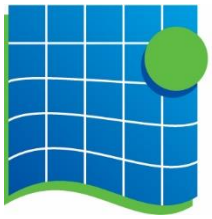

Foras na Mara
Marine Institute

A Review of Benthic Monitoring at Irish Finfish Aquaculture Sites During 2021

Marine Institute

Report Submitted to

Aquaculture and Foreshore Management Division,

Department of Agriculture, Food and the Marine

24th February 2022

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1. Glossary

ARPD – Apparent Redox Potential Discontinuity

AZE – Allowable Zone of Effect

BIM – Bord Iascaigh Mhara

LOI – Loss On Ignition

MI – Marine Institute

OM – Organic Matter

REDOX – REDuction OXygenation in marine sediments

DAFM- Department of Agriculture, Food and Marine

BAP- Benthic Amelioration Plan

2. Overview of the Benthic Monitoring Programme

In May 2000, following consultation with the industry and a number of statutory bodies (including the MI and BIM) the first version of a series of protocols detailing monitoring requirements at marine finfish farm sites was published by the Department of Communications Marine and Natural Resources. In August 2001, a revised Benthic Protocol was produced following consultation with industry and regulators. In 2008, the benthic protocol 'Monitoring Protocol No.1 for Offshore Finfish Farms-Benthic Monitoring, 2008' was reviewed and further revised which consisted of the inclusion of OM and REDOX (ARPD) as additional parameters to be measured. Also, AZE were established wherein varying levels of acceptable impact (thresholds) were defined. The Benthic Protocol is available on the DAFM website.[1]

Since 2008, it has been established[2] that all sites where marine finfish aquaculture was licenced would be subject to the Benthic Protocol, including those sites where benthic monitoring was not explicitly stated as a Condition in the licence. It is, therefore, the understanding of the Marine Institute that benthic monitoring is now a requirement for all marine finfish aquaculture sites in Ireland.

An annual report is prepared by the Marine Institute and submitted to DAFM and includes a review of the marine fish farm benthic survey reports received by the Benthos Ecology Group of the Marine Institute for surveys conducted during the previous year and a comment on their compliance with the

[1] https://assets.gov.ie/99270/feed7128-f7b3-4632-b192-0848a646159e.pdf

[2] Communication between MI and DAFF on Feb 12, 2009.

standards identified in the protocol. This report deals with marine surveys conducted during 2021. Comments on compliance with reporting requirements are also included.

Since the 2014 reporting cycle, there have been changes to the manner in which sites are assessed and reported on based on the audits provided by the consultants. The level of reporting compliance continues to be provided in this report, as before. In relation to environmental compliance a site would be deemed acceptable or unacceptable based on the information provided in the audits. As of the 2015 report, the classification is as follows:

1) **Acceptable**- conditions within the environmental standards stated in the Benthic Protocol.
2) **Not acceptable**- conditions not within the environmental standards stated in the Benthic Protocol.
3) **Indeterminate**- Essential information e.g. Residual Current direct, maximum biomass and current speed missing which prohibits judgement regarding the environmental condition at the site.

This change, the introduction of the 'indeterminate' classification, is due to reports being submitted with important technical information missing (e.g., residual current direction, stocking data, LOI, visual description, etc.).

3. Level of Reporting Compliance

In order to verify the number of sites that might be subject to the Benthic Protocol in 2021, the Marine Institute relied on a number of information sources:

1) Communication from operators responding to reminders from DAFM.
2) Direct communication by Marine Institute with operators allied with a review of other monitoring programmes (e.g. residues and sea lice programs).
3) Review of fish movements authorised under Council Directive 2006/88/EC.

On the basis of the information supplied, the MI determined that monitoring surveys were required at a total of 25 sites during 2021. A list of sites which were required to have surveys carried out and the level of compliance is provided in *Table 1* below.

Nationally, the level of reporting compliance with the Benthic Protocol during 2021 was 24 sites out of 25 eligible sites i.e. representing (96%) reporting compliance (*Table 2*). This is an increase on reporting compliance in 2020 (89.6%).

Table 1: List of marine finfish farms subject to benthic protocols at year-end 2021 and number of reports submitted

Location	Company (Licensee)	No. of sites eligible for survey during 2021	No. reports Submitted for 2021
Donegal			
Lough Swilly – T12/085	MOWI	1	1
Mulroy Bay – T12/077A, T12/077C, T12/077F, T12/77/7	MOWI	4	4
Inver Bay – T12/276	Ocean Farm	1	1
Inver Bay – T12/063A	MOWI	1	1
McSwyne's Bay – T12/266	Ocean Farm	1	1
Mayo			
Clew Bay – T10/058A, T10/058B	MOWI	2	2
Bellacragher Bay – T10/051	Curraun Fisheries Ltd	1	0
Galway			
Ballinakill Harbour – T09/132A	Mannin Bay Salmon Company Ltd	1	1
Clifden Bay – T09/096B, T09/127	Mannin Bay Salmon Company Ltd	2	2
Killary Harbour – T09/143	Curran Fisheries Ltd.	1	1
Betraghboy Bay – T09/107	MOWI	1	1
Betraghboy Bay – T09/093A	Marine Institute	1	1
Kilkieran Bay- T09/114, T09/136A, T09/141A	Bradan Beo Teoranta	3	3
Mannin Bay site –T09/140	Mannin Bay Salmon Company Ltd.	1	1
Kerry/Cork			
Bantry Bay –T05/444D, T05/444E	MOWI	2	2
Kenmare Bay – T05/233, T06/202	MOWI	2	2
TOTAL		**25**	**24**

4. Compliance with Environmental Guidelines

Of the 24 sites which provided survey reports in 2021, 12 demonstrated conditions that were within environmental standards and thus deemed acceptable as per the Benthic Protocol, 11 sites were unacceptable due to conditions not meeting the environmental standards as stated in the Benthic Protocol and 1 site was missing essential information therefore was deemed indeterminate (*Table 2 and Section 6*)

Table 2: Summary of compliance with reporting requirements and environmental standards 2001 – 2021.

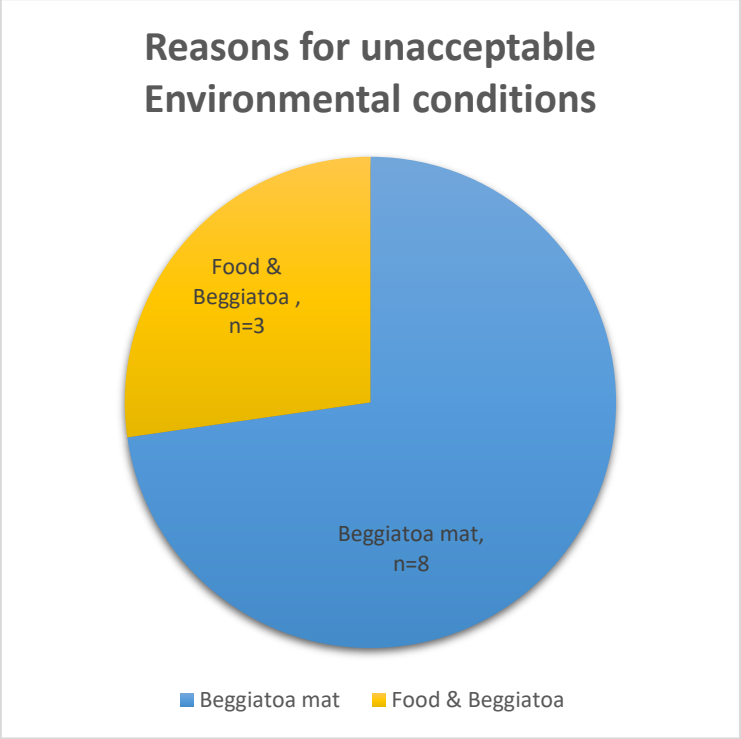
Year	**Number of sites eligible for survey**	***Reporting Compliance***	***Surveyed Sites Compliant with Environmental Standards***
2001	**27**	**65%** (17/27)	**94%**
2002	**55**	**62%** (34/55)	**94%**
2003	**54**	**54%** (29/54)	**100%**
2004	**50**	**50%** (25/50)	**100%**
2005	**48**	**60%** (29/48)	**100%**
2006	**36**	**80.5%** (29/36)	**100%**
2007	**34**	**91%** (31/34)	**100%**
2008	**35**	**43%** (15/35)	**100%**
2009	**34**	**44%** (15/34)	**100%**
2010	**28**	**68%** (19/28)	**89%**
2011	**28**	**53.5%** (15/28)	**80%**
2012	**29**	**65.5%** (19/29)	**79%**
2013	**30**	**60%** (18/30)	**88%**
2014	**27**	**81%** (22/27)	**54%**
2015	**26**	**69.23%** (18/26)	**100%**
2016	**24**	**37.5%** (9/24)	**88%**
2017	**28**	**70.4%** (19/27)	**74%**
2018	**23**	**92%** (23/25)	**91%**
2019	**28**	**96.4%** (27/28)	**78%**
2020	**29**	**89.6% (26/29)**	**84.6%**
2021	**25**	**96% (24/25)**	**50% (12/24)**

In 2021, the unacceptable environmental conditions were detected for two parameters:

1) Bacterial mats, e.g., *Beggiatoa* - *Beggiatoa* mat >50% within the AZE or Beggiatoa patches present outside AZE.
2) Food & *Beggiatoa*- Excessive waste feed within AZE and *Beggiatoa* mat >50% within the AZE or Beggiatoa patches present outside AZE.

Figure 1 summarises the findings in relation to sites that were non-compliant with environmental standards.

Figure 1: Reasons for unacceptable environmental conditions 2021



5. Overview and Recommendations for 2021 Audits

The number of sites for which surveys have been completed at sites that require benthic monitoring in 2021 (24/25) is an improvement on 2020 (26/29). Whereas levels of environmental compliance have decreased since 2020 (at 84.6%) with only 50% of the sites deemed acceptable in 2021. *Table 3* below provides an overview of environmental compliance for 2021.

Recommendations:

1) Section 13 (Remedial Action) of the Benthic protocol states that a 'Benthic Amelioration Plan (BAP) with the aim of achieving an acceptable benthic standard in the licensed area' should be submitted. A subsequent survey of the site will determine if this plan has been successful. Remedial actions for non-compliant sites in the past have been very low. Given the high number of non-compliant site in 2021 and the number of sites that have been non-compliant consecutively for 2 (n=1) and 3 years (n=2), it is recommended particular attention is paid to development of appropriate BAP's.
2) The MI consider that the use of one reference station per site as recommended in the Benthic Protocol does not enable a robust assessment of ecological effects at finfish farm sites. This deficiency was highlighted by the MI in 2016, when a revised version of the protocol was submitted for review to DAFM. In this revised document it is suggested that a minimum of three reference stations should be used. This would allow for accurate representation of natural variability in unaffected (reference) areas of the site and provide for meaningful comparison of potentially affected areas with reference conditions. The status of this revision is currently uncertain.
3) The values of parameters (maximum licenced biomass on site and mean current speed) used to determine the level of survey conducted should be clearly presented and defined. Maximum licenced biomass was not reported in any of the 24 reports received in 2021. All reports provided biomass at time of survey, it is unclear if this is also the maximum biomass licensed for the site.
4) The rationale for the selection of location and direction of the survey transect should be clearly communicated in the survey report. It has been noted that 10 of the 24 reports received did not identify the residual current direction. This raises questions regarding the suitability of some transects. When transects are chosen to run against the residual current this minimises the potential detection of any likely impact. As clearly identified in the protocols, it is important that transects are located at the areas likely to receive most impact from the cage group. Any deviation from this should be clearly communicated in the report and justified.

Direction of residual current should be clearly noted. The residual current is the direction of predicted spatial spread of organic waste over a full production cycle at a fish farm site.

Table 3: Overview of Environmental compliance 2021 (green cells represents acceptable environmental conditions; white cell represents indeterminate environmental conditions and red cells represent unacceptable environmental conditions).

DAFM site reference	Accumulated feed within AZE	Feed pellets outside AZE	Bacterial mat >50% within AZE	Bacterial mat outside AZE	Average %LOI within AZE <threshold value	Average %LOI outside AZE <threshold value
T05/233						
T05/444D						
T05/444E						
T06/202						
T09/093A						
T09/096B						
T09/107						
T09/114						
T09/127						
T09/132A						
T09/136A						
T09/140						
T09/141A						
T09/143						
T10/058A						
T10/058B						
T12/063A						
T12/077A						
T12/077C						
T12/077F						
T12/085						
T12/77/7						
T12/266						
T12/276						

6. Individual Farm Site Reports and Feedback

Monitoring Protocol No. 1 for Offshore Finfish Farms - Benthic Monitoring Individual Site Review			
Licensed Operator	MOWI Ireland Ltd.		
DAFM site code	T05/233		
Species	Salmon		
Date of survey	30th April 2021		
Stocking details	1141 T on site at time of survey		
Mean bottom current speed	20cm/sec mean current speed		
Maximum licensed Biomass	Not reported		
Level of Benthic Monitoring	1		
Direction of residual current flow	East to West		
Accumulated feed within AZE?	Yes	**Feed pellets beyond the AZE?**	No
Bacterial mat >50% within AZE?	Yes	**Bacterial mat outside of AZE?**	No
Visual Assessment- Overview	Bacterial mat and excess feed seen at a number of stations.		
Faunal analysis (Level 2 only)	N/A	N/A	
Redox Potential	4.8cm to 8.6cm at reference station. 0cm to 12.9cm at all other stations.		
Average %LOI within AZE	7.19	**Threshold value within AZE**	9.64
Average %LOI outside AZE	4.47	**Threshold value outside AZE**	6.02
Overall Assessment of Conditions	Unacceptable. Bacterial mat and feed pellets above allowable levels under and close to the cages.		
Previous Assessment	Acceptable 2020		

Monitoring Protocol No. 1 for Offshore Finfish Farms - Benthic Monitoring Individual Site Review			
Licensed Operator	MOWI Ireland Ltd.		
DAFM site code	T05/444D		
Species	Salmon		
Date of survey	9th September 2021		
Stocking details	943 T on site at time of survey. Stocked October 2020. Onsite biomass production of 877.5 T.		
Mean bottom current speed	5.9cm/sec mean current speed		
Maximum licensed Biomass	Not reported		
Level of Benthic Monitoring	2		
Direction of residual current flow	East- West		
Accumulated feed within AZE?	No	**Feed pellets beyond the AZE?**	No
Bacterial mat >50% within AZE?	Yes	**Bacterial mat outside of AZE?**	No
Visual Assessment- Overview	Bacterial mat >50%under T1, confined to under the cage only.		
Faunal analysis (Level 2 only)	4 groupings: a- Under b- T2 Edge c- T2 10M, T2 20M, T2 50M T1 Edge, T1 10m, T1 20m, REF		
Redox Potential	0.5cm to 10.4cm at reference station. 0cm to 16.7cm at all other stations.		
Average %LOI within AZE	10.66	**Threshold value within AZE**	10.28
Average %LOI outside AZE	7.73	**Threshold value outside AZE**	6.42
Overall Assessment of Conditions	Unacceptable		
Previous Assessment	Acceptable 2020		

Monitoring Protocol No. 1 for Offshore Finfish Farms - Benthic Monitoring Individual Site Review			
Licensed Operator	MOWI Ireland Ltd.		
DAFM site code	T05/444E		
Species	Salmon		
Date of survey	9th September 2021		
Stocking details	709 T on site at time of survey. Stocked October 2020. Onsite biomass production of 666 T.		
Mean bottom current speed	5.9cm/sec mean current speed		
Maximum licensed Biomass	Not reported		
Level of Benthic Monitoring	2		
Direction of residual current flow	East- West		
Accumulated feed within AZE?	Yes	**Feed pellets beyond the AZE?**	No
Bacterial mat >50% within AZE?	Yes	**Bacterial mat outside of AZE?**	No
Visual Assessment- Overview	Bacterial mat >50%under T1, Edge, T1 10m, T1 20m, Excess feed observed under the cage.		
Faunal analysis (Level 2 only)	3 groupings in MDS: a- T2 20m, T2 50m, Ref b- T1 Edge c- Under, T1 10M, T1 20m, T1 50m, T1 100m, T2 Edge and T2 10m.		
Redox Potential	3.2cm to 11.7cm at reference station. 0cm to 21.9cm at all other stations.		
Average %LOI within AZE	9.40	**Threshold value within AZE**	10.48
Average %LOI outside AZE	4.49	**Threshold value outside AZE**	6.55
Overall Assessment of Conditions	Unacceptable		
Previous Assessment	Acceptable 2020		

Monitoring Protocol No. 1 for Offshore Finfish Farms - Benthic Monitoring Individual Site Review			
Licensed Operator	MOWI Ireland Ltd.		
DAFM site code	T06/202		
Species	Salmon		
Date of survey	8th September 2021		
Stocking details	455 T on site at time of survey. Stocked February 2021		
Mean bottom current speed	30cm/sec mean current speed		
Maximum licensed Biomass	Not reported		
Level of Benthic Monitoring	1		
Direction of residual current flow	North to South		
Accumulated feed within AZE?	No	**Feed pellets beyond the AZE?**	No
Bacterial mat >50% within AZE?	Yes	**Bacterial mat outside of AZE?**	No
Visual Assessment- Overview	Bacterial mat cover out to 10m on T1 and edge on T2.		
Faunal analysis (Level 2 only)	N/A	N/A	
Redox Potential	2cm to 4.7cm at reference station. 0cm to 5.1cm at all other stations. Depth increased with distance from the cage.		
Average %LOI within	6.21	**Threshold value within AZE**	6.62
Average %LOI outside AZE	2.82	**Threshold value outside AZE**	4.13
Overall Assessment of Conditions	Unacceptable. Bacterial mat >50% under and close to cage.		
Previous Assessment	Acceptable 2020		

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	Mannin Bay Salmon Company Ltd.		
DAFM site code	T09/096B		
Species	Salmon		
Date of survey	12/05/2021		
Stocking details	Fallow for 10 years prior to stocking in Feb 2021 with 172 T of fish these were then harvested end of March 2021. No fish onsite at time of survey.		
Mean bottom current speed	Mean current speed 10 cm/sec		
Maximum licensed Biomass	Not reported		
Level of Benthic Monitoring	1		
Direction of residual current flow	NW-SW		
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 obvious signs of impact from aquaculture practices.		
Faunal analysis (Level 2 only)	N/A	N/A	
Redox Potential	0.5cm to 10.1cm at reference statin. 0.1cm to 13.5cm at all other stations.		
Average %LOI, Threshold within and outside AZE	The environmental survey report states: 'Due to the fact that there were no pens on site, and therefore no fish production, only one sample was taken as a reference value for the Ardbear site.'		
Overall Assessment of Conditions	Indeterminate		
Previous Assessment	None		

Monitoring Protocol No. 1 for Offshore Finfish Farms - Benthic Monitoring Individual Site Review			
Licensed Operator	MOWI Ireland Ltd.		
DAFM site code	T09/107		
Species	Salmon		
Date of survey	12th April 2021		
Stocking details	No fish onsite at time of survey. Harvested 25th March 2021.		
Mean bottom current speed	2.3cm/sec mean current speed.		
Maximum licensed Biomass	Not reported		
Level of Benthic Monitoring	1		
Direction of residual current flow	East to West		
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	0.5cm to 9.2cm at reference station. 0.1cm to 13.6cm at all other.		
Average %LOI within AZE	10.37	**Threshold value within AZE**	14.90
Average %LOI outside AZE	8.31	**Threshold value outside AZE**	9.31
Overall Assessment of Conditions	Acceptable		
Previous Assessment	Acceptable 2020		

Monitoring Protocol No. 1 for Offshore Finfish Farms - Benthic Monitoring Individual Site Review			
Licensed Operator	Bradan Beo Teoranta		
DAFM site code	T09/114		
Species	Salmon		
Date of survey	26th July 2021		
Stocking details	Stocked October 2019. 254,536 T harvested June 2021[3]. Fallow at time of survey.		
Mean bottom current speed	Mean max current 0.3m/sec		
Maximum licensed Biomass	Not reported		
Level of Benthic Monitoring	1		
Direction of residual current flow	Northwest to Southeast		
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	1cm to 10.5cm at reference station. 0cm to 11.8cm at all other. Depth increased with distance from the cages.		
Average %LOI within AZE	4.96	**Threshold value within AZE**	9.36
Average %LOI outside AZE	4.97	**Threshold value outside AZE**	5.85
Overall Assessment of Conditions	Acceptable		
Previous Assessment	Acceptable 2020		

[3] '254,536 T harvested' was derived from the benthic report submitted by the operator. It is clear this is an error.

Monitoring Protocol No. 1 for Offshore Finfish Farms - Benthic Monitoring Individual Site Review				
Licensed Operator	Mannin Bay Salmon Company Ltd.			
DAFM site code	T09/127			
Species	Salmon			
Date of survey	12th May 2021			
Stocking details	Stocked November 2019. These fish were relocated giving an onsite biomass production of 20 T prior to the audit. No fish onsite at time of survey.			
Mean bottom current speed	Mean current speed 10cm/sec			
Maximum licensed Biomass	Not reported			
Level of Benthic Monitoring	1			
Direction of residual current flow	NW-SW			
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 obvious signs of impact from aquaculture practices.			
Faunal analysis (Level 2 only)	N/A		N/A	
Redox Potential	0.1cm to 9.5cm at reference station. 0.0cm to 13.5cm at all other stations.			
Average %LOI within AZE	13.80	**Threshold value within AZE**		19.2
Average %LOI outside AZE	12.79	**Threshold value outside AZE**		11.88
Overall Assessment of Conditions	Acceptable			
Previous Assessment	Acceptable 2019			

Monitoring Protocol No. 1 for Offshore Finfish Farms - Benthic Monitoring Individual Site Review			
Licensed Operator	Mannin Bay Salmon Company Ltd.		
DAFM site code	T09/132A		
Species	Salmon		
Date of survey	5th July 2021		
Stocking details	Stocked in November 2020 with 21.5 T of fish. 347.75 T onsite at time of survey.		
Mean bottom current speed	Mean current speed 25cm/sec		
Maximum licensed Biomass	Not reported		
Level of Benthic Monitoring	1		
Direction of residual current flow	North-South		
Accumulated feed within AZE?	Yes	**Feed pellets beyond the AZE?**	No
Bacterial mat >50% within AZE?	Yes	**Bacterial mat outside of AZE?**	No
Visual Assessment- Overview	Bacterial mat > 50% coverage under the cage. Large amounts of excess feed also seen.		
Faunal analysis (Level 2 only)	N/A	N/A	
Redox Potential	0.7cm to 6.3cm at reference station. 0cm to 18.2cm all other stations.		
Average %LOI within	11.14	**Threshold value within AZE**	12.98
Average %LOI outside AZE	8.21	**Threshold value outside AZE**	8.11
Overall Assessment of Conditions	Unacceptable		
Previous Assessment	Acceptable 2019		

Monitoring Protocol No. 1 for Offshore Finfish Farms - Benthic Monitoring Individual Site Review			
Licensed Operator	Bradan Beo Teoranta		
DAFM site code	T09/136A		
Species	Salmon		
Date of survey	12th July 2021		
Stocking details	Stocked Oct 2020. 553 T on site at time of survey.		
Mean bottom current speed	Mean maximum 0.2m/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?	No	**Bacterial mat outside of AZE?**	No
Visual Assessment- Overview	Some casts close to cage		
Faunal analysis (Level 2 only)	N/A	N/A	
Redox Potential	0.5cm to 6cm at Reference station. 0.1cm to 13.5cm at all other stations		
Average %LOI within	8.45	**Threshold value within AZE**	14.58
Average %LOI outside AZE	8.06	**Threshold value outside AZE**	9.11
Overall Assessment of Conditions	Acceptable		
Previous Assessment	Acceptable 2020		

Monitoring Protocol No. 1 for Offshore Finfish Farms - Benthic Monitoring Individual Site Review			
Licensed Operator	Mannin Bay Salmon Company Ltd.		
DAFM site code	T09/140		
Species	Salmon		
Date of survey	5th July 2021		
Stocking details	Stocked June 2021 with 220 T. 180.6 T on site at time of survey.		
Mean bottom current speed	Mean current speed 10cm/sec		
Maximum licensed Biomass	Not reported		
Level of Benthic Monitoring	1		
Direction of residual current flow	Northwest- southeast		
Accumulated feed within AZE?	No	**Feed pellets beyond the AZE?**	No
Bacterial mat >50% within AZE?	Yes	**Bacterial mat outside of AZE?**	No
Visual Assessment- Overview	Beggiatoa mat >50% coverage Under T1 and Edge T2.		
Faunal analysis (Level 2 only)	N/A	N/A	
Redox Potential	3.5 to 9.5cm at reference station. 0.0 to 12.2cm at all other stations.		
Average %LOI within AZE	8.15	**Threshold value within AZE**	18.82
Average %LOI outside AZE	7.36	**Threshold value outside AZE**	11.76
Overall Assessment of Conditions	Unacceptable		
Previous Assessment	None		

Monitoring Protocol No. 1 for Offshore Finfish Farms - Benthic Monitoring Individual Site Review			
Licensed Operator	Bradan Beo Teoranta		
DAFM site code	T09/141A		
Species	Salmon		
Date of survey	12th July 2021		
Stocking details	Stocked March 2021		
Mean bottom current speed	Mean max current 0.1m/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?**	No
Visual Assessment- Overview	Bacterial mat >50% at edge of the cage T2.		
Faunal analysis (Level 2 only)	N/A	N/A	
Redox Potential	0.1cm to 8.2cm at reference station. 0cm to 17.4cm at all other. Depth increased with distance from the cages.		
Average %LOI within AZE	16.56	**Threshold value within AZE**	34.92
Average %LOI outside AZE	16.96	**Threshold value outside AZE**	21.82
Overall Assessment of Conditions	Unacceptable		
Previous Assessment	None previously received by the Marine Institute.		

Monitoring Protocol No. 1 for Offshore Finfish Farms - Benthic Monitoring Individual Site Review			
Licensed Operator	Curran Fisheries Ltd.		
DAFM site code	T09/143		
Species	Salmon		
Date of survey	26th July 2021		
Stocking details	1051 T were harvested 30th June 2021. Stocked November 2019		
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	Overall healthy appearance		
Faunal analysis (Level 2 only)	N/A	N/A	
Redox Potential	0.5cm to 6.6cm at reference station. 0cm to 14.8cm at all other stations.		
Average %LOI within AZE	23.39	**Threshold value within AZE**	36.4
Average %LOI outside AZE	20.34	**Threshold value outside AZE**	22.75
Overall Assessment of Conditions	Acceptable		
Previous Assessment	Acceptable 2020		

Monitoring Protocol No. 1 for Offshore Finfish Farms - Benthic Monitoring Individual Site Review			
Licensed Operator	MOWI Ireland Ltd.		
DAFM site code	T10/058A		
Species	Salmon		
Date of survey	26th May 2021		
Stocking details	140 T on site at time of survey. Stocked March 2020.		
Mean bottom current speed	Mean midwater current 12.4cm/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?	No	**Bacterial mat outside of AZE?**	No
Visual Assessment- Overview	Overall healthy appearance.		
Faunal analysis (Level 2 only)	N/A	N/A	
Redox Potential	0.1cm to 4.6cm at reference station. 0cm to 4.9cm at all other.		
Average %LOI within	2.73	**Threshold value within AZE**	4.76
Average %LOI outside AZE	2.77	**Threshold value outside AZE**	2.97
Overall Assessment of Conditions	Acceptable		
Previous Assessment	Acceptable 2020		

Monitoring Protocol No. 1 for Offshore Finfish Farms - Benthic Monitoring Individual Site Review			
Licensed Operator	MOWI Ireland Ltd.		
DAFM site code	T10/058B		
Species	Salmon		
Date of survey	26th May 2021		
Stocking details	1679 T on site at time of survey. Stocked March 2020.		
Mean bottom current speed	Mean midwater current 7.8cm/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?	No	**Bacterial mat outside of AZE?**	No
Visual Assessment- Overview	Waste feed and bacterial mat close to the cage within the allowable amount for within the AZE.		
Faunal analysis (Level 2 only)	N/A	N/A	
Redox Potential	0.1cm to 6.4cm at reference station. 0cm to 8.1cm at all other.		
Average %LOI within AZE	2.01	**Threshold value within AZE**	4.04
Average %LOI outside AZE	2.02	**Threshold value outside AZE**	2.52
Overall Assessment of Conditions	Acceptable		
Previous Assessment	Acceptable 2020		

Monitoring Protocol No. 1 for Offshore Finfish Farms - Benthic Monitoring Individual Site Review			
Licensed Operator	MOWI Ireland Ltd.		
DAFM site code	T12/063A		
Species	Salmon		
Date of survey	22nd April 2021		
Stocking details	492.1 T harvested April 1st.		
Mean bottom current speed	Mean current speed 5.3cm/sec		
Maximum licensed Biomass	Not reported		
Level of Benthic Monitoring	2		
Direction of residual current flow	East to West		
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	Visibility poor in images.		
Faunal analysis (Level 2 only)	3 groupings from MDS: a- T1 20m b- Under, T1 Edge, T1 10m, T2 Edge. c- T1 50m, T1 100m, T2 10m, T2 50m and Ref.		
Redox Potential	0.5cm to 10.1cm at reference station. 0cm to 16.1cm at all other stations.		
Average %LOI within AZE	9.89	**Threshold value within AZE**	15.62
Average %LOI outside AZE	7.55	**Threshold value outside AZE**	9.76
Overall Assessment of Conditions	Acceptable		
Previous Assessment	Acceptable 2020		

Monitoring Protocol No. 1 for Offshore Finfish Farms - Benthic Monitoring Individual Site Review			
Licensed Operator	MOWI Ireland Ltd.		
DAFM site code	T12/077A		
Species	Salmon		
Date of survey	21st September 2021		
Stocking details	Used as a holding site for broodstock prior to transfer to the hatchery. Socked October 2019 with 61.9 T. There was 75 T onsite 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	Northeast - southwest		
Accumulated feed within AZE?	No	**Feed pellets beyond the AZE?**	No
Bacterial mat >50% within AZE?	Yes	**Bacterial mat outside of AZE?**	No
Visual Assessment- Overview	Layer of Beggiatoa and some waste feed seen under cages.		
Faunal analysis (Level 2 only)	N/A	N/A	
Redox Potential	1.3cm to 15.7cm at reference station. 0 to 15.1cm at all other stations.		
Average %LOI within AZE	37.18	**Threshold value within AZE**	45.6
Average %LOI outside AZE	19.81	**Threshold value outside AZE**	28.5
Overall Assessment of Conditions	Unacceptable		
Previous Assessment	Unacceptable 2020 & 2019		

Monitoring Protocol No. 1 for Offshore Finfish Farms - Benthic Monitoring Individual Site Review			
Licensed Operator	MOWI Ireland Ltd.		
DAFM site code	T12/077C		
Species	Salmon		
Date of survey	11th August 2021		
Stocking details	428 T at time of survey. Stocked February 2021, production biomass 375 T.		
Mean bottom current speed	15cm/sec mean current speed		
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	Overall healthy appearance.		
Faunal analysis (Level 2 only)	N/A	N/A	
Redox Potential	6.7cm to 7.5cm at reference site. 0cm to 9.9cm at all other stations. Shallow under and edge of cage, depth increased with distance from the cage.		
Average %LOI within AZE	2.10	**Threshold value within AZE**	6.2
Average %LOI outside AZE	1.93	**Threshold value outside AZE**	3.88
Overall Assessment of Conditions	Acceptable		
Previous Assessment	Acceptable 2020		

Monitoring Protocol No. 1 for Offshore Finfish Farms - Benthic Monitoring Individual Site Review			
Licensed Operator	MOWI Ireland Ltd.		
DAFM site code	T12/077F		
Species	Salmon		
Date of survey	21st September 2021		
Stocking details	194 T were input December 2020. No fish onsite at time of survey. 325.4 T harvested prior to audit.		
Mean bottom current speed	Mean mid-water current speed 3.6cm/sec.		
Maximum licensed Biomass	Not reported		
Level of Benthic Monitoring	1		
Direction of residual current flow	North- north westerly.		
Accumulated feed within AZE?	No	**Feed pellets beyond the AZE?**	No
Bacterial mat >50% within AZE?	Yes	**Bacterial mat outside of AZE?**	No
Visual Assessment- Overview	Under T1 and T2 thick mat of Beggiatoa and signs of trapped gas.		
Faunal analysis (Level 2 only)	N/A	N/A	
Redox Potential	1.5cm to 14.1cm at reference station. 0cm to 18.2cm at all other stations		
Average %LOI within	16.9	**Threshold value within AZE**	33.5
Average %LOI outside AZE	16.41	**Threshold value outside AZE**	20.93
Overall Assessment of Conditions	Unacceptable		
Previous Assessment	Unacceptable 2020		

Monitoring Protocol No. 1 for Offshore Finfish Farms - Benthic Monitoring Individual Site Review			
Licensed Operator	MOWI Ireland Ltd.		
DAFM site code	T12/77/7		
Species	Salmon		
Date of survey	11th August 2021		
Stocking details	395 T at time of survey. Stocked February 2021, on-site production biomass 347.8 T.		
Mean bottom current speed	Mean current speed 42cm/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?	No	**Bacterial mat outside of AZE?**	No
Visual Assessment- Overview	Overall healthy appearance.		
Faunal analysis (Level 2 only)	N/A	N/A	
Redox Potential	6.2cm to 7.2cm at reference site. 0cm to 9.5cm at all other stations.		
Average %LOI within	3.02	**Threshold value within AZE**	7.9
Average %LOI outside AZE	2.87	**Threshold value outside AZE**	4.93
Overall Assessment of Conditions	Acceptable		
Previous Assessment	Acceptable 2020		

Monitoring Protocol No. 1 for Offshore Finfish Farms - Benthic Monitoring Individual Site Review			
Licensed Operator	MOWI Ireland Ltd.		
DAFM site code	T12/085		
Species	Salmon		
Date of survey	14th May 2021		
Stocking details	1052 T onsite at time of survey. Stocked November 2020. Biomass production of 460 T prior to the audit.		
Mean bottom current speed	Mean current speed 23cm/sec		
Maximum licensed Biomass	Not reported		
Level of Benthic Monitoring	1		
Direction of residual current flow	North-South		
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		
Redox Potential	3.5cm to 6.1cm at reference station. 1.2cm to 9.41cm at all other stations.		
Average %LOI within AZE	2.79	**Threshold value within AZE**	6.2
Average %LOI outside AZE	2.86	**Threshold value outside AZE**	3.88
Overall Assessment of Conditions	Acceptable		
Previous Assessment	Acceptable 2020		

Monitoring Protocol No. 1 for Offshore Finfish Farms - Benthic Monitoring Individual Site Review			
Licensed Operator	Ocean Farm Ltd.		
DAFM site code	T12/266		
Species	Salmon		
Date of survey	19th August 2021		
Stocking details	560 T at time of survey. 515 T onsite biomass production since stocking.		
Mean bottom current speed	10cm/sec mean current speed		
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?**	No
Visual Assessment- Overview	Under T1 and T2 > 50% coverage of bacterial mat.		
Faunal analysis (Level 2 only)	N/A	N/A	
Redox Potential	0.5 to 14.7cm at reference site. 0 to 15.4cm at all other stations.		
Average %LOI within	10.78	**Threshold value within AZE**	16.1
Average %LOI outside AZE	8.20	**Threshold value outside AZE**	10.06
Overall Assessment of Conditions	Unacceptable		
Previous Assessment	Unacceptable 2020 & 2019		

Monitoring Protocol No. 1 for Offshore Finfish Farms - Benthic Monitoring Individual Site Review			
Licensed Operator	Ocean Farm Ltd.		
DAFM site code	T12/276		
Species	Salmon		
Date of survey	18th August 2021		
Stocking details	Stocked October 2019. Fallow at time of survey. 1104 T harvested 5th August 2021.		
Mean bottom current speed	10cm/sec mean current speed		
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	Some dark patches of sediment close to cage but overall healthy appearance beyond this.		
Faunal analysis (Level 2 only)	N/A	N/A	
Redox Potential	6.7cm to 7.5cm at reference site. 0cm to 9.9cm at all other stations. Shallow under and edge of cage, depth increased with distance from the cage.		
Average %LOI within AZE	9.90	**Threshold value within AZE**	22.3
Average %LOI outside AZE	9.61	**Threshold value outside AZE**	13.93
Overall Assessment of Conditions	Acceptable		
Previous Assessment	Unacceptable 2020		