RAPPORT MA 14-26

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FIELD REPORT FROM FUREHOLMEN, NOVEMBER 2014.

INTEGRATED MULTITROPHIC AQUACULTURE (IMTA) MONITORING PROGRAM

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Title	Field report from Fureholmen, November 2014. Integrated Multitrophic Aquaculture (IMTA) monitoring program.
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Report no.	MA 14/26
Pages	22
Project no.	54778
Projects title	IMTA Solund
Source of funding	Hortimare AS
Reference	Reinier van den Biggelaar, Managing director Hortimare AS
ISSN	0804-5380
Distribution	Open
Keywords	IMTA, integrated aquaculture, aquaculture, seaweeds, cultivation, sustainable, monitoring
Approved by	Agnes Gundersen, Dir. research, Møreforsking AS
Approved date	30.12.2014

Abstract

A field study was conducted by Møreforsking on Hortimare's IMTA site in Solund in November 2014. This work aimed to (i) develop standard methods for environmental monitoring in an IMTA site, in order to quantify ecological effects of seaweed cultivation and (ii) start collecting data in situ a short time after deployment of the cultivating substrates at sea. Remote underwater visual (RUV) techniques were applied for documenting diversity and abundance of associated biota within seaweed cultivation fields as well quantitatively assess the surrounding marine vegetation. Current methods in use for MoM investigations in aquaculture facilities were applied for sampling and characterizing sediment quality across the site.

The results from this field work constitute the baseline of a full-scale monitoring program in which sampling will be repeated throughout the cultivation season in order to fully investigate the ecological interactions between the seaweed cultivation fields and the surrounding environment. The monitoring program will be extended to other IMTA sites where the same sampling methods will be applied.

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CONTENT

SUMMARY

IMTA (Integrated Multi-Trophic Aquaculture) refers to the simultaneous culture of species from different trophic levels, so that waste-products from one species become resources for the other(s).

Norway has the world's largest salmon production, and loses enormous amounts of nutrients from the salmon farms, with adversary consequences for the environment, compromising water quality. Hence, the country's potential for using excess nutrients from salmon farming for cultivation of seaweeds integrated with salmon farms is significant. Apart from serving in bio-remediation of aquatic environments, seaweed biomass cultivated at salmon farms may be used for a variety of purposes, including as food or in animal feeds, optimizing the production of an aquaculture site.

Seaweed cultivation fields will also create a temporary habitat for a variety of organisms such as fish and other invertebrates with potential positive effects on fish farming activities e.g. increasing predation on planktonic sea lice larvae. However, ecological functions of seaweed cultivation fields have not been systematically investigated. It is therefore essential to document the ecosystem stabilization effects of integrated seaweed cultivation to fish farms as well as to evaluate the impacts of seaweed fields on the fish rearing environment in order to safely develop IMTA in Norway and provide guidance to establish new sites.

In order to answer these knowledge gaps, a research program is currently being designed for monitoring a range of both physiochemical and biological parameters across IMTA sites throughout the seaweed cultivation period, over several years. The present field work conducted on Hortimare's pilot-scale IMTA site in Solund constitutes the baseline of the full-scale monitoring program and describes standard sampling methods directly applicable to other IMTA sites.

Remote underwater video (RUV) techniques were successfully used for documenting the diversity and abundance of associated biota within the seaweed fields. Since cultivation substrates were recently deployed and seedling were not visible, a very low biodiversity of macro fauna was observed in the seaweed fields as expected and only drifting ctenophores (*Bolinopsis infundibulum*) were visible on the recordings. Further improvement will be added to the camera rig in order to give a spatial measurement scale to the recording and limit lateral movements. Recordings will be analyzed following standards described in the literature.

Recordings of the surrounding natural kelp vegetation using a similar camera system showed *Laminaria digitata* to be dominant around the Fureholmen IMTA site. Spatial scale will be further implemented in future samplings in order to quantitatively estimate the abundance, diversity and cover of vegetation as well as biota in the sublittoral zone which may act as a bridge facilitating the colonization of seaweed fields.

The results from sediment sampling following standard environmental monitoring techniques (MoM B) showed a relatively high impact of the fish farm on the surrounding benthic ecosystem and increasing biodiversity away from the farm. Sampling over time will demonstrate weather seaweed fields positively affect the sediment by increasing biodiversity or negatively by increasing organic inputs to the seafloor.

1. INTRODUCTION

1.1. Background

Following an initiative from Møreforsking and Hortimare to evaluate ecosystem services provided by seaweed culture integrated with a fish farm, baseline sampling was conducted at Hortimare's seaweed cultivation site in Solund on November 17th and 18th 2014.

Hortimare is a Dutch company specialized in breeding and cultivating marine macroalgae. The company has been established in Solund since 2010 and operates a pilot-scale cultivation site of sugar kelp (*Saccharina latissima*) as part of an integrated multitrophic aquaculture system (IMTA) in collaboration with Sulefisk. Hortimare recently obtained an extension of their cultivation license to 2 ha and plans on further extension (10 ha) within the next years.

The aim of this field work was to (i) develop standard methods for environmental monitoring in an IMTA site, in order to quantify ecological effects of seaweed cultivation and (ii) start collecting data in situ. These methods will be directly applicable to other IMTA sites and later implemented in an extended monitoring program. Hortimare is engaged in several collaborative projects aiming to establish IMTA cultivation sites in western Norway, and Møreforsking is a research partner in several of those, so that the monitoring methods established will provide examples and guidance towards further development at other sites.

1.2. Ecosystem stabilization: services supplied by integrated culture of seaweeds to salmon farms

Cultivation of macroalgae at sea will create a temporary habitat for invertebrates and fish, possibly functioning as an artificial reef and contributing to ecological interactions within nearby ecosystems and aquaculture installations. Although such an effect has not been systematically investigated, seaweed cultivation fields have been observed to house associated biota i.e. mobile drifting or swimming organisms and attached fauna and flora (van't Land 2013, Smallegange 2014). Fish species such as ballan wrasse and lumpfish have been observed within cultivation units at Fureholmen during previous seasons. Through its ecological function and associated biota, seaweed farms may represent a barrier for plankton organisms approaching the fish farm and hence alter hydrodynamic as well as biological properties of the water column, e.g. the abundance of salmon lice larvae.

The overall aim of this project is to investigate how fish farms will be affected by the ecological aspects of an adjacent seaweed cultivation site, something that will have significant implications for the marketability of integrated seaweed cultures.

For this purpose, a range of both physicochemical and biological parameters will be monitored over several years in order to assess the (i) direct effects of seaweed farming on farmed fish and (ii) interactions with the surrounding ecosystem:

- Water quality profiles (e.g. oxygen, chlorophyll, turbidity)
- Current speed and direction
- Surrounding seaweed vegetation: diversity and abundance

– Associated biota to the cultivation fields: diversity and abundance
– Bottom sediments: sediment analysis, macro-faunal diversity and abundance
– Planktonic abundance of sea lice larvae

Limited time and resources only allowed focusing on selected aspects of the monitoring program which did not involve substantial investment in sampling devices and other equipment. Remote underwater video techniques (RUV) are non-destructive sampling methods that can easily be applied and replicated in situ and provide semi-quantitative information about species composition and relative abundance. Sampling protocols based on remote underwater video filming are commonly used in ecological studies, e.g. when investigating the colonization of artificial reefs by macro fauna (Lowry et al. 2012), the community structure and dynamics of coral reefs (Pelletier et al. 2012, Mallet et al. 2014), or the biodiversity response of kelp beds ecosystems after seaweed trawling in Norway (Steen 2010, Steen et al. 2013). A custom designed stationary camera rig was tested to investigate the biota associated to seaweed cultivation fields. This system was also used to make quantitative observations of the structure and abundance of the nearby natural seaweed vegetation.

In order to determine the effects of the seaweed farm on the bottom sediments e.g. apparent changes to oxygen balance, organic input (debris or epibiota lost from the seaweed farm collected on the bottom), alteration to sediment type, etc., current sampling techniques in use for environmental monitoring associated to aquaculture sites were applied in a slightly modified form (MoM investigation).

2. MATERIAL AND METHODS

2.1. Site description

The field work was conducted in the municipality of Solund, Norway, located at the mouth of the Sognefjord and consisting of numerous fjords, bays and inlets dotted with islands and skerries. Fureholmen site is located near the Hopsosen fjord's mouth (fig. 2.1a). Current hydrographic profile data registered at the fish farm by an environmental consulting company (Resipientanalyse AS 2012) showed the main current to be directed northwards within the top layer of the water column (0 – 15m).

Figure 2.1a: Map over Hopsosen fjord in Solund municipality

Hortimare's seaweed cultivation field consists of two squared units of 1 ha each (100 x 100 m), located both to the north and south of the fish farm, and fastened onto a main mooring line (fig. 2.1b). On either side, the distance between the seaweed units and the fish farm was approximately 100 m. Cultivation substrates were made of a ribbon mesh suspended from a floating tube perpendicular to the current direction. The northern unit is dedicated to research focusing on testing several ribbon materials as well as various distances between substrate lines with regard to their effect on seaweed growth and development, whereas the southern unit is used for production purposes. However, also in the southern unit, two different substrate types are being used.

Baseline monitoring field work took place on November 16 and 17, two weeks after deployment of the first substrates at sea which had been previously seeded with gametophytes of *Saccharina latissima*. At this stage, no seedlings were visible macroscopically (i.e. to the naked eye). Therefore, we did not expect abundance and diversity of associated organisms (mobile and sessile fauna) to be high. Rather, the purpose of the initial sampling effort in November was to establish a baseline documentation of the site (i.e. t0) a short time after deployment of the cultivation substrates and based on the selected parameters. Through repeated sampling efforts throughout the season environmental interactions of the seaweed cultivation site with the surrounding ecosystem will be quantified and temporal changes assessed in this context.

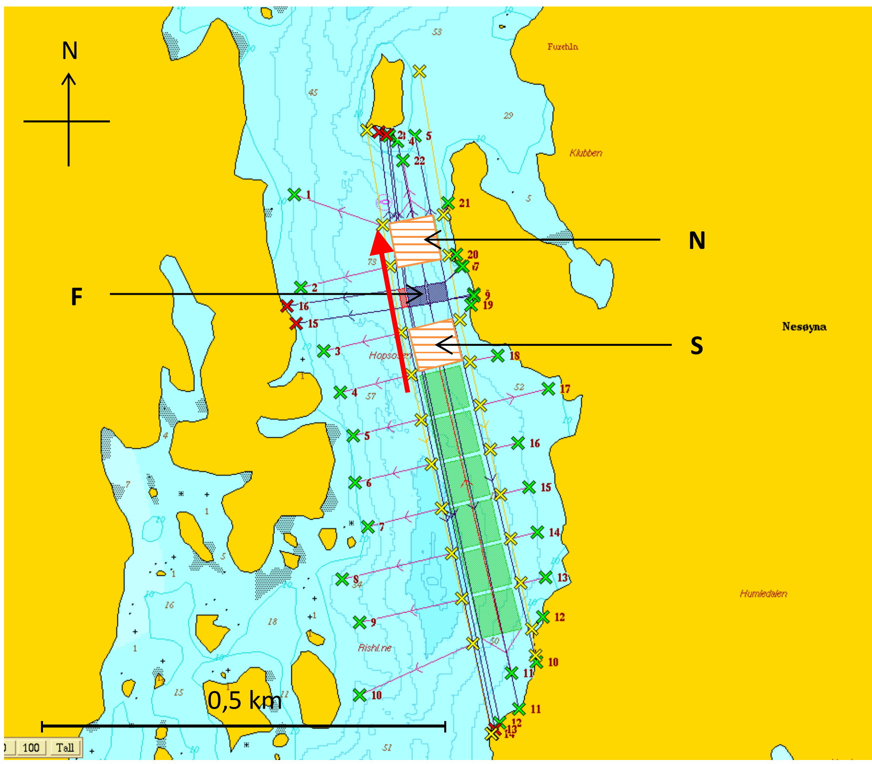


Figure 2.1b: Hortimare's cultivation site at Fureholmen. Hatched areas in orange represent the northern (N) and southern (S) cultivation units (100*100 m area). The red arrow represents the main current direction within the top layer of the water column, measured at the fish farm. The mooring frame is designed so that several cultivation units (green areas) can be added to the southern side of the field at a later stage.

2.2. Colonization of the cultivation units

A total of 10 sampling stations within the seaweed cultivation field unit were selected for assessment of associated mobile fauna using an RUV recording system, one central location in the northern unit (N) and nine in the southern unit (S).

Figure 2.2a: Video camera mounted on a stationary vertical rig to be suspended in the water column.

A video camera (GoPro Hero4^{TM}) was mounted to a stationary vertical rig, consisting of a camera support fastened to an aluminum pipe and suspended by a buoy so that the camera was placed at 1.5 m depth. A weight stabilized the rig so that it remained in vertical position at all times (fig. 2.2a). Observations consisted of video recordings of 10 minutes duration at sampling stations with varying distances from the shore and the fish farm (fig. 2.2b). These stations were sampled in order to investigate if variation in terms of colonization can be observed inside a field, and if the degree of exposure or the proximity to the fish farm and/or natural kelp beds along the shore, influence the biodiversity of organisms associated with seaweed cultivations. In the northern seaweed unit, where seeding of substrate material was not completed, and where a large variety of substrate material was used, we chose to limit sampling to a single extended duration (53 min) reference sample, collected in the same way as in the southern unit. In addition to video recordings, a still image (10 cm distance) of the seaweed colonization substratum was taken at each sampling location. The camera recorded MPEG video files at a 1920x1080 pixels resolution (high definition). No artificial lights were used during recordings. The images were subsequently analyzed on a computer screen using standard software that enables slow view, zooming and image capture such as GOM^{TM} player (version 2.2, Gretech Corporation 2003). Presence of macroscopic species (>1cm) was registered and abundance of species per cubic meter was estimated.

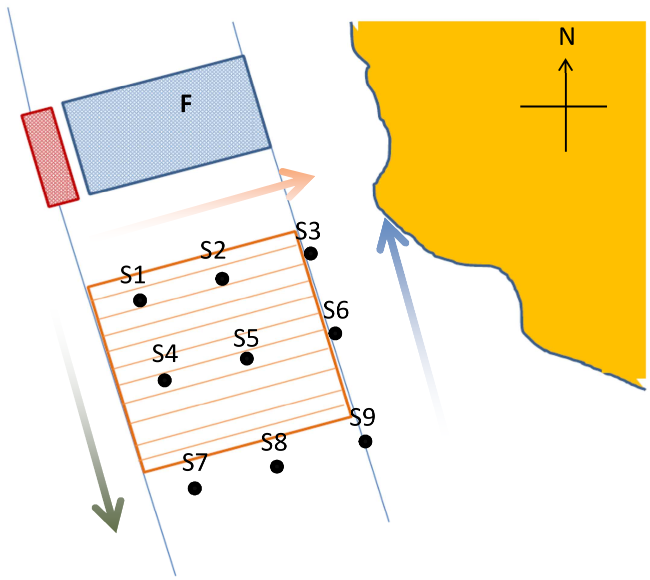


Figure 2.2b: Video sampling stations in the South cultivation field. The arrows represent hypothetical gradients for (i) increasing wave exposure (green arrow); (ii) increasing influence of the fish farm (blue arrow) and (iii) increasing effect of nearby marine vegetation (orange arrow), based on positioning towards the fjord mouth, proximity to the fish farm and the shore.

2.3. Surrounding marine vegetation

The natural marine vegetation adjacent to the IMTA site was documented by means of the same rig-mounted underwater camera system used in the cultivation fields (see above). By guiding the camera from a slow-moving boat and at a constant depth of approximately 1 m, three transects were assessed subsequently. The recording transects of 12, 14 and 4 min duration respectively were conducted along the western, eastern and northern side of the site (fig. 2.3) in order to collect qualitative visual information about the abundance of kelp beds and associated fauna, which may affect subsequent colonization and biodiversity in the seaweed cultivation field. Video footage was registered qualitatively and may be analyzed in more detail to compare with future video recordings at the same transects.

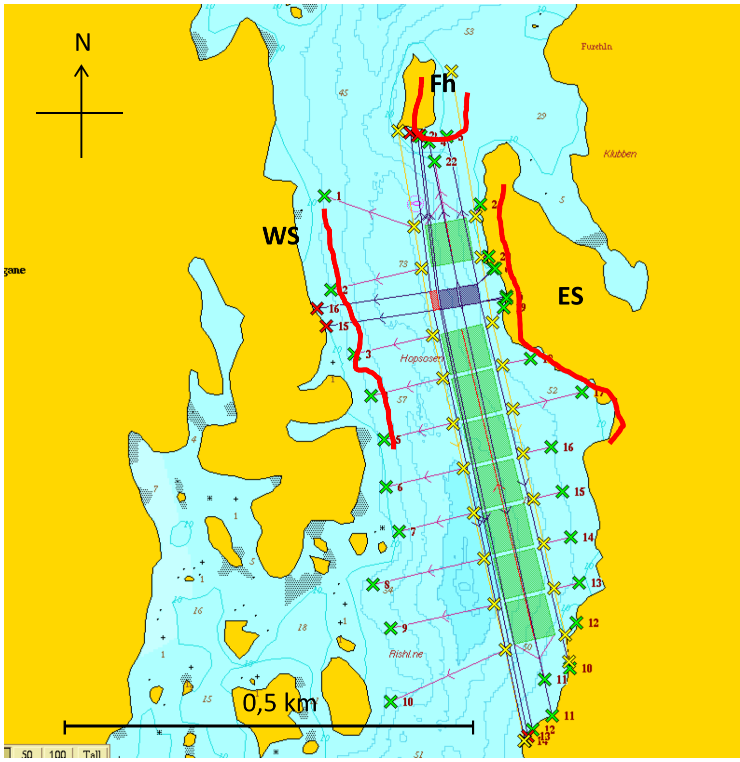


Figure 2.3: Video recording of natural marine vegetation surrounding the seaweed cultivation units. Three recording transects represented by solid red lines on the map were conducted: western shore (WS), eastern shore (ES) and Fureholmen (Fh).

2.4. Sediment sampling

Bottom sediment samples were collected at different sampling stations across the IMTA site (fig. 2.4), following a gradient of increasing distance from the fish farm to the north and south, as well as in relation to seaweed cultivation units. A Van Veen grab of 250 cm^2 was used. Whenever possible, two replicate samples were taken per location. Samples were recovered using a hydraulic winch and sieved on board the sampling vessel (1mm mesh size). Qualitative observations, following the MoM B standard procedures were used to assess the samples.

For each sampling station, an environmental indicator was calculated considering several characteristics of the sediment e.g. smell, color, consistency, presence of live fauna. Character values were assigned to categories (details see appendix 1). Benthic organisms observed in the samples were identified to taxonomic group (usually family level).

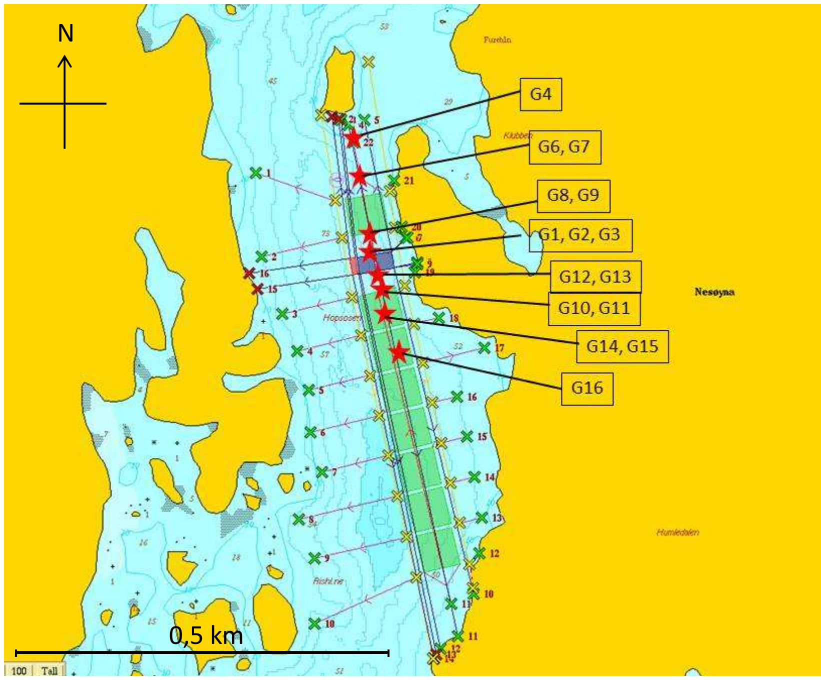


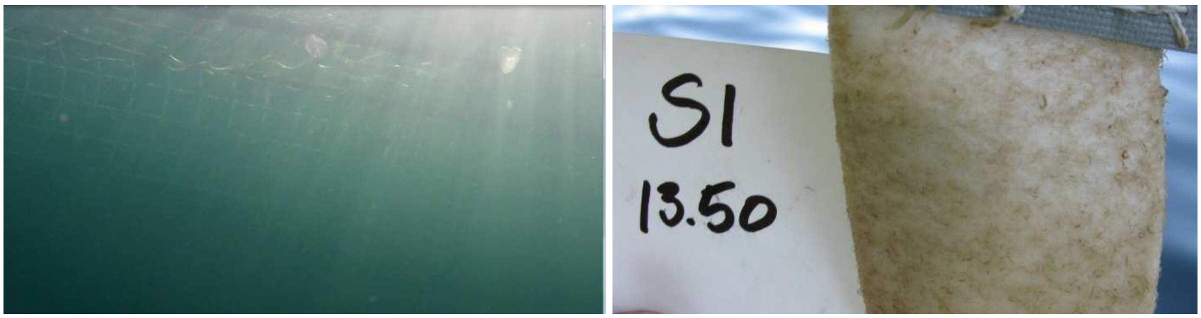
Figure 2.4: Bottom sediment sampling stations at IMTA site Fureholmen. Red stars indicate sampling locations, with sample identifiers for individual samples (see appendix 1).

3. RESULTS

3.1. Colonization of the cultivation units

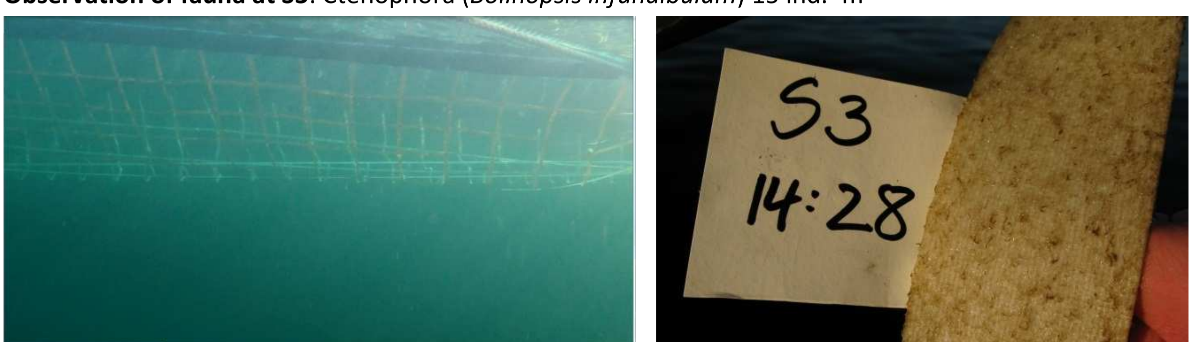
The only fauna observed consistently both in the 10 min recordings at the nine southern unit as well as the extended central location recording of the northern unit was the ctenophoran species *Bolinopsis infundibulum,* which was present in large numbers *,* figs. 3.1a, b*).*

Observation of fauna at S1: Ctenophora (*Bolinopsis infundibulum*) app. 7 ind.*m^{-3}

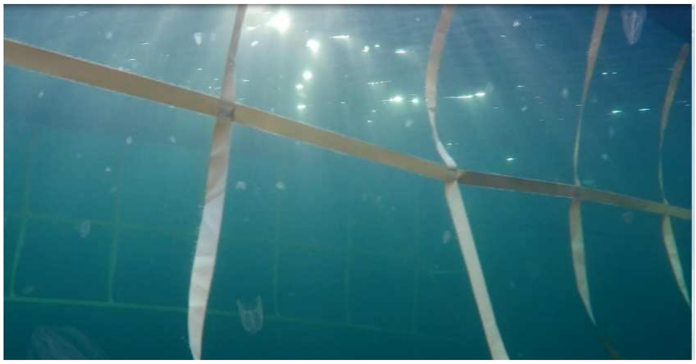


Observation of fauna at S2: Ctenophora (*Bolinopsis infundibulum*) 40 ind.*m^{-3}

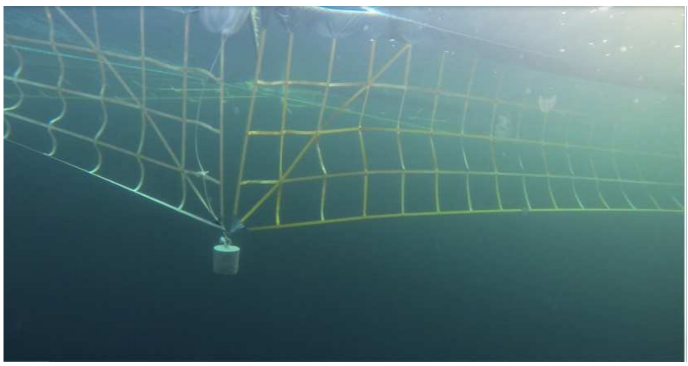
Observation of fauna at S3: Ctenophora (*Bolinopsis infundibulum*) 15 ind.*m^{-3}



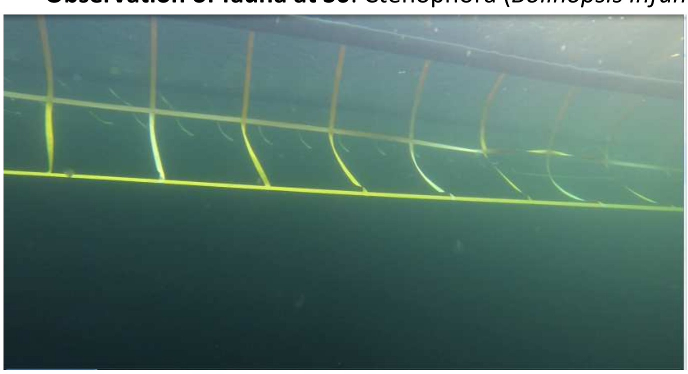
Observation of fauna at S4: Ctenophora (*Bolinopsis infundibulum*) 10 ind.*m^{-3}



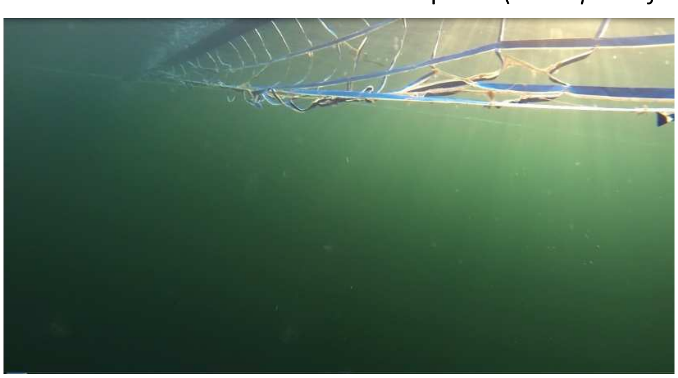
Observation of fauna at S5: Ctenophora (*Bolinopsis infundibulum*) 10 ind.*m^{-3}



Observation of fauna at S6: Ctenophora (*Bolinopsis infundibulum*) 10 ind.*m^{-3}



Observation of fauna at S7: Ctenophora (*Bolinopsis infundibulum*) 10 ind.*m^{-2}



Observation of fauna at S8: Ctenophora (*Bolinopsis infundibulum*) 15 ind.*m^{-3}

Observation of fauna at S9: Ctenophora (*Bolinopsis infundibulum*) 15 ind.*m^{-3}

Figure 3.1a: Example observations of fauna associated with cultivation substratum at several stations in the southern cultivation site, from 10min video recordings. Right: Close-up of the type of substrate used at the station.

Observation of fauna: Ctenophora (*Bolinopsis infundibulum*) 5 ind.*m^{-3}

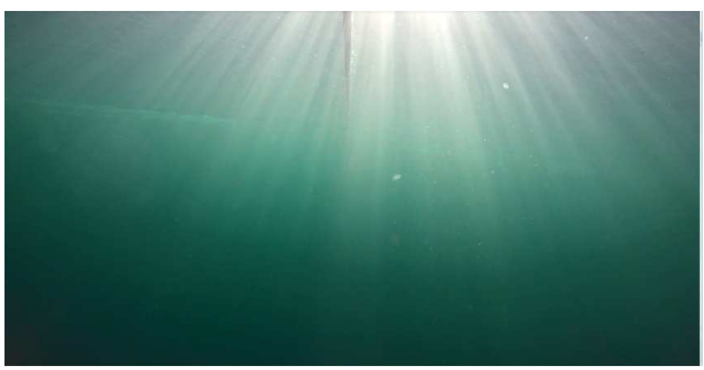


Figure 3.1b: Example observation of fauna associated with cultivation substratum at the central location in the northern cultivation site, from 53 min video recording.

3.2. Surrounding marine vegetation

Observation of fauna and flora at Furuholmen: The vegetation at the Fureholmen subtidal zone is dominated by kelp populations of *Laminaria digitata* epiphytised by the bryozoan *Membranipora membranacea* and the red alga *Polysiphonia sp.* (fig. 3.2a). Patches of calcareous algae of the Corallinaceae family were observed as well as individuals of the brown seaweed *Halidrys siliquosa.* Sea urchins, starfish, tunicates and soft corals (*Alcyonium digitatum*) were observed in the kelp beds. Numerous ctenophorans (*Bolinopsis infundibulum*) were registered drifting with the current. Fish juveniles were registered swimming near the kelp beds.

Figure 3.2a: Three selected examples of representative still images taken at the recording transect at Fureholmen.

Observation of flora and fauna at the eastern shore: The vegetation in the subtidal zone of the eastern shore is dominated by kelp populations of *Laminaria digitata* highly covered by the epiphytic bryozoan *Membranipora membranacea* (fig. 3.2b). The red alga *Palmaria palmata* was also registered growing epiphytically on the kelps. Soft corals (*Alcyonium digitatum*), sea urchins and sea anemones (Actiniaria) were observed among the kelps. Numerous ctenophorans (*Bolinopsis infundibulum*) were registered drifting with the current. Fish juveniles were registered swimming near the kelp beds.

Figure 3.2b: Three selected examples of representative still images taken at the recording transect along the eastern shore.

Observation of flora and fauna at the western shore: The vegetation in the subtidal zone of the western shore is dominated by kelp populations of *Laminaria digitata* highly epiphytised by the bryozoan *Membranipora membranacea* (fig. 3.2c) and some *Polysiphonia sp.* The red alga *Palmaria palmata* was also registered growing epiphitically on the kelps. Patches of calcareous algae of the

Corallinaceae family were observed. Urchins, starfish, tunicates, soft corals (*Alcyonium digitatum*), anemones (Actiniaria) as well as lump suckers (*Cyclopterus lumpus*) were observed among the kelps. Fish juveniles were registered swimming near the kelp beds.

Figure 3.2c: Two selected examples of representative still images taken at the recording transect along the eastern shore.

3.3. Sediment sampling

The sediments within the sampling area consisted of shell sand, shingle and gravel (appendix 1). An apparent gradient of increasing organic material and higher hydrogen sulfide content (qualitative visual and olfactory assessment) occurred with decreasing distance to the fish farm, both to the north and the south (fig. 3.3a). Particularly on the northern side of the farm, a strong hydrogen sulfide smell was noticed, which is characteristic of sediments depleted of oxygen as a consequence of high organic loading and high oxygen demand during bacterial decomposition. Benthic fauna was only observed away from the fish farm where the species registered were mainly polychaete worms, bivalves and gastropods (fig. 3.3b, appendix 2).

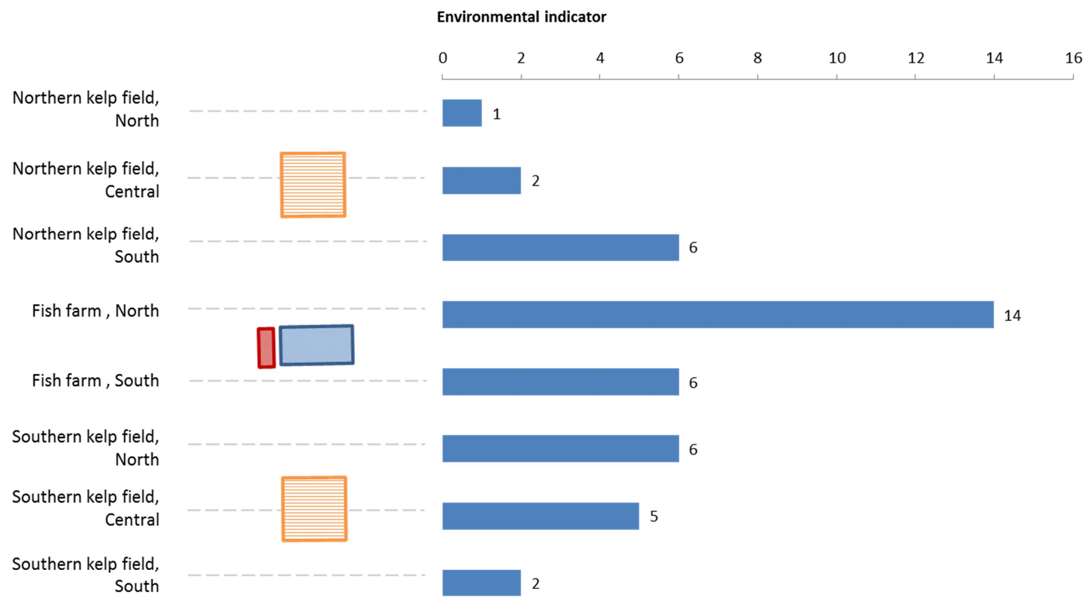
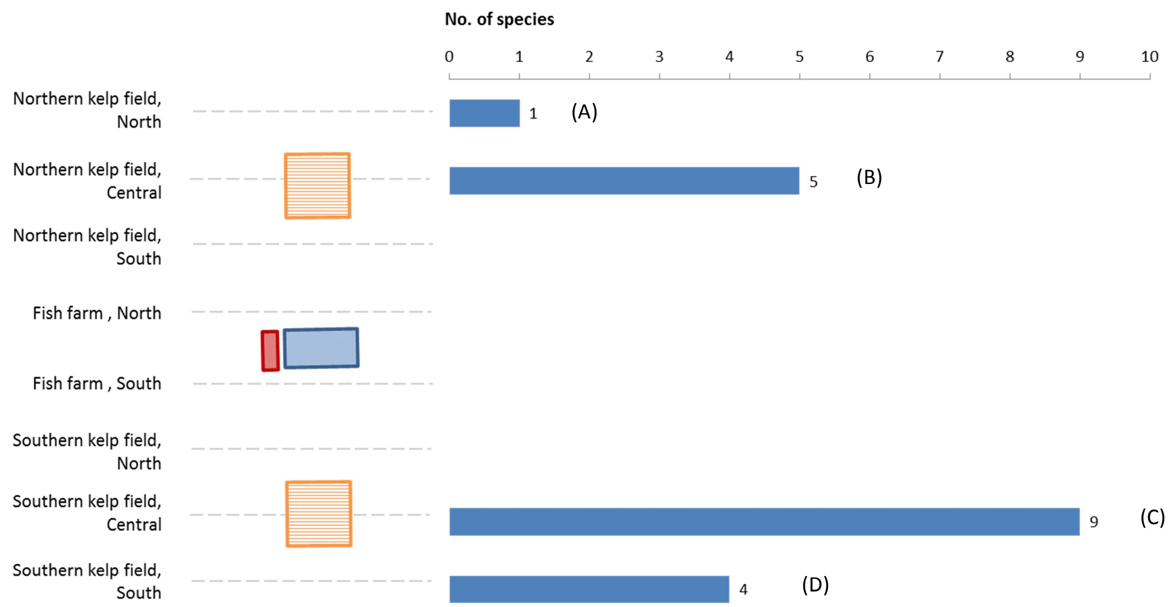


Figure 3.3a: Results from grab sediment samplings across the Fureholmen site. Hatched squares represent the northern and southern seaweed cultivation units, the blue rectangle marks the fish farm, and the red rectangle represents the farm's service platform.

The environmental indicator relates to the ecological state of the sampled station: the higher the indicator, the more the location is impacted by organic loading, oxygen depletion and presence of hydrogen sulfide, often with a consequence of benthic fauna being absent.



A Polychaeta
B Polychaeta (*Pectinaria sp.*), Bivalvia (*Thyrasia sp.,* + 2 undefined species), Gastropoda (*Naticidae*)
C Polychaeta (*Pectinaria sp., Spionidae*, + 4 undefined species), Bivalvia (5 species)
D Sand eel, sea urchin (*Echinocardium flavescens*), Polychaeta (*Pectinaria*), Gastropoda

Figure 3.3b: Number of species and taxonomic groups registered in sediment samples across the Fureholmen IMTA site.

4. DISCUSSION

The results from this field work are describing the ecological state of the Fureholmen IMTA site based on selected aspects, short time after deployment of the seeded substrates at sea (t0). Similar sampling throughout the cultivating season will be compared to it in order to assess the ecological interactions between a seaweed cultivation site and its surrounding environment.

The RUV methods used proved to be suitable for documenting the biota associated to seaweed cultivations fields. A very low biodiversity of mobile macro fauna was observed. Aside from numerous drifting ctenophores (*Bolinopsis infundibulum*), no other macrofauna was recorded. This confirmed our expectations, since seaweed seedlings were not yet visible and therefore did not offer shelter or food to mobile fauna.

Lateral camera movements as well as the lack of integrated spatial scale in the recordings limited options for quantitative video analysis in terms of species abundance and density. In the future, we therefore recommend video sampling including a frame attached to the camera and visible in the field of view, as well as filming at a fixed distance from the substratum, so that video footage will include a measurement scale for quantification of visible fauna. Stereo-camera systems allow more precise 3-dimentional perception and have successfully been used in other ecological studies (Harvey and Shortis 1995). Their use in an ecological monitoring program will be considered.

Video recordings will be analyzed following standard methods. For each species at each station, the maximum abundance (MaxN) will be estimated. MaxN is commonly used for the evaluation of fish assemblages (Priede and Bagley 1994, Cappo et al. 2004) and enumerates the maximum number of individuals belonging to each species within the limited field of view during a time interval (Willis and Babcock 2000, Watson et al. 2005, Stobart et al. 2007). This method avoids repeated counts of the same individual and gives a relative estimate of the species abundance which can then be expressed in densities i.e. number of individuals per m^3 ($ind.m^{-3}$). The results obtained for each station will be compared over time in order to estimate the effect of the (i) distance from the fish farm, (ii) the distance from the shore and natural vegetation and (iii) the wave exposure on the biotic assemblages of a seaweed cultivation field. However, the use of different substrates in the cultivation field will add complexity to the sampling design as differences in growth rates and abundances of kelp are expected. Accordingly, this may have a direct impact on the biotic colonization and must be taken into consideration. Sample recording within the cultivation fields every 2 months is expected to provide a reasonably accurate picture of colonization throughout the cultivation season. However, with increasing growth of seaweeds on the substrata, one might consider increasing the sampling frequency as well.

The same recording system maintained underwater from a boat was successfully used for the qualitative assessment of the surrounding sublittoral vegetation. However, the speed of the moving boat should be decreased if possible as the camera movements made it difficult to analyze the video and identify faunal species. The results showed *Laminaria digitata* to be dominant around the Fureholmen IMTA site. Natural kelp ecosystems close to the seaweed fields may act as a bridge facilitating the colonization of the cultivation units by mobile fauna. A future recording system that will allow spatial assessment as described above may be used to quantitatively estimate percent cover, abundance and diversity of the sublittoral vegetation as well as biota. Monitoring over time will provide information on the impact of a seaweed cultivation farm on the local biodiversity.

Systematic sediment sampling and assessment following Mom B criteria was conducted across the site. The results obtained represent the ecological condition at t0, of the benthic ecosystem, potentially affected by the seaweed cultivation fields. Our results confirm previous MoMB assessments which sampled the sediment directly around the fish farm. The sampling revealed relatively highly impacted sediments especially on the northern side of the site (Resipientanalyse AS 2013). Further sampling over time will demonstrate whether the seaweed fields affect the sediment by possibly (i) increasing biodiversity and mitigating adverse effects of the fish farm or (ii) by increasing organic input through seaweed debris accumulating on the seafloor. In the future, complete MoM B methodology (including pH and redox potential measurements) should be applied, and full MoM C analyses (with benthic faunal composition analysis) would be desirable.

The results from this field work constitute the baseline of a full-scale monitoring program which aims to investigate the ecological interaction between seaweed cultivation fields and its surrounding environment. The sampling methods are directly applicable to other IMTA sites.

Monitoring and sampling methods shall ultimately be operated either by the seaweed cultivation or fish farm technical staff following standard protocols.

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APPENDIX 1

Bottom sediments grab samples

Date		17.11	17.11	17.11	17.11	17.11	17.11	17.11	17.11	17.11	17.11	17.11	18.11	18.11	18.11	18.11	18.11	18.11
Grab No		G1	G2	G3	G4	G5	G6	G7	G8	G9	G10	G11	G12	G13	G14	G15	G16	G17
Depth (m)		70	70	70	10	10	60	60	70	75	70	70	78	78	85	85	95	95
No. of trials		1	1	1	2	4	3	1	1	1	2	1	1	1	2	2	1	3
Fauna	Yes=0 No=1	1	1	1	0		0	0	1	1	1	1	1	1	0	0	0	
Gas bubbling	Yes= 4 No=0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	
Color	Light/grey =0 Brown/black= 2	2	2	2	0		0	0	2	2	2	2	2	2	2	2	0	
Smell	None=0 Some=2 Strong=4	4	4	4	0		2	2	2	2	2	2	2	2	2	2	0	
Consistency	Firm=0 Soft=2 Loose=4	4	4	4	0		0	0	0	0	0	0	0	0	0	0	0	
Grab volume	< ¼ =0 ¼ - ¾ =1 > ¾ = 2	2	2	2	1		0	0	1	1	1	1	1	1	1	1	2	
Thickness of organic material	0 -2cm=0 2 -8cm=1 > 8cm=2	1	1	1	0		0	0	0	0	0	0	0	0	0	0	0	
Sum indicators		14	14	14	1		2	2	6	6	6	6	6	6	5	5	2	
Primary sediment	Shingle	+	+	+						+	+	+	+	+	+	+	+	
	Shell sand	+	+	+	+		+	+	+				+	+	+	+	+	
	Mud																	
	Silt																	
	Clay																	
Hard bottom						+												+

Bottom sediments observations

Grab No.	Fauna / Observations
G1	Nothing alive
G2	Nothing alive
G3	Nothing alive
G4	Polychete
G5	
G6	Polychaetes (*Pectinaria*), Bivalves (*Thyasira*)
G7	Gastropoda (*Naticcidae*), Bivalvia (2 species, + *Thyasira*)
G8	Nothing alive *Thyasira* shells, *Pectinaria* tubes, 1 Laminaria holdfast
G9	Nothing alive *Pectinaria* tubes, *Thyasira* shells
G10	Nothing alive
G11	Nothing alive
G12	Nothing alive
G13	Nothing alive many shells 3 species bivalves
G14	Polychaeta (*Spionidae*), 5 species of bivalves
G15	Polychaeta (*Pectinaria, Spionidae*, total 4 species), 3 species Bivalvia
G16	Sandeel?, heart sea urchin, Polychaeta (*Pectinaria*), Gastropoda
G17	

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