Bangor Mussel Producers Association

Code of Good Practice for mussel seed movements

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1. BACKGROUND AND INTRODUCTION TO THE CODE

i. The threat posed by Invasive Non-Native Species

It is widely accepted that one of the greatest threats to biodiversity across the globe is that posed by Invasive Non-Native Species. Globally, the introduction of organisms through human mediated dispersal into regions where they did not previously exist has resulted in significant ecological, economic and social consequences. The GB Invasive Non-Native Species Framework Strategy, launched in May 2008, provides a strategic framework within which the actions of government departments, their related bodies and key stakeholders can be better co-ordinated. The overall aim of the strategy is to minimise the risks posed, and reduce the negative impacts caused, by Invasive Non-Native Species in Great Britain, with an emphasis placed on prevention.

ii. Potential for mussel fisheries to contribute to the spread Invasive Non-Native Species

The seabed lay mussel fisheries operating in the Menai Strait are the largest in the UK and account for at least half of the entire UK output. The fisheries are entirely dependant on the import of 'seed' mussels from outside of the Fishery Order areas within which they operate. Seed mussels are fished and then re-laid onto leased plots within Fishery Orders in the Menai Strait, where they are cultured until they reach marketable size, at which stage they are lifted and sold. Seed mussel used in the Menai Strait is sourced most commonly from Caernarfon Bar and Morecambe Bay. In the past, supply has also been supplemented by seed mussels from south Wales (inside and outside of the Burry Inlet), the Thames estuary, the Wash, the south coast of England, Solway Firth, Dornoch Firth, Northern Ireland and the Republic of Ireland.

The import of large quantities of mussel seed into the Menai Strait from other areas around the UK has an associated risk of accidentally introducing Invasive Non-Native Species, not currently occurring in North Wales, with the mussels (either in the mussel seed, substrate or surrounding water). Until 1992, this risk was assessed under the Molluscan Shellfish (Control of Deposit) Order 1965 (amended 1974 & 1983), which was designed to control the introduction and spread of named shellfish pests and diseases in England and Wales. Decisions on whether or not to issue licences under this Order were carried out on the basis of known or believed incidences of diseases or pest species in the source areas. Though never formally revoked, this legislation was superseded in Great Britain by the Fish Health Regulations 1992 (amended 1997), which control fish and shellfish diseases, but contain no measures to control the spread of shellfish pests. The Welsh Assembly Government are currently investigating the re-introduction of consents under the Molluscan Shellfish (Control of Deposit) Order, such that the risk of accidentally introducing Invasive Non-Native Species amongst the mussels would be formally addressed through this licencing regime.

iii. The need for a Code of Good Practice for mussel fisheries in the Menai Strait

In the absence of current formal procedures, it was agreed in May 2007 by an inter-agency group, comprised of the Menai Strait mussel fishing sector, the Sea Fish Industry Authority (Seafish), the Countryside Council for Wales (CCW), the North Western and North Wales Sea Fisheries Committee (NW&NWSFC), the Welsh

Assembly Government (WAG), the Marine and Fisheries Agency (M&FA), the Centre for Environment, Fisheries & Aquaculture Science (CEFAS) and the GB Non-Native Species Secretariat (NNSS), that a Code of Good Practice relating to sourcing mussel seed and importing it into the Menai Strait should be drawn up. The objective of this Code is to develop a working protocol that will enable the shellfish industry to safely continue the practice of importing mussel seed from areas outside the Menai Strait in 2008, without contributing to the spread of Invasive Non-Native Species. The industry have pledged to strictly abide by the Code, as specified within a Memorandum of Understanding between the Menai Strait mussel fishing sector, the NW&NWSFC and CCW, a copy of which is provided in Appendix A.

iv. General approach in the Code and longer term options

This Code takes a semi-quantitative approach to assess the risk associated with the import of mussel seed, in order to ensure that the issue has been adequately addressed prior to the commencement of the 2008 seed fishing season and imports into the Menai Strait fisheries commence.

The protocol within this first draft of the Code of Good Practice is simple in form and draws upon the HACCP (Hazard Analysis and Critical Control Point) approach, which has been used to assess levels of risk associated with aquaculture operations elsewhere in the world, to prevent the spread of Invasive Non-Native Species. The HACCP approach to risk analysis and management is science based, systematic and recognized worldwide as an effective hazard control system. It identifies specific hazards and measures for their control, thus allowing regulators to assess what happens in various (aquaculture) operations and evaluate how potential hazards are being handled. The emphasis of this approach is on understanding the whole process and as such requires regulators and industry to communicate closely with each other. Hence CCW and the Menai Strait mussel fishing sector have worked in partnership to produce this Code, with input from other relevant organisations.

In the longer term it is recommended that a more quantitative risk assessment of the practices of the mussel industry is undertaken, further developing the ideas within this Code, using the HACCP approach and following guidance produced by Defra, whilst being informed by work currently underway within the UK and elsewhere in the world, to address the problems caused by Invasive Non-Native Species. CCW has commissioned a separate report to investigate these longer-term options.

2. THE CODE

i. Code protocol

The Code breaks down the various stages and operations involved in the sourcing, fishing and relaying of mussel seed and evaluates how potential hazards will be handled at each stage of the entire process. Further information on these operations is provided in Appendix B.

The principles of zonation incorporated into the Molluscan Shellfish (Control of Deposits) legislation are built into the Code, whilst acknowledging that the information on the known or believed incidences of pest species in the source areas has changed significantly since licences were last issued under this legislation. The development of this Code has therefore also been influenced by the approach taken by

the Department of Communications, Marine and Natural Resources in the Republic of Ireland to movements of seed mussels[1]. Although this protocol, introduced in 2006, addresses the risks associated with introducing the slipper limpet *Crepidula fornicata*, the general format has a wider application to other Invasive Non-Native Species and so has been adopted here.

The Code of Good Practice will be applicable to **both ship borne and road movements** of mussel seed into the Menai Strait, and will be in addition to any other regulations currently in force.

ii. Named species covered by the Code

A study undertaken by the Marine Biological Association for CCW identified eight Invasive Non-Native Species (INNS) with the potential to become present in mussel seed areas, either in the mussel seed, substrate or surrounding water and as such, with the potential to be transported into North Wales with seed. The eight INNS identified are as follows;

Violet sea squirt *Botrylloides violaceus*
Carpet sea squirt *Didemnum vexillum*
Solitary sea squirt *Corella eumyota*
Slipper limpet *Crepidula fornicata*
American jack knife clam *Ensis americanus*
Chinese mitten crab *Eriocheir sinensis*
Veined rapa whelk *Rapana venosa*
Wakame *Undaria pinnatifida*

The likelihood that an area dredged for mussel seed (including mussel seed, substrate and surrounding water) would contain any of these INNS depends on the prevalence of the species in the seed collection area (concentration) and whether the pest is evenly distributed throughout the area. In addition, the time of year of harvesting may play an important role in whether they are present in the dredged area. As such, these factors are all taken into account by incorporating certain species specific measures into the Code, as detailed in Appendix C, where a summary of information on these eight INNS is provided. More detailed information on the eight INNS is available in the CCW report of the contract[2]. A series of 'Pest identification cards' for these species has also been produced, which include a summary of relevant information. These identification cards will be produced in a format which can be carried onboard vessels engaged for fishing for mussel seed and are an integral part of the Code.

There may be other INNS with the potential to become present in mussel seed areas and the Code may need to be adapted, as understanding of these species improves, if the use of the Code is to persist in the longer-term. However, it is considered that by taking a precautionary approach to these eight species (the inclusion of some of which are precautionary in themselves), and by including measures within the Code to be

[1] Department of Communication, Marine & Natural Resources (Irish Republic) 2006., Procedures in relation to mussel seed movements from within the EU

[2] Sewell J., Pearce S., Bishop J. and Evans J.L. (2008). Investigations to determine the potential risk for certain non-native species to be introduced to North Wales with mussel seed dredged from wild seed beds. CCW Policy Research Report No. 06/3 pp82.

vigilant for unfamiliar species amongst the mussel seed, the risks of inadvertently introducing INNS via mussel operations in 2008 are significantly reduced, such that CCW are content for imports of mussels into the Menai Strait to continue.

iii. Zones in the Code

The Code will incorporate 3 zones:-

Red zone: **0-10 km** from known and verified populations of Invasive Non-Native Species (INNS). Movements of seed mussel to non-infected areas can only be allowed if there is no risk that INNS will be present in the mussels, substrate or surrounding water; or an independent survey has confirmed the absence of INNS[3]. Movement of mussel is permitted between infected areas.

Amber zone: **10 – 50 km** from known and verified populations of INNS. Movement of seed mussel allowed to non-infected areas can only be allowed if there is no risk that INNS will be present in the mussels, substrate or surrounding water; or an independent survey has confirmed the absence of INNS. Movement of mussel is permitted between infected areas.

Green Zone: **50km +** from known and verified populations of INNS. Movement of seed mussel is permitted to all areas.

For any imports of mussel seed approved under the above framework, further additional precautionary measures are to be undertaken, detailed in section v below.

iv. Vessel movements

Prior to movement of vessels from red to green zones, they will be thoroughly cleaned and denuded of any living organism. Fishing gear (mussel dredges) will also be cleaned of any organic material**.** Should the vessel be carrying ballast water, this will be replaced before entry into a green zone.

v. Additional precautionary measures

All mussel boats engaged in fishing for seed for relaying in the Menai Strait will carry onboard identification cards for the eight named Invasive Non-Native Species. Mussel operators will ensure that the crews of their boats are familiar with this information, such that vigilance for these and other 'abnormal' species is maintained during all fishing operations. If fishing for mussel seed occurs at night, floodlights will be used to illuminate working decks to ensure that this measure can be properly followed. If Invasive Non-Native Species are discovered amongst seed when prospecting or harvesting, seed is **not** to be brought to the Menai Strait for relaying and the reporting instructions on the pest identification cards should be followed.

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[3] The details of any surveys, including details of methodology will have to be agreed, in advance by CCW to ensure that they are sufficiently thorough and comprehensive to detect Invasive Non-Native Species at various stages of their lifecycle (i.e. possibly including larval stages, which would require microscopic examination).

vi. Schematic of Code of Good Practice

The procedures and measures detailed in sections i to v above have been summarised into a schematic flow diagram, designed to be printed on A4, laminated and carried onboard vessels engaged in fishing for mussels. This 'quick reference' version of the Code is provided in Appendix D.

vii. Monitoring of mussel lays

The industry (with contribution where possible from CCW and the NWNWSFC) will monitor mussel lays in the Menai Strait, post movement, for indications of any of the eight Invasive Non-Native Species (or other unfamiliar species). Eradication procedures will be followed immediately if an Invasive Non-Native Species is discovered in mussel lays.

viii. Eradication procedures

Whilst this Code is intended to prevent the accidental introduction of Invasive Non-Native Species not currently occurring in North Wales, eradication measures have been developed in the event that an Invasive Non-Native Species is discovered in mussel lays. Details of these measures are provided in Appendix E.

Appendix A Memorandum of Understanding between BMPA, NWNWSFC and CCW.

MEMORANDUM OF UNDERSTANDING (MoU) BETWEEN BANGOR MUSSEL PRODUCERS ASSOCIATION (BMPA), NORTH WESTERN AND NORTH WALES SEA FISHERIES COMMITTEE (NWNWSFC) AND COUNTRYSIDE COUNCIL FOR WALES (CCW)

1. **Purpose of MoU**

   This MoU is agreed between the Bangor Mussel Producers Association (BMPA), the North Western and North Wales Sea Fisheries Committee (NWNWSFC) and the Countryside Council for Wales (CCW). It outlines the status of the Code of Good Practice for mussel seed movements[2]. The purpose of the Code and the common desire between the BMPA, NWNWSFC and CCW is to prevent the accidental introduction of marine invasive non-native species into the commercial mussel fishery areas in the Menai Strait, North Wales.

2. **Status**

   This MoU is an agreement between BMPA, NWNWSFC and CCW. It sets out the status of the Code of Good Practice in relation to the importation of seed mussels into the commercial fisheries in the Menai Strait.

3. **Context of the MoU**

   This MoU recognises that the BMPA, the NWNWSFC and the CCW wish to prevent the accidental introduction of invasive non-native species into the Menai Strait with mussel seed imports. The MoU recognises that the mussel fisheries operating in the Menai Strait are dependent on the import of mussel seed in order to continue to operate.

   The CCW is an Assembly Government Sponsored Public Body, established by statute and charged with advising the Assembly Government and, for some purposes, the UK Government, on sustaining natural beauty, wildlife and the opportunity for outdoor enjoyment throughout Wales and its inshore waters.

   The NWNWSFC is the parliamentary agency having a duty to sustainably manage sea fisheries within its District. The NWNWSFC District extends from Cumbria to Ceredigion and to 6 miles from the shore.

   The BMPA is an association which is currently composed of the 4 mussel mariculture companies that operate within the boundaries of the 1962 Menai Strait East Fishery Order; Deepdock Ltd, Extra mussels Ltd, Myti Mussels Ltd and Ogwen Mussel Ltd.

[2] BMPA & CCW (2008) Bangor Mussel Producers Association Code of Good Practice for mussel seed movements. Version I, July 2008.

4. Key Principles

The BMPA have pledged to strictly abide by the Code for both ship borne and road movements of mussels into the Menai Strait.

CCW agrees that provided that the Code of Practice is adhered to, it does not object to the continued importation of mussel seed into the commercial fisheries in the Menai Strait.

The NWNWSFC agrees that operators relaying mussel seed in the Menai Strait should comply with the agreed code of good practice.

5. Signatures

5.1 Bangor Mussel Producers Association

……..……..……...Director, Deepdock Ltd

……Director, Extra Mussels Ltd

…….Director, Myti Mussels Ltd

……..…….Director, Ogwen Mussel Ltd

5.2 North Western and North Wales Sea Fisheries Committee

…….……Chief Executive

5.3 Countryside Council for Wales

……..…….Regional Manager, North

Appendix B Overview of mussel seed collection procedures.

General early life history of mussels

Mussels are either male or female (not hermaphrodites). Reproduction occurs through broadcast spawning, whereby eggs and sperm are released by the animals almost simultaneously into the wider environment where fertilisation takes place. Spawning can occur once or twice a year and depending on their condition, the mature fertilized eggs will relatively quickly develop into small, planktonic larvae that can remain in the water column for up to 90 days. Although free swimming to an extent, this is limited largely to vertical migration. Whilst planktonic, the larvae are distributed largely by the action of tides, currents and prevailing wind directions. At the appropriate time, the juvenile larvae (spat) undergo metamorphosis and drop out of the water column and attach to suitable substrate as recognisably small mussels (the 'seed'). This process can occur when the seed mussels are no more than 400-600 microns in size (approximately half a millimetre).

Locating mussel seed resources

Research, historical behaviour, working experience and developing sonar technology has enabled a greater in-depth understanding of potential and likely locations that may provide suitable conditions for an accumulation of mussel seed. Given the described extensive environmental factors that can influence the distribution of the mussel larvae whilst in the plankton, settlement is by no means certain to occur on an annual or even bi-annual basis.

Areas where seed beds have occurred with regularity in the past are checked. In intertidal locations, checking takes place visually, either on foot or using a helicopter in the case of the South America Skear in Morecambe Bay. In subtidal areas such as Caernarfon Bar, checking takes place remotely, utilising ground discrimination sonar and underwater cameras. Initial surveys of these locations will normally take place in early spring, with follow up surveys occurring monthly, to determine either the development of any settlement in terms of its fishability, or to see whether a more recent settlement has occurred.

During times of survey, Local Fisheries managers (Sea Fisheries Committees) are kept informed of the status of seed beds and general environmental conditions. Where seed beds are located within, or adjacent to, the boundaries of European Marine Sites (Special Areas of Conservation and Special Protection Areas), relevant Statutory Conservation Agencies (e.g. Countryside Council for Wales and Natural England) are informed.

Seed beds that are open for exploitation are all ephemeral, hence, if left the resource of seed would not persist and develop into a bed of fully grown mussels. Environmental factors such as exposure to prevailing autumnal gales, excessive current speeds or heavy predation will undermine the integrity of the seed bed and lead to wide scale dispersal and an expiration of the resource.

Application for authorisation to fish

On locating and identification of a seed bed by the Industry, the appropriate Sea Fisheries Committee (SFC) will immediately be informed. If the seed bed lies within,

or adjacent to the boundaries of a European Marine Site (EMS), such as in Morecambe Bay or Carmarthen Bay, the Statutory Conservation Agency will also be informed. A 'Test of Likely Significant Effect', possibly leading to an Appropriate Assessment is undertaken of the likely impact of the activity of fishing the seed bed (licenced through SFC and Marine & Fisheries Agency licences and authorisations) on the features of the EMS. Fishing for seed can only proceed if the activity is not deemed to have a likely significant adverse effect on the features of the EMS.

The timeline between application and receipt of an SFC authorisation to fish normally lies within a 28 day period.

Seed movement

Seed is moved in one of two ways, mainly by vessel and occasionally by road. Vessel movement is preferred for a number of reasons, it is rapid, the animals are more likely to be in a less stressed state and the environmental condition of the animals can be controlled to a higher degree. The vessel moving the seed in these situations is also the catching and relaying vessel.

Road transport has been utilised in the past, for example when either weather conditions or distance to relay site have made vessel movements difficult. Seed movement by road also occurs when the seed mussel has been bought from a third party.

In both incidences, the origin of the seed is easily determined and risks associated with any populations of invasive non-native species can be established prior to any relaying of seed occurring.

Seed Relay

In all cases, mussel seed will be re-laid by vessel, at controlled densities inside of the defined boundaries of leased ground. In the case of seed imported into the Fishery Order, initial relay will ideally be to an intertidal location, allowing the animal to develop certain physiological behavioural responses that might not otherwise occur if re-laid directly into subtidal. Post relay, intertidal beds are extensively monitored on a monthly basis, during low water spring tide. This will allow for early detections of any unusual mortality or occurrence of unwanted (including INNS) species to occur and allow for early use of remedial measures to reduce additional development of heightened risk.

Seed mussel that has over-wintered inside the boundaries of the Fishery Order will, in some cases, be moved to a subtidal location to complete grow out. Again during this process vigilance will be maintained by vessel crew for any INNS.

Appendix C Summary of information on the eight invasive non-native species specifically addressed in the Code of Good Practice.

Species	Current UK distribution	Relevant info on life cycle and preferred habitat	Species specific measures required in red, amber and green zones
Violet sea squirt *Botrylloides violaceus*	Extensive on south coast of England	Likely to inhabit low intertidal and shallow subtidal. Unlikely to inhabit areas of fully open coast. Known to grow on *Mytilus* sp. so may be present on mussel seed beds in dispersal range of existing populations. Adults are sessile, larvae only free-swimming for a few hours, so dispersal potential is low.	**Red zone**: Do not import seed from these areas to the Menai Strait, unless absence verified by independent survey. **Amber zone**: Collection permitted in this zone for import to the Menai Strait, but vigilance should be maintained in looking for this species during prospecting / fishing. If discovered in seed, reporting procedures to be followed and seed not to be brought to North Wales. **Green zone**: Collection permitted in this zone for import to the Menai Strait, but vigilance should be maintained in looking for this species during prospecting / fishing. If discovered in seed, reporting procedures to be followed and seed not to be brought to the Menai Strait.

Carpet sea squirt *Didemnum vexillum*	No confirmed records in UK but present in Malahide and Carlingford marinas in ROI	Occurs on hard substrata in the subtidal and shallow subtidal. Commonly grows on and over other sessile biota including mussels, so may be present on seed beds in dispersal range of existing populations. Adults are sessile, larvae only briefly free-swimming, so dispersal potential is low.	**Red zone**: Do not import seed from these areas to the Menai Strait, unless absence verified by independent survey. **Amber zone**: Collection permitted in this zone for import to the Menai Strait, but vigilance should be maintained in looking for this species during prospecting / fishing. If discovered in seed, reporting procedures to be followed and seed not to be brought to North Wales. **Green zone**: Collection permitted in this zone for import to the Menai Strait, but vigilance should be maintained in looking for this species during prospecting / fishing. If discovered in seed, reporting procedures to be followed and seed not to be brought to the Menai Strait.

Solitary sea squirt ***Corella eumyota***	Extensive on south coast of England, widespread around Irish coast	Likely to inhabit low intertidal and shallow subtidal. Unlikely to inhabit areas of fully open coast. Capable of growing on *Mytilus* sp. (observed growing on oysters) so may be present on mussel seed beds in dispersal range of existing populations. Adults are sessile, larvae only free-swimming for a few minutes, so dispersal potential is low.	**Red zone**: Do not import seed from these areas to the Menai Strait, unless absence verified by independent survey. **Amber zone**: Collection permitted in this zone for import to the Menai Strait, but vigilance should be maintained in looking for this species during prospecting / fishing. If discovered in seed, reporting procedures to be followed and seed not to be brought to North Wales. **Green zone**: Collection permitted in this zone for import to the Menai Strait, but vigilance should be maintained in looking for this species during prospecting / fishing. If discovered in seed, reporting procedures to be followed and seed not to be brought to the Menai Strait.

Slipper limpet *Crepidula fornicata*	Extensive in Wash, Thames region and south and south west coasts. Extensive in south Wales, as far north as Burry Inlet.	Occurs on a variety of substrates in low intertidal and shallow subtidal. Known to grow on *Mytilus* sp. so may be present on mussel seed beds in dispersal range of existing populations. Adults are benthic, larvae free-swimming for 4 to 5 weeks, so dispersal potential is high.	**Red zone**: Do not import seed from these areas to the Menai Strait. **Amber zone**: Collection may be permitted in this zone for import to the Menai Strait, if risk deemed negligible and / or absence verified by independent survey. If fishing does proceed, vigilance should be maintained in looking for this species during prospecting / fishing. If discovered in seed, reporting procedures to be followed and seed not to be brought to the Menai Strait. **Green zone**: Collection permitted in this zone for import to the Menai Strait, but vigilance should be maintained in looking for this species during prospecting / fishing. If discovered in seed, reporting procedures to be followed and seed not to be brought to the Menai Strait.

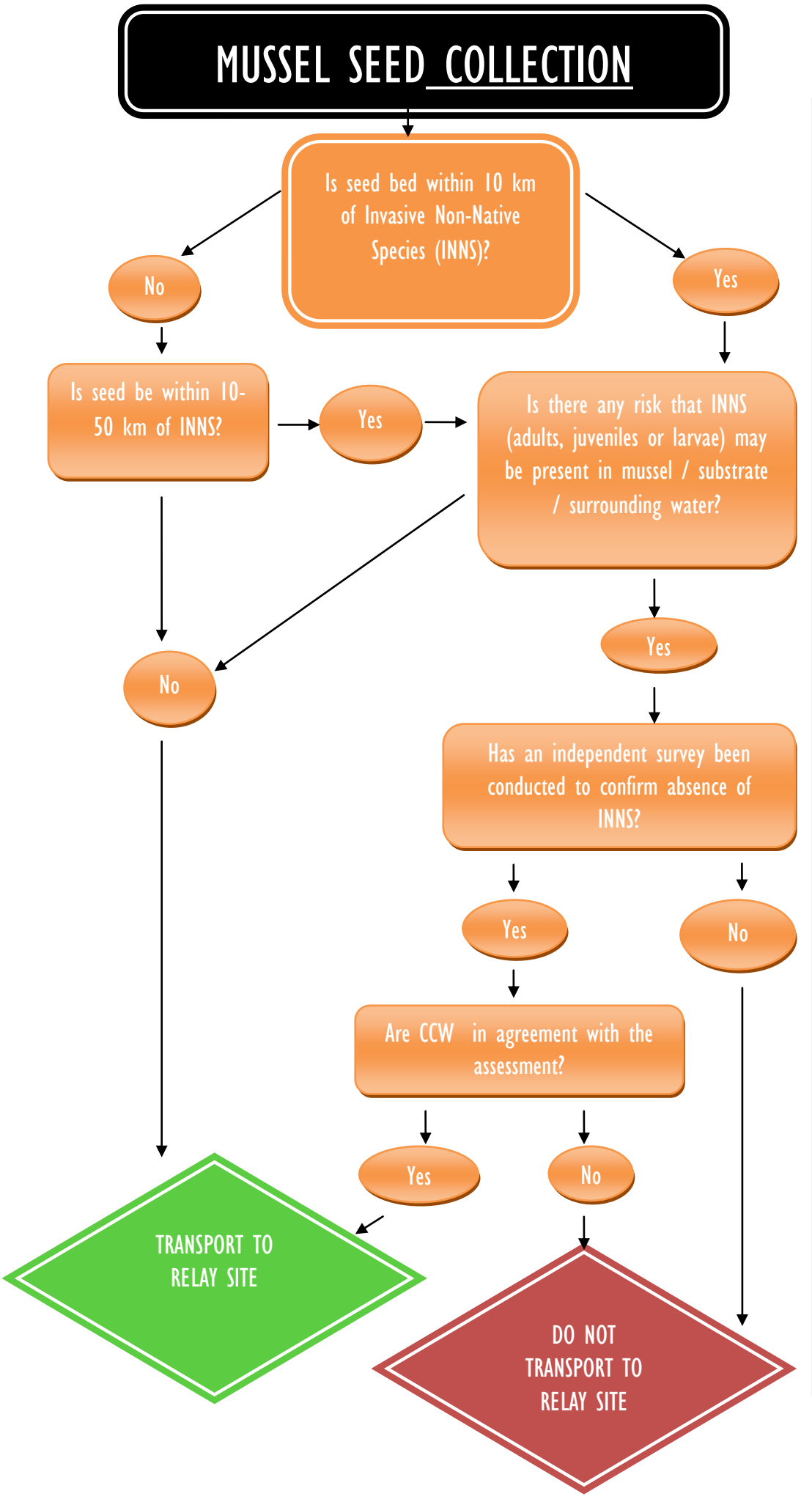
American jack knife clam *Ensis americanus*	Extensive on the east coast of England, including the Wash, Humber and Thames Estuary and in the Channel.	Occurs in intertidal and shallow subtidal sand and sandy mud flats, usually in estuaries and bays. Unlikely to be present in mussel beds. Adults are benthic, larvae free-swimming for 2 to 4 weeks, so dispersal potential is high. Larval settlement occurs over summer months.	**Red zone**: Do not import seed from these areas to the Menai Strait, unless absence verified by independent survey. **Amber zone**: Collection permitted in this zone for import to the Menai Strait, but vigilance should be maintained in looking for this species during prospecting / fishing. If discovered in seed, reporting procedures to be followed and seed not to be brought to North Wales. **Green zone**: Collection permitted in this zone for import to the Menai Strait, but vigilance should be maintained in looking for this species during prospecting / fishing. If discovered in seed, reporting procedures to be followed and seed not to be brought to the Menai Strait.

Chinese mitten crab ***Eriocheir sinensis***	The Wash, Rivers Thames, Medway, Dee and Duddon.	Adults occur in fresh or brackish water habitats, larval stage inhabits lower estuarine, saline areas. In autumn, adults migrate down rivers to the sea to reproduce. Females over-winter in deeper waters before moving back to brackish waters to hatch eggs in the spring. After settlement in the lower estuary, the juvenile crabs migrate upstream to freshwater. Adults are benthic, larvae free-swimming for several weeks, so dispersal potential is high.	**Red zone**: Collection permitted in this zone for import to the Menai Strait, at times of the year when larvae, juveniles and adults are not in the marine environment. **Amber zone**: Collection permitted in this zone for import to the Menai Strait, at times of the year when larvae, juveniles and adults are not in the marine environment. **Green zone**: Collection permitted in this zone for import to the Menai Strait, but vigilance should be maintained in looking for this species during prospecting / fishing. If discovered in seed, reporting procedures to be followed and seed not to be brought to the Menai Strait.

Veined rapa whelk ***Rapana venosa***	Found in North Sea not yet established in UK waters	Occurs on hard sand, muddy sand and hard substrata with attached bivalves. Likely to be attracted to mussel beds, as a food source, so may be present on mussel seed beds in dispersal range of existing populations. Eggs are laid attached to hard surfaces. Adults are benthic, larvae free-swimming for 3 to 6 weeks, so dispersal potential is high.	**Red zone**: Do not import seed from these areas to the Menai Strait, unless absence verified by independent survey. **Amber zone**: Collection may be permitted in this zone for import to the Menai Strait, if absence verified by independent survey. If fishing does proceed, vigilance should be maintained in looking for this species during prospecting / fishing. If discovered in seed, reporting procedures to be followed and seed not to be brought to the Menai Strait. **Green zone**: Collection permitted in this zone for import to the Menai Strait, but vigilance should be maintained in looking for this species during prospecting / fishing. If discovered in seed, reporting procedures to be followed and seed not to be brought to the Menai Strait.

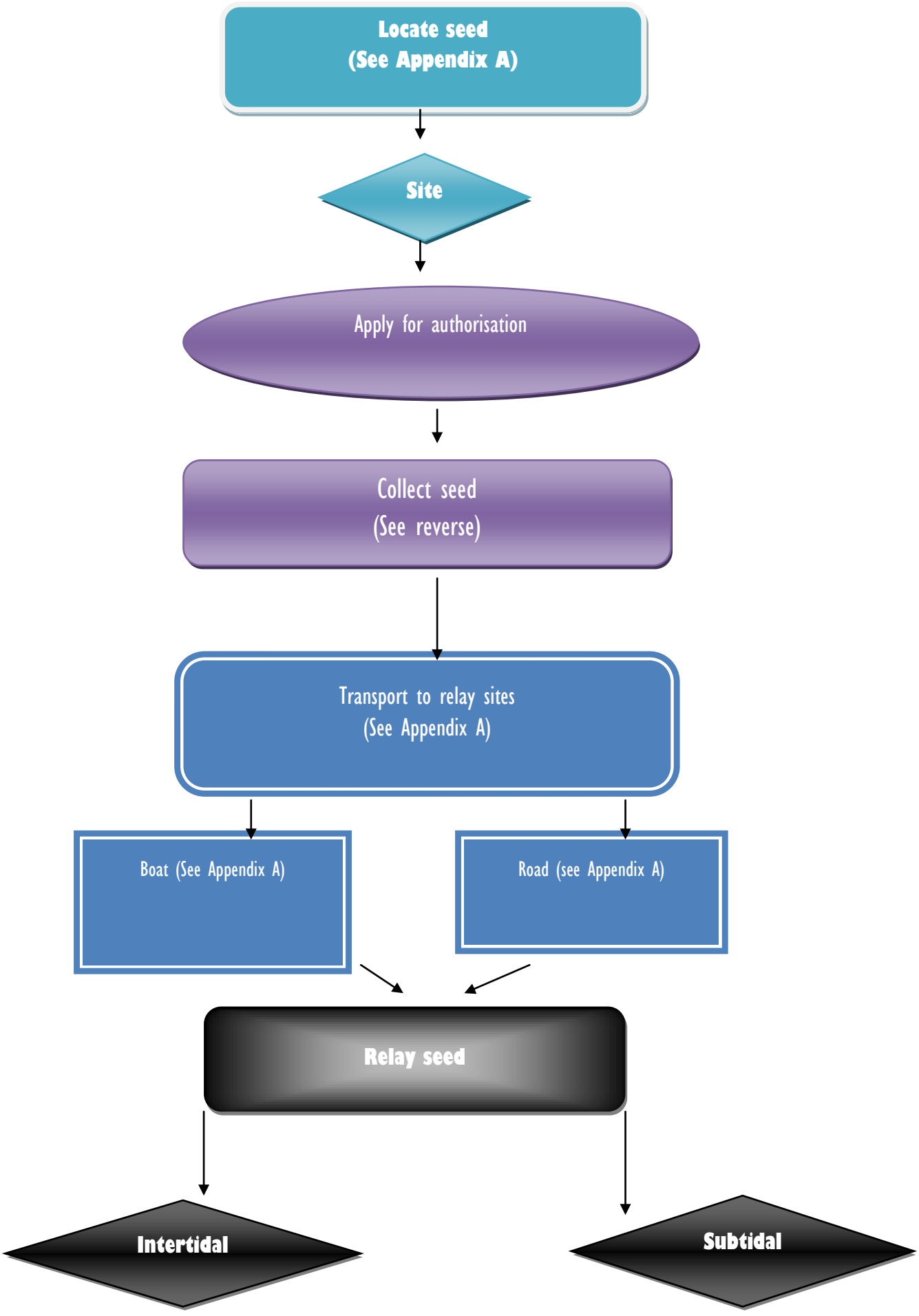
Wakame ***Undaria pinnatifida***	Extensive on south and south west coasts	Occurs on a range of hard substrata, ranging from stable rocky reefs to mobile cobble habitats. In soft habitats it grows on bivalve shells, invertebrates and epiphytically on other seaweeds. Spores may settle on mussel beds throughout the year, in dispersal range of existing populations. Spores are released in late spring / early summer and germinate at 20^0C, so dispersal potential is high.	**Red zone**: Do not import seed from these areas to the Menai Strait, unless absence verified by independent survey. **Amber zone**: Collection may be permitted in this zone for import to the Menai Strait, if absence verified by independent survey. If fishing does proceed, vigilance should be maintained in looking for this species during prospecting / fishing. If discovered in seed, reporting procedures to be followed and seed not to be brought to the Menai Strait. **Green zone**: Collection permitted in this zone for import to the Menai Strait, but vigilance should be maintained in looking for this species during prospecting / fishing. If discovered in seed, reporting procedures to be followed and seed not to be brought to the Menai Strait.

Appendix D Schematic of Code of Good Practice for mussel imports into the Menai Strait.



ADDITIONAL PRECAUTIONARY MEASURES

- Maintain vigilance at all times
- Use of floodlights during night fishing to allow effective visual inspection
- Ensure no hull fouling
- Ensure any ballast water is exchanged in appropriate locations


Locate seed
(See Appendix A)
Site
Apply for authorisation
Collect seed
(See reverse)
Transport to relay sites
(See Appendix A)
Boat (See Appendix A)
Road (see Appendix A)
Relay seed
Intertidal
Subtidal

Appendix E Eradication measures for removing invasive non-native species from mussel lays.

These eradication measures were developed under contract by the Bangor Mussel Producers Association (BMPA) and are informed by methods used during the 2007 programme to eradicate slipper limpet from the mussel lays in the eastern Menai Strait. Whilst these procedures focus on the slipper limpet, it is considered that they are generally applicable to most Invasive Non-Native Species (INNS).

1. Standard Operating Procedure: removal and eradication of slipper limpet *Crepidula fornicata* from mussel lays

In the event that slipper limpets are found on the BMPA's mussel lays during the routine monitoring program the following removal and eradication measures are triggered.

1.1 Slipper limpet control methods

The introduction of the slipper limpet *Crepidula fornicata* in the late 19th century to native oyster beds in Essex and along the south coast of England was very rapidly considered to be a threat to the oyster industry[4, 5]. The majority of control methods described in the literature is related to oyster beds and not specifically to mussel bottom culture sites. Earliest attempts to eradicate or control slipper limpets focused on their removal and included dredging and dumping above the high water mark and hand removal of individuals with the offer of a 'bounty' as encouragement[6]. Most recently, in efforts to control high density infestations in France, removal by suction dredges has been employed with varying success.

Other methods of control focused on killing the slipper limpets. A method of treating relatively small quantities of shellfish and oyster 'cultch' with hypersaline solutions are reported to be effective in controlling newly settled slipper limpets[7]. This method is currently being investigated by a Seafish Industry Authority funded project although it is difficult to envisage such a method being applicable to a very large amount of material such as required in this case.

The use of chain riddles has been routinely used on the Kent and Essex oyster beds to physically damage break up the slipper chains but this disturbance may actually act as a dispersal vector compounding the problem.

The practice of smothering slipper limpets by relaying clutch or by ploughing is reported to be effective as the slipper limpets are unable to unbury themselves[6, 8].

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[4] Dodd (1893) in Orton J.H. (1912). An account of the natural history of the slipper-limpet (*Crepidula fornicata*), with some remarks on its occurrence on the oyster grounds of the Essex coast. *Journal of the Marine Biological Association of the United Kingdom*, 9, 437-443.

[5] Crouch W. (1893). On the occurrence of Crepidula fornicata in Essex. *Proceedings of the Malacological Society*, 1, 19.

[6] Hancock D.A. (1969). Oyster pests and their control. Burnham on Crouch, Ministry of Agriculture Fisheries and Food. Laboratory Leaflet (New Series), No. 19.

[7] Franklin A. (1974). The destruction of the oyster pest Crepidula fornicata by brine-dipping. *Technical Report No 8*, Fisheries Laboratory, Ministry of Agriculture Fisheries and Food, Lowestoft.

[8] Korringa P. (1952). Recent advances in Oyster Biology (concluded). *Quarterly Review of Biology*, 27, 339-365.

Slipper limpets are primarily suspension feeders relying on food particles from the water column and although capable of clearing their feeding structures[9] it is unlikely that if completely smothered that they would be able to feed effectively. In addition, adult slipper limpets are sedentary and are unable to either burrow or reposition themselves once buried.

During the winter of 2006/7 slipper limpets were discovered on mussel lays in the Menai Strait. These mussels had been sourced from a site in the English Channel which was contaminated with slipper limpets. A series of measures were implemented to attempt to remove slipper limpets from the site; firstly the affected lay was dredged to remove as much of the mussels and associated material as was practicable, and; secondly mussels sourced from a slipper limpet clear area were relayed densely over the area in order to smother any remaining slipper limpets.

Subsequent joint agency (Countryside Council for Wales (CCW), North Wales & North Western Sea Fisheries Committee (NW&NWSFC) monitoring surveys have recorded two dead shells and no live slipper limpets (pers. com. Bill Cook NW&NWSFC).

In the absence of any viable alternative technique and in respect to its recent success, it is recommended that the **removal and smothering** approach is adopted as an appropriate response to any future inadvertent introduction of slipper limpets (or other Invasive Non-Native Species) into the mussels lays operated by BMPA members.

1.2 Step-By-Step Instructions for Removal of Slipper Limpets

These procedures are to be instigated as soon as operationally practicable after the discovery of introduced slipper limpets on the BMPA members mussel lays.

1. The first task is to identify the source of the infested mussel seed and to determine the extent of the area into which the infested mussel seed has been laid. This area should be clearly defined as a series of positions describing its perimeter. This provides a reference and allows the targeting of resources.

2. This infested area should be repeatedly dredged until the catch per unit effort (amount of mussel per haul) is so low as to be unviable to continue.

3. The removed infested mussels should now be removed from the site and not relayed anywhere within it. If a market cannot be found for these mussels the options are either:

    - Transportation for relaying in an area already infested with slipper limpets (probably close to the source of the mussel seed), or;

    - That they are put ashore for disposal

Step-By-Step Instructions for Smothering of Residual Slipper Limpets

[9] Johnson J.K. (1972). Effect of turbidity on the rate of filtration and growth of the slipper limpet, *Crepidula fornicata*. *Veliger*, 14, 315-320.

These procedures are to be instigated as soon as operationally practicable after removal of slipper limpet infested mussels from the mussel lays.

2. A source of seed mussel should be obtained from an area agreed by CCW and NW&NWSFC.

3. This slipper limpet free seed mussel is then washed onto the affected area in high densities. It is suggested that double the usual stocking density is used e.g. if the usual stocking density is 25 tonnes per hectare, relaying should be at 50 tonnes per hectare.

Bangor Mussel Producers Association has also developed procedures for follow-up surveys on mussel lays, to monitor for the presence of slipper limpet, to ensure that eradication is thorough.