



Blue Economy Opportunities for Scottish Farmed Shellfish

Crown Estate Scotland
November 2022
FINAL REPORT

PREPARED BY:
SAOS Ltd
The Rural Centre
Ingliston
Newbridge
EH28 8NZ

0131 472 4100
www.saos.coop

Contents

Contents

Introduction and Background	3
Approach.....	5
Roadmaps	14
Conclusions	18
Appendix 1	18
Appendix 2	18
Appendix 3	18
Appendix 4	18
Appendix 5	19
Appendix 6	19
Appendix 7	19
Appendix 8	19
Appendix 9.....	19

Introduction and Background

This Report on a Blue Economy Plan for the Scottish farmed shellfish sector has been prepared for Crown Estate Scotland (CES) by SAOS Ltd in partnership with Poseidon Aquatic Resource Management, New Nutrition Business Ltd (NNB) and ThinkAqua.

The research undertaken led to the development of two scenarios which will contribute to the growth of the sector. The themes of co-development, ecosystem services and alternative markets are integrated into these two scenarios – building on previous CES research relating to critical mass model studies and alternative markets for farmed Scottish shellfish. Each scenario forms the basis of a development roadmap that industry can take ownership of and ensure that its findings are integrated into the Scottish Government’s Blue Economy Action Plan and will also be available for other strategic purposes.

The focus of this activity is derived from the ambition to grow the Scottish farmed bivalve shellfish sector as outlined in the 2017 Aquaculture Growth to 2030 Strategy and more recently in the Blue Economy Action Plan of the Scottish Government’s Programme for Government (Sept 2020). Both drivers promote the sustainable growth of aquaculture in Scotland with consideration for economic, environmental, circular economy and social/cultural impacts across the rural geographies that rely on this sector’s activity. Additionally, the growth of the bivalve farming and processing sector will contribute to the Scotland Food & Drink Partnership’s Ambition 2030, whilst opportunities to develop new businesses and address circular economy and environmental investment opportunities will contribute to the resilience of the sector.

Shellfish farming is Scotland’s most sustainable blue food sector producing high quality protein with a low environmental footprint. The majority of production is centred on mussels on vertical single ropes suspended in the water from heavy horizontal ropes and flotation buoys arranged in long lines normally parallel to the shoreline. Young larval mussels known as spat may arrive naturally in the tide and settle on the ropes. Scallops can be grown in a similar fashion, hanging from lines, or grown in small, suspended net enclosures known as lanterns. Oysters are normally grown in bags made from heavy plastic mesh, either lying directly on the shore or laid on platforms known as trestles.

Shellfish farming can be conducted at a range of scales from a crofting, lifestyle business to large-scale operations as well as providing income for a range of supply chain businesses across some of the most remote areas of Scotland.

The shellfish species cultivated in Scotland are all filter feeders from the group known as bivalves. Shellfish do not need to be fed by the farmer, being entirely dependent on naturally occurring food and nutrients from the sea. Natural stocking and feeding means that shellfish farming is considered to be highly environmentally sustainable.

The shellfish farming sector has been established for over three decades in Scotland, and the latest available figures in 2019¹ included production of around 6.7k tonnes of mussels and 4.7m oysters – bringing in circa £30m (at retail sales) per annum. The sector has built a reputation for high quality and environmentally friendly food production, which is well received by the consumer. The sector's products are stocked in all UK major multi-national retailers, as well as most seafood wholesalers and many foodservice outlets. Approximately 5% of cultivated stocks are currently exported from the UK and the remainder enters the domestic UK market, primarily to England.

Shetland dominates Scottish mussel production at around 80% of farm output and the Scottish Shellfish Marketing Group represents more than 80% of the Scottish mussel sector. Domestic output has been relatively stable over the last ten years, but there is a national vision, and sufficient sea site capacity, to almost triple output by the 2030s to 21k tonnes of mussels as a key component of the shellfish sector's overall target growth. This could achieve an associated increase in the value of all shellfish (following processing) farmed in Scotland to circa £90m (at current prices).

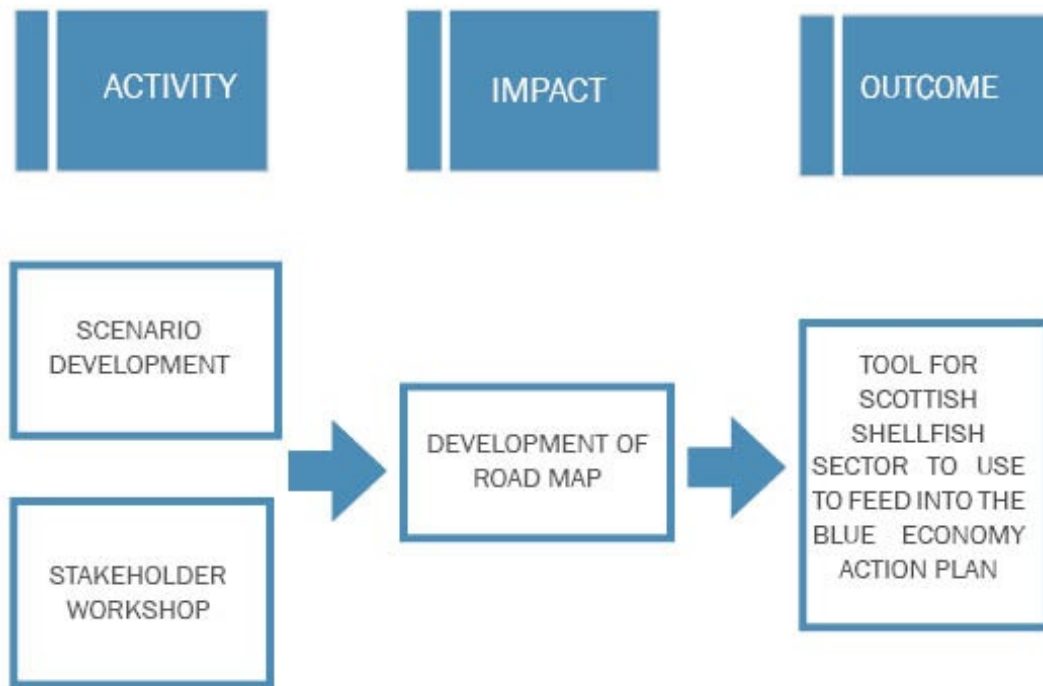
The challenges of scale and the limited potential for internal investments in the sector continue to constrain growth along with market challenges including competition of price and product format. To date the focus has been on production of high-quality mussels and oysters, capitalising on the provenance of production. If the sector is to grow then product format and market innovation is required, as well as exploration of alternative revenue streams including structural investment.

The shellfish sector needs to capitalise on its blue credentials to align the potential for Scottish Government investment with the critical and strategic areas the industry wishes to take forward – realising its development ambitions and supporting the continued growth of Scotland's reputation as a leader in sustainable production and climate change mitigation.

¹ Marine Scotland Data

Approach

A simple logic chain approach was adopted to develop two scenarios which would inform a viable plan for the future of the Scottish farmed bivalve industry as a key participant in Scotland's blue economy.



Scenario Development

The research phase of scenario development focussed on **identifying** prospects for industry growth by **developing** and **testing** scenarios which were informed by previous SWOT analyses and industry data. The overall approach combined a structured analysis with steering group and stakeholder consultation throughout the research timeline. The plan represents an optimal development strategy that offers realistic means for implementation.

The Steering Group comprised CES, Scottish Government and the Association of Scottish Shellfish Growers. The Stakeholder Group included a wider representation of organisations who provided input as to which bodies are best placed to drive forward development opportunities.

Initially eleven scenarios were presented to the Steering Group based around alternative markets, co-development and ecosystem services opportunities. Each was tested for its potential to contribute to the growth, development, investment potential and resilience of the Scottish farmed bivalve sector. This included new business activities/markets, value chains and potential new income streams.

The presentations associated with scenarios for Alternative Markets, Co-development and Ecosystem Services can be viewed in Appendices 1, 2 and 3 respectively. Each included a PESTLE analysis which examined the Key Drivers and Opportunities, Policy/Regulation and Consenting, Benefits, Barriers, Timescales and Actions. These were presented together with the extent to which the recommendations from previous studies - Critical Mass Study and the Alternative Markets Study - had been taken forward.

Following input from the Steering Group, two scenarios were selected that best reflected opportunities that would give a direction of travel to grow the sector

- (i) critical mass development
- (ii) ecosystem services and natural capital development for new production in less favourable sites

These scenarios are not mutually exclusive and alternative market opportunities were integrated into both. The Critical Mass Development Scenario is presented in Appendix 4 and Payment for Ecosystem Services/Increased Natural Capital Scenario is shown in Appendix 5.

Co-development indicates a development that is not made solely by a single shellfish developer, but in conjunction with:

- other aquaculture developers (to varying degrees)
- other marine developers (e.g. renewables)
- other marine users (e.g. environmental managers or local authorities)

As a result, there will be expected mutual benefits from such an arrangement which include:

- de-risking the development (e.g. more certain consent)
- reduced investment costs (e.g. through shared or subsidised costs)
- achieving economies of scale (e.g. enabling a larger, more viable development)

Analysis of the development scenarios included a review of scale and growth in target markets, expected investment costs and returns, and an indication of likely time to commercialisation. The plan for the two scenarios included objectives, outcomes, and prioritised timebound actions, along with the lead partner agencies and resources required.

The ecosystem services scenario was also assessed in terms of what is needed to ensure that the sector's contribution to sustainability targets (as defined in Government and commercial policies) was made. This included the identification of gaps in the evidence base that need to be addressed before green investment can be attracted, consideration of licencing of new sites, assessing positive news associated with growth in production and whether PES will influence production approaches.

Following further development, the two scenarios were presented to the wider Stakeholder Group in an online workshop to gather its collective views and provide clarification on the priorities and timescales associated with each. Prior to the meeting they had sight of the two scenarios.

Ten stakeholder organisations (Appendix 6) were invited and nine participated in an online meeting with the objective to capture views and comments on the two scenarios and to obtain a clear steer on preferences and priorities. In addition, the meeting aimed to identify barriers and, roles and responsibilities of organisations who were best placed to deliver/lead on the scenarios, capture indicative timescales and decide how to structure each scenario to feed into the BEAP.

Two presentations, which gave background to the alternative markets analysis and an understanding of the feasibility and challenges identified in the critical mass assessments, were given to the wider Stakeholder Group. These are found in Appendix 7.

Stakeholders were given an overview of previous research (Appendix 7) on alternative market development opportunities as the implications of these were relevant drivers to both scenarios – increased mussel demand will necessitate increases in production as well as offering routes to increase sales value growth.

After an introduction to each of the scenarios, the participants were invited to input their responses (both closed and free text) to six questions designed to gain an understanding of stakeholder preferences. Their anonymised responses can be found in Appendix 8.

After the meeting, the stages of a development roadmap for each scenario were developed and are presented in the final section of this report.

Stakeholder Meeting – Summary of Discussions

Alternative Markets Overview

The slides are available in Appendix 7.

In summary, growth opportunities exist in the current UK retail and foodservice markets and the potential for growth was presented in terms of displacing sources of imported mussels as well as growing consumption amongst existing customers and targeting new groups of consumers.

Innovation in product format was shown to be key in addressing a lack of product launches when compared to salmon. Deshelling capability is likely to drive the opening of new opportunities in retail and foodservice. Alternative markets associated with:

- (i) pet food sector (showing rapid growth) where the health halo that exists around mussels and joint health is transferable
- (ii) co-products extracted from shell or meat for supplements and nutraceutical markets

can all offer premium price returns.

The barrier to these opportunities is a lack of development and processing capabilities in Scotland (such as high-pressure processing and biorefining capabilities) to extract nutritional compounds from both shell and meat. Such facilities require significant investment. The lack of bioprocessing capabilities has also been identified in the oat, seaweed, and soft fruit sectors as a barrier to create a meaningful food ingredients sector in Scotland. Indeed, this could open up an opportunity for collaboration across sectors.

Three key points associated with alternative markets were highlighted:

- a need to establish the nutritional credentials of Scottish blue mussels for nutraceutical market – very few studies have been conducted in this area in comparison with studies on NZ green-lipped mussels
- mussel production volumes for alternative markets must be meaningful and guaranteed if competing to replace existing protein sources in animal feeds whilst quality standards must match that required for pet food markets
- a need to avoid any actions that undermine the premium reputation of line grown mussels in Scotland

The latter resonates with examples in the Scottish salmon, beef, and lamb sectors where strategies are in place to protect their high value branded products whilst also providing product for pet food and other sectors - so this could be addressed for the mussel sector.

Critical Mass Development Scenario

The slides are available in Appendix 7

This scenario focussed on mussels, but Pacific oysters cannot be discounted when developing the Scottish shellfish sector given their value.

Previous research (Poseidon, 2017) had shown that a farm scale below 200t/year shows marginal profitability.

Current licence capacity exists to achieve the growth ambitions by 2030, but improved production efficiency is needed to maintain profitability of the sector.

Shetland increased its share of production from 53% in 2010 to 80% in 2021. Some Shetland operators have purchased additional sites and collaborated with other owners to manage and harvest mussels on their behalf to achieve the more profitable scale identified in the critical mass approach.

Critical mass could be achieved with loch scale developments or offshore production sites (fewer, larger sites), but to achieve scale it is vital to obtain consent of local communities and create quality jobs.

A critical mass pilot for the Clyde identified nine sites across part of the water body that could be jointly developed to produce 2.5k tonnes. Other areas in Scotland could be identified for this approach.

Benefits to joint operation of multiple sites include: de-risking consenting process; sharing up front development costs; full utilisation of harvesting vessels; increasing successful spat collection and the improved feasibility of hatcheries.

A critical mass approach is consistent with Scotland's blue economy vision and National and Regional Marine Plan aquaculture objectives, but it still must be facilitated and led.

Points made by attendees:

- this type of development must start with the farmer
- DON'T assume that dredged mussels are lower quality as they are commanding a high price due to efficient process (cleaned, depurated) and good meat yield
- Scottish product tends to be low % meat/heavy shells as it takes three years to grow /often has fouling – everyone else has advanced
- 12-month supply – customers want shelf life, and this can't be done over 12 months - Scotland can't always achieve the quality and meat yield that is required across this period

[**Note:** in the Action Plan we propose research to explore these market perceptions as they contrast to concerns over reputational risk of alternative markets]

- Shellvolution project (£6.5m project spread over 10 years) is looking at challenges to growth in the HIE region. Three thematic areas - industry wide model for spat collection, farm and loch-scale predictive growth models, and supporting industry best practice models to support enhanced productivity and sustainability for businesses.

A wide discussion followed and addressed the following questions which were presented via Mentimeter (Appendix 8)

Q1 What are the main challenges in progressing a loch scale development model?

- finance/cost: a common challenge and increases with scale
- infrastructure: Shetland Council invested in piers which is necessary for fuel and time if sites are spread over a large area. Availability of infrastructure needs to be a selection criterion along with carrying capacity and marine environmental designations
- collaboration: difficult in practice with commercial operators – don't all necessarily have same vision/ambition. Collaboration with other users up and down the supply chain can also be challenging. Additionally, new knowledge requires collaboration between public and private partnerships with a science base

Q2 Who is best placed to lead on loch scale development?

A project-based group (multiple stakeholders) received most votes as it lends itself to collaborations. Additional points:

- has to be driven by sector to agree on best way forward and agree direction of travel, - with other bodies e.g. local authority contributing or taking a supporting role
- industry driven/led but buy-in from policy and decision makers needs to be there too if public money involved then assessment of case for additionality (impact on beneficiaries direct and indirect) and displacement.
- if loch-based system was to significantly uplift what is going to market then you have to appraise the impact of that on the existing private sector business sector that already exists

Q3 What role should other groups have in implementing loch scale development?

- facilitation and contribution by others
- entrepreneurial environment - given the risk of sector, knowledge-based opportunity for working with scientists, appetite for learning, innovating, developing and improving, entrepreneurial spirit needs to be nurtured
- labour availability – quality jobs needed
- water quality, marine planning
- application of new technologies to improve productivity and environmental performance

- access to finance
- market development support

Critical mass should be driven by the sector (both existing entrepreneurs and new entrants who see potential in economies of scale), but they need support from Government, policy makers and decision makers.

PES and Natural Capital Development Scenario

The slides are available in Appendix 7

A payment for ecosystem services was introduced during the Alternative Markets Study as an opportunity to grow overall mussel production, potentially in new areas, and make the industry more financially attractive, whilst also addressing coastal water quality issues. The availability of green finance potentially linked to a more overt reference to the ecosystem services provided by shellfish farming also served as a driver.

The original study had explored the potential to continue the trend of one-off, sporadic projects based largely on business-to-business agreements; or to create a payment incentive for new farms in specific areas using specific technology; or to pay all farmers (existing and new) for the ecosystem services provided generally by shellfish farming. After discussion with the Steering Group there was agreement to focus on the incentive for new farms in specific areas as this would help to drive innovation, address local water quality issues, and attract new entrants.

New sites in areas of need are more likely on the east coast of Scotland, where population density and agricultural intensity pose a greater risk to coastal water quality. Any development of shellfish farming in less-pristine waters raises immediate questions around the overall risk to the Scottish mussel brand, which is built around production in pristine waters; there are also questions around regulatory and licencing requirements, as well as food safety. If the farm was understood to have benefits for the coastal environment, would it need to go through the same planning regime? What are the monitoring needs and what would be the conditions for any payment to be released?

A key focus for production in these areas is likely to be pet food, to distance the product from that produced for human consumption. This may also reduce concerns about the growing water quality and depuration needs because the product will always be processed/cooked. Alternatively, the shellfish could simply be grown and remain in situ for sustained environmental benefit, and this may be supported differently.

PES systems are still relatively new globally, although examples exist in the USA with a blend of government and commercial payment processes. Some detailed exploration of similar systems has taken place in Northern Ireland and in Hampshire, England.

Further discussion followed and addressed the following Mentimeter questions (Appendix 8)

Q1 What are main challenges (or specific opportunities/actions needed) in progressing a PES model?

- determining the need for legislation – all of this may be possible under existing legislation, especially if examples from land-based natural capital/ecosystem services payment processes can be replicated (e.g. Peatland model from NatureScot)
- how will it be funded and who will pay for it?
- do we need to map where these locations are and highlight the potential to investors?
- monitoring could use existing criteria for quality, including the presence of specific organisms. In some locations it would be linked to increase/decrease in numbers of a particular species. Could be challenges with confirming small incremental changes over large areas/long periods
- depending on the scale of a single farm in relation to the service required it may be better to make payments based on specific infrastructure/management approaches rather than specific outcomes. Some benefits may not reach scale until a large number of farms are in a specific location

Q2 Who is best placed to lead on PES development?

Marine Scotland was considered best organisational lead although it was recognised that there is a potential role for others. SEPA already has data on water body classification and nutrient modelling, as well as discharge monitoring processes which could be accessed.

Q3 What roles should different groups have in implementing and monitoring PES?

Marine Scotland was identified as the lead agency, with monitoring input from SEPA and NatureScot. Additional proposals referenced the investment element, including a potential role for the Scottish National Investment Bank. There was recognition of the need for input from both financial backers and those with the skills to produce shellfish at scale and it was noted that they would form two separate groups.

PES Discussions

Open discussion followed, with repeated concerns expressed regarding the likely impact of increasing volumes on price and the reputational risk of PES-based production in lower-quality waters. However, it was highlighted that even Class A waters are not necessarily Class A all year round. It was also recognised that some mussel buyers are already seeking reassurance that salmon farming is not taking place close to the production site. Depuration is likely to be needed and any PES will need to consider these extra costs. There was also discussion that pet food manufacturers too are looking for high quality products with provenance.

In terms of the potential to include PES within the Blue Economy Action Plan, the timescale is for a high-level document in Autumn 2022, with detail being developed thereafter. A new seafood strategy and aquaculture vision are also due later in 2022. The vision won't make tonnage commitments, but will look to support industry growth generally.

In summary, the group agreed that PES could drive new farms particularly in areas of less pristine waters, but that policy development and regulatory requirements would need to be streamlined to define how it happens and prevent unintended consequences. There was a suggestion to map potential locations to help attract finance, and to drive innovation for greater natural capital development in support of the Blue Economy Action Plan.

Roadmaps

The process of consultation enabled roadmaps to be set out for each of the two development areas. These roadmaps include specific tasks required to bring the ideas to fruition and identify the resources needed to support that process, both from existing agencies and external experts. Recognised throughout is the priority for effective collaboration amongst different agencies and the need to attract investors into the sector.

Roadmap for Critical Mass Development

	Action	Detail and sub-tasks	Potential lead and partners	Timing and links to other actions	Resources
	Development Plan				
1	Legislation and policy review	To ensure these facilitate new large-scale developments & modifications. Based on Clyde pilot and highlighting Scotland-wide implications. Identify barriers and where such development could be facilitated. Including extent of designated shellfish waters	Lead: Marine Scotland Partners: SEPA, FSA, Local Authorities, Crown Estate Scotland	Priority action. 6-month review	Internal staff resources or funding for independent review (est. 6 months, £25-40k.)
2.a	Clyde Critical Mass Development Project	Define & establish roles of project partners & other stakeholders throughout the project cycle from pre-planning through to production	Lead: Project Team Commissioned by Marine Scotland Partners: (steering group): Crown Estate Scotland, Clyde Local Authorities, SEPA, FSA	After Action 1 (as barriers identified may determine appropriate model)	Commissioned Project proposed with dedicated resources to manage delivery of the Clyde pilot (est. 2 years, £120-150k)
2.b	Engagement with growers / prospective developers in the Clyde region	First engagement with existing growers in the region to gauge interest & views, explore potential business models. Depending on response, expansion to other growers / prospective developers	Lead: Clyde Local Authorities (or Clyde Marine Planning Partnership). Partner: Marine Scotland	As part of Action 2	Local authority planning staff, working with the Development Project (ongoing basis following pilot project set-up)
2.c	Community consultation in Clyde to determine acceptance and interest in significant shellfish farming development	Early engagement with communities encouraged to address concerns and identify opportunities for greater involvement (ownership/employment).	Lead: Clyde Local Authorities (or Clyde Marine Planning Partnership). Partner: Marine Scotland	As part of Action 3	Local authority planning staff, working with the Development Project (ongoing basis following action 2.b)

		Link with co-existence study proposals re. engagement with fishing interests			
3	Identification of other water bodies and roll-out of critical mass approach in those areas	Following on from successful progression of development in the Clyde region	Lead: Marine Scotland Partners: Other LAs or regional marine planning partnerships.	After Actions 1-4 (successful development in Clyde)	Marine Scotland staff engaging with regional marine planning partnerships (est. 3 months)
4	Marketing plan	To increase awareness of benefits of mussels among UK buyers	Lead: Seafish Partner: SSMG	After Actions 6-7	Specific project within Seafish marketing strategy (est. 1 year: 3 months development, 9-month implementation)
	Research Plan				
5	Carrying capacity research for Clyde region	Clyde pilot study used a precautionary estimate, suggesting an increase in permitted production possible with more research.	Lead: Marine Scotland Science Partners: SEPA, research institutes.	At same time as Action 2	Commission research: (est. 6 months)
6	Nutritional properties	Comparative review of nutritional properties (nutrient compounds & minerals) of Scottish mussels in raw, cooked, oil & powder forms c/w NZ green lipped and other shellfish	Lead: Food Standards Scotland Partner: Marine Scotland Science	Before Action 4	Commission research: <ul style="list-style-type: none"> Literature review Laboratory analysis (est. £50k, 6 months)
7	Market perception	Consultation with European buyers to identify positive aspects to capitalise upon and where improvements may be needed	Lead: Seafish Partner: ASSG	Before Action 4	Commission researched (est £20k, 3 months)
8	Extraction facilities feasibility study	Cost/ benefit analysis. Raw material supply (consistency of supply), capital costs, markets, locations and potential funding sources	Lead: Scottish Enterprise/Highlands & Islands Enterprise Partner: Marine Scotland	After Action 6 Informed by work on nutritional properties of Scottish mussel	Commission research (est. £50k, 6 months)

Roadmap for a Payment for Ecosystem Services/Natural Capital Development

All elements should be linked to Blue Economy Action Plan as it develops

	Action	Detail and sub-tasks	Potential lead and partners	Timing	Resources
1	Research and data collection	Evidence will be required to support policy development. Examples from the rest of world (North America, Northern Ireland, Denmark) can be built upon, but there will likely need to be specific data collection in Scotland	Potential lead agency: Marine Scotland, Crown Estate Scotland	Priority action. Year 1	External expertise with knowledge of specific systems. Government visit/workshop for cross-learning. (est. 6 months, £30-50k)
		Understand the economic viability of any business based around PES	Marine Scotland, Crown Estate Scotland	Year 1	Linked into work above
2	Regulatory requirements: Designation and monitoring needs	Explore processes required for identifying and designating potential areas where shellfish development would be encouraged through the provision of a PES, e.g. where there is a heavy nutrient loading into the coastal environment, or significant seabed impact. Advertise potential areas for lease	Marine Scotland, SEPA, NatureScot, Crown Estate Scotland	Early in Year 2	Add into agency programme of work as will likely need dedicated staff going forward. (0.25 FTE in each of 4 agencies)
		Planning processes may need to be updated to enable swifter, simpler processing of applications with a recognised positive contribution to natural capital (especially where the need is already recognised).	Planning departments, marine area partnerships	Start early in Year 2 , following initial research phase	Add into agency programme of work as will likely need dedicated staff going forward
		Monitoring process and criteria development. Monitoring of production at specific PES sites will need to be undertaken, especially if the PES requires quantifiable performance metrics. There may be scope to utilise existing measures for environmental degradation to understand gains.	Marine Scotland, SEPA, NatureScot	To be determined alongside area designation work later in Year 2	Add into agency programme of work as will likely need dedicated staff going forward. (0.25 FTE in each agency)
3	Valuation	Determine the value of any PES, potentially varied	Marine Scotland, SEPA, NatureScot	To be determined	Add into agency program of work as will likely need

		based on the both the need in a specific location and the effectiveness of the solution proposed. Take lessons from land-based examples (e.g. Peatlands, Rural Payments Scheme).		alongside items in Action 2. Likely end of Year 2	dedicated staff going forward. (0.25 FTE in each agency)
4	Promotion	The presence of a PES system would be pioneering and could attract investment to Scotland. Promotion of the system would be necessary	Marine Scotland, Crown Estate Scotland	Delivered once a clear system and areas have been identified. Likely start of Year 3	External expertise to support (£30k)
5	Updating	As the system is implemented lessons will be learnt. A process for review and update should be established	Marine Scotland lead, input from all	On-going from Year 3	

Conclusions

Key Points

If the Scottish shellfish industry is to grow there is a need for innovation in development strategies that likely lies in the more entrepreneurial parts of the current industry or in external companies. The industry, Government and other supporting agencies need to attract investors who can see the potential to scale the industry and satisfy new markets. Actively identifying and promoting key opportunities should enable this, but it will not happen without strategic investment and action by businesses and organisations such as Crown Estate and Marine Scotland.

The two main areas identified to offer this potential now have outline roadmaps for delivery. Critical mass development will require sites to be identified and potential promoted. Similarly, a payment for ecosystem services (or natural capital development) requires Government and associated agencies to identify and highlight the opportunities – alongside the development of any enabling environment.

Market opportunities exist in both new and existing sectors and any increase in production could help to drive growth without negatively impacting existing markets and reputations. However, competition in the marketplace on both quality and price needs to be considered. In light of these challenges, additionality in the form of supported critical mass development may help to attract investment at the scales needed to overcome economies of scale. A payment for ecosystem services could tip the economic balance, whilst also providing broader positive outcomes for Scotland's coastal environment. Investment in new processing technology could support development in other sectors of Scotland's economy.

We encourage all stakeholders to act upon the processes outlined in these roadmaps in order to realise the potential of Scotland's farmed shellfish sector as a key contributor to the rural economy.

Appendix 1

[Alternative Markets Scenarios presented to Steering Group Feb 2022](#)

Appendix 2

[Co-development Scenarios presented to Steering Group Feb 2022](#)

Appendix 3

[Ecosystem Services Scenarios presented to Steering Group Feb 2022](#)

Appendix 4

[Critical Mass Development Scenario August 2022](#)

Appendix 5

[Payment for Ecosystem Services/Increased Natural Capital Scenario August 2022](#)

Appendix 6

Organisations invited to Stakeholder Meeting August 2022

SEPA

Highland & Islands Enterprise

Seafood Scotland

Nature Scot

Argyll & Bute Council

Clyde Marine Plan

Shetland Council

Marine Scotland

Offshore Shellfish

Crown Estate Scotland

Appendix 7

[Presentation 1 delivered at Stakeholder Meeting August 2022](#)

[Presentation 2 delivered at Stakeholder Meeting August 2022](#)

Appendix 8

[Mentimeter results from Stakeholder Meeting August 2022](#)

Appendix 9

[Visual representation of roadmaps](#)