# Regulation of effluents and the release of organic nutrients from Norwegian aquaculture



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#### The Directorate of Fisheries -Brief presentation

Areas of operation:

- Management of marine resources
- Aquaculture management
- Coastal zone management

#### Our main objective:

The Directorate of Fisheries' shall promote profitable economic activity through sustainable and user-oriented management of marine resources and marine environment



#### Norwegian seafood export 1988 – 2018





#### Sale of farmed fish 1996-2018

Tonnes and value



-Value

\* Preliminary figures

## Sold quantity of farmed fish by species – 2018







#### Features in favor of Norwegian Aquaculture

- Long protected coastline, accessible areas
- Clean sea water with a high water replacement rate and good water quality
- Enough clean freshwater for smolt production
- Sparsely populated, but with good infrastructure
- Fairly good supply of fish feed
- Robust technology
- High level of scientific research in aquaculture



#### The Aquaculture Act

- •The new Aquaculture Act entered into force on 1. January 2006
- •Four focus areas:
- Growth and innovation in the industry
- •Simplification in governance
- Environmental sustainability
- •Need for production areas in the costal zone



#### The Aquaculture Act



#### **Production regulations**

•In 2005 the feed quotas were eliminated, and the effective constraint on salmon production in Norway has since been the number of licences and the maximum allowable biomass (MAB).

Maximum Allowable Biomass (MAB): the total weight of live fish that may be in the growing pens at any point in time.
One license = 780 tons MAB (market value of approx. NOK 200 mill.)

•Carrying capacity: the maximum quantity of fish that can be farmed at a site without the environmental impacts exceeding agreed tolerance limits.

#### Aquaculture licenses

- Aquaculture requires a license to from the government, and for production of salmon, trout and rainbow trout the regulation has two components/levels:
- Company level license
- Site level license
- •In sea:
- Approximately **1000** company level licenses for aquaculture of salmon, trout and rainbow trout.
- Approximately **1200** sites for marine production of salmon, trout and rainbow trout, of which approx. **650** are currently in use. The others are fallowed.
- •On land:
- In addition approx. **250** licenses for salmon in land based aquaculture, and **320** licenses for fish production in general on land.





### Number of aquaculture licenses



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#### The Aquaculture Act § 10 Environmental standard

Aquaculture facilities shall be established, operated and abandoned in an environmentally responsible manner.



#### «One-stop-shop» Applicant send in <u>one</u> application form (electronic version was launched in Aug.2015)



#### Application for a site level license -E.g. of minimum environmental documentation

- Hydrography
- Current data from different depth
- Oxygen
- Map documentation
- E.g. 3D maps showing bathymetry

#### • Sediment samples

- Grain/particle analysis
- TOM/TOC etc.
- Heavy metals, priority substances etc.

#### • Benthic fauna surveys

- Local impact zone
- Intermediate impact zone
- Recipient

#### • If needed:

- Tidal zone surveys (Macroalgae)
- Environmental Impact Assessment (EIA)
- Mapping/surveys of vulnerable marine habitat









Photo: Institute of Marine Research



#### **Pollution permit**

- A permit that contains limit values for types of pollution
- E.g. certain substances, noise, vibration, light, organic material etc.
- May also contain other terms and conditions, such as monitoring, fallowing, reporting etc.
- For land based aquaculture systems, it includes thresholds values for release of solids and dissolved organic material.
- Given by the County Governor
- Given in MAB based on the carrying capacity of the locality
- Legislation under revision
  Simplification of the pollution permit



#### **Environmental monitoring during production**



#### Environmental monitoring during next production cycle



#### **Different zones of impact**





#### Relationship between benthic fauna, oxygen and sediment



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Sediment

- Rusty brownish color shows • "oxidized" sediment.
  - Grey/black shows anoxic and "reduced" sediment.

Scale 1-4 in accordance with NS-• 9410:2016

(Pearson & Rosenberg 1978; Nilsson & Rosenberg 1997)

#### Quality assurance of environmental surveys and (possible) sanctions

- The surveys shall be conducted by a qualified agency that can document technical competence and which is independent from the employer or survey commissioner.
  In addition, the C-surveys shall be conducted by a company that is accredited for benthic sampling, for taxonomic analysis and technical evaluations and interpretation of findings.
- Reporting of environmental surveys shall be sent to the Directorate of Fisheries electronically.
- B-surveys shall be reported within 1 month from field date.
- All reported environmental surveys is followed up and quality-assured by the Directorate of Fisheries.
- Condition class 4 = unacceptable! Must fallow until new surveys shows ether good or very good. Given the history on the locality, may have to reduce the site MAB.
- Other tools can be used as well. Relocation of the site, use of technology that reduce the organic pressure.



#### What do the surveys tell us? Local impact zone – B-surveys

From 2010 to 2018 an average of more than 90 % of the facilities were classified with low or moderate organic loading on the seabed!

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Figure 1: Number of reported B-surveys

579 595

563

2009 2010 2011 2012 2013 2014 2015 2016 2017 2018

Condition class	2010	2011	2012	2013	2014	2015	2016	2017	2018
1 – low organic impact	74,1%	70,2%	72,3%	<b>70,9</b> %	74,4%	73,1%	74,8%	72,4%	71,3%
2 – moderate organic impact	<b>19,1</b> %	<b>19,8</b> %	<b>19,5</b> %	22,1%	<b>19,1</b> %	18,7%	18,8%	19,5%	20,2%
3 – high organic impact	5,3%	<b>8,9</b> %	<b>6,9</b> %	<b>6,0</b> %	<b>5,8</b> %	7,3%	<b>6,0</b> %	7,0%	7,0%
4 – overloading of the site	1,5%	1,1%	1,3%	<b>1,0</b> %	0,7%	<b>0,9</b> %	0,4%	1,1%	1,5%
	100%	100%	100%	100%	100%	100%	100%	100%	100%

200

100

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#### Environmental condition at the local impact zone B-survey 2018



## Relationship between benthic fauna, oxygen and sediment



• Rusty brownish color shows "oxidized" sediment.

• Grey/black shows anoxic and "reduced" sediment.

• Scale 1-5 in accordance with the WFD.

(Pearson & Rosenberg 1978; Nilsson & Rosenberg 1997)

THE READ

# Benthic fauna diversity in the intermediate impact zone C-survey

The results from 2016 and 2017 correspond with the results from the surveys in the local impact zone.

Over 90 % were classified as ether Good or Very good.

Stasjonsverdi C2 -Hele landet

	1	2	3	4	5
Rogaland/Vest Agder	7,7	84,6	7,7	0,0	0,0
Hordaland	0,0	91,7	0,0	8,3	0,0
Sogn og Fjordane	0,0	92,3	7,7	0,0	0,0
Møre og Romsdal	12,5	84,4	3,1	0,0	0,0
Sør-Trøndelag	22,9	62,9	11,4	2,8	0,0
Nord-Trøndelag	10,0	85,0	5,0	0,0	0,0
Nordland	23,9	65,2	10,9	0,0	0,0
Troms	29,4	70,6	0,0	0,0	0,0
Finnmark	23,4	73,3	3,3	0,0	0,0

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Alone, the release of organic material is not a limiting factor for growth in Norway at todays production volumes.

However, combined environmental factors have been limiting the growth: •Salmon lice (parasite) Problem for both farmed and wild salmon Escapees of farmed fish •Interaction with wild salmon population •Pollution and discharges •Organic loading and therapeutants Production areal

Which lead to....





#### **Development licenses**

Licenses (max of 15 years) given for new production technology that may solve at least one of the environmental challenges facing the industry.

- Salmon lice
- Escapees
- Release of discharges
- Production areal

Given between 2015-2017

104 applied 76 + (72 still in process) licenses granted A potential total of 57 010 + (56 160) tons biomass if used... May be converted to commercial licenses at a cost of NOK 10 mill.

With this the authorities helps to reduce the risk of developing environmental sustainable production technology



















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Low risk of local and regional effects from the release of organic material (both solids and dissolved) from aquaculture in Norway.

Key part of the regulation:

- Finding the right carrying capacity!
- Adequate environmental documentation during the application process!
- Sufficient monitoring during the production, and fallowing period...
- Adequate sanctions and compensatory measures...





Photo: Midt-Norsk Havbruk AS

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# The legal framework and control authorities



#### Examples of regional survey's, effecte on the recipient...

Marin

- Blue Planet AS Monitoring regional effects of aquaculture in high density production areas.
  - Rogaland
  - Hordaland
  - NCE Aquaculture (Blue Planet AS prodject leader
    - Nordland

Results showing good or very good conditions for all the quality elements, in accordance to WFD...



#### **Dissolved nutrients**

- local effects
- •Nitrogen and phosphate
  - Dilutes quickly, difficult to measure
  - Minor pulses can occur near pens
- •Minor risk at local effects in tidal zone
  - •18 farms and 16 reference stations where measured in Hardangerfjord
  - •Only small local effects at farms closer than 50 m from tidal zone







#### **Dissolved nutrients**

- regional effects

#### Risk

- An increase in dissolved nutrients may lead to eutrophication
  - Eutrophication = 50 % increase of phytoplankton biomass compared to natural conditions
  - May lead to increased oxygen consumption

Low risk with todays production volume....





#### The MOM-system Monitoring-Ongrowing fish farms-Modeling:

The obligatory program for monitoring the environmental impact of marine fish farming on the seabed beneath and around the fish farm is described in the standard NS 9410:2016 *"Environmental monitoring of benthic impact* from marine fish farms".

The monitoring program in the standard consists of two types of investigations,

- B- investigations (local impact zone)
- C-investigations (intermediate impact zone)



