Assessing Aquatic Spaces of Regulation: Key Issues and Promising Solutions

*Henrik Josefsson**

Abstract

Implementing measures on a large scale, including multiple bodies of water and activities, is emphasized as a prerequisite for achieving the Water Framework Directive's objective of 'good ecological status'. This article asks what kind of space of regulation is suitable for the ecological and hydrological systems and large-scale environmental problems of a river basin area. The conclusion is that the obligation of 'good ecological status' is coupled to each body of water, not multiple ones, and not designed for large-scale environmental problems that include multiple bodies of water. A larger-scale and management-adapted aquatic space of regulation is found in the Habitats Directive and the Liability Directive, since their space of regulation is more site-specific and adapted to environmental characteristics and problems of the legal space. A differentiation of spaces of regulation that facilitates management of large-scale environmental problems of a sub-basin or river stretch is proposed.

Consult the genius of the place in all; That tells the waters to rise and fall …
Alexander Pope[1]

1. Introduction

This article analyses the establishment of spaces of regulation of areas where the expanse of freshwater ecosystem is a dominant feature. Under EU law the assessment and management of freshwater ecosystems are dominated by the Water Framework Directive[2], however, other legal frameworks, such as the Habitats Directive,[3] and the Liability Directive[4] also provide freshwater spaces of regulation.[5] The purpose is to, first, examine if regulation of large-scale environmental problems, integrating multiple bodies of water, is compatible with the Water Framework Directive's space of regulation that 'body of wa-

* Ph.D. student, Faculty of Law, Uppsala University.

[1] Alexander Pope, *Epistle to Burlington,* lines 57–58.

[2] Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy (Water Framework Directive).

[3] Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora (Habitats Directive).

[4] Directive 2004/35/CE of the European Parliament and of the Council of 21 April 2004 on environmental liability with regard to the prevention and remedying of environmental damage (Liability Directive).

[5] 'Space of regulation' is used as an overarching concept to converge the different legal schemes of geographical differentiation of both social places and ecosystems. The differentiation is a mean to operationalize the different environmental objectives of each directive geographically.

ter' and the objective of 'good ecological status' actualizes. Secondly, the purpose is to examine if there exists alternative spaces of regulation or ecological spaces suitable for the management of large-scale environmental problems. Still, as the Water Framework Directive is the main legislative act as regards water management, this essay orients itself towards the Directive throughout and analyses how well the different directives correlate when they overlap.

This essay first discusses the possibility of the Water Framework Directive's unit of 'body of water', and objective of 'good ecological status' to include or interrelate multiple bodies of water and activities. Second, it exemplifies how the ecological space of a stream adjacent to a Natura 2000 area is perceived legally in the issuing of a hydropower permit. The third and fourth section provides an analysis and discusses different spaces of regulation, such as the Liability Directive's, the large-scale legal spaces of the Marine Strategy Directive[6] and the Landscape Convention[7]. An expanse of freshwater ecosystem may, ecologically, be differentiation through the use of units such as: community, population, ecosystem, lake, or river, for example. Section five introduces ecological reasoning discussing different ecological spaces for the assessment of river basin environmental problems, both with and without regard to the Water Framework Directive. The final section discusses how an expanse of freshwater ecosystem may be differentiated, to facilitate spaces of regulation that incorporates large-scale environmental problems.

2. Aquatic Spaces of Regulation

Legal objectives such as the Water Framework Directive's 'good ecological status' or the Habitats Directive's 'favourable conservation status' are connected to the units of their respective Directives. A 'body of water' is the unit to which 'good ecological status' applies (e.g. Art 2 (22), 4 (a)(ii)), and a 'Natura 2000 area' or a 'species population' within the European territory is the unit to which 'favourable conservation status' applies (e.g. Art. 3 and 1 (i)). When assessing the 'favourable conservation status' of a Natura 2000 area or a species population, the obligation may expand beyond of the unit to activities outside of geographical area or follow the species requirements for self-maintaining, if an activity significantly affects the 'favourable conservation status' of the of the Habitats Directives spaces of regulation (Art. 1 (e)(i), Art. 6 (2)(3)).

The spatial expansion of the obligation of 'favourable conservation status' is not possible, in relation to the Water Framework Directive's unit 'body of water', as the entire river basin is differentiated into different types of bodies of water or management units, each having a type-specific objective with a type-specific reference point associated with it (see Art. 4 (a)(ii), Annex V (1.2.) and Annex II (1.1.)(1.3.)). Another difference is that a Natura 2000 area may include waters that are not identified as 'bodies of water', since the Water Framework Directive applies to rivers, lakes, transitional waters, or coastal waters. Waters that cannot be clearly classified, as any of these categories (e.g. the narrow neck between two lake types), is not directly integrated into the provisions of the Water Framework Directive (see Annex II). Thus, the space of regulation of a body of water is not the same, ecologically or legally, as the legal space of a Natura 2000 area, and generates different obligations for the Member States.

[6] Directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008 establishing a framework for Community action in the field of marine environmental policy (The Marine Strategy).

[7] Council of Europe, 'European Landscape Convention, Florence. CETS No. 176 (Strasbourg: Council of Europe)'.

The difference between the spaces of regulation is due to the variables that direct the differentiation of the legal units. In the Habitats Directive, geographic, abiotic, and biotic features distinguish aquatic areas, a differentiation of units that seems to follow the Convention on Biological Diversity[8] and its definition of 'ecosystem' as a 'dynamic complex of plant, animal and micro-organisms communities and their non-living environment interacting as a functional unit' (Art. 2). In the Water Framework Directive, only abiotic parameters, in much more detail, are specified, to differentiate bodies of water from one another (see Annex II 1.2).

The following section discusses the suitability of the body of water as the space of regulations of 'good ecological status' when assessing and managing the ecological, and hydrological systems of an aquatic area, with regard to large-scale environmental problems.

2.1 The Water Framework Directive

In a recent Swedish official governmental report, the interconnectedness of a river basin was discussed from the perspective of implementing measures for multiple bodies of water and activities within a sub-basin or river section.[9] The report suggested that it should be possible for the government or competent authorities to issue general administrative provisions that implement general measures with regard to substantial, well documented, and similar environmental problems within a part of a river basin. Issuing this kind of provision is intended to breach permit rights and change the circumstances of multiple, permitted activities within a sub-basin or river section, for example. It has been argued that this kind of provision is a prerequisite for achieving the Water Framework Directive's objective of 'good ecological status'.[10] The space of regulation would then be on a large scale (e.g. multiple bodies of water or sub-basin), potentially incorporating ecological, hydrological, and hydrogeological systems. However, such large-scale regulation highlights many complex legal and ecological questions, which the report leaves to the administrative authorities to sort out. One question not discussed in the report is fundamental: is this kind of large-scale regulation compatible with the Water Framework Directive's space of regulation that 'body of water' and the objective of 'good ecological status' actualizes?

2.1.1 From River Basin to Body of Water

The obligation of 'good ecological status' is notable for both its ecological and legal complexity.[11] Part of the complexity is that the Water Framework Directive establishes an a priori typological system that differentiates the river basins into bodies of water (found primarily in Annex II). The primary focus of the differentiation is to allow for the assessment of biological and physico-chemical quality elements, and the way in which these are affected by human activity.

[8] Convention on Biological Diversity, United Nations 1992.

[9] SOU 2013:69. Vattenverksamhetsutredningen, *Ny Tid Ny Prövning: Förslag till Ändrade Vattenrättsliga Regler* 305–312.

[10] Daniel Hering and others, 'Assessment and Recovery of European Water Bodies: Key Messages from the WISER Project' (2013) 704 Hydrobiologia 1.

[11] See for example Brian Moss, 'The Water Framework Directive: Total Environment or Political Compromise?' (2008) 400 Science of the Total Environment 32; Daniel Hering and others, 'The European Water Framework Directive at the Age of 10: A Critical Review of the Achievements with Recommendations for the Future' (2010) 408 Science of the Total Environment 4007; Henrik Josefsson and Lasse Baaner, 'The Water Framework Directive – a Directive for the Twenty-First Century?' (2011) 23 Journal of Environmental Law 463; Henrik Josefsson, 'Achieving Ecological Objectives' (2012) 1 Laws 39.

Throughout the EU, more than 127,000 bodies of surface water have been identified, approximately 82 % being rivers, 15 % lakes, and the remaining 3 %, coastal and transitional waters.[12] The differentiation of bodies of water is a crucial step for obtaining a robust assessment and classification systems under the Water Framework Directive.[13] Establishing the body of water as the space of regulation for 'good ecological status', the Water Framework Directive specifies that the river basin should be differentiated into different types of bodies of water (system A). If a lake has a depth <3 m, 3 to 15 m, and >15 m, each area is designated as one of three types, and each type is compared to a type-specific 'high ecological status' lake reference point (Annex II 1.2.2.), for example. An alternative differentiation system (system B) complement the main differentiation method, but must achieve at least the same degree of differentiation as would be achieved using system A, that is, ensure that type-specific biological reference conditions may be reliably derived (see Annex II 1.1. (iv), 1.2.). For rivers, as one example, the defining features for this differentiation include altitude, latitude, longitude, geology, and size. For heavily modified and artificial bodies of water with the objective of 'good ecological potential', the lines drawn among types of bodies of water are based primarily on the changes in hydromorphological characteristics resulting from physical alternations caused by human activity, preventing the attainment of 'good ecological status' characteristics (see Art. 4 (3 (a)) Annex II 1.1. (v) and Annex V 1.2.5.).[14] For example, a dam affects the hydromorphological characteristics of a body of water, owing to its physical alteration of the flow of the heavily modified body of water.

Even if the Water Framework Directive leaves the way in which its provisions are achieved to the discretion of Member States, the differentiation process is not optional, but a material, procedural part of the Directive. The differentiation constructs the body of water as the unit to which the Water Framework Directive's objectives apply, and therefore the differentiation of bodies of water is an important procedural element for achieving 'good ecological status'. Each body of water is to be assessed and managed individually, as obligations such as non-deterioration and restoration are coupled to each body of water, and not multiple ones (e.g. see Art. 4 (1)(a)).[15] This highlights that the achievement of a good status for the ecological organization of aquatic ecosystems, communities, populations, and organisms is on the scale of a body of water, creating an impression that the river basin is a collection of separate bodies of water. In order to improve and maintain ecological status, this is how lawyers, governmental agencies, and the public are to frame the aquatic assemblage of different types of organisms and their abiotic environments.

The ecological assumption behind this differentiation of river basins is that biological communities in a type of body of water will deviate only slightly from the reference body of water and its biological communities, when they at-

[12] European Commission, 'Commission Staff Working Document European Overview (1/2) Accompanying the Document Report From the Commission to the Europea Parliament and the Council on the Implementation of the Water Framework Directive (2000/60/EC) River Basin Management Plans' 70.

[13] Ibid 58.

[14] See also 'Common Implementation Strategy For The Water Framework Directive (2000/60/EC) Guidance Document No 2 Identification of Water Bodies'.

[15] See also Lasse Baaner, 'The Programme of Measures of the Water Framework Directive-More than Just a Formal Compliance Tool' (2011) 8 Journal for European Environmental and Planning Law.

tain 'good ecological status' (see Annex V 1.2.). This means that you compare and assess sites by assuming that one site has certain desired attributes/elements/conditions, which are then compared to those of another site with undesirable elements or conditions. This reasoning is used experimentally, for example, when two similar sites exist, and one is experimented on, to understand and predict how ecosystems may respond to the induced stressors. In management under the Water Framework Directive, the reasoning may be practical: if human stressors impact a stretch of a river, one compare this stretch to a similar reference stretch, and through management measures, try to alter the impacted stretch, to make it similar to the reference stretch.[16] This may be of practical value, since a number of comparable bodies of water may be similarly assessed and managed.[17]

It should be kept in mind that the conditions for the previously mentioned practical management are the results of treating the river basin as consisting of multiple numbers of predefined elements, assessed and managed based on their similarities and differences, rather than site-specific characteristics. The ecological status of a body of water depends on how it resembles the units of the differentiation system of the Water Framework Directive, and not the site-specific structure of the ecological organization; instead, that status is assumed to follow from the structural factors that direct their differentiation. Thus, Annex II provides a grammar that, by a priori variables, determines how ecological spaces in EU river basins are alike, without assessing their individual attributes.[18]

As many biotic and abiotic site-specific interactions are fundaments to the ecosystem status of a stream or a lake framing the ecological organization of the river basin in this way, assessment and management under the Water Framework Directive differs from an assessment and management focused on the status of ecosystems.[19] The following sections attempt to address this divergence between the ecological space of an ecosystem and the space of regulation that the body of water actualize.

2.1.2 Managing Multiple Bodies of Water Under the Water Framework Directive – General Administrative Provisions

The idea behind a general administrative provision is quite simple: if multiple permitted activities considerably affect the ecological status of a river section and deteriorate the river section in a similar manner, then instead of reviewing each permit, a general measure could be implemented that allows for the ecological status of the river section to increase. The legal and ecological actuality of the river section is not necessarily so simple. Within a larger area with multiple activities, the bodies of water may be of different types, and each unit may carry different type-specific obligations that must be taken into account. Furthermore, the obligation of 'good ecological status' does not allow interim ecological losses within one body of water to be compensated by restoration or enhancement measures at another

[16] Nikolai Friberg and others, 'Biomonitoring of Human Impacts in Freshwater Ecosystems: The Good, the Bad and the Ugly' (2011) Volume 44 Advances in Ecological Research 1.

[17] Piet FM Verdonschot, 'Evaluation of the Use of Water Framework Directive Typology Descriptors, Reference Sites and Spatial Scale in Macroinvertebrate Stream Typology' in Mike T Furse and others (eds), *The Ecological Status of European Rivers: Evaluation and Intercalibration of Assessment Methods* (Springer Netherlands 2006).

[18] This analysis was inspired by Michel Foucault, *The Order of Things : An Archaeology of the Human Sciences* (Pantheon Books 1971) 136–137, 144–145.

[19] Guy Woodward, 'Biodiversity, Ecosystem Functioning and Food Webs in Fresh Waters: Assembling the Jigsaw Puzzle' (2009) 54 Freshwater Biology 2171; Friberg and others (n 16).

body of water, and Member States must prevent deterioration, and protect, enhance, and restore each body of water simultaneously (although the time frame for achieving the objectives may differ)(Art. 4 (1)(a)(i)(ii)(iii) and 4 (4)).

A general administrative provision aimed at changing ecological conditions of multiple bodies of water must ensure that the measure both prevents deterioration and simultaneously improve the ecological status of all bodies of water within a sub-basin, for example. Since the risk of ecological deterioration cannot be circumvented, owing to the site-specific ecological, legal, and technical complexity of each sub-basin or river section, an ecosystem focused administrative provision for multiple bodies of water must also correspond to the deterioration exemptions found in the Water Framework Directive. Consulting the exemptions is necessary as there can be no guarantee that management measures, as new modification of the physical characteristics of bodies of water (such as water flow or temperature), do not result in deterioration within the targeted or adjacent bodies of water.[20] Therefore, any provision affecting multiple bodies of water must clearly demonstrate that it is for the benefit of the environment and society in the absence of significant, better environmental options (it has to be a more suitable regulative instrument than separate reviews of each permitted activity), while all practicable steps are taken to mitigate any risk of adverse impact on any body of water (Art. 4 (7)(a)(c)(d)). This problem has been discussed by some Member States (e.g. the Netherlands and Denmark), and in the Netherlands, deterioration of one specific body of water may be compensated for by improvements to another body of water, or the river basin district as a whole.[21]

Ecologically, implementing general environmental measures as a legal method for the large-scale management of hydrological connectivity between multiple bodies of water, for example, is probably needed, if the status of the ecological organization of river sections, sub-basins, or river basins is to improve. However, a precautionary approach is needed, owing to the lack of knowledge of the large-scale rehabilitation of aquatic ecosystems.[22] Also questionable is whether large-scale measures are compatible with the way in which the Water Framework Directive couples the obligations of the Directive to the 'body of water' unit. Since the consequences for each body of water cannot be envisaged, in the implementation of management measures that change the physical characteristics of bodies of water, it must be clearly demonstrated that there is no better legal option available for the achievement of 'good ecological status' for each body of water affected, corresponding to the Water Framework Directive's exceptions for new modification of bodies of water (Art. 4 (7)(d)).

The more comprehensive management that a general administrative provision is intended to provide is appropriate in intent, but the Water Framework Directive's space of regulation is not differentiated for the purpose of managing bodies of water together, since the obligations of 'good ecological status' and non-deterioration are tied to each body of water, and not to the multiple bodies of water that constitute a sub-basin,

[20] For example, see Christian Feld and others, 'From Natural to Degraded Rivers and Back Again: A Test of Restoration Ecology Theory and Practice' (2011) 44 Advances In Ecological Research 119; Scott A Stranko, Robert H Hilderbrand and Margaret A Palmer, 'Comparing the Fish and Benthic Macroinvertebrate Diversity of Restored Urban Streams to Reference Streams' (2012) 20 Restoration Ecology 747.

[21] See Andrea Keessen and others, 'European River Basin Districts: Are They Swimming in the Same Implementation Pool?' (2010) 22 Journal of Environmental Law 197.

[22] Feld and others (n 20).

for example.[23] As one of the dominant features of aquatic ecosystems is hydrological connectivity among various parts of a sub-basin, this conclusion may be surprising. However, the hydromorphological quality elements are not part of the definition of 'good ecological status', but are defined only for 'high ecological status' bodies of water, and when establishing reference points, or defining a body of water as heavily modified (as a possible reference for hydromorphological characteristics) (see Art. 4 (3) and Annex V 1.1. 1.2.). The bodies of water are differentiated to allow for the assessment of the biological and physico-chemical quality elements, and not hydrological connectivity (see Annex V 1.2.). This means that, just because a differentiated river basin corresponds to the stipulated differentiation, and may facilitate the assessment of the quality elements, the space of regulation may still fail to provide a basis for appropriate management measures (as a general administrative provision) and assessment of hydrological or food web connectivity. Therefore, the space of regulation that a body of water provides may not coordinate the ecological, hydrological, and hydrogeological systems of the river basin (recital 33) without side-stepping the material, procedural part of the Water Framework Directive that the differentiation of bodies of water is.

There are alternatives for adapting the general administrative provision to the body of water construct, if there is a similar causality between multiple activities and a corresponding unsatisfactory body of water status. Each activity could be required to be investigated by the operator of the activity and reported to the competent authority, regarding how the activity might be adapted to increase the status of the body of water in question. The authorities could then assess the suggestions, and obligate the operators to realize the necessary measures. With this approach, measures would address a general environmental problem while being coupled to the body of water of each activity, and clearly be a better regulative option, in comparison to separate permit reviews of each activity.

How the differentiations of spaces of regulation may differ will now be demonstrated through a case study, which demonstrates three assessment and management spaces: the Habitats Directive's, the Swedish Environmental Court of Appeal's, and the Water Framework Directive's.

2.2 The Swedish Stream, Ljungån

When a court or administrative authority considers the review or issuing of a permit the assessment is often tied to the place of the activity (even if alternative locations and indirect effects need to be considered in accordance with the Environmental Impact Assessment Directive[24] (Annex IV (2) (5))). That the differentiation of the space of regulation is difficult has been demonstrated in Swedish case law regarding Natura 2000 areas on several occasions, and an aquatic example (and not an example of court practise) is that of the hydropower development of Ljungån. Ljungån was an unregulated stream located just outside the Natura 2000 area of Gimån.

[23] It is important to see that there is a difference between the assessment and the management obligation, as monitoring points may be selected based on the magnitude and impact of hydromorphological pressures as a whole, for example, and could include multiple bodies of water, whereas the environmental objectives apply to bodies of waters individually.

[24] Directive 2014/52/EU of the European Parliament and of the Council of 16 April 2014 amending Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment Text with EEA relevance.

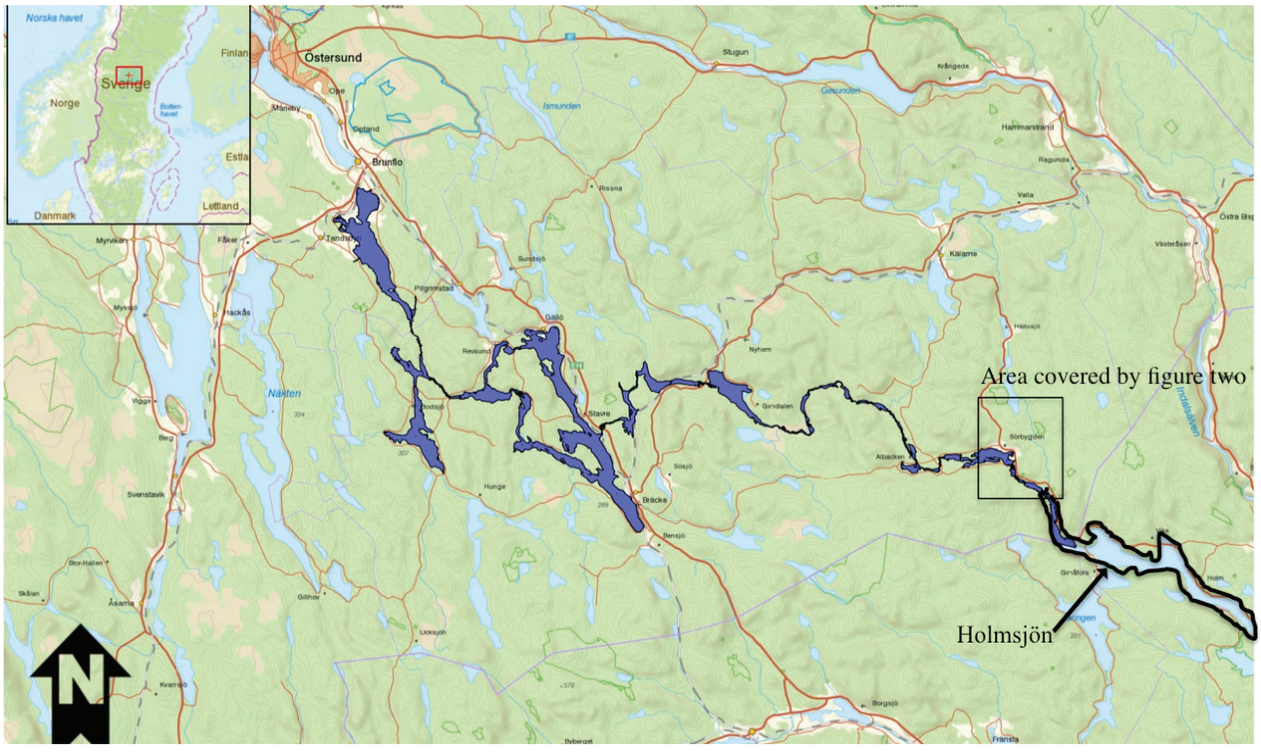

Figure 1. The Natura 2000 area of Gimån; the highlighted area is the Natura 2000 area.[25]

Gimån is a Natura 2000 area with several species and habitats of EU conservation value, such as Fennoscandian natural rivers (3210), oligotrophic to mesotrophic standing waters (3130), hard oligo-mesotrophic waters with benthic vegetation (3140), water courses of plain to montane levels (3260), *Cottus gobio* (European bullhead), and *Lutra lutra* (European otter). Ljungån is a tributary of the Natura 2000 area, and connects to the Gimån area through the regulated lake Holmsjön, which is part of the Natura 2000 area.[26] The Holmsjö area is characterized by dead riparian zones that make it difficult for organisms to find food in the lake, and tributaries, such as Ljungån, is an important part of the food web of the lake and the Natura 2000 area.[27] In the conservation plan for the Natura 2000 area, Ljungån is described as an important link in maintaining the conservation status of the Natura 2000 areas, and has many indicators of ecological value, such as bottom fauna of national conservation interest, and food web interaction from species such as *Salmo trutta* (salmon), *Lutra lutra* (otter), and *Thymallus thymallus* (grayling), which connect the food web of the Natura 2000 area to Ljungån. The otter is found in the Habitats Directive Annex IV, and specified as in need of strict protection. For the otter population of the Natura 2000 area, Ljungån appear to provide a space that supports the population's capacity to maintain itself (one of three criteria's for 'favourable conservation status', see Art. 1 (i)) with regard to the Natura 2000 area, especially with respect to the regulated lake section of the area. Both the Natura 2000 area and the otter had excellent status in the conservation plan, before exploitation. However, it is emphasized in the conservation plan that

[25] Map extracted from VISS database, http://www.viss.lansstyrelsen.se, 2014-06-23.
[26] Länsstyrelsen Jämtlands Län, 'Bevarandeplan För Natura 2000-Område Gimån SE0720294'.
[27] Ibid.

this status depends on the current hydrological-ecological network of tributaries that function ecologically.[28] That is, even if Ljungån is outside the protected area, the conservation values of the Natura 2000 area depend on the ecosystem functions of tributaries outside of the Natura 2000 area, of which Ljungån is indicated as the most important.

In 2004, the Swedish Environmental Court of Appeal permitted a new hydropower station and dam in the lower part of Ljungån, disrupting the hydrological and food web connection between the Natura 2000 area and the upstream section of Ljungån. Different administrative organizations, such as the National Conservation Agency and the County board considered that a new hydropower station and dam would significantly impact the conservation values of the Natura 2000 area, regardless of measures, such as the construction of a small artificial tributary. The court disagreed, and considered the measure sufficient to permit the hydropower station and dam, as habitats of EU conservation value are not directly affected by the exploitation, and only some species, principally the otter, are perceived as affected by the exploitation.[29] Since the exploitation affects the hydrological-ecological network that supports the otter's ability to maintain itself, and thereby affects its favourable conservation status by disturbing the species (Art. 12 (1)(b)), the decision may be criticized for a questionable assessment of the ecosystem interrelations and dependencies between Gimån and Ljungån, foremost with regard to the otter.[30] In other court decisions it has been emphasized that it is the comprehensiveness of habitat types and species that together should be assessed when determine if an activity will provide a deterioration of a Natura 2000 area.[31] But primarily, the differentiation of the Natura 2000 area may be criticized, as the space of regulation differs from the ecological space of Gimån. Because even if Article 4 specifies that, for aquatic species that range over wide areas, sites should be proposed that represent the physical and biological factors essential to the species' life cycle, Ljungån is not included in the Natura 2000 area. It would seem that in differentiating the Natura 2000 area, the specified habitat types were considered, and not the otter.

Above, the differences between the space of regulation of a Natura 2000 area and a body of water were discussed. In the implementation of the Water Framework Directive, the stream, Ljungån, was differentiated into two bodies of water, and each of its four watercourse tributaries was differentiated from Ljungån into uniform, isolated bodies of water (classification presented in figure two). The lake downstream from Ljungån, is differentiated into two bodies of water: upstream (Drogsjön), the body of water is classified as being of 'moderate ecological status', and downstream (Holmsjön), 'with moderate ecological potential'. The entire Natura 2000 area of Gimån is differentiated into 47 bodies of water, tributaries not included.[32]

---

[28] Ibid.

[29] In Swedish: "Den särskilt utpekade art inom Natura 2000-området som oavsett områdets utbredning skulle kunna påverkas av en utbyggnad av Ljungån är utter. Vidare kan vissa angivna skyddsvärda livsmiljöer, där karaktärsarter utgörs av öring och harr, påverkas. Med de skyddsåtgärder som enligt nedan bör föreskrivas för verksamheten finner Miljööverdomstolen att det föreligger förutsättningar att bevilja tillstånd till verksamheten enligt 7 kap. 28 b § miljöbalken." See Mark- och Miljööverdomstolen, 'Ljungån M 6581-05'.

[30] See also Henrik Josefsson, *Natura 2000: en rättsfallsanalys* (2008), D Master thesis.

[31] MÖD 2004:68 'Hägerums Kvarn II'.

[32] Information extracted from http://www.viss.lansstyrelsen.se, 2014-06-23.

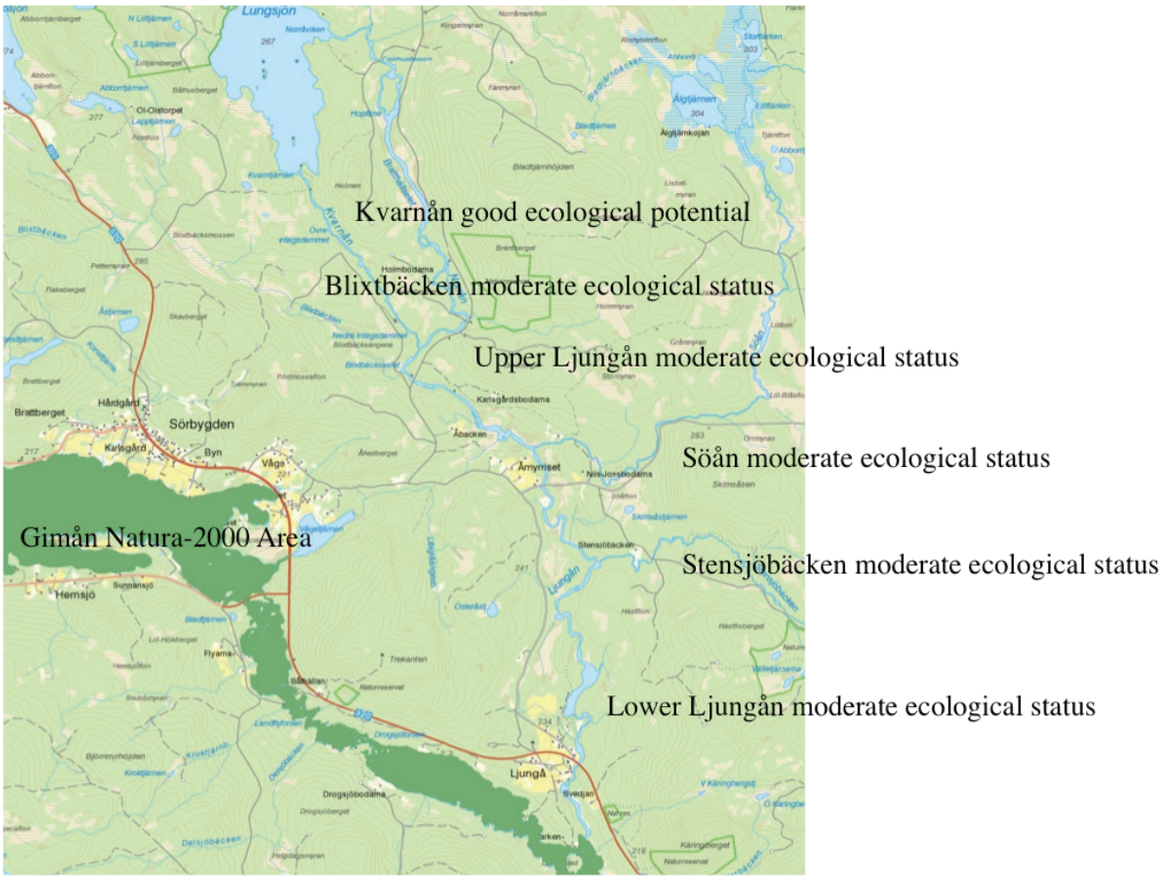

Figure 2. Ljungån, the Natura 2000 area; Gimån is highlighted.[33]

As discussed above, the Water Framework Directive is not constructed to assess and manage the site-specific hydrological-ecological interconnectedness between a stream and a lake, since the obligation of 'good ecological status' is coupled to the type-specific body of water. On the other hand, the Habitats Directive can provide an aquatic differentiation that may include hydrological-ecological interconnectedness, if this is part of the requirements of protected species, for example, even if this was not the case with Gimån.

Here, we have two different ecological perspectives that, based on habitat types, and species requirements or water quality, give rise to two different differentiation approaches with different spaces of regulation, as a consequence. If a conflict occurs between the objectives of 'good ecological status' and 'favourable conservation status', the Commission in general favours 'good ecological status', and the body of water as the space of regulation.[34] This interpretation is based on Article 4 (2) of the Water Framework Directive, which stipulates that the more stringent objective applies.[35] Whether the Commission is

[33] Map extracted from VISS database, http://www.viss.lansstyrelsen.se, 2014-06-23.

[34] European Commission, Links between the Water Framework Directive (WFD 2000/60/EC) and Nature Directives (Birds Directive 2009/147/EC and Habitats Directive 92/43/EEC).

[35] Another provision of the Directive, with regard to the Habitats Directive, is to create a register of protected areas within the river basin district, and include measures required by the Habitats Directive in the plans of measure (see Art. 6 and Annex VI (Part A)).

correct, and 'good ecological status' is in general more stringent for every site with overlapping spaces of regulation remains to be seen, and may become a question for the Court of Justice to consider, as the Commission behaviour creates a legitimate expectation that this is the interpretation that the Commission will apply in its assessment of Member State implementation.[36] As there are significant differences between the spaces of regulation the Commissions position can be controversial, as the small-scale space of a body of water seems contradictory to elements found in the Habitats Directive.

However, the Water Framework Directive and the Habitats Directive are not alone in regulating aquatic ecological elements; through its conceptualization of water degradation, the Liability Directive also provide a aquatic space of regulation. We next consider the similarities and differences between the Water Framework Directive and the Liability Directive's units.

2.3 The Liability Directive – Water Degradation

The main objective of the Liability Directive is to prevent and remedy damage to the environment. Here, 'environment' indicates protected species and natural habitats, in keeping with the Habitats Directive ('nature'), water (defined in accordance with the Water Framework Directive), and land (soil) (Art. 2 (12)). 'Damage to the environment' means a measurable, adverse change in a natural resource (means protected species and natural habitats, water and land (Art. 2 (12)), or measurable impairment of a natural resource service that may occur directly or indirectly (Art. 2 (2)). 'Services and natural resource services' refer to the functions performed by a natural resource for the benefit of another natural resource or the public (Art. 2 (13)). 'Water damage' refer to significant adverse effects on the ecological, chemical, and/or quantitative status and/or ecological potential of body of water (Art. 2 (1)(b) and Water Framework Directive Art. 2 (21), Annex V (1.1.) (1.2.)). 'Damage' means a measurable adverse status change in the ecological status, for example, of a body/bodies of water, which also can be assessed through measurable impairments of a natural resource service (Art. 2 (2)(12)). Service, here, refer to the activity of organisms or communities that result in functions that are beneficial for other natural resources or the public (Art. 2 (13)).

In principle, the liable party is the 'operator' who carries out an 'occupational activity'. There is a strict liability (without fault) for environmental damage for certain dangerous activities, which are listed in Annex III, and include water abstraction and impoundment of water subject to prior authorization, in pursuance of the Water Framework Directive's objectives (Annex III (6)). Operators carrying out other occupational activities are liable for any fault-based damage they cause to protected species and habitats. Operators are under an obligation to remedy environmental damage once it has occurred, and to bear the costs of the 'polluter'. If the operator fails to do so, or is not identifiable, the competent authority may step in and carry out the necessary preventative or remedial measures (Art. 6 (2)(3)).

For damage affecting water, protected species, and natural habitats (land will not be discussed here), the aim is to restore the environment to its undamaged/pre-damage state (Art. 2 (14), Annex II (1.1.1)) when damage from a listed (Annex III) activity have occurred or if other occupational activities damage protected species or habitats (Art. 3 (1(a)(b)). Damage remediation is achieved through measures intended to restore the baseline conditions by means of primary,

[36] See C-181/91 and C-248/91 *Parliament v Council / Parliament v Commission* [1993] ECR I-3713 para 12–14; C-137/92 *Commission v BASF* [1994] ECR I-2629 para 50.

complementary, and compensatory remediation (Art. 2 (11), (15) and Annex II). The damaged natural resource or impaired services must achieve baseline conditions or be replaced by identical, similar, or equivalent natural resources or services at the site of the incident, or at an alternative site (Annex II 1.1.2).

The Liability Directive's system for achieving baseline conditions complements the Water Framework Directive, not only by specifying that all practicable measures should be used to recover a damaged body of water to its status prior to the damage (see Water Framework Directive Art. 4 (6)(d)), but also has a system for how this should be done, and specifies how remediation should be conducted when recovery is not possible, or will take a substantial amount of time. The Liability Directive is unique in that it specifies techniques for remediating an area not achieving baseline conditions, termed 'habitat equivalency analysis' (HEA) and 'resource equivalency analysis' (REA) (see Annex II). If natural recovery is not possible, remedial measures should be employed to rehabilitate or replace damaged natural resources and/or impaired services, or provide an equivalent alternative to those resources or services (Art. 2 (10)). When determining the scale of complementary and compensatory remedial measures, the use of resource-to-resource or service-to-service equivalence approaches are considered first. With these approaches, actions that provide natural resources and/or services of the same type, quality, and quantity as those damaged are considered first. Where this is not possible, alternative natural resources and/or services must be provided. For example, a reduction in quality might be offset by an increase in the quantity of remedial measures (Annex II 1.2.2.). Complementary and compensatory remedial measures should be so designed that they provide for additional natural resources and/or services, to reflect the time required for measures to take effect; for example, the longer the period of time before the baseline condition is reached, the greater the number of compensatory remedial measures that will be undertaken (see Annex II 1.2.3.). The Liability Directive is intended to create a space of regulation that is site-specific, with the main objective of preventing and remedying damage where it has occurred, or if necessary, at an alternative site. This offers a flexible unit, where measures may be implemented outside the damaged area, if necessary.

If one or more bodies of water are damaged, and neither primary nor complementary measures can remediate them, or compensate for the damage during recovery, compensatory remediation at another site than the damaged area would be implemented, to compensate for the damage. This may be compared to the Water Framework Directive, where water degradation results in the obligation to prevent further deterioration, and take all practicable measures to remediate the effects to the body of water, and not an alternative body of water (see e.g. Art. 4 (6)(a)(c)(d)).

Even if the baseline for damage/temporary deterioration of bodies of water is the same, according to the Water Framework Directive and the Liability Directive, regarding restoration of the environment to its undamaged state, they differ in the remediation measures and the designated space of regulation. According to the Water Framework Directive, the body of water must be restored; for the Liability Directive, the space of regulation is the damaged area, and if interim losses occur, complementary and/or compensatory remedial measures must be implemented even if this falls outside the damaged body of water. This creates a larger and more flexible space of regulation than the Water Framework Directive's body of water. This enlargement of the space of regulation by the compensatory obligation is not possible under the ordinary man-

agement of the Water Framework Directive, or if only the Directive is invoked in the remediation damage/temporary deterioration.

The Liability Directive provides the option of implementing measures where needed, if water degradation occurs. Remediation of water degradation may be transferred throughout the river basin and not be bound to the damaged body/bodies of water, through the obligations stated in the Liability Directive. However, such practice does not correspond to the Water Framework Directive's differentiation system, which places obligations within the boundaries of each body of water. Thus, the space for remediating water degradation, and also damage to habitats and species protected by the Habitats Directive, is different than the space of regulation that is intended to provide for 'good ecological status'. The obligations may conflict, as interim ecological losses in one body of water cannot be compensated at another body of water during recovery, according to the Water Framework Directive. For compensatory remediation to be compatible with the Water Framework Directive, exceptions to the Directive must be considered as it provide a new modification of a body/bodies of water, such as no significantly better environmental option being available (see Art. 4 (7)(a)(c)(d)).

2.4 Alternative Legal and Ecological Perspectives

The Water Framework Directive has a rather small-scale space of regulation, and in comparison, the Habitats Directive may offer a larger space, although the scale depends on the habitats and species designated as protected, and the Liability Directive's space depends on the damage and the possibilities for remediating the damage. None of the Directives is explicitly large-scale, however there are other spaces of regulation that are large-scale, without being explicitly focused on freshwater ecosystems. Two such units are the Marine Strategies' 'marine regions' and 'sub-regions', and the Landscape Conventions' 'landscapes'. To compare the legal perspectives that specify the scale on which ecosystems should be managed, this section also exemplifies how different ecological views on effective differentiation of river basin ecosystems is discussed from an ecological perspective.

2.4.1 The Marine Strategy Directive

Both the Marine Strategy and the Maritime Spatial Planning Directive[37] use marine regions or sub-regions as the units to which their objectives apply. Although the Maritime Spatial Planning Directive appears to be the main focus, with its spatial attention, it bases its initial differentiation of units on the Marine Strategies' construct of 'marine region', and does not have a scheme of differentiation that complement or diverges from the Marine Strategy (see Art. 3). Therefore, we analyse only the Marine Strategies' spatial constructs of 'marine region' and 'sub-region'.

The differentiation of region and sub-region facilitates the implementation of the directive, and the differentiation should be considering hydrological, oceanographic, and biogeographic features (Art. 3 (2)). The units of 'marine region' and 'sub-region' are defined as the units to which the objective of 'good environmental status' applies (Art. 3 (5)). However, as Member States share regions and sub-regions, a certain differentiation based on each Member State's zone of sovereignty (e.g. delimited by each Member State's economic zone) adapts the predefined units to Member States' conditions of sovereignty (see Art. 4). The entire Baltic Sea compromises

[37] Directive 2014/89/EU of the European Parliament and of the Council of 23 July 2014 establishing a framework for maritime spatial planning.

one region, but the obligation of achieving 'good environmental status' for Sweden applies only to the Swedish part of the Baltic Sea. Even if the Member States that share the Baltic Sea Region must take into account the fact that each Member State's segment is part of the region of the Baltic Sea as a whole, and cooperate and coordinate activities, 'good environmental status' applies to each Member State's portion of the larger region (see Art. 3(9), 4, 5, and 6).

Since the ecosystem approach is integrated into 'good environmental status', and the objective is intended to allow marine ecosystems to function fully and maintain their resilience to human induced environmental change, the Marine Strategy establishes a space of regulation that contrasts with the Water Framework Directive's small-scale, body of water construct (see Art. 4 (5)). A potential difficulty in assessing and managing ecosystems within a Member State's part of a region or sub-region is that the unit includes multiple ecosystems and all marine waters within this area, and in achieving 'good environmental status', the objective is intended to represent the diversity of all constituent ecosystems (see e.g. Art. 13 (4)).

2.4.2 The Landscape Convention

Another large-scale space of regulation is the 'landscape' construct found in the Landscape Convention. In comparison to both the Water Framework Directive and the Marine Strategy, the Landscape Convention differs fundamentally in its scheme of differentiation of landscapes, as it does not use any predefined elements to construct the landscape unit. The Convention's definition of 'landscape' may include land, inland water, and marine areas (Art. 2)), and is differentiated based on the interaction of natural and human elements, and how these elements are perceived by people (Art. 1 (a)). The differentiation is open to what people perceive as landscape units, a differential process based on landscape democracy.[38]

As the interaction between natural and human elements changes continuously, the landscape as unit is intended to be an evolving entity, where human-created elements in the landscape should be assessed and managed together with more natural elements, and not necessarily separated.[39] For example, by including both heavily modified and natural bodies of water within the same water landscape, the intention is for assessment, management, and planning to address the entire landscape, and avoid dividing it into a number of component elements. The landscape unit should not be composed of its constituent parts, or be the sum of its parts, but be a whole, qualitative, space of regulation.[40]

Ideally, the public concerned differentiates landscapes from one another; in practice, this is probably accomplished by experts in conjunction with local inhabitants, and the actual differentiated landscape may become both a large-scale and a small-scale unit, depending on what the public concerned identifies and recognizes as a landscape. Hypothetically, this could lead to a heterogeneous mass of units that fit neither administrative units nor the biophysical outline of an area particularly well. At the same time, the legitimacy of management authorities could also increase, if the space of regulation somewhat follows what the eye of the observer considers logical or given.[41] Differentiating a lake into three

[38] Council of Europe, 'European Landscape Convention, Florence, Explanatory Report, Strasbourg: Council of Europe. CETS No. 176'.
[39] Ibid.
[40] Council of Europe, 'Recommendation CM/Rec(2008)3 of the Committee of Ministers to Member States on the Guidelines for the Implementation of the European Landscape Convention'.
[41] For example, see Barbara A Cosens, 'Legitimacy, Adaptation, and Resilience in Ecosystem Management' (2013) 18 Ecology & Society.

bodies of water as the lake varies in depth (<3 m, 3 to 15 m and >15 m), in accordance with the Water Framework Directive, may not seem logical to the public concerned. Or, if a lake has a narrow neck somewhere that results in two bodies of water, classifying one as 'heavily modified', but not the other, since the heavily modifying activity is located in one of the bodies of water, although the environmental stress is the same, is not necessarily logical either. The Marine Strategies' marine regions or sub-regions may also seem illogical: for example, traditionally, in Sweden the Baltic Sea has been differentiated into two larger areas, the Gulf of Bothnia and the actual Baltic Sea, differentiated by the Åland islands. As the environmental problems in the two areas also differ – in general, pollution in the north, and organic pollution in the south – including them both in the same space of regulation could seem illogical to the public concerned.

The landscape construct may be criticized as lacking in definition, and, as its differentiation is facilitated by public views, it may result in units that fail to incorporate the biophysical outline or relevant environmental problems. On the other hand, a priori schemes of differentiation are not necessarily better adapted to site-specific environmental problems, such as both the Water Framework Directive and the Marine Strategy suggest.

2.4.3 Aquatic Spaces of Regulation – Ecological Perspectives

Parameters relevant to typology are among the major sources of uncertainty in ecological assessment.[42] A differentiated unit may be a community, population, or ecosystem, if the focus is mostly abiotic or biotic. The differentiation may also be established by using other differentiation variables, such as geographical (e.g. lake, stream or river section) or administrative elements (e.g. county board or municipal), if this better fits the research questions and objectives.[43] The units of an ecosystem may also intersect other units, such as the administrative area of county board to study how the management authorities connect management actions to ecosystems; biotic elements may then be compared to the human-scale management of a landscape, for example.

With regard to the Water Framework Directive, there have been suggestions from the natural sciences for how the differentiation of units could be developed, either towards simplicity, aiming for manageability, or more sophisticated systems that are better adapted to addressing aquatic ecosystems.[44] A recurring, critical view is that a priori typological differentiation, with its broad categories of map-derived variables, fails to recognize the site-specific aspects of a river basin or body of water,[45] or, that typological river basin differentiation is a questionable method for describing how a river basin is affected or unaffected by establishing reference points in different ecological environments.[46] It is argued that instead of a priori judgements, more site-specific ecological aspects, such as the composition of river basin materials on which organisms are dependent, makes more sense, and

[42] See Hering and others (n 11).

[43] Jianguo (Jingle) Wu, 'Landscape Ecology' in Rik Leemans (ed), *Ecological Systems* (Springer New York 2013).

[44] For example, see Brian Moss and others, 'The Determination of Ecological Status in Shallow Lakes – a Tested System (ECOFRAME) for Implementation of the European Water Framework Directive' (2003) 13 Aquatic Conservation: Marine and Freshwater Ecosystems 507; Hering and others (n 11).

[45] Hering and others (n 11).

[46] Thomas R Whittier and others, 'Selecting Reference Sites for Stream Biological Assessments: Best Professional Judgment or Objective Criteria' (2007) 26 Journal of the North American Benthological Society 349; Friberg and others (n 21).

should be used.[47] Another criticism is that the differential process loses some of the benefits of being type-specific, since the Water Framework Directive demands a high degree of differentiation, which has negative consequences for the applicability of the typology system.[48] Others argue that the differentiation of bodies of water should be based on ecological processes, such as water-level regime, or geomorphological patterns, such as physical features of a river basin (artificial or natural).[49] In general, it may be said that these typological factors are more reliable, simply because they apply a differentiation that is based on variables that are ecologically significant in a given region (site-specific), and comply more closely with the character of aquatic ecosystems.[50]

Various concepts, without regard for the Water Framework Directive, have been used to describe, present, and differentiate aquatic ecosystem and the river basin, including 'riverine landscape' or 'riverscape', which focus on the macro-level of aquatic ecosystems. These representational concepts embrace a macro-level approach, focused on the patterns and processes associated with fluvial ecosystems, integrating ecological processes and spatial complexity.[51] Ecological context, such as site-specific interactions between flow-patterns, geomorphology, and temperature heterogeneity, which vary markedly among differing geologic, climatic, and topographic settings, should frame the differentiation of river basins from this perspective.[52] A site-specific, riverine, macro-scale differentiation could be based on the hydrological-ecological network of site-specific flow-patterns, sedimentation, nutrients, and organisms, abiotic and biotic site-specific elements that differentiate one unit from another.[53] Heterogeneity of biophysical habitat conditions, intrinsic connectivity between management units, and temporal fluctuations of variables, such as population abundance and nutrient levels, are potential ecological assessment and management metrics for such macro-units.[54] A riverine differentiation would establish units that are large enough

[47] Moss and others (n 44); John Davy-Bowker and others, 'A Comparison of the European Water Framework Directive Physical Typology and RIVPACS-Type Models as Alternative Methods of Establishing Reference Conditions for Benthic Macroinvertebrates' in Mike T Furse and others (eds), *The Ecological Status of European Rivers: Evaluation and Intercalibration of Assessment Methods* (Springer Netherlands 2006); Verdonschot (n 17); Richard K Johnson and others, 'Ecological Relationships between Stream Communities and Spatial Scale: Implications for Designing Catchment-Level Monitoring Programmes' (2007) 52 Freshwater Biology 939.

[48] Verdonschot (n 17).

[49] Roland Jansson, 'Heavily Modified Waters in Europe: Case Study on the Ume River in Northern Sweden' (2001).

[50] Hering and others (n 11); Davy-Bowker and others (n 47).

[51] James V Ward, 'Riverine Landscapes: Biodiversity Patterns, Disturbance Regimes, and Aquatic Conservation' (1998) 83 Biological Conservation 269; James V Ward, Florian Malard and Klement Tockner, 'Landscape Ecology: A Framework for Integrating Pattern and Process in River Corridors' (2002) 17 Landscape Ecology 35.

[52] James V Ward and JA Stanford, 'Thermal Responses in the Evolutionary Ecology of Aquatic Insects' (1982) 27 Annual review of entomology 97; Brian Moss and others, 'Climate Change and the Future of Freshwater Biodiversity in Europe: A Primer for Policy-Makers' (2009) 2 Freshwater Reviews 103; Julian D Olden and Robert J Naiman, 'Incorporating Thermal Regimes into Environmental Flows Assessments: Modifying Dam Operations to Restore Freshwater Ecosystem Integrity' (2010) 55 Freshwater Biology 86; Gary Brierley and others, 'Reading the Landscape Integrating the Theory and Practice of Geomorphology to Develop Place-Based Understandings of River Systems' (2013) 37 Progress in Physical Geography 601.

[53] Kevin E McCluney and others, 'Riverine Macrosystems Ecology: Sensitivity, Resistance, and Resilience of Whole River Basins with Human Alterations' (2014) 12 Frontiers in Ecology and the Environment 48.

[54] Ibid; James H Thorp, 'Metamorphosis in River Ecology: From Reaches to Macrosystems' (2014) 59 Freshwater Biology 200.

for assessment and management of the variations that produce changes, both downstream and upstream from an impacted area, including the activities that affect the possibility of rehabilitating a river section.[55] For example, in large-scale assessments, units of 50 km^2 have been used.[56]

With regard to the Water Framework Directive, ecological research emphasizes that a more site-specific differentiation that focuses on ecological aspects important to each space of regulation should be used, instead of the Water Framework Directive's differentiation system. Without regard to the Water Framework Directive, a more macro-scale differentiation is emphasized where a river basin's hydrological-ecological network should be used to differentiate units, using site-specific flow-patterns, for example. Understanding the river basin based on these ecological elements emphasizes that an obligation intended to enhance and protect the ecological status of a river basin must construct spaces of regulation that allow for assessment and management of both small-scale and large-scale, site-specific ecological properties.[57]

3. Discussion

If the spaces of regulation within a river basin are small-scale, the risk is that large-scale ecological properties that also create and enhance the ecological status of an aquatic area are disregarded in the assessment and management. The ecological space of these properties is generally located on larger scales, and may be assessed through site-specific elements, such as hydrological connectivity, migration of aquatic organisms, sediment transport, or the possibility of an (indicator) organism maintaining its population. The differentiation of aquatic Natura 2000 areas and bodies of water indicates an important difference between the ecological variables incorporated into the Habitats Directive and the Water Framework Directive. The aim of the Habitats Directive to protect designated species and habitats can result in large units that can provide species with the physical and biological factors essential to their life-cycles demands, whereas the Water Framework Directive demands a smaller-scale approach. The body of water construct found in the Water Framework Directive is formed for discrete types of bodies of water, and not to incorporate the fact that many aquatic ecosystems tend to be distributed along a gradient of conditions, along increases or decreases of ecological properties of the river basin, such as temperature, or the interconnectedness between upstream and downstream habitat quality. This results in a relatively artificial set of bodies of water that is not always ecologically or legally relevant, in terms of the environmental problems facing a sub-basin or river section. This makes the body of water ill-suited to management of the interactions among multiple ecosystems, populations, and organisms of an aquatic ecological organization, to implement regulative instruments that affect multiple bodies of water and activities, and introduce compensatory remediation measures for water degradation.

Partly, the lack of a large-scale focus in the Water Framework Directive is due to its focus on qualitative, rather than quantitative water management elements. For the Directive to be focused on more quantitative water management elements, the Member States would have had to be in unanimous agreement fifteen years ago, when approving the Directive, and they

[55] James H Thorp and others, 'Linking Ecosystem Services, Rehabilitation, and River Hydrogeomorphology' (2010) 60 BioScience 67.

[56] Richard H Norris and others, 'Very-broad-scale Assessment of Human Impacts on River Condition' (2007) 52 Freshwater Biology 959.

[57] Thorp and others (n 55).

were not (see Article 192(2) TFEU).[58] Therefore, the Water Framework Directive is primarily concerned with the quality of waters (see also recital 19). As hydromorphological pressure is mostly relevant once water quality has been enhanced to a level not severely affecting organisms, a focus on qualitative measures might also be reasonable as a first management step.[59] However, this also makes the quality measures, in the second step, directed at the degradation of features that affect organisms through alteration of habitat composition, flow dynamics, shading, or food web interactions, difficult to establish without side-stepping the coupling of body of water and 'good ecological status'. This means that although the flow regime of a body of water may be significantly altered downstream or upstream from an impoundment or an abstraction, unless the biological quality elements are affected, it could be classified as achieving 'good ecological status'.[60]

In many respects, a small-scale approach corresponds to the way in which ecological restoration has often been framed historically. Today, it is recognized that small-scale restoration is unsuitable for achieving long-term, measurable improvements to the ecological quality of a river basin.[61] Instead, a more holistic approach is required, emphasizing connectivity with adjacent ecological systems, for example.[62] For all water types, it is recognized that stressors acting at larger scales than small-scale bodies of water are more important for achieving results when implementing management measures.[63] It may be necessary to consider upstream conditions, such as naturally woody, riparian vegetation several kilometres upstream from a stretch (of water) for example.[64] Thus, the status of a body of water is coupled to the status of other bodies of water. For example, the part of the Gimån Natura 2000 area to which Ljungån is connected was Holmsjön, which is classified as having moderate ecological potential, and is characterized by dead riparian zones that make it difficult for organisms to find food. Increasing the status of Holmsjön should not be attempted principally within the lake's bodies of water, but within its tributaries, especially as the lake is a heavily modified body of water, and the regulation of the lake may, at most, be more environmentally friendly and, probably not cease.[65] The objective for Holmsjön, good ecological potential, is connected to the body of water of the lake, and therefore, measures to achieve this objective should be directed at the body of water, rather than adjacent bodies of water. Thus, it becomes difficult to adapt the space of regulation of a body of water to the environmental problems of the site.

For an effective space of regulation, a differentiated unit must correspond to both important ecological elements, and the kind of area and activities that are to be regulated, to achieve an improved ecological status at the river basin or sub-basin level. For example, managing multiple hydropower stations that affect both the seasons of water flow and the movement of organisms in a river section or sub-basin through a general

[58] See David Aubin and Frédéric Varone, 'The Evolution of European Water Policy: Towards Integrated Resource Management at EU Level' in Stefan Kuks and Ingrid Kissling-Näf (eds), *The Evolution of National Water Regimes in Europe: Transitions in Water Rights and Water Policies* (1st edn, Kluwer Academic 2005).

[59] Hering and others (n 10); Feld and others (n 20).

[60] For example, see Josefsson and Baaner (n 11).

[61] Feld and others (n 20).

[62] Piet FM Verdonschot and others, 'A Comparative Review of Recovery Processes in Rivers, Lakes, Estuarine and Coastal Waters' (2013) 704 Hydrobiologia 453.

[63] Armin W Lorenz and Christian K Feld, 'Upstream River Morphology and Riparian Land Use Overrule Local Restoration Effects on Ecological Status Assessment' (2013) 704 Hydrobiologia 489; Hering and others (n 10).

[64] Lorenz and Feld (n 63); Hering and others (n 10).

[65] Stranko, Hilderbrand and Palmer (n 20); Lorenz and Feld (n 63).

administrative provision, a larger space of regulation would be preferable to the body of water construct.

A differentiation based on site-specific hydromorphological structures could create a space of regulation that could be more easily used to implement measures relevant to the hydrological-ecological network of a sub-basin; to some extent, the Natura 2000 area of Gimån is an example of such a unit (even if this unit is not fully adapted to the environmental characteristics of the area, as exemplified above). A large-scale space of regulation, like Gimån, allows for more practical rehabilitation measures, as the Habitats Directive's units may refer to both site-specific ecological context and site-specific demands of organisms. The Gimån area provides a basis for assessment and management based on the comprehensiveness of the area, while the 47 bodies of water indicate a reductionist approach incapable of incorporating this comprehensiveness.

Even if a hydrological-ecological fit with the space of regulation is achieved, this does not mean that the unit is suitable for managing the interactions of activities and their pressure on the environment within a river basin. The unit should be differentiated, to allow for assessment that can provide information about the causes of deterioration, and not only that deterioration has occurred, and clearly couple this information to the legal obligation. As the case of Ljungån demonstrates, only providing information is not always enough, if the information cannot be firmly connected to a legal obligation that furnishes the legal system with a cause and effect relationship between the exploitation and the legal obligation that makes exploitation impossible. If there are characteristic elements within a Member State's legal system that affect the ecological status of ecosystems within a river basin, such as a regular, small-scale assessment of hydrological-ecological impact, it may be just as important to adapt the space of regulation to the characteristic legal elements as to the biophysical outline, if improved ecological status is to be achieved.[66] Therefore, site-specific spaces of regulation within a river basin should originate not only from ecological knowledge, but also legal knowledge, adapting the unit to the legal and ecological complexity and environmental problems of the place of regulation. It may be necessary to gain a comprehensive perception of the site-specific environmental problem and a social-ecological contextualization, using the public concerned and experts, as emphasized by the Landscape Conventions landscape construct, while not allowing environmental problems at river basin level to become normative, as such regional units, similarly to the Marine Strategies marine regions, risk becoming too diffuse for classification, objective-setting, and management generally.

If the Water Framework Directive intends to focus on coordination of the ecological, hydrological, and hydrogeological systems (recital 33), a different space of regulation should be created. The ecological status would then be measured on a larger scale then it is today, and the current assessment elements would have to be replaced or complemented by other variables.[67] Certain organism traits could be used to assess and manage the possibility of organisms maintaining themselves (Habitats Directive Art. 1 (i)), and the occurrence and abundance of these traits could be used to indicate an improved ecological status of the aquatic ecosystems of the area. The improved ecological status would then be achieved when management measures are not

[66] Timothy Moss, 'The Governance of Land Use in River Basins: Prospects for Overcoming Problems of Institutional Interplay with the EU Water Framework Directive' (2004) 21 Land Use Policy 85.

[67] For example, see Josefsson and Baaner (n 11).

needed for maintaining (indicator) organisms.[68] This would require spaces of regulation that allow for heterogeneous status perspectives within each unit, and for management measures that aim to improve 'good ecological status' sites towards even higher status. Because 'high status' sites are important for maintaining aquatic biodiversity, providing effective protection of these sites is important, and enhancing 'good status' sites to attain 'high status' could also be considered as important as achieving 'good ecological status' for 'moderate' sites.[69] Other parts of the specific area could then be left in a poorer ecological status, since measures there do not benefit the ecological status of the unit as a whole. From this perspective, it would be possible to prioritize the parts of the unit to be targeted, and if ecological deterioration occurs, over either short or long time spans, the deterioration could then be compensated for by additional measures, besides implementing all practicable steps to mitigate the deterioration at another part of the area, not only at the site of deterioration, and more easily incorporate any upstream or downstream (large-scale) effects of the deterioration.[70]

It is difficult to generalize about how the differentiation of the foregoing kind of space of regulation would be accomplished in practice, as the site-specific environmental characteristics and pressures of the river basin must be considered. However, we can use Ljungån and Gimån as an example, and base the differentiation on the conservation plan of the Natura 2000 area. We assume that for good ecological quality, hydrological and ecological connectedness is needed, and the pressure from the activities in the area are primarily coupled to their impact on hydrological and food web connectivity. Therefore, it is important that the space of regulation is large enough to incorporate the activities' impact on these ecological properties, and large enough to manage these properties without having to consider a multitude of spaces of regulation. A suitable management unit for the Gimån area would include Ljungån, both because it is ecologically important, and hosts an activity that affects the ecological quality of the area. Another method of differentiating site-specific ecological spaces of regulation is to use indicator organisms that demand an interconnected hydrological-ecological network. The differentiated unit should then correspond to both food web and hydrological demands of the organism, to enable it to achieve a state of self-maintenance, and be a viable component of the area (see Habitats Directive Art. 1 (i)). That is, if a population is able to maintain some of the conditions required for their own existence, they also have the capacity to be a viable component of the area. If the organism can contribute to the maintenance of its population and provide for food web connectivity, it also provides for the sustainment of the vigour/maintenance of the ecological organization.[71] Thus, organisms that are indicators of a good hydrological-ecological network, and involved in the large-scale mainte-

[68] Ibid.

[69] Hering and others (n 11); Kenneth Irvine, 'The Tragedy of the Threshold: Revising Perceptions for Aquatic Conservation' (2012) 22 Aquatic Conservation: Marine and Freshwater Ecosystems 705.

[70] Thorp and others (n 55).

[71] For example, see Cristian Saborido, Matteo Mossio and Alvaro Moreno, 'Biological Organization and Cross-Generation Functions' (2011) 62 The British Journal for the Philosophy of Science 583; Francine MR Hughes and others, 'Monitoring and Evaluating Large-Scale, "open-Ended" Habitat Creation Projects: A Journey rather than a Destination' (2011) 19 Journal for Nature Conservation 245; Francine MR Hughes, William M Adams and Peter A Stroh, 'When Is Open-Endedness Desirable in Restoration Projects?' (2012) 20 Restoration Ecology 291; Matteo Mossio, Leonardo Bich and Alvaro Moreno, 'Emergence, Closure and Inter-Level Causation in Biological Systems' (2013) 78 Erkenntnis 153; Nei Nunes-Neto, Alvaro Moreno and Charbel N El-Hani, 'Function in Ecology: An Organizational Approach' (2014) 29 Biology & Philosophy 123.

nance of the ecological organization, may suggest the spatial scale on which a site-specific ecological space of regulation should be located. In the case of Gimån, the hydrological and food web demands of the otter could be used to differentiate a space of regulation, which, in comparison to the Natura 2000 area, would include Ljungån. Even if the spaces are differentiated from each other, they should still be perceived as related to the whole river basin,[72] assuming that all major components of the ecological organization of a river basin or sub-basin contribute to conditions supporting ecological quality, and that damage to any component is of concern for all intersecting segments of the river basin.[73] This space of regulation could be translated into more detailed planning instruments (such as general administrative provisions), where certain activities are selected as being more important in terms of the environmental problems of the area, whereas other activities are left to future management plans of measures.

4. Conclusion

Spaces of regulation designated as units for assessing an ecological obligation should be able to address site-specific environmental problems and support management with legitimacy, if we are to improve river basin ecological status. How we frame the differentiation of units is essential, particularly when they are legally materialized through spaces of regulation.[74]

Even if the Water Framework Directive aims to adapt the administrative structure (river basin districts) to the significant ecological-hydrological elements of the river basin, the body of water as the assessment and management unit is not similarly adapted to significant ecological elements. For organisms that are dependent on hydromorphological elements such as hydrological connectivity, the clear-cut border that a body of water represents is problematic, as it implies that each body of water should be considered individually rather than in conjunction with others. The management of organisms dependent on a connected hydrological-ecological network would be much easier if the Water Framework Directive's space of regulation were differentiated based on the hydrological-ecological elements that such organisms depend on to self-maintain.

Larger spaces of regulation than the Water Framework Directive's 'body of water' may also provide a better space of regulation for implementing general administrative provisions aimed at providing general environmental/ecological measures within a sub-basin or river section, for example. Regulating multiple bodies of water through a general administrative provision is much more difficult, as type-specific obligations such as 'good ecological status' and non-deterioration are coupled to each body of water, and not multiple bodies of water. Therefore, to be an effective space of regulation, the unit should not only be hydrologically-ecologically site-specific, but also be adapted to the procedures of environmental and/or administrative law within each Member State. This demands that the space of

[72] For example, see Arthur Koestler, *The Ghost in the Machine* (Arkana 1989) 341–348; Elinor Ostrom, *Understanding Institutional Diversity* (Princeton University Press 2005) 11–12; Sven Erik Jørgensen and others, *A New Ecology: Systems Perspective* (1st edn, Elsevier 2007) 246–250.

[73] Norris and others (n 56).

[74] David Delaney, 'Beyond the Word: Law as a Thing of This World' in Jane Holder and Carolyn Harrison (eds), *Law and Geography* (Oxford University Press 2003); JB Ruhl, 'Law's Complexity: A Primer' (2007) 24 Ga. St. UL Rev. 885; David Delaney, *The Spatial, the Legal and the Pragmatics of World-Making: Nomospheric Investigations* (Reprint edition, Routledge-Cavendish 2011) 5; JB Ruhl, 'Panarchy and the Law.' (2012) 17 Ecology & Society.

regulation is adapted to national structures such as property and permit rights, and the environmental problems in which they may result.

The kind of aquatic space of regulation proposed here would not result in a pan-European typology, where the units are comparable, owing to the similarities from Member State to Member State, observer to observer, but units would be designed to meet specific legal and environmental needs, as they are adapted to the environmental problems and characteristics of each river basin.[75]

[75] Cf. Bas Pedroli, Teresa Pinto-Correia and Peter Cornish, 'Landscape – What's in It? Trends in European Landscape Science and Priority Themes for Concerted Research' (2006) 21 Landscape Ecology 421.