European Commission

Guidance on Aquaculture and Natura 2000

Sustainable aquaculture activities in the context of the Natura 2000 Network

Environment

Guidance document on aquaculture activities in the Natura 2000 Network

This document reflects the view of the European Commission services and is not of a binding nature.

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TABLE OF CONTENTS

INTRODUCTION

Background

Aquaculture represents a growing contributor to the production of aquatic food worldwide. Most fisheries in the world are currently near or above sustainable exploitation limits. In parallel, global consumption of fish as food has doubled in the period 1973-2003 and is expected to continue to rise (EC 2007[1]). According to FAO, globally, aquaculture accounted for about 46% of the world's fish food production for human consumption in 2008 and it is estimated that aquaculture will reach more than 50% by 2012[2]. Currently, about 70% of the fish consumed in the EU comes from outside the Union.

In the EU, aquaculture production is an important economic activity in many coastal and continental regions but has remained stable in recent years. The current reform of the Common Fisheries Policy aims, inter alia, to develop the full potential of EU aquaculture in line with the Europe 2020 objectives: sustainability, food security, growth and employment.

The challenges for the EU aquaculture sector are numerous; the limited access to space/water and licensing have been highlighted in particular. A better implementation of relevant EU legislation by Member States should ensure a level-playing field among economic operators on decisions affecting the development of aquaculture. In view of this, the Commission has committed itself to developing guidance documents to facilitate knowledge and implementation of its main environmental policy instruments, notably a guidance document on aquaculture activities and Natura 2000.

Natura 2000 is a network of sites designed to safeguard Europe's rarest and most endangered species and habitat types in accordance with the EU Habitats and Birds Directives, which are the cornerstones of the Europe's biodiversity policy. There is no automatic exclusion of any economic activities in and around Natura 2000. Instead, human activities need to comply with the provisions outlined in Article 6 of the Habitats Directive to ensure that these activities are in line with the conservation objectives of Natura 2000 sites.

In order to clarify applicable provisions the Commission has produced a number of guidance documents on the management of Natura 2000 sites (application of Article 6 of the Habitats Directive) . Some Member States are also producing guidance for their aquaculture industries on how to deal with this issue. However, there is general acceptance about the need to develop more specific EU guidance on the activities of aquaculture in relation to Natura 2000.

Purpose of this Guidance document

The aim of this document is to offer guidance which would facilitate the knowledge and implementation of EU legislation underpinning Natura 2000 in relation to aquaculture activities. The guidelines mainly focus on the implementation of the provisions of Art. 6(3) and 6(4) of the Habitats Directive (appropriate assessment of plans and projects) and are designed to contribute to a better understanding of the conservation objectives of the sites, promoting best practices which illustrate how nature protection provisions can be compatible with sustainable aquaculture development.

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[1] EC, 2007. Opportunities for the development of Community aquaculture. Consultation Document. available at: http://ec.europa.eu/fisheries/partners/consultations/aquaculture/consultation100507_en.pdf

[2] FAO. The state of world aquaculture 2010.

The document has been prepared in close collaboration with representatives of the aquaculture sector, experts, public authorities and NGOs via a dedicated EC Working Group. It is aimed at providing guidance mainly to aquaculture operators and public authorities, as well as to other stakeholders (e.g. site managers, NGOs, public) concerned.

Limitations of the document

This guidance document is intended to be bound by, and faithful to, the text of the Birds and Habitats Directives and to the wider principles underpinning EU policy on the environment and on aquaculture. Other potentially relevant EU environmental legislation (e.g. the Water Framework Directive, the Marine Strategy Framework Directive, the EIA and SEA Directives) are not discussed in detail.

The document **is not legislative in character**, it does not make new rules but rather provides further guidance on the application of those that already exist. As such, it reflects only the views of the Commission services and **is not of a legally binding nature**. It rests with the EU Court of Justice to provide definitive interpretation of a Directive. Wherever relevant, existing case law has been included when a clear position has already been taken by the Court.

The document also does not replace the Commission's existing general interpretative and methodological guidance documents on the provisions of Article 6 of the Habitats Directive[3]. Instead, it seeks to clarify specific aspects of these provisions and place them in the context of aquaculture activity in particular. The present guide must therefore always be read in conjunction with the existing general guidance and the two Directives[4].

Finally, the guidance recognises that the two nature Directives are enshrined by the principle of subsidiarity and that it is for Member States to determine the procedural requirements deriving from the Directives. The good practice procedures described in this document are not prescriptive in their intent; rather they aim to offer useful advice, ideas and suggestions based on extensive discussions with aquaculture industry representatives, NGOs and other stakeholders.

[3] "Managing Natura 2000 sites. The provisions of Article 6 of the 'Habitats' Directive 92/43/EEC". "Assessments of plans and projects significantly affecting Natura 2000 sites. Methodological guidance on the provisions of Article 6(3) and (4) of the Habitats Directive 92/43/EEC". "Guidance document on Article 6(4) of the 'Habitats Directive' 92/43/EEC".
http://ec.europa.eu/environment/nature/natura2000/management/guidance_en.htm

[4] The case-studies and examples mentioned in this document are included because of their illustrative value in terms of methodologies and approaches used, the Commission does not necessarily endorse all of their outcomes.

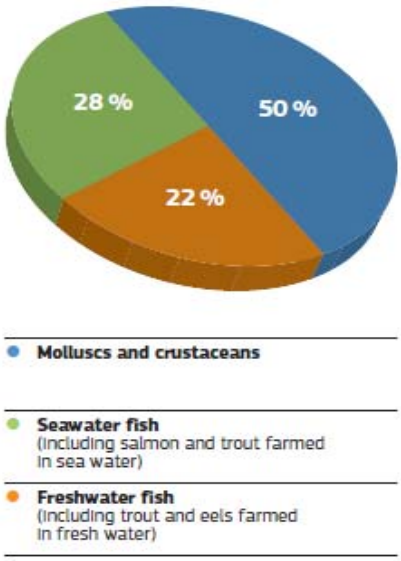
1. AQUACULTURE IN THE EU

- *Aquaculture should be understood as the rearing or cultivation of aquatic organisms using techniques designed to increase the production of the organisms in question beyond the natural capacity of the environment. The organisms remain the property of a natural or legal person throughout the rearing or cultivation stage, up to and including harvesting.*
- *Aquaculture can be characterised in a number of different ways, including the organism farmed, the culture environment, the production intensity and the type of production system used. An understanding of these is key to determining the interactions of aquaculture operations on the environment.*
- *Aquaculture in the EU is made up of three major sub-sectors, which have different histories and characteristics. These are shellfish farming (57% of total production in 2009), freshwater fish farming (18%) and sea fish farming (25%)[5]. Shellfish aquaculture produces around the same volume as finfish aquaculture but only represents around 34 percent of the total value (Framian, 2009[6]).*

1.1 The aquaculture production in the EU

Aquaculture production in the marine environment is dominant in the EU. Freshwater aquaculture is however an important segment of European aquaculture, especially in Central and Eastern EU countries.

Figure 1. Aquaculture production per product type (2009)



Source: FAO

[5] http://ec.europa.eu/fisheries/cfp/aquaculture/facts/index_en.htm
[6] Source: Eurostat

The EU aquaculture sector is essentially dominated by small and medium-sized enterprises. The main aquaculture producers in the EU are France, Spain, Italy, UK and Greece. Enlargement of the European Union has added importance to cyprinid culture in the freshwaters of Central and Eastern Europe. Sustainable aquaculture provides opportunities to reduce the dependence on wild stocks, to meet increased consumer demand, and maintain or create new jobs and businesses.

Figure 2: Aquaculture production by Member States (2009)

Total aquaculture production per Member State (2009)
(volume in tonnes live weight and value in thousands of EUR and percentage of total)

Aquaculture production

Value in thousands of EUR

NB: Not relevant for LU.

Source: Eurostat.

		%		%
BE	576	0.04%	4 035	0.12%
BG	7 912	0.61%	19 513	0.60%
CZ	20 071	1.54%	39 267	1.21%
DK	34 131	2.62%	88 240	2.72%
DE	39 957	3.07%	94 240	2.90%
EE	654	0.05%	2 235	0.07%
IE	47 212	3.63%	104 271	3.21%
EL	121 971	9.37%	397 791	12.25%
ES	268 565	20.63%	396 739	12.22%
FR	236 438	18.16%	697 965	21.50%
IT	162 325	12.47%	474 863	14.63%
CY	3 356	0.26%	16 464	0.51%
LV	517	0.04%	1 115	0.03%
LT	3 428	0.26%	6 655	0.21%
HU	14 171	1.09%	26 495	0.82%
MT	5 619	0.43%	47 057	1.45%
NL	55 561	4.27%	84 109	2.59%
AT	2 141	0.16%	13 879	0.43%
PL	36 503	2.80%	76 373	2.35%
PT	6 727	0.52%	34 064	1.05%
RO	13 131	1.01%	16 990	0.52%
SI	1 308	0.10%	3 069	0.09%
SK	823	0.06%	1 766	0.05%
FI	13 627	1.05%	39 582	1.22%
SE	8 540	0.66%	18 436	0.57%
UK	196 603	15.10%	540 741	16.66%
EU-27	1 301 866	100.00%	3 245 953	100.00%

The main products from Aquaculture in the EU are presented in the figure below.

Figure 3: The top 10 species produced in aquaculture in the European Union (2009)

Volume in tonnes live weight and percentage of total

		%
Mediterranean mussel	315 171	24%
Rainbow trout	199 905	15%
Blue mussel	179 041	14%
Atlantic salmon	157 647	12%
Pacific cupped oyster	106 065	8%
Gilthead seabream	96 278	7%
Common carp	70 761	5%
European seabass	57 478	4%
Japanese clam	34 406	3%
Turbot	9 019	1%

Value in thousands of EUR and percentage of total

		%
Rainbow trout	666 263	21%
Atlantic salmon	533 711	16%
Gilthead seabream	373 751	12%
Pacific cupped oyster	352 970	11%
European seabass	282 879	9%
Blue mussel	230 013	7%
Mediterranean mussel	178 542	6%
Common carp	134 493	4%
Japanese clam	105 979	3%
Atlantic bluefin tuna	69 072	2%

Source: Eurostat.

Source: Facts and figures on the CFP. 2012. Available at:
http://ec.europa.eu/fisheries/documentation/publications/pcp_en.pdf

1.2 Aquaculture methods and systems practiced in the EU

Aquaculture can be characterised in a number of different ways, including the organism farmed, the culture environment, the production intensity and the type of production system used. An understanding of these aspects is key to determining the interactions of aquaculture operations with the environment. The main aquaculture systems practiced in Europe, in sea water and fresh water, are summarily introduced in this section.

As regards the production intensity, it is usually understood that in extensive aquaculture there is no external supply of feed and this type of culture depends entirely on natural processes for production and supply of feed. In semi-intensive aquaculture, some supplementary feed may be used in addition to natural capacity to increase the production of fish. In intensive culture systems there is a greater dependency on the use of external feeds.

1.2.1 Aquaculture in the sea and coastal areas

Aquaculture activities that depend on sea water include different systems of shellfish and finfish farming, which are briefly introduced below. Hatchery productions for these types of systems are also briefly mentioned.

- *Shellfish farming*

Shellfish farming is primarily based on specimens born in the wild and on nutriments provided by the environment. The majority of European shellfish are mussels farmed in Spain, Italy, France and the Netherlands. Oyster farming is also an important activity in the EU, especially in France. Other shellfish species farmed in quantity in the EU include clams, Italy being the main producer.

Three main types of farming are practiced in the EU: shellfish rafts and longlines**,** intertidal and bottom shellfish culture (Huntington et al. 2006).

- Shellfish rafts and longlines. Mussel and other shellfish aquaculture in deeper waters, through the use of suspended ropes and longlines from floating rafts, has developed to take advantage of spat fall locations as well as areas of good water quality and food availability. This form of aquaculture has become a particular feature of the Galician coastline of Spain, as well as south, west and north west of Ireland and some Scottish lochs.

- Inter-tidal shellfish culture is practiced extensively in the Western part of Europe and is one of the older, more traditional forms of aquaculture in the EU. It takes place within the inter-tidal area, thus benefiting from relatively accessible land-based support as well as the dynamic physical environment of the land/water interface.

- Bottom shellfish culture is a form of shellfish culture where juvenile animals are placed or 're-layed' on a suitable substrate for on-growing. The substrate selected will depend upon the shellfish species being used – mussels and oysters prefer a hard or firm substrate whilst infaunal species such as clams prefer a softer substrate into which they can burrow. This form of aquaculture is often practised in shallow coastal or estuarine areas.

As regards the cultured species, mussels are the main species produced in the EU-27, with two species: the blue mussel *Mytilus edulis* and the Mediterranean mussel *Mytilus galloprovencialis*. Spain is by far the greatest producer of mussels by aquaculture, greater than the combined total of other important mussel producing countries such as Netherlands, France, Italy, Ireland and UK.

European aquaculture of mussels relies on collection of natural seed and spat. There are three main methods of culturing mussels up to market size: bottom cultivation, bouchot culture and the suspended rope method. The large Spanish mussel farming industry is rope-grown in coastal areas, whilst the French and Netherlands production tends to be on the bottom or using bouchot poles. Italian mussel production tends to use longlines in lagoons.

Some countries produce shellfish in offshore farms. France, for example has commercial offshore mussel farming in 3 areas (the Mediterranean Sea, the Atlantic Coast and the North Sea), and Belgium has 4 mussel areas in the North Sea. A recent report of the ICES Working Group on Marine Shellfish Culture provides, among others, an overview of this type of shellfish culture in its member countries (ICES, 2011[7]).

In relation to oysters, two species are cultured in Europe, but the vast majority of oysters farmed in the EU (over 95%) are the Pacific cupped oyster (*Crassostrea gigas*) rather than the native European flat oyster (*Ostrea edulis*) (Huntintong et al. 2010). The former is now the most widely reared oyster worldwide, and Europe is the world's fourth producer (118 132 tonnes in 2009, Eurostat 2011[8]). France is Europe's top oyster producer (104 640 tonnes in 2009; Eurostat 2011).

Four main methods of oyster rearing are used depending on environmental characteristics (tidal range, water depth, etc.) and local traditions (EC DG MARE[9]): Off-bottom culture (in mesh bags attached to trestles on the intertidal ground), bottom culture (placed directly on inter or subtidal ground), deep-water culture (in parks at depths of up to 10 metres), and suspended culture (on ropes, like mussels, making it possible to rear them offshore). Since they are constantly submerged, they fatten more quickly. This method is suitable for rearing in waters without tides, or offshore.

Other shellfish species cultured in Europe include clams, scallops and abalones. The two main species of clams cultured in Europe are *Ruditapes decussatus* (Linnaeus, 1758; also called grooved carpet shell) and *Ruditapes philippinarum* (Adams & Reeve, 1850; called Japanese carpet shell or Manila clam).

The farming of clams requires seeds which are obtained through natural spawning on production sites or in hatcheries. The spat are reared with different methods until the young clams can be seeded in intertidal zones or in lagoons to be harvested later. Growing techniques of clams are simple, consisting of regular maintenance of the substrate, avoiding algae, starfish and other predators, oxygenating the substrate, and maintaining an appropriate clam density and seeding juvenile clams.

Different techniques can be used for harvesting, by hand or from boats, using various collection tools. Mechanical harvesting can be carried out by suction or elevator dredges; a tractor equipped with a lateral conveyor belt can dig and grade clams from sandy bottom areas (FAO, 2011[10]).

[7] ICES. 2011. Report of the Working Group on Marine Shellfish Culture (WGMASC), 5–8 April 2011, La Trinité-sur-Mer, France. ICES CM 2011/SSGHIE:08. 92 pp.
[8] Eurostat, 2011. http://epp.eurostat.ec.europa.eu/portal/page/portal/fisheries/data/database#
[9] http://ec.europa.eu/fisheries/marine_species/farmed_fish_and_shellfish/oysters/index_en.htm
[10] FAO 2011. Cultured Aquatic Species Information Programme. Ruditapes philippinarum. Cultured Aquatic Species Information Programme. Text by Goulletquer, P. In: FAO Fisheries and Aquaculture Department [online]. Rome. Updated 1 January 2005. [Cited 15 June 2011]. http://www.fao.org/fishery/culturedspecies/Ruditapes_philippinarum/en

- *Shellfish hatcheries and mussel seed fisheries:*

Methods for culturing bivalves in a hatchery are well established for oysters and clams, while there are no commercial blue mussel hatcheries or nurseries in Europe, although controlled reproduction and subsequent spat and seed production is known to be technically feasible. A few hatcheries exist outside Europe (Blue Seed project[11]).

A number of successful techniques have also been developed for scallop hatcheries, which provide advantages over traditional spat collection for supplying seed to aquaculture operations, most notably in selective breeding, as well as providing a regular supply of spat at a low price.

Techniques for seed supply for mussel culture include collecting seed by natural settlement on ropes or other substrates, dredging wild seed beds and scraping mussel seed from rocks.

- *Marine finfish farming*

Culture of finfish species in the sea can be divided according to the location of the fish farm, which can be placed on the coastal area, or offshore.

Offshore aquaculture can be defined as taking place in the open sea with significant exposure to wind and wave action, and where there is a requirement for equipment and servicing vessels to survive and operate in severe sea conditions from time to time. The issue of distance from the coast or from a safe harbour or shore base is often, but not always, a factor.[12] However, there is no common definition. For example Holmer (2010[13]) provides some indication of the parameters that may be useful to distinguish three types of location of aquaculture (see Table 1).

Table 1. Definitions of coastal, off-coast and offshore farming based on some physical and hydrodynamical settings *(adapted from Holmer, 2010).*

	Coastal Farming	**Off-coast farming**	**Offshore farming**
Physical setting	< 500 m from shore < 10 m water depth Within sight of shore users	500 m to 3 km from shore 10 to 50 m water depth Usually within sight	>3 km from shore >50 m water depth On continental shelf Not visible from shore
Exposure	Waves < 1m Lcal winds Local currents Strong tidal currents Sheltered	Waves < 3 to 4 m Localised winds Localised currents Weak tidal currents Somewhat sheltered	Waves up to 5 m Ocean winds Ocean swell No tidal currents Exposed

In the **coastal area** aquaculture systems can take place in coastal lagoons or in land-based ponds and tanks. ***Lagoon culture*** is a traditional coastal aquaculture system originated from the Mediterranean, which uses the coastal lagoons to capture migrating fish fry and grow them on for human consumption. Extensive fish culture has been a traditional activity in some salt-marsh areas in Europe, where farms may obtain a natural fry recruitment by an adequate management of water in-flow with the tides.

[11] BLUE SEED Final Report. 2008. Available at: http://www.blueseedproject.com/client/files/BLUE_SEED_Final_Report.pdf

[12] Evaluation of the promotion of Offshore Aquaculture Through a Technology Platform (www.offshoreaqua.net)

[13] Holmer, M. 2010. Environmental issues of fish farming in offshore waters: perspectives, concerns and research needs. Aquacult Environ Interact Vol. 1: 57–70.

Methods have evolved over the past 50 years, leading to the gradual intensification of production as artificial feeding and water management technology have improved. Large brackish areas are enclosed to prevent the fish returning to the sea and complex permanent capture systems, fish barriers, are developed consisting of barriers in the channels connecting with the sea to catch the adults. Although some extensive systems depend upon natural fry within the system, most now rely on the stocking of juveniles from external sources.

Land-based ponds have stemmed from an intensification of lagoon and saltmarsh aquaculture where low-lying areas can benefit from the periodic inundation with spring tides. More modern pond systems have been built above the spring high tide mark but must then rely upon pumped water. These systems tend to be shallow (e.g. 0.75 to 1.5 m pond depth), extensive and therefore fairly large in nature. Pond systems can be used for finfish (e.g., sea bass and sea bream, sole, sea-grown rainbow trout), but also for shrimp and shellfish.

Earthen ponds are the main production system for seabass and seabream in Portugal and in Southern Spain. Different farms use various levels of intensification and pond size, but in general these are semi-intensive systems covering large areas, ponds ranging from one to several hectares. Although seabass and seabream are traditionally the target species produced, in such ponds commonly there is a natural stocking with wild larvae of other fish species, including the Senegalese sole (SEACASE project[14]) and, on an experimental scale, the North Sea sole (project Zeeuwse Tong, Netherlands).

On land, aquaculture can also take place in tanks supplied with sea water. ***Land-based tank*** systems are an intensive solution to culturing high value fish. Most systems are closed and the growing facilities are contained within a site that is separated from the external environment by physical filters and drains. Many such farms use recirculation systems and may even use artificial seawater, thus reducing the inflow and discharge of water to and from the farm. Progress in recirculation technology now offers new prospects for land-based aquaculture. Its use is being investigated for different species. The possibility of controlling the water parameters, particularly its temperature, frees the activity from climate constraints. The farming of turbot, sea bass and sea bream using this technique is thus expanding to the north of Europe.

Other aquaculture systems practiced in the sea hold fish captive in a large pocket-shaped net anchored to the bottom and maintained on the surface by a rectangular or circular floating framework. These ***sea cages*** are widely used for rearing finfish, such as salmon, sea bass and sea bream, and to a lesser extent trout, in coastal and open waters. The openness of the system makes it vulnerable to external influences (i.e. pollution events or physical impact) as well as exposing the adjacent environment to the stock, and the fish farm effluents.

In the EU, ***hatchery production*** of marine finfish species is dominated by the commercial production of seabass and seabream in Greece. Other producing countries for these species include Spain, Portugal, Italy and France. Commercial hatcheries in Europe also produce other aquaculture species as turbot, sole, etc.

[14] http://www.seacase.org/casestudies6.html http://www.seacase.org/casestudies2.html

1.2.2 Freshwater aquaculture

Different freshwater fish production systems can be distinguished in the EU mainly based on the intensity of the activity, on the system used to manage water resources and on the species used. There may be however some overlaps and transitions amongst freshwater fish production systems (Sustainaqua, 2009[15]).

Depending on the system used to manage water resources as in marine water, one may distinguish between pond fish farming, flow-through systems, recirculation systems, and cage cultures in freshwater lakes and rivers. One may also find mixed systems where two types are combined, one intensive and the other extensive and the water from the intensive system is taken and returned to the extensive system.

Production of freshwater fish in ***ponds*** is often considered as the oldest fish farming activity in Europe, dating back to medieval times. Typical fish ponds are earthen enclosures in which the fish live in a natural-like environment, feeding on the natural food growing in the pond itself from sunlight and nutrients available in the pond water. Fish pond production remains 'extensive' or 'semi-intensive' (with supplementary feeding) in most countries.

In traditional ***flow-through aquaculture systems***, water passes through the culture system only once and is then discharged back to the aquatic environment. The flow of water through the culture system supplies oxygen to the fish and carries dissolved and suspended wastes out of the system. Water is taken from the river, circulated through the farm and treated before being released downstream. All water in the farm is renewed at least once a day. The most widely-practiced form of flow-through aquaculture in Europe is trout farming, which is spread throughout Europe. Rainbow trout (*Oncorhynchus mykiss*) largely dominates European trout production (approximately 95% of the total production). The main producers in the EU are Italy and France, followed by Denmark, Germany and Spain. Most of the EU member states have trout farms near to rivers, and use concrete basins or ponds. Some lake cages are also in use.

Recirculation Aquaculture Systems (RAS) are land-based systems in which water is re-used after mechanical, chemical and biological treatment. These systems present several advantages, such as: water saving, a rigorous control of water quality, high biosecurity levels and an easier control of waste production as compared to other production systems. They have however high capital and high operational costs including high energy consumption. RAS represents still a small fraction of Europe's aquaculture production and is most significant in the Netherlands and Denmark. The main freshwater species produced in RAS are eel, trout and catfish but other species are already being produced using this type of technology.

Cage cultures in freshwater lakes and rivers also provide limited but important possibilities for freshwater aquaculture in certain water bodies.

Table 2. Some important species farmed in freshwater aquaculture in the EU

Common name	Latin name	Main EU producer countries
Trout	*Oncorhynchus mykiss*	Italy, France, Denmark, Spain, Germany
Carp	*Cyprinus carpio*	Czech Republic, Poland, Hungary, Germany, Slovakia
Sturgeon	*Acipenser Baerii, A. gueldenstaedtii, A. naccarii*	France Italy, Poland, Germany
Eel	*Anguilla Anguilla*	Netherlands, Denmark, Italy

[15] SustainAqua – Integrated approach for a sustainable and healthy freshwater aquaculture" (2009). SustainAqua handbook – A handbook for sustainable aquaculture.

1.2.3 Integrated aquaculture

In scientific literature, this term is used to refer to different forms of aquaculture, which may include polyculture, multi-trophic aquaculture and the integration of aquaculture with other activities, such as agriculture, etc. At the aquatic farm level, the term integration can be understood under two main concepts:

- rearing various species in the same production unit
- rearing a single species downstream from another (ICES, 2005[16]).

Integrated multi-trophic aquaculture (IMTA) includes organisms from different trophic levels of an ecosystem (e.g. fish, shellfish, algae), so that the byproducts of one become the inputs of another (Szeremeta et al., 2010[17]).

Such systems can be used to recycle waste nutrients from higher trophic-level species into the production of lower trophic-level crops of commercial value (Troell et al., 2009). IMTA may reduce the environmental impacts directly through the uptake of dissolved nutrients by primary producers (e.g. macroalgae) and of particulate nutrients by suspension feeders (e.g. mussels), and through removing the nutrients from the location (Holmer 2010). Bivalve molluscs filter algae and organic particles as food from the surrounding water. For instance, filter-feeding mussels act as natural nutrient-strippers by removing phytoplankton from the water. If the phytoplankton has grown using N and P originating from cages or tank discharges, then the shellfish production removes some of the added nutrients.

Molluscs can therefore have a positive effect on water quality in coastal areas and are well-suited to polyculture (co-production with other organisms). Some countries have already launched some integrated aquaculture pilot projects[18].

[16] ICES. 2005. Report of the Working Group on Environmental Interactions of Mariculture (WGEIM), 11–15 April 2005, Ottawa, Canada. CM 2005/F:04. 112 pp. Available at: http://www.ices.dk/products/CMdocs/2005/F/WGEIM05.pdf

[17] Szeremeta, A., Winkler, L., Blake, F., Lembo, P (eds). 2010. Organic Aquaculture. EU Regulations (EC) 834/2007, (EC) 889/2008, (EC) 710/2009 - Background, Assessment, Interpretation. IFOAM EU Group / CIHEAM - IAMB Bari. http://www.ifoam-eu.org/positions/publications/aquaculture/

[18] For example: Spain, where the National Advisory Board for Mariculture (JACUMAR in Spanish) launched a project called: “Integrated Aquaculture: Pilot experience for multi-trophic aquaculture development”. The project consists of developing inland and offshore pilot experiences of integrated culture systems, in order to indicate whether integrated systems improve the competitiveness of the undertakings, bringing them economic and environmental benefits ([18]). Successful experiences with clam culture downstream a fish farm have been carried out (JACUMAR 2011). http://www.magrama.gob.es/app/jacumar/planes_nacionales/Ficha_planes.aspx?Id=es&IdPlan=101; http://www.acuiculturaintegrada.com/proyecto/

2. CONSERVATION OF BIODIVERSITY AND THE NATURA 2000 NETWORK

- *The Natura 2000 Network aims to protect habitats and species of European interest that are rare or threatened. However it is not a system of strict nature reserves where all human activities are excluded. Its aim is to ensure that, within these Natura 2000 sites, human activities are undertaken in a way that still allows the site's conservation objectives to be reached..*
- *Within Natura 2000 sites, Member States must: 1) take appropriate conservation measures which correspond to the ecological requirements of the protected habitat types and species present on the sites; and 2) avoid damaging activities that could significantly disturb these species or deteriorate the habitats of the protected species or habitat types.*
- *There are many interesting examples of win-win coexistence between aquaculture and Natura 2000 sites. In many of those sites aquaculture has been practiced traditionally and is considered compatible or has adapted its operation to the conservation needs of the sites.*
- *In addition to protecting core sites through the Natura 2000 network the two directives also require that Member States establish a general system of protection for all naturally occurring wild bird species in the EU and for species listed in Annex IV of the Habitats Directive. These provisions apply both inside and outside protected sites.*

2.1 The EU Biodiversity Policy

The EU Biodiversity Strategy to 2020[19], published in May 2011, aims at reversing biodiversity loss and speeding up the EU's transition towards a resource efficient and green economy. It includes six mutually supportive and inter-dependent targets. The specific actions are set out in the Annex to the Communication. The full implementation of the Habitats and Birds Directives is the focus of Target 1. In relation to sustainable use of fisheries resources the Strategy states, under its action 14b), that *"the Commission and Member States will support the implementation of the Marine Strategy Framework Directive, including through providing financial incentives through the future financial instruments for fisheries and maritime policy for marine protected areas (including Natura 2000 areas and those established by international or regional agreements*)".

2.2 The Habitats and Birds Directives

The Habitats Directive 92/43/EEC, together with the Birds Directive 2009/147/EC[20], form the cornerstones of the EU's nature conservation policy They have two main purposes:

- to protect rare and endangered species across their entire natural range within the EU through a series of species protection provisions;
- to conserve the core areas of a number of rare and endangered species and habitat types through the designation and management of sites under the **Natura 2000 Network**.

[19] COM(2011) 244 final.. Our life insurance, our natural capital: an EU biodiversity strategy to 2020. SEC (2011) 540 final. SEC (2011) 541 final.
[20] http://ec.europa.eu/environment/nature/legislation/index_en.htm

What does "favourable conservation status" mean in practice?

The ultimate objective of the Habitats Directive is to ensure that the species and habitat types covered reach what is called a 'favourable conservation status' and that their long-term survival is deemed secure across their entire natural range within Europe.

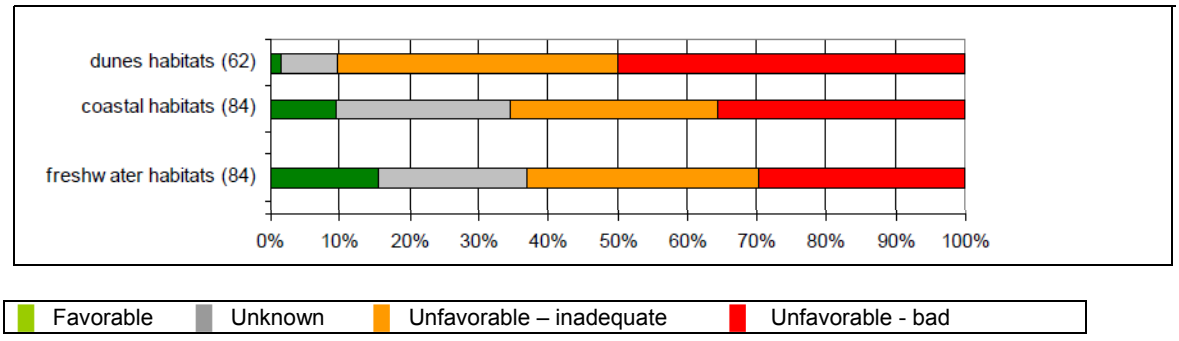
In the case of the species covered by the Directive (ref Article 1(i)) this means that:
- *populations are maintaining themselves over the long term and are no longer showing signs of continuing decline;*
- *their natural range is not being reduced;*
- *there is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis.*

In the case of a habitat type, a favourable conservation status (ref Article 1(e)) is achieved when:
- *its natural range and the areas it covers within that range are stable or increasing; and*
- *the specific structure and function which are necessary for its long-term maintenance are present and are likely to continue to exist in the foreseeable future;*
- *the conservation status of typical species that live in these habitat types is favourable as well.*

It should be noted that the two Directives do not cover every species of plant and animal in Europe (*i.e.*, not all of the EU's biodiversity). Instead, they focus on a sub-set of around 1500 (out of ca 100 000 or more species present in Europe) - which are so rare or threatened that they are in need of protection to prevent their extinction. These are often referred to as species of European interest or importance. These directives also protect around 230 "habitat types" (including marine and coastal habitats, freshwater habitats, wetlands, etc.), which are of European importance.

In 2007 the Member States reported for the first time on the conservation status of habitats and species covered by the Habitats Directive. On the basis of this, the Commission produced a consolidated report on the conservation status of each species and habitat type a biogeographical and EU level. These reports provide useful contextual information[21].

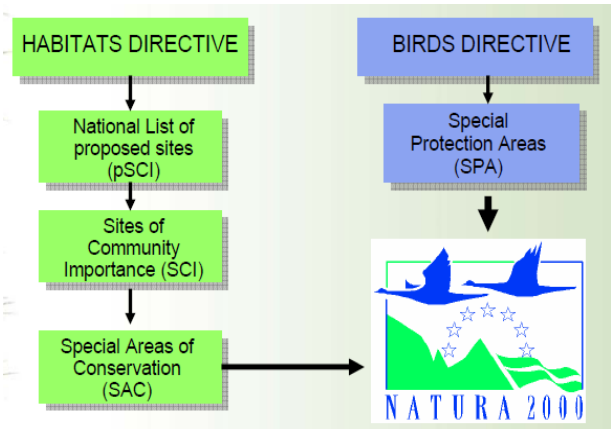
Figure 4. Assessment of conservation status of some groups of habitats that are relevant in relation to aquaculture development *(the number in brackets refers to the number of assessments carried out for each group) (from EC 2009[22]).*



[21] All reports are available at: http://biodiversity.eionet.europa.eu/article17 and http://ec.europa.eu/environment/nature/knowledge /rep_habitats/index_en.htm

[22] COM(2009)358 final. Report from the Commission to the Council and the European Parliament - Composite Report on the Conservation Status of Habitat Types and Species as required under Article 17 of the Habitats Directive. Available at: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2009:0358:FIN:EN:PDF

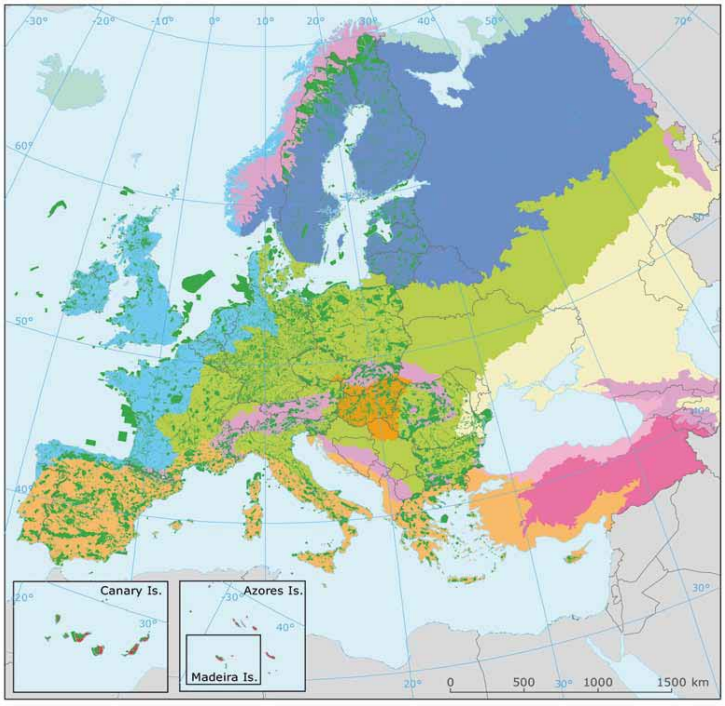
2.3 The Natura 2000 Network



At the heart of the two Nature Directives lies the creation of a Natura 2000 Network of sites which have been designated for species and habitat types of European importance listed in the respective annexes. By May 2012, some 26,000 sites were included in the Natura 2000 Network[23]. Together, they cover around 18% of the land area in the EU-27 with significant additional marine areas[24].

Each site will contribute to this process by setting conservation objectives and implementing conservation measures, as required, to meet these objectives. These in turn will be based on the status and specific ecological requirements of the protected species and habitats present within that particular site (see chapter 5 for details).

Figure 5: Distribution of Natura 2000 sites across EU-27.



The Natura 2000 Network is not a system of strict nature reserves where all human activities are excluded. Instead, it supports the principle of sustainable development. Its aim is to ensure that, within these Natura 2000 sites, human activities are undertaken in a way that ensures the conservation objectives which have been set for the site (in function of the species and habitat types of European interest present), can still be reached.

[23] European Commission, http://ec.europa.eu/environment/nature/natura2000/barometer/index_en.htm
[24] There is sometimes considerable overlap between SPAs and SCIs so the figures are not cumulative

Article 6 lays down the measures that must be taken within each Natura 2000 site. In particular Member States must:

- take appropriate conservation measures which correspond to the ecological requirements of the protected habitat types and species present on the sites (Article 6.1).
- avoid damaging activities that could significantly disturb these species or deteriorate the habitats of the protected species or habitat types (Article 6.2).

To help decide which conservation measures should be undertaken on individual Natura 2000 sites, the Habitats Directive encourages the development of management plans. These may be specifically designed for the site in question or integrated into other development plans.

Whereas Article 6(1) and (2) of the Habitats Directive concern the day-to-day management and conservation of Natura 2000 sites, Articles 6(3) and 6(4) lay down the procedure to be followed when planning new developments that might affect a Natura 2000 site[25]. This stepwise procedure is examined in detail in Chapter 5. Each Natura 2000 site is unique and must be examined on an individual case by case basis, especially when it comes to carrying out Appropriate Assessments under Article 6 of the Habitat Directive.

In addition to designating core sites under the Natura 2000 Network, Article 10 of the Habitats Directive also requires Member States to improve the ecological coherence of the network across the broader countryside by maintaining and, where appropriate, developing features of the landscape which are of major importance for wild fauna and flora, such as wildlife corridors or stepping stones, which can be used during migration and dispersal.

2.4. Aquaculture activities in Natura 2000 sites

Aquaculture activities are carried out in many Natura 2000 sites. From a first analysis[26] of existing aquaculture activities in the network, as reported by Member States and with the information compiled from the Natura 2000 database, it is now known that over 5% of the sites reported to host aquaculture activities at the time of their designation, which means over 1200 SPAs and SCIs[27]. In fact, many of these sites have been designated because this activity has maintained suitable habitats (eg. ponds) for species of EU interest. A significant number of these sites have their entire surface covered by aquaculture activities and include natural or human-made ponds, lakes or lagoons.

There are interesting examples of win-win coexistence between aquaculture and Natura 2000 sites (see section 3.6). In many of those sites aquaculture has been practiced traditionally and is considered compatible or has adapted its operation to the conservation needs of the sites. Some interesting examples are found in Southern Europe, as regards coastal aquaculture, and in Central Europe concerning freshwater aquaculture. There are many well-known Natura 2000 areas in Europe where aquaculture activities are currently taking place sustainably, such as the Wadden Sea in the Netherlands, Arcachon in France, the Sado Estuary in Portugal, Doñana in Spain, shellfish culture in England and Wales and several Lochs in Scotland.

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[25] This applies to SCIs, SACs and SPAs and concerns not just plans or projects inside a Natura 2000 sites but also those that are outside but could have a significant effect on the conservation of species and habitats within the site. For instance a dam constructed upstream on a river that could alter or stop the regular flooding of an important wetland for birds within an SPA further downstream.

[26] This analysis was made using the Natura 2000 dataset from the DG ENV of the European Commission (May 2011). This dataset contains 26124 Natura 2000 sites (SCIs and SPAs).

[27] The Natura 2000 database provides information about the sites of the network and the activities carried out in them, including aquaculture.: http://www.eea.europa.eu/data-and-maps/data/natura-2000

2.5 Guidance on Natura 2000

The European Commission has published several guidance documents on the establishment and management of the Natura 2000 network that are also relevant for the development of aquaculture activities. They include the interpretation of the provisions of Article 6 of the Habitats Directive on the management of Natura 2000 sites, methodological guidance for the Assessment of plans and projects significantly affecting Natura 2000 sites[28], guidelines for the establishment of the Natura 2000 network in the marine environment[29], as well as series of good practice[30].

Other relevant guidance is also available at national level on management of Natura 2000 sites and on conservation management of habitats and species protected by the Nature Directives[31]. A compilation of relevant information sources that may be useful for the purpose of this guidance document is provided in Annex 2.

2.6 Other important relevant provisions

In addition to the Natura 2000 network ,the two directives also provide for a general system of protection, both inside and outside Natura 2000 sites, for all naturally occurring wild bird species in the EU (Birds Directive, Article 5) and for animal and plant species listed in Annex IV of the Habitats Directive (Article 12[32] and Article 13) – see Annex 1.

Furthermore, environmental objectives under the Water Framework Directive 2000/60/EC and the Marine Strategy Framework Directive 2008/56/EC need to be considered when planning or managing aquaculture activities. Relevant provisions also apply both inside and outside Natura 2000 sites and, like those for the EIA and SEA directives, are summarised in Annex 1.

[28] See: http://ec.europa.eu/environment/nature/natura2000/management/guidance_en.htm
[29] http://ec.europa.eu/environment/nature/natura2000/marine/index_en.htm
[30] http://ec.europa.eu/environment/nature/natura2000/management/best_practice_en.htm
[31] The Joint Nature Conservation Committee website for instance, provides information on marine habitats and species, as well as on SACs and SPAs for the UK. Also the Scottish Natural Heritage website includes an interactive map identifying the Scottish Natura 2000 site, with advice on SAC management also present. Another example is the Guidance on Natura 2000 and aquaculture that has been published in France (*Référentiel pour la gestion dans les sites Natura 2000 en mer - Les cultures marines)*, which aim to help actors managing aquaculture activities in the marine sites.
[32] See Guidance document on the strict protection of animal species of Community interest under the Habitats Directive http://ec.europa.eu/environment/nature/conservation/species/guidance/index_en.htm

3. THE POTENTIAL IMPACTS OF AQUACULTURE ACTIVITIES ON NATURE AND WILDLIFE

- *The effects of different aquaculture systems depend on a number of factors, including the hydrographic conditions of the farm's location, the type of cultured organisms and the production method, management practices, etc.. These factors must all be taken into account when assessing possible risks.*
- *Different aquaculture systems may exert different impacts and cause diverse effects on the natural environment, which may include habitat loss or deterioration, species disturbance, and the displacement of species as well as changes in local communities. However, some aquaculture systems may have positive effects for the biodiversity of the site.*
- *The sensitivity and resilience of ecosystems, and the assimilative capacity of the environment are key to determining the magnitude and significance of the impact.*
- *Siting is often the most important factor to consider in order to prevent and reduce potential impacts from aquaculture activities, together with the implementation of good management practices and adequate mitigation measures, which are currently well known for the most significant pressures in the different aquaculture systems.*

3.1 The need for a case by case approach – relevant factors

All types of farming interact with the environment, and aquaculture is no exception. Potential effects of different aquaculture systems are widely described in the scientific and technical literature. Those effects are highly specific to the site and depend on the environmental and rearing conditions. Any possible risks must be assessed taking into account all the relevant features and their specific condition as well as the conservation objectives of the relevant site. It should be also stressed that possible negative effects may be mitigated with appropriate management, location etc.

There are many factors that influence the ultimate impact of aquaculture. Among these, the location of the farm, the type of cultured organisms (fish, crustaceans, molluscs, other invertebrates and seaweeds) and the methods used (eg. quantity and type of food, stock density, chemical use) determine the environmental impact of the different kinds of aquaculture activities. Moreover, the sensitivity or vulnerability of the environment to possible pressures from aquaculture activities is also a key factor. All these factors determine the assimilative capacity of the environment to aquaculture activities.

3.1.1 The site

The location and siting of aquaculture is probably the single most important factor in determining its environmental impact. The ecological characteristics, e.g., biodiversity, ecosystem structure, dynamics and interrelationships of living communities may be distinct in different sites. Also the conservation objectives are specific to each Natura 2000 site.

Furthermore, environmental variables will determine, to a certain extent, the type and degree of impact from aquaculture pressures. Hydrographic and topographic site characteristics are very important, in particular for sea-based and land-based farms relying on natural water movements (currents, tides) for adequate water exchange and waste dispersal. Lifespan, possibilities for expansion and intensification, and the ecological effect of a farm are often determined by the physical characteristics of the selected site. The level and extent of ecological change may, therefore, vary from site to site.

3.1.2 The cultured species

Aquaculture organisms differ significantly in their biological and eco-physiological characteristics. Reproduction, feeding habits, food and nutritional requirements, behaviour, growth capacities, water quality requirements, stress tolerance and susceptibility to parasites and disease characterize the suitability of a species to be cultured.

The very specific characteristics of the cultured organisms also determine the type, magnitude and range of ecological implications. Biological interactions between cultured organisms and wild communities are also to be considered and may be restricted to the immediate vicinity of the site or affect wider areas.

3.1.3 The culture method

The choice of the culture method will, to some extent, depend on the selection of the species and the site. Aquaculture farms can operate under extensive, semi-intensive and intensive conditions.

For certain open systems, production intensity is a reasonable indicator of potential impact, not withstanding the environmental features and local assimilative capacity (see below). In terms of European aquaculture, the most obvious example is cage culture, where a site's biomass will be roughly indicative of the overall potential environmental pressure exerted by the farm.

Nevertheless the local conditions of the site and the management techniques can contribute to reducing or eliminating the possible impacts of this kind of aquaculture system. However for closed systems, the intensity of production is not necessarily an indicator of its potential impact on the environment - for instance, a highly intensive farm using recirculation may be environmentally benign due to its isolation from the external environment.

In extensive aquaculture, mainly shellfish culture, there is no external supply of feed or medicine and this type of culture depends entirely on natural processes for production and supply of feed. It is carried out in the natural environment as a natural component of the ecosystem. Therefore the goods and services of shellfish to the environment (Ferreira et al, 2011, Coen & Shumway, 2011) are an intrinsic contribution of shellfish culture to natural processes.

This concerns filtration and nutrient regeneration, providing food for higher trophic levels (birds) and habitat for (epi)benthic species. Although in this report the focus is on potential negative impacts of aquaculture on the conservation objectives of Natura 2000 areas, it should be acknowledged that extensive aquaculture also acts as an instrument in nature management and conservation, thereby invoking positive effects on maintenance goals (Smaal et al, 2010).

3.1.4 Sensitivity, resistance and resilience

Some types of ecosystems are more sensitive than others to the environmental 'pressures' resulting from aquaculture (while bearing in mind that the latter is a general term covering many different activities which may have different effects according to the way they are managed). The word sensitivity in relation to aquaculture activities may be described as the extent to which aquaculture production will result in an 'impact' on the ecosystem in which the aquaculture takes place.

It may depend on:

- the different kinds of environment in which aquaculture takes place, and the physical conditions;
- the different kinds of biological community that are found in environments used for aquaculture, and the 'resistance' of each type of community to aquacultural effects.

Sensitivity is dependent on the intolerance of a species or habitat to damage from an external factor and the time taken for its subsequent recovery. A sensitive species or habitat is one that is adversely affected by an external factor arising from human activities or natural events (killed/destroyed, 'high' intolerance) and is expected to recover over a very long period of time, i.e. >10 or up to 25 years ('low'; recoverability). Intolerance and hence sensitivity must be assessed relative to change in a specific factor (MarLIN, 2005). Environmental conditions that render an ecosystem less sensitive include greater dispersion at the farm scale and faster exchange at the water body scale. Ecological theory suggests that well-balanced biological communities - those that contain a variety of species and a mixture of life forms - are more capable of resisting 'pressure' (Tett et al., 2007).

Resistance is 'the ability of an ecosystem to withstand disturbance without undergoing a phase shift or losing structure or function' (Odum, 1989). Different species and habitats have different degrees of *resistance* to pressures. The degree to which a particular conservation unit is impacted by a particular pressure varies depending on the conservation unit and the pressure involved. (Crowe et al., 2011).

Resilience is the capacity of the system to recover from change. Marine ecosystems have an inherent resilience to damage and loss, which varies depending on natural conditions and the nature and level of pressures impacting on them. Relatively exposed areas that naturally experience high levels of physical disturbance may recover from anthropogenic physical disturbance more quickly than those in sheltered areas. (Crowe et al., 2011).

3.1.5 Assimilative and carrying capacity[33]

The ***assimilative capacity*** can be defined as the ability of the ecosystem in a water body to absorb anthropogenic inputs of substances without damaging the health of the ecosystem or its ability to provide goods and services.

[33] Further information about determination of assimilative and carrying capacity can be found in the ECASA toolbox (http://www.ecasatoolbox.org.uk/the-toolbox/informative/key-ideas/ management-for-sustainability).
Recently, a model for the estimation of the aquaculture carrying and waste assimilating capacities of fjordic water bodies has been elaborated and tested testing in a typical Scottish fjord (Tett et al. 2011). It is a physical-biological model, intended as a water quality management support tool by simulating pressure-impact relationships.

The ***carrying capacity*** in aquaculture is defined as the maximum biomass of a farmed species that can be supported without violating the maximum acceptable impacts to the farmed stock and its environment. Carrying capacity depends, *inter alia*, on the capacity of the ecosystem to re-supply substances such as oxygen, consumed by all farmed animals, or phytoplankton, consumed by filter-feeding bivalves (Tett *et al*., 2011).

3.2 Main potential pressures and impacts from different aquaculture systems - possible mitigation and good management practices

As mentioned above, the observed impacts of aquaculture on a given site are generally not directly transferable to another site, even under similar farming and environmental conditions since a number of parameters generate considerable variability in the observed effects.

It needs to be stressed that by properly implementing relevant EU and national legislation (including licensing and control) most of the potential pressures and impacts from aquaculture are prevented or minimised. In addition, the aquaculture operators are voluntarily making significant efforts to apply good management practices (e.g. codes of conduct, monitoring, certification). In addition, organic aquaculture is promoted by the EU. Some relevant information in this regard is included in Annex 1.

In the context of this guidance document, it is relevant to understand the potential effects on habitats and species protected under the Nature Directives, which are the target of conservation in Natura 2000 sites.

The potential effects to be considered in this regard may be classified in two main categories:

- ✓ Habitat loss or degradation and modification of the communities present on it.
- ✓ Disturbance and displacement of species.

Habitats may be lost or degraded owing to the building of infrastructures, installation of facilities and use of equipment and tools (e.g. for harvesting), which may cause a direct physical impact on habitats and communities. Benthic habitats and communities may also be impacted by sedimentation of organic wastes, while increased turbidity and nutrient enrichment of water may alter the conditions on which some communities and pelagic species depend and cause their displacement from the site. The effects from the use of chemical products in some aquaculture activities must also be considered.

Disturbance to species and their displacement from the site can arise from the construction and the operation of aquaculture farms, for instance from noise and light during management activities or the need to control predation on farms. Other biological interactions between the farmed species and the species occurring in the site must be taken into account, in particular the possible effects of escapes, such as interbreeding or direct competition from alien species used in aquaculture.

The main interactions between different farming systems and the natural environment are briefly described below, with an indication of the possible effects on habitats and species of EU interest, and of the mitigation measures that can be applied to avoid or reduce the effects well as examples of measures applied to avoid the negative impacts.

A more detailed description of the main pressures and effects that can arise in different aquaculture systems has been provided in previous studies financed by the European Commission (Huntington et. al. 2006, 2010).

3.2.1 Marine cage culture

Cage culture can lead to increased **sedimentation** of particulate organic waste beneath the cages. Mussel and/or polychaete reefs, seagrass beds, sand & mudflats, maerl beds and seaweed beds may be potentially affected by sedimentation from poorly sited cage farms (Huntington et al. 20006, Crowe et al. 2011, Ragot 2009, Wilding and Hughes 2010).

Seagrass beds directly beneath or in close proximity to fish cages can be adversely impacted by deposition of solid organic waste. Effects on Posidonia and Zostera beds are known (Ruiz et al. 2001, 2010, Diaz Almela et al. 2008, Apostolaki et al. 2007, Marba et al. 2006, Pergent-Martini et al 2006, Cancemi et al. 2003, Crowe et al. 2011). The critical factor causing impacts appears to be solid waste deposition and the consequent high organic loading and deoxygenation of sediments (Wilding and Hughes 2010).

The accumulation of organic material on the substrate increases the sediment community's oxygen demand and can have effects on sediment chemistry, which may cause changes in species diversity, abundance and biomass of benthic fauna and flora (Wilding & Hughes, 2010, Holmer et al. 2007, Maldonado et al. 2005, Vezulli et al. 2008, Tomasetti et al. 2009, Vita et al. 2004, Mirto el al 2009).

Appropriate siting of the cages and farm management is particularly important in this kind of aquaculture system. Control and limitation of the stock density are used to reduce the possible impacts caused by particulate organic waste. The improvement of feed digestibility, as well as systems to reduce food waste can also mitigate these impacts. The use of extruded and high digestibility feeds, use of modern automatic feed distribution systems, daily control of the amount of feed aimed at minimizing the feed dispersion and waste in the environment, are some of the possible mitigation measures that are often applied to reduce this type of effects.

Hydrodynamic conditions play an important role in the dispersion of organic waste and the reduction of estimable effects (Cromey et al., 2002a; Modica et al., 2006; Sara et al., 2006).

Computer models are available to assist in predicting the extent and degree of organic deposition from aquaculture facilities and are used to identify potential impact from a farm. For instance, the DEPOMOD model predicts deposition and biological effects of waste solids from marine cage farms to the seabed based on the site bathymetry and hydrographic regime combined with the maximum fish tonnage and stocking density of the farm (Cromey et al. 2002b; Cromey et al. 2002c). The MERAMOD model (Cromey, C., 2008) was developed from the DEPOMOD model and validated for sea bass and bream farms in the Eastern Mediterranean.

Fish cages release dissolved compounds directly into the surrounding water column, including ammonia, nitrate and phosphate together with dissolved organic carbon. Sources include fish excretory products and dissolution from feed pellets or faecal particles. The effects of this input into the water column may be rather limited when there is rapid dispersal (Holmer 2010).

Nutrient enrichment of the water column has been detected around sea bream and sea bass cages in the Mediterranean (Dalsgaard & Krause-Jensen, 2006, La Rosa et al. 2002). However, only limited impacts have been documented and this is generally considered one of the less severe impacts (Sara 2007). Machias et al. (2005) showed that the primary production increased in farm surroundings under oligotrophic conditions in the Mediterranean Sea, eventually stimulating productivity at higher trophic levels.

Recent studies suggest that enrichment by salmon farm nutrients is generally little (Laurent et al. 2006) and there is no evidence of eutrophication or algal blooms from nutrient release in Scottish salmon farms (Smayda 2006). In view of the lack of evidence for harmful ecosystem

effects of nutrient release from salmon farms, it has been concluded that benthic habitats of biodiversity value in the UK are unlikely to be affected by this form of discharge (Wilding & Hughes, 2010).

By moving the farms further offshore to more exposed conditions, the dispersal of nutrients is expected to increase, minimizing the pressure on the environment (Wilding and Huges 2010, Pitta et al. 2009).

Other potential risk impacts from marine cages that may be considered include those related to **chemical use**, especially over sensitive habitats such as *Zostera* and *Posidonia* beds (Ragot 2009, Huntington et al. 2006). Similarly, mud habitats, mussel beds and reefs have low tolerance and resistance to some synthetic compounds used in aquaculture (Crowe et al. 2011, Huntington et al. 2006, Wilding and Hughes 2010).

A reduced use of chemicals and other artificial substances in aquaculture has been promoted in recent years together with the development of alternative environment-friendly substances and methods of treatment, securing favourable conditions for fish. Restrictions to the use of chemical compounds are usually applied in sensitive areas. Eco-friendly antifouling coatings and products can be used. These might include silicone-based coatings, polyurethanes and enzymatic technologies (IUCN, 2007). Biological methods are being recently tested to control biofouling[34].

Risks from chemicals can be managed through the application of appropriate Environmental Quality Standards under the Water Framework Directive. In Scotland environmental quality objectives (EQOs) are used to assess the impact of mariculture and to control discharges (OSPAR, 2009).

Cages may attract **predators** (wild fish, piscivorous birds, aquatic mammals), which may cause damage to the netting. (Holmer 2010). In Scotland, the common seal (*Phoca vitulina*) feeds primarily on fish and can, on occasion predate on salmon farmed in pens. To protect their stocks, some farms use good husbandry techniques, the acoustic deterrent (which should be in line with relevant international agreements) or anti predator nets.

Physical impacts of infrastructure are also possible since cages may be anchored on the seabed and risk to damage physically the seabed habitat. However, proper siting and design of aquaculture infrastructures, avoiding their location on especially sensitive habitats and considering the best technical solution for each type of area (e.g. adapting mooring structures to the conditions of the seabed substrate) can help avoid and minimise these potential adverse effects. In Scotland, for instance, some mooring anchors and equipment required for securing the position of the salmon farm pens are situated in deep water to avoid overlap between the farming activity and sensitive habitats (eg. reefs).

Large enclosures could also have an effect on current circulation and light penetration. Risks can be managed, if necessary, by limiting the sizes of complexes and re-siting them regularly (Nash et al. 2005).

Disturbance impacts from management activities are usually fairly low and transitory when the cages are in deeper water, away from bird nesting of foraging areas.

The **escape of fish**[35] from cages may cause undesirable genetic effects in wild populations through interbreeding, and ecological effects through predation, competition and the possible

[34] See for instance the guidelines of the CRAB project:
http://www.crabproject.com/client/files/CRAB_Best_Practice_Guidelines.pdf
[35] The introduction of alien species for their use in aquaculture is regulated by Regulation 708/2007.

transfer of diseases to wild fish. An issue of particular concern is that of interbreeding[36] of Atlantic salmon as this may lead to loss of fitness in river-specific sub-populations (Naylor et al. 2005). A recent EU project (Prevent Escape[37]) aims to elaborate recommendations and guidelines for aquaculture technologies and operational strategies that reduce escape events.

As mentioned above, benthic impacts can be minimised by siting the farm in highly flushed areas and limiting the biomass and stocking density of the fish to avoid excessive waste. The approach taken by farm operators in order to minimise adverse effects at their sites now incorporates selecting sites with good water exchange and management practices that minimise food waste and chemical usage. The use of 'high energy' (i.e. resulting in reduced ammonia-N loading) and 'low pollution' diets (i.e. high digestibility, low phosphorus), along with the development of improved feeding management, have reduced the production of wastes. Routine removal of dead fish and fouling organisms is also usually applied.

3.2.2 Shellfish rafts and longlines

Mussel and other shellfish aquaculture in deeper waters, through the use of suspended ropes and longlines from floating rafts, has developed to take advantage of spat fall locations as well as areas of good water quality and food availability. These systems may lead to **increased levels of suspended sediments** under the farms resulting from the deposition of pseudofaeces, which in turn impact the benthos.

The deposition of faeces and pseudo-faeces beneath mussel farms may lead to **organic enrichment of sediments** (Hargrave et al. 2008b) and cause changes in benthic communities (Danovaro et al. 2004, Ysebaert et al. 2009). The effects of suspended culture depend on local conditions and the scale under consideration. The impacts of suspended mussel culture on benthic infaunal communities are typically limited in magnitude except under extreme conditions (poor flushing or exceedingly great stocking densities) (McKindsey et al, 2011).

Impacts of suspended rope culture are mainly limited to sedimentation effects on wild mussel reef communities and other sensitive sublittoral habitats such as polychaete reefs, seagrass beds, sandbanks, maerl beds and seaweed beds (Huntington et al. 2006). Impacts are considered to be lower under longlines than under rafts as the amount of pseudofaeces falling from longlines is spread over a larger area (OSPAR 2009). An overview of studies on the influence of mussel farms on benthic communities is provided in McKindsey at al. 2011.

Suspended shellfish culture may also have an **impact on the water column** in both terms of dissolved oxygen levels as well as nutrients. However, the location of this type of system in areas with good water exchange and thus good dispersion of nutrients usually reduces the risk for such effects. In fact, the regeneration of inorganic nutrients through mineralization of biodeposits, either in the water column or on the bottom, stimulates nutrient availability for phytoplankton. This positive feedback by filterfeeders is an important mechanism in shallow ecosystems, that eventually stimulates primary production, hence bivalve food production (Smaal & Prins 1993; Dame,2012).

Intensive shellfish farming strips primary production from the water column and, if a bay is too heavily farmed, the carrying capacity of the body of water in which the farms are located can be exceeded, resulting in adverse conditions for wild and cultured populations (WWF 2010b). As this would have a direct negative impact on the yield of the farmed shellfish, overgrazing would result in a reduction of the shellfish culture activities.

[36] A Research project funded by the European Commission has carried out an evaluation of genetic impact of aquaculture activities on native populations (GENIMPACT 2007).
[37] Prevent Escape: www.sintef.no/preventescape

It has been estimated that mussel culture may extract around 10% of primary production from a given area (Figueiras et al. 2002) in the rías of Galicia. This may have beneficial results for oligotrophic communities such as sea grasses but might restrict food availability for other filter feeders such as polychaete worms and sand or mudflat communities (Huntington 2006).

This potential to remove phytoplankton can also be used as a solution to the additional nutrient loading that results from fish cultivation. By integrating fish (fed) aquaculture with seaweed and shellfish (extractive) aquaculture, the wastes of one resource user become a resource (fertiliser or food) for the others (Scottish Executive 2002). There have been several studies investigating the potential benefits of cultivating mussels in order to mitigate nutrient input as part of an integrated multi-trophic aquaculture with farmed fish (Troell et al, 2009)

Disturbance to sensitive species may also occur but the maintenance and harvesting of suspended grown bivalves has little direct impact (OSPAR 2009). Both longlines and rafts can increase both primary and secondary production by providing space for algae and fauna to grow on. Such systems also act as nursery areas for fish and this food resource can also provide additional food resources for diving birds (OSPAR, 2009).

Sedimentation of faeces and pseudofaeces can be estimated by simple models and compared with appropriate EQS in order to estimate a safe shellfish loading. Some modelling tools are available to predict footprints of benthic loading around mussel farms (see reviews in Giles et al. 2009; Weise et al. 2009). The degree to which organic matter is dispersed initially and redistributed subsequently is positively correlated with local current regimes (Hartstein and Stevens 2005; Giles et al. 2009).

As regard the removal of phytoplankton, models have been developed to determine the optimum stocking density at which shellfish production is maximised without negatively impacting growth rates and minimising the impact on the environment (Kaiser and Beadman 2002, Duarte et al. 2008).

The appropriate location of shellfish rafts and longlines in areas with good water exchange, and the adequate dimensioning of the farm using predictive models that allow estimating footprints of benthic loading can minimise the main possible effects of these systems.

3.2.3 Intertidal shellfish culture

Inter-tidal shellfish systems are generally fairly extensive, although they can be concentrated in estuaries and may have an impact on sensitive habitats or on important bird feeding and fish nursery areas (Huntington et al. 2006).

A potential impact is the **smothering** of nearby inter-tidal and sub-littoral habitats with **faecal and pseudofaecal material**, as well as other detritus generated by the culture process, which can affect reefs, sea grasses, sand flats and maerl beds (Huntington et al. 2006, Ragot 2009). In highly energetic waters faeces and pseudofaeces may be spread over some distance. Intertidal systems are so dynamic that normallysmothering is effectively counteracted by waves and currents.

In order to gauge the significance of smothering effects due to shellfish cultivation, it is useful to:

- Identify the receiving habitat types, understand their response to smothering, for example changes to infaunal and epifaunal communities, and determine the affected area, which can thus be compared to the total area of these biotopes within the site where the mussel cultivation takes place (eg. the Natura 2000 site).

- Evaluate the quantity of sediment that is displaced into the water column, and ascertain the level of sedimentation (sinking and deposition of suspended matter onto the seabed). The impacts of increased turbidity (resulting from deposition and dredging of cultivated mussels) could be assessed by comparison with background turbidity levels.

There is also a potential risk when using **alien organisms**. However, the possible impact from the introduction of alien species for their use in aquaculture is regulated by Regulation 708/2007, which includes a permit system with specific procedures and risks assessments. Furthermore, the use of alien species is restricted or subjected to particular conditions. In North Wales, the adoption of a 'Code of Good Practice for Mussel Seed Movements', has been put in place to avoid the accidental introduction of non-native species through the importation of mussel seed from other places.

The maintenance required by inter-tidal facilities may lead to **disturbance**, including from access roads, especially in important bird foraging and over-wintering areas (Huntington et al. 2006). Some operational conditions regarding wildlife protection are usually applied in order to avoid any disturbance.

3.2.4 Bottom shellfish culture

This form of aquaculture is often practised in shallow coastal or estuarine areas where habitats of conservation interest may be present, such as sand and mud flat or seagrass communities, and thus there may be conflicts over use and management of the area (Huntington et al. 2006).

The main potential pressures from bottom culture include some degree of **sedimentation** from both animal excretion and the dredging process used for harvesting, as well as some physical disturbance. The influence of bottom cultures on the sedimentary environment and on the macrobenthic community seems to be rather local (Ysebaert et al. 2009).

Sublittoral benthic habitats such as sand/mud flats/banks may be impacted by **smothering from sediments** generated from excretory products or following harvesting, especially if hydraulic or physical dredges are used. If smothering occurs periodically then the level of recoverability is usually reasonable, especially if beds are scoured by currents (Huntington et al. 2006)

The introduction of **alien species** may represent a pressure exerted by bottom culture[38]..There may be also a risk of **pathogen transmission** from cultured to wild populations, although high pathogen loads from bottom culture are unlikely (OSPAR 2009).

Dredging for seed and the harvesting of on-bottom culture shellfish may have impacts on the seabed and benthic communities as well as on non-target commercial species, such as wild scallops and clams.

In some countries (eg. United Kingdom, Ireland) seed mussels are dredged once a layer of mussel mud has built up (mussel mud is an accumulation layer of mussel faeces and pseudofaeces which can be 30 to 40cm thick and can detach from the underlying substratum and become unstable). This allows the collection of seed mussels with a relatively small impact on the subsurface fauna. In addition, dredging activities are seasonal, which will allow a period of recovery for the seabed habitat and the benthos.

[38] As previously stated the possible impact from the introduction of alien species for their use in aquaculture is regulated by Regulation 708/2007.

In the Netherlands, the harvest of intertidal mussel seed beds is only permitted in autumn on unstable beds which are susceptible to being flushed away during winter storms (Maguire *et al*. 2007). However, in the Netherlands, if there is sufficient spat fall, a spring harvest may also take place.

In 2009 a Dutch policy was developed for seed mussel collection systems, which consists of a floating rope for seed mussels to attach themselves to. Since 2000, experiments have been carried out to test in how far these systems are a promising alternative to bottom seed fisheries, and an additional resource in case bottom recruitment might fail. The mussel fishery sector, government and nature organisations have agreed to phase out traditional methods and make room for the alternative collection systems.

The exploitation of mussel seed resources may be of particular concern. Currently in the Wadden Sea every year an inventory is made of shell fish stocks in the coastal zone to find out whether seed mussels are in sufficient supply to allow fishery to take place. The fishermen have organised themselves into a producer's organisation (PO). The PO applies for a permit from the Ministry of Economic Affairs, Agriculture and Innovation. The application is accompanied by an assessment, analysing the effects of the fishery against the conservation targets of the Natura 2000 site.

For avoiding seabed disturbance the Government has initiated an open plan process together with all the parties concerned (fishery and recreational sectors, nature organisations, provincial authorities) to draw up policy for the years 2010-2013. This involved selecting suitable locations for seed mussel collection systems.

3.2.5 Land based tank systems for marine species

Most of these systems are closed and the growing facilities are contained within a site that is separated from the external environment by physical filters and drains. Some farms use recirculation systems and may even use artificial seawater, thus reducing the inflow and discharge of water to and from the farm (Huntington et al. 2006).

However, some effects from **sedimentation, biogeochemical changes and chemical release** can be noticed especially in the area near the culture site and at some distance form it. All benthic habitats sensitive to these pressures could be potentially affected (Huntington et al. 2006, Ragot 2009).

To avoid this, in some farms (eg. in Italy) the outflow water, before being discharged into the communication canal between the lagoon and the sea, is microfiltered through a rotating filter and is settled and purified through a circuit of settling basins. This allows the absorption of nourishing substances by the microalgae. An automatic grate cleaner at the exit of the water keeps the microalgae in the purifying basins. Monitoring of the algal situation in the coastal area surrounding some tank systems is also carried out in order to analyze possible biogeochemical changes.

There may be some impact on sublittoral habitats such as reefs and seagrass beds from increased nutrients and biological oxygen demand. However, this very much depends upon the level of wastewater treatment conducted by the farm, which can be highly efficient (Huntington et al. 2006, Ragot 2006, Aquaetreat 2007).

Strict controls and treatment of effluents from tanks are sometimes carried out. This might involve aeration of effluents to increase aerobic breakdown of wastes prior to discharge, thereby reducing biological oxygen demand of effluent. An increased use of water re-cycling would also be useful to limit discharges. Control of leakage may also be carried out through

pond/dyke compaction or use of liners to avoid seepage and nutrient enrichment of nearby waters.

Pressures from **infrastructure** could impact supralittoral habitats such as saltmarshes, sand dunes and shingle if the farm were to be built on these habitats. In practice this would be highly unusual, as most land-based farms would be built upon firmer ground further inland and planned to avoid any conflicts with nature conservation interests. As such, physical habitat alteration can be minimized or mitigated.

Most intensive land-based farms are both well managed to reduce the eventual **use of chemotherapeutant or pathogen load** in production systems, and outputs of these to the external environment can be managed through filtration and water treatment (Huntington et al. 2006, Ragot 2006).

Disturbance from these farms is minimal, as many facilities are either indoors or confined to a small area. Predator control is also likely to be minimal and mostly passive in nature i.e. netting and screening (Huntington et al. 2006, Ragot 2009). The introduction of **alien species** may also have an impact[39].

3.2.6 Land based ponds for marine species farming

Pond systems often require considerable areas of land to support the ponds and their related infrastructure (water supply and effluent canals). The **construction** of coastal pond farms, usually involving a 'cut and fill' approach, may have high potential impacts on these areas. If the ponds have been prepared from lagoon areas, there is the potential for altering the local hydrological regime and thus impacting on the functionality of the remaining parts of the lagoon (Huntington et al. 2006).

The impacts during operation of pond farms depend upon the species being cultured and the type of water supply regime being employed. Whilst some species require flow-through systems, others may require only the occasional topping up of ponds to compensate for seepage and evaporation – the latter then have a short-term pulse of detritus-laden effluent during harvest draw-down. There is the potential to ameliorate much of the impact of both flow- through and pulse discharges using settlement ponds and biofiltration (Huntington et al. 2006).

Organic sediments can occur around the discharge area. To avoid organic sediments some commonly used measures in Italy are mechanical removal of algae on water surface, residual sediments treatment with oxygen and water movement in dedicated ponds, use of liquid oxygen in the ponds and in effluent channels, etc. Pond farms frequently fringe the edge of lagoon areas (e.g. the Mesolonghi and Amvrakikos lagoons in Greece) and their discharges – both individually and cumulatively - may impact seagrass beds as well as other sensitive habitats or the water body's ecology.

The establishment of coastal pond farms could result in the **alteration of saltmarsh areas**, and supralittoral sand dunes and shingle could also be affected if the farm is located in areas where those habitats are present (Huntington et al. 2006). However, suitable siting and management measures of pond farms can easily avoid impacting on these types of habitats.

The control of **predators** may be a serious issue for pond farms. The use of nets for covering ponds against birds attack is, when feasible, a widely used measure in most of the farms.

[39] As previously stated the possible impact from the introduction of alien species for their use in aquaculture is regulated by Regulation 708/2007.

Land-based farms are able to treat waste water streams before they are discharged into the environment. The use of ponds to settle suspended solids allows a large proportion of organic and inorganic materials to be removed. Dissolved nutrients can also be removed through filtration, with biological techniques such as reed bed systems and algal beds, as well as using bivalve-lined effluent canals (Huntington et al. 2006).

3.2.7 Lagoon culture

Extensive lagoon culture has in general low pressures, although may impact on the local wildlife and bird populations through a combination of operational disturbance as well as targeted predator control. Another pressure may result from the **use of alien or locally-absent species** such as the Manila clam (*Ruditapes philippinarum*)[40].

The main habitats that may be impacted by lagoon farming are those typical of lagoon areas – sand and mud flats, seagrass beds and kelps and seaweeds. Other areas – polychaete and mussel reefs and maerl beds may also be potentially impacted if found within or adjacent to lagoonal areas.

Sand and mudflats might be subject to **smothering from sediments** emanating from the farm, and by any **change in the trophic status of the water body** due to hypernutrification and organic deposition. They are important feeding habitats for avian waders and support considerable invertebrate infaunal communities. These may also be impacted by any significant change in overall productivity resulting from the introduction and husbandry of monoculture or restricted polyculture.

Sea grass communities may be impacted by increased water turbidity, either due to some level of siltation but more likely from harvesting activities that involves raking or hydraulic-assisted extraction of clams. Seagrasses might also be subject to removal during harvesting and have low levels of recoverability from rhizome displacement.

However, as mentioned above lagoon culture is usually an extensive system with low pressures, which under good practice management can even provide suitable habitats and contribute to biodiversity conservation (see section 3.6). Ponds and lagoons may be designed to contain flood events and thus prevent release of effluents.

Predator control is an issue in lagoon aquaculture. Nowadays, predator control is made more challenging, as many predators are protected by Member State and EU legislation, especially within designated sites of conservation interest[41].

For extensive lagoon farms, fisheries lakes and those farms that are affected by migration routes, this issue remains a very severe problem. The large ponds cannot be covered by protective netting and face extensive losses every year. In many cases, the situation is further complicated by the existence of Natura 2000 sites in close proximity[42].

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[40] As previously stated the possible impact from the introduction of alien species for their use in aquaculture is regulated by Regulation 708/2007.

[41] Under Article 9 of the Birds Directive or Art. 16 of the Habitats Directive Member States can, by way of derogations, take measures to limit the impact of protected species.

[42] The particular case of the Great Cormorant is the subject of research projects (e.g. INTERCAFE: http://www.intercafeproject.net/index.html) and an EU platform set up (http://ec.europa.eu/environment/nature/cormorants/home_en.htm)

3.2.8 Freshwater fish aquaculture systems

The main pressures from freshwater aquaculture may be **sedimentation, changes in bio-chemistry and hazardous substances** (Huntington et al. 2010). The relative impacts can be avoided or mitigated with different water treatment systems currently available[43].

Trout and carp are cultured in land-based pond and raceway systems. Sedimentation risk from land-based tanks and pond culture is moderate for rivers with low flow rates, but this can be minimised with settlement ponds. On the other hand, ponds can have a positive role eg. by retaining the soil brought by the stream from the upper basin.

There is also a possible risk of eutrophication through effluent discharge to rivers. As carp are omnivorous and mainly cultured in ponds, there is less likelihood of nutrient enrichment than with raceway and tanks systems used for trout. Currently many trout farms use modern technologies (low production intensity index, outflow water systems like settling tanks, mechanical aeration systems or liquid oxygen, effluent analysis, etc.) which allow them to exploit water resources efficiently and to offset potential detrimental effects, eutrophization in particular, on the receiving water body.

In Atlantic rivers the risk of reduced oxygen levels from nutrient enrichment increases in the summer months with higher temperatures and lower flows. The impact on flora and fauna can be significant. This can and should be avoided or mitigated with seasonal abstraction limits. Continental rivers are typified by high volumes of water suggesting risk of nutrient enrichment is low, as is the risk from chemical use.

Chemical use in trout culture poses moderate risk to rivers. For trout farming within river systems, permits are generally provided based on dilution being sufficient to ensure downstream impacts are negligible.

Aquaculture in ponds is dominated by extensive carp culture, which poses low or negligible risk to water quality elements other than the potential effect on hydromorphology from the construction of pond-lakes in flood plain areas. Most of the ponds have a very long history and therefore they have merged well with the landscape, where they play an important role in e.g. the ecological stability and increase the capacity of an area to receive flood waters and sustain water in the landscape.

3.2.9 Summary overview of all potential pressures and impacts

The table below illustrates the kind of issues to be considered when assessing different types of aquaculture systems. It is only intended to summarise the information provided in the previous sections about all possible effects. **It must be stressed that these potential impacts do not always appear or might not be relevant for the conservation objectives of a particular site**.

A **case by case approach is needed** to identify the actual potential impacts, which depend on the environmental and rearing conditions and on the mitigation measures and appropriate management practices that must be applied to avoid or minimise such effects. Furthermore, **many of those issues are regulated under EU or national legislation.**

[43] Water treatment of intensive aquaculture systems and new methods to reduce the farm effluents have been addressed in a project funded by the European Union under the Sixth Framework Programme (Sustainaqua, Varadi et al. 2009)

Table 3. Checklist of issues to be considered in different aquaculture systems

Aquaculture system / Potential Impacts	Coastal and marine							Freshwater		
	Cage culture	Shellfish rafts and longlines	Intertidal shellfish culture	Bottom shelfish culture	Land based tanks	Land based ponds	Lagoon culture	Fish ponds	Flow-through system	Recir-culation system
Sedimentation	X	X	X	X		X	X	X	X	
Biogeochemical change in water	X	X			X	X	X	X	X	
Chemical input	X				X	X			X	X
Infrastructure impact			X	X	X	X	X		X	X
Disturbance	X	X	X	X	X	X	X	X	X	X
Predator control	X	X	X	X	X	X	X	X	X	
Interbreeding	X				X	X			X	
Pathogen transmisison	X		X	X	X	X	X	X	X	
Alien species	X	X	X	X	X	X	X	X	X	
(the introduction of alien species for their use in aquaculture is regulated by Regulation 708/2007)										

Table 4. Example of a possible classification of key habitats and species sensitivity to guide risk assessment *(from Huntington et al 2006)*

Habitats / species	*Pressure categories*								
	Sedimentation	Biogeochemical change in water	Chemical input	Infrastructure impact	Disturbance	Predator control	Interbreeding	Pathogen transmission	Alien species
Reefs: mussel beds communities	x	x	x	x				x	
Reefs: polychaete worm communities	x	x	?	x				?	
Seagrass beds on sublitoral sediments	x	x	x	x		x			x
Sandbanks, mudflats and sandflats	x	x	x	x	x	x			x
Maerl beds	x	x	?	x					x
Kelp and seaweed communities	x	x	?	x					x
Saltmarsh communities	x	x	x	x	x	x		?	
Sand dune communities			x	x	x	x			
Shingle communities	x			x	x	x		?	
Cetaceans			x		x	x			
Pinnipeds			x		x	x			
Otters	x		x	x	x	x			
Fish	x	x	x		x		x	x	x
Birds	x		x	x	x	x			

3.3 Examples of sustainable aquaculture in natural areas that contribute to biodiversity

There are numerous examples of sustainable development of aquaculture activities that play an important role in environmental conservation and enhancement of biodiversity, retention of water in the landscape and flood protection. Aquaculture systems can be compatible with sensitive habitats and can provide environmental benefits and services. Aquaculture activities are carried out in many Natura 2000 sites and can be fully compatible with the preservation of the sites natural values.

Providing suitable habitats for species of EU interest

- Fishponds, especially in Central and Eastern Europe, provide a very important habitat for large numbers of water birds. Very often such fishponds were created on the site of former natural wetlands and, due to the extensive management, have evolved into semi-natural wetlands supporting high biodiversity. In this way inland aquaculture has replaced natural marshes in hosting a high diversity of aquatic plants and animals. At the moment many of these aquaculture facilities are within or close to Natura 2000 sites. In countries such as the Czech Republic, Romania and Hungary, sites with fishponds make up a quarter or more of all special protection areas (SPAs) in the country (BirdLife, 2011).
- Extensive fish ponds are usually surrounded by reed belts and natural vegetation, thus providing important habitats for flora and fauna. Many pond fish farms have been turned into multifunctional fish farms, where various other services are provided for recreation, maintenance of biodiversity and improved water management (Varadi et al, 2009).
- Fish farming activity has also preserved ponds and wetlands when the pressure to turn them into cultivated areas was very strong (1970-1990). Some of the best preserved freshwater wetlands of the Region Friuli Venezia Giulia, survived the simplification of the hydrographic network and drainage that have affected the Friuli plain during the last century thanks to the fish farm activity. In some aquaculture ponds in the Veneto Plain (Italy) the largest wintering colony of the Cormorant and one of the last colonies of *Bombina variegata* in the plain are found nearby the existing aquaculture areas.
- In Belgium some aquaculture producers are involved in conservation projects aimed at the restoration of open marsh landscape for Bittern and Little Bittern, and have implemented other measures like the maintenance of ponds free of fish to contribute to the conservation of tree frog.
- In some farms in Lorraine, France, aquaculture systems allow the development of specific aquatic flora in highly natural ponds with shallow banks.
- Another example of positive effect of aquaculture activity is found in the Lombardia region, where a farm breeds autochthonous sturgeon (*Acipenser naccarii*), not only for the market, but also for restocking Po and Ticino rivers.

Adopting best practices that contribute to biodiversity conservation

- Fish farms included in natural areas have often adopted a Code of Best Practice and apply suitable measures for minimizing any potential impacts. They also contribute to the conservation of habitats and species that are present on the site.
- The Natural Park of La Brenne in France is made up of near 4000 ponds created by man from the High Middle Ages. Nowadays they play a key role in the preservation of flora and fauna, especially waterfowl nesting and migratory birds. Aqua-environmental measures "*fish ponds*", are applied in the park, whose main objective is to develop aquaculture production methods contributing to the improvement of the environment and preservation of nature. Some of these measures aim to recreate or maintain favourable conditions for insects, amphibians, birds and fish (creation of open water behind the reeds, creation of shallow, reed beds or planting nympheas, remove willows invading reed, etc.) to maintain vegetation belts, to avoid fertilization, to manage alien species like coypu, muskrat and crayfish (shooting, trapping, use of filters), etc.
- In some fishponds in Slovakia, a common practice is to prevent the removal of aquatic vegetation, which has led to patches of Typha and Phragmites in a considerable part of the fishpond-system farms. These serve as breeding site for heron-like birds (Purple Heron, Spoonbill, Night Heron), for the Marsh Harrier, for the Bittern, Little Bittern, Red-necked Grebe, Black-necked Grebe (now rare) and the Ferruginous Duck.

- In Poland, some key elements of good practice that aim to make compatible farming activity with Natura 2000 conservation objectives are, for example, the maintenance of important breeding places for birds such as reeds, islands and fragments of osiers, building of floating islands (platforms) for terns, use of the mown rushes left in the ponds as breeding space, construction of observation towers for birdwatchers, etc.

- In Czech Republic, the Nesyt Fishpond which is part of the Natura 2000 site "Lednice fishponds" and which hosts fish farming activities, has integrated summer drainage as a management measure to create suitable environmental conditions for halophilous plants of exposed pond substrates and for some threatened wetland birds (Sychra & Danihelka, 2010[44]).

Figure 6. Narrowleaf dock (Rumex maritimus) in the central part of Nesyt fishpond during its summer drainage

- Suitable management of aquaculture in coastal areas has proved to be beneficial to the conservation of natural areas and the species they host, e.g. in many parts of Southern Europe. In Sado Estuary (Portugal) aquaculture is mainly based on the use of ancient saltpans transformed for extensive and/or semi-intensive production in polyculture regime. Under this scope extensive and semi-intensive aquaculture activities are authorized under certain conditions of sustainable use and integrated management practices that aim at protecting natural habitats for nature conservation and biodiversity.
- Similar use of ancient saltpans for aquaculture is made in the Bahía de Cadiz Natural Park, Spain, where aquaculture activities are included in the Management Plan of the protected area and are considered compatible with the preservation of the natural values of the site under certain conditions.

<u>Supporting the systems that provide environmental benefits and services</u>

- Shellfish culture can provide ecosystem services through the removal of inorganic nutrients from eutrophied ecosystems (bioextraction). Mussels are cultured and harvested as a method of water quality management in areas with diffuse nutrient inputs, e.g. in Sweden (Lundalv, 2011). Shellfish and seaweed can also be cultured in combination with fish farming, in integrated multitrophic aquaculture (IMTA), where shellfish and seaweed are harvested to compensate for nutrient enrichment through the metabolism of fish feed. This is under development in Norway and the Mediterranean.
- The abandonment of traditional fish farms can lead to their drying up, encroachment by scrub and trees or replacement with other land use; all of which leads to the decline of biodiversity. It is therefore advisable that fishponds that provide important habitats are adequately managed and supported so that their natural values and the ecosystems services they provided are conserved and possibly enhanced.

[44] Sychra, J. and Danihelka, J. 2010. The summer drainage of Nesyt Fishpond in 2007: a successful conservation measure or ecological catastrophe?, pp 10-11, In: European Pond Conservation Network, Newsletter No. 3, Spring 2010. Available at: http://campus.hesge.ch/epcn/pdf_files/newsletters/EPCN_Newsletter_3.pdf

4. THE IMPORTANCE OF STRATEGIC PLANNING

- *The development and application of spatial planning, including maritime spatial planning (MSP), together with integrated coastal zone management (ICZM) can facilitate the allocation of appropriate sites - with the correct water quality - for aquaculture activities.*
- *Most of the potential environmental impacts of aquaculture can be managed and minimized through the appropriate siting and management of farms. Site selection is a critical factor for determining the environmental pressures originating from an aquaculture activity and for ensuring the acceptability of aquaculture systems in sensitive sites.*
- *Key information is needed for spatial planning to allow the identification of conflicts between different interests at a strategic level. In particular, information about all Natura 2000 sites in the areas where aquaculture activities are planned will be crucial. Sensitivity maps can be prepared taking into account the type of aquaculture activities that are planned, the type of ecosystems and habitats and the hydrodynamic conditions in those areas.*
- *Operational measurements of the capacity of the environment to accommodate aquaculture without unacceptable impacts should be taken into account for aquaculture farm site selection and site management. Areas with evidence of limited assimilative capacity should be avoided.*

4.1 Spatial planning and strategic environmental assessment

The challenges that emerge from the growing competing uses of freshwaters- and sea (e.g. maritime transport, fishing, aquaculture, leisure activities, energy production, etc.) must be addressed, while the needs of local populations and the protection and conservation of the environment have to be fulfilled.

Spatial planning, including maritime spatial planning, is a public process which allows different demands of the sectoral policies to be examined in an integrated way across a broad geographical area so that a more coherent regional development strategy can be drawn up that maximises win-wins and minimises conflicts wherever possible.

It also provides for a more balanced development framework because it enables social, economic and environmental concerns to be taken into account very early in the planning process. In addition, it may encourage different economic sectors, interest groups and the general public to become engaged through public consultation, thereby ensuring greater transparency in the decision making process.

Spatial planning is a particularly useful tool for examining how to support economic and social development whilst at the same time avoiding or reducing, wherever possible, potentially negative impacts on the natural environment, and preserving the integrity of Natura 2000 sites. The fact that this happens at early stage in the planning process is important as the scope for examining alternative approaches and scenarios is usually much greater at this level. Strategic spatial planning leads to a more predictable and stable planning framework for all concerned. This should, in turn, help reduce the risk of unforeseen difficulties and delays at later stages, for instance at the level of individual projects.

Some Member States have signalled their intention to update their inventory of potential sites for aquaculture. Furthermore, many Member States have already introduced a regime for maritime spatial planning at national level or are in the process of doing so. In this context, a level playing field at national level should be ensured for aquaculture activities alongside with other sectors and policies. Spatial planning has a key role to play in providing guidance and reliable data for the location of economic activities, giving certainty to investors, avoiding conflicts and finding synergies between activities and environments. The role and function of aquaculture should be identified in this context.

The European Commission is promoting maritime spatial planning as a stable and transparent way to improve the competitiveness of the EU maritime economy and to ensure effective cross-border planning on trans-national issues. In 2008, the European Commission published a maritime spatial planning roadmap[45]. This roadmap was followed up by a progress report in 2010 which, inter alia, concluded that further work on marine spatial planning (MSP) would be needed at EU level[46].

Test projects on Maritime Spatial Planning: MASPNOSE and Plan Bothnia

The Commission has co-financed two test projects on MSP in the Baltic Sea (BOTHNIA) and in the North East Atlantic, including the North Sea and the Channel area (MASPNOSE). Each project involves bodies from different Member States and aims to gain practical experiences in applying MSP in a cross-border area. These projects run for 18 months and were concluded in May 2012. A call for proposals for further test projects in other European sea basins will be launched during the course of 2012.

Further information about these tests projects can be found at:
http://ec.europa.eu/maritimeaffairs/spatial_planning_en.html

The development and application of maritime spatial planning together with integrated coastal zone management (ICZM) (cf. 4.2) can facilitate the allocation of appropriate sites - with the correct water quality - for aquaculture applications. In addition, these planning tools could facilitate anticipating risks from, for instance, climate change effects, floods or coastal erosion that may affect aquaculture sites.

The Commission is preparing a new proposal to develop integrated processes for maritime planning and coastal management which would help in achieving the above-mentioned objectives for nature protection. In the context of strategic planning, spatial plans or aquaculture plans and programmes, will need to be subject to a Strategic Environmental Assessment under the SEA Directive if they fulfil relevant conditions under that Directive.

Where such plans and programmes are likely to significantly affect one or more Natura 2000 sites, an Appropriate Assessment in accordance with article 6.3 of the Habitats Directive will also be required[47]. These assessments provide a mechanism for examining the extent and degree of potential negative effects on the environment and for exploring viable alternatives. For more details about the Appropriate Assessment of Plans and Programmes see chapter 5.

[45] *http://ec.europa.eu/maritimeaffairs/spatial_planning_en.html*
[46] COM(2010) 771. Maritime spatial planning in the EU - Achievements and future development.
[47] The need for such assessment should also take into account the potential for aquaculture to adversely affect the integrity of Natura 2000 sites even where there is no spatial overlap between the Natura 2000 area and the aquaculture site (e.g. water quality downstream).

European Research and maritime spatial planning

The European Commission finances, within the 7th Framework Programme, several projects related to the management of coastal areas and maritime spatial planning in order to increase the knowledge base necessary to support sustainable management and the related decision making processes.

The most relevant projects are:

- MESMA – Monitoring and evaluation of spatially managed areas
- COEXIST – Integration in coastal waters: a roadmap to sustainable integration of aquaculture and fisheries
- SECOA – Solutions for environmental contrasts in coastal areas
- COCONET – Network of marine protected areas and assessment of the wind energy potential in the Mediterranean and Black Sea

Further information can be found on the Research and Innovation website: http://ec.europa.eu/research/index.cfm

4.2 Integrated Coastal Zone Management

Integrated coastal zone management (ICZM) is a dynamic process which promotes the sustainable management of coastal zones and seeks to balance the environmental, social and economic dimensions of sustainable development within the limits set by the area's natural characteristics and carrying capacity. The objective of ICZM is to properly take into consideration all policies, sectors and, as far as possible, individual interests, involving all coastal stakeholders in a participatory way. Aspects like ecosystem conservation and economic development are also taken into account. ICZM can facilitate aquaculture site selection and sustainable management together with Maritime Spatial Planning.

Following a EU Recommendation in 2002[48], Member States have used ICZM to regulate the spatial deployment of economic activities and set up spatial planning systems for Europe's coastal waters. The Recommendation identifies aquaculture among the sectors and areas to be addressed in the future National ICZM strategies. Building on the experiences gained with this Recommendation, the European Commission is preparing a new joint initiative on integrated processes for maritime planning and coastal management (see also 4.1).

Examples of ICZM in Europe

All around Europe, there are many efforts being made to implement ICZM and many lessons could be taken from others' experiences if they were more easily accessible. The website OURCOAST seeks to bring to light these experiences, the knowledge and the tools that have been developed, why and how they have been put into practice. The data base can be searched according to:
- Geographical selection
- Themes (Adaptation to risk, Sustainable use of resources, Sustainable economic growth)
- Key approaches (Integration, Participation, Knowledge-based, Ecosystem based approach, socio-economic and technical)

The following examples for aquaculture activities can be highlighted:
- Co-ordinated Local Aquaculture Management Systems for selected Irish water bodies (CLAMS) –
- Integrated management of mussel fishery and aquaculture under changing baselines due to regime shifts in Denmark.

Source: http://ec.europa.eu/ourcoast/index.cfm?menuID=3

[48] Recommendation 2002/413/EC of the European Parliament and of the Council of 30 May 2002 concerning the implementation of Integrated Coastal Zone Management in Europe.

4.3 Determining suitable locations for aquaculture developments

It is widely acknowledged that most of the potential environmental impacts of aquaculture can be managed, minimised or enhanced through an understanding of the processes involved and the appropriate siting and management of farms.

Site selection is a critical factor for determining the environmental pressures originating from an aquaculture activity and in ensuring the acceptability of aquaculture systems in sensitive sites. This includes the position of the site relative to the feature of conservation interest, whether the facility is concentrated in one position or dispersed around a number of sites and whether the facility is exposed to risk from natural elements (e.g. strong prevailing winds, wave action, etc) or conflict with other coastal users (e.g. navigation, fishing activities, recreational users) (Huntington et al., 2006).

In order to develop a sustainable aquaculture plan or project and to minimise the potential negative impacts and even strengthen the positive ones, aquaculture planners need to be fully aware of the environmental context. Aquaculture planning and site selection should be based on the best legal, environmental, technical and socio-economic knowledge to enhance the viability of the process.

Operational measurements of the capacity of the environment to accommodate aquaculture without unacceptable impacts should be taken into account for aquaculture farm site selection and site management. Areas with evidence of limited carrying or assimilative capacity should be avoided (IUCN 2009, Scottish Parliament, 2002[49]) when determining suitable locations.

Seed mussel collection systems in Natura 2000 sites in Netherlands

In 2009 a policy was developed for seed mussel collection systems in Netherlands. The mussel fishery sector, government and nature organisations have agreed to phase out traditional methods and make room for the alternative collection systems. The Government has initiated an open plan process together with all parties concerned (fishery and recreational sectors, nature organisations, provincial authorities) to draw up policy for 2010-2013. This involved selecting suitable locations for seed mussel collection systems. Some 890 hectares in Natura 2000-sites Waddenzee, Oosterschelde and Voordelta were designated as potential locations. Apart from nature, other interests relating to recreation, safety and archaeology were also weighed in the selection process.

The Government carried out an appropriate assessment of the potential locations. The assessments were based on a worst-case scenario. The ecological effects of the seed mussel collection systems on the seabed, birds and seals were studied.

Sources:
Beleid mosselzaadinvanginstallaties 2010 t/m 2013. http://www.rijksoverheid.nl/documenten-en-publicaties/brochures/2010/01/04/beleid-mosselzaadinvanginstallaties-mzi-s-2010-t-m-2013.html
Rapport C089/09: Passende Beoordeling voor mosselzaadinvang (MZI) in Nederlandse kustwateren http://english.minlnv.nl/portal/page?_pageid=116,1640321&_dad=portal&_schema=PORTAL&p_file_id=43669

4.4 Key information for spatial planning - identifying conflicts at a strategic level

A key to good spatial planning is sound geographical knowledge. Much of the planning is done with the help of maps which makes it possible to overlay different interests, activities, resources, etc. on base maps that show the area's natural geography and existing land uses. From these overlays, decisions can be made about zoning certain areas for particular types of development.

[49] The relevant section of the Scottish Parliament's report can be found at http://www.scottish.parliament.uk/business/committees/historic/x-transport/reports-02/trr02-05-vol01-02.htm#2 (beginning just above paragraph 19).

A first step to identify possible conflicts with Natura 2000 would require overlying maps showing the location and boundaries of Natura 2000 sites within a particular geographical region with the potential aquaculture sites identified. By this means, it should be possible to quickly identify areas where there may be a higher risk for conflict. The ***Natura 2000 viewer*** is available online and may be is used for detailed site specific overviews (see box).

The Natura 2000 viewer – immediate online access to Natura 2000 maps

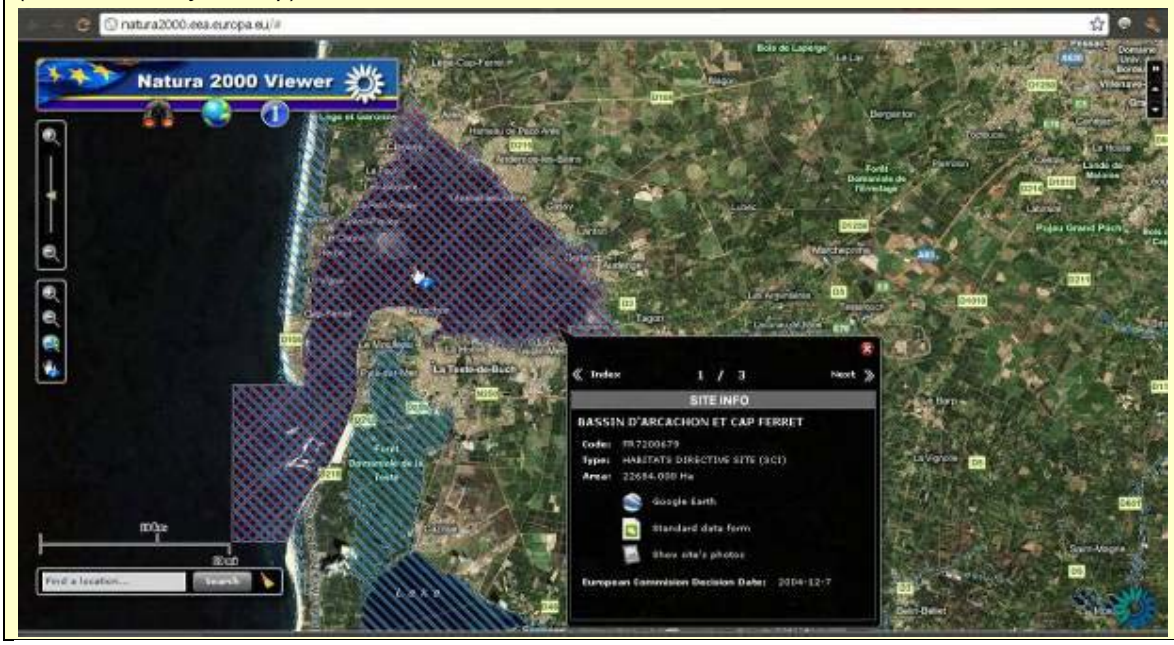
The European Commission, with the assistance of the European Environment Agency (EEA), has developed a new on-line facility called the 'Natura 2000 viewer' which enables the user to locate and explore Natura 2000 sites anywhere in the EU at the press of a button.
See: http://natura2000.eea.europa.eu/)

Various different search options are available:

- browse in a particular area to see which, if any, Natura 2000 are present – for instance along a coastal zone. By typing in the location: eg nearest village, the map will automatically zoom into that area and highlight all the Natura 2000 sites present there.
- locate a specific Natura 2000 site for which the name or site code is already known
- search for a particular species or habitat type protected under the Habitats Directive and see which sites have been designated for it
- search according to different backgrounds: a street map, a satellite map, a Corine Land Cover map or a biogeographical map.

For each Natura 2000 identified on the map a standard data sheet is available which identifies the species and habitat types for which it was designated, estimated population sizes and conservation status, and the importance of that site for the species. These Standard Data Forms are the forms that have been officially submitted to the Commission as part of the designation process and need to be cross referenced with the annexes of the Directives

Example of map from Natura 2000 viewer for the Atantic coast in France. In Red the SPA site designated under the Birds Directive, in blue the SCI site designated under the Habitats Directive (sometimes they overlap)



Detailed investigation of potential conflict areas should also consider the sensitivity of the ecosystems and habitats that are present in the respective Natura 2000 sites where (or close to which) aquaculture activities are planned, as well as the hydrodynamic conditions in the concerned area, as these have a significant influence on the transport of sediments and waste.

Sensitivity maps can be prepared taking into account the type of aquaculture activities that are planned and their predictable pressures, the type of ecosystems and habitats and the hydrodynamic conditions in those areas.

The new Commission initiative on maritime spatial planning and coastal zone management (cf. 4.1) is inter alia intended to contribute to the integration of these different information needs leading to the preparation of such multi-user maps. The experiences gained with the Natura 2000 areas will be helpful to this end.

4.5 Examples of aquaculture planning and aquaculture activities in Natura 2000 areas

Some administrations provide support for a good planning of aquaculture activities, especially in areas where this kind of activity has a traditional importance for the local economy. A relevant example can be found in Scotland where aquaculture is guided by the Scottish Government, with planning of individual developments governed by Local Authorities.

Scotland: planning for aquaculture

The Scottish Government aims to promote a policy that supports the sustainable economic growth of aquaculture. The need for high standards of environmental protection is recognised at every stage of fish farm planning, operation and regulation

Spatial planning for aquaculture in Scotland dates back to the late 1980s, when Fish Farming Framework Plans where first produced to fill a perceived gap in planning guidance for the industry at local level. This approach has since been adopted by other local authorities and refined over time. Currently the Local Authority is the competent authority in relation to fish farm developments. All new or modifying fin-fish developments (over 0.1 ha) are subject to EIA.

The Local Authority is also required to take into account the direct and cumulative effects of the proposed development on the environment. This may include the carrying capacity (designated on the basis of predictive modelling to estimate nutrient enhancement and benthic impact in sea lochs), visual impact and the effects on the landscape (landscape guidance is produced by Scottish Natural Heritage), effects on the marine historic environment and the sea or loch bed, and fish disease risk.

Any new development (or modification, depending on what that modification involves) must also obtain a licence either from the Scottish Environment Protection Agency or from Marine Scotland in relation to discharges from fish farm sites, or wellboats. In addition, a voluntary Code of Good Practice has been developed by fish farming stakeholders addressing a range of issues outwith planning control, including: cage and equipment design, bio-security, management and operational practices.

In instances where a development is likely to have a significant effect on a Special Areas of Conservation, an Appropriate Assessment is undertaken to address the potential impact on the conservation feature prior to any planning decision being taken by the competent authority. Loch Sunart is an example of an aquaculture framework plan that incorporates a marine SAC[50].

[50] More information available at: http://www.highland.gov.uk/NR/rdonlyres/9676B889-D077-4B70-8706-0AF9EBAE3720/0/loch_sunart_september_2004.pdf

Recently, there have been attempts to develop more integrated plans, covering aquaculture alongside other activities, and extending into the marine environment. Detailed plans like those for Sound of Mull and Loch Fyne have attempted to highlight areas for potential expansion of aquaculture developments, based on constraints mapping. This has proved more difficult in plans covering larger areas (like that for Shetland).

Examples of these more integrated plans are:

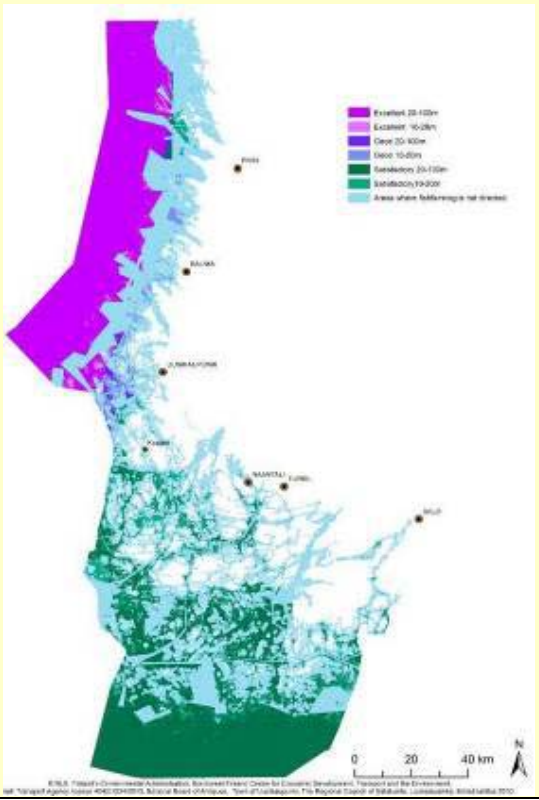
- Sound of Mull marine planning pilot: General policies on aquaculture, Locational policies for aquaculture
- Loch Fyne ICZM plan
- Shetland marine planning pilot

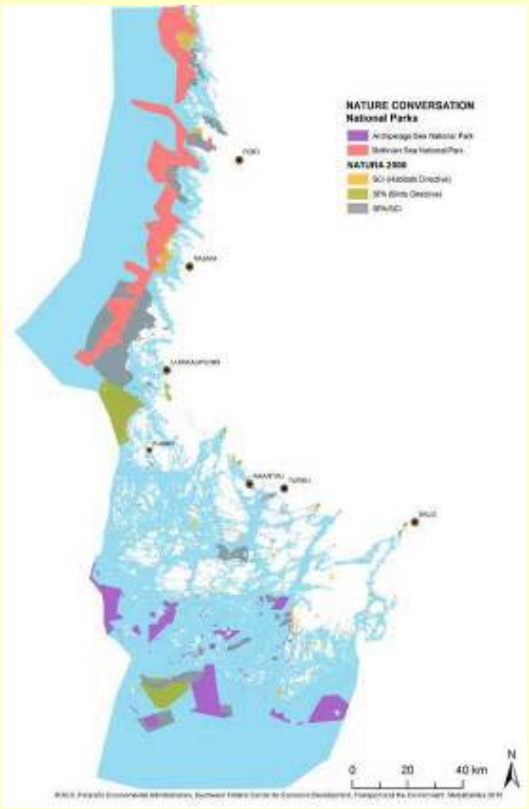
A National Marine Plan will govern more detailed planning at the regional level and bring greater clarify to decision making in the marine environment. In addition, Local Authority development plans will provide advice on areas that are suitable for aquaculture development and areas where such development may be constrained.

The Southwest Finland and Satakunta aquaculture site selection plan is an example of regional planning. The selection plan was prepared in a wide regional expert working group, with delegates from the aquaculture industry, environmental and fishery administration, regional planning organisations and research.

Finnish aquaculture site selection plan

The purpose of the national aquaculture site selection plan is to direct new fish farms to water areas, which are suitable from the environmental, fish farmers´ and other coastal users' point of view. The Southwest Finland and Satakunta working group used GIS spatial planning tool to identify suitable water areas for aquaculture production. At the coast, unsuitable water areas were excluded with buffers concerning the depth of sea, summer cottages, water ways, nature protection areas etc.





In the preliminary site selection plan fish farms were not directed in national parks. Moreover, the working group suggested that new fish farms should not be without complete investigations established in Natura 2000 areas with underwater reefs (SCI sites/Habitat Directive), if depth is lower than 20 meters. In addition, a 500 meter wide safety zone during the nesting time was modeled around the bird Islands in Natura 2000 areas (SPA sites/Bird Directive).

With these wide safety zones it is unlikely that fish farms have a significant effect to the nature values protected with Natura 2000 sites. However, the need for an **Appropriate Assessment** is evaluated in connection with production license application. Fish farmers can apply production licenses in the water areas, which are not identified in the aquaculture site selection plan. If this kind of site is inside NATURA area, exhaustive assessments are needed to support the application.

5. STEP-BY-STEP PROCEDURE FOR AQUACULTURE PLANS AND PROJECTS AFFECTING A NATURA 2000 SITE

- *The Habitats Directive (article 6) sets out a series of safeguards that must be applied to plans and projects that are likely to have a significant effect on a Natura 2000 site. The first step is to determine whether a plan or project may have a significant effect upon a Natura 2000 site. In such case, it should undergo an Appropriate Assesment (AA).*
- *The purpose of the AA is to assess the implications of the plan or project in respect of the site's conservation objectives, individually or in combination with other plans or projects. The conclusions should enable the competent authorities to ascertain whether or not the plan or project would adversely affect the integrity of the site concerned.*
- *The appropriate assessment must consider all the potential pressures and impacts on the sites' conservation interests. The Appropriate Assessment must focus on the species and habitats that have justified the site's designation as a Natura 2000 site and all the elements that are essential to the functioning and the structure of that site.*
- *AAs should be made on a case by case basis, with a degree of expertise available at each stage of the assessment. The appraisal of effects should be based on the best scientific knowledge available, expert judgement and on-site surveys, as required.*
- *The outcome of the AA is legally binding. If it cannot be ascertained that there will be no adverse effects on the integrity of the Natura 2000 sites, even after the introduction of mitigation measures or conditions in the development permit, then the plan or project cannot be approved unless the derogation procedure under Article 6 (4) is invoked.*

5.1 Article 6 of the Habitats Directive

Article 6 of the Habitats Directive sets out provisions which govern the conservation and management of Natura 2000 sites and determines the relationship between conservation and land-use. Paragraph (1) requires the establishment of the necessary conservation measures, and is focused on positive and proactive interventions. Paragraph (2) requires that within Natura 2000 sites habitat deterioration and significant species disturbance is avoided.

Paragraphs (3) and (4) on the other hand set out a series of procedural and substantive safeguards that must be applied to plans and projects that are likely to have a significant effect on a Natura 2000 site. This procedure is designed to:

- Fully assess the impacts of plans or projects that are likely to have a significant negative effect on a Natura 2000 site by means of an Appropriate Assessment;
- Ascertain through the Appropriate Assessment, whether the impact will adversely affect the integrity of the site and, if this is the case, whether the plan of project can still be approved if certain mitigation measures or planning conditions have been introduced that remove or minimise the adverse effects on the site to a non-significant level;

- Provide a mechanism for approving, in exceptional circumstances, plans or projects that have an adverse effect on a Natura 2000 site even after the introduction of mitigation measures, if these plans or projects are considered to be necessary for imperative reasons of overriding public interest but where no suitable alternative solutions exist (cf Art 6.4)

ARTICLE 6 (3) and (4) of the HABITATS DIRECTIVE

- *6(3). Any plan or project not directly connected with or necessary to the management of the site but likely to have a significant effect thereon, either individually or in combination with other plans or projects, shall be subject to appropriate assessment of its implications for the site in view of the site's conservation objectives. In the light of the conclusions of the assessment of the implications for the site and subject to the provisions of paragraph 4, the competent national authorities shall agree to the plan or project only after having ascertained that it will not adversely affect the integrity of the site concerned and, if appropriate, after having obtained the opinion of the general public.*

- *6(4). If, in spite of a negative assessment of the implications for the site and in the absence of alternative solutions, a plan or project must nevertheless be carried out for imperative reasons of overriding public interest, including those of a social or economic nature, the Member State shall take all compensatory measures necessary to ensure that the overall coherence of Natura 2000 is protected. It shall inform the Commission of the compensatory measures adopted. Where the site concerned hosts a priority natural habitat type and/or a priority species, the only considerations which may be raised are those relating to human health or public safety, to beneficial consequences of primary importance for the environment or, further to an opinion from the Commission, to other imperative reasons of overriding public interest.*

5.2 When is the Article 6 procedure applicable?

The assessment and authorisation procedure under Article 6(3) and (4) applies to any activity (or changes to an existing activity) which:

a) Is not directly connected with or necessary to the management of a Natura 2000 site;
b) Is likely to have a significant effect thereon, either individually or in combination with other plans or projects, in view of the site's conservation objectives.

It covers:

- Plans or projects affecting sites classified under the *Birds Directive* and sites designated or proposed to be designated under the *Habitats Directive (*both are part of the Natura 2000 network.)[51]
- *Plans* that serve as a framework for development consents and individual *projects*. This ensures that the potential impacts on Natura 2000 sites are taken into account at both the strategic planning level and at the level of each individual project[52].
- Plans or projects *inside* and *outside* the Natura 2000 site if they are likely to have a significant effect on the Natura 2000 site (e.g. a project located upstream a Natura 2000

[51] For Potential SPAs (IBA), Article 6(3)-(4) is not applicable but Article 4(4) of the BD is applicable. Areas which have not been classified as SPAs but should have been so classified continue to fall under the regime governed by the first sentence of Article 4(4) of the Birds Directive [Basses Corbières, C-374/98]. For potential pSCIs: MSs are required to take protective measures that are appropriate, from the point of view of the Directive's conservation objective, for the purpose of safeguarding the relevant ecological interest which those sites have at national level [Dragaggi, C-117/03; Bund Naturschutz, C-244/05].

[52] Case C-6/04: 20 October 2005.

site may still have a significant effect on the species and habitats downstream in that Natura 2000 site and vice versa)[53].

- Aquaculture activities that were authorised before the designation of the site as Natura 2000 must, to the extent that they constitute a project and are likely to have a significant effect on the site concerned, undergo an assessment of their implications for that site where they are continued after designation of the site[54]. This also applies to authorised aquaculture developments where new aspects are introduced or management is changed (e.g. intensification).

5.3 A step-by-step procedure

The procedure laid out in Article 6(3) and 6(4) should be carried out in stages. Every stage determines whether a further step in the process is required. For instance if, after the first step, it is concluded that there will be no significant effects on the Natura 2000 site, then the plan or project can be approved without the need for further assessment.

The following flow chart (Figure 7) demonstrates how the stages are applied and how decisions are reached on the authorisation or rejection of a plan or project. Subsequent sections in this chapter examine each of the stages to be undertaken as part of the process under Article 6.3.

It is clear from the above that this decision-making process is underpinned by the precautionary principle. The emphasis should be on objectively demonstrating, with reliable supporting evidence, that there will be no adverse effects on the integrity of Natura 2000 sites[55]. For this reason, the lack of scientific data or information on the potential risk or significance of impacts cannot be a reason to proceed with the plan or project.

STAGE 1. SCREENING

5.4 When is an Appropriate Assessment (AA) needed?

The first step is designed to determine whether or not an AA is needed. If it can be determined with certainty that the plan or project is not likely to have a significant effect, either individually or in combination with other plans or projects, then the plan or project can be approved without further assessment.

5.4.1 Gathering information about the plan or project and the Natura 2000 site(s)

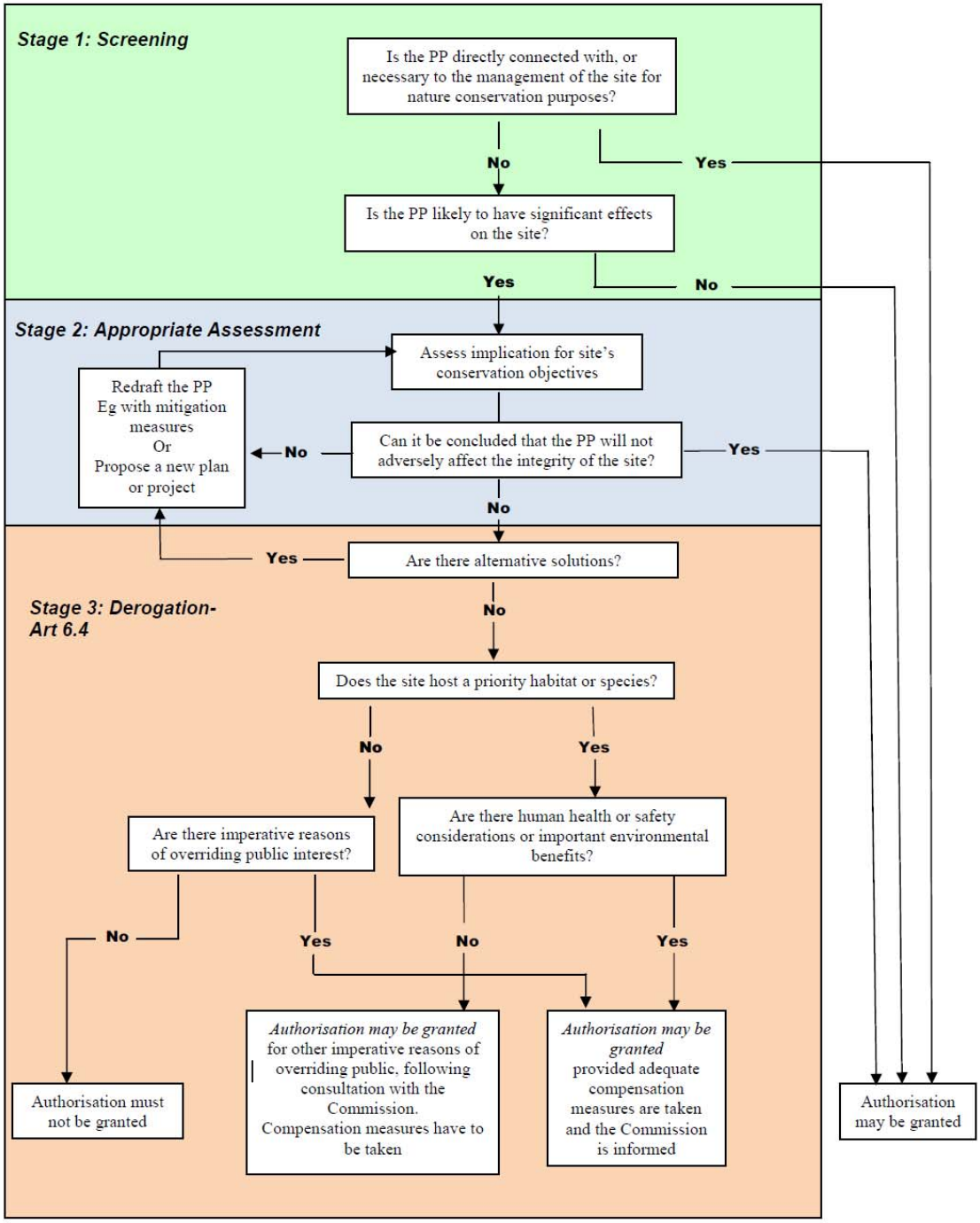
The screening exercise is usually carried out by the authority responsible for the adoption of the plans or the approval of development applications and/or the nature authorities. Most often they will seek the assistance of, and base their evaluation on, the information received from the developers, environmental authorities or contracted experts. The collaboration of nature conservation authorities is crucial, as they can provide all the relevant information on the Natura 2000 sites that should be taken into account at this stage.

[53] Case C-98/03 paragraph 32: "…In its definition of measures to be subject to an assessment of the implications, the Directive does not distinguish between measures taken outside or inside a protected site."

[54] See Judgement of the ECJ on case C-226/08 (Papenburg). “Ongoing maintenance works which were authorized under national law before the expiry of the time-limit for transposing the Habitats Directive, must, to the extent that they constitute a project and are likely to have a significant effect on the site concerned, undergo an assessment of their implications for that site where they are continued after inclusion of the site in the list of SCIs pursuant to the third subparagraph of Article 4(2) of that directive”.

[55] See Waddensea ECJ ruling C-127/02

Figure 7. Flow chart of Article 6(3)-(4) procedure



To carry out the screening exercise, sufficient information should be gathered both on the aquaculture plan or project and on the Natura 2000 site(s) that might be affected. In the case of the plan or project, this information should include data on the location of the farm and associated infrastructures in relation to the Natura 2000 site(s), as well as details on the timing and duration of all the planned activities during each stage of the project's cycle, i.e. construction, operation, maintenance, etc.

Information must also be gathered on the species and habitat types for which the sites have been designated and on the overall conservation objectives of the site (see further details under 5.5). Part of this information can be found in the Natura 2000 Standard Data Forms or in the site designation or management plans where available.

Natura 2000 Standard Data Form

The Standard Data Form which is available for each Natura 2000 site contains information on the EU protected species and habitat types for which the site has been designated (often referred to as 'target features') and provides a broad assessment of the condition of each species or habitat type on that site (scored from A to D). It provides information about surface area, representativity and conservation status of the habitats present in the site, as well as the global assessment of the value of the site for conservation of the natural habitat types concerned. For the species present in the site, information is provided on their populations, status (resident, breeding, wintering, migratory) and on the site value for the species in question.

Conservation measures and management plans

For special areas of conservation, Member States shall establish the necessary conservation measures involving, if need be, appropriate management plans specifically designed for the sites or integrated into other development plans, and appropriate statutory, administrative or contractual measures which correspond to the ecological requirements of the natural habitat types in Annex I and the species in Annex II present on the sites.

When available, Natura 2000 management plans can provide information about the sites' conservation objectives, the location and status of the species and habitats occurring in the site, their threats and the *conservation measures required to improve their conservation status, which can be useful for the screening stage and for the appropriate assessment.*

It is worth recalling that the initial screening undertaken here is not the same as a full-scale Appropriate Assessment – it only requires sufficient information to be able to decide if there is likely to be a significant effect or not.

It is strongly recommended that information on the Natura 2000 site is gathered prior to the design of a plan of project (i.e. even before screening stage) so that possible sensitivities regarding nature and wildlife can be identified and taken into consideration during the preparation of a development proposal. This could, for instance, influence the choice of location for the farm as well as its actual design so that only the most appropriate sites are taken forward.

It is also very useful, at an early pre-screening stage, for developers to hold initial discussions with their planning authority and with the statutory nature conservation authorities to learn more about the potential environmental constraints the project might face and how these might be best avoided. This could also help to identify any potential issues to watch out for or any gaps in scientific knowledge that might need further investigation before the plan or project is approved.

Experience has shown that good research and consultation right from the start before work begins on the development proposal helps to avoid unnecessary time and expense on unsuitable sites later on.

***Key activities at the stage of screening**:*

- *Identify the geographical scope of the plan or project, and its main characteristics*
- *Identify all Natura 2000 sites that might be affected by the plan or project.*
- *Identify the qualifying interests of the Natura 2000 sites concerned (i.e. the habitats and species for which the sites are designated) and the sites' conservation objectives.*
- *Identify which of those species and habitats could be affected by the planned activities*
- *Analyse other plans or projects which could, in-combination with the planned activities, give rise to a likely significant effect on Natura 2000 sites.*
- *Analyse all possible interactions between the plan or project activities, either individually or in combination with other plans or projects, and the qualifying interests, the ecological functions and processes that support them.*
- *Determine whether significant impacts are likely to occur, justify the conclusion and record the final decision of the screening stage.*

5.4.2 Determining if the plan or project "is likely to have a significant effect"

An Appropriate Assessment will only be required for those plans or projects that are '….*likely to have a significant effect ...'*. The first step is therefore to identify which of the species and habitats for which the Natura 2000 has been designated (the qualifying interests) could be significantly affected by the planned activities.

All the potential pressures from the planned aquaculture activities, either through direct overlap (e.g. sedimentation on seabed areas) or induced at a larger scale (e.g. nutrient enrichment), that might have significant effects on the conservation objectives of the Natura 2000 site should be identified and the sensitivity and vulnerability of the relevant species and habitats to those pressures should be considered to assess the risk of significant effects.

The emphasis is on a **'likelihood'** of significant effects – not certitude. This shows the precautionary nature of this initial test. The biodiversity elements liable to be affected (habitats, species, ecological processes) should be determined, taking into account their sensitivity in relation to the planned activities. Where the preliminary evaluation indicates that there may be grounds for concern, or where there is a doubt whether the effects are likely to be significant or not, an Appropriate Assessment must be carried out to ensure that these potential effects can be studied in full. The lack of information or data cannot be used as a reason for not carrying out an Appropriate Assessment[56].

The **significance of the effects** is linked **to the site's conservation objectives** and will depend on the **degree** of the impact and the **sensitivity** or vulnerability of habitats and species to the potential pressures and impacts from the aquaculture activities. The degree to which a particular area is impacted by a particular pressure varies depending on the species and habitats present in the area and on the pressure involved. Effects must also be considered for other species and habitats that may be important (e.g. as a food source, for breeding or refuge, etc.) for the species and habitats for which the site has been designated, which can be included in the conservation objectives for that reason. In assessing the potential effects of a plan or project, their significance must be established in the light, inter alia, of the characteristics and specific environmental conditions of the site concerned by that plan or project[57].

The analysis of sensitivity of marine habitats has been the focus of recent projects and studies that are relevant to this guidance document. The *Marine Life Information Network* (MarLIN), an

[56] ECJ ruling C-127/02 Waddensea, paragraph 43 et. seqq.:
[57] Case C-127/02, paras 46-48

initiative of the Marine Biological Association of the United Kingdom, has undertaken an assessment of sensitivity to different impacts for habitats around the coasts of Britain and Ireland[58].

A recent study in Ireland has carried out an assessment of potential impacts of pressures associated with human activities on sea bed habitats (Crowe et al 2011)[59]. The study involved a systematic review of the literature and consultation with appropriate experts and analysed the resistance of sea bed habitats to potential impacts of different pressures on extent and quality, as well as the likely time to recovery (resilience).

In relation to species and habitats' potential sensitivity to impacts of aquaculture, some countries (e.g. France and United Kingdom) have published guidelines to help identify the potential negative effects derived from fish farming activities on some habitats and species of the Habitats and Birds Directives. Some other national initiatives provide useful tools and information to support marine species and habitat conservation, sustainable management, protection and planning. Relevant information sources are included in Annex 2.

5.4.3 Assessing the risk of potential cumulative effects with other plans and projects

The screening process applies to plans or projects either individually or *in combination with other plans or projects*. It may be that one aquaculture project alone might not have a significant effect but, if taken in combination with other plans or projects (other fish farms or other developments) within the area, the cumulative effects may turn out to be significant. It is necessary at the stage of screening to identify other plans or project which might have combined effects on the site with the project under assessment.

The geographical scale over which these cumulative effects need to be considered will depend on the exact circumstances and scale of the plan or project being studied but should cover a sufficiently large area to capture any cumulative effects. The relevant nature conservation authorities will be able to help identify the possible plans or projects that need to be considered as part of the in-combination test.

5.4.4 Recording the screening decision

As screening is a legal requirement, the reasons for the final decision is to whether or not to carry out an Appropriate Assessment should be recorded and sufficient information should be given to justify the conclusion.

If the conclusion of screening is that no significant effects on Natura 2000 sites are likely to occur, there is no need to proceed further. Where it is concluded that the planned activities are likely to cause significant effects on the site, the screening stage can also be useful to identify the issues to be considered in detail in the Appropriate Assessment.

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[58] MarLIN 2005. Marine life protection. Marine Life Information Network: Biology and Sensitivity Key Information Sub-programme [on-line]. Plymouth: Marine Biological Association of the United Kingdom. Available at: http://www.marlin.ac.uk

[59] A framework for managing sea bed habitats in near shore Special Areas of Conservation. Tasman P. Crowe, Jayne E. Fitch, Chris L. J. Frid & Paul J. Somerfield. Report for the Department of the Environment, Heritage and Local Government, Ireland. April 2011

EXAMPLE OF TEST OF LIKELY SIGNIFICANT EFFECT ('SIGNIFICANCE TEST')

Mussel seed cultivation in the Wash and North Norfolk Coast European Marine Site (SAC), England

The assessment of impacts of mussel cultivation activities considered issues at the on-growing and harvesting stages of mussel cultivation, but not the seed collection stage – which is subject of another consent procedure. The Test of Likely Significant (TLS) Impact was prepared by the consenting authority and submitted to the nature conservation authority (Natural England). The TLS concluded that the leasing of plots for shellfish cultivation was not necessary for conservation management purposes, and that the leases were likely to have a significant effect on the site. The specific issues were: changes in nutrient levels (through the presence of a large additional biomass of mussels compared with the natural level), and the smothering of natural biotopes by covering with cultivated mussel beds or disturbed and re-settled sediments. Table below provides a summary of some of the potentially affected features, the relevant conservation objectives for those features, and the potential impact mechanisms for effects resulting from the mussel cultivation activities. It shows the issues to be considered in detail in the appropriate assessment, based on Natural England's scoping advice for this review.

Conservation features or sub- features	**Potential impact mechanisms from mussel cultivation activities**	**Significant: to be considered in full appropriate assessment**	**Relevant conservation objectives (outlines)**
Intertidal mudflats and sandflats	Physical loss by smothering.	Yes, the intertidal area potentially lost through smothering because of shellfish cultivation is not significant compared with the total extent of intertidal area in the Site, but the proportion of individual biotopes affected needs to be considered.	Biotope composition of littoral sediment – maintain the variety of biotopes in each sub-feature (mud, muddy sand, sand & gravel), allowing for natural succession / known cyclical change. Sediment character (sediment type) – maintain distribution of mud, muddy sand, sand & gravel, allowing for natural succession / known cyclical change. Extent of characteristics biotopes Distribution of biotopes – maintain distribution of biotopes in each sub-feature (mud, muddy sand, sand & gravel), allowing for natural succession / known cyclical change Species: composition of characteristic biotopes.
	Physical damage by abrasion	No, no potential for significant damage through abrasion since mussel dredge scoops mussel from surface of pseudofaeces but does not abrade intertidal substratum.	
	Biological disturbance through selective introduction of species	No: *Mytilus edulis* occurs naturally within this sub-feature. Presence of mussels increases epifaunal diversity compared with original substratum, though cultivated mussel beds less divers than natural beds (cultivation leases not granted in natural mussel or cockle bed areas).	
Subtidal sandbanks	Physical loss by smothering.	Yes, the intertidal area potentially lost through smothering because of shellfish cultivation is not likely to be significant compared with the total extent of subtidal sandbanks in the Site, but this needs further evaluation in the full assessment.	Extent – no change in extent of sublittoral sediment habitat Distribution – maintain the pattern of distribution of predominant habitats throughout the feature (within "Large shallow inlets and bays" feature)
	Physical damage by abrasion	No, no potential for significant damage through abrasion since mussel dredge scoops mussel from surface of pseudofaeces but does not abrade intertidal substratum. Cultivated mussel lays primarily in intertidal areas with only very small spill-over into adjacent shallow subtidal areas.	
	Biological disturbance through selective introduction	No: *Mytilus edulis* occurs naturally within this sub-feature. Presence of mussels increases epifaunal diversity compared with original substratum, though cultivated mussel beds less	

	of species	divers than natural beds (cultivation leases not granted in natural sublittoral mussel bed areas).	
Large shallow inlets and bays	Changes in nutrient and/or organic enrichment	Yes: There is potential for significant changes in nutrient levels through the presence of large additional biomass of filter-feeding and faeces/pseudo-faeces-producing mussels compared with natural levels. Potential competition for food with natural cockle and mussel populations. Extent and impacts of changes require further evaluation in full assessment	Water quality – target values should default to appropriate national or international standards where appropriate. If sufficient local data are available to establish the baseline condition, site-specific targets can be set.
Common seal (Harbour seal)	Physical loss through smothering Disturbance through noise or visual presence	Smothering – Yes, the intertidal area potentially lost through smothering because of shellfish cultivation is not significant compared with the total extent of intertidal area in the Site, but the proportion of seal haulout sites affected needs to be considered. Disturbance – No: the unobtrusive nature of lay activities, habituation by Common seals to human activity, and location of mussel lays away from identified haulout sites means that lay activities are not likely to cause significant disturbance to this feature	Extent (distribution of moulting harbour seals within the site) – a stable or increasing area of usage within the site Population – a stable or increasing number of harbour seals throughout the site
Sabellaria spimulosa reef	Physical loss through smothering Physical damage by abrasion	Yes, possibly mussels lays are not granted in or adjacent to areas where *Sabellaria spimulosa* occurs. However, the potential for smothering *Sabellaria spimulosa* reef within the Site as a result of disturbance and re-settlement of sediment resulting from shellfish cultivation needs further evaluation in the full assessment. No, mussel lays are not permitted in or adjacent to areas where *Sabellaria spimulosa* reef occurs.	Extent – no change in extent of *Sabellaria spimulosa*reef allowing for natural succession / known cyclical change
SPA species Non-breeding birds, non-breeding Annex I birds, non-breeding assemblage of > 20,000 waterfowl	Disturbance through noise or visual presence Biological disturbance through selective extraction / introduction of species	No – the Tofts, Roger, Thief and Hull Sands are bird-rich core areas but there is no evidence that either relaying or dredging mussels, or lay inspection on foot, have a significant disturbance effect on SPA species. No: *Mytilus edulis* occurs naturally within the Site. Presence of cultivated mussels provides additional food supply to mussel-predating SPA-species and to birds feeding on associated epifauna. This Review does not consider origin of seed mussel (since that aspect is not regulated by the WFO).	Habitat extent – no decrease in extent from established baseline, subject to natural change. Population size (non-breeding birds, non-breeding Annex I birds, non-breading assemblage of > 20.000 waterfowl) – populations must not decline by 50% or more from recorded baselines

STAGE 2. CARRYING OUT THE APPROPRIATE ASSESSMENT

5.5 The purpose of the Appropriate Assessment

The purpose of the Appropriate Assessment (AA) is to assess the implications of the plan or project **in respect of the site's conservation objectives**, taking into account any cumulative effects which result from the combination of that project with other plans and projects. The AA must precede the approval decision and enable the competent authority to ascertain whether the plan or project would not adversely affect the integrity of the site.

It is the responsibility of the competent authority to ensure that the AA is carried out. In that context the developer may be required to provide all necessary information to the competent authority in order to enable the latter to take a fully informed decision. In so doing the competent authority may also collect relevant information from other sources as well.

The term '*appropriate*' essentially means that the assessment needs to serve the aim of the Habitats and Birds Directives – i.e. that of conserving the species and habitat types of European importance covered by the two Directives in the context of the conservation objective of the Natura 2000 sites, and that the assessment has to be a *reasoned* decision – i.e. to disclose the reasoned basis for the subsequent decision.

In this respect, it is important to recall that, in contrast to the EIA or SEA, the outcome of the Appropriate Assessment is legally binding for the competent authority and conditions its final decision. Thus, if it cannot be ascertained that there will be no adverse effects on the integrity of the Natura 2000 site, even after the introduction of mitigation measures, then the plan or project cannot be approved, unless the conditions of Article 6(4) are met. This applies also in the case of doubt over the impacts.

Steps for an Appropriate Assessment of aquaculture plans and projects

5.5.1 Determine the scope and focus of the assessment: setting the baseline and gathering further information

The focus of the Appropriate Assessment should be on the possible effects of the plan or project on the habitat types and the species for which the Natura 2000 site is designated. This should also include any indirect effects on these species and/or habitat types, for instance on their supporting ecosystems and natural processes. Scoping will ensure that the AA is well focused and provides clear terms of reference for evaluating the potentially negative effects of the aquaculture project on the conservation objective of the Natura 2000 site(s). Its aim is to identify more precisely what impacts the AA should cover and to ensure that all necessary information is gathered to enable these impacts to be assessed correctly.

The terms of impact analysis should be agreed with the authorities in order to improve the cost-efficiency of the evaluation procedure and simplify the process. At this stage it is also useful to define the study area; some modelling tools are available to predict the areas where effects from s possible aquaculture pressures (e.g. sedimentation, nutrient enrichment) can be noticed, taking into account the local conditions (eg. currents, depth, etc.).

This stage builds on the information already gathered under the screening exercise but, this time, any gaps in knowledge should also be filled in as far as possible so that the assessment can be made on sound scientific grounds. **Sound baseline data is of vital importance as the AA has to be able to ascertain with certainty that the proposal will not affect the integrity of the site concerned.**

Information needed for the AA and who is expected to provide the information

The **information about the plan or project** should contain details of all elements that are relevant for the assessment, including the following:

- Information on all the activities involved in the aquaculture development
- Maps with precise location of all the aquaculture activities and associated works (in relation to the Natura 2000 site(s) in the given area);
- Details about the implementation, duration and timing of all the aquaculture activities (construction, operation and maintenance, harvesting, etc.)
- Details about mitigation measures to be applied in relation to the potential impacts.

This information is usually expected to be provided by developers.

The **information about the Natura 2000 site** should contain relevant details on the following:

- The conservation objectives of the site and the conservation measures set, including management plans etc;
- On each species and habitat type for which the site is designated and suitable maps of their location within the site over time (eg over an annual lifecycle);
- Evaluation of extent and quality of habitats and species in the site.
- Data on the usage of the site for activities such as foraging, breeding, resting, staging or hibernating, by relevant species;
- Data on the representativity and conservation status of habitats and species in the site and in general (including, inter alia, data on population size, degree of isolation; ecotype, genetic pool; age class structure, etc.);
- Data on ecological structure and functioning of the site and its overall conservation state;
- The role of the site within the biogeographical region and the Natura 2000 network;
- Any other aspects of the site or its wildlife that is likely to have an influence on its conservation state and objectives (eg current management activities, other developments..)

This information should be provided by the competent authorities for Natura 2000, which are responsible for setting conservation objectives and conservation measures for the Natura 2000 sites.

Details of any **other plans or projects in the area** whether planned or already on-going.

The authorities responsible for giving the consent and the competent nature conservation authorities should identify the possible plans or projects that need to be considered to assess possible cumulative effects; information could also be gathered by the operator wherever possible.

In some cases, further baseline ecological and survey field work may be necessary to supplement existing data. Detailed surveys and fieldwork should focus on those qualifying interests that are sensitive to the project actions.

Sensitivity should be analysed taking into account the possible interactions between the project activities (nature, extent, methods, potential pressures and effects, etc.) and the habitats and species concerned (location, ecological requirements, vital areas, behaviour, etc.). Such survey work should be based on agreed scoping with relevant competent public authorities, appropriate nature conservation public bodies, aquaculture sector, NGOs, scientists and the public.

Information gathering is necessarily an iterative process. If the first identification and analysis of effects reveals that there are important gaps in knowledge, then further surveys and monitoring work will need to be undertaken in order to complete the picture. This will ensure there is a sufficient basis of scientific knowledge to be able to make a reasoned decision.

Detailed surveys may also help design the proposed activities in a way that prevents any possible adverse effects on the sites' qualifying features (see example below).

Fish farms in Loch Sunart, Scotland

In 2005 Marine Harvest Scotland carried out a major restructuring of its operations within Loch Sunart SAC; 9 salmon and halibut farms were consolidated into 3 larger salmon farms with the remaining leases surrendered or made dormant. The consolidation resulted in smaller farms in shallower water being surrendered in favour of deeper sites (greater than 30m of water). Appropriate assessments were carried out on the whole of Loch Sunart during the consolidation project. The Annex I habitats present as a qualifying feature include reefs which are present in Loch Sunart. The Annex II species that are a primary reason for selection of this site includes the otter (Lutra lutra).

Video surveys of the seabed were completed prior to finalising these development proposals. The aim of these baseline studies was to determine whether any qualifying features were present in areas of potential impact. The development proposals were then adapted accordingly to prevent significant impacts to the integrity of the SAC.

Advice and guidance was taken from Scottish Natural Heritage as to the most appropriate method of positioning moorings avoid impact on qualifying features (reefs. Drop down cameras were used during installation to prevent mooring equipment from being installed upon qualifying reef species.

Source: Marine Harvest (Scotland) Ltd., Scottish Salmon Producers' Organisation, Joint Nature Conservation Committee.

5.5.2 Assessing the impacts on the Natura 2000 site

The Appropriate Assessment should address the potential effects on the conservation objective of the Natura 2000 site from all the aspects of the plan or project, and cover all the stages of the aquaculture project, for instance: site preparation, building or installation of infrastructure and facilities, operation and maintenance activities, decommissioning, etc.

It will be useful to describe the precise location, timing, frequency and duration of all the activities involved in the aquaculture development. This is necessary to analyse the potential pressures and impacts which may occur at different times of the year or of the day. Details of potential ecological effects of each activity on the site, their sources and the mechanism by which the impact may occur should also be provided.

Table 5. Example of seasonal, daily and tidal profile of activities associated with mussel production in a shellfish farm in the Atlantic Region[60]

Activity	Low tide	High tide	Day	Night	J	F	M	A	M	J	J	A	S	O	N	D
SEED MUSSEL FISHERY: Dredging of seed mussel in the fishery area		X	X									L	H			
NURSERY: Placement of seed in the nursery and husbandry of seed	X	X	X		L	L	L	L	L				H	L	L	L
ONGROWING: Dredging of transplanted seed mussel from intertidal to subtidal ongrowing areas		X	X							H	H	H				
HARVESTING: Dredging of mussels from the sub-tidial channel for harvest and sale		X	X		H	L	L						L	H	H	H
Disturbance (related to mussel production, other fishing and aquaculture and recreation)	X	X	X		L	L	L	L	L	L	L	L	L	L	L	L

X= Activity, H= high levels of activity, L= Low levels of activity

Table 6. Example of potential impacts of mussel cultivation –lay activities– on SPA interests[61]

Activity	Frequency	Duration	Impact mechanism	Impact score (0 = no impact; 5 = severe impact)
Ground inspection (on-foot inspection of lay area usually by 1 - 3 persons)	Infrequent: (2-3 times every month per lay)	Two hours, over low water period	Disturbance (visual presence)	**1** Low frequency and low density activity; oystercatchers habituate to human presence.
Deposition of mussel seed onto lays from fishing vessel over high water	Variable: Frequent (up to twice per week) during peak re-stocking period; No activity (for two to three years during on-growing period).	Two hours, over high water period	Disturbance (noise and visual presence);	**0** Eider ducks loaf or feed in area during high water periods but are habituated to presence of fishing vessels and resilient to disturbance. Other SPA species not present over high water.
			Smothering of underlying habitat by deposition of mussels;	**2** Local impact on underlying habitats but not considered to have an adverse impact on the European site because of relatively small area of habitat affected. [Smothering considered in original Review of Consents Report (ESFJC July 2008).]
			Biological disturbance through introduction of large biomass of prey species	**2** Alters natural feeding patterns – e.g. eider ducks predate heavily on cultivated mussels – can cause positive impact on SPA populations for duration of on-growing period.
Harvesting of cultivated mussels from lays	Variable: Frequent (up to daily) during peak harvesting period (December to March); No activity (for up to three years) during on-growing period.	Two hours, over high water period	Disturbance (noise and visual presence);	**0** Eider ducks loaf or feed in area during high water periods but are habituated to presence of fishing vessels and resilient to disturbance. Other SPA species not present over high water.
			Biological disturbance through selective extraction of (introduced) prey species	**2** Removal of cultivated mussels could adversely affect mussel-predating bird species (oystercatcher and eider) when natural mussel stocks are low, but cultivated mussels are human interference to the ecosystem and could be argued to support "artificially" high numbers of dependent bird species when natural stocks are low. If SPA populations were adversely affected as a direct result of harvesting mussels from WFO lays it could be regarded as a population shift back to the natural equilibrium.

[60] Adapted from: Appropriate Assessment of the impact of mussel fishing and mussel, oyster and clam aquaculture on Castlemaine Harbour SAC and SPA, Marine Institute, Ireland. 2011).

[61] Source: Mussel Cultivation in The Wash. Assessment. Additional Information. ESFJC. 2008

Chapter 3 gives an overview of the kind of effects that may be associated with aquaculture systems and identifies the species or habitat types that have proven to be particularly vulnerable to this form of development. The effects of each project will be unique and must be evaluated on **a case-by-case basis**.

The impacts of the plan or project should be measured against the site's conservation objectives. For instance if the objective is to ensure that the population of a bird species reaches a certain population within 10 years and conservation measures are foreseen to ensure this happens, will the plan or project prevent this conservation objective from being realised? If no specific conservation objectives have been set then it can be taken that the conservation objective is to prevent further deterioration of the site and its target features from the time it was included in the Natura 2000 network (Article 6(2) of the Habitats Directive).

Conservation objectives

The conservation objectives for a Natura 2000 site are determined at member state level. The SDF provides information regarding the qualifying interests of a Natura 2000 site and, in the absence of more detailed definition of conservation objectives for a Natura 2000 site, they can be considered as such. Some countries have developed more detailed conservation objectives for their Natura 2000 sites either at a strategic level across a suite of sites, or at an individual site level. Some sites may also have management plans or management objectives that provide clear indications about the conservation objectives to be attained.

Examples of site-specific conservation objectives developed for Annex I habitats may include, for instance, keeping certain habitat area stable or increasing; for species occurring in the site, conservation objectives can set e.g. population numbers to be maintained, long term population trend stable or increasing or distribution area to be preserved. Adequate baseline information is needed to set site-specific conservation objectives.

The site's qualifying interest and conservation objectives should have been already identified in the screening stage. At this stage however more detailed information may be needed to be able to properly conduct the assessment.

In this regard, it may be useful to consider the parameters that are used to assess the conservation status of habitats and species of EU interest. As regards habitats, these parameters include the range, the area covered by the habitat type within its range, as well as specific structures and functions (including typical species)[62]. These parameters can also be useful both for setting conservation objectives (at the site level) and for the assessment of the effects of aquaculture activities on habitats and species for which the site has been designated.

The assessment should analyse any possible change or deterioration of the extent and quality of habitats and species present in the site, based on the potential effects identified for the different project activities and on the location, status and sensitivity of those habitats and species.

[62] A first assessment of the conservation status of the species and habitats protected under the Habitats Directive was published in 2009. This provides useful information on the conservation status of each of the species and habitats listed in the Habitats Directive per country and biogeographical region.

Example of conservation objectives considered in the Appropriate Assessment

AA of aquaculture developments in Castelmaine Harbour SAC and SPA (Ireland)

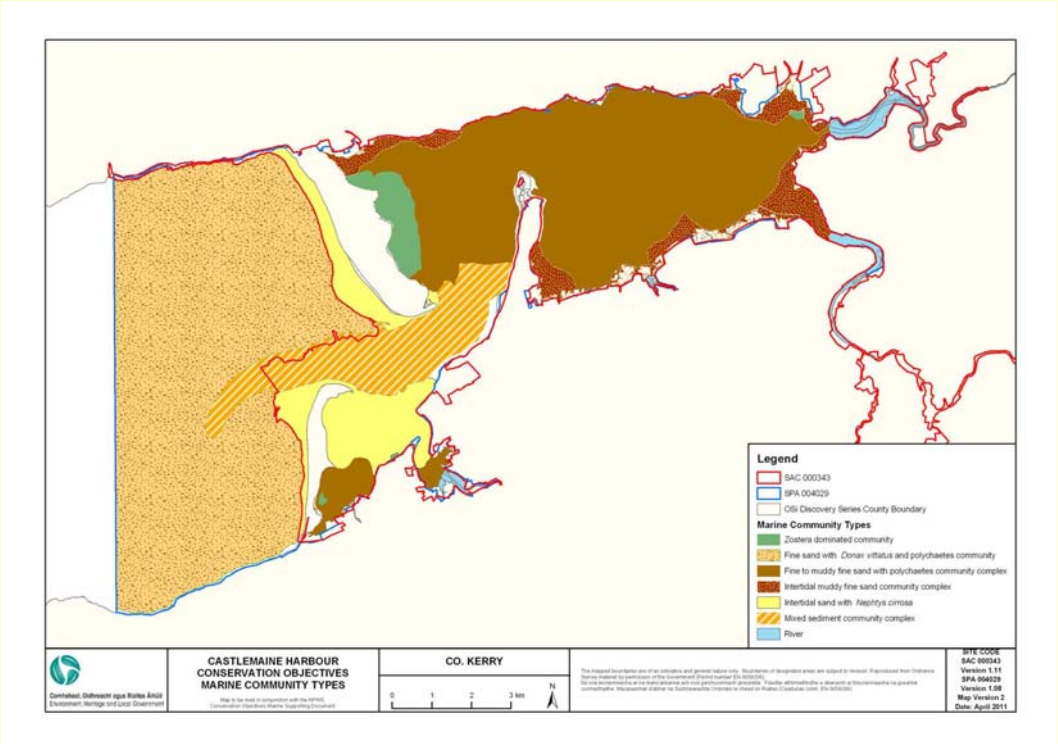
A full appropriate assessment process was conducted for multiple aquaculture and supporting projects in Castlemaine Harbour SAC and SPA. The site-specific conservation objectives set by the nature conservation authorities (National Parks and Wildlife Service, NPWS) for the site were considered in the AA:

- To maintain the favourable conservation condition of the following species: sea lamprey, river lamprey, salmon, otter, petalwort, red throated diver, cormorant, light bellied brent geese, wigeon, mallard, pintail, scaup, common scoter, oystercatcher, ringed plover, sanderling, bar tailed godwit, redshank, greenshank, turnstore and chough.
- To maintain the favourable conservation condition of the following habitats: estuaries, mudflat and sandflats not covered by seawater at low tide, annual vegetation of driftlines, perennial vegetation of stony banks, salicornia and other annuals colonising mud and sand, Atlantic salt meadows, Mediterranean salt meadows, embryonic shifting dunes, shifting dunes along the shoreline with *Ammophila arenaria*, fixed coastal dunes with herbaceous vegetation (grey dunes), dunes with *Salix repens ssp. argentea* (*Salix arenariae*) and humid dune slacks.
- To restore the favourable conservation condition of alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior.*

An example of specific conservation objectives and targets for a marine habitat included in Annex I of the Habitats Directive to facilitate the appropriate assessment process is presented below.

Objective: to maintain the favourable conservation condition of Mudflats and sandflats not covered by seawater at low tide in Castlemaine Harbour, which is defined by the following list of attributes and targets.

- Target 1: The permanent habitat area is stable or increasing, subject to natural processes
- Target 2: The extent of the Zostera dominated community is conserved, subject to natural processes.
- Target 3 The following community types should be conserved in a natural condition: Intertidal muddy fine sand community complex; Fine to muddy fine sand with polychaetes community complex; Intertidal sand with *Nephys cirrosa*.



Once all the necessary baseline data has been gathered, the assessment of the potential impacts can begin. As described above this should be done in light of:

- best scientific knowledge in the field (ECJ Ruling on case C-127/02)
- site conservation objectives;
- ecological characteristics and conservation condition of the site and its target features.

The appraisal of effects must be based on objective and, if possible, quantifiable criteria. A common means for that is through the use of key indicators, such as habitat loss or degradation, species population affected, key ecological functions altered, etc. Some possible attributes to be considered in the assessment are presented in the following table.

Table 7 Some examples of attributes considered in the assessment of potential effects, in relation to possible conservation objectives at the site

Attributes	***Conservation objectives***	***Assessment of effects***
Habitat area	The area occupied by the target habitats should be stable or increasing (overall target areas can be set).	Possible reduction of habitat areas (estimated surface and percentage of total area in the site).
Habitat structure and function	The communities of target habitats should be stable in distribution and composition. Habitat functions and the ecological parameters on which the habitat persistence depends are maintained.	Possible losses in distribution area, deterioration in species composition, disturbance of typical species, etc. Loss or degradation of functions (e.g. as feeding, refuge or breeding areas)
Species abundance and distribution, population structure, etc.	Species populations are stable or increase (target numbers can be set). Population trends are improving. Species distribution, including vital areas and connectivity, is maintained or improved (e.g. through habitat improvement and re-colonisation of improved areas). Population structure is conserved.	Species disturbance and displacement from areas that it would otherwise occupy. Changes in the numbers or distribution areas used by the target species. Loss or degradation of critical habitats and vital areas (surface affected and percentage of total area in the site). Effects on critical stages in the species-life cycle.

Example of parameters that may be considered in the appraisal of effects on habitats/species of Community interest that have justified the site designation

- Total amount of affected habitat and percentage in relation to the estimated total habitat surface within the Natura 2000 site.
- Estimated number of affected individuals and proportion of the species population occurring in the site.
- Estimated habitats and species population trends in the affected area and on the site.
- Rarity and overall trends of affected habitats and species;
- Existence of a habitat or species restoration programme which may be affected by the project.
- Reversibility of the effect or potential recovery of damaged elements from existing sources inside or outside the site.
- Distribution of concerned habitats or species distribution within the Natura 2000 site (continuous, scattered, dispersed, etc.)
- Effects on the overall ecological functioning of the Natura 2000 site.

Predicting the likely impacts of an aquaculture project/plan can be difficult as one should have a good understanding of ecological processes of the environment and conservation requirements of particular species or habitat types likely to be affected. Cooperation between operators and authorities is crucial in the appropriate assessment. It is strongly recommended that the competent authorities secure the necessary expert advice and support in carrying out the field surveys and impact assessment.

The assessment should apply the best available techniques and methods to estimate the extent and magnitude of the effects. A number of models are currently available, for instance, to simulate and predict the effects of nutrient enrichment from fish farms over marine areas.

Commonly used methods for predicting impacts:

Some of the techniques commonly used are listed below:

- *Direct measurements*, for example of areas of habitat lost or affected, proportionate losses from species populations, habitats and communities.
- *Flow charts, networks and systems diagrams* to identify chains of impacts resulting from direct impacts; indirect impacts are termed secondary, tertiary, etc. impacts in line with how they are caused. Systems diagrams are more flexible than networks in illustrating interrelationships and process pathways.
- *Quantitative predictive models* to provide mathematically derived predictions based on data and assumptions about the force and direction of impacts. As regards aquaculture projects, predictive modelling often plays an important role as some impacts often depend on hydrological conditions that may influence for instance sedimentation processes that may affect the underwater biota.
- *Population level studies* are potentially beneficial for determining population level effects of impacts to bird or bat or marine mammal species, for instance.
- *Geographical information systems (GIS)* used to produce models of spatial relationships, such as constraint overlays, or to map sensitive areas and locations of habitat loss. GIS are a combination of computerised cartography, storing map data, and a database-management system storing attributes such as land use or slope. GIS enable the variables stored to be displayed, combined, and analysed speedily.
- *Information from previous similar projects* may be useful, especially if quantitative predictions were made and have been monitored in operation.
- *Expert opinion and judgment* derived from previous experience and consultations on similar projects
- *Description and correlation*: physical factors (eg water regime, current, substrate) may be directly related to distribution and abundance of species. If future physical conditions can be predicted then it may be possible to predict future developments of habitats and populations or responses of species and habitats on this basis.
- *Carrying out assimilative and capacity analyses* involves identifying the threshold of stress below which populations and ecosystem functions can be sustained. It involves the identification of potentially limiting factors, and mathematical equations are developed to describe the capacity of the resource or system in terms of the threshold imposed by each limiting factor.
-

Adapted from: "Assessment of plans and projects significantly affecting Natura 2000 sites. Methodological guidance on the provisions of Article 6(3) and (4) of the Habitats Directive 92/43/EEC"; http://ec.europa.eu/environment/nature/natura2000/management/docs/art6/natura_2000_assess_en.pdf.

Impacts should be predicted as precisely as possible, and the basis of these predictions should be made clear (this means also including some explanation of the degree of certainty in the prediction of effects). Wherever possible, predictions should be presented in such a way as to make them verifiable.

For each effect identified, the significance of the impact will depend on a number of relevant parameters such as: the magnitude of the impact, the extent, the duration, the intensity, the timing, the probability, etc.

Example: Methods for the assessment of effects.

Appropriate Assessment of mussel fishing and mussel, oyster and clam aquaculture on Castlemaine Harbour SAC

The significance of the possible effects of the proposed activities on habitats is determined on the basis of Conservation Objective guidance prepared by the nature conservation authority (National Parks and Wildlife Service, NPWS), considering:

1. The degree to which the activity will disturb the qualifying interest. By disturb it is meant a change in the characterising species, as listed in the Conservation Objective guidance for constituent habitats.
2. The persistence of the disturbance in relation to the resilience of the habitat.
3. The area of habitats or proportion of populations disturbed. A percentage is set above which an effect shall be considered significant.

An example for two of the project activities is shown below:

Activity	Relevant ecological effects (from statement of AA)	Habitat affected	Community affected within habitat	FCS Parameter	FCS following proposed activity	Significance of impact	Rationale	Supporting evidence	Confidence
2. Dredging of seed mussel from the intertidal sand flat	Dredging effectively removes the mussel bed from the area thereby changing the existing biota in the dredged area Dredging can potentially displace fine materials onto sensitive *Zostera* communities west of the nursery area	1140/1130	Fine to muddy sand with polychaetes community complex; intertidal muddy fines sand community complex	Habitat area	Stable (4.3% and 5.7% for habitats 1140 and 1130, respectively)	Minor and temporary	The % overlap of activity with any benthic Community is less than 15%.	GIS	High
				Community distribution	Stable (6.8% and 2.1% area altered or affected, respectively)	Minor and temporary			High
				Area occupied by seagrass on sand	Stable	None			High

Activity	Relevant ecological effects (from statement of AA)	Habitat affected	Community affected within habitat	FCS Parameter	FCS following proposed activity	Significance of impact	Rationale	Supporting evidence	Confidence
6. Intertidal culture of clams	Preparation of beds and relaying of seed can dominate existing fauna leading to change in community structure. Dredging effectively removes the infauna and disturbs sediments and leads to changes in fauna	1130/1140	Intertidal sand with Nephtys cirrosa ; Fine to muddy sand with polychaetes community complex	Habitat area	Stable (nominal overlap of 0.3% of 1130 and 0.4% of 1140)	Minor	The % overlap of activity with Habitat and Community is below 10 and 15% respectively.	GIS	High
				Community distribution	Stable (2.21% and 0.1% overlap, respectively)	Minor			High

FCS: Favourable Conservation status (as measured by the parameters) indicated

5.5.3 Considering the cumulative effects

Cumulative effects may arise when several aquaculture projects are present within a given area, or as the result of the combined impacts of aquaculture and other types of activity (e.g. fishing, recreation, etc.); this points to the benefits of strategic planning (see Chapter 4).

In many coastal areas multiple human activities overlap and the combined effects of more than one activity can lead to a greater or lesser impact than each acting individually (an interactive effect). When decision making occurs it is important to consider the potential additive or interactive (synergistic or antagonistic) effects of pressures and the subsequent impacts they may cause.

For example, seafloor disturbance aside, an area with active fin fish aquaculture may benefit, ecologically, from the introduction of algal or shell fish aquaculture because these species effectively consume excess nutrients derived from fin fish aquaculture (an antagonistic effect). On the other hand, adding sewage effluent to a bay with fin fish aquaculture may cause deleterious effects greater than those expected from each pressure individually (a synergistic effect) (Crowe et al 2011).

The **geographical scale** over which these cumulative effects need to be considered will depend on the exact circumstances and scale of the plan or project being studied, on the site conditions (e.g. currents, etc.) and on the potential for far field effects from the project activities. However, it should cover a sufficiently large area to capture any cumulative effects that may arise with the plan or project under assessment. Again, the competent nature conservation authorities will be able to help identify the possible plans or projects that need to be considered as part of the in-combination test.

The cumulative impact assessment should focus on the receptor as opposed to the environmental effect, and looks at the capacity of the receptor to adapt to additional change. The cumulative impact assessment may consider issues that have been scoped out of the impact assessment because they are not considered to be significant individually, but may be significant when considered in combination with others (Scottish Government, 2007[63]).

Different methods have been developed to help assess the potential for cumulative environmental effects of activities. An example of this type of tools is a model developed by Sutherland et al. (2007[64]) for the evaluation of marine sites. To estimate cumulative effects, the model utilizes site specific spatial datasets representing natural resources abundance, habitat inventory, values from commercial and recreational activities, and influence plumes from sources of effluents present at the site.

These datasets are processed as thematic layers in a GIS describing the marine site. Experiments determined that the model works well in estimating the cumulative effects of interacting component layers associated with various marine sites.

5.5.4 Identifying suitable mitigation measures

Mitigation measures are aimed at minimising or even cancelling the negative impact of a project. As such, they should be directly linked to the likely negative effects which have been identified during the assessment described above. Avoidance or reduction of impacts at source should be the preferred options (EC 2000).

[63] Scottish Government, 2007. Environmental Impact Assessment - Practical Guidelines Toolkit for Marine Fish Farming. Prepared by RPS, Epsilon Resource Management Limited.

[64] Sutherland, M., Y. Zhao, D. Lane, and W. Michalowski. 2007. Estimating Cumulative Effects using Spatial Data: An aquaculture case study. In Geomatica, Vol. 61, No. 1, pp. 349-353.

Mitigation measures are an integral part of the specifications of a plan or project and should be considered during the AA. In practice this creates an iterative process: projects which may seem unsuitable at first can thus be improved with the introduction of adequate mitigation measures to ensure that adverse effects on the integrity of the Natura 2000 site are prevented.

The identification and description of mitigation measures should contain:
- details of each of the measures proposed and an explanation of how it will avoid or reduce the adverse impacts which have been identified;
- evidence of how they will be implemented and by whom;
- a timetable for implementation relative to the plan or project (some may need to be put in place before the development can proceed);
- details of how the measure will be monitored and how the results will be fed back into the day-to-day operation of the aquaculture project.

Mitigation measures in the aquaculture context should be understood as technically feasible solutions that are the least damaging for habitats, for species and for the integrity of the Natura 2000 site, especially if alternative locations are not feasible. Mitigation measures should be focused on ensuring that the sites' conservation objectives can continue to be met and on retaining those elements on which the integrity of the site depends. Examples of potential measures for avoiding or minimising impacts from aquaculture operations have been included in Chapter 3 in relation to the main potential impacts described from different aquaculture systems.

5.5.5 Assessing whether there are no adverse effects on site integrity

Once the potential effects of the project have been assessed as accurately as possible, the Appropriate Assessment can move onto the next stage which is to determine whether the impacts w*ill adversely affect the integrity of the Natura 2000 site*, either alone or in combination with other plans or projects.

This means determining whether the plan or project will adversely affect:
- the coherence of the site's ecological structure and function, across its entire area,
- the habitats, complex of habitats and/or
- the populations of species for which the site is designated.

Integrity of the site

Biological integrity can be defined as all those factors that contribute to the maintenance of the ecosystem, including structural and functional assets. In the framework of the Habitats Directive, the "integrity"' of the site is linked to the conservation objectives for which the site was designated as part of the Natura 2000 Network (EC 2007b). It has been usually defined as "the coherence of the site's ecological structure and function, across its whole area, that enables it to sustain the habitat, complex of habitats and/or populations of species for which the site is classified" (EC 2000b). As regards the meaning of 'integrity', this can be considered as a quality or condition of being whole or complete. In a dynamic ecological context, it can also be considered as having the sense of resilience and ability to evolve in ways that are favourable to conservation. (EC 2000b).

A site can be described as having a high degree of integrity where the inherent potential for meeting site conservation objectives is realised, the capacity of self-repair and self-renewal under dynamic conditions is maintained, and a minimum of external management is required. When looking at the "integrity of the site", it is therefore important to take into account a range of factors, including the possibility of effects manifesting themselves in the short, medium and long-term (EC 2000b).

Authorisation of a plan or project granted in accordance with Article 6(3) of the Habitats Directive necessarily assumes that it is considered not likely to adversely affect the integrity of the site concerned and, consequently, not likely to give rise to deterioration or significant disturbances within the meaning of Article 6(2) (ECJ ruling on case C-127/02 para. 36).

The assessment of effects on site integrity should focus on identifying whether the project:

- causes changes to significant ecological functions necessary for the target features;
- significantly reduces the area of occurrence of habitat types or viability of species populations in the given site which are target features;
- reduces the site diversity;
- leads to the site fragmentation;
- leads to a loss or reduction of the key site characteristics (e.g. tree cover, regular annual floodings) which the status of the target feature depends on;
- disturbs or deteriorates critical species habitats such as roosting, feeding or breeding sites of species for which the site was designated;
- disturbs meeting the site conservation objectives.

It is important to bear in mind that the focus of the assessment should be on objectively demonstrating, with supporting evidence, that there will be no adverse effects on the integrity of the Natura 2000 site, in light of its conservation objectives[65]. Thus, the competent authority, in order to authorise a plan or project, has to be sure that *no reasonable scientific doubt remains as to the absence of such effect* (ECJ ruling C-127/02, Waddensea).

To sum up, there are two possible conclusions that can be drawn from this assessment:
- there is no adverse effect and the project or plan can be approved as it stands;
- there will be adverse effects or adverse effects cannot be ruled out.

The latter does not necessarily mean that the plan or project is automatically refused. The competent authority could ask the developer to redesign or relocate the farm or introduce mitigation measures that would avoid or eliminate the predicted adverse effects. This would then normally imply a second evaluation round in the Appropriate Assessment to ensure that the mitigation measures/safeguards are indeed sufficient.

5.5.6 Recording the results of the Appropriate Assessment

Whatever the results of the AA, they should be clearly recorded. In this respect, the Appropriate Assessment report should be sufficiently detailed to demonstrate how the final decision was reached, and on what scientific grounds the decision was made. This is confirmed by an ECJ ruling: *The appropriate assessment should contain complete, precise and definitive conclusions capable of removing all reasonable scientific doubt as to the effects of the works proposed on the site concerned* (Commission/Italy, C-304/05).

The Appropriate Assessment report should:

- describe the project or plan in sufficient detail for members of the public to understand its size, scale and objectives;
- describe the baseline conditions and conservation objectives of the Natura 2000 site;
- identify the adverse effects of the project or plan on the Natura 2000 site;
- explain how those effects will be avoided through mitigation;
- set out a timescale and identify the mechanisms through which the mitigation measures will be secured, implemented and monitored.

The Appropriate assessment can also set relevant conditions for the project implementation to ensure that potential effects are avoided.

[65] A plan or project with significant adverse effects cannot be accepted on the grounds that the conservation status of the habitat types and species it hosts will anyway remain favourable within the Member State or the EU as a whole.

Outline for an Appropriate Assessment Report

Example: AA of mussel aquaculture on a SAC and SPA

- Details of the proposed operations/activities
  - Mussels seed fishery and ongrowing
  - Intertidal/seafloor aquaculture
- Activities with potential in combination effects
- Potential disturbance effects
- Conservation objectives and interests at the site
  - Qualifying interests and conservation objectives in the SAC
  - Qualifying interests and conservation objectives in the SPA
- Ecological effects
  - Details of potential ecological effects of each proposed activity, on the SAC and SPA conservation objectives, their sources and the mechanism by which the impact may occur.
- Appropriate Assessment Screening
- Appropriate Assessment: Special Area of Conservation
  - Methods for Appropriate Assessment
  - Assessment of sub-tidal fishing for seed mussel
  - Assessment of relaying of seed mussel on the inter-tidal sand flat
  - Assessment of dredging of half-grown mussel from the inter-tidal area
  - Assessment of relaying and dredging of mussels in the sub-tidal area
  - Assessment of predator control, winkle picking, discharges
  - Assessment of the effects of shellfish production and in combination effects on the Conservation Objectives for Otter, Salmon and Lamprey
- Appropriate Assessment: Special Protection Area
  - Assessment of the effects of fisheries and aquaculture production on waterbirds
    - The status of bird populations of special conservation interest in the SPA
    - Assessment of mussel seed fishery
    - Assessment of the effects of intertidal mussel relay in the fishery area:effects of mussel cover on habitat suitability for waterbirds
    - Assessment of intertidal relay of mussels in the mussel order area: effects of human disturbance
    - Assessment of sub-tidal relaying of mussels
    - Assessment of potential for cumulative impacts: the combination of aquaculture activities
    - Assessment of potential for cumulative impacts: recreation in association with aquaculture
- Appropriate Assessment Conclusion Statement
  - SAC Features
  - SPA Features
- Scope for additional monitoring and mitigation
- Annexes: detailed technical information in support of the conclusions in the assessment.

STAGE 3. THE DEROGATION PROCEDURE UNDER ARTICLE 6.4

5.6 The scheme of Article 6.4

The requirements of Article 6(4) of the Habitats Directive establish a set of conditions, which must be met for the competent authority to authorise, by way of derogation, a plan or project in case the AA cannot show that the integrity of the Natura 2000 site concerned will not be adversely affected by it. Being an exception to Article 6(3), the fulfilment of the conditions under which it may be applied is subject to strict interpretation and will only be passed in exceptional circumstances.

These conditions relate to the absence of alternatives, the presence of imperative reasons of overriding public interest (IROPI) and the adoption of all necessary compensatory measures.

The European Commission has published a Guidance Document on Article 6(4) of the Habitats Directive (EC 2007b) which provides clarification of the concepts of alternative solutions, imperative reasons of overriding pubic interest, compensatory measures, overall coherence and the opinion of the Commission required in some cases[66].

5.6.1 The absence of alternative solutions

The search for alternatives can be quite broad and should be linked to the public objectives of the plan or project. It could involve alternative locations, different scales or designs of development, or alternative processes. If the intention is to develop or increase aquaculture production, the question is then: can this be achieved in a less damaging way, for instance, by selecting a more appropriate site elsewhere or by resizing or scaling down the plan or project.

In practice, alternative solutions should normally already have been identified within the framework of the initial assessment under Article 6(3). They are part of the iterative process seeking to improve the siting and design of a plan or project at the earliest stages.

In conformity with the principle of subsidiarity, it rests with the competent national authorities to assess the relative impact of other alternatives on the site concerned or any other Natura 2000 site that might be affected. The alternative solutions chosen should also in principle undergo the same screening exercise as the original plan or project and could be subject to a new AA.

The competent authorities have also to analyse and demonstrate first the need of the plan or project concerned. Thus, the zero option should also be considered at this stage – i.e. the option of not carrying out the project.

5.6.2 Imperative reasons of overriding public interest (IROPI)

In absence of an alternative solution IROPI may be considered. The concept of imperative reason of overriding public interest is not defined in the Directive. However, it is clear from the wording of Article 6(4) that only public interests, irrespective of whether they are promoted either by public or private bodies, can be balanced against the conservation aims of the Directive. Thus, projects developed by private bodies can only be considered to meet this condition of Article 6(4) where such public interests are served and demonstrated (EC 2007b).

[66] http://ec.europa.eu/environment/nature/natura2000/management/guidance_en.htm

Such public interests may include human health, public safety, beneficial consequences of primary importance for the environment, and other interests of a social (e.g. employment) or economic nature.

To fulfil the requirements of Article 6(4) of the Habitats Directive, the competent national authorities have to make their approval of the plans and projects in question subject to the condition that the balance of interests between the conservation objectives of the Natura site(s) affected by those initiatives and the above-mentioned imperative reasons weighs in favour of the latter.

It should be noted that the conditions of overriding public interest are even stricter when it comes to the realisation of a plan or project likely to adversely affect the integrity of a Natura 2000 site that hosts qualifying *priority* habitats and/or species, where those habitats and/or species are affected. These can only be justified if the imperative reasons of overriding public interest concern:

- human health and public safety or
- overriding beneficial consequences for the environment, or,
- for other imperative reasons if, before granting approval to the plan or project, the opinion of the Commission has been given (EC 2007b).

5.6.3 The adoption of all necessary compensatory measures

Compensatory measures, as described in Article 6(4) of the Habitats Directive, constitute the "last resort" and are used only when the decision has been taken to proceed with a plan or project that could have an adverse effect on the integrity of the Natura 2000 site because no alternatives exist and the project has been judged to be of overriding public interest under the conditions described above.

The compensatory measures constitute measures specific to the unavoidable adverse effects of a project or plan. They aim to ensure that the overall coherence of Natura 2000 is protected, and should provide compensation corresponding directly to the negative effects on the species or habitat concerned.

It is considered good practice to take compensatory measures as close as possible to the affected area in order to maximise chances of protecting the overall coherence of the Natura 2000 network. As a general principle, the compensatory measures should be in place and working before the work on the plan or project has begun. This is to help buffer the damaging effects of the project on the species and habitats by offering them suitable alternative locations in the compensation area.

The information on the compensatory measures should be submitted to the Commission before they are implemented and indeed before the realisation of the plan or project concerned (EC 2007b).

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ANNEX 1. EU POLICY AND LEGAL FRAMEWORK, AND INITIATIVES TO PROMOTE SUSTAINABLE AQUACULTURE

1. The EU Policy Framework for the aquaculture industry

Under the Common Fisheries Policy the main instruments addressed to aquaculture are the European Fisheries Fund (Council Regulation (EC) No 1168/2006) and the Common organisation of the markets in fishery and aquaculture products (Council Regulation (EC) No.104/2000). Many of the factors and drivers shaping aquaculture have a strong dimension of subsidiarity and are shaped by the priorities and decisions taken at national and regional level.

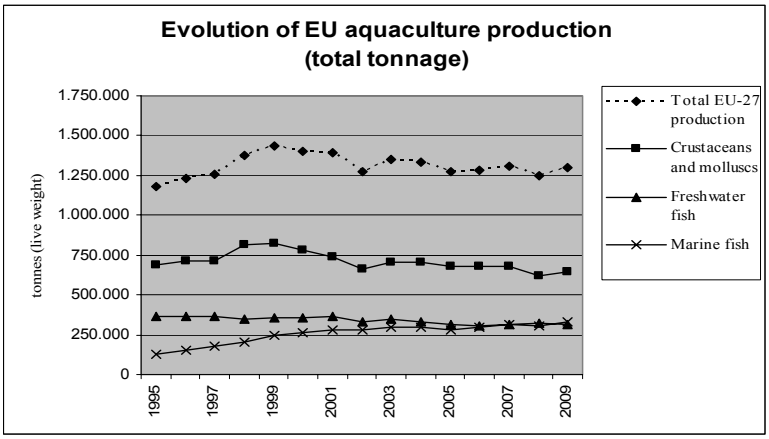
The *European Fisheries Fund (EFF*) adopted in 2006[67] sets the framework to contribute to the sustainable growth of aquaculture in Europe until 2013. Under its Axis 2, in particular, *aqua-environmental measures* may support the use of aquaculture production methods helping to protect and improve the environment and to conserve nature.

The on-going process of reform of the Common Fisheries Policy aims to promote sustainable aquaculture through national strategic guidelines and the creation of an Advisory Council for Aquaculture for stakeholder consultation and advice. EU "horizontal" legislation, such as environmental protection requirements, public health protection rules for fisheries products, animal health law is applicable to aquaculture industry and its products as appropriate.

2. Aquaculture trends and environmental factors influencing production in the EU

Globally, aquaculture remains a growing and important production sector – with annual growth rate of 8.3 % worldwide between 1970 and 2008 (5.3% between 2006 – 2008). The aquaculture production reached 68.3 million tonnes in terms of volume and US$105.4 billion in terms of value in 2008. Globally, aquaculture accounted for 45.7% of the world's fish food production for human consumption in 2008 (up to 42.6% in 2006).

The total aquaculture production in the EU was close to 1.3 million tonnes, worth some €3.2 billion in 2009. The EU overall aquaculture unfortunately does not follow the global trend of growth and is rather stagnating.



[67] Council Regulation (EC) No 1198/2006

The absolute majority of the EU production is destined for the EU market. Exports of EU aquaculture products remain very limited (about 122.000 tonnes "live weight equivalent" in 2009). The aquaculture products imported to the EU play an important role (about 2 million tonnes "live weight equivalent", worth app. € 4.6 billion in 2009) – they represent 22% of volume and 32% of value of the total seafood imports.

The EU is committed to a high level of environmental protection and a number of provisions exist to ensure that the development of aquaculture is sustainable from an environmental point of view. It also needs to be stressed that aquaculture requires water of the highest quality to guarantee health of aquatic animals and safe and high quality products. Environmental aspects of aquaculture are confirmed to be very important issues for this sector.

In terms of nature conservation, the implementation of Natura 2000 is often perceived as a major limiting factor for development of aquaculture and access to space in some Member States. The development of interpretation or guidance documents on EU environmental legislation, of common estimators of "carrying capacity", of scientific evaluations and impact assessment guidelines on the basis of common predictive models, are often quoted as ways forward. Increased consultation and discussion among stakeholders and authorities (rather than imposed measures) are also called for.

The increasing competition for space and water represents a major challenge for further development of freshwater fish farming and aquaculture production sites in coastal areas. Public acceptance of aquaculture development in an area is usually inversely proportional to the population density and the tourist attractiveness of the area. Extensive aquaculture in inland ponds and wetlands or in coastal lagoons also faces increased competition with other economic developments (agriculture, industry, tourism…)[68]. Spatial planning, including Integrated Coastal Zone Management, is considered a useful tool for the allocation of suitable sites for the development of aquaculture activities.

3. Relevant EU environmental legislation

Under the EU environmental law, the Water Framework Directive and the Marine Strategy Framework Directive provide a framework for the definition and preservation of fresh and marine waters in the EU. Other EU Directives relevant to the environmental aspects of aquaculture are: Directive 67/548/EEC on dangerous substances, Directive 2006/113/EC known as "Shellfish Directive"[69] and Directives affecting the marketing of veterinary medicinal products. Of relevance is also the Regulation on "alien species"[70] which aims to assess and minimise the possible impact of the introduction of alien species for its use in aquaculture by establishing a permit system at Member State level. Resolutions and Communications related to ICZM[71] are also relevant for aquaculture sector. Furthermore, the EU Directives on Environmental Impact Assessment (EIA) and Strategic Environmental Assessment (SEA) may also apply. The Birds and Habitats Directives are addressed in the main document focusing on site management provisions; however their species-related provisions may also be relevant.

Summary information on some of these provisions is provided below.

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[68] Opportunities for the development of Community aquaculture. Consultation document. European Commission, 2007. Available at: http://ec.europa.eu/fisheries/partners/consultations/aquaculture/index_en.htm

[69] This directive will be replaced in 2013 by the EC Water Framework Directive (WFD). This must provide at least the same level of protection to shellfish waters as the Shellfish Waters Directive.

[70] Council Regulation (EC) No 708/2007 of 11 June 2007 concerning use of alien and locally absent species in aquaculture.

[71] Available at:http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:C:2009:295E:0001:0004:EN:PDF

3.1 The Water Framework Directive (WFD)

The WFD (2000/60/EC), which applies to inland water and coastal water up to 1 nautical mile from coastal State baselines, aims to protect and enhance all surface waters and groundwater so that they reach a good ecological and chemical status by 2015. It establishes a framework to prevent further deterioration of aquatic ecosystems and introduces the consideration of the biological community, as well as the natural structure and functions of the aquatic ecosystem, as a quality element in the assessment of surface water status.

There are strong links between the WFD and the Habitats and Birds Directives, they have broadly similar ambitions in terms of aiming to prevent further deterioration and enhance the ecological condition of aquatic ecosystems but have different legal requirements and important differences too. If the Natura 2000 measures require stricter ecological conditions in terms of water quality than those required for achieving Good Ecological Potential under the WFD then the stricter measures must be applied (in accordance with Art 4.2 of the WFD) and vice versa

3.2 The Marine Strategy Framework Directive (MSFD)

The MSFD (2008/56/EC) applies to marine waters which include the coastal waters covered by the WFD (in those particular aspects not addressed by the WFD) but extends to those waters which are still under sovereignty of the Member States (mainly EEZ). Some of the MSFD objectives are similar to the WFD but it goes beyond in many areas such as descriptors on biodiversity or marine litter and noise. Although the lesser concentration of aquaculture activities in marine areas beyond 1 nautical mile makes this instrument less relevant at present, the expected development of offshore aquaculture means this could be more relevant for aquaculture in the future. (Huntington et al. 2010).

The Directive requires Member States to develop, on a regional basis, marine strategies that must contain a detailed assessment of the state of the environment, a definition of good environmental status at regional level and the establishment of environmental targets and monitoring programmes with the overall objective of maintaining or achieving good environmental status in the marine environment by 2020 at the latest. Requirements under the MSFD apply to all aquaculture activities in marine waters, whether located within or outside Natura 2000 areas. In all cases the stricter obligations apply.

Aquaculture is one of the pressures to be addressed in the initial assessments performed by Member States and due in October 2012. On this basis, good environmental status criteria and environmental targets are set by Member States. Member States must also identify marine protected areas other than those designated as Natura 2000 sites (cf. Article 13.4 and 13.5).

3.3 Species protection provisions under the Birds and Habitats directives

In addition to protecting core sites through the Natura 2000 network the two Nature directives also require that Member States establish a general system of protection for all naturally occurring wild bird species in the EU and for species listed in Annex IV of the Habitats Directive These provisions apply both inside and outside protected sites. The exact terms are laid down in article 5 of the Birds Directive and Article 12 (for animals) and Article 13 (for plants) of the Habitats Directive[72].

[72] See Guidance document on the strict protection of animal species of Community interest under the Habitats Directive http://ec.europa.eu/environment/nature/conservation/species/guidance/index_en.htm

Article 5 of Birds Directive

Member States should take the requisite measures to establish a general system of protection for all wild bird species throughout their natural range within the EU.

In particular they should prohibit the following:
- deliberate killing or capture by any method;
- deliberate destruction of, or damage to, their nests and eggs or removal of their nests;
- taking their eggs in the wild and keeping of eggs;
- deliberate disturbance of these birds particularly during the period of breeding and rearing, in so far as this would have a significant negative effect on the birds;
- keeping the birds in captivity and their sale.

Articles 12 and 13 of Habitats Directive

Member States should take the requisite measures to protect the species listed in Annex IV throughout its natural range within Europe. In the case of **protected animals** this means prohibiting the:
- deliberate killing or capture by any method;
- deliberate disturbance, particularly during breeding, rearing, hibernation and migration;
- deliberate destruction or taking of eggs in the wild;
- deterioration or destruction of breeding sites or resting places;
- the keeping, sale and transport of specimens the from the wild.

In the case of **protected plants** this means prohibiting the:
- deliberate picking, collecting, cutting, uprooting or destruction of such plants in the wild;
- keeping, transport of sale of such species taken from the wild.

3.4 The SEA and EIA Directives

The purpose of the *Directive on Strategic Environmental Assessment* (SEA Directive 2001/42/EC) is to ensure that the environmental consequences of ***certain plans and programmes*** are identified, assessed and taken into account during their preparation and before their adoption.

A Strategic Environmental Assessment is mandatory for a variety of plans and programmes (i.e. prepared for agriculture, forestry, fisheries, energy, industry, transport, waste management, water management, telecommunications, tourism, town and country planning or land use) which set the framework for future development consent of projects listed in the 'EIA Directive'. An SEA should also be carried out on any plans or programmes, which, in view of the likely significant effect on sites, have been determined to require an assessment pursuant to Article 6 or 7 of the Habitats Directive.

Ultimately, the SEA aims to encourage a more integrated and efficient approach to territorial planning where environment, including biodiversity considerations, are taken into account much earlier on in the planning process and at a much more strategic level. This usually leads to fewer conflicts further down the line at the level of individual projects. It also allows for a more appropriate siting of future developments away from areas of potential conflict with nature conservation[73].

While the SEA process operates at the level of plans and programmes, the *Directive on Environmental Impact Assessment* (85/337/EEC, amended in 2009[74]operates at the level of individual public and private projects. Thus, development consent for projects[75] which are

[73] To be noted that the Aarhus Convention requires public consultation on plans relating to the environment even without an SEA

[74] Consolidates version available at: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CONSLEG: 1985L0337:20090625:EN:PDF

[75] The EIA Directive defines 'project' as the execution of construction works or of other installations, schemes, or interventions in the natural surroundings and landscape.

likely to have significant effects on the environment should be granted only after an assessment of its likely environmental effects has been carried out.

The EIA Directive distinguishes between projects requiring a mandatory EIA (so-called Annex I projects) and those where Member State authorities must determine, in a procedure called "screening", if projects are likely to have significant effects, taking into account criteria in Annex III of the Directive (so-called Annex II projects). Intensive fish farming is included under Annex II. In accordance with article 4.2 of the EIA directive, for projects listed in Annex II, the Member States shall determine through: (a) a case-by-case examination, or (b) thresholds or criteria set by the Member State, whether the project shall be made subject to an assessment. Member States shall ensure that the determination made by the competent authorities under paragraph 2 is made available to the public.

The relationship between SEA, EIA and the Appropriate Assessments under the Habitats Directive

There are many similarities between the procedures for SEA and EIA, and the Appropriate Assessments carried out for plans or projects affecting Natura 2000 sites under the Habitats Directive. But this does not mean they are one and the same, there are some important distinctions too. Therefore, **an SEA and EIA cannot replace, or be a substitute for, an Appropriate Assessment as neither procedure overrides the other**.

They may of course run alongside each other or the Appropriate Assessment may form part of the EIA/SEA assessment but, in such cases, the Appropriate Assessment should be clearly distinguishable and identifiable in the SEA's Environmental Report or in the EIA's Environmental documentation, or should be reported on separately so that its findings can be differentiated from those of the general EIA or SEA[76].

One of the key distinctions between SEAs/EIAs and Habitats Directive's Appropriate Assessments is that they measure different aspects of the natural environment and have different criteria for determining 'significance'. Another is the scope of the Directives: SEAs/EIAs apply in the case of all plans and projects that fall within their scope irrespective of where they are proposed to be located in the EU territory. The Appropriate Assessment, on the other hand, is only applicable to those plans and projects that could have an adverse effect on a Natura 2000 site.

There is also an important distinction as regards the outcome of the assessment. The assessments under the SEA and EIA lay down procedural requirements and do not establish obligatory environmental standards. The assessment under the Habitats Directive on the other lays down obligations of substance. In other words, if the Appropriate Assessment determines that the plan or project will adversely affect the integrity of a Natura 2000 site, the authority cannot agree to the plan or project as it stands unless, in exceptional cases, they invoke special procedures for projects deemed to be of overriding public interest.

This contrasts with the SEAs/ EIAs which are designed to make the planning authorities fully aware of the environmental implications of the proposed plan or project so that these *are taken into account* in their final decision.

[76] See EC guidance document: "Assessments of plans and projects significantly affecting Natura 2000 sites. Methodological guidance on the provisions of Article 6(3) and (4) of the Habitats Directive 92/43/EEC".

Table 2: Comparison of procedures under AA, EIA and SEA

	AA	EIA	SEA
Which type of developments are targeted ?	Any **plan** or **project** which - either individually or in combination with other plans/projects - is likely to have an adverse effect on a Natura 2000 site (excluding plans or projects directly connected to the management of the site)	All **projects** listed in Annex I. For projects listed in Annex II the need for an EIA shall be determined on a case by case basis and depending on thresholds or criteria set by Member states (taking into account criteria in Annex III)	Any **Plans** and **Programmes** or amendments thereof which are (a) prepared for agriculture, forestry, fisheries, energy, industry, transport, waste management, water management, telecommunications, tourism, town and country planning or land use and which set the framework for future development consent of projects listed in Annexes I and II to Directive 85/337/EEC, or (b) which, in view of the likely effect on sites, have been determined to require an assessment pursuant to Article 6 or 7 of Directive 92/43/EEC.
What impacts need to be asssessed relevant to nature?	The Assessment should be made in view of the site's conservation objectives (which are set in function of the species/ habitat types for which the site was designated.) The impacts (direct, indirect, cumulative..) should be assessed to determine whether or not they will adversely affect the integrity of the site concerned.	Direct and indirect, secondary, cumulative, short, medium and long-term, permanent and temporary, positive and negative significant effects on ….'fauna and flora'	Likely significant effects on the environment, including on issues such as biodiversity, population, human health, fauna, flora, soil, water, air, climatic factors, material assets, cultural heritage including architectural and archaeological heritage, landscape and the interrelationship between the above factors;
Who carries out the Assessment?	It is the responsibility of the competent authority to ensure that the AA is carried out. In that context the developer may be required to carry out all necessary studies and to provide all necessary information to the competent authority in order to enable the latter to take a fully informed decision. In so doing the competent authority may also collect relevant information from other sources as appropriate.	The developer	The competent planning authority
Are the public/ Other authorities consulted?	Not obligatory but encouraged 'if appropriate'	Compulsory –consultation to be done before adoption of the development proposal Member States shall take the measures necessary to ensure that the authorities likely to be concerned by the project by reason of their specific environmental responsibilities are given an opportunity to express their opinion on the request for development consent. Ditto for the public.	Compulsory –consultation to be done before adoption of the plan or programme. The authorities and the public shall be given an early and effective opportunity within appropriate time frames to express their opinion on the draft plan or programme and the accompanying environmental report before the adoption of the plan or programme or its submission to the legislative procedure Member States must designate the authorities to be consulted which, by reason of their specific environmental responsibilities, are likely to be concerned.
How binding are the outcomes ?	Binding. The competent authorities **can agree to the plan or project only after having ascertained that it will not** adversely affect the integrity of the site.	The results of consultations and the information gathered as part of the EIA ***must be taken into consideration*** in the development consent procedure.	The environmental report, as well as the opinions expressed ***shall be taken into account*** during the preparation of the plan or programme and before its adoption or submission to the legislative procedure.

In addition to the above-mentioned EU policy and legal framework, many organisations and Member States have undertaken action to boost sustainable aquaculture development. Various initiatives on a national, European and also global level develop and permanently update codes of conduct, sustainability indicator and certification systems, in order to achieve a common and accepted understanding of sustainability in aquaculture among all stakeholders and how to achieve these goals in practice.

Organic fish farming has been introduced in several European countries since the 1990s according to specific national codes of practice. In order to harmonise national rules and private schemes and give a minimum standards for organic aquaculture at EU level, rules on organic aquaculture animal and seaweed production were laid down under EU organic legislation[77]. The new Regulation applies as from 1 July 2010.

Some examples are the *FAO Technical Guidelines for Aquaculture development*[78], the *Guide for the Sustainable Development of Mediterranean Aquaculture. Interaction between Aquaculture and the Environment* developed by the *World Conservation Union (IUCN)*[79], the *Guide for sustainable aquaculture on trout farming* (UICN, 2011)[80], and the *Code of Conduct for European Aquaculture (FEAP)*, which are used ues

Another relevant example is the *ICES Code of Practice on the Introductions and Transfers of Marine Organisms* (2003)[81], which sets out recommended procedures and practices to diminish the risks of detrimental effects from the intentional introduction and transfer of marine (including brackish water) organisms.

In addition, the EU is a member of the North Atlantic Salmon Conservation Organization (NASCO). Particularly relevant to the aquaculture sector is the *Resolution by the Parties to the Convention for the Conservation of Salmon in the North Atlantic Ocean to Minimise Impacts from Aquaculture, Introductions and Transfers, and Transgenic on Wild Salmon Stocks* (2003).

The EU is also a party to the 1992 OSPAR Convention for the Protection of the Marine Environment of the North-East Atlantic, which has direct implications for marine aquaculture, for example, through *Recommendation 94/6 on Best Environmental Practice (BEP) for the Reduction of Inputs of Potentially Toxic Chemicals from Aquaculture*.

There are also national initiatives that aim at promoting sustainable aquaculture production, through relevant guidance (eg. France, Denmark, UK, etc.) or accreditation schemes (eg. Ireland, etc.).

[77] Commission Regulation (EC) No 710/2009
[78] FAO Technical Guidelines for Responsible Fisheries. No. 5: Aquaculture development.
[79] Guide published in 2007, developed in collaboration with the Spanish Ministry of Agriculture, Fisheries and Food and the European Federation of Aquaculture Producers (FEAP).
[80] UICN (2011). Guide pour le développement durable de l'aquaculture : Réflexions et recommandations pour la pisciculture de truites. Gland, Suisse et Paris, France : UICN.
[81] Available from: http://www.ices.dk/reports/general/2003/Codemarineintroductions2003.pdf

4.1 Examples of EU funded projects to promote sustainable aquaculture

Some EU funded projects aim at promoting methods for the sustainable aquaculture development. Among these, the SEACASE project is worthy of note[82]. The final goal of this project was to develop effective tools for sustainability of extensive and semi-intensive aquaculture production in Southern Europe, while minimizing its environmental impacts and improving the quality and public image of its products. They had also analyzed and developed environmentally friendly farming protocols as well as certification possibilities to be proposed for voluntary use by the industry.

Another project aimed to develop an Ecosystem Approach for sustainable aquaculture (ECASA)[83]. A key deliverable of this project is a virtual toolbox to help owners and operators of fin-fish and shell-fish farms in selecting farm sites and operating farms, so as to minimize environmental impact and ensure the sustainability of sites and water bodies for aquaculture.

The EU project CONSENSUS (2005-2008)[84], a "Multi-stakeholder involvement towards protocols for sustainable aquaculture in Europe", developed a set of sustainability indicators as a starting point for a certification system for sustainable aquaculture and for a benchmarking process that is based on low environmental impact, high competitiveness and ethical responsibility with regard to biodiversity and animal welfare. All major organisations and associations within aquaculture production were involved.

The EU project SustainAqua[85] aimed to make the European freshwater aquaculture industry more sustainable by improving production methods, research potential market applications and increase product quality, SustainAqua undertook five different case studies in Europe representative of the most relevant freshwater aquaculture systems and fish species. Various practical techniques were tested, on how to strengthen the diverse aquaculture farms in Europe in a sustainable way, from extensive and semi-intensive pond systems, which predominate in Central and Eastern Europe, to intensive recirculation aquaculture systems (RAS) as they are practiced in North-Western Europe. The main findings are described in the Handbook for Sustainable Aquaculture, which is a main product of the project.

The EATIP – European Aquaculture Technology & Innovation Platform website (http://www.eatip.eu) contains summaries (Technical Leaflets) of EU-funded aquaculture research projects made in the 5, 6 and 7 Framework Research Programmes. These documents were prepared within the scope of the Profet Policy and Aquainnova projects. Many projects address the environmental impacts and sustainability issues of aquaculture.

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[82] SEACASE will undertake case studies of extensive and semi-intensive aquaculture production systems in Portugal, Spain, France, Italy and Greece to develop good-practice guides and quality certification standards. See also: http://www.seacase.org/

[83] ECASA project: http://www.ecasa.org.uk/index.htm

[84] CONSENSUS project, available from: http://www.euraquaculture.info/

[85] Integrated approach for a sustainable and healthy freshwater aquaculture: a handbook for sustainable aquaculture. Project N°: COLL-CT-2006-030384, 6th Framework Programme.

ANNEX 2. Information on Natura 2000 sites and habitats and species of European interest in EU countries

Some national sources (web sites) provide useful information to support species and habitat conservation, sustainable management, protection and planning. These tools can also be useful to determine the sensitivity of habitats and species to different pressures, including from aquaculture activities, as they provide information about ecological requirements, threats and other relevant issues. Some relevant sources are included below.

AUSTRIA

Entwicklung von Kriterien, Indikatoren und Schwellenwerten zur Beurteilung des Erhaltungszustandes der Natura 2000-Schutzgüter (Development of criteria, indicators and threshold values to the judgement of the condition of the Natura 2000 protection goods). In German
http://www.umweltbundesamt.at/umweltschutz/naturschutz/natura_2000/gez/

Lower Austria: *Natura 2000 - Der niederösterreichische Weg* (regional government website on Natura 2000 in Lower Austria). In German.
http://www.noe.gv.at/Umwelt/Naturschutz/Natura-2000.html

Tyrol: Website with general information on N2000 in the Tyrol region (in German).
http://www.tirol.gv.at/themen/umwelt/naturschutz/natura2000-tirol/

BELGIUM

Natura 2000 habitats: doelen en staat van instandhouding. Versie 1.0 (ontwerp). Onderzoeksverslag. (Natura 2000 habitats: conservation objectives and conservation status. In Dutch) http://www.inbo.be/docupload/2426.pdf

Flanders: Information about Natura 2000 plans in Flanders (in Dutch), including the conservation objectives for the sites, parameters for the favourable conservation status in terms of habitats surface, and "measures and instruments".
http://www.natuurenbos.be/nl-BE/Thema/Natuur/Natuurrichtplannen.aspx

BULGARIA

Maps and information on Natura 2000 sites in Bulgaria:
http://www.natura2000bg.org/natura/bg/index1.php

CZECH REPUBLIC

Zásady managementu stanovišť druhu v evropsky významných lokalitách (*Principles of management of the habitat of species at sites of European importance*). In Czech
http://www.mzp.cz/cz/zasady_managementu_stanovist

Provides recommendations for the conservation of selected habitats of species of wild fauna and flora of European importance (103 taxa: 63 animal and 40 plant species), which are primarily intended for the preparation of management plans for Natura 2000 sites. Includes information on the biology and ecology of each species and main threats, factors and activities that may negatively affect the the species population of in sites of European importance.

Website with information on Natura 2000 sites in the country. In Czech. www.natura2000.cz.
See also: http://drusop.nature.cz

DENMARK

Natura 2000 plans:
http://www.naturstyrelsen.dk/Naturbeskyttelse/Natura2000/Natura_2000_planer
Technical and scientific background documents are also available from the National Environmental Research Institute at: www.dmu.dk.

GERMANY

Information about Natura 2000 sites (management, interactive map, etc.), and the habitats and species of European interest (conservation status monitoring, etc.) in Germany:
http://www.bfn.de/0316_natura2000.html

Habitat Mare web site. The Federal Agency for Nature Conservation provides in this website extensive information on current research findings and background information on marine nature conservation, in particular the Natura 2000 - SPAs in the German North and Baltic Seas: .http://www.bfn.de/habitatmare/de/

Managementmaßnahmen in Küstenlebensräumen und Ästuarien der Nord- und Ostsee (NaBiV 91, 2010). Management measures in coastal habitats and estuaries of the Baltic and North Seas (NaBiV 91, 2010). Publication. BfN.

Baden-Württemberg http://www.lubw.baden-wuerttemberg.de/servlet/is/44492/
http://www.uvm.baden-wuerttemberg.de/servlet/is/66368/

Bayern: http://www.lfu.bayern.de/natur/natura_2000/index.htm
http://www.stmug.bayern.de/umwelt/naturschutz/natura2000/index.htm
http://www.forst.bayern.de/funktionen-des-waldes/biologische-vielfalt/schutzgebiete/natura2000/index.php

Berlin:
http://www.stadtentwicklung.berlin.de/natur_gruen/naturschutz/natura2000/de/management/index.shtml

Brandenburg: http://www.mugv.brandenburg.de/cms/detail.php/bb1.c.221574.de
http://www.naturschutzfonds.de/unsere-arbeit-fuer-die-natur/natura-2000-managementplanung.html

Hesse: www.natureg.de , still in preparation/progress; at the moment:
http://natureg.hessen.de/natureg/index.html# provides information used for Natura 2000 management (*Artensteckbriefe, Artenhilfskonzepte* – in German); additional information will be uploaded soon, such as management plans, special information on species/habitats occurrence in the Natura 2000 sites, guidance documents, expert reports, etc

Mecklenburg-Vorpommern: http://www.regierung-mv.de/cms2/Regierungsportal_prod/Regierungsportal/de/lm/Themen/Naturschutz_und_Landschaftspflege/NATURA_2000/Managementplanung/index.jsp

North-Rhine-Westfalia: http://88.198.49.242/mako/install/

Rheinland-Pfalz: http://www.naturschutz.rlp.de ; http://www.natura2000.rlp.de

Sachsen: Management planning: http://www.umwelt.sachsen.de/umwelt/natur/21184.htm
Short versions of plans: http://www.umwelt.sachsen.de/umwelt/natur/18744.htm#19114
Mapping and valuation codes etc.: http://www.umwelt.sachsen.de/umwelt/natur/18723.htm

Sachsen-Anhalt: Information on ongoing planning as well as final plans available (website of the Landesamt für Umweltschutz): http://www.sachsen-anhalt.de/index.php?id=35704

Schleswig-Holstein: www.natura2000.schleswig-holstein.de
Provides information on Natura 2000, including conservation objectives, conservation-oriented water maintenance, etc. In German

Thuringia: Artengruppen (*Groups of species)* In German
http://www.tlug-jena.de/de/tlug/umweltthemen/natur_und_landschaft/artenschutz/artengruppen/
Provides factsheets on species of different groups (Mammals, bats, amphibians, reptiles, crustaceans, molluscs, dragon-flies, beetles, butterflies, flower plants, ferns, lichens, birds)

ESTONIA

http://www.envir.ee/1684

SPAIN

Information about Natura 2000: http://www.magrama.gob.es/es/biodiversidad/temas/red-natura-2000/

Bases ecológicas preliminares para la conservación de los tipos de hábitat de interés comunitario en España (Ecological bases for conservation of habitat types of Community interest in Spain). Information about ecological requirements, conservation Management, etc. for all habitat types of European interest that are present in Spain. http://www.jolube.es/Habitat_Espana/indice.htm

Directrices para la redacción de planes o instrumentos de gestión de las Zonas de Especial Protección para las Aves (ZEPA). Guidelines for the preparation of Management plans for SPAs. Includes information about conservation measures for all bird species included in Annex I of the Birds Directive which are present in Spain, their main treats and activities which may be in conflict with their conservation, disturbance from human activities, etc.
http://www.seo.org/programa_seccion_ficha.cfm?idPrograma=24&idArticulo=3331

FRANCE

Cahiers d'habitats: factsheets with an updated synthesis of the scientific knowledge and conservation management measures for all habitats and species present in France (incl. activities that may affect the habitats, etc.).
http://natura2000.environnement.gouv.fr/habitats/cahiers.html

Référentiel pour la gestion dans les sites Natura 2000 en mer - Les cultures marines Guidance on Natura 2000 and aquaculture in France Agence des aires marines protégées. 2009.
http://www.aires-marines.fr/images/stories/donnees/RTE/TOME1_Referentiel_CULTURES_MARINES_01_2010_BD.pdf

Les habitats et les espèces Natura 2000 en mer. Référentiel pour la gestion des activités de pêche professionnelle, cultures marines, sports et loisirs en mer dans les sites Natura 2000 en mer. Agence des aires marines protégées. 2009. Provides information on conservation status and threats for all habitat types protected under Natura 200 and on the possible pressures on them from fisheries, aquaculture and leisure activities in the sea.
http://ecorem.fr/files/_TOME_2_Les_HABITATS_et_les_ESPECES_Natura_2000_en_mer_V2_comp.pdf

HUNGARY

Information about Natura2000 sites:
http://www.naturaterv.hu/

IRELAND

Information about all Natura2000 sites (Conservation objectives, etc.):
http://www.npws.ie/protectedsites/conservationmanagementplanning/

ITALY

Abruzzo:
http://www.regione.abruzzo.it/xAmbiente/index.asp?modello=menuAreeProBio&servizio=xList&stileDiv=mono&template=default&msv=areeProt

Regione Marche:
http://www.ambiente.regione.marche.it/Ambiente/Natura/ReteNatura2000.aspx

Piedmont: http://www.regione.piemonte.it/parchi/retenatura2000/
http://www.regione.piemonte.it/sit/argomenti/parchi/retenatura2000.htm
http://gis.csi.it/parchi/datialfa_2k.htm

Sardinia: http://www.sardegnaambiente.it/foreste/foreste_parchi/areeprotette/retenatura.html

Sicilia: http://www.artasicilia.eu/web/natura2000/index.html

Trentino: http://www.areeprotette.provincia.tn.it/natura2000/index.html

NETHERLANDS

http://www.natura2000.nl/pages/homepage.aspx

LITHUANIA

A resolution adopted in 2004 informs about restricted and permitted activities for each habitat type of European interest. In Lithuanian
http://www3.lrs.lt/pls/inter3/dokpaieska.showdoc_l?p_id=274764&p_query=&p_tr2=

POLAND

Information about Natura 2000, habitats and species.
http://natura2000.gdos.gov.pl/natura2000/#1

PORTUGAL

Plano sectorial da rede Natura 2000. Sectoral Plan of the Natura 2000 network. Provides information about all Natura 2000 sites, habitats and species of European interest that are present in Portugal.
http://www.icn.pt/psrn2000/fichas_sitios.htm
http://www.icn.pt/psrn2000/fichas_valores_naturais.htm

SLOVAKIA

Information about natura 2000: www.sopsr.sk/natura/,
www.enviro.gov.sk, and www.daphne.sk.

SLOVENIA

Information about Natura 2000: http://www.natura2000.gov.si/

SWEDEN

Information about Natura 2000, species and habitats, management plans for Natura 2000 in Sweden, available via SEPA's web-site:
http://www.naturvardsverket.se/sv/Start/Naturvard/Skydd-av-natur/Natura-2000/

UNITED KINGDOM

Joint Nature Conservation Committee (JNCC) - SAC Interest Features
http://www.jncc.gov.uk/ProtectedSites/SACselection/SAC_habitats.asp

UK Biodiversity Action Plan – Habitats: http://www.ukbap.org.uk/habitats.aspx

JNCC Assessment of the conservation status of each habitat on Annex I of the Directive: http://www.jncc.gov.uk/page-4064

Marine Protected Areas: http://jncc.defra.gov.uk/page-4524

Marine Life Information Network: Biology and Sensitivity Key Information Sub-programme [on-line]. Marine Biological Association of the United Kingdom. Available at: http://www.marlin.ac.uk

Scotland: http://www.snh.gov.uk/protecting-scotlands-nature/protected-areas/international-designations/sac/sac-location/

England: http://www.naturalengland.org/ourwork/conservation/designatedareas/default.aspx

Northern Ireland: http://www.doeni.gov.uk/niea/protected_areas_home

Wales: http://www.ccw.gov.uk/Splash.aspx