

Project Title: Marine oil snow (MOS) formation and its role in the fate of crude oil in NE Atlantic waters

Host institution: Heriot-Watt University

Supervisor 1: Dr. Tony Gutierrez

Supervisor 2: Dr. Martin Jones (Newcastle Univ.); Collaborators: Dr. Alejandro Gallego (MSS).

Project description:

Oil spills at sea are one of the most disastrous of anthropogenic pollution events. With oil exploration moving further into deeper waters (>1000m), this raises concern because of the unpredictability and current lack of experience and know-how in dealing with a deep-sea spill. A distinctive feature of the Deepwater Horizon (DWH) oil spill was the formation of unprecedented quantities of Marine Oil Snow (MOS). MOS of macroscopic cm-size dimensions can be described as a mucilaginous floating organic matter containing entrained crude oil within its amorphous matrix. The genesis and factors influencing its formation are not yet well resolved, but based on events from the DWH spill, **MOS forms primarily in surface waters in the presence of crude oil and then rapidly sinks to the ocean floor.** It has been suggested that increasing the residence time of MOS in the water column enhances the biodegradation of its entrained oil by the community of attached/associated microorganisms, **thus reducing the amount of oil reaching the seabed that could potentially impact benthic ecosystems.** This PhD project will focus on understanding MOS formation in coastal waters of the North-East Atlantic, particularly in regions where oil exploration is prevalent such as in the North Sea and Faroe-Shetland Channel (FSC). The project objectives are to: 1) determine the conditions leading to MOS formation at different coastal sites (e.g. Scottish east coast and Shetland west coast); 2) investigate the diversity and abundance of oil-degrading microbial communities associated with MOS aggregates formed in different waters; and 3) measure crude oil biodegradation rates associated with MOS. This work will provide new information on whether, like during the DWH oil spill, MOS could be formed during a major spill in the NE Atlantic, the conditions influencing this, and what role MOS plays in the transport of crude oil hydrocarbons to the sea floor. The information gained could also feed into models that account for biological controls influencing the fate of oil in marine environments, and in-turn feed into optimising bioremediation/oil-spill response contingency plans. The supervisory team comprises members with extensive experience and expertise in ocean sampling and the microbiology of oils spills, as well as in the analysis of crude oil biodegradation. In summary, this project is designed with the ultimate aim of producing new information from lab and field experiments to predict the fate and impacts of crude oil to benthic ecosystems.

Research theme: Environmental Impact and Regulation. The project aims to fill a major knowledge gap on the formation of MOS in NE Atlantic waters where it has not yet been investigated, and its role in the fate of crude oil within the water column.

Research context: Gutierrez (1st super.) has to-date published 8 peer-reviewed publications related to the DWH oil spill; he currently has two PhD students working on related projects and has enduring collaborations with US groups in North Carolina and Georgia related to the DWH spill. Jones (2nd super.) collaborates with oil industry groups and his experience is directly relevant here. Gallego offers the student a free berth on research cruises to the FSC and knowledge of the area.

Research costs: Main costs are for microbiological & molecular work that will be supported through this studentship. Costs for travel on field trips to coastal waters for sampling will be covered by the PI.

Career routes: Independent or industry-based environmental consultant; specialist researcher with an environmental government agency (e.g. SEPA) or career in academia.