



## Characteristics, structure and resources of the sector

### Summary

Ranking sixth in the world's leading exporters of fish products, Denmark has a strong position in fish production and aquaculture has a long and well established tradition in the country. The main product produced is rainbow trout from freshwater ponds and mariculture units, the latter also producing roe as an important by-product. Eel is farmed in recirculated freshwater tank systems; mussels and oysters are produced in minor quantities and turbot fry is exported for further on-growing. A variety of other species are raised primarily for restocking which represents an increasing share of total turnover.

Total annual aquaculture production in Denmark was around 36 000 tonnes in 2003, or 3.3 percent of the total fish production in Denmark, worth 20 percent of the total value of fish produced. Earnings from the aquaculture sector were about US\$ 114 million, making it worth more than the economically important Danish cod fisheries; about 90 percent of production goes for export. More than 800 people are directly employed in production (just above 600 being full-time employees), mainly in traditional fish farming. In addition, a significant number of people are employed in associated industries such as processing and smoking.

Danish aquaculture is strictly regulated by environmental rules, with the exception of full recirculation eel farms, all Danish fish farms have to be officially approved in accordance with the Danish Environmental Protection Act. A fixed feed quota is assigned to each individual farm in addition to specific requirements including feed conversion ratios, water use and treatment, effluents, removal of waste and offal, etc.

### History and general overview

The North American rainbow trout (*Oncorhynchus mykiss*) has been farmed in Danish freshwater ponds for more than 100 years, since the 1950s it has also been produced in offshore cages and since the 1970s in land-based marine aquaculture units. Also during the 1970s, eel (*Anguilla anguilla*) farming in recirculated freshwater tanks was developed which also led to the creation of a niche market for the export of Danish recirculation technology for use in aquaculture for a range of species.

With growing environmental awareness, strict environmental regulations have been introduced for Danish aquaculture since 1987. At a national level, maximum values were stipulated for effluents such as nitrogen (N), phosphorus (P) and organic substances (O) produced from freshwater as well as marine aquaculture. These regulations, based on fixed feed quotas for each individual farm, virtually caused a halt to any further increases in production for Danish trout farming, except for the effects of developing improved feed composition and feeding techniques. Theoretically, documented evidence of N, P and O effluent levels below the individual farm limit might overrule its feed quota, but since no effective measuring techniques were available, the feed quotas, once given, could not be changed.

However, the feed quotient (kilos of feed required to produce one kilo of fish) have been improved by 25 percent since 1987. Furthermore, in freshwater aquaculture, water treatment and recirculation techniques have continually developed, so on the whole, local environmental requirements have been complied with while on a national level, effluent levels have been reduced by around 50 percent during the period.

In accordance with EU regulations, several areas have been assigned as habitat areas, bird protection and/or Ramsar (the Ramsar Convention on Wetlands) areas. In accordance with a national regulation, no approval shall be granted for the construction of new or modification or expansion of existing saltwater fish farms and marine aquaculture establishments if to do so could bring about deterioration of the habitat types or habitats of species on the site or cause disturbance that would have significant consequences for the species for which the site is designated.

No licences have been issued for new freshwater fish farms since the introduction of environmental regulations. Around 40 percent of the freshwater fish farms have since closed, mainly as a result of county buy-ups and the abolition of farms in order to improve environmental and fish passage conditions in the adjacent streams. Approvals and feed quotas are assigned to the individual farm and can not easily be transferred to others. At its peak in 1995, the production from Danish freshwater ponds reached just above 36 000 tonnes, by 2003, production had fallen to about 24 500 tonnes, worth US\$ 63 million, from 337 farms. All of these farms are located in Jutland, the western peninsula of Denmark.

Since the introduction of environmental regulations, only one licence for a new Danish marine fish farm has been issued in 2004. Besides environmental regulations production is very much dependent on weather conditions and can sometimes be disturbed by oil pollution resulting from the shipping industry. Fluctuating from one year to another, production peaked in 1993 at about 7 900 tonnes from 30 farms with offshore cages and about 1 500 tonnes from 10 land-based salt water farms. In 2003, production was about 7 200 and 900 tonnes from 24 and 10 farms, worth US\$ 24 and US\$ 3 million, respectively

Excluding the value of eggs and roe which was not categorised.

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Eel farming has not been subject to setbacks due to environmental regulations, but during the 1990s was affected by heavy competition in the market for glass eels (*European eel, Anguilla anguilla*). On top of a decreasing influx of glass eels from the Atlantic Ocean, a growing proportion of the glass eel catches that were not used directly for human consumption in the Southern European market were bought by Asian fish farmers (mainly from China) for ongrowing at steadily increasing prices. In addition, the import into the EU of final eel products from Asia has led to strong competition in that market.

Production from Danish eel farming peaked in the late 1990s at about 3 000 tonnes a year from a total of 30 farms. Subsequently, most of the farms have been closed and the 2003 production dropped to 2 000 tonnes, worth US\$ 17 million from 11 farms. However, Danish eel aquaculture as an industrial sector is sustaining a developing industry for recirculation technology that has an important export market.

In Denmark considerable numbers of farmed fish are released each year into natural water bodies, for example, marshes, lakes, streams and marine water areas. The release of fish is undertaken mainly to compensate for the lack of natural spawning possibilities or recruitment and to improve conditions for recreational fishing. Finally, fish are released when restoring lakes – so-called biomanipulation – and as a method of rehabilitating stocks of endangered fish species.

The main financial contributor to fish releases is a fund administered by the Ministry of Food, Agriculture and Fisheries. Anglers and spare-time fishermen (fishing for home consumption) pay for annual licences that generate more than US\$ 5 million a year, which helps to finance restocking projects and research supplemented by funding from other public authorities and private organisations. In the beginning, fish restocking in Denmark mainly concentrated on salmon, however, in recent years the area of attention has broadened to include many fish species, among

which eel is very important.

Danish shellfish production, which historically has depended on fisheries, is now second in the EU as a result of the favourable conditions for shellfish production found in shallow Danish waters. The main product produced is blue mussel, which is also, along with oysters, a priority for the rapidly growing Danish shellfish farming industry, albeit it is still in its infancy. Production in 2003 was at just 11 tonnes, by 2004 a total of 44 licences had been granted and about the same numbers of applicants were awaiting completion of their application. To help in the promotion of the development in this sector, the Danish Shellfish Centre has been established and aided by regional, national and EU funding.

In general the development of Danish commercial aquaculture production has been slow for about 15 years, however, following the recommendations from advisory committees (2002, 2003 and 2004), adjustments to the regulations are being considered for both marine and freshwater farming and to some extent new optimism is growing in the industry. Also working in this direction is the new strategy, introduced by the EU Commission in 2002, for sustainable development of European aquaculture which is aiming at an annual growth of 4 percent

COMMUNICATION FROM THE COMMISSION TO THE COUNCIL AND THE EUROPEAN PARLIAMENT: A STRATEGY FOR THE SUSTAINABLE DEVELOPMENT OF EUROPEAN AQUACULTURE. COM(2002) 511 final, Brussels 19.9.2002.

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#### Human resources

Table 1. Number of employees in Danish aquaculture in 2003

	Freshwater	Offshore	Marine, land-based	Re-circulation	Others	Total
Male full-time	372	45	9	45	13	484
Female full-time	19	4	1	3	2	29
Male part-time	98	2	3	10	2	115
Female part-time	22	0	0	3	1	26
Male, season	36	72	3	3	8	122
Female, season	13	30	–	–	–	43
Total	560	153	16	64	26	819

Notes: Full-time employment: At least 90 percent of a normal working year.  
Part time employment: At least 30 percent but less than 90 percent of a normal working year.  
Season employment: Less than 30 percent of a normal working year.

Source of information: Danish Directorate of Fisheries, Aquaculture Register 2003.

#### Farming systems distribution and characteristics

All freshwater fish farms in Denmark are located on Jutland in the western part of the country which possesses the most abundant flowing streams.

The land based marine farms are located in Ringkjøbing Fjord on Jutland.

All Danish offshore farms are located in the inner marine waters. Offshore farms cover in total 1-2 square kilometres, equalling about 0.02 percent of Danish marine territory.

About 90 percent of Danish farmed eel production takes place in Jutland.

Shellfish farms are almost exclusively located in the Limfjord, the strait dividing the northernmost part of Jutland.

#### Freshwater aquaculture

Denmark was among the European pioneers in systematic pond farming of rainbow trout

([Oncorhynchus mykiss](#)) around the beginning of the 20th century. In 1914 Denmark had about 140 trout farms, primarily producing for export. Production fell drastically during and between the two great wars, but then began to flourish again. In 2003 there were 337 freshwater pond farms owned by about 200 farmers.

Today, the greater part of the Danish freshwater trout production is sold for processing at a "portion size" of 250–350 grams weight. Fish juveniles are also produced in specialised hatcheries and sold for further on-growing in freshwater ponds and mariculture units, or for restocking purposes. A small but growing amount is sold for "put-and-take" angling.

In recent years the feed and feeding techniques have been improved to such a degree that the average feed conversion ratio in Danish fish ponds has been reduced to about 0.95 (= one kilo feed required for the production of a one kilo fish). This development has been dependent on the use of high-quality fish meal and fish oil, primarily produced from Danish sandeel fisheries in the North Sea.

Danish pond farming is subject to a variety of environmental regulations aimed at securing the water quality of rivers and lakes and reducing eutrophication of the open sea. A particular departmental order stipulates a number of requirements for the establishment and operation of freshwater farms. Counties assign individual limits to the fish farms on the annual amount of feed it can use and effluents it is allowed to produce, in addition to specific requirements regarding feed conversion ratios, water treatment, taking samples, keeping of operational records, filtering ponds and canals, removal of waste and offal etc.

There is a growing need for investment in measures required to meet the tightening environmental regulations which has resulted in economic strains being placed on fish farmers. One of the problems is that there has not yet been an efficient, reliable and cost-effective method developed for analysing the amount of N, P and organic effluents entering into the rivers. The 'model farm' concept, however, introduced by the recommendations of an advisory committee on freshwater aquaculture has created some degree of optimism within the industry.

### Marine aquaculture

The first Danish mariculture installations were developed in the 1950s using cages located close to land, with the development of technology during the 1970s offshore cages were introduced. By 2003 Denmark had 24 offshore marine fish farms and 10 land based plants, pumping sea water through tanks ashore.

The main product from offshore cages as well as from land-based units is large rainbow trout, 2–5 kilos each. An essential by-product is the roe, which is salted and marketed as 'caviar', this is exported mainly to Japan and contributes substantially to the Danish mariculture economy. Competition, however, is increasing in this market and prices are decreasing.

Danish land-based seawater aquaculture usually follows the same production pattern as offshore farms. The land based system has some environmental advantages, however, since it is possible to filter the water, at least in part, before it is released back to the sea. Costs for establishing as well as running land-based seawater farms are higher than for freshwater ponds and offshore mariculture which renders them less attractive in a market where there is severe competition on product prices.

In recirculated seawater tanks, small quantities of turbot fry are produced for export for further on-growing, mainly in Southern Europe; in addition, some plaice are produced for restocking purposes.

Apart from small quantities produced for restocking, Denmark has no salmon farms, in recent years, world production of farmed salmon has increased drastically, followed by a subsequent reduction in

prices. Danish fish farmers have suffered because of this, since salmon and large trout would be competing directly in the low price end of the market.

### Eel farming

Eel ([Anguilla anguilla](#)) farming is a relatively new activity only in existence for about the last 25 years, but the recirculation technology is now well established and also suitable for a number of other species. Denmark currently has 11 eel farms.

There is still room for development of a feed that is better suited for the specific requirements of eels that are being cultured. Not least because many details relating to eel reproduction remain to be fully understood, in spite of many years of research it is not yet possible to produce eel fry in captivity, however, there is some optimism that progress is being made in this area.

With recirculation technology requiring the water to be filtered and rinsed, Danish eel farming has had no difficulty in complying with environmental regulations. Danish eel farming technology is of a high standard and there is a considerable level of export of this technology and know-how.

### Shellfish farming

Blue mussels ([Mytilus edulis](#)) and the European flat oyster ([Ostrea edulis](#)) have been farmed from time to time in small quantities within the Danish fjords, in 2003, production totalled 11 tonnes. Farmed mussels grow quicker than wild mussels and have a higher 'meat percentage', as a result of this, they are used primarily for direct consumption and are sold at higher prices than wild caught mussels.

A steady increase in Danish shellfish farming is expected in the future, following recommendations from a special committee (2004), 44 licences have been granted, mainly for farms in the Limfjord in Northern Jutland, and new facilities are being established.

Danish coastal marine areas and the Wadden Sea provide very good conditions for shellfish production in the shallow, relatively calm waters. By filtering the water during feeding, the shellfish are removing nutrients and thereby contributing towards counteracting the effects of eutrophication. Cultivating shellfish in the water column accelerates the growth considerably compared to bottom culture, and regular harvest /thinning further accelerates the growth of the remaining shellfish.

From time to time, algal blooms arise due to eutrophication giving rise to a risk of toxin accumulation in the shellfish, however, strict veterinary precautions are taken in accordance with EU and national regulations. Specific shellfish production areas are assigned and are subject to requirements relating to water quality, regular control of the products, etc., and the problems with algal blooms do not usually cause serious harm to the industry.

### Cultured species

Table 2. Danish aquaculture production in 2003 by volume and value

Species	Production	
	Tonnes	US\$ million
rainbow trout	33 440	89.763
eel	2 011	17.233
brook trout	226	1.020
trout, not specified	79	0.840
salmon	16	0.800
brown trout	97	0.562
pike	...	0.141

blue mussel	11	...
turbot	5	...
pikeperch	6	...
Total	35 891	110.360

Note: Excluding values of eggs and roe, which were not categorised.

Source of information: Danish Directorate of Fisheries, Aquaculture Register 2003.

#### Practices/systems of culture

Table 3. Danish aquaculture: Number of farms and facilities of different types in 2003

—	Number of						
	Farms	Ponds	Canals	Tanks	Cages	Mussel wires	Others
Freshwater	337	7 504	497	3 719	40	0	31
Mariculture, offshore	24	0	0	0	186	0	0
Mariculture, land based	10	50	54	7	0	0	1
Recirculation	30	133	6	752	0	0	318
Others	13	6	0	0	4	52	149
Total	414	693	557	4 478	230	52	499

Source of information: Danish Directorate of Fisheries, Aquaculture Register 2003.

#### Freshwater aquaculture

The majority of freshwater farms have traditional ponds dug into the ground water is taken into the ponds from a stream via a channel, usually assisted by a small dam in the stream. The water is then channelled through an array of ponds, each of which typically measures 25–35 x 5–7 metres and is 0.7 metres deep. From the pond outlets the water is then guided through a back channel which is also used for rearing fish, before it is output back into the stream thorough a precipitation basin, about 1 metre deep.

Normally, the water is oxygenated either by a central pump or by floating devices in the ponds. An increasing number of farms are recirculating the water after being first passed though micro filters and biological filters, thereby reducing the water intake and the discharge of nutrients from the farm.

The trout are harvested when they reach 'portion size' at about 250–350 grams weight, gutted and frozen or smoked for sale. A substantial amount, however, are exported alive, mainly to the German market.

#### Mariculture

In a typical Danish mariculture unit, trout at about 1 kilo in weight in spring (March–April) are transferred from freshwater ponds to offshore net cages. Feed is administered by feeding machines that distribute the feed over the cages from a boat, or from a platform via hoses to each of the cages. In autumn/early winter (October–December) the fish are harvested at a size of about 2–5 kilo, gutted and frozen or filleted and smoked.

Due to the risk of ice during cold winters, the sea around Denmark is not suitable for mariculture all year around, so at the end of the season, the cages are taken ashore for maintenance and repair and also for storage until the following spring.

Production methods used in land-based aquaculture using sea water resemble those used for



freshwater aquaculture, however, the water has to be pumped both in and out of the farm. The trout produced are of the same size as in offshore farming.

### Eel farming

Fry (glass eels) caught from natural waters are the raw material for eel farming, the eels are reared in indoor tanks using tap water at 20–25 °C. The water is continually recirculated through mechanical and biological filters, oxygenated and disinfected using ultraviolet treatment. Feed is administered manually or by automatic feeding machines.

A proportion of the production is sold as fingerlings for restocking purposes; however, the majority is grown on and exported for human consumption at about 100–200 grams each. Smaller amounts are grown to a size of 300–800 grams.

### Shellfish farming

Mussels are usually cultivated on vertical ropes or in socks hanging from suspended lines ('longline' systems) tied to floating buoys which are anchored to the bottom. Mussel 'seed' (larvae) settle naturally on the hanging ropes in spring time. Almost all Danish waters carry plenty of mussel seed. The growing mussels are usually transferred from the ropes to socks in the autumn and harvested the following summer at a size about 45–55 mm.

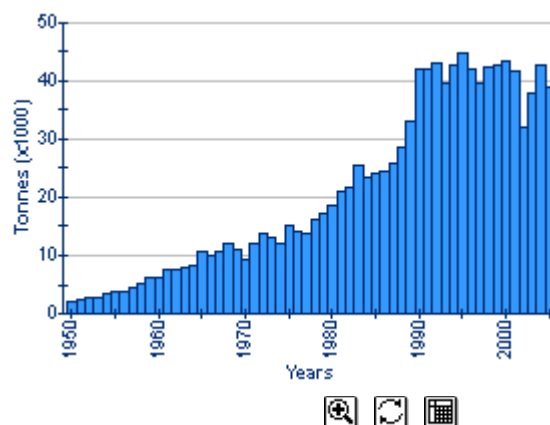
Oyster seed is produced and cultivated most successfully in tanks, at a size of 30–40 mm the small oysters are transferred to the sea in baskets or trays hanging from suspended lines or lying on the bottom. Ongrowing takes place for 1.5–2 years before reaching a harvest size of 70–100 grams.

### Sector performance

#### Production

The graph below shows total aquaculture production in Denmark according to FAO statistics:

**Reported aquaculture production in Denmark (from 1950)**  
(Fao Fishery Statistic)



(Source: FAO Fishery Statistics, Aquaculture production)

#### Market and trade

The main income from the Danish export

Net export figures. Source of information: Statistics Denmark and The Danish Aquaculture Organisation.

➦ of aquaculture products is derived from smoked trout, including fillets. In 2003 exports were 3 850 tonnes worth US\$ 42 million. These exports predominantly go to Germany (73 percent), Switzerland (7 percent) and Belgium (6 percent).

Exports of gutted, chilled and frozen trout (including fillets) in 2003 were just over 8 700 tonnes worth US\$ 39 million, mainly to Germany but also to The Netherlands, Sweden and Belgium.

Exports of live trout (portion size) from freshwater farms in 2003 were 5 100 tonnes, worth US\$ 18 million, mainly to Germany.

Salted trout roe and 'caviar' is exported almost exclusively to Japan, in 2003 the export amounted to 544 tonnes worth US\$ 5 million.

Export figures for Danish farmed eels are not easily extracted from the official statistics which include also export of wild caught eels. However, around 80 percent of the eels from Danish aquaculture are exported live to The Netherlands for harvesting and smoking. In 2003, this amounted to approximately 1 600 tonnes worth just over US\$ 13 million.

#### Contribution to the economy

The total aquaculture production in 2003 was estimated at 36 000 tonnes or 3.3 percent of the total national fish production and worth 20 percent of the total value of fish produced. However, the earnings from the aquaculture sector at about US\$ 114 million, made it worth more than the economically important Danish cod fisheries. Over 90 percent of aquaculture production goes for export. It is estimated that 800 people are directly employed in production, however, a significant number of people are employed in associated industries such as processing and smoking.

#### Promotion and management of the sector

##### The institutional framework

Though being an integrated part of the Danish fisheries sector and as such covered by the Fisheries Act under the Ministry of Food, Agriculture and Fisheries, the Danish aquaculture industry is mainly governed through the implementation of environmental regulations.

The Ministry of the Environment is in charge of administrative and research activities in the area of environmental protection and planning, the Ministry has three agencies, one corporate management centre and two independent research institutes. Two independent appeal boards and one Environmental Assessment Institute are also linked to the Ministry.

##### The governing regulations

The

[http://www.fao.org/fi/website/FIRetrieveAction.do?dom=countrysector&xml=naso\\_denmark.xml&lang=en](http://www.fao.org/fi/website/FIRetrieveAction.do?dom=countrysector&xml=naso_denmark.xml&lang=en) Fisheries act (2004, as amended) regulates the management, control and development of fisheries and aquatic resources in Denmark. Chapter 13 addresses ocean farming and establishes a licensing system governing the establishment and operation of mariculture facilities. The Act grants the Minister of Food, Agriculture and Fisheries general power to make regulations with regard to the issuing of licences for the establishment and operation of ocean farms. The Regulation on the establishment and operation of ocean farms (1991)

Available at: <http://www.retsinfo.dk/>

➦ sets forth more detailed rules on the licensing system of mariculture facilities. The issuing of licences has been delegated to the Danish Directorate of Fisheries.

For aquaculture facilities taking in fresh water, facilities that are placed on land taking in marine water, and for the fish farming of mussels, oysters etc., no regulations have been issued pursuant to the Fisheries act (2004) concerning licensing. For fish farming that requires feed, however, an approval according to the



[http://www.fao.org/fi/website/FIRetrieveAction.do?dom=countrysector&xml=naso\\_denmark.xml&lang=en](http://www.fao.org/fi/website/FIRetrieveAction.do?dom=countrysector&xml=naso_denmark.xml&lang=en)Environment protection act (2001) is required. For the fish farming of mussels, oysters etc., an application for a licence shall be filed with the Directorate of Fisheries in accordance with the Instruction on Applications for Bivalve Aquaculture in the Limfjord (2003).

For more information on aquaculture legislation in Denmark please click on the following link: [National Aquaculture Legislation Overview - Denmark](#)

### Applied research, education and training

Applied research in relation to aquaculture in Denmark is primarily undertaken by the Danish Institute for Fisheries Research (DIFRES) under the Ministry of Food, Agriculture and Fisheries as well as a few other government-run research institutions. They are financed by basic funding from the ministry, linked to 'result contracts', as well as by allocations from different sources on the basis of specific research projects. Each of the institutions has a governing board to whom the director refers and to a great extent they set their own research priorities within the framework of the contract.

DIFRES carries out research and investigations relating to sustainable exploitation of live marine and freshwater resources, including aquaculture. Further, DIFRES acts as a counsellor to the Minister of Food, Agriculture and Fisheries, to other authorities, international commissions, the fishing industry and fishery organisations. DIFRES is managed by a director referring to a Governing Board with representation from the fishing industry including aquaculture, professional and industrial bodies, national research councils and members of the staff.

DIFRES has four research departments, one of which being the Department of Marine Ecology and Aquaculture. A main area of research is nutritional physiology in fish larvae and the use of live feed, which are critical parameters in aquaculture. This field is central to efforts to develop total production concepts applying to all life cycle stages from egg to the final product and promoting the use of alternative species of fish and shellfish in aquaculture.

Another DIFRES department deals with processing and improvement of the quality of fish products as well as quality assurance in the fish industry, covering raw material, process and product, microbiology and hygiene.

DIFRES cooperates with Danish universities in high level education within the scientific areas of the institution. There is no official Danish education specifically related to aquaculture, either at university or at lower levels, however, the Danish Aquaculture Organisation is working on proposals for an institutionalised education, following recommendations from the special committees on freshwater and marine aquaculture.

Working with documentation of the effects of recirculation technologies in freshwater aquaculture, the Department of Marine Ecology and Aquaculture cooperates with the National Environmental Research Institute (NERI) under the Ministry of Environment. Within the area of aquaculture systems, methods and environmental effects, this cooperation contributes to developing new technologies primarily in freshwater aquaculture, minimising the use of electricity, oxygen and feed, and reducing effluent levels of nutrients and traces of medicines and ancillary materials.

NERI undertakes scientific consultancy work, the monitoring of nature and the environment as well as applied and strategic research, its task being to establish a scientific foundation for environmental policy decisions. NERI also investigates the turnover and effects of N and P, the effects of selected hazardous substances, sustainable utilisation of water resources and the restoration of lakes and

watercourses.

A number of DIFRES and NERI research projects relating to aquaculture actively involve the Danish Aquaculture Organisation which unites all branches in the industry (freshwater and marine aquaculture, eel farming, feed producers as well as processing and export).

The Danish Institute for Food and Veterinary Research is a governmental research institute under the Ministry of Family and Consumer Affairs. The Department of Poultry, Fish and Fur Animals performs research, diagnostics and advisory services concerning diseases and zoonoses in poultry, fish, fur animals, wildlife and pets. The research focuses on the development of methods for detection of pathogenic and zoonotic agents, as well as on the interaction between host and pathogens aimed at prevention and treatment of disease.

The diagnostic and consultancy services of the Department of Poultry, Fish and Fur Animals support livestock producers, veterinarians and authorities, and are part of the veterinary contingency plan for infectious diseases. The department is a national reference laboratory for infectious diseases in poultry, fish and fur animals, as well as the EU and OIE reference laboratory for fish diseases.

The Danish Shellfish Centre (DSC) is a research and development organisation in Northern Jutland, sustained by regional funding and national funding for R&D projects. The objectives of the centre are to promote sustainable shellfish culture, fisheries and processing by exploiting the natural resources of plants and animals in coastal waters, thereby benefiting the industry, the public and the environment, converting new knowledge into industrial practice.

DHI Water & Environment is an independent, international consulting and research organization approved as an authorized technological service institute by the Ministry of Science, Technology and Innovation. Over a number of years, DHI has been consulting on aquaculture and environment topics; the main DHI services in this field are impact assessment, operational forecasting, modeling of production and clean technology.

A list of links to institutions and organisations is included at the end of this document.

#### Trends, issues and development

Since the introduction in Denmark of strict environmental regulations in the late 1980s, no licence has been issued for any new freshwater fish farms and only one licence for a new marine fish farm has been given (2004). Approvals and feed quotas are strictly tied to the individual farm and can not easily be transferred to others. Many freshwater farms have in fact been closed in order to improve environmental conditions in streams. On the whole, production has declined over the period.

Against the international background of increasing potential for aquaculture production, given the increasing pressure on marine catches, Denmark has had special committees looking into the potential for this sector. The freshwater and saltwater aquaculture committees in 2002 and 2003 respectively, recommended increasing the production efforts within a sustainable framework, stimulated by economic incentives. For both sub-sectors, a prerequisite for development has been a change to the present regulation system which is based on fixed feed quotas.

One concrete result of the recommendations is the 'model farm' plan with a strong link between investment in production, investment in equipment and management for environmental purposes. The plan makes it possible for the individual freshwater farm to more than double its production (up to +130 percent). So far, the implementation of the plan shows that the perspectives of increased production, improved environment and fish passages in the streams go together in a way that has attracted considerable interest among Danish and European aquaculturists.

For marine aquaculture, the main potential is connected with locating offshore cages in areas with optimum conditions for diluting and spreading emissions from the cages. An integrated mapping of Danish marine waters showing the different restrictions and potentials has been carried out to promote this development. The environmental rules for marine fish farming are in a process of readjustment to provide for a flexible regulation system based on documentation of environmental effects rather than stiff production limits by way of fixed feed quotas.

Further, an ad hoc advisory shellfish board was established in 2003 mainly along the same lines (also including the potential for shellfish fisheries) in order to optimise the total exploitation of Danish shellfish resources, primarily Blue mussel and European oyster. Based on interim recommendations from the committee, certain areas of the Limfjord (in the northern part of Jutland) were assigned to shellfish production and licensing began in early 2004. The recommendations of the board (2004) among others include transferable five-year licences and the establishment of a permanent advisory committee in order to integrate all relevant commercial and environmental aspects in the administration and the development of the industry. Amendments to the Fisheries Act in part implementing the recommendations are underway.

In 2004, a new Regulation on Organic Aquaculture came into force for a voluntary red Danish 'Organic' label. Farmed fish for organic labelling may be treated with antibiotics only once, and no genetically modified or biologically treated fish are allowed on the farm. The 'organic' label can only be used for fish from the family Salmonidae (salmon and trout) and European eel. The label has attracted some attention, but production still is very small.

There has been growing concern as to the status of wild stocks of European eel, catches have been decreasing for decades, for adult eels as well as for glass eels and many natural biotopes are considered as being endangered. Glass eel prices have exploded due to increasing international exports outside Europe. In order to secure the stocks and continued glass eel supplies for farming, Danish eel farmers in cooperation with European colleagues in the 1990s suggested to the EU Commission that measures should be taken to this effect. Following advice from biologists, the Commission is now working on proposals in order to protect and develop the European eel stock

COMMUNICATION FROM THE COMMISSION TO THE COUNCIL AND THE EUROPEAN PARLIAMENT: Development of a Community Action Plan for the management of European Eel. COM(2003) 573 final, Brussels 01.10.2003.

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The prevailing hope in the Danish aquaculture industry is that international as well as EU pressure for development of the industry will lead to quick changes in the direction of realistic environmental regulations that do not handicap the industry as a worthy competitor in the national and international market.

#### References

#### Related links

[Danish Directorate of Fisheries](#)

[Danish Environmental Protection Agency \(environmental regulation, marine aquaculture\)](#)

[Danish Forest and Nature Agency \(environmental regulation, freshwater aquaculture\)](#)

[Danish Institute for Food and Veterinary Research](#)

[Danish Institute of Fisheries Research](#)

[Danish Plant Directorate \(feed regulations\)](#)

[Danish Shellfish Centre](#)

[Danish Veterinary and Food Administration](#)

[DHI Water & Environment](#)

[FAO FishStat Plus – Universal software for fishery statistical time series](#)

[Governmental information](#)

[Information on aquaculture research and other initiatives](#)

This is the official on-line legal information system of the Danish State, with links to all Acts and regulations, all in Danish. Translations of some of the central acts etc. can, however, in some cases be found on the homepage of the relevant ministry.

[⚡ Legal Information \("Retsinformation"\):](#)

[National Environmental Research Institute](#)

[Organisation of Danish shellfish farmers](#)

[The Danish Aquaculture Organization](#)

[The Ministry of Environment](#)

[The Ministry of Family and Consumer Affairs \(veterinary and food regulations\)](#)

[The Ministry of Food, Agriculture and Fisheries](#)