This synopsis is the product of a workshop held by regional stakeholders on the conflict between cormorants and protected river fish in the context of nature conservation. The workshop took place on 6 May 2025 in Koblenz following the 'Conference on Dialogue: Predation as a Problem for Protected Fish and Bird Species?'. The synopsis summarises the opinions and comments expressed by the participants during the workshop. It does not represent any official decisions or recommendations by the institutions involved. The German version of this synopsis was compiled in four feedback loops with the participation of all co-authors and was subsequently translated into English. The synopsis serves solely to document and summarize the discussions held as part of the EU project 'ProtectFish' and does not claim to be comprehensive or to provide a final assessment of scientific or legal aspects.

Synopsis of the Regional Stakeholder Workshop on Potential Cormorant Management

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On 6 May 2025, a regional stakeholder workshop was held in Koblenz following the "Conference on Dialogue: Predation as a Problem for Protected Fish and Bird Species?". Both events were held as part of the EU project "ProtectFish", which investigates the protection of threatened European river fish from excessive cormorant predation. The workshop aimed to provide a foundation for professional and science-based discussions on predation and its impacts on protected river fish species. In particular, the discussion focused on whether - and under what conditions - conservation-oriented cormorant management might be necessary. Participants included representatives from science, nature conservation authorities, nature conservation associations, and practical conservationists, all with backgrounds in birds, fish, or environmental protection. They primarily addressed the following points:

- Shared understanding of the problem
- Current state of knowledge and identification of knowledge gaps
- Need for action
- Development of potential measures
- Further steps

This synopsis attempts to concisely present the main content and viewpoints of the workshop and to outline potential consensus-based management options.

There is a **broadly shared understanding regarding the aims of species conservation**. The high importance of nature conservation, with the objective of preserving and promoting aquatic and terrestrial biodiversity, was acknowledged by all participants. The objectives and obligations set forth by European directives, such as the Habitats and Birds Directives, the Water Framework Directive, and the Convention on Biological Diversity (CBD), not only represent a consensus, but also provide a common basis for conservation efforts as well as a legal obligation. It was also agreed that predation is a natural phenomenon. Nevertheless, in certain rivers or river sections, conflicts arise between conservation efforts for threatened wild fish populations and the risks these populations face from the legally protected cormorant. There was consensus that, in some cases, active management of both fish and cormorant populations may be necessary to achieve

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conservation objectives. Participants acknowledged that these discussions are inherently anthropocentric. Throughout this text the term “cormorant control” refers to all legal measures which locally reduce predation pressure and thereby restricting the cormorant’s habitat. In practice, cormorant control is at present largely restricted to lethal measures.

It was also noted that, in addition to their direct contribution to biodiversity, fish play a major ecological role in river ecosystems and can thereby indirectly protect and support other species. Thus, measures addressing cormorant predation may be required to achieve conservation targets and fulfil relevant legal obligations. However, cormorant management measures require evaluation in terms of their necessity and effectiveness. Effectiveness of management interventions is evaluated in terms of their contribution to the stabilisation or recovery of fish populations and the preservation of associated ecosystem services, rather than by the number of cormorants culled or local changes in their abundance. Measures are intended to ensure that the cormorant population maintains a favourable conservation status. Any predation management requires careful planning and close monitoring, which should address both the sustainable maintenance of cormorant populations (e.g., counts) and fish populations (e.g., electrofishing surveys). For these purposes, there is need for a more intensive monitoring in streams, in addition to the existing cormorant monitoring (in Rhineland-Palatinate since 1994, Ministerium für Klimaschutz, Umwelt, Energie und Mobilität Rheinland-Pfalz & GNOR 2023) and Water Framework Directive (WFD) fishing surveys (since 2006).

Significant **knowledge gaps** remain regarding the role of cormorants in the observed large-scale decline of fish populations, as well as the effectiveness and feasibility of additional measures to manage cormorant predation. In principle, it is difficult to provide scientific evidence that cormorant predation is one of the main causes - or even the decisive cause - of decline in fish densities. Temporal correlations between increased cormorant presence and declines in fish populations may suggest a link, but they do not provide evidence of causality. Other environmental stressors are frequently cited as potential causes of the decline, including climate change, morphological degradation, habitat fragmentation, chemical inputs from agriculture and wastewater treatment, as well as recreational fishing and catfish predation. However, studies using PIT-tags (Passive Integrated Transponders) and radio-telemetry have demonstrated that cormorant predation can be so intense that it may lead to a local collapse of affected fish populations (Gromann & Pinter 2022; Ovegard et al. 2020; Jepsen et al. 2018; Freyhof et al. 2023). From a scientific perspective, cormorant predation can therefore be regarded as a significant factor contributing to the decline of fish populations, including protected species such as Atlantic salmon and European grayling. However, this general finding does not imply that cormorant predation necessarily drives population declines wherever cormorants and protected river fish species co-occur. The discussion highlighted that, on the one hand, decisions need to be made on a case-by-case basis, but on the other hand, limited resources prevent detailed causal analyses for every instance. Therefore, a sufficiently plausible linkage may serve as an adequate basis for management action.

It remains generally unclear which **potential measures** would effectively alleviate pressure on threatened fish populations and which of these measures are technically feasible. This represents both the largest knowledge gap and a significant research need. During the workshop, three fundamentally different approaches were discussed:

I) a large-scale, pan-European reduction of cormorant population density;

II) a local, targeted, and consistent (lethal) cormorant control; and

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III) the restoration of natural river structures, potentially effective enough to ensure that sufficient fish survive even under intense cormorant predation, thus maintaining the population.

Regarding **large-scale reduction (I)**, both the feasibility and effectiveness were primarily questioned. Historical experience with reducing gull populations along the coast has shown that an enormous effort is required to achieve a measurable reduction in population density (Herrmann 2009). In contrast, the management of the Svalbard Pink-footed Goose *(Anser brachyrhynchus)* has been highlighted as a good-practice example of adaptive harvest management; this experience shows that population control was achieved within a few years under coordinated international efforts (Madsen et al. 2024), which highlights that there is still uncertainty about how easily the cormorant population could be managed.[1] A population model of the cormorant demonstrates the high resilience of the population to regulatory interventions (Gröger et al. 2019). A substantial reduction in population densities would require significant interventions in the breeding population (removal of breeding birds; reducing breeding success alone is far less effective). In the case of breeding bird removal, it is expected that part of the population will be replaced by non-breeders (population reserve) or immigrants from [1]other areas. The proportion of breeding birds that can be replaced is unknown. Based on this, Gröger et al. (2019) modelled various scenarios, consistently showing that very intensive, continuous interventions would be necessary to achieve long-term population regulation. The current population size must also be considered: the breeding population in the Baltic region (the main overwintering area for cormorants in Central Europe) exceeds 200,000 breeding pairs (Herrmann et al. 2021). The effectiveness of population reduction measures was also controversially discussed: On the one hand, the effectiveness of reducing cormorant predation pressure on relieving fish populations was questioned, since any decline in cormorant numbers at the pan-European scale would not be evenly distributed across feeding habitats. Prime foraging sites would likely remain under pressure, while suboptimal habitats - typically smaller rivers - would be abandoned first. On the other hand, it was argued that even a slight reduction in predation could enable some adult fish to survive, and, given their high reproductive potential, these survivors could secure the persistence of local fish populations.

Regarding **local, targeted, and consistent cormorant management (II),** there was consensus that the goal of such measures is to reduce local predation pressure at specific rivers serving as habitats for particularly threatened fish species. The success of these management measures would be reflected in the stabilization or recovery of local fish populations, especially those of threatened species. Implementing this approach requires a clear spatial concept with designated threatened fish protection areas. A near-wide-scale cormorant control would be ineffective because the method aims to manage cormorant feeding habitats. It was also noted that, in the case of cormorant control, the intensity must be very high to achieve a consistent and substantial reduction of cormorant roosting populations and thereby providing a significant relief to local fish populations. These experiences are drawn particularly from predator control in bird protection. The Baltic region was identified as the core breeding area of the cormorant population. Intensive culling in central to southern German states such as Rhineland-Palatinate, Hesse, or North Rhine-Westphalia would have no impact at the population level given the current size of the Baltic breeding population. A minor reduction of predation pressure by cormorants was considered generally ineffective, especially considering the potential of disturbance to other legally protected species. A major deficit identified was the frequent lack

[1] *Note: This addition was inserted after the authors' approval to provide an example of successful adaptive management strategies.*

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of adequate monitoring, so that sufficient data on the effects of intense cormorant control measures in Rhineland-Palatinate are not yet available. In summary, cormorant control is considered particularly effective when it is spatially restricted, but very intensive and targeted. Accompanying monitoring is recommended.

Regarding **natural river structures or improvements (III),** the discussion focused on whether a natural river structure could provide adequate protection from cormorants. However, there is currently no evidence that natural hydromorphological features, or the presence of cover and deep-water areas, effectively protect fish from cormorant predation. Moreover, Baer & Konrad (2010) demonstrated in their project that even substantial input of deadwood had no positive effect on brown trout populations. Winter mortality remained high after the increase of river structure by the introduction of deadwood. The commonly cited principle: "If the river structure is diverse with shelter, there is no problem with cormorant predation", was not supported in this study. Regardless, it was noted that rivers in Rhineland-Palatinate lack natural structures, and previous restoration efforts have not succeeded in fully re-establishing near-natural river conditions. There was consensus that, depending on the river, achieving a natural river structure with 10-25 % deadwood (Dahm et al., 2013) is far from the reality of current management and therefore not feasible in the short term. It became clear that awareness of the composition of truly natural rivers must be raised. All stakeholders agreed that structure-improving measures specifically designed for fish protection, which also benefit other protected species, should be investigated as potential protective measures. It was also noted that, if these structures provide sufficient protection for spawning fish, as in approach (I), only the survival of individual adult fish may be ensured, which would support the survival of the local population. In any case, securing habitat quality - including water quality and structural integrity - is fundamental for the protection of threatened fish species and for maintaining or restoring healthy population levels. If habitats are degraded, additional measures, such as predation management, are unlikely to be effective.

Important **needs for action** including improving communication channels among different stakeholders, closing significant knowledge gaps, planning effective local, targeted, and consistent (lethal) cormorant control, and investigating non-lethal protection measures were highlighted. Representatives from nature conservation associations emphasized that habitat restoration should be prioritized. Furthermore, interdisciplinary, holistic approaches should also be considered, as rivers are open systems subject to multiple stressors. A counterpoint was raised that previous efforts to improve river structure (restoring connectivity, increasing habitat diversity) have not led to improvements in threatened fish populations. Thus, habitat restoration is undoubtedly necessary, but may not be sufficient.

Currently, there is no **effective channel for exchanging knowledge and practical experience** among bird and nature conservation associations, fish protection practitioners, environmental authorities, and scientists. Improving or developing these channels was defined as an urgent need, potentially to be addressed first at the regional level. The workshop could mark the beginning of more intensive communication, but documenting knowledge and experience in appropriate journals was also considered an important option. The initially perceived lack of evidence for predation effects on wild fish populations may be due to insufficient communication between scientists and conservation associations. This gap should be addressed through appropriate publications in conservation journals.

Furthermore, **relevant knowledge gaps** exist that should be closed to enable effective and appropriate cormorant predation management. These include the effectiveness and feasibility

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of targeted management measures, as well as the improvement of population models for cormorants (particularly estimating population reserves) and threatened river fish species.

Non-lethal or structure-enhancing measures for fish protection should also be developed, tested, and evaluated (e.g., nets, fish protection cages, natural shelters). The development and assessment of additional protective measures for protected and threatened river fish was discussed. One possible measure is the short-term netting or covering of winter habitats with strings or ropes. However, netting is only feasible outside EU bird protection areas, as nets pose a significant injury risk to flying birds, including species protected in these areas (e.g., kingfisher, black stork). Covering winter habitats with strings or ropes - even relatively dense - is considered a much lower risk to birds and is therefore regarded as feasible. Another option could be the permanent installation of fish protection cages, allowing fish to escape from diving cormorants. However, issues of flood protection of such installations must be addressed. It should also be evaluated whether such passive protection measures alone provide sufficient protection or must be combined with (lethal) cormorant control. A joint project involving fisheries and conservation authorities, conservation organizations, and scientists is needed to test and evaluate different protection measures. To this end, an appropriate consortium must be formed and the necessary funding obtained or provided to implement the project.

There was consensus that, given the current state of our rivers, the conservation or even improvement of populations of threatened river fish species and fish species providing important ecosystem services (e.g., common nase) will not be possible without some form of cormorant predation management. Therefore, **possible application and implementation of management measures were discussed** in detail:

- Large-scale reduction of population density

  For large-scale population reduction, reducing reproductive rates by oiling eggs was discussed as a possible measure. To achieve a widespread population effect, a very large proportion of eggs would need to be oiled. The advantage of this measure lies in its relatively wide-ranging effect and in the fact that it controls the population at the egg stage, which reduces the necessity for lethal control of adult cormorants. The rationale behind this measure is that overall predation pressure would be reduced, as the cormorant population would then be limited by artificially decreased reproductive rates rather than by food availability. However, Gröger et al. (2019) show in their modelling calculations that the effectiveness of reproductive inhibition as a measure to control population size is limited. The intervention would need to cover a very large proportion of the total population's clutches (well over 50 %), which is unrealistic given the size of the Baltic and North Sea populations, especially as a large proportion of cormorants breed in nests which are difficult to access in tree colonies and sometimes in protected areas. Lethal removal of breeding birds would be significantly more effective, but could involve the culling of tens of thousands of individuals per year, depending on population compensation (activation of non-breeders or immigration). Such interventions in breeding colonies, often located in protected areas where cormorants breed alongside other species, are unlikely to be legally permissible or gain public approval.

  Since smaller rivers are generally not preferred feeding habitats for cormorants, a disproportionate reduction in predation pressure in these areas can be assumed. This reduction should be sufficient to exceed a relatively low threshold in fish population density (survival of a few adult fish). Given the relatively high reproductive rate of many fish species, this could be sufficient for the survival of the population.

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- Local limited, targeted, and consistent cormorant control
  Lethal cormorant control measures are not intended to reduce the overall cormorant population and are not capable of doing so. The goal of such measures is to prevent birds from entering or remaining in designated fish protection areas through targeted control, which may include lethal methods. Cormorant control is particularly effective when birds can relocate to rivers or river sections where no control is applied. Thereby, foraging pressure is shifted to areas where fish populations are considered less vulnerable or of lower conservation value. For Rhineland-Palatinate, a concept was recently developed as a specification of the recent cormorant regulation "Landesverordnung zur kontrollierten Entwicklung der Kormoranbestände (2009)" by the Ministry for Climate Protection, Environment, Energy, and Mobility of Rhineland-Palatinate (MKUEM) and has been used since 2024 in assessing permissions for lethal cormorant control. River sections designated as fish protection areas include particularly rivers in the grayling and barbel regions. Areas without cormorant control are mainly along major rivers such as the Rhine, Moselle, and Saar, as well as in shallow lakes and reservoirs, often within protected nature or protected bird areas.

  The advantage of locally limited, consistent cormorant control is the possibility of local planning, implementation, and monitoring, as well as compliance with current European and national legislation. Control of cormorants in designated areas for fish protection is permitted in Rhineland-Palatinate from August 15 to February 15 (KormoranV RP §2). A problem arises in North Rhine-Westphalia, where lethal cormorant control in winter in Natura 2000 sites is not permitted, excluding many streams that serve as habitats for protected or threatened fish species.

  Shooting during the breeding season may also be permitted as an exceptional measure under the Federal Nature Conservation Act in Germany (§45 BNatschG). For animal welfare reasons, it must be ensured that no parent birds are killed, which would otherwise cause nest failure. This requires maintaining an appropriate distance between control (shooting) sites and breeding colonies. Until reliable data on daily activity ranges during chick rearing in low mountainous areas is available, no general distance can be specified and decisions must be made on a case-by-case basis. Drawbacks of locally limited lethal cormorant control are the high effort required for continuous implementation, as well as the potential disturbance to other wildlife due to intensive culling.

- Establishing passive protective structures
  This hitherto insufficiently researched method assumes that passive protective structures in rivers can sufficiently reduce cormorant hunting success to allow enough adult fish to survive, thereby preventing critical population density thresholds of the respective fish species from being breached. The advantage of such passive measures is that they avoid the need for culling cormorants, which significantly reduces management effort and is generally viewed positively from an ethical standpoint.

  However, experience with various protective structures indicates that cormorants quickly habituate and do not permanently avoid these areas or show reduced hunting success (Russell et al., 2012). If cormorants rapidly adapt to the structures, combining passive protection with lethal control may be necessary. In such cases, however, a substantially lower intensity of culling may be sufficient to additionally protect areas with high structural diversity or existing passive measures. The main disadvantages of this approach are its currently uncertain effectiveness and, for measures such as nets or fish protection

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cages, potentially high installation costs, the effort required to cover sensitive habitats, and significant maintenance costs, particularly during and after flooding events.

During the workshop, no consensus was reached regarding which of the three measures is legally and ethically permissible, technically feasible, and sustainably effective. Consequently, no clear recommendation could be made concerning the prioritization of any specific measure. The closest agreement among participants was that cormorant management, including lethal control, may be fundamentally necessary but should be implemented following a three-step evaluation process: measure planning, monitoring impact on cormorants, and monitoring impact on fish. Participants did not reach a consensus on the future role of passive protective structures compared with predation control through the reduction of the European cormorant population or localized cormorant management.

As a **next step**, it was agreed to intensify dialogue between the represented stakeholder groups to enable constructive, fact-based discussions. The first step in this process is the preparation and publication of this synopsis. The ProtectFish project will assess the significance of cormorant predation for European grayling, as well as the effectiveness and effort associated with cormorant control measures, and will publish the results on the project website and in relevant conservation journals. Additionally, efforts will be intensified to close the knowledge gaps identified above. Representatives from the Upper Fisheries Authority of Rhineland-Palatinate (SGD Nord), the Upper Nature Conservation Authority of Rhineland-Palatinate (SGD Nord), the Nature Conservation Association BUND (BUND, Rhineland-Palatinate branch), the Society for Nature Conservation and Ornithology Rhineland-Palatinate (GNOR), and scientists plan to prepare a project proposal to enable the installation and assessment of fish protection cages.

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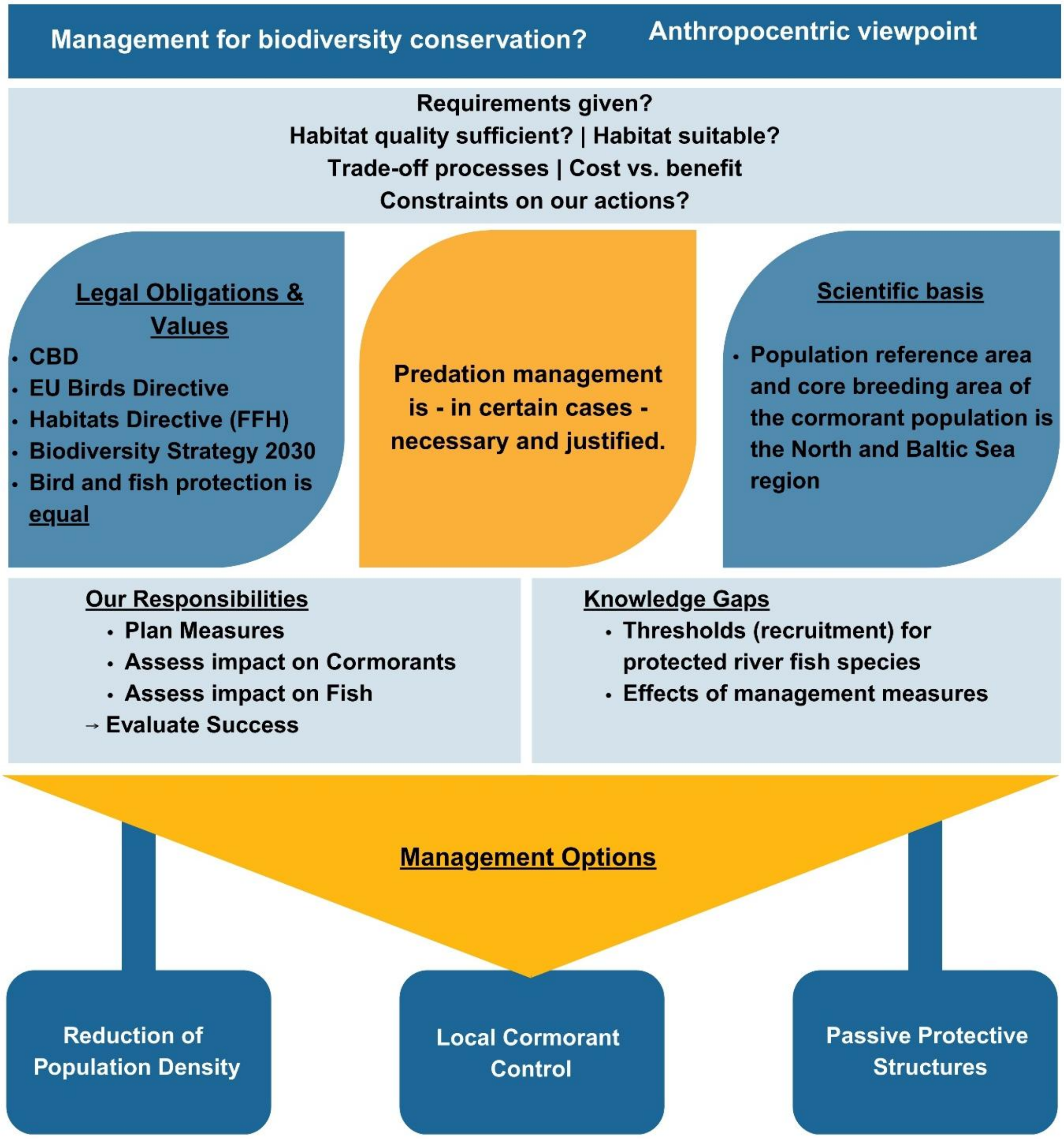

Figure 1: Key aspects and main questions of the discussion.

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