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Securing success for the Nature Restoration Law

The EU law would complement many others, but challenges loom

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In an attempt to halt and reverse biodiversity losses, the European Commission has proposed a new regulation, the Nature Restoration Law (NRL). It could become a cornerstone of Europe's ambitions to restore biodiversity and ecosystem services for decades to come (1) and demonstrate global leadership in addressing ongoing environmental crises. The draft of the law, which is a first globally, has been under political pressure from various sides, and scientists have contributed intensively to the discussion (2). After trilogue negotiations among the European Parliament, the Council of Europe, and the European Commission, the final text of the NRL has been agreed on (see the box). However, it will still be subject to final votes within the Council and Parliament. Here, we assess the potential for the NRL to overcome problems associated with implementation of related European Union (EU) legislation, strategies, and policies and what can be learned for implementation of the NRL.

The NRL acknowledges that existing EU legislation and policies have so far failed to halt biodiversity losses (1) and consequently, without new instruments, cannot meet the targets of international agreements, such as the Kunming-Montreal Global Biodiversity Framework. Although some of the NRL's aims and approaches overlap with other EU directives, strate-

gies, and policies, in particular with the EU Biodiversity Strategy for 2030, the NRL is distinct in terms of its coverage targeting the majority of European ecosystem types, its strong focus on restoration, and its provision of binding targets and clear timelines. This potential for regulatory power may largely explain the contested nature of its passage into legislation.

The prospect of the NRL achieving its aims will be strongly determined by other European legislation and policies that address the environment as well as land and water uses (see fig. S1). Policy coherence requires complementary objectives and instrument mixes within environmental domains (3) while mainstreaming environmental objectives into other policy

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domains (4). These may enhance options for, or pose restrictions on, the implementation of the NRL. Key directives, some of which came into force decades ago, include the Habitats Directive (HD), Birds Directive (BD), Water Framework Directive (WFD), and Marine Strategy Framework Directive (MSFD). They share aims in safeguarding Europe's biodiversity but have not halted its decline. The Biodiversity Strategy for 2030 (BS) targets halting biodiversity loss, while the Forest Strategy (FS) and Common Fisheries Policy (CFP) address major land and sea uses. Last, the Common Agricultural Policy (CAP) has the largest budget and affects nearly 40% of the EU's terrestrial area, yet agriculture

remains the lead driver of biodiversity loss (5). Together, these directives and policies cover a broad range of targets, sectors, and approaches and are representative for other instruments that will also interact with the NRL implementation (see the supplementary materials for details on our analysis of existing legislation, strategies, and policies).

LESSONS LEARNED

In developing the NRL, the EU has learned from past experiences with European environmental legislation and policies and avoids several obstacles that have obstructed their implementation.

As a regulation, the NRL will come into force soon after it has been passed by the EU Parliament. This is an advantage in comparison with the HD/BD, WFD, and MSFD, which needed to be transposed into national law—a process that takes several years. Although the NRL will also need national implementation—for example, through National Restoration Plans (NRPs)—these could be passed by authorities without legislative procedures. This is a major advantage because speed is vital for tackling the biodiversity crisis and fulfilling the EU's international commitments (6).

The NRL sets ambitious quantitative targets in terms of both the areas to restore and the timeframe, with targets for 2030, 2040, and 2050 (see the box). Experiences with previous legislation support this approach. The WFD and the MSFD defined deadlines for meeting the good status of all water bodies and seas (although in the case of the WFD allowing for an extension), but these firm deadlines made continuous restoration activities with intermediate targets more difficult. Timing, however, is

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also an issue for the NRL. The NRL's success hinges on prompt action and the provision of effective tools for achieving targets within short timeframes, recognizing the necessary time for nature to recover.

The NRL defines measurable and applicable indicators for restoration success. These include the area of restored habitats, which is easy to document and to control. Other more generic indicators, such as the Grassland Butterfly Index, are well established, thus facilitating imple-

mentation. A third group of indicators will require some standardization, such as indicators of forest restoration. Although no specific indicators are defined for marine ecosystems, criteria from the MSFD could be applied. Hence, the NRL can to a large degree capitalize on existing indicators, in sharp contrast to the WFD, MSFD, and HD/BD, all of which ignited extensive indicator development processes that delayed implementation.

Another advantage is the use of NRPs,

which has the potential to provide an appropriately tailored national framework for NRL implementation. Although all the above-listed directives are implemented at the national level, there have been particularly good experiences when actions take account of local contexts and needs, as seen with the River Basin Management Plans under the WFD. It is therefore imperative to ensure that the NRPs will be backed by robust implementation tools that adopt an adaptive cycle, whereby the commission can request member states to increase their ambition.

Key features of the EU Nature Restoration Law

Chapter I: General Provisions

- Defines the overall targets (continuous recovery of nature, fulfillment of climate change objectives and international regulations)
- Defines key terms: Favorable reference area (minimum area to ensure the long-term viability of a habitat type), good condition (characteristics that ensure favorable conservation status according to the HD or good environmental status according to the MSFD), sufficient quality and quantity of habitat (conditions required by a species for maintaining itself on a long-term basis)

Chapter II: Restoration Targets and Obligations

- For Natura 2000 sites (Article 4): Good condition (30% by 2030, 60% by 2040, 90% by 2050); and favorable reference area (30% of the area needed to reach the goal for each habitat type by 2030, 60% by 2040, 100% by 2050); improved connectivity
- For habitats of species listed in Annexes II, IV, and V of Habitats Directive and of Birds Directive (Art. 4): Reach sufficient quality and quantity of habitats (no time frame given)
- Marine Ecosystems (Art. 5): Reaching good condition (30% by 2030, 60% by 2040, 90% by 2050) and favorable reference area (at least 30% by 2030, 60% by 2040, and 100% by 2050)
- Urban Ecosystems (Art. 6): No loss in total national area of urban green spaces, achieve thereafter an increasing trend
- Rivers, floodplains (Art. 7): Removal of barriers to longitudinal and lateral connectivity to achieve restoration targets and 25,000 km of free-flowing rivers; maintain and improve natural functions of floodplains
- Pollinator populations (Art. 8): Improve pollinator diversity, reverse decline of pollinator populations by

2030; achieve thereafter an increasing trend of pollinator populations

- Agricultural ecosystems (Art. 9): Increasing trend at national level in two of the three indicators: "Grassland Butterfly Index," "stock of organic carbon in cropland mineral soils," "share of agricultural land with high-diversity landscape features"; targets for "Common Farmland Bird Index": increase by 10% (2030), 20% (2040), and 30% (2050) for member states with depleted farmland bird populations, and by 5% (2030), 10% (2040), and 15% (2050) for member states with less depleted populations; restoration of organic soils in agricultural use constituting drained peatlands: 30% (by 2030), 40% (by 2040), 50% (by 2050)
- Forest ecosystems (Art. 10): Increasing trend at national level of the "Common Forest Bird Index" and in 6 out of 7 additional indicators such as standing deadwood or forest connectivity

Chapter III: National Restoration Plans

- Obliges member states to prepare restoration plans to implement the measures required for targets of Chapter II, and to quantify the area to be restored
- Member states have full flexibility to use or to discard funds from Common Agricultural Policy and Common Fisheries Policy for NRL implementation

Chapter IV: Monitoring

- Obliges member states to monitor indicators for restoration targets; progress reports by the Commission

Chapter VI: Final Provisions

- Application of the NRL will be evaluated by 2033, including possibly legislative proposals for amendments
- "Emergency brake" allows member states to halt NRL implementation in farmland, if agricultural production is at risk

ADVANCING IMPLEMENTATION

The NRL's aims reach well beyond the targets of existing legislation and policies (see the box). In addition, the NRL offers great potential to boost the implementation of other European directives and policies. Whereas the WFD and MSFD focus on individual ecosystem types (surface water and marine ecosystems), the HD/BD take a broader approach, including a wide range of habitats, and the BS is even more comprehensive (7) because it addresses species, habitats, ecosystems, ecological processes, and public engagement. The NRL is broad but targets specific ecosystem types with tailor-made approaches (see the box and fig. S1). It may therefore have impacts beyond the targeted ecosystems: For example, restoring agricultural ecosystems and forests has the potential to benefit rivers and lakes, and restoring peatlands can positively affect the landscape's water budget (8). Consequently, implementation of the NRL can substantially benefit the implementation of the HD/BD, WFD, and MSFD. This is most obvious for the HD/BD, which addresses a greatly overlapping list of habitats and species. The WFD and the MSFD can benefit from reduced pollution from agriculture and from the additional approaches the NRL provides. For example, the WFD does not explicitly address floodplains, although floodplains play an important role in the healthy functioning of rivers and their ecological quality (9). Also, the implementation of the BS will benefit from the restoration measures initiated by the NRL.

At first glance, the NRL may seem to be "conservative." It focuses mainly on the protection and restoration of habitats per se and of habitats for individual species. This is reminiscent of an approach from the 1980s, seemingly ignoring calls for more systemic, adaptive, and integrated approaches to managing nature. Article 8, with its focus on pollinators, is an exception to this. Ecosystem-based approaches, nature-based solutions, and co-benefits of

restoration for other environmental and societal objectives are mentioned, but the text does not elaborate on their implementation. Despite this, the NRL holds considerable potential to operate at ecosystem levels, providing widespread societal benefits, particularly through the increased supply of ecosystem services (10). Enhancing landscape structure and rewetting peatlands can increase the resilience of agricultural ecosystems to droughts and pests, and restoring pollinator populations can have direct positive impacts on agricultural production. Similarly, reconnecting rivers with their floodplains can mitigate flood risks (11); increasing urban green spaces can benefit urban climate and people's health; increasing forest diversity can enhance resilience to extreme events; and restoring marine ecosystems can benefit recreation (12).

AVOIDING PITFALLS

A recurring problem with the implementation of European environmental legislation and policies is the gap between targets and effective implementation options. HD, BD, WFD, and MSFD have so far not achieved their aims, and neither has the BS (see table S2). Reasons are manifold. Besides shortcomings in aims and approaches (see table S3, a to g), a common denominator is the lack of resources needed to implement them successfully, including funding, human resources, appropriate planning procedures, and administrative capacities for implementation. The passing of legislation and policies have not always been followed by the provision of appropriate resources and capacity-building for implementation and monitoring. The NRL encounters similar challenges because it is even more ambitious. Implementation at the national level must therefore assure a stringent procedure and a resilient funding structure, as suggested by the original Commission proposal. Although the targets are legally binding, the measures to achieve them will be voluntary actions by land and water owners and managers, who would need to accept co-responsibility and possess the capacity to respond. This requires not only financial investments but also supportive institutions for cooperation, peer-to-peer learning, business models that support land-use change, and societal acceptance to work with nature.

The required resources are not exclusively of public origin. After the NRL's approval, the EU and member states are tasked with mobilizing private financing of restoration, endorsing suitable business models that incorporate cost recovery (13). These may involve refined carbon credit

trading, collaboration with insurance companies to mitigate flood or drought risks, or customized options for investing in nature. The European Investment Bank, and its enhanced capacity to offer advisory services alongside conventional financing, could assume a more prominent role in this regard.

It will be of equal importance to acquire public funds for restoration of nature from other components of the EU budget—in particular, regional development and agriculture. So far, despite the installment of relevant instruments, the CAP has not succeeded in achieving the aims of HD, BD, and WFD. The CAP is unlikely to contribute sufficiently to the NRL implementation if its support schemes are not modified to strengthen the ambition of measures, strictly enforce cross-compliance, and increase funding for focused measures. A

“Although the targets are legally binding, the measures to achieve them will be voluntary actions...”

specific clause is granting member states full flexibility in using or foregoing CAP or CFP funds for NRL implementation. Using these funds could potentially offer unprecedented, cost-efficient opportunities for both the NRL and the CAP and CPF. The CAP's agriculture-environment-climate measures, along with the somewhat less ambitious “Eco-schemes,” could support habitat restoration and the recovery of pollinator populations. Implementing the NRL in farmlands is also vital for achieving various goals, including river-floodplain connectivity, river to coast-marine connectivity (through controlled floods), peatland targets (through alternative agricultural schemes such as paludiculture), and even urban restoration (by maintaining urban and peri-urban green and blue spaces). Simultaneously, addressing climate change in agriculture necessitates restoration measures such as landscape water storage, reduced livestock densities, and diminished nitrogen inputs.

The trilogue negotiations have introduced two further elements that substantially weaken the NRL. First, member states may permanently deprioritize restoration actions in areas used for other targets such as renewable energy infrastructure and military facilities. Second, the inclusion of an “emergency brake” enables member states to temporarily sus-

pend NRL implementation in farmland, over their entire area, under exceptional circumstances that affect land availability for agricultural production. However, an evaluation of the NRL planned for 2033 could result in legislative proposals for amendments, including a better coherence with other legislation or policies.

Translating ambitions into actions still requires a close alignment with both existing and emerging European legislation and policies. Stability in the legislative developments is crucial, considering that nature restoration requires long-term perspectives. Provision of funding schemes will determine whether the NRL will address current pressures and drive much-needed transitions. Given the urgency of global crises, Europe cannot afford to delay; the opportunity to install and implement an ambitious law, and the opportunity to show global leadership, should not be missed. ■

REFERENCES AND NOTES

1. European Commission. “Report from the Commission to the European Parliament, the Council and the European Economic and Social Committee: The state of nature in the European Union. Report on the status and trends in 2013 - 2018 of species and habitat types protected by the Birds and Habitats Directives.” COM(2020) 635 final (Publications Office of the European Union, 2020).
2. G. Pe'er et al., “Scientists support the EU's Green Deal and reject the unjustified argumentation against the Sustainable Use Regulation and the Nature Restoration Law” (2023); <https://tinyurl.com/4ttp8mds>.
3. R. Fischer et al., *Land Use Policy* **127**, 106546 (2023).
4. M. Nilsson et al., *Environ. Policy Gov.* **22**, 395 (2012).
5. S. Rigal et al., *Proc. Natl. Acad. Sci. U.S.A.* **120**, e2216573120 (2023).
6. N. Pettorelli et al., *J. Appl. Ecol.* **58**, 2384 (2021).
7. S. Vallecillo et al., “EU-wide methodology to map and assess ecosystem condition: Towards a common approach consistent with a global statistical standard,” *EUR 31226 EN* (Publications Office of the European Union, 2022).
8. P. Borrelli, P. Panagos, D. Wuepper, *Int. Soil Water Conserv. Res.* **8**, 102 (2020).
9. S. Larsen et al., *PLOS ONE* **14**, e0213227 (2019).
10. R. S. De Groot et al., *Conserv. Biol.* **27**, 1286 (2013).
11. J. J. Opperman et al., *Science* **326**, 1487 (2009).
12. S. Pousou, S. Ferrini, R. K. Turner, M. C. Uyerra, Á. Borja, *Front. Mar. Sci.* **5**, 2018.00375 (2018).
13. C. M. Duarte et al., *Nature* **580**, 39 (2020).

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Supplementary Materials for
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Materials and Methods

For each of the following legislation, strategies and policies, we extracted key targets, strengths and weaknesses related to conservation and restoration of habitats and biodiversity, using the published text of the legislation, strategies and policies, and (if available) recent review papers:

- Habitats Directive (HD)
- Birds Directive (BD)
- Water-Framework Directive (WFD)
- Marine Strategy Framework Directive (MSFD)
- Biodiversity Strategy for 2030 (BS)
- Forest Strategy (FS)
- Common Agricultural Policy (CAP)
- Common Fisheries Policy (CFP)

We particularly looked into identifying co-benefits to be expected from the implementation of the Nature Restoration Law (NRL) legislation, in particular socio-economic benefits, and a reflection on lessons learnt that might help with the implementation of the NRL. We then rated the degree to which the targets have been met, using the most recent official reports on the implementation of the legislation, strategy or policy.

For each legislation, strategy or policy, we compiled implementation challenges (from literature and expert opinion) that have been responsible for the failure to achieve their targets, e.g., administrative obstacles, responsibilities, lack of funding, and contradicting targets. For each of these challenges, a qualitative / narrative check was performed on (i) if (and how) the challenge is addressed by the NRL and (ii) if similar challenges are to be expected for the implementation of the NRL (narratively and along a scoring of 0 to 2 with 0 = not relevant; 1 = partly relevant; and 2 = relevant). We checked if these obstacles are also applicable for the NRL implementation and formulated recommendations on how the NRL could overcome the particular challenges.

For FS, CFP, CAP, we performed a literature analysis on which of their targets and implementation steps have obstructed the achievement of biodiversity goals. Similar to the analysis of implementation obstacles, we performed a qualitative / narrative check on which of these obstructions is addressed at all by the NRL and if similar challenges are to be expected for the implementation of the NRL.

We then compiled the results of the previous four steps separately for each legislation, strategy or policy (tables S2e to S2g) and summarised in table S1.

Table S1. Overview of main references used to compile the Supplementary Text and tables S2 and S3.

Legislation, strategy, policy	References
Habitats Directive (16)	1, 19, 20, 21, 23, 24, 25, 26, 27, 28, 29
Birds Directive (17)	23, 25, 27, 30, 1, 29
Water Framework Directive (33)	32, 33, 34, 35, 36, 37, 38
Marine Strategy Framework Directive (42)	41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58
Biodiversity Strategy for 2030 (61)	61, 62, 63 64
Forests Strategy (66)	66, 67
Common Fisheries Policy (69)	69, 70, 71, 72, 73, 74
Common Agriculture Policy (76)	76, 77, 78, 18, 79, 80, 81, 82, 83

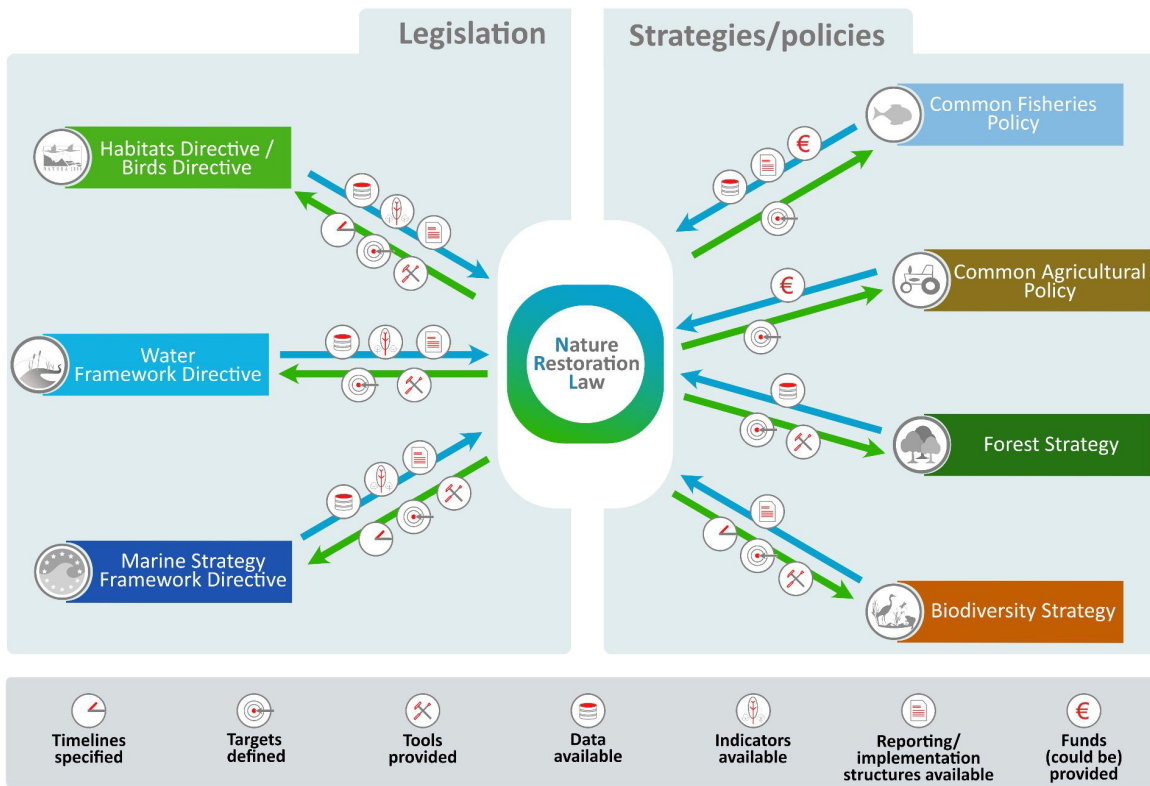


Fig. S1. Possible relations between the Nature Restoration Law (NRL) and other European environmental legislation, strategies and policies.

Supplementary Text

Habitats Directive (HD) and Birds Directive (BD)

Targets, strengths and weaknesses: The aim of both HD (14) and BD (15) was to install and mainstream protection measures of selected species and habitats across the EU. The target is to maintain or reach favourable conservation status for all wild bird species in the EU and their habitats (BD), non-bird animal and plant species as well as habitats (HD) that are ‘of community interest’, i.e., endangered, vulnerable or rare. For this purpose, Annexes list valuable and threatened species and habitats, and Member States established protected areas, forming the Natura2000 network. Especially the deterioration prohibition stated in Article 6(2) fuelled an increase in conservation activities and made it possible to judicially halt environmentally damaging practices (e.g. CJEU Cases C-117/00 (16), C143/02 (17)). The main strength of the directives is the creation of an EU wide network of protected areas through the Natura2000 network. In theory, this could ensure mainstreamed conservation efforts and wildlife that can flourish independent of national borders. In practice, however, even though enforcement of the laws by the European Court Justice is considered to be strict (18), the implementation of the Directives is slow and effects remain patchy. Merely 27% of species and 15% of habitats have reached favourable conservation status (1), while 81% of habitats and 63% of species are still in unfavourable status. Moreover, compared to 9% of habitats show improving trends, 36% show deterioration. Similarly, species assessments show an improving trend for 6% of species, but a deteriorating trend for 35% (1). Given the soft requirements for connectivity restoration in Natura 2000 sites, it could be argued that the failure to implement a proper, EU-wide network of protected sites is by design (19). Similarly, the focus on conservation instead of specific restoration with clear restoration norms, the inflexible structure of the Annexes with no adaptation or updating process in place, and the lack of a deadline to reach the targets are by-design weaknesses of the Directives (20, 21). A lack of funding and lack of personnel qualified to create management plans, perform monitoring and work with stakeholders and national authorities are furthermore commonly identified as major challenges to the implementation and have led to vast differences in the implementation between member states (25, 29).

How the NRL can support the implementation: Large parts of the NRL are building upon the Habitats Directive, potentially improving restoration and conservation efforts through setting targets to establish effective and area-based restoration measures to cover all ecosystems in need of restoration and at least 20 % of the European Union’s land and sea areas. The Birds and Habitats Directives have no specific quantitative, area-based or time-bound targets for Member States to carry out restoration measures, just to report on the measures taken, their purpose, location and expected time-frame when a habitat or species response would be expected. In this respect, the NRL can be viewed as a strong enabler by requiring more quantitative targets for restoration actions to achieve the HD and BD goals. The NRL also addresses the need to identify funding mechanisms to implement NRL-related restoration actions, granting Member States full flexibility in utilizing or foregoing CAP or CFP funds for NRL implementation.

Lessons learned that help with the NRL implementation: Designation of Natura 2000 sites and the implementation of restoration measures had been criticised as top-down and non-inclusive especially in the starting phase of the legislation’s implementation (29). The preparation of management plans for Natura 2000 areas is not mandatory and was consequently not performed for all sites. Where management plans have been created, standards differ widely between Member States (29). This has led to unclear responsibilities, a lack of funding designated towards nature

restoration and subsequently, a lack of qualified personnel to perform this task (25). Strategies to aid implementation of restoration measures were developed by the European Commission, such as the development of guidance for economic sectors or the formation of an expert group on the management of Natura2000 sites (23, 83). Still, the Directives' targets are far from being met and obstacles are still related to stakeholder engagement and organisation of the management plans. What is needed to improve the implementation of both BD and HD is not only more ambitious and quantified targets like the NRL proposes; but much more a functioning support system around the Directives, concerning funding, organisational support from the EU where local authorities can learn from experts, and training programmes in how to engage with different stakeholder groups. The NRL requires Member States to provide appropriate funding, yet it remains in the Member States' responsibility whether CAP or CFP funds are used for NRL implementation. While these provisions are still vague, they are an improvement compared to the current practice of HD/BD implementation.

Importantly, the NRL requires Member States to set up National Restoration Plans, which need to be approved by the EU commission. These plans will offer opportunities to learn from best practices, provide specific guidance to those Member States that need it and orchestrate cooperation and synergies between Member States' activities. While the Annexes of the Habitats and Birds Directives are rigid without much room for adaptation, the NRL proposes to update annexes after five years.

Even though interpretation and enforcement of the Directives by the European Court Justice is considered strict (18), critics claim the European Commission abandoned their post as 'Guardians of the Treaties' in recent years by drastically reducing the number of infringement procedures even where they would have been warranted (22). A support system for the implementation of the NRL can only help so far if failure to comply is not strictly prosecuted.

Water Framework Directive (WFD)

Targets, strengths and weaknesses: The WFD (31) aims at achieving the 'good ecological status' for all surface waters, which is defined by biodiversity-related criteria, e.g., abundance and diversity of aquatic organisms. The WFD was a step in widening the focus from point-source pollution to understanding aquatic ecosystem functioning and the wide range of ecosystem services these ecosystems provide (34). The WFD can serve as a prime example for establishing a Europe-wide monitoring system and has initialised a multitude of restoration actions, while its targets have only been achieved to a minor degree: by 2015, only 40% of the surface waters were in 'good status', i.e., their biodiversity remained depleted. Nevertheless, the WFD is the prime driver of aquatic ecosystem restoration in Europe and through the mandatory requirement for public participation, gave impetus to integrated basin planning and cross-sectoral dialogue (38). A large number of individual restoration measures have been performed under the WFD, which have led to local ecosystem status enhancement and widespread socioeconomic benefits (84).

How the NRL can support the implementation: Direct linkages of WFD and NRL are minor. The NRL targets rivers (Article 7), but it is focussed on selected impacts, in particular connectivity. While measures to enhance connectivity can support the probability of achieving good status, other stressors have a stronger impact on ecological status, in particular water pollution and habitat degradation (85, 86), the effects of which are becoming more acute due to the high water temperature peaks associated with global warming. However, the targets for urban systems

(Article 6), agricultural ecosystems (Article 9) and rewetting peatlands (Article 9) could be very beneficial also for water bodies, which are strongly affected by catchment land use. Therefore, a strong indirect effect on water bodies can be expected if the NRL targets are met.

If the NRL demands higher ecological status due to Natura 2000 commitments, WFD objectives are supported as well. However, should these habitats be deemed very common and widespread, the deadline becomes 2050 and the potential derogations proposed under Article 17 may apply.

Lessons learned that help with the NRL implementation: In terms of monitoring, the WFD is a prime example on how to implement a Europe-wide monitoring system. Lessons learned for the NRL include the importance of intercalibration of national assessment systems and the importance to centrally collect original monitoring data. In terms of measure implementation, the WFD experience underlines that restoration is not successful if the responsible authorities have no options to mitigate stressors originating from adjacent land. It also underlines that ambitious and binding targets help with initialising restoration measures, but are not necessarily met if they are not accompanied by sufficient restoration tools, funding and political will. Article 11 leaves open, if CAP-funds, including the European Agricultural Fund for Rural Development (EAFRD), are used to support freshwater restoration (39).

The most recent reviews of River Basin Management Plans show that it takes time to embed the integrated basin approach but there are signs that more challenging issues are now being addressed (e.g., e-flows). The WFD has a holistic view on aquatic ecosystems and thus requires that all relevant stressors / pressures are addressed, which is often not realistic. Against this background, the more limited and targeted NRL goals seem to be more feasible and achievable; whilst the adaptive management approach of the NRL plans allows for learning and improvement. Recital 49 offers an important acknowledgement of the synergistic relationship between agricultural land use and floodplain or riparian restoration when such restoration can ‘benefit of the long-term functioning and productivity of the agricultural ecosystems’. To see that such synergy is achieved, it will be important to set targets on the level of Member States and provide conflict resolution mechanisms where there are competing claims on land and water uses. The introduction of an “emergency brake” (article 22a), allowing member states to temporarily halt the implementation of Article 9 under extreme (but poorly defined) conditions, could undermine progress to restoration (and therefore to WFD objectives).

Marine Strategy Framework Directive (MSFD)

Targets, strengths and weaknesses: The MSFD (40) aims at achieving the ‘good environmental status’ for all regional seas (i.e., Baltic Sea, North-East Atlantic Ocean, Mediterranean Sea and Black Sea), which is defined by eleven descriptors, including biodiversity, non-indigenous species, commercial species, food webs, eutrophication, seafloor integrity, hydrography, contaminants in the environment, contaminants in seafood, litter and energy/noise. The MSFD can serve as a prime example for establishing a European ecosystem-based management (EBM) approach, in which humans and their activities are considered part of the marine system, and they should be undertaken in a sustainable way, to achieve good environmental status. If this status is not achieved by 2020 (or 2026), a program of measures, including restoration actions, must be implemented by each Member State. A certain number of individual restoration measures have been performed under the MSFD, as well as other measures of protection and conservation of the seas (44, 48).

How the NRL can support the implementation: Linkages of MSFD and NRL include some marine habitats, such as seagrasses, sediment bottoms, rocky habitats and dunes, but also habitats of iconic species, such as marine mammals, sharks or seabirds. The NRL targets coastal (Article 4) and marine ecosystems (Article 5), focussing on selected impacts, and related to Marine Protected Areas and Habitats Directive. Since some of the targets are included in the MSFD programmes of measures set up by member states, the NRL can reinforce the achievement of MSFD goals.

Lessons learned that help with the NRL implementation: In terms of monitoring, the MSFD is an example on how to collaborate within European Regional Seas to jointly monitor them (45, 56). However, some weaknesses and threats still remain (50). Lessons learned for the NRL include: (i) harmonize the target setting, at least regionally, improving the evaluation and comparability of the updated monitoring programmes; (ii) ensure consistency in the monitoring programmes among countries, for indicators and criteria; (iii) assign a detailed list of species and habitats to each monitoring programme; (iv) consider natural and seasonal variability for monitoring and restoration (55). In terms of measure implementation, the MSFD experience underlines that restoration is not successful if the competent authorities have no options to mitigate stressors originating from adjacent countries or Areas Beyond National Jurisdiction. The MSFD has a holistic view on marine ecosystems (under the EBM approach) and thus requires that all relevant human activities and pressures, as well as the ecosystem components, are addressed. Against this background, the more limited and targeted NRL goals seem to be more feasible and achievable, especially those related to the protected areas, if these targets are enforced.

Biodiversity Strategy for 2030 (BS)

Targets, strengths and weaknesses: The Biodiversity Strategy for 2030 (BS) of the EU (59), a non-binding strategy, aims at halting biodiversity loss and preserving ecosystem functioning by protecting at least 30% of the EU's land, while restoring ecosystems. For this, it targets creating green and blue infrastructure, i.e., wildlife corridors and ecological networks, improving connectivity between protected areas. It also aims at reducing anthropogenic stress through more sustainable agriculture, fisheries, forest management, and urbanisation and halting the establishment of invasive species. The BS offers a comprehensive approach addressing multiple dimensions of biodiversity protection, including the species level, habitat protection, entire ecosystems and ecological processes (60). It also acknowledges the importance of public engagement and awareness and promises regular monitoring and reporting with a long-term vision (63). This makes the BS a key example for an interdisciplinary approach towards biodiversity protection. However, meeting the ambitious targets is obstructed by several challenges, including that the targets are not legally binding, so that only 15% of habitats and 27% of species listed in the HD and 47% listed in the BD are not under risk of extinction (1), despite aiming to improve the status of 100% of the habitats and 50% of the species. Reasons are limited funding and resources and varying degrees of implementation among EU member states and conflicts with short term economic objectives. Also, policy coherence with other legislation is challenging, and unharmonized monitoring methods across the EU further halt rapid progress. Lastly, slow adaptation to global and climate change may further retard successful protection of biodiversity (61, 62, 64). Nonetheless, the BS offers a foundation for pan-European ecosystem management and joint efforts for biodiversity protection.

How the NRL can support the implementation: The NRL partly builds on the BS, both targeting ecosystem restoration at different spatial scales of a multitude of ecosystems (NRL Articles 4-10). The NRL can support the implementation of the BS through by improving enforceability of joint targets by providing binding targets, approaches and timelines, quantifying these, and further supporting public involvement and introducing novel funding opportunities. Hence, harmonising different environmental legislation, strategies and policies will be crucial to successfully reach the environmental targets.

Lessons learned that help with the NRL implementation: The BS is a clear commitment of the European Union to stop biodiversity loss while enabling sustainable development. It is a pioneer interdisciplinary strategy with clear ambitious targets regarding several environmental legislation and policies (60) and is in line with international agreements such as the UN Sustainable Development goals (88) and the Convention on Biological Diversity (89). However, its success greatly relies on the Member State's willingness to implement the strategy and to provide sufficient funding, planning, governance and enforcement, and to mitigate competing interests (64). These topics will also be crucial for the NRL implementation, but as a regulation, the NRL will provide a much stronger lever. Particularly the lack of enforcement of several environmental policies, such as the CFP and the CAP (90, 82) highlights the need for binding targets that are now provided by the NRL. These must be supported by sufficient funding, planning and a long-term economic perspective.

Forest Strategy to 2030 (FS)

Targets, strengths and weaknesses: As an additional initiative of the European Green Deal that is building on the EU Biodiversity Strategy for 2030, the Commission adopted a new EU Forest Strategy to 2030 (65). The FS outlines a vision and concrete actions for increasing the quantity and quality of forests in the EU and strengthening their protection, restoration and resilience. It aims to facilitate adapting Europe's forests to new conditions, weather extremes and high uncertainty brought about by climate change (65). The main objectives of the FS are effective afforestation, forest preservation and restoration in Europe, to help to increase the absorption of CO₂, reduce the incidence and extent of forest fires, and promote the sustainability of forest-based bioeconomy, while accounting for biodiversity. It also aims to strictly and effectively protect all primary and old-growth forests in the EU. Most importantly, the FS demands that clear cutting practices in the EU countries should be used only in duly justified cases (65). It also requires adequate distribution of funding for landowners dedicated to restoring their forests through carbon credits compensations and payments for ecosystem services. Implementing the NRL alongside the EU Forest Strategy for 2030 presents opportunities for synergistic ecosystem restoration, enhanced forest governance, climate change mitigation, and green job creation. However, challenges may arise due to conflicting objectives, competing land use priorities, stakeholder engagement, and monitoring requirements.

In practical terms, the FS defines 'thresholds and ranges' that establish the boundaries of sustainability. The FS includes a pan-European indicator set to monitor progress towards the Strategy's objectives. Two thirds of the objectives and commitments identified in the FS can be monitored at least partially - and in some cases weakly - by those indicators, whereas new indicators need to be developed for the remaining third (66).

How the NRL can support the implementation: The Nature Restoration Law establishes a legal framework for ecosystem restoration, including forests, aligning with the FS goals. It can prioritise biodiversity conservation, supporting diverse forest ecosystems and sustainable forest management. The law can foster coordination among different groups of stakeholders, as well as enhance monitoring and evaluation of restoration projects, by allocating resources and incentives. Public awareness and engagement can be further promoted, while research and innovation can contribute to effective forest restoration and management. Additionally, the NRL can address climate change challenges, emphasising climate-resilient approaches to protect forests from climate impacts.

Lessons learned that help with the NRL implementation: Implementing the NRL can benefit from setting well-defined goals and guidelines for ecosystem restoration, ensuring clarity and consistency in actions, by adopting robust monitoring and evaluation processes to measure the impact of restoration activities and make informed decisions. It can learn from employing an adaptive management approach, enabling adjustments in response to emerging challenges and new information. Furthermore, the FS underlines that the NRL should ensure sufficient resources and incentives to motivate stakeholders to participate actively in restoration activities as well as to focus on long-term objectives for ecosystem restoration, recognizing that positive outcomes may take time to materialise (67). There is also a need for long-lasting support and political will to achieve restoration goals.

Common Fisheries Policy (CFP)

Targets, strengths and weaknesses: The CFP (68) aims at having all fish stocks within safe limits in Europe, defined by the Maximum Sustainable Yield, which is the largest catch that can be taken from a species' stock without reducing the size of the population (72). The CFP recognises that fishing activities affect marine ecosystems through seabed disturbance, bycatch of key species and effects on marine food webs (70). However, at the same time, fisheries are affected by climate change, river nutrient discharges and other human pressures (e.g., agriculture, industry, shipping, etc.), introducing diverse pollutants at sea, such as litter, traditional and emerging contaminants (69, 73). The CFP implementation needs to be strengthened, especially regarding: (i) the landing obligation; (ii) the contribution to the implementation of environmental legislation and the related governance system; (iii) the improvement of the knowledge base and the strengthening of the ecosystem-based approach, keeping in mind both socio-economic and environmental objectives; (iv) the allocation of quotas at national level and the transparency of the process; (v) the sector's energy transition; and (vi) the development of biophysical and socioeconomic indicators to be used in fisheries management and conservation measures (72).

How the NRL can support the implementation: Linkages of CFP and NRL include marine habitats, such as seagrasses, sediment bottoms, rocky habitats and dunes, but also habitats of iconic species, such as marine mammals, sharks or seabirds (some of them affected by bycatch). The NRL targets coastal (Article 4) and marine ecosystems (Article 5), focussing on selected impacts, and related to Marine Protected Areas and Habitats Directive. Since some of the targets are related to the CFP, the NRL can reinforce the achievement of CFP objectives. Vice versa, Member States can use CFP funds to fund restoration activities under the NRL.

Lessons learned that help with the NRL implementation: In terms of monitoring, the CFP is an example of how long-term and detailed data recording for biophysical variables that characterise

many stocks, can be obtained by collaborating within large organisations (e.g., Copernicus, ICES, CIESM). Lessons learned for the NRL include: (i) the harmonisation of methods across stocks and seas will improve the evaluation and comparability for the recovery of restored habitats; (ii) consistency in the use of indicators needs to be ensured; (iii) a detailed list of species and habitats in the NRL is useful for implementation; (iv) the interaction among species needs to be considered (72, 74).

Common Agricultural Policy (CAP)

Targets, strengths and weaknesses: Following Article 39 of the Treaty on the Functioning of the EU (75), the CAP aims to support productivity, farm incomes and stable markets. Recently, the CAP also included operational targets of environmental sustainability by promoting sustainable farming practices, as reflected in the CAP objectives for the funding period 2023-2027 (Article 6). The environmental objectives specifically seek to promote sustainable land management practices, enhance biodiversity protection on agricultural landscapes, improve water resource management, and introduce climate change mitigation measures. This should be achieved by three key elements in the updated ‘green architecture’ of the CAP, particularly ‘enhanced conditionality’ (formerly Cross Compliance and Greening) defining basic standards to which farmers have to adhere, newly established Eco-Schemes as voluntary measures in Pillar 1, and Agri-Environmental and Climate Measures (AECM) in the CAP’s rural development plan (Pillar 2) – with the aim to incentivize farmers to improve agricultural practices (91, 92). While the CAP’s targets of (short term) food security and financial support have been met (92), targets of environmental sustainability have been only achieved to a minor degree (79, 81). The environmental targets set too low requirements for environmental protection; and the introduced eco-schemes, in many Member States, may not be ambitious enough to generate change in management and restoration. It has been shown that the AECMs have the potential to support the specific implementation of the BD and HD, depending on the regional design and funding of targeted measures (94). However, in total, the AECM did not receive sufficient funding budgets; the investments are not balanced between uniform payments; and many of the measures chosen by member states are not effective enough to promote environmental protection and biodiversity-friendly farming (77, 83). The CAP could still potentially serve as a key instrument to achieve the future NRL-targets in terms of biodiversity protection and habitat restoration, and has some instruments to promote pan-European improvements for land use management challenges. However, the high share of CAP subsidies that are independent of business models and farm practices (especially Direct Payments) sets a challenge to transform agriculture toward a more environmentally friendly orientation (59, 78, 86). Furthermore, most farmers are exempt from basic good practices (‘Good Agricultural Ecological Condition’, GAEC) as required by enhanced conditionality. Recent derogations from some of these standards, cancelling the Ecological Focus Areas (EFA) in the year 2022, and cancelling Good agricultural and environmental conditions (GAECs) 7 and 8 in 2023 in response to the Russian war against Ukraine, demonstrate high sensitivity of the CAP to deregulation pressures, and highlighting the importance of an external legislative framework.

How the NRL can support the implementation: Both CAP and the NRL target sustainable, resilient and biodiverse agriculture (NRL Articles 8 and 9), thus addressing the largest share of land use in Europe (93). The NRL can support the implementation of the CAP’s environmental targets by setting clear, binding, and more ambitious targets for 2030, 2040 and 2050, by e.g., promoting

diverse landscapes, securing (and increasing) the stock of organic carbon in soils and restoring pollinator populations. These are practically achievable through existing CAP instruments, as they merely require an update of Eco-Scheme lists, improving the alignment of some existing instruments (e.g. payments for Areas of Natural Constraints) and possibly conducting some changes of funding priorities in the CAP. Other agricultural measures target extensification (or in rare cases abandonment) of farm practices to allow habitat restoration and rewetting of peatlands. In cases where land is taken out of production, they go beyond the CAP and possibly complementing it. However, lacking a clear financial plan, a substantial change based on the NRL alone is unlikely and will need more ambitious targets in the next update of the CAP. Many approaches of the current CAP contradict the NRL targets, in particular the main focus on direct payments. If the NRL, in particular Articles 8 and 9, should be successful, the next CAP needs to have a much stronger focus on results-based agri-environmental measures that particularly support the NRL's aims, for example funding schemes for rewetting peatlands. It is of crucial importance that measures to implement the NRL can also capitalise on CAP funds, but this option was unfortunately delegated to Member States' responsibilities in the NRL. Given the demonstrated low ambition of most Member States with regards to farmland biodiversity, this is a risk. For land that is taken out of agricultural production, additional funding beyond the CAP needs to be more clearly defined.

Lessons learned that help with the NRL implementation: The CAP is an example for EU-wide policy acting over decades with a long-term perspective (92). It fosters promising approaches of incentivizing agricultural transition to more sustainable land management with approaches such as the Eco-Schemes, rural development plans or the associated Farm to Fork Strategy. In terms of environmental objectives, however, the implementation is not very successful, partly due to conflicts of interest with short term economic goals and the funding of business-as-usual farming models, diluting ambitious environmental protection measures (81). Also, the funding of environmental transition is not sufficient (77), highlighting the importance of securing funding for NRL implementation. The more ambitious and binding targets for environmentally friendly agricultural management, as proposed by the NRL (particularly Articles 8 and 9), and the introduction of new and scientifically well-established indicators (butterflies, carbon stocks, landscape features) can yield more promising results and are hence important to retain and even expand. Also, by highlighting the economic sense of investing in environmental protection with larger returns than the initial costs, the NRL may help delivering promising results also for farmlands.

Table S2. Biodiversity-related targets and degree of achievement obtained by the individual legislation, strategies and policies.

Legislation	Ecosystem types addressed	Organism groups addressed	Biodiversity-related targets	Degree of target achievement
Habitats Directive	Terrestrial, freshwater and marine	Habitats (EUNIS)	Favourable conservation status of defined habitats and species	15% of habitats, 27% of species in good conservation status
Birds Directive	Terrestrial, freshwater and marine	Birds	Favourable conservation status of all bird species and of habitats of certain bird species	47% of bird species in good conservation status
Water Framework Directive	Rivers, lakes, transitional and coastal waters	Phytoplankton, phytobenthos, macrophytes, invertebrates, fish	Good ecological status / potential of all surface waters by 2027	By 2015, 40% of surface waters met targets, 60% failed
Marine Strategy Framework Directive	Marine waters from coast to EEZ boundary	All marine, from plankton to mammals	Good environmental status in all seas by 2026	By 2020, loss of marine biodiversity has not been halted; marine ecosystem condition is generally not 'good'; signs of recovery for some species and areas
Biodiversity Strategy for 2030	Terrestrial (soil, agriculture, urban, forests), freshwater, marine	All from Habitats from plants to invertebrates and vertebrates	Coherent trans-European nature network; Protection of at least 30% of land and sea by 2030	By 2020: 15% of habitats and 27% of species listed in Habitats Directive and 47% of species listed in Birds directive not under risk of extinction

Legislation	Ecosystem types addressed	Organism groups addressed	Biodiversity-related targets	Degree of target achievement
Forests Strategy	Forests	All components of forest biodiversity	Biodiversity friendly afforestation and reforestation; Closer-to-nature-forestry practices; forest reproductive material	Recently adopted strategy, not yet quantified
Common Fisheries Policy	Marine (and freshwater)	Fish, shellfish	All fish stocks within safe limits	In 2018, from 188 stocks 22% in good status (using 2 criteria), and further 34% (using one criterion)
Common Agricultural Policy	Agricultural ecosystems, soil, indirectly other ecosystems (e.g., aquatic ecosystems) by reduction of diffuse pollution	Farmland birds, pollinating insects, soil organisms, aquatic organisms, High-Nature Value and Natura2000 habitats and species	Maintain and enhance biodiversity to support agricultural production - particularly by Ecological Focus Areas; Climate Change mitigation by Agri-Environment-Climate-Measures	Few positive outcomes - local success depending on farmers engagement; CAP has mainly objectives, rather than quantifiable targets (except for share of Ecological Focus areas or share of organic farming, which slightly increased)

Table S3a. Implementation challenges for meeting the biodiversity-related targets of the **Habitats Directive (HD) and the Birds Directive (BD)** and relation to NRL text. Column ‘Is a similar challenge expected...’: 0 = not relevant; 1 = partly relevant; and 2 = relevant.

Challenges of implementation	(How) does the NRL address this challenge?		Is a similar challenge expected for the implementation of the NRL?	Recommendations for NRL implementation to overcome the challenge
Policy				
Lacking or weak political commitment and support for biodiversity policy	When writing National Restoration Plans, synergies with other sectors/measures can be identified	1	Less relevant, as the NRL targets are binding, likely leading to stronger policy support	
Finance, economy and capacity				
Funding <ul style="list-style-type: none"> • Insufficient funding designated for implementing the Directives • Unsuitable financing mechanisms resulting in a lack of management plans for implementation 	<ul style="list-style-type: none"> • Financial incentives for member states • Integration of NRL-objectives into EU-Funding programmes 	2	Appropriate and flexible funding will also be decisive for the implementation of National Restoration Plans under the NRL. There is an investment gap of over 40 billion euros for NRL (94).	Establish appropriate funding mechanisms, also using private funding and funding provided by the CAP
Institutional capacity <ul style="list-style-type: none"> • Insufficient personnel capacities • Lack of knowledge and/or skills of management staff 	Not addressed	2	Well-trained personnel will be even more relevant for the NRL implementation, as the targets are more ambitious and to be implemented in a shorter timespan.	Enhance and train personnel in the relevant authorities.

Challenges of implementation	(How) does the NRL address this challenge?		Is a similar challenge expected for the implementation of the NRL?	Recommendations for NRL implementation to overcome the challenge
Implementation barriers				
Communication barriers between authorities and stakeholders	Open and inclusive preparation of National Restoration Plans	2	Communication will be even more relevant for the NRL implementation, as the targets are more ambitious and to be implemented in a shorter timespan	Training programmes in how to engage with different stakeholder groups
Inconsistencies / intransparency <ul style="list-style-type: none"> • between Member States in designation and management of protected sites (Natura 2000) • within Member States, if implementation is delegated to federal states or regions • management plans not consistent in scope and content, as these are just optional instruments • High complexity of the Directives and corresponding guidelines result in a lack of transparency and understanding by implementing authorities 	Obligatory National Restoration Plans	2	The proposed content for the Restoration Plans is fairly concrete, however, inconsistencies between Member States will remain, as it is up to the Member States how the targets will be achieved	Clear guidelines for National Restoration Plans.

Challenges of implementation	(How) does the NRL address this challenge?		Is a similar challenge expected for the implementation of the NRL?	Recommendations for NRL implementation to overcome the challenge
Conflicts in targets with other sectors or measures, such as Climate Change mitigation	<ul style="list-style-type: none"> NRL targets more closely linked to Climate Change mitigation Integrated planning towards areas where both can be achieved simultaneously 	2	<ul style="list-style-type: none"> Conflict with land users will inevitably occur, but conflicts with Climate Change mitigation measures will be less relevant Despite integrated planning approaches, it is still likely that the space will not suffice the needs for both biodiversity protection and the constantly growing economy 	<ul style="list-style-type: none"> Develop guidance for economic sectors; establish expert groups Transition of economy needed to live within 'planetary boundaries'
Data and monitoring				
Lack of data for the assessment of sites	Obligatory monitoring programmes under the NRL	1	NRL indicators are simpler as compared to the BD/HD indicators; but monitoring and reporting requirements are set too sparsely in most cases (every 6 years)	Harmonise indicators between countries and regions to enable comparability of results; ensure yearly monitoring
Rigid and outdated species lists in the Annexes with no adaptation practice	Update of the Annex lists after five years	2	All restoration targets are based on the condition of Annex species/habitats, so careful and adaptive selection is crucial	Ensure ecologically sound selection and adaptation of targeted habitats
Soft requirements for connectivity in Natura2000 sites	No quantification for improved connectivity is included, but measures outside Natura2000 sites can improve connectivity	1	Connectivity will remain as a challenge, but NRL has more options to improve connectivity	Formulate clear targets and indicators of connectivity

Table S3b. Implementation challenges for meeting the biodiversity-related targets of the **Water Framework Directive (WFD)** and relation to NRL text. Column ‘Is a similar challenge expected...’: 0 = not relevant; 1 = partly relevant; and 2 = relevant.

Challenges of implementation	(How) does the NRL address this challenge?		Is a similar challenge expected for the implementation of the NRL?	Recommendations for NRL implementation to overcome the challenge
Policy				
Ecological and political timescales <ul style="list-style-type: none"> • Implementation and success of restoration measures requires long time periods • Insufficient knowledge on how fast biota will respond to restoration • Long time needed to implement measures that require land use change • Time lags due to internal nutrient loading and low recolonisation potential expected 	Not addressed	2	Long time periods for the achievement of the goals, independently from implemented restoration actions, are expected (e.g., due to required recolonisation)	Success should not only be measured by the achievement of status, but also by the degree of implemented restoration actions
Finance, economy and capacity				
Financing <ul style="list-style-type: none"> • The use of WFD economic instruments is partial and not well implemented in many Member States 	Not addressed	2	There is an investment gap of over 40 billion euros for NRL (78)	Use a combination of financial strategies to fund NRL including public incentives, cost-recovery measures and private investments

Challenges of implementation	(How) does the NRL address this challenge?		Is a similar challenge expected for the implementation of the NRL?	Recommendations for NRL implementation to overcome the challenge
<p>Lack of governance tools to address the main stressors affecting ecological status</p> <ul style="list-style-type: none"> • No direct influence of implementing organisation on riparian and catchment land use • lack of capacity to direct voluntary measures 	Indirectly addressed by the demand for the removal of lateral barriers and floodplain restoration	2	<ul style="list-style-type: none"> • Impacts of surrounding land use on status of Natura2000 sites is likely, independently from implemented restoration actions • Difficulty in spatially targeting measures associated with other legislation, strategies and policies 	Strong policy coherence mechanisms in developing but crucially implementing and reviewing National Restoration Plans
Implementation barriers				
Slow implementation of measures due to conflict with over land and water uses (e.g., hydropower) and lack of skills/capacity in implementing Natural Water Retention Measures or paludiculture	Not addressed	2	Lack of political will, lack of capacity building for advisors, resistance from land managers can be expected	Better policy coherence with CAP measures
Slow and insufficient progress in ecological status improvement	Indirectly addressed by the demands for additional restoration actions (removal of longitudinal and lateral barriers)	2	As targets are ambitious and not only influenced by the implementation of restoration measures, but also by large-scale stressors and recolonisation obstacles, slow progress in habitat condition improvement is expected, too	Success should not only be measured by the achievement of status, but also by the degree of implemented restoration actions

Challenges of implementation	(How) does the NRL address this challenge?		Is a similar challenge expected for the implementation of the NRL?	Recommendations for NRL implementation to overcome the challenge
Derogations (Article 7) allows less stringent objectives or timescales	Not addressed	0	There is no mechanism for derogation but the objectives are targeted, so Member States can choose where to target their efforts. Conflicts between private and public good delivery is likely to impede implementation.	Illustrate where and how working with nature can protect private enterprises and society from risks or increase productivity. Conflict resolution processes and tools should be developed.
<p>Bridging ecology and management in River Basin Management Plans</p> <ul style="list-style-type: none"> • Deriving management decisions from ecological data are difficult in case of complex multi-stressor situations • Some assessment metrics are not related to specific pressures (general degradation metrics) and are difficult to apply to plan restoration measures 	Not addressed	1	It is only vaguely outlined how management / restoration decisions are to be based on monitoring results	Monitoring results, amended by data on implemented restoration actions, should be centrally collected and stored to allow for an assessment of restoration efficiency

Challenges of implementation	(How) does the NRL address this challenge?		Is a similar challenge expected for the implementation of the NRL?	Recommendations for NRL implementation to overcome the challenge
<p>Emerging stressors</p> <ul style="list-style-type: none"> Assessment metrics often focussed on ‘traditional stressors’ (organic pollution, eutrophication) Lack of attention for emerging stressors (climate change, water scarcity, alien species) included 	Not addressed	2	Effects of emerging stressors are not addressed explicitly, only as a reason for the non-fulfilment of targets according to Article 4. Overall, the NRL is targeting both, biodiversity decline and climate change.	Consider ecosystem development (‘prestation’) rather than restoration targets
<p>Ecological status response to restoration</p> <ul style="list-style-type: none"> Response of biota to restoration measures in complex multi-stressor situations poorly predictable Lack of data and experience on spatial and temporal scales required for restoration 	Not addressed	1	<ul style="list-style-type: none"> NRL allows for considerable degree of freedom on how the targets will be achieved No central collation of data and experiences on restoration activities and their successes planned 	Monitoring results, amended by data on implemented restoration actions, should be centrally collected and stored to allow for an assessment of restoration efficiency
Data and monitoring				
<p>Intercalibration</p> <ul style="list-style-type: none"> Differences in national assessment systems, due to biomonitoring traditions Effort and time required for intercalibration has been more than expected 	Not addressed	1	<ul style="list-style-type: none"> Most monitoring criteria according to Art. 17 (e.g., habitat area) do not need to be intercalibrated Condition of habitat types is assessed differently by member states 	Consider intercalibration of habitat condition between member states to avoid differently stringent targets

Challenges of implementation	(How) does the NRL address this challenge?		Is a similar challenge expected for the implementation of the NRL?	Recommendations for NRL implementation to overcome the challenge
<p>Monitoring data</p> <ul style="list-style-type: none"> • Comparability of original data between countries is limited due to different sampling methods, taxonomic resolution and density of sampling sites • Original data are not centrally stored 	Not addressed	1	There are no plans for central collection of original monitoring data	Europe-wide collection of original monitoring data should be planned from the very beginning of the implementation
<p>Surveillance monitoring and operational monitoring</p> <ul style="list-style-type: none"> • Very few surveillance monitoring sites in many member states, which limits European State-of-Environment overviews, as well as the detection of emerging stressors and long-term trends • No Europe-wide data base on surveillance monitoring 	Not addressed	1	Monitoring is focussed on the improvement of conditions, not on long-term changes caused by other drivers, e.g., climate change	A fraction of the monitoring sites should be placed in habitats that already achieve good condition, to allow for unbiased analysis of long-term trends

Challenges of implementation	(How) does the NRL address this challenge?		Is a similar challenge expected for the implementation of the NRL?	Recommendations for NRL implementation to overcome the challenge
<p>Monitoring requirements of WFD and other European legislation</p> <ul style="list-style-type: none"> • Definitions of objectives and requirements of WFD and other directives are not always consistent • Potential synergies of monitoring systems resulting from different directives not fully exploited 	Not addressed	1	The NRL is capitalising on the condition assessment of the HD and on the ecosystem condition assessment in the accounting framework, but ignores assessment results of other directives	In case of freshwater habitats, good condition (according to Article 3) could be defined as ‘good ecological status’

Table S3c. Implementation challenges for meeting the biodiversity-related targets of the **Marine Strategy Framework Directive (MSFD)** and relation to NRL text. Column ‘Is a similar challenge expected...’: 0 = not relevant; 1 = partly relevant; and 2 = relevant.

Challenges of implementation	(How) does the NRL address this challenge?		Is a similar challenge expected for the implementation of the NRL?	Recommendations for NRL implementation to overcome the challenge
Policy				
<p>Ecological and political timescales</p> <ul style="list-style-type: none"> • Implementation and success of restoration measures require long time periods • Insufficient knowledge on how fast species, habitats and ecosystem services will respond to restoration • Long time needed to implement measures that require human activities change 	Not addressed	2	Long time periods for the achievement of the goals, independently from implemented restoration actions, are expected (e.g., due to required recolonisation)	Success should not only be measured by the achievement of status, but also by the degree of implemented restoration actions
Implementation barriers				
Lack of governance tools to address the main pressures affecting environmental status No direct influence of organisation responsible for sea uses	Indirectly addressed by involving various ecosystem types that influence each other	2	Impacts of surrounding uses on status in protected areas is likely, independently from implemented restoration actions	Strong cooperation with land and sea users and the relevant legislation, strategies and policies, in particular with the CAP

Challenges of implementation	(How) does the NRL address this challenge?		Is a similar challenge expected for the implementation of the NRL?	Recommendations for NRL implementation to overcome the challenge
Slow and insufficient progress in environmental status improvement	Indirectly addressed by the demands for additional restoration actions	2	As targets are ambitious and not only influenced by the implementation of restoration measures, but also by large-scale pressures and recolonisation obstacles, slow progress in habitat condition improvement is expected also for NRL-related measures	Success should not only be measured by the achievement of status, but also by the degree of implemented restoration actions
Bridging ecology and management <ul style="list-style-type: none"> Deriving management decisions from ecological data are difficult in case of complex multi-pressures situations Some indicators and criteria are not related to specific pressures (general degradation) and are difficult to apply to plan restoration measures 	Not addressed	1	It is only vaguely outlined how management / restoration decisions are to be based on monitoring results	Monitoring results, amended by data on implemented restoration actions, should be centrally collected and stored to allow for an assessment of restoration efficiency

Challenges of implementation	(How) does the NRL address this challenge?		Is a similar challenge expected for the implementation of the NRL?	Recommendations for NRL implementation to overcome the challenge
<p>Emerging pressures</p> <ul style="list-style-type: none"> Assessment criteria often focussed on ‘traditional pressures’ (eutrophication) No (or still little tested) criteria for the effects of emerging pressures (climate change, non-indigenous species, noise, litter) included 	Not addressed	2	<p>Effects of emerging stressors are not addressed explicitly, only as a reason for the non-fulfilment of targets according to Article 4</p> <p>Overall, the NRL is targeting both, biodiversity decline and climate change</p>	Consider ecosystem development (‘pre-restoration’) rather than restoration targets
<p>Environmental status response to restoration</p> <ul style="list-style-type: none"> Response of species, habitats and ecosystem services to restoration measures in complex multi-pressure situations poorly predictable Lack of data and experience on spatial and temporal scales required for restoration 	Not addressed	1	<ul style="list-style-type: none"> NRL allows for considerable degree of freedom on how the targets will be achieved No central collation of data and experiences on restoration activities and their successes planned 	Monitoring results, amended by data on implemented restoration actions, should be centrally collected and stored to allow for an assessment of restoration efficiency
Data and Monitoring				

Challenges of implementation	(How) does the NRL address this challenge?		Is a similar challenge expected for the implementation of the NRL?	Recommendations for NRL implementation to overcome the challenge
<p>Monitoring data</p> <ul style="list-style-type: none"> • Comparability of original data between countries is limited due to different sampling methods, taxonomic resolution, density of sampling sites, and spatial and temporal cover • Original data are not centrally stored (raw data used in the assessments are not available) 	Not addressed	2	There are no plans for central collection of original monitoring data	Europe-wide collection of original monitoring data should be planned from the very beginning of the implementation
<p>Coordinated monitoring among Member States sharing the same regional sea</p> <ul style="list-style-type: none"> • Very few coordinated monitoring surveys, to ensure results comparability and reduce costs of monitoring • No Europe-wide database on monitoring 	Not addressed	2	Monitoring is organised in already existing networks, but needing adaptation to include more species and descriptors, as well as ensuring full spatial cover and long-term monitoring, to understand changes caused by climate change	Ensure that adequate monitoring networks cover spatio-temporal changes, to allow for unbiased analysis of long-term trends

Challenges of implementation	(How) does the NRL address this challenge?		Is a similar challenge expected for the implementation of the NRL?	Recommendations for NRL implementation to overcome the challenge
<p>Monitoring requirements of MSFD and other European legislation</p> <ul style="list-style-type: none"> • Definitions of objectives and requirements of MSFD and other directives are not always consistent (e.g. Habitats and Birds Directives) • Potential synergies of monitoring systems resulting from different directives not fully exploited 	Not addressed	2	The NRL is capitalising on the condition assessment of the HD and on the ecosystem condition assessment in the accounting framework, but ignores assessment results of other directives.	In case of marine systems, good condition (according to Article 3) could be defined as 'good environmental status'.

Table S3d. Implementation challenges for meeting the biodiversity-related targets of the **Biodiversity Strategy for 2030 (BS)** and relation to NRL text. Column ‘Is a similar challenge expected...’: 0 = not relevant; 1 = partly relevant; and 2 = relevant.

Challenges of implementation	(How) does the NRL address this challenge?		Is a similar challenge expected for the implementation of the NRL?	Recommendations for NRL implementation to overcome the challenge
Policy				
<p>Political collaboration</p> <ul style="list-style-type: none"> • Success relies on willingness of Member States, as the targets are not binding and coordination across and within Member States (e.g. designation of protected areas or Natura 2000 sites) • Management plans often not in accordance with EU standards • Conflict with short term economic objectives • Most protected area designations by country-based assessments, yielding inconsistencies, management gaps and lacking connectivity 	<ul style="list-style-type: none"> • EU-wide platform for coordination and cooperation and provision of binding targets, approaches and timelines • EU-wide monitoring and reporting framework • Financial incentives for member states • ‘EU Green Network’ of natural and semi natural areas 	1	Despite financial incentives and EU-wide coordination and cooperation planned, the success still relies on the EU-Member States. Question remains, if financial incentives/legal requirements will be sufficient to target short term economic objectives.	Internalisation of externalities, so that short term objectives are no longer economically sound, if not sustainable for the long term
Finance, economy and capacity				

Challenges of implementation	(How) does the NRL address this challenge?		Is a similar challenge expected for the implementation of the NRL?	Recommendations for NRL implementation to overcome the challenge
<p>Economy</p> <ul style="list-style-type: none"> • Competing interest in land/sea use may result in designation of protected areas in remote, isolated areas • Incompatibilities with other policies such as CAP (direct payments potentially increasing further intensification of agriculture) • Blue growth in marine areas can potentially compromise biodiversity protection 	<ul style="list-style-type: none"> • EU Green Network (ecological corridors) • Financial incentives 	1	<p>Question remains, if the financial incentives proposed will be sufficient. The EU Green Network is a good start to connect restored habitats</p>	<p>Internalisation of long term effects of economic practice</p>

Challenges of implementation	(How) does the NRL address this challenge?		Is a similar challenge expected for the implementation of the NRL?	Recommendations for NRL implementation to overcome the challenge
Funding/Monitoring <ul style="list-style-type: none"> Financial resources are not sufficient to implement all desired measures Payment gap for management of current protected areas Lack of funding for monitoring past implementation projects Funding from private sector may have other motives Potential conflicts with stakeholders, lacking involvement or misinformation despite efforts 	<ul style="list-style-type: none"> Integration of NRL-objectives into EU-Funding programmes Economic incentives for conservation and restoration 	1	Appropriate and flexible funding will also be decisive for the implementation of National Restoration Plans under the NRL. There is an investment gap of over 40 billion euros for NRL (79)	Rather implement measures now than postponing them. Ensure long term funding dedicated for biodiversity (conservation covenants); use EU Taxonomy to ensure eligibility of private investments.
Institutional capacity <ul style="list-style-type: none"> The success of the BS relies on capacities of national authorities, NGOs and research and public engagement - joint work is a challenge 	Not addressed	2	The same problem is likely to occur	Provision of enough funding needed and education
Implementation barriers				

Challenges of implementation	(How) does the NRL address this challenge?		Is a similar challenge expected for the implementation of the NRL?	Recommendations for NRL implementation to overcome the challenge
<p>Public awareness</p> <ul style="list-style-type: none"> Some of the currently protected areas are used for recreational activities with potential negative impacts 	<ul style="list-style-type: none"> Promotion of sustainable tourism practices Education 	2	Similar challenges are expected, because promotion and education alone will not be sufficient	Enforcement and potentially barriers needed to protect especially sensitive species from stress
<p>External pressures</p> <ul style="list-style-type: none"> Current protected areas affected by global change such as climate change, invasive species Ecosystem management sometimes rather harm than protect ecosystems (e.g. by planting exotic trees) Simple planting of trees does not benefit biodiversity, but rather forest renewal 	<ul style="list-style-type: none"> Linking existing protected areas across EU Member States - more connected networks are more resilient New tools and approaches of management and conservation 	1	Although the linking of existing and new protected areas is likely to increase the resilience, external pressures is likely to increase over time	Continuous adaptation to global changes
<p>Conflicts in targets</p> <ul style="list-style-type: none"> Potential conflicts between climate and biodiversity protection 	Integrated planning approach to find areas where both can be achieved simultaneously	1	Despite integrated planning approaches, it is still likely that the space will not suffice the needs for both biodiversity protection and the constantly growing economy	Transition of economy needed to live within 'planetary boundaries'

Challenges of implementation	(How) does the NRL address this challenge?		Is a similar challenge expected for the implementation of the NRL?	Recommendations for NRL implementation to overcome the challenge
International cooperation <ul style="list-style-type: none"> The Strategy does not specify how ‘externalisation’ of biodiversity burden should be prevented (e.g., rain forests) 	Promotion of sustainable and responsible consumption support of international efforts of biodiversity protection and EU-trade agreements	1	Global crises and trade agreements cannot be predicted and influenced easily. Therefore, externalisation cannot be precluded easily.	Aiming for global cooperation and coordination e.g. by investment funds
Data and monitoring				
Data <ul style="list-style-type: none"> Soil biodiversity only partly addressed, rather as a side effect from other measures 	Increasing share of organic farming (Article 9, currently removed) requires national strategies for soil health improvement	1	Protection of soil biodiversity still appears to be considered a ‘by product’ but is at least highlighted	Clear focus on transition to more sustainable land uses

Table S3e. Implementation challenges for meeting the biodiversity-related targets of the **Forest Strategy (FS)** and relation to NRL text. Column ‘Is a similar challenge expected...’: 0 = not relevant; 1 = partly relevant; and 2 = relevant.

Challenges of implementation	(How) does the NRL address this challenge?		Is a similar challenge expected for the implementation of the NRL?	Recommendations for NRL implementation to overcome the challenge
Policy				
Conflicting Objectives: Forest restoration activities may involve the removal of certain tree species or modification of forest landscapes, which could potentially conflict with biodiversity conservation (e.g. of grasslands) and sustainable forest management	Indirectly addressed by the requirement of national restoration plans that may address these conflicts	2	Conflicts between restoration targets and approaches for different ecosystems may occur, but due to the specificity of the targets defined for individual ecosystem types these will be limited	Identifying priority areas for the restoration of individual ecosystems in the national restoration plans
Finance, economy and capacity				
Stakeholder engagement and participation: Ensuring effective involvement of diverse stakeholders, including forest owners, local communities, NGOs, and indigenous groups. It requires transparent decision-making processes, capacity building, and addressing conflicting interests and power dynamics to avoid resistance from stakeholders.	National restoration plans offer additional options to liaise different stakeholders groups including governments, private sector actors, local communities, and NGOs	1	Liaising stakeholder interests and gaining support from various societal groups for restoration activities is a challenge for the NRL as well	Aligning the NRL with the FS, there is an opportunity to strengthen forest governance, promote stakeholder participation, and ensure the effective implementation of restoration measures in forested areas
Implementation barriers				

Challenges of implementation	(How) does the NRL address this challenge?		Is a similar challenge expected for the implementation of the NRL?	Recommendations for NRL implementation to overcome the challenge
Climate change impacts: Significant impacts on forests and the forest sector expected, which will require adaptation measures and sustainable forest management	The focus of the NRL is much more on restoration rather than on sustainable forest management	2	The NRL's targets are similarly affected by climate change. At the same time, the NRL can contribute to climate change mitigation efforts by emphasising reforestation and afforestation activities.	Implementation should include adaptive management approaches
Competing land use Priorities: The availability of land for restoration projects and sustainable forest management may be limited due to competing demands for agriculture, urbanisation, or infrastructure development	Indirectly addressed by the requirement of national restoration plans that may address these conflicts	2	Conflicts between targets for individual ecosystem types are likely to occur as well	Definition of priority areas for restoration of individual ecosystem types
Data and Monitoring				
Establishing robust monitoring frameworks, data collection systems, and indicators to track the implementation of restoration measures, sustainable forest management practices, and the achievement of desired outcomes is complex and resource-intensive.	The NRL specifies a number of seven indicators for forest biodiversity, which are straightforward to address but may still need further refinement. Six out of seven indicators shall be chosen.	1	Though indicators have been defined, they may still need refinement to enable a straightforward monitoring	Monitoring and evaluating the outcomes of restoration activities to enable evidence-based improvements in restoration and management practices

Table S3f. Implementation challenges for meeting the biodiversity-related targets of the **Common Fisheries Policy (CFP)** and relation to NRL text. Column ‘Is a similar challenge expected...’: 0 = not relevant; 1 = partly relevant; and 2 = relevant.

Challenges of implementation	(How) does the NRL address this challenge?		Is a similar challenge expected for the implementation of the NRL?	Recommendations for NRL implementation to overcome the challenge
Policy				
Eco-schemes in most countries are not ambitious enough to generate a change in management (= restoration), funding periods not always align with the time needed to achieve environmental outcomes.	not addressed	1	The NRL will build on existing legislation, strategies and policies such as the possibility to set up eco-schemes. However, the target of restoration may result in higher ambitions of the EU-member states for eco-schemes.	Consider more ambitious, Europe-wide Eco-schemes
CFP alignment with MSFD objectives. Complex policy framework with numerous regulations can pose challenges for fishers understanding and complying with requirements.	Aiming to keep administrative burden as limited as possible, ensuring appropriate infrastructure for public access, reporting and data-sharing between public authorities	1	Although this point is regarded, the administrative burden is unlikely to disappear completely.	Better engage stakeholders and try to simplify, without oversimplifications
Finance, economy and capacity				

Challenges of implementation	(How) does the NRL address this challenge?		Is a similar challenge expected for the implementation of the NRL?	Recommendations for NRL implementation to overcome the challenge
Mechanisms to compensate fishers if areas are taken out of fishing especially for restoration and rewilding	Compensation through incentives and buyers of ecosystem services	2	Funding appears not sufficient to compensate for all nature restoration, as largely based on existing legislation, strategies and policies that lack funding.	Provision of funding needed, as long-term return expected
Overall CFP investments should be better balanced with biodiversity conservation.	not addressed	1	The NRL will build on CFP, so it will face a similar challenge.	Increase incentives for environmentally friendly and sustainable fishing methods.

Table S3g. Implementation challenges for meeting the biodiversity-related targets of the **Common Agricultural Policy (CAP)** and relation to NRL text. Column ‘Is a similar challenge expected...’: 0 = not relevant; 1 = partly relevant; and 2 = relevant.

Challenges of implementation	(How) does the NRL address this challenge?		Is a similar challenge expected for the implementation of the NRL?	Recommendations for NRL implementation to overcome the challenge
Policy				
The CAP’s Good Agricultural and Environmental Conditions (GAEC) set too low requirements in terms of area and quality, and most farmers are exempt of these. Even with these, many farmers do not comply, due to tradition, resistance to change, and insufficient monitoring.	not addressed	1	Even though stakeholder involvement is planned and may contribute to improve and specify targets, the NRL is largely dependent on a more ambitious CAP	Joint involvement with farmers and environmentalists to work on the future of farming, including agricultural transition
Eco-schemes in most countries are not ambitious enough to generate a change in management (= restoration), the yearly funding approach does not align with the time needed to achieve many of the environmental outcomes	not addressed	1	The agri-environmental targets of the NRL are also largely dependent on member states’ implementation, however restoration may result in higher ambitions of the EU-member states for eco-schemes, particularly in Natura2000 sites	Close cooperation of NRL and CAP jointly defining more ambitious, Europe-wide eco-schemes

Challenges of implementation	(How) does the NRL address this challenge?		Is a similar challenge expected for the implementation of the NRL?	Recommendations for NRL implementation to overcome the challenge
<p>Conflict of CAP objectives (time-lag): CAP balances multiple objectives, including environmental protection, economic viability, social challenges - while trade-off occur among objectives. Long-term, short term economic considerations (by agricultural lobbies and pharmaceutical industry) and farm income sometimes overshadow environmental priorities and consequently, dilute ambitions of environmental protection measures.</p>	<p>Focussing on Ecosystem Services and Economics of Biodiversity</p>	1	<p>Contrasting objectives with land users (in particular farmers) are expected</p>	<p>Ensure funding and independence of lobbyism and involve investment funds and insurance companies</p>
<p>CAP fails to integrate objectives of WFD, Sustainable Pesticide Use directives, SDGs, Aichi Targets, Green Deal. Complex policy framework with numerous regulations can pose challenges for small farmers understanding and complying with requirements and requires a lot of administrative capacity</p>	<p>Aiming to keep administrative burden for all entities as limited as possible, ensuring appropriate infrastructure for public access, reporting and data-sharing between public authorities</p>	1	<p>Although this point is regarded, the administrative burden is unlikely to disappear completely</p>	<p>Better engage stakeholders and try to simplify, without oversimplifications</p>
<p>Finance, economy and capacity</p>				

Challenges of implementation	(How) does the NRL address this challenge?		Is a similar challenge expected for the implementation of the NRL?	Recommendations for NRL implementation to overcome the challenge
CAP lacks mechanisms to compensate farmers if land is taken out of production especially for restoration, including rewetting and rewilding	Compensation through incentives and buyers of ecosystem services	2	As funding appears not sufficient to compensate for all nature restoration, as largely based on existing legislation, strategies and policies that lack funding. The European Development Fund and Horizon Europe would need to step in.	Provision of funding needed, as long-term return expected
Agricultural Environmental and Climate Measures (AECM) have insufficient budgets and, in some areas (e.g. rich soils), low uptake by farmers	not addressed	2	Funding is not clear yet, so similar problems of funding are to be expected	Ensure enough funding (maybe in cooperation with insurance companies), as in the long term the investments are likely to be fruitful; incentivise Member States to seek coherence between CAP and NRL
Overall CAP investments are not balanced between business as usual farming and biodiversity-friendly farming, with predominant uniform payments least effective for biodiversity conservation	not addressed	1	Depending on how strongly the NRL will build on the CAP, similar problems are expected	Increase incentives for environmentally friendly farming methods
Implementation barriers				

Challenges of implementation	(How) does the NRL address this challenge?		Is a similar challenge expected for the implementation of the NRL?	Recommendations for NRL implementation to overcome the challenge
Lack of targeted measurements: CAP does not adequately address diverse environmental issues across the different European regions, failing to address region-specific challenges (e.g., regarding soil conditions, climate, etc.), nor focus on small farms (High Nature Value Farmlands)	By being based on several legislation, strategies and policies including EU soil strategy	0	No	Work interdisciplinarily
Missing indicators for impacts on biodiversity	NRL introduces new three well-established indicators within Article 9, and Article 8 addresses pollinators	1	The new indicators offer a significant improvement but the list of (non-pollinator) indicators is very short. Monitoring and reporting requirements (every 6 years) is insufficient to assess the status and respond appropriately.	Promote and incentivise yearly monitoring regardless of reporting requirements by the Commission

References

1. European Commission, “Report from the Commission to the European Parliament, the Council and the European Economic and Social Committee, The state of nature in the European Union, Report on the status and trends in 2013 - 2018 of species and habitat types protected by the Birds and Habitats Directives” (COM(2020) 635 final, Publications Office of the European Union, 2020).
2. G. Pe’er, D. Hering, J. Kachler, H. Bruelheide, H. Wittmer, A. Bonn, I. Herzon, E. Ladouceur, N. M. van Dam, N. Selva, L. Bosco, S. Lakner, J. Settele, G. Hagedorn, D. Saavedra, M. Friedrichs-Manthey, C. Sirami “Scientists support the EU’s Green Deal and reject the unjustified argumentation against the Sustainable Use Regulation and the Nature Restoration Law” (2023); <https://tinyurl.com/4tpt8mds>.
3. R. Fischer, M. Lippe, P. Dolom, F.K. Kalaba, F. Tamayo, B. Torres, Effectiveness of policy instrument mixes for forest conservation in the tropics-Stakeholder perceptions from Ecuador, the Philippines and Zambia. *Land Use Policy* **127**, 106546 (2023).
4. M. Nilsson, T. Zamparutti, J. E. Petersen, B. Nykvist, P. Rudberg, J. McGuinn, Understanding Policy Coherence: Analytical Framework and Examples of Sector–Environment Policy Interactions in the EU. *Environmental Policy and Governance* **22(6)**, 395-423 (2012).
5. S. Rigal, V. Dakos, H. Alonso, A. Auniņš, Z. Benkő, L. Brotons, T. Chodkiewicz, P. Chylarecki, E. de Carli, J.C. Del Moral, C. Domşa, V. Escandell, B. Fontaine, R. Foppen, R. Gregory, S. Harris, S. Herrando, M. Husby, C. Ieronymidou, F. Jiguet, J. Kennedy, A. Klvaňová, P. Kmecl, L. Kuczyński, P. Kurlavičius, J.A. Kålås, A. Lehtikoinen, Å. Lindström, R. Lorrillière, C. Moshøj, R. Nellis, D. Noble, D. Palm Eskildsen, J.-Y. Paquet, M. Péliissié, C. Pladevall, D. Portolou, J. Reif, H. Schmid, B. Seaman, Z.D. Szabo, T. Szép, G. Tellini Florenzano, N. Teufelbauer, S. Trautmann, C. van Turnhout, Z. Vermouzek, T. Vikstrøm, P. Voříšek, A. Weiserbs, Vincent Devictor, Farmland practices are driving bird population decline across Europe. *Proceedings of the National Academy of Sciences of the United States of America*, **120(21)**, e2216573120 (2023).
6. N. Pettorelli, N. A. J. Graham, N. Seddon, M. Maria da Cunha Bustamante, M. J. Lowton, W. J. Sutherland, H. J. Koldewey, H. C. Prentice, J. Barlow, Time to integrate global climate change and biodiversity science-policy agendas. *Journal of Applied Ecology* **58**: 2384-2393 (2021).
7. S. Vallecillo, J. Maes, A. Teller, J. Babí Almenar, J. Barredo, M. Trombetti, D. Abdul Malak, M. Paracchini, A. Carré, A. Addamo, B. Czúcz, G. Zulian, F. Marando, M. Erhard, C. Liquele, C. Romao, C. Polce, A. Pardo Valle, A. Jones, M. Zurbaran-Nucci, M. Nocita, V. Vysna, A. Cardoso, E. Gervasini, C. Magliozzi, R. Baritz, M. Barbero, V. Andre, I. Kokkoris, P. Dimopoulos, V. Kovacevic, A. Gumbert, “EU-wide methodology to map and assess ecosystem condition : towards a common approach consistent with a global statistical standard” (EUR 31226 EN, Publications Office of the European Union, 2022).
8. P. Borrelli, P. Panagos, D. Wuepper, Positive cascading effect of restoring forests. *International Soil and Water Conservation Research* **8 (1)**, 102 (2020).
9. S. Larsen, U. Karaus, C. Claret, F. Sporcka, L. Hamerlík, K. Tockner, Flooding and hydrologic connectivity modulate community assembly in a dynamic river-floodplain ecosystem. *PLOS ONE* **14 (4)**, e0213227 (2019).

10. R. S. De Groot, J. Blignaut, S. Van Der Ploeg, J. Aronson, T. Elmqvist, J. Farley, Benefits of Investing in Ecosystem Restoration. *Conservation Biology* **27**, 1286-1293 (2013).
11. J. J. Opperman, G. E. Galloway, J. Fargione, J. F. Mount, B.D. Richter, S. Secchi, Sustainable floodplains through large-scale reconnection to rivers. *Science* **326(5959)**, 1487-1488 (2009).
12. S. Pouso, S. Ferrini, R. K. Turner, M. C. Uyarra, Á. Borja, Financial Inputs for Ecosystem Service Outputs: Beach Recreation Recovery After Investments in Ecological Restoration. *Frontiers in Marine Science* **5**, 2018.00375 (2018).
13. C. M. Duarte, S. Agusti, E. Barbier, G. L. Britten, J. C. Castilla, J.-P. Gattuso, R. W. Fulweiler, T. P. Hughes, N. Knowlton, C. E. Lovelock, H. K. Lotze, M. Predragovic, E. Poloczanska, C. Roberts, B. Worm, 2020. Rebuilding marine life. *Nature* **580**, 39-51 (2020).
14. European Parliament, Council of the European Union, “Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora” (Publications Office of the European Union, 1992).
15. European Parliament, Council of the European Union, “Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds” (Publications Office of the European Union, 2009).
16. “Commission of the European Union v Ireland. Failure by a Member State to fulfil its obligations - Directives 79/409/EEC and 92/43/EEC - Conservation of wild birds - Special protection areas.” (Case C-117/00, European Court Reports, 2002).
17. “Commission of the European Communities v Italian Republic. Failure of a Member State to fulfil obligations - Directive 92/43/EEC - Conservation of natural habitats - Wild fauna and flora.” (Case C-143/02, European Court Reports, 2003).
18. H. Schoukens, K. Bastmeijer, “Species Protection in the European Union: How Strict is Strict?” in *The Habitats Directive in its EU Environmental Law Context: European Nature’s Best Hope?*, C.-H. Born, A. Cliquet, H. Schoukens, D. Misonne, G. Van Hoorick, Eds. (Routledge, 2014), pp. 120-146.
19. J. Verschuuren, “Connectivity: is Natura 2000 only an ecological network on paper?” in *The Habitats Directive in Its EU Environmental Law Context: European Nature’s Best Hope?*, C.-H. Born, A. Cliquet, H. Schoukens, D. Misonne, G. Van Hoorick, Eds. (Routledge, 2014), pp. 303-320.
20. N. Hoek, A Critical Analysis of the Proposed EU Regulation on Nature Restoration: Have the Problems Been Resolved? *European Energy and Environmental Law Review* **31(5)**, 320-333 (2022).
21. P. Cardoso, Habitats Directive species lists: urgent need of revision. *Insect Conservation and Diversity* **5(2)**, 169-174 (2012).
22. R. D. Kelemen, T. Pavone, Where Have the Guardians Gone? Law Enforcement and the Politics of Supranational Forbearance in the European Union. *World Politics* **75(4)**, 779-825 (2023).

23. Ecologic Institute UCL Centre for Law and the Environment, “The Implementation of the Natura 2000; Habitats Directive 92/43/ECC and Birds Directive 79/409/ECC (Preparation for an ex-post territorial impact assessment)” (European Union, Committee of the Regions, 2015).
24. G. Louette, D. Adriaens, D. Paelinckx, M. Hoffmann, Implementing the Habitats Directive: How science can support decision making. *Journal for Nature Conservation* **23**, 27-34 (2015).
25. European Commission (2016), “Fitness Check of the EU Nature Legislation (Birds and Habitats Directives) Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds and Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora” (SWD(2016) 472 final, Publications Office of the European Union, 2016).
26. V. Hermoso, M. Clavero, D. Villero, L. Brotons, EU's conservation efforts need more strategic investment to meet continental commitments. *Conservation Letters* **10(2)**, 231-237 (2016).
27. Alliance Environnement, “Evaluation of the impact of the CAP on habitats, landscapes, biodiversity: Final Report” (Publications Office of the European Union, 2019).
28. P. Delbosc, I. Lagrange, C. Rozo, F. Bensettiti, J.-B. Bouzillé, D. Evans, A. Lalanne, S. Rapinel, F. Bioret, Assessing the conservation status of coastal habitats under Article 17 of the EU Habitats Directive. *Biological Conservation* **254**, 108935 (2021).
29. R. W. Kruk, G. de Blust, R. C. van Apeldoorn, I. M. Bouwma, A. R. J. Sier, “Information and communication on the designation and management of Natura2000 sites. Main Report 2: Organizing the management in 27 EU Member States” (Alterra-rapport 2044, Alterra, 2010); <https://nora.nerc.ac.uk/id/eprint/10807/>.
30. A. Gamero, L. Brotons, A. Brunner, R. Foppen, L. Fornasari, R. D. Gregory, S. Herrando, D. Hořák, F. Jiguet, P. Kmecl, A. Lehtikoinen, Å. Lindström, J.-Y. Paquet, J. Reif, P. M. Sirkiä, J. Škorpilová, A. van Strien, T. Szép, T. Telenský, N. Teufelbauer, S. Trautmann, C. A.M. van Turnhout, Z. Vermouzek, T. Vikstrøm, P. Voříšek, Tracking Progress Toward EU Biodiversity Strategy Targets: EU Policy Effects in Preserving its Common Farmland Birds. *Conservation Letters* **10(4)**, 394-401 (2017).
31. European Parliament, Council of the European Union, “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” (Publications Office of the European Union, 2000).
32. D. Hering, A. Borja, J. Carstensen, L. Carvalho, M. Elliott, C. K. Feld, A.-S. Heiskanen, R. K. Johnson, J. Moe, D. Pont, A. Lyche Solheim, W. van de Bund, The European Water Framework Directive at the age of 10: A critical review of the achievements with recommendations for the future. *Science of the Total Environment* **408**, 4007-4019 (2010).
33. European Environment Agency, “Environmental indicator report 2018. In support to the monitoring of the Seventh Environment Action Programme” (EEA Report No 19/2018, Publication Office of the European Union, 2018); <https://www.eea.europa.eu/publications/environmental-indicator-report-2018>.

34. T. Giakoumis, N. Voulvoulis, (2018). The Transition of EU Water Policy Towards the Water Framework Directive's Integrated River Basin Management Paradigm. *Environmental Management* **62(5)**, 819-831 (2018).
35. European Commission, "Fitness Check of the Water Framework Directive and the Floods Directive" (SWD(2019) 439 final, Publications Office of the European Union, 2019).
36. European Commission, "Report from the Commission to the Council and the European Parliament on the implementation of the Water Framework Directive (2000/60/EC), the Environmental Quality Standards Directive (2008/105/EC amended by Directive 2013/39/EU) and the Floods Directive (2007/60/EC)" (COM(2021) 970 final, Publications Office of the European Union, 2021).
37. European Commission, "Assessment of Member States' progress in the Programmes of Measures during the second planning cycle of the Water Framework Directive. Member State: Spain" (Publications Office of the European Union, 2021).
38. S. Wuijts, H. Van Rijswick, P. P. J. Driessen, H. A. C. Runhaar, Moving forward to achieve the ambitions of the European Water Framework Directive: Lessons learned from the Netherlands. *Journal of Environmental Management* **333**, 117424 (2023).
39. A. Zingraff-Hamed, B. Schröter, S. Schaub, R. Lepenies, U. Stein, F. Hüesker, C. Meyer, C. Schleyer, S. Schmeier, M. T. Pusch, Perception of bottlenecks in the implementation of the European Water Framework Directive. *Water Alternatives* **13(3)**, 458-483 (2020).
40. European Parliament, Council of the European Union, "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 (Marine Strategy Framework Directive)" (Publications Office of the European Union, 2008).
41. Á. Borja, M. Elliott, J. Carstensen, A.-S. Heiskanen, W. van de Bund, Marine management - Towards an integrated implementation of the European Marine Strategy Framework and the Water Framework Directives. *Marine Pollution Bulletin* **60**, 2175-2186 (2010).
42. Á. Borja, J. M. Garmendia, I. Menchaca, A. Uriarte, Y. Sagarmínaga, Yes, We Can! Large-Scale Integrative Assessment of European Regional Seas, Using Open Access Databases. *Frontiers in Marine Science* **6**: 10.3389/fmars.2019.00019 (2019).
43. J. van Leeuwen, J. Raakjaer, L. van Hoof, J. van Tatenhove, R. Long, K. Ounanian, Implementing the Marine Strategy Framework Directive: A policy perspective on regulatory, institutional and stakeholder impediments to effective implementation. *Marine Policy* **50**, Part B: 325-330 (2014).
44. C. Bertram, T. Dworak, S. Görlitz, E. Interwies, K. Rehdanz, Cost-benefit analysis in the context of the EU Marine Strategy Framework Directive: The case of Germany. *Marine Policy* **43**, 307-312 (2014).

45. N. Zampoukas, A. Palialexis, A. Duffek, J. Graveland, G. Giorgi, C. Hagebro, G. Hanke, S. Korpinen, M. Tasker, V. Tornero, V. Abaza, P. Battaglia, M. Caparis, R. Dekeling, M. Frias Vega, M. Haarich, S. Katsanevakis, H. Klein, W. Krzyminski, M. Laamanen, J. C. Le Gac, J. M. Leppanen, C. Lips, T. Maes, E. Magaletti, S. Malcolm, J. M. Marques, O. Mihail, R. Moxon, C. O'Brien, P. Panagiotidis, M. Penna, C. Piroddi, W. N. Probst, S. Raicevich, B. Trabucco, L. Tunesi, S. van der Graaf, A. Weiss, S. A. Wernersson, W. Zevenboom, "Technical guidance on monitoring for the Marine Strategy Framework Directive (EUR 26499 EN, Publications Office of the European Union, 2014).
46. K. A. Alexander, P. Kershaw, P. Cooper, A. J. Gilbert, J. M. Hall-Spencer, J. J. Heymans, A. Kannen, H. J. Los, T. O'Higgins, C. O'Mahony, P. Tett, T. A. Troost, J. van Beusekom, Challenges of achieving Good Environmental Status in the Northeast Atlantic. *Ecology and Society* **20** , 49-59 (2015).
47. T. Berg, K. FÜRhaupter, H. Teixeira, L. Uusitalo, N. Zampoukas, The Marine Strategy Framework Directive and the ecosystem-based approach – pitfalls and solutions. *Marine Pollution Bulletin* **96**, 18-28 (2015).
48. G. J. Piet, R. H. Jongbloed, A. M. Knights, J. E. Tamis, A. J. Pajmans, M. T. van der Sluis, P. de Vries, L. A. Robinson, Evaluation of ecosystem-based marine management strategies based on risk assessment. *Biological Conservation* **186**: 158-166 (2015).
49. S. J. Boyes, M. Elliott, A. Murillas-Maza, N. Papadopoulou, M. C. Uyarra, Is existing legislation fit-for-purpose to achieve Good Environmental Status in European seas? *Marine Pollution Bulletin* **111**, 18-32 (2016).
50. J. Patrício, S. Little, K. Mazik, K.-N. Papadopoulou, C. Smith, H. Teixeira, H. Hoffmann, M. Uyarra, O. Solaun, A. Zenetos, G. Kaboglu, O. Kryvenko, T. Churilova, S. Moncheva, M. Bučas, A. Borja, N. Hoepffner, M. Elliott, European Marine Biodiversity Monitoring Networks: strengths, weaknesses, opportunities and threats. *Frontiers in Marine Science* **3**, 10.3389/fmars.2016.00161 (2016).
51. M. Cavallo, Á. Borja, M. Elliott, V. Quintino, J. Touza, Impediments to achieving integrated marine management across borders: The case of the EU Marine Strategy Framework Directive. *Marine Policy* **103**, 68-73 (2019).
52. H. Backer, "The HELCOM Ecosystem Approach: time for quantification, integration, and measures", thesis, University of Helsinki (2020).
53. European-Commission, "Report from the Commission to the European Parliament and the Council on the implementation of the Marine Strategy Framework Directive (Directive 2008/56/EC)" (COM(2020) 259 final, Publications Office of the European Union, 2020).
54. A. Palialexis, V. Tornero, E. Barbone, D. Gonzalez, G. Hanke, A. C. Cardoso, N. Hoepffner, S. Katsanevakis, F. Somma, N. Zampoukas, "In-Depth Assessment of the EU Member States' Submissions for the Marine Strategy Framework Directive under articles 8, 9 and 10" (EUR 26473 EN, Publications Office of the European Union, 2014).
55. A. Palialexis, V. Kousteni, F. Somma, „In-depth assessment of the Member States' reporting for the Marine Strategy's biodiversity monitoring" (EUR 29767 EN, Publications Office of the European Union, 2019).

56. A. Palialexis, V. Kousteni, L. Boicenco, L. Enserink, K. Pagou, U. L. Zweifel, F. Somma, A. Cheilari, D. Connor, Monitoring biodiversity for the EU Marine Strategy Framework Directive: Lessons learnt from evaluating the official reports. *Marine Policy* **128**, 104473 (2021).
57. J. Reker, C. Murray, E. Royo Gelabert, K. Abhold, S. Korpinen, M. Peterlin, D. Vaughan, J. H. Andersen, „Marine Messages II. Navigating the course towards clean, healthy and productive seas through implementation of an ecosystem-based approach” (EEA Report 17/2019, Publications Office of the European Union, 2019).
58. A. McQuatters-Gollop, L. Guérin, N. L. Arroyo, A. Aubert, L. F. Artigas, J. Bedford, E. Corcoran, V. Dierschke, S. A. M. Elliott, S. C. V. Geelhoed, A. Gilles, J. M. González-Irusta, J. Haelters, M. Johansen, F. Le Loc'h, C. P. Lynam, N. Niquil, B. Meakins, I. Mitchell, B. Padegimas, R. Pesch, I. Preciado, I. Rombouts, G. Safi, P. Schmitt, U. Schückel, A. Serrano, P. Stebbing, A. De la Torre, C. Vina-Herbon, Assessing the state of marine biodiversity in the Northeast Atlantic. *Ecological Indicators* **141**, 109148 (2022).
59. European Commission, “EU Biodiversity Strategy for 2030” (COM(2020) 380 final, Publications Office of the European Union, 2020).
60. Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services IPBES, “Scoping report for a thematic assessment of the underlying causes of biodiversity loss, and the determinants of transformative change and options for achieving the 2050 Vision for Biodiversity (transformative change assessment)” (Annex II to decision IPBES-8/1, IPBES Secretariat, 2021); https://www.ipbes.net/sites/default/files/2021-07/20210719_scoping_report_for_the_transformative_change_assessment_1.pdf.
61. M. Dieter, H. Weimar, S. Iost, H. Englert, R. Fischer, S. Günter, , ... & Zhunusova, E. (2020). Assessment of possible leakage effects of implementing EU COM proposals for the EU Biodiversity Strategy on forestry and forests in non-EU countries (No. 159). Thünen Working Paper. doi:10.3220/WP1604416717000 urn:nbn:de:gbv:253-202011-dn062850-7.
62. J. Cortina-Segarra, I. García-Sánchez, M. Grace, P. Andrés, S. Baker, C. Bullock, K. Decler, L. V. Dicks, J. L. Fisher, J. Frouz, A. Klimkowska, A. P. Kyriazopoulos, D. Moreno-Mateos, P. M. Rodríguez-González, S. Sarkki, J. L. Ventocilla, Barriers to ecological restoration in Europe: expert perspectives. *Restoration Ecology* **29(4)**, e13346 (2021).
63. A. Rinaldi, Biodiversity 2030: a road paved with good intentions: The new EU Commission's biodiversity Strategy risks to remain an empty husk without proper implementation. *EMBO reports* **22(6)**, e53130 (2021).
64. V. Hermoso, S. B. Carvalho, S. Giakoumi, D. Goldsborough, S. Katsanevakis, S. Leontiou, V. Markantonatou, B. Rumes, I. N. Vogiatzakis, K. L. Yates, The EU Biodiversity Strategy for 2030: Opportunities and challenges on the path towards biodiversity recovery. *Environmental Science & Policy* **127**, 263-271 (2022).
65. European Commission, “EU Forest Strategy for 2030” (COM(2021) 572 final, Publications Office of the European Union, 2021).

66. M. Lier, M. Köhl, K. T. Korhonen, S. Linser, K. Prins, A. Talarczyk, The New EU Forest Strategy for 2030: A New Understanding of Sustainable Forest Management? *Forests* **13**, 245-265 (2022).
67. N. Lovrić, C. Fraccaroli, M. Bozzano, A future EU overall strategy for agriculture and forest genetic resources management: Finding consensus through policymakers' participation, *Futures* **151/ 2023**, 103179 (2023).
68. "Regulation (EU) No 1380/2013 of the European Parliament and of the Council of 11 December 2013 on the Common Fisheries Policy" (Official Journal L354, Publications Office of the European Union, 2013).
69. S. Niiranen, J. Yletyinen, M. T. Tomczak, T. Blenckner, O. Hjerne, B. R. MacKenzie, B. Müller-Karulis, T. Neumann, H. E. M. Meier, Combined effects of global climate change and regional ecosystem drivers on an exploited marine food web. *Global Change Biology* **19**, 3327-3342 (2013).
70. S. Raicevich, P. Battaglia, T. Fortibuoni, T. Romeo, O. Giovanardi, F. Andaloro, Critical Inconsistencies in Early Implementations of the Marine Strategy Framework Directive and Common Fisheries Policy Objectives Hamper Policy Synergies in Fostering the Sustainable Exploitation of Mediterranean Fisheries Resources. *Frontiers in Marine Science* **4**, 10.3389/fmars.2017.00316 (2017).
71. R. Froese, H. Winker, G. Coro, N. Demirel, A. C. Tsikliras, D. Dimarchopoulou, G. Scarcella, M. Quaas, N. Matz-Lück, Status and rebuilding of European fisheries. *Marine Policy* **93**, 159-170 (2018).
72. M. Aranda, C. Ulrich, B. Le Gallic, L. Borges, S. Metz, R. Pallezo, M. Santurtún, "Research for PECH Committee - EU Fisheries Policy - latest developments and future challenges" (PE 629.202, Policy Department for Structural and Cohesion Policies, 2019).
73. S. Bossier, J. R. Nielsen, E. Almroth-Rosell, A. Höglund, F. Bastardie, S. Neuenfeldt, I. Wählström, A. Christensen, Integrated ecosystem impacts of climate change and eutrophication on main Baltic fishery resources. *Ecological Modelling* **453**, 109609 (2021).
74. European Environment Agency [EEA], "Status of marine fish and shellfish stocks in European seas. [Indicator Specification]" (CSI 032, European Environment Agency, 2021); <https://www.eea.europa.eu/data-and-maps/indicators/status-of-marine-fish-stocks-5>.
75. "Consolidated version of the Treaty on the Functioning of the European Union Part Three - Union Policies And Internal Actions Title III - Agriculture And Fisheries Article 39 (ex Article 33 TEC)" (Official Journal C202 p. 62-63, Publications Office of the European Union, 2007).
76. G. Pe'er, L. V. Dicks, P. Visconti, R. Arlettaz, A. Baldi, T. G. Benton, S. Collins, M. Dieterich, R. D. Gregory, F. Hartig, K. Henle, P. R. Hobson, D. Kleijn, R. K. Neumann, T. Robijns, J. Schmidt, A. Schwartz, W. J. Sutherland, A. Turbe, F. Wulf, A. V. Scott, EU agricultural reform fails on biodiversity. *Science* **344**, 1090-1092 (2014).

77. G. Pe'er, A. Bonn, H. Bruelheide, P. Dieker, N. Eisenhauer, P. H. Feindt., G. Hagedorn, B. Hansjürgens, I. Herzon, Â. Lomba, E. Marquard, F. Moreira, H. Nitsch, R. Oppermann, A. Perino, N. Röder, C. Schleyer, S. Schindler, C. Wolf, Y. Zinngrebe, S. Lakner, Action needed for the EU Common Agricultural Policy to address sustainability challenges. *People and Nature* **2(2)**, 305-316 (2020).
78. G. Pe'er, J. A. Finn, M. Díaz, M. Birkenstock, S. Lakner, N. Röder, Y. Kazakova, T. Šumrada, P. Bezák, E. D. Concepción, J. Dänhardt, M. B. Morales, I. Rac, J. Špulerová, S. Schindler, M. Stavrinides, S. Targetti, D. Viaggi, I. N. Vogiatzakis, H. Guyomard, How can the European Common Agricultural Policy help halt biodiversity loss? Recommendations by over 300 experts. *Conservation Letters* **15(6)**, e12901 (2022).
79. T. Kuhmonen, (2018). Systems view of future of wicked problems to be addressed by the Common Agricultural Policy. *Land Use Policy* **77**, 683-695 (2018).
80. A. Navarro, J. V. López-Bao, EU agricultural policy still not green. *Nature Sustainability* **2(11)**, 990-990 (2019).
81. F. Recanati, C. Maughan, M. Pedrotti, K. Dembska, M. Antonelli, Assessing the role of CAP for more sustainable and healthier food systems in Europe: A literature review. *Science of the Total Environment* **653**, 908-919 (2019).
82. European Court of Auditors ECA, “Special Report 13: Biodiversity on farmland: CAP contribution has not halted the decline” (QJ-AB-20-012-EN-N, European Court of Auditors, 2020)
83. K. Heyl, T. Döring, B. Garske, J. Stubenrauch, F. Ekardt, The Common Agricultural Policy beyond 2020: A critical review in light of global environmental goals. *Review of European, Comparative & International Environmental Law* **30(1)**, 95-106 (2020)
84. European Commission, “Financing Natura 2000 in 2014-2020 – Guidance Handbook” (ENV.B.3/SER/2012/002, Publications Office of the European Union, 2013).
85. S. del Saz-Salazar, F. Hernández-Sancho, R. Sala-Garrido, The social benefits of restoring water quality in the context of the Water Framework Directive: A comparison of willingness to pay and willingness to accept. *Science of The Total Environment* **407(16)**, 4574-4583 (2009).
86. European Environment Agency [EEA]. “European waters – Assessment of status and pressures 2018” (*EEA Report No 7/2018*. European Environment Agency, 2018).
87. J. U. Lemm, M. Venohr, L. Globevnik, K. Stefanidis, Y. Panagopoulos, J. van Gils, L. Posthuma, P. Kristensen, C. K. Feld, J. Mahnkopf, D. Hering, S. Birk, Multiple stressors determine river ecological status at the European scale: Towards an integrated understanding of river status deterioration. *Global Change Biology* **27(9)**, 1962-1975 (2021).
88. United Nations [UN], “General Assembly resolution, Transforming our world: the 2030 Agenda for Sustainable Development” (A/RES/70/1, United Nations, 2015); <https://www.refworld.org/docid/57b6e3e44.html>.
89. United Nations Environment Programme (1992). “Convention on biological diversity” (Secretariat of the Convention on Biological Diversity, 1992).

90. J. M. da Rocha, S. Cerviño, S. Villasante, The common fisheries policy: an enforcement problem. *Marine Policy* **36**, 1309-1314 (2012).
91. G. Pe'er, Y. Zinngrebe, F. Moreira, C. Sirami, S. Schindler, R. Müller, V. Bontzorlos, D. Clough, P. Bezák, A. Bonn, B. Hansjürgens, A. Lomba, S. Möckel, G. Passoni, C. Schleyer, J. Schmidt, S. Lakner, A greener path for the EU Common Agricultural Policy. *Science* **365(6452)**, 449-451 (2019).
92. W. Grant, *The common agricultural policy* (Bloomsbury Publishing, 1997).
93. Eurostat, "Farms and farmland in the European Union – statistics" (ISSN 2443-8219, Eurostat, 2022); https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Farms_and_farmland_in_the_European_Union_-_statistics#Farms_in_2020.
94. G. Hudson, G., S. Hart, A. Verbeek, Investing in nature-based solutions. State-of-play and way forward for public and private financial measures in Europe. (pdf: QH-04-23-551-EN-N). Retrieved from https://www.eib.org/attachments/lucalli/20230095_investing_in_nature_based_solutions_en.pdf (2023).