Foras na Mara
Marine Institute

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14 February 2024

Aquaculture Licence Appeals Board
Kilminchy Court
Dublin Road
Portlaoise
Co. Laois R32 DTW5

Your Ref: **AP2/1-2/2023**
Site Ref: **T09/093**

To whom it may concern,

In reference to your letter dated 20 December 2023, requesting further information regarding our application for a renewal of the aquaculture licence for site T09/093, we enclose the following records and documents as outlined below. Records have been included from 2017 onwards, as that was the year in which the conditions of the licence were amended by the Department of Agriculture, Food and the Marine to change the species cultivated on site to finfish, shellfish and seaweed, for research purposes (see attached).

1. Relevant information relating to environmental and ecological surveys.

Benthic Monitoring (Monitoring Protocol No. 1)

- Benthic monitoring reports 2016 – 2023. **Record 1 – 7.**
- Benthic monitoring individual site review 2018 - 2022. **Record 8.**
- Marine Institute Benthic Audit Report 2022. **Record 9.**

Water Column Monitoring (Monitoring Protocol No. 2)

- Water column monitoring reports 2019 – 2023. **Record 10.**

Sea Lice Monitoring (Monitoring Protocol No. 3)

- Sea lice monitoring data for *Lepeophtheirus salmonis* and *Caligus elongatus* 2018 – 2023. **Record 11.**

Fish Health/Veterinary Reports

- Fish Health Authorisations 2017 – 2023. **Record 12.**
- DAFM Veterinary Inspector follow-up reports 2018 – 2023. **Record 13.**
- Health Reports
    - Health report lumpfish 2018, **Record 14.**
    - Report 19/176a 2019, **Record 15.**
    - Report 20/012a 2020, **Record 16.**
    - Report F113-21 2021, **Record 17.**
    - Report 0171ie23 2023, **Record 18.**

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Information on Current Speed

- Lehanagh Pool ADCP Report – in order to obtain data on the mean bottom-current speed and direction of residual current flow, an acoustic doppler current profiler (ADCP) was deployed on site between July 2022 and February 2023. The information obtained will be used to inform future benthic monitoring surveys. **Record 19.**
- Current meter data – A Valeport MIDAS ECM was deployed on site to measure surface currents (at a depth of 4 m) and a short report is included. **Record 20.**

Information on Current Models and Wave Height

- Information on hydrodynamic modelling and currents is included in section 4.
- There is currently no information available regarding wave height at the site. A short report describing wave height at the entrance to the Bay was provided in the original application.

2. Information relating to species stocked.

- A list of all species and numbers stocked on to the site is included. **Record 21.**
- In 2020, DAFM provided a template and requested a quarterly report of the biomass of finfish stocked on site. A copy of the submitted reports is provided. **Record 22.**

3. Reports from the Marine Engineering Division.

- Marine Engineering Division reports 2020 – 2023. **Record 23.**

4. A modelled output image showing the risk of spread of infectious diseases from the site.

- A short report is included illustrating the dispersion of particles in the Bay from the site using a particle-tracking model coupled to 3D currents generated by a hydrodynamic model. **Record 24.**

5. A copy of the Integrated Pest Management Plan.

- Lehanagh Pool Integrated Pest Management Plan 2022. **Record 25.**

6. Natura Impact Statement.

- In Part 5 of the licence application form, section 4a NIS was incorrectly entered as 'yes' instead of 'n/a' as per Section 2.1 (xvi) of the original application form.

We remain available should you require any further information.

Yours sincerely,

Neil Ruane
FEAS Aquaculture Section

Department of
Agriculture,
Food and the Marine
An Roinn
Talmhaíochta,
Bia agus Mara

27 July 2017

Site Ref: T09/093A

Dr. Dave Jackson
Marine Institute,
Rinville,
Oranmore,
Co. Galway

FISHERIES (AMENDMENT) ACT, 1997 (NO.23), FORESHORE ACT, 1933 (NO. 12)
NOTIFICATION OF MINISTER'S DECISION TO GRANT AN AMDENMENT OF AQUACULTURE LICENCE (AQ176) AND A REPLACEMENT FORESHORE LICENCE.

Dear Dr. Jackson,

I would like to inform you that the Minister for Agriculture, Food and the Marine has approved the granting of an amendment of the Marine Institutes existing Aquaculture Licence(AQ176) and a replacement Foreshore Licence, to change the species cultivated from cod to finfish, shellfish and seaweed for research purposes at site No.T09/093A (See attached information note). I enclose a copy of the public notice of the decision which **the Department** has arranged to have published in "The Connacht Tribune" and "Iris Oifigiuil".

Any person aggrieved by the decision may, in accordance with Section 41 of the Fisheries (Amendment) Act 1997, appeal against it in writing to the Aquaculture Licences Appeals Board. This appeal must be lodged within one month beginning on the date of the publication of the decision.

In addition, a person may question the validity of the Foreshore Licence determination by way of an application for judicial review, under Order 84 of the Rules of the Superior Court (SI No. 15 of 1986). Practical information on the review mechanism can be obtained from the Citizens Information Board at: http://www.citizensinformationboard.ie/

The amended Licence will be issued to you as soon as possible after the end of the period of one month from the date of publication of the notice in "The Connacht Tribune", if there is no appeal.

Please also find enclosed the conditions that will apply to the amended Aquaculture Licence and the Foreshore Licence that may be issued by the Minister.

Yours sincerely,

Thérèse ó Cuaig

Aquaculture and Foreshore Management Division

An Roinn Talmhaíochta,
Bia agus Mara
Department of Agriculture,
Food and the Marine

S.12 (3) OF THE FISHERIES (AMENDMENT) ACT, 1997(NO.23)
INFORMATION NOTE TO APPLICANT FOR THE PURPOSE OF REGULATION 18 OF THE AQUACULTURE (LICENCE APPLICATION) REGULATIONS 1998

REFERENCE NO:	**T09/93**
APPLICANT:	**Marine Institute**
AQUACULTURE TO WHICH DECISION RELATES:	to change the species cultivated from cod to finfish, shellfish and seaweed for research purposes at a site in Lehannah Pool, Beirtreah Buí Bay, Co. Galway
NATURE OF DECISION:	Grant of Amendment Aquaculture Licence and replacement Foreshore Licence
DATE OF DECISION:	**26 July 2017**
CONDITIONS OF LICENCE:	See attached.
DURATION OF LICENCE:	As per existing licence 35 Years; expiry date 31 May 2019
ISSUE OF LICENCE:	The amendment licence will be dated and issued as soon as practicable after the end of the period of one month from the date of publication of a notice in a newspaper circulating in the vicinity of the aquaculture, if no appeal is made to the Aquaculture Licences Appeals Board within that period, under Section 40 and 41 if the Fisheries (Amendment) Act, 1997.

Note: It has been decided to grant the applicant a separate Foreshore Licence under the Foreshore Act, 1933 (No.12), contemporaneous with the Aquaculture Licence, subject to standard conditions applicable to Foreshore Licences.

Donegan, Fergus (Alab)

From: Neil Ruane [redacted]
Sent: Wednesday 14 February 2024 12:23
To: Alab, Info
Subject: T09/093 S46 response Marine Institute

Importance: High

Dear ALAB,

In response to your letter dated 20 December 2023, the Marine Institute has submitted the requested information today via HEAnet FileSender.

We would be grateful if you could confirm receipt of the files.

Regards,

Neil.

Neil Ruane, FEAS Aquaculture Section
Marine Institute | Rinville | Oranmore | Co. Galway | H91 R673 | Ireland

Foras na Mara
Marine Institute

Treanbeg Marine Consulting

Fergal Guilfoyle
[redacted]

Treanbeg Marine Consulting is a trading name of Treanbeg Shellfish Ltd [redacted]

22nd December 2016

Benthic monitoring report for Lehanagh Pool, Bertraghboy Bay, Co Galway.
License site AQ 176, Client Marine Institute

Author: Fergal Guilfoyle – Treanbeg Marine Consulting

Client: Frank Kane
[redacted]

Field survey conducted on 24th November 2016

Introduction:

The Marine Institute holds the Aquaculture and Foreshore licenses for a small marine finfish aquaculture growout site in Bertraghboy Bay, Co Galway. All such licensed sites are required to be monitored and to conduct an annual benthic survey. There was no stock onsite during the survey. Cod (*Gadus morhua)* had been transferred onsite in 2014 , as a trial and the site had been harvested out in 2015.

Treanbeg Marine Consulting conducted the 2016 survey.

Bertraghboy Bay in Co Galway

The Lehanagh Pool site is situated in Cashla Bay (aka Cashel Bay) which is located at the north-eastern extremity of Bertraghboy Bay.

Figure 1: Satellite image from GoogleEarth with the general location of the Lehanagh Pool site indicated.

Figure 2: Close up of the cage layout at Lehanagh Pool. There are currently 2 empty square cages approximately 10mx10m and one empty circular cage with a diameter approximately 10m.

Department of Agriculture, Food and the Marine (DAFM) benthic monitoring protocol:

The DAFM benthic monitoring protocol details the extent, detail and scope of surveys. This depends on the current regime on site and the biomass for which the site is licensed. The license being surveyed is limited to a maximum production of 100 tonnes of Cod and therefore the site was subject to Level I monitoring.

Level 1 monitoring involves:

Level I: Video/photographic and visual observations (see Section 6) and recordings shall be made at the following stations:

- At a minimum of 2 sites directly beneath the cages
- At the edges of the cages
- Two transects at right angles to each other. Along each transect sampling stations at +/- 10m, +/- 20m, +/- 50m and + 100m from the cages (see Figure 1)
- At a control site (see criteria in Section 4 below)

In addition to the above, the following samples / measurements shall be taken at the same stations as above. These will be used to calculate sediment quality parameters.

- A minimum of one Redox potential readings shall be made at each sampling station (Section 7).
- A single sediment sample for Organic Carbon measurement (Section 8).

Methods:

Field work was undertaken on 24th November 2016.

The weather was calm and sunny.

Grab samples were made at each of the sample stations indicated in the chart below.

A 0.025m2 van veen grab was used to collect each sample. A successful grab was taken at each sample site.

Redox was measured at 1cm intervals from the surface (1cm), to the sediment depth to which the probe reading returned a negative result and therefore indicated a discontinuity in the redox potential of the sediment. The redox meter was calibrated against standard Zobell's solution.

The sediment sample was inspected and the appearance was noted together with a description of the sediment type.

A sub-sample was removed for organic carbon analysis. % Organic Carbon was determined by combustion, one of the methods approved in the DAFM monitoring programme. Tests were subcontracted to Glan Uisce Teo labs, Furbo, who in turn send the samples to the UK for analysis.

A dive was undertaken to take photographs of the seabed at each of the stations indicated below. Unfortunately on the day the primary camera lighting system malfunctioned and it was not repairable onsite. A secondary camera system was used but the quality of the photographs fell short of the high standard expected. However the photographs and video, together with the notes made onsite by the diver, are of sufficient quality to allow for an assessment of the sediment surface quality under the cages and at various distances from the cages.

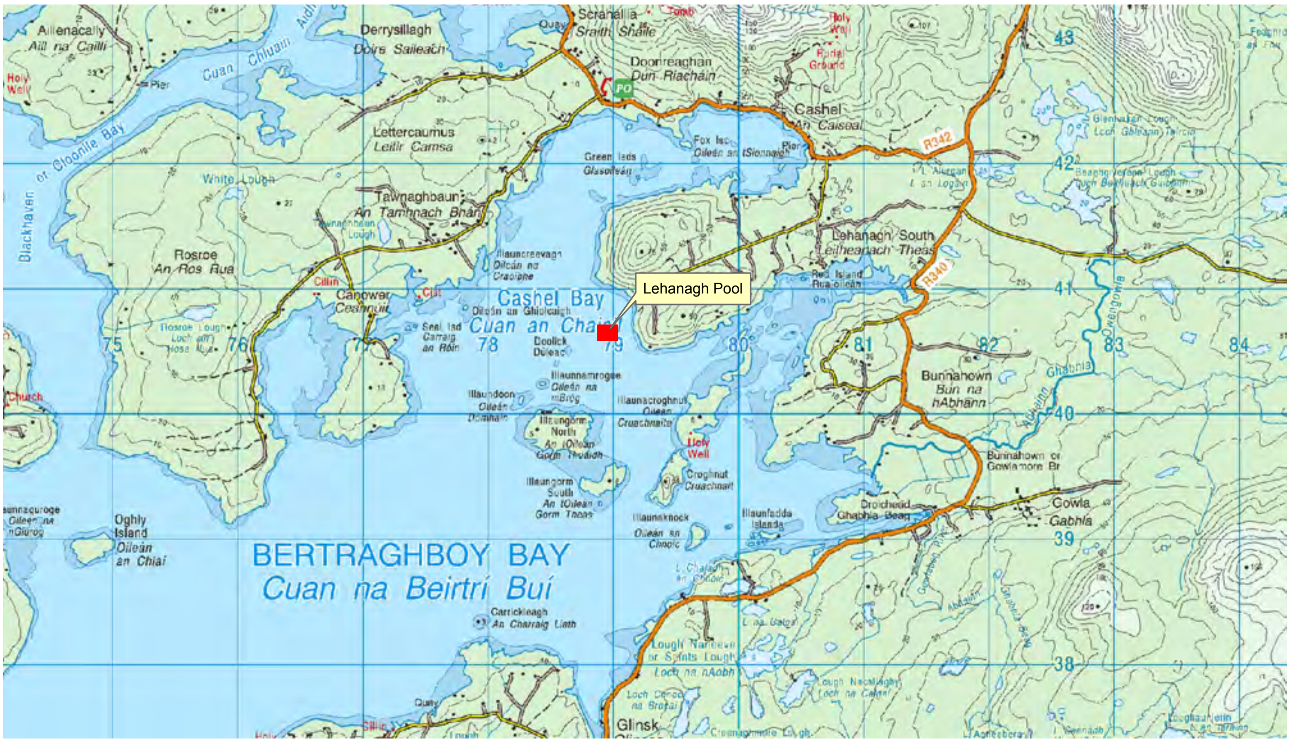


Figure 3: OS map of the general area of the cage site with the Lehanagh Pool site indicated.

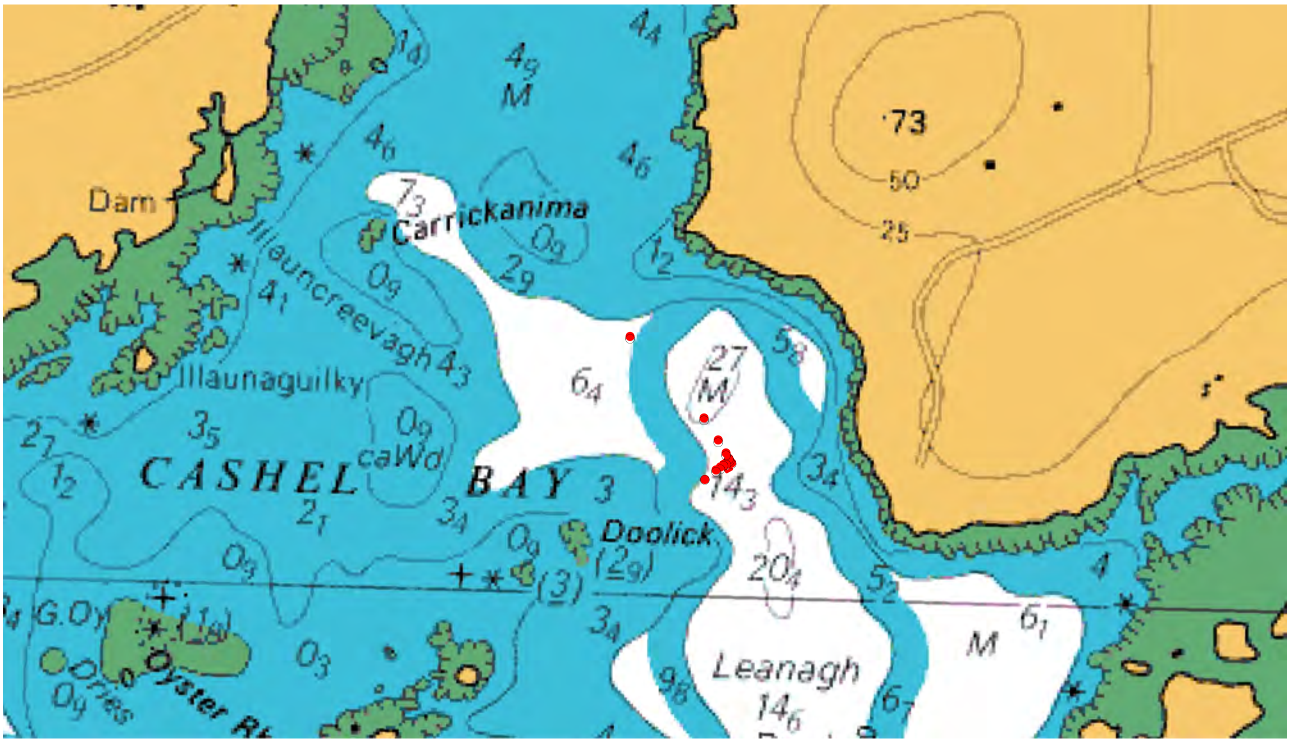


Figure 4: Admiralty chart of the general site area with the sampling stations indicated.

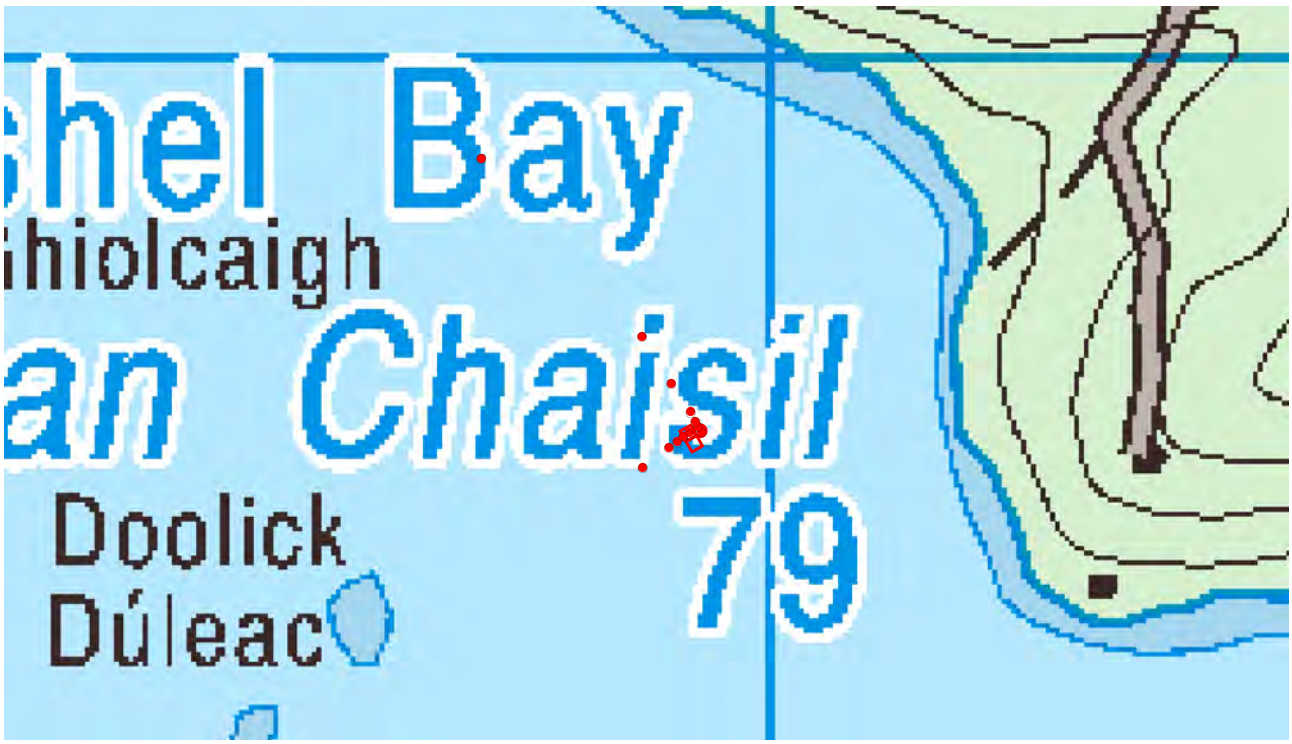


Figure 5: OS map of the site area with the sampling stations indicated.

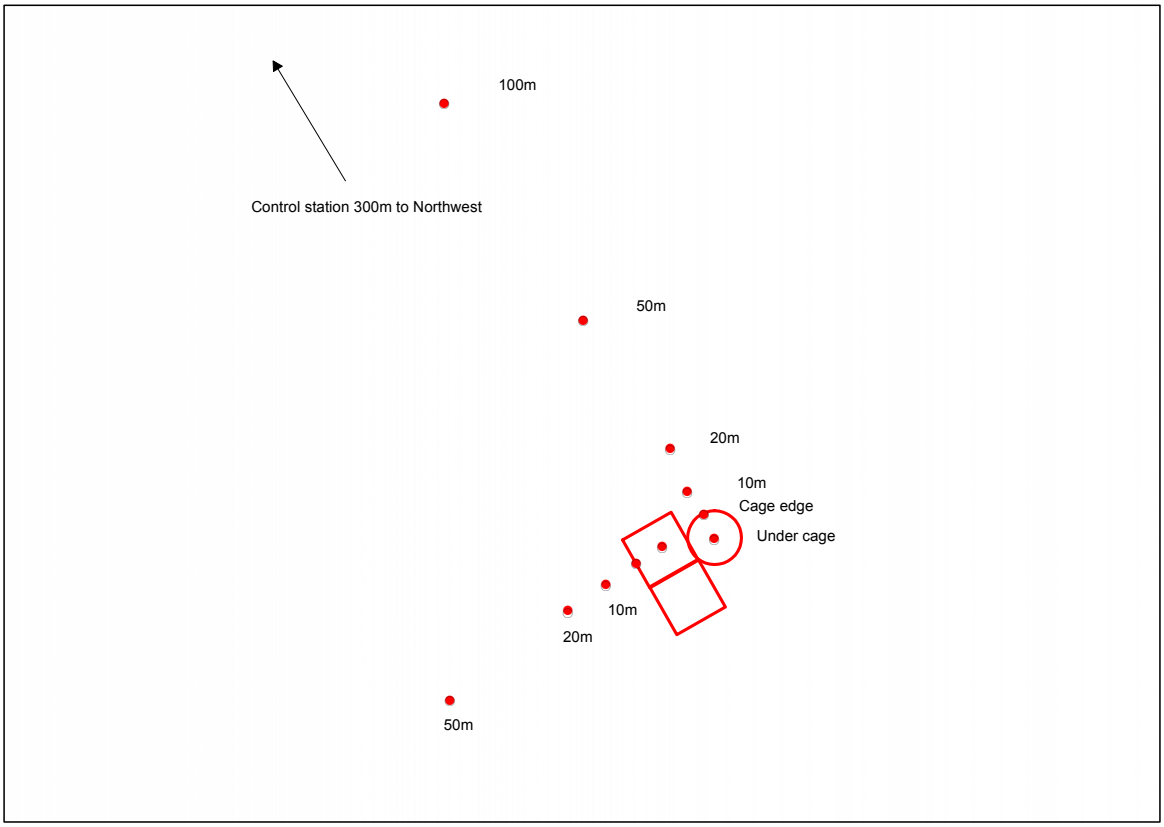


Figure 6: Diagram of the site area with the layout of the 3 cages (empty) and the location of the sampling stations indicated. The control site is not shown on the diagram but was approximately 300m northwest of the cages.

Results:

REDOX:

The apparent redox potential discontinuity (ARPD), the % organic carbon content and the general visual description of the sediment are tabulated in Table 1:

Transect	Sample station	ARDP Depth	Organic Carbon Content	Description
1 Northwest	Under cages	2cm	4.04	Thick grey mud
1 Northwest	Cage edge	2-3cm	3.31	Thick grey mud
1 Northwest	10m	3cm	3.64	Thick grey mud
1 Northwest	20m	2cm	4.24	Thick grey mud
1 Northwest	50m	2cm	4.42	Thick grey mud
1 Northwest	100m	1cm	3.93	Mud, shell and sand
2 Southwest	Under cages	2cm	3.2	Thick grey mud
2 Southwest	Cage edge	2cm	7.25	Thick grey mud
2 Southwest	10m	3cm	3.98	Thick grey mud
2 Southwest	20m	1cm	4.44	Thick grey mud
2 Southwest	50m	2cm	4.3	Thick grey mud
Control site 300m NW	Control	3cm	2.63	Mud, shell and sand

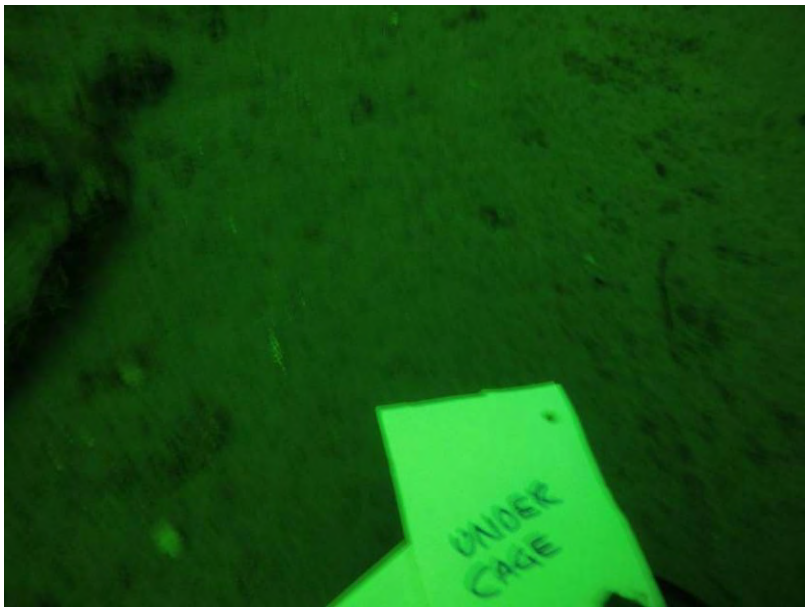
Visual description of sediment surface:

Transect	Sample station	Description of seabed surface	Beggiatoa Mat	Visible impact from fish farm
1 Northwest	Under cages	Sediment is fine mud and the seabed is healthy looking, covered with filamentous algae, with no obvious signs of biological impact from the pressence of the farm. No indication of bacterial mat (Beggiatoa spp) There is some rubbish on site. Mussel shells, car tyre, length of rope, filamentous algae (Audouinella spp.), loose brown algae, Zostera stems (loose).	No	No biological impact obvious, some litter items
1 Northwest	Cage edge	Sediment is fine mud and the seabed surface appeared healthy. No visual impact of the presence of fish cages. No Beggiatoa present. Surface is covered with filamentous algae. Diver reports various shells and zostera fragments.	No	No
1 Northwest	10m	Sediment is fine mud but not covered with any algae. No visual impact of the presence of fish cages. No Beggiatoa present. Tracks of molluscs and crustaceans visible on surface.	No	No
1 Northwest	20m	Sediment is fine mud and partially covered with filamentous algae. No visual impact of presence of fish cages. No Beggiatoa present. Diver reports shells and fragments of crustaceans.	No	No
1 Northwest	50m	Sediment is fine mud, partially covered with filamentous algae. Some shell and tracks of crustaceans and molluscs. Some loose brown algae fragments.	No	No
1 Northwest	100m	Sediment surface is sand, shell and fine mud. Some filamentous algae cover. Many shells of various mollusc species.	No	No
2 Southwest	Under cages	Sediment is fine mud. Some filamentous algae coverage. No obvious signs of biological impact from the pressence of the farm. No indication of bacterial mat (Beggiatoa spp) There is some rubbish on site. Mussel shells, filamentous algae (Audouinella spp.), loose brown algae.	No	No biological impact obvious, some litter items
2 Southwest	Cage edge	Sediment is fine mud and the seabed surface appeared healthy. No visual impact of the presence of fish cages. No Beggiatoa present. Surface is covered with filamentous algae. Diver reports various shells and zostera fragments.	No	No
2 Southwest	10m	Sediment is fine mud with some filamentous algae cover. No visual impact of the presence of fish cages. No Beggiatoa present. Some shell and obvious signs of crustacean presence.	No	No
2 Southwest	20m	Sediment is fine mud with thick layer of filamentous algae (Audouinella spp.). Appearance is healthy and there is not obvious visual indication of an impact from the fishfarm cages.	No	No
2 Southwest	50m	Sediment is fine mud with thick layer of filamentous algae (Audouinella spp.). Appearance is healthy and there is not obvious visual indication of an impact from the fishfarm cages.	No	No
Control site 300m NW	Control	Sediment is fine mud, shell and some sand. Some filamentous algae (Audouinella spp.) present. Appearance is healthy and there is not obvious visual indication of an impact from the fishfarm cages. Diver reports that there is no indication of an impact from the farm cages at any stage on 300m swim from under cages to 300m control site or along transect to south-west from under cages to 50m station. Only impact is few pieces of rubbish directly under cages (tyres, ropes etc)	No	No

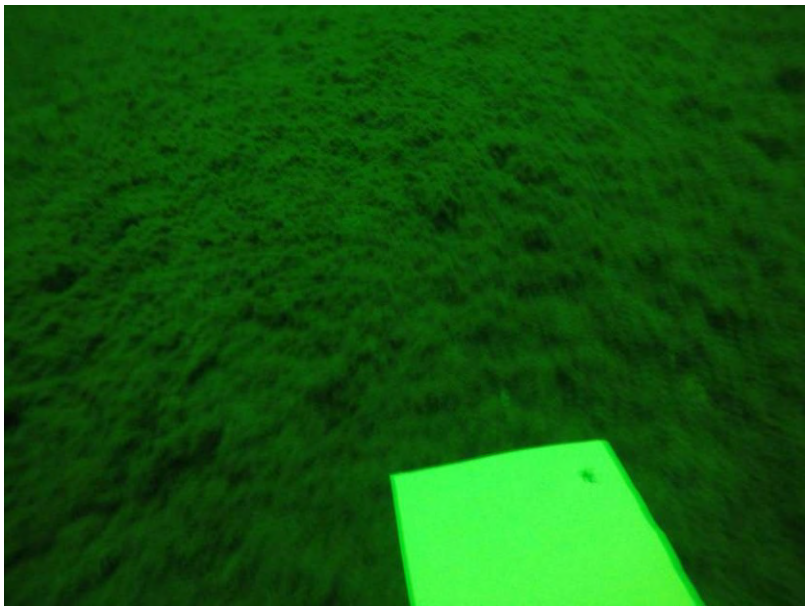
Table 2: A description of the seabed from photographs, videos and divers notes.

The photographs from each of the sample stations are shown below. The description in table 2 above is derived from these photographs, divers notes and the visual inspection of the sediment in the grab sample at each station.

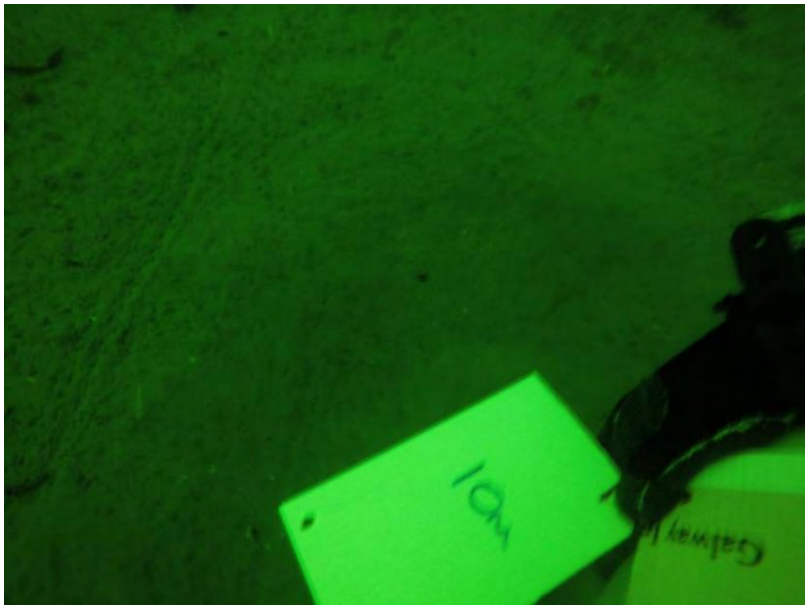
T1 North-west Under Cages:



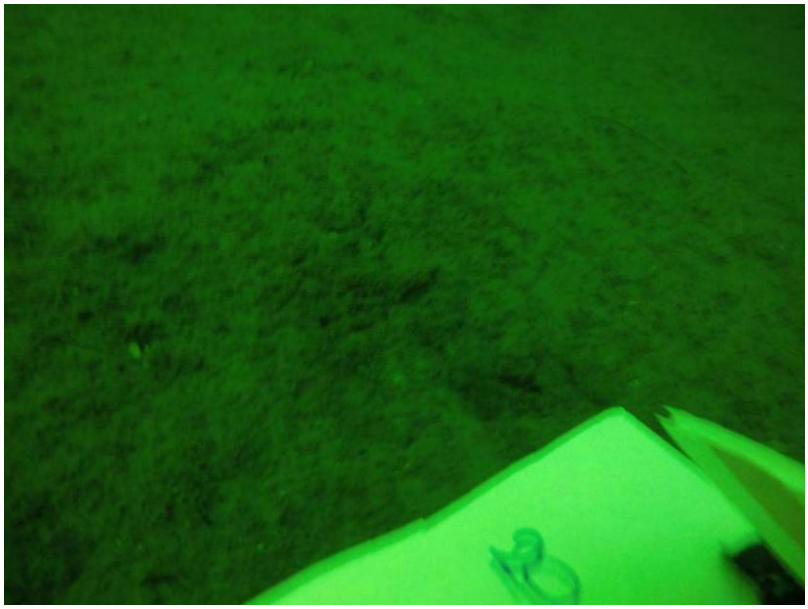
T1 Northwest Cage Edge:



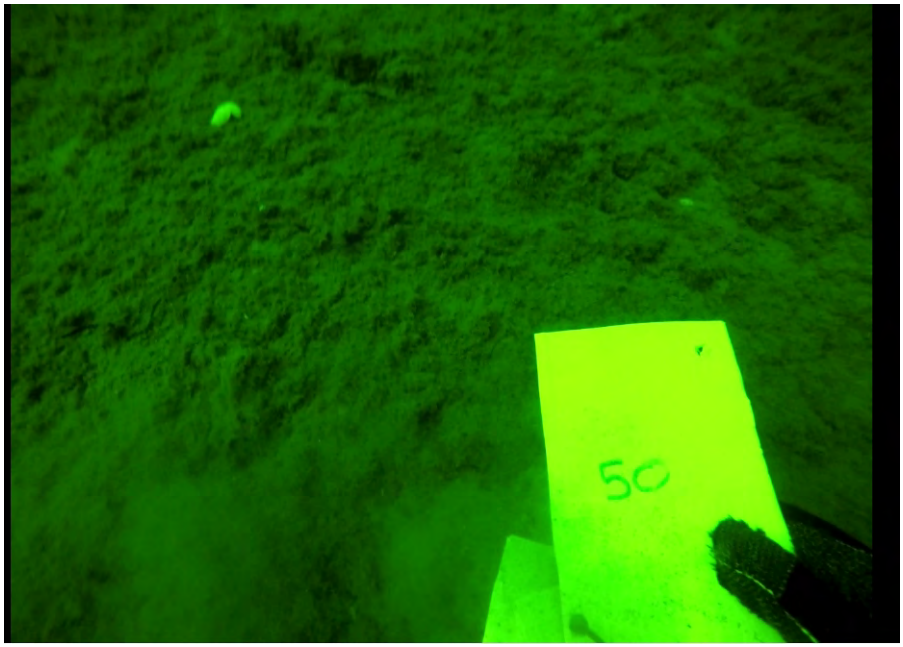
T1 North-west 10m:



T1 North-west 20m:

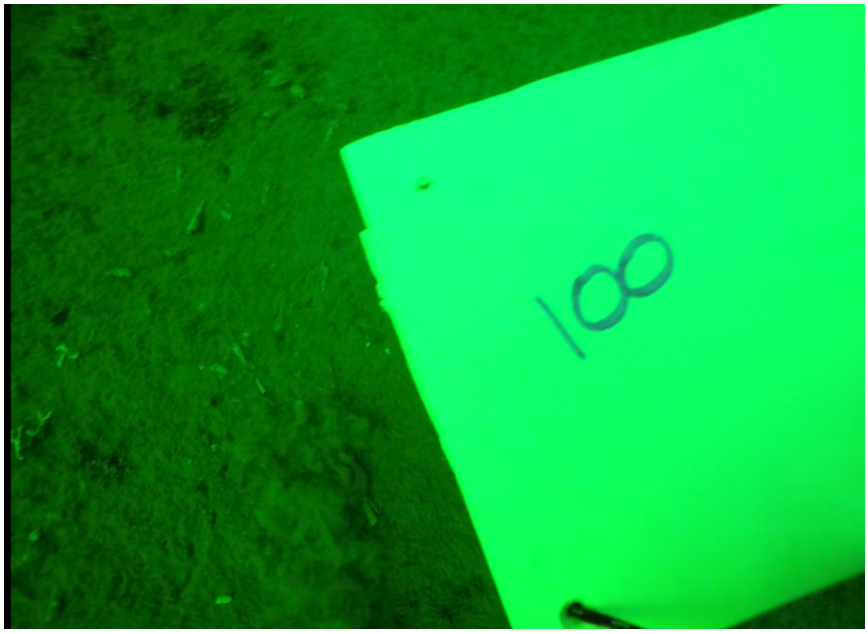


T1 North-west 50m

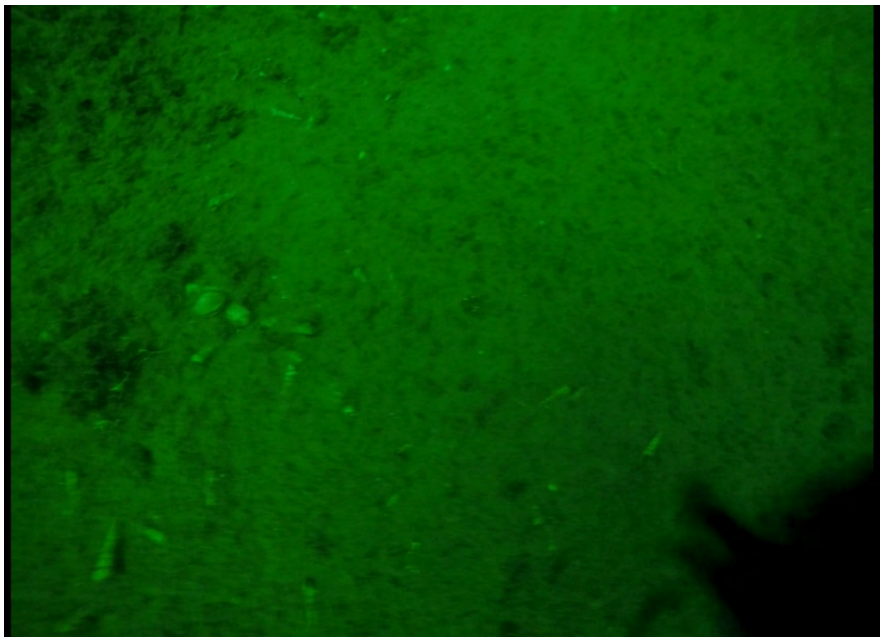


T1 North-west 100m

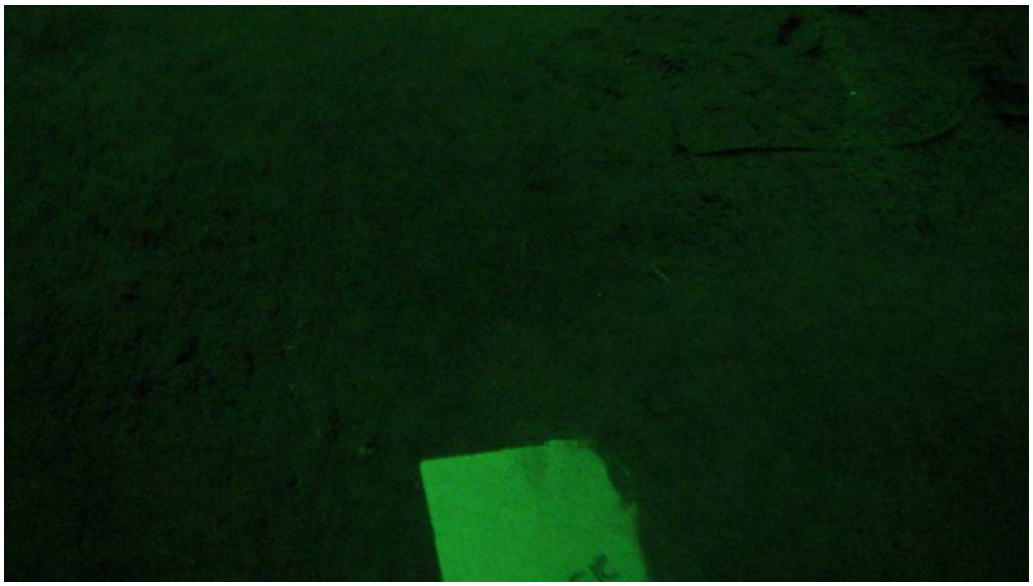
T1 North-west 100m:



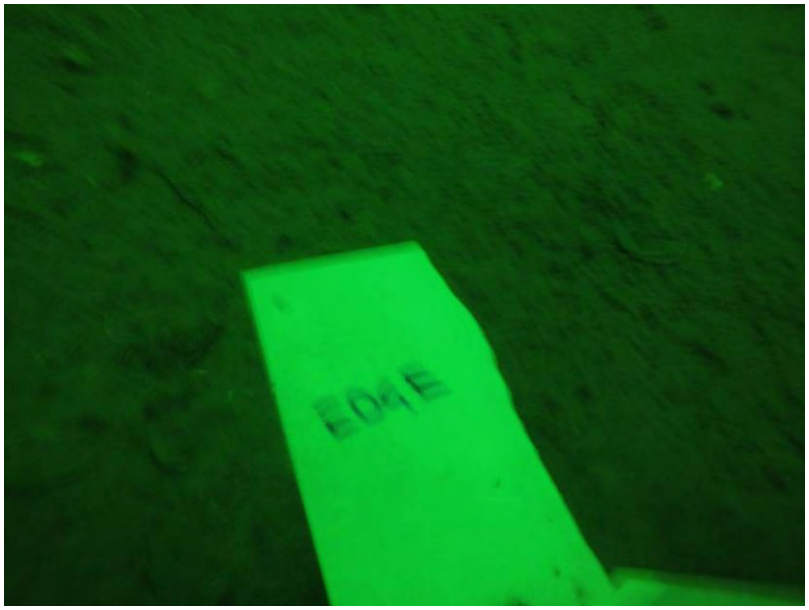
T1 North-west 100m:



T2 South-west Under Cages:

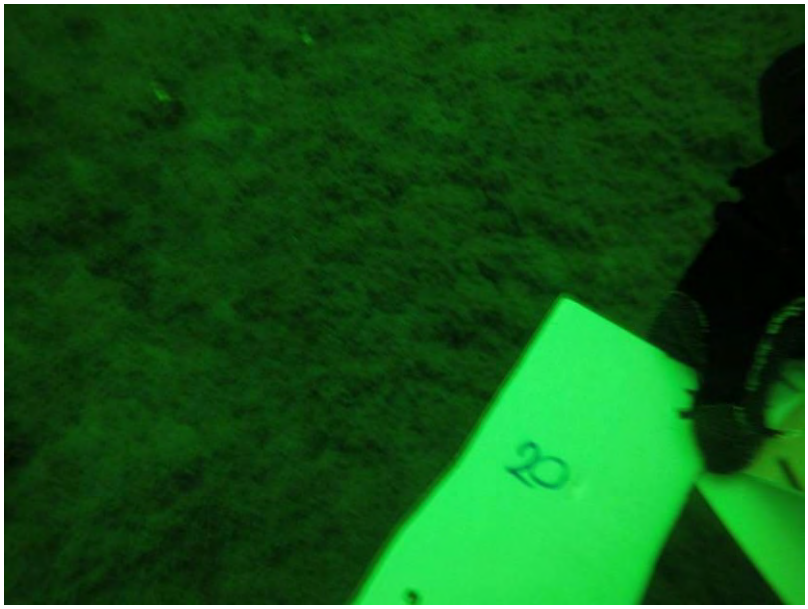


T2 South-west Cage Edge:

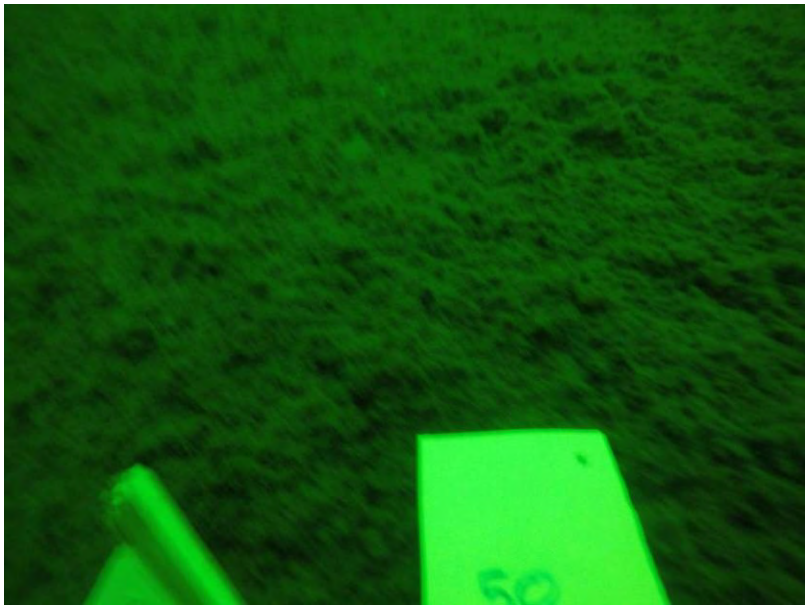


T2 South-west 10m:

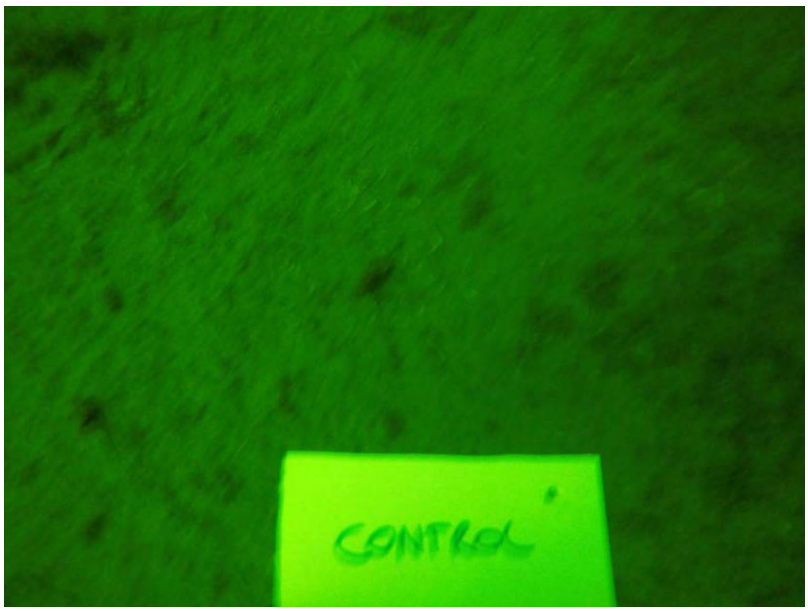
T2 South-west 20m:



T2 South-west 50m:



Control:



Discussion:

The weather was perfect on the day of sampling, calm and sunny. All samples were taken successfully and all results have been returned from lab.

There was a technical issue which prevented the use of the primary drop camera. The use of a diver and secondary camera equipment was adequate but the photographs were not of the high quality usually provided. However the photographs used, together with video taken and notes recorded by the diver have allowed an adequate assessment of the sediment quality both under the cages and at various distances from the cages, as specified in the DAFM benthic monitoring protocol.

The sediment is similar at all sampling stations with only minor differences at the 100m and 300m, control station. Thick mud indicates a low energy hydrographic regime in this area.

The redox discontinuity (ARDP) is close to the surface at all sites (range 1-3cm) which would be expected in think mud such as that found in the bay. There is no indication that this has been affected by the presence of the farm cages. The sediment gets a little sandier at the control site and at the 100m NW station and this is reflected in the slightly deeper ARDP of 3cm at the control site but it is not reflected at the 100m station which was recorded at 1cm below the seabed surface.

The seabed surface shows no significant pattern from under the cages out-towards at increasing distances and the control site. Except for a few pieces of litter directly under the cages and at the cage edges, which is unfortunate but expected, there is no discernable impact from the presence of farm cages on site. It has been some months since the cages were stocked and therefore no impact would be expected to remain on site.

The % organic carbon analysis confirms the visual assessment that there is no measureable impact of the farm on the organic carbon content of the sediments, under the cages or at some distance from the cages. The highest level recorded was 7.25 at the south-west cage edge. This was significantly higher than the average ((4.1) but the other 3 results from under the cages and at the cage edges were all below to the average 4.04, 3.31 and 3.2 and so this single result does not seem to be indicative of the general organic content under the cages.

The control site does return the lowest result 2.63% but this is probably related to the nature of the seabed which has a sandier content than the other stations. This would result is a lower organic carbon result which would not be related to distance from the farm site.

Conclusion:

From the results of survey conducted and reported above there appears to be no measureable, visible or discernable impact of the farm cages on the seabed in the vicinity of the farm cages moored at Aquaculture License AQ176, located at Lehanagh Pool, Cashla Bay, Bertraghboy Bay, Co Galway.

Fergal Guilfoyle

22nd December 2016

Treanbeg Marine Consulting

Benthic Monitoring Survey report for Aquaculture License No. T09/093A. Monitoring Protocol No. 1 for Offshore Fin Fish Farms

Report Author

Dr Colin Hannon

May 2018

Report Details

Report Author	Dr Colin Hannon
[redacted]	[redacted]
Client	Marine Institute
[redacted]	[redacted]
Survey Location	Beirtreah Buí Bay, Cashel, Co. Galway
Aquaculture License Number	T09/093A
Survey Date	17th May 2018
Task	Level 1 benthic monitoring as defined by the Department of Agriculture, Food and the Marine Protocol (DAFM, 2008)
Report Completion date	11 July 2018

Introduction

A marine benthic survey was carried out at the Marine Institutes licensed aquaculture site at Lehanagh Pool in Beirtreah Buí Bay, Cashel, Co. Galway (Aquaculture License No. T09/093A) on the 17th of May 2018. The survey was carried out to the requirements set out in Monitoring Protocol No. 1 for Offshore Finfish Farms (DAFM, 2008)

At the time of the survey there were two fish pens (50m diameter) containing a biomass of 5,000 salmon smolt (*Salmo salar*) and 500 lump-suckers (Cleaner fish) (*Cycloplerrrs lumpus*). During the survey, there were two pens connected to the grid with one other attached to one of the grid cans to the North of the site (This pen did not contain fish or had a net hanging and was not connected to the grid).

The licensed site at Lehanagh Pool (Aquaculture License No. T09/093A) was previously subject to Level 1 benthic monitoring as defined by the Department of Agriculture, Food and the Marine (DAFM, 2008).

Level 1 monitoring involves as per DAFM, (2008):

Level I: Video/photographic and visual observations and recordings shall be made at the following stations:

- At a minimum of 2 sites directly beneath the cages,
- At the edges of the cages,
- Two transects at right angles to each other. Along each transect sampling stations at +/- 10m, +/- 20m, +/- 50m and + 100m from the cages,
- At a control site.

In addition to the above, the following samples / measurements shall be taken at the same stations as above. These will be used to calculate sediment quality parameters.

- A minimum of one Redox potential readings shall be made at each sampling station,
- A single sediment sample for Organic Carbon measurement.

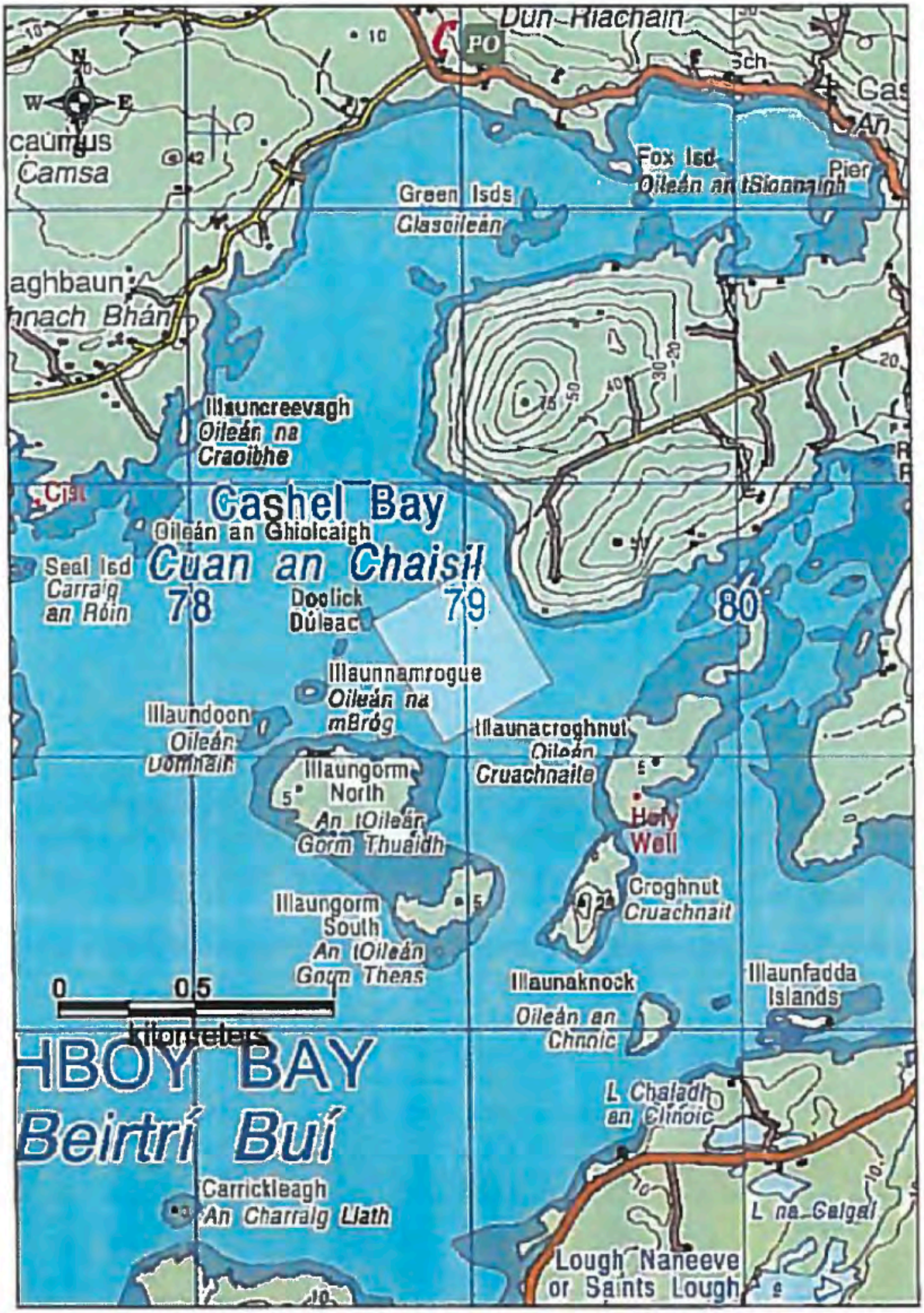


Figure 1. Ordinate survey map of the licensed site at Lehanagh Pool (Aquaculture License No. T09/093A). (Map from aquaculture license application, Ref: T9/93).

Method

Benthic monitoring survey was conducted on the 17th of May 2018 at the Lehanagh Pool site. Weather conditions were sunny and sea state was calm. Survey was conducted 1-2 hours after low water on that day using the fish farm polar boat.

Grab samples were made at each of the sample stations indicated in the table below (Table 1). A 0.025m^2 Van-Veen grab was used to collect each benthic sample. A successful grab was taken at each of the sample station and this location was taken using a Garmin handheld GPS mapping unit. The Apparent Redox Discontinuity Potential (ARDP) was measured from cores taken from each of the successful grab samples and this data has been tabulated in table 1 in the results section of this report.

Benthic sediment samples collected using the Van-Veen grab were then sub-sampled to collect sediment (approx. 100ml) for total organic carbon (TOC %) analysis. Each sample was labeled and stored in a 250ml plastic container with an air tight lid and kept cool in a refrigerated box. Sediment type and description can be found in Table 1 in the results section.

Total organic carbon samples were given to Glan Uisce Teo, Furbo, Co. Galway for analysis who then sub-contracted the sample TOC analysis to Complete Lab Solutions (CLS), Rosmuc Co. Galway. Results of TOC% were returned one month after the samples been delivered to Glan Uisce Teo on the 17th of May 2018.

Dive Survey

Two dive transects were undertaken, one in a Northwest direction (100m) and one in a Southwest direction (50m). A third dive was carried out 500m in distance Northwest of the farm site which acts as the control site for the survey. Each transect was recorded (video) using a GoPro camera and digital images were also taken at each of the sample stations as per DAFM Level-1 monitoring. Detailed visual dive notes along with footage and images from the transects are compiled in Table 1 in the results section. Images from the dive survey from the different sample stations are contained in the document.

Results

Sample Station	TOC Results (%)	GPS Sample Locations	Sediment description & Visual Impacts from Fish Farm	APRD	Bacterial Matting
Northwest Under Cage	3.62	53°24.048'N 009°49.118'W	Thick grey mud. Small amount of pellets directly under cage. No other visual fish farm impacts	1cm	None
Northwest Cage Edge	3.59	53°24.048'N 009°49.116'W	Thick grey mud. No visual impacts	1-2cm	None
Northwest 10m	3.42	53°24.052'N 009°49.122'W	Thick grey mud. No visual impacts	1-2cm	None
Northwest 20m	4.40	53°24.056'N 009°49.129'W	Thick grey mud. No visual impacts	2cm	None
Northwest 50m	3.68	53°24.100'N 009°49.233'W	Thick grey mud. No visual impacts	2cm	None
Northwest 100m	3.87	53°24.500'N 009°49.160'W	Thick grey mud. No visual impacts	2cm	None
Control Northwest 500m	2.86	53°24.800'N 009°49.320'W	Thick grey mud with sand and shells. No visual impacts	2-3cm	None
Southwest Under Cage	3.62	53°24.300'N 009°49.900'W	Thick grey mud. Small amount of feed pellets. No other visual impacts	1-2cm	None
Southwest Cage Edge	3.91	53°24.300'N 009°49.110'W	Thick grey mud. No visual impacts	2cm	None
Southwest 10m	4.34	53°24.300'N 009°49.800'W	Thick grey mud. No visual impacts	2cm	None
Southwest 20m	4.41	53°24.200'N 009°49.900'W	Thick grey mud. No visual impacts	1-2cm	None
Southwest 50m	3.85	53°24.100'N 009°49.100'W	Thick grey mud. No visual impacts	2cm	None

Table 1. Lists the percentage total organic carbon along with sample site location and sediment description included fish farm visual impact. No bacterial matting was noted during the transect dives.

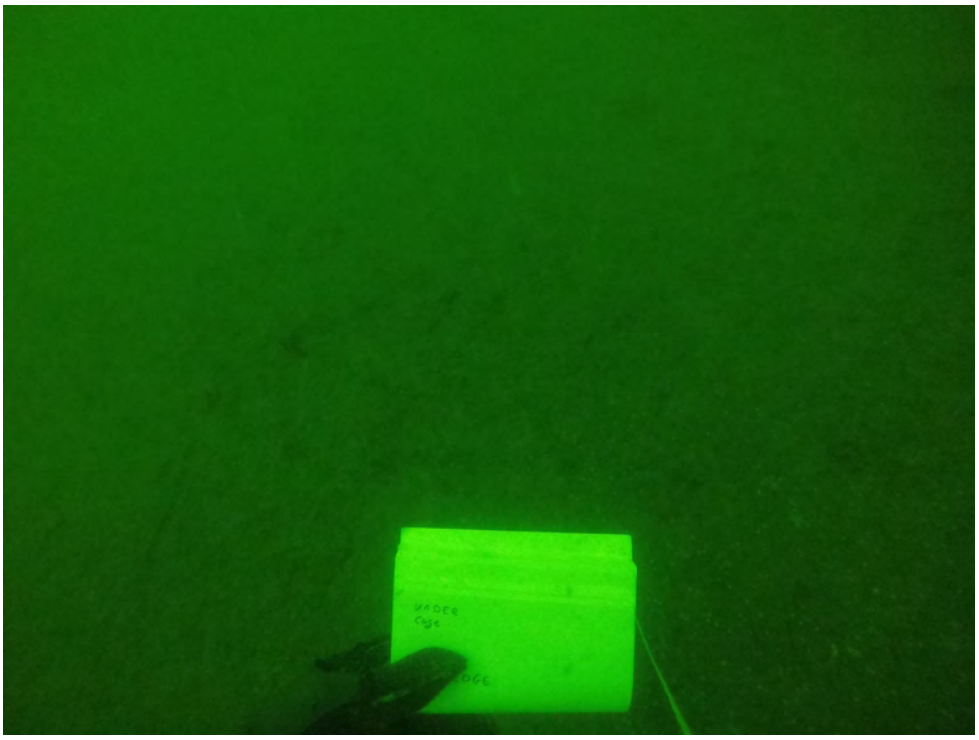


Figure 2. Under Cage Northwest of fish pens


Figure 3. Cage Edge Northwest transect

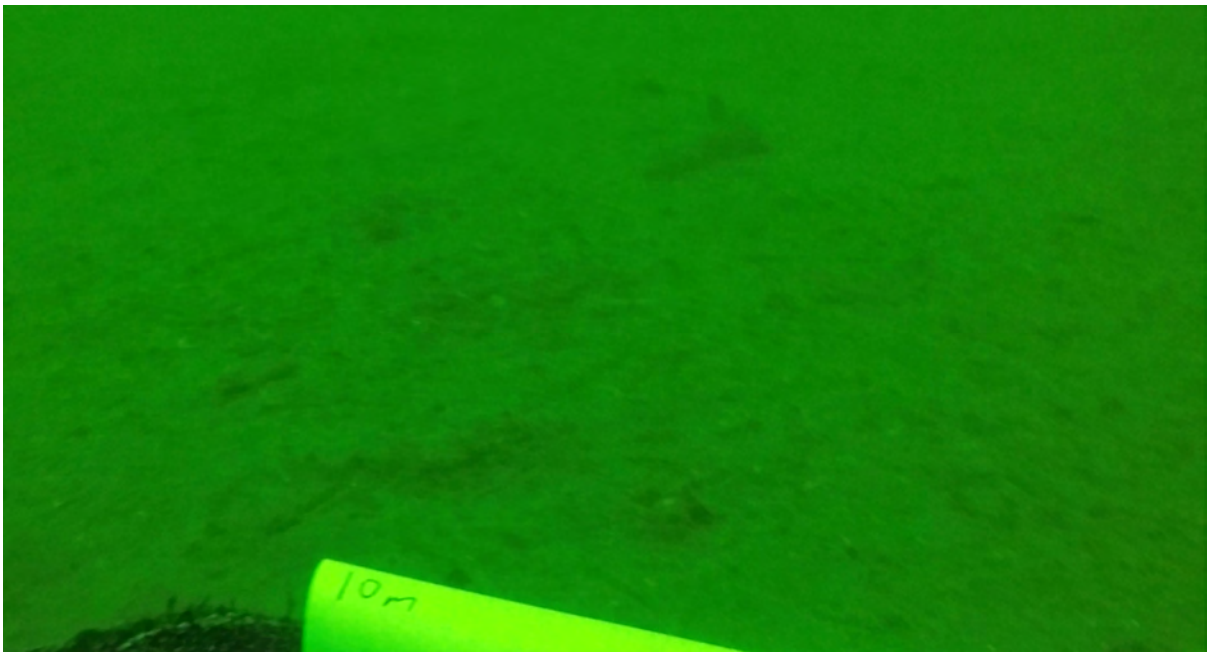


Figure 4. 10m Northwest transect

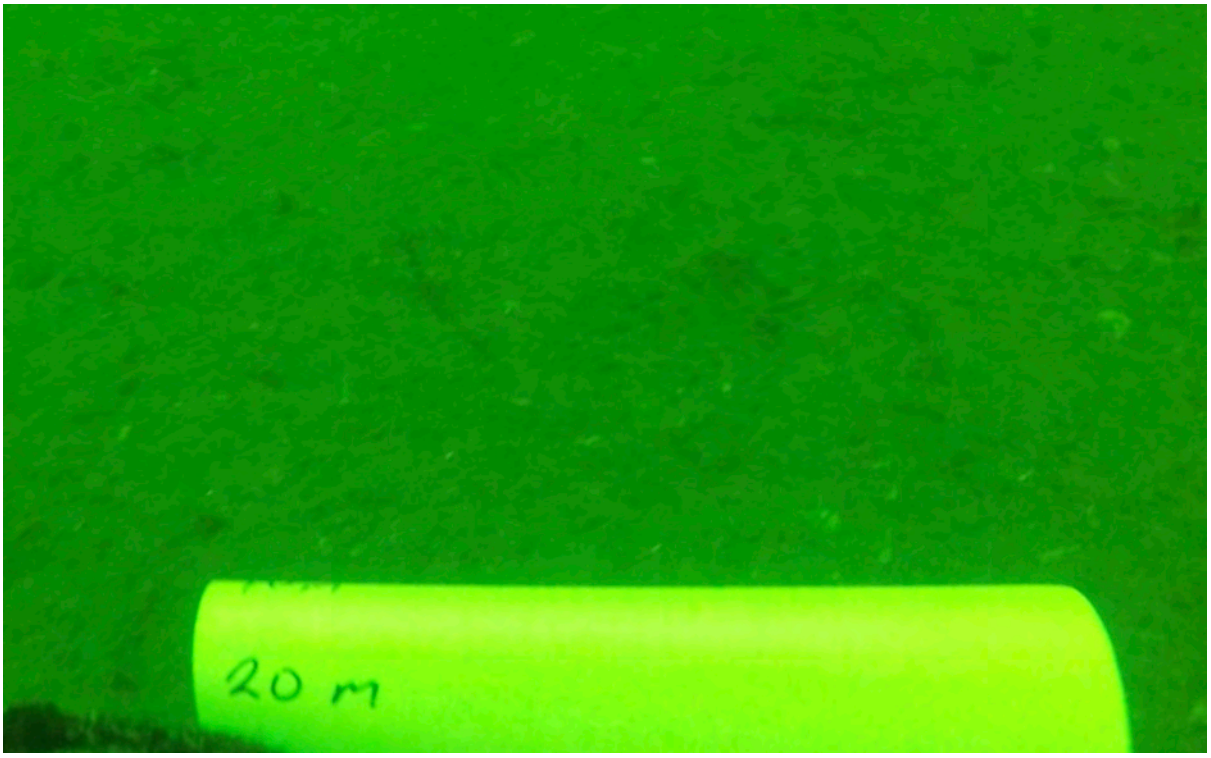


Figure 5. 20m Northwest transect

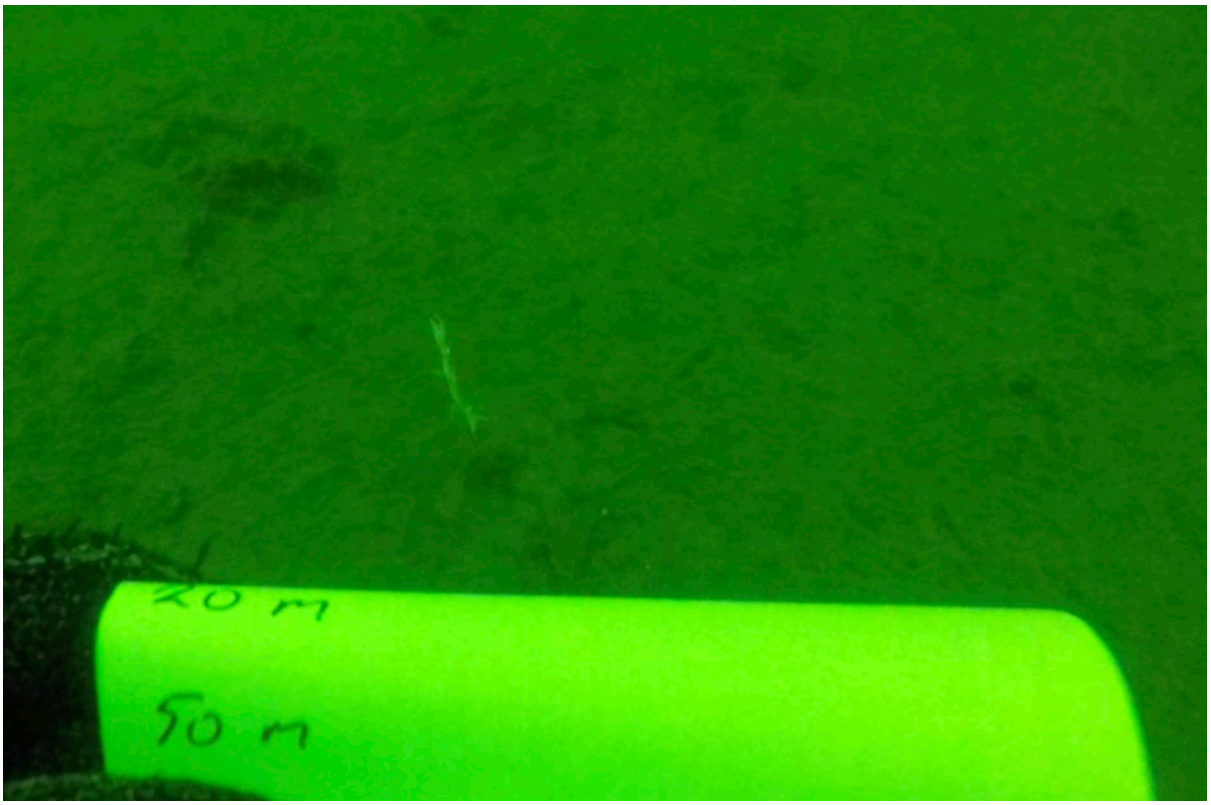


Figure 6. 50m Northwest transect

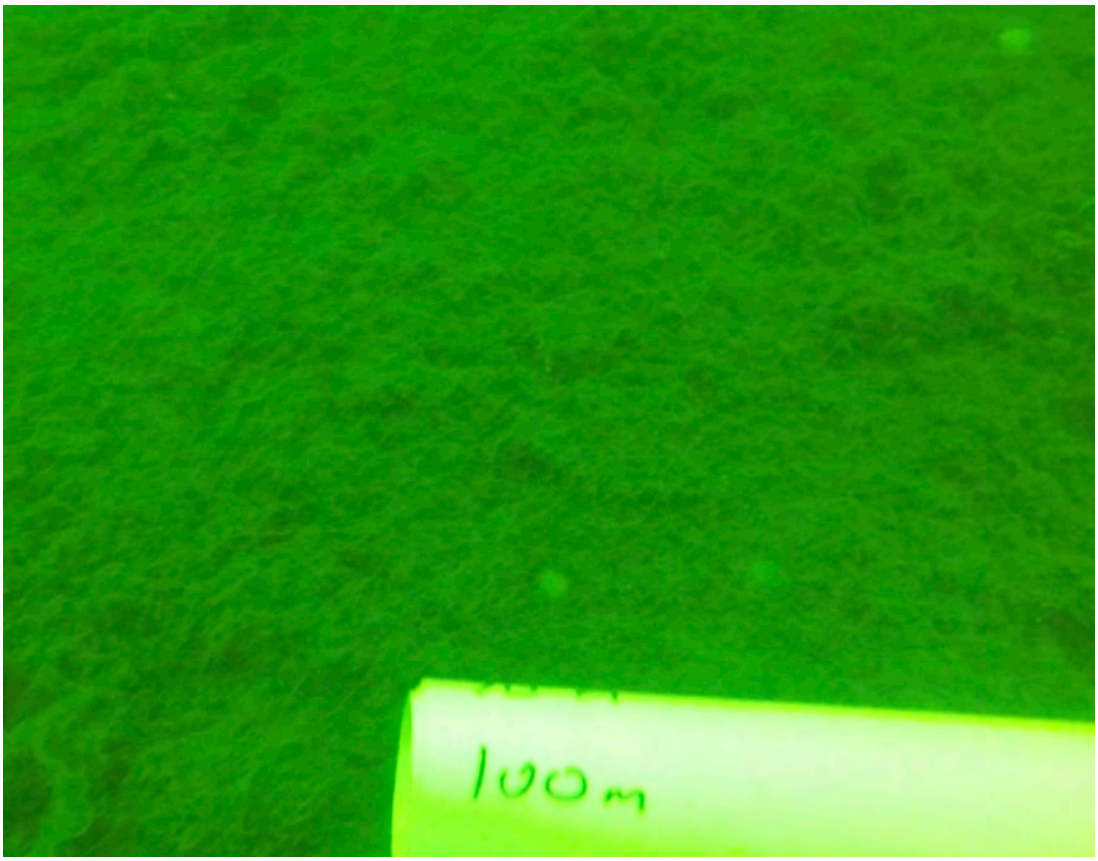


Figure 7. 100m Northwest transect

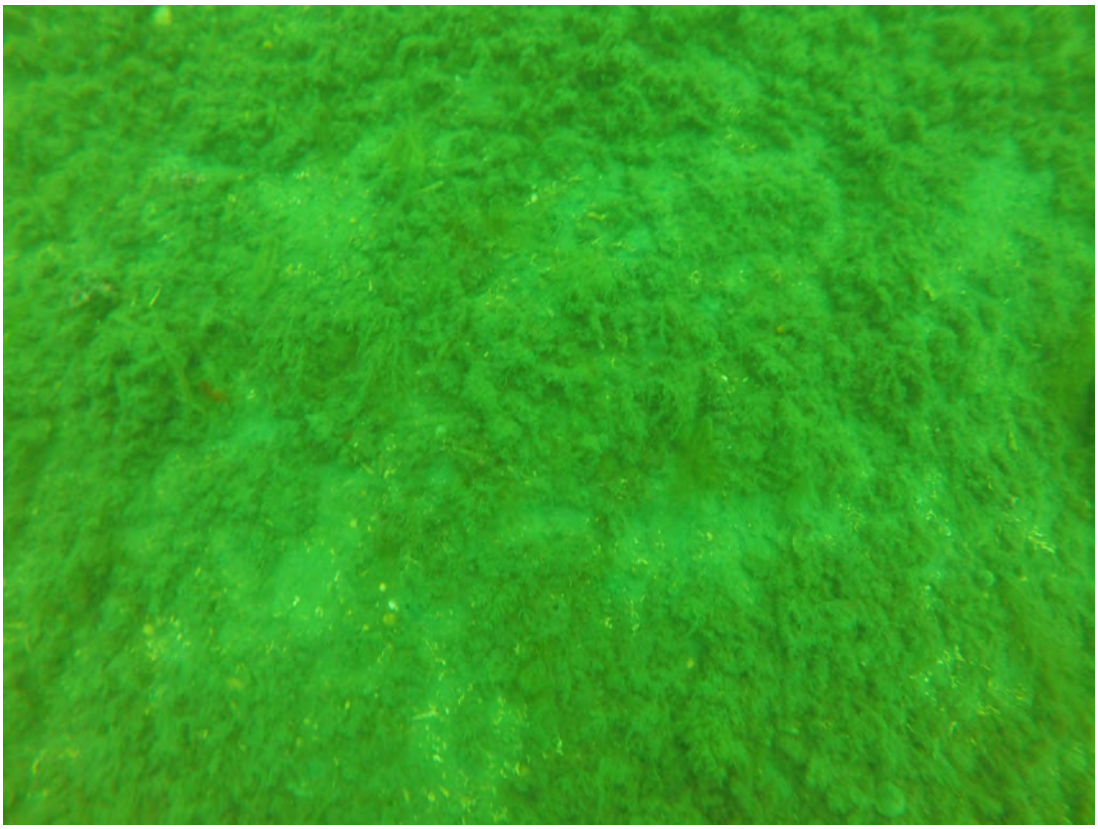


Figure 8. Control site 500m Northwest transect of the fish pens

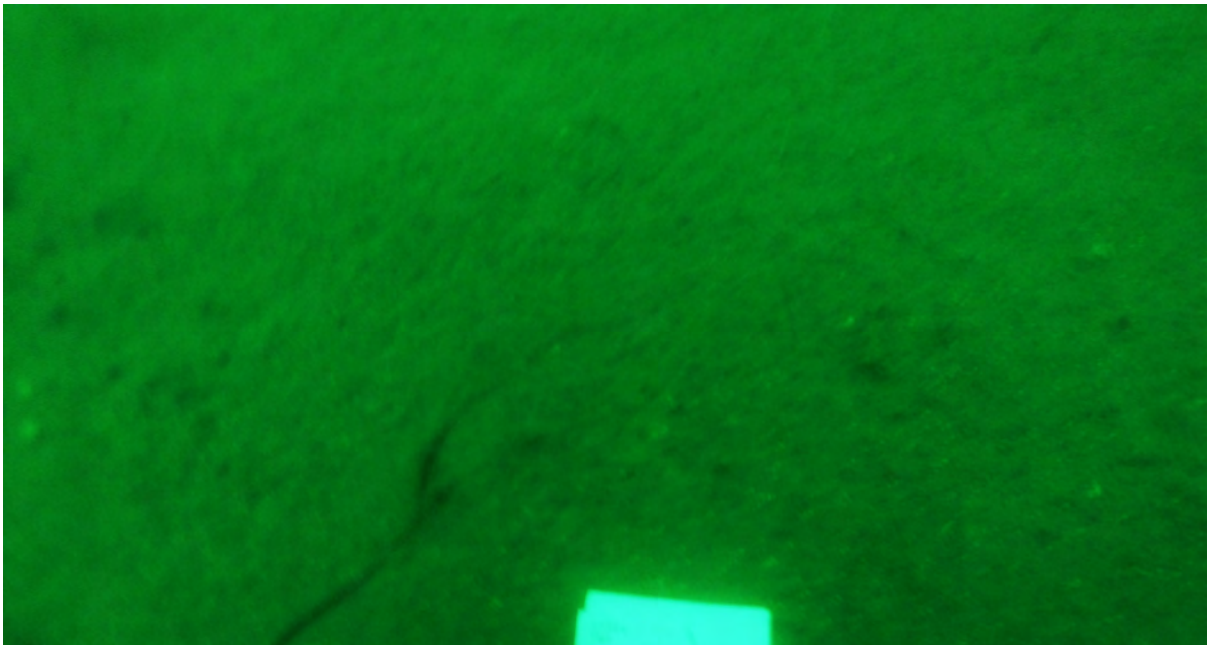


Figure 9. Under cage Southwest transect. Some feed pellets can be seen in the figure.

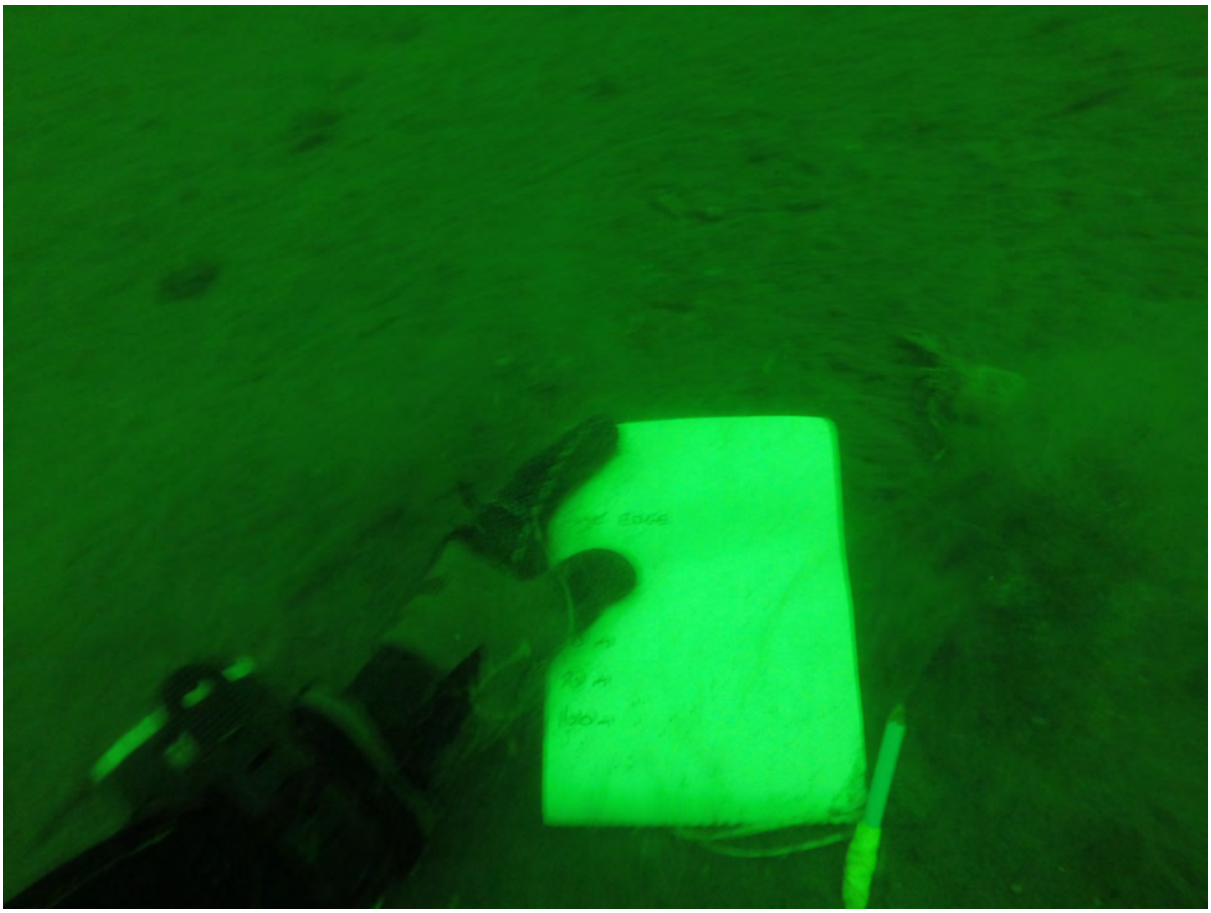


Figure 10. Cage Edge Southwest transect

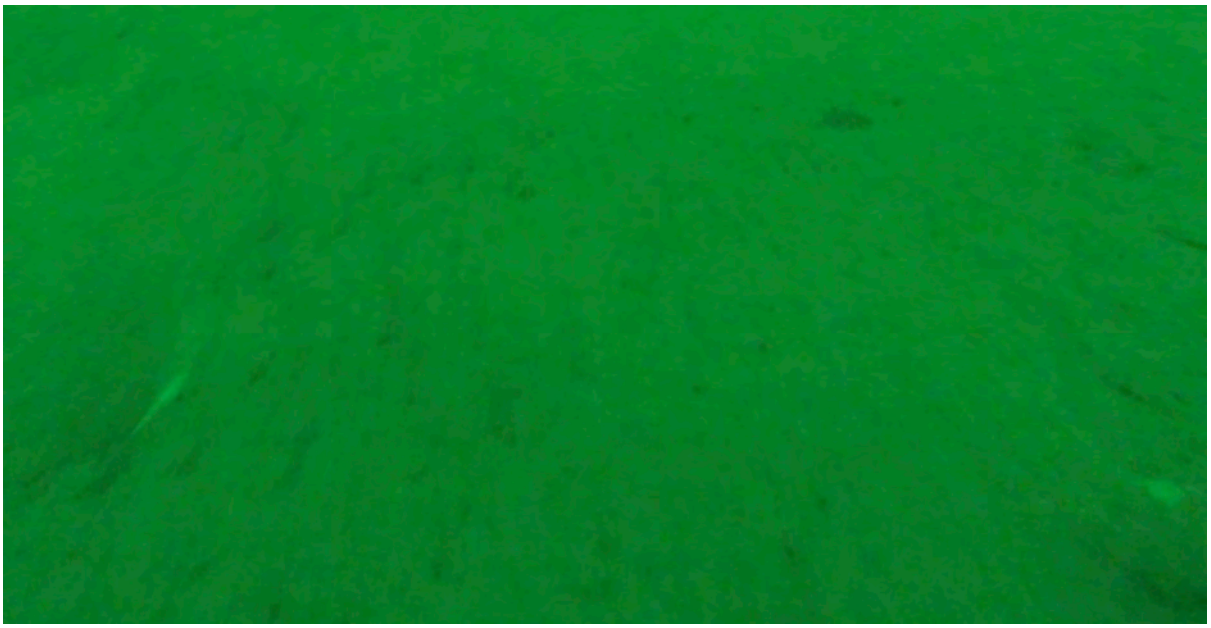


Figure 11. 10m Southwest transect

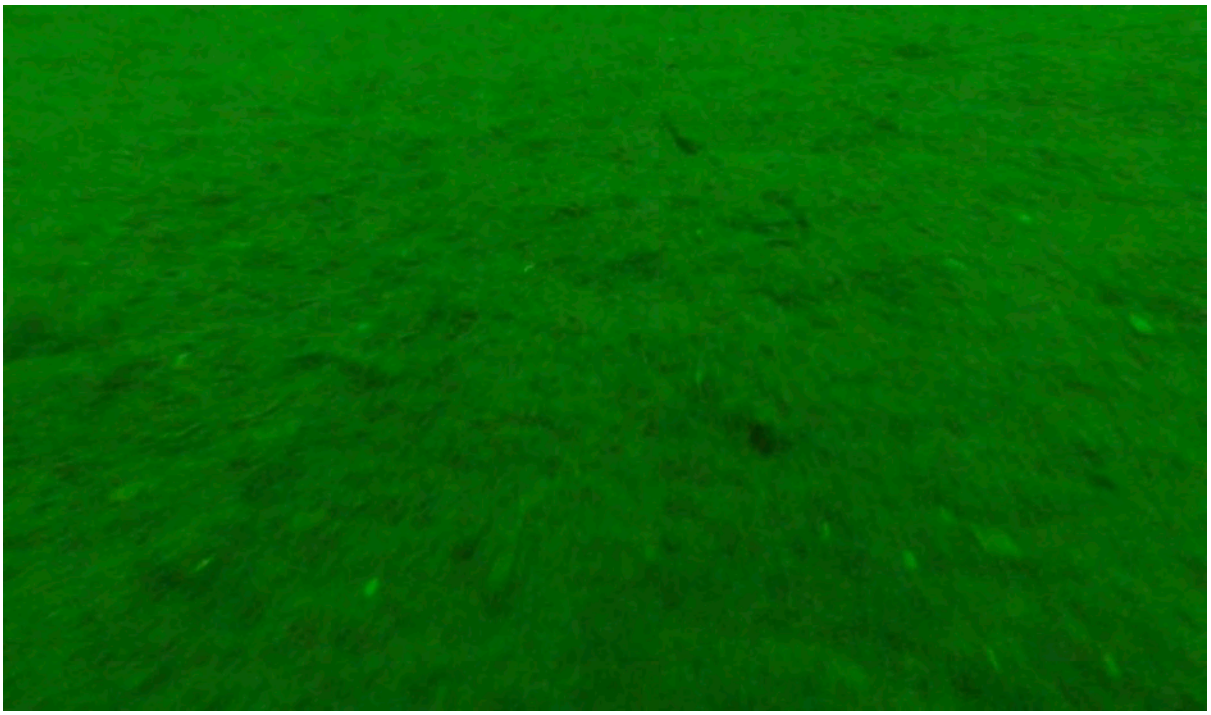


Figure 12. 20m Southwest transect

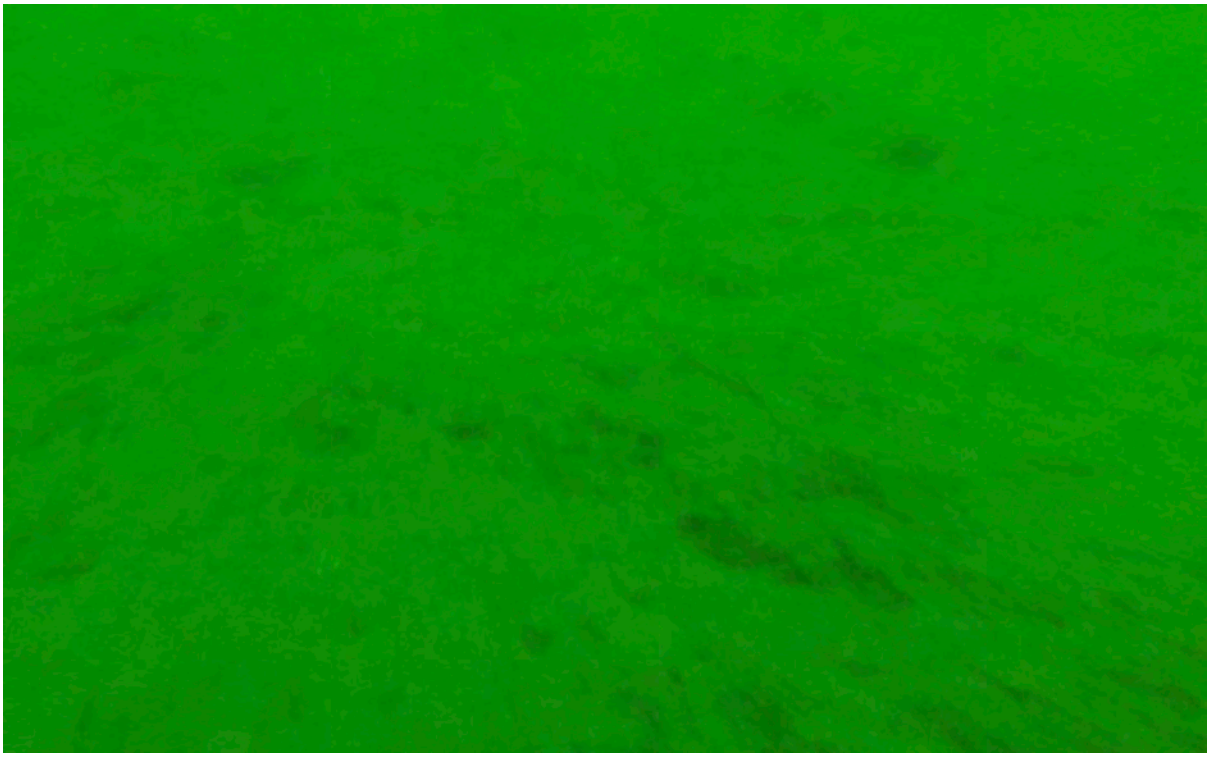


Figure 13. 50m Southwest transect

Discussion

The fish farm site at Lehanagh pool overall was very tidy and well maintained with no associated fish farm wastes found on the site. The seabed dive survey did not note any impacts from the fish fam other than a small amount of uneaten feed pellets on the Northwest (Figure 2) and Southwest (Figure 9) sample stations directly under the cage (Table 1). No bacterial matting was observed under or at any of the sample stations. No fish farm waste or discarded objects were noted on either of the two dive transects.

No significant difference was noted in the TOC (%) samples when returned from the lab. No significant difference was noted in the sediment type or species abundance between the stations other than the control (500m Northwest) had shells mixed through the sediment. The Control site was also shallower (6m) than the other sample stations which were on average between 20m and 18m respectively.

Conclusion

The survey which was carried out on the 17th of May 2018 and reported here has resulted in no discernable, visual or measurable impacts from the fish farm site on the seabed at Lehanagh pool, Beirtreah Buí Bay, Cashel, Co. Galway license number T09/093A.

References

DAFM, 2008; Monitoring Protocol No.1 for Offshore Finfish Farms - Benthic Monitoring. Revised December 2008. PP. 8. Department of Agriculture, Food & the Marine. Dublin Ireland. URL: https://www.agriculture.gov.ie/media/migration/seafood/aquacultureforeshoremanagement/marinefinfishprotocols/Benthic%20Monitoring.pdf.

Benthic Monitoring Survey report for Aquaculture

License No. T09/093A.

Monitoring Protocol No. 1 for Offshore Fin Fish Farms

Report Author

Dr Colin Hannon

December 2019

Report Details

Report Author	Dr Colin Hannon
[redacted]	[redacted]
Client	Marine Institute
[redacted]	[redacted]
Survey Location	Beirtreah Buí Bay, Cashel, Co. Galway
Aquaculture Licence Number	T09/093A
Survey date	15th December 2019
Task	Level 1 benthic monitoring as defined by the Department of Agriculture, Food and the Marine Protocol (DAFM, 2008)
Report completion date	28th January 2020

Introduction

A marine benthic survey was carried out at the Marine Institutes licensed aquaculture site at Lehanagh Pool in Beirtreah Buí Bay, Cashel, Co. Galway (Aquaculture License No. T09/093A) on the 15th of December 2019. The survey was carried out to the requirements set out in Monitoring Protocol No. 1 for Offshore Finfish Farms (DAFM, 2008)

At the time of the survey there were two fish pens (50m diameter) containing a biomass of 9,000 salmon smolt (*Salmo salar*) and 750 lump-suckers (Cleaner fish) (*Cycloplerrrs lumpus*).

The licensed site at Lehanagh Pool (Aquaculture License No. T09/093A) was previously subject to Level 1 benthic monitoring as defined by the Department of Agriculture, Food and the Marine (DAFM, 2008).

Monitoring procedure

Level 1 monitoring involves as per DAFM, (2008):

Level I: Video/photographic and visual observations and recordings shall be made at the following stations:

- At a minimum of 2 sites directly beneath the cages,
- At the edges of the cages,
- Two transects at right angles to each other. Along each transect sampling stations at +/- 10m, +/- 20m, +/- 50m and + 100m from the cages,
- At a control site.

In addition to the above, the following samples / measurements shall be taken at the same stations as above. These will be used to calculate sediment quality parameters.

- A minimum of one Redox potential readings shall be made at each sampling station,
- A single sediment sample for Organic Carbon measurement.

Site location

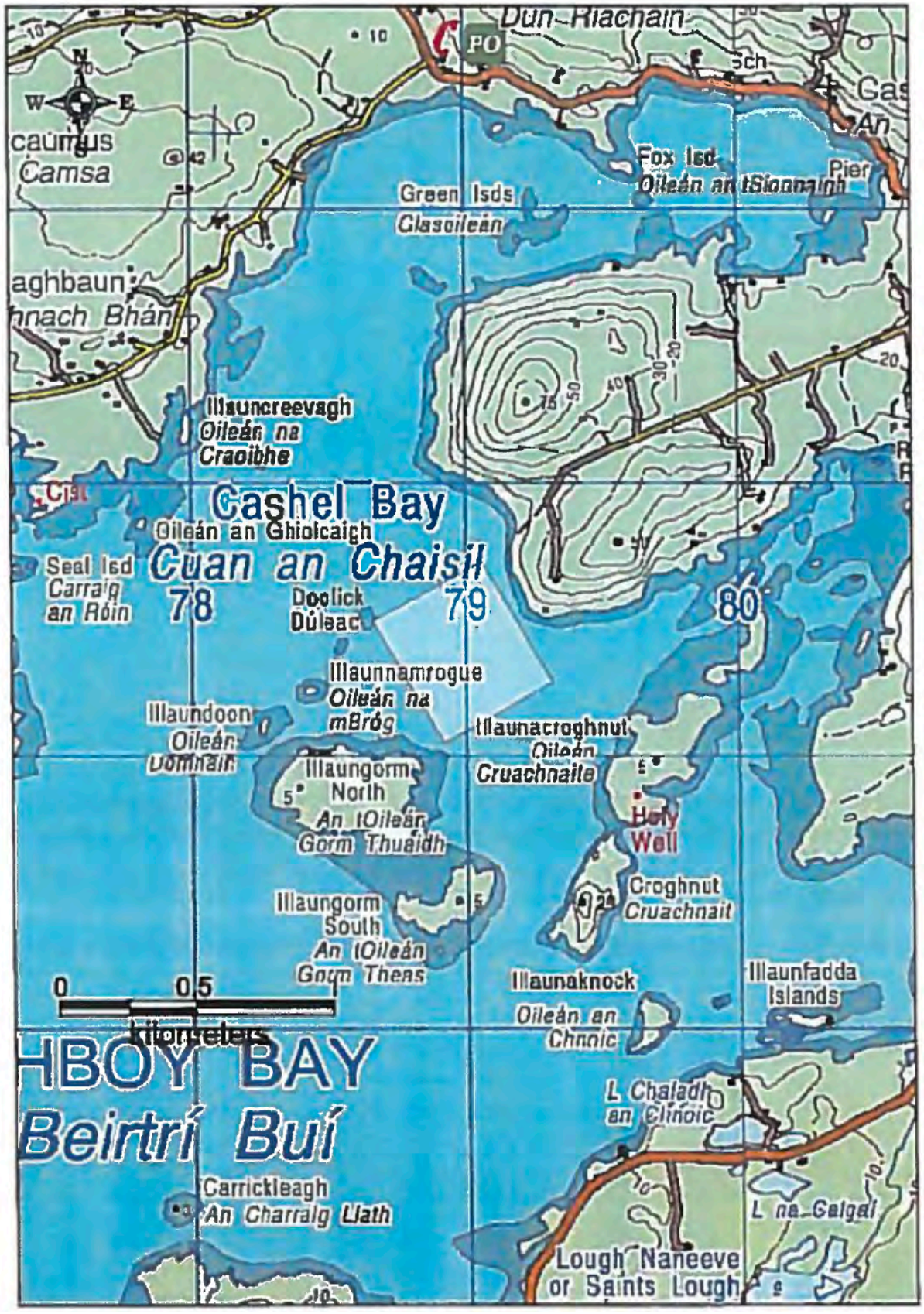


Figure 1. Ordinate survey map of the licensed site at Lehanagh Pool (Aquaculture License No. T09/093A). (Map from aquaculture license application, Ref: T9/93).

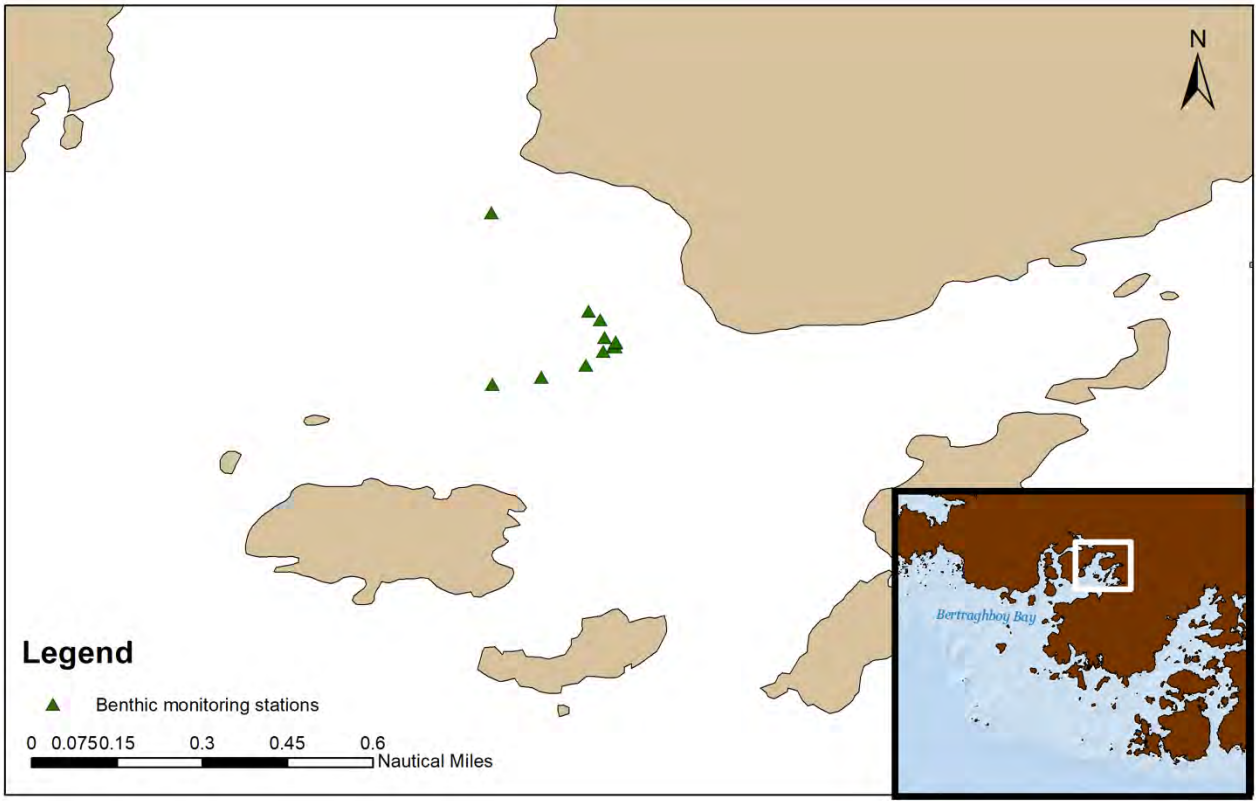


Figure 2. Positions of sampling stations for benthic monitoring at Lehanagh Pool. GPS locations are presented in Table 1.

Method

Benthic monitoring survey was conducted on the 15th of December 2019 at the Lehanagh Pool aquaculture site. Weather conditions were sunny and sea state was calm. Survey was conducted at approx. high water on the same date using the fish farm polar boat.

Grab samples were made at each of the sample stations indicated in the table below (Table 1). A 0.025m^2 Van-Veen grab was used to collect each benthic sample. A successful grab was taken at each of the sample station and this location was taken using a Garmin handheld GPS mapping unit. The Apparent Redox Discontinuity Potential (ARDP) was measured from cores taken from each of the successful grab samples and this data has been tabulated in table 1 in the results section of this report.

Benthic sediment samples collected using the Van-Veen grab were then sub-sampled to collect sediment (approx. 100ml of marine sediments) for total organic carbon (TOC %) analysis. Each sample was labelled and stored in a 250ml plastic container with an air tight lid and kept cool in a refrigerated box. Sediment type and description can be found in Table 1 in the results section.

Samples for total organic carbon analysis were delivered to Complete Lab Solutions (CLS), Tuam Road, Galway for processing an analysis on the 16th of December and completed on the 27th of December.

Dive Survey

Two dive transects were undertaken, one in a Northwest direction (50m) and one in a Southwest direction (100m). A third dive was carried out 500m in distance Northwest of the farm site which acts as the control site for the survey. Each transect was recorded (video) using a GoPro camera and digital images were also taken at each of the sample stations as per DAFM Level - 1 monitoring. Detailed visual dive notes along with footage and images from the transects are compiled in Table 1 in the results section. Images from the dive survey from the different sample stations are contained in this document.

On the day of the survey sea condition were calm, however the site was subjected to successive days of storm action in the days previous which reduced underwater visibility greatly which made obtaining clear images of the seabed extremely difficult. This report contains detailed visual descriptions of the sea bed at each transect location.

Results

Sample Station	TOC Results (%)	GPS Sample Locations	Sediment description & Visual Impacts from Fish Farm	APRD	Bacterial Matting
Northwest Under Cage	7.0	53°24.049'N 009°49.172'W	Thick grey mud. No visual fish farm impacts	1-2cm	None
Northwest Cage Edge	6.8	53°24.051'N 009°49.172'W	Thick grey mud. No visual impacts	1-2cm	None
Northwest 10m	6.4	53°24.059'N 009°49.192'W	Thick grey mud. No visual impacts	1-2cm	None
Northwest 20m	6.0	53°24.499'N 009°49.121'W	Thick grey mud. No visual impacts	2cm	None
Northwest 50m	5.58	53°24.105'N 009°49.220'W	Thick grey mud. No visual impacts	2cm	None
Control Northwest 500m	2.83	53°24.278'N 009°49.39'W	Thick grey mud with sand and shells. No visual impacts	3cm	None
Southwest Under Cage	6.6	53°24.043'N 009°49.176'W	Thick grey mud. No visual impacts	1-2cm	None
Southwest Cage Edge	8.0	53°24.042'N 009°49.173'W	Thick grey mud. No visual impacts	2cm	None
Southwest 10m	6.5	53°24.034'N 009°49.194'W	Thick grey mud. No visual impacts	2cm	None
Southwest 20m	6.6	53°24.01'N 009°49.225'W	Thick grey mud. No visual impacts	1-2cm	None
Southwest 50m	6.5	53°23.989'N 009°49.303'W	Thick grey mud. No visual impacts	2cm	None
Southwest 100m	6.6	53°23.976'N 009°49.389'W	Thick grey mud. No visual impacts	2cm	None

Table 1. Lists the percentage total organic carbon along with sample site location and sediment description included fish farm visual impact. No bacterial matting or impacts were noted during the transect dives.

Survey images

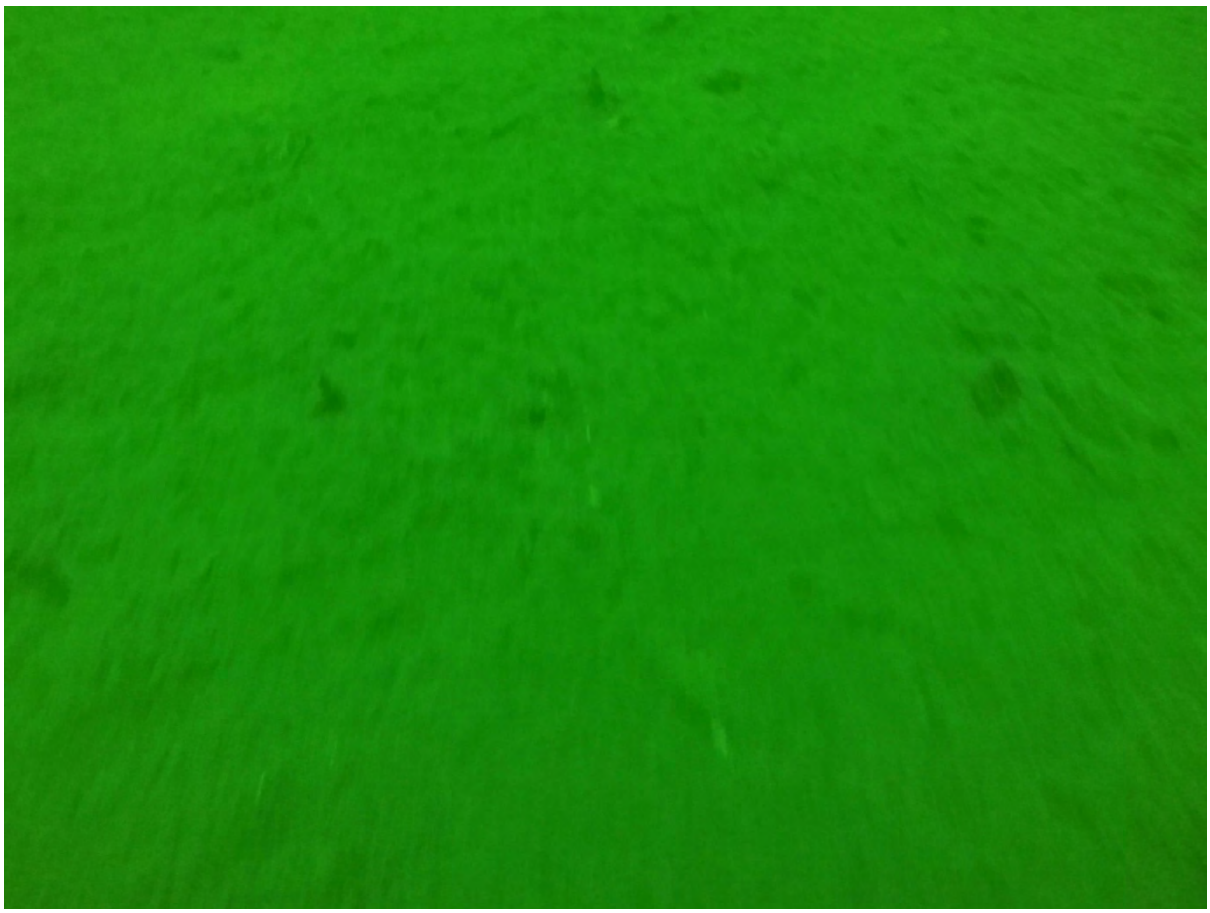


Figure 3. North West Under cage

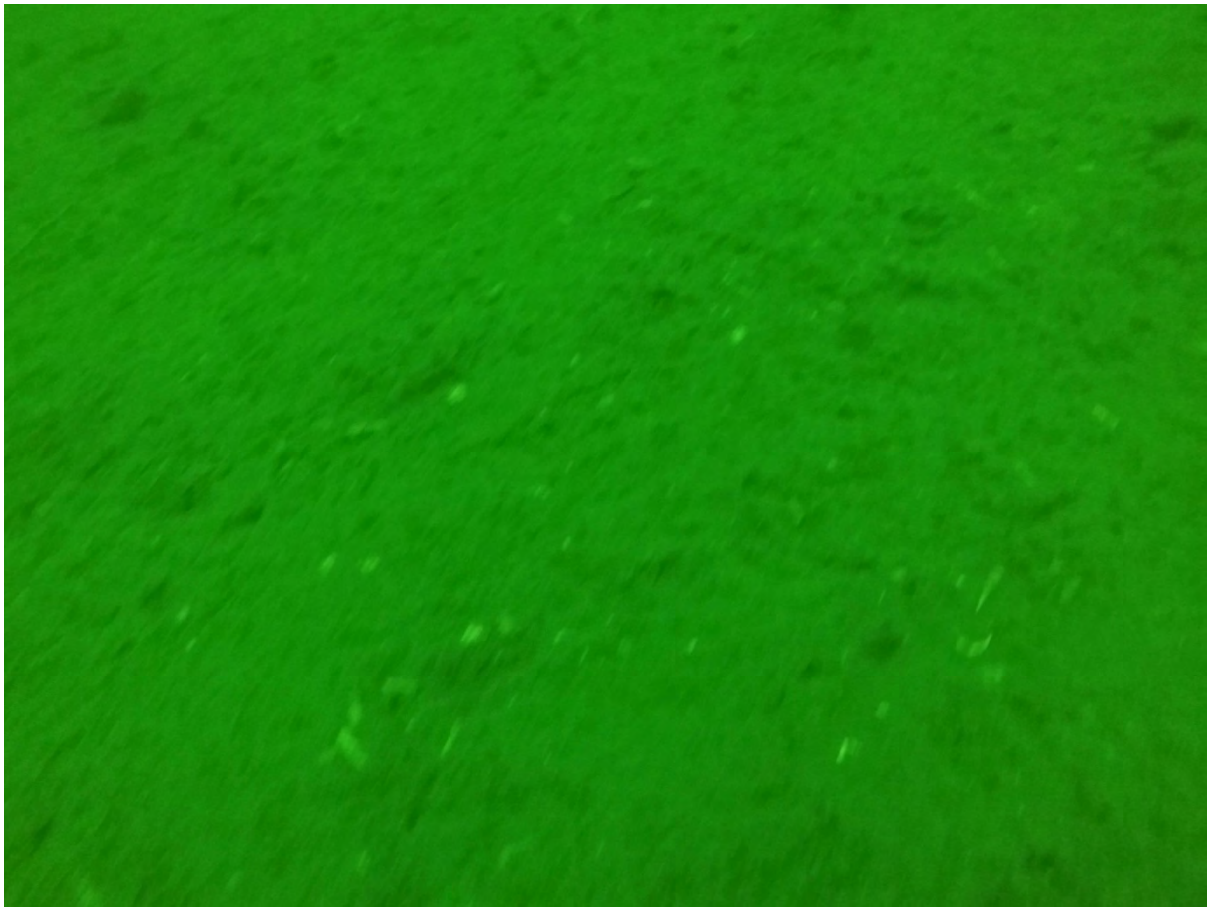


Figure 4. North West Cage Edge

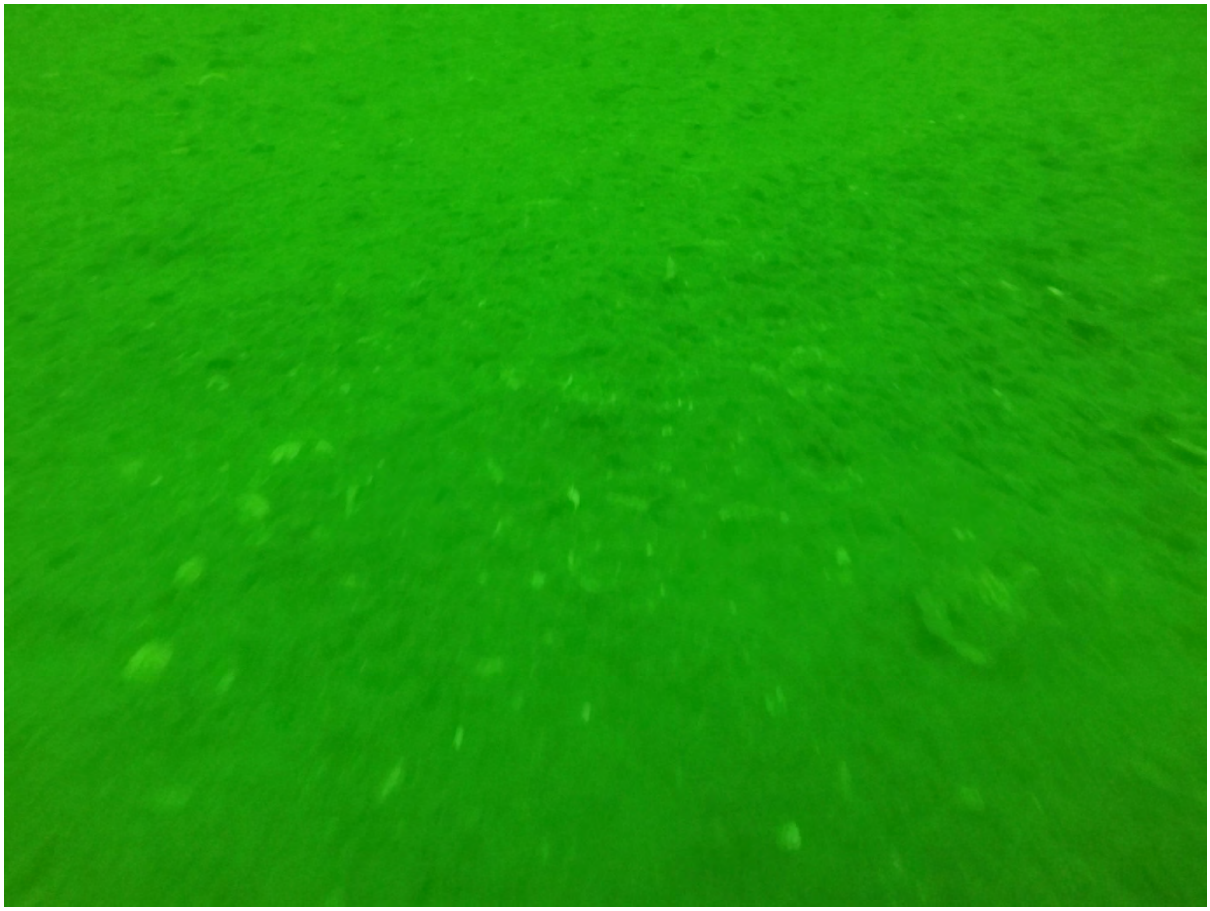


Figure 5. North West 10m

Figure 6. North West 20m

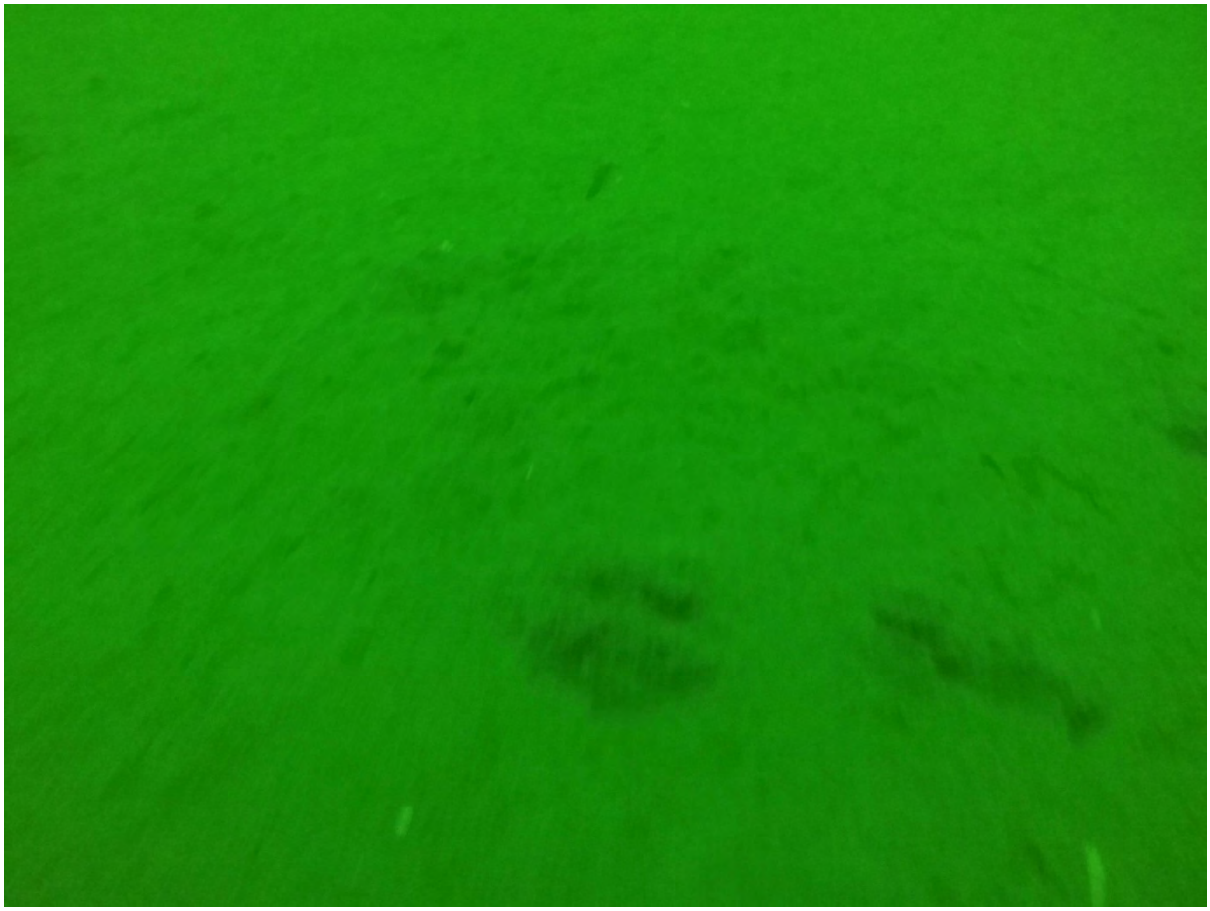


Figure 7. North West 50m

Figure 8. 500m Control.

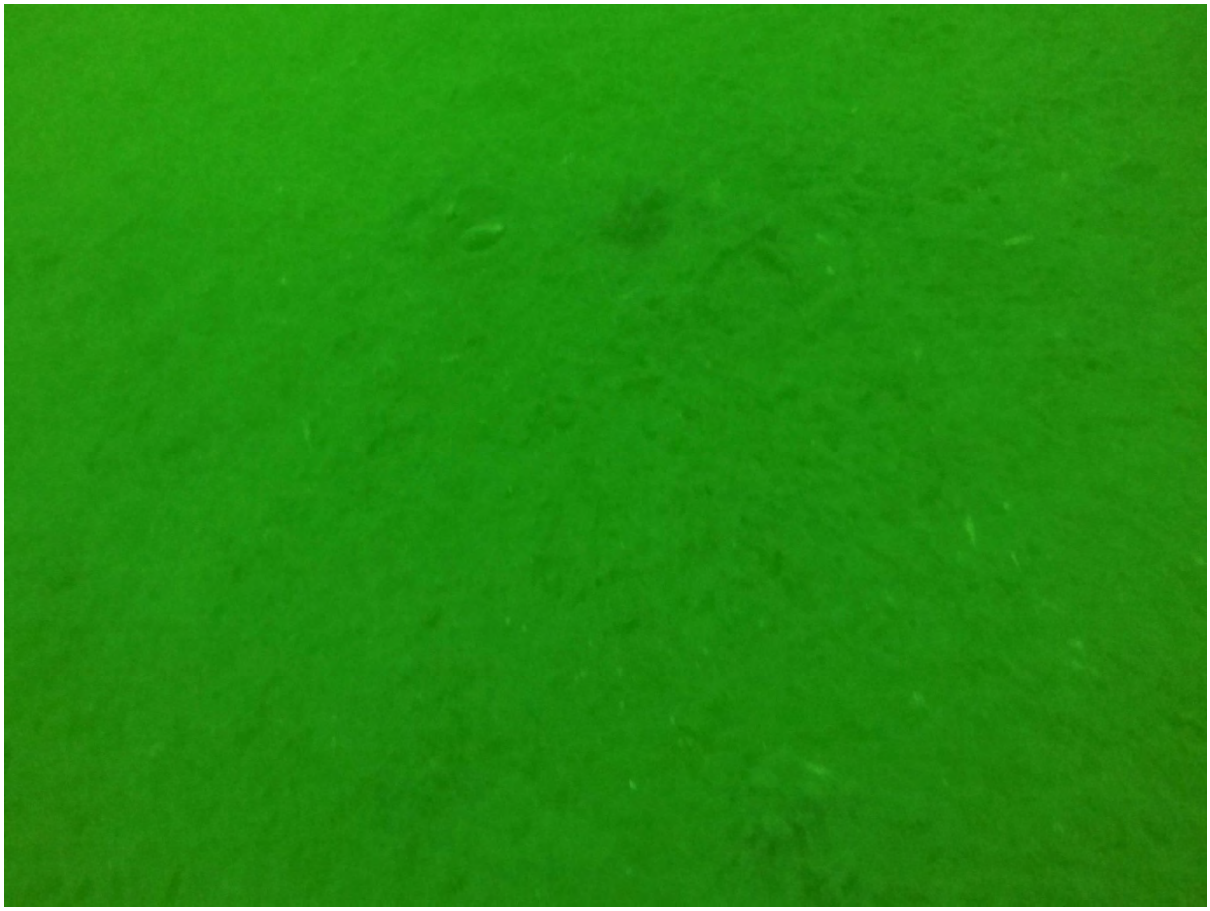


Figure 9. South West Under Cage

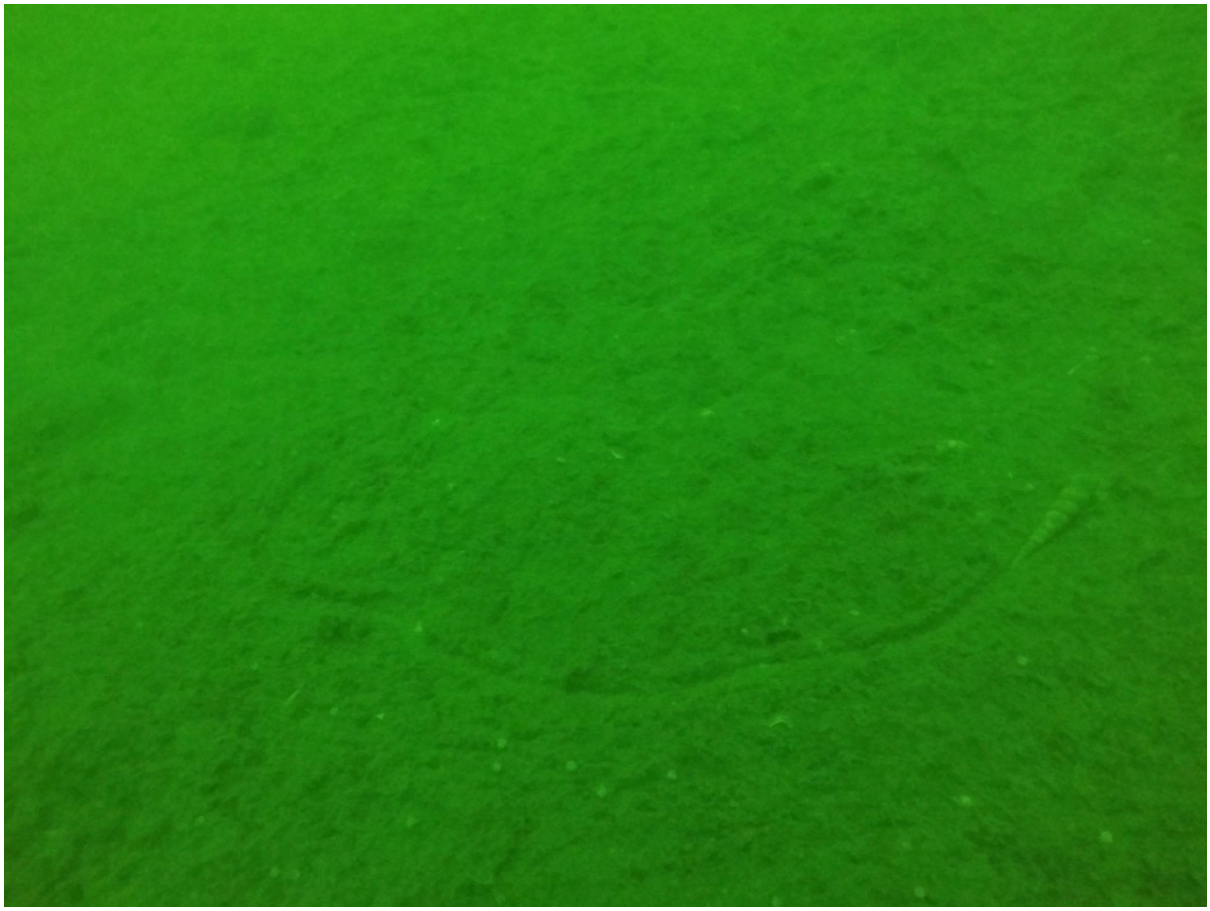


Figure 10. South West Cage Edge.

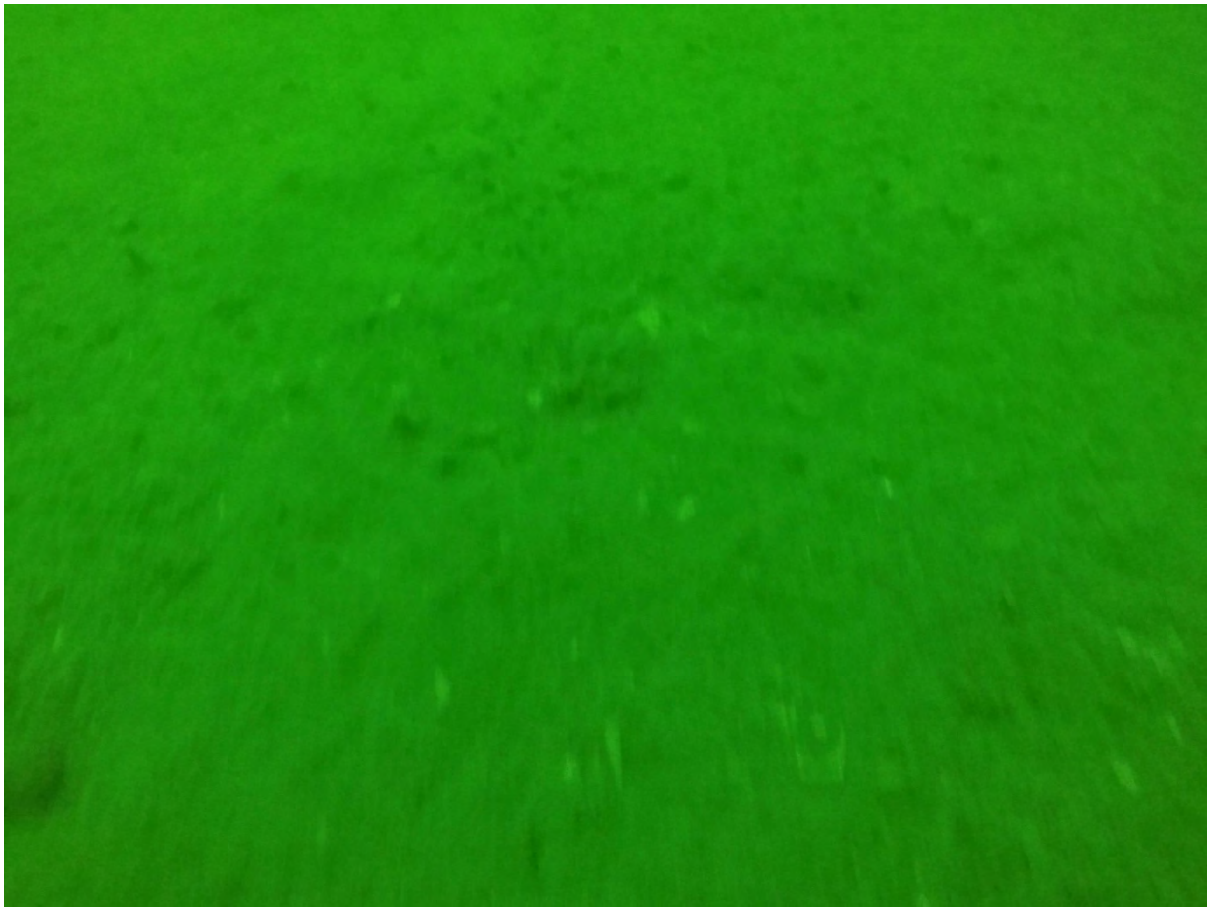


Figure 11. South West 10m.

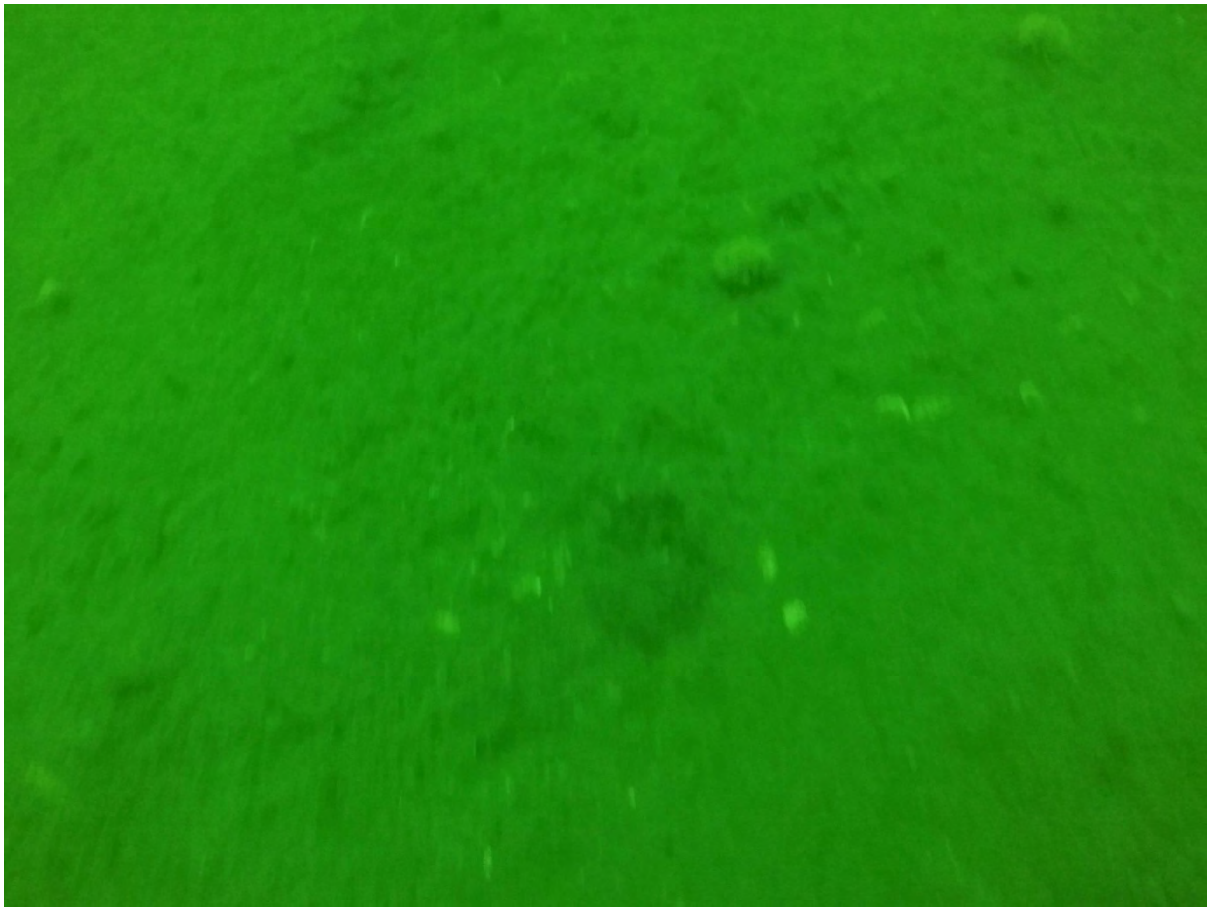


Figure 12. South West 20m

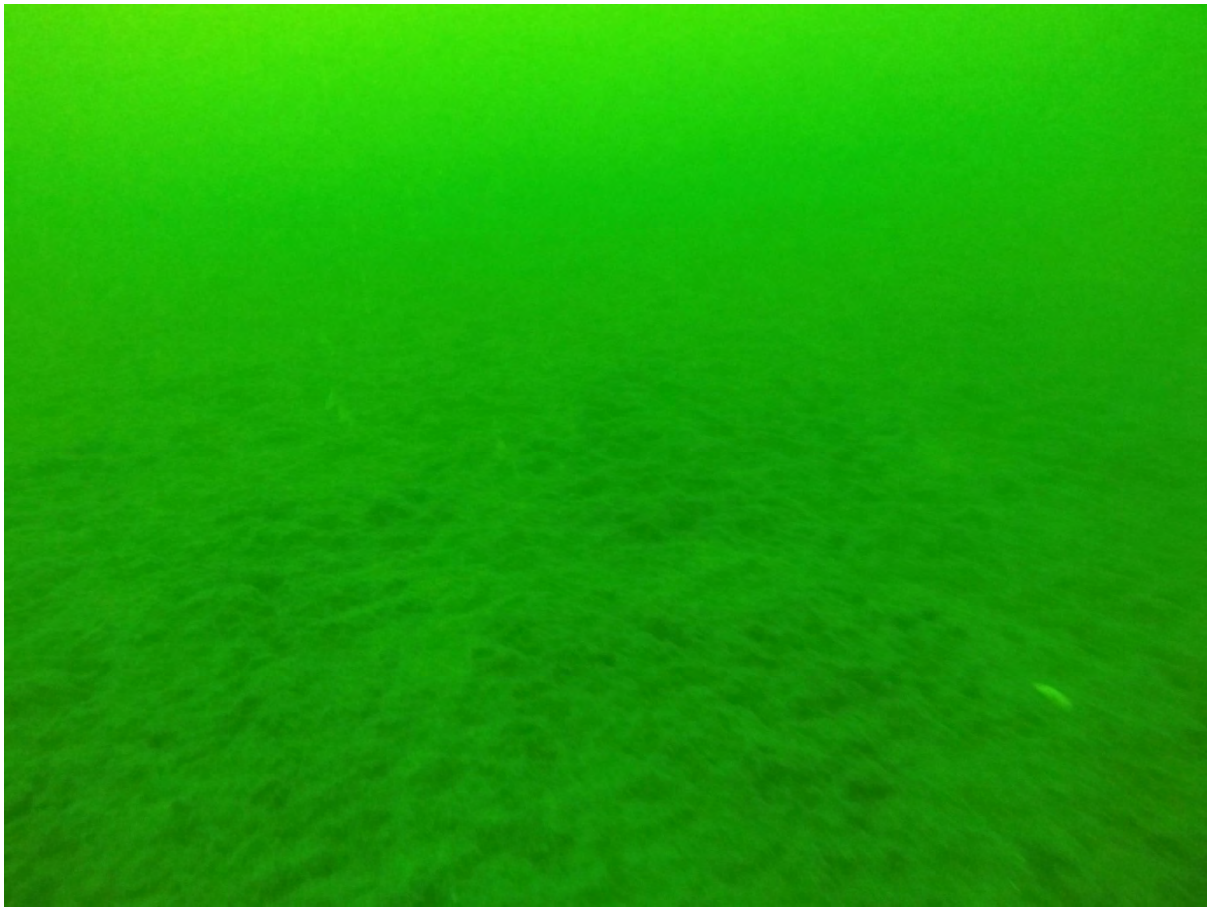


Figure 13. South West 50m.

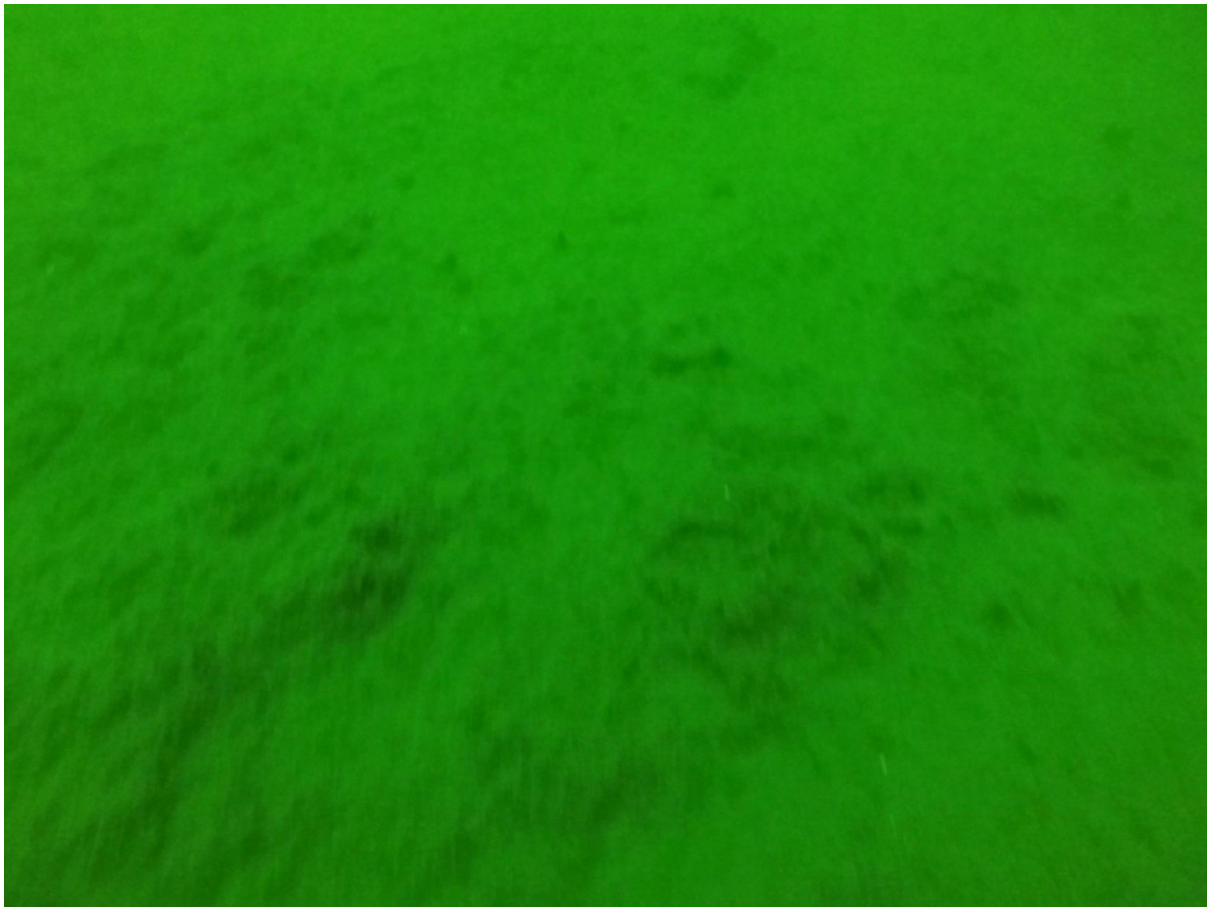


Figure 14. South West 100m.

Discussion & Conclusion

The fish farm site at Lehanagh pool, Cashel Co. Galway (Licence No. T09/093A) is well maintained and no associated fish farm wastes were found on site or surrounding surveyed areas. The seabed survey did not note any fish farm impacts or discarded objects. No bacterial matting was noted at any of the surveyed sample stations.

The survey was carried out on the 15th of December 2019 and reported here has resulted in no discernible, visual or measurable impacts from the fish farm site on the seabed at Lehanagh pool, Beirtreah Buí Bay, Cashel, Co. Galway license number T09/093A.

References

DAFM, 2008; Monitoring Protocol No.1 for Offshore Finfish Farms - Benthic Monitoring. Revised December 2008. PP. 8. Department of Agriculture, Food & the Marine. Dublin Ireland. URL: https://www.agriculture.gov.ie/media/migration/seafood/aquacultureforeshoremanagement/marinefinfishprotocols/Benthic%20Monitoring.pdf.

Benthic Monitoring Survey report for Aquaculture License No. T09/093A. Lehanagh Pool, Cashel, Co. Galway

Report Author

Dr Colin Hannon

September 2020

Report Details

Report Author	Dr Colin Hannon
[redacted]	[redacted]
Client	Marine Institute
[redacted]	[redacted]
email	Alan.drumm@marine.ie
Survey Location	Beirtreah Buí Bay, Cashel, Co. Galway
Aquaculture Licence Number	T09/093A
Survey date	13th August 2020
Task	Level 1 benthic monitoring as defined by the Department of Agriculture, Food and the Marine Protocol (DAFM, 2008)
Report completion date	14th September 2020

Introduction

A marine benthic survey was carried out at the Marine Institutes licensed aquaculture site at Lehanagh Pool in Beirtreah Buí Bay, Cashel, Co. Galway (Aquaculture License No. T09/093A) on the 13th of August 2020. The survey was carried out to the requirements set out in the departments benthic monitoring protocol (DAFM, 2008).

At the time of the survey there were five fish pens (50m diameter) on site with only two pens containing fish, with a total biomass of three tonnes of Salmon (*Salmo salar*).

The licensed site at Lehanagh Pool (Aquaculture License No. T09/093A) was previously subject to Level 1 benthic monitoring as defined by the Department of Agriculture, Food and the Marine (DAFM, 2008).

Monitoring procedure

Level 1 monitoring involves as per DAFM, (2008):

Level I: Video/photographic and visual observations and recordings shall be made at the following stations:

- At a minimum of 2 sites directly beneath the pens,
- At the edges of the pens,
- Two transects at right angles to each other. Along each transect sampling stations at +/- 10m, +/- 20m, +/- 50m and + 100m from the cages,
- At a control site.

In addition to the above, the following samples / measurements shall be taken at the same stations as above. These will be used to calculate sediment quality parameters.

- A minimum of one Redox potential readings shall be made at each sampling station,
- A single sediment sample for Organic Carbon measurement.

Site location

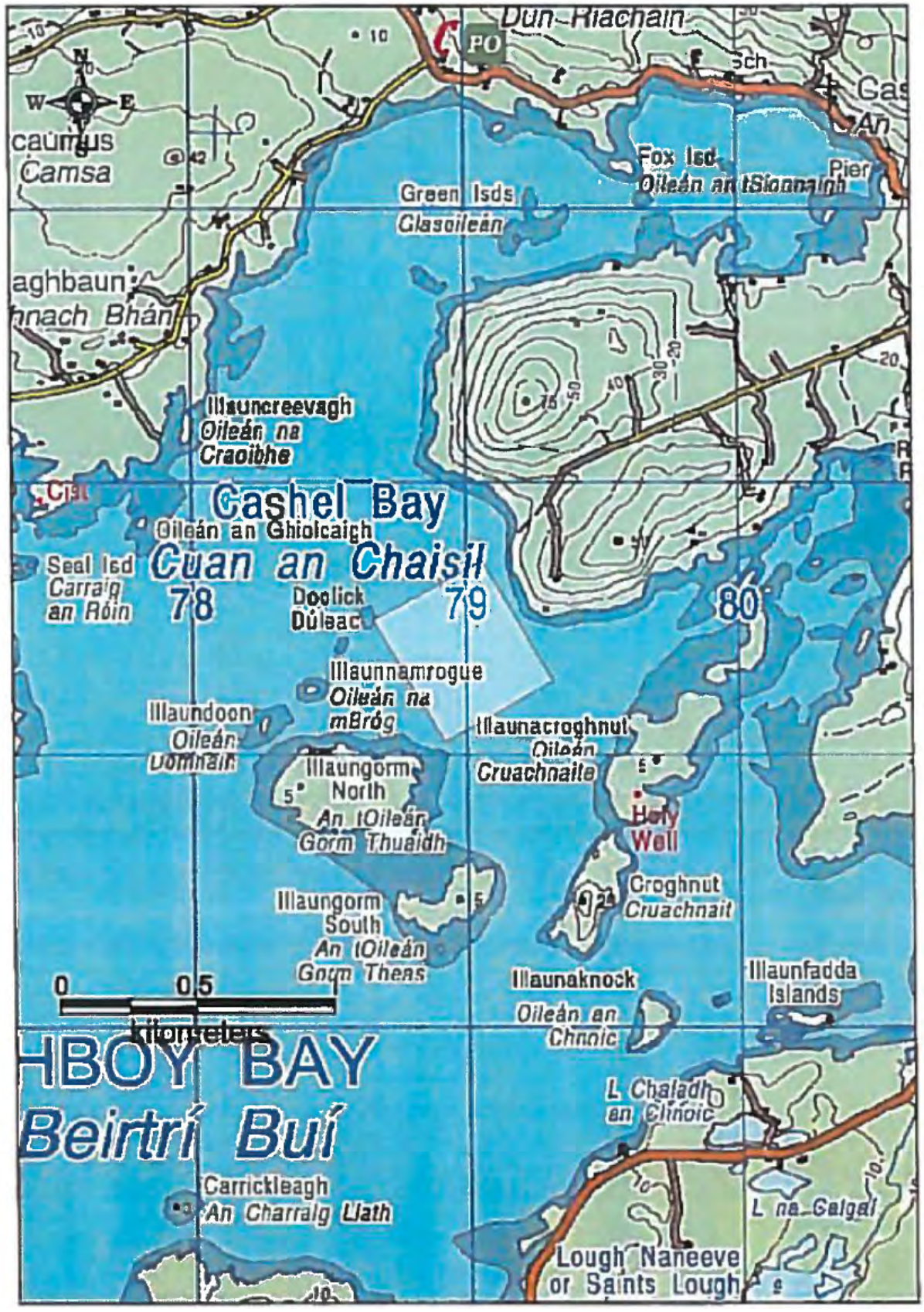


Figure 1. Ordinate survey map of the licensed site at Lehanagh Pool (Aquaculture License No. T09/093A). (Map from aquaculture license application, Ref: T9/93).

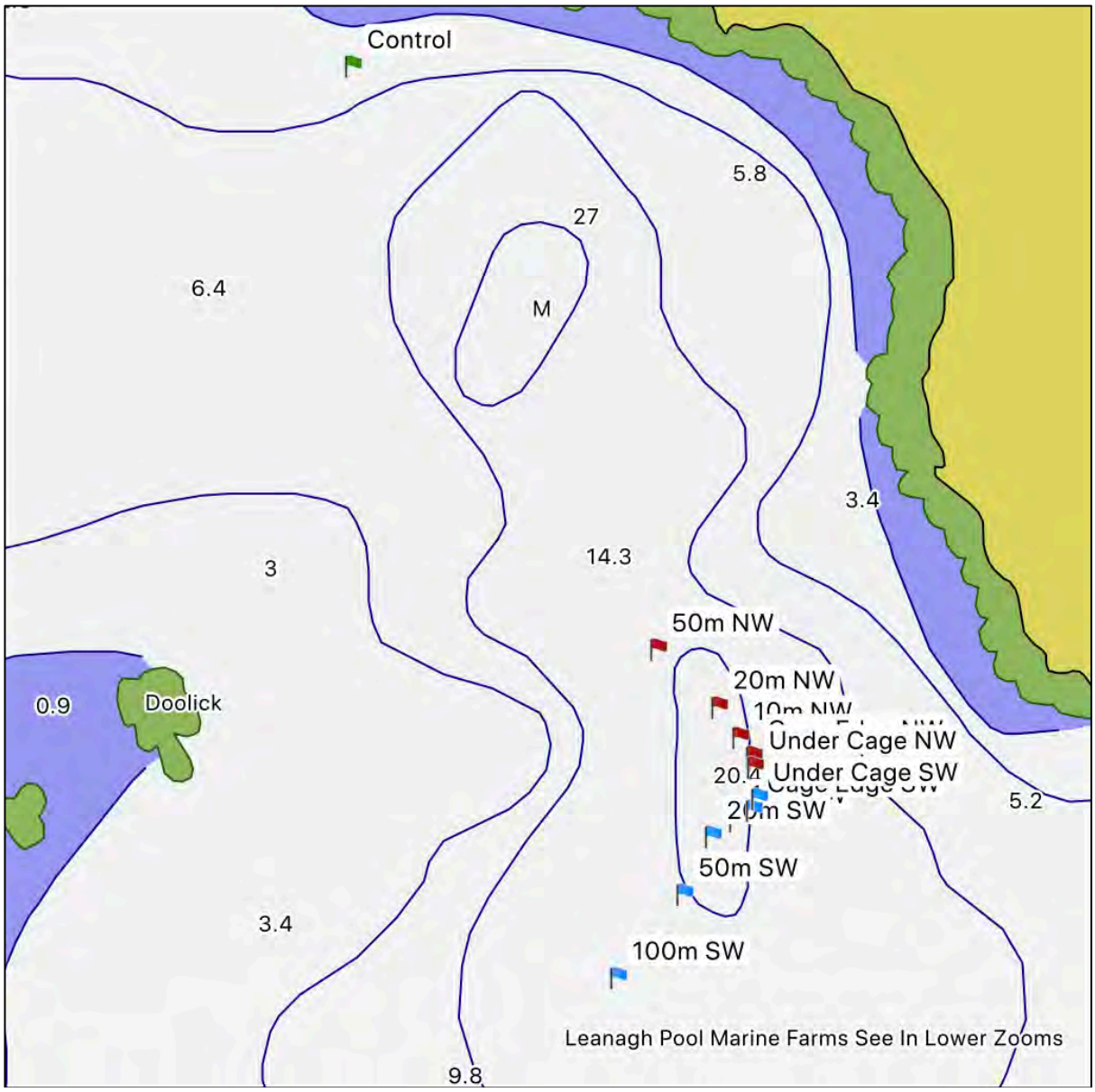


Figure 2. Overview of benthic sampling locating including the 500m control reference.

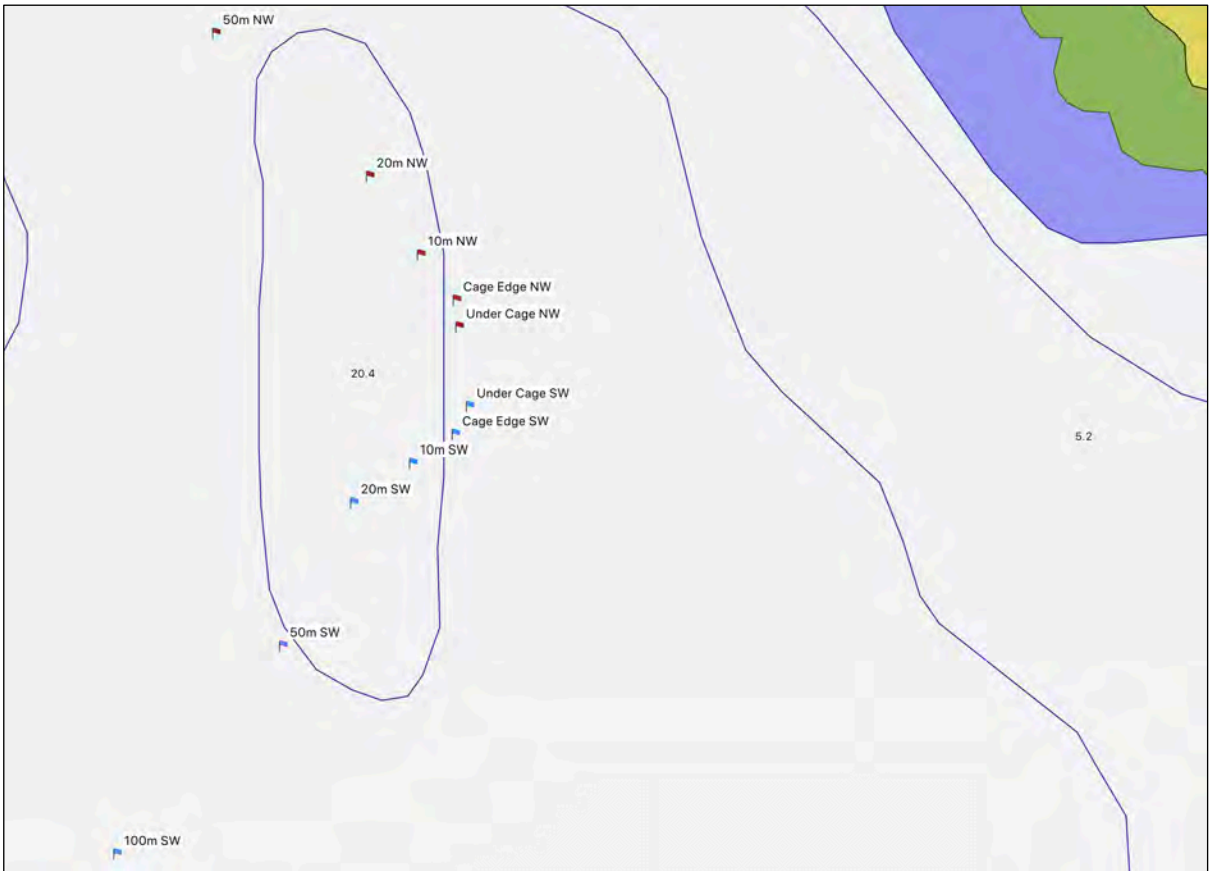


Figure 3. Positions of sampling stations for benthic monitoring at Lehanagh Pool. GPS locations for each station are presented in Table 1.

Method

Benthic monitoring survey was conducted on the 13th of August 2020 at the Lehanagh Pool research site. Weather conditions were sunny and sea state was calm. Survey was conducted at mid tide water on the same date using the marine institutes work boat.

Grab samples were made at each of the sample stations indicated in the table below (Table 1). A 0.025m^2 Van-Veen grab was used to collect each benthic sample. A successful grab was taken at each of the sample station and this location was taken using a Garmin handheld GPSMap 64X mapping unit in the format of WGS84. The Apparent Redox Discontinuity Potential (ARDP) was measured from cores taken from each of the successful grab samples and this data has been tabulated in table 1 in the results section of this report.

Benthic sediment samples collected using the Van-Veen grab were then sub-sampled to collect sediment (approx. 100ml of marine sediments) for total organic carbon (TOC %) analysis. Each sample was labelled and stored in a 250ml plastic container with an air tight lid and kept cool in a refrigerated box. Sediment type and description can be found in Table 1 in the results section.

Samples for total organic carbon analysis were delivered to Complete Lab Solutions (CLS), Tuam Road, Galway for processing an analysis on the 14th of August 2020 and completed on the 11th of September 2020.

Dive Survey

Two dive transects were undertaken, one in a Northwest direction (50m) and one in a Southwest direction (100m). A third dive was carried out 500m in distance Northwest of the research site which acts as the control site for the survey. Each transect was recorded (video) using a GoPro camera and digital images were also taken at each of the sample stations as per DAFM Level - 1 monitoring. Detailed visual dive notes along with footage and images from the transects are compiled in Table 1 in the results section. Images from the dive survey from the different sample stations are contained in this document.

On the day of the survey sea condition were calm, however the site was subjected to successive days of storm action in the days previous which reduced underwater visibility greatly which made obtaining clear images of the seabed extremely difficult. This report contains detailed visual descriptions of the sea bed at each transect location.

Results

Sample Station	TOC Results (%)	GPS Sample Locations	Sediment description & Visual Impacts	APRD	Bacterial Matting
Northwest Under Cage	4.10	N 53° 24.046 W 009° 49.161	Thick grey mud. No visual impacts	1-2cm	None
Northwest Cage Edge	4.87	N 53° 24.050 W 009° 49.162	Thick grey mud. No visual impacts	1-2cm	None
Northwest 10m	4.56	N 53° 24.057 W 009° 49.171	Thick grey mud. No visual impacts	1-2cm	None
Northwest 20m	1.69	N 53° 24.069 W 009° 49.184	Thick grey mud. No visual impacts	2cm	None
Northwest 50m	3.92	N 53° 24.091 W 009° 49.223	Thick grey mud. No visual impacts	2cm	None
Control Northwest 500m	2.43	N 53° 24.315 W 009° 49.416	Thick grey mud with sand and shells. No visual impacts	3cm	None
Southwest Under Cage	4.71	N 53° 24.034 W 009° 49.159	Thick grey mud. No visual impacts	1-2cm	None
Southwest Cage Edge	3.98	N 53° 23.997 W 009° 49.206	Thick grey mud. No visual impacts	2cm	None
Southwest 10m	4.75	N 53° 24.025 W 009° 49.173	Thick grey mud. No visual impacts	2cm	None
Southwest 20m	4.88	N 53° 24.019 W 009° 49.188	Thick grey mud. No visual impacts	1-2cm	None
Southwest 50m	4.48	N 53° 23.997 W 009° 49.206	Thick grey mud. No visual impacts	2cm	None
Southwest 100m	4.41	N 53° 23.965 W 009° 49.248	Thick grey mud. No visual impacts	2cm	None

Table 1. Lists the percentage total organic carbon along with sample site location and sediment description included sites visual impact. No bacterial matting or impacts were noted during the transect dives.

Survey images

Figure 4. North West Under Cage, some uneaten food can be seen.

Figure 5. North West Cage Edge

Figure 6. North West 10m

Figure 7. North West 20m

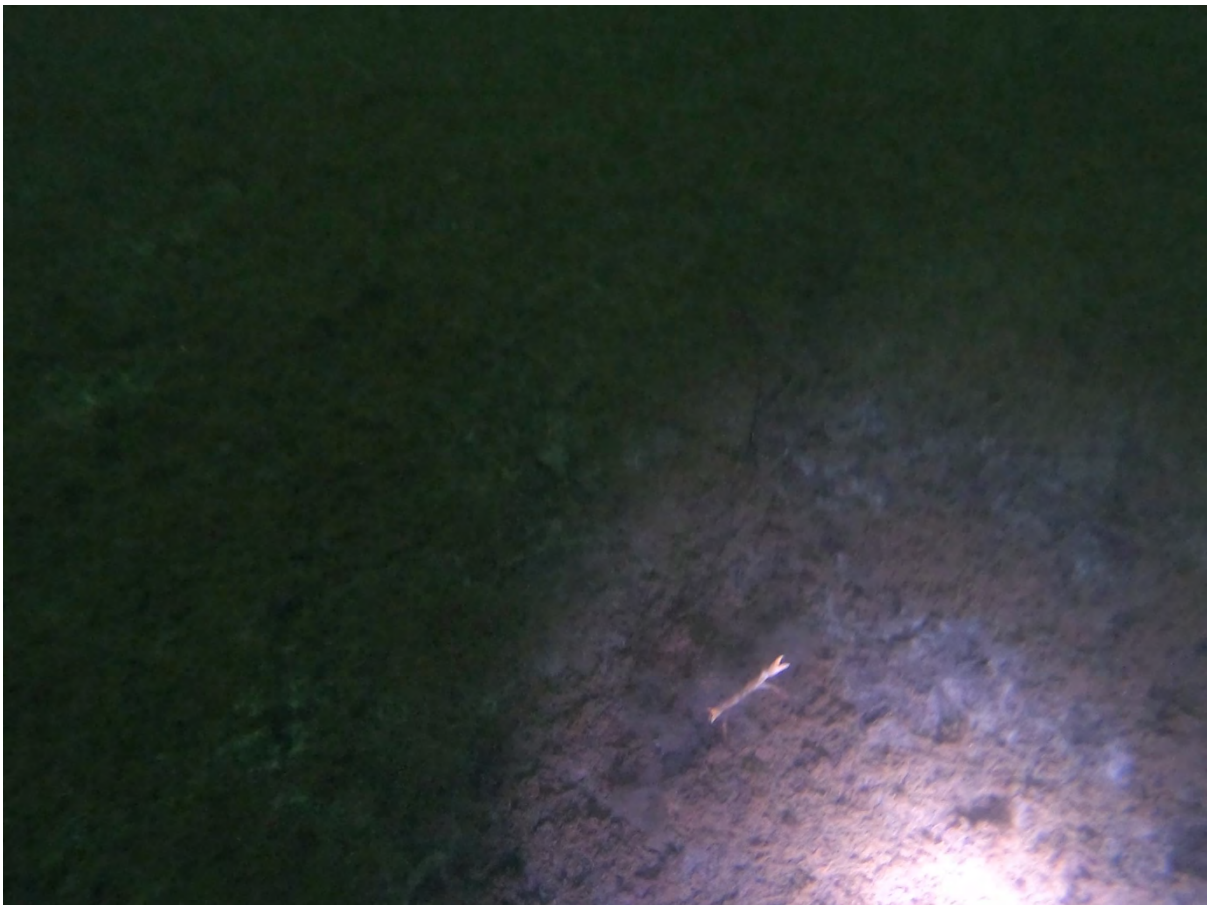


Figure 8. North West 50m

Figure 9. 500m Control Reference.

Figure 10. South West Under Cage. Some uneaten food can be seen.

Figure 11. South West Cage Edge.

Figure 12. South West 10m.

Figure 13. South West 20m

Figure 14. South West 50m.

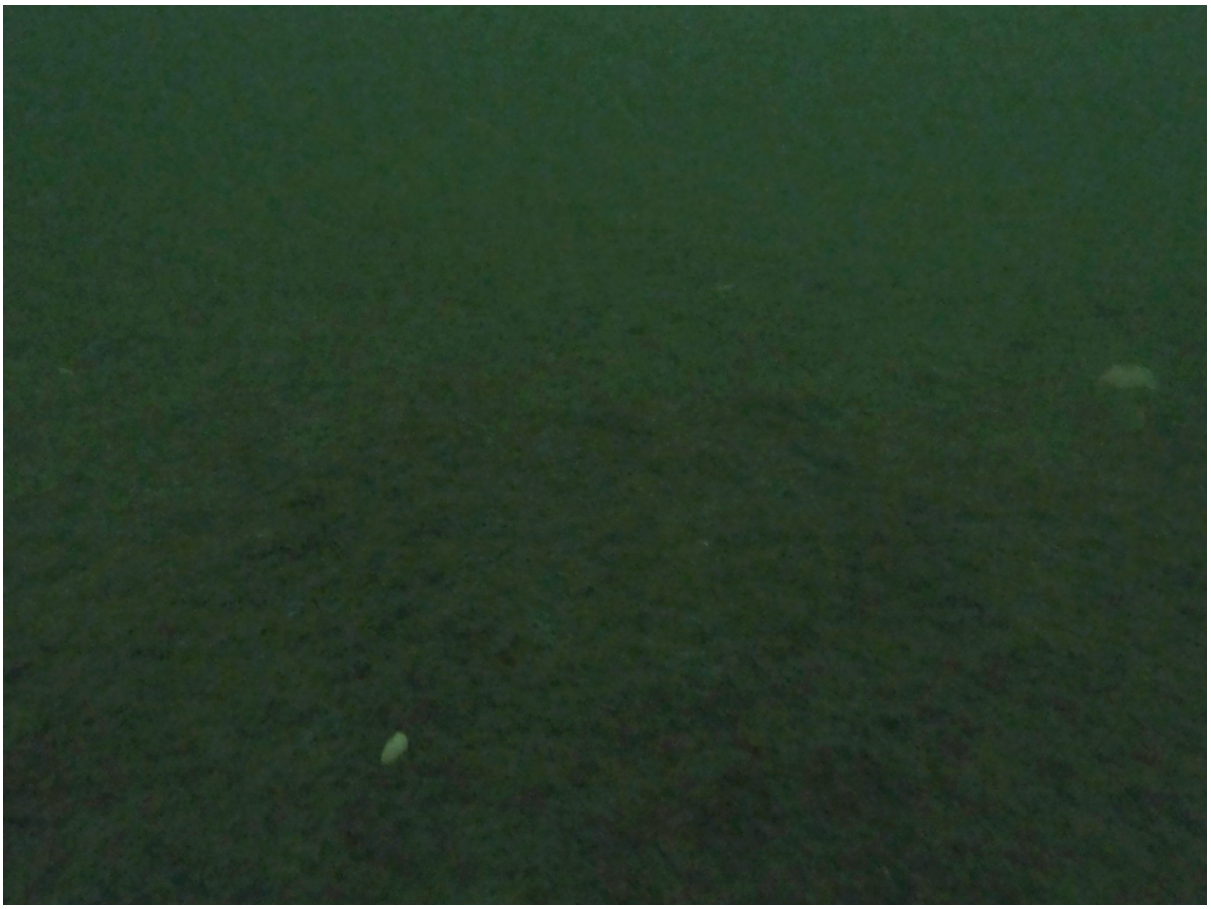


Figure 15. South West 100m.

Discussion & Conclusion

The marine research site at Lehanagh pool, Cashel Co. Galway (Licence No. T09/093A) is well maintained and no associated aquaculture wastes were found on site or surrounding surveyed areas. Some uneaten feed pellets were observed directly under the fish pens. The seabed survey did not note any direct impacts or discarded objects. No bacterial matting was noted at any of the surveyed sample stations.

The survey was carried out on the 13th of August 2020 and reported here has resulted in no discernible, visual or measurable impacts from the research site on the seabed at Lehanagh pool, Beirtreah Buí Bay, Cashel, Co. Galway license number T09/093A.

References

DAFM, 2008; Monitoring Protocol No.1 for Offshore Finfish Farms - Benthic Monitoring. Revised December 2008. PP. 8. Department of Agriculture, Food & the Marine. Dublin Ireland. URL: https://www.agriculture.gov.ie/media/migration/seafood/aquacultureforeshoremanagement/marinefinfishprotocols/Benthic%20Monitoring.pdf.

Environmental Survey at Lehanagh Pool Aquaculture site, Berthraboy Bay Co. Galway

September 2021

Produced by

AQUAFACT International Services Ltd

On behalf of

Marine Institute

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Report Approval Sheet

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AQUAFACT

1. Introduction

This report documents the environmental conditions of the seabed at a Marine Institute research site at Lehanagh Pool (-9.82024W; 54.40171N), Cashel Bay (Bertraghboy Bay) Co. Galway on 17th September 2021 (see Figure 1 for location map). Bertraghboy Bay, with a main body of water opening to the south-west onto a shallow coastal ledge (*ca.* 15m-30m), has a maximum depth of 22m in the inner bay proper and 40m in the outer bay (British Admiralty Chart No. 2709). Cashel Bay forms a relatively extensive subsystem opening into the head of the bay while Cloonile and Roundstone Bays are two inlets opening into it from the north. There is a narrow entrance between Inishtreh and Inishnee, to Bertraghboy Bay proper. The outer coastal ledge is bounded to the southwest by an extension of the submarine escarpment which extends from Golam Head through mile Rocks and Wild Belows to Murvey Shoal. Beyond the escarpment the water depth falls to over 100m.

Bertraghboy Bay itself is fed primarily by one main river, the Owenmore or Ballynahinch River which feeds into the upper end of Cloonile Bay. The Owengola and Gowlabeg Rivers, feeding into the head of Bertraghboy Bay on the east, are the largest of several smaller rivers around the Bay. Water salinities are high except for Cloonile Bay. The outer bay has a coastal rather than an estuarine character.

Water movement in the bay is mainly caused by tidal forces. Tides in the area are semi-diurnal with a mean spring range of 4.2m and a mean neap range of 1.8m. Fast tidal flows (in the order of 1.5ms^{-1}) are found over much of the tidal cycle in narrow areas such as the mouth of Bertraghboy Bay proper and at the entrance to Cloonile Bay. Offshore currents are relatively weak and rarely exceed 0.5ms^{-1}. However, this region is exposed to the prevailing south-westerly winds and experiences pronounced turbulence in stormy weather. Water exchange varies from site to site. It is best in the open sea and the larger bays and much less in the small inlets at the north and northeast of Bertraghboy Bay. Over much of Bertraghboy Bay, particularly in the outer bay regions, the bottom terrain is highly irregular.

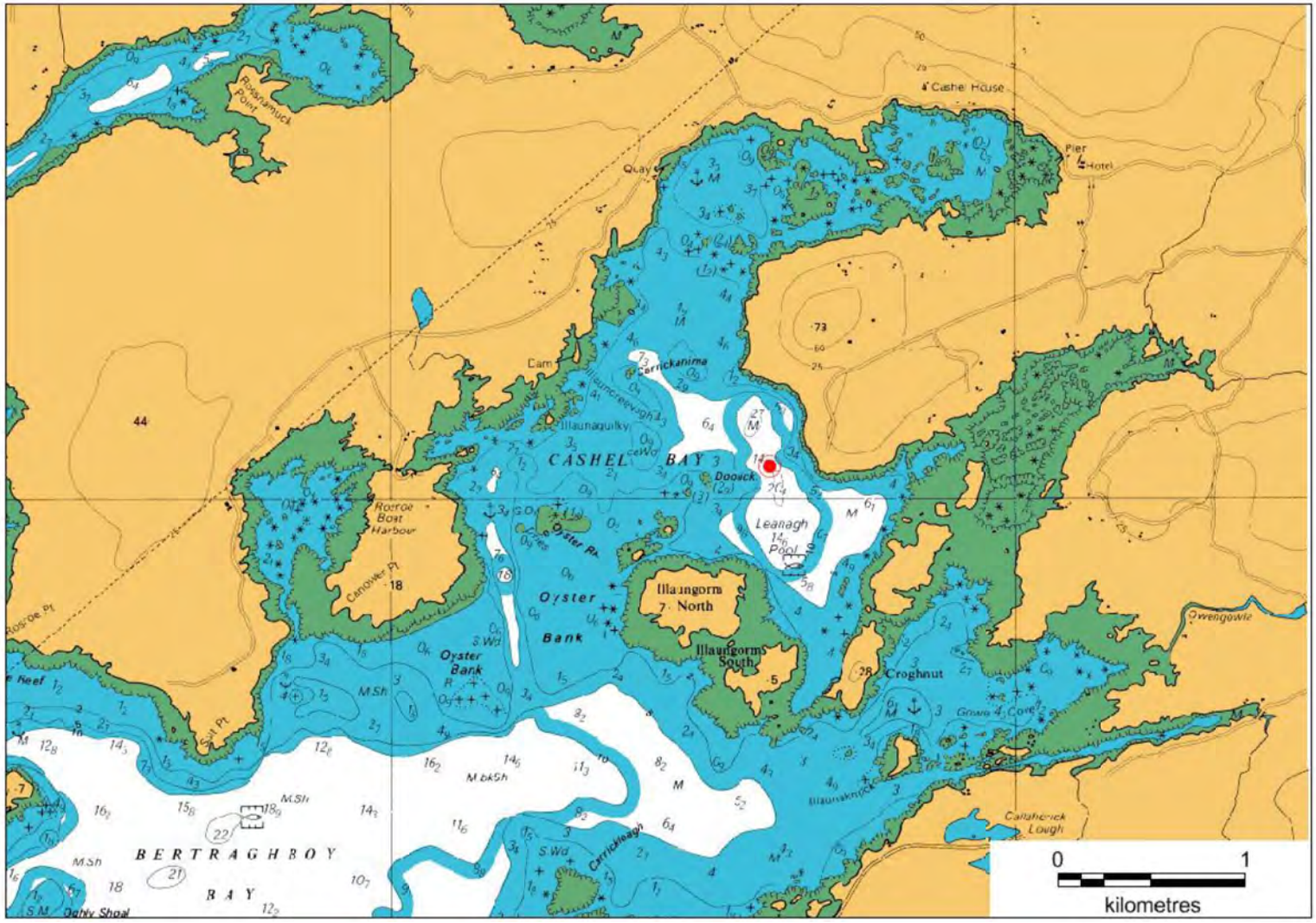

Figure 1-1: Location of the aquaculture site in Bertraghboy Bay, Co. Galway (-9.82024W; 54.40171N)

1.1. Offshore finfish farms – benthic monitoring

The main objective of the survey was to assess the overall state of the environment in relation to the salmon production process. The sites were surveyed according to the revised Benthic Monitoring Guidelines laid down by the Department of Agriculture, Fisheries and Food (December 2008). The benthic monitoring requirements at a fish farm are dependent on the level of biomass held at the site and the local hydrography. Table 1.1 below sets out the level of benthic monitoring required based on tonnage produced and mean current speeds at a fish farm:

Table 1-1. Matrix of production tonnage versus current speed to determine level of benthic monitoring required.

	Mean Current Speed (cms^{-1})		
Tonnage	**<5**	**5-10**	**>10**
0-499	Level I	Level I	Level I
500-999	Level II	Level I	Level I
>1000	Level II	Level II	Level I

The current speed is a mean value calculated from maximum current measurements over spring and neap tidal cycles at the surface and near the bottom. The tonnage refers to the maximum biomass predicted for each site. An annual survey must be carried out at each site (production and smolt) operated by a company. A level I or level II survey may be carried out as follows:

Level I: Video/photographic and visual observations and recordings shall be made at the following stations:

- At a minimum of 2 sites directly beneath the pens
- At the edges of the pens
- Two transects at right angles to each other. Along each transect sampling stations at +/- 10m, +/- 20m, +/- 50m and + 100m from the pens
- At a control site

In addition to the above, the following samples/measurements shall be taken at the same stations as

above. These will be used to calculate sediment quality parameters.

- A minimum of one Redox potential reading shall be made at each sampling station.
- A single sediment sample for Organic Carbon measurement.

Level II: In addition to the above, two replicate grab samples shall be captured at each of the sample stations for faunal analysis. The exact locations of sampling points should be agreed in advance with the Department of Agriculture Fisheries and Food (DAFF). The identification and abundance of macro-faunal invertebrates shall be estimated and tabulated. Identification of fauna to the level of species will be required.

The present survey at the Lehanagh Pool site was carried out at Level I.

It is important to take note that the exact position of the individual pen structures are not permanently fixed to a single position and there is a relatively large lateral movement due to depth, wind, currents and tides. For this reason bottom stations particularly at the under, edge and 10m zones are taken at the time of sampling but may vary relative to the overlying pen position under various environmental conditions.

2. Sampling Procedure & Processing

All survey work took place on the 17th September2021. The dive at the Lehanagh Pool site was conducted at a maximum depth of 20m and underwater visibility on the day was moderate at approximately 3m. The survey took place under the north-eastern pen of the five pen arrangement at the time of survey and benthic transects followed by the divers are shown in Figure 2.1 below.

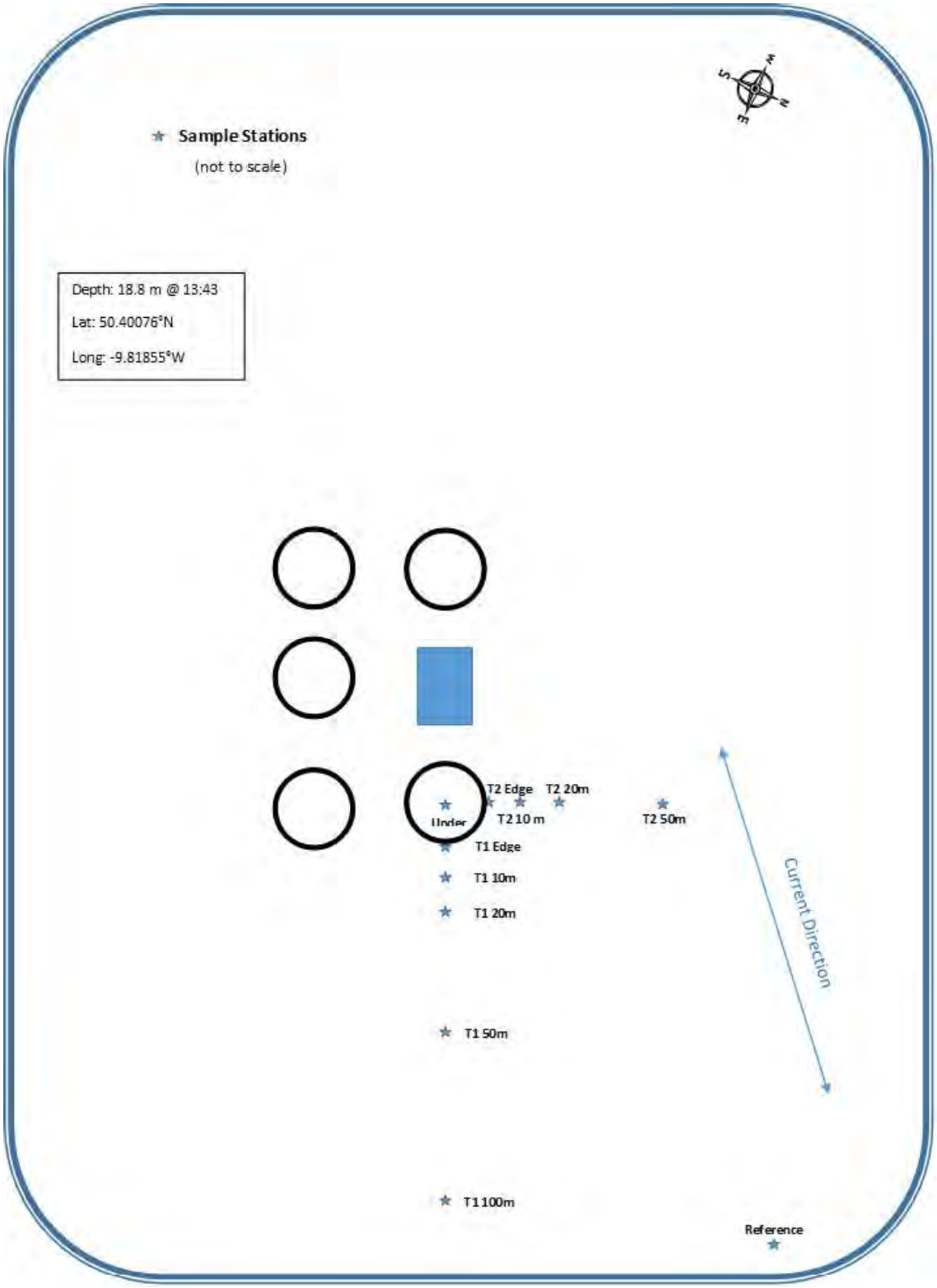

Figure 2-1: Location of dive transects at Lehanagh Pool on 17th September 2021.

Disinfection

Prior to the dive survey all diving equipment, suits and boats were thoroughly disinfected utilising both a dipping and spraying protocol.

2.1. Dive survey

Two dive transects (one parallel with the direction of the prevailing current and one perpendicular to the prevailing current) were laid out from the sea surface at each site using a boat equipped with a GPS mapper. Pen locations were noted as DGPS positions using a Trimble GeoXT, which is capable of sub-meter horizontal accuracy using real time corrections from the integrated EGNOS (European Geostationary Navigation Overlay System) receiver. Acoustic beacons were deployed to assist the divers in locating transect marks while underwater. The underwater survey itself involved the direct observation, sampling and recording (photographic and written) of benthic conditions by qualified biologists at a number of sites along the transects:

- directly under the pen (T1 Under)
- under the edge of the pen (T1 Edge)
- at 10m (T1 10m, T1 10m), 20m (T1 20m, T2 20m), 50m (T1 50m, T2 50m) and 100m (T1 100m) from the pens.

A reference station (Ref) was also assessed to give a representation of ambient benthic conditions in the area immediately surrounding the pen installations and served for comparison purposes. As such, it represents the 'undisturbed' condition of the seafloor surrounding the sites – it was taken at a distance *c.* 180m from the pen installations.

All dives were carried out by highly experienced, qualified biologists who made notes of features and species encountered during the dives – these were transcribed to logs upon surfacing. In addition to standard SCUBA gear the divers were equipped with:

- A high end dSLR camera for photographing epibenthos. Photographs were taken at the prescribed stations along each transect and observations on benthic conditions at the site were noted down. The camera used was a Nikon D200 in a Subal ND20 underwater housing fitted with a 12-24mm lens and two INON strobes.
- A hand-held dSPI camera for photographing sediment profiles, i.e. images were taken of the

sediment in cross profile at depths of to 23cm (Mean redox measurements were made using digital sediment profile imagery (SPI). This unit uses a Canon EOS 450D camera with Nikkor optics).

- A SONAR receiver & compass for underwater navigation.
- Pre-labelled bags to store sediment samples for organic carbon analysis.
- Dive slates and waterproof pencils for making notes.
- Torches.

The divers photographed representative areas of the sediment and fauna and recorded observations in situ at the various stations investigated. Notes were completed during discussion immediately on surfacing and a map of the dive track was drawn up. Observations recorded during the dive may include:

- Presence of bacterial mats and uneaten food
- Presence of farm-derived litter
- Presence of gas bubbles or anoxic areas
- Animals visible or evidence of their presence
- Macroalgae visible
- Sediment colour and texture – among other things.

By noting the species of animals present and their densities, any tracks of animals or the presence of species that are known to be connected with certain states of benthic enrichment, the health of the benthos (including the highlighting of some potential problems) may be gauged.

2.2. Sediment Profile Imagery (SPI)

A Sediment Profile Image (SPI) was also acquired at each of the stations mentioned above. These images were acquired using a diver-deployed sediment profile imaging camera system. This system is comprised of a digital SLR camera in a water-tight pressure vessel that is mounted above a prism that penetrates the upper 25cm of sediment (see Figure 2.1 for image). The sediment profile is viewed through a plexiglass window. Its image is reflected to the camera lens via a plane mirror. Illumination is provided by an internally-mounted strobe.

The diver depresses the unit into the seafloor and manually triggers the camera. This process is repeated at each station investigated. The prism unit is filled with distilled water – thus ambient water clarity is never a limiting factor in image quality.

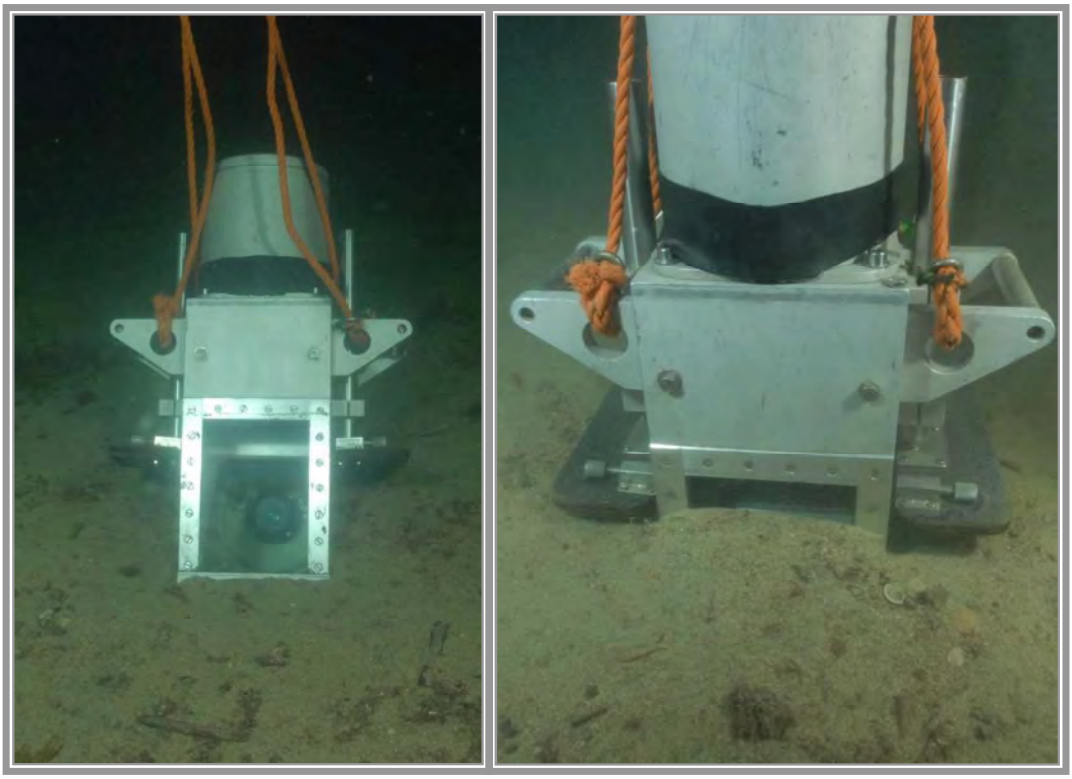

Figure 2-2. Diver operated Sediment Profile Imaging camera. The left-hand image gives a view of the camera at the sediment surface. The right-hand image shows the SPI camera when inserted into the sediment.

A great deal of information about benthic processes is available from sediment profile images. Measurable parameters, many of which are calculated directly by image analysis, include physical/chemical parameters (i.e. sediment type measured as grain size major mode, prism penetration depth providing a relative indication of sediment shear strength, sediment surface relief, condition of mud clasts, redox potential discontinuity depth and degree of contrast, sediment gas voids) and biological parameters (i.e. infaunal successional stage of a well documented successional paradigm for soft marine sediments (see Pearson and Rosenberg, 1978), degree of sediment reworking, dominant faunal type, epifauna and infauna, depth of faunal activity, presence of microbial aggregations).

For the purposes of the current survey the primary feature of interest is the depth of oxygen penetration into the sediments in the vicinity of the finfish pens (this information is required to satisfy the

requirements of the Benthic Monitoring Protocol (DAFF, 2008). In this case the apparent redox potential discontinuity or ARPD depth is measured. Features of particular interest that may be gleaned from SPI images taken in sediments in the vicinity of finfish pens include the presence of:

- uneaten feed pellets (and depth of this material)
- faecal casts
- and depth of shell gravel deposits
- of gas voids in the sediment (refer to Figure 2.2)

Figure 2-3. Typical sediment profile images with examples of features.

2.3. Sampling for Organic Carbon Analysis

Sediment samples for organic carbon analysis were collected at all of the stations.

All samples were stored in pre-labelled plastic bags, kept in cold freezer boxes on board the vessel and frozen at -20°C on return to the lab.

Organic carbon analysis was carried out by ALS laboratories using the Loss on Ignition (LOI) technique. This method involves oven drying the sediment sample in a muffle furnace (450°C for a period of 6 hours) after which time the organic content of the sample is determined by expressing as a percentage the weight of the sediment after ignition over the initial weight of the sediment.

3. Results

3.1. Recent stocking history

This site was restocked on 20th April 2021 when 22,225 fish, at an average weight of 112g, were input to the site. The site had been fallow for approximately 4 weeks prior to this input. At the time of the survey, 8,219 fish with an average weight of 489 g remained on site. Just prior to the survey, 4.7 tonnes of fish were culled (13th September) giving an onsite biomass production of just over 6.2 tonnes prior to the survey.

Figure 3-1. Pens on Lehanagh Pool, 17th September 2021

3.2. Seabed physical characteristics

The seabed at Lehanagh Pool is composed of a mix of sediment types with areas of mud/very fine sands and muddy fine sand with filamentous algal turf.

3.3. Photographic record; Transect 1

A total of six stations were investigated along Transect 1.

3.3.1. Under Pen Location

The seafloor directly under the pens consisted of a fine muddy sediment (Figure 3-2). There was some indication of organic enrichment with a light layer of *Beggiatoa* spp. overlying the mud (white layer) with a scattering of waste food on the seafloor. Tracks through the sediment indicate the presence of crabs.

Figure 3-2. T1 – Under pen, Lehanagh Pool, 17th September 2021

3.3.2. Edge of pen

The seafloor under the edge of the pen was composed of fine mud with a light cover of filamentous algal turf (*Audouinella* sp.) and some drift macroalgae branches (Figure 3.3). Tracks left by mobile macrofauna revealed a dark sediment under the algal turf indicating shallow redox depths. The mat of *Beggiatoa* spp. recorded at the previous station was absent.

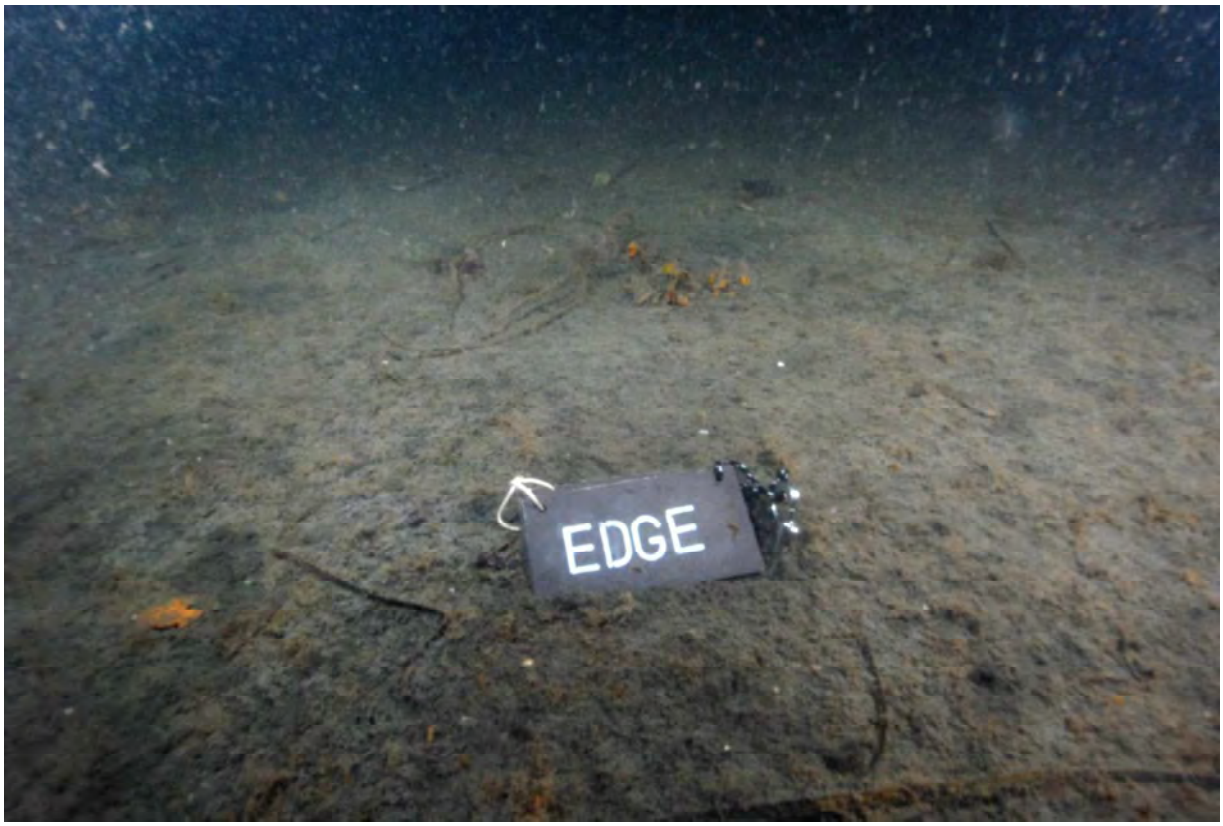

Figure 3-3. T1 – Pen edge, Lehanagh Pool, 17th September 2021

3.3.3. 10m from the pen

Sediments at the 10m station were composed of a fine mud with a light cover of filamentous algae tufts and some drift algae (Figure 3-4). A Harbour crab, Liocarcinus depurator, was imaged and dark grey sediment indicated shallow redox depths.

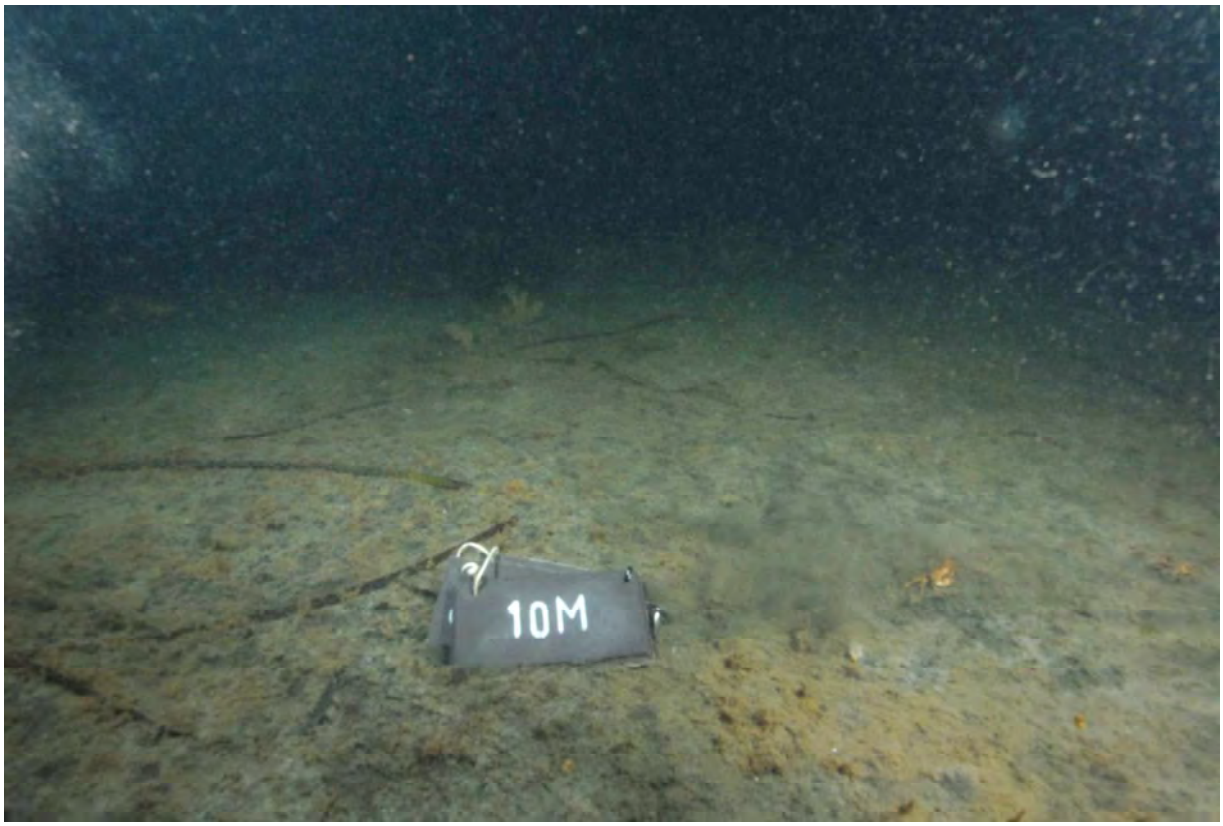

Figure 3-4. T1 – 10m, Lehanagh Pool, 17th September 2021

3.3.4. 20m from the pen

There was little change to benthic conditions on moving 20 m along Transect 1 where the seafloor was composed of a fine mud with filamentous algae and a light cover of *Beggiatoa* sp. over the surface (Figure 3-5). A small amount of decaying food was present.

Figure 3-5. T1 – 20m, Lehanagh Pool, 17th September 2021

3.3.5. 50m from the pen

There was no obvious change on moving 50 m along this transect with the fine muddy sediment seafloor having a cover of filamentous algae and *Beggiatoa* sp. over the surface (Figure 3-6). A number of ascidians (*Ascidiella aspersa*) were noted attached to a hard substrate in the sediment.

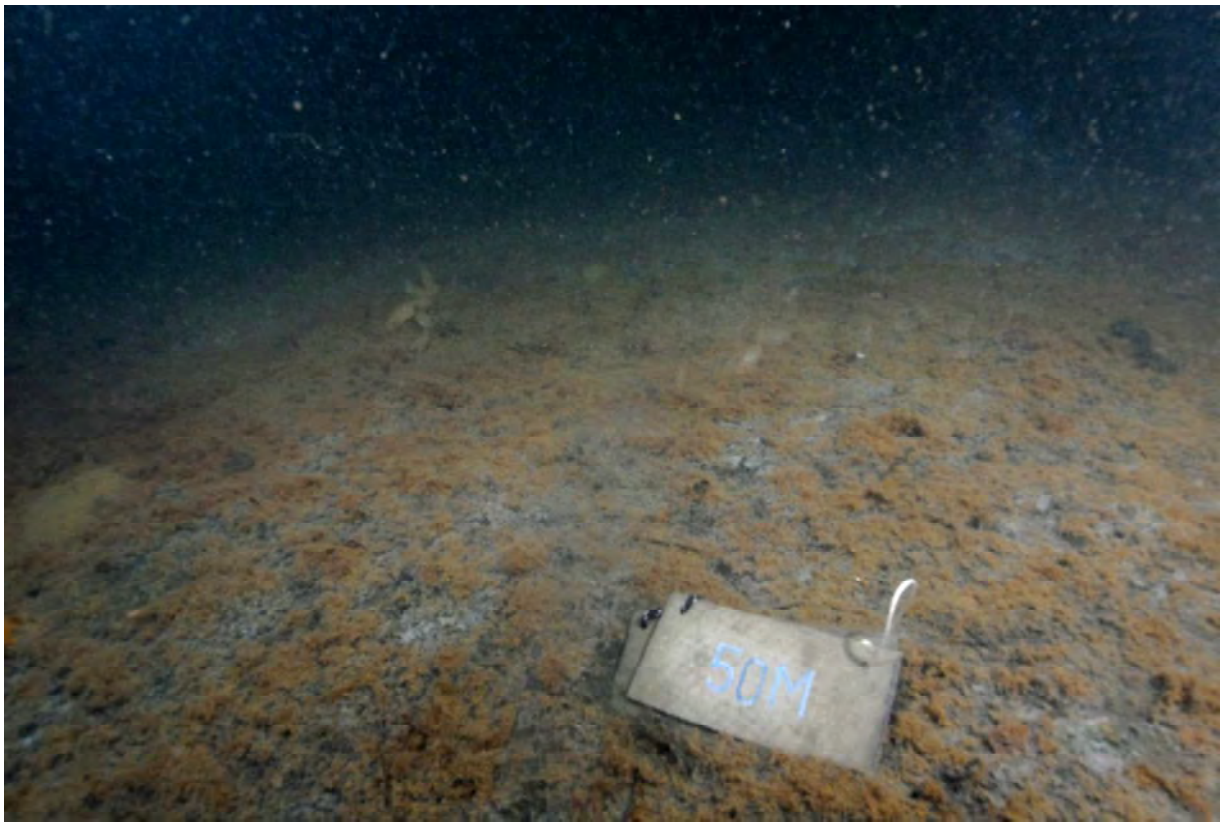

Figure 3-6. T1 – 50m, Lehanagh Pool, 17th September 2021

3.3.6. 100m from the pen

The seafloor at the 100m station was composed of a mud/fine sand mix with a covering of filamentous algae tufts (*Audouinella* sp.) (Figure 3-7). A mat of Beggiatoa sp. could be seen under the algal tuft. Particles of loose macroalgae were also present along with a shore crab, *Carcinus maenas*. This station marked the end of Transect 1.

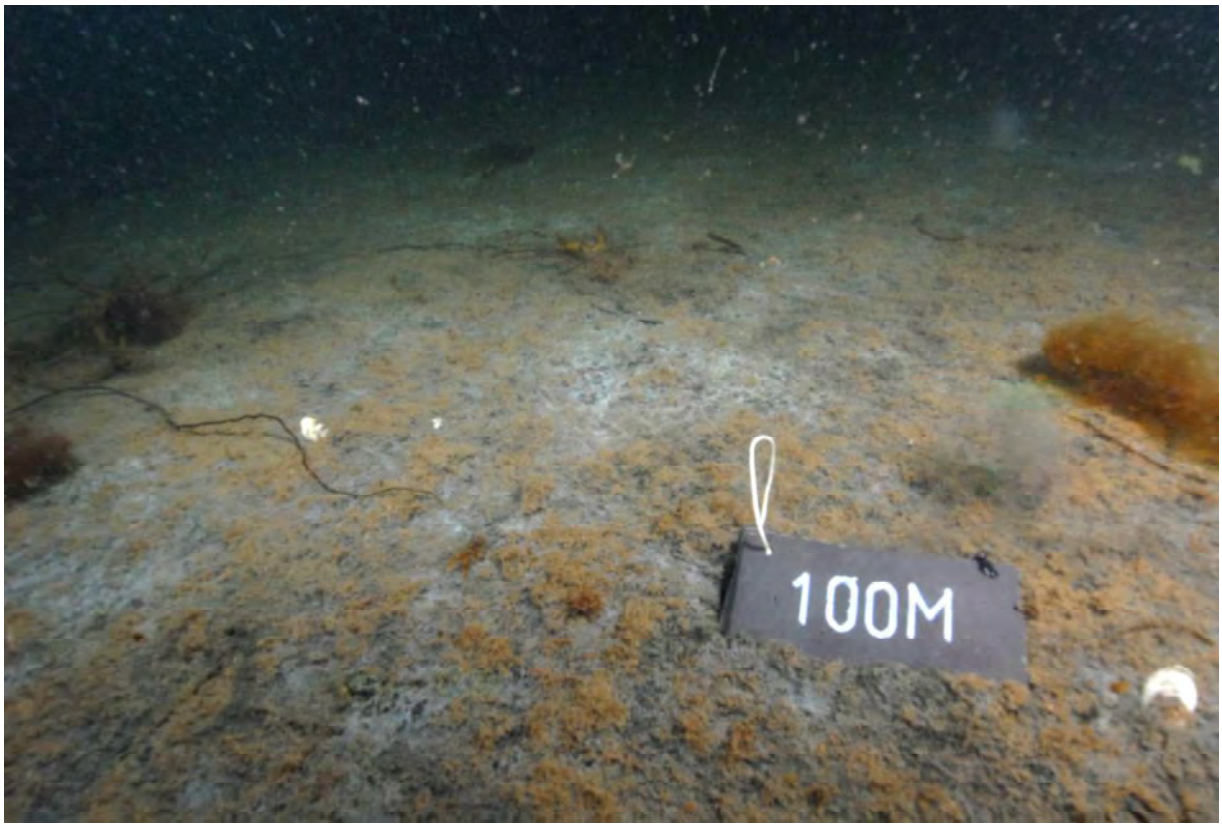

Figure 3-7. T1 – 100m, Lehanagh Pool, 17th September 2021

3.4. Sediment Profile Imagery – Transect 1

Figure 3-8 presents sediment profile images taken at the six stations visited on Transect 1 of the Lehanagh Pool site. They display a single image and the maximum and minimum apparent redox potential discontinuity (ARPD) depths measured at each station. Each image is 15.5cm × 25cm.

ARPD depths ranged from a minimum of 0 cm (all stations) to a maximum of 8.7 cm (T1 50 m) with the mean ARPD ranging from 0 cm to 1.4 cm. The composition of sediments at each station can be seen – fine muddy sand with occasional shell fragments.

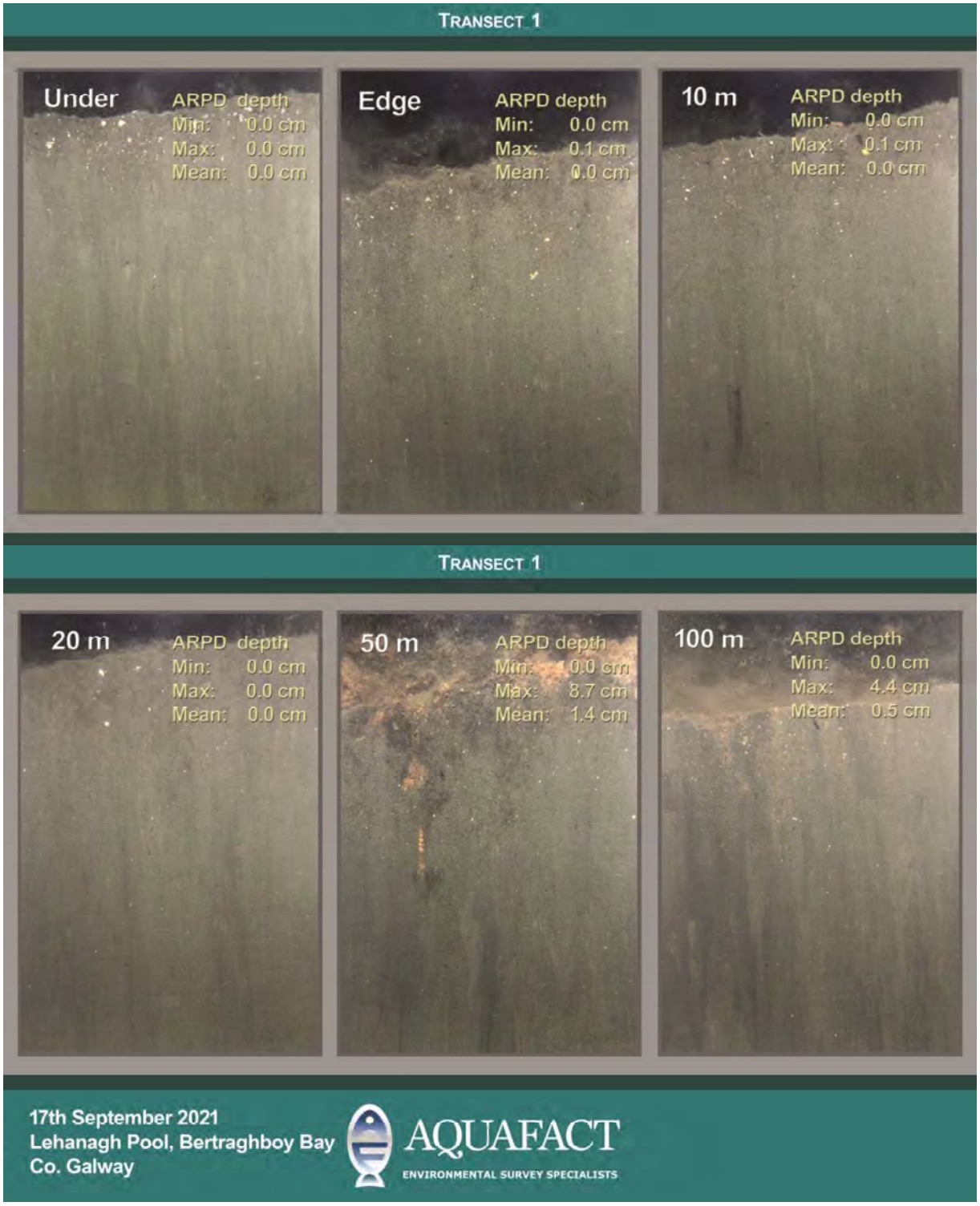

Figure 3-8 Sediment Profile Images from each of the stations along Transect 1, 17th September 2021.

3.5. Photographic record; Transect 2

A total of five stations were investigated on Transect 2 with an additional (reference) station investigated *c.* 180m from the pen edge.

3.5.1. Under Pen Location

The seafloor at the under pen station for Transect 2 consisted of fine muddy sediment with a scattering of waste food and faecal casts over its surface (Figure 3-9). A number of drift algae blades were present.

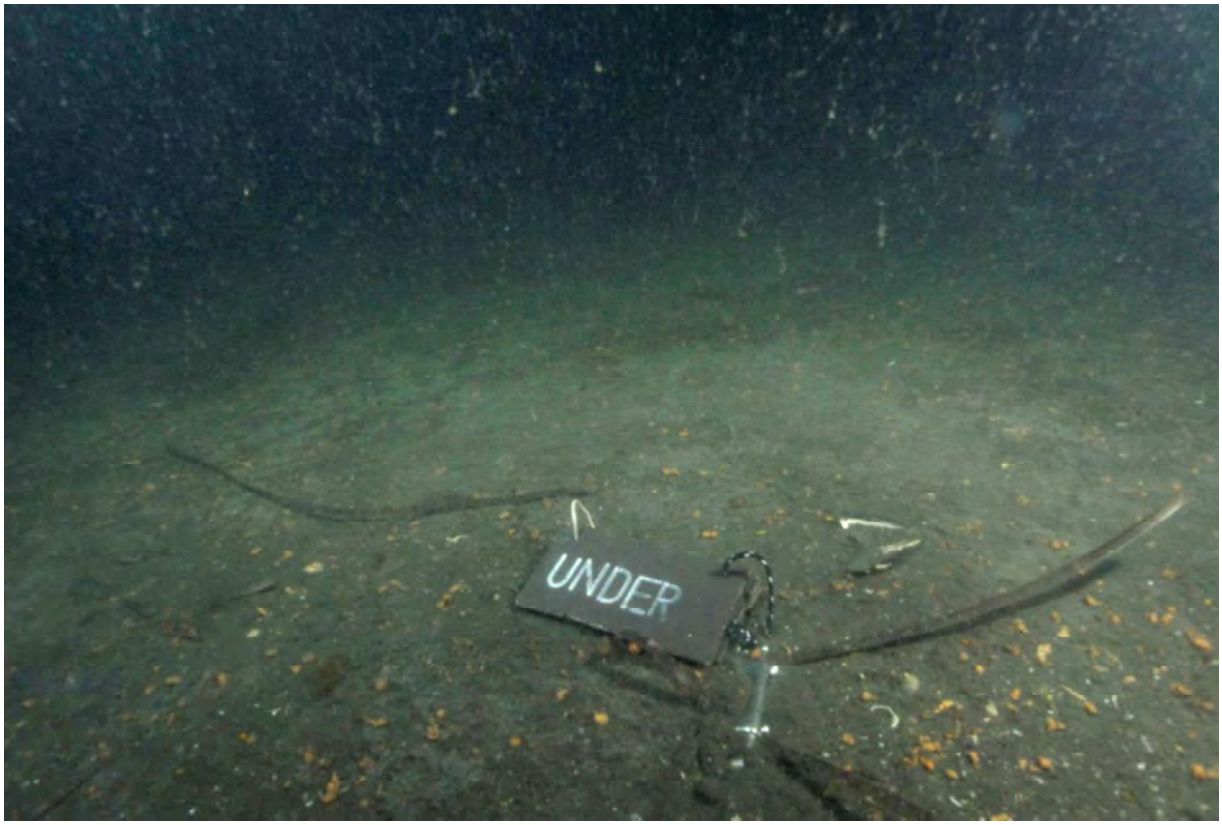

Figure 3-9. T2 - Under pen, Lehanagh Pool, 17th September 2021

3.5.2. Edge of pen

The seafloor under the edge of the pen along Transect 2 consisted of fine muddy sediment with a light cover of algal tufts and benthic diatoms (Figure 3.10). Where the algal cover was disturbed, dark sediment could be seen indication shallow redox depths.

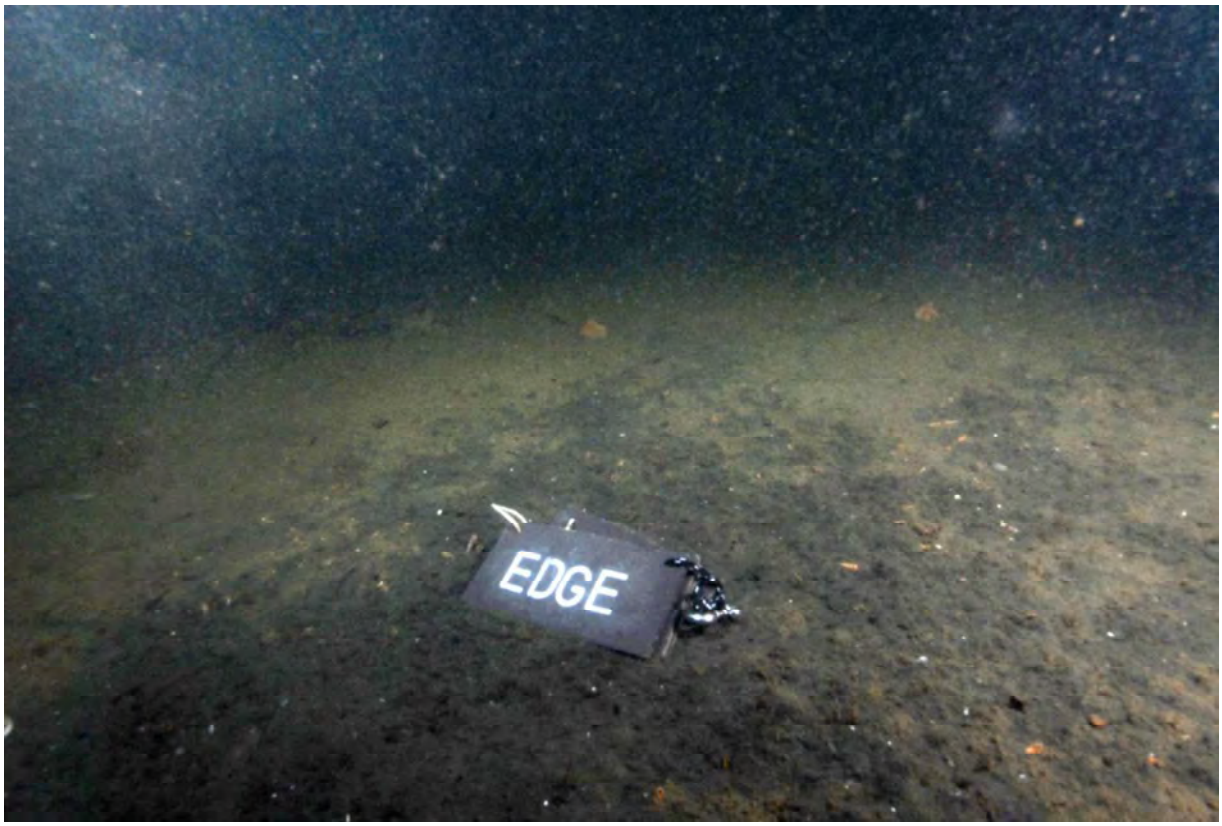

Figure 3-10. T2 – Pen edge, Lehanagh Pool, 17th September 20212

3.5.3. 10m from the pen

The seafloor at the 10 m station along Transect 2 was composed of a mud/fine sand mix with a covering of filamentous algae tufts (*Audouinella* sp.) (Figure 3-11). A lobe shell, *Philine quadripartite*, was noted foraging over the bottom. There was no obvious impact from the aquaculture activity at this station.

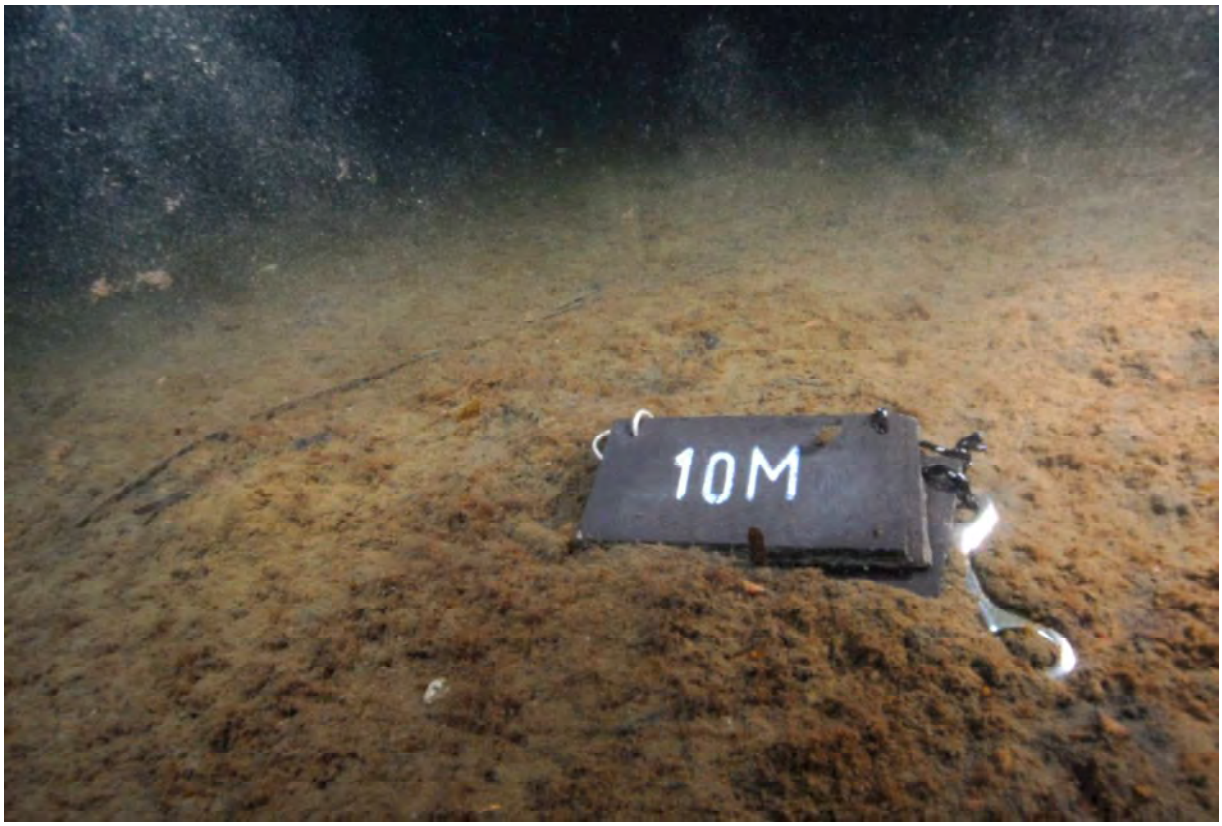

Figure 3-11. T2 - 10m, Lehanagh Pool, 17th September 2021

3.5.4. 20m from the pen

Sediments at the 20m station were composed of a mud/fine sand mix with a filamentous algal cover (Figure 3-12). Patches of algal were bare revealing a dark sediment underneath with a light bacterial mat over its surface.

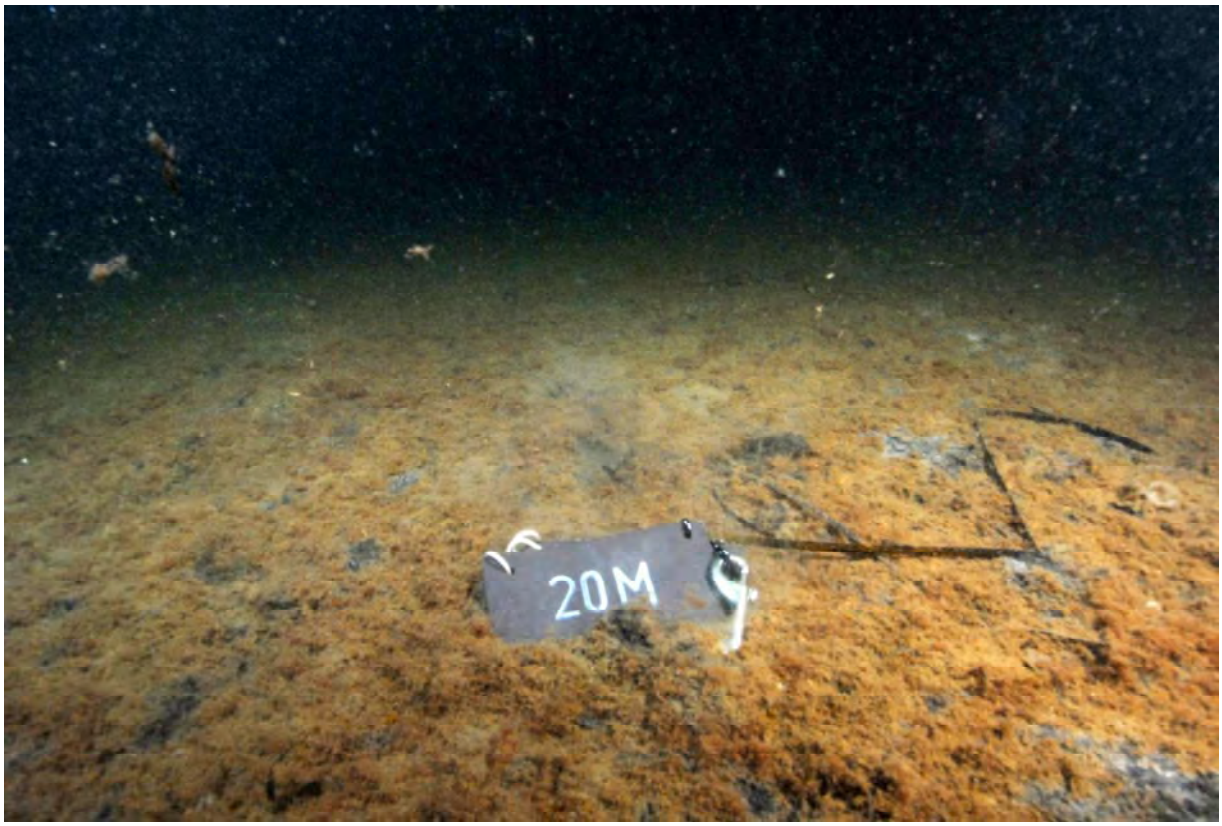

Figure 3-12. T2 – 20m, Lehanagh Pool, 17th September 2021

3.5.5. 50m from the pen

There was no change in benthic conditions on moving along Transect 2 to the 50 m station (Figure 3-13). The seafloor was composed of a mud/fine sand mix with a filamentous algal There were no obvious signs of the finfish rearing operation. A hermit crab, with a sponge (*Suberites* sp.) covered shell, is imaged in the photograph.

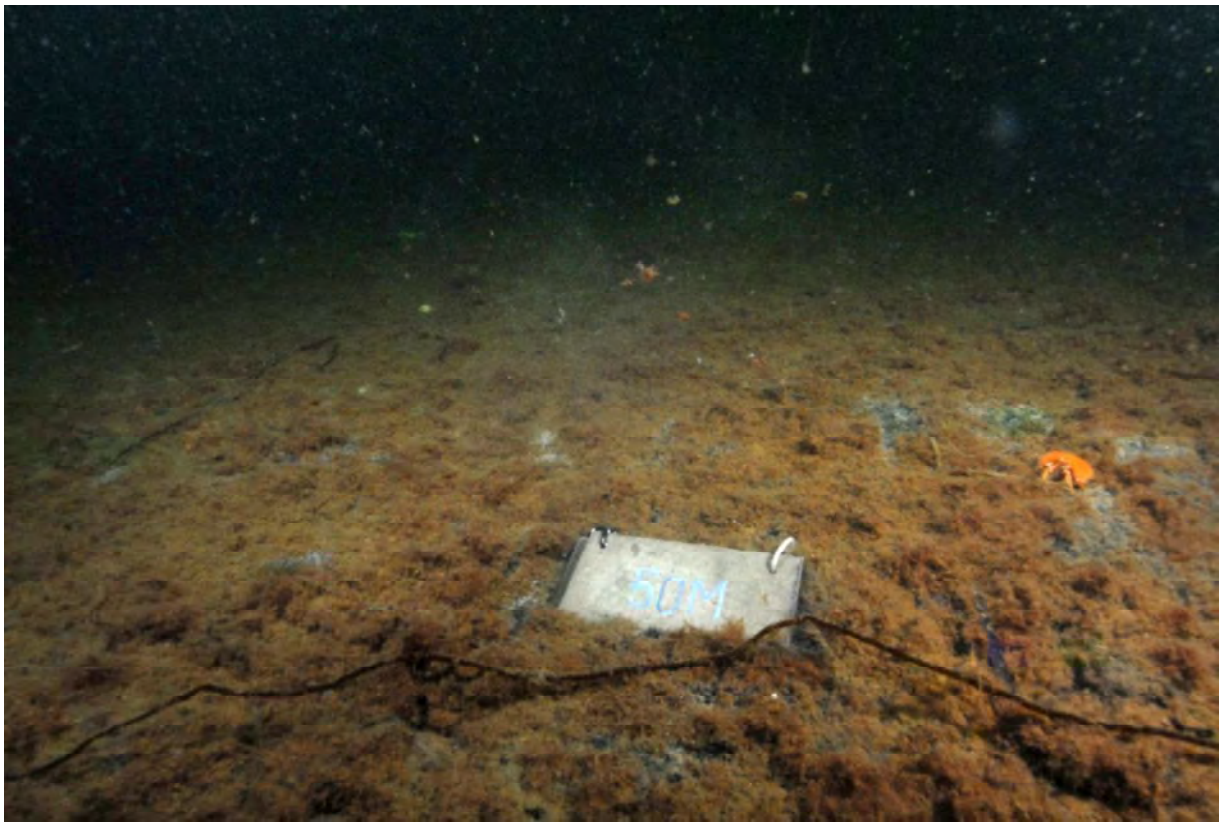

Figure 3-13. T2 – 50m, Lehanagh Pool, 17th September 2021

3.6. Reference Station

This photograph was taken at a distance of approximately 180m from the pen edge (Figure 3-14). Sediments at the reference station were composed of a mud/fine sand mix with a cover of filamentous algae. A small nudibranch (*Cuthona* sp.) is imaged in the photograph alongside a lobe shell, *P. quadripartite*.

Seafloor conditions recorded at this station can be considered typical of the surrounding area, uninfluenced by the presence of the finfish rearing facility.

Figure 3-14. Reference Station, Lehanagh Pool, 17th September 2021

3.7. Sediment Profile Imagery – Transect 2

Figure 3-15 presents sediment profile images taken at the five stations visited on Transect 2 of the Lehanagh Pool site and a Reference Station located approximately 180 m from the pens. They display a single image and the maximum and minimum apparent redox potential discontinuity (ARPD) depths measured at each station. Each image is 15.5cm × 25cm.

ARPD depths ranged from a minimum of 0.0 cm (all stations) to a maximum of 6.6 cm (T2 20 m) along Transect 2 while the ARPD at the Reference station ranged from 0.0 cm to 14.4 cm, the deep redox depth associated with a burrowing polychaete that is seen in the image. Mean APRD's ranged from 0.0 m to 2.0 along Transect 2 and a mean APRD of 1.4 cm was recorded at the Reference station. The composition of sediments at each station can be seen – fine muddy sand with occasional shell fragments with filamentous algae at the sediment water interface.

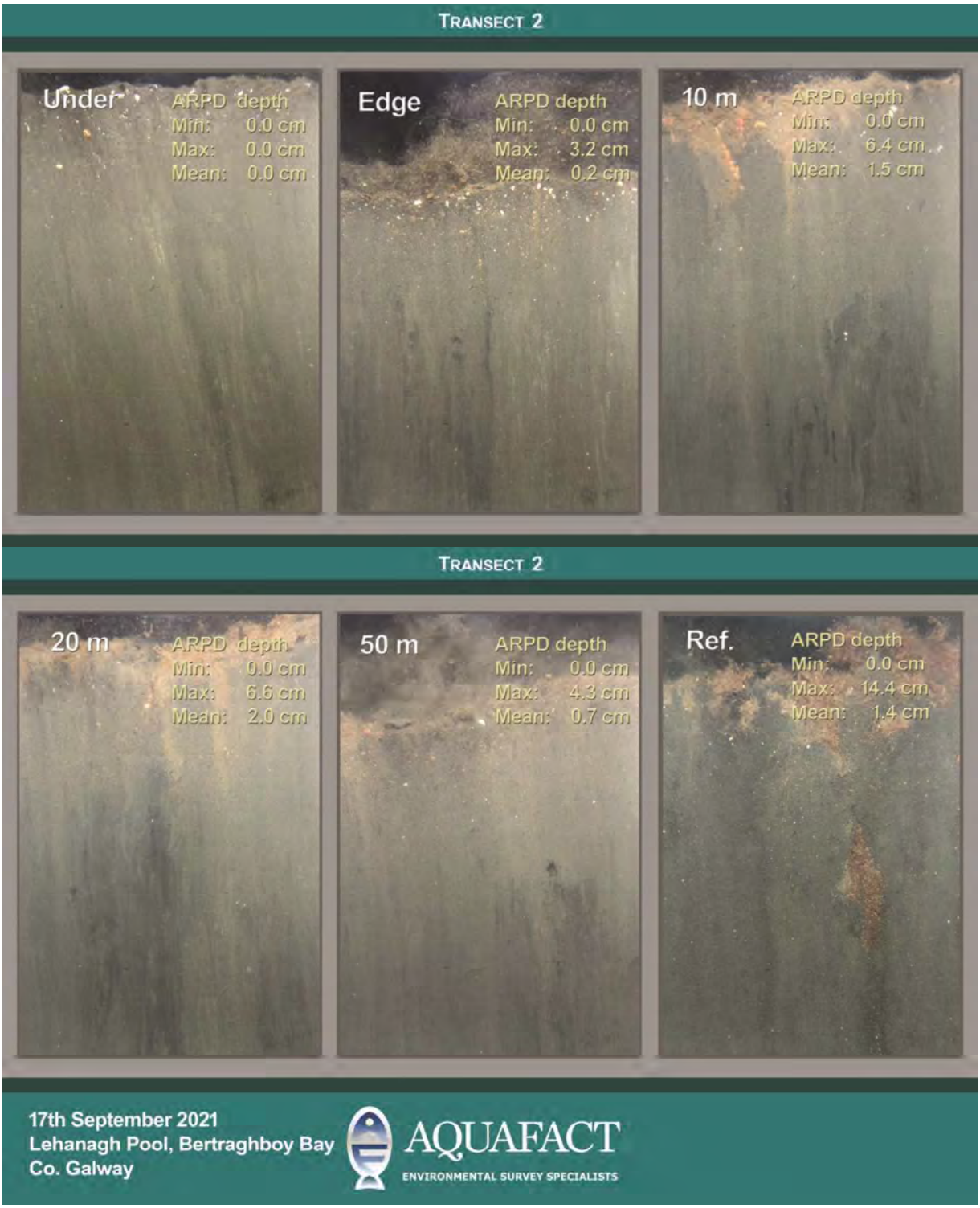

Figure 3-15 SPI images from each of the stations along Transect 2 and Reference Station

3.8. Organic Carbon Analysis & ARPD Depths

Table 3-2 presents the organic carbon results from the Lehanagh Pool stations. Organic carbon levels ranged from 20.0% (T2 Edge) to 27.1 (T1 50m). Apart from the T1 50 m and 100 m stations, the remaining stations had an organic carbon content similar to the reference station.

Table 3-1: carbon results for Lehanagh Pool, 17th September 2021 (% values, Loss on Ignition at 450°C).

T1	**Under**	**Edge**	**10m**	**20m**	**50m**	**100m**
LOI %	20.5	20.2	20.5	22.0	27.1	25.3
T2	**Under**	**Edge**	**10m**	**20m**	**50m**	**REF**
LOI %	-	20.0	20.7	20.2	20.6	20.8

Table 3-3 shows in tabular form the ARPD depths from the SPI images from Lehanagh Pool (see Sections 3.4 and 3.6). In general, APRD's are shallow or on the sediment water interface. The deeper maximum APRD recorded at the Reference Station is due to the presence of a burrowing polychaete that is seen in the image.

Table 3-2: ARPD Depths for Lehanagh Pool, 17th September 2021

Station		Transect 1	Transect 2
Under	Range (cm)	0 – 0	0 – 0
	Mean (cm)	0	0
Edge	Range (cm)	0 – 0.1	0 – 3.2
	Mean (cm)	0	0.2
10m	Range (cm)	0 – 0.1	0 – 6.4
	Mean (cm)	0	1.5
20m	Range (cm)	0 - 0	0 – 6.6
	Mean (cm)	0	2.0
50m	Range (cm)	0 – 8.7	0 – 4.3
	Mean (cm)	1.4	0.7
100m	Range (cm)	0 – 4.4	-
	Mean (cm)	0.5	-
Reference	Range (cm)	-	0 – 14.4
	Mean (cm)	-	1.4

4. Conclusion

A benthic audit survey was carried out at an aquaculture site at Lehanagh Pool, Bertraghboy Bay on 17th September 2021. The survey followed the DCMNR Level 1 monitoring protocols (refer to Table 1 for tonnage/current speed relationships to identify level of benthic monitoring required).

In the present survey beneath the Lehanagh Pool site pen block there were some signs of impact from the aquaculture operations on the benthos that included:

- layer of *Beggiatoa* spp. at the sediment surface directly under the pens and out to the 100 m station along Transect 1,
- waste food and faecal casts scattered over the seafloor directly under the pens,
- shallow redox depths under and out to 20 m station along Transect 1

Given that the site is a depositional zone with naturally shallow redox depths, the ARPD depths were relatively good at those stations outside the immediate footprint of the pens along Transect 2 and similar to that recorded at the Reference Station. Similarly, the organic carbon content at the majority of the stations were typical of an inshore fine sediment environment with no significant difference recorded between the Reference Station and the stations sampled along the transects.

It is probable that the blanket cover of filamentous algal turf (*Audouinella* sp.), reduces the oxygen exchange with the underlying sediment and also retains organic material input from the overhead aquaculture operations.

5. References

Department of Communication, the Marine and Natural Resources. 2008. Monitoring Protocol No. 1 Offshore Finfish Farms – Benthic Monitoring

Solan, M., Benjamin D. Wigham, Ian R. Hudson, Robert Kennedy, Cristopher H. Coulon, Karl Norling, Hans C. Nilsson and Rutger Rosenberg, 2004. In situ quantification of bioturbation using time-lapse fluorescent sediment profile imaging (f-SPI), luminophore tracers and model simulation. Marine Ecology Progress Series Vol. 271, pages 1-

Benthic Monitoring Survey report for Aquaculture License No. T09/093A. Lehanagh Pool, Cashel, Co. Galway

Report Author

Dr Colin Hannon

October 2022

Report Details

Report Author	Dr Colin Hannon
[redacted]	[redacted]
Client	Marine Institute
[redacted]	[redacted]
Survey Location	Beirtreah Buí Bay, Cashel, Co. Galway
Aquaculture Licence Number	T09/093A
Survey date	25th October 2022
Task	Level 1 benthic monitoring as defined by the Department of Agriculture, Food and the Marine Protocol (DAFM, 2008).
Report completion date	30th November 2020

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Introduction

A marine benthic impact survey was carried out at the Marine Institutes licensed aquaculture research site at Lehanagh Pool, Beirtreah Buí Bay, Cashel, Co. Galway (Aquaculture License No. T09/093A) on the 25th of October 2022. The survey was carried out to the requirements set out in the departments benthic monitoring protocol (DAFM, 2008) Level 1 monitoring including monitoring 15 stations in total as requested by the Marine Institute. 12-stations along transects at the cages three at control locations. Transect 1 (T1) is orientated in the direction of the residual current and Transect two (T2) is perpendicular to Transect one. Video stills, sediment LOI and REDOX measurements are to be taken at each station.

At the time of the survey there were five fish pens (50m diameter) on site. There was no Salmon biomass (*Salmo salar*) on site at the time of the survey as all fish were harvested out during September 2022.

The licensed research aquaculture site at Lehanagh Pool (Aquaculture License No. T09/093A) was previously subject to Level 1 benthic monitoring as defined by the Department of Agriculture, Food and the Marine (DAFM, 2008).

Monitoring procedure

Level 1 monitoring involves as per DAFM, (2008):

Level I: Video/photographic and visual observations and recordings shall be made at the following stations:

- At a minimum of 2 sites directly beneath the pens,
- At the edges of the pens,
- Two transects at right angles to each other. Along each transect sampling stations at +/- 10m, +/- 20m, +/- 50m and + 100m from the cages,
- At a control site (Three in total).

In addition to the above, the following samples / measurements shall be taken at the same stations as above. These will be used to calculate sediment quality parameters.

- A minimum of one Redox potential readings shall be made at each sampling station,
- A single sediment sample for Organic Carbon measurement.

Site location

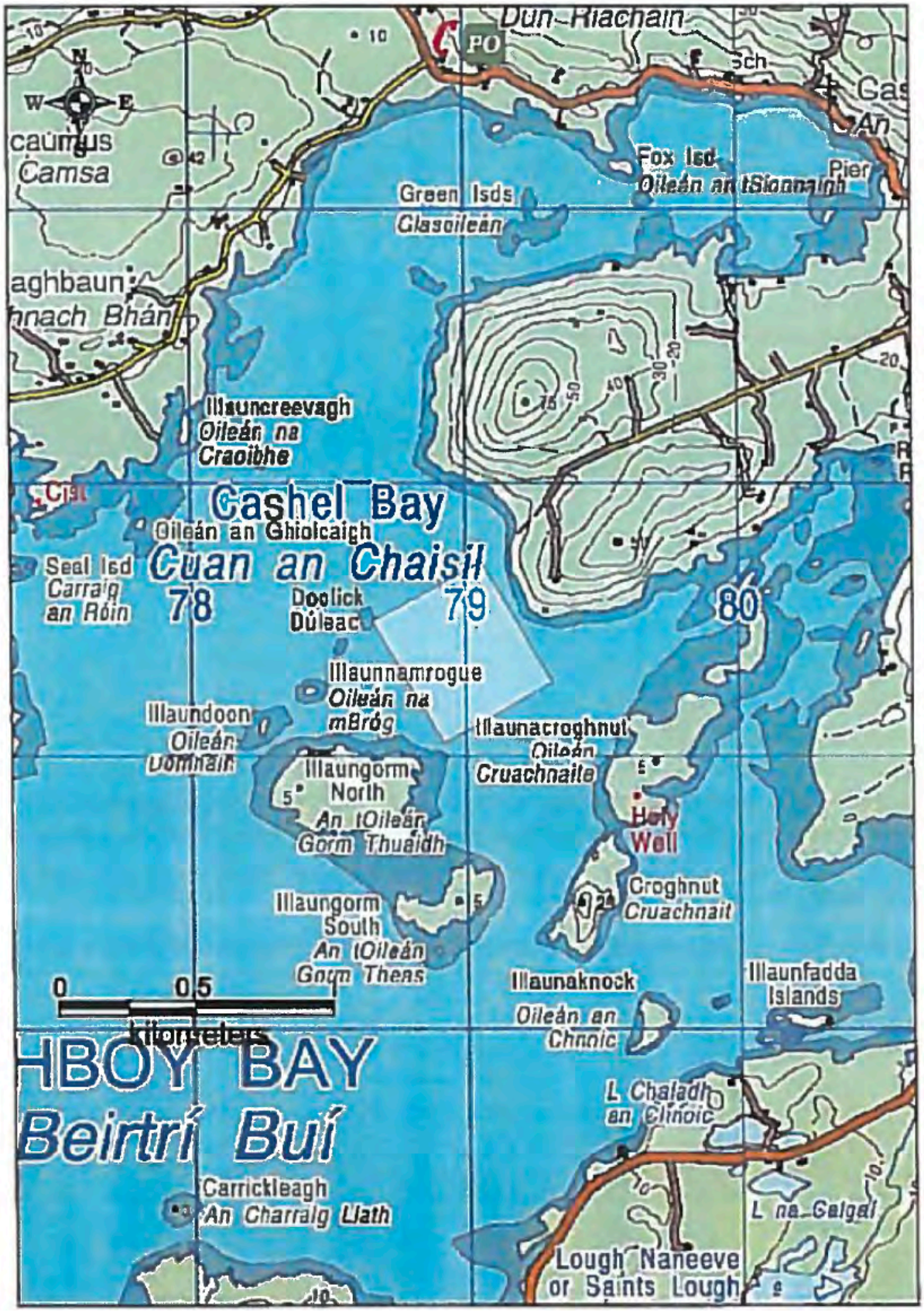

Figure 1. Ordinate survey map of the licensed site at Lehanagh Pool (Aquaculture License No. T09/093A). (Map from aquaculture license application, Ref: T9/93).

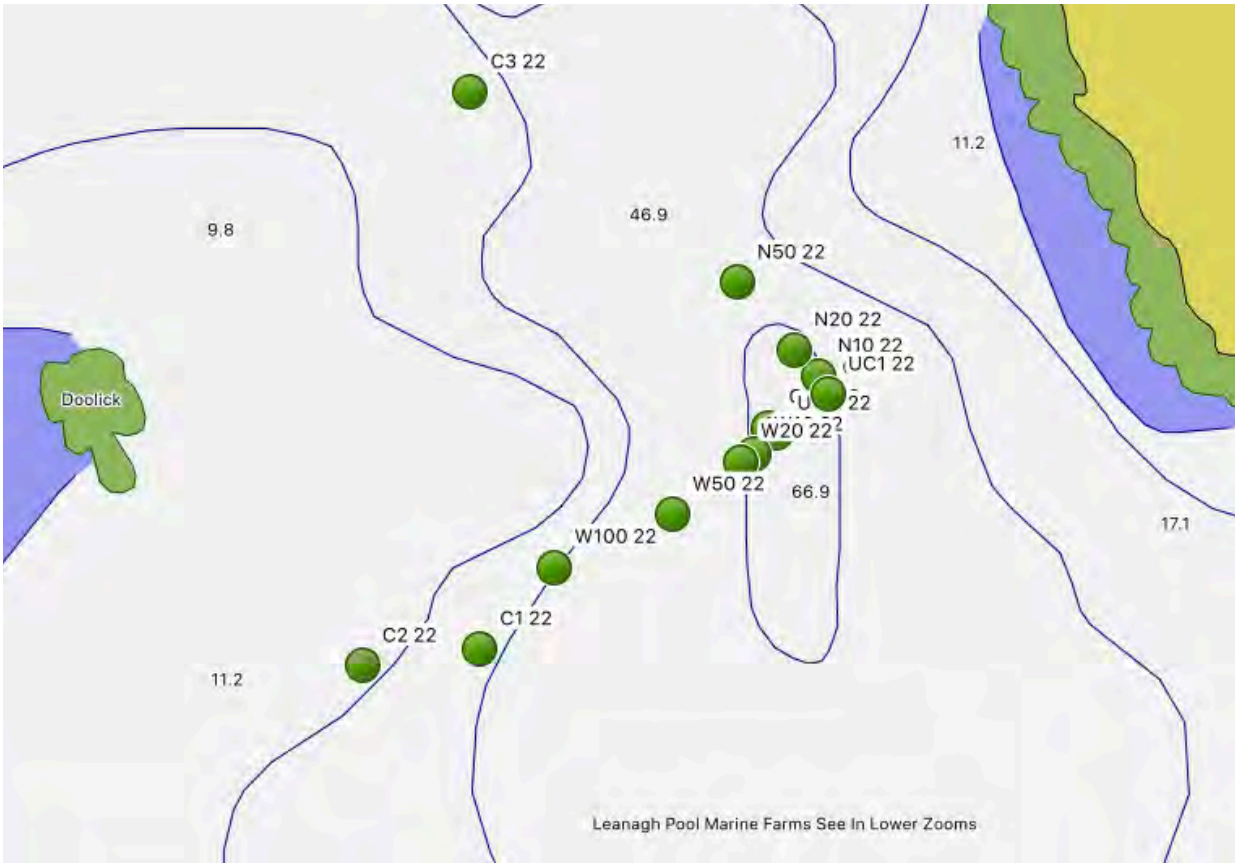

Figure 2. Overview of sampling stations at the Lehanagh Pool aquaculture research site. Sampling stations are along two transects (North and West), including three control reference sites greater than 200m from the aquaculture site. GPS locations plotted using a hand held GPSMAP 64x and Garmin BlueChart. GPS locations for each station are presented in Table 1.

Method

Benthic monitoring survey was conducted on the 25th of October 2022 at the Lehanagh Pool research site. Weather conditions were sunny and sea state was calm. Survey was conducted at mid tide water on the same date using the Marine Institutes work boat.

Grab samples were made at each of the sample stations indicated in the table below (Table 1). A 0.025m^2 Van-Veen grab was used to collect each benthic sample. A successful grab was taken at each of the sample station and this location was taken using a Garmin handheld GPSMap 64X mapping unit in the format of WGS84. The Apparent Redox Discontinuity Potential (ARDP) was measured from cores taken from each of the successful grab samples and this data has been tabulated in table 1 in the results section of this report.

Benthic sediment samples collected using the Van-Veen grab were then sub-sampled to collect sediment (approx. 100ml of marine sediments) for total organic carbon (TOC %) analysis. Each sample was labelled and stored in a 250ml plastic container with an air tight lid and kept cool in a refrigerated box. Sediment type and description can be found in Table 1 in the results section.

Processing sediments

Sediment samples were collected for TOC analyses as part of Level I monitoring and the same analytical method to be used for all samples. At each sampling location, sediment samples for TOC shall be collected from the sample surface (0-2 cm). The sample shall be stored in an airtight container and deep frozen or frozen then freeze dried, for later analysis. TOC is to be measured using the loss on Ignition method outlined below:

1. The collected sediments should be homogenised by hand and dried in an oven at 100 °C for 24 hours.
2. A sample of dried sediment should be placed in a mortar and pestle and ground down to a fine powder.
3. 1 g of this ground sediment should be weighed into a pre-weighed crucible and placed in a muffle furnace at 450°C for a period of 6-hours.
4. The sediment samples should be then allowed to cool in a desiccator for 1-hour before being weighed again.
5. The organic matter of the sample is determined by expressing as a percentage the weight of the sediment after ignition over the initial weight of the sediment (Table 1).

Dive Survey

Two dive transects were undertaken, one in a North direction (50m) and one in a Westerly direction (100m). Three more dives were carried out greater than 200m in distance North and West of the research site which acts as the control site for the survey.

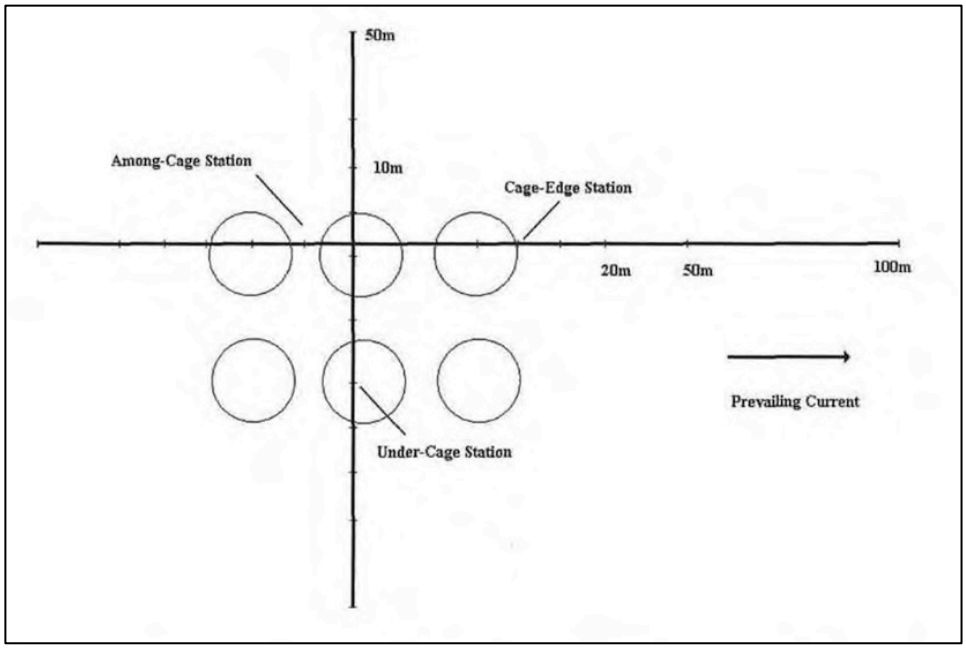

Figure 3. Transect plan as illustrated in DAFM, 2008; Monitoring Protocol No.1 for Offshore Finfish Farms.

Each transect was recorded (video) using a GoPro camera with video lights and digital images were also taken at each of the sample stations as per DAFM Level - 1 monitoring. Detailed visual dive notes along with footage and images from the transects are compiled in Table 1 in the results section. Images from the dive survey from the different sample stations are contained in this document.

On the day of the survey sea condition were calm, however the site was subjected to successive days of storm action in the days previous, at the time of the survey conditions and underwater visibility was good. This report contains detailed visual descriptions of the sea bed at each transect location.

Results

Sample Station	TOC Results (%)	GPS Sample Locations	Sediment description & Visual Impacts	APRD	Bacterial Matting
North Under Cage	4.11%	N 53° 24.070 W 009° 49.170	No food or faecal material can be seen. Some fragments of macroalgae can be seen along with other algal material. Thick grey mud. No visual impacts.	1cm	None
North Cage Edge	3.47%	N 53° 24.069 W 009° 49.173	No food or faecal material can be seen. Fragments of macroalgae and sea grass can be seen in figure 5. Substrate is a heavy thick mud with light sediments on the surface. Thick grey mud. No visual impacts	1-2cm	None
North 10m	3.94%	N 53° 24.076 W 009° 49.176	No food or faecal material can be seen. Substrate is heavy thick mud with light sediments on the surface. Thick grey mud. No visual impacts	1-2cm	None
North 20m	3.98%	N 53° 24.084 W 009° 49.187	Substrate is heavy thick mud with light sediments on the surface. Swimming crabs can be seen sorting through surface sediments. No associated aquaculture impacts can be observed. Thick grey mud. No visual impacts.	2cm	None
North 50m	4.10%	N 53° 24.104 W 009° 49.216	No associated aquaculture impacts can be observed. Substrate is a thick grey mud. No visual impacts	2cm	None
Control Site 1	3.13%	N 53° 23.993 W 009° 49.345	Shallow section of the bay approx. 5m in depth. Sediment is a heavy mud mixed with shell and stones with light sediments on the surface	>2cm	None
Control Site 2	2.13%	N 53° 23.988 W 009° 49.404	Shallow site, approx. 5m in depth, large amounts of algal material, sediment is a heavy thick mud mixed with shell. Light sediments on the surface.	>2cm	None

Control Site 3	2.30%	N 53° 24.162 W009° 49.350	Shallow site approx. 5m in dept, substrate isa heavy thick mud with large amount of shell mixed through sediments.	>2cm	None
West Under Cage	3.86%	N 53° 24.059 W 009° 49.196	No uneaten feed or faecal material can be seen. Small fragments of macroalgae can be seen in figure 10. Thick grey mud. No visual impacts	1-2cm	None
West Cage Edge	4.42%	N 53° 24.060 W 009° 49.200	No uneaten feed or faecal material can be seen. Small fragments of macroalgae and seagrass can be seen in figure 11. Thick grey mud. No visual impacts	<2cm	None
West 10m	4.05%	N 53° 24.052 W 009° 49.208	No uneaten feed or faecal material can be seen. Small fragments of macroalgae and seagrass can be seen in Figure 12. Substrate is a heavy thick mud with light sedimants on the surface. Thick grey mud. No visual impacts	<2cm	None
West 20m	4.32%	N 53° 24.050 W 009° 49.214	Small fragments of seagrass can be seen in the figure. Substrate is a heavy thick mud with light sedimants on the surface No visual impacts.	1-2cm	None
West 50m	3.06%	N 53° 24.034 W 009° 49.248	No associated aquaculture impacts can be observed. Fragments of seagrass can be seen in Figure 14. Thick grey mud. No visual impacts	<2cm	None
West 100m	4.40%	N 53° 24.018 W 009° 49.308	No associated aquaculture impacts can be observed, fragments of seagrass can be observed in Figure 15. Thick grey mud. No visual impacts	<2cm	None

Table 1. Lists the percentage total organic carbon along with sample site location and sediment description included sites visual impact. No bacterial matting or impacts were noted during the transect dives (T1, T2 and control sites).

Survey images

Figure 4. Station 1: North Under Cage, No food or faecal material can be seen. Some fragments of macroalgae can be seen along with other algal material.

Figure 5. Station 2: North Cage Edge, No food or faecal material can be seen. Fragments of macroalgae and sea grass can be seen in figure 5. Substrate is a heavy thick mud with light sediments on the surface.

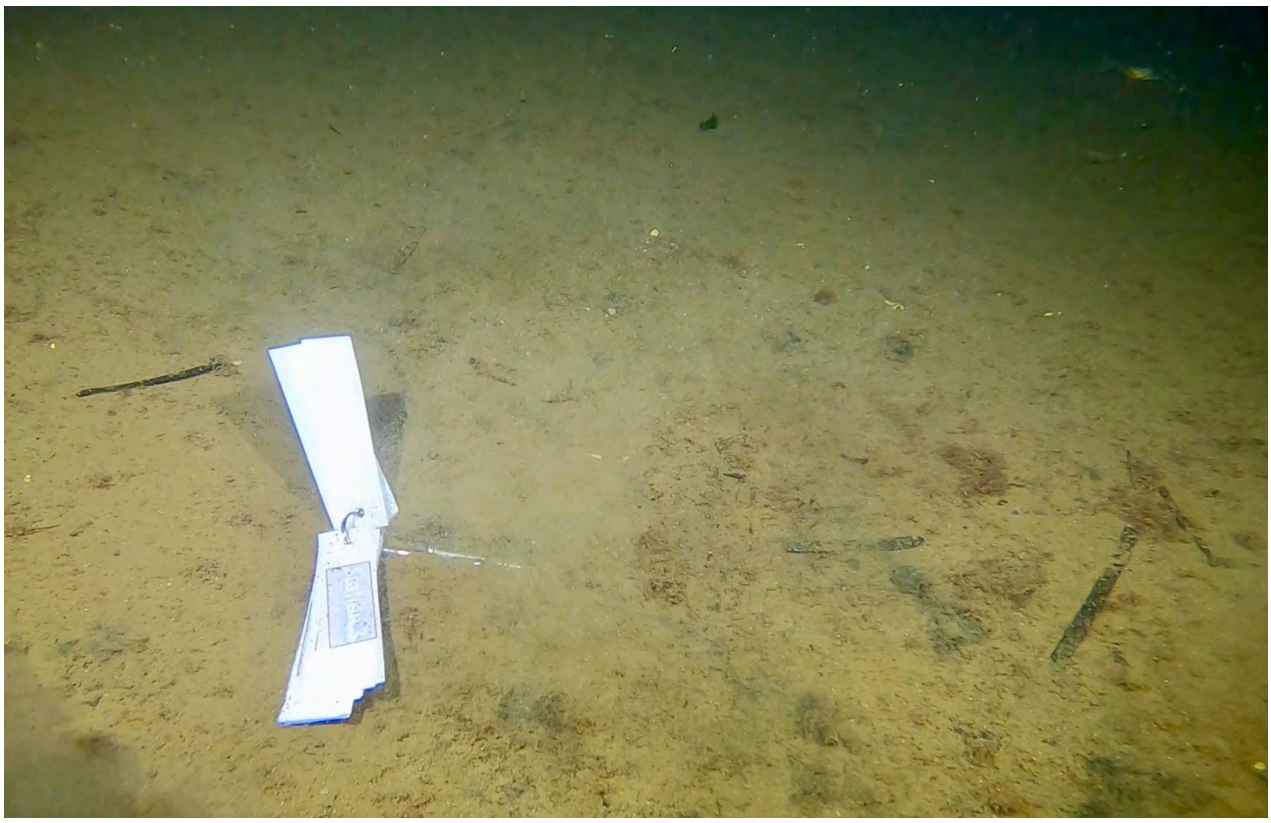

Figure 6. Station 3: North 10m, No food or faecal material can be seen. Substrate is heavy thick mud with light sediments on the surface.

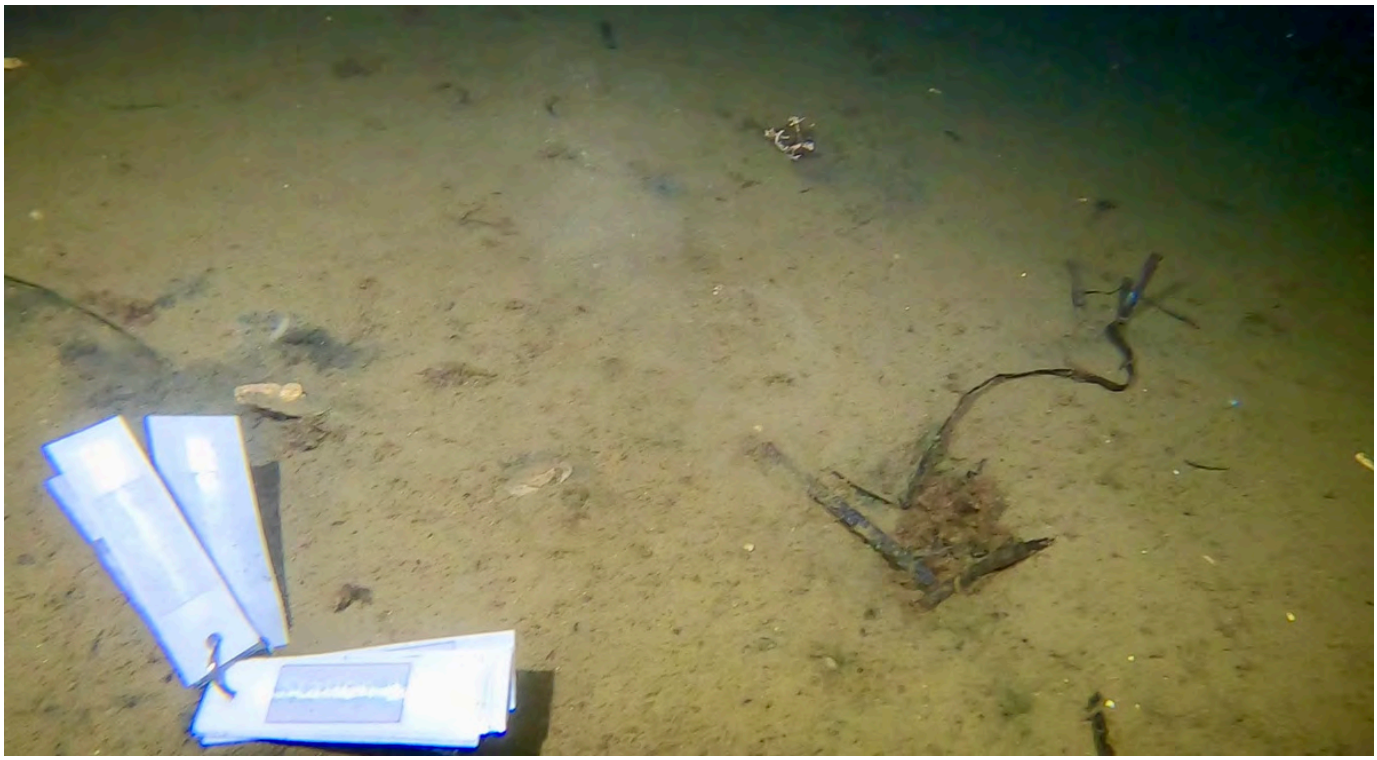

Figure 7. Station 4: North 20m, Substrate is heavy thick mud with light sediments on the surface. Swimming crabs can be seen sorting through surface sediments. No associated aquaculture impacts can be observed.

Figure 8. Station 5: North 50m, No associated aquaculture impacts can be observed.

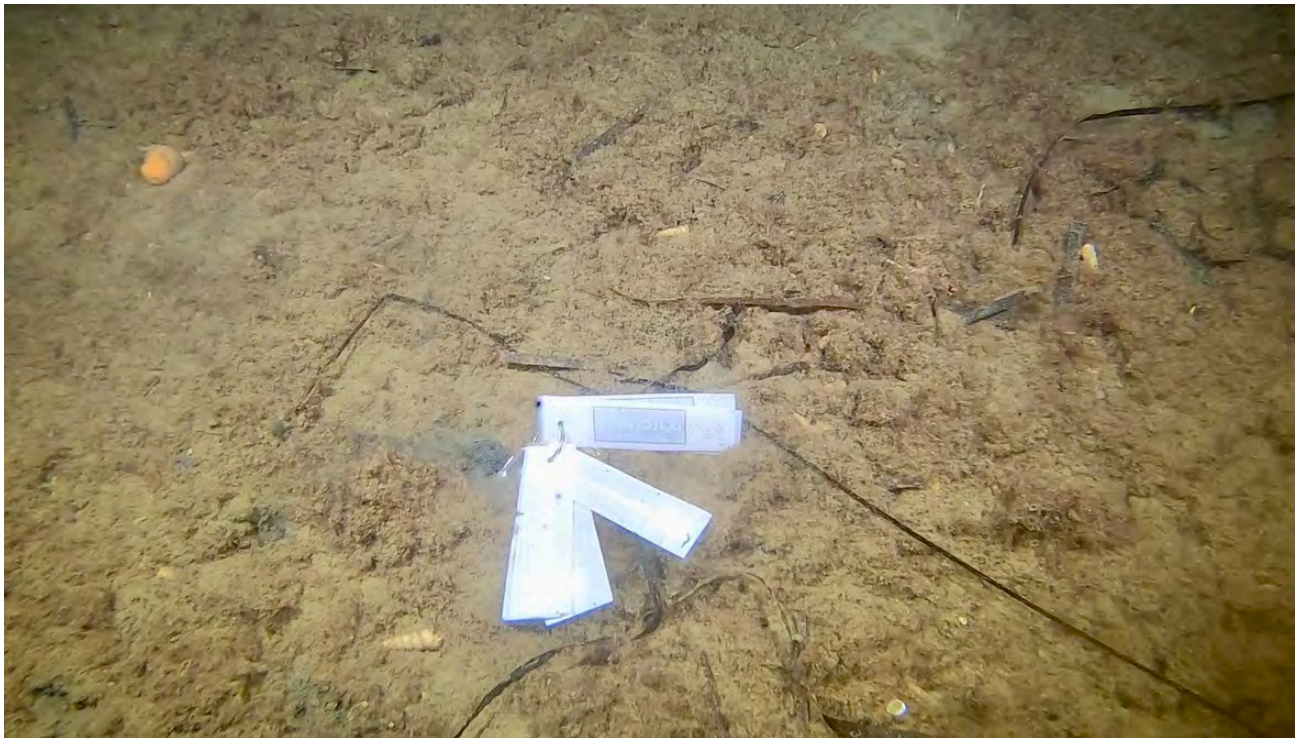

Figure 9. Station 6: North 100m, station requested by the Marine Institute. Fragments of seagrass can be seen in the figure. No associated aquaculture impacts can be observed.

Figure 10. Station 7: West West Under Cage. No uneaten feed or faecal material can be seen. Small fragments of macroalgae can be seen in the figure.

Figure 11. Station 8: West Cage Edge. No uneaten feed or faecal material can be seen. Small fragments of macroalgae and seagrass can be seen in the figure.

Figure 12. Station 9: West 10m No uneaten feed or faecal material can be seen. Small fragments of macroalgae and seagrass can be seen in the figure. Substrate is a heavy thick mud with light sedimants on the surface.

Figure 13. Station 10: West 20m, Small fragments of seagrass can be seen in the figure. Substrate is a heavy thick mud with light sedimants on the surface.

Figure 14. Station 11: West 50m. No associated aquaculture impacts can be observed. Fragments of seagrass can be seen in the figure

Figure 15. Station 12: West 100m, No associated aquaculture impacts can be observed, fragments of seagrass can be observed in the figure.

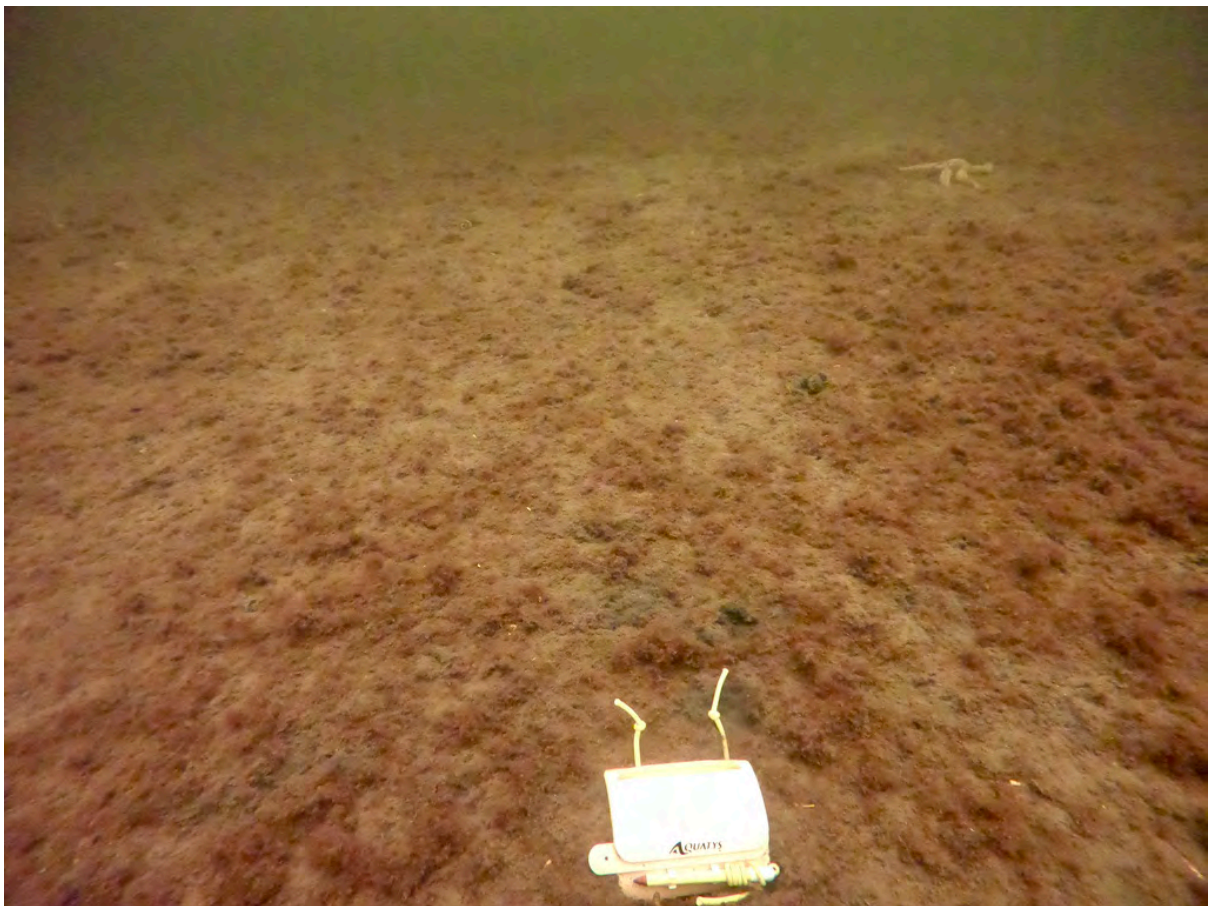

Figure 16. Control Site 1: Shallow section of the bay approx. 5m in depth. Sediment is a heavy mud mixed with shell and stones with light sediments on the surface.

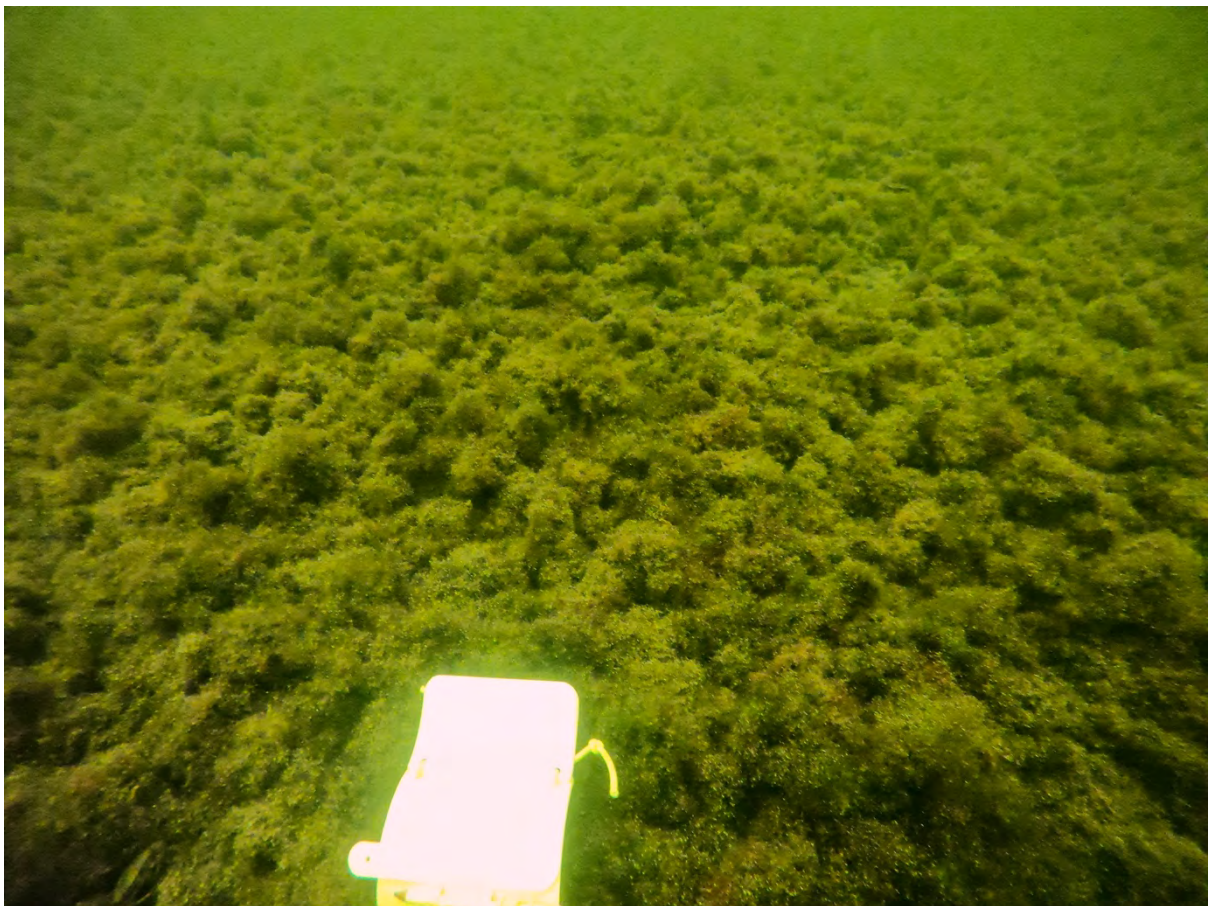

Figure 17. Control Site 2: Shallow site, approx. 5m in depth, large amounts of algal material, sediment is a heavy thick mud mixed with shell. Light sediments on the surface.

Figure 18. Control Site 3: Shallow site approx. 5m in dept, substrate isa heavy thick mud with large amount of shell mixed through sediments.

Discussion & Conclusion

The Marine Institute Research site at Lehanagh pool, Cashel Co. Galway (Licence No. T09/093A) is well maintained and no associated aquaculture wastes or materials were found on site or surrounding surveyed areas including control sites.

No uneaten feed pellets or faecal materials were observed directly under the fish pens. The seabed survey did not note any direct impacts or discarded objects. No bacterial matting was noted at any of the surveyed sample stations on either transect.

The survey was carried out on the 25th of October 2022 and reported here has resulted in no discernible, visual or measurable impacts from the research site on the seabed at Lehanagh pool, Beirtreah Buí Bay, Cashel, Co. Galway license number T09/093A.

References

DAFM, 2008; Monitoring Protocol No.1 for Offshore Finfish Farms - Benthic Monitoring. Revised December 2008. PP. 8. Department of Agriculture, Food & the Marine. Dublin Ireland.URL:https://www.agriculture.gov.ie/media/migration/seafood/aquacultureforeshoremanagement/marinefinfishprotocols/Benthic%20Monitoring.pdf.

Benthic Monitoring Survey report for

Aquaculture License No. T09/093A.
Marine Institute, Aquaculture Research Site:
Lehanagh Pool, Cashel, Co. Galway

Report Author

Dr Colin Hannon

November 2023

Report Details

Report Author	Dr Colin Hannon
[redacted]	[redacted]
Client	Marine Institute
[redacted]	[redacted]
Survey Location	Beirtreah Buí Bay, Cashel, Co. Galway
Aquaculture Licence Number	T09/093A
Survey date	30th September 2023
Task	Level 1 benthic monitoring as defined by the Department of Agriculture, Food and the Marine Protocol (DAFM, 2008).
Report completion date	8th November 2023

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Introduction

A marine benthic impact survey was carried out at the Marine Institutes licensed aquaculture research site at Lehanagh Pool, Beirtreah Buí Bay, Cashel, Co. Galway (Aquaculture License No. T09/093A) on the 30th September 2023 (Figure 1). The survey was carried out to the requirements set out in the departments benthic monitoring protocol (DAFM, 2008) Level 1 monitoring. A request for an update number of 15 stations in total as requested by the Marine Institute. 12-stations along transects at the cages three at control locations. Transect 1 (T1) is orientated in the direction of the residual current and Transect two (T2) is perpendicular to Transect one. Video stills, sediment LOI and REDOX measurements are to be taken at each station.

At the time of the survey there were five fish pens (50m diameter) on site. There was no Salmon biomass (*Salmo salar*) on site at the time of the survey as all fish were harvested out during the previous months.

The licensed research aquaculture site at Lehanagh Pool (Aquaculture License No. T09/093A) was previously subject to Level 1 benthic monitoring as defined by the Department of Agriculture, Food and the Marine (DAFM, 2008).

Monitoring procedure

Level 1 monitoring involves as per DAFM, (2008):

Level I: Video/photographic and visual observations and recordings shall be made at the following stations:

- At a minimum of 2 sites directly beneath the pens,
- At the edges of the pens,
- Two transects at right angles to each other. Along each transect sampling stations at +/- 10m, +/- 20m, +/- 50m and + 100m from the cages,
- At a control site (Three in total).

In addition to the above, the following samples / measurements shall be taken at the same stations as above. These will be used to calculate sediment quality parameters.

- A minimum of one Redox potential readings shall be made at each sampling station,
- A single sediment sample for Organic Carbon measurement.
- Extra sampling sites were requested by the Marine Institute along transects and including two extra control sites (Figure 2).

Site location

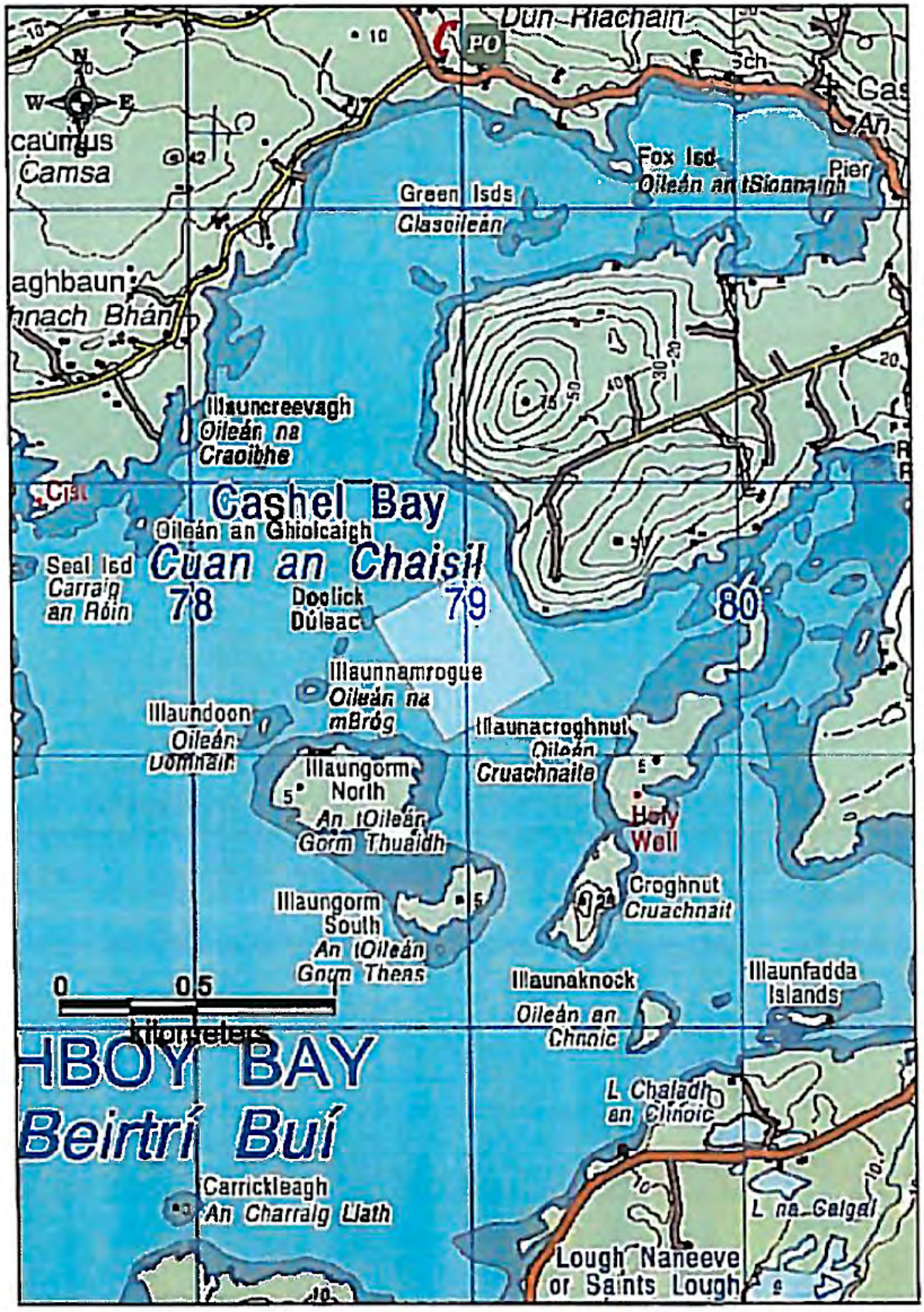


Figure 1. Ordinate survey map of the licensed site at Lehanagh Pool (Aquaculture License No. T09/093A). (Map from aquaculture license application, Ref: T9/93).

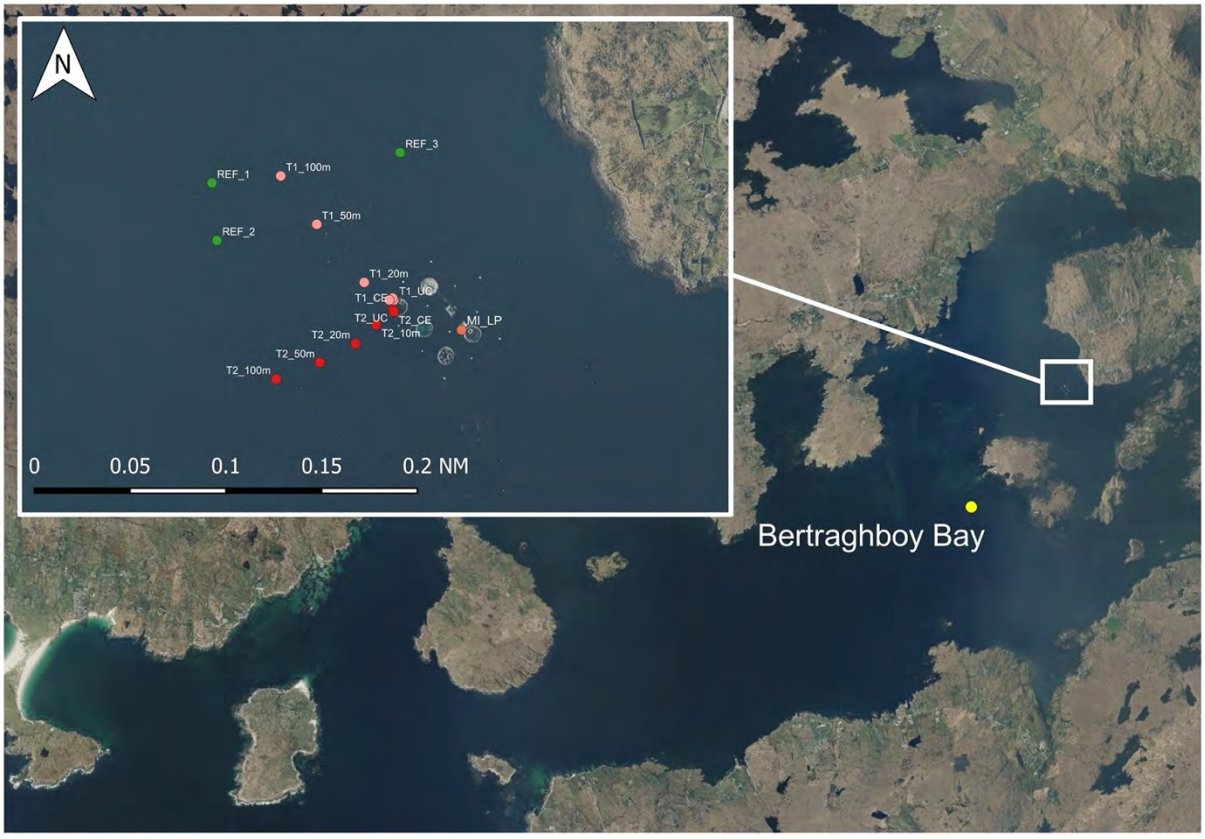


Figure 2. Overview of sampling stations at the Lehanagh Pool aquaculture research site. Sampling stations are along two transects (North and West), including three control reference sites greater than 200m from the aquaculture site. GPS locations plotted using a hand held GPSMAP 64x and plotted using QGIS 3.34.0 'Prizren'. GPS locations for each station are presented in Table 1.

Method

Benthic monitoring survey was conducted on the 30th September 2023 at the Lehanagh Pool research site. Weather conditions were sunny and sea state was calm. Survey was conducted at mid tide water on the same date using the Marine Institutes work boat.

Grab samples were made at each of the sample stations indicated in the table below (Table 1). A 0.025m^2 Van-Veen grab was used to collect each benthic sample. A successful grab was taken at each of the sample station and this location was taken using a Garmin handheld GPSMap 64X mapping unit in the format of WGS84. The Apparent Redox Discontinuity Potential (ARDP) was measured from cores taken from each of the successful grab samples and this data has been tabulated in Table 1 in the results section of this report.

Benthic sediment samples collected using the Van-Veen grab were then sub-sampled to collect sediment (approx. 100ml of marine sediments) for total organic carbon (TOC %) analysis. Each sample was labelled and stored in a 250ml plastic container with an air tight lid and kept cool in a refrigerated box. Sediment type and description can be found in Table 1 in the results section.

Processing sediments

Sediment samples were collected for TOC analyses as part of Level I monitoring and the same analytical method to be used for all samples. At each sampling location, sediment samples for TOC shall be collected from the sample surface (0-2 cm). The sample shall be stored in an airtight container and deep frozen or frozen then freeze dried, for later analysis. TOC is to be measured using the loss on Ignition method outlined below:

1. The collected sediments should be homogenised by hand and dried in an oven at 100 °C for 24-hours.
2. A sample of dried sediment should be placed in a mortar and pestle and ground down to a fine powder.
3. 1g of this ground sediment should be weighed into a pre-weighed crucible and placed in a muffle furnace at 450ºC for a period of 6-hours.
4. The sediment samples should be then allowed to cool in a desiccator for 1-hour before being weighed again.
5. The organic matter of the sample is determined by expressing as a percentage the weight of the sediment after ignition over the initial weight of the sediment (Table 1).

Dive Survey

Dive team mobilised and deployed to site at Cashel, Co. Galway. Two dive transects were undertaken, one in a North direction (100m) and one in a Westerly direction (100m). Three more dives (control sites) were carried out greater than 200m in distance North and West of the research site which acts as the control site for the survey.

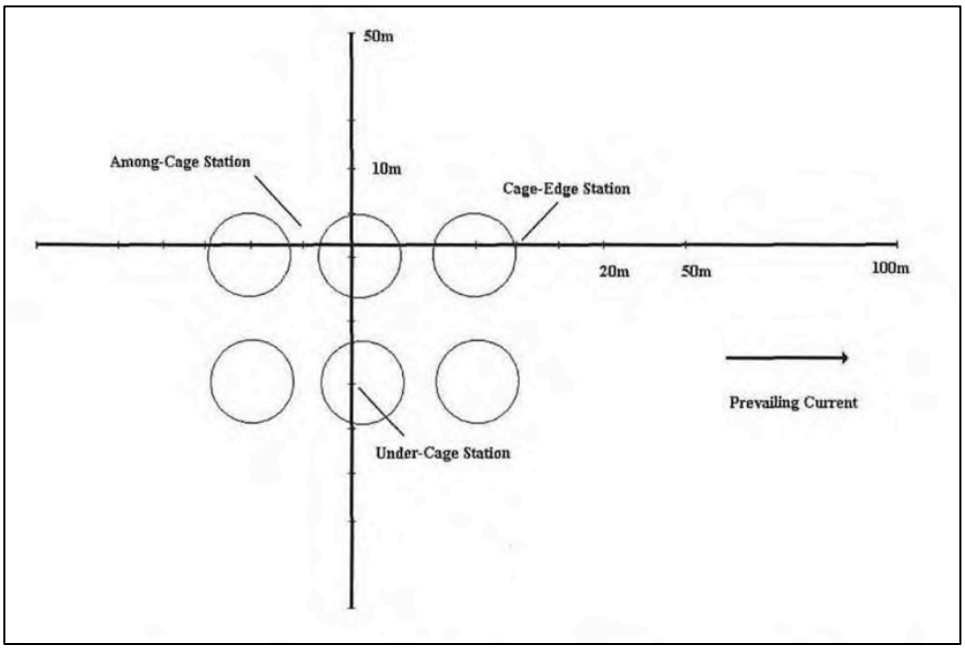


Figure 3. Transect plan as illustrated in DAFM, 2008; Monitoring Protocol No.1 for Offshore Finfish Farms.

Each transect was recorded (video) using a GoPro camera with underwater video lights and digital images were also taken at each of the sample stations as per DAFM Level - 1 monitoring. Detailed visual dive notes along with footage and images from the transects are compiled in the results section. Images from the dive survey from the different sample stations are contained in this document.

On the day of the survey sea condition were calm. At the time of the survey conditions and underwater visibility was good. This report contains detailed visual descriptions of the sea bed at each transect location.

Results

Company: Marine Institute. Site: Lehanagh Pool, Cashel, Co. Galway			Redox Visual & Probe				
Sample Station	**TOC Results (%)**	**GPS Locations (WGS84)**	**Min (cm)**	**Max (cm)**	**Mean (cm)**	**Bacterial Matting**	**Depth (m)**
T1 North Under Cage	14.9	N53° 24.055' W9° 49.197'	1	2	1.5	None	22.5
T1 North Cage Edge	25.2	N53° 24.054' W9° 49.196'	1	2	1.5	None	22.5
T1 North 10m	15.3	N53° 24.047' W9° 49.211'	1	2	1.5	None	22.5
T1 North 20m	17.8	N53° 24.037' W9° 49.229'	1	2	1.5	None	21
T1 North 50m	17.0	N53° 24.027' W9° 49.260'	2	3	2.5	None	18
T1 North 100m	20.0	N53° 24.018' W9° 49.298'	2	3	2.5	None	16
Control Site 1	18.2	N53° 24.120' W9° 49.356'	2.5	3.5	3	None	13.5
Control Site 2	18.3	N53° 24.090' W9° 49.351'	2	4	3	None	12
Control Site 3	18.6	N53° 24.137' W9° 49.192'	2.5	3.5	3	None	13
T2 West Under Cage	14.9	N53° 24.060' W9° 49.196'	1	1.5	1.25	None	22
T2 West Cage Edge	16.5	N53° 24.061' W9° 49.197'	1	1.5	1.25	None	22
T2 West 10m	16.7	N53° 24.060' W9° 49.200'	1	2	1.5	None	21.5
T2 West 20m	17.1	N53° 24.069' W9° 49.222'	1	2	1.5	None	18
T2 West 50m	19.4	N53° 24.099' W9° 49.264'	2	3	2.5	None	15.5
T2 West 100m	17.8	N53° 24.124' W9° 49.296'	2	3	2.5	None	13.5

Table 1. Lists the percentage total organic carbon (%) along with sample site location. No bacterial matting or impacts were noted during the transect dives (T1, T2 and control sites (three))

Survey images

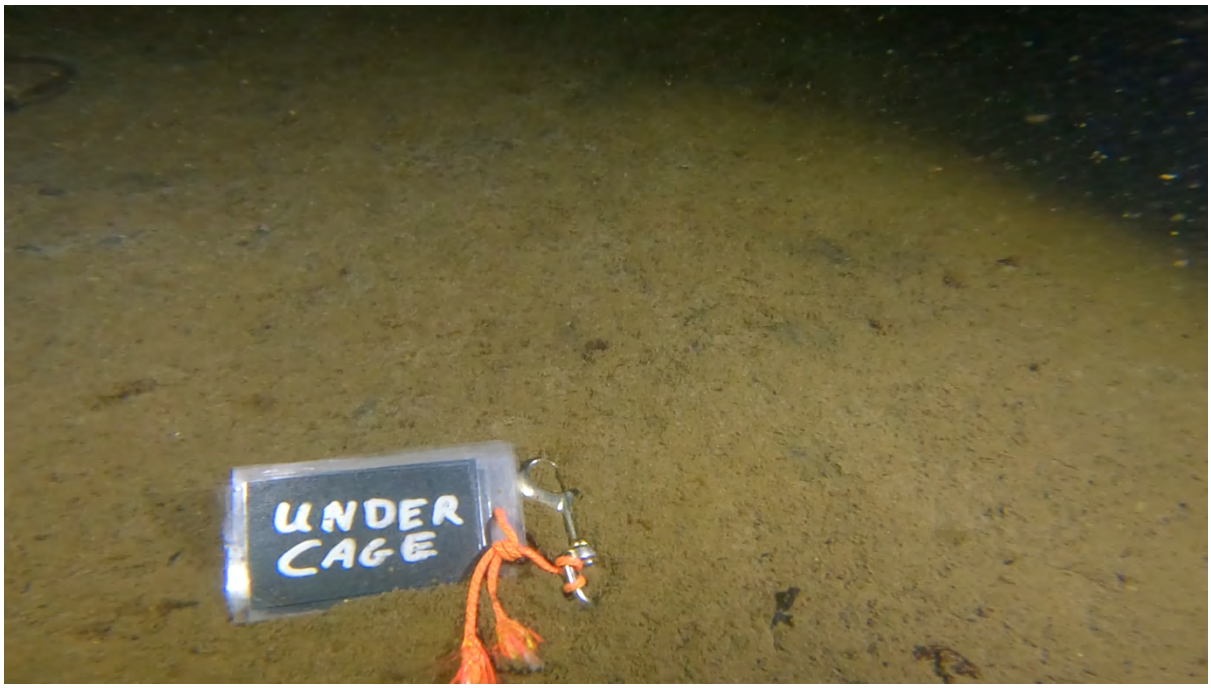


Figure 4. Station 1: T1 North Under Cage, No food or faecal material can be seen. Substrate is a heavy thick mud with light sediments on the surface.

Figure 5. Station 2: T1 North Cage Edge, No food or faecal material can be seen. Substrate is a heavy thick mud with light sediments on the surface.

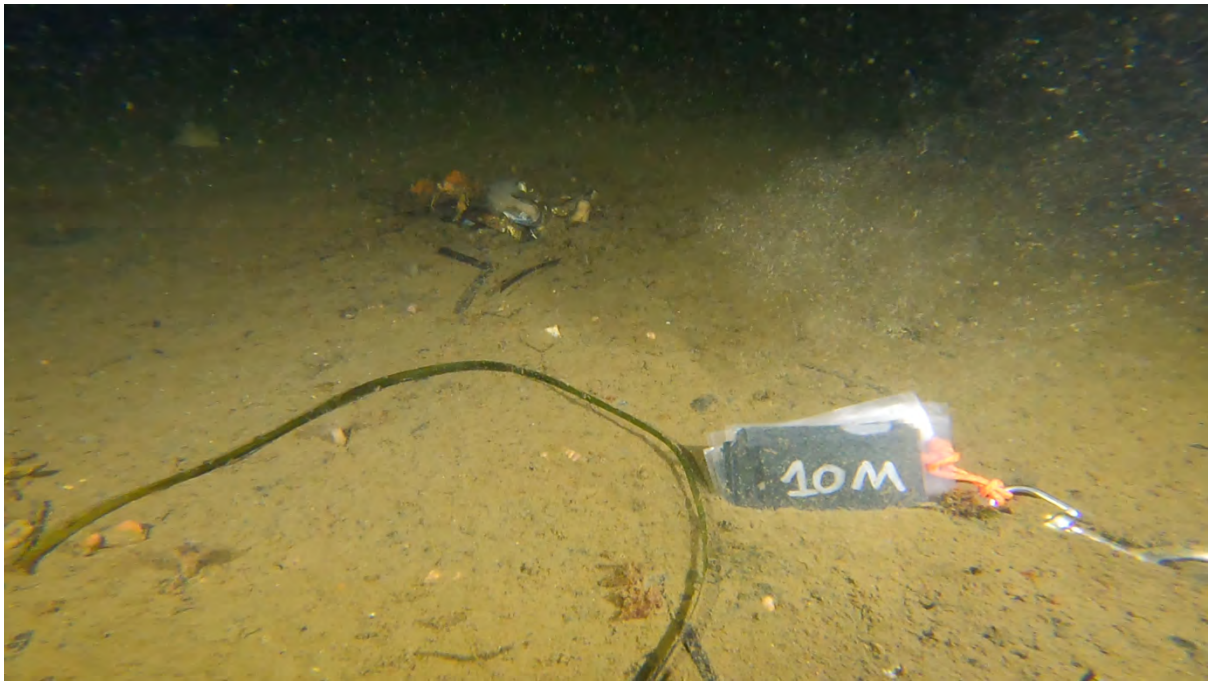


Figure 6. Station 3: T1 North 10m, No food or faecal material can be seen. Substrate is heavy thick mud with light sediments on the surface. Fragments of seagrass can be seen along with some tubeworms attached to clumps of mussel shell.

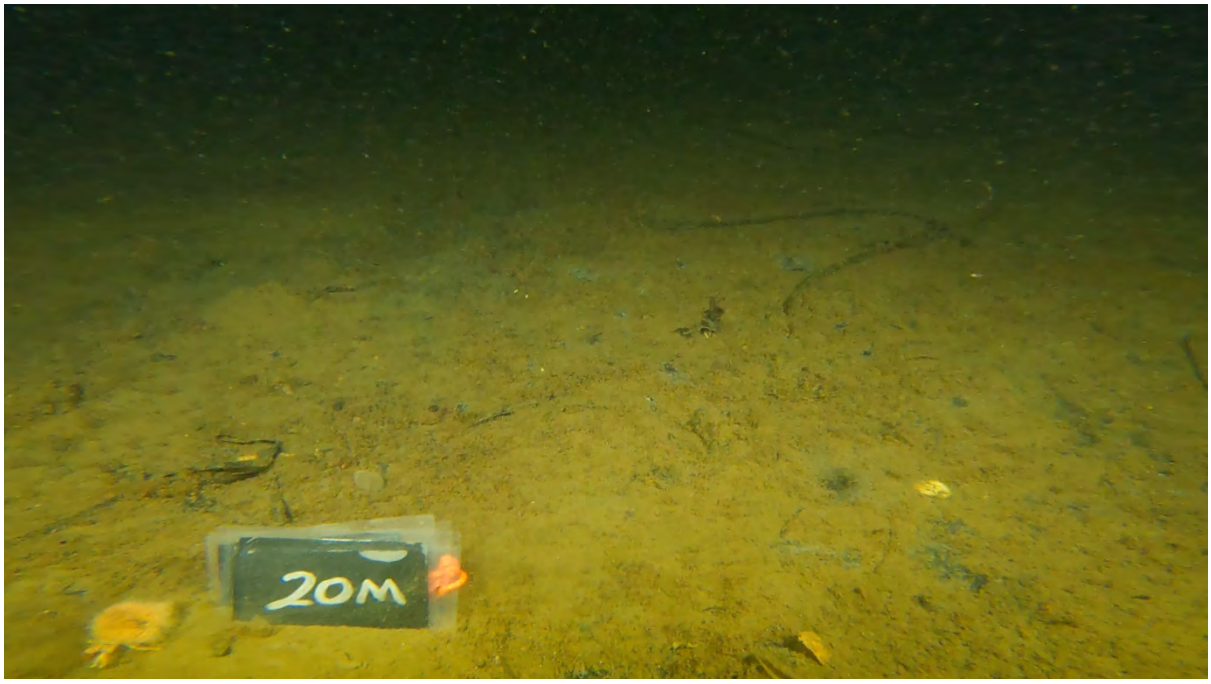


Figure 7. Station 4: T1 North 20m, Substrate is heavy thick mud with light sediments on the surface. Hermit crabs can be seen walking around. No associated aquaculture impacts can be observed.

Figure 8. Station 5: T1 North 50m, No associated aquaculture impacts can be observed.

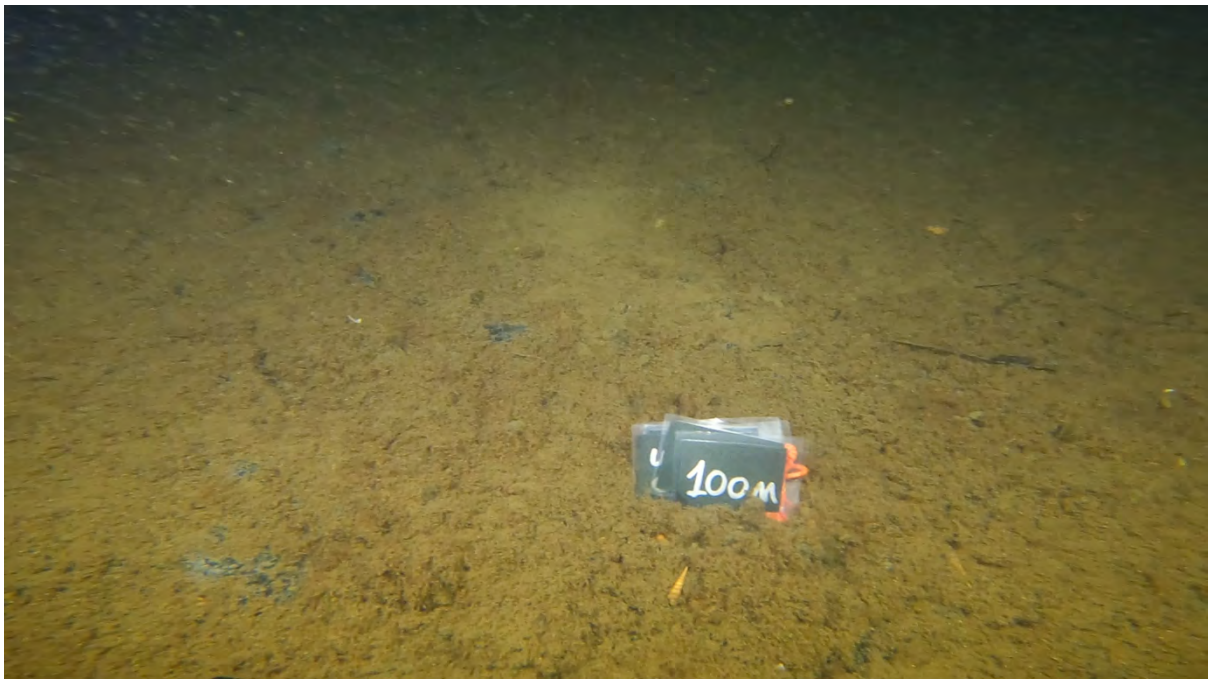


Figure 9. Station 6: T1 North 100m, No associated aquaculture impacts can be observed. Fragments of seagrass, heave thick mud mixed with shell.

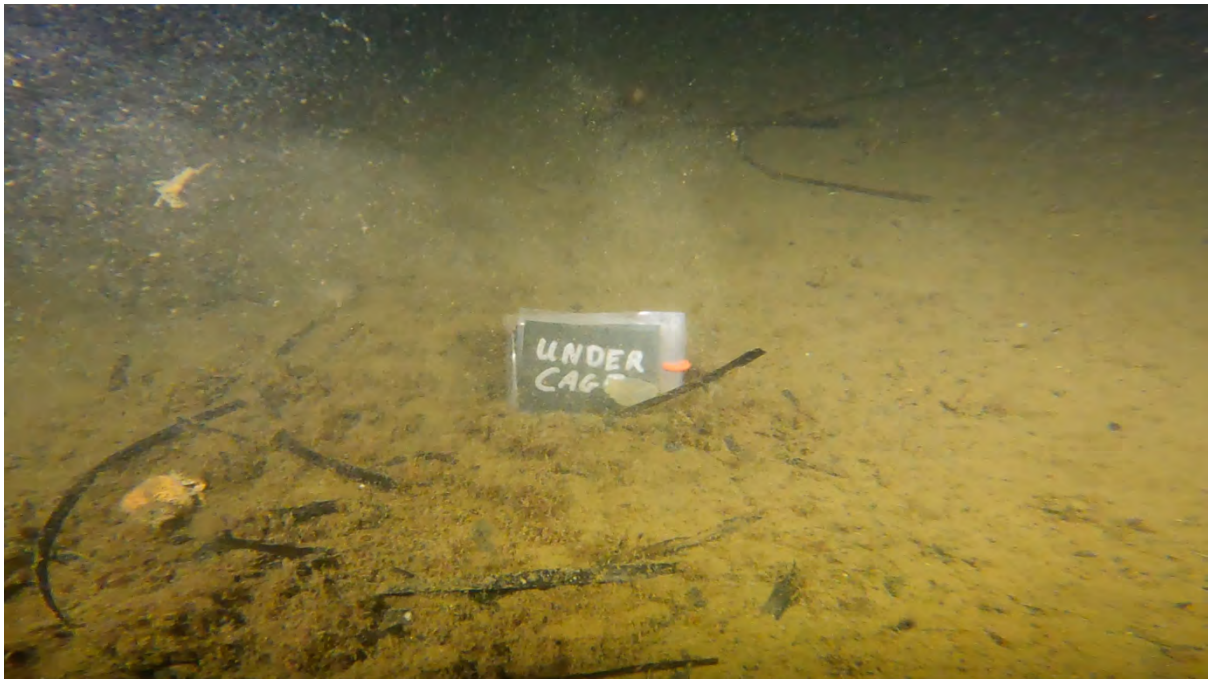


Figure 10. Station 7: T2 West Under Cage. No uneaten feed or faecal material can be seen. Small fragments of seagrass can be seen in the figure along with hermit crabs.

Figure 11. Station 8: T2 West Cage Edge. No uneaten feed or faecal material can be seen. Small fragments of seagrass can be seen in the figure.

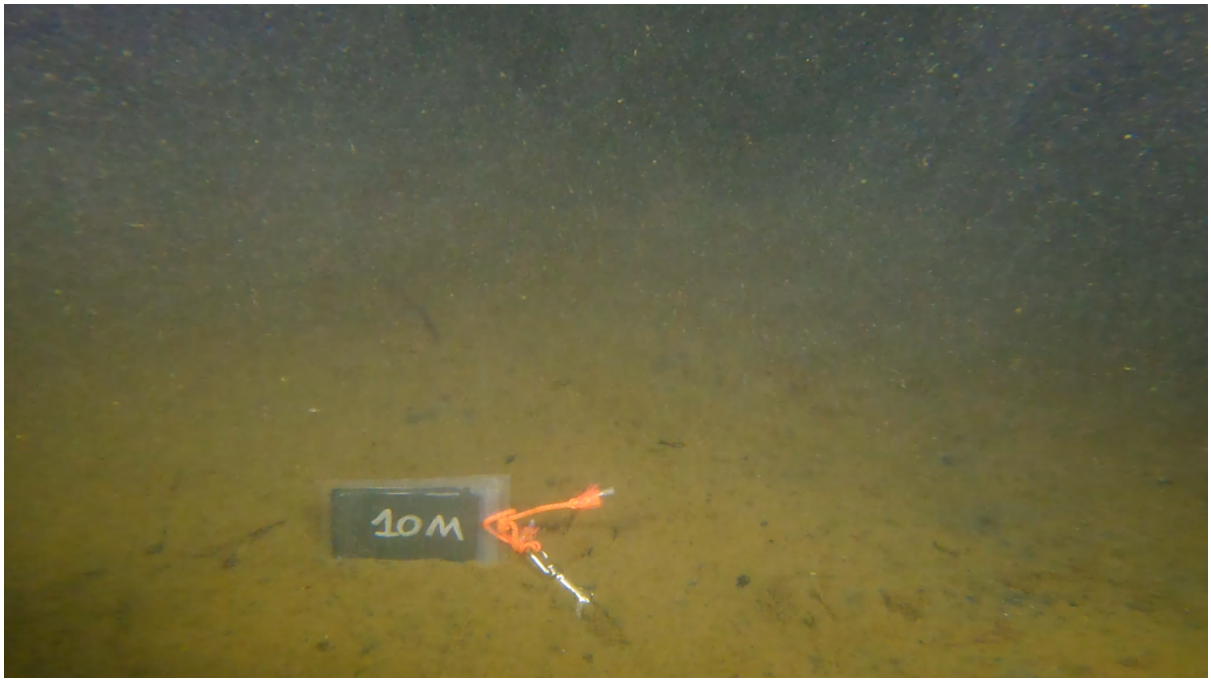


Figure 12. Station 9: T2 West 10m No uneaten feed or faecal material can be seen. Substrate is a heavy thick mud with light sedimants on the surface.

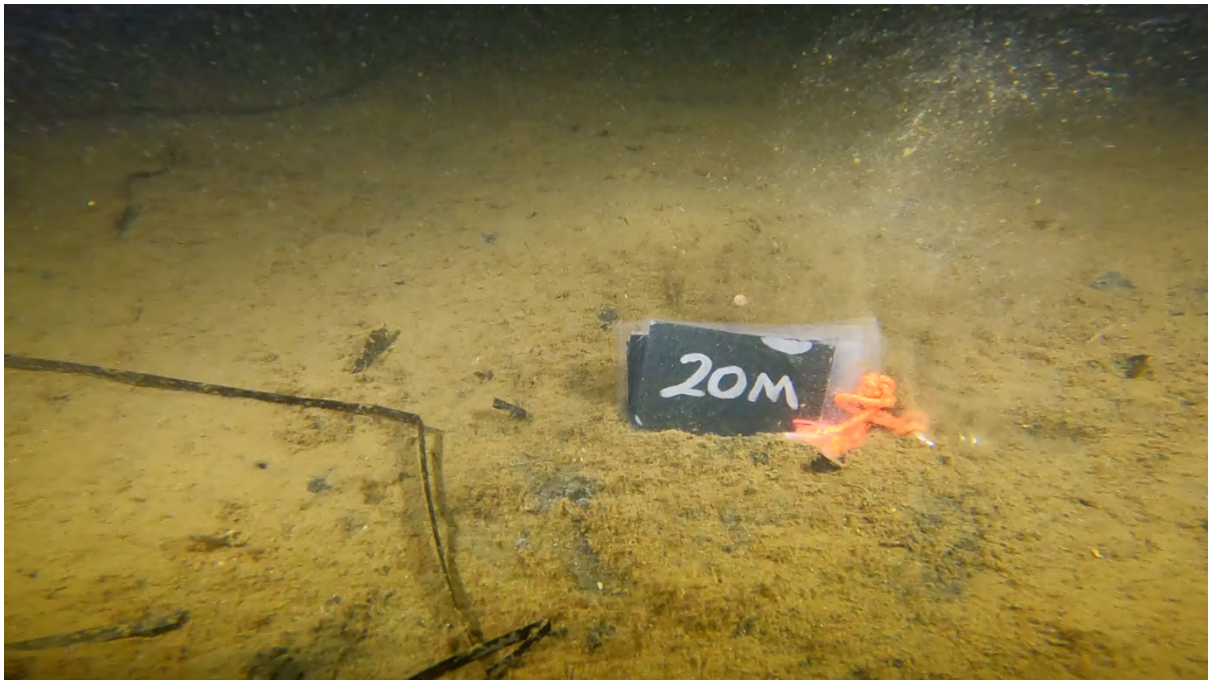


Figure 13. Station 10: T2 West 20m, Small fragments of seagrass can be seen in the figure. Substrate is a heavy thick mud with light sedimants on the surface.

Figure 14. Station 11: T2 West 50m. No associated aquaculture impacts can be observed. Fragments of seagrass can be seen in the figure.

Figure 15. Station 12: T2 West 100m, No associated aquaculture impacts can be observed, fragments of seagrass can be observed in the figure.

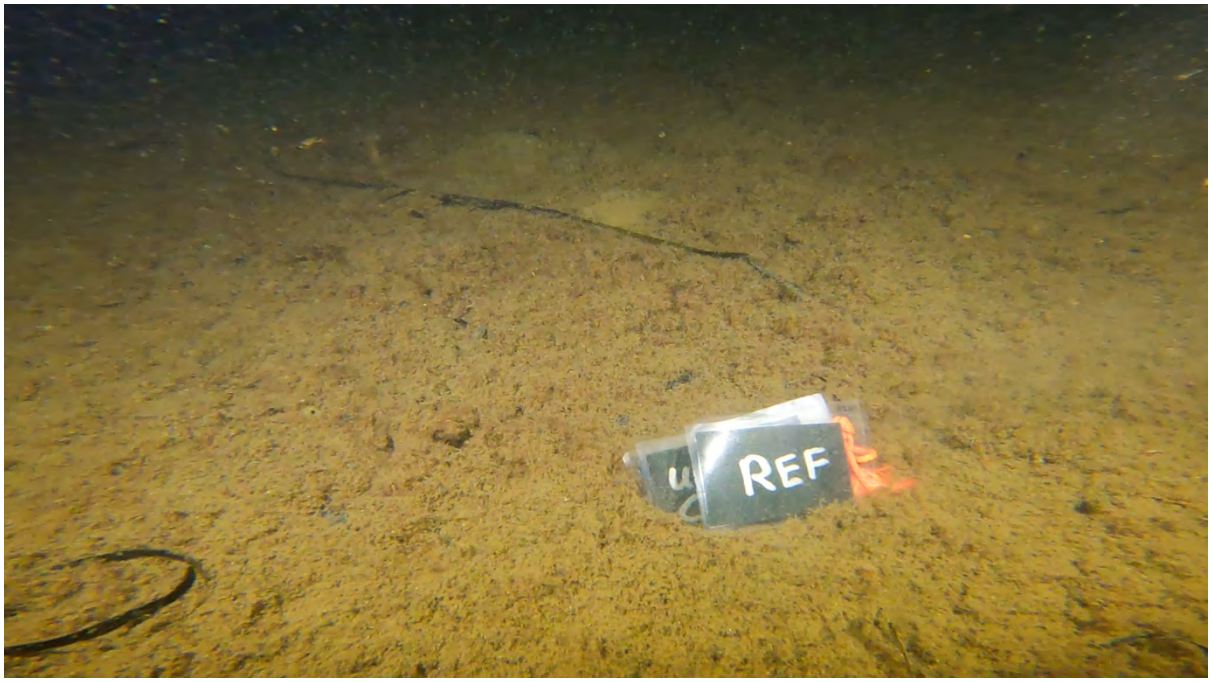


Figure 16. Control Site 1: approx. 13m in depth. Sediment is a heavy mud mixed with shell.

Figure 17. Control Site 2: approx. 13m in depth, sediment is a heavy thick mud mixed with shell. Light sediments on the surface.

Figure 18. Control Site 3: approx. 13m in dept, substrate is a heavy thick mud with large amount of shell mixed through sediments.

Discussion & Conclusion

The Marine Institute Research site at Lehanagh pool, Cashel Co. Galway (Licence No. T09/093A) at the time of survey was been fallowed and no fish in pens onsite. Overall the whole site is well maintained and no associated aquaculture wastes or materials were found on site or surrounding surveyed areas including the three control sites.

No uneaten feed pellets or faecal materials were observed directly under the fish pens. The seabed survey did not note any direct impacts or discarded objects. No visible impacts from the previous production run could be observed. No bacterial matting was noted at any of the surveyed sample stations on either transect.

The survey was carried out on the 30th September 2023 and reported here has resulted in no discernible, visual or measurable impacts from the research site on the seabed at Lehanagh pool, Beirtreah Buí Bay, Cashel, Co. Galway license number T09/093A.

References

DAFM, 2008; Monitoring Protocol No.1 for Offshore Finfish Farms - Benthic Monitoring. Revised December 2008. PP. 8. Department of Agriculture, Food & the Marine. Dublin Ireland.

URL:https://www.agriculture.gov.ie/media/migration/seafood/aquacultureforeshoremanagement/marinefinfishprotocols/Benthic%20Monitoring.pdf.

Monitoring Protocol No. 1 for Offshore Finfish Farms - Benthic Monitoring Individual Site Review 2018			
Licensed Operator	Marine Harvest		
Site name and DAFM site code	Lehanagh Pool site, T09/093A		
Species	Salmon (and lump-suckers)		
Date of survey	17th May 2018		
Stocking details	Two cages 5,000 salmon & 500 lump-suckers		
Mean bottom current speed	No provided		
Maximum licensed Biomass	Not provided		
Level of Benthic Monitoring	Level 1		
Direction of residual current flow	Not provided		
Accumulated feed within AZE?	No	**Feed pellets beyond the AZE?**	No
Bacterial mat >50% within AZE?	No	**Bacterial mat outside of AZE?**	No
Visual Assessment- Overview	Small amount of waste feed directly under the cages.		
Faunal analysis (Level 2 only)	N/A	N/A	
Redox Potential (Relate to control and sediment type)	ARPD was similar to that seen at the reference site.		
Average %LOI within AZE	3.91	**Threshold value within AZE**	5.72
Average %LOI outside AZE	4.04	**Threshold value outside AZE**	3.57
Overall Assessment of Conditions - 2018	**Acceptable.** Some information missing regarding biomass and mean bottom current speed. Site appears to be healthy. %LOI slightly exceed the threshold value outside the AZE, this could be due to the muddy sediment found at this site.		
Previous Assessment 2017	No report 2017. Previously acceptable in 2015.		

Monitoring Protocol No. 1 for Offshore Finfish Farms - Benthic Monitoring Individual Site Review				
Licensed Operator	Marine Institute			
Site name and DAFM site code	Lehanagh Pool, T09/093A			
Species	Salmon and lump- sucker.			
Date of survey	15th December 2019			
Stocking details	At the time of the survey there were two fish pens (50m diameter) containing a biomass of 9,000 salmon smolt and 750 lump-sucker fish.			
Mean bottom current speed	Not included			
Maximum licensed Biomass	Not included			
Level of Benthic Monitoring	Level 1			
Direction of residual current flow	Not included			
Accumulated feed within AZE?	No	**Feed pellets beyond the AZE?**		No
Bacterial mat >50% within AZE?	No	**Bacterial mat outside of AZE?**		No
Visual Assessment- Overview	No visual signs of impact from aquaculture practices.			
Faunal analysis (Level 2 only)	N/A		N/A	
Redox Potential (Relate to control and sediment type)	APRD depths increased slightly with distance from cage. APRD depth at the control site was 3cm, whereas the ARPD depth under and close to the cage was 1-2cm.			
Average %LOI within AZE	6.7	**Threshold value within AZE**		5.66
Average %LOI outside AZE	5.21	**Threshold value outside AZE**		3.53
Overall Assessment of Conditions				
Previous Assessment				
Recommendations for License holders				

Monitoring Protocol No. 1 for Offshore Finfish Farms - Benthic Monitoring Individual Site Review				
Licensed Operator	Marine Institute			
DAFM site code	T09/093A			
Species	Salmon			
Date of survey	13th September 2020			
Stocking details	3 T of fish at the site at time of survey.			
Mean bottom current speed	Not reported			
Maximum licensed Biomass	Not reported			
Level of Benthic Monitoring	1			
Direction of residual current flow	Not reported			
Accumulated feed within AZE?	No	**Feed pellets beyond the AZE?**		No
Bacterial mat >50% within AZE?	No	**Bacterial mat outside of AZE?**		No
Visual Assessment- Overview	Photographs of very poor quality.			
Faunal analysis (Level 2 only)	N/A		N/A	
Redox Potential (Relate to control and sediment type)	Reference station 3cm. All other stations between 1cm and 2cm depth.			
Average %LOI within AZE	4.19	**Threshold value within AZE**		4.86
Average %LOI outside AZE	3.87	**Threshold value outside AZE**		3.03
Overall Assessment of Conditions	Acceptable			
Previous Assessment	Unacceptable 2019			

Monitoring Protocol No. 1 for Offshore Finfish Farms - Benthic Monitoring Individual Site Review			
Licensed Operator	Marine Institute		
DAFM site code	T09/093A		
Species	Salmon		
Date of survey	17th September 2021		
Stocking details	Onsite production biomass of 6.2 T prior to survey. Stocked April 2021.		
Mean bottom current speed	Offshore currents of 0.5m/sec		
Maximum licensed Biomass	Not reported		
Level of Benthic Monitoring	1		
Direction of residual current flow	Not reported		
Accumulated feed within AZE?	No	**Feed pellets beyond the AZE?**	No
Bacterial mat >50% within AZE?	Yes	**Bacterial mat outside of AZE?**	Yes out to 100m T1
Visual Assessment- Overview	Bacterial mat cover <50% under cages and patches seen out to 100m.		
Faunal analysis (Level 2 only)	N/A	N/A	
Redox Potential	0cm to 14.4cm at reference station. 0cm to 8.7cm at all other. Depth increase with distance from cage.		
Average %LOI within AZE	20.58	**Threshold value within AZE**	41.6
Average %LOI outside AZE	23.04	**Threshold value outside AZE**	26
Overall Assessment of Conditions	Unacceptable. Bacterial mat >50% under and close to cage, patches out to 100m.		
Previous Assessment	Acceptable 2020		

Monitoring Protocol No. 1 for Offshore Finfish Farms - Benthic Monitoring Individual Site Review			
Licensed Operator	Maine Institute		
DAFM site code	T09/093A		
Bay	Bertraghbuí Bay		
Species	Salmon / mixed		
Date of survey	25th October 2022		
Stocking details	No fish on site at time of survey. All harvested during September 2022.		
Mean bottom current speed	Not reported		
Maximum licensed Biomass	Not reported		
Level of Benthic Monitoring	I		
Direction of residual current flow	Not reported		
Accumulated feed within AZE?	No	**Feed pellets beyond the AZE?**	No
Bacterial mat >50% within AZE?	No	**Bacterial mat outside of AZE?**	No
Visual Assessment- Overview	Overall healthy appearance.		
Faunal analysis (Level 2 only)	N/A	N/A	
Redox Potential (Relate to control and sediment type)	T1: 1.0cm to 2.0cm T2: 1.0cm to 2.0cm Reference station: >2cm		
Average %LOI within AZE	4.01	**Threshold value within AZE**	5.04
Average %LOI outside AZE	3.97	**Threshold value outside AZE**	3.15
Overall Assessment of Conditions	Acceptable		
Previous Assessment (Year)	Unacceptable (2021)		

Date	18/11/2022
Subject	Lehanagh Pool - Benthic Monitoring
Written	Elena Pagter - Scientific Advisor, Louise Healy - STO, Benthos Ecology Unit & Frank Kane - Team Lead, BEU, MI
Checked and approved	Francis O'Beirn - Manager, Licensing and Policy, Marine Institute

Memorandum

Lehanagh Pool Benthic Report

Benthic Audit Background

The Marine Institute holds a licence for the cultivation of a number of species (including salmon) at Lehanagh Pool, in Betrabuoy Bay, Co. Galway. The site is subject to annual benthic monitoring according to the Department of Agriculture, Food and the Marine Protocol No 1[1].

For the 2019 audit, the site was deemed unacceptable, with % LOI outside the AZE more than 1.25 times higher than the acceptable threshold. All previous years' audits found "Observations: No evidence of bacterial mats."

For the 2020 audit, the site was deemed acceptable though the photo quality in the report was poor.

A benthic survey (Level 1) was conducted at the site in September 2021 which involved sampling along two transects (Figure 1). This survey found evidence of *Beggiatoa* spp. at the sediments directly under the pens and out to the 100 m station along Transect 1. Evidence of *Beggiatoa* covering was greater than 50% within the Allowable Zone of Effects (AZE) and *Beggiatoa* was present outside the AZE, therefore failing to meet the Environmental Standards set out in the protocol.

The Benthos Ecology Team (MI) carried out a video survey of the licenced site in March 2022. Four transects were taken with up to nine stations taken along each transect. Images were captured by camera on a frame to assess the state of the benthic environment per station. Stations were sampled from pen edge out to a maximum of 545 m (Figure 2). Two additional stations were sampled at 510 m (station LP36) and 540 m (station LP37). The "OG" point is representative of the latitude and longitude that were recorded in the 2021 benthic audit report image (Figure 1). The survey found that the site had an overall healthy appearance, with bacterial mats present at some stations. There was no evidence of impact from the aquaculture practices observed in the collected survey images.

On 25 October 2022, the Benthos Ecology Team again carried out a video survey of the site. Two transects were taken with five stations taken along each transect (Figure 3). Three additional stations were sampled at 250 m from the aquaculture site. At each station video and images were recorded of the benthic environment. The site was fallow at the time of the survey, with 6,692 kg of fish having been harvested in September 2022.

[1] Monitoring Protocol No. 1 for Offshore Finfish Farms - Benthic Monitoring (subject to revision from time to time). December 2008

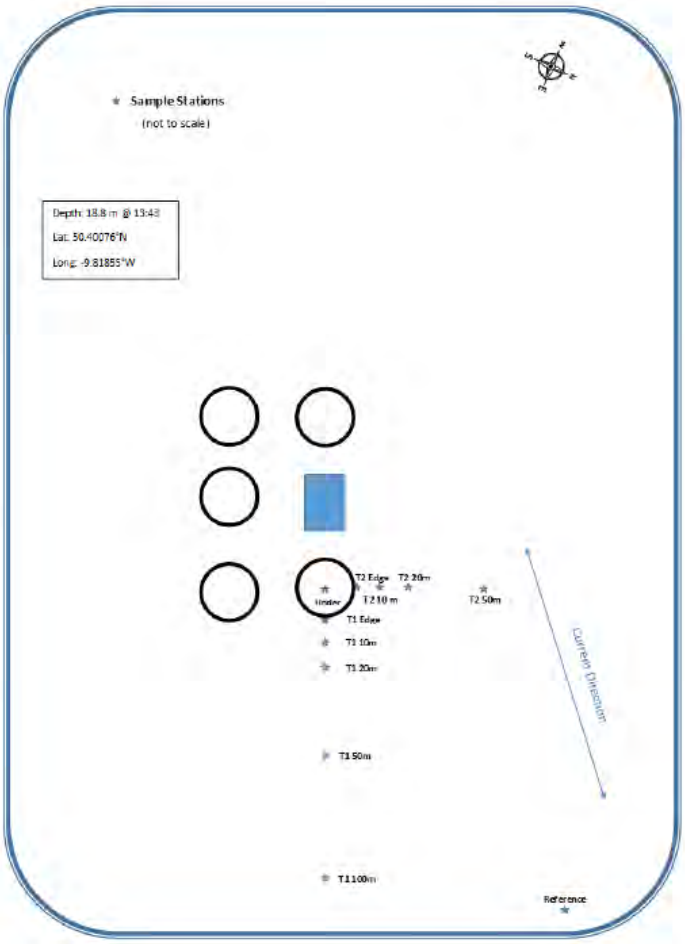


Figure 1 Location of dive transects on 17th September 2021 benthic audit

Figure 2 Map of the four transects taken at Lehanagh Pool with depths (m) for each station. Light blue open circles are net pens on site. OG is one of the original benthic audit points from 2021

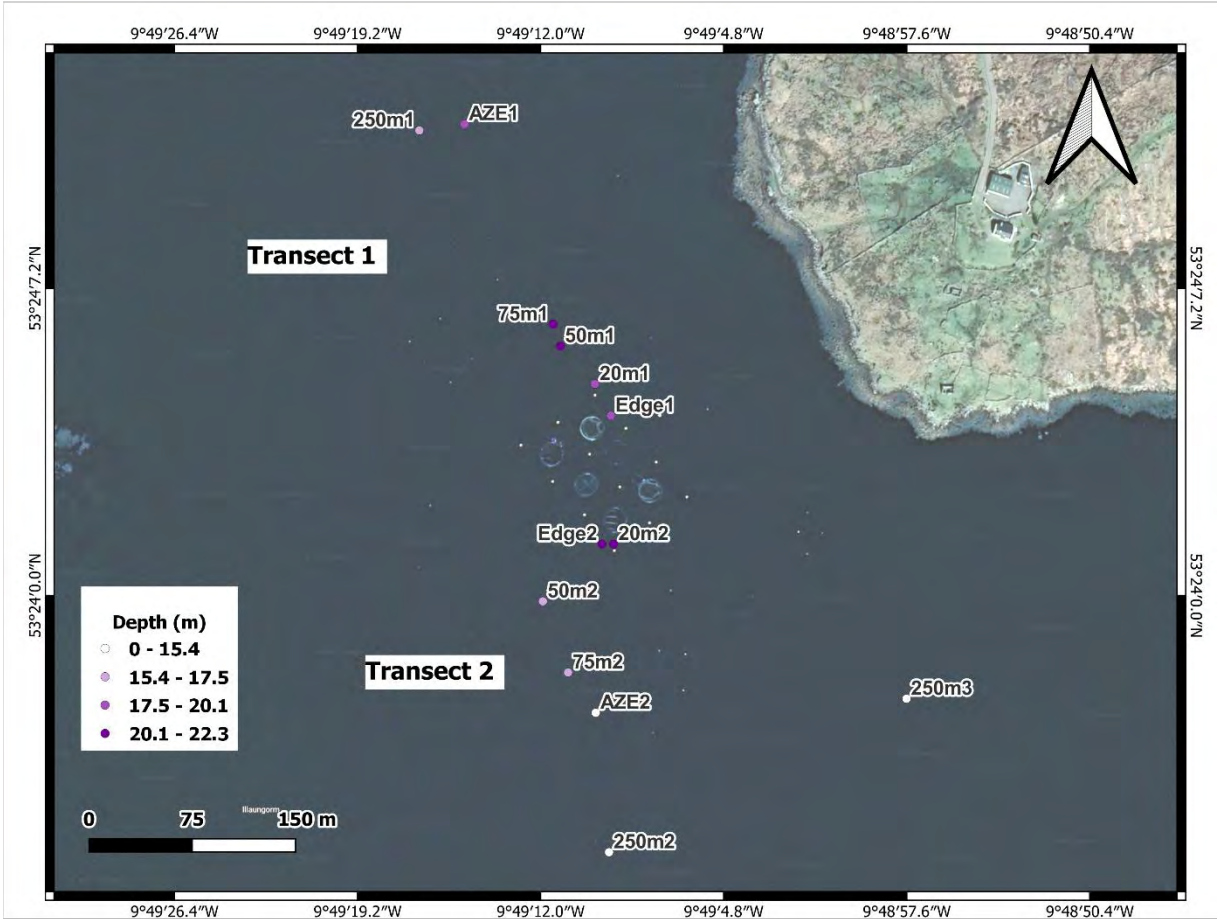


Figure 3 Map of the two transects taken at Lehanagh Pool with depths (m) for each station. Light blue open circles are net pens on site.

Description of Sites

To accurately and clearly represent the benthos at each station, a single image was selected from the collected images. The best quality image is presented for each station, with accompanying identifier, depth, sediment description, biological features, and observations.

Images, Station Details & Observations

Station: Edge 1

Depth: 19.69 m

Sediment Description: Sand and muddy sand

Biological Features: Filamentous algae cover and polychaete feeding tentacles, *Turitella* sp. and shell debris

Observations: No evidence of waste feed, faecal material, bacterial mats or out gassing

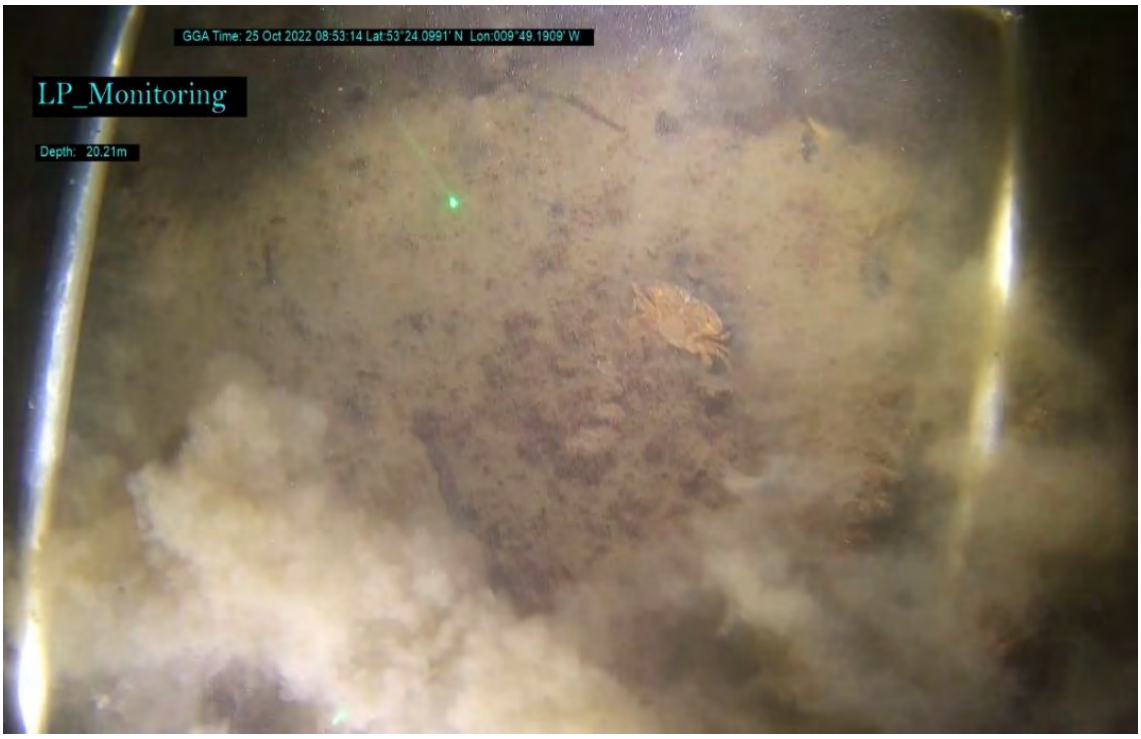
Station: 20m 1

Depth: 19.79 m

Sediment Description: Sand and muddy sand

Biological Features: Anemones and ascidian attached to rock surface. Drift algae, *Turitella* sp. Filamentous algae, drift *Zostera* sp.

Observations: No evidence of waste feed, faecal material, bacterial mats or out gassing



Station: 50m 1 **Depth:** 20.21 m

Sediment Description: Sand and muddy sand

Biological Features: Filamentous algae tufts, *Carcinus maenas*,

Observations: No evidence of waste feed, faecal material, bacterial mats or out gassing

Station: 75m 1 **Depth:** 20.21 m

Sediment Description: Sand and muddy sand

Biological Features: Filamentous algae cover, shell debris and drift *Zostera* sp.

Observations: No evidence of waste feed, faecal material, bacterial mats or out gassing

Station: AZE 1 **Depth**: 18.55 m

Sediment Description: Sand and muddy sand.

Biological Features: Filamentous algae cover and drift *Zostera* sp.

Observations: No evidence of waste feed, faecal material, bacterial mats or out gassing

Station: 250m (1)

Depth:16.48 m

Sediment Description: Sand and muddy sand

Biological Features: Filamentous algae cover, *Turritella* sp. and drift *Zostera* sp., maerl

Observations: No evidence of waste feed, faecal material, bacterial mats or out gassing

Station: Edge 2

Depth: 22.28 m

Sediment Description: Sand and muddy sand

Biological Features: Filamentous algae cover, drift algae, maerl and patches of bacterial mats

Observations: No evidence of waste feed, faecal material or out gassing

Station: 20m 2

Depth: 22.28 m

Sediment Description: Sand and muddy sand

Biological Features: Filamentous algae cover, drift algae and patches of bacterial mats

Observations: No evidence of waste feed, faecal material or out gassing

Station: 50m 2

Depth: 16.06 m

Sediment Description: Sand and muddy sand

Biological Features: Filamentous algae cover and patches of bacterial mats

Observations: No evidence of waste feed, faecal material or out gassing

Station: 75m 2

Depth: 16.48 m

Sediment Description: Sand and muddy sand

Biological Features: Filamentous algae cover and drift algae

Observations: No evidence of waste feed, faecal material, bacterial mats or out gassing

Station: AZE 2

Depth: 15.13 m

Sediment Description: Sand and muddy sand

Biological Features: Filamentous algae cover and patches of bacterial mats

Observations: No evidence of waste feed, faecal material or out gassing

Station: 250m (2)

Depth: 14.51 m

Sediment Description: Sand and muddy sand

Biological Features: Filamentous algae cover and patches of bacterial mats

Observations: No evidence of waste feed, faecal material or out gassing

Station: 250m (3)

Depth: 7.46 m

Sediment Description: Sand and muddy sand

Biological Features: Filamentous algae cover

Observations: No evidence of waste feed, faecal material, bacterial mats or out gassing

Summary of findings

From the images and video captured during the October 2022 survey, it appears that the area surveyed at Lehanagh Pool has an overall healthy appearance, with Transect 2 showing some evidence of bacterial mats. Lehanagh Pool is considered sheltered and depositional and therefore, it is likely that the presence of bacterial mats may be naturally occurring throughout the site (250m - 2). Such bacterial mats have been described in a number of similarly sheltered habitats (Hill *et al*, 2016)[2]. No evidence of impact from aquaculture practices were observed in the images from this survey.

[2] Hill, J.M., Tyler-Walters, H. & Garrard, S. L. 2016. Beggiatoa spp. on anoxic sublittoral mud. In Tyler-Walters H. and Hisock K. (eds) Marine Life Information Network: Biology and Sensitivity Key Information REvies, [on-line]. Plymouth: Marine Biological ASsosciation of the United Kingdowm. [cited 03-11-2022]. Available from: https://marlin.ac.uk/habitat/detail/181

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Marine Institute,
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ANNUAL REPORT Jan. 2019-March 2019

Lehanagh Pool

The following sites were monitored:

1. Cage site	DGPS:	53° 24.068' N	9° 49.125' W
2. Control site	DGPS:	53° 23.537' N	9° 49.186' W

Water sampling was carried out at a single point at the cage site and at the control site monthly from January 2019 to March 2019. Samples were taken at the surface, mid-water and just above the sediment. Analysis was carried out in accordance with the Department of the Marine and Natural Resources' Monitoring Protocol No.2 – Offshore Finfish Farms, Water Column Monitoring. The results are shown on Pages 2 and 3.

Sampling was carried out using an I.O.S. sampling bottle for depth samples. Temperature was measured with a mercury thermometer and salinity was measured in the laboratory using a WTW salinity meter. Ammonia samples were filtered on site. The nutrient samples were filtered in the laboratory within four hours of sampling.

Test methods. The following methods were used for sample analysis:

Total ammonia : J.P. Riley and K. Grasshoff (based on Koroleff and Solorzano)
Phosphate : in-house method based on Murphy and Riley (1962)
Nitrite : in-house method based on Bendschneider and Robinson (1952)
Nitrate : in-house method based on Strickland and Parsons (1972)

Comments:

Temperature and salinity readings showed that the water was stratified on all sampling occasions with a strong freshwater influence at the surface. A minimum surface temperature of 7.6 °C was measured at the cage site in January.

Ammonia values were low with a slight increase at the bottom of the cage site in February and at the contral site in March. Nitrate and phosphate values showed maximum levels in January and had decreased in March due to the onset of spring algal growth. Nutrient levels at the cage site compared well to measurements taken at the control site.

DATE: 12th April 2019

SIGNED. Mary Hensey
Mary Hensey M.Sc.
MANAGER

Marine Institute,
Furnace,
Newport,
Co. Mayo.

ANNUAL REPORT Jan. 2019-March 2019

Lehanagh Pool

Site 1. Cage site

Date	Site	Depth m	Secchi m	Temperature °C	Salinity	Ammonia µg-at/l N	Nitrate µg-at/l N	Nitrite µg-at/l N	Phosphate µg-at/l P
23.01.19	Cages	0	4	7.6	30.9	1.08	3.89	0.26	0.35
23.01.19	Cages	10		8.0	32.0	0.97	6.14	0.24	0.45
23.01.19	Cages	18		8.2	32.2	0.74	5.41	0.24	0.46
20.02.19	Cages	0	4	9.0	27.7	<0.71	2.65	0.20	0.18
20.02.19	Cages	10		9.0	29.2	0.91	3.94	0.22	0.20
20.02.19	Cages	18		8.7	31.5	4.28	5.15	0.35	0.35
20.03.19	Cages	0	4	9.6	25.4	1.25	2.01	0.28	0.23
20.03.19	Cages	10		9.0	29.6	2.39	3.48	0.32	0.39
20.03.19	Cages	20		9.1	31.0	1.82	3.45	0.37	0.48

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ANNUAL REPORT Jan. 2019-March 2019

Lehanagh Pool

Site 2. Control Site

Date	Site	Depth m	Secchi m	Temperature °C	Salinity	Ammonia µg-at/l N	Nitrate µg-at/l N	Nitrite µg-at/l N	Phosphate µg-at/l P
23.01.19	Control	0	4	7.5	30.9	0.74	4.17	0.27	0.41
23.01.19	Control	7		8.1	31.9	1.08	5.16	0.26	0.47
23.01.19	Control	15		8.3	32.2	0.91	5.29	0.24	0.47
20.02.19	Control	0	5	9.1	27.6	0.91	2.89	0.15	0.16
20.02.19	Control	7		9.0	29.1	0.80	3.94	0.18	0.18
20.02.19	Control	15		8.8	29.8	1.08	4.62	0.20	0.18
20.03.19	Control	0	4	9.5	26.4	1.77	2.43	0.24	0.33
20.03.19	Control	10		9.5	29.1	1.08	2.93	0.27	0.39
20.03.19	Control	17		9.5	30.7	4.50	3.78	0.34	0.57

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ANNUAL REPORT Feb. 2020-March 2020

Lehanagh Pool

The following sites were monitored:

1. Cage site	DGPS:	53° 24.068' N	9° 49.125' W
2. Control site	DGPS:	53° 23.537' N	9° 49.186' W

Water sampling was carried out at a single point at the cage site and at the control site in February and March 2020. Samples were taken at the surface, mid-water and just above the sediment. Analysis was carried out in accordance with the Department of the Marine and Natural Resources' Monitoring Protocol No.2 – Offshore Finfish Farms, Water Column Monitoring. The results are shown on Pages 2 and 3. The nutrient results are presented as µg-at/l as in previous years and also in mg/l as in the monthly reports.

Sampling was carried out using a Van Dorn sampling bottle for depth samples. Temperature was measured with an Oxyguard Polaris DO meter and salinity was measured in the laboratory using a WTW salinity meter. The nutrient samples were filtered in the laboratory within four hours of sampling.

Test methods. The following methods were used for sample analysis:

Total Ammonia : CLS 202 Ammonia for seawater
Nitrate : CLS 203 Nitrate in saline waters
Nitrite : CLS 204 Nitrite in saline waters
Phosphate : CLS 205 Phosphate saline and low level

Comments:
Temperature and salinity readings showed that the water was stratified on all sampling occasions with a strong freshwater influence at the surface. A minimum surface temperature of 7.1 °C was measured at the cage site in February. The minimum temperature measured the previous winter was 7.6 °C.

Ammonia values were low on both occasions. Nitrate and phosphate values were similar to the maximum values measured the previous winter. Nutrient levels at the cage site compared well to measurements taken at the control site.

DATE: 28th April 2020

SIGNED. Mary Hensey
Mary Hensey M.Sc.
MANAGER

Marine Institute, **ANNUAL REPORT** Feb. 2020-March 2020
Furnace,
Newport,
Co. Mayo. **Lehanagh Pool**

Site 1. Cage site

Date	Site	Depth m	Temperature °C	Salinity	Ammonia µg-at/l N	Nitrate µg-at/l N	Nitrite µg-at/l N	Phosphate µg-at/l P
24-02-20	Cages	0	7.5	26.4	<0.71	4.21	<0.21	0.32
24-02-20	Cages	10	7.2	29.2	<0.71	5.50	<0.21	0.45
24-02-20	Cages	20	7.1	28.2	0.86	4.86	<0.21	0.35
16-03-20	Cages	0	7.5	29.3	<0.71	3.93	<0.21	0.35
16-03-20	Cages	10	7.6	29.6	<0.71	4.43	<0.21	0.42
16-03-20	Cages	20	7.7	30.4	1.43	5.71	<0.21	0.48

Date	Site	Depth m	Temperature °C	Salinity	Ammonia mg/l N	Nitrate mg/l N	Nitrite mg/l N	Phosphate mg/l P
24-02-20	Cages	0	7.5	26.4	<0.010	0.059	<0.003	0.010
24-02-20	Cages	10	7.2	29.2	<0.010	0.077	<0.003	0.014
24-02-20	Cages	20	7.1	28.2	0.012	0.068	<0.003	0.011
16-03-20	Cages	0	7.5	29.3	<0.010	0.055	<0.003	0.011
16-03-20	Cages	10	7.6	29.6	<0.010	0.062	<0.003	0.013
16-03-20	Cages	20	7.7	30.4	0.020	0.080	<0.003	0.015

Marine Institute, **ANNUAL REPORT** Feb. 2020-March 2020
Furnace,
Newport,
Co. Mayo. **Lehanagh Pool**

Site 2. Control Site

Date	Site	Depth m	Temperature °C	Salinity	Ammonia µg-at/l N	Nitrate µg-at/l N	Nitrite µg-at/l N	Phosphate µg-at/l P
24-02-20	Control	0	7.1	26.6	<0.71	4.29	<0.21	0.32
24-02-20	Control	6	7.1	26.9	<0.71	4.29	<0.21	0.29
24-02-20	Control	12	7.2	29.1	<0.71	5.43	<0.21	0.39
16-03-20	Control	0	7.7	29.6	<0.71	4.29	<0.21	0.39
16-03-20	Control	6	7.6	29.5	<0.71	4.21	<0.21	0.39
16-03-20	Control	12	7.7	30.3	<0.71	4.86	<0.21	0.42

Date	Site	Depth m	Temperature °C	Salinity	Ammonia mg/l N	Nitrate mg/l N	Nitrite mg/l N	Phosphate mg/l P
24-02-20	Control	0	7.1	26.6	<0.010	0.060	<0.003	0.010
24-02-20	Control	6	7.1	26.9	<0.010	0.060	<0.003	0.009
24-02-20	Control	12	7.2	29.1	<0.010	0.076	<0.003	0.012
16-03-20	Control	0	7.7	29.6	<0.010	0.060	<0.003	0.012
16-03-20	Control	6	7.6	29.5	<0.010	0.059	<0.003	0.012
16-03-20	Control	12	7.7	30.3	<0.010	0.068	<0.003	0.013

SAOTHARLANN CHONAMARA TEO.
Rosmuc, Co. Galway.

Marine Institute,
Furnace,
Newport,
Co. Mayo.

ANNUAL REPORT Dec. 2020-March 2021

Lehanagh Pool

The following sites were monitored:

1. Cage site	DGPS:	53° 24.068' N	9° 49.125' W
2. Control site	DGPS:	53° 23.537' N	9° 49.186' W

Water sampling was carried out at a single point at the cage site and at the control site monthly from December 2020 to March 2021. Samples were taken at the surface, mid-water and just above the sediment. Analysis was carried out in accordance with the Department of the Marine and Natural Resources' Monitoring Protocol No.2 – Offshore Finfish Farms, Water Column Monitoring. The results are shown on Pages 2 and 3.

Sampling was carried out using a Van Dorn sampling bottle for depth samples. Temperature was measured with an Oxyguard Polaris DO meter and salinity was measured in the laboratory using a WTW salinity meter. The nutrient samples were filtered in the laboratory within four hours of sampling.

Test methods. The following methods were used for sample analysis:

Total Ammonia:	CLS 202 Ammonia for seawater
Nitrate :	CLS 203 Nitrate in saline waters
Nitrite :	CLS 204 Nitrite in saline waters
Phosphate :	CLS 205 Phosphate saline and low level

Comments:
Temperature and salinity readings showed that the water was stratified on all sampling occasions with a strong freshwater influence at the surface at times. A minimum surface temperature of 6.3 °C was measured at the cage site in February. The minimum temperature measured the previous winter was 7.1 °C.

Ammonia values were low on all sampling occasions. Nitrate and phosphate values were similar to the maximum values measured the previous winter. Nutrient levels at the cage site compared well to measurements taken at the control site.

DATE: 31st March 2021

Marine Institute, **ANNUAL REPORT** Dec. 2020-March 2021
Furnace,
Newport,
Co. Mayo. **Lehanagh Pool**

Site 1. Cage site

Date	Site	Depth m	Temperature °C	Salinity	Ammonia mg/l N	Nitrate mg/l N	Nitrite mg/l N	Phosphate mg/l P
12-12-20	Cages	0	8.4	31.1	0.012	0.066	0.003	0.015
12-12-20	Cages	10	8.6	31.6	0.012	0.073	0.004	0.017
12-12-20	Cages	20	8.7	31.7	0.019	0.080	0.004	0.018
15-01-21	Cages	0	8.6	30.8	<0.010	0.059	0.003	0.011
15-01-21	Cages	10	8.6	32.7	<0.010	0.070	0.003	0.014
15-01-21	Cages	20	8.6	33.4	0.014	0.076	0.003	0.016
08-02-21	Cages	0	6.3	31.4	<0.010	0.097	0.003	0.016
08-02-21	Cages	10	6.5	31.9	<0.010	0.102	0.003	0.017
08-02-21	Cages	20	6.9	32.4	<0.010	0.106	0.003	0.018
08-03-21	Cages	0	8.0	31.6	<0.010	0.062	0.003	0.012
08-03-21	Cages	10	8.2	32.0	<0.010	0.064	0.003	0.013
08-03-21	Cages	20	8.0	32.1	0.010	0.070	0.003	0.015

Marine Institute, **ANNUAL REPORT** Dec. 2020-March 2021
Furnace,
Newport,
Co. Mayo. **Lehanagh Pool**

Site 2. Control Site

Date	Site	Depth m	Temperature °C	Salinity	Ammonia mg/l N	Nitrate mg/l N	Nitrite mg/l N	Phosphate mg/l P
12-12-20	Control	0	8.4	31.0	0.010	0.067	0.004	0.018
12-12-20	Control	6	8.6	31.4	<0.010	0.071	0.004	0.016
12-12-20	Control	12	8.9	31.9	<0.010	0.076	0.003	0.016
15-01-21	Control	0	8.6	31.2	<0.010	0.066	0.003	0.013
15-01-21	Control	5	8.7	31.8	<0.010	0.069	0.003	0.013
15-01-21	Control	10	8.8	33.0	<0.010	0.070	0.003	0.014
08-02-21	Control	0	6.2	31.8	<0.010	0.098	0.003	0.017
08-02-21	Control	5	6.5	31.6	0.016	0.101	0.003	0.018
08-02-21	Control	10	7.1	31.9	0.014	0.114	0.003	0.019
08-03-21	Control	0	7.7	31.9	<0.010	0.067	<0.003	0.013
08-03-21	Control	6	8.0	32.2	<0.010	0.066	<0.003	0.013
08-03-21	Control	12	7.9	32.3	<0.010	0.072	0.003	0.013

Complete Laboratory Solutions

Marine Institute

Furnace

Newport

Co. Mayo

Following sites were monitored:

1.Lehanagh Pool Cage Site

2.Control Site

MONITORING & ANALYSIS PERFORMED BY:

Saotharlann Chonamara Teo.

ROSMUC, CONNEMARA, CO. GALWAY,

H91YK81

Complete Laboratory Solutions

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December 2021-March 2022

The Following Sites Were Monitored:

1.Lehanagh Pool Cage site	**DGPS: 53°, 24. 068' N**	**9°49.125'W**
2. Control Site	**DGPS: 53° 23.537' N**	**9°49.186'W**

Introduction:

Water sampling was carried out at a single point at the cage site and the control site December 2021 through March 2022.

Samples were taken at the surface, midwater and just above the sediment. Analysis was carried out in accordance with the Department of the Marine and Natural Resources Monitoring Protocol No.2-Offshore Finfish Farms, Water Column Monitoring.

Sampling:

Sampling was carried out using a Van Dorn sampling bottle for depth samples. Temperature was measured with an Oxyguard Polaris DO Meter and salinity was measured in the laboratory using WTW salinity meter. The nutrient samples were filtered within four hours of sampling.

Test Methods: *The following methods were used for sample analysis:*

Total Ammonia: CLS 202 Ammonia for Seawater
Nitrate: CLS203 Nitrate in saline waters
Nitrite: CLS204 Nitrite in saline waters
Phosphate: CLS205 Phosphate in saline and low level

Comments:

Temperature and salinity readings showed that the water was stratified on all sampling occasions with a strong fresh water influence at the surface at times. A minimum surface temperature of 7.8°C was measured at the cage site in March. The minimum temperature that was measured at the cage site during the previous winter was 6.3°C.

Ammonia values were low on all sampling occasions.
Nitrate and phosphate values were similar to maximum values measured the previous winter. Phosphate values were similar to the previous year's. Nutrient levels at the cage site compared well to the control site.

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Sample No.	Report No.	Receipt Date	Sample ID	Salinity	Temperature (site)	Phosphate as P filtered (low level SW or saline)	Nitrate as N saline waters	Nitrite as N saline waters	Ammonia as N (saline water)
1388499	471835	02/12/21	Lehanagh Pool Cage 0m	30.9	9.5	0.011	0.030	0.005	<0.010
1388500	471835	02/12/21	Lehanagh Pool Cage 10m	32.6	10.1	0.014	0.039	0.005	<0.010
1388501	471835	02/12/21	Lehanagh Pool Cage 20m	32.8	9.9	0.015	0.039	0.006	<0.010
1402223	475189	13/01/22	Lehanagh Pool Cage 0M	27.4	8.4	0.010	0.038	<0.003	<0.010
1402224	475189	13/01/22	Lehanagh Pool Cage 10m	29.9	8.5	0.013	0.048	<0.003	0.010
1402225	475189	13/01/22	Lehanagh Pool Cage 20m	31.2	8.5	0.015	0.051	<0.003	0.020
1410588	477498	04/02/22	Lehanagh Pool Cage 0M	31.8	9.0	0.014	0.053	<0.003	<0.010
1410589	477498	04/02/22	Lehanagh Pool Cage 10m	32.3	9.2	0.017	0.078	<0.003	<0.010
1410590	477498	04/02/22	Lehanagh Pool Cage 20m	33.0	9.1	0.017	0.087	<0.003	<0.010
1425034	480957	15/03/22	Lehanagh Pool Cage 0M	30.3	8.0	0.006	0.034	<0.003	<0.010
1425035	480957	15/03/22	Lehanagh Pool Cage 10m	30.6	7.9	0.010	0.036	<0.003	<0.010
1425036	480957	15/03/22	Lehanagh Pool Cage 20m	31.6	7.8	0.007	0.056	<0.003	0.012

Sample No.	Report No.	Receipt Date	Sample ID	Salinity	Temperature (site)	Phosphate as P filtered (low level SW or saline)	Nitrate as N saline waters	Nitrite as N saline waters	Ammonia as N (saline water)
				ppt	°C	mg/l	mg/l	mg/l	mg/l
1388502	471836	02/12/21	Lehanagh Pool Control 0M	30.8	8.9	0.013	0.028	0.004	<0.010
1388503	471836	02/12/21	Lehanagh Pool Control 6M	31.4	9.6	0.014	0.027	0.005	<0.010
1388504	471836	02/12/21	Lehanagh Pool Control 12M	32.8	9.8	0.015	0.040	0.005	<0.010
1402220	475188	13/01/22	Lehanagh Pool Control 0M	27.6	8.2	0.009	0.038	<0.003	<0.010
1402221	475188	13/01/22	Lehanagh Pool Control 6M	28.6	8.3	0.010	0.041	<0.003	<0.010
1402222	475188	13/01/22	Lehanagh Pool Control 12M	30.5	8.3	0.012	0.051	<0.003	<0.010
1410585	477497	04/02/22	Lehanagh Pool Control 0M	31.8	9.1	0.017	0.065	<0.003	<0.010
1410586	477497	04/02/22	Lehanagh Pool Control 6M	31.9	9.08	0.015	0.066	<0.003	<0.010
1410587	477497	04/02/22	Lehanagh Pool Control 12M	32.2	9.1	0.015	0.063	<0.003	<0.010
1425044	480960	15/03/22	Lehanagh Pool Control 0M	31.3	8.0	0.005	0.037	<0.003	<0.010
1425045	480960	15/03/22	Lehanagh Pool Control 8M	31.3	8.0	0.017	0.052	0.005	0.015
1425046	480960	15/03/22	Lehanagh Pool Control 15M	31.5	8.0	0.007	0.034	<0.003	<0.010

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Marine Institute

Furnace

Newport

Co. Mayo

December 2022-March 2023

Following sites were monitored:

1.Lehanagh Pool Cage Site

2.Control Site

MONITORING & ANALYSIS PERFORMED BY:

Saotharlann Chonamara Teo.

ROSMUC, CONNEMARA, CO. GALWAY,

H91YK81

Complete Laboratory Solutions

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Complete Laboratory Solutions

December 2022-March 2023

The Following Sites Were Monitored:

1.Lehanagh Pool Cage site	**DGPS: 53°, 24. 068' N**	**9°49.125'W**
2. Control Site	**DGPS: 53° 23.537' N**	**9°49.186'W**

Introduction:

Water sampling was carried out at a single point at the cage site and the control site monthly December 2022 through March 2023.

Samples were taken at the surface, midwater and just above the sediment. Analysis was carried out in accordance with the Department of the Marine and Natural Resources Monitoring Protocol No.2-Offshore Finfish Farms, Water Column Monitoring.

Sampling:

Sampling was carried out using a Van Dorn sampling bottle for depth samples. Temperature was measured with an Oxyguard Polaris DO Meter and salinity was measured in the laboratory using WTW salinity meter. The nutrient samples were filtered within four hours of sampling.

Test Methods: *The following methods were used for sample analysis:*

Total Ammonia: CLS 202 Ammonia for Seawater
Nitrate: CLS203 Nitrate in saline waters
Nitrite: CLS204 Nitrite in saline waters
Phosphate: CLS205 Phosphate in saline and low level

Comments:

Temperature and salinity readings showed that the water was stratified on all sampling occasions with a strong fresh water influence at the surface at times. A minimum surface temperature of 7.3°C was measured at the cage site in January. The minimum temperature that was measured at the cage site during the previous winter was 7.8°C.

Ammonia values were low on all sampling occasions.
Nitrate and phosphate values were similar to values measured the previous winter.
Phosphate levels showed maximum values in January and February and had decreased in March due to algal growth, a normal occurrence for the time of year.
Nutrient levels at the cage site compared well to the control site.

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Receipt Date	Sample ID	Salinity	Temperature (site)	Phosphate as P filtered (low level SW or saline)	Nitrate as N saline waters	Nitrite as N saline waters	Ammonia as N (saline water)
30/11/22	Lehanagh Pool Cage 0M	28.3	9.9	0.010	0.058	0.003	0.012
30/11/22	Lehanagh Pool Cage 10m	29.7	10.1	0.012	0.068	0.003	0.012
30/11/22	Lehanagh Pool Cage 20m	29.9	10.4	0.013	0.068	0.003	0.014
20/01/23	Lehanagh Pool Cage 0M	29.1	7.3	0.012	0.065	<0.003	0.012
20/01/23	Lehanagh Pool Cage 7m	32.2	8.3	0.016	0.090	0.003	0.019
20/01/23	Lehanagh Pool Cage 15m	32.2	8.4	0.016	0.090	0.003	0.017
24/02/23	Lehanagh Pool Cage 0M	30.9	9.5	0.010	0.068	<0.003	<0.010
24/02/23	Lehanagh Pool Cage 10m	31.4	9.6	0.013	0.087	<0.003	<0.010
24/02/23	Lehanagh Pool Cage 20m	31.8	9.6	0.013	0.095	<0.003	<0.010
30/03/23	Lehanagh Pool Cage 0M	29.4	10.2	0.006	0.025	<0.003	<0.010
30/03/23	Lehanagh Pool Cage 7m	29.8	10.2	0.007	0.031	<0.003	<0.010
30/03/23	Lehanagh Pool Cage 15m	30.3	10.1	0.008	0.038	<0.003	<0.010

Receipt Date	Sample ID	Salinity	Temperature (site)	Phosphate as P filtered (low level SW or saline)	Nitrate as N saline waters	Nitrite as N saline waters	Ammonia as N (saline water)
		ppt	°C	mg/l P	mg/l	mg/l	mg/l
30/11/22	Lehanagh Pool Control 0M	28.1	10.2	0.012	0.058	0.003	0.014
30/11/22	Lehanagh Pool Control 10M	28.9	10.3	0.012	0.063	0.003	0.011
30/11/22	Lehanagh Pool Control 20M	29.5	10.4	0.012	0.067	0.003	0.018
20/01/23	Lehanagh Pool Control 0M	29.6	6.2	0.012	0.071	<0.003	0.013
20/01/23	Lehanagh Pool Control 7M	31.8	7.5	0.015	0.086	<0.003	0.011
20/01/23	Lehanagh Pool Control 15M	32.3	8.3	0.015	0.093	<0.003	0.016
24/02/23	Lehanagh Pool Control 0M	30.7	9.5	0.011	0.070	<0.003	<0.010
24/02/23	Lehanagh Pool Control 6M	31.1	9.6	0.012	0.090	<0.003	<0.010
24/02/23	Lehanagh Pool Control 12M	31.5	9.5	0.012	0.098	<0.003	<0.010
30/03/23	Lehanagh Pool Control 0M	29.7	10.3	0.007	0.031	<0.003	<0.010
30/03/23	Lehanagh Pool Control 7M	29.8	10.3	0.011	0.052	<0.003	0.010
30/03/23	Lehanagh Pool Control 15M	29.9	9.9	0.008	0.035	<0.003	<0.010

Sea Lice Numbers Report

	Date	Cage	No. Fish Sampled	*Lepeophtheirus salmonis*					*Caligus elongatus*				
				Male	Female	F + eggs	Juvenile	Total	Male	Female	F + eggs	Juvenile	Total
BERTRAGHBOY BAY													
MARINE INSTITUTE													
Lehanagh Pool													
Atlantic Salmon, 2018	27/04/2018	Std	15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	04/05/2018	Std	38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	15/05/2018	Std	36	0.06	0.00	0.00	0.03	0.08	0.06	0.06	0.00	0.00	0.11
	21/05/2018	Std	29	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.03
	29/05/2018	Std	29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	06/06/2018	Std	28	0.00	0.00	0.00	0.04	0.04	0.00	0.04	0.04	0.14	0.18
	19/06/2018	Std	28	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.07	0.00	0.14
	03/07/2018	Std	8	0.00	0.00	0.00	0.13	0.13	0.00	0.13	0.13	0.00	0.13
	18/07/2018	Std	10	0.00	0.00	0.00	0.00	0.00	0.10	0.00	0.00	0.20	0.30
	26/07/2018	Std	30	0.00	0.00	0.00	0.03	0.03	0.00	0.17	0.13	0.03	0.20
	02/08/2018	Std	29	0.03	0.00	0.00	0.45	0.48	0.10	0.03	0.03	0.03	0.17
	24/08/2018	Std	93	0.49	0.56	0.47	0.15	1.20	0.52	1.49	1.34	0.03	2.04
	03/09/2018	Std	30	0.23	0.20	0.17	0.10	0.53	0.00	0.07	0.07	0.00	0.07
	04/09/2018			Fallowed									
Atlantic Salmon, 2018 S1/2	27/02/2018	Std	30	0.10	0.00	0.00	0.10	0.20	0.23	0.17	0.03	0.43	0.83
	27/02/2018	R	30	0.03	0.03	0.00	0.10	0.17	0.00	0.03	0.00	0.40	0.43
	28/02/2018			Fallowed									

Atlantic Salmon, 2019	28/05/2019	Std	43	0.21	0.00	0.00	2.09	2.30	0.14	0.28	0.00	0.00	0.42
	07/06/2019	Std	40	1.28	0.00	0.00	3.48	4.75	0.05	0.23	0.18	0.10	0.38
	14/06/2019	Std	40	0.58	0.03	0.03	1.93	2.53	0.68	0.65	0.43	0.28	1.60
	14/06/2019	R	30	0.97	0.13	0.10	1.83	2.93	0.83	0.73	0.23	0.20	1.77
	21/06/2019	R	30	1.60	0.13	0.07	2.37	4.10	0.37	1.30	1.07	0.07	1.73
	25/06/2019	Std	30	0.90	0.10	0.00	1.20	2.20	0.53	0.77	0.73	1.17	2.47
	28/06/2019	R	28	0.61	0.00	0.00	2.29	2.89	0.39	1.64	1.39	0.21	2.25
	03/07/2019	Std	30	0.50	0.00	0.00	0.70	1.20	0.27	0.70	0.57	0.00	0.97
	09/07/2019	Std	33	0.18	0.00	0.00	0.15	0.33	0.00	0.00	0.00	0.00	0.00
	12/07/2019	R	26	0.27	0.00	0.00	0.23	0.50	0.04	0.04	0.04	0.04	0.12
	19/07/2019	R	20	0.90	0.10	0.10	1.25	2.25	0.25	0.30	0.20	0.15	0.70
	26/07/2019	R	18	0.33	0.11	0.06	1.44	1.89	0.11	0.11	0.06	0.00	0.22
	26/07/2019	R	12	0.25	0.08	0.08	1.08	1.42	0.00	0.00	0.00	0.00	0.00
	26/07/2019			Fallowed									
Atlantic Salmon, 2019 S1/2	25/01/2019	R	18	0.67	0.00	0.00	0.72	1.39	1.89	3.78	1.94	2.89	8.56
	12/02/2019	Std	12	0.75	0.50	0.00	2.17	3.42	3.33	9.50	5.08	4.33	17.17
	28/02/2019	Std	25	1.24	0.76	0.36	0.92	2.92	3.08	15.44	11.68	0.36	18.88
	28/02/2019	Std	21	0.90	0.52	0.33	0.95	2.38	2.57	10.71	8.57	1.19	14.48
	28/02/2019			Fallowed									
Atlantic Salmon, 2020	26/05/2020	Std	30	0.47	0.10	0.00	1.53	2.10	0.00	0.00	0.00	0.00	0.00
	04/06/2020	R	39	0.87	0.15	0.03	0.79	1.82	0.00	0.03	0.03	0.00	0.03
	10/06/2020	R	38	0.68	0.13	0.05	0.13	0.95	0.00	0.00	0.00	0.00	0.00
	25/06/2020	Std	26	0.31	0.00	0.00	2.42	2.73	0.04	0.00	0.00	0.00	0.04
	25/06/2020	R	8	0.63	0.13	0.13	1.25	2.00	0.00	0.13	0.00	0.00	0.13
	26/06/2020	R	10	0.60	0.00	0.00	0.50	1.10	0.00	0.10	0.10	0.00	0.10
	02/07/2020	Std	37	1.27	0.46	0.16	3.14	4.86	0.14	0.38	0.11	0.00	0.51

	10/07/2020	R	32	0.19	0.03	0.00	0.44	0.66	0.03	0.06	0.06	0.00	0.09
	23/07/2020	Std	38	1.00	0.32	0.13	0.50	1.82	0.00	0.50	0.34	0.00	0.50
	28/07/2020	Std	36	0.19	0.00	0.00	0.11	0.31	0.00	0.00	0.00	0.00	0.00
	29/07/2020	R	37	3.30	1.65	0.22	4.46	9.41	0.22	0.84	0.57	0.00	1.05
	31/07/2020	R	34	3.41	0.62	0.18	2.29	6.32	0.00	0.15	0.09	0.00	0.15
	13/08/2020	Std	30	2.27	0.43	0.17	3.60	6.30	0.10	0.33	0.30	0.00	0.43
	13/08/2020	R	29	3.38	0.48	0.38	7.03	10.90	0.03	0.21	0.14	0.00	0.24
	08/09/2020	Std	27	3.85	4.11	3.81	2.30	10.26	0.19	0.74	0.56	0.00	0.93
	08/09/2020	R	30	4.73	0.60	0.40	1.97	7.30	0.10	0.23	0.13	0.00	0.33
	09/09/2020			Fallowed									
Atlantic Salmon, 2020 S1/2	08/01/2020	R	45	0.09	0.00	0.00	0.27	0.36	0.16	0.29	0.09	0.02	0.47
	29/01/2020	Std	30	0.47	0.10	0.10	0.47	1.03	0.00	0.07	0.07	0.10	0.17
	05/02/2020	Std	27	0.19	0.19	0.15	0.59	0.96	0.00	0.00	0.00	0.15	0.15
	13/03/2020			Fallowed									
Atlantic Salmon, 2021	19/05/2021	Std	30	0.03	0.00	0.00	0.17	0.20	0.07	0.00	0.00	0.00	0.07
	19/05/2021	R	38	0.42	0.00	0.00	0.55	0.97	0.00	0.00	0.00	0.00	0.00
	02/06/2021	Std	30	0.00	0.00	0.00	0.03	0.03	0.00	0.00	0.00	0.00	0.00
	02/06/2021	R	30	0.00	0.03	0.03	0.07	0.10	0.00	0.07	0.00	0.07	0.13
	17/06/2021	Std	30	0.13	0.00	0.00	0.00	0.13	0.03	0.03	0.00	0.00	0.07
	17/06/2021	R	31	0.10	0.00	0.00	0.03	0.13	0.00	0.06	0.06	0.10	0.16
	12/07/2021	Std	28	0.18	0.00	0.00	0.29	0.46	0.21	0.21	0.21	0.04	0.46
	12/07/2021	R	30	0.03	0.00	0.00	0.00	0.03	0.03	0.00	0.00	0.00	0.03
	12/07/2021	R	31	0.52	0.26	0.13	0.26	1.03	0.26	0.81	0.77	0.03	1.10
	27/07/2021	R	28	0.14	0.25	0.25	0.07	0.46	0.18	0.43	0.43	0.00	0.61
	28/07/2021	Std	38	0.21	0.05	0.05	0.00	0.26	0.05	0.32	0.26	0.03	0.39
	04/08/2021	R	30	0.10	0.13	0.13	0.00	0.23	0.00	0.00	0.00	0.00	0.00
	16/08/2021	Std	35	0.09	0.06	0.06	0.00	0.14	0.03	0.31	0.31	0.00	0.34

	23/08/2021	Std	43	0.00	0.02	0.00	0.02	0.05	0.00	0.02	0.02	0.00	0.02
	20/09/2021	Std	30	0.00	0.03	0.00	0.03	0.07	0.00	0.03	0.03	0.00	0.03
	20/09/2021	R	32	0.03	0.03	0.03	0.00	0.06	0.00	0.00	0.00	0.00	0.00
	06/10/2021			Fallowed									
Atlantic Salmon, 2021 S1/2	22/01/2021	R	30	0.23	0.03	0.00	0.50	0.77	0.93	1.97	1.63	0.00	2.90
	22/01/2021	R	30	0.23	0.00	0.00	0.30	0.53	1.60	2.07	1.40	0.00	3.67
	10/02/2021	Std	30	0.70	0.07	0.03	1.63	2.40	1.63	2.87	2.40	0.30	4.80
	10/02/2021	R	30	0.50	0.10	0.07	1.53	2.13	1.60	2.87	2.17	0.60	5.07
	04/03/2021	Std	32	1.50	0.25	0.19	1.97	3.72	2.56	7.28	4.81	0.13	9.97
	04/03/2021	R	31	0.55	0.16	0.03	1.13	1.84	2.29	5.26	3.32	0.52	8.06
	18/03/2021			Fallowed									
Atlantic Salmon, 2022	06/05/2022	R	33	0.12	0.00	0.00	1.15	1.27	0.00	0.06	0.00	0.00	0.06
	06/05/2022	R	30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	20/05/2022	Std	30	0.10	0.00	0.00	0.27	0.37	0.00	0.03	0.00	0.00	0.03
	20/05/2022	R	30	0.30	0.00	0.00	0.17	0.47	0.00	0.00	0.00	0.00	0.00
	03/06/2022	Std	31	0.03	0.13	0.03	0.13	0.29	0.00	0.13	0.06	0.00	0.13
	03/06/2022	R	35	0.23	0.00	0.00	0.29	0.51	0.00	0.00	0.00	0.00	0.00
	16/06/2022	Std	30	2.30	0.13	0.03	8.87	11.30	0.00	0.20	0.13	0.03	0.23
	16/06/2022	R	30	5.23	0.33	0.20	5.40	10.97	0.10	0.30	0.23	0.00	0.40
	01/07/2022	Std	30	3.67	2.67	1.73	1.80	8.13	0.00	0.00	0.00	0.00	0.00
	11/07/2022	R	30	4.50	1.20	1.13	0.33	6.03	0.00	0.00	0.00	0.00	0.00
	26/07/2022	Std	30	0.80	0.07	0.07	0.53	1.40	0.00	0.00	0.00	0.00	0.00
	26/07/2022	R	31	2.84	2.00	1.90	0.58	5.42	0.00	0.00	0.00	0.00	0.00
	02/08/2022	Std	30	1.97	1.70	1.30	1.13	4.80	0.00	0.00	0.00	0.00	0.00
	29/08/2022	Std	30	0.83	0.40	0.33	0.93	2.17	0.00	0.00	0.00	0.00	0.00
	29/08/2022	R	31	2.48	3.00	2.81	2.16	7.65	0.00	0.00	0.00	0.00	0.00
	05/09/2022			Fallowed									

Atlantic Salmon, 2022 S 1/2	21/12/2021	R	30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	27/01/2022	Std	33	0.00	0.00	0.00	0.52	0.52	0.15	0.64	0.55	0.06	0.85
	25/02/2022	Std	34	0.09	0.00	0.00	0.09	0.18	0.79	1.41	0.97	0.65	2.85
	16/03/2022			Fallowed									
Atlantic Salmon, 2023 S 1/2	07/12/2022	Std	28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	07/12/2022	R	36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	07/12/2022	R	14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	16/01/2023	Std	30	0.00	0.00	0.00	0.03	0.03	0.03	0.07	0.00	0.03	0.13
	16/01/2023	R	39	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.03	0.05
	16/01/2023	R	36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	02/02/2023	Std	51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	02/02/2023	R	31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	02/02/2023	R	48	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.02
	23/02/2023	Std	39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	23/02/2023	R	32	0.00	0.00	0.00	0.00	0.00	0.03	0.03	0.03	0.00	0.06
	23/02/2023	R	31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	06/03/2023			Fallowed									
Atlantic Salmon, 2023	16/05/2023	R	28	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.04
	06/06/2023	Std	35	0.00	0.03	0.03	0.00	0.03	0.00	0.09	0.06	0.00	0.09
	06/06/2023	R	13	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.08	0.00	0.08
	12/07/2023	Std	33	0.00	0.00	0.00	0.30	0.30	0.00	0.09	0.03	0.06	0.15
	23/08/2023	Std	26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	31/08/2023			Fallowed									

Foras na Mara
Marine Institute

Regulation (EU) 2016/429 of the European Parliament and of the Council of 9 March 2016 on transmissible animal diseases and amending and repealing certain acts in the area of animal health ('Animal Health Law')

Fish Health Approval Certificate

FHA-000595 - Marine Institute, Galway (Lehanagh Pool Finfish) (the 'Operator')

The Marine Institute in exercise of its powers under Article 181 of Regulation (EU) 2016/429, and subject to the conditions set out in the schedule, grants approval to the Operator to operate an aquaculture production business (the 'Activity') at Lehanagh Pool,Lehanagh Pool, Bertraghboy Bay,Galway (the 'Premises') with species Atlantic salmon, Lumpsucker, Wrasse kept at the establishment.

Schedule

1. The Activity shall be carried out at the Premises in compliance with the plans and particulars submitted with the application for a fish health approval, and with the conditions set out in this approval and in any aquaculture licence which may be granted under the Fisheries (Amendment) Act 1997, as amended, and in accordance with the provisions of the Regulation (EU) 2016/429.

2. This approval is non-transferable. Any proposed change to the operation of the Activity shall be notified to the Marine Institute for its prior approval. Any alteration to the identity of the Operator shall invalidate the approval from the date upon which that change took effect.

3. The Operator shall not be entitled solely by reason of the grant of this approval to carry on the Activity. For the avoidance of doubt, this approval does not approve the Activity or the carrying on of any activity in a manner that does not comply with any legislation which may be relevant to the Activity.

4. This approval shall cease to have effect on revocation or refusal of an aquaculture licence for the Premises, if applicable.

5. The Marine Institute reserves the right to refuse or revoke approvals on breach of any of these conditions or otherwise in accordance with the Article 184 of Regulation (EU) 2016/429.

Signature:

On behalf of the Marine Institute

Dated: 09/08/2023

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Foras na Mara
Marine Institute

Regulation (EU) 2016/429 of the European Parliament and of the Council of 9 March 2016 on transmissible animal diseases and amending and repealing certain acts in the area of animal health ('Animal Health Law')

Fish Health Approval Certificate

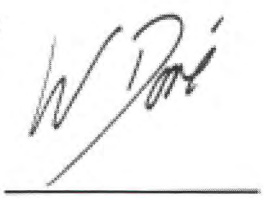
FHA-000677 - Marine Institute, Galway (Lehanagh Pool Shellfish) (the 'Operator')

The Marine Institute in exercise of its powers under Article 181 of Regulation (EU) 2016/429, and subject to the conditions set out in the schedule, grants approval to the Operator to operate an aquaculture production business (the 'Activity') at Bertraghboy Bay (Lehanagh Pool), Galway (the 'Premises') with species European flat oyster Ostrea edulis, Blue mussel Mytilus edulis, Variegated scallop Chlamys varia, King scallop Pecten maximus, European lobster Homaras gammarus, T. descussatus, R. philippinarum and Venerupis corrugata kept at the establishment.

Schedule

1. The Activity shall be carried out at the Premises in compliance with the plans and particulars submitted with the application for a fish health approval, and with the conditions set out in this approval and in any aquaculture licence which may be granted under the Fisheries (Amendment) Act 1997, as amended, and in accordance with the provisions of the Regulation (EU) 2016/429.
2. This approval is non-transferable. Any proposed change to the operation of the Activity shall be notified to the Marine Institute for its prior approval. Any alteration to the identity of the Operator shall invalidate the approval from the date upon which that change took effect.
3. The Operator shall not be entitled solely by reason of the grant of this approval to carry on the Activity. For the avoidance of doubt, this approval does not approve the Activity or the carrying on of any activity in a manner that does not comply with any legislation which may be relevant to the Activity.
4. This approval shall cease to have effect on revocation or refusal of an aquaculture licence for the Premises, if applicable.
5. The Marine Institute reserves the right to refuse or revoke approvals on breach of any of these conditions or otherwise in accordance with the Article 184 of Regulation (EU) 2016/429.

Signature:



On behalf of the Marine Institute

Dated: 13/01/2023

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Marine Institute
Foras na Mara

European Communities (Health of Aquaculture Animals and Products) Regulations 2008, S.I. No. 261 of 2008, as amended by S.I. No. 389 of 2010 and S.I. No. 430 of 2011

Fish Health Authorisation Certificate
FHA-000595 - Marine Institute (the 'Operator')

The Marine Institute in exercise of its powers under the European Communities (Health of Aquaculture Animals and Products) Regulations 2008 - 2011, and subject to the conditions set out in the Schedule, authorises the Operator to operate an aquaculture production business (the 'Activity')
at Lehanagh Pool , Galway / T09/093, 176 (the 'Premises')

Schedule

1. The Activity shall be carried out at the Premises in compliance with the plans and particulars submitted with the application for a fish health authorisation including the Fish Health Management Plan, and with the conditions set out in this authorisation and in any aquaculture licence which may be granted under the Fisheries (Amendment) Act 1997, as amended, and in accordance with the provisions of the EC (Health of Aquaculture Animals and Products) Regulations 2008 – 2011.
2. This authorisation is non-transferable. Any proposed change to the operation of the Activity shall be notified to the Marine Institute for its prior approval. Any alteration to the identity of the Operator shall invalidate the authorisation from the date upon which that change took effect.
3. The Operator shall not be entitled solely by reason of the grant of this authorisation to carry on the Activity. For the avoidance of doubt, this authorisation does not authorise the Activity or the carrying on of any activity in a manner that does not comply with any legislation which may be applicable including, but not limited to:
   a. EC (Health of Aquaculture Animals and Products) Regulations 2008 – 2011
   b. Fisheries (Amendment) Act 1997, as amended, and relevant Regulations
   c. Local Government (Water Pollution) Act 1990, as amended, and relevant Regulations
   d. Foreshore Act 1933, as amended, and relevant Regulations
   e. Planning and Development Act 2000, as amended, and relevant Regulations
   f. EC (Birds and Natural Habitats) Regulations 2011, S.I. 477 of 2011, as amended
4. This authorisation shall cease to have effect on revocation or refusal of an aquaculture licence for the Premises, if applicable.
5. The Marine Institute reserves the right to refuse or revoke authorisation on breach of any of these conditions or otherwise in accordance with the EC (Health of Aquaculture Animals and Products) Regulations 2008 – 2011.

Signature: 

On behalf of the Marine Institute

Dated: 20/10/2017
Original date of issue: 27/09/2013

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Marine Institute
Foras na Mara

European Communities (Health of Aquaculture Animals and Products) Regulations 2008, S.I. No. 261 of 2008 as amended.

Fish Health Authorisation Certificate
FHA-000677 - Marine Institute, Galway (Lehanagh Pool Shellfish) (the 'Operator')

The Marine Institute in exercise of its powers under the European Communities (Health of Aquaculture Animals and Products) Regulations 2008 as amended, and subject to the conditions set out in the Schedule, authorises the Operator to operate an aquaculture production business (the 'Activity') at Bertraghboy Bay (Lehanagh Pool) , Galway (the 'Premises')

Schedule

1. The Activity shall be carried out at the Premises in compliance with the plans and particulars submitted with the application for a fish health authorisation including the Fish Health Management Plan, and with the conditions set out in this authorisation and in any aquaculture licence which may be granted under the Fisheries (Amendment) Act 1997, as amended, and in accordance with the provisions of the EC (Health of Aquaculture Animals and Products) Regulations 2008 as amended.
2. This authorisation is non-transferable. Any proposed change to the operation of the Activity shall be notified to the Marine Institute for its prior approval. Any alteration to the identity of the Operator shall invalidate the authorisation from the date upon which that change took effect.
3. The Operator shall not be entitled solely by reason of the grant of this authorisation to carry on the Activity. For the avoidance of doubt, this authorisation does not authorise the Activity or the carrying on of any activity in a manner that does not comply with any legislation which may be applicable including, but not limited to:
   a. EC (Health of Aquaculture Animals and Products) Regulations 2008 as amended
   b. Fisheries (Amendment) Act 1997, as amended, and relevant Regulations
   c. Local Government (Water Pollution) Act 1990, as amended, and relevant Regulations
   d. Foreshore Act 1933, as amended, and relevant Regulations
   e. Planning and Development Act 2000, as amended, and relevant Regulations
   f. EC (Birds and Natural Habitats) Regulations 2011, S.I. 477 of 2011, as amended
4. This authorisation shall cease to have effect on revocation or refusal of an aquaculture licence for the Premises, if applicable.
5. The Marine Institute reserves the right to refuse or revoke authorisation on breach of any of these conditions or otherwise in accordance with the EC (Health of Aquaculture Animals and Products) Regulations 2008 as amended.

Signature:

On behalf of the Marine Institute

Dated: 19/11/2019

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An Roinn Talmhaíochta,
Bia agus Mara
Department of Agriculture,
Food and the Marine

Marine Institute
Foras na Mara

Pauline O'Donohoe,
Marine Institute,
Rinville,
Oranmore
Co. Galway

26 June 2018

Cc: Michael Hough, Veterinary Inspector

Re: Fish Health Inspection: **FHA-595 – Marine Institute**
Lehanagh Pool, Bertraghboy Bay, Co. Galway

Dear Pauline,

A site inspection was carried out at the above referenced site on 15/06/2018 by Michael Hough, Veterinary Inspector, under the provisions of Council Directive 2006/88/EC and S.I. No 261 of 2008 (as amended).

In reference to this inspection, no follow up action is required based on the Veterinary Inspectors observations on the day.

Regards,

Bill Doré
Fish Health Unit Manager

An Roinn Talmhaíochta, Bia agus Mara
Department of Agriculture, Food and the Marine

Marine Institute
Foras na Mara

Pauline O'Donohoe

Marine Institute, Galway

Rinville

Oranmore

Galway

Date: 01 July 2019

CC: Michael Hough, Veterinary Inspector

Re: Fish Health Inspection: **FHA-000595: Marine Institute, Galway**

Lehanagh Pool, Bertraghboy Bay, Galway

Dear Pauline O'Donohoe

A site inspection was carried out at the above referenced site on 27 June 2019 by Michael Hough, Veterinary Inspector, under the provisions of Council Directive 2006/88/EC and S.I. No 261 of 2008 (as amended).

In reference to this inspection, no follow up action is required based on the Veterinary Inspectors observations on the day.

Should you have any queries on this matter, please contact the Fish Health office on 091 387 200 or by email to fishhealth@marine.ie

Regards,

Bill Doré

Fish Health Unit Manager

An Roinn Talmhaíochta, Bia agus Mara
Department of Agriculture, Food and the Marine

Marine Institute
Foras na Mara

Pauline O'Donohoe

Marine Institute, Galway

Rinville

Oranmore

Galway

Date: 31 August 2020

CC: Michael Hough, Veterinary Inspector | Neil Ruane, Marine Institute

Re: Fish Health Inspection: **FHA-000595: Marine Institute, Galway**

Lehanagh Pool, Bertraghboy Bay, Galway

Dear Pauline O'Donohoe

A site inspection was carried out at the above referenced site on 22 July 2020 by Michael Hough, Veterinary Inspector, under the provisions of Council Directive 2006/88/EC and S.I. No 261 of 2008 (as amended).

In reference to this inspection, no follow up action is required based on the Veterinary Inspectors observations on the day.

Should you have any queries on this matter, please contact the Fish Health office on 091 387 200 or by email to fishhealth@marine.ie

Regards,

Bill Doré

Fish Health Unit Manager

An Roinn Talmhaíochta, Bia agus Mara
Department of Agriculture, Food and the Marine

Foras na Mara
Marine Institute

Pauline O'Donoghue

Marine Institute, Galway (Lehanagh Pool Shellfish)

Rinville

Oranmore

Galway

Date: 13 October 2021

Inspection Type	Shellfish
FHA Number	FHA-000677
Reference Number	SHELL-2021-0127
Inspecting Officer	Michael Hough
Date of Inspection	16 August 2021

An inspection was carried out at the above Aquaculture Production Business on the above date and by the above named Veterinary Inspector, under the provisions of Council Directive 2006/88/EC and S.I. No 261 of 2008 (as amended). In reference to this inspection, no follow-up action is required based on the Veterinary Inspectors observations on the day.

Should you have queries regarding this letter please contact the Fish Health Unit office in writing or by telephone on 091 387200 or the Veterinary Inspector who carried out the Inspection.

Yours faithfully,

Authorised Officer: M. Wlo ..... **Date:** 05-11-21.

pp **(Michael Hough)**

Bill Doré (Fish Health Unit Manager)

Foras na Mara
Marine Institute

An Roinn Talmhaíochta,
Bia agus Mara
Department of Agriculture,
Food and the Marine

Pauline O'Donohoe

Marine Institute, Galway

Rinville

Oranmore

Co. Galway

Date: 30 September 2022

CC: Michael Hough, Veterinary Inspector

Re: Fish Health Inspection: **FHA-000595: Marine Institute, Galway**

Lehanagh Pool, Bertraghboy Bay, Co. Galway

Dear Pauline O'Donohoe

A site inspection was carried out at the above referenced site on 22 August 2022 by Michael Hough, Veterinary Inspector, under the provisions of Regulation (EU) 2016/429 and Article 14 of Regulation (EU) 2017/625.

In reference to this inspection, no follow up action is required based on the Veterinary Inspectors observations on the day.

Please note, in reference to the ranking of this aquaculture establishment under the national risk based surveillance scheme, the Marine Institute is undertaking a review of each establishment in accordance with the requirements as set out in Regulation (EU) 2016/429, the "Animal Health Law". We will be in touch to confirm your ranking once this process is complete for all establishments.

Should you have any queries on this matter, please contact the Fish Health office on 091 387 200 or by email to fishhealth@marine.ie

Regards,

Bill Doré

Fish Health Unit Manager

Foras na Mara
Marine Institute

An Roinn Talmhaíochta,
Bia agus Mara
Department of Agriculture,
Food and the Marine

Pauline,

Marine Institute, Galway (Lehanagh Pool Finfish)

Rinville

Oranmore

Galway

Date: 08 June 2023

Re: Fish Health Inspection: **FHA-000595 : Marine Institute, Galway (Lehanagh Pool Finfish)**

Lehanagh Pool, Lehanagh Pool, Bertraghboy Bay,Galway

Dear Pauline,

A site inspection was carried out at the above referenced site on 30/05/2023 11:00 by Marie Dodd, Veterinary Inspector, under the provisions of Regulation (EU) 2016/429 and Article 14 of Regulation (EU) 2017/625.

In reference to this inspection, no follow up action is required based on the Veterinary Inspectors observations on the day.

Should you have any queries on this matter, please contact the Fish Health office on 091 387 200 or by email to fishhealth@marine.ie

Regards,

Bill Doré

Fish Health Unit Manager

CC: Marie Dodd, Veterinary Inspector

FishVet Group

Pauline O'Donohoe & Jack D'Arcy
Marine Institute,
Rinville, Oranmore,
Co. Galway

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12th September 2018

HEALTH AND WELFARE MONITORING OF LUMPFISH STOCK IN LEHANAGH POOL SITE

The lumpfish stock at Lehanagh Pool was monitored from 26.06.18 to 24.07.18 to assess fish health and welfare. A series of macroscopic external and internal anatomical and pathological parameters were evaluated in order to determine their feasibility to estimate fish welfare. Samples for laboratory analyses (i.e. parasitology, histology, bacteriology, PCR) were also periodically taken to assess health condition and causes of mortality.

Parameters scored for the external examination

All following parameters, except length, weight and other lesions, were scored from 0 to 3 (0 = absent, 1 = mild, 2 = moderate, 3 = severe).

- Length (cm)
- Weight (g)
- Caudal fin erosion
- Dorsal and pectoral fin erosion
- Skin erosion
- Skin congestion
- Skin discolouration
- Sucker deformity
- Cataracts
- Other lesions

Parameters scored for the internal examination

- Liver colour (see scoring scale below)
- Stomach content (0 = not feeding, 1 = feeding)
- Gill condition
- Other lesions

Liver colour scores: 1 = 2 = 3 =  4 =  5 =  6 = 

Summary of findings

During the monitoring period, FishVet Group (FVG) carried out one site visit and four additional sampling points where fish were delivered to the FVG office for clinical evaluation and laboratory analyses.

Unfortunately, high sub-acute mortalities occurred during the sampling period, which limited the number of individuals examined and therefore the evaluation of the welfare scoring system. Despite this, the results and observations obtained, although preliminary, indicate the suitability of the parameters selected to monitor fish health and welfare. Further studies and samples would be required in order to develop a welfare scoring guide with pictures of the different parameters or lesions and grades of severity.

High water temperatures and low oxygen levels, considered to be due to heavy fouling of the pen's net, occurred during the sampling period.

The external/skin condition of the fish deteriorated during the sampling period, with eroded/ulcerated mouth lesions being the most prominent skin damage in the fish sampled. In the sampling point carried out on the onset of the mortality (3rd sampling, 13.07.18), almost all the fish examined showed such lesions in the mouth, with associated presence of filamentous bacteria in some fish. Necrotic patches on the gills and skin lesions on flanks with associated presence of filamentous bacteria were also occasionally observed. The filamentous bacteria observed are consistent with *Tenacibaculum* sp., and *T. maritimum* was detected by PCR in kidney samples. Three *Tenacibaculum* species have been described in lumpfish, *T. maritimum*, *T. dicentrarchi*, and *T. finnmarkense*. Although *Tenacibaculum* spp. can be primary pathogens, the appearance of the mouth/skin/gill lesions in this case are suggestive of zooplankton/jellyfish damage, with secondary colonisation/infection of the lesions with *Tenacibaculum* and *Vibrio* species.

Mild sucker deformity was only noted in two of the fish sampled, but fish showing more severe sucker deformities may have died before the start of the monitoring period (comment from the Marine Institute). Sucker deformity has been associated with poor welfare and low pen survival, but the extent of this in this case is unkown.

Neoparamoeba perurans, aetiological agent of amoebic gill disease (AGD), was detected from the second sampling point (11.07.18) onwards, but gross and histological AGD lesions were not observed until the last sampling point (24.07.18). A two weeks period between PCR detection and first gross AGD lesions is a normal observation in farmed Atlantic salmon.

The histopathology assessment revealed a significant granulomatous inflammation affecting the deeper layers of the flank muscle in 60% to 100% of the fish sampled (n=20). These lesions were observed in all sampling points, and are most likely related to the insertion of the tags. A chronic reaction around injection points is a common finding in vaccinated or tagged fish. Although the clinical effect of the described muscle lesions is unclear or difficult to quantify, the severity of the reaction observed in some individuals was most likely affecting the welfare and health status of the fish.

The histopathology assessment also revealed a systemic microsporidia infection in 20% (1st and 2nd sampling points), 66% (4th sampling point) and 14% (5th sampling point) of the fish examined. No histology samples were taken at the 3rd sampling point due to all fish submitted being mortalities. The microsporidia infection observed is consistent with *Tetramicra brevifilum*, and *T. brevifilum* has been previously described in lumpfish in Ireland. Although

the level of infection noted may not be sufficient to cause mortality on the affected fish, the infection did most likely have a negative impact on the welfare and health status of the fish.

A significant number of fish also showed some level of inflammation in the peri-pancreatic fat, liver and/or kidney. The cause/s of these pathological changes are unknown, but such lesions are not unusual findings on lumpfish histology screenings. Although significant at a microscopic level, the lesions in these organs are not considered clinically significant or a cause of morbidity/mortality.

The liver colour was scored as 4 (i.e. bright orange) in most fish, and this is considered the normal liver colouration in healthy lumpfish. A slightly paler colour was noted in some of the fish, but not enough samples were available to correlate colour variations with either body condition or health status. Most of the mortalities sampled on the 3rd sampling point had a liver colour of 3, but this is most likely due to post-mortem changes.

Most of the fish sampled were feeding and had feed pellets in their stomachs. At the start of the project, the amount of fat around the pyloric caeca and in the liver hepatocytes were considered as potential parameters to assess, both grossly and by histology, the body condition and health/welfare status. However, not enough variation was observed on the fish sampled to establish a scoring scale for the levels of fat storage.

To conclude, the sub-optimal and challenging environmental conditions (i.e. high water temperatures and low oxygen levels) and the zooplankton damage with associated *Tenacibaculum* infection occurred during the sampling period are considered the main causes of mortality and poor welfare in the lumpfish stock. The AGD, *T. brevifilum* infection, and muscle inflammation (due to tag insertion) detected are also believed to have had a significant impact on fish health and welfare, although they are not considered as primary/single causes of mortality at the level of severity observed.

Sampling points and results

Sampling point 1:

Site visit carried out on 26.06.18 (ref. 18/222a and 18/234a)

External examination: thirty fish were sub-sampled, anaesthetised and examined. Skin, fins and eyes appeared in very good condition, with only mild caudal fin erosion (non-active) and mild deformity of the fin rays noted in some fish. Low numbers of *Caligus* sp. were noted in some fish (average 0.56 *Caligus*/fish). Full data is provided at the end in Table 1.

Internal examination: ten fish were sampled for gross gill assessment and internal examination. Gills and internal organs appeared in very good condition, and no abnormalities were detected. All fish were feeding and had the stomach full of pellets. Liver colour was scored as 4 (i.e. bright orange) in all fish, but 2/10 fish (lower body condition fish or fish showing sucker deformity) showed a slightly paler liver colour (Fig.1). Full data is provided at the end in Table 2.

Laboratory analyses: five fish were sampled for fresh microscopy, histology, bacteriology and PCR analyses.

- *Fresh microscopy:* gill and skin scrapes were taken and examined under the light microscope. No bacteria, parasites or fungi were observed in any of the samples.

- *Bacteriology:* kidney swabs were inoculated into tryptone soya agar plus 2% NaCl (TSASA) and Columbia blood agar (CBA). No bacterial growth was obtained in any of the samples.
- *PCR:* gill swabs were taken and tested for *Neoparamoeba perurans*. All swabs were negative. Heart, kidney and spleen samples were fixed in RNAlater and stored at -20ºC for further testing if required.
- *Histology:* all organs were taken and fixed in 10% neutral buffered formalin (NBF). Results are as follows:
  - Fish 1 – Gills: single encysted metacercaria in gill filament and single large epitheliocystis-like cyst in lamella. GIT: marked depletion of peri-pancreatic adipose tissue levels. Liver: marked depletion of vacuolation of hepatocytes. No significant findings on the other organs (skin and skeletal muscle, heart, kidney and spleen).
  - Fish 2 – No significant findings on any of the organs examined (gills, skin and skeletal muscle, heart, GIT, liver, kidney and spleen).
  - Fish 3 – Skin and skeletal muscle: mild multifocal granulomatous inflammation in muscle and mild focal myocyte necrosis. GIT: moderate focal granulomatous inflammation in peri-pancreatic adipose tissue. No significant findings on the other organs (gills, heart, liver, kidney and spleen).
  - Fish 4 – Skin and skeletal muscle: moderate multifocal granulomatous inflammation in muscle and mild multifocal myocyte necrosis. GIT: mild multifocal granulomatous inflammation in peri-pancreatic adipose tissue. Liver: mild multifocal hepatitis. No significant findings on the other organs (gills, heart, kidney and spleen).
  - Fish 5 – Gills: mild multifocal lamellar epithelium hyperplasia, mild multifocal microsporidia xenomas in gill filaments, single encysted metacercaria in gill filament, and single large epitheliocystis-like cyst in lamella. Skin and skeletal muscle: moderate multifocal granulomatous inflammation and mild multifocal microsporidia xenomas in muscle. Liver: mild multifocal hepatitis. Kidney: single microsporidia xenoma in interstitium. No significant findings on the other organs (heart, GIT and spleen).

Summary: The lumpfish population appears in very good external condition and there are no indications of any welfare challenges at this stage. Parasitology, bacteriology and gill swabs screening were negative. The histopathology assessment revealed mild to moderate granulomatous inflammation in skeletal muscle and/or peri-pancreatic adipose tissue in 3/5 fish, a systemic microsporidia infection in 1/5 fish, and mild hepatitis in 2/5 fish. One fish also showed decreased fat levels in visceral fat and liver.

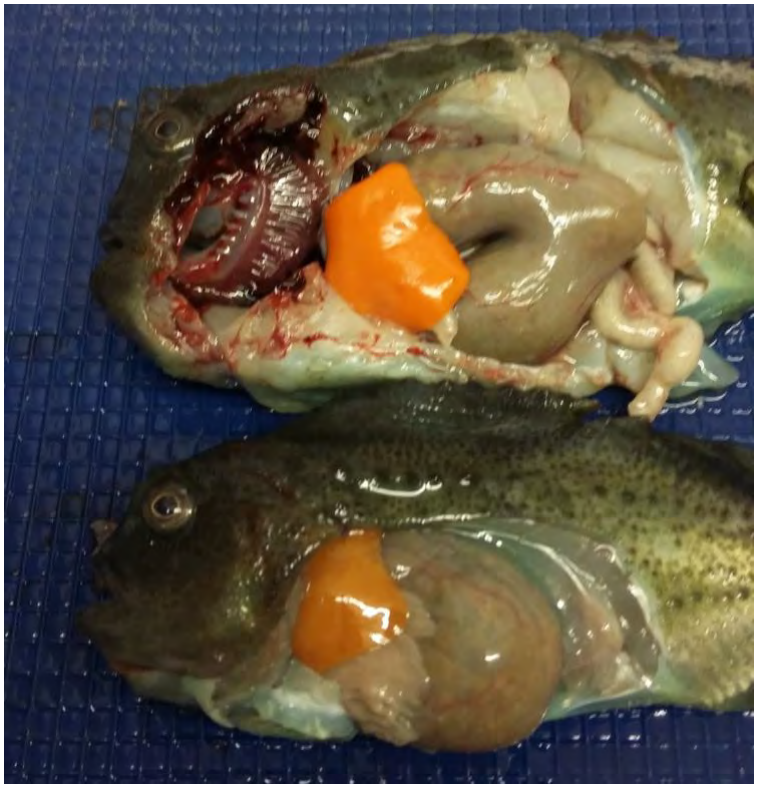

Figure 1: lumpfish showing bright orange liver colour (score 4, top fish) and slightly pale orange liver colour (score 4 pale, bottom fish).

Sampling point 2:

Fish sampled on 11.07.18 (ref. 18/245a). Five live fish submitted to the FVG office.

External examination: five fish were examined. Two fish showed eroded/ulcerated lesions in the mouth. Three fish had mild fin erosion, with one of the fish showing yellow discolouration in the eroded fin. No lesions were noted in the body skin and eyes appeared in good condition. Full data is provided at the end in Table 1.

Internal examination: five fish were sampled for gross gill assessment and internal examination. One fish had necrotic patches on the gills. No abnormalities were detected in gills or internal organs of the other fish. All fish were feeding and had pellets in the stomach. Liver colour was scored as 4 (i.e. bright orange) in all fish. Full data is provided at the end in Table 2.

Laboratory analyses: all fish were sampled for fresh microscopy, histology, bacteriology and PCR analyses.

- *Fresh microscopy:* gill and skin scrapes were taken and examined under the light microscope. Low numbers of *Trichodina* and sessile protozoa were observed on the gills of fish 1 and 3.
- *Bacteriology:* kidney swabs were inoculated into tryptone soya agar (TSA), tryptone soya agar plus 2% NaCl (TSASA), Columbia blood agar (CBA), marine agar (MA) and thiosulfate-citrate-bile salts-sucrose agar (TCBS). No bacterial growth was obtained in any of the samples.
- *PCR:* gill swabs were taken and tested for *Neoparamoeba perurans*. Four out of the five fish tested positive for *N. perurans*, with Ct values ranging from 35.0 to 39.1 (full results in Table 2). Heart, kidney and spleen samples were fixed in RNAlater and stored at -20ºC for further testing if required.

- *Histology:* all organs were taken and fixed in 10% neutral buffered formalin (NBF). Results are as follows:
  - Fish 1 – Gills: moderate multifocal lamellar necrosis and tissue sloughing with significant bacterial presence, including filamentous bacteria, in affected areas. Skin and skeletal muscle: mild multifocal inflammation in muscle of flank sample. Mouth lesion shows focally severe skin ulceration, with inflammation, necrosis and haemorrhage of underlying dermal and muscle tissues, and associated presence of high numbers of filamentous bacteria in exposed tissues. GIT: mild multifocal granulomatous inflammation in peri-pancreatic adipose tissue. Liver: slight depletion of fat/vacuolation, mild multifocal granulomas. No significant findings on the other organs (heart, kidney and spleen).
  - Fish 2 – Skin and skeletal muscle: moderate multifocal granulomatous inflammation in muscle (Fig. 2). Liver: mild multifocal hepatitis. GIT: mild multifocal granulomatous inflammation in peri-pancreatic adipose tissue. Kidney: mild multiple foci of inflammation and necrosis in interstitium. No significant findings on the other organs (gills, heart and spleen).
  - Fish 3 – Gills: low numbers of *Trichodina* between lamellae, two large epitheliocystis-like cyst in lamella. No significant findings on the other organs (skin and skeletal muscle, heart, GIT, liver, kidney and spleen).
  - Fish 4 – Gills: mild multifocal hyperplasia of the lamellar epithelium. GIT: mild multifocal granulomatous inflammation in peri-pancreatic adipose tissue. Liver: slight depletion of vacuolation of hepatocytes. No significant findings on the other organs (skin and skeletal muscle, heart, kidney and spleen).
  - Fish 5 – Gills: single large epitheliocystis-like cyst in lamella. Skin and skeletal muscle: moderate multifocal microsporidia xenomas and mild multifocal granulomatous inflammation in muscle. Heart; moderate multifocal endocarditis in spongy layer of ventricle, and mild multifocal presence of small microsporidia xenomas in lumen of ventricle. GIT: mild multifocal granulomatous inflammation and single microsporidia xenoma in peri-pancreatic adipose tissue. Liver: mild multifocal microsporidia xenomas in parenchyma. Kidney: single microsporidia xenoma in interstitium. Spleen: mild multifocal microsporidia xenomas in parenchyma.

Summary: Two fish showed eroded/ulcerated mouth lesions and one fish showed necrotic patches on the gills. Filamentous bacteria were observed on histology associated to the mouth and gills lesions. Parasitology showed low levels of *Trichodina* and sessile protozoa on the gills of two fish, but these are not considered clinically significant. PCR analysis detected *Neoparamoeba perurans* in 4/5 fish but at low levels (high Ct values). Bacteriology screening was negative. The histopathology assessment revealed mild to moderate granulomatous inflammation in skeletal muscle and/or peri-pancreatic adipose tissue in 4/5 fish, a systemic microsporidia infection in 1/5 fish, and mild hepatitis in 2/5 fish. Two fish also showed decreased fat levels in liver.

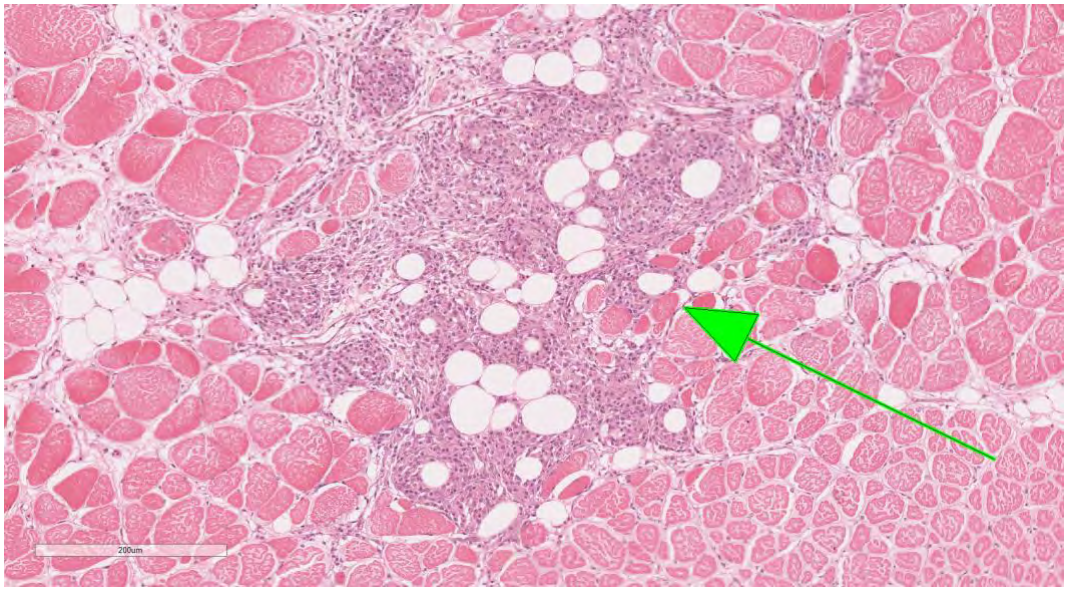

Figure 2: moderate granulomatous inflammation (arrow) in flank skeletal muscle.

Sampling point 3:

Fish sampled on 13.07.18 (ref. 18/248a). Thirty dead fish submitted to the FVG office.

External examination: 29 out of the 30 fish submitted showed eroded/ulcerated/haemorrhagic lesions in the mouth (Fig.3). Ten of the fish were further examined and scored. Besides the mouth lesions, most fish also showed mild fin erosion and one fish showed a mild sucker deformity. Full data is provided at the end in Table 1.

Internal examination: ten fish were sampled for gross gill assessment and internal examination. The gill condition could not be assessed due to post-mortem/autolytic changes. Liver colour was scored as 3 (i.e. pale yellow-orange colour) in all fish except one, but the colour change could be post-mortem. Two out of the ten fish were not feeding. Full data is provided at the end in Table 2.

Laboratory analyses: five fish were sampled for fresh microscopy and PCR analyses. Ten fish were sampled for bacteriology.

- *Fresh microscopy:* gill and skin scrapes were taken and examined under the light microscope. Suspected amoebae parasites were observed on the gills, but the severe autolytic changes compromised the parasitology assessment.
- *Bacteriology:* kidney swabs were inoculated into tryptone soya agar (TSA), tryptone soya agar plus 2% NaCl (TSASA), Columbia blood agar (CBA), marine agar (MA) and thiosulfate-citrate-bile salts-sucrose agar (TCBS). Skin and/or mouth swabs from five additional fish were inoculated into MA. The following bacteria were identified from kidney swabs: *Vibrio splendidus*-clade, *Vibrio ichthyoenteri* and *Photobacterium piscicola*.
- *PCR:* gill swabs were taken and tested for *Neoparamoeba perurans*. Three out of the five fish tested positive for *N. perurans*, with Ct values ranging from 35.9 to 38.9 (full results in Table 2). Heart, kidney and spleen samples were fixed in RNAlater. Kidney samples were tested for *Tenacibaculum maritimum*, and all samples tested positive with Ct values ranging from 24.8 to 30.9 (full results in Table 2). Heart and spleen samples were stored at -20ºC for further testing if required.
- *Histology:* no histology samples were taken since no accurate histopathology assessment can be done on dead fish.

Summary: 29/30 fish showed eroded/ulcerated mouth lesions. All fish submitted were dead, so no macroscopic assessment of gills or histology could be undertaken. PCR testing detected *Neoparamoeba perurans* in gills of 3/5 fish (low levels, high Ct values), and *Tenacibaculum maritimum* in kidney of all fish (low to moderate levels, medium to high Ct values). The bacterial species identified by the bacteriology/culture screening are not considered primary disease agents, and their role on the health status of the fish sampled is unclear.

Figure 3: severe mouth lesion in dead fish.

Sampling point 4:

Fish sampled on 18.07.18 (ref. 18/253a). Three live fish submitted to the FVG office.

External examination: three fish were examined. One fish showed an eroded/ulcerated lesion in the mouth and moderate corneal oedema in one eye. Another fish showed an eroded skin lesion in the flank. All three fish showed mild caudal fin erosion. Full data is provided at the end in Table 1.

Internal examination: three fish were sampled for gross gill assessment and internal examination. No abnormalities were detected in gills or internal organs. All fish were feeding and had the stomach full of pellets. Liver colour was scored as 4 (i.e. bright orange) in all fish, but 1/3 fish showed a slightly paler colour. Full data is provided at the end in Table 2.

Laboratory analyses: three fish were sampled for fresh microscopy, histology, bacteriology and PCR analyses.

- *Fresh microscopy:* gill and skin scrapes were taken and examined under the light microscope. Filamentous bacteria and motile rods were observed in the scrape taken from the skin lesion on fish 3.
- *Bacteriology:* kidney swabs were inoculated into tryptone soya agar plus 2% NaCl (TSASA), marine agar (MA) and thiosulfate-citrate-bile salts-sucrose agar (TCBS). No bacterial growth was obtained in any of the samples.
- *PCR:* gill swabs and heart, kidney and spleen samples fixed in RNAlater were taken and stored at -20ºC for further testing if required.

- *Histology:*

- Fish 1 – Gills: mild multifocal microsporidia xenomas in gill filaments and gill arch (Fig.4). Skin and skeletal muscle: moderate multifocal microsporidia xenomas, and moderate multifocal granulomatous inflammation, necrosis and fibrosis in muscle of flank sample (Fig. 5). Focally severe skin ulceration and dermal inflammation and necrosis in mouth lesion. GIT: mild multifocal presence of microsporidia xenomas in peri-pancreatic adipose tissue and in muscular layer of intestine. Kidney: mild multifocal granulomatous inflammation in interstitium. Spleen: single microsporidia xenoma in parenchyma. No significant findings on the other organs (heart and liver).
- Fish 2 – Gills: moderate multifocal lamellar haemorrhages. Skin and skeletal muscle: moderate multifocal granulomatous inflammation, necrosis and fibrosis in muscle of flank sample. GIT: mild multifocal granulomatous inflammation in peri-pancreatic adipose tissue. Eye: mild multifocal microsporidia xenomas in muscle behind the eye. No significant findings on the other organs (heart, liver, kidney and spleen).
- Fish 3 – Skin and skeletal muscle: moderate multifocal granulomatous inflammation, necrosis and fibrosis in muscle flank sample. Lesion sample shows skin ulceration, moderate dermal inflammation and low numbers of bacteria in exposed dermis. Fin sample shows focally severe ulceration and haemorrhage/inflammation of dermis with numerous bacteria (rods and filamentous) in exposed tissues (Fig. 6). GIT: mild multifocal granulomatous inflammation in peri-pancreatic adipose tissue. Liver: mild multifocal hepatitis. Kidney: mild focal inflammation/necrosis in interstitium. No significant findings on the other organs (gills, heart and spleen).

Summary: One fish showed an eroded/ulcerated mouth lesion and one fish had an eroded lesion in flank. Filamentous bacteria were observed in association with the lesions on histology and fresh scrapes. Bacteriology screening was negative. The histopathology assessment revealed mild to moderate granulomatous inflammation in skeletal muscle and/or peri-pancreatic adipose tissue in 3/3 fish, a systemic microsporidia infection in 2/3 fish, and mild hepatitis in 1/3 fish.

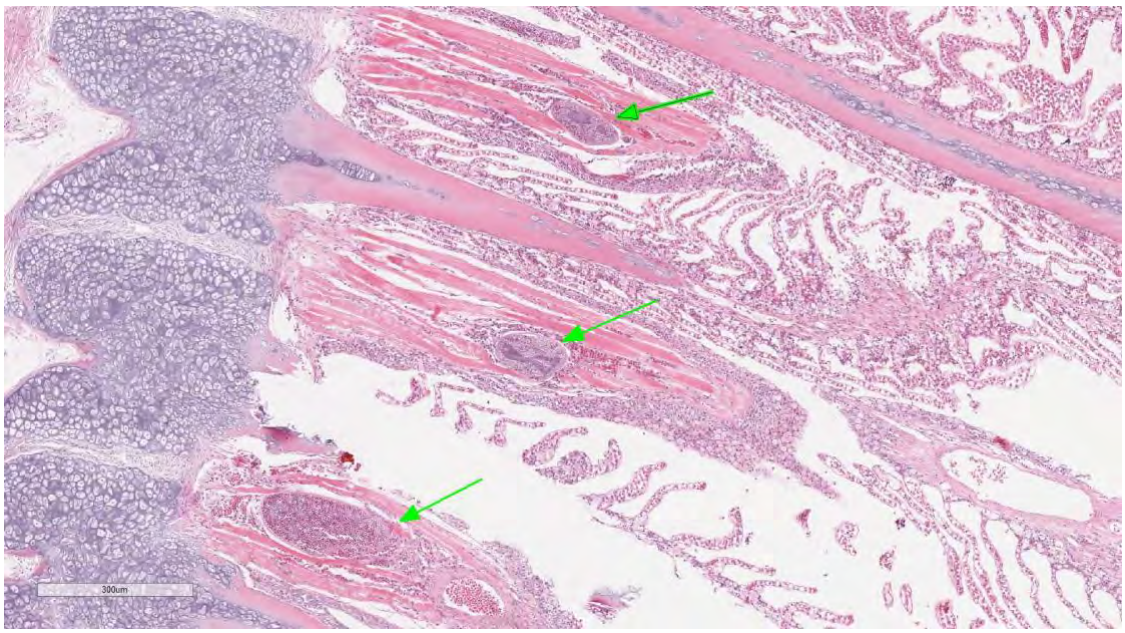

Figure 4: microsporidia xenomas (arrows) in gill filaments.

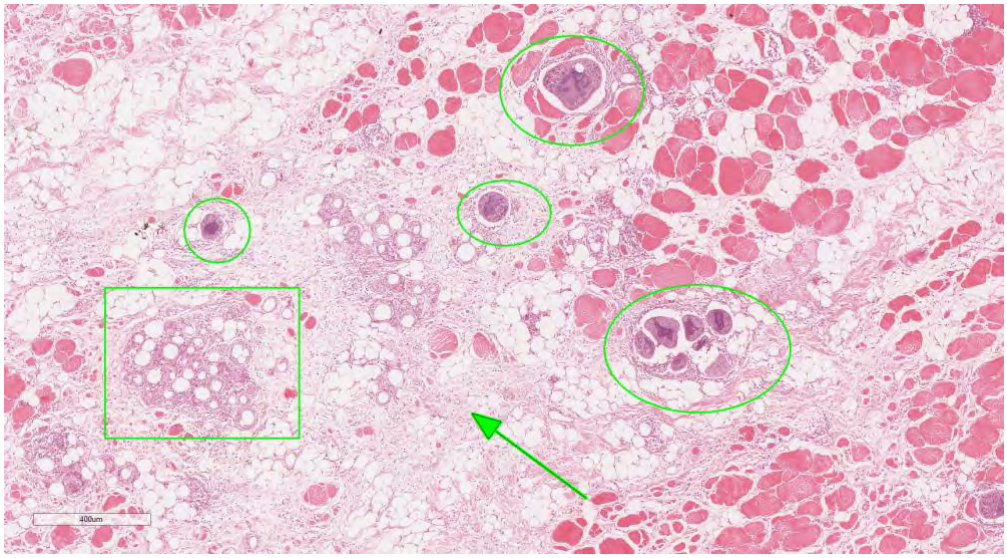

Figure 5: moderate multifocal microsporidia xenomas (circles), moderate multifocal granulomatous inflammation (square), and loss of muscle bundles and fibrosis (arrow) in flank muscle.

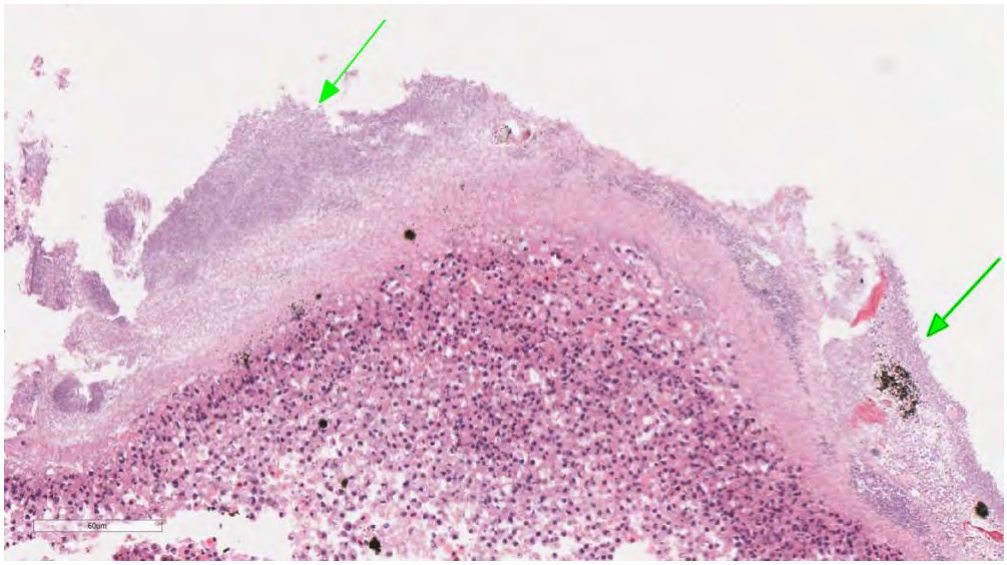

Figure 6: fin lesion with large numbers of filamentous bacteria (arrows) in exposed dermis.

Sampling point 5:

Fish sampled on 24.07.18 (ref. 18/267a). Twelve live fish submitted to the FVG office.

External examination: twelve fish were examined. One fish showed an haemorrhagic and ulcerated lesion in the mouth. One fish showed severe erosion and haemorrhage in one pectoral fin. Full data is provided at the end in Table 1.

Internal examination: twelve fish were sampled for gross gill assessment and internal examination. Seven fish showed mild to moderate white patches on the gills consistent with AGD lesions (Fig. 7). One fish showed small cysts on the liver. Two fish were not feeding and had the stomach full of liquid. Liver colour was scored as 4 (i.e. bright orange) in all fish, but 3/12 fish showed a slightly paler colour. Full data is provided at the end in Table 2.

Laboratory analyses: five fish were sampled for fresh microscopy, bacteriology and PCR analyses. Seven fish were sampled for histology.

- *Fresh microscopy:* gill and skin scrapes were taken and examined under the light microscope. Low to moderate numbers of amoebae were observed on gills of three fish. Low

numbers of *Trichodina*, sessile protozoa and/or *Ichthyobodo* were present on gills of most fish.

- *Bacteriology:* kidney swabs were inoculated into tryptone soya agar plus 2% NaCl (TSASA), marine agar (MA) and Columbia blood agar (CBA). No bacterial growth was obtained in any of the samples.
- *PCR:* gill swabs and heart, kidney and spleen samples fixed in RNAlater were taken and stored at -20ºC for further testing if required.
- *Histology:*

- Fish 1 – Gills: moderate multifocal AGD pathology with low numbers of amoebae present, and mild multifocal microsporidia xenomas in gill filaments. Skin and skeletal muscle: sample not present. Heart: mild multifocal microsporidia xenomas in spongy layer of ventricle. GIT: mild to moderate microsporidia xenomas in peri-pancreatic adipose tissue and gastric mucosa, and moderate multifocal granulomatous inflammation in peri-pancreatic adipose tissue. Liver: moderate multifocal microsporidia xenomas in parenchyma, and mild multifocal hepatitis. Kidney: mild multifocal microsporidia xenomas in interstitium. Spleen: moderate multifocal microsporidia xenomas in parenchyma.
- Fish 2 – Gills: mild multifocal AGD pathology with low numbers of amoebae present. Skin and skeletal muscle: moderate multifocal inflammation in white muscle. Heart: sample not present. Liver: moderate multifocal hepatitis with mild presence of necrotic cells and fibrin deposits within the inflammatory foci. No significant findings on the other organs (GIT, kidney and spleen).
- Fish 3 – Gills: mild multifocal lamellar haemorrhages and epithelial hyperplasia. Mild focal AGD pathology but no amoebae observed. Skin and skeletal muscle: mild multifocal inflammation in white muscle. GIT: mild multifocal granulomatous inflammation in peri-pancreatic adipose tissue. Kidney: moderate focal interstitial oedema and infiltration of inflammatory cells around collecting ducts. No significant findings on the other organs (heart, liver, spleen and brain).
- Fish 4 – Gills: moderate multifocal granulomatous inflammation in gill arch, and mild multifocal lamellar epithelium hyperplasia and fusion. Skin and skeletal muscle: moderate multifocal granulomatous inflammation with associated myocyte necrosis in white muscle. GIT: mild multifocal granulomatous inflammation in peri-pancreatic adipose tissue. Kidney: sample not present. No significant findings on the other organs (heart, liver, spleen and brain).
- Fish 5 – Gills: moderate focal AGD pathology with moderate numbers of amoebae present (Fig. 8), mild multifocal lamellar epithelium hyperplasia, and mild multifocal large epitheliocystis-like cysts in lamellae. GIT: mild multifocal granulomatous inflammation in peri-pancreatic adipose tissue. No significant findings on the other organs (skin and skeletal muscle, heart, liver, kidney, spleen and brain).
- Fish 6 – Gills: mild multifocal lamellar fusions, haemorrhages and branchitis, mild multifocal large epitheliocystis-like cysts in lamellae, single encysted metacercaria in gill filament, and very low numbers of *Trichodina*. Skin and skeletal muscle: mild focal inflammation in white muscle of flank sample. Mouth lesion shows focally severe ulceration, dermal inflammation and necrosis, and low numbers of mixed bacteria (including filamentous bacteria) in exposed tissues (Fig. 9). GIT: mild multifocal granulomatous inflammation in peri-pancreatic adipose tissue. Liver: mild multifocal hepatitis. No significant findings on the other organs (heart, kidney, spleen and brain).

- Fish 7 – Skin and skeletal muscle: mild multifocal granulomatous inflammation and myocyte necrosis in white muscle. Heart: sample not present. GIT: mild multifocal granulomatous inflammation in peri-pancreatic adipose tissue. No significant findings on the other organs (gills, liver, kidney and spleen).

Summary: One fish showed an eroded/ulcerated mouth lesion, and filamentous bacteria were observed in association with the lesion on histology. Bacteriology screening was negative. Mild to moderate AGD lesions and presence of amoebae were observed macroscopically and by histology in around half of the fish. The histopathology assessment revealed mild to moderate granulomatous inflammation in skeletal muscle and/or peri-pancreatic adipose tissue in 6/7 fish, a systemic microsporidia infection in 1/7 fish, and mild hepatitis in 3/7 fish.

Figure 7: AGD lesion (white mucous patch) in gills.

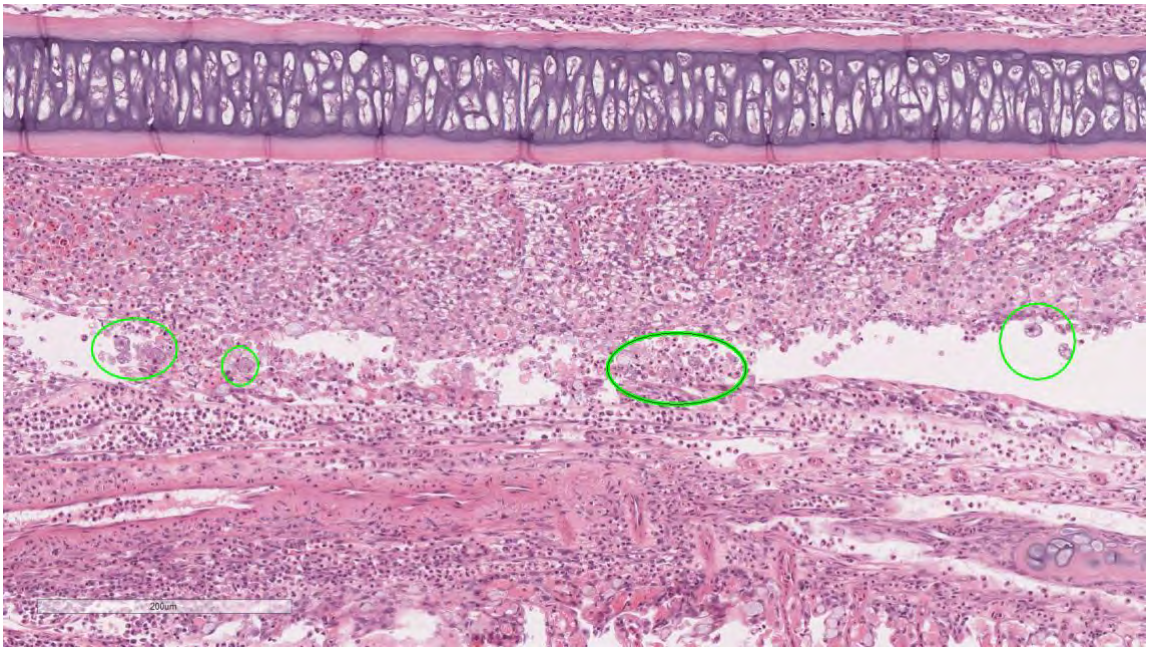

Figure 8: AGD lesion with moderate numbers of amoebae (circles) present.

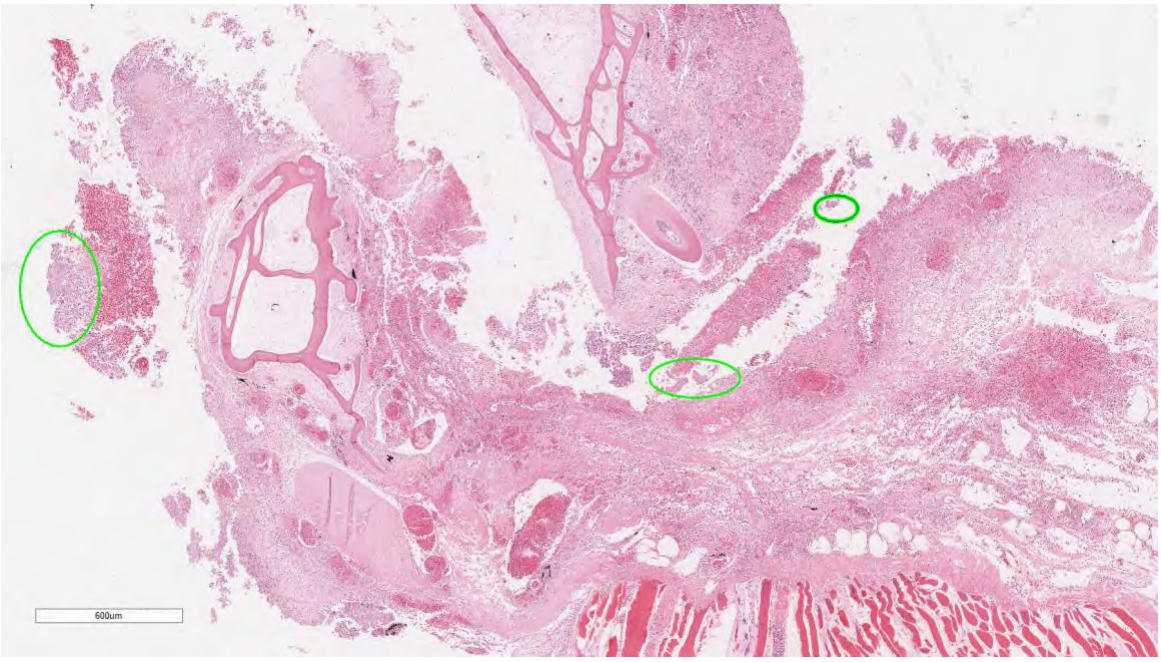

Figure 9: mouth lesion showing focally severe ulceration, dermal inflammation and haemorrhage, and bacterial aggregates in exposed tissues (circles).

Table 1: scoring results for external examination.

Fish	Length (cm)	Weight (g)	Caudal fin erosion	Dorsal and pectoral fin erosion	Skin erosion	Skin congestion	Skin discoloration	Sucker deformity	Cataracts	Other lesions
Date: 26.06.18 (ref. 18/222a and 18/234a)										
1	13.9	85	1	0	0	0	0	0	0	No
2	17.8	208	1	0	0	0	0	0	0	No
3	15.2	106	1	0	0	0	0	0	0	No
4	14.8	105	1	0	0	0	0	0	0	No
5	14.5	90	1	0	0	0	0	0	0	No
6	14.2	106	1	0	0	0	0	0	0	No
7	15.0	106	1	0	0	0	0	0	0	No
8	14.0	80	1	0	0	0	0	0	0	No
9	12.4	64	1	0	0	0	0	0	0	No
10	14.8	90	0	0	0	0	0	0	0	No
11	14.9	100	1	0	0	0	0	0	0	Mild deformity of caudal fin rays
12	13.8	65	0	0	0	0	0	0	0	No
13	16.3	184	0	0	0	0	0	0	0	No
14	15.2	114	1	0	0	0	0	0	0	No
15	14.9	112	1	0	0	0	0	0	0	No
16	14.4	92	0	0	0	0	0	0	0	No
17	14.7	93	1	0	0	0	0	0	0	No
18	13.9	84	1	0	0	0	0	0	0	No
19	15.9	118	0	0	0	0	0	0	0	No
20	15.7	112	0	0	0	0	0	0	0	No
21	14.3	84	1	0	0	0	0	0	0	No
22	14.5	130	0	0	0	0	0	0	0	No
23	15.1	110	1	1	1	1	1	1	1	Opercular deformity
24	14.7	87	1	0	0	0	0	0	0	Mild deformity of caudal fin rays
25	15.9	126	1	0	0	0	0	0	0	Mild deformity of caudal fin rays
26	14.9	92	1	0	0	0	0	0	0	Mild deformity of dorsal fin rays
27	15.0	128	1	0	0	0	0	0	0	Mild deformity of caudal fin rays
28	14.1	84	1	0	0	0	0	0	0	Mild deformity of caudal/pectoral fin rays
29	12.6	55	1	0	0	0	0	0	0	No
30	13.2	68	1	0	0	0	0	0	0	Mild deformity of caudal/dorsal fin rays
Date: 11.07.18 (ref. 18/245a)										
1	13.0	71	1	1	1 (*)	0	0	0	0	(*) Eroded/ulcerated lesion in mouth
2	14.0	100	1	0	0	0	0	0	0	No
3	14.0	92	0	1	0	0	0	0	0	Yellow discoloration in eroded fin
4	15.5	124	0	0	0	0	0	0	0	No
5	16.0	127	0	0	1 (*)	0	0	0	0	(*) Eroded/ulcerated lesion in mouth

Table 1 (continuation): scoring results for external examination.

Fish	Length (cm)	Weight (g)	Caudal fin erosion	Dorsal and pectoral fin erosion	Skin erosion	Skin congestion	Skin discoloration	Sucker deformity	Cataracts	Other lesions
Date: 13.07.18 (ref. 18/248a)										
1	14.0	93	1	1	1 (*)	1	0	0	0	(*) Eroded/ulcerated lesion in mouth
2	13.0	62	1	1	2 (*)	0	0	0	0	(*) Eroded/ulcerated lesion in snout
3	13.5	75	1	0	3 (*)	0	0	0	0	(*) Eroded/ulcerated lesion in mouth
4	15.5	115	1	1	3 (*)	0	0	1	0	(*) Eroded/ulcerated lesion in mouth
5	14.4	83	1	1	0	0	0	0	0	No
6	15.4	109	1	0	1 (*)	0	0	0	0	(*) Eroded/ulcerated lesion in mouth
7	14.4	75	1	2	2 (*)	0	0	0	0	(*) Eroded/ulcerated lesion in mouth
8	14.5	98	1	0	1 (*)	0	0	0	0	(*) Eroded/ulcerated lesion in mouth
9	15.6	100	1	0	2 (*)	0	0	0	0	(*) Eroded/ulcerated lesion in mouth
10	13.9	70	0	0	2 (*)	0	0	0	0	(*) Eroded/ulcerated lesion in mouth
Date: 18.07.18 (ref. 18/253a)										
1	14.4	85	1	0	1 (*)	0	0	0	0	Moderate corneal oedema (*) Eroded/ulcerated lesion in mouth
2	14.5	108	1	0	0	0	0	0	0	No
3	13.8	97	1	0	1 (*)	0	0	0	0	(*) Eroded lesion in flank
Date: 24.07.18 (ref. 18/267a)										
1	14.5	98	0	0	0	0	0	0	0	Very mild deformity dorsal fin
2	15.0	81	0	3	0	0	0	0	0	Severe erosion and haemorrhage in pectoral fin
3	12.2	70	0	0	0	0	0	0	0	No
4	15.8	125	0	1	0	0	0	0	0	No
5	15.0	107	0	1	0	1	0	0	0	Unilateral congestion in pectoral fin
6	16.2	110	0	0	3 (*)	0	0	0	0	(*) Haemorrhagic/ulcerated lesion in mouth
7	15.2	106	0	0	0	0	0	0	0	No
8	16.0	123	0	0	0	0	0	0	0	Mild deformity of opercula
9	16.8	179	0	0	0	0	0	0	0	No
10	15.9	111	0	0	0	0	0	0	0	No
11	16.0	113	0	0	0	0	0	0	0	No
12	15.1	105	0	0	0	0	0	0	0	No

Table 2: scoring results for gill assessment, internal examination and laboratory samples analysed.

Fish	Internal examination				Laboratory samples taken				
	Gills	**Liver**	**Stomach content**	**Other lesions**	**Fresh scrapes gill and skin**	**Bacteriology**	**Histology**	**Gill swab *N. perurans* PCR (Ct value)**	**PCR H+K+S[(1)]**
Date: 26.06.18 (ref. 18/222a and 18/234a)									
1	No lesions	4	1 (full pellets)	No	Negative	Negative	Results in report	Negative	Storage -20ºC
2	No lesions	4	1 (full pellets)	No	Negative	Negative	Results in report	Negative	Storage -20ºC
3	No lesions	4	1 (full pellets)	No	Negative	Negative	Results in report	Negative	Storage -20ºC
4	No lesions	4 pale	1 (full pellets)	No	Negative	Negative	Results in report	Negative	Storage -20ºC
5	No lesions	4	1 (full pellets)	No	Negative	Negative	Results in report	Negative	Storage -20ºC
6	No lesions	4	1 (full pellets)	No	n/a	n/a	n/a	n/a	n/a
7	No lesions	4 pale	1 (full pellets)	No	n/a	n/a	n/a	n/a	n/a
8	No lesions	4	1 (full pellets)	White casts/liquid in intestine	n/a	n/a	n/a	n/a	n/a
9	No lesions	4	1 (full pellets)	No	n/a	n/a	n/a	n/a	n/a
10	No lesions	4	1 (full pellets)	No	n/a	n/a	n/a	n/a	n/a
Date: 11.07.18 (ref. 18/245a)									
1	Moderate multifocal necrotic patches	4	1 (liquid and pellets)	No	*Trichodina* and sessile protozoa	Negative	Results in report	38.1	Storage -20ºC
2	No lesions	4	1 (full pellets)	No	Negative	Negative	Results in report	Negative	Storage -20ºC
3	No lesions	4	1 (full pellets)	No	*Trichodina* and sessile protozoa	Negative	Results in report	35.0	Storage -20ºC
4	No lesions	4	1 (full pellets)	No	Negative	Negative	Results in report	37.4	Storage -20ºC
5	No lesions	4	1 (full pellets)	No	Negative	Negative	Results in report	39.1	Storage -20ºC
Date: 13.07.18 (ref. 18/248a)									
1	Not assessable - mort	3	1 (feeding)	No	Suspected amoebae but autolytic changes	Results in report	Not taken - mort	Negative	24.8[(2)]
2	Not assessable - mort	3	1 (feeding)	No	As above (fish 1)	Results in report	Not taken - mort	37.9	29.3[(2)]
3	Not assessable - mort	3	1 (feeding)	No	As above (fish 1)	Results in report	Not taken - mort	38.9	26.7[(2)]
4	Not assessable - mort	3	0 (not feeding)	No	As above (fish 1)	Results in report	Not taken - mort	35.9	27.6[(2)]
5	Not assessable - mort	3	0 (not feeding)	No	As above (fish 1)	Results in report	Not taken - mort	Negative	30.9[(2)]
6	Not assessable - mort	3	1 (feeding)	No	n/a	Results in report	Not taken - mort	n/a	n/a
7	Not assessable - mort	3	1 (feeding)	No	n/a	Results in report	Not taken - mort	n/a	n/a
8	Not assessable - mort	4	1 (feeding)	No	n/a	Results in report	Not taken - mort	n/a	n/a
9	Not assessable - mort	3	1 (feeding)	No	n/a	Results in report	Not taken - mort	n/a	n/a
10	Not assessable - mort	3	1 (feeding)	No	n/a	Results in report	Not taken - mort	n/a	n/a

(1) H = heart; K = kidney, S = spleen

(2) Ct values for *Tenacibaculum maritimum* PCR from kidney samples

Table 2 (continuation): scoring results for gill assessment, internal examination and laboratory samples analysed.

Fish	Internal examination				Laboratory samples taken				
	Gills	**Liver**	**Stomach content**	**Other lesions**	**Fresh scrapes gills and skin**	**Bacteriology**	**Histology**	**Gill swab *N. perurans* PCR (Ct value)**	**PCR H+K+S[(1)]**
Date: 18.07.18 (ref. 18/253a)									
1	No lesions	4	1 (full pellets)	No	Negative	Negative	Results in report	Storage -20ºC	Storage -20ºC
2	No lesions	4	1 (full pellets)	No	Negative	Negative	Results in report	Storage -20ºC	Storage -20ºC
3	No lesions	4 pale	1 (full pellets)	No	Filamentous bacteria and motile rods in skin lesion	Negative	Results in report	Storage -20ºC	Storage -20ºC
Date: 24.07.18 (ref. 18/267a)									
1	Moderate AGD	4	0 (not feeding, liquid in stomach)	Slightly enlarged kidney and spleen	Moderate amoebae. Mild *Trichodina*	Negative	Results in report	Storage -20ºC	Storage -20ºC
2	Mild AGD	4 pale	0 (not feeding, liquid in stomach)	No	Mild amoebae. Mild *Trichodina* and *Ichthyobodo*	Negative	Results in report	Storage -20ºC	Storage -20ºC
3	Mild AGD	4 pale	1 (full pellets)	No	Mild amoebae. Mild *Trichodina* and sessile protozoa	Negative	Results in report	Storage -20ºC	Storage -20ºC
4	No lesions	4	1 (full pellets)	No	Mild *Trichodina*	Negative	Results in report	Storage -20ºC	Storage -20ºC
5	No lesions	4	1 (full pellets)	Mild scaring on liver	Negative	Negative	Results in report	Storage -20ºC	Storage -20ºC
6	Moderate AGD	4 pale	1 (full marine organisms)	Small cysts on liver	n/a	n/a	Results in report	n/a	n/a
7	No lesions	4	1 (full pellets)	No	n/a	n/a	Results in report	n/a	n/a
8	Mild AGD, pale tips	4	1 (full pellets)	No	n/a	n/a	n/a	n/a	n/a
9	Mild AGD	4	1 (full pellets)	No	n/a	n/a	n/a	n/a	n/a
10	Mild AGD, pale tips	4	1 (full pellets)	No	n/a	n/a	n/a	n/a	n/a
11	No lesions	4	1 (full pellets)	No	n/a	n/a	n/a	n/a	n/a
12	No lesions	4	1 (full pellets)	No	n/a	n/a	n/a	n/a	n/a

[(1)] H = heart; K = kidney, S = spleen

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Mr. Alan Drumm,
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Date: 22.8.2019

VETERINARY HEALTH REPORT

Ref. no.: 19/176a
Site: Lehanagh Pool

The site was visited on the 24.7.19 to assess the general health status of Atlantic salmon. Elevated mortality, lethargic fish and casts were reported. Samples were taken for histology, microscopy, serology and chloride analysis. Findings as follows.

Pen 1 (Burrishoole stock)

Clinical examination: a subpopulation of fish was schooling at the side of the nets and could be caught without feed. 14 of these were examined. Average body condition was poor. Amoebic gill disease (AGD) like pathology was present (average gill score 2.3, highest score 4). Further gill pathology in the form of single necrotic filaments and eroded tips was present at a very low level. Most fish had no feed and casts in the hind guts, mild to moderate scale loss and overall mild fin erosion were present. 15 fish were caught with feed in the centre of the cages. Average AGD score in these was 3.3, highest score was 4. All fish had casts in the hind gut. Body, skin and fin condition was better than fish caught without feed. *Caligus* and *Lepeophtheirus salmonis* were present at low levels. **Necropsy:** 10 fish examined. Visceral fat levels were low, most fish had not been feeding and had casts in the hind gut. No further abnormalities seen.

Sentinel cage 1 (Burrishoole stock and Fanad stock)

Clinical examination: 12 fish were caught for clinical examination. AGD like pathology was present (average score 1.5, highest score 3). Fish were in better body condition than those in pen 1, though one fish showed moderate focal scale loss associated with petechial haemorrhaging and one fish was notably smaller and in poorer condition than others. Mild scale loss and fin erosion were present. **Necropsy:** 4 fish examined. No abnormal findings.

Histology: 3 fish sampled in pen 1.

Fish 1 (caught without feed) – Gills: moderate multifocal AGD, mild epitheliocystis, mild focal proliferation of basal lamellae, chloride cells present on lamellae, mild diffuse pathology consistent with waterborne irritation. Heart: mild focal pericarditis. Liver: mild single cell necrosis. No further abnormalities.
Fish 2 (caught without feed) – Gills: moderate to severe AGD, mild diffuse pathology consistent with waterborne irritation. Muscle: mild focal fibrosis in red muscle. Liver: mild focal necrosis. Heart: mild focal inflammation in spongiform myocardium. No further abnormalities.
Fish 3 (caught with feed) – Gills: severe AGD, mild diffuse pathology consistent with waterborne irritation. Kidney: high levels of melanin. No further abnormalities.

Chloride analysis: 10 fish were sampled in pen 1.

	fish caught without feed at the side	fish caught with feed
Individual values	172, 182, 185, 235, 150	166,159, 161, 160, 150
Average	184.5	159.2

Serology: 10 fish from pen 1 were tested for SAV viremia and antibodies. All samples tested negative.

Parasitology*:* skin and gill scrapes were taken from 3 fish from pen 1. Moderate to high levels of amoeba were present on AGD like lesions. No further significant findings.

Interpretation of findings:

- Severe amoebic gill disease was present and is considered the likely cause of elevated mortalities. Mild gill pathology consistent with waterborne insult was additionally seen on histopathology. Epitheliocystis seen on fish 1 is considered an incidental finding.
- Heart and muscle pathology seen on histopathology was unspecific and not considered clinically significant. Casts are likely due to fish being starved or not feeding. Mild liver pathology seen is likely secondary, caused by gill pathology.
- There was no indication of past or present salmonid alphavirus infection on serology.
- Chloride levels in all fish tested were considered abnormally high and levels in fish caught without feed at the side of the net appear to be higher than those in random fish caught with feed. This indicates osmoregulatory difficulties, as can occur with failed smoltification for example. However, this conclusion cannot be drawn as AGD can also cause increased plasma chloride levels in salmon (e.g. Hvas et al. 2017) and all fish tested had clinical AGD.
- Fish in the sentinel cage (Fanad and Burrishoole stock) appeared to be in better condition than fish in pen 1, though the cage environment may be a factor as well as genetics.

Felix Scholz, DVM PhD

Samples processed for case 19/176a

Histology	6 slides

Serology SAV antibodies and virology	10
Chloride analysis	10

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Date: 12/03/2020

VETERINARY HEALTH REPORT

Ref. no.: 20/012a
Site: Lehanagh Pool

The site was visited on the 5.2.2020 to assess the general health status of Atlantic salmon and lumpfish on site (pen standard 1). Elevated mortality associated with external lesions was reported in salmon. Samples were taken for histology, bacteriology, qPCR, microscopy and serology. Findings as follows.

Salmon

Clinical examination: 16 fish were caught with feed and fins, skin, gills and eyes examined for signs of disease. Gills were in good overall condition, mild focal pale discolouration was present on the gills of low numbers of fish (sampled for qPCR and histology). Two fish presented with a small ulcerative lesion on the flank. Mild scale loss and fin erosion were present. Lethargic fish with severe ulcerative lesions around the dorsal fin were present. 3 were caught for examination, all showed moderate to severe active fin erosion. **Necropsy:** fish with lesions showed petechial haemorrhaging in peripancreatic fat (4/4) and ecchymotic haemorrhaging in the liver (1/4). No significant findings in 3 randomly sampled fish.

Histology: 3 fish sampled in pen 1.
Fish 1 – Gills: focal areas of moderate hyperplasia on occasional gill filaments and mild multifocal lamellar tip fusion with lacunae formation. Skin Lesion: loss of normal epithelium and scales, widespread inflammation and fibrosis with scattered degenerating and necrotic cells throughout the dermis. Small pockets of bacteria observed on the surface of the lesion. No significant findings in any of the other organs sampled.
Fish 2 – Spleen: depletion of white pulp and focal areas with necrotic cells, pigment and melanin deposition (most likely reactive changes due to the skin lesion). Skin lesion: loss of epithelium and extensive mats of bacteria (*Tenacibaculum* – like) extending down into the red muscle tissue. Inflammation was observed in the

muscle but very little reactive change was observed in the more superficial skin layers. No significant findings in any of the other organs sampled.

Fish 3 – Gills: small focal areas of sloughing, telangiectesis and necrosis were observed. Heart: extensive severe epicarditis with inflammatory cells, fibrin deposition and necrosis. Mild multifocal cardiomyopathy. Spleen: reactive changes similar to S2. Skin lesion – section shows muscle layers only. Mats of bacteria (*Tenacibaculum* – like) can be seen on the surface and extending down deep into the muscle tissue. In the muscle tissue the bacteria appear as large basophilic rods and there is some associated inflammation. No further abnormal findings.

Bacteriology: samples from lesions and head kidneys of 3 salmon were inoculated onto tryptone soy agar (TSA), TSA + 2% NaCl, thiosulfate-citrate-bile salts-sucrose agar and Columbia blood agar + 2% NaCl. Plates were incubated at 22°C. Pure growth was obtained from the kidneys of 2 salmon on TSA, TSA+2% NaCL and CBA+2%NaCL, samples were identified as atypical *Aeromonas salmonicida* type 3 (subspecies *achromogenes*). Mixed growth was present on lesion samples.

Serology: 5 fish were tested for SAV viremia and antibodies. All samples tested negative.

Parasitology*:* skin and gill scrapes were taken from 3 fish. No significant findings.

qPCR: 5 gills swabs were tested for *Neoparamoeba perurans*. All samples tested negative.

Lumpfish

Clinical examination: lumpfish were caught around hides. Fish were scored following MI internal protocols. The fish were in good overall external condition and showed no signs of infectious diseases. **Necropsy:** 8 fish sampled. No internal indications of disease were seen. 3 fish had only very little feed in the gastrointestinal tract. Vaccine residues were present in all fish examined.

Histology:

Fish 1 - Gills: very mild focal sloughing. No significant abnormalities in the other organs.

Fish 2 - No significant abnormalities in any of the organs sampled.

Fish 3 - No significant abnormalities in any of the organs sampled.

Fish 4 - Kidney: mild focal haemorrhage. No significant abnormalities in the other organs.

Fish 5 - Gills: mild sloughing and necrosis observed near the base of the gill filaments. Pancreas / GIT vaccine reaction surrounding the normal tissue. No significant abnormalities in the other organs.

Bacteriology: samples from lesions and head kidneys of 5 lumpfish were inoculated onto tryptone soy agar (TSA), TSA + 2% NaCl, thiosulfate-citrate-bile salts-sucrose agar and Columbia blood agar + 2% NaCl. Plates were incubated at 22°C. No significant findings.

qPCR: 5 gills swabs were tested for *Neoparamoeba perurans*. All samples tested negative.

Interpretation of findings:

Pathology consistent with systemic infectious disease was present in salmon. The cause of ulcerative skin lesions and associated reported mortality is uncertain, but possible causes were identified.

- *Aeromonas salmonicida* ssp. *achromogenes* (atypical *Aeromonas salmonicida* subtype 3) was isolated from 2 of 3 lethargic fish with lesions sampled. This species has been associated with mortalities in salmon in both fresh and saltwater in Ireland, though the clinical presentation of large ulcerative lesions is not typical. Small ulcerative lesions observed on 2 randomly sampled fish are possibly associated with the infection. Histology showed bacterial colonisation consistent with *Tenacibaculum* sp. on lesions. *Tenacibaculum* are common secondary infections and these are possibly secondary to physical injury or other primary aetiology, such as possibly small lesions due to *Aeromonas* infection. Severe active fin erosion on fish with large lesions is also likely due to, or exacerbated by, *Tenacibaculum* infection. Internal pathology and histopathology consistent with systemic disease was present, but secondary infections are likely contribution to the clinical presentation.
- Gills were in good overall condition, the cause of mild gill pallor is unknown but the presentation was not considered clinically significant. *N. perurans* was not detected by qPCR or microscopy and no pathology consistent with amoebic gill disease was present on histology samples.
- There was no indication of past or present salmonid alphavirus infection on serology.
- Lumpfish were in good overall condition, no infectious agents were detected but only random fish from hides were examined. Examination of mortalities is recommended.

The source of the *Aeromonas salmonicida* ssp. *achromogenes* infection is unknown, but infection in the hatchery is possible and fish there should be monitored for indications of the infection in future. There are anecdotal reports of this subtype infecting lumpfish, testing moribund lumpfish for the infection is recommended if possible.

Antibiotic treatment is not indicated due to low level of mortalities and proximity of culling.

Felix Scholz, DVM PhD

Samples processed for case 20/012a

Histology	18 slides
Serology SAV antibodies and virology	5
bacteriology	8
qPCR	10

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FISH HEALTH REPORT

FHU REPORT NUMBER:	**F/113/21**	**DATE ISSUED:**	12/10/2021

CUSTOMER:	[redacted]	**SAMPLE LABORATORY I.D.:**	**F/113/21**
ADDRESS:	Marine Institute Rinville Oranmore Co. Galway	**SAMPLE RECEPTION FORM:**	A110-27-21
SITE:	Lehanagh Pool	**DATE/TIME SAMPLED:**	13/09/2021 10:00
SAMPLE DETAILS:	A. Salmon 1+ x 20 (Pen 6) A. Salmon 1+ x 20 (Pen 3)	**DATE RECEIVED:**	14/09/2021

DETAILS:

Forty 1+ Atlantic salmon, were sampled and screened for pathogens including those listed under Commission Regulation (EU) 2016/429 as part of a pre-movement health check.

VIROLOGY

Date/time processed: 14/09/2021 10:00

Tissue samples (2 pools of 10 fish from pen 3) were screened for the presence of viral haemorrhagic septicaemia (VHS), infectious haematopoietic necrosis (IHN), infectious pancreatic necrosis (IPN) viruses by cell culture **(Test Method FHU-65)**.

The results of these tests were negative**.**

HISTOLOGY*

Two fish, both from pen 3, were sampled for histopathology. Significant pathology was noted in the gill tissue of both fish examined, with varying levels of hyperplasia and fusion thought to be associated with a previous amoeba infection. Low levels of amoeba were evident in the gill of both fish examined. There were no significant findings in any other tissues examined.

MOLECULAR*

Kidney tissue from eight pools (5 fish per pool) were screened for *Aeromonas salmonicida** by real-time PCR methods.

All samples tested negative for *A. salmonicida**.

*** non accredited method**

Heart tissue from eight pools (5 fish per pool) were screened for Piscine reovirus (PRV)*, Piscine myocarditis virus (PMCV)*, and Salmonid alphavirus (SAV)* by real-time RT-PCR methods.

All samples tested negative for PRV*, PMCV* and SAV*.

Gill tissue from eight pools (5 fish per pool) were screened for *Desmozoon lepeophtherii*, Tenacibaculum maritinum*, Neoparamoeba perurans** and *Branchimonas cysticola** by real-time PCR methods

All samples tested positive for *D. lepeophtherii** and *N. perurans*,* 6/8 pools tested positive for *T. maritinum*,* and 7/8 pools tested positive for *B. cysticola*.* The Cq values and pen numbers are detailed in the table below.

		Pathogen			
Pen	**Sample #**	***N. perurans***	***D. lepeophtherii***	***T. maritinum***	***B. cysticola***
	Pool 1	35.1	30.2	35.4	24.1
	Pool 2	33.9	30.5	35.7	29.7
	Pool 3	36.5	32.5	28.7	26.6
3	Pool 4	33.0	29.3	-	24.3
	Pool 1	32.4	24.8	29.0	30.1
	Pool 2	31.2	25.0	31.0	30.9
	Pool 3	37.9	29.2	-	-
6	Pool 4	34.1	28.2	35.0	32.5

S White

_____

Dr. Samantha White
Finfish Health Team Leader

Conditions:

1. This report relates only to the items tested by the laboratory
2. This report may not be reproduced, except in its entirety and only with prior agreement of the Marine Institute.

cc. Neil Ruane, Jamie Downes, FEAS, Marine Institute.
Alan Drumm, Newport, Marine Institute.
Bill Dore and Ayesha Power, Marine Institute, Competent Authority Regulation (EU) 2016/429

*** non accredited method**

PHARMAQ Analytiq

Mr. Neil Ruane,
Marine Institute,
Rinville,
Galway.

Date: 2/8/23

Pharmaq Analytiq
Unit 7b Oranmore Business Park
Oranmore
Co. Galway, Ireland

t. +353 91 792997

FINAL VETERINARY REPORT

Ref. no.: 0171ie23

Site: Lennaghpool Trial Site

The site was visited on the 13th July 2023 to monitor the trial progress and to assess the health status of the fish. Fish were sampled from two pens and the findings were as follows:

Sentinal Pen 4

Clinical appearance: six fish were subsampled and examined. Eyes, fins, skin and gills were in good condition. Mild focal skin lesions, in the form of raised scales and haemorrhage, were observed on two fish.

AGD Score: Average AGD score was 1.2 (Range 0 – 2).

Necropsy: two fish were subsampled. Both of these fish had mild skin lesions. No internal abnormalities were observed.

Sentinal Pen 5

Fish from this sentinel pen were subsampled, examined and injected with the trial compound during the visit. General observations on the full procedure were as follows:

Fish were initially crowded for sampling in the sentinel pen, then were transferred to an anaesthetic bath in small batches of 2 – 4 fish. Once the desired plane of anaesthesia was achieved, fish were removed from the anaesthetic bath. Gill scores and swabs were taken from each of the

fish following which each was injected in the dorsal flank with the trial medicine. Fish were then transferred to an oxygenated recovery tank until they were swimming and behaving normally. Once the fish were fully recovered, they were returned to the original pen.

Clinical appearance: 18 fish were subsampled and examined. Eyes, fins and gills were in good condition. There was mild diffuse scale loss evident on some of the fish. Mild focal skin lesions, in the form of scale loss and haemorrhage, were observed on 3/18 of the fish.

Necropsy: one moribund and one recent mortality were subsampled. Both of these fish had mild skin lesions. No internal abnormalities were observed.

Histology: one fish sampled. Gills showed a low level of Trichodinids present. Numerous areas of focal hyperplasia and fusion, likely due to previous amoeba infection. There was a low level of epicarditis in the heart. Spleen, Liver, kidney & pyloric caecae showed no significant findings. Lateral line musculature appears normal. A portion of lesion material also sampled which showed hemorrhaging and necrosis in the epidermis and dermis with slight involvement of the underlying muscle fibers. There were no other significant findings observed.

Molecular testing and bacteriology

Molecular testing: kidney tissue from four fish (two from Pen 4, two from Pen 5) was sampled and tested by RT PCR for *Piscirickettsia salmonis* and *Aeromonas salmonicida.* 1/4 fish tested positive for *P. salmonis* (Pen 5) with low levels of bacteria indicated (Ct value 31.24). All fish tested negative for *A. salmonicida.*

Bacteriology: two fish were sampled for bacteriology from each pen. Kidney tissue and skin lesion were swabbed and was plated onto TSA and TCBS. Two of the skin lesions showed growth consistent with *Vibrio* species on TCBS (One from each of Pen 4 and 5). There was no significant growth on any of the kidney plates after 72 hours.

Interpretation of findings:

The trial procedure was well executed with minimal fish stress and optimal handling techniques being employed. There was evidence of some mild skin lesions on the occasional fish, in part due the need for repeated crowding and netting during the trial. Detection of *Vibrio* species in such lesions is common as a secondary infection as it is ubiquitous in the marine environment and not likely to be significant. *Piscirickettsia salmonis*, occasionally responsible for causing skin lesions on fish, was also detected at low levels on molecular screening in one fish. However, the lesions

observed were more consistent with physical abrasion, rather than infection with this bacterium and the *P. salmonis* was not likely to be of clinical significance at the time of sampling.

Dr. Susie Mitchell MVB

Samples procesed for case 0171ie23

Histology	1 (Marine Institute processed and read)
Bacteriology	2
PCR	4 (Marine Institute processed)

Lehanagh Pool ADCP deployment details

Location of deployment: -9.817944, 53.399942.

Water depth: approx. 16 metres.

Deployment period: 16 July 2022 to 28 Feb 2023.

ADCP instrument used: RDI 1200 khz.

ADCP Configuration: The instrument was configured to resolve 25 0.2 metre depth bins so the total velocity profile was 5 metres starting at approximately 1 metre above the seabed.

Lehanagh Pool ADCP statistics

There is an inequality in the spring-neap cycles at the site so for the statistics below (Table 1), the spring-neap cycle actually covers two successive spring-neap cycles.

The mean speed for the bottom bin (i.e. ~1 metre above the seabed) is remarkably similar for the spring-neap cycle and the full deployment (Jul 2022 – Feb 2023). Also the mean speed of the full profile (i.e. averaged over the whole 5 metre profile) is very similar to that for the bottom bin which points to a lack of vertical structure in the velocity profile.

There is no strong residual direction at the site and that can best be visualised in the rose plot in Figure 1 which shows a relatively even spread over all directions, though the ellipsoid shape associated with a tidal regime is somewhat apparent in the slight stretching of the rose plot in an axis running SSE-NNW.

Figure 2 shows a 7-day time series of current magnitude and direction just to give an idea of variability at the site. The magnitude of the speed in the bottom and top bins is broadly the same which points to no significant vertical structure. This is not surprising given that the ADCP profile only covers the bottom third of the full depth profile at the site.

	Min Speed (m/s)	Mean Speed (m/s)	Max Speed (m/s)	Residual Direction (degrees)
Spring-Neap cycle, 1m above seabed	0	0.055	0.214	147
Spring-Neap cycle, full profile	0	0.056	0.259	151
Full Deployment, 1m above seabed	0	0.050	0.235	237
Full Deployment, full profile	0	0.053	0.386	176

Table 1: Velocity statistics. For residual direction note that the direction convention is “direction to” (i.e. 0 is to the north, 90 is to the east, 180 is to the south, 270 is to the west).

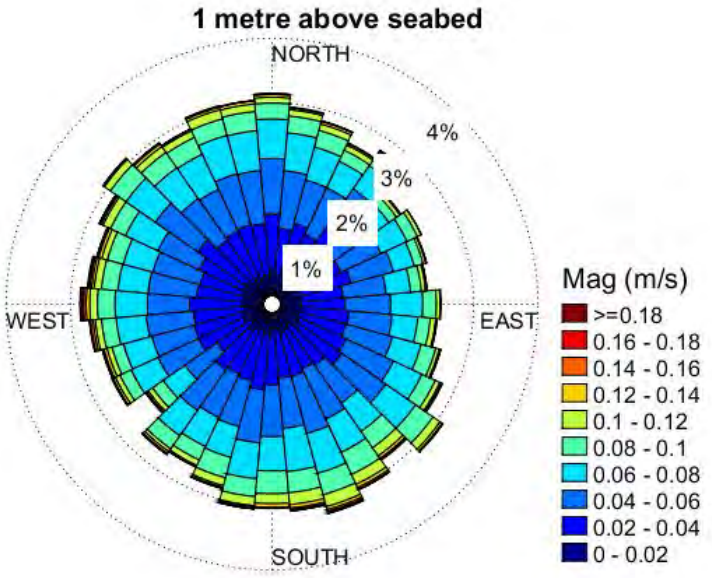


Figure 1: Rose plot showing distribution of direction and magnitude over full deployment for the ADCP bottom bin (approximately 1 metre above seabed)

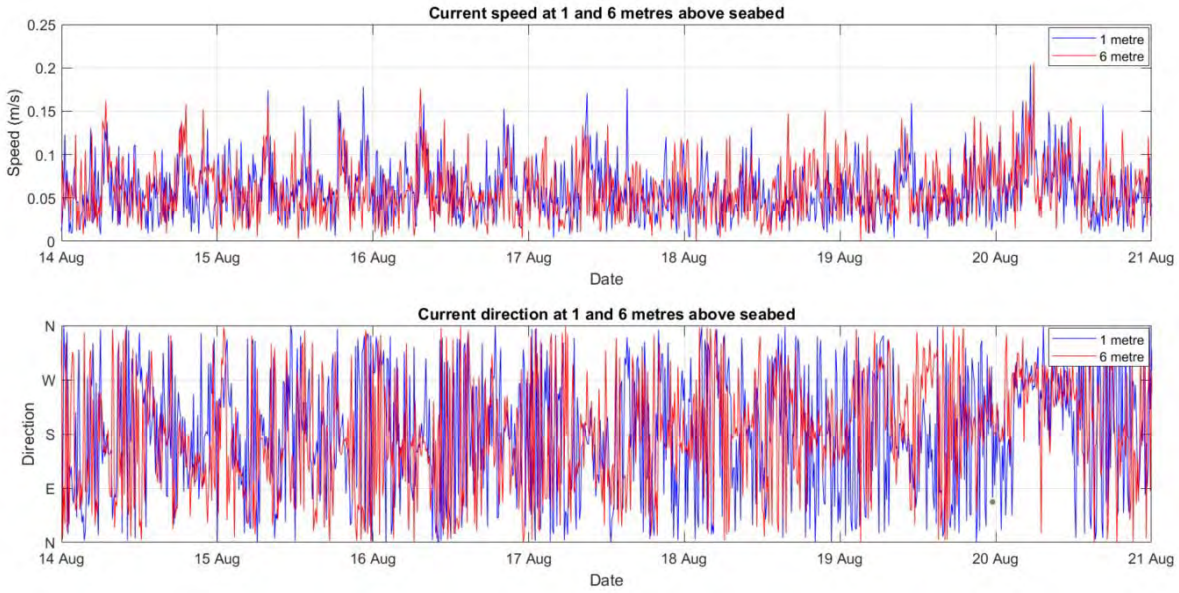


Figure 2: Time series of current speed (top) and direction (bottom) for bottom (1 metre above seabed) and top (6 metres above seabed) velocity bins

Current meter data – Lehanagh pool

A Valeport MIDAS ECM (Electromagnetic Current Meter) was deployed at Lehanagh Pool to measure the current speeds on site. It was deployed from the surface and measured at a depth of approximately 4m. At this depth, typical directional flow is from east to west +/- 35 °. The highest velocity was measured at 1.93 m/s in February 2021 during a spring tide (Fig. 1). More typical flows are displayed in Figs 2 & 3 which display velocities closer to the average flow on site (0.058 m/s).

Instrument: MIDAS CTD
Serial_Number: 62567
Software: Valeport Datalog X2

Parameter	Velocity (m/s)
Max X (horizontal plane)	1.933
Min X (horizontal plane)	0.000
Average X (horizontal plane)	0.058
Average Y (Vertical plane)	0.012

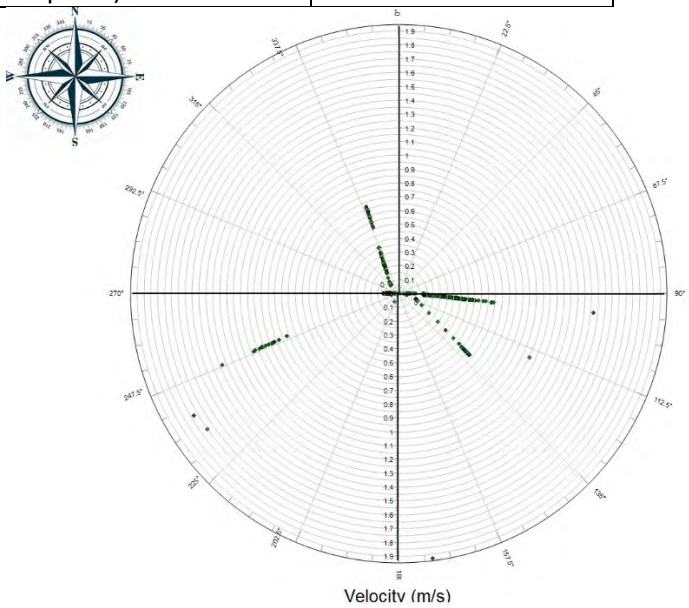


Figure 1 18th Feb – 19th March 2021

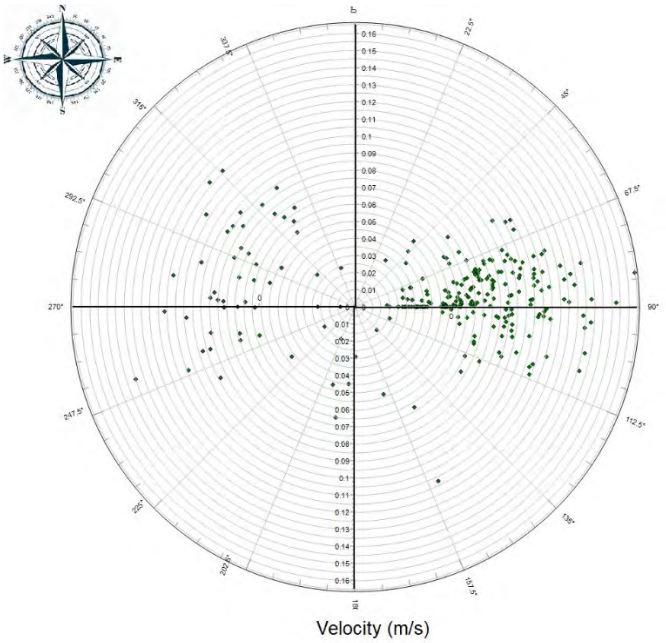


Figure 2 15th Aug -26th Aug 2019

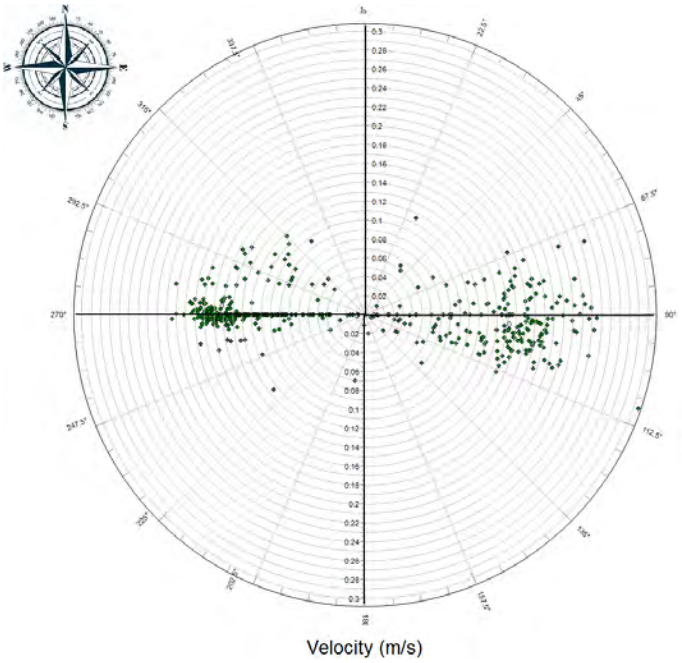


Figure 3 26th Aug - 18th Sept 2019

REGISTER OF MOVEMENTS Lehenagh Pool - INWARD								
DATE OF MOVEMENT	**NAME, ADDRESS SITE OF ORIGIN**	**SPECIES**	**NUMBER OF FISH**	**AVERAGE WEIGHT (g)**	**TRANSPORTER USED**	**NUMBER OF MORTALITIES OBSERVED ON ARRIVAL**	**DETAILS OF RECEIVING POND**	**COMMENTS**
9-12/12/17	Marine Institute Newport	Atlantic Salmon *Salmo salar*	9834	55g	Peter O'Malley	0	Kames Sea Cages	
9-12/04/18	MHI Pettigo	Atlantic Salmon *Salmo salar*	5300	90g	Marine Institute	0	Kames Sea Cages	
9-11/05/18	Marine Institute Newport	Atlantic Salmon *Salmo salar*	2300	120g	Marine Institute	0	Kames Sentinel Sea Cages	
01/05/18	NUIG Lab Carna	Lumpfish *Cyclopterus lumpus*	500	30g	Marine Institute		Kames Sea Cages	
11/05/18	Padstow	European lobster *Homaras gammarus*	204		Marine Institute	8	Oyster cage on Longline	
10/04/18	Carna Research Station	Lumpfish *Cyclopterus lumpus*	510	37g	Marine Institute	0	50m Kames Cage	Transferred well
20/06/18	NUIG/ISC	Seaweed	seed	seed	NUIG/ISC			
12/11/18	MI Newport	Atlantic Salmon *Salmo salar*	4800	70g	TOTS with MI	1	50m Kames Cage	Transferred well
08/05/19	MI Newport	Atlantic Salmon *Salmo salar*	7500	65g	TOTS with MI	2	50m Kames Cage	Transferred well
10/05/19	MI Newport	Atlantic Salmon *Salmo salar*	2797		TOTS with MI	0	Sentinel Cages	
16/05/19	MI Newport	Atlantic Salmon *Salmo salar*	5421	65g	TOTS with MI	0	50m Kames Cage	Transferred well
23/11/19	MI Newport	Atlantic Salmon *Salmo salar*	9000	70g	TOTS with MI	0	50m Kames Cage	Transferred well
17/01/20	Bantry Marine Research Station	Lumpfish *Cyclopterus lumpus*	750	23g	Marine Institute		50m Kames Cage	Transferred well
17/01/20	Northwest Shellfish Ltd.	King scallop *Pecten maximus*	596		Jerry Gallagher	0	Pen 2 4 x chinese lantern nets	
28/04/20	MI Newport	Atlantic Salmon *Salmo salar*	2649		TOTS with MI	0	Cage 4	Transferred well HYDROFISH
29/04/20	MI Newport	Atlantic Salmon *Salmo salar*	2663		TOTS with MI	0	Cage 2	Transferred well HYDROfish
30/04/20	MI Newport	Atlantic Salmon *Salmo salar*	7587	72g	TOTS with MI	0	Cage 3	Transferred well
13/10/20	Bantry Marine Research Station	*Alaria esculenta*	300 m		Marine Institute			
25/11/20	MI Newport	Atlantic Salmon *Salmo salar*	4000	92g	TOTS with MI	1000	Cage 2	Issues with reg on 1 tank
25/11/20	MI Newport	Atlantic Salmon *Salmo salar*	4000		TOTS with MI		Cage 6	Transferred well
26/11/20	Bantry Marine Research Station	Lumpfish *Cyclopterus lumpus*	600	30g	Marine Institute	0	Pen 2 & Pen 6	Successful transport
26/11/20	Bantry Marine Research Station	*Alaria esculenta*	50 m		Marine Institute			
16/01/21	Northwest Shellfish Ltd	King scallop *Pecten maximus*	980		Jerry Gallagher		Bubble ring	7 X Chinese lantern nets
30/03/21	Dunmanus Bay	Purple sea urchin *Paracentrotus lividus*	100		Clear Seas	0	Pen 6	1 X blue basket, 1X black basket
21/04/21	MI Newport	Atlantic Salmon *Salmo salar*	5425	340g	Peter O Malley	4	Pen 3 (RAS Salmson)	Transferred well
28/04/21	MI Newport	Atlantic Salmon *Salmo salar*	6300	125g	Peter O Malley		Pen 1 (4 sentinal pens) and Pen 5 (5 sentinal pens)	Transferred well
29/04/21	MI Newport	Atlantic Salmon *Salmo salar*	10500	125g	Peter O Malley		Pen 6 (Flow through Salmson) Pen 2 5,254(BIM)	
21/07/21	Atlantic Technical University	Black sea cucumber *Holothuria forskali*	54	150-200g	Atlantic Technical University		Custom made benthic cages	INEVAL project
20/10/21	Catron Point Shellfish	*Alaria esculenta*	234m	Sporophyte	Marine Institute		Low trophic grid	
29/11/21	MI Newport	Atlantic Salmon *Salmo salar*	5000	90g				
20/10/21	Catron Point Shellfish	*Saccharina latissima*	225m	Sporophyte	Marine Institute		Low trophic grid	
04/11/21	Carna Research Station	European lobster *Homaras gammarus*	48	Stage 5 Juvenilles	Carna Research Station		Low trophic grid	2 Morts in transfer
05/11/21	Cashel Bay	Variegated scallop *Chlamys varia*	250	Mixed Grade	Marine Institute		Low trophic grid	Derived from natural settlement
20/12/21	Carna Research Station	European lobster *Homaras gammarus*	119	Stage 5 Juvenilles	Carna Research Station		SBCC Units on LTG	
11/04/22	MI Newport	Atlantic Salmon *Salmo salar*	7181	115	Peter O'Malley		Pen 2	Transferred well.
12/04/22	MI Newport	Atlantic Salmon *Salmo salar*	7553	115	Peter O'Malley		Pen 6	Transferred well.
25/04/22	MI Newport	Atlantic Salmon *Salmo salar*	4060	250	Peter O'Malley		Pen 3	Transferred well.
26/04/22	MI Newport	Atlantic Salmon *Salmo salar*	4061	250	Peter O'Malley		Pen 3	Transferred well.
29/03/22	Cashel bay	Flat oyster *Ostrea edulis*	324		Comharchumann Sliogeisc		Ocean tumblers on LTG, longline and control site	Fished from Cashel bank under S59 order by Marcus Connelly
15/07/22	Atlantic Technical University	Black sea cucumber Holothuria forskali	54	150-200g	Atlantic Technical University		Custom made benthic cages	INEVAL project
24/10/22	Bantry Marine Research station	*Alaria esculenta* & *Saccharina latissima*	450m	1g	Marine Institute	0	LTG, LL, Control site	
15/11/22	MI Newport	Atlantic Salmon *Salmo salar*	4,550	60g	Marine Institute		Pen 6 plus 2 Sentinel Pens	SRA Stock. Sentinels for Smoltscreen Project.
24/01/23	Bantry Marine Research station	Lumpfish *Cyclopterus lumpus*	500	15g	Marine Institute		Pen 6	
27/04/23	MI Newport	Atlantic Salmon *Salmo salar*	7,800	120g	Peter O'Malley		PENS 6 & 1 with 3000 in each. Plus 6 Sentinel pens with 300 in each	
10/10/23	Bantry Marine Research station	*Alaria esculenta* & *Saccharina latissima*	450m		Marine Institute		Low trophic grid	
09/05/23	Mowi, Scotland & Ireland	Ballan wrasse *Labrus bergylta*	200	60g	Migdale Transport (Truck), Marine Institute		Deployed amongst the Astral salmon in Pen 6	
22/11/23	Newport	Atlantic Salmon *Salmo salar*	3000	80g	Marine Institute		Pen 6 for Astral IMTA.	

DAFM STOCK REPORT 2020

SITE NAME	LICENCE REF.	AQ ref.	2020 Opening biomass Kg	Closing biomass Kg	Harvest biomass Kg	Biomass moved (in) Kg	Biomass moved (out) Kg	Site currently active Y/N
Lehanagh Pool	T09/93A	AQ176	928.73	1092.47				Y

Harvest biomass refers to biomass of fish sampled and/or culled at the end of each study.

NOTE:

DAFM QUARTERLY STOCK REPORT

SITE NAME	LICENCE REF.	AQ ref.	Q1 2021 Opening biomass Kg	Closing biomass Kg	Harvest biomass Kg	Biomass moved (in) Kg	Biomass moved (out) Kg	Site currently active Y/N
Lehanagh Pool	T09/93A	AQ176	1092.47	0	1197.23	n/a	n/a	Y

Q2 2021 Opening biomass Kg	Closing biomass Kg	Harvest biomass Kg	Biomass moved (in) Kg	Biomass moved (out) Kg	Site currently active Y/N
0	4527.6		2487.86	n/a	y

Q3 2021 Opening biomass Kg	Closing biomass Kg	Harvest biomass Kg	Biomass moved (in) Kg	Biomass moved (out) Kg	Site currently active Y/N
4527.6	4018.53	4669.38	n/a	n/a	Y

Q4 2021 Opening biomass Kg	Closing biomass Kg	Harvest biomass Kg	Biomass moved (in) Kg	Biomass moved (out) Kg	Site currently active Y/N
4018.53	873.97	4020	488.92	n/a	Y

DAFM QUARTERLY STOCK REPORT

SITE NAME	LICENCE REF.	AQ ref.	Q1 2022 Opening biomass Kg	Closing biomass Kg	Harvest biomass Kg	Biomass moved (in) Kg	Biomass moved (out) Kg	Site currently active Y/N
Lehanagh Pool	T09/93A	AQ176	873.97	0	1020		n/a	N

Q2 2022 Opening biomass Kg	Closing biomass Kg	Harvest biomass Kg	Biomass moved (in) Kg	Biomass moved (out) Kg	Site currently active Y/N
0	6399.3		3724.66		y

Q3 2022 Opening biomass Kg	Closing biomass Kg	Harvest biomass Kg	Biomass moved (in) Kg	Biomass moved (out) Kg	Site currently active Y/N
6399.3	0	6692.3			N

All stocks harvested in September and site fallowed.

Q4 2022 Opening biomass Kg	Closing biomass Kg	Harvest biomass Kg	Biomass moved (in) Kg	Biomass moved (out) Kg	Site currently active Y/N
296	364				Y

Restocked 1 pen with 4500 smolts on 15/11/2022

DAFM QUARTERLY STOCK REPORT

SITE NAME	LICENCE REF.	AQ ref.	Q1 2023 Opening biomass Kg	Closing biomass Kg	Harvest biomass Kg	Biomass moved (in) Kg	Biomass moved (out) Kg	Site currently active Y/N
Lehanagh Pool	T09/93A	AQ176	364	0	750	N/A	N/A	N

All stocks culled on 6/3/2023 site now fallow.

Q2 2023 Opening biomass Kg	Closing biomass Kg	Harvest biomass Kg	Biomass moved (in) Kg	Biomass moved (out) Kg	Site currently active Y/N
936	1375	302	N/A	N/A	Y

Restocked on 27/4/2023

Q3 2023 Opening biomass Kg	Closing biomass Kg	Harvest biomass Kg	Biomass moved (in) Kg	Biomass moved (out) Kg	Site currently active Y/N
1375	0	1496			N

All stocks culled and site now fallow.

Q4 2023 Opening biomass Kg	Closing biomass Kg	Harvest biomass Kg	Biomass moved (in) Kg	Biomass moved (out) Kg	Site currently active Y/N
240	270				Y

Restocked Pen 6 with 3000 smolts on 22/11/2023

An Roinn Talmhaíochta,
Bia agus Mara
Department of Agriculture,
Food and the Marine

MARINE FISH FARM INSPECTION REPORT

Rannán Innealtóireachta Muirí
Marine Engineering Division

File No.	Inspection Date	Report Date	Report By
T09/093A	10/12/2020	03/02/2021	KS

DEPARTMENT OF AGRICULTURE, FOOD AND THE MARINE.

MARINE FISH-FARM INSPECTION

FILE NO:	T09/093A
AQUACULTURE LICENCE NO.:	AQ 176
NAME OF LICENCEE:	Marine Institute
NAME OF OPERATOR:	Marine Institute
SITE / FARM NAME:	Lehannah Pool
SITE / FARM LOCATION:	Lehannah Pool, Beirtreah Buí Bay, Co Galway
LAND BASE:	Marine Institute, Furnace, Newport, Co. Mayo.
INSPECTED BY:	Kate Sayers
DATE OF INSPECTION::	10/12/2020

RECORDS:

Are Records of:

	Good	Ave	Poor
Smolts bought on to the farm:	√		
Amount of fish harvested:	√		
Mortalities:	√		

MANAGEMENT:

Are chemicals stored properly?……..... Yes/~~No~~
Is food stored properly? ……..…….…….……..... Yes/~~No~~

	Public	Private
Is the Pier used:	√	

Name of Pier:……..... Lettercaumus, Cashel, Co. Galway

If Pier is public is its use causing an obstruction?.....~~Yes~~/No

	Major	Intermediate	Minor
If Yes is obstruction:			

Is there equipment/supplies on the shore?……..Yes/~~No~~
If yes, is it stacked neatly?……..Yes/~~No~~

Is there any litter or debris on the shore or public pier
that may have come from the farm? ..... ~~Yes~~/No

Is there provision for litter collection and removal?..... Yes/~~No~~
(Barna Waste)

Are land based facilities kept tidy? …….…….. Yes/~~No~~

Are disinfection facilities readily accessible:-
Footbath?…….…….…….. Yes/~~No~~
Handwash?…….……..…….. ~~Yes~~/No
Wheelbath?…….……..…….. ~~Yes~~/No

Licence Stocking and Production Conditions:

	Species	Licensed Harvest Finfish (Tonnes)	Combined Licensed Production (Tonnes)	Current Biomass On Site
Finfish	Cod, Salmonids, Wrasse, Lumpsucker	50	100	0.8 tonnes
Shellfish	Blue Mussels, Other Bivalves, Sea Urchins, Crustaceans.	-		Unknown**
Seaweed	Marine Micro Algae of the Genera Alaria, Laminaria	-		Unknown**

** It is not known what the current biomass onsite is for seaweed or shellfish. The site is being used for research purposes; therefore the production of each species is relatively small and likely to be far less than the licenced production.

CAGES:

Type	Number	Size	Depth (Net)
Polar Circle	5	50m	15-18m

LOCATION OF CAGES:

Checked by	
Visual Insp	**Survey Instrument**
Yes/~~No~~	**Yes/~~No~~**
	G.P.S.

Are all cages in Licenced area?.....Yes/~~No~~

Are cages configured as specified? .....Yes/~~No~~
Are the cages moored as specified? .....Yes/~~No~~
Are cages tidily arranged? .....Yes/~~No~~

VISUAL IMPACT:

Visual impact of farm:

Major	Intermediate	Minor
		√

NAVIGATIONAL AIDS:

Are navigation lights installed on corner cages?.....Yes/~~No~~
Are navigation lights installed as specified? .....Yes/~~No~~
Are navigation lights working? .....Yes/~~No~~
Are navigation buoys installed as specified? .....Yes/~~No~~
Are radar reflectors fitted? .....Yes/~~No~~
Are walkways non-slip? .....Yes/~~No~~
Are walkways of adequate width? .....Yes/~~No~~

WEAR OR FATIGUE:

Wear or fatigue on:	Major	Intermediate	Minor
Mooring ropes:			√
Shackles/Eyes:			√
Joint/Hinges:			√
Nets:			√
Fouling on the nets:			√

ANTI PREDATOR MEASURES:

Are there top predator nets? ..... Yes/~~No~~
Are there underwater predator nets? ..... ~~Yes~~/No
Is there a seal scarer? ..... ~~Yes~~/No

SAFETY MEASURES:

Do cages carry:
Life-belts (with lines)? .....…….....~~Yes~~/No
Flares? .....…….....~~Yes~~/No

Did all persons seen at sea wear life-jackets?……..... Yes/~~No~~

MORTALITIES:

How are dead fish disposed of :……. Morts are sent to College Proteins for disposal.
Did you observe this?..... ~~Yes~~/No

WATER QUALITY:

Is there any increase in the turbidity of the water?..... ~~Yes~~/No
Is there any visible trace of oil, fat or grease
on the water or on the shoreline? .....~~Yes~~/No
Is there any evidence of scum, froth or foam on the water?..... ~~Yes~~/No
Is there any litter or debris in the water?.....~~Yes~~/No

OTHER COMMENTS:

All Structures and mooring grid are within the licensed area. Structures are in good condition. Lights and radar reflectors are present on the outer polar circle cages.
2 cages were stocked with fish on the day of the inspection.

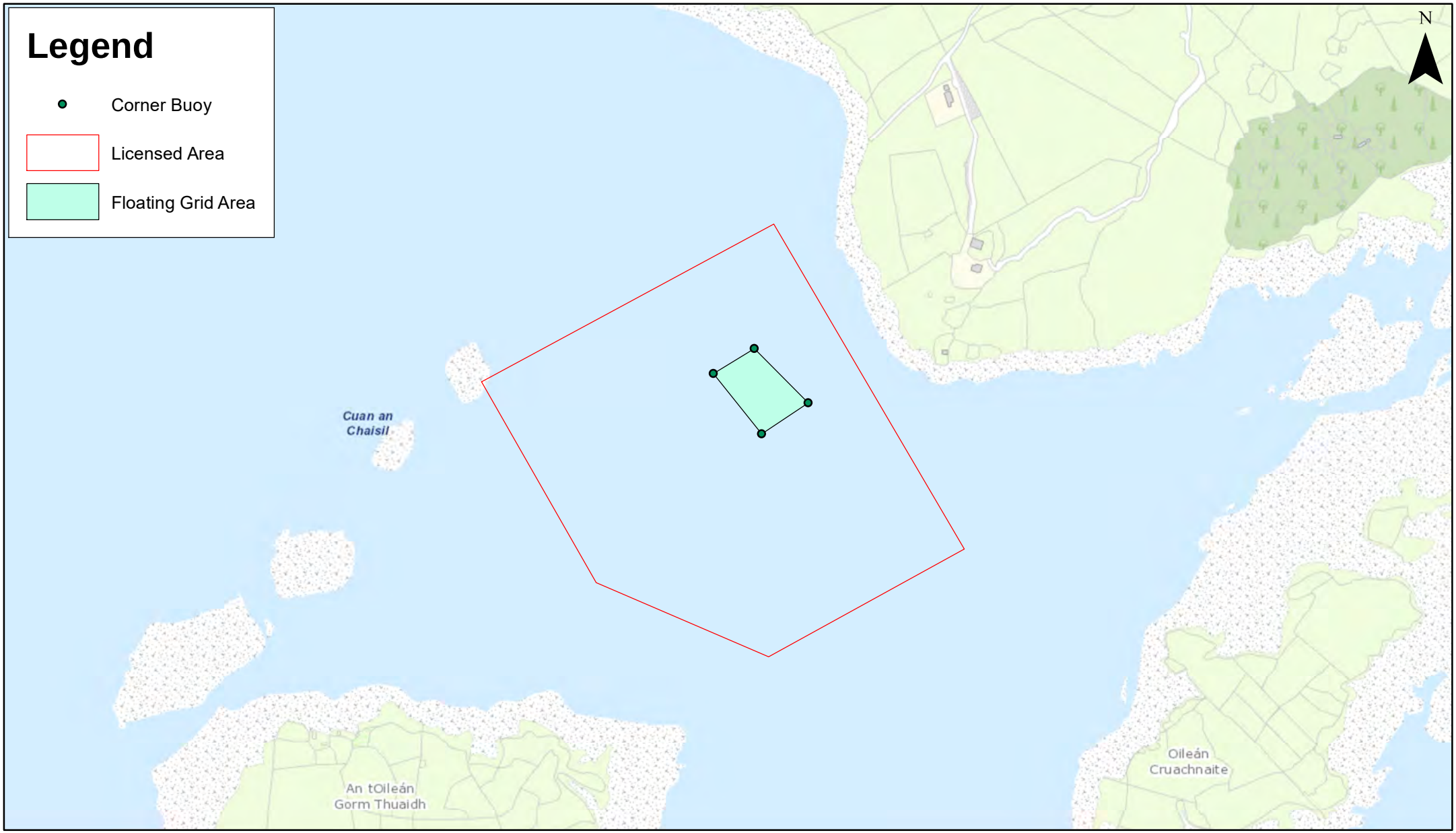
Production and harvest of finfish from this site are within the licence limits.

Production = Closing Stock + Harvest - (Opening stock + Imports - Exports)

2020	
Opening stock (tonnes)	1.1
Imports (tonnes)	0
Exports (tonnes)	0
Harvest (tonnes)	1.9
Closing stock (tonnes)	0.8
Actual Production (tonnes)	1.6
Licensed Production (tonnes)	100

Figure 1 Fish Cages and ring used for seaweed research

Figure 2 Navigation marker



Prepared by: Kate Sayers, DAFM
Date of Survey: 10/12/2020
Scale: 1:5,000 @ A3

Marine Institute T09/093

An Roinn Talmhaíochta,
Bia agus Mara
Department of Agriculture,
Food and the Marine

MARINE FISH FARM INSPECTION REPORT

Rannán Innealtóireachta Muirí
Marine Engineering Division

File No.	Inspection Date	Report Date	Report By
T09/093A	13/12/2021	23/02/2022	RC

DEPARTMENT OF AGRICULTURE, FOOD AND THE MARINE.

MARINE FISH-FARM INSPECTION

FILE NO:	T09/093A
AQUACULTURE LICENCE NO.:	AQ 176
NAME OF LICENCEE:	Marine Institute
NAME OF OPERATOR:	Marine Institute
SITE / FARM NAME:	Lehannah Pool
SITE / FARM LOCATION:	Lehannah Pool, Beirtreah Buí Bay, Co Galway
LAND BASE:	Marine Institute, Furnace, Newport, Co. Mayo.
INSPECTED BY:	Raphael Crowley
DATE OF INSPECTION:	13/12/2021

RECORDS:

Are Records of:

	Good	Ave	Poor
Smolts bought on to the farm:	√		
Amount of fish harvested:	√		
Mortalities:	√		

MANAGEMENT:

Are chemicals stored properly?……..... Yes/~~No~~
Is food stored properly? ……..…….…..…….....Yes/~~No~~

	Public	Private
Is the Pier used:	√	

Name of Pier:……..... Lettercaumus, Cashel, Co. Galway

If Pier is public is its use causing an obstruction?.....~~Yes~~/No

	Major	Intermediate	Minor
If Yes is obstruction:			

Is there equipment/supplies on the shore?……..Yes/~~No~~
If yes, is it stacked neatly?……..Yes/~~No~~

Is there any litter or debris on the shore or public pier
that may have come from the farm? ..... ~~Yes~~/No

Is there provision for litter collection and removal?..... Yes/~~No~~
(Barna Waste)

Are land based facilities kept tidy? …….…….. Yes/~~No~~

Are disinfection facilities readily accessible:-
Footbath?…….…….. Yes/~~No~~
Handwash?…….……..…….. ~~Yes~~/No
Wheelbath?…….……..…….. ~~Yes~~/No

Licence Stocking and Production Conditions:

	Species	Licensed Harvest Finfish (Tonnes)	Combined Licensed Production (Tonnes)	Actual Production (Tonnes)
Finfish	Cod, Salmonids, Wrasse, Lumpsucker	50	100	6.7
Shellfish	Blue Mussels, Other Bivalves, Sea Urchins, Crustaceans.	-		Unknown*
Seaweed	Marine Micro Algae of the Genera Alaria, Laminaria	-		Unknown*

* The site is being used for research purposes; the production of each species is relatively small and likely to be far less than the licenced production.

CAGES:

Type	Number	Size	Depth (Net)
Polar Circle	5	50m	15-18m

LOCATION OF CAGES:

Checked by	
Visual Insp	**Survey Instrument**
Yes/~~No~~	**Yes/~~No~~**
	G.P.S.

Are all cages in Licenced area?.....Yes/~~No~~

Are cages configured as specified? .....……..... Yes/~~No~~
Are the cages moored as specified? ..... Yes/~~No~~
Are cages tidily arranged? ..... Yes/~~No~~

VISUAL IMPACT:

Visual impact of farm:

Major	Intermediate	Minor
		√

NAVIGATIONAL AIDS:

Are navigation lights installed on corner cages?.....…….....Yes/~~No~~
Are navigation lights installed as specified? …….....Yes/~~No~~
Are navigation lights working? .....Yes/~~No~~
Are navigation buoys installed as specified? .....…….. Yes/~~No~~
Are radar reflectors fitted? .....…….....Yes/~~No~~
Are walkways non-slip? .....…….. Yes/~~No~~
Are walkways of adequate width? .....……..…..…..……..…. Yes/~~No~~

WEAR OR FATIGUE:

Wear or fatigue on:	Major	Intermediate	Minor
Mooring ropes:			√
Shackles/Eyes:			√
Joint/Hinges:			√
Nets:			√
Fouling on the nets:			√

ANTI PREDATOR MEASURES:

Are there top predator nets? ..... Yes/~~No~~
Are there underwater predator nets? ..... ~~Yes~~/No
Is there a seal scarer? ..... ~~Yes~~/No

SAFETY MEASURES:

Do cages carry:
Life-belts (with lines)? .....…….....~~Yes~~/No
Flares? .....…….....~~Yes~~/No

Did all persons seen at sea wear life-jackets?……..... Yes/~~No~~

MORTALITIES:

How are dead fish disposed of :……. Morts are sent to College Proteins for disposal.
Did you observe this?..... ~~Yes~~/No

WATER QUALITY:

Is there any increase in the turbidity of the water?..... ~~Yes~~/No
Is there any visible trace of oil, fat or grease
on the water or on the shoreline? .....~~Yes~~/No
Is there any evidence of scum, froth or foam on the water?..... ~~Yes~~/No
Is there any litter or debris in the water?.....~~Yes~~/No

OTHER COMMENTS:

All Structures and mooring grid are within the licensed area. Production and harvest of finfish from this site are within the licence limits.

An Roinn Talmhaíochta,
Bia agus Mara
Department of Agriculture,
Food and the Marine

MARINE FISH FARM INSPECTION REPORT

Rannán Innealtóireachta Muirí
Marine Engineering Division

File No.	Inspection Date	Report Date	Report By
T09/093A	14/12/2022	06/01/2023	KS

DEPARTMENT OF AGRICULTURE, FOOD AND THE MARINE.

MARINE FISH-FARM INSPECTION

FILE NO:	T09/093A
AQUACULTURE LICENCE NO.:	AQ 176
NAME OF LICENCEE:	Marine Institute
NAME OF OPERATOR:	Marine Institute
SITE / FARM NAME:	Lehannah Pool
SITE / FARM LOCATION:	Lehannah Pool, Beirtreah Buí Bay, Co Galway
LAND BASE:	Marine Institute, Furnace, Newport, Co. Mayo.
INSPECTED BY:	Kate Sayers
DATE OF INSPECTION:	14/12/2022

RECORDS:

Are Records of:

	Good	Ave	Poor
Smolts bought on to the farm:	√		
Amount of fish harvested:	√		
Mortalities:	√		

MANAGEMENT:

Are chemicals stored properly?…….Yes/~~No~~
Is food stored properly? ……..Yes/~~No~~

	Public	Private
Is the Pier used:	√	

Name of Pier:……..... Lettercaumus, Cashel, Co. Galway

If Pier is public is its use causing an obstruction?.....~~Yes~~/No

	Major	Intermediate	Minor
If Yes is obstruction:			

Is there equipment/supplies on the shore?……..Yes/~~No~~
If yes, is it stacked neatly?……..Yes/~~No~~

Is there any litter or debris on the shore or public pier
that may have come from the farm? ……. ~~Yes~~/No

Is there provision for litter collection and removal?…….Yes/~~No~~
(Barna Waste)

Are land based facilities kept tidy? ……..Yes/~~No~~

Are disinfection facilities readily accessible:-
Footbath?…….. Yes/~~No~~
Handwash?…….. ~~Yes~~/No
Wheelbath?…….. ~~Yes~~/No

Licence Stocking and Production Conditions:

	Species	Licensed Harvest Finfish (Tonnes)	Combined Licensed Production (Tonnes)	Actual Production (Tonnes)
Finfish	Cod, Salmonids, Wrasse, Lumpsucker	50	100	3.5
Shellfish	Blue Mussels, Other Bivalves, Sea Urchins, Crustaceans.	-		Unknown*
Seaweed	Marine Micro Algae of the Genera Alaria, Laminaria	-		Unknown*

* The site is being used for research purposes; the production of each species is relatively small and likely to be far less than the licenced production.

CAGES:

Type	Number	Size	Depth (Net)
Polar Circle	5	50m	15-18m

LOCATION OF CAGES:

Checked by	
Visual Insp	Survey Instrument
Yes/~~No~~	Yes/~~No~~
	G.P.S.

Are all cages in Licenced area?.....Yes/~~No~~

Are cages configured as specified? .....Yes/~~No~~
Are the cages moored as specified? .....Yes/~~No~~
Are cages tidily arranged? .....Yes/~~No~~

VISUAL IMPACT:

Visual impact of farm:

Major	Intermediate	Minor
		√

NAVIGATIONAL AIDS:

Are navigation lights installed on corner cages?.....Yes/~~No~~
Are navigation lights installed as specified? .....Yes/~~No~~
Are navigation lights working? .....Yes/~~No~~
Are navigation buoys installed as specified? .....Yes/~~No~~
Are radar reflectors fitted? .....Yes/~~No~~
Are walkways non-slip? .....Yes/~~No~~
Are walkways of adequate width? .....Yes/~~No~~

WEAR OR FATIGUE:

Wear or fatigue on:	Major	Intermediate	Minor
Mooring ropes:			√
Shackles/Eyes:			√
Joint/Hinges:			√
Nets:			√
Fouling on the nets:			√

ANTI PREDATOR MEASURES:

Are there top predator nets? ……Yes/~~No~~
Are there underwater predator nets? ……~~Yes~~/No
Is there a seal scarer? ……~~Yes~~/No

SAFETY MEASURES:

Do cages carry:
Life-belts (with lines)? ……~~Yes~~/No
Flares? ……~~Yes~~/No

Did all persons seen at sea wear life-jackets?……Yes/~~No~~

MORTALITIES:

How are dead fish disposed of:……Morts are sent to College Proteins for disposal.
Did you observe this?…… ~~Yes~~/No

WATER QUALITY:

Is there any increase in the turbidity of the water?……~~Yes~~/No
Is there any visible trace of oil, fat or grease
on the water or on the shoreline? ……~~Yes~~/No
Is there any evidence of scum, froth or foam on the water?……~~Yes~~/No
Is there any litter or debris in the water?……~~Yes~~/No

OTHER COMMENTS:

All Structures and mooring grid are within the licensed area. Production and harvest of finfish from this site are within the licence limits.

Dispersion from Lehanagh Pool, Bertraghboy Bay, under different wind conditions

The dispersion of a generic disease outbreak from Lehanagh Pool, Bertraghboy Bay (53°24'2.53"N 9°49'7.39"W) is considered here using a particle-tracking model coupled to the 3D currents generated by a hydrodynamic model. The period under consideration is July 2018. Three 10-day simulations were run independently: (a) 1st July 00:00 to 11th July 00:00, (b) 11th July 00:00 to 21st July 00:00, (c) 21st July 00:00 to 31st July 00:00. In each of these simulations, a total of 100,000 particles were continuously released at 3-meters depth at Lehanagh Pool during the whole 10-day period, so that a wide range of oceanographic conditions were considered.

The currents in the area are mainly affected by tidal and wind-driven circulation. The wind pattern changed during the month, with the first 13 days characterized by changing easterly and westerly winds, whereas the rest of the month was dominated by westerly winds, which are predominant for most of the year (Fig. 1).

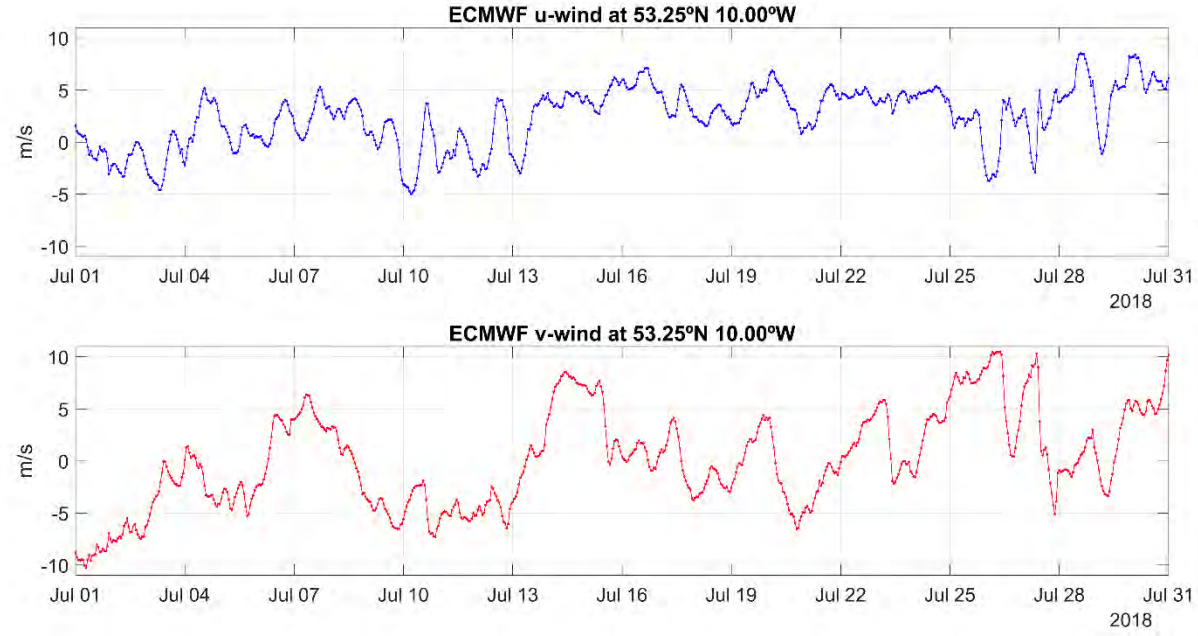


Figure 1. ECMWF winds near Lehanagh Pool in July 2018. (a) *u*-wind component, with positive values meaning westerly winds, and negative values meaning easterly winds. Notice the change in pattern after 13 July, with mostly westerly winds. (b) *v*-wind component, with positive values meaning southerly winds, and negative values meaning northerly winds. Again, notice the change in pattern before 13 July, with a combination of southerly and northerly winds, and after 13 July, with mostly southerly winds.

For each simulation, the results are presented in Figs. 2-4. The maps show the cumulative times (minutes) spent by all the particles (100,000) in 0.001°-resolution cells, both in latitude and longitude. In order to read the maps, the areas highlighted in warmer colours indicate higher residence times, or higher persistence of water, suspended solids and dissolved substances in a given area.

Fig. 2 shows the results for days 1-10. Here, there is greater export out of Bertraghboy Bay. When the surface currents from the hydrodynamic model are examined, it is clear that the wind regime has a large impact, with easterly and northerly winds causing a predominant outward surface circulation during most of the days, facilitating that water and dissolved and suspended substances leave the bay. Under this scenario, once the water leaves the bay, it will normally continue its way westward out of Galway Bay and to the Atlantic Ocean. It is important to highlight that these conditions are not predominant here.

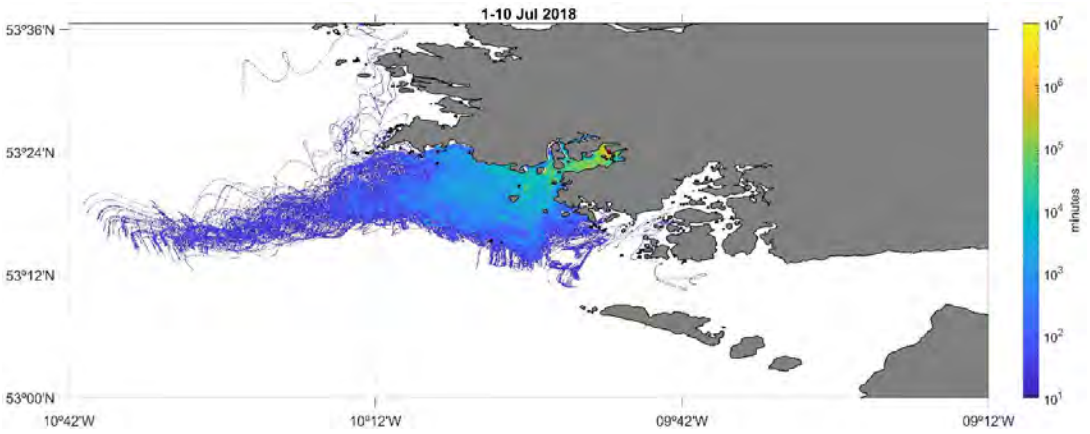


Figure 2. Cumulative retention times (min.) for run #1, from 1st to 10th of July

Southwesterly winds are far more common, typically linked to low-pressure systems. These conditions were predominant during the rest of the month (Figs. 3, 4). As a result, surface circulation at the entrance of Bertraghboy Bay is predominantly inwards, export out of the bay is reduced and there is greater retention within the bay. Fig. 3 can be regarded as a transition between Fig. 2 (easterly winds, outward flow, large export and low retention) and Fig. 4 (southwesterly winds, inward flow, almost full retention within Bertraghboy Bay).

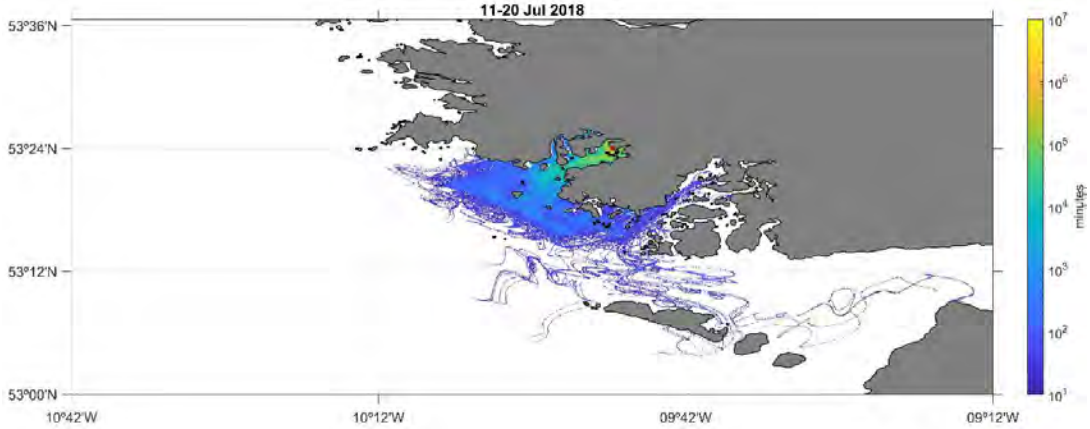


Figure 3. Cumulative retention times (min.) for run #2, from 11th to 20th of July

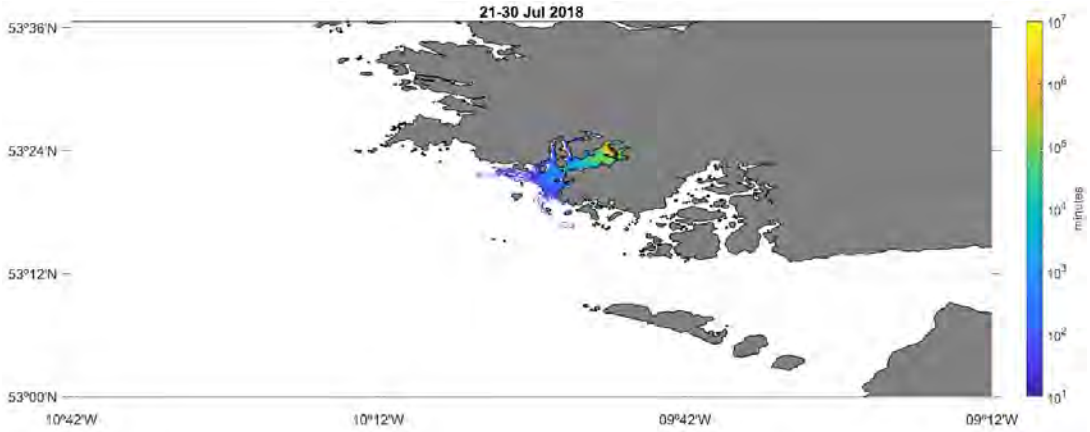


Figure 4. Cumulative retention times (min.) for run #3, from 21st to 30th of July

Figure 5 shows the impact of these different wind regimes on the surface circulation, with outward surface flow in run #1, and inward surface circulation in run #3, under the influence of the predominant southwesterly winds.

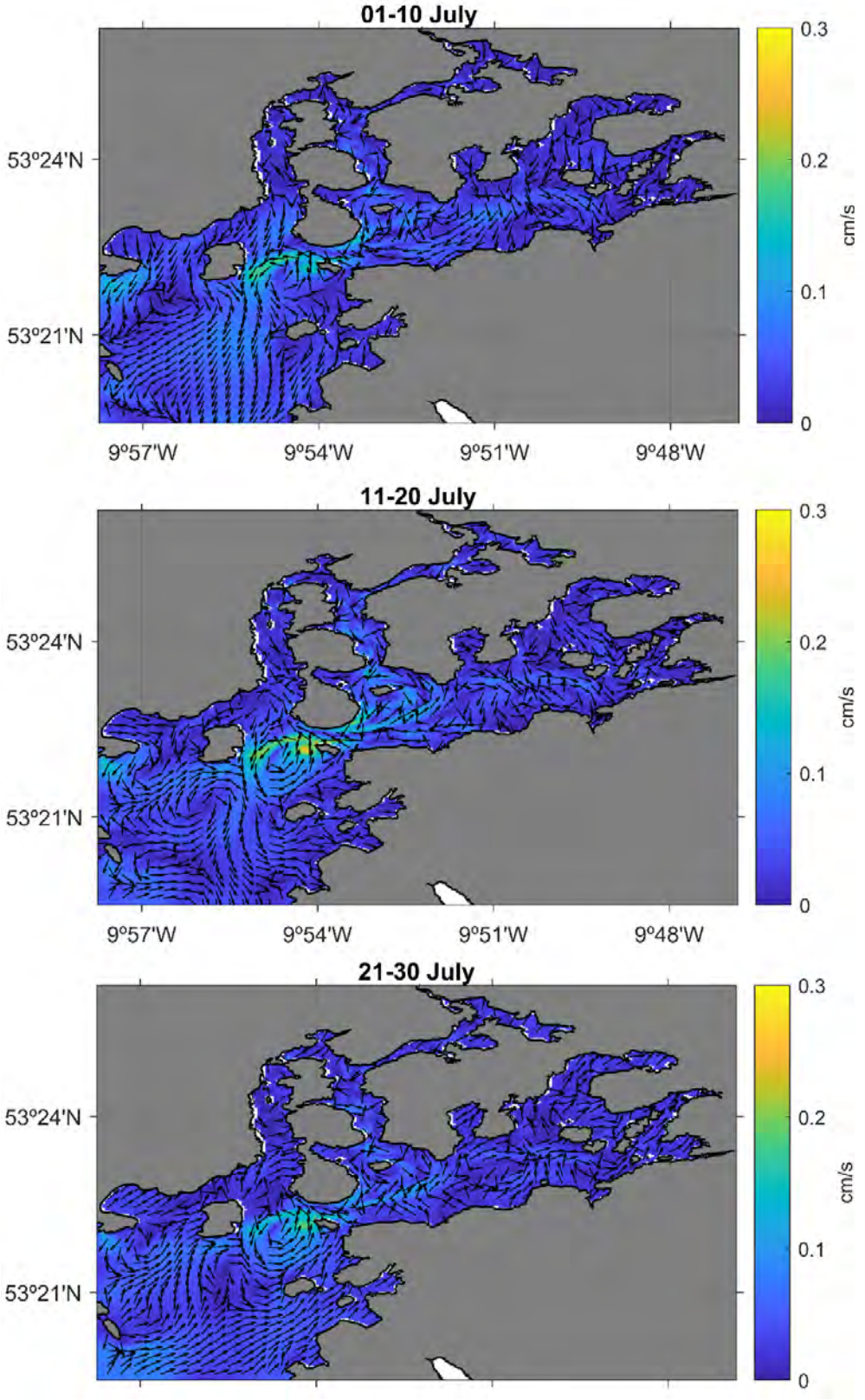


Figure 5. 10-day average surface circulation for runs #1 (top), #2 (middle), and #3 (bottom)

MODEL DESCRIPTION

This study was performed in Bertraghboy Bay, a semi enclosed bay on the West coast of Ireland.

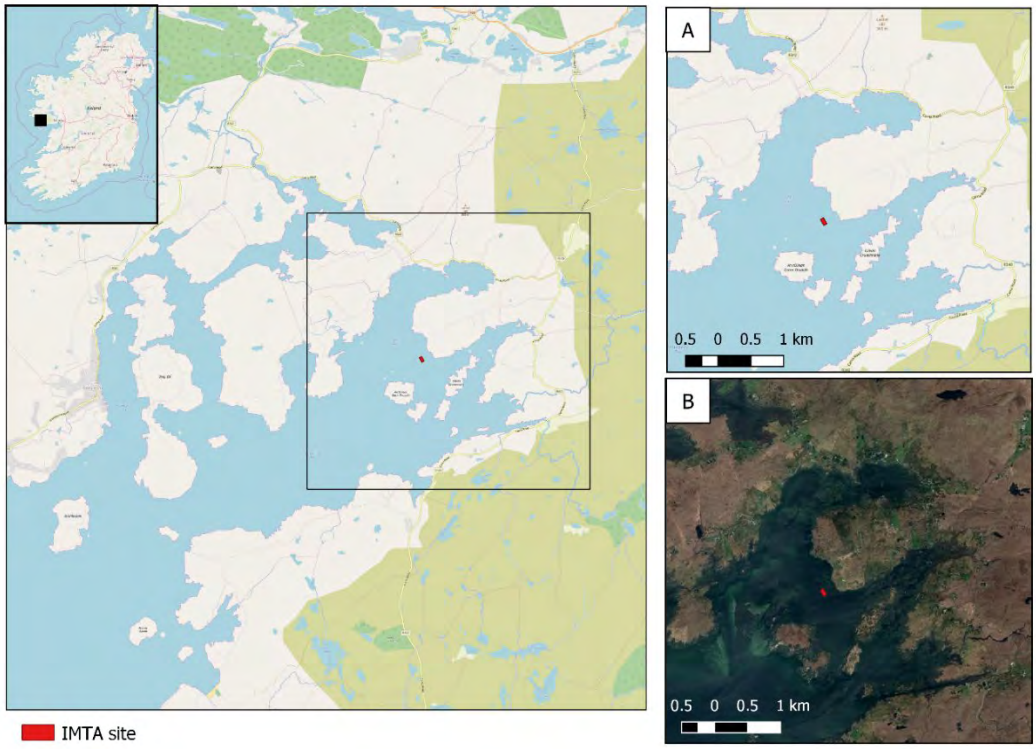


Figure 1: Location of the IMTA site in Bertraghboy Bay in the west of Ireland.

The site is within a sheltered enclosed area to the east of Bertraghboy Bay (Figure 1) that is shallow with low current flows. Current speeds and directions were measured using two Valeport Midas ECM current meters deployed over a 15-day period near the test site at an average of 9.6 m and 15 m water depths. The resulting tidal ellipse and cumulative vector plots for mid water and seabed currents are given in Figure 2. The mean current speeds were 0.040 and 0.028 m/s for mid water and seabed respectively, and residual currents and directions were 0.028 m/s at 171°N and 0.015 m/s at 180°N for mid water and seabed respectively. These are indicative of a location with poor current flow and little dispersive capacity for fish cage waste. Any discharge from the cages at this site are likely to be dispersed initially to the south and any particulate wastes would be deposited to the seabed close to the cages.

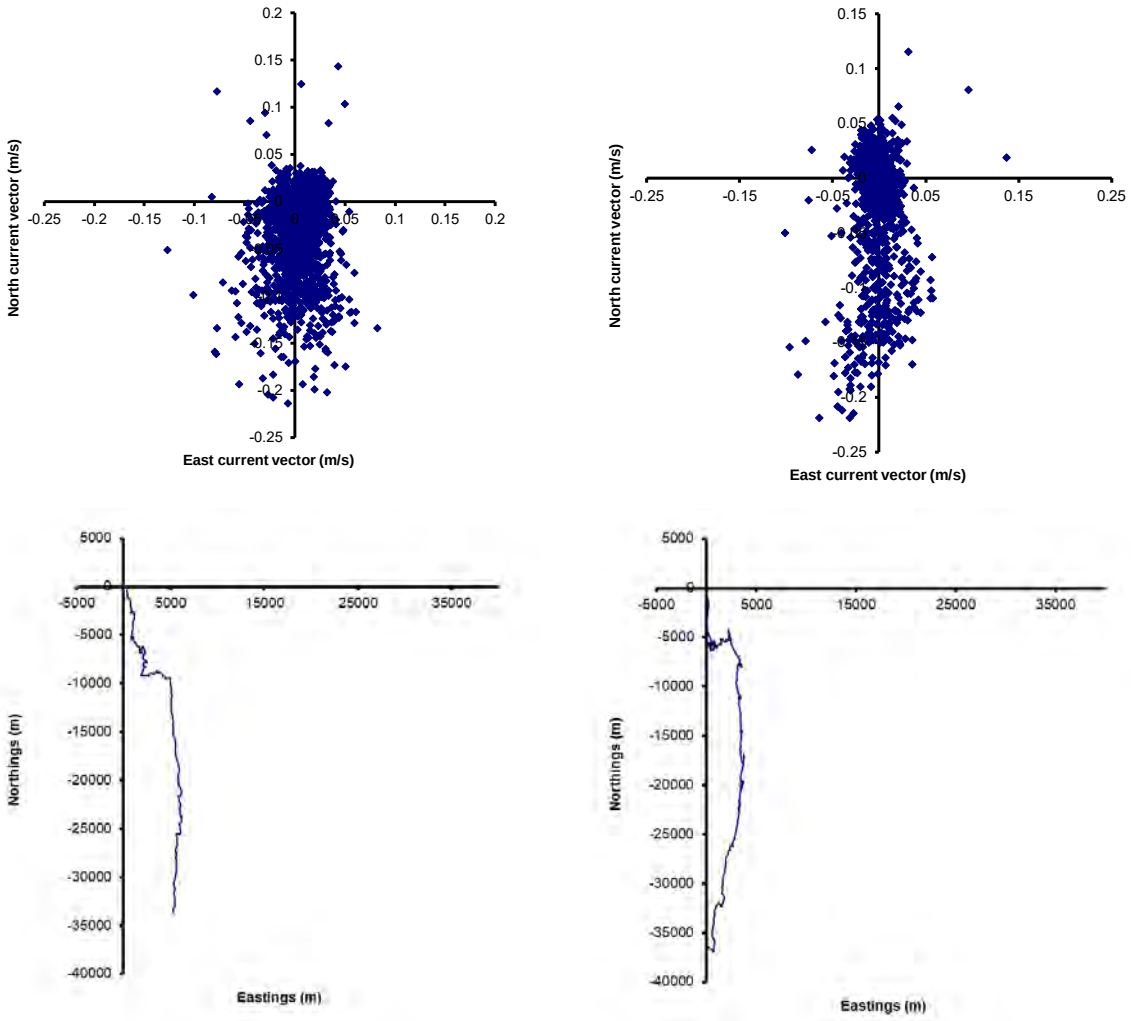


Figure 2: Tidal ellipse and cumulative vector plots for measured mid water and seabed currents over 15 days at the test site in Bertraghboy Bay.

A Regional Ocean Modelling System (ROMS) hydrodynamic model spanning the waters between (53°26'13.20"N, 9°57'43.20"W) and (53°19'30"N, 9°46'48"W) was established under the TAPAS project. The 3D model is based on the ROMS, a free-surface, hydrostatic, primitive equation ocean model described in Shchepetkin and McWilliams (2005)[1]. The grid has a horizontal resolution of 50x50m, with 10 vertical sigma layers. The timestep is 5s with 5 barotropic steps for stability. The model bathymetry (Figure 3) is a combination of LIDAR data from the INFOMAR database and admiralty chart 2709; admiralty data was necessary to fill gaps in the INFOMAR dataset in deeper waters (>20m) between the inside and the outside of the mouth of the bay.

[1] Shchepetkin, A. & McWilliams, J.C. 2005. The regional oceanic modelling system (ROMS): a split-explicit, free-surface, topography-following-coordinate oceanic model. Ocean Modelling 9: 347-404. https://doi.org/10.1016/j.ocemod.2004.08.002

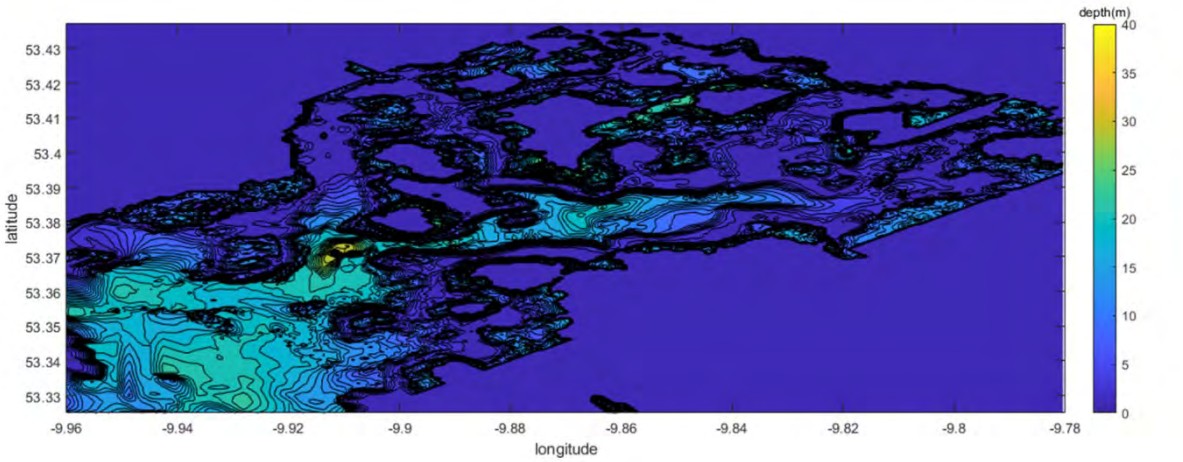


Figure 3: Bertraghboy model bathymetry

Initial conditions and 10-minute frequency boundary conditions for the model are taken from the operational MI Connemara hydrodynamic model (200x200m grid resolution), which itself is nested in the operational MI North East Atlantic hydrodynamic model (1.3x1.3km approx. grid resolution). The model is forced using three-hourly ECMWF atmospheric data comprising wind and thermal fluxes.

Five rivers were included in the model: Recess, Owengowla, Gowlabeg, Letterdife and Derrysillagh. Flow estimates for each river were derived from a rainfall-runoff regression model which was derived based on daily rainfall data from Met Éireann's weather station at Mace Head and flow measurements from the OPW for the river Cashla. Discharge data for Cashla was thus estimated from 2018 daily rainfall data, and flow percentiles were generated from the resultant time series. An expression was derived to relate flow percentiles from Cashla to flow percentiles for each of the five rivers, based on data made available from the Irish EPA Hydrotools service. Estimated flow time series for the five rivers discharging to Bertraghboy were consequently generated.

INTEGRATED PEST MANAGEMENT PLAN

LEHANAGH POOL MARINE RESEARCH SITE

2022

Contents

Integrated Pest Management Plan: Lehanagh Pool Marine Research Site

1. INTEGRATED PEST MANAGEMENT

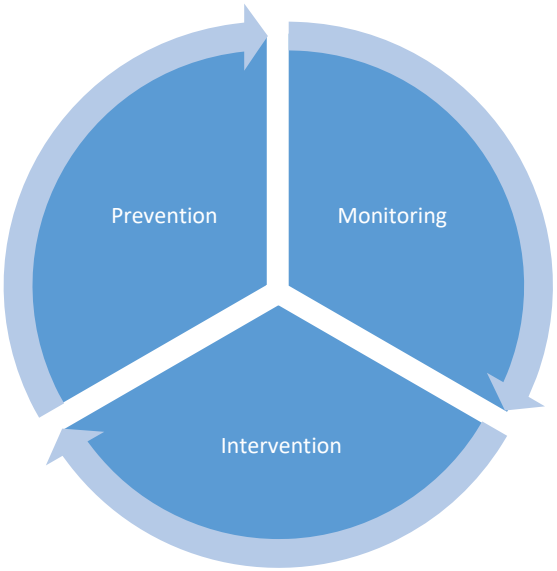
Integrated pest management (IPM) is an approach used to control pests in the agriculture sector and has been widely adopted in marine aquaculture for the control of parasitic infestations. The IPM approach can provide direct benefits to producers through regular monitoring enabling timely decisions based on observations and an optimum use of control methods considering the current health status of the stock, economic considerations, and potential environmental impacts.

The Lehanagh Pool site (T09/093A) is a research site run by the Marine Institute supporting a number of national and internationally funded research projects with particular focus on integrated multi-trophic aquaculture (IMTA). IMTA allows for the production of multiple species, from different trophic levels, within a location in a way that allows the outputs and wastes (e.g., nitrogen, phosphorus, etc.) associated with fed species e.g. Atlantic salmon, to be recaptured and be used as nutrients for the growth of the lower trophic species (e.g. seaweed utilising the nutrient output from fin fish). The site also contributes to ongoing environmental and water quality monitoring in the coastal marine environment.

Regulated by the Health Products Regulatory Authority (HPRA), Lehanagh Pool is an authorised establishment (AE19121) under the EU (Protection of Animals Used for Scientific Purposes) Regulations 2012 (SI 543 of 2012 as amended) and EU Directive 2010/63/EU[1].

[1] Directive 2010/63/EU of the European Parliament and of the Council on the protection of animals used for scientific purposes. Official Journal of the European Union L 276/33 – 79.

This Plan outlines the approach to be taken by the Marine Institute for the control of sea lice *Lepeophtheirus salmonis* and *Caligus elongatus* infestations at the Lehanagh Pool Marine Research Site.



Schematic outline of the Integrated Pest Management Plan for Lehanagh Pool.

2 PREVENTION

2.1 Single Bay Management

Single Bay Management has been in place for all Atlantic salmon farming areas in Ireland since 1997 and was designed to co-ordinate and ensure that husbandry practices on each farm in the management areas are compatible.

The Marine Institute will adhere to the principles of Single Bay Management:

- Fallowing – see section 2.2 below.
- Stocking – see section 2.2. below.
- Annual plans – a pest management plan will be developed for the control of sea lice at the site and will be updated annually as required.

- Health certification – all stocks of finfish will be certified prior to any movement on site as required under the EU 'Animal Health Law'[2]. A Fish Health Management Plan is updated annually.
- Husbandry practices – practices include daily monitoring of fish and infrastructure, regular removal of dead fish and at the end of each cycle all fish are removed, culled and disposed of in a rendering facility.
- The Marine Institute is also a member of the Bertraghboy Bay/Kilkieran Bay Coordinated Local Aquaculture Management System (CLAMS).

2.2 Stocking & Fallowing

Only a single generation of Atlantic salmon will be stocked on site at any one time. The current stocking regime is for S0 Atlantic salmon smolts to be stocked each year in late November until early March the following year. A second stocking of S1 Atlantic salmon smolts occurs in late April until the end of August/early September. This stocking plan is subject to change depending on the requirements of the specific projects being supported on site.

Fallowing will be undertaken for a minimum of 30 continuous days, twice per year, as outlined in the DAFM Protocol on Fallowing[3]. The site is fallowed of Atlantic salmon twice per year, from mid-March to late-April and from September to late-November, as outlined in the figure below.

An outline of the typical stocking and fallowing periods for the Lehanagh Pool Marine Research Site.

[2] Regulation (EU) 2016/429 of the European Parliament and of the Council on transmissible animal diseases and amending and repealing certain acts in the area of animal health ('Animal Health Law'). Official Journal of the European Union L 84/1 – 208.

[3] Department of the Marine & Natural Resources, 2000. Protocol for fallowing at offshore fin fish farms.

2.3 Health Management & Welfare

A fish health management programme is in operation and is outlined in the *Fish Health Management Plan* for the site, which is reviewed annually. All aspects of fish husbandry relating to disease are covered, in particular bio-security protocols preventing the introduction of pathogens and the containment of disease outbreaks should they occur. Feed stores are designed to prevent contamination by vermin and protocols dealing with the handling and feeding of fish are designed to prevent the spread of any aquatic pathogens.

The Lehanagh Pool Marine Research Site holds a valid Fish Health Authorisation (FHA-595). All fish are monitored daily and health checks are carried out routinely on a representative number of fish (the number of pens and fish examined is variable and depends on observed swimming behaviour and feeding patterns). Fish are also screened as pre-smolts prior to any movement on to the site, by the Fish Health Unit of the Marine Institute and subject to inspection by DAFM Veterinary Inspectors. Standard fish treatment and hygiene protocols are also documented in the *Fish Rearing Manual* for Lehanagh Pool. Fish husbandry procedures are also subject to inspection by HPRA under the protection of animals used for scientific purposes regulations.

3 MONITORING

3.1 Monitoring Requirements

At a minimum, sea lice monitoring is performed as outlined in Monitoring Protocol No. 3[4]. When Atlantic salmon are stocked on site, monitoring is performed on a fortnightly basis during the months of March – May and monthly thereafter. In practice, sea lice levels are monitored more frequently and if levels are deemed to be increasing appropriate action will be taken when required.

[4] Department of the Marine and Natural Resources, 2000. Monitoring protocol no. 3 for offshore finfish farms – sea lice monitoring and control.

3.2 Sampling

At least two pens on the site will be sampled on a monthly basis from June – February, and twice monthly from March – May, when fish are on site. Thirty fish per pen will be sampled at each inspection, depending on the numbers of fish stocked for the trials. There are currently five pens on site into which Atlantic salmon can be stocked, therefore at least 40% of the pens are sampled at each inspection.

3.3. Reporting

All reports are retained within the site record files and made available for inspection when required by DAFM Veterinary Inspectors and HPRA officers. Details to be recorded in each report include:

- Date of inspection
- Pen number and fish stock
- Total ovigerous females per fish – *L. salmonis* & *C. elongatus*
- Total adult male per fish – *L. salmonis* & *C. elongatus*
- Total adult female per fish – *L. salmonis* & *C. elongatus*
- Total mobile pre-adult per fish – *L. salmonis* & *C. elongatus*
- Water temperature, dissolved oxygen levels & *salinity*

4 INTERVENTION

4.1 Veterinary Medicines

Authorised veterinary medicines for the control of sea lice will not be routinely used on the site, with the exception of specific research projects authorised by HPRA.

4.2 Biological Control

Biological control of sea lice levels will be undertaken through the use of hatchery reared cleaner-fish. Currently, only lumpfish, *Cyclopterus lumpus* are available in Ireland. Lumpfish will primarily be used for the winter/spring stocking of S0 Atlantic salmon smolts at a rate of

4 – 10 lumpfish per 100 Atlantic salmon. Prior to movement on site, cleanerfish will be certified as disease free and all movements will be notified to the Fish Health Unit at the Marine Institute as required under the animal health law.

The cleanerfish will also contribute to small scale studies into the welfare and performance of these fish using a PIT tag antennae array. The array allows us to obtain an accurate reading on the number of cleanerfish in a pen and their movements in relation to feeding (choice of diets) and habitat preference (choice of hides).

4.3 Freshwater/Hyposaline Bathing

When required, sea lice levels will be controlled during the spring/summer input of S1 Atlantic salmon smolts by freshwater/hyposaline bathing. In conjunction with BIM, the Lehanagh Pool site uses a reverse osmosis (RO) unit producing potable water from sea water. RO removes virtually all salt and other impurities (Fig 1). This yields ion-modified water with greatly reduced content of salt and heavy metals. Technically the RO unit achieves purity using membranes with pore sizes < 1 nm (0.001 µm). Practically all dissolved solids are retained, what passes the membrane is based on solubility and diffusion in the membrane material itself. Pressure is the driving force for the separation, and in RO plants pressures from 30 to 85 bar must be applied. With the help of RO, it is now possible for organic farms to be independent of a freshwater source on land, transforming sea water to fresh water and in so doing maximizing biosecurity.

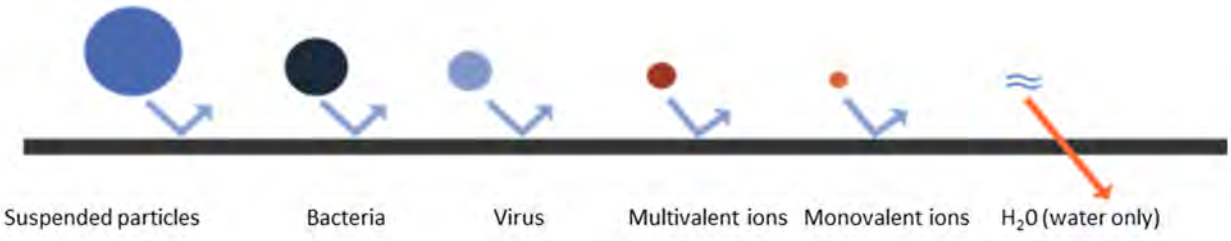


Fig. 1. Reverse osmosis (RO) with pore size < 0.001 µm producing freshwater

A tarpaulin pen (5 x 5 x 2 m) is filled with hyposaline water with the fish to be treated pumped into the pen for a minimum four-hour bathing period, before being pumped back to their

original pen (Fig. 2). This method has been shown to be effective in the control of both sea lice and amoebic gill disease[5].

Fig. 2. Bathing pen filled with RO hyposaline water for sea lice/AGD treatments.

[5] McDermott et al. 2021. Novel use of nanofiltered hyposaline water to control sea lice and amoebic gill disease, on a commercial Atlantic salmon farm. Aquaculture Reports 20, 100703.