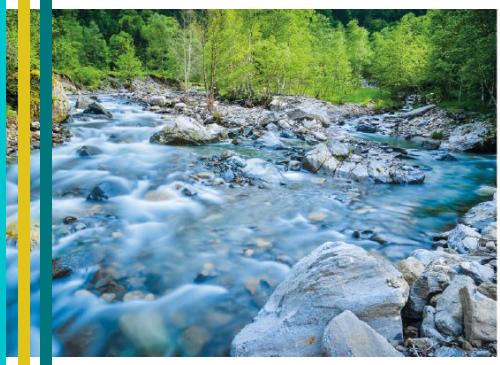


Synergies and Differences between Biodiversity, Nature, Water and Marine Environment EU Policies[1]

Overview

Major international agreements and European and national policies, including the EU 2020 Biodiversity Strategy, have recently been implemented to tackle global declines in biodiversity. However, despite these efforts, targets are far from achieved in aquatic ecosystems. In order to revert current trends, it is necessary to not only understand the mechanisms that drive on-going biodiversity loss, but to also identify where existing policies can either hinder or support biodiversity conservation efforts.

This AQUACROSS report addresses this issue through (1) identifying the main international and European-level policy drivers affecting biodiversity conservation targets (negatively or positively) and (2) identifying and reviewing synergies and barriers between key environmental policies protecting aquatic biodiversity in freshwater, coastal and marine realms in Europe.

Findings from this report will be applied as recommendations for further research in the AQUACROSS project. Though this work will primarily be used within the project to frame research in policy, there are important lessons that can be useful for EU policy-makers:

1. Despite some progress, Europe remains far from achieving policy objectives and having healthy aquatic ecosystems.

   A vast majority of freshwater and coastal habitats are deteriorated while many marine species are in critical conditions. Reaching the EU Biodiversity Strategy objectives in aquatic ecosystems remain very challenging.

[1] *This is the executive summary of AQUACROSS Deliverable 2.1: Synergies and Differences between Biodiversity, Nature, Water and Marine Environment EU Policies. The full version of this document can be found at www.aquacross.eu in project outputs*

2. The EU Biodiversity Strategy largely relies on other EU policies to achieve its objectives for aquatic ecosystems.

   *Importantly, the **Birds and Habitats Directives (Nature Directives)**, the **Water Framework Directive (WFD)** and **Marine Strategy Framework Directive (MSFD)** stand out as key pieces of legislation, but they are either supported (positive synergies) or in competition (conflicts) with multiple other environmental and sectoral policies.*

3. There is clearly scope to mainstream further policy actions in sectoral policies.

   The emphasis of the policy framework is to establish environmental targets and to some extent tackle pressures; EU policy is weakest in diverting (economic) support from economic activities (e.g. agriculture, aquaculture, fishing, industries, tourism) that can harm aquatic biodiversity.

4. Ecosystem-based Management (EBM) has the potential to be a useful tool for policy integration, and there is scope to make the concept operational through the implementation of existing key environmental policies: the Nature Directives, WFD and MSFD.

   Several existing synergies between the four directives were observed, but there is scope for more integration with regards to monitoring programmes, objectives and targets, planning processes, and decision-making criteria (e.g. exemptions and derogations).

Furthering Science

To support improved implementation of European environmental policies and further the application of EBM, political decision-making must be based on sound science. The AQUACROSS report DL2.1 examined the key threats to aquatic biodiversity and their associated pressures. Linking these threats to aquatic systems back to their social and political drivers provided a basis to better understand where policy gaps exist and where further research is needed.

Bridging Policies

Though there have been numerous efforts to establish a political framework to conserve and protect biodiversity in the EU, the work undertaken in this report shows that there is still a long way to go before such efforts can be deemed successful. This work identifies and analyses key environmental policies that potentially promote or hinder biodiversity conservation. Furthermore, this work pushes the exploration, application and clarification of the EBM concept to policy-making and applied research. An EBM mapping analysis of EU environmental policies provides a first take on the suitability of the concept to be used in policy review analyses.

Promoting Innovation

While certain challenges must be addressed through amendments to policy and further coordination between policy realms, other areas can offer opportunities for businesses to close this gap. This report touches upon the impact of sectoral public policies and economic development in either hindering or supporting EU 2020 Biodiversity Strategy targets in aquatic environments. This work highlights areas for amending sectoral policies to promote environmentally-friendly innovation in the future. It also presents key areas for further policy developments and improved implementation, in particular with regards to the application of EBM in environmental policy. Businesses can capitalise on these observations in order to develop innovative products and solutions for improved decision-making and management of aquatic realms.

1 Introduction

The EU 2020 Biodiversity Strategy aims to implement the Strategic Plan for Biodiversity 2011-2020 and the Aichi Targets. It identifies six targets that cover the main factors driving biodiversity loss and aim to reduce existing pressures on nature.

Target 1	Target 2	Target 3
· Conserving and restoring nature through better application of the Birds and Habitats Directives with the goal of halting biodiversity loss and restoring biodiversity by 2020.	· Maintaining, enhancing and restoring (15% as minimum by 2020) ecosystems and their services, by integrating green infrastructure into land-use planning.	· Ensuring the sustainability of agriculture and forestry through enabling existing funding mechanisms to assist in the application of biodiversity protection measures.
Target 4	**Target 5**	**Target 6**
· Ensuring sustainable use of fisheries resources by 2015 with the goal of achieving MSFD targets by 2020.	· Combating invasive alien species.	· Addressing the global biodiversity crisis and meeting international biodiversity protection obligations.

However, the "*Mid-term Review of the EU Biodiversity Strategy to 2020*", published by the European Commission in October 2015, concluded that "***at the current rate of implementation, biodiversity loss and the degradation of ecosystem services will continue throughout the EU***". Three main reasons for this failure were identified: (i) weak level of implementation and enforcement efforts by Member States, (ii) need for more effective integration of relevant policies, and (iii) setting of "*coherent priorities underpinned by adequate funding*."

Recognising these challenges, the **AQUACROSS project focused part of its work on exploring how the current policy framework either supports or hinders the achievement of the EU Biodiversity Strategy targets**. By identifying the most significant threats to aquatic biodiversity, as well as by reviewing the gaps and limitations of the policy framework in place, AQUACROSS contributes to improving aquatic biodiversity protection in Europe and promoting the implementation of an EBM approach.

2 The AQUACROSS Project and DL2.1

The AQUACROSS project, funded under the EU's Horizon 2020 Research and Innovation Programme, seeks to improve the management of aquatic ecosystems, thereby supporting the achievement of the EU 2020 Biodiversity Strategy and the Strategic Plan for Biodiversity 2011-2020.

As part of the project work, Deliverable 2.1 (DL2.1) aims to **identify and highlight the synergies, barriers and opportunities between water-, marine- and nature-relevant policies for more effective implementation of environmental protection policies across aquatic ecosystems in Europe**. The objectives of the report are to determine how EU policies and laws contribute to achieve and/or hinder EU and international biodiversity targets and evaluate the coherence and/or incoherence of current environmental protection policies affecting the management of aquatic ecosystems.

3 Policy Framework for Aquatic Biodiversity

A large number of European policies can directly or indirectly impact aquatic biodiversity. By considering common policy goals, data streams, objectives, and definitions, existing EU policy frameworks could potentially be better streamlined to contribute more purposefully to meet global initiatives. Thus, one of the first steps in AQUACROSS was to **identify and characterise existing European policies relevant to the achievement of EU 2020 Biodiversity Strategy in aquatic ecosystems**. The objective was to understand relevant EU policies, their objectives and implementation logic, as well as to identify what should be considered in more detail in further analysis. Annex 2 of the report provides the templates used for the analysis and Annex 3 provides the individual policy reviews.

What are the key EU environmental policies relevant for protecting aquatic biodiversity?

The EU Biodiversity Strategy is translated into action in aquatic realms through a complex array of environmental policies and laws, including the MSFD, WFD, the Nature Directives, the Invasive Alien Species Regulation, as well as a number of sectoral policies, such as the Common Agricultural Policy. **The key EU environmental policies relevant for protecting aquatic biodiversity are the Nature Directives, the WFD and the MSFD**.

Key Environmental Policies Relevant for Protecting Aquatic Biodiversity

The Nature Directives

The Birds Directive (BD) aims to protect all wild bird species naturally occurring within the EU. The Habitats Directive (HD) aims to conserve natural habitats and wild fauna and flora in the European territory of the Member States to which the treaty applies. Both Directives require Member States to (1) establish a strict protection regime for all wild European bird species and other endangered species listed in the HD, both inside and outside protected sites; and (2) to designate core sites for the protection of species and habitat types, and for migratory birds as listed in the HD and the BD. Together, these designated sites form a network of nature areas, known as the European Natura 2000 Network.

The Water Framework Directive

The WFD aims to promote long-term sustainable water management based on a high level of protection of the aquatic environment. All rivers, lakes, estuaries, groundwater and coastal waters out to one nautical mile (12 nautical miles for chemical status) all fall within the scope of the WFD. Divided into units called water bodies, the WFD set ambitious environmental targets aiming for “good status” of all freshwater, transitional and coastal water bodies, and for groundwater, by 2015, and introduces the principle of preventing any further deterioration of status.

The Marine Strategy Framework Directive

The MSFD’s objective is to protect and preserve the marine environment, prevent its deterioration and restore the environment in areas where it has been adversely affected. Covering marine waters within the sovereignty or jurisdiction of Member States as well as the seabed and subsoil, the MSFD aims to achieve or maintain ‘good environmental status’ (GES) in the waters concerned by 2020. The MSFD defines GES as the environmental status of marine waters where these provide ecologically diverse and dynamic oceans and seas which are clean, healthy and productive within their intrinsic conditions, and the use of the marine environment is at a level that is sustainable.

To what extent are the key environmental policies relevant for protecting aquatic biodiversity achieving their goals?

A review was carried out on the level of implementation of the Nature Directives, WFD and MSFD. The work was based on an assessment of relevant European Commission, European Environment Agency and other European-wide reports. Results show that progress made with the implementation of the Nature Directives, WFD and MSFD mirrors the limited success of the EU Biodiversity Strategy so far. Although EU environmental policies have delivered many improvements, **Europe remains far from meeting their proposed policy objectives and having healthy aquatic ecosystems**.

Nature Directives

· The draft findings of the fitness check consultant report on the Nature Directives note that their objectives were not being met, even though they were implemented in the 1980s. The Directives contributed to reducing the rate of degradation of ecosystems, mainly due to implementation of protected areas, but the overall measures taken thus far are not yet sufficient to meet their objectives. The development of conservation measures, the establishment of financing mechanisms and the management of external features have all been identified as areas where progress is not on track.

WFD

· An assessment report of the WFD found that its objectives are currently not met, as half of European rivers, lakes, and coastal and transitional waters are in less than good ecological status or potential. Two types of measures are required by the WFD: basic measures which refer to existing requirements under EU legislation which may contribute to reaching WFD objectives, and supplementary measures which are those necessary to reach WFD objectives when basic measures are not sufficient. The European Commission evaluated that in many cases the basic measures dictated by the WFD do not suffice to meet its goals.

MSFD

· Assessments of the MSFD's effects on the marine environment show mixed results. A significant problem with assessment proves to be the high number of species and habitats assessed that are categorised as unknown and the linked monitoring difficulties. The European Commission has stated the shortcomings of Member States' submissions and the first phase of implementation progress of the MSFD in terms of adequacy, consistency and coherence.

Which other EU policies are relevant for the achievement of the EU Biodiversity Strategy?

In addition to the Nature Directives, the WFD and MSFD, other policies are relevant to the EU Biodiversity Strategy. They include "emission control" policies, such as the Nitrates Directive or the Urban Wastewater Directive, "sectoral" policies, such as the Common Agricultural Policy or the Common Fisheries Policy, and general "growth" and infrastructure development policies, such as transport policies or cohesion and structural funds.

As an example, Figure 1 below illustrates the **range of policies influencing the achievement of the EU Biodiversity Strategy in aquatic environments** highlighting the complexity of the policy framework. The inner core includes those EU policies directly mentioned in the EU Biodiversity Strategy; the outer core is additional policies identified by the initial review work. Specific review templates for the displayed policies can be found in Annex 3 of the report.

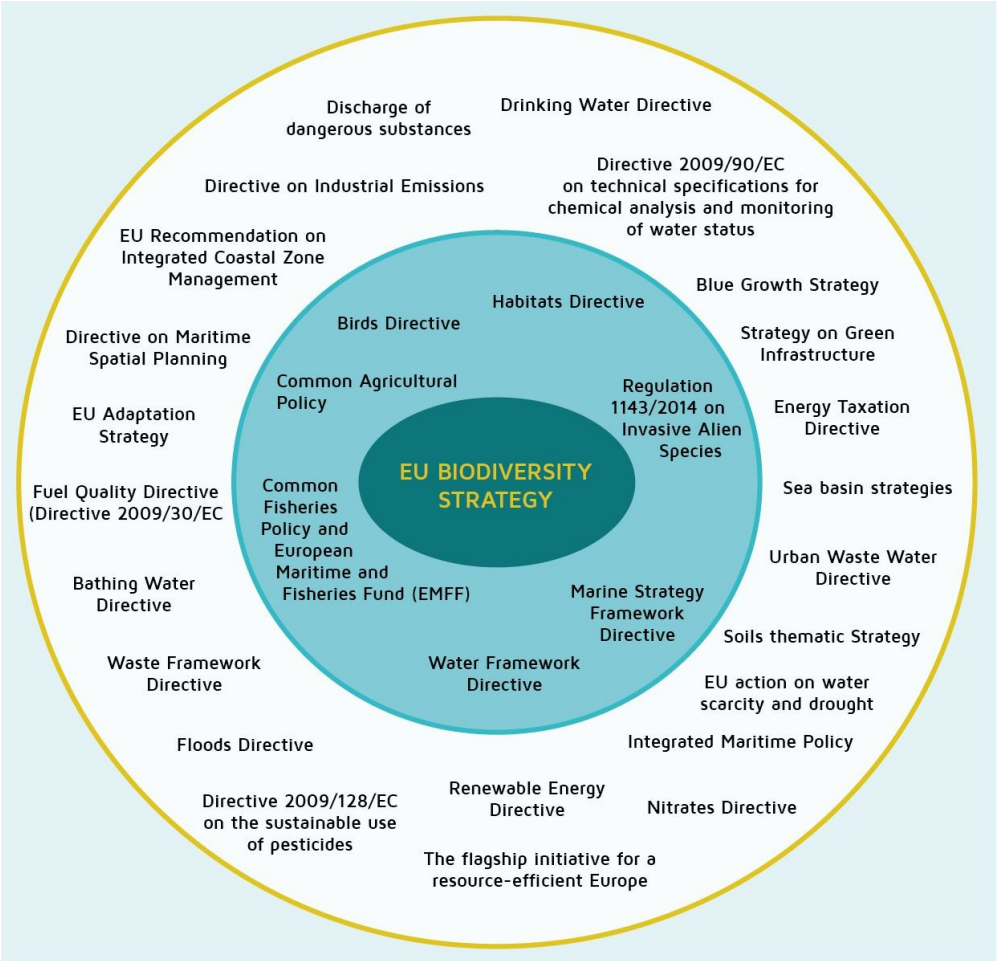


Figure 1: Initial Policy Review: Inner and Outer Core of Considered Policies Relevant for the Achievement of the EU 2020 Biodiversity Strategy Targets

4 Aquatic Biodiversity Threats Assessment

The initial policy review presented above shows that there are numerous policies that both directly and indirectly affect the achievement of the EU 2020 Biodiversity Strategy targets. To understand the impact of European policies on aquatic biodiversity, the report examines in more depth how European policies influence sectoral drivers (economic activities) resulting in pressures on the aquatic environment. Sectoral drivers are linked to their respective governing European policies, which are then assessed for their influence (positively or negatively) on aquatic biodiversity.

To carry out this analysis, the **Drivers-Pressures-State-Impact-Response (DPSIR) framework** was used. The DPSIR framework is a concept that helps to disentangle the biophysical and social aspects of a system under study and is a component of the AQUACROSS concept. It can help categorise threats to aquatic biodiversity along a defined causal chain, including natural and human Drivers and Pressures leading to changed State in aquatic biodiversity and associated ecological, social and economic Impacts. Following that causal chain, Responses aim to reduce Impacts by acting on Drivers, Pressures or State. Annex 4 of the report provides the templates used to analyse the threats, while Annex 5 includes the individual threat analysis.

- Literature review of present pressures on aquatic biodiversity
- Select significant key threats following the DPSIR framework.

- Analyse key mechanisms that drive biodiversity loss
- Determine trends in biodiversity loss as well as in sectoral drivers

- Synthesise strengths and weaknesses of the EU policy framework for each identified threat
- Draw conclusions for limitations and gaps in policy framework

What is threatening aquatic biodiversity in Europe?

For the purposes of this report, a selection of Pressures was made in order to illustrate a good range of policy challenges across the freshwater, coastal and marine continuum. After an initial assessment, the following **six key threats that significantly impose pressures on aquatic ecosystems and threaten their biodiversity** were identified.

- **Nitrogen pollution**: Nitrogen is a limiting nutrient in aquatic environments and an enrichment of this nutrient can contribute to an increase in plant growth, changes in nutrient cycling, uncontrolled growth of algae, eutrophication, acidification, an increase of organic matter settlement, stimulation of cyanobacteria blooms, oxygen depletion, and mortality of benthic fauna and fish. In cases where nitrogen leaches into the groundwater, the pollutant ultimately reaches surface rivers and eventually impacts freshwater bodies such as wetlands, lakes and rivers, as well as terrestrial ecosystems that interact with these water bodies.
- **Extraction of species**: Biodiversity is affected through the active removal of living organisms and genetic resources from the ecosystem while the aquatic habitat can be disrupted as a result of the processes involved in extractive activities, e.g. overfishing, bottom trawling, mechanical seaweed harvesting, wild fish for feedstock. This affects population abundance and parameters (including age, and sex ratios), which sequentially can impact the entire makeup of the species concerned and the related food web in highly unpredictable ways.
- **Water abstraction**: The over-abstraction of water resources from both surface water and groundwater bodies can lead to reduced river flows, lower lake and groundwater levels, and the drying-up of wetlands, influencing natural flow regimes, which is the most important determinant for rivers and wetland ecosystems. Changes in flow features (e.g. the width, depths, velocity patterns and shear stresses within the system) can lead to different responses in ecosystem components and the overall ecosystem function, as aquatic species have developed life history strategies in response to the natural flow regimes.
- **Invasive Alien Species**: Invasive alien species (IAS) are species that are transported outside of their natural range across ecological barriers due to direct or indirect human action. Some of these species cannot adapt to the new environment and die out quite rapidly, but others may survive, reproduce and spread. IAS can affect native biological diversity by means of introducing competition, predation and transmission of diseases between alien and native species. The highest numbers of IAS are found in aquatic ecosystems with high levels of connectivity with other ecosystems, high human frequency and high levels of disturbance.

- **Alteration to morphological conditions of aquatic habitats**: Alterations to morphology are linked to a range of pressures on aquatic ecosystems such as constructions (e.g. dams, weirs, dykes and levees), channelization, straightening, deepening or dredging, and mineral extraction. These anthropogenic interferences can negatively impact biodiversity in a direct and indirect manner. Dams, for example, fragment habitat and migration opportunities, and may cause species extinction. With modified flow dynamics, bed material may be trapped and coarsened, which consequently leads to the depletion of spawning gravels
- **Plastic Waste in the aquatic environment**: By allowing plastic waste to enter aquatic ecosystems, biodiversity can be injured and die due to the entanglement in floating debris or through ingesting of microplastic particles. Research shows that these microplastics can also attract toxic chemical pollutants to their surface, harming further the animals that ingest them. Evidence shows that plastics can be responsible for the increase of range of non-native species through transportation of organisms and the creation of novel habitat.

Are threats to aquatic biodiversity increasing or decreasing?

The status of aquatic biodiversity in Europe is largely inadequate, especially since recent assessments reveal poor results for freshwater, coastal and marine waters all across Europe. It remains important to consider past and future trends, as they can help determine if the course of political action in place permits the recovery of biodiversity, or if policies need to be adjusted in order to achieve sufficient numbers in all aquatic species in European waters.

Some threats appear to have undergone positive trends in recent years. Reduction in nitrogen concentration in European waters has undergone a positive trend over the last 30 years. However, most European coastal waters still carry enough nitrogen in water bodies to lead to eutrophication. In terms of species extraction, signs of improvement within the EU are also present. However, the level of knowledge on species extraction is still very limited, especially in the Mediterranean Sea and Black Sea regions, making it impossible to assess change over time. Invasive alien species (IAS) are being introduced in Europe's seas with increasing regularity. Currently, Europe's seas harbour around 1 400 IAS, 80% of which have been introduced since 1950. The amount of plastic waste generated has dramatically increased in the 20th century and is pervasive now to all water realms. Monitoring, data accuracy and availability are still a major issue. Some trends are yet unclear, in particular regarding hydro-morphological alterations. While it is established that water abstraction in Europe has generally decreased since the 1990s, it is expected that water stress will remain a concern, and that improvements in efficiency will not be able to offset all impacts of climate change.

In summary, **while there are some positive tendencies present for threats on aquatic biodiversity in Europe, the negative trends persist**. Even though regulatory and monitoring frameworks are in place and the negative effects of threats on biodiversity are scientifically proven, progress in species conservation is too gradual or ineffective to make a sustainable impact. It needs to be determined whether a fault is present in the policy frameworks in place to prevent degradation or if other factors contribute to this decline.

What are the sectoral drivers of pressures that lead to aquatic biodiversity loss?

AQUACROSS has identified a number of **key drivers of aquatic biodiversity loss** in order to link these activities to **key pressures on aquatic biodiversity**. Some drivers were identified across multiple

threats and have been grouped below, while others play a more significant role in relation to a single (see Table 1).

Table 1: Summary of Key Drivers in Relation to their Contribution to Key Threats to Aquatic Biodiversity

	Nitrogen Pollution	Extraction of Species	Water Abstraction	Invasive Alien	Morphological Alterations	Plastic Waste
Agriculture	X		X		X	
Urban areas	X		X		X	X
Water utilities	X		X		X	
Commercial fishing		X				X
Aquaculture	X	X		X	X	X
Energy	X		X		X	
Transport	X			X	X	X
Industry	X	X	X		X	X
Waste sector	X					X
Tourism	X		X		X	X
Species trade				X		

Overview of the economic importance of sectoral drivers to the European economy

Though these key drivers and their activities contribute to producing pressures that threaten aquatic biodiversity, they also represent significant economic sectors that the European economy relies upon. They lead to economic growth, are important for employment, and supply valuable services and products necessary to society, such as food, energy and clean water. Policy responses need to account for these socio-economic factors, understand the economic driving forces underpinning threats to aquatic biodiversity, and the likely trajectory of current and future pressures.

Table 2 presents a synthesis of the information gathered per driver. The provided figures confirm that **drivers underpinning aquatic biodiversity loss also represent critical sectors for the European economy**. Forecasts also indicate an intensification of each driver, which is likely to result in higher pressure on aquatic ecosystems and further biodiversity loss. European policies need to account for these trends, and provide adequate responses.

Table 2: Drivers Leading to Negative Impacts to Aquatic Biodiversity and their Future Economic Outlook

Driver	Impact on key threat to aquatic biodiversity	Significance to European Economy	Trends
Agriculture	Nitrogen inputs through diffuse pollution; water for irrigation purposes; required infrastructure causes alteration to morphology; land reclamation and drainage.	Utilised agricultural area: 170 million hectares (2013); 10.8 million farms operating in the EU-28 (2014); Employs 9.5 million people, 4.4% of total employment (EU-28, 2013); Share of agriculture in EU-27's GDP (GVA/GDP): 1.2% (2013)	↑
Urban areas	Contributes to alterations in morphology; discharges of untreated municipal sewage are a major source of plastic pollution; contributes significantly to water abstraction and nitrogen pollution.	67% of EU GDP in metropolitan regions of more than 250 000 inhabitants;7% of the EU's population live in cities of over 5 million inhabitants; In the EU: 26 cities of more than 1 million inhabitants, and 373 cities of more than 100 000 inhabitants; 72.4% of population lives in cities, towns and suburbs	↑
Water utilities	Contributes to water abstraction and nitrogen pollution; discharges contribute to nitrogen and plastic.	Involves 75 400 enterprises and employs 1.5 million people; A GVA of 97.5 billion EUR	↑
Commercial fishing	Contributes to species extraction; trawling affects genetic structure of a species population; plastic waste generated during commercial fishing.	GVA of EU fisheries amounts to 3.4 billion EUR; Provides 127 686 jobs; 83 590 fishing vessels registered in the EU fleet	→
Aquaculture	Contributes to excess nitrogen through fish feed and through N_2O emissions to the atmosphere; linked to alteration to morphology.	Supplies 24% of Europe's seafood (2014); GVA of 1 500 million EUR (EU-28) (2013); 80 000 employees in a full time equivalent of around 27 000 jobs (2013); 8th biggest aquaculture producer in the world (2015)	↑
Energy	Causes dredging and direct physical modifications to the seabed through the construction of oil and gas infrastructure; combustion of fossil fuels of coal lead to nitrogen atmospheric emissions and subsequent deposition; abstracts water for cooling purposes	Renewable sources supply 25% of primary energy production in Europe; Hydropower accounts for 16.6% of primary energy production, the EU 28's largest renewable energy resource (2013); Offshore wind: 10% of total wind energy in EU; 35 000 employees; GVA of 2.4 billion EUR; Crude oil and gas: 9.1% and 15.5%, respectively, of energy supply	↑
Transport	Contributes to nitrogen emissions through the combustion of fossil fuels and the subsequent atmospheric deposition; impacts the morphology; shipping introduces IAS. major driver of plastic waste	Road transport: 49.4% of total good transport within the EU, inland waterways: 4%, intra-EU maritime transport: 31%; Turnover for road freight: 312 billion EUR; 2 945 700 employees; Turnover for road passenger: 121 billion EUR; 1 988 500 employees; Shipping: 75% of imported and exported goods by weight; 50.7% of EU trade	↑
Industry	Contributes to nitrogen emissions through wastewater discharges; emissions of pollutants and sediments downstream; industrial plastic waste becomes marine debris. Blue biotechnology depends on the extraction of aquatic genetic resources	Chemical is the 5th largest industry of EU; contributes 7% of EU's manufacturing added value; 17% of global production; 19 000 firms in the mining and quarrying industry in EU-28; 3.3 million firms in construction; Blue biotechnology industry: GVA of 800 million EUR; 18 000 natural products and 4 900 patents associated with genes of marine organisms	→
Waste sector	Contributes to plastic waste; contributes to the emissions of a range or pollutants	Turnover of 137 billion EUR; 2 million jobs; 1.1% of EU GDP.	↑
Tourism	Demands water abstraction; contributes to emission of nitrogen through wastewater; tends to alter the natural environment causing, for example, changes in siltation	Tourism contributes up 10% of EU GDP; employs 12 million people (2013); Turnover of 941 075 million EUR.; Coastal and maritime tourism: 3.2 million jobs and 183 billion EUR in GVA; or 1/3 of the EU's maritime economy.	↑
Species trade	A key pathway for IAS introduction, in particular the marine ornamental fish trade.	Total value of imports for ornamental fish into the EU is 72.3 million EUR; Imports of freshwater species into EU accounts for 82.9% of the total value of imports for the year.	→

Which EU policies directly and indirectly influence aquatic biodiversity?

Overall, **the European policy framework represents a comprehensive set of legislation and regulations protecting aquatic biodiversity**. The review has shown that there are number of transversal environmental policy instruments which work across threats (e.g. Nature Directives, WFD, MSFD, LIFE, EIA, and SEA) as well as more specific ones for each threat.

- Regarding **nitrogen pollution**, the Urban Waste Water Treatment Directive (91/271/EEC) and the Nitrates Directive (91/676/EEC) set target values for the eutrophic state of freshwater and coastal waters, and promote measures to reduce nitrogen emissions respectively from the domestic and industrial sector, and the agricultural sector. Other relevant policies include the Drinking Water Directive (98/83/EC) the Bathing Water Directive (previously 76/100/EEC, now 2006/7/EC) and the Groundwater Directive (2006/118/EC). The WFD integrates all these objectives in its status assessment and the establishment of River Basin Management Plans and Programmes of Measures, while the MSFD mostly relies on freshwater and land related policies, such as the WFD and the Common Agricultural Policy, to reduce nitrogen emissions. The nitrogen threat is also tackled through legislation on air quality protection, with the National Emission Ceilings Directive (2001/81/EC), the Directive on Industrial Emissions concerning Integrated Pollution Prevention and Control (2008/1/EC), and the Ambient Air Quality Directive (2008/50/EC). All three seek to reduce NO_X emissions through controls on emissions (e.g. licensing and authorisations) and the promotion of best available techniques (e.g. more efficient combustion processes).

- In terms of **species extraction**, the Common Fisheries Policy mainly promotes measures to reduce pressures from fishing activities, for example by increasing selectivity and reducing unwanted catches. Furthermore, it should lead, as it is the case with the multi-species plan for the Baltic, to the adoption of multi-species plans that contain conservation measures with quantifiable targets to restore and maintain fish stocks at levels capable of producing Maximum Sustainable Yield and control over the number of fishing capacity of the fishing fleet. Some of these measures are financially supported by the Regulation (508/2014) on the European Maritime and Fisheries Fund and reinforced by the MSFD.

- **Water abstraction** is considered in the WFD, which promotes measures to tackle pressures (e.g. water use efficiency, alternative water sources) and mitigate the impact on state of water abstraction (e.g. artificial recharge of groundwater bodies). Also, the principle of recovery of the costs of water services (Art. 9), including environmental and resource costs and hence the impact of water services on the environment, is implemented via water pricing, which provide incentives for users to use water resources efficiently. Further emphasis is given in the EU policy framework on water reuse and groundwater recharge through the Communication (2007) "Addressing the challenge of water scarcity and droughts in the European Union", and the Communication (2015) "Closing the loop -An Action plan for the Circular Economy". Water use in agriculture is targeted via a register and authorisation scheme on irrigation and funding for improving irrigation techniques under the Common Agricultural Policy.

- Combating **IAS** is established through the Directive (29/2000) on "protective measures against the introduction into the Community of organisms harmful to plants or plant products and against their spread within the Community", the Regulation (304/2011) concerning use of alien and locally absent species in aquaculture, and the Regulation (1143/2014) on invasive alien (non-native) species. The latter regulation foresees three

types of interventions: prevention, early detection and rapid eradication, and management. Aside from these regulations, the Nature Directives place restrictions on the deliberate introduction of alien species into the wild. Most of the regulations, policies and directives focus on decreasing pressures (i.e. restrict and regulate IAS introduction into the wild) but not drivers (e.g. transport, aquaculture).

- **Alterations to morphology** are not tackled by specific policies, but more or less explicitly integrated in the Nature Directives, WFD and MSFD. The WFD establishes a specific management regime for water bodies most affected by morphological changes through their designation as Heavily Modified Water Bodies. The Note (2011) "Towards Better Environmental Options for Flood Risk Management" encourages the adoption of less intrusive flood risk protection measures such as Natural Water Retention Measures. Transversally, the Environmental Impact Assessment (EIA) Directive (2011/92/EU, amended by 2014/52/EU) and the Strategic Environmental Assessment (SEA) Directive (2001/42/EC) are important instruments for considering and minimising impacts of new morphological alterations. Sectoral funding, such as those provided by the Regulation (1305/2013) on support for rural development by the European Agricultural Fund for Rural Development, can be used to restore the morphological state of freshwater and coastal waters.

- There are specific directives and policies in place to limit and eliminate **plastic waste**. The Waste Framework Directive (2008/98/EC) sets the basic concepts and definitions related to waste management, such as definitions of waste, recycling, recovery. The Packaging and Packaging Waste Directive (94/62/EC) requires Member States to ensure that preventive measures are implemented by, for example, national programmes, extended producer responsibility programmes, and to develop packaging reuse systems for the reduction of the impact of packaging and packaging waste on the environment. The wastewater treatment sector is, as mentioned above, regulated by the Urban Waste Water Treatment Directive (91/271/EEC). The Communication (2011/571) Resource Efficient Europe sets out concrete actions on marine litter by establishing Special Areas of Conservation together with the Nature Directives' Natura 2000 Network and designating, for instance, that by 2020, market and policy incentives reward business investments in efficiency.

The review showed that environmental policies may establish specific targets to reach a state of aquatic environment, or may require measures that tackle pressures and drivers impacting state. Nature Directives focused on protecting habitats and species and the environmental targets of the WFD and MSFD. The reviewed threats are well covered by these four directives with further targets specifically set by other Directives for nitrogen (e.g. nitrogen standards), species extraction (e.g. Maximum Sustainable Yield) and IAS. Current policy developments on Ecological Flows and Green Infrastructure provide the basis for further policy action on the water abstraction and morphological threats. There may be indirect links, for example when a general objective aims to improve total environmental status. Environmental mainstreaming is also another avenue, for example when conditions are attached to the distribution of sectoral subsidies.

However, **there remain significant deficits within the EU legal framework**, reflected by the unfavourable results of the Biodiversity Strategy Mid-Term Review that suggest a wide array of persisting negative trends in biodiversity loss. Table 3 below identifies those policies that promote threats to Aquatic Biodiversity. Overall, the EU policy landscape appears to have a mixed effect: in some ways it provides protection to aquatic biodiversity, in other ways, it encourages activities that lead to further deterioration.

Table 3: Summary of European Policy Mechanisms that Directly or Indirectly Lead to Threats to Aquatic Biodiversity

Sectoral Policies	Promoted Drivers											Key Threats to Aquatic Biodiversity					
	Agriculture	Urban Areas	Water Utilities	Fishing	Aquaculture	Energy	Transport	Industry	Waste sector	Tourism	Species Trade	Nitrogen Pollution	Species Extraction	Water Abstraction	Invasive Alien Species	Alterations to Morphology	Plastic Waste
Regulation (508/2014) on the European Maritime and Fisheries Fund				■	■			■				✔	✔		✔	✔	✔
Regulation (380/2013) on the Common Fisheries Policy				■	■							✔	✔		✔	✔	✔
Communication (COM (2004) 254 final/2) Innovation in the Blue Economy	■				■							✔	✔				
Regulation (1307/2013) establishing rules for direct payments to farmers under support schemes	■											✔		✔		✔	
Regulation (1305/2013) for European Agricultural Fund for Rural Development	■											✔		✔		✔	
Regulation (1300/2013) on Cohesion Fund						■	■					✔			✔	✔	✔
Regulation (1301/2013) on Regional Development Funds		■	■			■	■	■		■		✔		✔		✔	✔
Directive (2009/28/EC) on the promotion of the use of energy from renewable resources	■					■						✔		✔		✔	
Communication (COM/2014/014 final) Towards an Industrial Renaissance			■					■						✔			✔
Communication (COM/2010/0352 final) Europe, the world's No. 1 tourist destination										■				✔			✔
Communication (COM (2004) 453 final) on Short Sea Shipping			■				■					✔			✔	✔	
White paper (COM (2011) 144 final) Roadmap to a Single European Transport Area			■				■								✔		✔
Floods Directive (2007/60/EC)			■													✔	
Fuel Quality Directive (2009/30/EC)	■											✔					
Regulation (710/2009) on organic aquaculture animal and seaweed production					■								✔		✔		

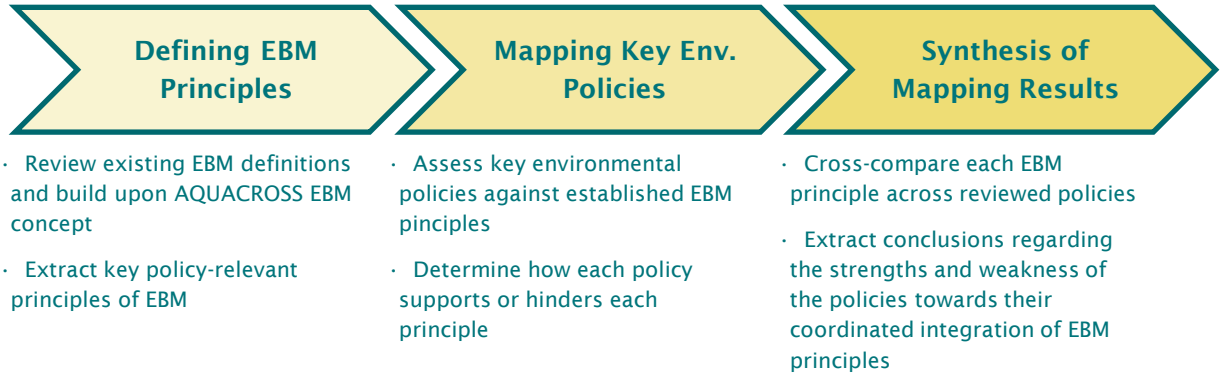
Legend:
- ■ = Direct support (funding mechanisms) that increase threats to aquatic biodiversity;
- ■ = Encouraging a change of sectoral practices that leads to increase the threat;
- ■ = Promotion of the threat through new practices by changing the regulatory landscape
- ☐ = Not applicable

5 Synergies and Barriers between Policies and Biodiversity Protection

As the previous section showed, there are many policies that impact aquatic biodiversity in the EU, either directly or indirectly through their promoted measures or financing instruments. The key environmental policies—the Nature Directives, the WFD and MSFD—are the main ones that aim to protect aquatic biodiversity against negative pressures. As such, this section reviews the synergies and barriers between these policies to assess how they work together to achieve this goal through the implementation of EBM.

In AQUACROSS, EBM is seen as an integrative approach to help address the challenges around implementing policies that govern aquatic ecosystems, and can be used to sustainably manage and protect biodiversity. The aim of this assessment is to **evaluate the possible future use of EBM as an integrative policy concept for the improved protection of aquatic biodiversity**. With this European "policy framing", work within the AQUACROSS case studies will examine more specifically the implementation challenges and innovations from a bottom-up perspective.

The assessment began with a review of EBM definitions to identify policy relevant principles of EBM. Following this, the key environmental policies were compared against these principles to highlight the individual performance of each policy in promoting or possibly hindering each principle. Results of this step were then synthesised to provide an overview of all policies and their ability to coordinate to promote EBM for aquatic ecosystems and to protect their biodiversity. The templates used for this assessment are included in Annex 6 and the results of the individual analysis for each policy are provided in Annex 7 of the main report.



A policy-relevant definition of EBM

One of the first steps of the assessment involved the identification of principles of EBM that are (i) relevant to AQUACROSS and aquatic ecosystems and (ii) mindful of existing policy requirements. EBM is a complex concept, incorporating a wide range of principles. Though the concept of EBM has taken root in the political sphere, there is currently no single, agreed-upon overarching definition of EBM. However, it can generally be understood as any management or policy option intended to restore, enhance and/or protect the resilience of an ecosystem so as to sustain or improve the flow of ecosystems services and conserve biodiversity (see AQUACROSS Deliverable 3.1- Innovative Concept). This includes any course of action purposely intended to improve the ability of an ecosystem to remain within critical thresholds, to respond to change and/or to transform to find a

new equilibrium or development path. As such, the following **policy-relevant principles for EBM were developed for the purpose of the assessment**. These are summarised in Figure 2.

1 EBM considers ecological integrity, biodiversity, resilience and ecosystem services	• focuses on multiple ecosystem services and aims to maximise their joint value • considers the dynamic relationships within ecosystems
2 EBM is carried out at appropriate spatial scales	• considers ecosystem rather than jurisdictional boundaries to reach decisions and take actions at the appropriate level • considers complex and adaptive processes • may require transboundary cooperation
3 EBM develops and uses multi-disciplinary knowledge	• requires a multi-disciplinary approach • relies on a detailed understanding of the socio-ecological system, drawing on scientific as well as local and traditional knowledge
4 EBM builds on social-ecological interactions, stakeholder participation and transparency	• acknowledges social-ecological interactions and seeks to balance ecological and social concerns • considers synergies and trade-offs between benefits and beneficiaries • gives preference to transparent and inclusive decision-making • seeks to build consensus on a shared vision for the future
5 EBM supports policy coordination	• facilitates cooperation and collective action across different stakeholder and policy domains to share the array of ecosystem services obtained • creates new opportunities to pursue different policy objectives simultaneously
6 EBM incorporates adaptive management	• aims to increase adaptative capacity by restoring critical ecosystems and strengthening social capacities to respond to a range of possible future scenarios • weighs short-term management options against long-term benefits of alternative interventions • monitors impact and regularly revisits management tools

Figure 2: Policy Relevant Principles of Ecosystem-based Management

Do the key EU policies sufficiently integrate the EBM principles?

With the policy-relevant principles developed, it is possible to analyse how key environmental policies relevant to protecting aquatic biodiversity incorporate these principles. This part of the analysis is based on different aspects of each Directive's respective legislation, including, **objectives** (i.e. overall objectives as well as targets and standards), **spatial and temporal scales** (i.e. units of management), **planning processes and steps**, and **management measures** promoted to achieve each Directive's aims. In addition, supporting documents issued by the European Commission (e.g., EU communications, Common Implementation Strategy guidance documents and texts, relevant publications, etc.).

The results of this analysis are visually presented in Table 4, below. Overall, the **Nature Directives are the least comprehensive in their incorporation of the EBM principles**. With one icon for each principle, this indicates that the legislative text and supporting documents are somewhat supporting if not neutral in their representation of each principle. As such, the Nature Directives do

not integrate many of the elements of EBM; but, on the other hand, the directives do not prevent EBM implementation and some of their requirements are coherent with EBM principles. Conversely, the WFD and the MSFD (both more recent policies than the Nature Directives) better incorporate elements of the EBM principles. **The WFD is somewhat supportive of the EBM principles overall**; its strengths are in the development and use of multi-disciplinary knowledge, policy coordination, and adaptive management. Though it lacks some elements of the EBM principles, like the Nature Directives, it does not prevent EBM implementation. Lastly, **the MSFD is the most aligned piece of legislation with the EBM principles**, with many principles categorised as supported and only two categorised as being somewhat supported if not neutral.

Table 4: Comparison of Main Environmental EU Directives against EBM Principles

EMB Principles	1	2	3	4	5	6
	Ecological integrity, biodiversity, ecosystem services and resilience	Appropriate spatial scales	Development and use of multi-disciplinary knowledge	Socio-ecological interactions, stakeholder participation and transparency	Policy coordination	Adaptive management
Birds Directive						
Habitats Directive						
Water Framework Directive						
Marine Strategy Framework Directive						

Legend: Two icons = Supporting; One icon = Supporting/Neutral; No icons = Hindering

Can EBM act as an integrative policy concept across key environmental policies protecting aquatic biodiversity?

Overall, there is a lot of EU policy support for the implementation of EBM and potential to increase synergies between policies with this purpose. A summary of key findings of the main strengths and weaknesses or challenges of the current policy context is provided in Table 5. The EU policy framework in the form of the Nature Directives, WFD and MSFD support several key dimensions of EBM, with the MSFD being the most explicit about EBM implementation. In practice, however, **mechanisms and instruments set in place in the legislative framework are still limited**, especially with regards to the implementation of the ecosystem services approach, the integration of planning processes and monitoring programmes, the integration of local knowledge in the decision-making process, coherent approaches to exemptions and derogations, and the consideration of uncertainties in management and governance.

Table 5: Strength and Challenges in the Coordination of the Nature Directives, WFD and MSFD for the Implementation of EBM

EBM Principle	Strengths	Weaknesses/Challenges
1: EBM considers ecological integrity, biodiversity, resilience and ecosystem services	Reviewed policies support the key concepts of EBM implicitly, with undisputed linkages in their objectives with biodiversity conservation.	No clear policy framework for taking into account ecosystem services and managing trade-offs, which reduces the potential effectiveness of the policy instruments towards biodiversity protection. The WG MAES framework could be applied to streamline approaches among the directives.
2: EBM is carried out at appropriate spatial scales	Management is encouraged at relevant ecological scales, while multiple levels in social systems (and the need to coordinate) are acknowledged.	No clear framework or guidance on how to work across scales; no clear acknowledgment of cross water realms linkages (except in MSFD); objectives set a specific scales (e.g. water body level in WFD) may not take into account ecological dynamics
3: EBM develops and uses multi-disciplinary knowledge	Reviewed directives encourage inter-disciplinary approaches and consider societal values and interest in decision-making	No explicit requirement to integrate local knowledge (e.g. to improve contextual understanding of management units). Differences in objectives, scope and approaches result in different monitoring needs. Synergies in monitoring programmes can be exploited. The main objective should be to integrate monitoring as far as possible.
4: EBM builds on social-ecological interactions, stakeholder participation and transparency	Participation is an element of all reviewed directives and mechanisms are crafted to enable a balance between ecological and social concerns.	Unclear distribution of powers and role of local communities in decision-making unclear (e.g. who decides?). Multiple types of criteria for derogations among directives which increase potential for different interpretation and conflicts
5: EBM supports policy coordination	Policy coordination is strongly encouraged. Scope for revisions of the legal acts to foster further policy integration in line with Biodiversity Strategy objectives. Scope for funding instruments to support integration of Programme of Measures	Few specific mechanisms that help strong coordination are proposed, especially outside protected areas.
6: EBM incorporates adaptive management	Policies support evaluation of management measures, with clear (although separate) planning cycles for the Nature Directives, WFD and MSFD.	No strong framework for dealing with uncertainties (and climate change), no legislative guidance with regards to timescale envisaged, limited length of regulatory requirements (e.g. WFD revisions in 2020s) and no clear methodological proposition (e.g. use of scenarios)

6 Conclusions

This report aimed to identify the main international and European level policy drivers affecting biodiversity conservation targets (negatively or positively), as well as, to identify synergies, opportunities and barriers between existing environmental and related sectoral policies relevant for the protection of aquatic ecosystems. This work focused on the implementation of the EU 2020

Biodiversity Strategy, examining how it interacts and relies on other policies as well as how existing policies can promote better management of aquatic ecosystems through EBM.

Despite the existence of multiple international agreements on the conservation and preservation of biodiversity, much of the world's and Europe's biodiversity levels remain in decline. The EU 2020 Biodiversity Strategy, in particular, is failing to meet its targets and other key environmental policies are similarly challenged. Thus, while some progress has been made, **Europe remains far from achieving policy objectives and having healthy aquatic ecosystems**. A vast majority of freshwater and coastal habitats are deteriorated while many marine species are in critical conditions.

To better implement the EU Biodiversity Strategy, other EU policies must be implemented to achieve the Biodiversity Strategy objectives for aquatic ecosystems, including the Nature Directives, the WFD and MSFD. These Directives are either supported or in competition with multiple other environmental and sectoral policies, the legal and policy provisions of which can either directly or indirectly aim to reduce pressures on aquatic ecosystems and biodiversity or reinforce those pressures.

There is clearly **scope to mainstream further policy actions in sectoral policies by mainstreaming biodiversity protection into existing policy frameworks**. The emphasis of the policy framework is to establish environmental targets and to some extent tackle pressures. As seen through the assessment of threats to aquatic biodiversity, the EU policy framework is more developed for a number of pressures, such as extraction of species, input of nitrogen, invasive alien species and, increasingly so, plastic waste. Water abstraction and alterations to morphology of aquatic habitats are addressed by few specific policy instruments at the EU level. In addition, EU policy is weakest in diverting (economic) support from economic activities (e.g. agriculture, aquaculture, fishing, industries, tourism, etc.) that can harm aquatic biodiversity.

Operationally, how can Member States and regional authorities improve the coherence of EU policies to meet biodiversity targets? This was examined through the EBM analysis, which researched **the potential for implementing EBM as an innovative, integrative management approach for the safekeeping and protection of aquatic biodiversity**. The analysis focused on the Nature Directives, WFD and MSFD as the four key environmental policies aiming to protect aquatic biodiversity, and revealed that EBM can for the most part be made operational through their implementation.

The four directives put a lot of emphasis on considering ecological integrity in management approaches, coordinating between multiple ecological and social scales, using multi-disciplinary knowledge, encouraging stakeholder participation, establishing more transparent reporting, increasing policy coordination and establishing adaptive cycles of revisions. Although few mechanisms and instruments currently exist, **the four directives do not conflict with a number of other dimensions of EBM**, such as the use of the ecosystem services approach to guide decision-making, the building of social-ecological resilience, co-management with local communities, and the consideration and management of uncertainties in decision-making.

Several existing synergies between the four directives were observed, but there is scope for more integration with regards to monitoring programmes, objectives and targets, planning processes, and decision-making criteria (e.g. exemptions and derogations). These issues, and how to overcome them, must be further examined and researched through practical experiences in a bottom-up approach.

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