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## **Assessment of the Fisheries Impact of Seawater Use by Offshore Facilities**

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### **Abstract**

Proposals to construct multiple offshore liquefied natural gas terminals (LNG) in the United States that planned to use seawater as a heat source for vaporization of LNG have prompted assessments of the potential for entrainment of marine organisms in seawater intakes to impact fisheries. The publication of multiple impact assessments for facilities in the same region facilitated a critical review of the techniques currently in use and led to research on improvements in assessment methodology. This paper reviews existing assessment techniques and describes methodological improvements that have been developed in recently published research. The original assessments for these facilities concluded that the impacts of entrainment were minor. Applying recently developed techniques to a reassessment of the cumulative effects of multiple facilities showed that impacts on key species were significantly reduced, compared to the results of previous studies. The finding that multiple LNG terminals are predicted to have minor impacts suggests that other types of offshore facilities using smaller amounts of seawater will have even less significant impacts on fishery resources.

### **Introduction**

Offshore facilities use seawater for a variety of important, and even critical, processes or activities: cooling of engines and other equipment, heating for revaporization of liquefied natural gas (LNG), fire fighting, preparation of drilling fluids, and generation of fresh water for personnel or process support. Facility seawater intake rates<sup>1-6</sup> range from 10 m<sup>3</sup>/s for LNG terminals down to about 0.1 m<sup>3</sup>/s for smaller production platforms (Figure 1). Seawater intakes pose a risk to marine life from impingement of larger organisms, i.e., trapping by flow forces against intake screens, or entrainment of smaller organisms that pass through intake screens and are subjected to mechanical, thermal, or chemical stresses within facility systems. Impingement risks can be managed through appropriate sizing of intakes, which controls face velocities and associated flow forces, and selection of intake protection screens, which prevent larger organisms from being entrained. However, intake screens with even the smallest practical mesh sizes allow passage of eggs and larvae of marine species and subject these life stages to entrainment stress.

Proposals by different companies to construct multiple offshore LNG terminals in the United States Gulf of Mexico (Figure 2) led to the preparation of environmental impact assessments that included analyses of the potential impact of entrainment in seawater intakes on fisheries. The United States Coast Guard (USCG), the regulatory agency that grants permits for the construction of offshore LNG terminals in the United States, prescribed a common method and database<sup>8</sup> for all entrainment assessment studies. The publication, within a few years, of a number of very similar studies of the impacts of facilities in the same region provided an ideal opportunity for the critical review of the appropriateness and robustness of the impact assessment methodology<sup>1,8</sup> and results.

This paper presents an overview of methods and input data needs for entrainment assessments, reviews the key findings of a critical review of the methodology, and discusses the application of alternative methods that have been developed based on recently published research. The assessment results provide the basis for interpreting entrainment losses in terms of their potential impact on fishery resources.

### **Impact Assessment Methods**

Entrainment results in losses of the eggs and larvae of marine organisms. The ecological importance of these life stages for the functionality of fisheries rests on their role in supporting populations of older organisms that comprise harvestable marine resources, forage for other marine organisms, and individuals needed to maintain future populations. As a result, the entrainment assessment begins with estimation of the number of eggs and larvae subject to entrainment and then projects these losses to some estimate of the losses of more mature organisms.