Practical experiences: The northern European perspective

Telfer T.C., Beveridge M.C.M.

in

Uriarte A. (ed.), Basurco B. (ed.).
Environmental impact assessment of Mediterranean aquaculture farms

Zaragoza : CIHEAM
Cahiers Options Méditerranéennes; n. 55

2001
pages 85-90

Practical experiences: The northern European perspective

T.C. Telfer and M.C.M. Beveridge[1]
Institute of Aquaculture, University of Stirling, Stirling, FK9 4LA, UK

SUMMARY – Fish farming in northern Europe in terms of the physical environment and cultivated resource is fundamentally different to that in the Mediterranean Sea. However, historically there has been a greater emphasis put on environmental assessment, monitoring and regulation which gives a valuable lesson of the process of marine environmental management, which may also be of use in a Mediterranean context. The process of environmental assessment for coastal aquaculture in northern Europe will be described using case studies which illustrate the regulatory and management procedures employed in Scotland and Norway. Impacts from nutrient wastes and chemicals used in fin fish aquaculture and their assessment by modelling and survey techniques, will be addressed, and comments made into the effectiveness of these approaches for long term management.

Key words: Aquaculture regulation, northern Europe, fish farming.

RESUME – *"Expériences pratiques : La perspective de l'Europe du Nord". La pisciculture en Europe du Nord est fondamentalement différente de celle de la Méditerranée, en ce qui concerne le milieu physique et la ressource cultivée. Cependant, historiquement, l'accent a été mis sur l'évaluation, surveillance et la régulation de l'environnement, ce qui apporte une leçon très valable du processus de gestion de l'environnement marin, qui pourroit être utile également dans le contexte méditerranéen. Cet article décrit le processus d'évaluation de l'environnement pour l'aquaculture côtière en Europe du Nord en utilisant des études de cas qui illustrent les procédures réglementaires et de gestion employées en Ecosse et Norvège. Les impacts des déchets des produits nutritionnels et chimiques utilisés par l'aquaculture et leur évaluation à travers des techniques de modélisation et d'enquête seront examinés, ainsi que l'effectivité de ces approches dans la gestion à long terme.*

Mots-clés : *Réglementation en aquaculture, Europe du Nord, pisciculture.*

Introduction

Environmental impact assessment and environmental regulation of marine aquaculture is highly dependant on historical and political infrastructure as well as the physical properties of the habitats used. Historically, in northern Europe, marine fish farming has been carefully and constantly monitored and regulated over a longer timeframe than that in the Mediterranean. However as mariculture within the Mediterranean expands and its needs conflict with those of other water users, environmental assessment, regulation and management are becoming more important and many lessons may be learnt from the experiences in northern Europe. Even here though methods of environmental management can vary between countries.

Many northern European countries are involved in mariculture – particularly Norway, Scotland, Ireland, the Netherlands, France and Germany – farming several species including, Atlantic salmon, rainbow trout, mussels and oysters. This paper will look in detail the two largest aquaculture producers in northern Europe as examples of environmental assessment and regulation, Scotland and Norway.

In Scotland and Norway most mariculture is undertaken within sheltered bays and fjordic systems (called sea lochs in Scotland). Here salmon and some trout are grown primarily in cages, and mussels and oysters grown on rope lines or in trays and lanterns. Mussels and oysters are not perceived as an environmental problem as they use natural resources for seed and do not employ artificial feeds or medicants to enhance growth. Although they do impact on sediments, the only effects considered by environmental managers is their use of space within a bay or on the shore and potential visual impacts.

[1]Current address: FRS (Scotland's Fisheries Research Service), Freshwater Laboratory, Faskally, Pitlochry, Perthshire, United Kingdom.

Fish farming, on the other hand, employs methods that add artificial feeds, medicants and antifoulants to the environment and are therefore monitored for impacts and carefully regulated. The wastes input by fish farming are varied and include excretory products, uneaten feeds and faecal material, which may cause localised nutrient enrichment, and chemotherapeutants and antifoulants, which may have toxic effects. Escaped fish are also considered a waste product as they may lead to changes in genetic composition of wild salmon stock, which has discreet geographically separated genetic pools. Like shellfish culture, fish farming has a requirement for space and therefore may effect other users and also have a visual impact.

How the problems caused by these effects are addressed in Norway and Scotland will be described using case studies based on the regulatory procedures for each country and how effectively they work. This paper is written by, and from the point of view of, environmental scientists working on the investigation and management of the environmental effects of coastal aquaculture.

Environmental assessment and management of fish farms in Norway

Assessment of environmental impacts of marine aquaculture in Norway is primarily targeted towards fin fish farming, and is part of the statutory coastal environmental management procedures. Environmental regulation of fish farming in Norway has been formalised for the past decade and is considered as a model approach for many regulatory plans. Norwegian assessment centres around two consecutive processes involving, firstly site selection and calculation of carrying capacity – LENKA (Bergheim *et al.,* 1991; Ibrekk *et al.,* 1993) – and secondly the regulatory, management and monitoring procedure – MOM (Ervik *et al.,* 1997).

LENKA is a coastal zone management plan designed for aquaculture development. It allows growth of the industry within the bounds of sensible exploitation of the coastline. Basically, the coastal regions used for aquaculture are divided into discrete areas. For each area a carrying capacity has been calculated and categorised in terms of "potential for further aquaculture", by taking into account all industries discharging into these coastal environments and other user interests. Consents for sites and allowable aquaculture discharges are then assigned based on the category of the particular area.

Once a fish farm is in place, its environmental management and regulation is governed under the Modelling On-growing fish farms Monitoring (or MOM) system, which is designed to ensure good rearing conditions and to avoid pollution. It is based on a general concept for regulating environmental impact for which there are three main elements: (i) simulations of impact by modelling; (ii) control of the impact by instigation of a monitoring programme; and (iii) permissible limits for environmental impact by imposing environmental quality standards (EQSs).

MOM is based on the premise that fish farm sites should not deteriorate over time and that the impact must not lead to the extinction of the benthic infauna beneath the sea cages. The system recognises three degrees of exploitation of a site, each of which is linked to a level of monitoring (see Fig. 1). If the third degree of exploitation is exceeded, the site is considered as overexploited. The monitoring programme consists of three types of investigation labelled A, B and C, where: (i) A (Level 1) is a simple sedimentation measurement beneath the net pens; (ii) B (Level 2) is a characterisation of the sediment conditions beneath the fish farm and comparison to EQSs set in MOM; and (iii) C (Level 3) is a sediment fauna study and comparison with general EQSs for infauna investigations.

MOM distinguishes between three zones of impact around a fish farm: local, intermediate and regional impact zones. The environmental impact is largest in the local impact zone where larger particles settle. Here A-, B- and C investigations are used. Conversely, in the intermediate impact zone the nutrient effects are less, primarily due to the sedimentation of smaller particles. This zone is monitored by B- and the C investigations. In the regional impact zone the more sensitive areas are monitored by the C investigation. There are limitations imposed on who can perform the different survey types, e.g. surveys B and C may only be conducted by recognised specialists in the field.

Environmental assessment and management of fish farms in Scotland

The legal and regulatory framework for environmental management of aquaculture in Scotland is complex but under the process of review and simplification. The complication is primarily due to the

infrastructure of land ownership and responsibility of regulation of the environment. In the UK, coastal areas (including the seabed) are owned by the Crown and therefore managed by the Crown Estates Commission (CEC). Environmental regulation of industrial or trade effluents on the other hand, including those from fish farms, is the responsibility of the Scottish Environment Protection Agency (SEPA). However, both bodies have the statutory obligation to consult other governmental bodies and interested groups. A simplified plan for the regulation path in Scotland is given in Fig. 2.

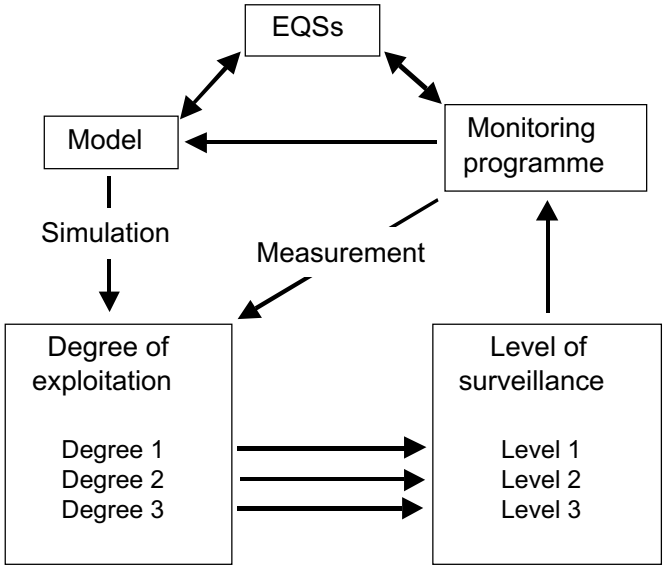

Fig. 1. Diagram of the mechanism of the MOM system (based on Ervik *et al.,* 1997).

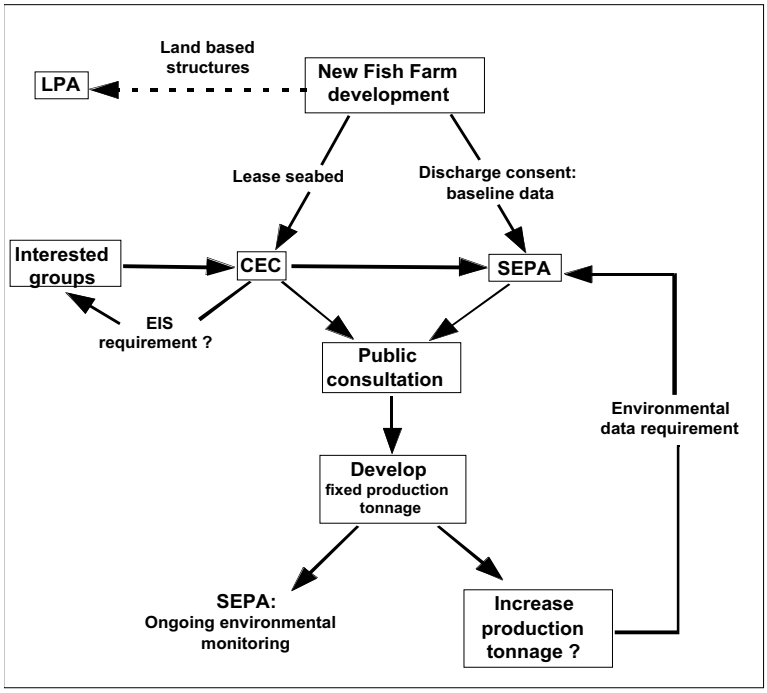

Fig. 2. Flow diagram to illustrate the process of environmental regulation and management of marine fish farms in Scotland. CEC – Crown Estates Commission, SEPA – Scottish Environment Protection Agency, LPA – Local Planning Authority.

For new fish farms or further development at existing sites there are two parallel procedures: (i) application for a seabed lease from the CEC; and (ii) obtaining an effluent discharge consent from SEPA. Environmental regulation in Scotland only concerns fish farming, so while shellfish farms need permission from the CEC to use the space within the coastal region they are not considered as polluters of the marine environment.

To grant a seabed lease the CEC must consult groups such as Scottish Natural Heritage (SNH) and the Scottish Executive Rural Affairs Department (SERAD). SERAD have developed locational guidelines for marine fish farms in conjunction with SNH and the fish farming industry, which also incorporate elements of the "Habitats Directive" for wild salmon and sea trout. The coastline is categorised into three areas on the basis of their natural heritage, physical attributes, hydrographic characteristics and existing levels of development, where:

(i) Category 1. Fish farming is only acceptable under extreme circumstances and must demonstrate no significant adverse environmental effects.

(ii) Category 2. Prospects for future fish farm developments are limited and there is potential only for expansion of existing sites.

(iii) Category 3. Areas where there are better prospects of satisfying environmental requirements.

Other requirements to obtain a seabed lease may be an Environmental Impact Assessment (EIA). This is imposed under EC Directive 85/337/EC as amended by 97/11/EC which is translated into Scottish law as "Environmental Impact Assessment Regulations (Fish Farming in Marine Waters) 1999". Here any new farm or extension to previous farm requires an EIA where the development is either in a sensitive area, it is designed to hold a maximum fish biomass of equal to or greater than 100 tonnes or it is equal to or greater than 0.1 ha in surface area of marine waters.

The second process is application for discharge consent from SEPA, under the "Environment Act (Scotland) 1995". Under this act, fish and shellfish farms are excluded from being in the proximity of other developments (see Table 1) and must provide environmental data from which a decision on discharge consent can be made. This data includes hydrographic and sediment characterisation of the site by collection of 15 day tidal current data and a sediment baseline survey. The hydrographic data are used in dispersion models to estimate the amount of material entering the environment from which the maximum biomass supportable by the site is estimated.

Table 1. Separation distances for a new salmon farm and existing developments

Activity	Distance (km)	
	Fish farm	Shellfish farm
Salmon farm	8.1	3.7
Shellfish farm	3.2	0.8
Public viewpoint	1.6	0.8
Hotel/tourist centre	1.6	0.8
Houses	0.8	0.4
Wildlife colony	0.8	0.4
Anchorage	0.4	0.4
Fishing ground	0.4	0.4

The CEC and SEPA will then submit the proposal to public consultation by advertising details of the development in local newspapers. At this stage there may be objections and a review process is undergone. If consented, the site is placed in one of three categories (not to be confused with those of SERAD) based on the maximum biomass and hydrography at the locality (see Table 2). This biomass sensitivity matrix is then used to decide on the monitoring regime. In future, if there is a wish to

increase the size of the fish farm or alter the discharge consent in any way the process is undergone again.

Table 2. Biomass sensitivity matrix for monitoring

Biomass (tonnes)	Mean current speed (m/s)		
	<0.05	0.05 to 0.10	>0.10
0 – 499	Cat 1	Cat 1	Cat 1
50 – 999	Cat 2	Cat 1	Cat 1
≥1000	Cat 3	Cat 3	Cat 2

After consent, environmental management of the fish farm takes the form of periodic monitoring of the site for comparison to EQSs, and submission of production figures and amounts of food and chemotherapeutants used to SEPA. Three levels environmental monitoring are used depending on the site category:

(i) Category 1 sites. A video/photographic survey along a transect away from the cages or a small scale biological survey beneath the cages. This is carried out in the second (last) year of the growth cycle at time of peak biomass. The EQS used for the data is based on the number of polychaete species. If the EQS is not met then a more detailed survey is required.

(ii) Category 2 sites. As Category 1 but carried out annually.

(iii) Category 3 sites. An annual video/photographic survey and a biological survey at peak biomass (see Fig. 3 for example of sample station layout). Samples are analysed for number of taxa, species richness and Infaunal Trophic Index (WRC, 1992). Multivariate analysis should be used for data interpretation. Sediments may also be analysed for copper and zinc concentrations, if required.

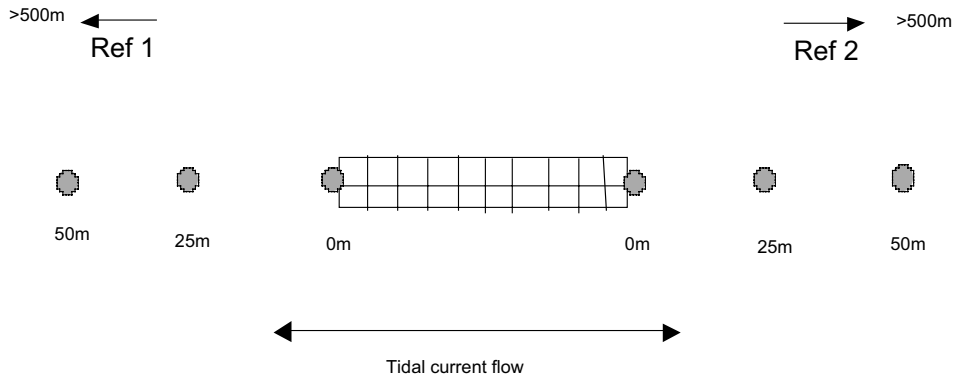

Fig. 3. Example of usual sampling station layout used for monitoring of fish farms at Category 3 sites in Scotland. Ref. 1 and 2 are reference stations beyond the influence of the fish farm.

The regulators in Scotland, SEPA, have statutory powers in that they may refuse a discharge consent based on environmental data and sound public opinion. If the post-development discharge consent is breached or there is considerable environmental impact shown by the monitoring, SEPA can decrease the maximum production biomass or close the farm down. However, there is an appeals process open to the fish farmer.

All details of statutory obligations, applications for discharge of nutrient and chemical waste and monitoring plans are given in the incidental publication "Regulation and monitoring of marine cage fish farming in Scotland. A procedures manual" (SEPA, 1999). Parts of this publication are available via the internet (http://www.sepa.org.uk/).

Conclusions

Both systems outlined here, the Norwegian and the Scottish, use similar approaches in that they select and impose restrictions based on a categorisation of coastal areas and implement a monitoring regime on the basis of production biomass and physical characteristics of the aquaculture site. The system in Scotland appears to be more complicated, but this is a legacy of historical legislation and practice, and is presently under review. These systems are effective, as much of the guidelines have been decided in consultation with both statutory environment groups and "stakeholders" and are therefore also relevant to the aquaculture and the environment. Cost of environmental regulation and monitoring is an emotive point as, while environmental groups consider the costs low, much of the industry considers them high and a form of environment tax. This viewpoint though conforms to the practice of the regulators (particularly in Scotland), who use a "polluter pays" approach to environmental regulation.

This paper outlines the approaches to regulation used in Norway and Scotland as examples. Other European countries, such as Ireland, have a broadly similar approach which implements EC Directives within their own legal and regulatory framework, but may put different emphasis on particular parts. For example in Ireland great store is put on very detailed EIAs. Other countries such as France have a different approach due to varied forms of aquaculture and a different legal framework.

While both the Norwegian and Scottish approaches will benefit with further use and development of their regulatory systems, these frameworks provide an excellent basis for environmental management of coastal aquaculture. However, there are several issues which may be considered in future, e.g. use of an integrated coastal management approach employing tools such as Geographic Information Systems, development of effective assessment tools to investigate the fate of chemotherapeutant wastes, and development and validation of accurate dispersion and dilution models for aquaculture wastes in all coastal habitats.

References

Bergheim, A., Abel, J.B. and Seymour, E.A. (1991). Past and present approaches to aquaculture waste management in Norwegian net pen culture operations. In: *Nutritional Strategies and Aquaculture Waste*, Proceedings of the First International Symposium on Nutritional Strategies in Management of Aquaculture Wastes, Cowey, C.B. and Cho, C.Y. (eds). University of Guelph, Ontario (Canada).

Ervik, A., Kupta Hansen, P., Aure, J., Stigebrandt, A., Johannessen, P. and Jahnsen, T. (1997). Regulating the local environmental impact of intensive marine fish farming. I. The concept of the MOM system (modelling-ongrowing fish farms-monitoring). *Aquaculture*, 158: 95-94

Ibrekk, H.O., Kryvi, H. and Elvestad, S. (1993). Nationwide assessment of the suitability of the Norwegian coastal zone and rivers for aquaculture (LENKA). *Coastal Management*, 21: 53-73.

SEPA (1999). *Regulation and Monitoring of Marine Cage Fish Farming in Scotland. A Procedures Manual Version 1.0.* Scottish Environment Protection Agency, Stirling.

WRC (1992). *Development of a biotic index for the assessment of the pollution status of marine benthic communities*. Water Research Council, Final Report NR 3102/1.