Review of Management Arrangements for the Irish Sea Mussel Seed Fishery: A Discussion Document

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About this consultation

Background

The current management system for the bottom grown mussel sector in Ireland has been in place for more than ten years, with policy for the mussel seed fishery based on recommendations set out in the 2008 *Rising Tide* expert group report. However, several issues (e.g. seed availability, mussel production, changes to aquaculture licensing) have come to the fore over the intervening period, and it is now seen as timely to re-examine the basis for the current set of policies governing the operation of the Irish mussel seed fishery, particularly in the Irish Sea.

Recent advice received from the Marine Institute has highlighted inconsistencies in the management approach to the Irish Sea stock and raised concerns about the harvest strategy given continued low biomass of mussel seed in the Irish Sea. In addition, the results of a husbandry review process, which has been underway for a number of years with the aims of aligning allocations more closely with the available seed resource and optimising the productivity derived from wild mussel seed re-laid in licensed aquaculture plots, need to be included in the management arrangements. New and revised aquaculture licences are also coming into the system and these may need to be factored in to the mussel seed allocation process.

Considering these issues, it is proposed to review the current management system for the Irish Sea mussel seed fishery and consider changes that could better support productivity and sustainability.

The purpose of this consultation is to seek the views of those with an interest in the Irish Sea mussel seed fishery regarding the management arrangements for this fishery. This consultation is issued by the Secretariat to the Bottom Grown Mussel Consultative Forum on behalf of the Republic of Ireland's Department of Agriculture, Food and the Marine. The information received during this consultation will inform policy decisions on the management arrangements for this fishery.

Documents

The consultation pack contains a Discussion Document and a Submission Document.

This Discussion Document is broken into three parts which are for information only:

- Part 1 provides an overview of the current arrangements for the fishery,
- Part 2 identifies possible limitations to the current approach and outlines possible measures to address these limitations, and
- Part 3 examines the research plan.

The Submission Document **requires a response from you** to the questions provided. The Submission Document has two parts. These are:

- Part 1 - Tell us about you, and
- Part 2 - Give us your views.

This is your opportunity to ensure the issues which are important to you are included in policy developments for this sector.

How to have your say

You can complete and submit the Submission Document online at the following webpage:

https://www.surveymonkey.com/r/F6FJYGK

Submission Documents will also be accepted:

- by email to: inshore@agriculture.gov.ie (with the subject line 'Mussel Seed Fishery Consultation')
- by post to: Mussel Seed Fishery Consultation
  Marine Programmes Division
  Department of Agriculture, Food and the Marine
  National Seafood Centre
  Clonakilty, Co. Cork P85 TX47

The closing date for responses is: Tuesday, 31 December 2019.

Freedom of Information and Data Protection

Any comments/submissions received are subject to the Freedom of Information Acts and/or the European Communities (Access to Information on the Environment) Regulations 2007 and may also be published on the Department's website (excluding contact details). Please advise us if any of the detail you have provided is sensitive on the basis that it is personal, confidential or commercially confidential. Please identify this detail and give clear reasons why you think it should not be released. The Department will, where possible, consult with you about any information which you have identified as sensitive information before making a decision in response to a request for release under the Freedom of Information Acts.

PART 1 - Management arrangements for Irish Sea mussel seed fishery

1.1 Policy context

The mussel seed fishery on the island of Ireland has been managed on an all-island basis by the Minister for Agriculture, Food and the Marine (DAFM) in Ireland, the Department of Agriculture, Environment and Rural Affairs (DAERA) in Northern Ireland and the cross-border Loughs Agency. In 2008, Ministers from Ireland and Northern Ireland published the findings of an expert-led review in the report *The Rising Tide*. The recommendations of this report form the policy basis for the two Ministers in managing the mussel seed fishery and bottom mussel culture around the island of Ireland. The guiding policy statement in *The Rising Tide* says:

> 'The purpose of the regulation and management regime for the mussel seed resource shall be to ensure the sustainable exploitation of the wild mussel seed resource and to maximise the benefits derived from that resource in terms of volume and value of the mussel crop subsequently grown, harvested and processed with the objective of generating sustainable economic activity and employment in coastal communities.'

1.2 Roles and responsibilities

- DAFM manages fishing opportunities available to the Irish fishing fleet as well as aquaculture licensing in the Republic of Ireland.
- The Marine Institute is the statutory body whose function is (*inter alia*) to undertake sea-fisheries research, assess and advise on the sustainable exploitation of the marine fisheries resources in the waters around Ireland and on the impacts of fisheries on the ecosystem.
- Bord Iascaigh Mhara (BIM) has responsibility for stock assessment of mussel seed in the 'traditionally fished' beds. BIM assists and promotes the Irish seafood industry by providing technical expertise, business support, funding, training and promoting responsible environmental practice.
- The Sea-Fisheries Protection Authority (SFPA) is the independent statutory body responsible for enforcement of sea-fisheries and seafood safety legislation.

1.3 Consultative structure

The Bottom Grown Mussel Consultative Forum ('the Forum') was established in 2009 pursuant to a recommendation of *The Rising Tide* report. The Forum facilitates the management of the fishery on an all-island basis, making recommendations to the two Ministers on various aspects of the fishery, e.g. opening and closing dates of the fishery, seed survey plans, etc. The Forum also provides a point of contact for the industry, facilitating discussion on issues in the sector. The Forum is chaired by BIM and includes officials from that agency as well as DAFM in Ireland, DAERA in Northern Ireland, the cross-border Loughs Agency, the SFPA and elected operator representatives from all areas around the coast.

1.4 Mussel production

1.4.1 Mussel seed: raw material for bottom grown mussel production

Wild mussel seed is an essential raw material for the bottom grown mussel aquaculture industry. Bottom Growing Mussel farmers fish for wild mussel seed that is then transplanted onto their licensed aquaculture sites for on-growing and later harvesting. The supply of mussel seed is almost entirely reliant on the settlement of mussel seed in relatively small areas in the Irish Sea. The amounts of seed fished year-to-year have been variable, with total annual quantities ranging from more than 22,000 tonnes to less than 3,000 tonnes over the period from 2008 to 2017 (Figure 1). It should be appreciated that when viewed over a longer period the mean fished biomass of mussel seed from the Irish Sea is in the range of 7,000 to 10,000 tonnes.

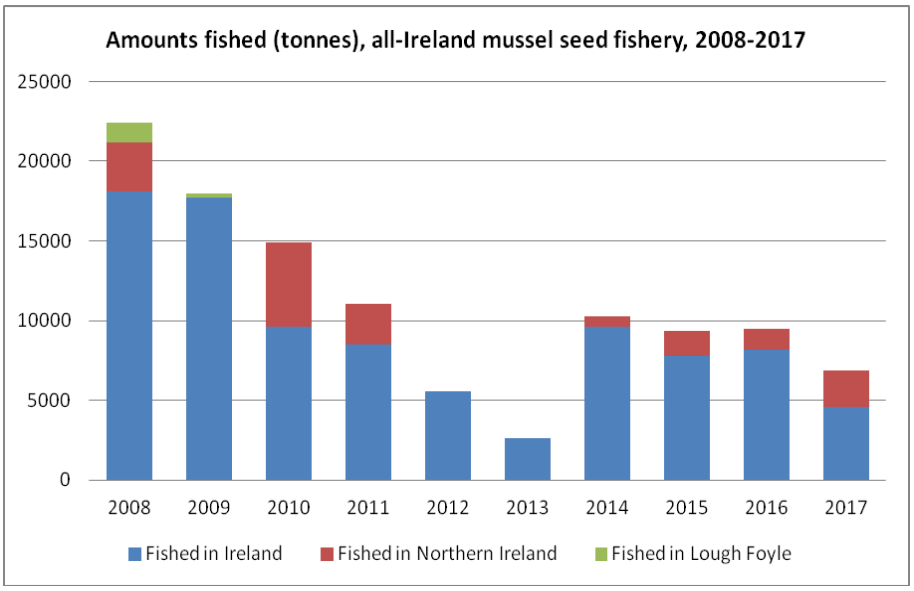

Figure 1. Annual mussel seed production in Ireland 2008-2017. Data compiled by BIM and SFPA.

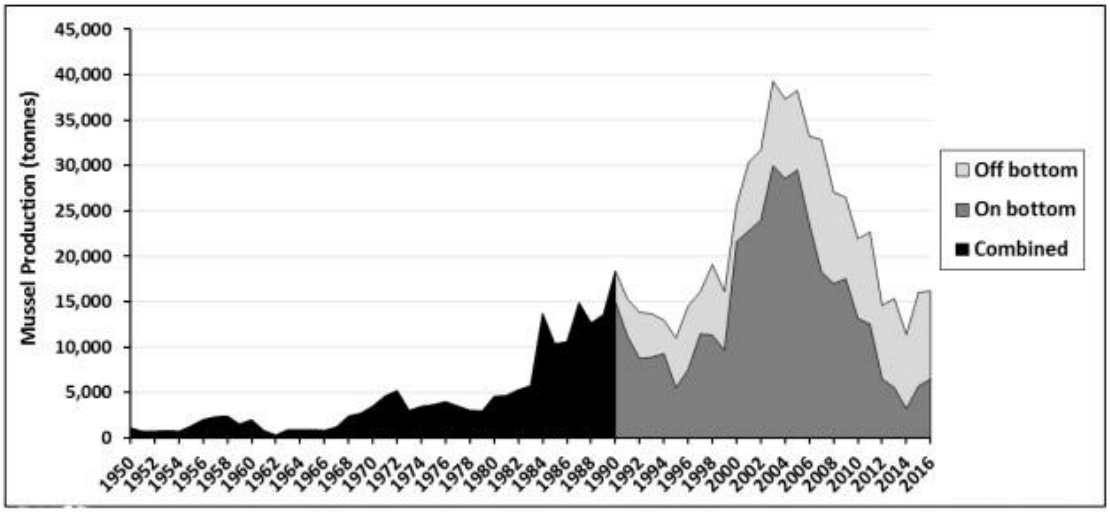

Figure 2. Annual production of bottom mussel in Ireland (1950-2016) with landings split between on bottom and off bottom cultivation after 1990 (Source FAO and Eurostat).

Mussel seed fishing is conducted using a variety of equipment types. By far the most commonly used dredge type is one of a modified Dutch design. Depending on size, vessels may deploy two or a maximum of four dredges at a time. The dredge is composed of a fixed bar (of between 2 and 4 meters in length, known as the 'mud bar', which is without teeth) and a frame with a net bag attached, which is 2-3 meters in length to retain the seed mussel catches. The dredge is designed to skim the surface of the substrate and separate mussels from the underlying sediment. This mud bar in effect 'peels' the overlying seed mussel 'mat' away from the underlying substrate and in doing so removes the mussel seed which is caught in the bag which follows the bar.

The spatial extent of the seed fishery is limited by substrate type. Mussel seed fishing targets areas of sands, coarse sands and mixed bivalve shell. Mobile gear cannot be deployed in rocky or reef areas; therefore these areas are not targeted. BIM estimates that, based on data it has collected since 2010, the annual average area of the mussel seed fishery in the Irish Sea is approximately 350 hectares.

1.4.2 Mussel aquaculture production

According to the BIM Annual Aquaculture Survey (2018), production of bottom grown mussels in Ireland in 2017 was 7,800 tonnes with a value of approximately €9 million. In 2017 the sector grew by 53% in value and 22% in volume compared to 2016. Production peaked in the period 2003-2006, but subsequent poor recruitment to the mussel seed beds led to a period of significant decline. Production increased in 2015 and 2016 following improved recruitment of seed in 2014 and 2015.

Bottom mussels are sold in fresh (live) and prepared forms (fresh, frozen vacuum-packed mussel in sauce), as advanced ready meals (half shell with toppings) and as frozen meats into the wholesale, retail and food service markets. Products are largely exported to Europe (France, Benelux (Belgium, the Netherlands, and Luxembourg), the United Kingdom, Germany and others) and the United States (prepared frozen mussels in sauce). The main competition for Irish mussels comes from France and Holland, and the demand for Irish mussels has suffered in recent years in the face of abundant Dutch supply.

1.5 Management arrangements for the Irish Sea fishery

1.5.1 Harvest strategy

The harvest strategy for mussel seed in the Irish Sea – occurring, as it does, in certain limited and discreet areas of the seabed of the south Irish Sea – is based on the assumption that fishing for seed in those areas and moving it to aquaculture sites for on-growing will have no significant effect on the overall spawning potential and larval production and therefore that the fishery, in and of itself, is highly unlikely to lead to recruitment overfishing.

This 'dredge and relay' activity is a unique feature of the fishery, whereby the mussel seed biomass is not removed from the Irish Sea ecosystem but is in fact retained in more sheltered locations where it typically spawns three or four times during the 'fattening' period, thereby creating an additional spawning biomass. The fish and relay process may therefore enhance spawning output by increasing the survival of mussel seed transferred to sheltered sites.

The fishery targets juvenile mussels that have settled in the same year and are regarded as ephemeral features, which do not subsequently significantly contribute to the overall spawning biomass of mussels in the Irish Sea. The harvest strategy considers these mussels to be ephemeral as subtidal seed beds in the Irish Sea can be lost to predation and physical processes, such as storms, particularly over the winter months.

Mussel broodstock are distributed widely in the greater Irish Sea in contrast to the very limited and discrete areas over which mussel seed are fished. Evidence suggests that there is generally an abundance of mussel seed larvae in the Irish Sea and that larval supply is unlikely to constrain spat fall. Under this assumption, therefore, the view has been that there is no need to constrain catch or fishing effort on the very limited areas of mussel seed beds identified that can actually be fished. Mussel seed beds also occur in areas which are not suitable for dredge fishing, such as rocky benthic and intertidal habitats and within some Natura 2000 sites not open to fishing. The strategy also, broadly, assumes that there is a single stock of mussels in the Irish Sea and therefore that finer scale spatial management is not warranted.

1.5.2 Stock assessment

Surveys of mussel seed beds are conducted by BIM from April to September (inclusive) using both a 'light' and 'heavy' box dredge. Survey methods involve side-scan sonar to locate seed beds combined with biological sampling using a small sample dredge and/or grab. These data are used to estimate the biomass of mussel seed in the bed at the time of the survey. Seed survey reports are published on the BIM and Irish Sea Portal Pilot (ISPP) websites as they become available.

Industry also undertake limited mussel seed surveys using ground discrimination software on board the vessels and commercial fishing equipment. These industry surveys report presence or absence of mussel seed but do not quantify the amounts. Surveys are generally conducted on 1-2 available

tides in advance of the defined opening periods. Surveys are only conducted in areas of suitable substrate and exclude Natura 2000 sites which are generally closed to mussel seed fishing. These industry derived data are not incorporated into the BIM biomass estimates unless the survey vessel has followed up on the industry report and quantified the 'new' bed.

The BIM survey reports provide, *inter-alia*, indications of average seed size and the presence, absence or threat of predation.

1.5.3 Harvest control rules

The assumption behind the harvest strategy is that the harvest rate, on those limited areas open to fishing, does not need to be managed. There are no reference points that would inform a harvest rule related to seed biomass in a given year and that would be derived from some observed relationship between stock and recruitment. Instead the key harvest control rules revolve around which areas are opened for fishing and which remain closed or are inaccessible, but these are not explicitly concerned with conservation of spawning biomass.

1.5.4 Restricted access

Access to the opportunity to fish for mussel seed is restricted to licensed and registered Irish sea-fishing boats. To fish for seed, Irish-registered sea-fishing boats require an authorisation under section 13 of the Sea-Fisheries and Maritime Jurisdiction Act 2006. Mussel seed authorisations are only provided to those sea-fishing boats which are directly connected with a bottom grown mussel aquaculture operator or are contracted to fish on behalf of same. A mussel seed authorisation can only be awarded to fish on behalf of an operator who holds a mussel seed 'allocation' for his/her aquaculture site. In the period 2014-2018, an average of 39 authorisations allowing operators access to the Irish Sea mussel seed fishery were granted each year. A number of authorisations in each of these years involved more than one aquaculture site.

An authorisation to fish for mussel seed specifies various conditions, including the quantity of seed that may be fished (the allocation). Allocations of mussel seed (rights to fish) to individual operators have largely remained static since 2005, initially pending the outcome of *The Rising Tide* report and then on foot of a recommendation from the report that allocations should remain static pending the implementation of a performance-based allocation system. To take account of anomalies that may have arisen with the passage of time since allocations were originally awarded, operators have been allowed in recent years to seek a review of their situation. These anomalous allocation reviews are conducted by application to the Department, assessment of the case by a sub-committee of the Forum, and consideration of recommendations by the Minister. This has led in recent years to modest increases in allocations for a small number of operators.

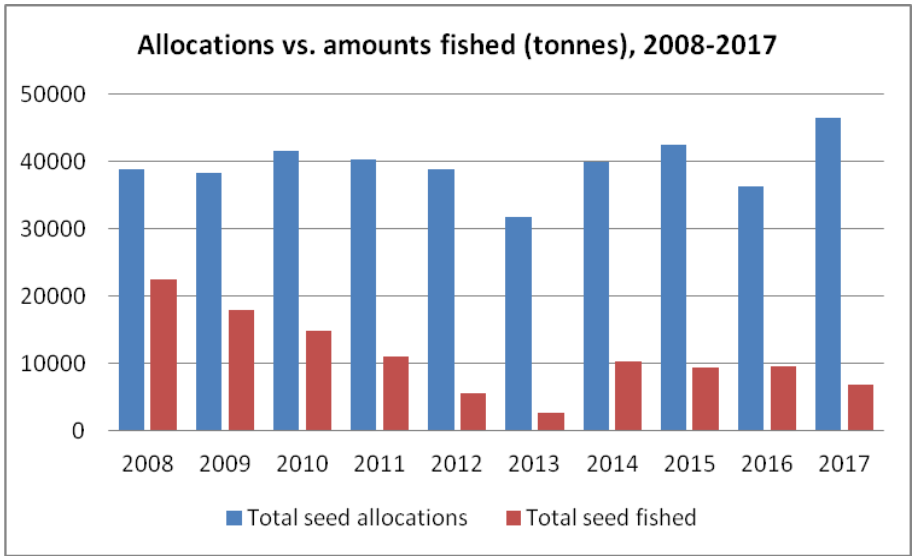

Figure 3. Annual total tonnage of mussel seed allocated for fishing and actual landings 2008-2017

The total volume of mussel seed allocations issued to fishing boats in recent years are significantly larger than the amounts of seed that are fished or the amounts estimated to be available from the BIM biomass estimates, i.e. uptake of fishing allocations is very low and reflects a disconnect between allocation criteria and the annual biomass estimated to be available (Figure 3)

1.5.5 Seasonal controls

Fishing for mussel seed is allowed only for defined periods of time during the year. When fishing of mussel seed is allowed for such a period of time, boats in the fishery can only operate during suitable tides (permitted tides ≤7m on Llanelli tide tables). During the suitable tides, fishing for mussel seed may only take place between 06:00hrs and 18:00hrs each day. Together these controls restrict the amount of time boats can fish for mussel seed in any given year. In 2018, for example, mussel seed fishing was allowed during the period from 17 September to 21 December 2018 (set out in S.I. No. 369 of 2018 – Sea-Fisheries and Maritime Jurisdiction (Mussel Seed) (Opening of Fisheries) Regulations 2018). The suitable tides during this period amounted to 45 days in 2018 during which mussel seed fishing could take place. However, fishing for mussel seed is also dependent on other factors, such as suitable weather conditions, seed availability, etc. BIM estimates that, since 2010, mussel seed fishing in the Irish Sea has taken place an average of 20 days per year.

The Forum makes recommendations to the Minister proposing dates for mussel seed fishing to take place. Generally, such a recommendation will only be made in light of evidence of seed resources of a reasonable quantity and quality such as may be identified by prior surveys of seed beds. In 2014, the Forum agreed that a minimum survey biomass of 1,500 tonnes must be identified before making a recommendation on fishing activity. This however does not operate as a limit reference point, given that the biomass could be reduced to well below 1,500 tonnes under the unconstrained harvest strategy. The minimum size of seed is not regulated or incorporated into any harvest control rule.

The Forum also has a standing arrangement whereby the fishing of individual seed beds may be proposed to the Minister on a case-by-case basis if the beds are suitable for commercial fishing and confirmed to be under risk of predation from starfish or, less frequently, green crab (a force majeure proviso). Predation can be a significant source of mortality in mussel seed beds. The reference points for this are:

- At a level of 10 starfish m-2 being detected in a mussel seed bed, the Forum should immediately consult with industry and the management authorities as to the course of action that should be pursued for the bed.
- At a level of 20 starfish m-2, force majeure should immediately be implemented and a recommendation made to open the bed on the earliest available tide.

In considering recommendations from the Forum to allow fishing, the Minister takes into account information from BIM's surveys on the quantity and quality of mussel seed identified. The Minister also considers advice from the Marine Institute (on stock conservation issues, disease control issues, biotoxins and interactions with Natura 2000 sites where relevant) and any advice from the SFPA about control and enforcement.

1.5.6 Restricted areas

Fishing for mussel seed is prohibited or restricted in a number of Natura 2000 sites in the Irish Sea where mussels are known to occur in order to protect the integrity of the sites concerned. The various restrictions and requirements are set out in Fisheries Natura Declaration No. 3 of 2018 (Mussel Fishing) and Fisheries Natura Declaration No. 2 of 2019 (Mussel Fishing).

1.5.7 Fish health regulations

The disease risk associated with the movement of Irish mussel seed is considered to be low. However, to comply with fish health requirements, proposed movements of seed from mussel seed beds in waters within Ireland's jurisdiction must be notified in advance to the Fish Health Unit (FHU)

at the Marine Institute. The relevant forms and details are available from: https://www.fishhealth.ie/fhu/moving-fish-shellfish/movement-wild-mussel-seed and can be submitted to notification@marine.ie. Once issued, fish health approvals for each operator will be valid throughout the year for the periods when mussel seed fishing is allowed. These regulations also apply to movement of mussels between aquaculture sites and are therefore also relevant under section 1.6 below.

1.5.8 Sustainability certification

The bottom grown mussel fishery first achieved Marine Stewardship Council (MSC) certification in July 2013 and, uniquely in the Irish context, has maintained the certification through annual audits and recertification since then. The MSC certification program is a market-based instrument aimed at recognizing sustainable fishing practices using a credible, independent, third-party assessment process. It means sustainable fisheries can be recognised and rewarded in the marketplace and gives an assurance to buyers and consumers that their seafood comes from a well-managed and sustainable source.

The MSC standard has three overarching principles that every fishery must prove that it meets:

- Principle 1: Sustainable fish stocks - Fishing must be at a level that ensures it can continue indefinitely and the fish population can remain productive and healthy.
- Principle 2: Minimising environmental impact- Fishing activity must be managed carefully so that other species and habitats within the ecosystem remain healthy.
- Principle 3: Effective management - MSC certified fisheries must comply with relevant laws and be able to adapt to changing environmental circumstances.

1.6 Operational and regulatory measures in mussel aquaculture sites

1.6.1 Mussel production cycle

Seed that is captured in the Irish Sea is relayed by pumping the seed, mixed with seawater, from the boat's hold onto the licensed mussel sites. Relaying is generally at a density of 20-40 tonnes per hectare depending on seed size. Mussels are grown for between 18-36 months, depending on the growth rates and the size of the initial seed input. During on-growing, a range of husbandry activities are undertaken, such as predator control and transfer of mussel stocks between licensed sites, in order to maximise the return ratio (seed relay to mussel production). The biomass of seed re-laid into individual licenced plots needs to be limited so that good growth rate is maintained. Furthermore, the total biomass of mussels, across all licenced plots within a production area, also needs to be constrained to enable growth. Both local density and total standing stock (or Maximum Allowable Biomass (MAB)) in an area are therefore important in maintaining productivity.

1.6.2 Seafood safety

The Hygiene Package of European Union (EU) Regulations stipulates requirements for ensuring the safety of food for human consumption and contains explicit provisions for live bivalve molluscs such as mussels. Official controls (Regulation (EC) No. 854/2004) are carried out by the SFPA to monitor compliance by food business operators (including mussel farmers) with hygiene requirements including microbiological limits and biotoxin limits (EU Regulation No. 853/2004). As the competent authority, the SFPA is obliged to classify production areas from which harvesting of live bivalve molluscs (including mussels) is permitted for human consumption and to monitor harvested products through sampling regimes. Gatherers may only harvest live bivalve molluscs from these production areas which have fixed boundaries and which are classified as being of class A, B or C in accordance with Regulation (EC) No. 854/2004. If the biotoxin levels increase above acceptable levels, producers are prohibited from bringing to market the seafood products from the area.

1.6.3 Conditions of aquaculture licences

A range of conditions may apply to individual aquaculture licences which constrain the way in which the site can be used. These conditions have been developed to limit how mussel relaying may alter habitat structure and function within Natura 2000 sites. They also constrain the proportion of the site that can be used for relay in a given time period. This is consistent with maintaining growth rates within these sites.

1.7 Fisheries control

The current control measures for this fishery include a pre-fishery inspection for each participant vessel prior to commencement of the fishery to ensure compliance with pre–defined requirements. These include the Sea-Fisheries and Maritime Jurisdiction Act 2006 (No. 8 of 2006); the Mussel Seed (Fishing) Regulations 2006 (S.I. No. 311 of 2006); the Molluscan Shellfish (Conservation of Stocks) Regulations 2006 (S.I. No. 345 of 2006); the European Communities (Health of Aquaculture Animals and Products) Regulations 2008 (S.I. No. 261 of 2008); the European Communities (Natural Habitats and Birds) (Sea-fisheries) Regulations 2013 (S.I. No. 290 of 2013); Fisheries Natura Declaration No. 2 of 2018 (Mussel Fishing), and Fisheries Natura Declaration No. 3 of 2019 (Mussel Fishing). Monitoring of vessel fishing activity is undertaken by utilisation of the requisite onboard Vessel Monitoring System (VMS) position reporting system and aligned with specific vessel inspections.

Catch and effort data is collated in relation to vessel location and reported seed catches and is submitted to the SFPA in the form of an EU logsheet. The fact that that seed allocations are generally in excess of what is caught means that verification of seed quantities and measures such as hold surveys for control purposes are reduced as control priorities in respect of this fishery at present.

The SFPA is tasked to the monitoring and control of the mussel seed fleet operations in respect of the Natura 2000 provisions in relation to aquaculture sites. To this end, fine scale vessel positioning data is required to adequately monitor seed fishing in any closed or restricted areas.

PART 2 - Review of the management procedure

2.1 Harvest strategy

2.1.1 Possible limitations

- The assumptions behind the harvest strategy may not be entirely valid. Not all mussels fished in the Irish Sea are immature and there is some overwintering, spawning potential and spawning output from seed beds which varies annually and spatially. This was outlined in the report of Maguire *et al* (2007).
- The strategy assumes that fishing for seed has no effect on the stability and spawning potential of seed beds in subsequent years. Dredging may increase instability and by removing the seed bed the rate of settlement of new spat may be compromised. There is no direct evidence of this in the Irish Sea, but biologically the mechanism by which seed settle is related to small scale topographic relief and current dynamics close to the sea bed which change when the seed bed is removed.
- Extensive evidence from side-scan surveys carried out by BIM demonstrates gross benthic changes caused by natural processes which are greater in magnitude than any conceivable impact from the seed fishery.
- Larval dispersal modelling suggests that the scale of dispersal is limited and that for the purpose of management more than one stock could be identified.
- The harvest strategy may not sufficiently or systematically take account of, and has little information on, the overall mussel spawning stocks in the Irish Sea.

2.1.2 Possible revisions

- Given that the overall spawning stock status is largely unquantified and that the 'traditionally fished' seed beds may from time to time contribute to spawning, it might be argued that the harvest strategy should explicitly allow for some protection of spawning output from the 'traditionally fished' seed beds.
- Given that the overall spawning stock status is largely unquantified, and that larval dispersal may be more limited spatially than hitherto appreciated, a number of stock management units in the Irish Sea might be recognised. The stock management units could be defined from further research, such as larval dispersal modelling.

2.2 Stock assessment and monitoring

2.2.1 Possible limitations

- Survey estimates of total mussel seed biomass in the Irish Sea from BIM surveys cannot be complete given the biological sampling effort and sampling design, excluding as it does many seed beds outside the 'traditionally fished' areas.
- Industry surveys contribute some presence absence data by occasionally locating beds not found by the BIM survey effort, however the value of this data can be limited if, due to time pressures, the BIM survey vessel cannot follow up the discovery and carry out a systematic examination.
- There is no assessment of the overall spawning stocks which are, in the main, located in areas other than the 'traditionally fished' seed beds and that could inform the future prospects for seed supply.

2.2.2 Possible revisions

- Under a revised harvest strategy and new harvest control rules, conservation of spawning potential within seed beds could be made operational.
- Biomass estimates and spawning potential indicators from the survey data could be developed and used to inform the harvest rate. Estimates of these indicators would, therefore, need to be rigorous, precise and timely, if the acquisition of such data is practicable and cost effective.
- The analysis methods need to incorporate methods to detect the edge of the bed and methods to interpolate the biological point sampling data taking into account spatial autocorrelation.
- Under the aegis of the Forum, it may be possible to agree an improved industry survey methodology which would be of greater value to the assessment of the stock.
- The distribution of spawning stocks outside the seed bed areas should be assessed periodically. There is anecdotal information that benthic mussel settlement and biomass in the Irish Sea generally may be declining for reasons unknown. This needs to be monitored to inform the industry regarding future seed biomass potential and possibly to inform the harvest rules within seed beds which may need to be more conservative if spawning biomass elsewhere is declining.
- The locations of spawning stocks could be informed by reversed larval tracking and could be monitored at sentinel sites.
- Spawning stocks within Natura 2000 sites should be further assessed given that in some cases they are protected from fishing and locations are known. These may be important spawning reservoirs.
- The surveys on seed beds should be undertaken as close as possible to the anticipated opening dates of the fishery given that mussel biomass and size distribution changes significantly over short periods of time.
- Partial protection of the seed settlements (revised harvest strategy, Natura 2000 sites) along with an improved survey strategy would allow the investigation of overwintering rates and spawning potential, hence helping to better understand the significance of the potential contribution, if any, of these ephemeral beds to the overall population dynamics.
- Any area where mussel seed is to be protected from mussel seed fishing activity would also need to be protected from other bottom-towed fishing gears

2.3 Harvest control rules

2.3.1 Possible limitations

- The sum of the allocated fishing opportunities for mussel seed in the Irish Sea is much higher than the sum of the survey biomass estimates, and the landings are a small proportion of the allocated opportunities.
- The mussel seed fishing allocation criteria are complicated and demand led. There is a strong link to the relay site which may, in the past, have driven applications for aquaculture licences. There is currently approximately 3,500 hectares licensed for bottom mussel growing.
- The existing harvest rules are based on a single ubiquitous mussel stock in the Irish Sea, of which only a small proportion are exploited by the fishery. Therefore, existing harvest rules are largely unrelated to the status of the overall spawning stock of mussels in the Irish Sea or to the spawning potential of ephemeral mussel seed beds.

2.3.2 Possible revisions

- An annual Total Allowable catch (TAC) could be estimated for mussel seed in the Irish Sea from the annual survey biomass estimates. This TAC could be equal to the annual survey estimates or discounted by some harvest control rule (see below).
- The TAC would define the total biomass of seed that would be fished from the Irish Sea in a given year. Seed fishing opportunities, limited by such a TAC, could be allocated to eligible operators in a variety of ways so as to minimise significant disruption to existing businesses and to enable fair and equitable access to the resource. The following are possible options that could be explored:
    - Seed fishing opportunities would not be allocated. Instead all authorised vessels would be allowed to fish until the year's TAC had been taken.
    - To reduce competition between vessels and to enable more equitable access to the resource, available seed fishing opportunities under the TAC could be apportioned between different vessel groups based on vessel size.
    - The seed fishing opportunities could be allocated each year to individual eligible operators as 'seed fishing caps' based on an agreed set of criteria.
    - If more than one management unit is identified in the Irish Sea in the future, the TAC for each stock unit would be determined separately. The seed fishing opportunities then would be divided between the stock units in accordance with these TACs.
- The production of mussels within relay bays is already constrained so that it is within the carrying capacity of the bay. However, given that local growth rates within licenced plots can also be density dependent, a Maximum Allowable Biomass (MAB) or Standing Stock could also be specified for each aquaculture licence plot. This could be based on the product of the area of the site and appropriate relay densities.
- Access could be linked to a 'use it or lose it' rule, whereby an operator who repeatedly fails to take up allocated fishing opportunities would have access to the fishery restricted over time.
- New harvest control rules could be designed to constrain the harvest rate in line with spawning potential in the 'traditionally fished' seed beds. This rule would use biological data on size distribution, size at maturity and spawning potential from the surveys. The revised rules could result in:
    - Fishing later in the year and with no spring fishery.
    - More precise control on where fishing occurred within the seedbed.
    - Harvest rate in proportion to the spawning potential of the bed at time of survey (described in Figure 4, which shows a conceptual harvest control rule based on an index of spawning potential in a mussel bed that would require lower harvest rates in beds where the index

indicated higher spawning potential and higher range in size/age. A high harvest rate may still be justified as the slope of the stock recruitment (SR) relationship at low spawning biomass for mussels is likely to be high.).

- Some adaptive management to inform future harvest strategies could be adopted. These could include, if it were practicable and cost effective to obtain the necessary data:
  - Fine scale spatial management of seed beds to assess the effects of fishing on bed stability.
  - Not fishing small beds located during survey to estimate growth and survival of mussels in unexploited beds.

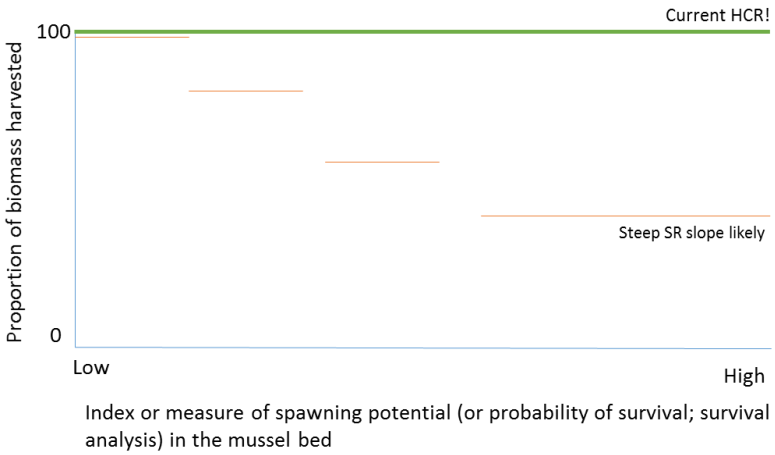

Figure 4. Conceptual harvest control rule based on index of spawning potential in a mussel bed.

2.4 Fisheries control approach

2.4.1 Possible limitations

- Catch and effort data is routinely provided by industry members, however due to the nature of the fishery (allocated fishing opportunities versus outtake, difficulty assessing onboard quantities during inspection) control inspections are reduced as a control priority for the SFPA at this time.
- During control inspections it is difficult to ascertain the amount of seed onboard due to a lack of an accurate method of determining the amount of seed dredged and retained onboard a vessel, due to the waste which is also captured in dredge operations.
- The 'black box' system has not been subject to investment in recent years as the VMS system required by statute is now capable of providing the level of positional accuracy that will be required to monitor the fishery at an acceptable cost.

2.4.2 Possible revisions

- While hold markings may afford a basic estimation to operators which can be used to provide an estimate for the catch onboard in order to report outtake and to complete log sheet records, methods to assess seed to spoil quantities onboard such as Remote Electronic Monitoring (REM) and catch sampling plans may be investigated in future.
- The SFPA intends to improve the fine scale monitoring of the fishery by the transition to a GSM (Global System for Mobile communication) based VMS system in 2019 which will be capable of providing positional data at 5 minutes intervals or less if required. It is further intended that vessels <12m LOA (overall length) will be similarly aligned with the larger operators and provided with accurate reporting technologies to provide positional reporting and catch returns to the SFPA (via Fisheries Monitoring Centre or equivalent monitoring solution).
- It is possible that REM solutions to ensure accurate recording of the seed outtake and subsequent landings may be considered and could include the placing of load sensors on individual dredges or the monitoring of catch during discharge from the vessel, but this needs to be investigated further to find the right technical solutions to the issues outlined.
- Further measures that may be required include restrictions on fishing activity, restricting vessels to fishing areas based on their respective allocation allowance and restricting fishing to single area operations only.
- While additional control oversight of these vessels can be provided through the increased staffing in ports such as Howth and Dunmore East in 2019, a decision on any new management measures for the fleet must be coupled with a review of the control priorities and thus inform future control measures.

PART 3 - Monitoring and research

3.0 Introduction

A number of monitoring and research programmes are ongoing or planned that will provide evidence as to the sustainability of the current, or any revision of, the harvest strategy.

3.1 Existing programmes

Existing monitoring and research programmes can support any revised harvest control rules described above. BIM, Marine Institute, Aberystwyth and Bangor Universities are involved in the following research through the Ireland Wales Interreg project BLUEFISH:

- Mapping of mussel beds throughout the Irish Sea (intertidal and subtidal).
- Predictive modelling (3D particle track) of mussel larval dispersal, this is supported by larval monitoring and drogue studies undertaken as part of the BIM work programme.
- Identification and assessment of site specific environmental parameters, (anthropogenic and biological) that might influence mussel reproductive and seed performance at relay sites.
- Genetic studies to see relatedness of mussel populations (larvae and adults) - relatedness of stocks to spat - pre and post settlement.
- Genetic relatedness within mussel population(s) to inform climate change management strategy. This will be achieved by determining levels of genetic biodiversity and reproductive capacity in mussel populations in the Irish Sea region, to establish geographical scales of local population identity, interconnection among these populations and their fecundity. Determine genetic relatedness between local populations and spat collection areas, plus an assessment of potential pre- and post-settlement genetic selection that may change under predicted climate scenarios.
- Survey methodology and data analysis should be reviewed by relevant experts to determine the scope to provide quantitative biomass estimates for all mussel seed beds prior to harvest.

3.2 Proposed new programmes

- Characteristics of mussel seed bed - Information on the biological characteristics of mussel seed beds in order to develop a spawning potential index and to assess the stability of seed beds can be developed using enhanced surveys.
- Monitoring and assessment of seed relays.
- Monitoring of post relay survival and growth in relation to site characteristics and husbandry.
- For conversion ratio monitoring - Improvement in conversion ratios, rather than the total biomass of seed fished, is the key to increasing mussel production for the market. Even small percentage increases in seed survival following relay could have dramatic effects on production.
- Structured empirical field experiments that investigate the causes of mortality from fishing seed to production for market should be designed and resourced. Best practice guidelines would then be produced and adopted. Future allocation rules could be linked to conversion ratios in order to make best use of the natural seed resource.

Please now give us your feedback on the issues discussed above in the companion Submission Document.