Results of Ostrea edulis hatchery inventory on reliability of supply for Dutch restoration projects

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1. Context and objective

The context of this report is the development of *Ostrea edulis* (flat oyster) reefs in European waters. Reef development methods were tried out in pilots across various marine environments during the last decade. Through these experiments, it has become clear that flat oyster reef development should move into an new phase, characterized by:

- Scaling up, from pilot dimensions (total number of mostly adult oysters deployed in the Dutch part of the North Sea around 90.000 so far) to ecosystem dimensions (order of magnitude of oysters to be deployed around 1-10 million per project).
- Settling these oysters on substrate which optimally allows their survival, growth and reproduction under the conditions of the deployment location (dimensions varying from bivalve shells to materials of several kg per unit).

These conditions can only be met if flat oysters are produced in dedicated hatcheries, with subsequent settling of produced oyster larvae on substrate (resulting in 'spat-on-substrate') that fits project requirements and including location characteristics (water depth, sea floor condition, turbulence etc.).

Therefore, the objective of this research is to answer the following question: Are flat oyster hatcheries able to reliably produce millions of healthy larvae and successfully induce their settlement on specific substrate, as required for reef development projects?

2. Approach

Results reported here are obtained in two ways. On the one hand from the investigation conducted by Philine zu Ermgassen on behalf of the Native Oyster Network of UK and Ireland (NON-UK/Ireland, with support by various other organisations) in the period February to October 2025. This investigation entails:

- A questionnaire, sent to a variety of flat oyster hatcheries and reef development project managements. Most hatcheries and projects were located in UK and Ireland, but also France, Netherlands, Italy, Denmark and Germany were included.
- Three workshops with native oyster hatchery and reef development project representatives.

The NON-UK/Ireland project generously agreed to share their findings. Therefore, the results reported below are partially based on it. The main findings of the enquiry are summarized in the Appendix to this report.

On the other hand, results reported here are based on direct information supplied by hatcheries in The Netherlands (Stichting Zeeschelp, Roem van Yerseke, Blue Linked) in the period August-October 2025.

3. Results

Basic findings of the NON-UK/Ireland investigation are:

- Hatcheries and restoration projects are preparing for scaling up and spat-on-substrate production, in terms of production capacity as well as demand.
- However, there are still various barriers to scaling up flat oyster production, the main ones being:

    - A vicious circle: supply follows demand, but large-scale demand is still uncertain for many projects, since these depend on various external factors (funding, disease regulation, permitting etc.). And, as long as demand is insecure, investment decisions to scale up production by hatcheries are pending.
    - Technical issues in hatcheries, causing uncertainties in supply and settlement on substrate.
    - Differences in permitting regimes (such as disease and related transport regulations) between European countries.

Yet, during the workshops, it appeared that these problems are gradually being overcome:

- Governmental marine nature regeneration programs are currently being developed (among others due to the EU Nature Restoration Regulation) and also private funding projects are increasing, leading to more reliable, longer term perspectives for flat oyster demand related to reef development projects.
- Production reliability in hatcheries is increasing, with some pioneers being able to deliver large amounts of healthy flat oysters on substrate with specified characteristics on demand (given preparation time of about 6 months). The main example is Stichting Zeeschelp.
- Disease regulation is being developed in various countries and transport permits (especially UK-EU) are being streamlined.

In The Netherlands, these trends are supported by an increased flat oyster seed demand by commercial growers. Background to this is that the flat oyster population in the Oosterschelde is increasing, probably caused by the development of tolerance to the *Bonamia* disease. This causes commercial growers to be more interested in flat oyster cultivation than in the past decades.

All in all, perspectives for scaling up flat oyster production and producing spat-on-substrate are reasonably good, particularly in The Netherlands. However, the number of hatcheries scaling-up production is still small and experiences with producing (and deploying) spat-on-substrate are limited. Therefore, optimization of the production-settlement-deployment chain is required. The following variables should thereby be taken into account:

- Health and genetic diversity of the larvae as produced by the hatchery.
- Substrate material, including the functionality of settlement enhancement coatings (e.g. BESE-reefpaste).
- Composition and amount of feed for larvae and spat.
- Effects of environmental variables such as temperature, light, oxygen, water refreshment rate and water purification on larval development and subsequent settlement success.
- Deployment methods and related logistics of flat oysters settled on substrate,.

This requires a dedicated optimization and related experimentation program, in which various hatcheries and organisations working on logistics and deployment should take part, among others to investigate whether results are reproducible in varying circumstances.

In order to broaden production capacity, it is also advised to document and publish the results of this program, so that knowledge can be transferred internationally, to other/new players in the flat oyster production field.

Appendix

Upscaling European *Ostrea edulis* seed production to meet restoration needs

Data summary

A questionnaire was distributed to hatchery managers across Europe, that had a history of supplying *O. edulis* seed to restoration projects. Additionally, a questionnaire was prepared in French for hatchery managers that are currently not engaged with producing for restoration purposes. This questionnaire was distributed to SENC via their president (June 2025), but we received no responses. We thank all respondents for their time.

Oyster hatchery managers

Eleven hatcheries submitted responses to our request for details. This encompasses the majority of hatcheries in Europe that currently produce *O. edulis* for restoration purposes. German producers are currently not represented, as the Helgoland Oyster Hatchery declined to submit a response, and the Thünen Institute was not producing oysters at the time that the questionnaire was distributed (June 2025), although the intention is for them to do so to meet German demand in the coming years.

Of the eleven hatcheries that submitted a response, six are situated in a *Bonamia* positive area, one is in an area where the disease status is unknown, and four are situated in *Bonamia* free areas.

When asked which products are currently available for sale, two hatcheries responded that this question was not applicable, because they produced *Ostrea edulis* seed for their local restoration efforts exclusively. Of the remaining nine hatcheries, seven stated that they sell larvae, eight have single seed and eight have spat on shell available for sale. Only two hatcheries sell submarket sized oysters, and only one market size. See figure A.1.

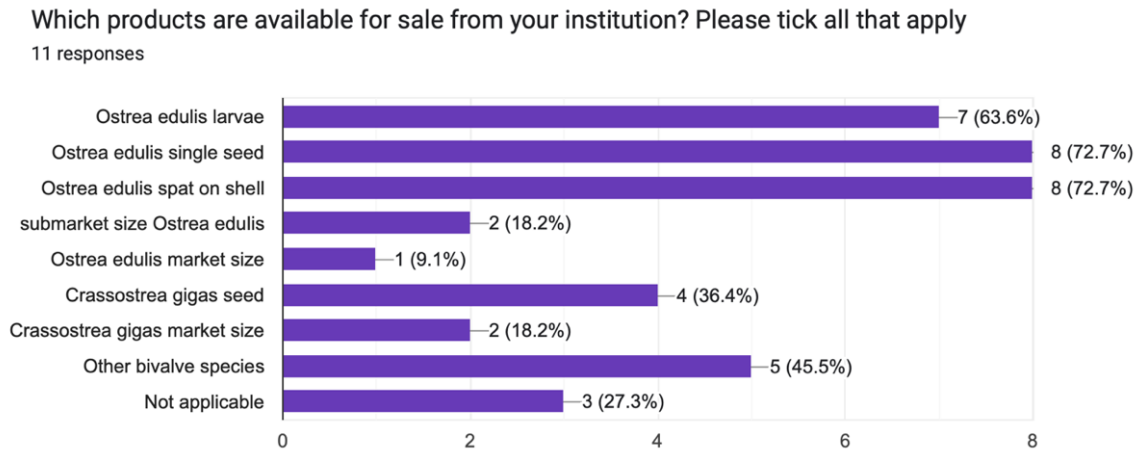

Figure A.1: Frequency at which oyster products are available from hatcheries that submitted responses to the questionnaire.

Six of the hatcheries produce at least one other bivalve species, alongside their *O. edulis* production.

Four of the eleven hatcheries are research hatcheries, with two of these producing *O. edulis* seed exclusively for local restoration efforts. Of the remaining seven, four commercial hatcheries have fielded more than five enquiries related to the provision of native oyster seed for restoration purposes. See figure A.2.

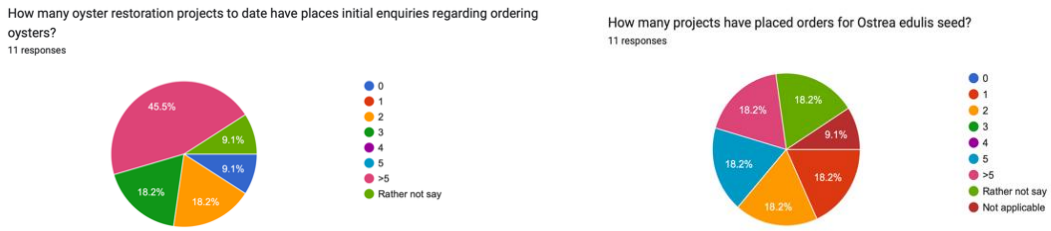

Figure A.2: The number of restoration projects that each hatchery reported as having made enquiries, or having placed orders for *O. edulis* products.

Six hatcheries stated that they have been able to fulfill all restoration related orders, three had not fulfilled every order, and two indicated this question was not applicable, either because they partner closely with a restoration effort, or projects are incomplete.

Issues identified in not fulfilling orders related to various reasons including the expense and space required to grow oysters to demand grade size. Many hatchery managers acknowledge that there is a risk of placed orders not being met, with six of nine hatcheries estimating the risk of not meeting placed orders at greater than 10% under current investment.

As relates to capacity within existing hatcheries, hatcheries reported producing a median of 32,500 oyster seed in 2023 and 210,000 in 2024. The number of seed produced spanned from (including values >0) 10,000-50,000,000 in 2023 and 10,000 and 100,000,000 in 2024, although the larger values reported pertained to competent larvae as opposed to settled seed oysters.

Nine of the eleven hatcheries were either planning to scale up production, or would be prepared to do so if there was an established demand. One research hatchery and one commercial hatchery stated that they currently had no plans to scale up *O. edulis* production. Of the seven hatcheries that were able to provide an estimate as to their current capacity, the median capacity was reported as 8 million, and the total was reported as >350 million, although this was caveated by space requirements being met, and some hatcheries reported larvae as opposed to expected seed. This number should therefore be taken as no more than a rough indication of potential capacity.

The primary challenges identified by hatcheries in producing a consistent supply of native oyster seed included: grow out space, implications for trade of being situated in a *Bonamia* positive area (*Bonamia* regulation), broodstock availability and quality, phytoplankton production/quality, finance, lack of demand, relative ease with which other alternative species can be produced, water quality, lack of skilled personnel, uncertainty in market in coming years, *Vibrio*, maintenance cost of maintaining disease free broodstock, cultch preparation. Larvae and seed mortalities were also mentioned.

When asked to identify the main challenges in bringing *Ostrea edulis* produced into the restoration market, the following issues were identified: being located in a *Bonamia* positive area, reliable long term commitments with commercial pricing, Brexit policy, lack of a market (especially for single seed oysters), mismatch between size that can be easily maintained in the facility and the size demanded by the customer, orders being placed inconsistently and over short timescales, limitations relating to movement of Grade B oysters to the EU, restrictions in exporting from biosecure hatcheries situated in *Bonamia* positive areas, lack of certainty about what the market is and how it will develop (including uncertainty regarding decommissioning in the off shore), and limited capacity/skills in the sector.