas platforms have several advantages as sites for invertebrates containing MNPs. First, the structures support an abundant and diverse assemblage of marine invertebrates, including many with potentially important natural products. Second, the artificial structures are essentially marine reserves – areas where commercial and recreational harvesting are typically restricted. Lastly, harvest/culture of MNPs can be sustainable at the platforms, as evidenced by the continuous harvesting of *Mytilus galloprovincialis* mussels at several platforms by a California aquaculture company over the past 20 years.

California Study

To evaluate the potential use of oil and gas platforms as sustainable sources of invertebrates with MNPs, the authors investigated the distribution, abundance, and population dynamics of marine invertebrates at seven offshore oil and gas platforms in the Santa Barbara Channel off California, USA. Funding for the project came from the Mineral Management Service and Coastal Maine Institute, U.C. Santa Barbara.

Photographic surveys were used to compare the distribution and abundance of invertebrate species among the platforms. Photographs were taken at depths of 6, 12, 18, and 24 m from four randomly chosen conductor pipes. Species composition and invertebrate coverage were determined from the photographs using point contact methods.

Ceramic tiles and scrub pads were deployed as recruitment surfaces at each platform to compare the recruitment of invertebrates among platforms during 90-day periods. The use of both hard and fibrous substrates allowed measurements of the recruitment of a wide variety of invertebrates, since species vary in their substrate preferences.

Many of the invertebrate species with potentially useful pharmaceutical products are suspension feeders. To evaluate the growing conditions for suspension feeders at the platforms, four sets of tagged *Mytilus galloprovincialis* mussels were enclosed in mesh cages and suspended between adjacent conductor pipes at each platform. The mussels were measured and growth rates were calculated every 90 days, with new sets of mussels deployed for each season.

Distribution, Abundance

Across all platforms, the most abundant invertebrates, accounting for 83% of the total surface cover, were anemones, hydroids, sponges, and tubiculous amphipods. The exotic encrusting bryozoan *Watersipora cucullata* was observed only on platform Gilda and the exotic *Diadumene* sp. anemone was recorded only on platform Gail.

The invertebrate communities varied greatly among platforms. Although anemones occurred at up to 60% coverage, the dominant species varied with location (Figure 1). While *Corynactis californicus* was the dominant anemone on platforms at the southeast end of the channel, its coverage was less than 7% on platforms to the northwest. At platform Gail, the most abundant anemone was the exotic *Diadumene* sp.

In contrast, mean cover of the anemone *Metridium senile* was about 50% at the most northwest platforms and as low as 1% on platforms to the southeast. The cover of sponges was more variable, with up to 35% cover at Gail and the two most northerly platforms.

This data illustrates which of the seven platforms could be important sources for specific organisms containing MNPs. For example, efforts to harvest/culture the *Haliclona* sp. sponge or *Watersipora cucullata* encrusting bryozoan would be limited to one or two specific platforms. In contrast, several platforms appear suitable as sources for the anemones C. *californicus* and *M. senile*.

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Recruitment

There were also significant differences in the recruitment of invertebrates among platforms and seasons (Figure 1). In particular, species like the branching bryozoan *Bugula neritina* were limited to only a few platforms, whereas species like the hydroid *Plumularia* sp. were more widespread. Recruitment also appeared strongly seasonal for some species, but continuous for others.

Recruitment data is useful for evaluating which platforms may provide sustainable sources of MNPs. For example, recruitment of the branching bryozoan *Bugula neritina* was not detected at the most southeasterly platform, even though this species occurs there. This finding suggested that harvesting/culturing *B. neritina* at this site would likely not be sustainable. Knowledge of recruitment seasons and strength is also beneficial for determining sites for the collection of start-up cultures.

Invertebrates found under oil platforms include sponges, bryozoans, and various anemones.

Growth

The growth rates of mussels were also found to vary significantly among platforms and seasons, with the fastest growth occurring at different locations depending on the season. In the summer, growth was significantly faster at the four southern platforms. In contrast, winter growth was faster at the most northwesterly platform.

The evaluation of growth rates of mussels among platforms is useful for determining which sites provide favorable growing conditions for suspension feeders. Overall, these results indicated that the four most southeastern platforms provided slightly more favorable growing conditions for suspension feeders due to the higher summer growth rates.

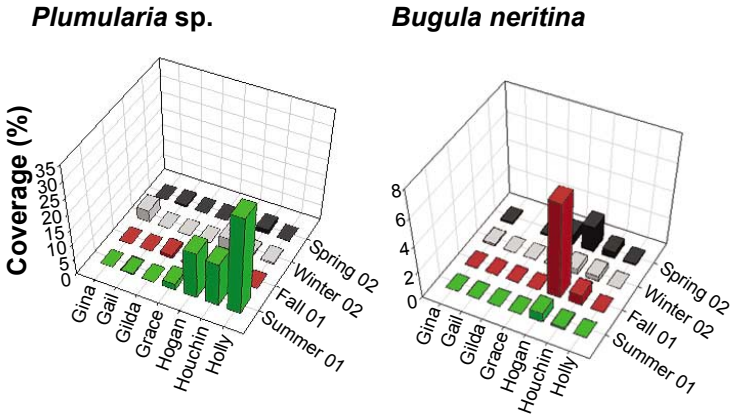

Figure 1. *Recruitment of selected invertebrates at seven oil and gas platforms.*