CHAPTER 4
BIOSECURITY IN NATIVE OYSTER RESTORATION

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KEY SUMMARY POINTS

- **The movement of people, equipment, materials, and oysters between locations carries with it the risk of moving harmful organisms, such as diseases and invasive non-native species.**
- **Translocation of material and oysters from one water body to another is never risk-free and should be avoided where possible.**
- **Never translocate material from a water body with an oyster disease or high impact invasive species present, to one where it is absent.**
- **Always undertake real-time assessment of the sites and oysters or cultch material, rather than assuming protocols are effective, and that existing test and survey results reflect actual status.**
- **Hatcheries producing certified oysters in disease-free areas can be used for both aquaculture or restoration purposes. Hatcheries producing uncertified oysters in disease designated areas can only be used for restoration purposes in their areas alone.**

INTRODUCTION: UNDERSTANDING THE BIOSECURITY RISKS

The "European Guidelines on Biosecurity In Native Oyster Restoration" published by the Native Oyster Network and NORA seeks to outline the suite of considerations associated with translocation. This section is a summary of the most salient points. For further detail visit the Native Oyster Network – UK & Ireland or NORA websites to download the full guidance.

Disease is a major threat to native oysters both in aquaculture and in the wild. In particular the haplosporidian *Bonamia ostreae*, which causes the disease bonamiosis, is still expanding its range in Europe and can cause up to 90% mortality when it arrives in a population. Similarly, invasive non-native species (INNS) are considered a key threat to biodiversity throughout European waters. Vectors include shipping and recreational boating, but a major cause has been shellfish movements. The presence or introduction of a disease or INNS species may negatively impact the conservation objectives for protected species and habitats. They also pose a threat to the success of native oyster restoration through; competition for food and space, predation, by being pest species, negatively impacting the biodiversity associated with healthy biogenic habitat, and reputational damage.

Native oyster restoration methods currently in practice include the translocation of cultch, spat attached to empty shells or pieces of shells (spat-on-shell), hatchery reared spat, or adult oysters (Chapter 3). Each of these methods carries with it the risk that species and/or pathogens are also translocated. It is important to acknowledge that the risk posed by the movement of oysters, cultch, equipment and people between sites may be significant. This need not prevent restoration activities, but it is important that restoration projects perform appropriate risk assessments of their activities with biosecurity in mind, and that protocols are developed to minimise risks where they are identified.

OYSTERS AS A VECTOR OF DISEASE AND INNS

Throughout recent history, oysters have been vectors of INNS and disease. That oysters are traded live, have complex shell structures, and may be returned to the water for further growth as opposed to being consumed on land, are all factors that have contributed to the significant number of unintentional translocations attributed to movement of commercial oyster species. To give some idea of the potential for oysters to be a vector of unintended species introduction, the European presence of more than sixty species native to the Pacific Northwest, can be attributed to movements of the Pacific oyster since the 1960's.

While most introduced species do not result in significant harm in their introduced range, a number of species associated with historical translocations of oysters have resulted in serious impacts for oysters and for the wider marine community. For example, the American slipper limpet (*Crepidula fornicata*), American oyster drill (*Urosalpinx cinerea*) and oyster pathogen (*Bonamia ostreae*) (see Figure 4.1), all entered European waters via shipments of oysters from outside Europe. *Bonamia ostreae*, as an example, has since spread to numerous locations throughout European waters, with devastating consequences for native oyster habitats and commercial producers. Whilst movement of shellfish is not the only vector of disease and INNS, projects to restore native oyster populations need to adopt rigorous biosecurity protocols in order to avoid an action with an intended positive ecological benefit, resulting in a negative impact.

WHICH DISEASES AND INNS POSE A RISK IN NATIVE OYSTER RESTORATION?

There have been few successful eradication attempts for marine non-native species or diseases in open waters. Therefore, the only reliable method of control is to prevent their introduction. There is no way to predict which species will become problematic in an introduced range. That said, there are certain attributes related to both the life history of the species and the condition of the receiving site which can indicate the likelihood of species becoming problematic, and invasion history from other locations can also be a useful indicator. Assessments of whether or not a species is likely to become invasive in a new location requires expertise. Fortunately, there are many statutory bodies throughout the UK and Europe which provide such assessments to the public (e.g. Non-Native Species Secretariat). These lists can be used to identify which species are of particular concern when considering where to source oysters or cultch material. Every introduction to a new area has the potential to become invasive. Therefore, while biosecurity protocols should prioritise the prevention of key identified problem species, they should also, under all circumstances, mandate cleaning any materials and equipment moved, to avoid accidental introductions.

BOX 4.1: INFORMATION ON THE KNOWN *OSTREA EDULIS* PATHOGENS

Several pathogenic species are of particular note in the context of native oyster restoration in Europe. These include the notifiable diseases of bivalves to the OIE and/or to the European Commission (EC) (Anonymous-a, 2018)[1] :

- Bonamiosis – *Bonamia ostreae* (OIE/EC – present in Europe)
- Bonamiosis – *Bonamia exitiosa* (OIE/EC – present in Europe)
- Marteiliosis – *Marteilia refringens* (OIE/EC – present in Europe)
- Denman Island Disease – *Mikrocytos mackini* (EC – not currently present in Europe)
- Ostreid herpesvirus infection* – Herpes virus OsHV-1-µvar (present in Europe) (notifiable in a few zones in Ireland and the UK only. While not currently listed as a susceptible host, there are reports of the virus present in *O. edulis* and as such this pathogen should also be considered as a precaution.

Although not notifiable, many other pathogenic species are known for *Ostrea edulis*, including:

- *Gyrodinium aureolum*,
- *Herrmannella duggani*,
- *Mytilicola intestinalis*,
- *Ostracoblabe implexa*,
- *Haplosporidium armoricanum*,
- *Hexamita inflata*,
- *Perkinsus mediterraneus*,
- *Pseudoklossia* (Genus of)
- *Papovaviridae* (Family of)
- *Nocardia crassostreae*
- *Vibrio* spp. (e.g. *V. alginolyticus*, *V. anguillarum*, *V. coralliilyticus*, *V. neptunius*, *V. ostreicida*, *V. tubiashi*

It is extremely important for restoration practitioners to be aware of the notifiable diseases and also that there are numerous other parasites and pathogens to which the native oyster is susceptible (Box 4.1). Some of these, such as *Marteilia refringens* and *Marteilia pararefringens* can be transmitted between the native oyster and blue mussels (*Mytilus edulis*), while OsHV-1 can be transmitted between native and Pacific oysters (*Crassostrea gigas*). It is the responsibility of the restoration practitioner to implement appropriate disease prevention and management protocols and to report any increased and unexplained mortalities to the relevant competent authority for investigation.

American slipper limpet *Crepidula fornicata*
Impact: Filter feeder that can compete with oysters and produce excessive biodeposits which can smother oysters.

American oyster drill *Urosalpinx cinerea*
Impact: Voracious predator of oysters, which can cause significant mortality, especially of juveniles.

Oyster pathogen *Bonamia ostreae*
Impact: Causes the disease bonamiosis by attacking the immune system of *Ostrea edulis* and can result in mass mortalities.

Figure 4.1: Examples of the impact of invasive non-native species (INNS) and pathogens, *Crepidula fornicata*, *Urosalpinx cinerea*, *Bonamia ostreae*, on the native oyster. Photo (left): Zoe Holbrook. Photo (middle): iNaturalist.org, Encyclopedia of Life creative commons CC BY-NC license. Photo (right): Fisheries Research.

It is difficult to avoid the risk of translocating known or potential INNS or diseases. More difficult still, is the prospect of unknown INNS and diseases. A disease may be subclinical in a population that has co-evolved with it, and therefore not apparent. Once transferred to a naive population it may cause high mortalities and disruption.

BIOSECURITY AS AN INTEGRATED PART OF RESTORATION PRACTICE

INNS and diseases can be moved between sites whenever people and equipment are moved, not only when oysters or cultch material are placed in the water. As such it is important that all people participating in oyster restoration activities, including science and monitoring, comply with standard 'Check, Clean, Disinfect, Dry' protocols (see Figure 4.2).

Check before you leave a site all equipment including wetsuits, vessel, boots, buckets etc. Remove all visible hitchhikers, sediment, and debris. If this occurs away from the site, ensure that all material is at least disposed of in a bin, not near a watercourse. Under circumstances of enhanced risk, disposal should be to a specified biological waste disposal route (possibly including incineration).

Clean all equipment including the vessel and bilge tank with freshwater. Do not let water drain back into the sea, as spores and eggs can persist for some time.

Disinfect – under circumstances of enhanced risk, a biocide/disinfectant should also be used.

Dry all equipment thoroughly, ideally in sunlight, before moving to a new marine location.

Restoration projects should make biosecurity a central theme in all activities. All activities should be subject to a biosecurity risk assessment, and protocols should be put in place for all common activities. This can also function as a useful awareness building and learning exercise if engaging the volunteers or students. Projects should apply a Precautionary Approach when planning their activities.

Stop the spread

The success and reputation of a restoration project can be negatively impacted by accidental introductions of invasive species and pathogens. Project equipment such as vans, boats and field kit can all be vectors for their transmission, which will ultimately damage the marine environment and wildlife.

CHECK

Check your equipment, clothing and boats after carrying out fieldwork for fouling material. Ensure that you remove anything that you find and dispose of it in the appropriate manner.

CLEAN

Clean all fieldwork items thoroughly with freshwater as soon as possible. Ensure that you pay attention to items such as fieldwork clothing, restoration equipment, trailer wheels and areas that are damp or hard to reach.

DIS INFECT

Disinfect – where the risks are higher, include disinfection as part of cleaning procedures.

DRY

Dry – ensure that you drain water from any water remaining on fieldwork items, and equipment such as a trailer and boat. Try to dry all equipment for as long as possible before next usage.

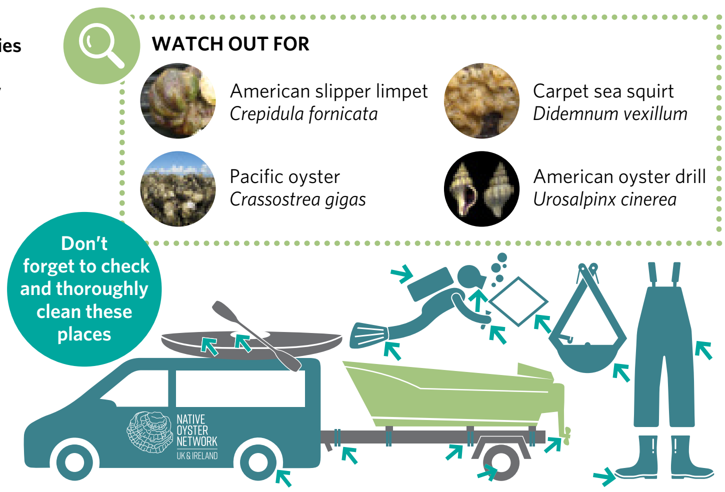

Figure 4.2: Biosecurity considerations to prevent transmission during restoration practice and fieldwork: Areas to be vigilant with when cleaning after carrying out fieldwork for oyster restoration projects: Check – Clean – Disinfect – Dry.

BOX 4.2: EXAMPLES OF INTERNATIONAL, NATIONAL, AND SUBNATIONAL RESOURCES RELATING TO BIOSECURITY

International:

Marine biosecurity has an international legislative framework: The European Union Member States, Council Directive 2006/88/EC (24/10/2006) sets out animal health requirements for aquaculture animals and products, and on the prevention and control of certain diseases in aquatic animals (https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX%3A32006L0088).

The OIE Aquatic Animal Health Code (2019) provides standards for the improvement of aquatic animal health worldwide (https://www.oie.int/en/standard-setting/aquatic-code/access-online/) and the Regulation (EU) 2016/429 ('Animal Health Law') sets rules to control transmissible animal diseases and that have broad impacts on public or animal: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32016R0429&from=EN.

National:

The Aquatic Animal Health (Scotland) Regulations 2009, AAH (England and Wales) Regulations 2009, and AAH (Northern Ireland) Regulations 2009 implement Council Directive 2006/88/EC (as amended) in the UK. NB: EU Directive 2006/88/EC will be replaced by Regulation 2016/429 from April 2021 (https://eur-lex.europa.eu/legal-content/en/TXT/?uri=CELEX:32016R0429).

Some useful advice on Marine Biosecurity Planning, INNS and marine diseases can be found at http://www.nature.scot and CEFAS http://www.cefas.co.uk.

Subnational:

On a regional level, Inshore Fisheries and Conservation Authorities or communities may produce Biosecurity Action Plans to manage shellfish (e.g. North western Inshore Fisheries and Conservation Authority Biosecurity Plan https://www.nw-ifca.gov.uk/app/uploads/NWIFCA-Biosecurity-Plan.pdf

LEGISLATIVE OBLIGATIONS

The impacts of the introduction of shellfish diseases and INNS have long been acknowledged, and international institutions have developed legislation and reporting systems to address these threats (see Box 4.2 for some examples). It is the responsibility of all restoration practitioners to ensure that they are aware of and adhere to relevant legislation on biosecurity and disease management. They should also be aware that legislation and guidance function on a variety of scales (Figure 4.3 illustrates the many levels of regulation).

Note: It is the responsibility of the restoration practitioners to seek advice from the relevant competent authorities and ensure that they meet legal requirements. Failure to do so can result in legal consequences.

GOING BEYOND LEGISLATIVE REQUIREMENTS AND 'OWNING' THE RISK

Maintaining a high level of biosecurity in restoration work is imperative both for ecological success, and to maintain a social licence for such activities. Working with stakeholders and the public to ensure that these risks are understood, should be built into project plans. For example, it is not uncommon for the public to misunderstand the biosecurity threats and believe that they are helping the ecology of the area by disposing of their own waste oyster shells directly into the wild. As such shells have clearly not been subjected to translocation protocols, they present the very real risk of accidentally introducing pests and diseases. Working with stakeholders can prevent such misunderstandings and increase engagement with projects.

Restoration practitioners should also bear in mind that most existing national policies and legislative frameworks relevant to translocations for restoration are based on risk profiles of the aquaculture industry. Restoration, however, potentially carries far higher risks because oysters are returned prematurely to the ecosystem. Given this, statutory routine monitoring may be less frequent than desired. Even with the most stringent testing and biosecurity procedures, it remains possible that a disease agent or INNS may be or become present at the restoration site where translocations have occurred (Figure 4.4). Therefore, restoration projects should take responsibility for the biosecurity of their operations and apply a greater stringency than may be legally required.

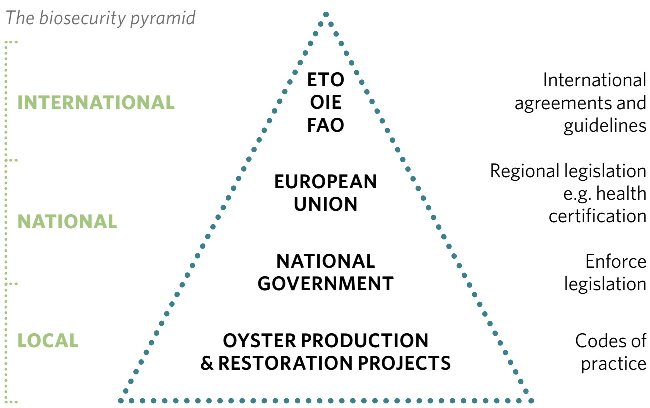

Figure 4.3: Legislation and policy regarding biosecurity function at a variety of scales, all of which projects should be aware of and seek advice on. Figure adapted from Oidtmann *et al.* (2011).

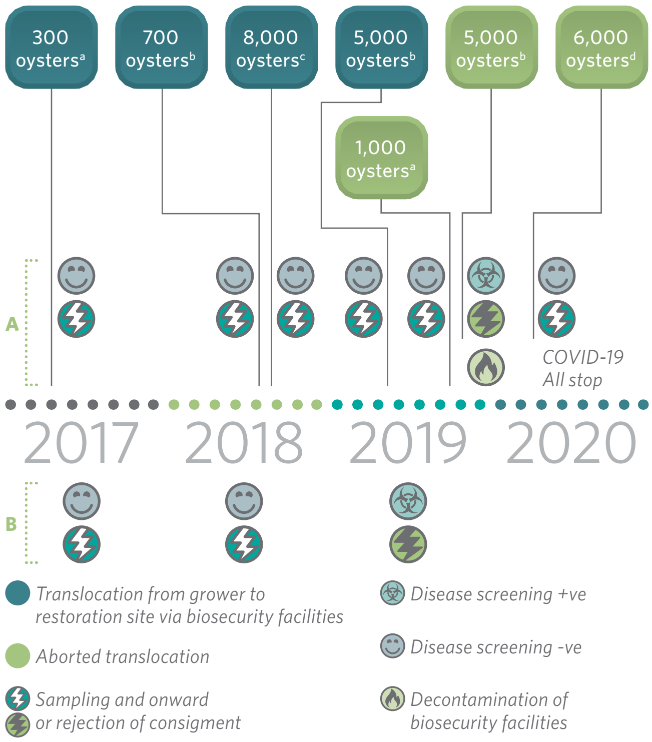

Figure 4.4: Schematic of biosecurity disease-screening activity of a restoration project based on a redacted but real case study. A = independent project-based testing of consignments translocated between oyster growers and the restoration site (via closed-circuit biosecurity holding facilities). B = project-based confirmatory testing of restoration site. All project testing (A&B) in addition to favorable (for disease) statutory government testing and accreditation of suppliers. Despite screening of all consignments, confirmatory annual screening of restoration site and rejection of consignment that tested positive for *Bonamia ostreae*, the restoration site tested positive in 2019 for said disease. Superscript letters indicate the four different suppliers.

BIOSECURITY GUIDELINES FOR NATIVE OYSTER AND CULTCH TRANSLOCATION

Introduction

Given that all translocations carry with them a risk of accidental introduction, it is important that avoiding the risk by avoiding translocations be considered in project planning. If projects decide to proceed with translocations despite the inherent risks, comprehensive protocols, and actions to mitigate and reduce the risks should be developed on the project level. It is critical that;

1. The relevant authorities (see Chapter 2, Table 2.4) are informed of all planned activities, and;
2. Projects seek advice from, and work in partnership with, the relevant authorities throughout the project.

Projects should seek to exceed the legally mandated standard. Native oyster restoration in the UK and Europe is still in its infancy and the science to support best practice protocols has not yet been fully developed. Consequently, a project's translocation protocol should be well documented with relevant data collected to demonstrate the efficacy of the protocol.

Translocating live oysters from open areas

Before deciding whether translocation of oysters or cultch is the appropriate action, it is important to weigh up the following considerations:

1. **Why risk translocation?** Consider why you want to translocate. Are there local stocks that could be used? Can the project timeline be adapted to allow for the use of hatchery reared stock or local spat collection?
2. **Are there local sources?** Identify local sources. If possible, use oysters from local sources and environments.
3. **If translocating:**
   i) Do not consider donor sites outside of the native range of the European native oyster.
   ii) Do not consider donor sites with high-risk invasive species or diseases that are not present at the receiving site.
   iii) Minimise the physical distance between the donor and recipient site.
   iv) Avoid large movements across latitudinal gradients.
4. **Physical and chemical cleaning.** If translocation is decided upon, both physical and chemical cleaning of the oysters is likely to be required.
   i. Cleaning is a time-consuming process and adequate time and manpower must be factored into the translocation plan.
   ii. The sensitivity of the young oysters may mean that many biosecurity treatments are inappropriate. In the case of spat that have spent time in the water outside the hatchery setting, hatchery reared, or locally sourced spat may be the only option.

Note: Translocation also refers to movements from hatcheries where oysters have been in contact with unsterilised seawater.

Where projects determine that translocation is the necessary approach, and the necessary resources (time, space and personnel) have been acquired to undertake translocation in a biosecure manner, the following steps should be taken.

Risk assessment

The first step in scoping appropriate donor sites should be desk based to reduce resource usage and gain a high-level overview of potential sites. The disease status of both the donor and recipient sites must be considered. Comprehensive existing OIE, EU and local regulation surrounding the testing, movement and monitoring of pathogens and disease should be adhered to as an absolute baseline (reference Box 4.2). Project managers should contact their regulators directly for a comprehensive search of available data on pathogens and invasive species. Some useful data on non-native species can be found within the JNCC Marine Recorder Snapshot, or from the National Biodiversity Network Atlas or local survey data.

It is also important to consider what non-native species are present in areas with high connectivity to the donor areas (e.g. adjacent waterbodies, ports, or bays). There is a high risk of these spreading into the donor site.

Donor site surveys

Once a potential donor site has been identified, it is recommended that the current disease status of the site be confirmed through further testing, unless statutory testing is known to have taken place recently. Without exception, animals must only be moved to recipient sites from donor sites with equal or higher health status. Pathogen screens should be done using recommended methods (e.g. https://www.oie.int/en/animal-health-in-the-world/information-on-aquatic-and-terrestrial-animal-diseases/).

Similarly, for INNS, once a potential donor site has been identified, it is recommended that a site survey be undertaken to ensure that the information assessed is current and accurate. Particular care should be paid to potential and high-risk INNS. The JNCC Marine Method Finder has a list of suitable monitoring approaches for each habitat.

Should an aggressive INNS such as *Didemnum vexillum* or a notifiable shellfish disease be recorded at the donor site, then oysters should not be translocated from the site. If less aggressive non-native species are identified from previous data or surveys of the donor site, then a marine biosecurity plan may be an option to identify measures that can reduce the risk of non-native species introduction. This may be required by regulators and/or competent authorities before consent is given for the translocation.

Guidance on authoring such a plan has been produced by Cook *et al.* (2014), see key references.

Physical cleaning

If the origin and donor sites have been found suitable by the preceding steps, oysters obtained for translocation should be first inspected, then physically cleaned and inspected again to ensure no visible epibiota persists. This process should be completed at the donor site to ensure epibiota is not transferred elsewhere. It is also recommended that treatment and transport of oysters takes place in the late autumn to late winter to minimise initial amount of epibiotic growth.

Figure 4.5: The exterior (left) and interior (right) of a native oyster infested by a boring sponge (*Cliona celata*). Photos: Luke Helmer.

Oysters with associated heavy infestations of boring sponges (e.g. *Cliona celata*, see Figure 4.5) will have holes that can be difficult to clean. These should be discarded responsibly at the donor site.

Physical cleaning can be done by hand (scrape/scrub off) and/or mechanical methods, such as cement mixers or shellfish cleaning machines. If mechanical treatment (as opposed to cleaning by hand) is undertaken, a large sample size of the treated oysters should be closely examined in order to determine that the epifauna have been effectively removed. Repeat treatment should be undertaken if epibiota are discovered.

Following physical cleaning, oysters should be left to recover in filtered seawater for a minimum of three days before undergoing chemical treatment. Wastewater should be disposed of appropriately. **Note:** no amount of physical cleaning will remove harmful biota present within the oyster itself.

Spat are more sensitive than older oysters so physical and chemical cleaning is not recommended. Spat-on-shell that have been exposed to open water should only be moved within the same water body as long as the donor site has an equal or higher health status compared to the recipient site.

Chemical treatment

The purpose of chemical treatment is to reduce the risk of INNS transfer by killing shell epibiota that may have survived the physical cleaning of the oysters. Remaining epibiota might include scraps of clonal organisms such as sponges, bryozoans, sea squirts or certain types of seaweed, as well as hardy spores and resting/reproductive stages of other organisms (see Figure 4.6).

Some organisms such as keel worms, barnacles and other bivalves can clamp-shut to avoid ingress of fluids and are therefore able to survive the chemical treatment just as well as the oysters. Care should be taken in the physical cleaning stage to make sure that the tubes of keel worms are removed or broken open, that barnacles are removed or broken open and that there are no small bivalves hidden in the hinge-line of the oysters.

Various chemicals have been used for the surface sterilisation of oysters and they range in their expense and availability, including hypochlorite, formaldehyde, and commercial fish-farm treatments such as Virkon™. There is not a clear evaluation of the relative effectiveness of different treatments, but the obvious abiding principle is that it should be toxic to the epibiota in the concentration and exposure time used. Exposure-times can vary, and bulk dunking methods have been used. Dunking methods may be more preferable and efficient with younger oysters (< 10g) because the shells appear to seal-shut well. Sponging oysters with the chemical treatment (whilst using appropriate Personal Protective Equipment) might be deemed more appropriate in larger adult oysters where the gape of the shell may be worn or damaged and therefore less likely to seal well if fully submerged in a chemical bath.

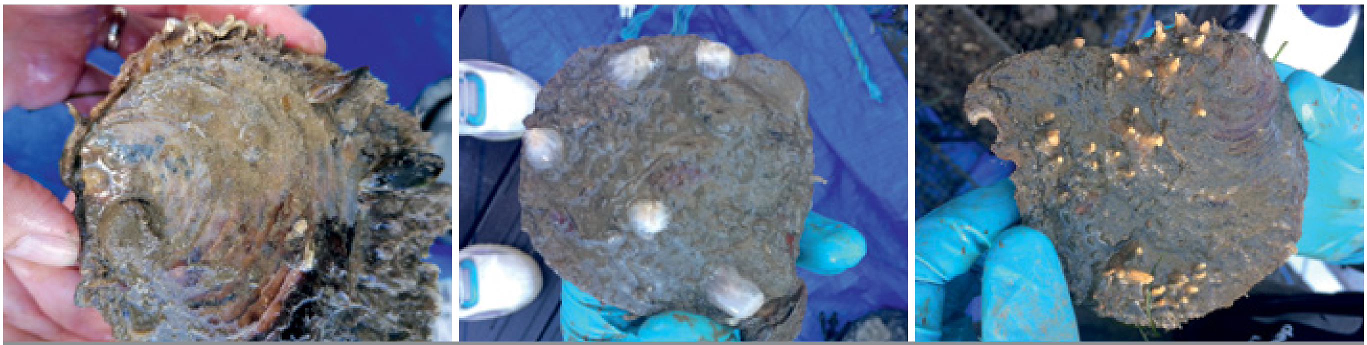

Figure 4.6: Examples of bryozoans (left), anemones (centre) and sponges (right) on uncleaned native oysters that may remain even after physical treatment. Photos: Luke Helmer.

Turrell *et al.* 2018 undertook a thorough review of the literature regarding chemical treatments of oysters in order to develop recommendations for moving *C. gigas* from an aquaculture site with a high risk INNS (*Didemnum vexillum*). A complete review of the tested options and the resulting impacts on the target INNS and the shellfish are provided in their report. The method recommended for field tests as a result of the review was immersion in freshwater (salinity < 2ppt) for at least 24 hours.

Quarantine

Following treatment, oysters should be kept in tanks and the bottom of the tanks inspected for recently dead or living organisms.

Due diligence

There is currently no agreed method that, when applied, renders living oysters completely biosecure for translocations. It is therefore critical that each translocation attempt validates the efficacy of the biosecurity measures undertaken with a thorough screening.

While disease screening is one of the first steps undertaken when determining whether a stock is suitable for translocation, a further screening for diseases may be undertaken prior to stock released into the wild. As a minimum, this should include all of the notifiable diseases (For native oysters: bonamiosis (*Bonamia ostreae* and *Bonamia exitiosa*) and marteiliosis (*Marteilia refringens*), as well as oyster herpes virus), following the relevant OIE recommended procedures.

Contributing to improved biosecurity guidelines

Rendering living oysters' low risk for translocation is costly and the efficacy of actions is not well documented. We therefore urge projects to submit their experiences to the Native Oyster Network or NORA Secretariat.

There are guidelines for hatchery production that stipulate broodstock from areas with notifiable disease should not be used as broodstock to produce spat destined for disease free areas (see section on 'biosecurity guidelines for European native oyster hatcheries'). It should be noted that there is a substantial longer-term restoration advantage in using broodstock from high disease load areas that have likely developed a degree of tolerance to diseases such as Bonamiosis. This will require methods to ensure disease free offspring that still carry the genetic resistance. These methods are the subject of active investigation.

TRANSLOCATING SHELL CULTCH OR OTHER SUBSTRATES

Materials commonly used as substrate for reef construction are shell cultch or stones/aggregates and stones. Rock that is not from the sea is not a biosecurity risk. Though project managers will need permits from their regulatory authorities before deploying any substrate to a restoration site. All material used for restoration should be free of contaminants such as pesticides, oil and heavy metals.

It is unusual to have a supply of shell from the local water body. If such a supply exists, it is unusual to be confident that no shell from animals outside the local water body can enter the shell supply chain. If these conditions are met with a high degree of certainty regulators may concede to allowing the shell to be returned to the water untreated. Generally, the source of all the shell being supplied cannot be guaranteed, so the shell must be treated as though it was from a high biosecurity risk area. In this case, the shell must be treated to ensure that living marine organisms or spores of pathogens can no longer contaminate the material. What is deemed suitable treatment should be agreed with the relevant authorities. The most common treatment is to weather (expose to the elements) the material for a minimum of 12 months, turning the shells every two months where material is deposited < 15cm high, and twice monthly if deposited more deeply. Any rock or other material dredged from the ocean should be treated in the same way.

As with all other stages of biosecurity practice, it is the responsibility of the project to ensure that the treatment has been effective in removing any unwanted organisms and spores. This may include visual examination of the material. As a general guideline, material should be weathered until there is no evidence of residual biology remains, dried or otherwise. Effective method of assessment and the appropriate sample size for assessing the status of the clutch material should be agreed with the relevant authorities.

BIOSECURITY GUIDELINES FOR EUROPEAN NATIVE OYSTER HATCHERIES

Introduction

Where no reliable and large sources of wild seed are available, reef restoration depends on seed brought in from different sources. This demand can be addressed by hatchery production. Hatchery production is not in itself biosecurity risk free. Projects seeking to use hatchery reared seed should inform themselves of the biosecurity measures in place when considering hatchery partners and should confirm or seek to develop in partnership with the hatchery, the degree of biosecurity controls required. This section introduces the steps that are commonly taken in hatchery settings and is designed to support informed communication between practitioners and hatcheries. Those seeking greater detail of hatchery protocols may visit the Native Oyster Network – UK & Ireland or NORA websites to download the full biosecurity guidance and see the publications recommended in further reading at the end of this chapter.

Biosecurity Measures Plan (BMP)

All Aquaculture Production Businesses (APB's), including hatchery operations, must be authorised by the competent authority. Although licensing and permitting procedures depend on the hatchery characteristics (e.g. site, region, species farmed, aim and scale of production), an essential requirement for ABP authorisation is an approved Biosecurity Measures Plan (BMP). The BMP describes defined measures to prevent or reduce the risk of introducing diseases/pests into the hatchery, spreading diseases/pests within the hatchery or the transfer from the hatchery to the aquatic environment, via three steps:

1. Identification of major routes for potential disease/pest transmission in oyster hatcheries (Table 4.1).
2. Risk assessment for each disease/pest transmission route.
3. Definition of measures to minimise the risk of disease/pest transmission.

Table 4.1: Level, means and routes of transmissions of pests and disease through a hatchery.

LEVEL OF TRANSMISSION	MEAN OF TRANSMISSION	ROUTES OF TRANSMISSION
Entry-level	Livestock	e.g. import of wild broodstock.
	Feed/algae	e.g. purchase of algal paste from external suppliers.
	Water	e.g. intake of water.
	Equipment	e.g. admission of gear from outside the hatchery.
	People	e.g. entry of the hatchery by visitors.
	Settlement substrates	e.g. transfer of shells.
Internal level	Livestock	e.g. movement of broodstock, larvae or spat between production area.
	Feed/algae	e.g. algal cultures.
	Equipment	e.g. sharing of gear between production areas.
	People	e.g. movement of staff between different production areas.
Exit level	Livestock	e.g. discard of mortalities.
	Water	e.g. discharge of water.
	Equipment	e.g. disposal of wastes.
	People	e.g. exit of the hatchery by visitors.

As part of their daily operations, hatcheries should organise and maintain routines that enable the operators to observe and trace any potential transmission events. Stringent record keeping should be basic practice for any hatchery operation and must take into account shellfish movements, mortalities, disposal of stock, stock health, water parameters and water quality. These factors, and the list of tasks assigned to each of them, fall within the Standard Operating Procedures (SOP) of a facility and allow for appropriate emergency response plans to be developed. Should an event occur that triggers the emergency response plan, and therefore requires intervention, actions can be taken to halt further spread or contamination both within and onward out of the facility.

All native oyster hatcheries will have to produce unique and personalised BMPs and SOPs, since they will have to deal with different biosecurity challenges. The level of biosecurity in hatcheries can range between very strict and moderate, depending on both the aim/purpose of the production, and the disease status of the donor stock and designation of the receiving site. These factors also have important implications for translocation of broodstock and hatchery output.

Translocation of native oysters, in the context of bonamiosis or other diseases affecting this species, can be reasonably undertaken in terms of biosecurity as long as they originate from areas which have an equal (or higher) health status as the receiving area. For the same reason, a water body with a greater disease designation than the hatchery location should not be considered as a potential source of broodstock. It is unnecessary and illegal to transfer oysters from a diseased area to a disease-free area; therefore, this practice is not considered.

For example:

- Hatcheries producing **certified oysters** in **disease-free areas** can be used for both aquaculture or restoration purposes. *This hatchery could only receive oysters from other disease-free areas, but hypothetically they could export oysters to areas of any disease designations.*
- Hatcheries producing **uncertified oysters** in **disease designated areas** can only be used for restoration purposes. *This hatchery could not export any oysters except to (very) local areas. In this 'local to local' scenario, broodstock could possibly be disease-resistant, maximising the chance of self-sustaining wild population of O.edulis. Hypothetically this hatchery could receive oysters from any area.*

Note: It is recommended that both donor and receiving sites are located in the same region as the hatchery, in order to avoid, as much as possible, the translocation of invasive non-native species between different areas.

WORKSHOP CONTRIBUTORS

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