Mussel seed – constraints and opportunities

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Presentation in two parts

Stepping Stone Project

- Update on progress
- Lessons Learned

Next Steps

- Sector Ambitions
- Main barriers
- Unblocking constraints
- Future work….

Update on the pilot hatchery for *Mytilus edulis*

The Scottish Shellfish Hatchery,
Stepping Stone Project

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University of the
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Project Rationale

- Aim:

To test the commercial feasibility of establishing a shellfish hatchery, with initial focus on mussels

SPRING BAY SEAFOODS

Scottish Shellfish Marketing Group

University of the Highlands and Islands
Oilthigh na Gàidhealtachd agus nan Eilean

NAFC Marine Centre
University of the Highlands and Islands

Funders and project setup

Phase 1
Setup and Enabling

HIE
Highlands and Islands Enterprise
Iomairt na Gàidhealtachd 's nan Eilean

University of the Highlands and Islands
Oilthigh na Gàidhealtachd agus nan Eilean

Scottish Shellfish Marketing Group

Scottish Aquaculture Innovation Centre

Phase 2
Research & Development

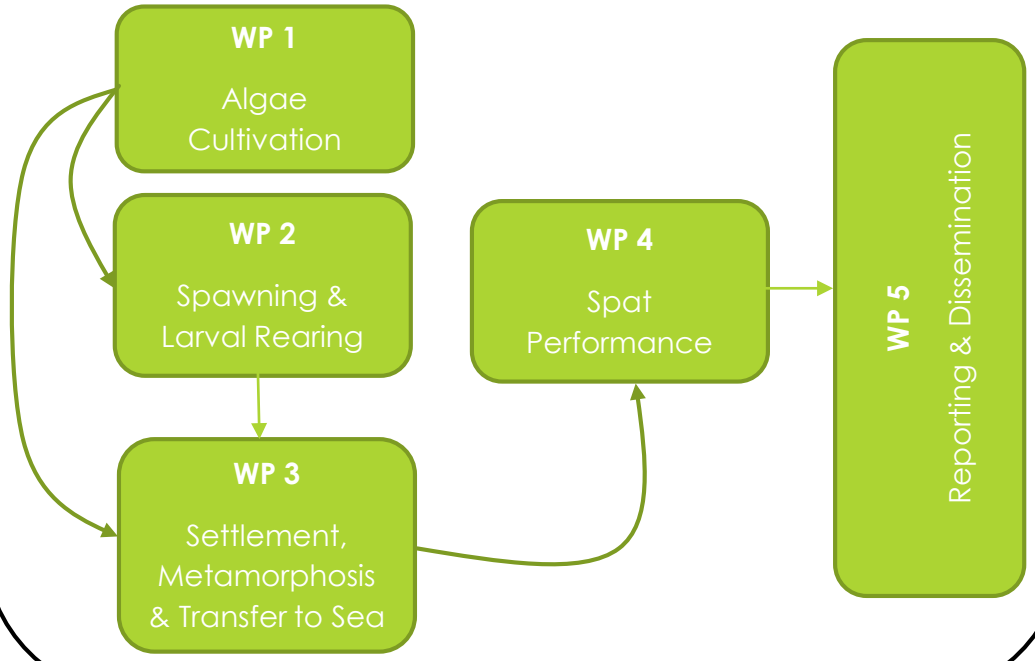
European Maritime and Fisheries Fund

Phase 1
Complete

Phase 2
Spawning Seasons 2017 & 2018

Work Packages & Associated Projects

Stepping Stone Project



Associated R&D Projects

- Developing **Genetic Tools** for mussel hatchery management & future breeding programs
- **SAIC-Hatch:** improve shellfish production techniques
  - Live feeds; Bacteriology; Settlement; Transfer to sea;

NAFC Marine Centre

The Team

Danny Cowing

Project Officer /
Research Associate

Raquel Quinta

Project Technician

Gregg Arthur

Aquaculture Manager

Tariq Mohammed

Engineer / Technician

John McEvoy

Summer Students

Mark Jones

Stephen Leask

Agata Delnicka

Hannah Bloomer

Associated R&D Projects

Lesley McEvoy
Aquaculture Scientist

Blažka Satler
Research Associate

Bryce Daly

- Commercial mussel and oyster hatchery operator (Tasmania)
- Two Knowledge Exchange Visits (total 5 weeks)
  - May 2017 and 2018
  - Training, troubleshooting and benchmarking of
    - rearing systems
    - techniques
    - protocols

SPRING BAY SEAFOODS

Summary of Improvements from 2017 season

- Demonstrated improvements at each stage of production process
  - Algae production
  - Egg Incubation
  - Larval Incubation
  - Settlement

Results – WP1 – Algae Cultivation

- Diatom algae species (Batch culture System)
- Flagellate algae species (SeaCAPS System)

Both systems achieved a satisfactory level of production
But nether achieved the full performance level (cell densities) wanted

Some ongoing **fine-tuning** of the culture environment Is required

Hygiene / Microbiology

Temperature

pH

Carbon Dioxide

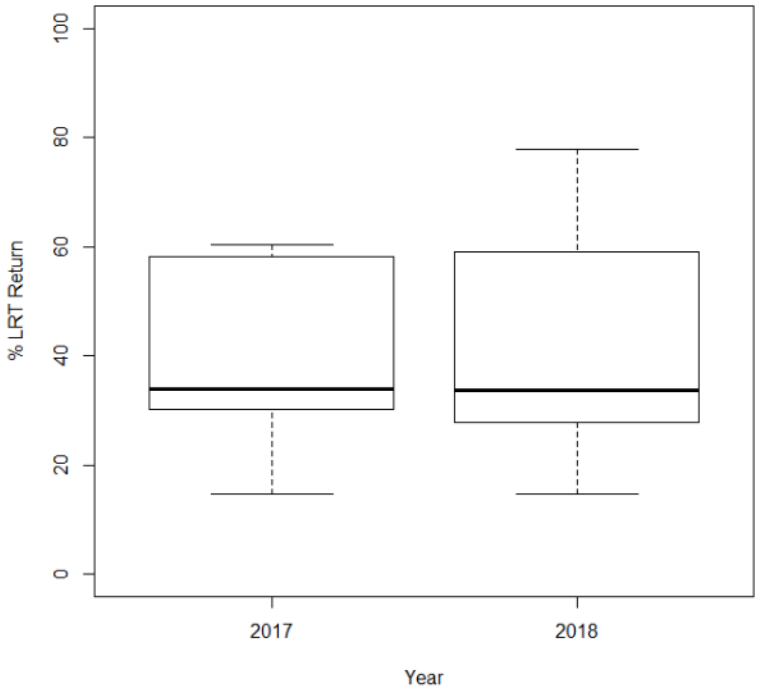
Results – WP2 – Broodstock & Spawning

- Around five billion eggs incubated during project
  - ~2 billion in 2017
  - ~3 billion in 2018

- Budget of 3 spawnings for in 2018
- Undertook 30 spawnings
  - 2018 spawning season started two months behind the 2017 spawning season
  - Peak Spawning seen in July
  - We haven't seen an autumn peak this year

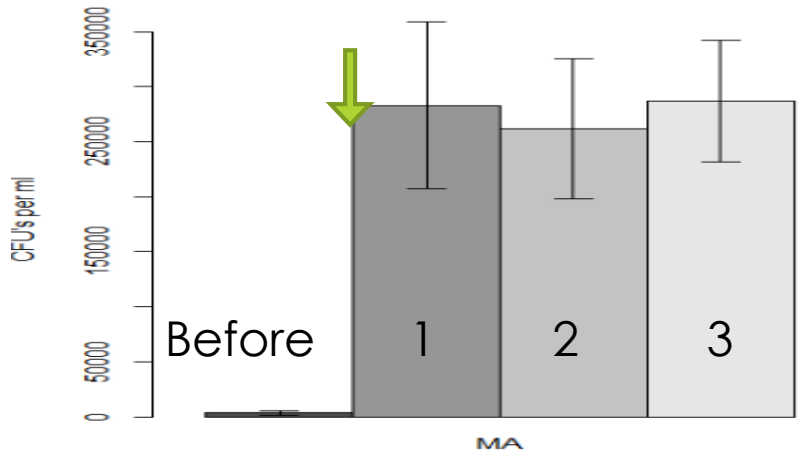
Egg Incubation

- Returns of D-larvae lower than SBS
- Average return was similar both years but the increased spread in 2018 show there were more better performing batches in 2018 compared to 2017
- Egg stocking densities were increased latterly in project without issue



Egg Incubation

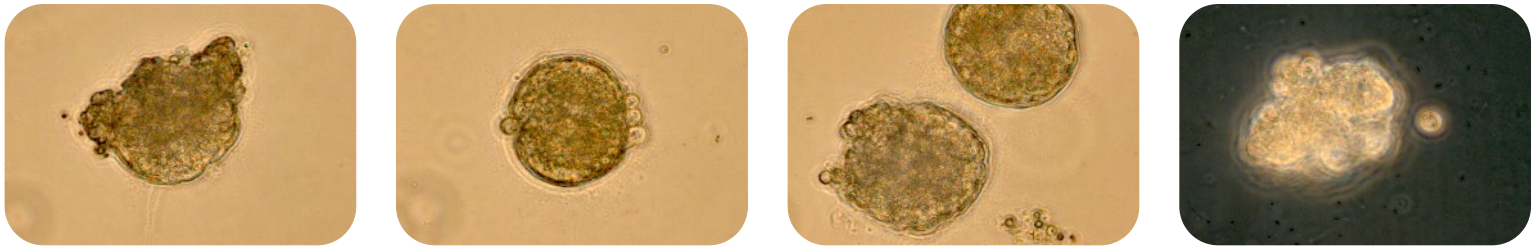
- Some improvements made to tank design and protocol
- Consistent bacterial spike after introduction of fertilised eggs is a concern

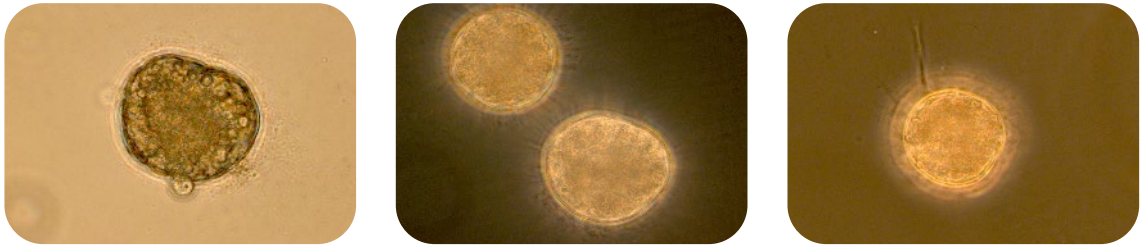


Days post fertilisation

Results – WP2 – Broodstock & Spawning

- Also observed deformities in eggs, trocophores and larvae





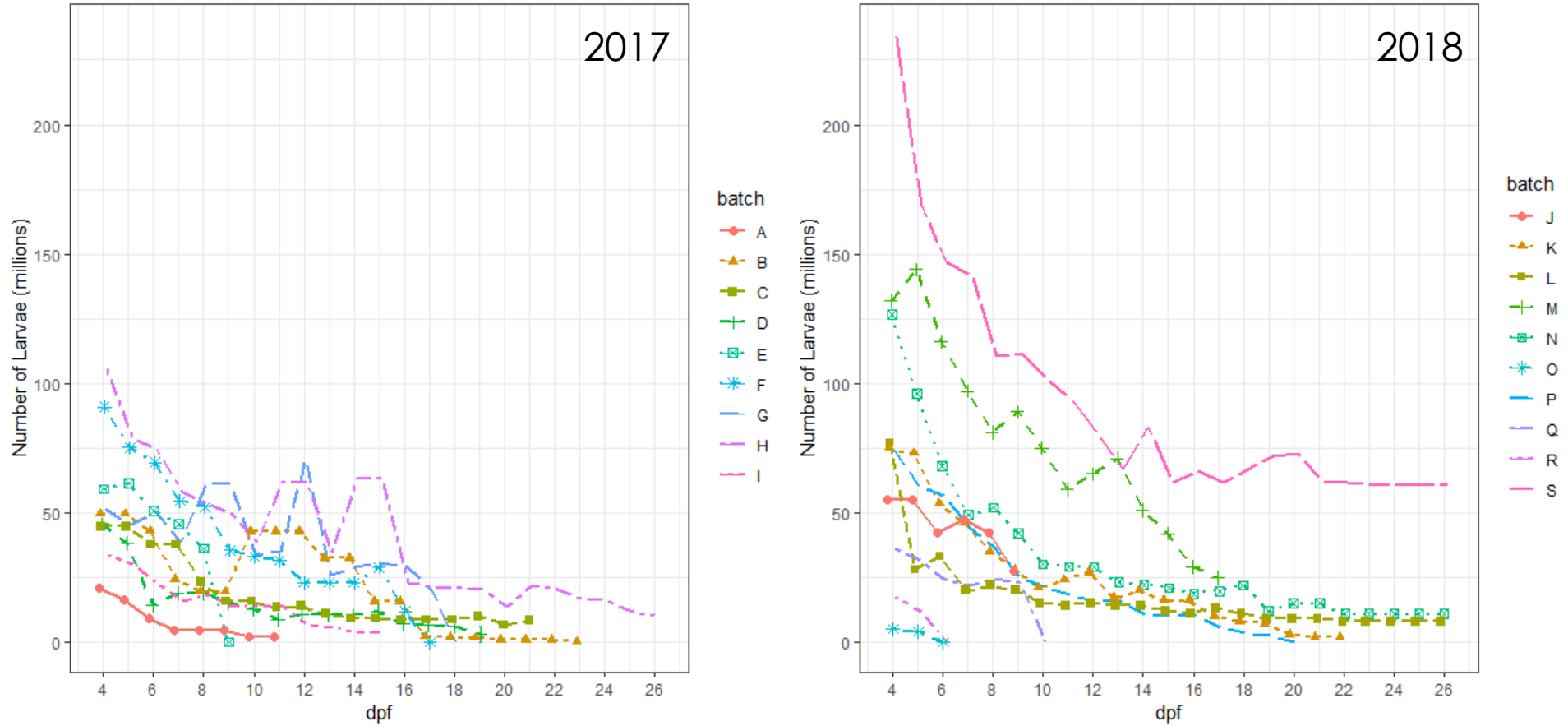
Good Good

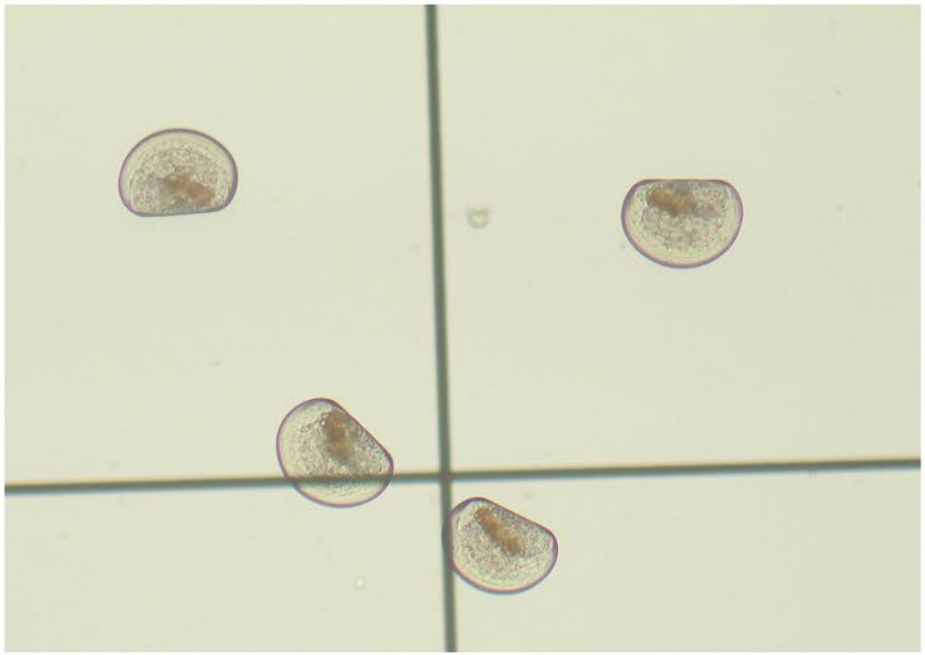
Possible causes of larval deformities

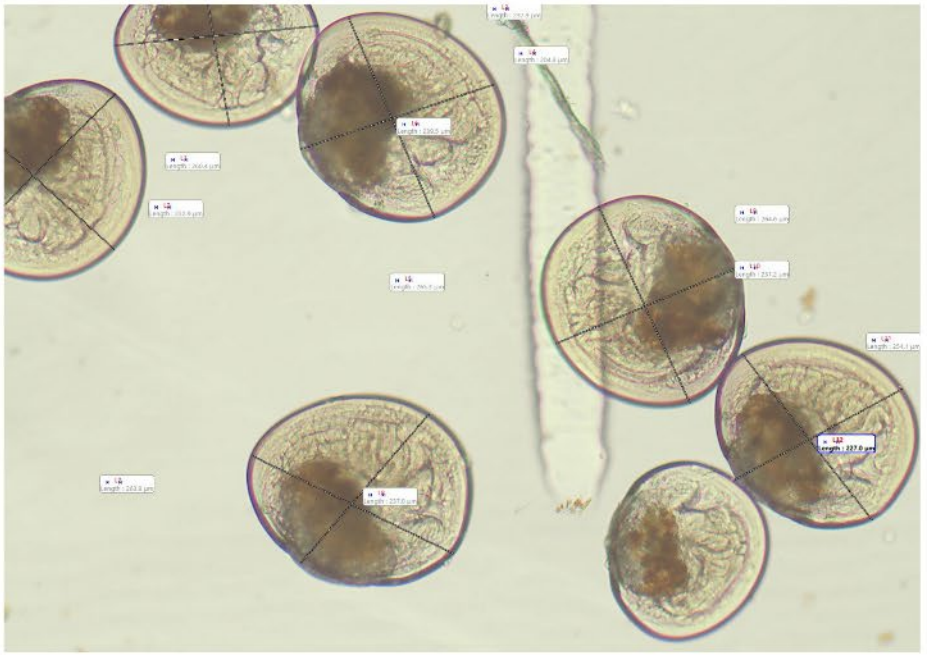
Systems & Protocols	• Equipment Design / Setup • Effects of using new equipment • Broodstock handling protocols • Fertilisation protocols	Unlikely
Environment	•Incubation temperatures •Water quality •Infection (bacteria)	Possible
Broodstock	• Health • Infection (bacteria) • Egg and sperm quality • Toxins (broodstock and/or water supply)	Likely

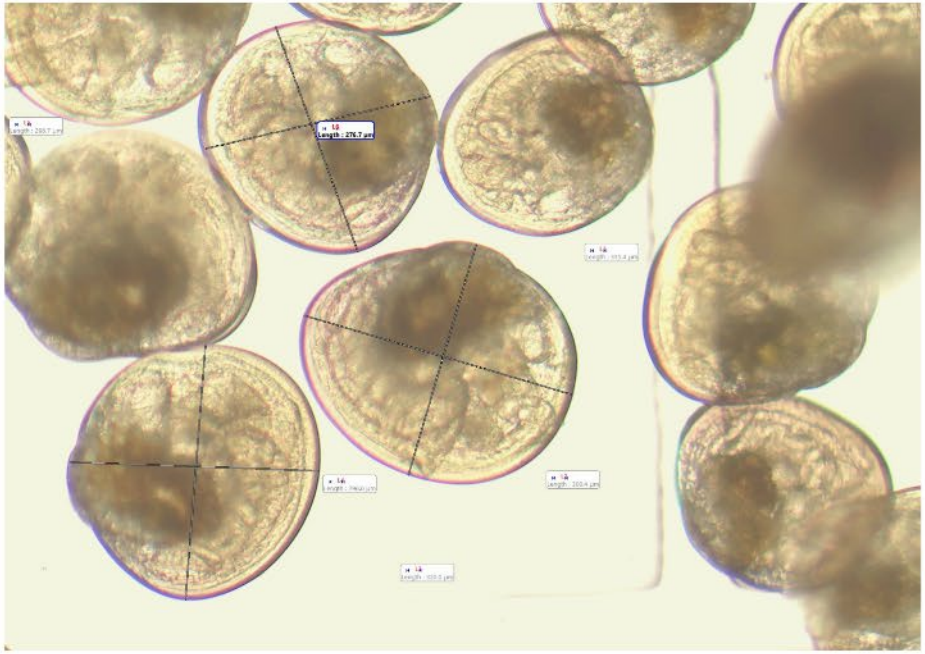
Results – WP2 – Larval Rearing

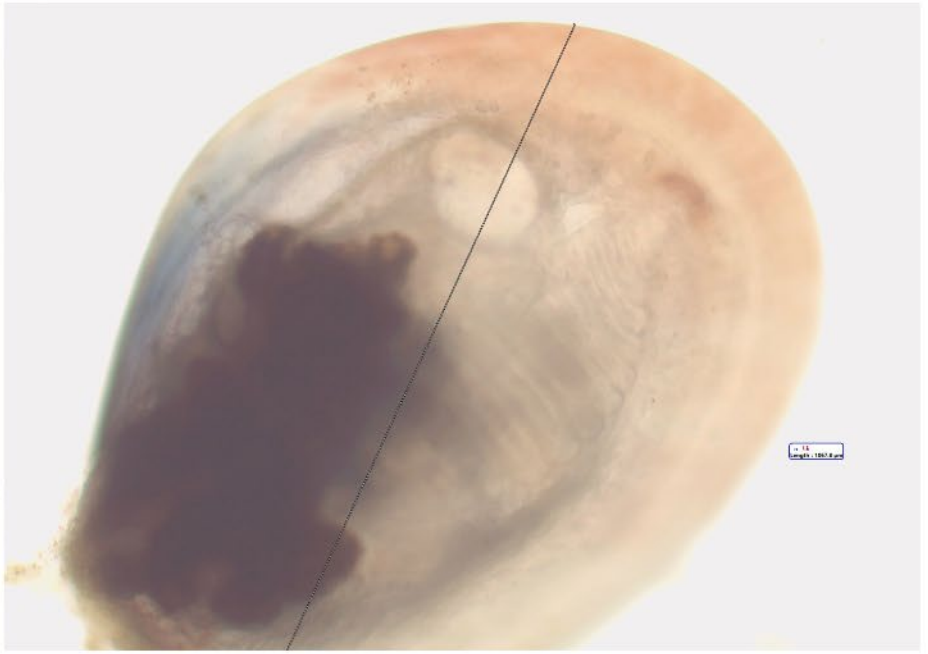
- Over 19 batches of larvae incubated





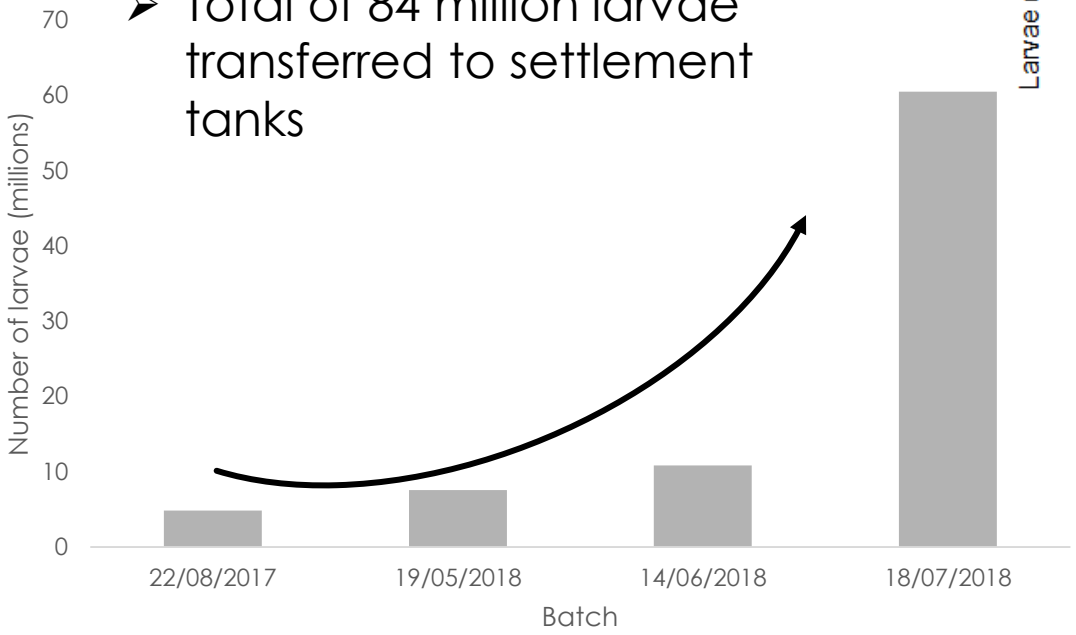


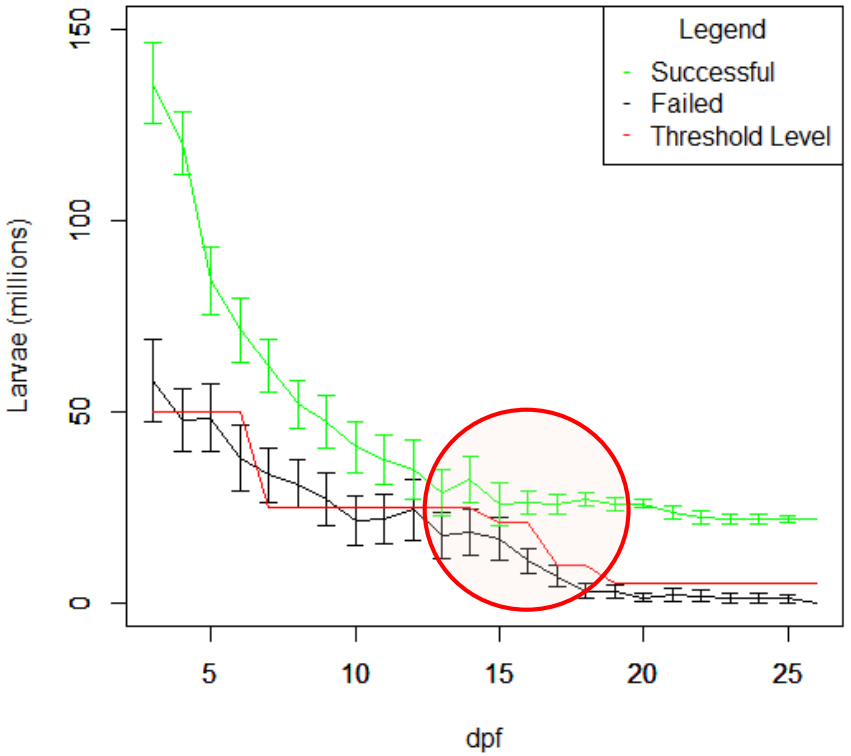




Results – WP3 – Settlement and Metamorphosis

- Improvement in later survival (post day 15)
- 4 successful batches
- Total of 84 million larvae transferred to settlement tanks





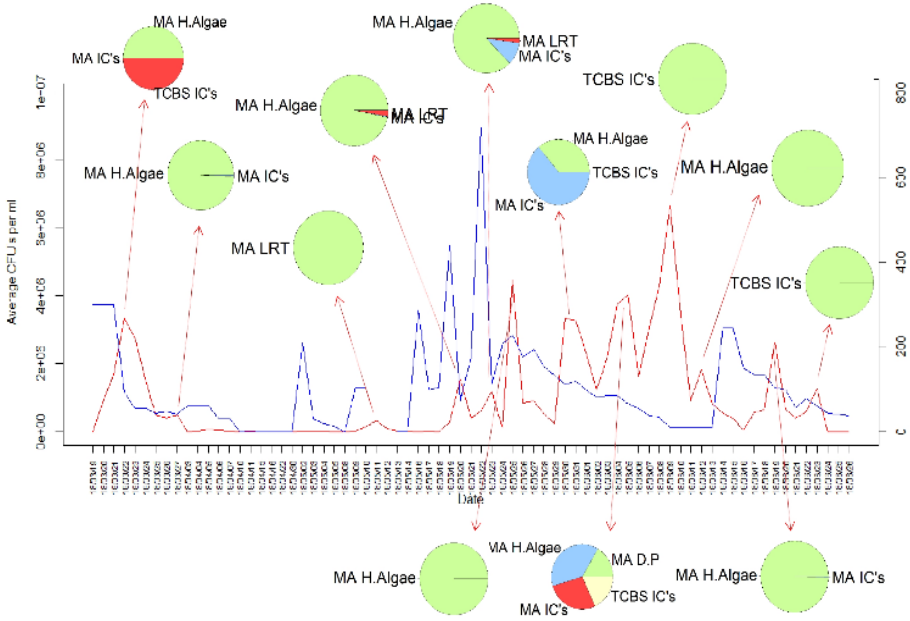
Preparation of rope for deployment

Results so far – WP4 – Spat Performance

- Good growth and retention

Lessons learned

- Transfer of technology from different species has been successful
- Importance of the close working relationship between Industry, Project Board and delivery team
- Relying on wild Broodstock has shown that to be a weak ‘link’
- Need more time to investigate the larval production methods
- Some room for improvement in algae production methods



Stepping Stone Project (slide from ASSG 2016)

- Commercial Hatchery(s)

Low "risk"

Engage or Walk Away if concept fails to stand up biologically (or economically)

?

- Commercial Hatchery at Pilot Scale
  - Proof of Concept
  - Transfer of existing technology into existing facilities

Complete

- **Goal** = Improved **production** and **sales**

Part 2
NEXT STEPS

Ambition to Grow

&

Future Opportunities

PRODUCTIVITY

EFFICIENCY

PROFITABILITY

GROWTH

SCALE

Current Production tonnage of mussels is at an all-time highest level

328 people employed (increase 4% c.f. 2016)

Ambition
21,000 tonnes of mussel production p.a.

HIE
Highlands and Islands Enterprise
Iomairt na Gàidhealtachd 's nan Eilean

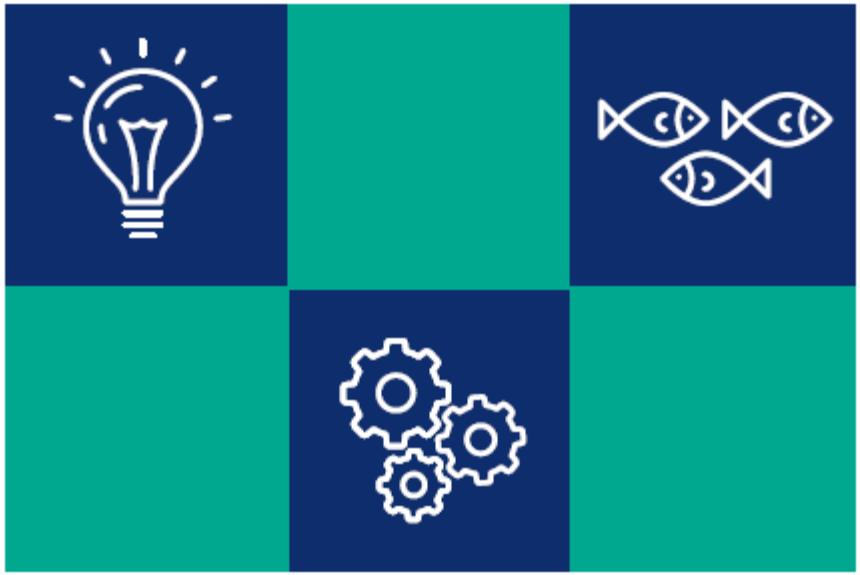
Scottish Aquaculture Innovation Centre

Scottish aquaculture: a view towards 2030

An innovation roadmap and sector needs study conducted by Imani Development and SRSL, on behalf of the Scottish Aquaculture Innovation Centre and Highlands and Islands Enterprise

February 2017

SRSL imani DEVELOPMENT



Sectoral value of £90M p.a.

Market Driven Supply Chains

Key Barriers

- Lack of co-ordination between individual farmers
- Under-utilisation of available farm capacity
- Varying practices and site yields
- Inconsistent spat supply
- Fragmented and inconsistent production information systems

SCOTTISH MUSSELS

MDSC

Scottish Mussels producers adopt new supply chain practices to deliver £1m of new volume

MDSC has helped the Scottish mussels sector to:

Remodel its supply chain to help increase production from existing farms by up to 60%

Instigate development of new database and mussel growth monitoring system to improve selection and yield

Bridge the understanding of requirements between farmers and processors

Background

The Scottish Shellfish Marketing Group (SSMG) is responsible for over 75% of Scottish farmed mussel production, with its 17 members supplying mussels to processing units in Shetland and Bellshill for further added value to sell to wholesalers and all the UK multiple retailers.

Current farming and supply chain practices are at near maximum production capacity, yet the market demand for Scottish farmed mussels is forecast to significantly outstrip supply over the next decade. If the Scottish sector were unable to fulfil this market opportunity, it would open the door to competitors from elsewhere. The identified market opportunity was to supply a further £3.1m of product per annum at farm gate prices from existing resources, through better design and management of the supply chain - £2.8m from volume increase and £0.3m from yield improvements through an improved, co-ordinated harvest approach.

The Challenge

The key barriers identified were:

- Lack of co-ordination between individual farmers
- Under-utilisation of available farm capacity
- Varying practices and site yields
- Inconsistent spat supply (mussel seed)
- Fragmented and inconsistent production information systems

Scottish Shellfish Marketing Group

The Support

To understand the ongoing issues, the MDSC team analysed the supply chain from farm to processing by:

- Investigating the factors that could stop growers from maximising yield and output
- Mapping the existing chain, highlighting issues, pressure points, gaps and deficiencies and good practice
- Redesigning the supply chain to make best use of farm sites in producing spat and on-growing of mussels
- Identifying areas where inconsistent production information hindered output and decision making
- Working with group members to understand full capacity and capability issues in the chain

Key Outputs

- Redesign of supply chain with internal trading system for spat
- £1m of additional product now in process with potential to add a further £2m
- Database system being created to capture data in "real time" from the farms, which will help provide more accurate forecasts for future production to further improve volume, cash flow and quality
- Greater collaborative working and sharing of resources, expertise, labour and boats

Continuity of supply to plan production efficiently is essential if the sector is to pursue the substantial market growth potential that exists

'It has been of real benefit to have access to expertise that can map out the issues in our current supply chain and develop a new model that has the potential to significantly increase our shellfish output from the same number of sites. It has been very useful in stimulating other work, such as the improvement in the data information we collect and share, driving more efficiency into the chain.'

Evolution of the Shellfish Sector

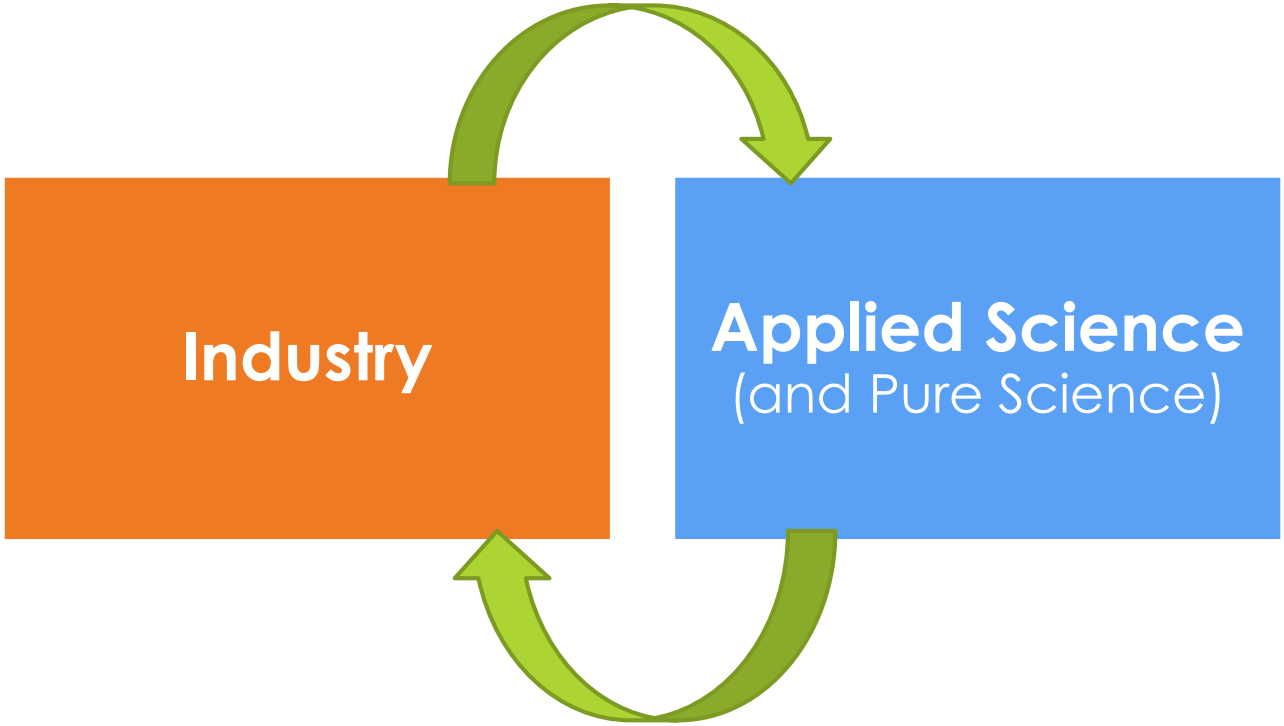
- Consistent message from Industry over a number of years

- Needs an **intentional** and **concerted** effort to breakdown the key barriers
- A positive, practical example of this is the Stepping Stone project

Barriers

- Understanding the causes and impacts of current **Biological** and **Environmental** challenges
- Improving **production efficiencies**

Shell-volution



Shell-volution

Priority 1: Securing Spat Resources	Priority 2: Enhancing Farm Performance	Priority 3: Sharing Practice
• Wild Recruitment • Hatchery Production	• Carrying Capacity • Data collection and Monitoring	• Efficiencies • Benchmarking • Management • Economics • Impacts • Farm Science

Shell-volution: Securing Spat Resources Recruitment of wild spat

- Collate and interrogate current knowledge of spat-fall across region
- Remodel the industry-wide management techniques for best-practice in recruitment of wild spat
- Establish biotic and abiotic enablers and inhibitors to successful recruitment
- Monitor existing (and potential) spat collection sites

Shell-volution: Securing Spat Resources Hatchery Production of Spat

- Improve the Technological Readiness Level of the concept for commercialisation of a Mussel Hatchery
- Enhance existing protocols using outputs from recent experience and R&D
  - Broodstock Management techniques
  - Improve methodologies for producing
    - Algae
    - Larvae
    - Spat

Shell-volution

- Discussion

thanks to all the funders and participants

European Maritime
and Fisheries Fund

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