

Cullen Fellow: Population structure of lobster (*Homarus gammarus*) in Irish waters

Background

Lobster is the essential commercial species exploited by the inshore fishing fleet in Ireland. Without lobster the majority of the inshore fleet of over 1,700 registered vessels would simply not survive commercially. The profile of the fishery at 800 tonnes landed annually, a value of probably €11m 90% of which is exported, participation of approximately 1,000 vessels involving probably 1,500 fishermen, buyers, transport companies and exporters indicates the real social and economic value of this fishery.

Lobster are caught almost exclusively in Irish territorial waters and their management is essentially under national control. Current management is limited to technical measures; a minimum size, a maximum size and a prohibition on the landing of v-notched lobsters. There is no input (effort) or output (landings) control. Assessment of stock and exploitation status suggests that egg production is low and limiting stock productivity and fishing mortality is high. Effort is increasing and there is debate about the future sustainability of the fishery.

Current scientific work on lobster in Ireland is limited to standard fishery monitoring; catch effort statistics and indicators and size distribution data are collected routinely by the Marine Institute. Egg per recruit assessments provide indicators of exploitation status relative to putative reference points and suggest significant over exploitation. There is no research on biological characteristics or crucially on population structure and source sink dynamics, which would identify the appropriate scales for stock management.

In the period 2004-2007, based on larval dispersal modelling, tagging and profiles of the industry activity regional management, involving 6 separate stock and management units, was proposed as part of the implementation of a management plan developed at the time. This was not implemented for various reasons, but the key questions relating to the stock structure remain uncertain.

In 2010, following a similar and earlier project implemented by QUB with the lobster fishery in the north east coast of Ireland, tissue samples (including developing eggs) from 2,000 lobsters that were v-notched and released by fishermen at Inis Óirr (Aran Islands) were retained for genetic fingerprinting (<http://www.qub.ac.uk/bb-old/prodohl/GEL/gel.html>). Progeny of these lobsters can be identified; maternity from tissues from female v-notched lobster and paternity from the fertilised eggs carried by those v-notched females. Such progeny should, based on crude estimates of recruitment and growth rate be appearing in the commercial fishery in 2016. Locating and identifying these progeny now represents a unique (other than the QUB study) opportunity to answer crucial questions on the biology and population structure and dynamics of Irish lobster stocks.

Proposal

We propose a **three-year PhD project** to genetically profile all tissue samples of lobsters released from Inis Óirr during the period 2010-2016.

In collaboration with the MI Inshore fisheries team the progeny of these lobsters will be searched for in commercial and pre-commercial lobsters captured by commercial vessels. Tissue samples will be obtained from undersized and commercial sized lobsters in the commercial catch at various distances from the release sites to identify the scale of dispersal and survival of cohorts that have settled in particular locations. By searching for progeny of genetically tagged lobsters released annually between 2010 and 2016 in the population a number of questions can potentially be answered

1. Over what distance have the progeny of genetically tagged lobsters dispersed through the larval phase and therefore what is the likely geographic population structure. Such data can be used to validate biophysical oceanographic models of lobster larval dispersal and to provide advice on how many management units are required to provide for optimum management of the resource?
2. What is the duration of time from egg production to recruitment to the fishery (lobsters cannot be aged) and how variable is this process?
3. How long does a genetically identifiable cohort of lobsters survive under the given fishing regime i.e. what is the mortality rate in the population, is there an inherent carrying capacity?
4. Considering the reproductive biology is there single paternity or multiple paternity or any evidence of sperm limitation, effective population size (N_e)?
5. Is there variable and selective contribution of 'individuals' and 'families' of lobsters to recruitment that is related to maternal size (and the size limits used to manage the fishery)?
6. Can pedigrees, beyond parent-offspring relationships (i.e. un-sampled parents such as brothers, sister, uncles, aunts) be derived as a basis to estimate population quantitative biological parameters such as heritabilities for size and growth rate?

Outcome

The potential evidence base within the genetically tagged population and its progeny is immense and diverse and has the potential to make significant and valuable contributions to lobster biology and management. These issues are of direct and immediate relevance to the Irish industry and discussions currently playing out at the industry representative structures (the Regional and national Inshore Fisheries Forum). The evidence is also very relevant to how Ireland approaches the assessment of Maximum Sustainable Yield (MSY) for this commercial species as required by the MSFD and CFP by 2020.

Financial Details

The Fellowship award will be up to €24,000 per annum. This amount comprises a maintenance award of €16,000 to the student as well as payment of fees to the host institution. The maximum fees payable to the college will be €6,000 per annum. The Fellowship award includes a travel budget of up to €2,000 per annum for the sole use of the student and is payable on a reimbursement basis direct to the host institution at which the postgraduate student (Fellow) is registered. All field-work and travel covered by the €2,000 travel budget is for travel taking place within the island of Ireland.

Marine Institute Co-Supervisor

Dr. Oliver Tully, Fisheries Ecosystems Advisory Services