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From controversy to dialog in aquaculture

Kine Mari Karlsen, Otto Andreassen and Bjørn Hersoug (UiT)

Nofima is a business oriented research institute working in research and development for aquaculture, fisheries and food industry in Norway.

Nofima has about 350 employees.

The main office is located in Tromsø, and the research divisions are located in Bergen, Stavanger, Sunndalsøra, Tromsø and Ås.

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See chapter 1.

Summary/recommendation in Norwegian:
Det er store ambisjoner for vekst og utvikling av akvakulturnæringen, men samtidig møter den betydelig motstand og er utvilsomt kontroversiell. Nofima har etablert et internasjonalt nettverk for å få mer kunnskap om kontroversen om akvakultur; hva skaper konflikt, hvordan kommer den til uttrykk og kan det være skjulte årsaker til konfliktene? Dette er kunnskap som er viktig for å forstå konfliktene, og vil være nyttig for å kunne dreie prosessen fra kontrovers til dialog. Nofima har nylig arrangert en workshop om kontroversen med deltagere fra universiteter og forskningsinstitusjoner i Norge, Canada, Færøyene, Island og Sverige. Funnene er presentert i denne rapporten.

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1 Summary

The Norwegian government has great ambitions for growth and development in the Norwegian aquaculture industry. At the same time, the aquaculture industry also encounters significant opposition by different stakeholders and is undoubtedly controversial. The aquaculture industry contributes to regional and social development in the Arctic, and supplies highly demanded seafood. On the other hand, the industry is criticized for having a negative impact on both the environment and local communities, including indigenous people.

The Nofima Food Research Institute has taken the initiative to establish an international network in order to acquire more knowledge on the aquaculture controversy, focusing on: what are the conflicts, how are they framed and expressed; how do the conflicts arise, and which similarities and differences are there in Arctic countries? This knowledge is important to understand the controversy around aquaculture, and thus to turn the process from controversy to dialogue.

The AquaLog project `Intensive aquaculture and sustainable regional development in the Arctic – From controversy to dialog` is a network project funded by the Nordic Centre for Spatial development (NORDREGIO), Nordic Council of Ministers. The project`s objective is to understand factors and forces that influence the aquaculture controversy in the Arctic. The first AquaLog workshop was arranged in April 2015 in Tromsø, Norway. This report presents the results of this workshop.

The participants of the workshop were from the University of Ottawa, Canada, the University in Holar on Iceland, Sweden's University of Agriculture, The University of Tromsø, the Fiskaaling research institute on the Faeroe Islands, company Torsta AB from Sweden and Nofima from Norway.

The findings can be summarized as follows:

- The workshop revealed that the controversies in five Arctic countries concern several of the same issues. This despite the countries being very different in terms of the size of the countries and populations, and production volumes, etc.
- The controversies in the involved Arctic countries vary in range. They all have in common that the aquaculture industry is accused of having negative impacts on the environment. In the sea this is linked to e.g. escapes, sea lice, diseases and emissions, while in fresh water farming over-fertilization is central.
- Spatial and user-group conflicts have risen to the surface, often between aquaculture and other groups such as tourism, fisheries, outdoor activities, and local or indigenous people.
- The workshop also revealed that the conflicts seem to be caused by other issues than those that seem most apparent. For example, a narrow focus on environmental sustainability can confine the conflict to an environment issue. This can conceal other fundamental undecided issues such as the distribution of the industry's advantages and disadvantages, rural development, rights, and social and cultural consequences.

2 Background

The Arctic is rich in resources, which presents both challenges and opportunities for the Arctic communities. Intensive aquaculture is a new industry, and has become important for regional development in rural areas. If the intensive aquaculture industry in the Arctic is to be in a position to supply the population with healthy food, it is dependent on its capability to balance economic growth and sustainable development. This industry has the ambition to expand; however, aquaculture is facing major challenges related to environment, climate changes (e.g. higher water temperature) and the local/global political and economic tensions (e.g. global corporate control over local area and resources). In addition, the aquaculture industry meets increased negative publicity from various corners of the society, which can result in a poor image. Nature conservationists, nearby residents and sports anglers (wild salmon, trout, char and other wild fish species) argue that intensive fish farming is not sustainable due to negative environmental impacts. The use of wild fish as input to intensive fish farming (as feed) is another source of concern for some critics, claiming that in a world with hunger and lack of food security, wild fish (mainly pelagic species) should be used directly for human consumption. Area conflicts are becoming more visible, often with other interests (recreational, tourist, etc.) and local/indigenous peoples, in addition to disagreements in relation to the most basic issues of power and control. An increasing number of municipalities consider what they receive as benefit for offering their most valuable areas to the intensive aquaculture industry to be too little.

The aquaculture industry itself claims not only to be sustainable, but also to be the most efficient livestock farming, giving the least ecological footprint. The politicians are caught in the middle, meeting competing claims and often also conflicting advice. In this respect, it is of particular interest to understand the aquaculture controversy in the Arctic communities.

2.1 Objective

The overall objective of the project is to establish a network to understand *factors and forces that influence the aquaculture controversy* in the Arctic. The aquaculture controversy in the Arctic will be highlighted by exchanging knowledge from already completed and on-going research projects in Sweden, Iceland, Faeroe Islands, Norway, and Canada.

The specific objectives are to:

- Identify **similarities and differences** regarding the aquaculture controversy in the various Arctic communities,
- Identify challenges and opportunities in relation to **sustainable regional development** of aquaculture in the Arctic, and its interaction with the Arctic communities,
- Better understand and manage the **effects of aquaculture on indigenous peoples** and Arctic communities,
- **Transfer knowledge** to politicians and bureaucrats,
- Influence upcoming **sustainability strategies and initiatives**, and
- **Establish research projects** related to aquaculture development management in the area.

2.2 Sustainable development

FAO, EU and different Nordic countries have developed guidelines for sustainable development of aquaculture. Sustainable development is complicated, includes different facets (different criteria, indicators, and levels), and different criteria may come into conflict with each other, e.g. energy consumption and employment. In general, there is a need to develop knowledge on implementation of sustainable regimes in intensive aquaculture to identify the optimal balance between producing more food where the renewable resources are optimally utilized and the resources are managed in a sustainable manner. The comparison of sustainable development within the involved countries in this project can contribute with new knowledge to the authorities, society, aquaculture industry, and researchers, and thereby strengthen the Nordic influence on this field, both regionally and internationally.

Sustainable development is a complex concept, and several perspectives and approaches exist. It is assumed that the aquaculture controversy is linked to the disagreement of what is to be sustained and for how long, in addition, how to weight the different sustainable perspectives of sustainable development: environmental, economic, social, and institutional. Some stakeholders state that the environmental dimension has to be the basis fundament in sustainable development, while others think that all sustainability dimensions are of equal importance. It is clear that this controversy affects sustainable development of aquaculture.

A Nordic co-ordination where the aim is to identify the similarities and differences regarding the aquaculture controversy in Norway, Sweden, Iceland, Faroe Islands and Canada can be positive for the Nordic countries due to exchanging knowledge, identification of synergies and constructive arguments. This can be important input to develop an improved governmental framework for further growth of a sustainable aquaculture industry in the respective Nordic countries.

3 AquaLog workshop

The AquaLog workshop was held 14th–15th April 2015, Nofima, Tromsø, Norway. The title of the workshop was `Intensive aquaculture and sustainable regional development in the Arctic – From controversy to dialog.

3.1 Programme

Day one:

- Welcome and introduction, Bjørn Hersoug, Co-ordinator
- Presentation of the AquaLog partners
- Visit a salmon farm, Lerøy Aurora, Sessøy, Norway

Day two:

- Sustainable aquaculture development in the Arctic – what to include? Kine Mari Karlsen and Otto Andreassen, Nofima, Norway
- Aquaculture and the Canadian Arctic: an as-yet undiscovered country, Nathan Young, University of Ottawa, Canada
- Factors and forces in Swedish aquaculture research activities, Eva Brännäs, Swedish University of Agricultural Sciences, Sweden
- Social acceptens pre and post Aquabest project, Erik Olofsson, Torsta AB, Sweden
- Aquaculture in the Faroe Islands: Regulations and controversies, Knud Simonsen, Aquaculture Research Station of the Faroes, Faroe Islands
- Controversies between salmon farmers and anglers in Iceland, Helgi Thorarensen, Holar University College, Iceland
- Aquaculture governance and controversy in Norway: Jahn Petter Johnsen, Otto Andreassen, Bjørn Hersoug and Ann-Magnhild Solås, Nofima/The Arctic University of Norway, Norway
- Sustainable coexistence between salmon culture and coastal fisheries, Bjørn-Steinar Sæther, Nofima, Norway
- Against a new regulation regime - will it affect the controversy? Bjørn Hersoug, Nofima/The Arctic University of Norway, Norway
- Discussion - From controversy to dialog
- Summary of the workshop and further plans, Bjørn Hersoug

First day – visit a salmon farm

At the first day, we visited a salmon farm, Lerøy Aurora located at Sessøya, Norway.

3.2 Participants

The following institutions and companies participated at the AquaLog workshop:

- Nofima, Norway
- The Arctic University of Norway, Norway
- Swedish University of Agricultural Sciences, Sweden
- University of Ottawa, Canada
- Fiskaaling, Faroe Island
- Holar University College, Iceland
- Torsta AB, Sweden

4 Presentations

4.1 Sustainable aquaculture development in the Arctic – what to include?

Kine Mari Karlsen and Otto Andreassen

Nofima AS, Norway

Abstract:
Both the Norwegian politicians and Norwegian aquaculture industry have big ambitions for further development and growth of the Norwegian salmon farming. Studies conclude that it may be possible to achieve a Norwegian aquaculture production of a value of 240 billion NOK (30 billion USD) in 2050. However, the Norwegian government requires that the aquaculture production should be sustainable until further growth is allowed.

Sustainable development is a vague, general and dynamic concept, and several approaches and concepts to assess sustainable development are available. The Brundtlands definition in the report `Our Common Future` from World Commission on Environmental and Development (WCED) was one of the first definitions with a global perspective of sustainable development (WCED 1997); *`development that meets the needs of the present without compromising the ability of future generations to meet their own needs`*. The Commission concluded that sustainable development should include three dimensions of sustainability; economic, social and environmental sustainability. To achieve a sustainable development of the society, a satisfactory development of these dimensions is necessary.This is illustrated in Figure 1, where sustainable development is the roof of the building with the three dimensions environmental, economic, social as the load-carrying pillars. The foundation of the construction includes administration and management, so-called institutional sustainability.

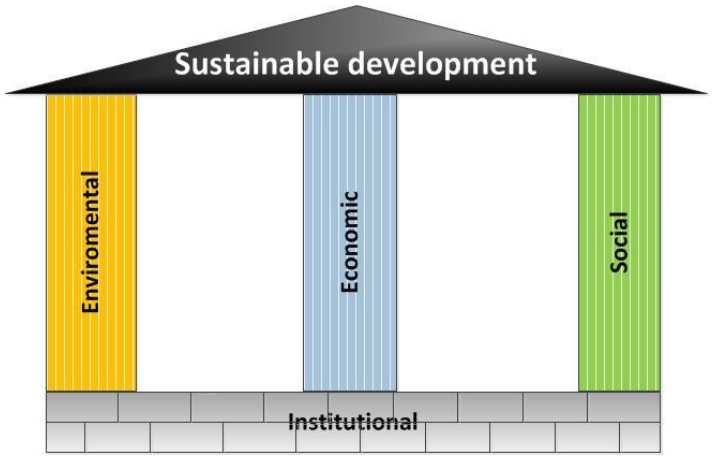


Figure 1 Framework for sustainability development. Modified from Heijungs et al. (2010)

Each level of sustainable development follows its own path by defining specific criteria (also called objectives) and indicators of sustainable development (Keeble et al., 2003). Indicators are tools used to monitor sustainable development within a sector linked to specific criteria, while criteria define what to achieve with such development.

Some stakeholders have focused on a limited area of one dimension of sustainable development; while other stakeholders have a broader perspective. A too narrow perspective of sustainable development is illustrated in Figure 2, where the focus is mainly on the environmental dimension, and less on the economic and social dimensions, and the focus on the institutional dimension is weak and fragmented. For example, the stakeholders can either focus on few environmental sustainability indicators, sea lice and escapes, and state that the aquaculture industry is not sustainable, or they can choose not to pay attention to lice and escapes, and then perhaps conclude that the salmon industry is sustainable. The consequence of a one-sided perspective is an unbalanced and weak construction of the sustainability building.

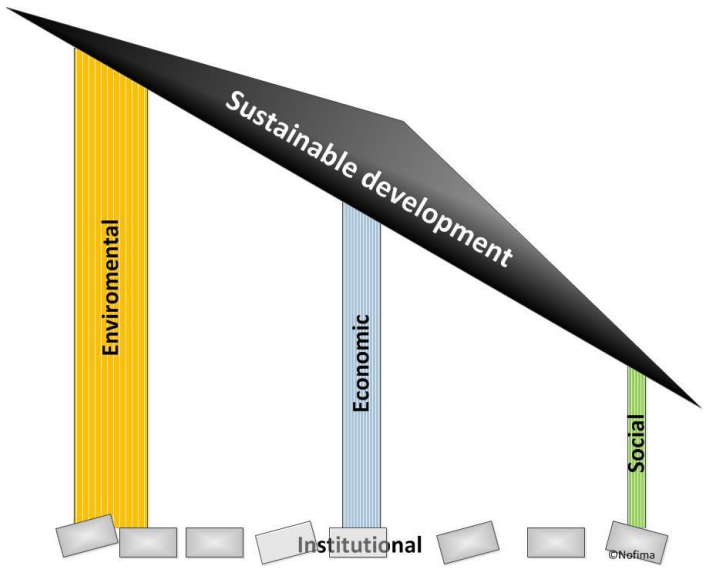


Figure 2 One-sided perspective of sustainable development - an unbalanced and weak construction

A too narrow focus on environmental sustainability can be problematic, because it can lock the discussion to environmental issues, and hide important questions of aquaculture development regarding for example social and cultural consequences, rights, local and global development, and management. Thus, a broader perspective on sustainability is necessary. But, sustainable development is a complex concept, used and perceived differently by various stakeholders at different levels; local, regional and global. This makes implementing the concept of sustainability in practice challenging, particularly when taking the different levels of sustainability into account.

The key is to find the right balance between advantages and disadvantages of the different dimensions of sustainability. Resources should be utilized effectively (economic sustainability), the society should maximize its utilization of the resources (social sustainability), at the same time as the environmental footprint should be at an acceptable level or as small as possible (environmental sustainability).

Sometimes, different criteria may come into conflict with each other, e.g. energy consumption and employment. In such situations, it is necessary to identify these criteria and find a suitable and acceptable compromise which can lead to the definition a set of operational criteria of sustainable development.

In Norwegian aquaculture, currently, sustainability is related to the environmental dimension. This is also reflected in the management and regulations, which focus on environmental sustainability,

while economic and social sustainability are not prioritised. This may indicate that Norwegian aquaculture is partly founded on different sustainability principles than other food- and resource-based industries.

References

Heijungs, R., G. Huppes & J.B. Guinée. (2010). Life cycle assessment and sustainability analysis of products, materials and technologies. Toward a scientific framework for sustainability life cycle analysis. *Polymer Degradation and Stability*, **95**:3, pp. 422–428.

Keeble, J.J., S. Topiol & S. Berkeley (2003). Using Indicators to Measure Sustainability Performance at a Corporate and Project Level. *Journal of Business Ethics,* **44**:2, pp. 149–158.

WCED (1997). *Our Common Future*, World Commission on Environment and Development**:** pp. 43.

Sustainable aquaculture development in the Arctic – what to include?

by

Kine Mari Karlsen and Otto Andreassen
Nofima AS, Norway

Sustainable aquaculture development in the Arctic – what to include?

Kine Mari Karlsen and Otto Andreassen
Nofima AS, Norway

- Definition
- Framework
- Criteria
- Different perspectives
- Narrow vs. broader perspective
- What is the problem?
- Right balance of different perspectives
- What is the challenge?

Sustainable development

"...*development that meets the needs of the present without compromising the ability of future generations to meet their own needs*"

Brundtland Commissions, 1987

3

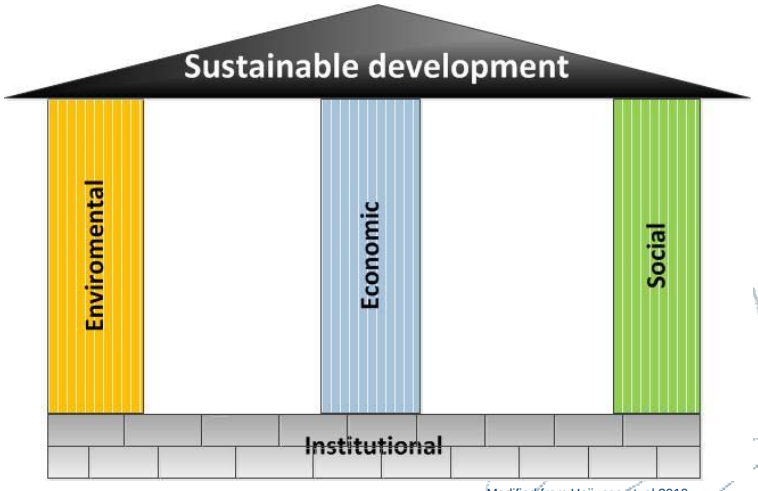
CODE OF CONDUCT

FOR

RESPONSIBLE FISHERIES

4

Popular framework



Modified from Heijungs et. al 2010

Nofima

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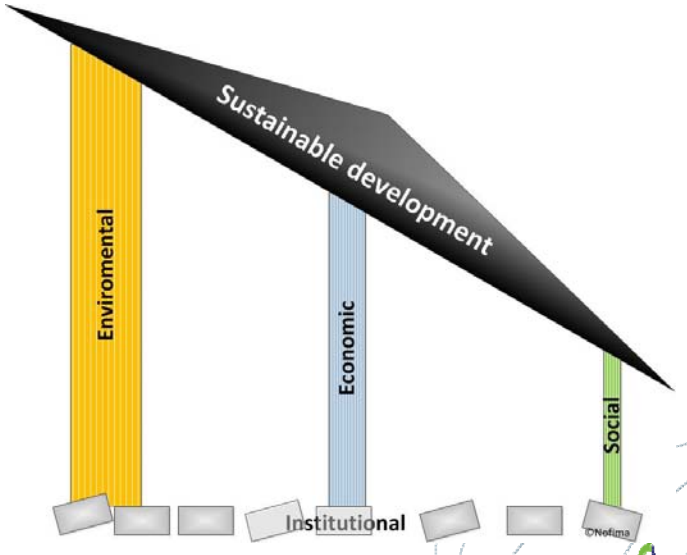
… and a one-sided perspective gives an unbalanced and weak construction



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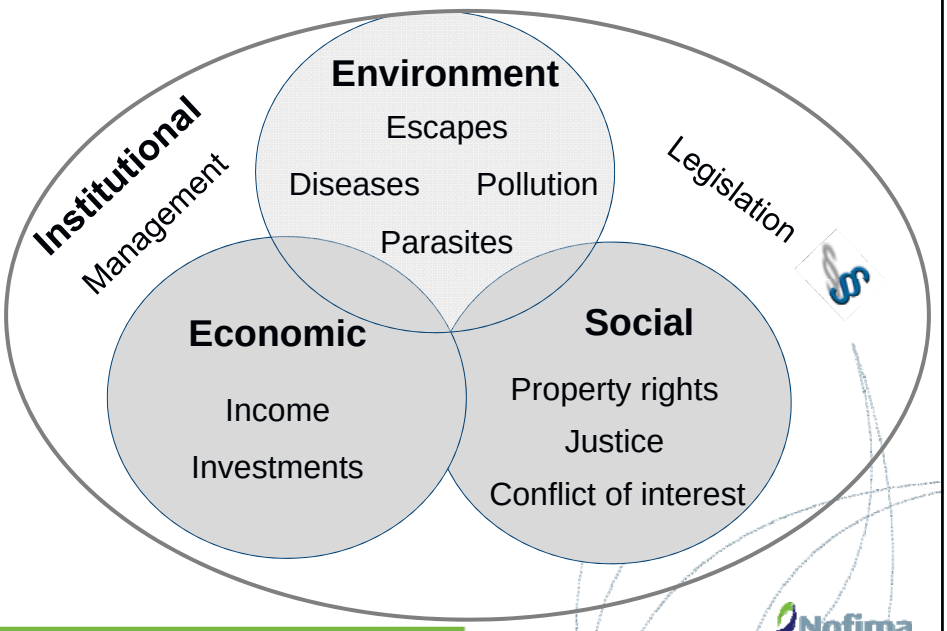
Criteria



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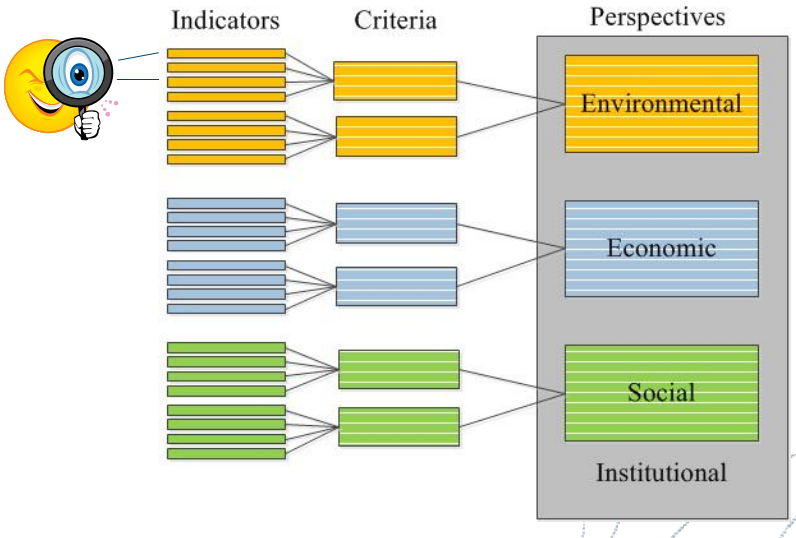
Narrow sustainability perspective



Modified from Keeble et al, 2003

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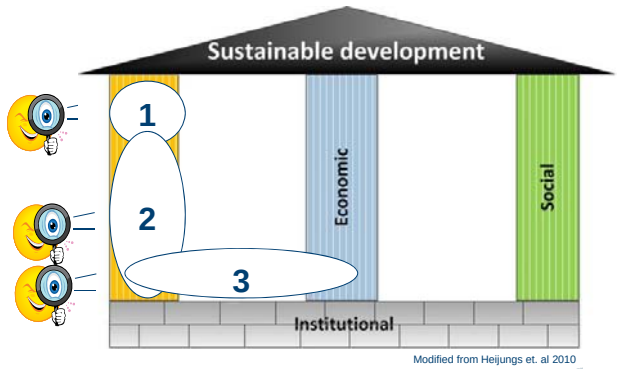
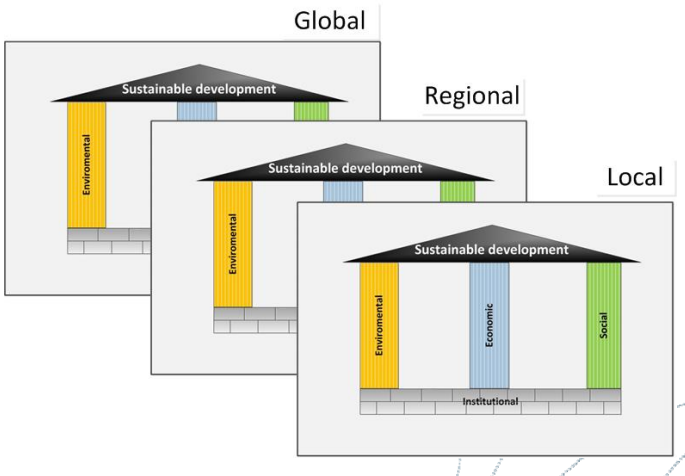
What is the problem?



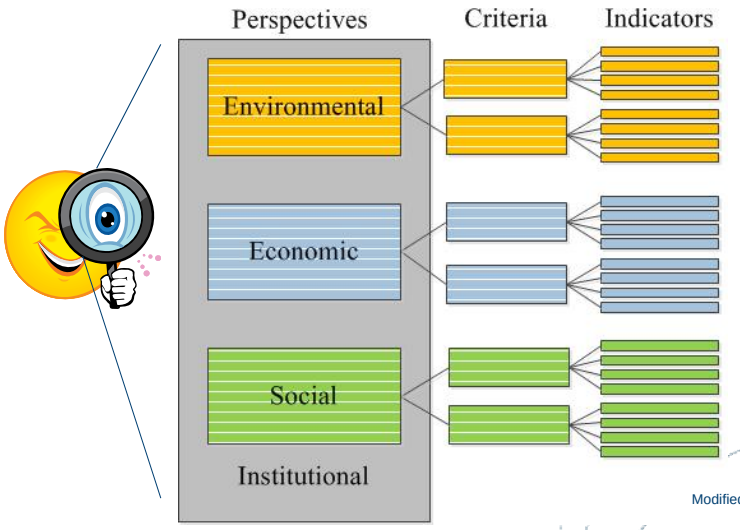
Modified from Heijungs et. al 2010

- Too narrow focus on environmental sustainability – discussion is locked to environmental issues
- This hide other important questions of aquaculture development
  - social and cultural consequences, rights, local and global development and management etc.

…this is complicated



…a broader perspective on sustainability is necessary



Modified from Keeble et al, 2003

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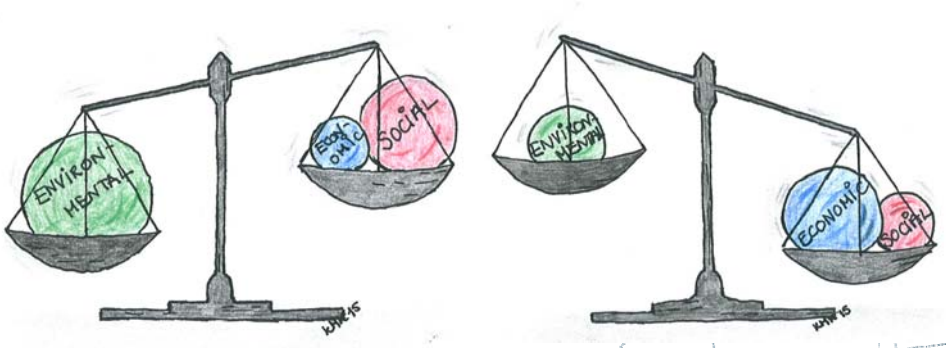
…key to find the right balance between advantages and disadvantages



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What is the challenge?

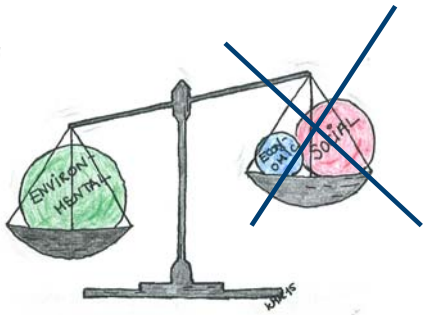
The different perspectives of sustainability are not in balance and not integrated

Example:

In a discussion document to the Norwegian Parliament it says:

Environmental considerations shall be the only issue in an evaluation of allowing growth in the aquaculture or not

Lack of industry-neutral principles for sustainability



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Summary

- A too narrow focus on only environmental sustainability hide important questions of aquaculture development
- It is important to find the right balance between advantages and disadvantages of different perspectives for sustainability
- Lack of industry-neutral principles for sustainability – more knowledge is needed

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4.2 Aquaculture and the Canadian Arctic: an as-yet undiscovered country

Nathan Young

University of Ottawa, Canada

Abstract:
Canada is an Arctic nation, but its northern regions remain under-developed. The vast majority of the Canadian population is urban, and lives in the country's extreme south within several hundred kilometres of the Canada-United States border. The Canadian resource sector remains strong, but is geographically concentrated in different regions of the country. Forestry, for instance, has a strong presence in central Canada (particularly in the provinces of Ontario, Québec, and New Brunswick) and in the western provinces of British Columbia and Alberta. Oil and gas production is concentrated in the provinces of Newfoundland and Labrador, Alberta, and Saskatchewan. Large-scale commercial fisheries and aquaculture are, for the moment at least, absent from the Canadian North and concentrated on the Atlantic and Pacific coasts of the country.

Aquaculture production in Canada remains well below capacity, at about 1/13th of Norway's. Canada has the world's longest coastline, with many suitable sites for finfish aquaculture, particularly on the Pacific coast of British Columbia, but also in the provinces of Nova Scotia and Newfoundland and Labrador (most well-suited sites in New Brunswick are already occupied). Several factors have inhibited further expansion.

In southern regions where aquaculture is already present, social resistance has slowed industry development. In British Columbia, long-standing environmental concerns include potential damage to the sea-floor, the potential impacts of escaped farmed Atlantic salmon (an exotic species) in Pacific waters, and the potential for disease and pathogen transfer from farmed to wild salmon stocks. Several activists, including high-profile independent biologist Alexandra Morton, have argued that sea lice outbreaks are particularly damaging to wild Pacific salmon, particularly from farms sited along the migration routes of juvenile salmon as they leave freshwater and enter the marine environment. Activists have also suggested that consumption of farmed salmon poses human health risk, although this aspect of the controversy appears to have ebbed in recent years. There is ongoing debate about the role of aquaculture in rural development, particularly its capacity to absorb the displaced labour force from a reduced commercial fishery, and potential aesthetic conflicts with wilderness tourism. The controversy in British Columbia is also entangled with the ongoing contestation of Aboriginal rights. The government of British Columbia has been negotiating modern treaty agreements with dozens of coastal First Nations groups since the early 1990s, and several First Nations communities and organizations are upset that aquaculture development has been permitted and promoted by both federal and provincial governments prior to agreements on treaties.

The controversy in Atlantic Canada has generally been less intense than in the Pacific arena, with one notable exception – the recent involvement of commercial lobster fishers. The lobster fishery is one of the few growing fisheries in Canada. With a labour-intensive harvesting process, the lobster fishery is a major employer and important political constituency. In 2009, reports emerged of significant lobster "kills" from the use of chemical sea lice treatments in nearby fish farms. Subsequently, lobster fishermen have also protested the siting of farms near lobster breeding grounds, fearing benthic pollution will further harm the fishery.

Similar conflicts are expected should aquaculture expand into Canada's Arctic region. Canada's North has the highest proportional concentration of indigenous peoples relative to the settler population (mostly First Nation or "Indian" in the Western Arctic territories of The Yukon and The Northwest Territories, and mostly Inuit in the Eastern Arctic territory of Nunavut). Many indigenous communities continue to harvest marine resources as part of a subsistence economy. Existing industrial activities in the Arctic, particularly oil and gas exploration (seismic testing), are controversial and opposed by many community leaders and elders, who see it as a threat to subsistence harvesting. It is important to note, however, that the Government of Nunavut has declared that it will not pre-judge the potential expansion of commercial fisheries and aquaculture to its territories. Nunavut is the least-developed and least-wealthy of the three Arctic territories, and the Government of Nunavut has adopted a generally pro-development stance in the hopes of attracting investment. Climate change is altering the Canadian Arctic, increasing the number of ice-free days in nearshore waters. While aquaculture expansion in the Canadian North is not feasible for the moment, the day may come when it is possible to farm Canada's Arctic waters, and important decisions will need to be made.

Aquaculture and Canadian Arctic: an as-yet undiscovered country

by

Nathan Young
University of Ottava, Canada

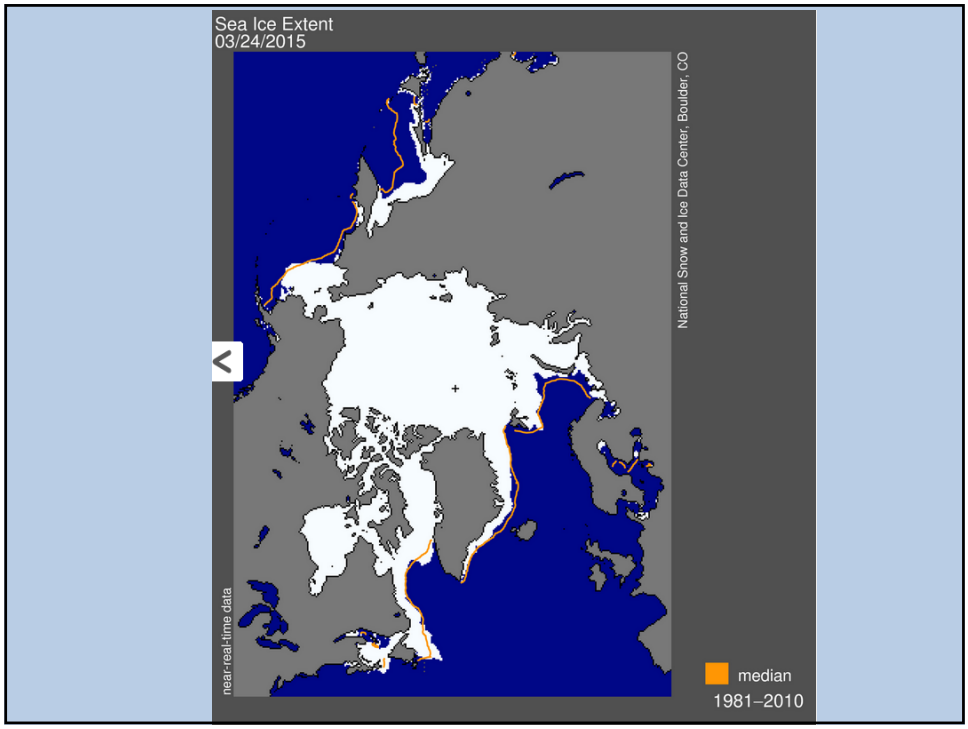
Aquaculture and the Canadian Arctic: an as-yet undiscovered country

Nathan Young
University of Ottawa, Canada

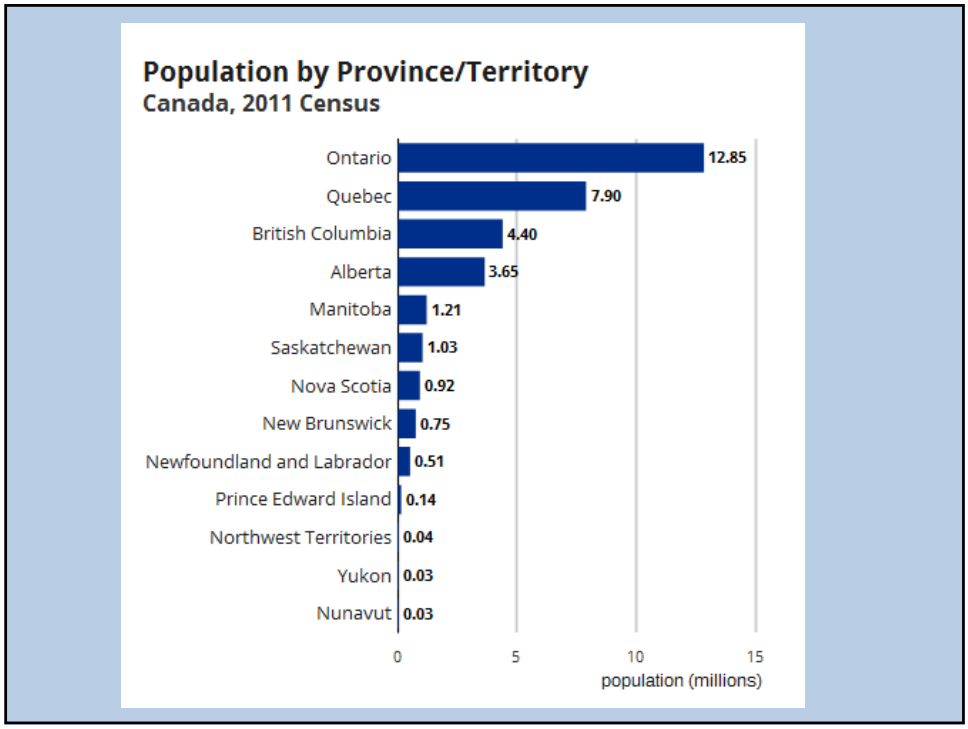
uOttawa

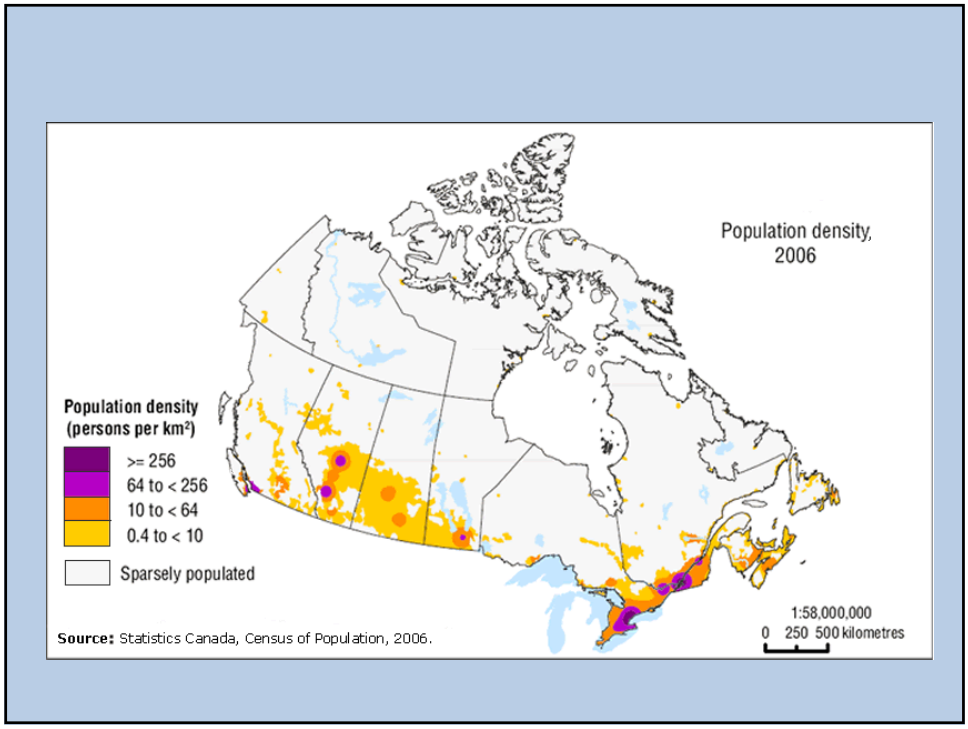
Canada
Social Sciences and Humanities Research Council of Canada

AquaNet


Sea Ice Extent
03/24/2015
National Snow and Ice Data Center, Boulder, CO
near-real-time data
median
1981–2010


Tuktoyaktuk on June 1st, 2013


Population by Province/Territory
Canada, 2011 Census
Ontario 12.85
Quebec 7.90
British Columbia 4.40
Alberta 3.65
Manitoba 1.21
Saskatchewan 1.03
Nova Scotia 0.92
New Brunswick 0.75
Newfoundland and Labrador 0.51
Prince Edward Island 0.14
Northwest Territories 0.04
Yukon 0.03
Nunavut 0.03
0
5
10
15
population (millions)


Population density, 2006
Population density (persons per km²)
>= 256
64 to < 256
10 to < 64
0.4 to < 10
Sparsely populated
Source: Statistics Canada, Census of Population, 2006.
1:58,000,000
0 250 500 kilometres

Aquaculture across Canada

2013 Canadian Aquaculture Production Statistics (tonnes)

	Nfld	PEI	NS	NB	Que	Ont	Man	Sask	Alta	BC	CANADA (1)
Finfish											
Salmon	..	..	6,517	18,837	0	0	x	x	x	74,673	100,027
Trout	..	..	203	0	1,262	3,580	x	x	x	62	6,736
Steelhead	..	..	0	0	0	0	x	x	x	682	682
Other	..	..	60	0	1	22	x	x	x	391	696
Total Finfish	22,196	0	6,780	18,837	1,263	3,602	x	x	x	75,808	130,337
Shellfish											
Clams	0	0	358	0	0	0	0	0	0	2,476	2,834
Oysters	0	2,812	356	739	10	0	0	0	0	5,592	9,509
Mussels	4,354	22,894	1,051	41	448	0	0	0	0	291	29,080
Scallops	0	0	0	5	11	0	0	0	0	91	107
Other	0	0	203	5	22	0	0	0	0	0	230
Total Shellfish	4,354	25,706	1,968	790	491	0	0	0	0	8,450	41,760
Total Aquaculture	26,550	25,706	8,748	19,627	1,754	3,602	x	x	x	84,258	172,097
Re-stocking (2)											
Total (incl. re-stocking) (2)	26,550	25,706	8,748	19,627	1,754	3,602	x	x	x	84,258	172,097

Challenges for Canadian Aquaculture

- High costs (labour & environmental monitoring)
- High regulatory & compliance burden
- Jurisdictional overlaps (access to coastline)
- “Staples trap” (reliance on single market = lack of innovation & value-added production)
- High vulnerability to currency and market fluctuations
- Low road vs. High road
- Social protest
- Competing expert narratives (supportive and critical)

Four axes of controversy

- Environmental impacts and integrity
- Human health
- Rural/coastal futures
- Aboriginal rights

Science and Expertise

Unique Challenges in the Arctic region

Geophysical

- Ice
- Water temperature
- Lack of infrastructure (roads, ports, electricity)
- Distance to processing and markets (winter roads, summer isolation)

Social & political

- Labour force
- Aboriginal title and claim
- Subsistence activities & cosmology
- Suspicion of Arctic development (existing moratoria)
- Austerity (lack of research)

Change is in the Air

- Climate change
- Community-based aquaculture (in partnerships, and as leaders)
- Government of Nunavut – pro-development stance

Thank you

- Questions?

Nathan.Young@uottawa.ca

4.3 Factors and forces in Swedish aquaculture research activities

Eva Brännäs

Department of Wildlife, Fisheries and Environmental Studies, Swedish University of Agricultural Studies (SLU)

Abstract:
The production of farmed fish is the second lowest in Europe in spite of huge resources of clean water. The fish farming and research activities related to Aquaculture have been strongly influenced by the attitude to fish farming by the public and also by different priorities by the Government and the University.

Plans and interest for intensive fish farming in Sweden started in the 80´s. The attitude to this new farming industry was very positive from the beginning. Jobs and fish for the table market were going to be created. Several new permits for fish farming were given. SLU started a department of Aquaculture. The head of the department was assigned to Professor Lars-Ove Eriksson whom managed to persuade the University to localize the department in Umeå instead of the originally decided position in Uppsala, the central and main position of SLU. The research finance for Aquaculture research both from governmental and other foundations was sufficient and a research group focusing on applied aquaculture research was initiated. The research focused mainly on salmonid fish and in particular on developing fish farming of Arctic charr. Several projects financed the evaluation of the most suitable population for farming, it´s basic behavior in farming situation together with other topics and breeding programs was initiated both on Arctic charr and rainbow trout. The future and potential for farming fish in Sweden seemed bright and a national association of fish farmers was initiated!

The problem arouse already in the late 80`s and increased in 90´s to some extent caused by lack of knowledge by the authorities as well as the new fish farmers. Localizations were approved on sites not suitable for net-pen farming, especially Arctic charr farming in shallow lakes close to the Baltic coast where the water became too warm in the summer. The result was local eutrophication, fish deceases, fish mortality and an increasing negative attitude from the public and decision makers. The Fishery Board, which had the responsibility to develop fish farming activities in Sweden had already from the beginning a very negative view on fish farming and regarded aquaculture as a competitive activity to fisheries. The research funding for applied Aquaculture projects decreased and most funding on fish related research focused on conservation biology or basic fish biology. The research activities at the department of Aquaculture “adapted” to the reduced funding for applied research and the focus became evaluation of river restorations, fish ecology, genetics and behavioral ecology. However, the breeding program on Arctic charr was possible to maintain but not on rainbow trout. The first governmental inquest on how to improve the conditions for Aquaculture in Sweden was published in 2000 but did not result in any change of attitudes towards fish farming by neither decision makers nor public. As a result of the reduced number of fish farmers, their national association had to reduce their activities.

In spite of the generally negative development of fish farming in Sweden, a few Arctic charr farmers managed to increase the production and interest of Arctic charr for the table market. The farming is still at a small scale (2000 tons annually) but economically successful. The farmers are skilled and

have access to an Arctic charr strain with a high growth rate as an effect of the breeding program. The department of Aquaculture also supported the farmers with knowledge and in fact functioned as a substitute to the national association of fish farmers. The fish are mainly farmed in the extremely oligotrophic lakes created by hydroelectric damming and also create employment in remote areas.

These factors; employments and the location of farms in "already ruined waters with hardly any natural reproduction of wild fish" as well as SLU:s initiated research on alternatives to fish meal and fish oil in the diet for farmed fish arose the interest of the new government in 2006 and a new inquest was initiated "Sweden: an Aquacultural nation in the making" SOU 2009:26 that was published 2009 and stated as follows:

"*this inquiry finds that there are good opportunities for a growing aquaculture industry in Sweden. A major unexploited resource in our country, which can be used for good advantage to aquaculture, is the regulated lakes and waterpower reservoirs along the dammed rivers in the north parts of the country. These waters were naturally poor in nutrients, but, after water regulation, have been further depleted to what are now almost sterile conditions. Cultivation of fish in these waters would be a restoration action as the increased amount of nutrients would serve to bring the aquatic environment closer to the natural state. Sweden is on the whole a nation rich in waters with 95 700 lakes of more than one hectare in size, and with a very long coast. The lakes cover nine per cent of the nation's surface, approximately 40 000 square kilometres. Clearly, Sweden has a great potential for aquaculture when viewed against this background."*

This time the inquiry resulted in funding both for the breeding programs (the breeding of rainbow trout restarted) as well as research both from SLU and national funding. A research group at SLU, mainly in Umeå with approximately 15 persons including post-docs and PhD students was initiated. The future and potential for farming fish as well as Aquaculture related research in Sweden seemed bright again. The Board of Fisheries was closed down and the responsibility for the development of Aquaculture was assigned to the Board of Agriculture. The assignment was received positively but the knowledge was lacking. University reorganization was performed in 2013-2014 on the faculty and Aquaculture was transferred to the faculty of Veterinary Medicine and Animal Housing in Uppsala. The Faculty in Umeå became a strict Forestry Faculty with one department focusing on animals including fish in the Forestry landscape "Department of Wildlife, Fish and Environmental studies". Due to conflicting research interests the main aquaculture research group in Umeå decided to change research focus back to fish ecology, behavior and genetics of wild fish why a new research group has to be formed, which will take time. In addition, the negative attitudes towards fish farming, especially in net-pens have increased together with funding. At present, the main focus on Aquaculture research are Aquaponics, RAS with giant shrimps, tilapia and mainly warm water species. These activities have no actual commercial production but appear appealing to decision makers.

In summery the following main reason has resulted in the situation of Aquaculture, farming as well as research activities;

Decision makers lack knowledge on Aquaculture why negative and false facts by media and public results in cowardice instead of arguments on true facts that support aquaculture.

The research activities are limited due to a small industry but still very important for the activity to grow further. That makes it very sensitive to sudden changes in funding as well as University priorities and knowledge and cooperation that has taken decades to achieve can be lost in a very short time.

Factors and forces in Swedish aquaculture research activities – The impact of attitudes from the society as well from the Scientific word on Aquaculture research

by

Eva Brännäs
Swedish University of Agriculture Sciences

Factors and forces in Swedish aquaculture research activities

The impact of attitudes from the society as well from the Scientific word on Aquaculture reseach

Eva Brännäs
Professor Dept Wildlife, Fish and Environmental Studies,
Swedish University of Agricultural Sciences

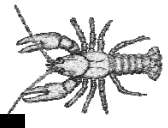
In 2009 the last goverment initiated an inquest or action plan to speed up Aquaculture production in Sweden

Arctic charr

10.000 tonnes rainbow trout
2.000 tonnes Arctic charr
mussels
eal

Rainbow trout

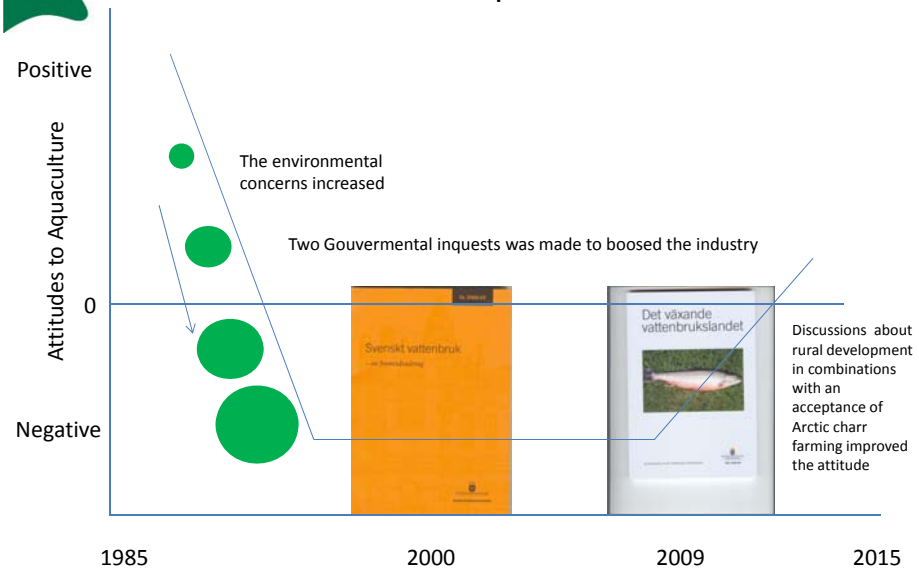
Mussels



Cray fish

Eel

General attitudes to Aquaculture in Sweden



A priority was Arctic charr farming in the nutrient depleated water reservoirs

Dept Aquaculture/ Wildlife, Fishery and Environmental Studies (VFM)

- 1987 Dept Aquaculture
  - Fish biology
- 2009 VFM

Fish farming, Breeding program
Basic research / genetics
Fish migration / restoration

Funding for aquaculture reseach was given

Fundings for quaculture reserch were difficult to get from 1990-2009

Fundings for aquacutre research were given

- Fish biology + genetics
- Aquaculture

Faculty of Forestry

- 2014 faculty organisation
  - Fish biology

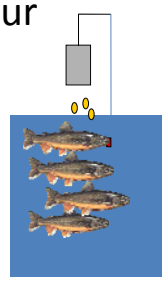
Aquaculture to Faculty of Veterinary Science
Basic research / genetics
Fish migration / restoration

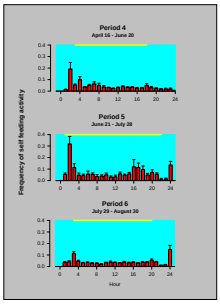
Aquaculture research from 1985-1990
Basic biology/feeding behaviour

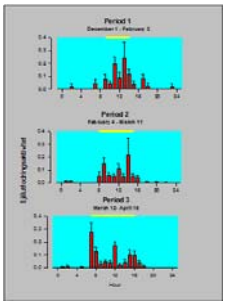
Applied research

-Breeding
-Compare behavior A. charr and rainbow trout
-Stocking density
-Effect of temperature on growth etc.
-Feeding budgets
-Salt-water tolerance
-Seasonal biology
-Social hierarchies

Self-feeding

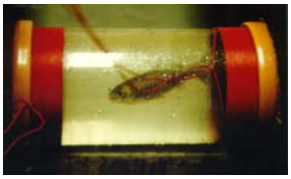


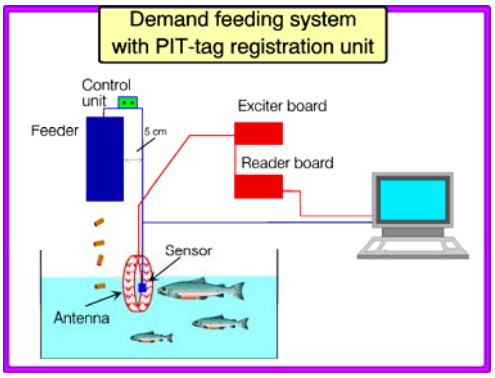




Basic Fish Biology from 1990-2009

Using PIT-tag systems to evaluate individual behaviour





Feeding behaviour
Nocturnal versus diurnal behaviour
Social Behaviour
Learning
Self-selection of macronutrients
Fish Migration

Evaluation of resturation in Swedish rivers

Back to Applied research after 2009

Breeding programs

Jan Nilsson Eva Brännäs

Sustainable feed ingredients

Hanna Carlberg, Eva Brännäs, Anders Kiessling
Torbjörn Lundh, Jana Pickova

Environmental loads from fish farms

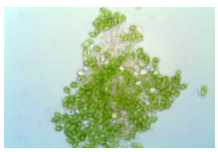
Anders Alanärä

Reprocuction

Henrik Jeuthe, Eva Brännäs, Jan Nilsson, Monica Schmitz

Biology, seasonality and feeding behaviour

Eva Brännäs, Jan Nilsson, Anders Alanärä and Hanna Carlberg



Algae ”in action”

Francesco Gentili

Breeding

Breeding programs (gouvermental assignements)
Arctic charr Rainbow trout

Started in the mid 80`s

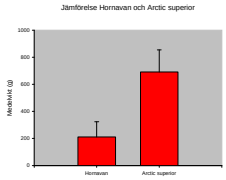
Stopped in the early 90`s

Ongoing

8th generation 0+ was tagged in december

Started again 2011

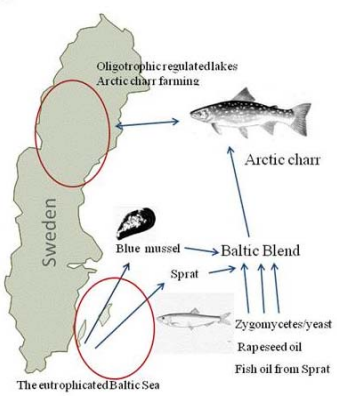
Collecting present and new material

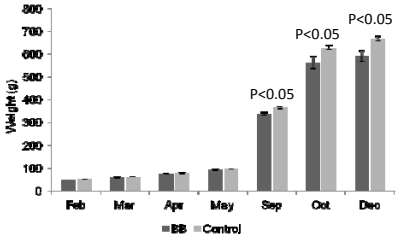


Sustainability in Arctic charr farming

Hanna Carlberg, Eva Brännäs , Anders Kiessling, Jana Pickova and Torbjörn Lundh

Aquabest, Baltic Blend

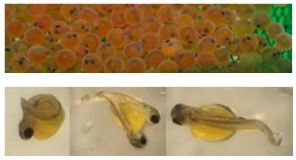




Reproduction

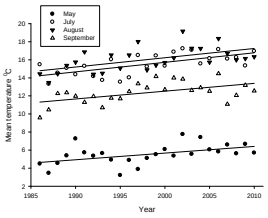
Henrik Jeuthe Eva Brännäs, Jan Nilsson,, Monika Schmitz UU, Ian Mayer No

Evaluation of a low and unpredictable egg quality in Arctic charr

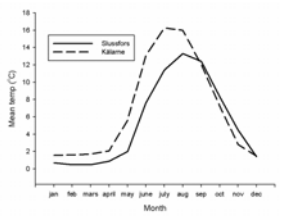


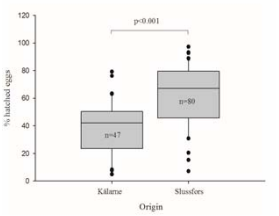
-Temperature
-Sperm quality
-Hormon analysis
-Stress response
-Triploids

Temperature increase



Effect of temperature





Future of Aquaculture at SLU

Feeding giant prawns with microbes

4.4 Social acceptens pre and post Aquabest project

Erik Olofsson

Torsta AB, Sweden

Abstract:
For almost 25 years the oligotrophic cold waters in hydropower dams, in northern parts of Sweden has been pointed out to have a great potential for open cage aquaculture with cold water species. In the beginning of 1990 there were 52 small scale fish farms in the region of Jämtland, the permits raged from 1-100 tons of fish production. From 1995 to 2007 all with the exception of 2 farms ended their production, and the total production volume in 2007 was only 300 tons divided in 250 tons of arctic char and 50 tons of rainbow trout. In the beginning of 2007 the institute of rural development, Torsta AB, was given the task to investigate the reason of this this big decline and way there is no progress in aquaculture development in the region of Jamtland. An interview with all 52 companies showed that a lot of problems were associated with the locations of the fish farms. Problems such as, conflicts with neighbors, sabotage, environmental problems, low production due to high temperatures, ice problems, mink and otter predation, but also the increased competition from Norwegian salmon and low knowledge about aquaculture business closed down the companies. An interview with existing fish farmers and scientists pointed out the answer to why the potential wasn't developed. The economical, bureaucratically and time consuming licensing process was a threshold too big for the new entrepreneurs with low knowledge.

The conclusion was to get the municipality's to put good aquaculture locality's in there comprehensive plans. Where a good location is defined as: conflict free, high production capacity and with a good ecosystem carrying capacity for aquaculture, in other words a social, economical and ecological sustainable aquaculture sites.

On a national level the eutrophication of the Baltic Sea was a threat to an increased production of aquaculture but if sprat and herring from the Baltic could be used as an ingredient to a Baltic sea based fish feed, aquaculture in the Baltic area would be more environmentally friendly and nutrient neutral.

In 2011, the BSAP project Aquabest[1] was granted money, the project had 4 different work packages administration and information. The main goal of the project was to demonstrate that the Baltic Sea region aquaculture has the potential to become a sustainable and responsible food production system, accepted by all stakeholders.

WP3. Exploring the national legal frameworks and suggest new rules including incentives for environmentally sustainable aquaculture. WP leader Finnish Game and Fisheries Research Institution.

WP4. Producing an aquaculture localizing manual for the BSR. WP leader SWE partner Region Jämtland.

WP5. Closing the nutrient loop by developing new fish feed based upon BSR-based nutrients. WP leader SWE partner SLU.

[1] http://www.aquabestproject.eu/

WP6. Developing and spreading knowledge about salt water recirculating systems. Wp leader DTU Denmark.

The wp4 aim was to create a manual for localization of sustainable aquaculture for open cage systems in Jämtland hydropower dams, the model was written so that with small changes, it could be used as a general model for localizing aquaculture sites whole Baltic Sea area. The manual was created in a real case scenario where 10 new sites for fish farms where located in Jämtland, by using standard spatial planning tools, GIS, nutrient load calculations and stakeholder consultations.

The Aquabest results was all over positive, municipality's started to use the results in the work with the comprehensive plans, NGO's where positive to a more sustainable development and land owners and fish conservation organizations saw a chance to make money on land lease and a fishing licenses.

During the project one new company started to lock for a 6000 ton license in the lake Storsjön in Jämtland. The company did not wait for the results of the project instead they put one of the farm sites just outside the shore of one of the most expensive residential areas in the whole region, that was not popular among the people living in that area. A campaign to smear aquaculture started and in just a couple of weeks they had succeeded to find a lot of information from various places on how bad this business would be for the lake. Information was taken from all over the world and summed up to a picture that showed the "truth" about aquaculture.

Wild fish would be sick and die, farmed fish will escape and eat all the food for the wild fish, escapees would destroy breeding grounds of wild fish, fishing would no longer be possible, the lakes would be destroyed by eutrophication, the lake bottom would be covered with feed and fish feces, the water can no longer be used as drinking water due to parasites, hormones and antibiotics, farmed fish was to toxic to eat and so on. Yacht Clubs and trolling clubs joined the campaign and wrote a lot of letters in the local newspapers. The media saw that there was a conflict and did everything they could to put gasoline on the fire, and sell more newspapers. Some journalist also saw an opportunity to tilt the debate towards their own personal opinion about aquaculture. Soon afterwards some local politicians saw an opportunity to join the debate and make a name for themselves as "protectors of the environment". Also the personal of Environmental Examination Commission that gives out the licenses for fish farming was affected by the conflict and the licensing process slowed down due to very aggressive campaign towards aquaculture.

Everything just stopped, all new local entrepreneurs that in the beginning of the aquabest project was interested of aquaculture was too scared to continue and today there are only companies from outside the region and the country that are showing interest in the aquabest farming sites. The municipality's where on the political level no longer positive towards aquaculture, and the ones the where positive went silence. The 6000 ton farm has not yet been granted with a permit.

My conclusion is when something like this happen national specialist organizations like the Swedish board of Agriculture that during this period crated a national strategy on aquaculture (http://webbutiken.jordbruksverket.se/sv/artiklar/svenskt-vattenbruk-en-gron-naring-pa-bla-akrar-strategi-2012-2020.html) has to join the debate.

Hopefully the results from the Aqualog project can give me some clue to how this type of campaigns can be eased in the future, so that aquaculture can be the tool for rural development that It ones was said to be.

Social acceptens pre and post Aquabest project

by

Erik Olofsson
Torsta AB, Sweden

TORSTA AB

Region of Jämtland
institute of rural development

Themes

Agriculture
Aquaculture
Forestry
Food
Energy
FoU rural development

AQUACULTURE IN JÄMTLAND

ALL THE PRODUCTION IS IN HYDRO POWER DAMS

52 company's in 1990
2 company's in 2007

Production 2007 300 tons

2007

”Mer Värt Vatten”

100

New Jobs in the field of Aquaculture by

2013

Jämtlands Läns Landsting FISKERIVERKET Jegrelius

Result

Entrepreneurs do not have the knowledge or the money to get a permit for a fish farm

Week communications between producers and retailers

Aquaculture is considered to cause eutrophication in the Baltic sea and polluting the local waters

New project XX

New feed that is nutrient neutral to the Baltic sea

New conflict free Fish farm locations in municipal comprehensive plans

Search for conflict free aquaculture sites and describe the ecosystems carrying capacity for aquaculture.

In three steps

1. GIS

2. CC for nutrient load on site and in whole lake

3. Start consultation process for implementation of aquaculture sites in the municipal comprehensive plans

AQUABEST
Sustainable Aquaculture in the Baltic region

14 partners i 8 Baltic country's
2011-06-01 – 2014-04-01
3 700 000 euro

AQUABEST

AQUABEST

4 different wp and plus administration and information

WP3. Exploring the national legal frameworks and suggest new rules including incentives for environmentally sustainable aquaculture. Fin

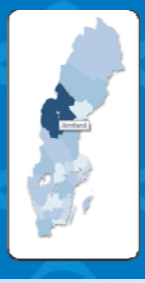
WP4. Producing a manual for localizing aquaculture in the BSR.
(*SWE partner Region Jämtland*)

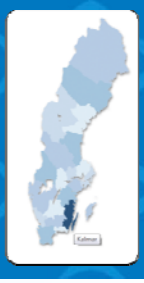
WP5. Closing the nutrient loop by developing new fish feed based upon BSR-based nutrients.
(*SWE partner SLU*)

WP6. Developing and spreading knowledge about salt water recirculating systems.
DTU Danmark

AQUABEST WP4
spatial planning, search for space to achive sustanibility

Jämtland and Kalmar case





Erik Olofsson
Torsta AB

The aim of WP4

Answers to 3 questions

What is the best location for an aquaculture farm ?

How much production is possible ?

What has to be done to get social acceptance?

+

Create a financial model of fish farms that can be accepted by banks and investors.

The method of WP4

Do in a real case scenario and find locations for:

10 new sites for fish farms in Jämtland

10 new sites for blue mussel farms in Kalmar

In total 6 reports 3 from Jämtland and 3 from Kalmar

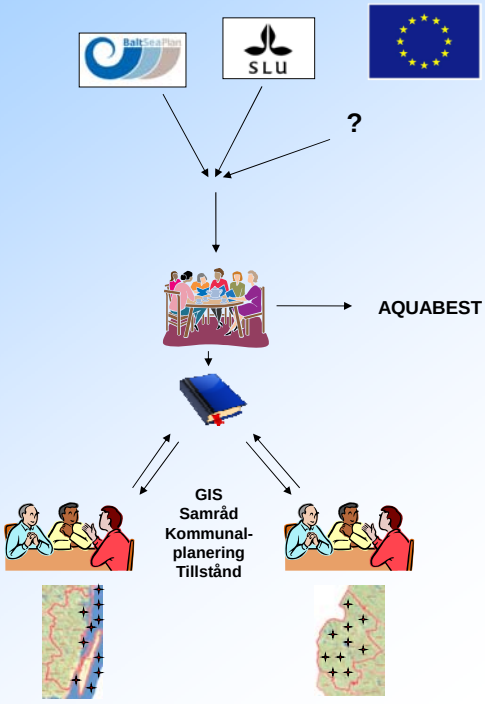
Compiled in a localization manual for aquaculture farms

Establish working groups.

1. Compilation of existing knowledge about spatial planning regarding aquatic and aquaculture.

2. Formation of the reference group for the development of the localization manual

3. Formation of working groups in Jämtland and Kalmar for the use and further development of the planning model in each county. Resulting in at least 10 possible locations in each county.

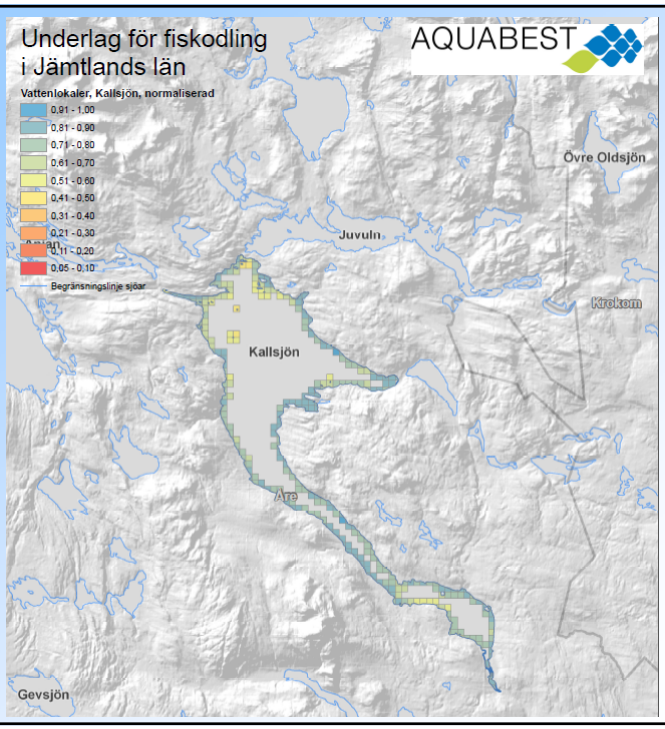


AQUABEST

Baltic Sea Region Programme 2007–2013

In practice.

1. **GIS. Geographical space for aquaculture**
2. **Consultation process. Social space for aquaculture.**
3. **Environmental data. Biological space for aquaculture.**
4. **Financial model for a north Swedish aquaculture farms. Where are the money?**



Answer to the second question

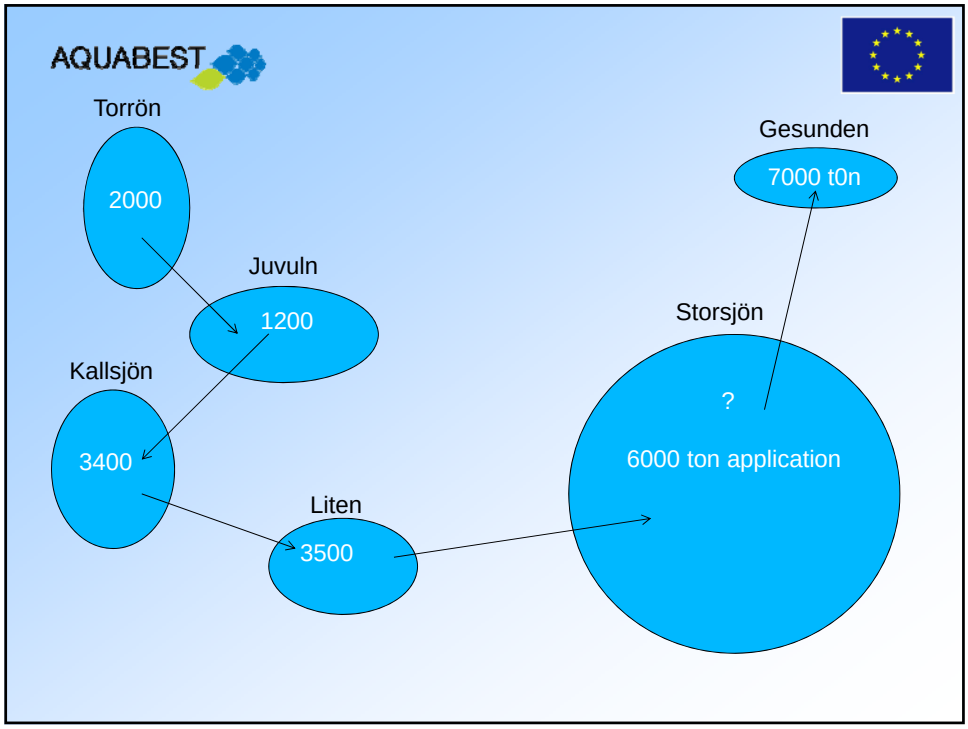
Production capacity / tons of fish

Torrön	1998	river of indalsälven
Juvuln	1354	-II-
Kallsjön	3464	-II-
Liten	3924	-II-
Gesunden	7258	-II-
Hotagen	2179	Hårkan
Hetögeln	2638	Faxälven
Svaningen	3315	-II-
Flåsjön	621	Fjällsjöälven
Lossen	309	Ljusnan
Tot	27060	

Answer to the third question

Results from stakeholder consultations from Jämtland

1. All municipality's are positive/a bit positive
2. Six of these municipality's are pointing out aquaculture as a future business in there comprehensive plans
3. County board don't want to anticipate a future licensing process
4. Companies should increase their processing in the region
5. All municipalities are keen about their water
6. Fish conservation organizations and water owners are positive



AQUABEST

Results the Jämtland Case

Good recomendations on location of aquaculture farms

A better knowledge of the production capacity.

A ongoing public discussion about Aquaculture will increase acceptens

Aquaculture in comprehensive plans in process

We need to know more about the retention of phosforus in these hydropower dams

The shit storm

A 6000 ton application for an open cage fish farm in Storsjön made the critics wake up.

In four mounts the local news where flooded with Negative aspects of aquaculture.

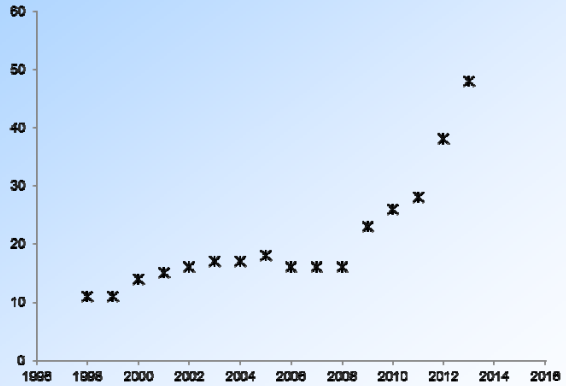
45 negative news articles in just 3 mounts (spring 2013) in one of two newspapers

Aquabest project where accused of opening the Pandora's box and destroying the waters and the fish in Jämtland lakes

All local entrepreneurs that where initially interesting in aquaculture was to scared to continue.

So here we are!!

Production 2015 is 4500 tons in 4 company's and the number of employs has more than doubled. New entrepreneurs are locking at "conflict free" Aquabest sites in Jämtland, The one in Storsjön is still waiting for the permit.




Tack för mig,
Frågor ? Jasså !
AQUABEST

4.5 Aquaculture in the Faroe Islands: Regulations and controversies

Knud Simonsen

Aquaculture Research Station of the Faroes, Faroe Islands

Abstract:

Introduction

The Faroe Islands is an archipelago which can be encircled within a diameter of 111km about 300km from the nearest neighbouring country. On the shelf and in the straits the tidal currents are quite strong (Simonsen and Niclasen, 2011), and due to its location in the north Atlantic, the wave conditions are quite severe with expected maximum significant wave above 18m on the western shelf and about 12m on the eastern shelf (Niclasen and Simonsen, 2012).

The history of salmonid fish farming in the Faroe Islands dates back to the late 1960-is, and it grow into an industry consisting of many relatively small operators during the 1980-is in the sheltered bays and straits with calm waters. The industry reached a production of nearly 20.000 tonnes in gutted weight in the early nineties, before it experience its first major depression (Fig. 1). After the recovery from this set back the industry increased steady to a production of 52.000 tonnes in 2003 (Fig. 1), which at that time accounted for approximately 1/3 of the total export value from the Faroe Islands.

However, in year 2000 was the first outbreak of the ISA, which caused the industry major challenges in the following years, as the production declined to 15,600 tonnes in 2006 (Fig. 1). This motivated a restructuring of the industry, and new management practices and regulations were developed. Under this new regulation scheme the industry has grown to a total production of 86.000 tonnes in 2014, which accounts for nearly 50% of the export value of the country. Moreover, most key figures like mortality, growth rate, feed factor, etc. are in the better end for the industry, and the produced volume in 2014 is obtained with 25% fewer smolts than used in the maximum production prior to the ISA crisis (Fig. 1). However, a dominating industry, although successful, may also cause some controversies.

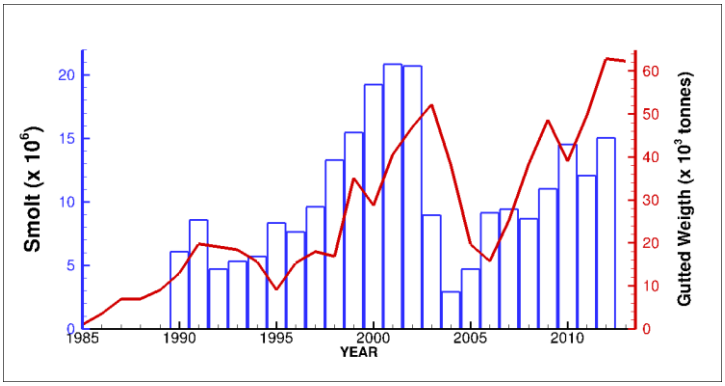


Figure 1: Total annual production of salmonids in the Faroe Islands in gutted weight (line) and number of stocked smolt (bars). Source: Until 1995 from the news bulletin Alitíðindir published by www.fiskaaling.fo, and thereafter from Statistics Faroe Islands (www.hagstova.fo).

Main points in the regulation

The first part of the new regulation was implemented in 2003, and later slight adjustments are incorporated (www.logir.fo). The main elements in the new regulations are zonation, single year classes, surveillance, fallowing between production cycles and regulation of all transport. Some details are given below.

Managements zones (MZ) were established, which in the first version generally were identical to a single fjord or bay separated by areas with well mixed waters mainly due to strong tidal currents. The exception was three straits, which contained 2-4 management zones, which by lateral agreement between the operating companies has mainly been coordinated as a single MZ. However, in 2012-14 the extend of a MZ was generally changed to a larger area, which also could include the more energetic waters outside the bays traditionally used for fish farming. One of the arguments for this change was that expansion of the industry required a move from the inner part of the bays into waters with physically more exposed waters with better circulation.

In each MZ only a single generation is allowed and at least two months fallowing period is required in the entire MZ between each production cycle. There are strict procedures for all transport between zones and between farms and land, which are under surveillance of the authorities. Benthic monitoring are mandatory in late summer. If given measures exceeds threshold values, then actions like restriction in feeding, moving the farm or early slaughter of the fish may be issued by the authorities.

Before restocking the farmer has to submit a contingency plan to the authorities, which includes documented procedures for removing dead fish and capability to remove the entire stock within 14 days in case of detection of a harmful disease. Samples for analysis for a number of diseases are taken monthly, and veterinary inspection are mandatory at least four times annually for sea cages. There are limitations for the allowed fish density in the cages, with the maximum of 25 kg m^{-3} for fish larger than 3kg, and the authorities can set restrictions on the biomass within a MZ.

Controversies

In the Faroe Islands there is long tradition to harvest from the sea, and sea fish farming seems to be accepted as such by the locals. However, no rules without exceptions, although they are rare.

Tourism is an growing industry, which in a recent campaign presented the islands as 'unspoiled'. This caused some comments that sea cages are unexpected in pictures of spectacular landscape formations. In the establishment of a new farming site the nearby residents complained about the artificial light used in the cages during the dark winter months and the negative effect of the cages on the view.

Traditional fishery is mainly of the coast and since most commercial fishery is only allowed at some distance from the coast, the potential for area conflicts is limited. However, in some of the sheltered bays and straits is a fishery of around 60 tonnes annually of a local lobster stock. This catch has a role in the growing tourist industry, and especially in the development of the Nordic and Faroese cuisine as a brand. Expansion of farming sites in these regions may conflict with the relatively spatially limited growing grounds of this lobster stock.

At its maximum there were 63 relatively small mainly locally own operators in the 1980'ies. Mainly in periods of the major set backs, that has been in the history of the Faroese aquaculture, the number of companies is decreased to only four companies in 2014. Only one of these companies, which operates four sites, are 100% Faroese owned. The remaining 21 sites are all operated by companies, which either are fully controlled by foreign interests, or have a significant foreign interest in their ownership. This might be at odd with the political statements about local control over local area and resources.

Summary

Under the new management system the Faroese fish farming industry has steadily increased the production to more than 82,000 total weight in 2014, and most key figures are good compared to the industry globally.

These results may partly be explained by the new regulation, but a generally improved husbandry practice, and that the smolts generally are bigger when stocking the cages, are likely also of significant importance.

Conflicts between the aquaculture and other stakeholders are quite few compared to other regions. However, there are examples of tourists and nearby residents complaining mainly over spoiled view and area conflict arising due to expanding fish farming into areas of interest of a local lobster fishery.

Of importance is also that the number of operators is limited. In 2014 the number companies is reduced to 4, which shorten the process for required adjustments in the management system as well to implement national wide actions. However, a relatively large foreign interest in the ownership of the industry are subject to critical local comments.

References

Simonsen, K. and Niclasen B. 2011. On the energy potential in the tidal streams in the Faroe Islands, Tech. Rep., NVDRit 2011:01, University of the Faroe Islands, www.setur.fo.

Niclasen B. and Simonsen, K.,2012. High resolution wave climate of the Faroe Shelf Tech. Rep., NVDRit 2012:03, University of the Faroe Islands, www.setur.fo.

Aquaculture in the Faroe Islands – regulations and controversies

by

Knud Simonsen
Fiskaaling/Aquaculture Research Station
of the Faroe Islands

Aquaculture in the Faroe Islands
- regulations and controversies

Knud Simonsen,

Fiskaaling/Aquaculture Research Station of the Faroe Islands

www.fiskaaling.fo

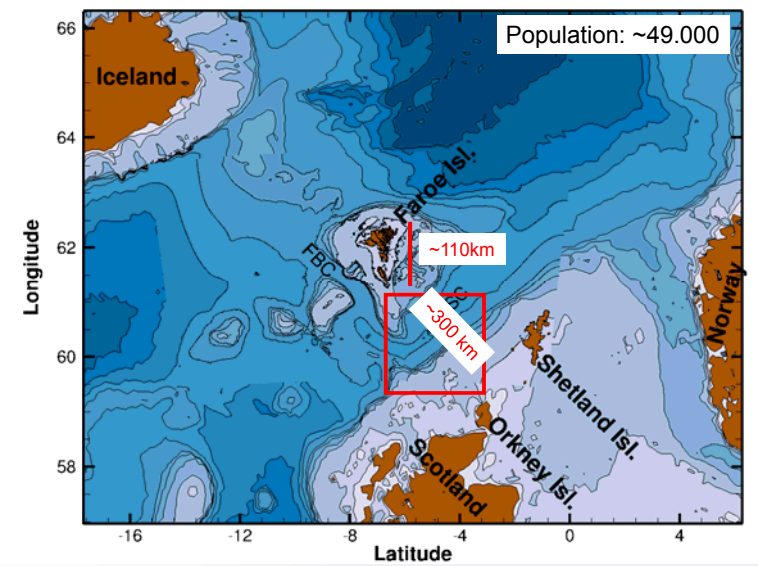
Presented at the AquaLog workshop in Tromsø, 15'th of April, 2015

The next few minutes...

- Aquaculture in the Faroe Islands
  - Physical settings
  - History
- Main pointd in the regulations since 2003
- Local controversies
  - Conflicting area interests
  - Centralization ~ District interests
  - Feed supply
- Feed supply
- Summary

Faroe Islands

Fiskaaling
Aquaculture Research Station of the Faroes



Tides and waves

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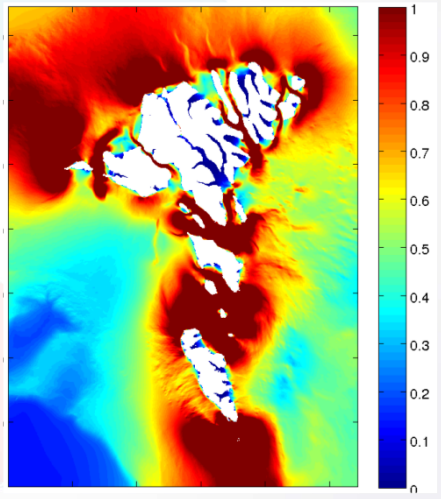
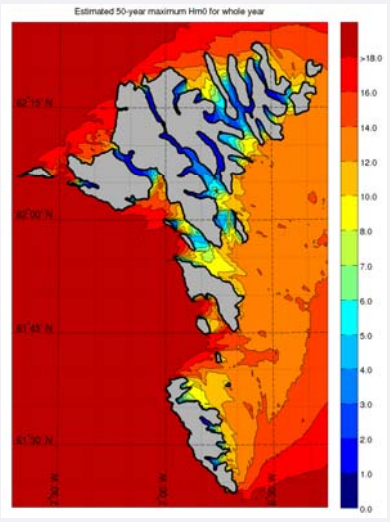
Tidal Current (m/s)
Max on 12 dec 2011



Simonsen & Niclasen, 2012

Estimated 50 year wave height



Niclasen & Simonsen, 2012

History

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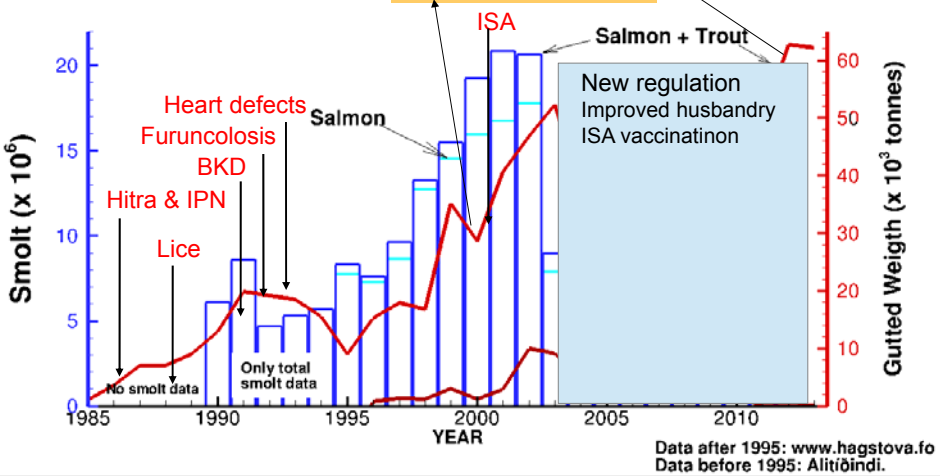
The industry: we plan to produce 100.000 tonnes in year ~~2005~~ 2020

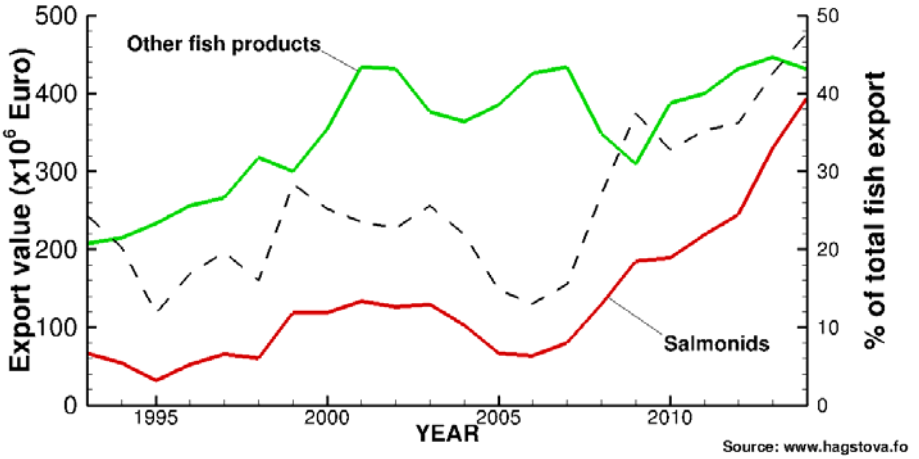
2014 production: ~1.7 ton./capita



Data after 1995: www.hagstova.fo
Data before 1995: Alitíðindi.

The export value

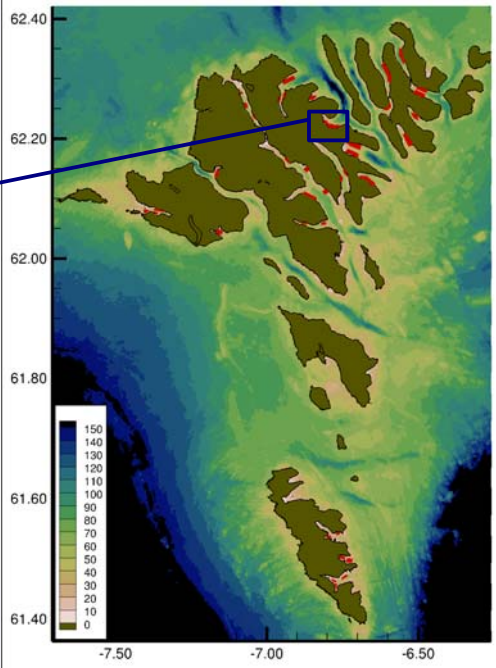
Fiskaaling
Aquaculture Research Station of the Faroes



Source: www.hagstova.fo

Location of the farming sites

A site is an area, which might be large compared to a standard sized farm.



The 'birth' of the new regulation

Fiskaaling
Aquaculture Research Station of the Faroes

Faroese Fish Farmer Association
&
Faroese Veterinary Authorities

↓ ↑

Veterinary Science Opportunities (VESO), Norway

Review of existing knowledge and recommendation

Tidal Residual currents

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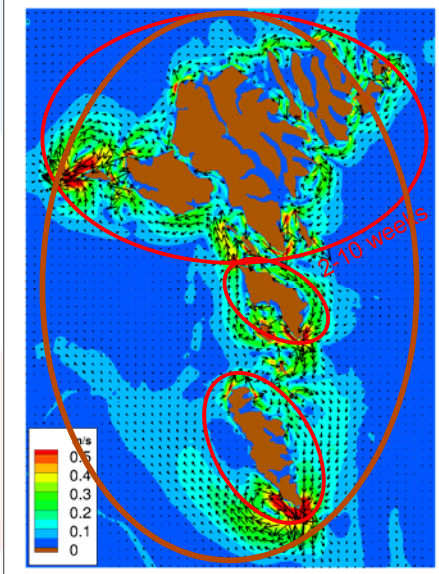
Aquaculture Research Station of the Faroes

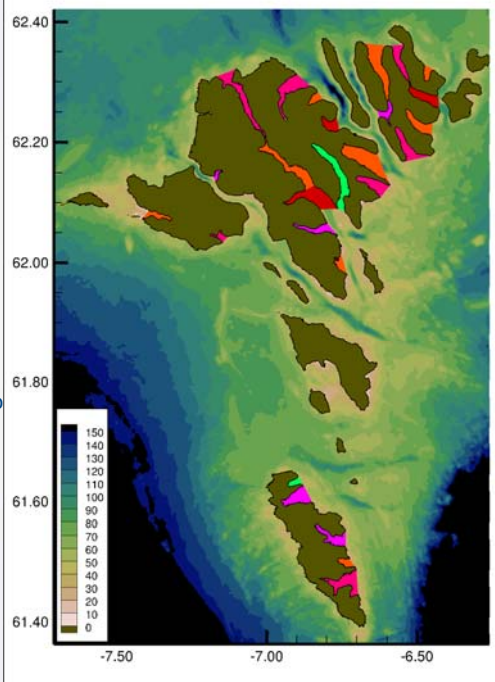


'Things' are not watched away, but are largely kept on the shelf.

The 'new' regulation

Main principle: All in-All out

- MZ = 'one fjord'
  - 'isolated' by strong tidal currents
- Only single year class
- Minimum 2 mth fallow
- Restricted transport between zones
- Min 5 km between sea sites in different zones
- Min 2.5 km distance between sea sites in same zone
- Min 1 km distance between all units on land and sea
- Veterinary control (sea 6/year; land 12/year)
- Report (mortality, movements, feeding, etc) to FFVA weekly.



Points in the regulation

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Aquaculture Research Station of the Faroes

- Licence for a MZ is time limited to up to 12 years
- Benthic monitoring
  - Annually late summer (→ constrains in feeding, moving the plant, slaughter)
  - Before restocking (→delay in restocking, reduced stock, no restocking)
- Approval of contingency plan.
  - Incl. documentation of capability to
    - Safe removal of 1% of biomass/day
      - Removal of dead fish is required in at least 5 days weekly if weather permits
    - Removal of the entire biomass within 2 weeks
  - Documented plan to reduce the sea lice abundance (since [illegible])

Density limitations

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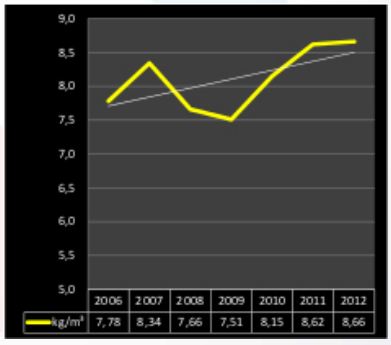
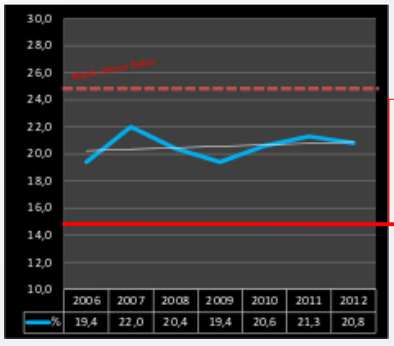
Fish Size	Max Density
< 1 kg	10 kg m^{-3}
1-2 kg	15 kg m^{-3}
2-3 kg	20 kg m^{-3}
3< kg	25 kg m^{-3}

DS from 1999. Latest change: nr 134; 16.10.2009

Average of all stocked fish



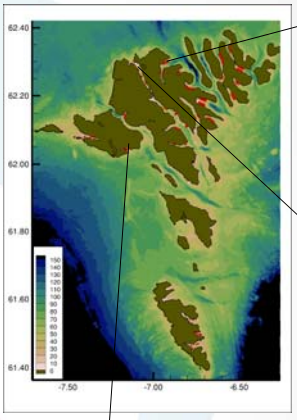
Mean max. density before harvest



Limit practiced by some companies

Courtesy: R. Dam, Avrik/Faroese Fish Farmers Association

Site examples



Results (average for the industry)

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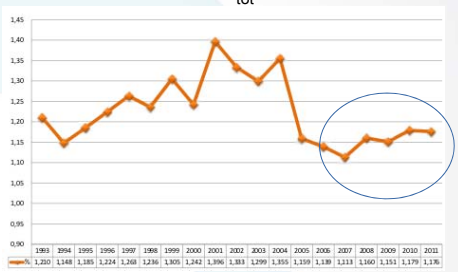
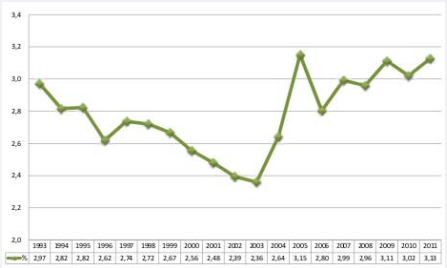
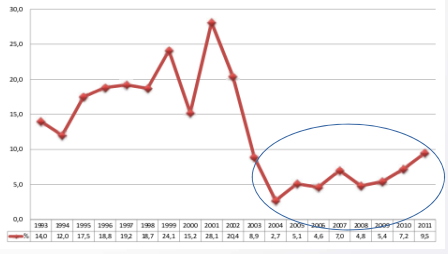
Feedfactor, FCR_{tot}



Growth rate TGC



Mortality after sea stocking (%)



Courtesy: R. Dam, Avrik/Faroese Fish Farmers Association

Modification of MZ's

In 2012, and again in 2014:
- Existing MZ are enlarged
- New MZ are introduced

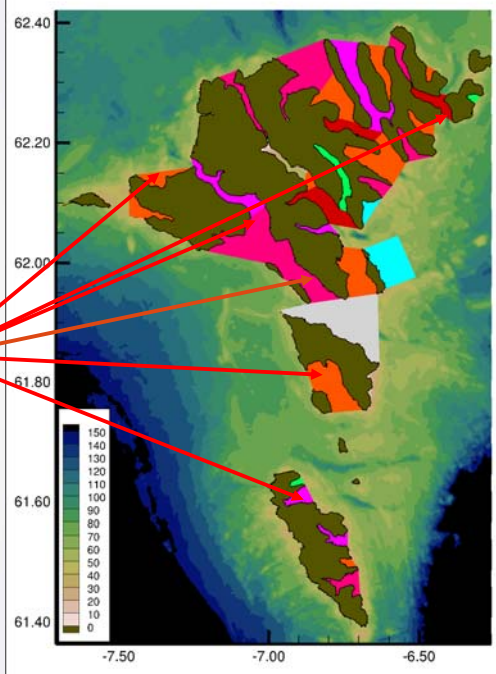
- ~~MZ = 'one fjord'~~
- MZ = 'an area'

Sites currently investigated as potential new sites

Allocated 'non-salmonid' farming

No farming area. Broodstock in landbased facilities.

Testsite for offshore cages



Controversies

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- Long traditions in harvesting the sea.
- Generate jobs in the villages in the fish farming fjords
- Most sites/hatcheries were started by locals
- No native wild salmon stock (but an angler association)

- ==> has been, - and still is, very few controversies!!!

- But.....

At new sites..

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At a suburb to the capital Torshavn:
Complains about noise, disturbing light and spoiled view.

… a new trend that people want to harvest something else than food from the sea?

Expanding tourist industry

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- wants pictures of 'unspoiled' landscape!!

Picture: www.hiddenfjord.com

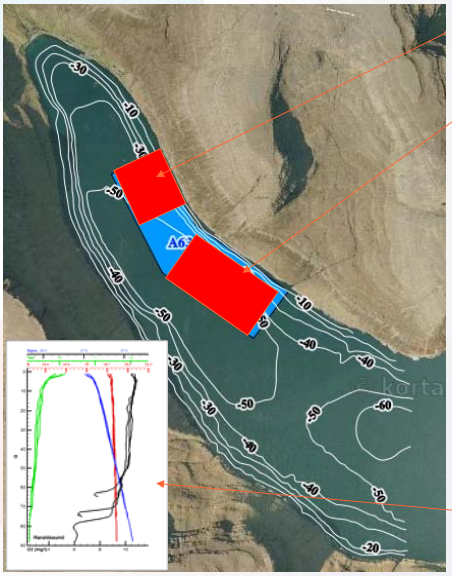
Lobster fishery

In average ~60tonnes/year

Catched with traps (Since 1980)

Market:
- Local hotels
- High class resturants around the world.

Lubster fishery ~ fish farming



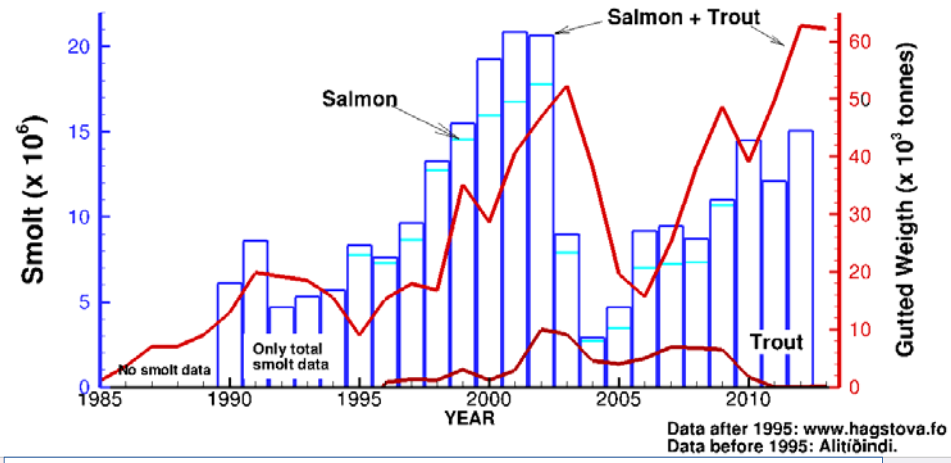
Location of cages for many years

Arguments to move further out in the fjord
- Better circulation
- Reduce the bottom footprint in the inner fjord
- It is within the licenced area
- Possible to increase the biomass

But this is also an important area for the lubster fishery, which is part of the growing 'Faroese Kitchen' brand.

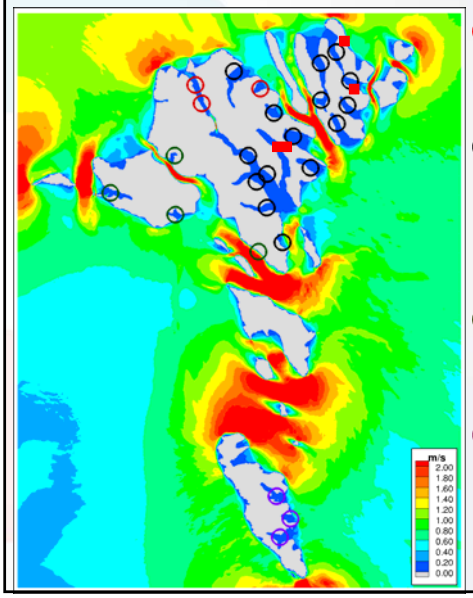
Temporary low O2 values are seen
(This example is from another fjord!!)

History: Number of companies



Companies:	63	21	6	3,5

Present companies



Marine Harvest Faroes
Sea farms and smolt station
Owner: 100% Marine Harvest (Norway)

Bakkafrost
Owner: ~20% Faroese; ~ 80% abroad
Is building
- Two large smolt stations
- A central slaugther and processing plant

Luna /Hiddenfjord
Sea farms and smolt station
Owner: 100% Faroese

Faroe Farming
Sea farms
Owner: 49% Bakkafrost; 51% Faroese investor

Feed supply

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Aquaculture Research Station of the Faroes

Pelagic fish → fish meal and oil → fish feed → salmon

Criticised

Whole frozen:
Processing at some distance from the fishing fields:
- Fillets: To human consumption (thawed / refrozen)
- Cut off & enrails:
  - Fish meal and oil (Not highest quality)
  - For soup or other food products
  - Waste (?)

Processing close to/on the fishing fields:
- Cut off & enrails → fish meal and oil → fish feed → salmon
- Fillets: To human consumption (fresh /frozen)

Time between catch and processing is important to obtain high quality products.

High valued products: Difficult market and tax barries situation!!

Summary

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Aquaculture Research Station of the Faroes

- The regulation implemented as a reaction to the ISA-outbreaks around year 2000 included e.g.:
  - 'All in – All out' principle with fallow periods
  - Frequent veterinary and health monitoring
  - Generally improved husbandry practice
- The produced biomass in 2012 & 2013 was 20% heigher than prior to the ISA-crises, but from 25% fewer individuals.
- Most key figures like growth rate, feed factor, mortality, etc. have improved substantially.
- However, trends in some key figures are of increasing concern, although the figures are still 'good' for the industry.

Summary

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Aquaculture Research Station of the Faroes

Controversies:

Locally **very few** compared to other countries:
- No native wild salmon stock, although some angling
- Tendencies to area conflicts
  - Pollution (noise, light, view) of nature
    - Complains from locals as well as tourist
  - Local lubster fishery
  - Jobs: Centralization ~ fjord districts

Feed supply
- The Faroe Islands has relatively large pelagic resources
- Has potential to increase the total human food and aquaculture feed production by better utilization of existing resources:
  - Increased 'local' processing for human consumption
  - Increased feed production from wast products

- Challenges in form of international market protection

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Aquaculture Research Station of the Faroes

Thank you for your attention.

Questions?

Photos: G. á Norði (1,3) & J. E. Simonsen (2)

4.6 Controversies between salmon farmers and anglers in Iceland

Helgi Thorarensen

Holar University College, Iceland

Abstract:
Overall, the growth of Atlantic salmon aquaculture in Iceland has been slow and tumultuous considering that natural conditions are in many ways favourable. Three periods of growth can be identified: The first one in the late nineties when the construction of several large land based farms saw the production reach just over 2 000 mt. Then from 2002 to 2006, cage aquaculture was started primarily in the eastern part of the country. This was the first time the larger fishing and fish processing companies, such as Samherji, invested significantly in aquaculture development. These projects were abandoned, in part due to the high value of the IKR at the time which left no profits. The final growth phase started in 2011 and is still in full force with new cage farms expanding in the Northwest and Eastern fjords.

The salmon production in Iceland was 6 400mt in 2014 and has increased rapidly during the past few years. Currently, valid licences allow the production of about 28 000 mt. However, plans and applications being processed add up to over 80 000 mt production. The carrying capacity of Icelandic fjords has not been fully estimated and only preliminary results are available. Therefore, licencing authorities are poorly prepared for evaluating these applications.

The first wave of salmon aquaculture development created only limited controversies and these were primarily around the import of Norwegian salmon strains after Icelandic strains proved unusable for aquaculture. At that time, most of salmon was produced in land based farms where the imported strains were perceived as posing only a limited threat to wild populations. In contrast, the second and third waves of salmon aquaculture development have been characterized by significant controversies. The main dispute is between salmon farmers on one hand and the owners of rivers, sellers of angling licences and anglers on the other. To protect salmon rivers and to mediate the dispute, the ministry of agriculture in 2004 limited sea cage aquaculture primarily to the Northwest and Eastern Fjords, away from the main salmon rivers. In these areas, there are few and small salmon rivers. The angling lobby was not content with this resolution and the dispute is still raging.

The angling lobby claims that aquaculture salmon will affect natural stocks by infecting wild smolts with lice and with the mixing of escapes with wild populations. Moreover, they claim that salmon aquaculture seriously pollutes the ocean. All these arguments are familiar from similar disputes in Norway and other countries. Clearly, these are all significant threats. It is, however, not clear how much threat salmon faring poses with the current or planned production. Salmon farmers have responded by claiming that salmon farming does not pose a significant environmental threat. Moreover, any potential threats should be weighed against the socio-economic impact salmon farming can have in these areas. The communities in the Northwest and Easts have suffered depopulation in recent year, in part due to centralization of fishing quotas in few but large companies. The long tradition of fish and fish processing in these communities provides important experience for future development of aquaculture.

The dispute has been aggressive and polarised. Both sides have used questionable arguments that are ill founded by scientific research. The discussion has primarily been led by the angling lobby with harsh statements about aquaculture that may be true, partially true or not true at all. Although the aquaculture side can give valid responses to some of these claims, this puts them in a difficult position from a public relations perspective. Moreover, some of the claims from the aquaculture side are equally questionable as those of the angling lobby. If this dispute is to be reconciled or lead to some fruitful conclusion it is important to redefine the discussion, place it into context and set the appropriate points of references for the discourse.

Controversies between salmon farmers and anglers in Iceland

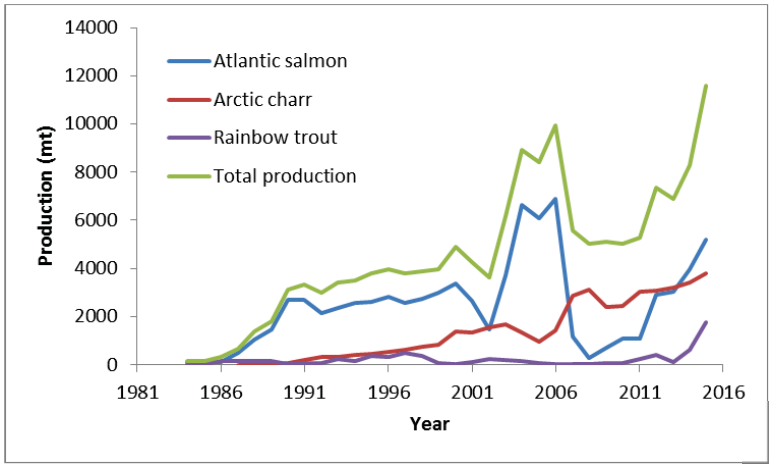
by

Helgi Thorarensen
Holar University College, Iceland

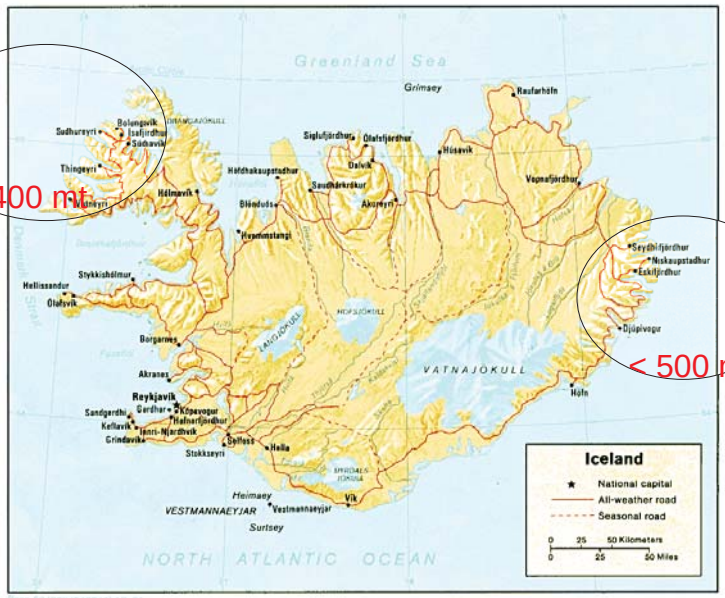
Controversies between salmon farmers and anglers in Iceland

Helgi Thorarensen

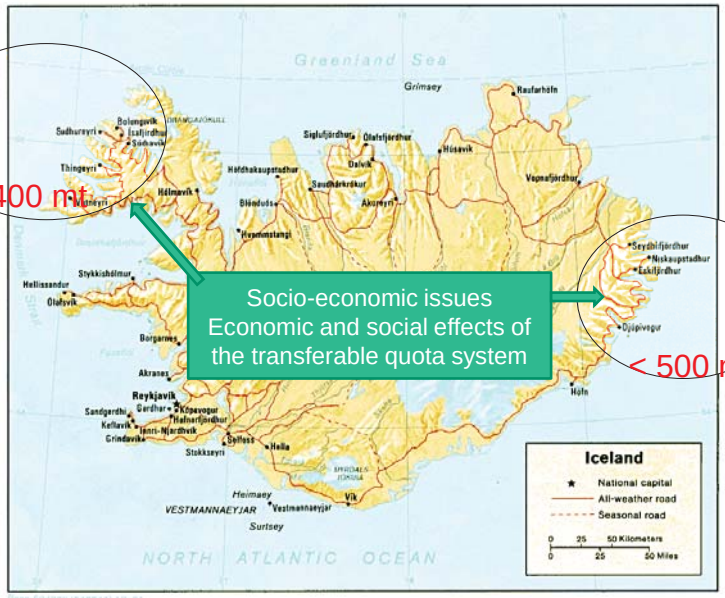
Production of Atlandic salmon in Iceland



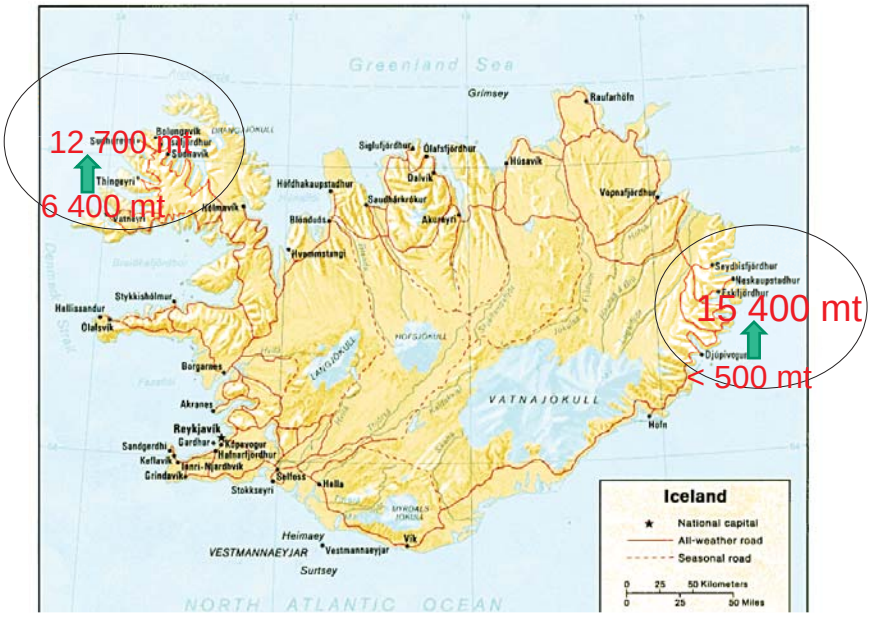
Current production of salmon and trout



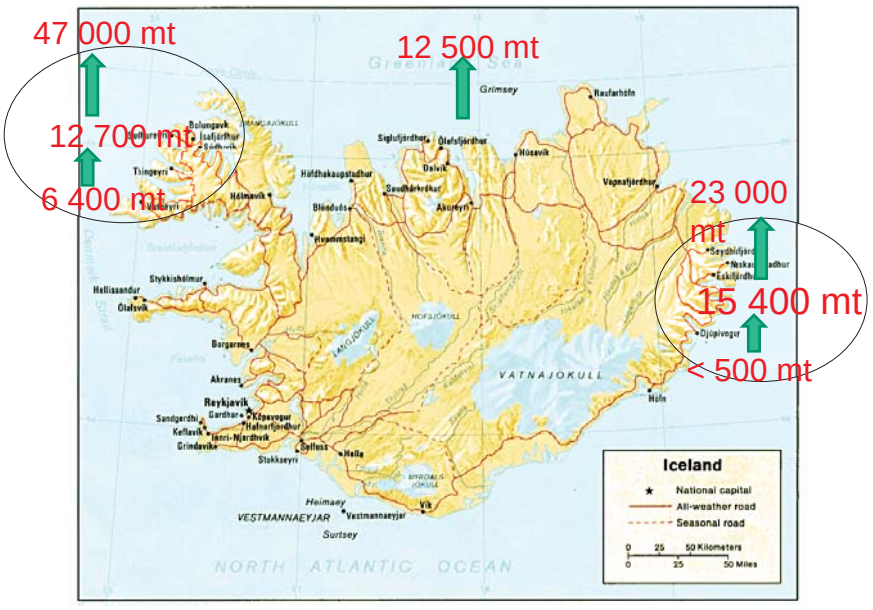
Current production of salmon and trout



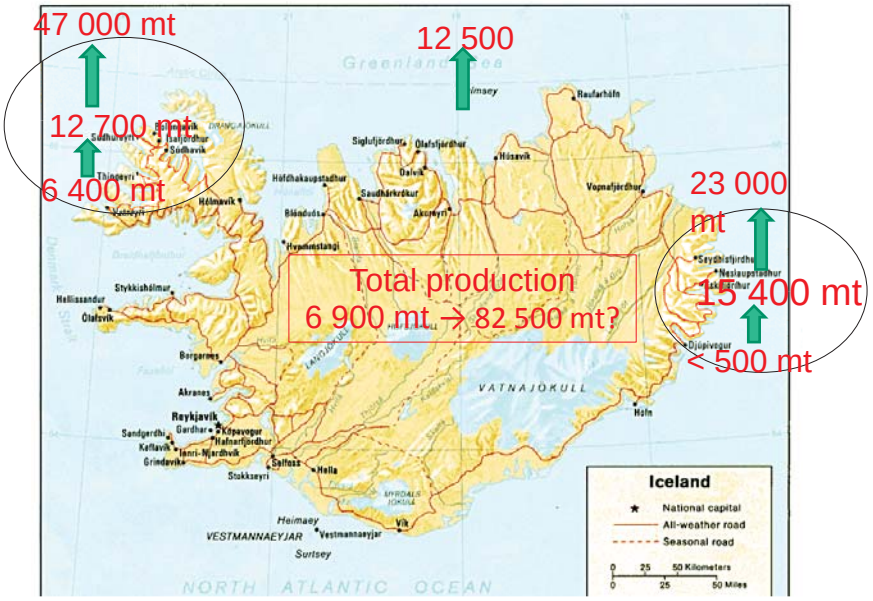
Current valid concessions for salmon or trout



Production with applications planned or in progress for salmon or trout concessions



Production with applications planned or in progress for salmon or trout concessions



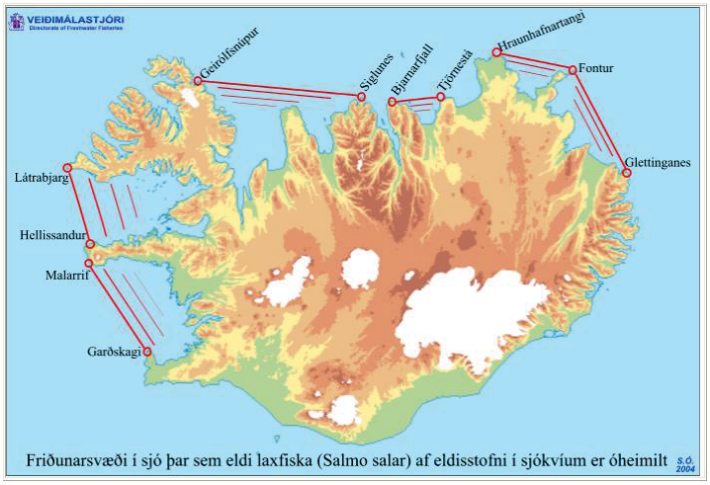
Coastal zoning in Iceland

- Concessions have been granted for over
  28 000 mt production
- Carrying capacity for net cage aquaculture has not been estimated yet
- Preliminary estimates for carrying capacity available for some areas

Controversy

- Aquculture vs. angling clubs and sellers of fishing licences
- At the core, this controversy is about financial or potential financial interests
- One side does not have a moral high ground

Areas closed to cage aquaculture



Anglers and sellers of fishing licences

- Notes from a meeting organized by the above:
  - Aquaculture is the only food production in the world that does not need to clean their waste
  - The tides will carry waste, drugs and fish oil from aquaculture to nearby shores
  - The coastal biota is in grave danger
  - Salmon lice are leathal to fish from neighbouring rivers
  - Genetic mixing of aquaculture fish with wild populations will have long term negative effect on the wild stocks (as shown by research)

Anglers and sellers of fishing licences cont.

- The Norvegian science council has declared that due to aquaculture there is no catch in 110 rivers in Norway
- The fish populations have collapsed
- Coastal fisheries have been hard hit by cage aquaculture in Norway and Canada
- Alaskans have banned all cage culture of salmon to protect the immage of their fisheries of wild salmon

200 salmons escape from fish farm

- Representative from fish farm: „The fish will never enter rivers“
- Representative from fish farm: „Very little chance of mixing with wild fish“

Aquaculturist counters claims from anglers

- Releases of fish in rivers can negatively affect wild populations
- The salmon used for aquaculture has lost it‘s ability to survive in nature

The position of NASF

- Salmon farming in cages negatively affects the immage of Iceland as a food producing country and as a tourist destination
- Orri Vigfusson spokesman: “The NASF believes that it is in the best interest of wild salmon and Icelandic fisheries that aquaculture of salmon in cages is banned”

Change of course in Norwegian aquaculture

- Norwegian authorities with emergency meetings because of various damage caused by aquaculture
- Pollution, parasite epidemics and escapes loaded with antibiotics have changed the policy of the authorities
- Local authorities in more than 60 communinties are fighting net cage aquaculture

Calling scientists to vitness against

The consequences of o
sea-based fish farn

Dr. P. Gargan, Inland Fisheries

Iceland 14th March

Brief history of sea lice (*L.salmonis*) impacts

Recent evidence of sea lice impact on salm

THE CONSERVATION FUND

Atlantic Salmon Growout Trials in Freshwater Closed-Containment Systems at The Conservation Fund Freshwater Institute

Examples of discussion

Anglers

- Aquaculture in cages is the most dangerous form of food production there is
- 7000 mt aquaculture polluts as much as a community with 160 000 recidents
- Land based aquaculture polutes less than cage culture

Fish farmers

- Aquaculture produces three times less waste than any other form of animal protein production
- No, only as a community with 28 000 residents
- No, energy cost because of pumping is high and land based aquaculture pollutes as much as cage culture

Positive effects of aquaculture on regional development

Markaður fyrir meiri lax

● Dótturfyrirtæki Fjarðalax hefur hafið umhverfismatsferli fyrir sjókvíaeldi í Eyjafirði, Seyðisfirði og Mjóafirði ● Árgangaskipt eldi eins og á Vestfjörðum

Helgi Bjarnason
helgi@mbl.is

Fjarðalax hyggst hefja sjókvíaeldi á laxi í Eyjafirði, Seyðisfirði og Mjóafirði. Hugmyndin er að vera aðeins með einn árgang í hverjum firði og hvíla síðan aðstöðuna eftir að laxinum hefur verið slátrað.

Áformuð uppbygging Fjarðalax á Norður- og Austurlandi er í nafni dótturfélags Fjarðalax, Norðanlax ehf. Kynnt hafa verið drög að tillögu að matsáætlun um verkefnið en það er fyrsta stig umhverfismatsferlis. Almenningi er gefinn kostur á að kynna sér málið á vef Fjarðarlax, fjardarlax.is, og gera athugasemdir fyrir 6. mars.

Morgunblaðið/Helgi Bjarnason

Fjarðalax Áformað er að 20-30 starfsmenn verði í hverjum firði þegar lax-

Norðanlax

» Áformin ganga út á að vera með allt að 8 þúsund tonna hámarksframleiðslu í hverjum firði en þó ekki meiri en 12.500 yfir þriggja ára tímabil.

» Stærðarhagkvæmni er mikil í fiskeldi og því hafa stöðvar almennt sett stefnuna á svo mikla framleiðslu.

» Áætlað er að 20-30 starfsmenn þurfi að ráða vegna daglegrar starfsemi í Eyjafirði og jafnmarga í hinum fjörðunum, alls 60-90 manns.

Possiblities in tourism destroyed by aquaculture

Tækifæri í ferðaþjónustu

Orri Vigfússon. Ljósm: NASF.

Ný skýrsla um tækifæri í ferðaþjónustu á Vestfjörðum, sem unnin er af Gústaf Gústafssyni í Bolungarvík fyrir NASF, verndarsjóð villtra laxastofna, var kynnt í gær. Orri Vigfússon er stjórnarformaður NASF og hafa samtökin talað mjög gegn laxeldi í sjó en mikil áform eru um stóraukið laxeldi á Vestfjörðum og segir Orri að skýrslan hafi verið gerð til að benda Vestfirðingum á aðra möguleika í atvinnusköpun. „Við komum alltaf með lausnir þar sem við erum að vinna og í þessari skýrslu bendum við á mikla möguleika sem Vestfirðingar eiga í ferðaþjónustu. Vestfirðir eru aftur úr í ferðaþjónustu og það er hægt að laga MEST með því að hjálpa ungu fólki við að setja upp lítil fyrirtæki í ferðaþjónustu," segir Orri.

„Svo skal böl bæta að benda á annað verra“

- Fish farmers:
  - Anglers have in the past mixed populations between rivers
  - There is evidence to suggest that stock enhancment will cause changes in wild populations
  - During periods of sea ranching, more than double the number of wild smolts were released in Iceland (the chairman of the anglers club owned one of these companies)

Conclusions

- The discussion about salmon aquaculture is immature
- Both sides have some valid arguments but these tend to be lost among the schools of red herrings
- Anglers make claims that are in some cases wrong and other cases misleading (let them deny it)
- Fish farmers are in defence and are not responding well to the claims of the

4.7 Aquaculture governance and controversy in Norway

Jahn Petter Johnsen[1], Otto Andreassen[2], Bjørn Hersoug[12] and Ann-Magnhild Solås[12]

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[2]Nofima, Tromsø, Norway

Abstract:

Natural resource governance is based on interventions that regulate human behavior (Berkes, 2007). The interventions are defined on basis of assumption of how human actions impact on nature (Pálsson 2006). Since nature is not directly accessible, nature has to be represented through specific governable objects that can be the foundation for defining interventions (Johnsen et al. 2009, Johnsen 2014). Governable objects are constituted when the components and processes in an ecosystem through specific techniques are symbolically transformed into bounded objects that can be measured, quantified or modeled in ways that make it possible to create specific intervention mechanisms for governance, as is done with a fish stock. "The managed fish stock" can serve as an example of the creation of a governance object. The fish stock" is produced through modeling and simulation as an object of knowledge that over time will be more and more stable and durable as a governance object. The fish stock that we regulate is in this sense "constructed".

In our conceptual model (illustrated in slide 14), governance is understood as an interaction between two subsystems: The governing system and the system-to-be-governed (Jentoft 2007). The governance system produces and processes knowledge about the system-to-be-governed, and converts this knowledge into management instruments, i.e. a system of regulatory practices (Johnsen et al. 2009). This conceptual understanding of governance includes policymaking, decision-making, administrative actions and formal management, and the natural and social interactions that constitute the socio-ecological system-to-be-governed. Governance is used here as having a broader meaning for governing, while management denotes the targeted formal actions that are undertaken to regulate the fish farming. Two mechanisms for information feedback are depicted in the model. On the right hand side, there is a technical and scientific information system for monitoring the effects on the natural system. The left side of the figure in slide 14 depicts the control and regulatory instruments that have been created to regulate human activity in relation to the estimated effects and impacts. Additionally, a governance system can have public information channels that go directly from the system-to-be-governed, or representatives of this system, to the governing system (middle arrow). In this way, the dynamic and complex character of natural and social systems becomes reduced to specific tangible governable objects. In addition, the political and ideological part of the model illustrates that governance is not only a technical process.

Different from the fish stock, coastal space is still in the making as a governance object. Moreover, while the fish stock management is the responsibility of one knowledge authority, the Institute of Marine Research, one Political authority, the Ministry of Trade and Fisheries, and one executive management body, the Fisheries Directorate, aquaculture governance is more complicated. Coastal space is the responsibility of several knowledge bodies, political and administrative authorities. Coastal space is not yet constructed and stabilized as a defined and bounded governance object. This has implications for the governance of aquaculture. There are overlapping responsibilities, conflicting goals and values. This organization structure has resulted in a complicated planning and management system with a variety of governance tools – all with great ambitions, but involving

considerable problems of coordinating the different stakeholder interests – and with tensions between the various governance levels. Local concerns may easily be overrun by national priorities and plans, while national goals may be undermined by local foot dragging and protests (Hersoug 2013).

The Aquaculture controversies in Norway is in one way or another related to management and administrative practice, either through actions meant to help, reveal or attempts to deal with the controversy. Policy objectives, management systems and regulations are all complex, and to some extent characterised by a lack of coordination. Tensions occur both vertically between different management levels, and horizontally between sector authorities, or neighbouring municipalities. This makes it challenging for the industry to relate to the management system, and also to integrate the different governance needs. In addition, there are increased pressures in the coastal zone regarding new ways to harvest, use, and protect coastal nature and resources. Global and external interests also play an increasingly larger role in local communities. Thus, the controversies are very complex.

Disputes over aquaculture in Norway often arise when new licenses are announced by the Ministry of Trade, Industry and Fisheries, when fish farms apply for new or larger sites, and when coastal zone planes are prepared by the local communities (in Norway, planning of the near-shore sea space is a task delegated to the municipalities). The controversies are mostly framed and expressed along four axes; 1) access to sea areas, 2) effects on the natural environment, in particular sea lice and escapes, 3) fishing, commercial- and recreational fishing, and 4) community development, the distribution of advantages and disadvantages.

One of the major themes of the controversy seems to be the struggle for and access to sea areas, but there may be reason to question whether there are other conditions that prevails. Aquaculture is a very area-efficient way to produce food. A normal sized aquaculture site today has around the same extent as the infields at old day's smallholdings. On such a confined area the annual production volume of farmed salmon are more than the total meat production in the agricultural industry in both Troms and Finnmark County. The overall physical area seizure for all sites for salmon farming in Norway is less than 0.5 percent of the sea area within the baseline of Norway. It is thus likely that the controversy currently are more about political tolerance and social acceptance than lack of physical space, and environmental constraints.

Today, the focus is mainly on environmental concerns, which also are reflected in the regulatory regime where the environmental concerns seems to be almost the only thing that can stop applications for new or bigger aquaculture sites. However, it is obvious that also, other aspects should be taken into consideration, but a narrow focus on environmental sustainability tends to lock the aquaculture controversy in Norway to environmental issues, thus, many fundamental issues regarding the salmon farming industry (social and cultural impact, rights, knowledge, and governance, local versus global development etc.) are suppressed.

Research findings indicate that the controversies might also stem form an immature governance regime that is fragmented, and suffers from a lack of coordination and a diversity of objectives, signals, practices etc. Hence, developing more knowledge about how and why the controversies arise is essential. So is developing governance models that reduces and resolves controversies, rather than adding to them.

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Berkes, F. (2007). *Sacred ecology*, 2nd edition. Routledge. New York and London: Taylor and Francis Group.

Hersoug, B. (2013). The battle for space: The position of Norwegian aquaculture in integrated coastal zone planning. In: *Global challenges in integrated coastal zone management* (Eds. Moksness, Dahl & Støttrup). Sussex: Wiley-Blackwell, pp. 159–168.

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Johnsen, J.P., P. Holm, S. Sinclair & D. Bavington (2009). The cyborgisation of the fisheries. On attempts to make fisheries management possible. *Maritime Studies (MAST)*,**7**, pp. 9–34.

Pálsson, G. (2006). Nature and society in the age of post-modernity. In: *Reimagining political ecology* (Eds. A. Biersack and J.B. Greenberg). Durham, NC: Duke University Press, pp. 70–93.

Links to two articles about space as governance object:

http://www.maritimestudiesjournal.com/content/13/1/2

http://www.ecologyandsociety.org/vol19/iss2/art60/

Aquaculture governance and controversy in Norway

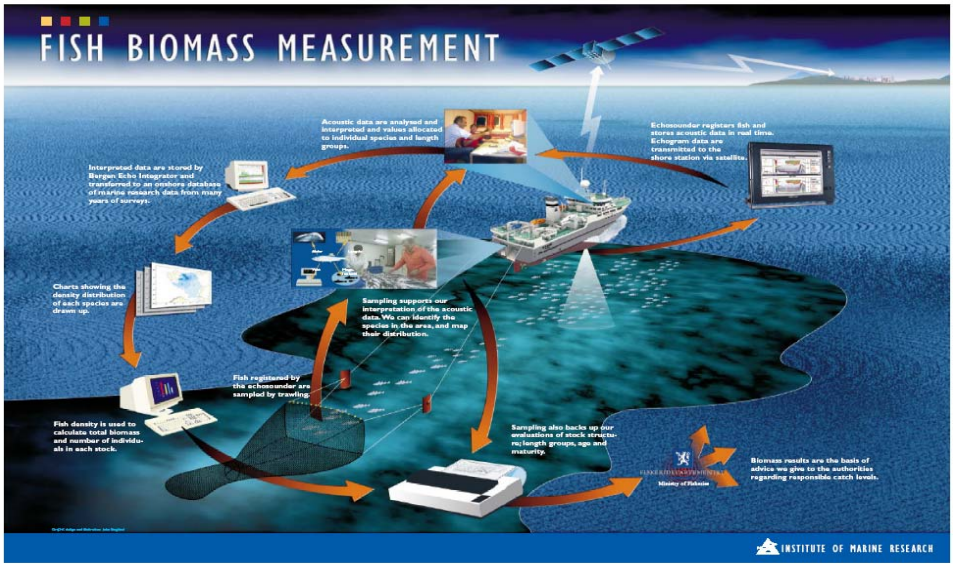
by

Jahn Petter Johnsen
Otto Andreassen
Bjørn Hersoug
Ann-Magnhild Solås
Nofima/The Arctic University of Norway

How to govern Nature?

- Through regulation of human behaviour
- By the use of representations of Nature that makes interventions possible – Management Objects
- Due to path dependency and institutional "lock-in" Management Objects will over time be more and more stable and durable

Construction of a Management Object



«The managed fish stock»

- Not the same as the fish in the sea
- Science produces “the fish stock” as an object of knowledge, through modelling and simulation
- Stock estimates are starting point for a bundle of institutionalised management practices
- The fish stock is “made” and stable

Different from the fish stock, coastal space

as a Management Object is still in making

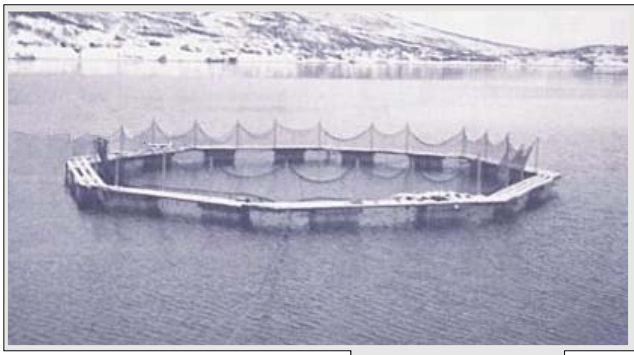
Theoretical Perspective:

- Science and Technology study perspective
- Actor-Network Theory
- Management Objects are seen as multiple objects
- Example: Arteriosclerosis. From Mol A 2002. The Body Multiple: Ontology in Medical Practice.
- The cyborg fish, Johnsen, Holm, Sinclair and Bavington (2009), Johnsen, Murray and Neis (2009).

Norwegian Coastal Planning

- The Plan and Building Act (PBA)(1965)
  - Municipal responsibility
  - Physical planning on land – coordination between sectors and use of area
  - Avoid conflicts between different users
- 1985 – Harbour areas included in the PBA
- 1989 – Coastal Planning to the baseline
- 2009 (New PBA) Municipality planning to 1 nm outside the baseline

Why coastal planning?



Cages in the sea made it posible to intensify the production

Access to coastal area became an asset and resource for fish farming

A struggle for access to area started

The management regime was established

Ecosystem based approch (EA)

- Shift in approach and focus from users' rights and interests to user impact on the ecosystem
- Rights, impacts and responsibility are seen in relation
- EA focuses on functionality and dynamics
- Relationships between a variety of actors and components
- From 2D(area) to 3D (space)

From area to space : Example: The site for aquaculture

Stakeholders: Many

Interests and stakeholders: fishers and sea transport

Anchoring and user conflicts

Physical

Chemical

Biological

Ecological

Political

Economic

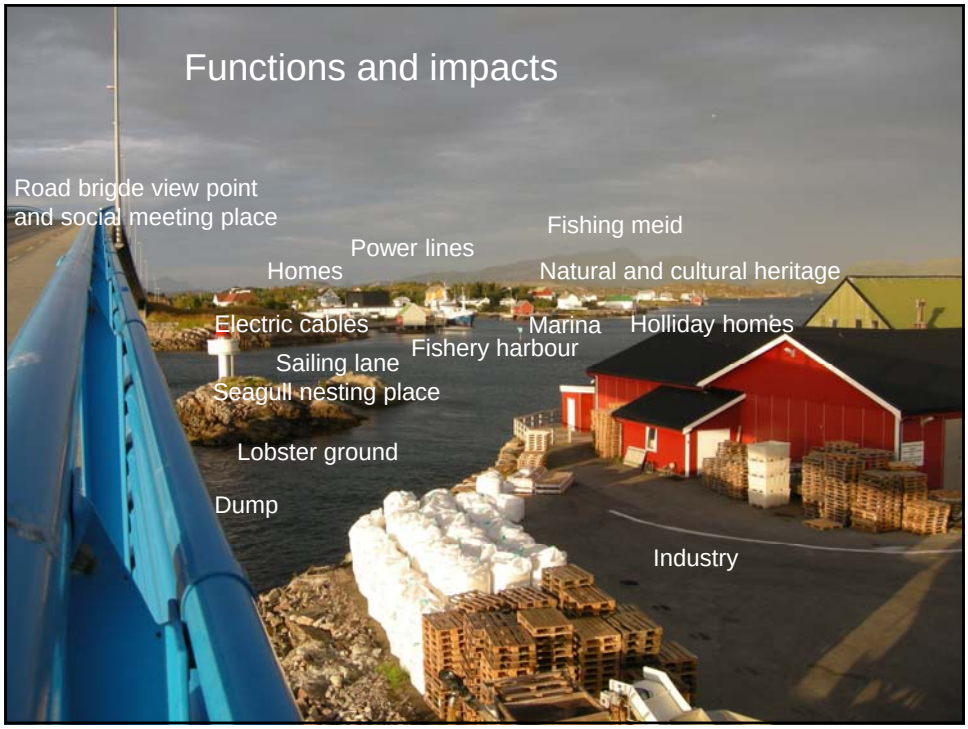
Social

Cultural

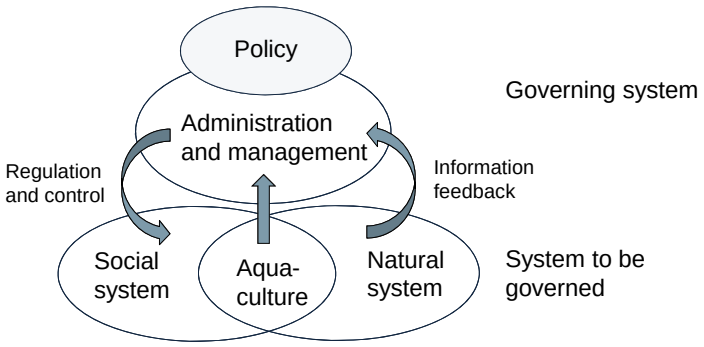
Impacts and risks

1970s

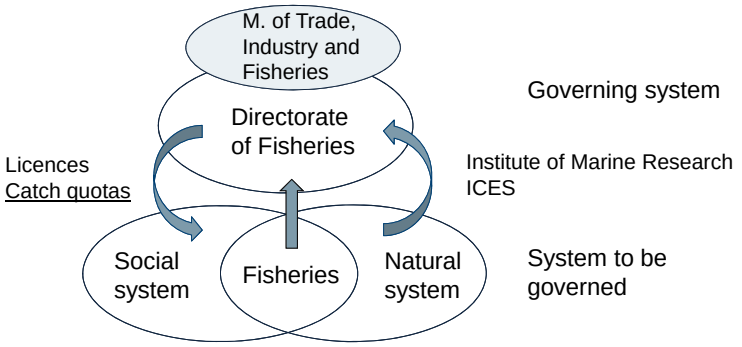
Today



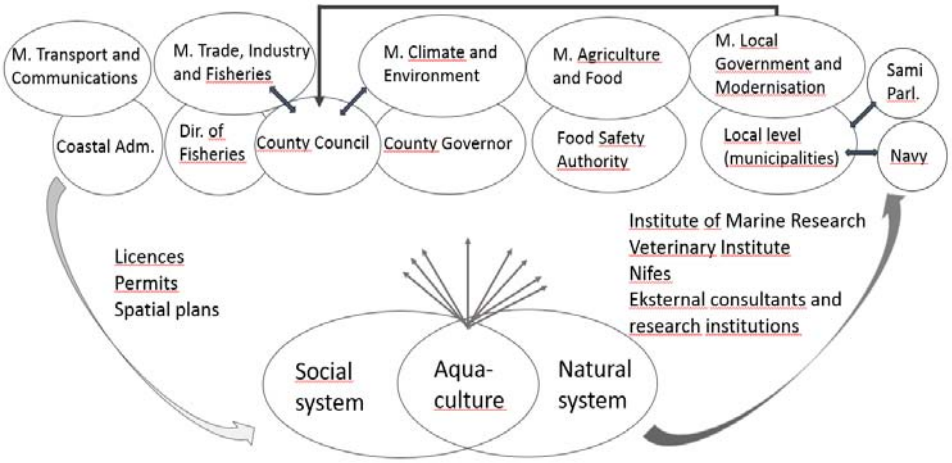
Governance model



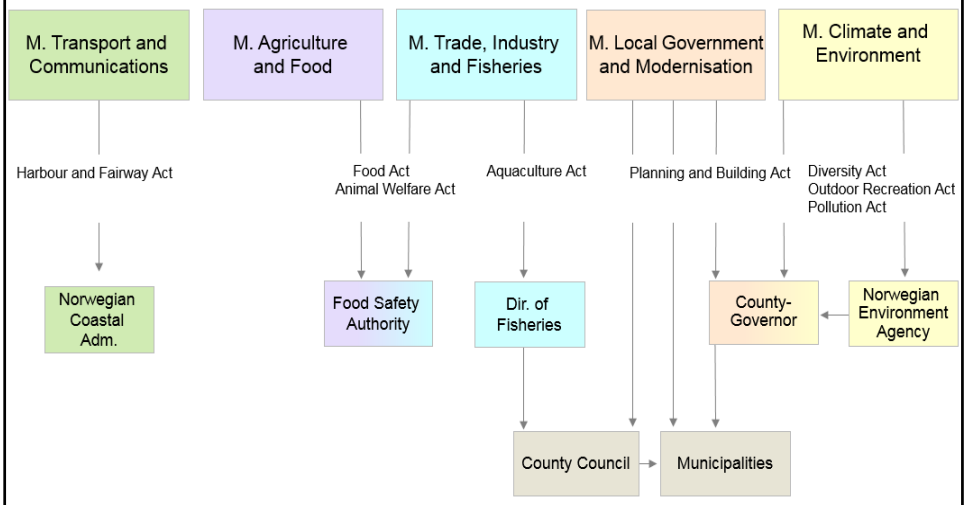
Governance model: Fisheries



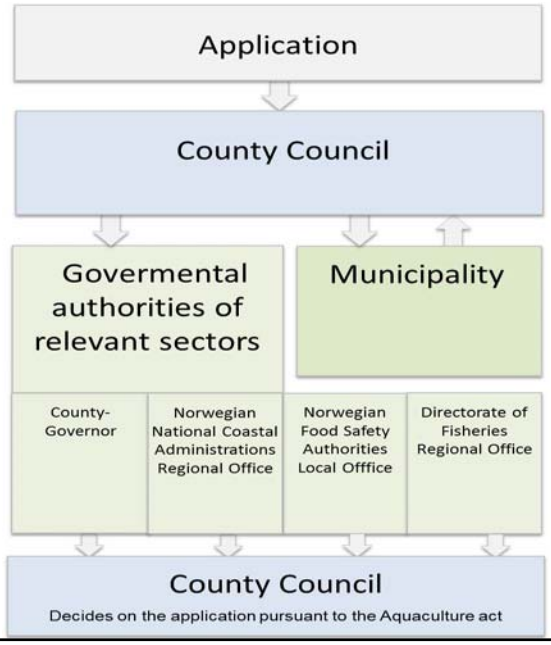
Governance model: Aquaculture

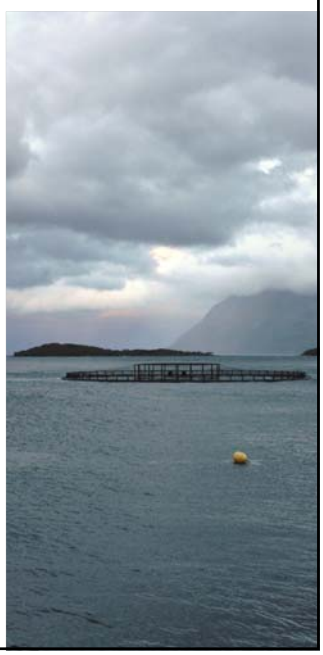


Governance in Norway: Aquaculture



Aquaculture Site Application Process

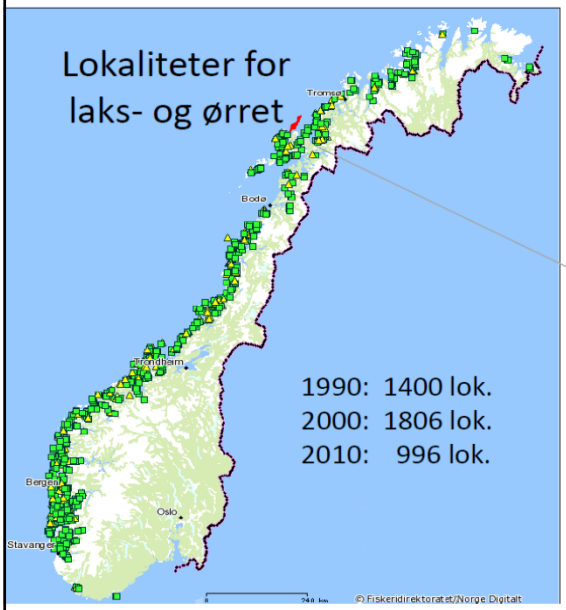




Controversy increases when:

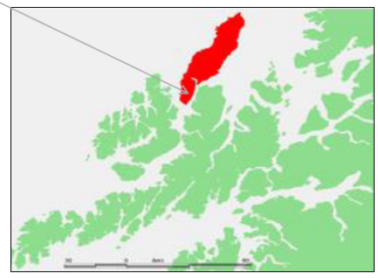
- New licenses are announced
- Fish farmers apply for new sites
- When coastal zone plans are prepared

Controversy: A battle for space, or ..?



Fysisk arealbeslag

Havoverflate	59 km²
Inkl. ferdselsforbud	82 km²
Inkl. fiskeforbud	194 km²
Sjøbunn	420 km²



Controversy in Norway:

- Environmental impact
  - Sea lice
  - Escaping
- Fishing
  - Wild salmon
  - Marine fish
- Rural development
  - Distribution of advantages and disadvantages
  - Rights

Controversy in Norway; mainly focus on environmental issues

- A too narrow focus and regulation on almost only environmental issues leads to lock the controversy
- Thus, it leads to hide many fundamental issues regarding the salmon farming industry (social and cultural impact, rights, knowledge, and governance, local versus global development…).

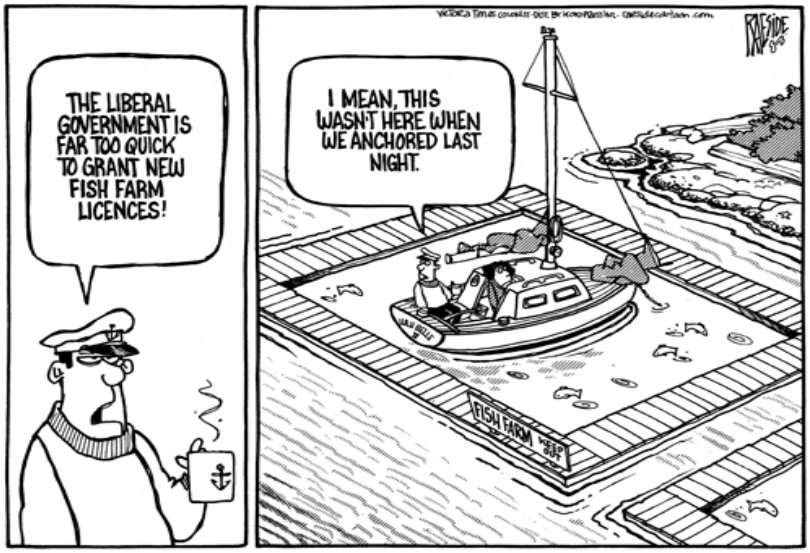
Does the regulatory regime add to the controversy?

- Fragmented
- Diversity of objectives and signals
- Diversity of practises
- Lack of coordination

Institute of Marine Research

Directorate of Nature Management

Thank you



http://www.raesidecartoon.com

4.8 Sustainable coexistence between salmon culture and coastal fisheries

Bjørn-Steinar Sæther[1], Ingebrigt Uglem[2], Ørjan Karlsen[3], Pablo Sanchez-Jerez[4], Karl Øystein Gjelland[3] and Pablo Arechavala Lopez[4]

[1] Nofima AS, Norway, [2] Norsk Institutt for Naturforskning AS, Norway, [3] Havforskningsinstituttet, Norway, [4] University of Alicante, Spain

Abstract:
Aquaculture and coastal fisheries are significant industries that share the same resources and areas. Whilst coastal fisheries are based on smaller boats (under 11 meters) and has a long tradition, intensive salmon farming, by comparison, is relatively new with its 50 years or so history. The number of fishing vessels is declining whereas the fish farming production is increasing, but the trends are not related as such. The scale of production means that salmon farming have to be regarded as an ecosystem-modifying factor in coastal marine areas. This presentation will focus on the possible interactions between salmon farming and coastal marine fisheries in Norway.

There have been several claims from fishermen that wild maturing coastal cod shies away and abort migrations into fjords with salmon farms. What may explain such a behavior (repulsion) is unclear, and contradict observations that fish farms act as fish aggregating devices (FAD). As cod use olfactorial chemical cues to find food, and intra-specific communication, it was hypothesized that such avoidance could be due to waterborne chemical cues released by the salmon affecting the cod behaviour. Such mechanism was demonstrated under laboratory conditions, as wild caught naïve cod changed behavior when presented to water from a salmon tank. Further, that this was mediated through olfaction. However, the hypothesis was not valid when tested in nature. It is well known amongst fishermen and fish farmers, and has been described in several scientific papers, that wild fish aggregate close to the farms. This may be due to shelter, as in reefs, but can be enforced by increased availability of food, either due to nutrient enrichment from organic load or waste feed. We have data that implies that the frequency of wild fish close to fish farms correlates to the biomass and feeding rates at the farm. The wild fish is usually located directly under the farms and, thus, not available to conventional fisheries due to the 100 meter fishing restriction zone around the farms. However, the abundance of wild fish is usually also elevated outside the restriction zone, something many fishermen do take advantage of, as some catch a substantial portion of their annual cod quota close to fish farms. It is speculated that saithe may find fish farms so attractive habitats that some do not migrate to their natural on-growing areas in the Northern sea and stay away from their natural spawning grounds.

The increased access of food to wild fish in the vicinity of fish farms can be seen on the increased liver sizes. The hepatosomatic index (HIS) is usually higher in farm-associated fish than fish from control areas without fish farms. The filet quality may also be affected by fast growth, and as with wild fish feeding massively on capelin or herring, the muscle becomes softer and more prone to splitting. In most cases, however, the quality is less of an issue and more dependent on fishing method and handling than farm association. We have conducted blind tests using professional panels as well as staff at the Norwegian Institute of Nature Research, and both concluded that there was very little difference in taste, smell and texture between farm-associated and control saithe.

The wild fish living from the organic waste from the farms, being waste feed or plants/animals that lives from feacal material, may offer an important ecosystem service, removing local organic waste material from the environment. If stable over time, this could form basis for larger wild fish populations locally. Based on ecological theory, it is to be expected that wild animals take advantage of any nutritional excess offered to them, comparable to a fertilizer effect. Unless other basic environmental requirements are not met, it would be more of a surprise if nature did not adapt. Wild fish may also reduce possible negative consequences of escapees, especially if small fish are escaping fish farms.

Fish that grow fast, or build large energy stores, tend to mature at an earlier age. Early maturation means faster turn-over of the generations, and higher biomass production, but only as long as the wild life is continuously sustained with food. However, the quality of the lipids may also play an important role for the successful reproduction, also in the wild. Fatty acid composition of the fish eggs is important to the egg quality and survival. In particular, marine fatty acids are required whereas fatty acid of plant origin may cause reduced egg quality. It is not known, however, if the nutritional access to plant material from fish feed is sufficient to cause negative effects on the eggs and offspring of farm-associated wild marine fish.

From the above, it is clear that there may be both short and long term effects of fish farming activity on wild fish populations. These effects can be both positive or negative, dependent on the stakeholder perspective.

There is growing evidence for positive population effects. This is likely due to increased nutrient availability to farm-associated fish. This may lead to larger harvestable fish stocks, but the aggregation of the fish close to the farms will reduce the availability to conventional fisheries. The quality of farm-associated fish is debated, an effect that could be similar to what we see in wild cod while feeding on capelin. However, any negative effects on the flesh quality seem to be limited and possible to reduce by proper handling. If the fish is kept alive after catch possible negative effects on flesh quality can be completely avoided by starving the fish for 2-3 weeks. Any effects on migratory behaviour, especially during maturation, may cause long-term negative effects on reproductive success and consequently reduction of wild fish stocks. The increased energy stores can also lead to increased fertility, resulting in a larger number of offspring per fish. It cannot be ruled out, though, that such an effect can be counterbalanced by reduced egg quality.

Sustainable coexistence between salmon culture and coastal fisheries

by

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Universidad de Alicante, Spain

Nofima

Sustainable coexistence between salmon culture and coastal fisheries

Bjørn-Steinar Sæther, Ingebrigt Uglem, Ørjan Karlsen, Pablo Sanchez-Jerez, Karl Øystein Gjelland and Pablo Arechavala Lopez

FHF

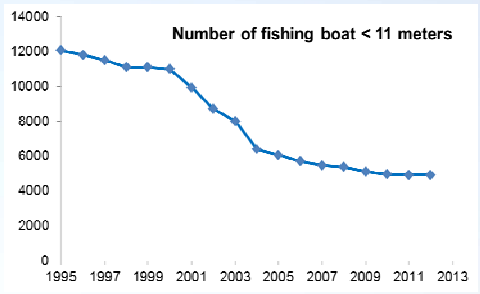
HAVFORSKNINGSINSTITUTTET
INSTITUTE OF MARINE RESEARCH

NINA
Norwegian Institute for Nature Research

Universitat d'Alacant
Universidad de Alicante

Coastal fisheries

- Mostly smaller boats (< 11 meter)
- Local small scale fishery after a range of species – depending on season and availability
- The small scale local fisheries have declined during the last decades
- But still several thousand coastal fishermen – with fishing as either a fulltime or part time job



2

Salmon farming

- Salmon farming is a large and relatively new industry
- Norway produced 1.24 million tons of salmonids in 1006 licences in 2012
- More than 1.6 million tonnes of feed were used in Norwegian aquaculture in 2012
- Small scale coastal fisheries is in comparison a small, but traditional industry
  - This relationship shapes the interactions between the industries, as fish farming by many is regarded as being the cause of issues in the fisheries

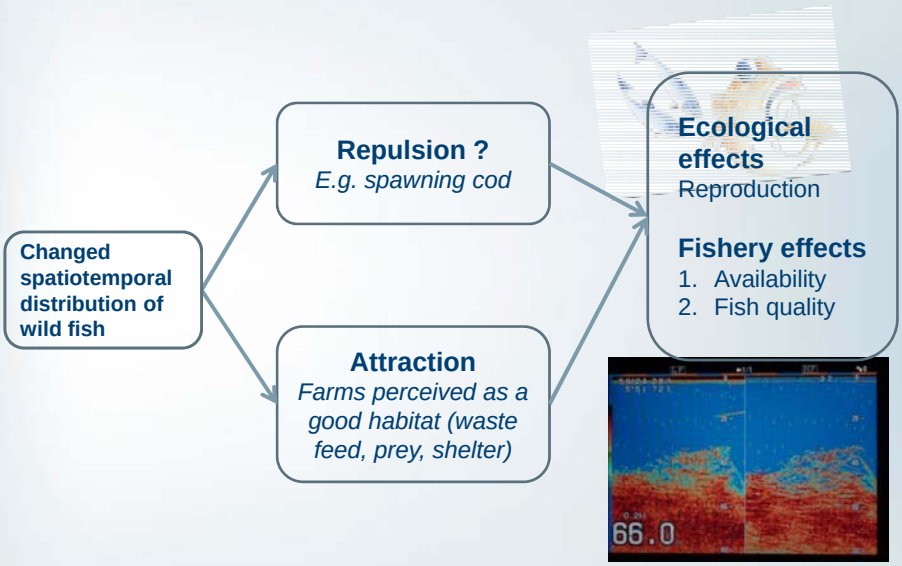
3

Coexistence– aquaculture and coastal fisheries

- Aquaculture and fisheries are significant industries that share the same resources and areas.
- Coastal fisheries relatively small but long traditions
- Salmon farming may be regarded as a significant ecosystem modifying factor in coastal marine areas
- Several areas where positive coexistence between the industries are challenged:
  - Areas
  - Organic waste, sediment and food safety
  - Diseases
  - Interactions between salmon farming and coastal marine fisheries in Norway

4

Spatio-temporal distribution of wild fish



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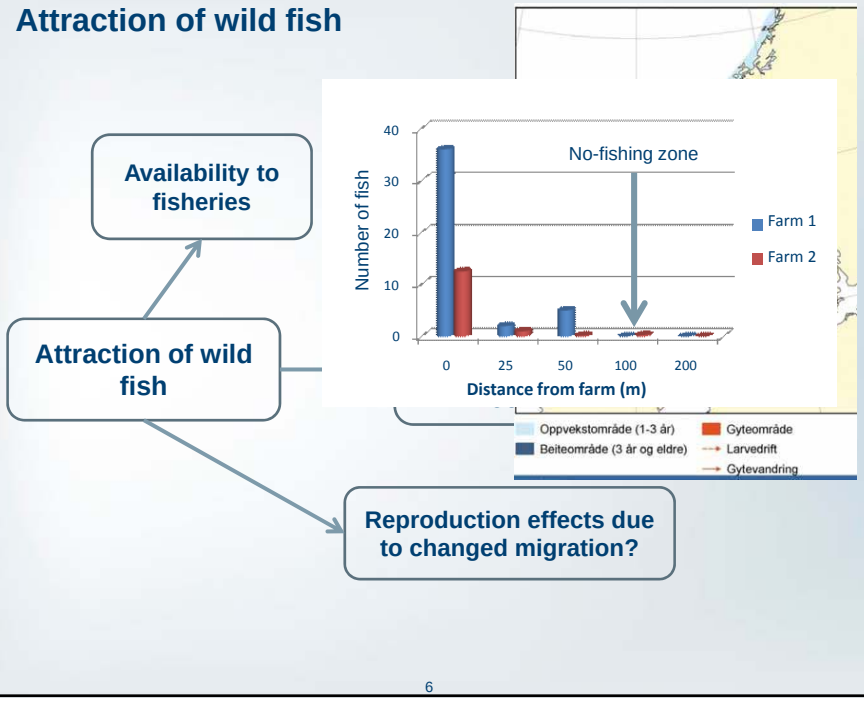
Attraction of wild fish



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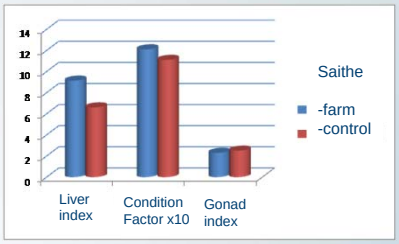
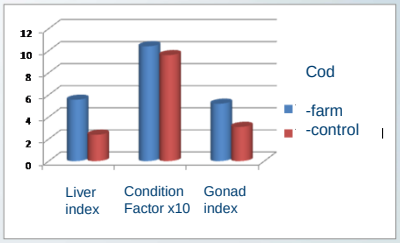
Attraction increase growth and condition

- Saithe: between 12 and 92 % of the fish with pellets
- Cod: 11 – 32 %





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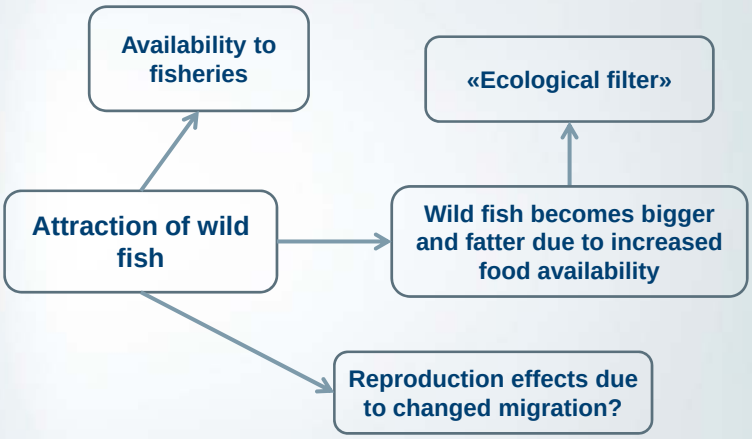
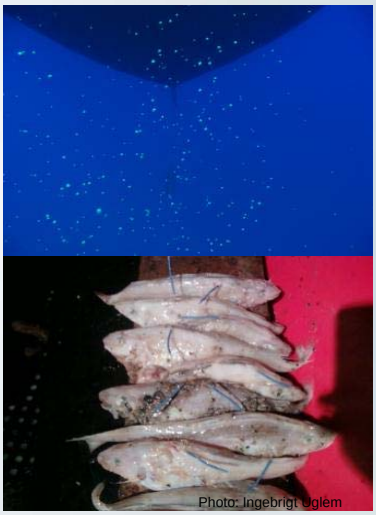
Attraction of wild fish



8

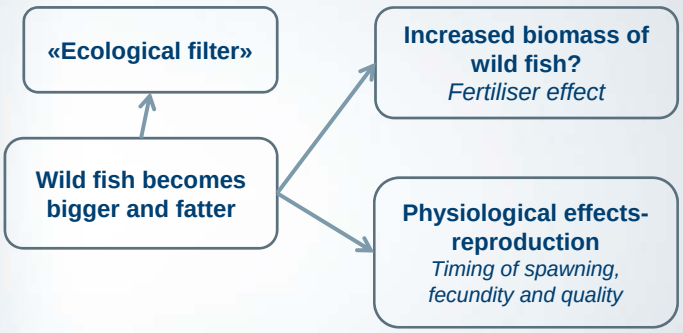
Attracted wild fish feed on organic waste and prey on escapees

- Wild fish feed on waste feed
  - Reduce negative benthic effects
- Estimated 1.4% of feed (waste) eaten by wild saithe (Dempster et al. 2009)
  - Significant part of the waste?
- Large wild fish may prey on small escapees



9

Wild fish becomes bigger and fatter



10

Physiological effects- reproduction

- Attracted fish are fatter, higher condition factor, liver index and gonad index compared to controls
- Early maturation?
- Higher energy reserves and gonads – increased fecundity
- Oocyte quality?
  - FA in feed → FA in fish
  - FA → oocyte quality

Photo: Ingebrigt Uglem

Assessing the Influence of Salmon Farming through Total Lipids, Fatty Acids, and Trace Elements in the Liver and Muscle of Wild Saithe *Pollachius virens*

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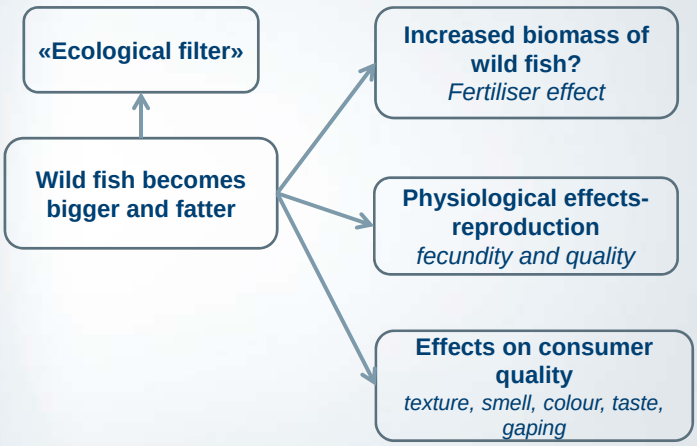
Wild fish becomes bigger and fatter



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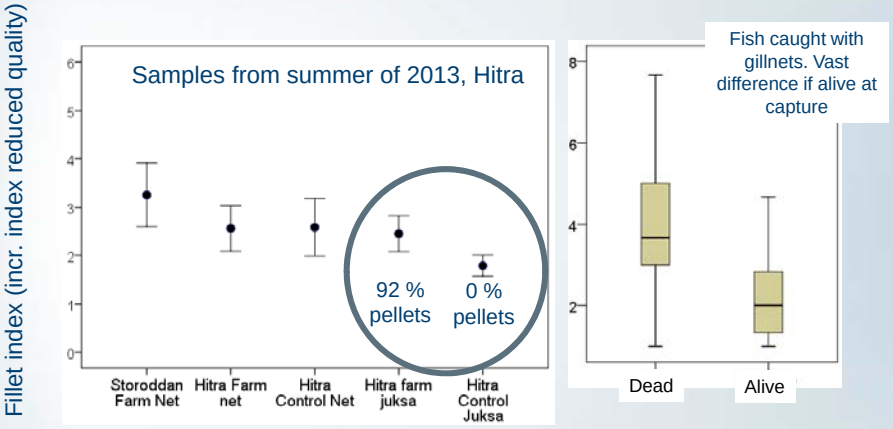
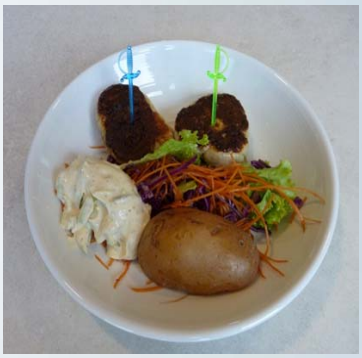
Consumer quality – fillet index



13

Consumer quality - taste

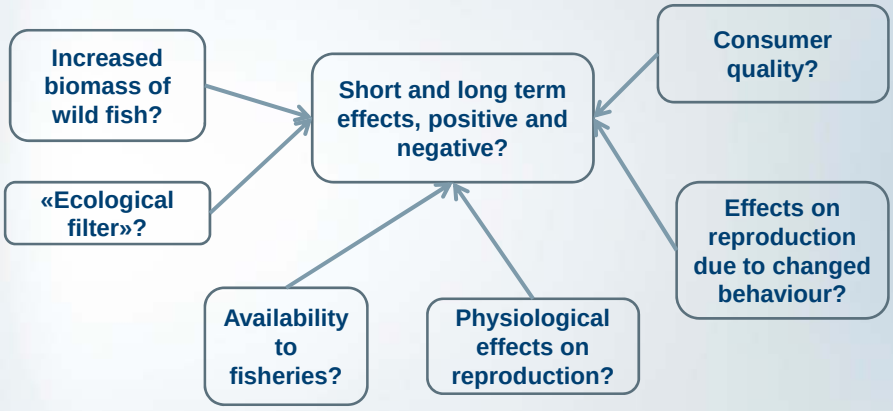
- Blind test
- Lunch at NINA September 2013
- Menu: saithe-burgers with traditional side order
- No significant preferences



Preference	N	%
Farm saithe	36	34,3
Control saithe	42	40,0
No difference	27	25,7

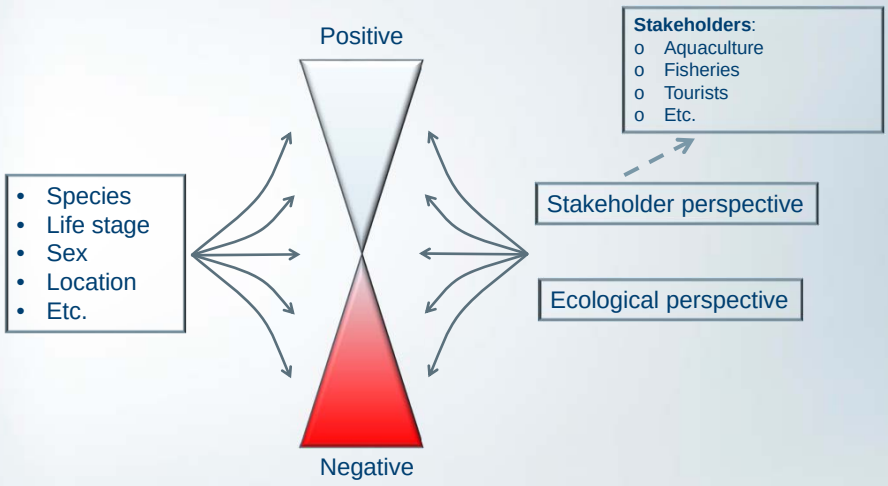
14

Salmon farming vs coastal fisheries



15

Positive or negative impact?



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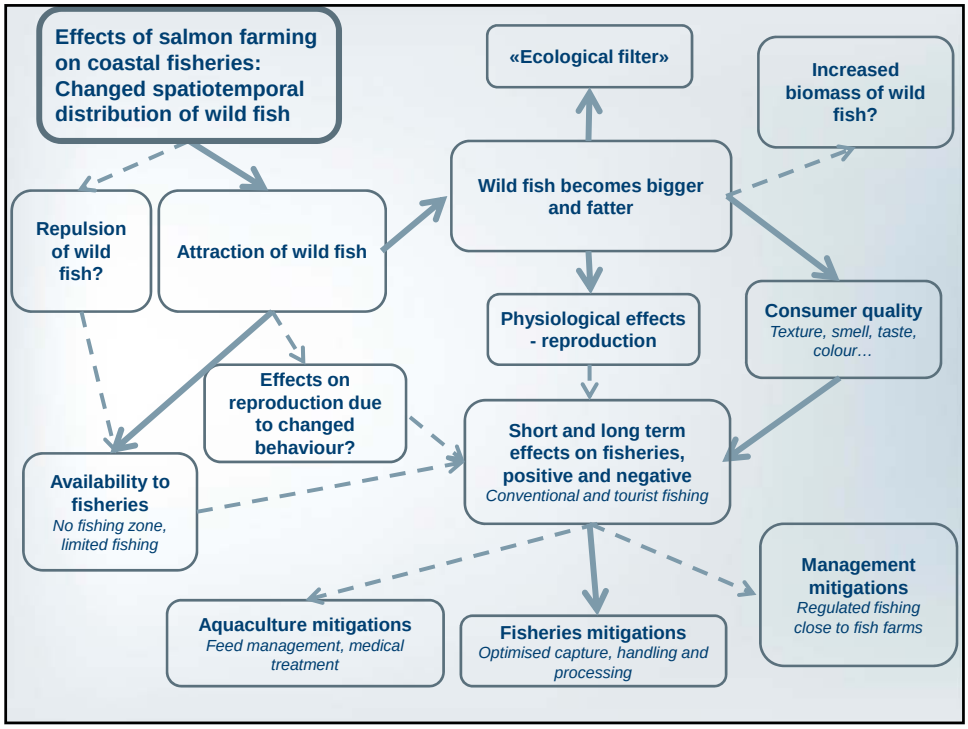

Effects of salmon farming on coastal fisheries: Changed spatiotemporal distribution of wild fish
«Ecological filter»
Increased biomass of wild fish?
Repulsion of wild fish?
Attraction of wild fish
Wild fish becomes bigger and fatter
Physiological effects - reproduction
Consumer quality
Texture, smell, taste, colour…
Effects on reproduction due to changed behaviour?
Short and long term effects on fisheries, positive and negative
Conventional and tourist fishing
Availability to fisheries
No fishing zone, limited fishing
Management mitigations
Regulated fishing close to fish farms
Aquaculture mitigations
Feed management, medical treatment
Fisheries mitigations
Optimised capture, handling and processing

4.9 Against a new regulation regime - will it affect the controversy?

Bjørn Hersoug

Nofima/NFH, University of Tromsø, the Arctic University of Norway The Arctic University of Norway, Norway

Abstract:
While the old outgoing Labor/center/left government tried to get around the political limitations on further growth by introducing green licenses, the new conservative/right government proposed a completely new policy regulating growth. The proposal, introduced in 2014 was sent out for public hearing with a view to be presented for the Norwegian Parliament by late spring 2015. The proposal is concerned with the lack of clarity regarding future growth in the salmon sector, trying to suggest a predictable growth path, thus reducing the uncertainty for the salmon farmers. Right from the beginning it is stressed that the future growth of the sector has to take place within a sustainable framework. This means that further growth will be determined by biological sustainability, as defined by various possible parameters. The proposal, which was later developed to a White Paper, contains three different alternatives for further growth:

1. The first implies "business as usual", i.e. to continue the present practice of allocating new licenses through license rounds, when the government sees fit. However, the new government is adamant that licenses from now on shall be allocated on "objective criteria", not on shifting political likes and dislikes.

2. The second suggests that growth shall be determined by a fixed annual growth rate, leaving the environmental concerns to other regulatory measures.

3. The third is to make growth dependent on an operational management rule (similar to the Operational Management Procedures we find in fisheries management). Predictability is here secured by a set of environmental indicators, being decisive for growth (or reduction) of production.

The Ministry made no attempt of hiding that the third alternative was its preferred solution, using most of the 60 pages document to spell out how such a system could be worked out, and how it would operate in practice. Here we do not have the space to elaborate the proposal in detail, but suffice to say that a number of questions are left open, asking the stakeholders to comment, and if they disagree, to come up with better solutions. The groundwork for the proposal was made by an expert group, the Area Committee, delivering its report in 2010, where the main idea was to divide the coast in production areas and manage growth according to fish mortality as the central indicator. While the idea of using production areas and put-out zones received wide acclaim, the use of fish mortality as the main indicator met with stern resistance. So when the idea was taken up again in 2014, the main indicator should be sea lice, that is, the frequency of sea lice in a particular area. For the sake of illustration the coast has been divided in 11-13 production areas, where all licenses are connected to a particular area (different from the present seven management areas). Critical values have been suggested, similar to what we find in the fisheries management system, originally developed by the International Council of Exploration of the Seas (ICES), where traffic lights (green, yellow and red) indicate where growth can take place, areas under observation and areas requiring reduction in terms of annual production, as measured by allowable biomass (MTB). Other indicators can be connected to the system, such as local and regional pollution, but at this stage only the

frequency of sea lice has been developed to the necessary sophisticated level to be used as an indicator.

The idea behind the proposal is not only to regulate growth, but to make the salmon farmers collectively more responsible for the environmental standard in their production areas. For obvious reasons the presence of sea lice will vary from one put-out zone to another, thus opening for different grading within a production area, but in the end the different grades will be weighted, and the area will be assigned a value or simply, a traffic light color. On the issue of how production capacity shall be allocated, the proposal suggests a Solomonic solution, partly increasing capacity by annual or semi-annual license rounds and by allowing the existing farmers to expand with a certain percentage. In terms of payment, the Ministry prefers public auction of new licenses, although making an opening for the use of fixed prices and lottery. For fear of subsidy or dumping allegations (primarily from the EU), the Ministry will not prioritize any particular group, neither in terms of size (small-scale versus large-scale), nor in terms of preferred technical solutions. "The Ministry considers biological sustainability the most important requirement for future growth, while the market seems not to be a reason why the authorities shall regulate the production capacity" (NFD 2014: 22). Nevertheless, the Ministry insists on maintaining the license system untouched, although the actual production connected to each license will vary, depending on where it is located and how well the farmers in the area are able to keep down the sea lice level.

At this stage it is important to stress that the new regulatory regime is still on the drawing table and many details are to be decided at a later stage, not least influenced by a rather diversified response from the various stakeholders, often combining elements from all three solutions as their preferred option.

The success of such a regime will depend on whether the authorities are able to stabilize the regime, i.e. to get the system accepted and institutionalized. Along this route there are several challenges. The first relates to the connection between sea lice and the environmental state, influencing the wild salmon and trout. While the Institute of Marine Research is proclaiming a definite and clear connection, other researchers and not least the farmers themselves point to other factors explaining the poor conditions for out-migrating wild salmon and trout (FHL 2015, Bellona 2015). Basing the environmental state on one indicator only may also seem like a risky strategy, although the Ministry opens for adding more indicators (such as pollution) at a later stage.

Secondly, the critical values are still being debated, and while 0.5 sea lice per salmon seems to be accepted as a common denominator, the new limits introduced by the green licenses (0.25 and 0.1) are by many experts considered unrealistic. Many farmers still demand a more scientific explanation for the fixed critical values, although most seem to accept that keeping down the level of sea lice in general, will reduce the impact on wild salmon and trout. And even more important (to the farmers); this will, if successful, reduce the costs of delousing, which already constitute more than 3 billion NOK per year. Thirdly, many stakeholders, both inside and outside the industry, doubt the counting regime that has been established, accusing some farmers of under-reporting. The authorized count by the Norwegian Food Authority is accepted, but NFA will in any case only be able to control a few farms every week. Fourthly, the public sanctions are heatedly debated. Slaughtering part of or an entire batch of salmon will of course have dramatic economic consequences, as will the requirement of halving the put-out for the next production cycle on specific locations as now being implemented by NFA's sanctions' regime. Many farmers and their organizations have already warned that they find

the collective punishment inherent in the new growth regime unfair and illegal. All farmers in an area could be forced to reduce their put-out, due to the practice of one bad farmer, not able to keep the agreed limits of sea lice.

Last but not least, the new proposed growth regime seems to confound two different, but closely related systems; the license system giving a person or a company the right to farm, and the locality (site) system, allocating space as to where to farm. So far these two systems have been kept isolated, as the right to farm is a prerequisite to apply for a site, but not the other way around. The right to farm has been decided by the state (the Ministry) while the site allocation is in principle up to the municipalities, although the county authorities are responsible for the process and the final distribution. By suggesting, as in the new proposal, that companies risk their license MTB if not complying with the environmental requirements as measured by the sea lice indicator, the authorities mix the two systems, which may not be the most convenient way of obtaining the goal that all partners agree on, namely a sustainable salmon industry. In that respect, the “new” sanctions regime is built upon a different logic, in that specific sites are being monitored and required to reduce its MTB for the next production cycle. Sites are here the central theme, not the licenses and their accompanying MTB.

Against a new regulation regime - will it affect the controversy?

by

Bjørn Hersoug
The Arctic University of Norway

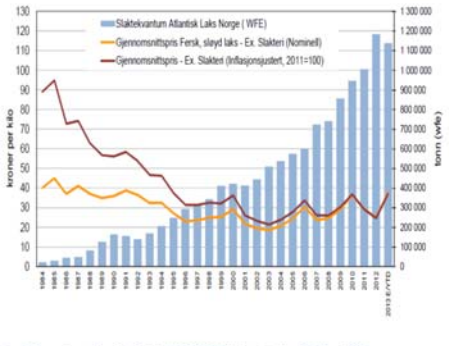
Against a new regulation regime - will it affect the controversy?

Bjørn Hersoug,

the Norwegian College of Fishery Science,
University of Tromsø,
the Norwegian Arctic University

Development of the Norwegian salmon industry

- Rapid growth over the last 30 years
- Crisis in 1990 and 2002
- A cyclical industry
- Enormous expectations:
  1.3 mill. tons x3 in 2030
  1.3 mill. tons x5 in 2050



The sky is the limit?

- There are markets for increased production
- There is capacity for increased production
- BUT there are political problems= limits to further growth:
- Sea lice
- Escapes

Disputed areas

- Sea lice affecting wild salmon
- Escapes mixing with wild salmon
- Resistance against any expansion by wild salmon fishers, conservation interests, and increasingly among politicians from all parties
- Resistance from coastal municipalities


DAMNED LICE

This estate once teemed with wild salmon but today they are being destroyed by parasites. Now Jenny Scobie is fighting to restore the species to its glory days

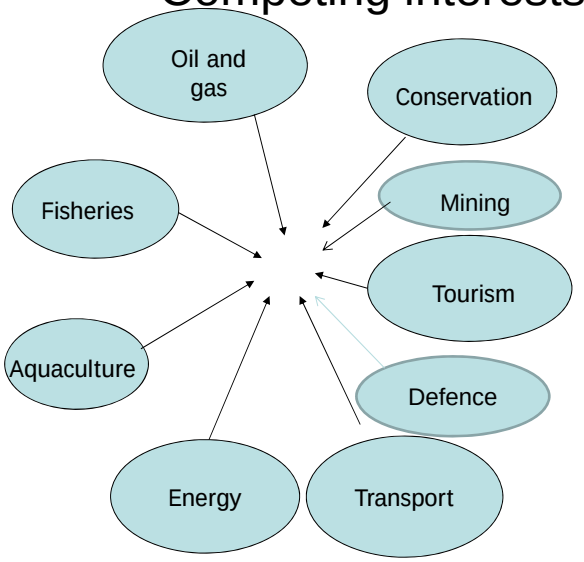
No pay, no cure

- 276 coastal communities
- Deciding on locations to the base lines+ 1 nautical mile (ca. 100 000 km2)
- A –areas for aquaculture, or
- Multipurpose areas (NFFFA)
- Demand: annual area fee or production fee
- Now receiving 40% of new license fees

"I understand you gave it all to the poor, but do you have any receipts?"

AquaLog 2015

Competing interests



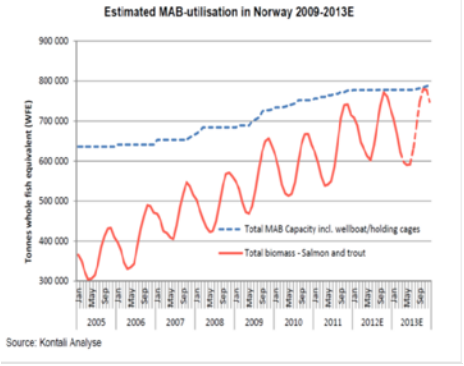
Before:
Fisheries and coastal transport

Now:
Several competing stakeholders, often demanding quick decisions

AquaLog 2015

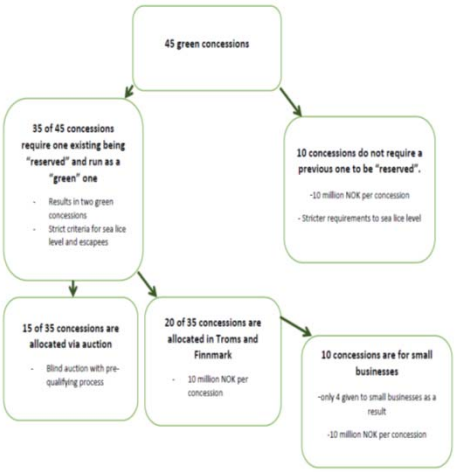
Green licenses: A large scale experiment

- Great interest: 240 applications
- A scientific committtee responsible for picking the winners
- Focus on escapes and sea lice
- Not on new technological concepts (like ocean net pens)



AquaLog 2015

Green, greener, greenest



AquaLog 2015

The lucky winners

large companies in red)

- Nor Seafood AS
- Nor Seafood AS
- Nord Senja Laks AS
- Nord Senja Laks AS
- Nordlaks Oppdrett AS
- Gratanglaks AS
- Kleiva Fiskefarm AS
- Salaks AS
- Wilsgård Fiskeoppdrett AS
- Wilsgård Fiskeoppdrett AS
- Grieg Seafood Finnmark AS
- Grieg Seafood Finnmark AS
- Grieg Seafood Finnmark AS
- Grieg Seafood Finnmark AS
- Mainstream Norway AS
- NRS Finnmark AS
- NRS Finnmark AS
- NRS Finnmark AS
- NRS Finnmark AS
- NRS Finnmark AS

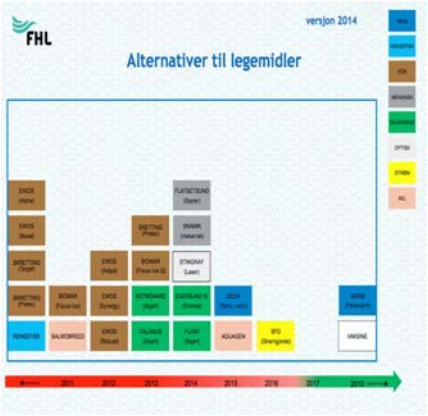
- Bindalslaks AS
- Engesund Fiskeoppdrett AS
- Hardingsmolt AS
- Lerøy Vest AS
- Mainstream Norway AS
- Marine Harvest Norway AS
- Nekton Havbruk
- Norsk Havbrukssenter
- Senja Akvakultursenter AS
- Sulefisk AS

- Salmar Farming AS 66 000 000
- Salmar Farming AS 66 000 000
- Salmar Farming AS 64 000 000
- Salmar Farming AS 64 000 000
- Mainstream Norway AS 63 011 000
- Mainstream Norway AS 63 011 000
- Mainstream Norway AS 63 011 000
- Salmar Farming AS 62 000 000
- Salmar Farming AS 62 000 000
- NRS Feøy AS 56 000 000
- Bjørøya Fiskeoppdrett AS 55 100 000
- Mainstream Norway AS 55 011 000
- Mainstream Norway AS 55 011 000
- Salmar Farming AS 55 000 000
- Salmar Farming AS 55 000 000

AquaLog 2015

New projects to reduce sea lice

- Laser
- Fresh water
- Skirts
- Snorkel
- Cleansing fish
- Feed
- Triploid salmon
- Increased size of smolt (up to 1 kg)
- Genetics
- Vaccines



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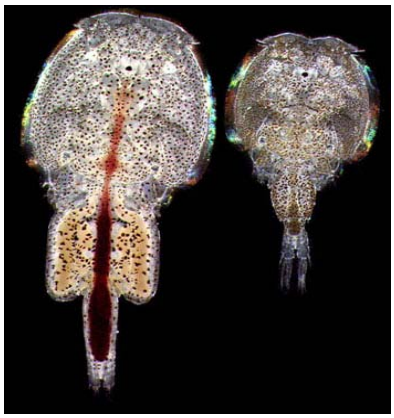
Difficult demands

- For 35 licenses, no more than 0.25 sea lice per fish (3 treatments)
- For 10 licenses, 0.1 sea lice (3 treatments)
- Difficult to keep this level, except in the extreme north



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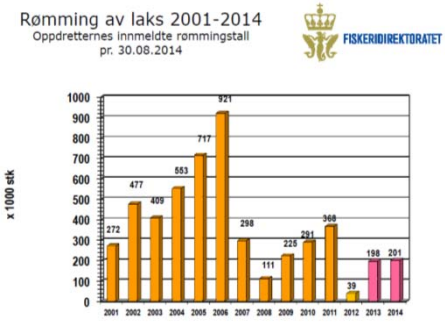
Political pressure

- No more farms and no more areas before the sealice and escapement problems have been solved
- So far: no quick fix!
- But several promising projects
- Short time from invention to commercial use
- The open Norwegian aquaculture research system



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Results (+ and -)

+

- Sea lice and escapes are important loss factors for the industry
- Sea lice treatment: 3 NOK/kg
- Internalising environmental risk factors may increase sustainability (see e.g. the use of antibiotics in Norway)
- Creative solutions to obtain new licenses

-

- 3 different regulations (0.1, 0.25 and 0.5)
- What if the targets are not reached?
- Economic risks
- Uneven income for municipalities (risk of collusion and corruption)
- Unclear criteria for selection

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Three new initiatives

1. 5% increase for all farmers (pending)
2. A new management regime based on environmental indicators (sea lice)
3. New control regime by the Norwegian Food Authority (50% reduction if not keeping with the sea lice requirements)

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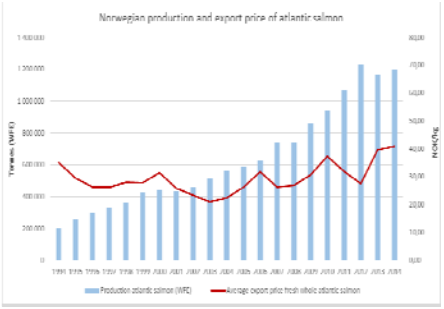
5% increase in MTB

- Have been tried before, but only Troms and Finnmark were allowed to increase
- Growth by established or new owners?
- Payment according to fixed price
- Municipalities receiving 50% (?)



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A new management regime

- 11-13 production zones
- Environmental quality based on indicators
- So far; only sea lice
- Traffic light system
- If red: 6% reduction in MTB in whole area
- If green: 6% increase
- No compensation for reductions

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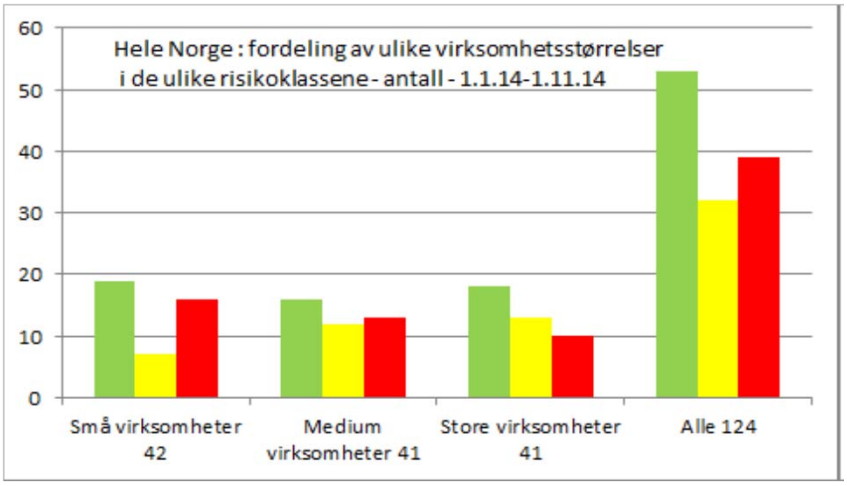
Sanctions regime of NFA



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Distribution of different size groups in terms of having sea lice infested localities.

Landbased production

- New White Paper on land based aquaculture (March 2015)
- Not limited by licenses
- Free establishment (but according to existing laws regulating land use)
- No license fee
- Could imply new innovations

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Future challenges

Different challenges:

- Persuade Norwegian politicians regarding fixed growth
- Pursuade Norwegian municipalities regarding more space
- Pursuade foreign consumers about health benefits

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