



ECOLOGY OF CORMORANTS IN A CHANGING WORLD

ABSTRACTS SUBMITTED FOR THE CONFERENCE:

PRAGUE (Czechia), 3-6 FEBRUARY 2026
Czech University of Life Sciences

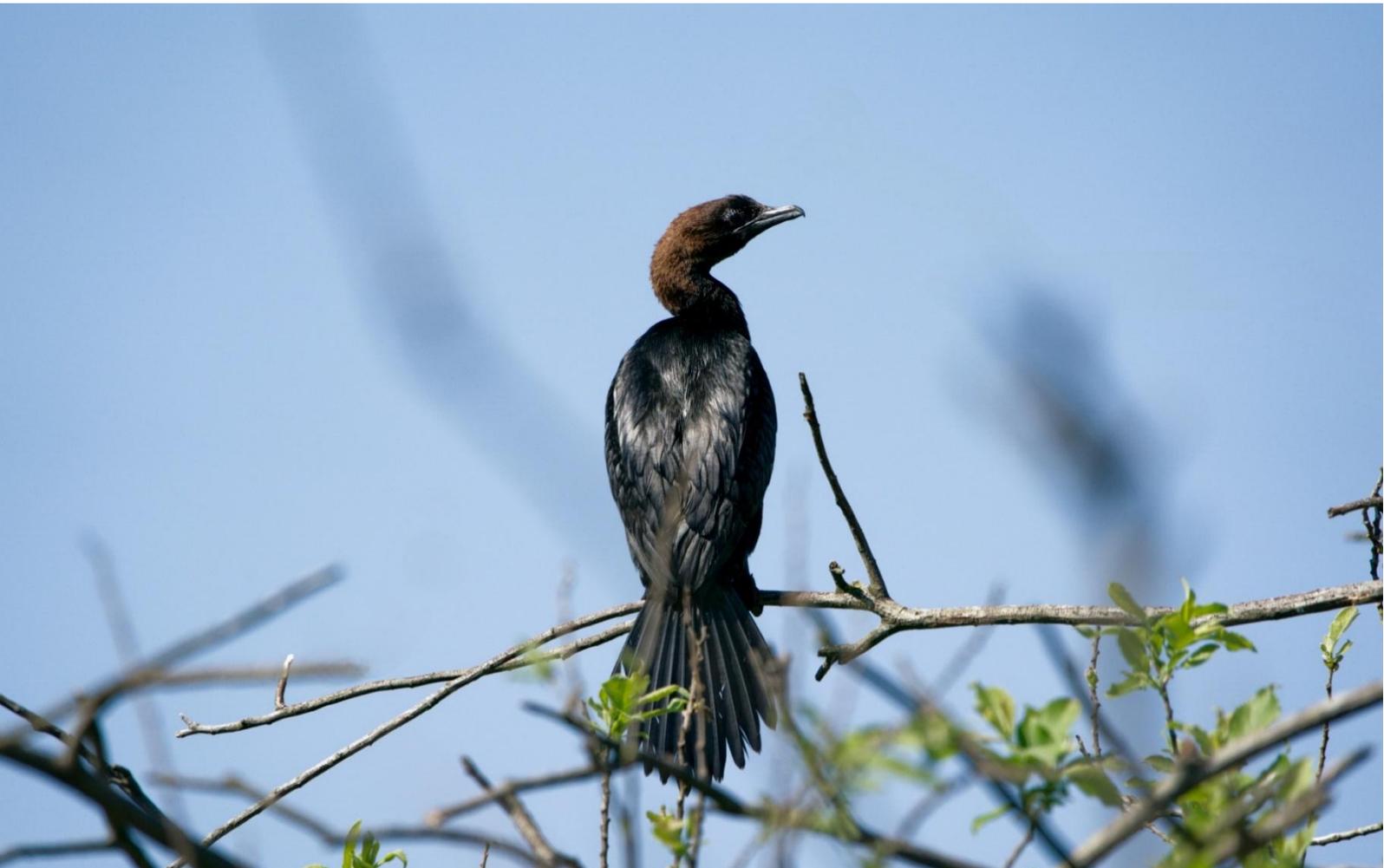


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Talks

Tuesday 3 February

Evening talk

1. Cormorant: A Cultural History of Greed and Prejudice

Gordon McMullan^{1*}

For centuries, the cormorant has been hated and persecuted – shot, poisoned, its nests destroyed, its eggs oiled. It has been treated as an invader, a foreigner, an intruder into someone's Eden. Persecution led to the bird's extinction in parts of Europe in the late nineteenth and early twentieth centuries; its successful return in the last half century has been treated by some involved in the fishing industry as evidence that the birds should be exterminated all over again. Cormorant-fisheries conflicts underline the extent to which socio-cultural and scientific understandings of natural phenomena can radically diverge; they also show how prejudice against animals/birds and against human beings intersect, with implications both for humans and for animals.

Cormorant is the cultural history of a supposedly 'greedy' bird that is the object of ongoing global conflict between fishing interests on the one hand and scientists and environmentalists on the other. The book argues that the long-term history of human interactions with, and attitudes to, a given animal or bird is crucial to understanding human-animal conflicts in the contemporary world. Cormorants have in fact been the object of loathing for centuries, a loathing that has mutated across time in response to changes in human culture and society. An indigenous bird across most of the world, the cormorant is nonetheless treated – in contrast with its cousin, the

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mythically nurturing, Christ-like pelican – as an unwelcome foreign intruder perceived as evil and greedy. Centuries ago, the bird was associated antisemitically with Jews; now it is more likely to be a vehicle for prejudice against Black, Muslim or Asian people. The loathing the cormorant inspires now cannot be detached from the bird's long history in Western culture – nor can that loathing be detached from the loathing certain people have for other kinds of people. If you hate cormorants, it seems, you probably hate (certain kinds of) people. If we are to understand the place in the world of the zoological cormorant, the book argues, we need also to understand the cultural cormorant and how it has come into being over time.



Wednesday 4 February

Session 1 - Keynote

2. Cormorants in a changing world: don't kill the messengers within the realm of aquatic top-predators indicating the state of coastal and inland water systems

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40 Species of cormorants and shags worldwide are found on all continents, occupying diverse waters ranging from near arctic to tropical conditions. Both freshwater and marine habitat is used to depths up to 100m or more. By exploring ecological conditions of and adaptations by several of these species worldwide, the enormous flexibility to changing environmental conditions is shown. Two species are repeatedly accused for being a nuisance to fisheries' interests, both commercial and sports fisheries: double-crested cormorant *Nannopterum auritum* and great cormorant *Phalacrocorax carbo*. Both species have their base in close connection with completely altered and man-affected water systems.

In The Netherlands cases exist where great cormorants and fishes (and fisheries) still live hand in hand. Without having interfered in neither breeding nor wintering population at all during the last 60 years (in 1965 the species was completely protected), the breeding population is gradually going down, starting more than a decade ago at the large open waters. After a partial inland shift into smaller water bodies (which experienced an increasingly better water quality) the population along the coast and large lakes now seems to adapt to the generally lower fish stocks by a strong decline in number of breeding pairs. This is the likely result of the effect of ever lower levels of nutrients entering the system providing less food and leading to lower fish stocks. This is considered a strong sign of bottom-up regulation therefore, instead of the supposed top-down regulation by avian predators as often determines the discussion. Our historically huge IJsselmeer colonies have vanished completely or are back to numbers of the early 1970s, without any interaction with humans since long (no disturbance, no culling of eggs and/or young, no shooting). Instead, declining fish stocks combined with increased visibility under water, which hampers social foraging, give less room for thriving colonies nowadays. Also, the arrival of natural predators added to these effects, as well as competition with migrating cormorants from abroad that have their harvest of 0+ fish and small species earlier in the winter season than before.

Pikeperch and Perch fisheries still have a good future in the lake and as biodiversity has increased, the fish population is composed of many more species than in 1970, when trawling was banned and paralleled the start of the increase in cormorant numbers. By long term monitoring of the diet of cormorants in the lake (more than 40 years) their indicator role is demonstrated, also showing the arrival of invasive species. The Dutch angling community thrives in the country along with enormous efforts to restore former connections between water systems by construction of fish ladders and improving under water habitat at landscape level.

Could this sequence of events be eventually the future for the situation elsewhere in Europe? The water quality of the eastern part of the breeding area, when the Gulf of Bothnia and greater Baltic will go back to lower nutrient levels again (which was pivotal the other way round in recent history), the prediction is that cormorants will decline in number and adapt their breeding number

to the available resources. And only after the breeding populations in the East have gone down again, we will also experience a lower number of migratory birds in late summer and autumn elsewhere along the flyway (central and southern Europe). This also holds for any perceived damage on fish farms during migration and winter, but exploitation by cormorants of these hotspots will only stop as cormorant numbers would return to extremely low numbers. As shown by pan-European counts, the distribution of cormorants in summer and winter is following strict patterns, being far more dispersed in winter than in summer. Only after the large open waters and coastal areas elsewhere in Europe have been freed from their nutrient overload, we may expect the total population to decline. But as the EU Water Framework Directive calls for this nutrient emission reduction this will be the trend for sure! In the meantime, we could be very busy in trying to “resolve the problem” in another way, by suppressive managing of the natural world or looking for political goat paths and scarecrows. But the real problem, believe it or not, are ourselves, as long as we are not able to restrict our (far too high) expectations in terms of harvest of the natural environment. And killing the messenger is not helping at all to restore the water quality, not to say that it is barely feasible (and extremely costly with a lot of side effects) to reduce cormorant numbers at a continental level!

It is therefore necessary to monitor the distribution of cormorants in both winter and summer again to see what trends are visible on a continental scale already. Also, more systematic data are needed to conclude on reproductive rate and estimates of natural and additive mortality. And, finally, a recommended closer look at other water systems, with other species of cormorants in order to get a better understanding of their capacity to use, but never over-exploit natural fish resources.



Session 1

3. Introduction to the ProtectFish project

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Many EU freshwater ecosystems are heavily stressed by multiple pressures – physical barriers, chemical and organic pollution. A recent documented increasing predation pressure is strongly affecting the survival chances of many EU river fish species. ProtectFish focuses its activities on the cormorant-grayling conflict, by assessing the impact of cormorant predation on the status of EU-protected river fish species.

The project's main objectives are to:

1. Evaluate the current conservation status, monitoring, reporting and protective measures of EU-listed river-fish species.
2. Update and expand the scientific knowledge of cormorant populations in the EU and assess effective, balanced, and feasible methods for their management.
3. Using historic and new data on the status of fish and cormorant populations and their interactions, generate knowledge-based recommendations for balanced, integrative and adaptive management of river biodiversity.

The project has only been running 18 months, so there are no important results to present, thus the talk will try to point out the main benefits of the results and the obstacles to achieving these and how there may be a way out of the present conflicts.

4. Wintering Cormorants in Czechia: Changes in numbers, distribution and habitat selection

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The Great Cormorant *Phalacrocorax carbo* has been a regular wintering species in Czechia since 1985. The number of wintering Cormorants has been increasing ever since. More than 1,000 individuals were recorded annually since 1993. Finally, wintering numbers were recorded between 12,000 and 20,000 from 2000 to 2024. The wintering cormorant numbers increase in all wetland types available in the Czech Republic, i.e. rivers, fishponds, reservoirs, and industrial waters, despite regulation measures. These measures (shooting and flushing of Cormorants) aim at reducing cormorant predation on fish populations in rivers and streams, as well as fish stocks in man-made waterbodies, especially fishponds and reservoirs, and are permitted mostly during non-breeding periods. Since 2019, the Ministry of Agriculture has paid hunters the amount of 500 CZK (i.e. about 20 EUR) per individual Cormorant shot. In total, more than 10,000 individuals are shot annually since 2020. The talk will include a site-level analysis of the effect of Cormorant killing level on the numbers of occurring Cormorants in the given and following winter seasons, as well as on the numbers and diversity of other waterbird species.

5. Inefficiency of shooting to regulate the numbers of great cormorants wintering in France

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France represents the most important wintering country for the Great Cormorant in Europe, hosting the three subspecies *Phalacrocorax carbo sinensis*, *Ph. C. carbo* and *Ph. C. norvegicus*, the strong increase of the first since 1980 leading to a deep resentment among fish farmers and anglers in continental France. Despite the status of a strictly protected species, the ministry in charge of the environment authorized control shots on wintering cormorants as early as 1996, in increasing numbers, from 12% of the population present in January to 44% in 2019-2021, both in fish ponds (annual quota of 29,000 birds) and in open waters (21,280 birds). Following legal appeals from the League for the Protection of Birds (LPO), open-water shooting was banned between 2022 and 2024, leading to fears among fish farmers and anglers of an explosion in wintering numbers. This temporary halt (abandoned for 2025-2027) represents a quasi-experimental situation of studying the effectiveness of regulation by shooting thanks to the existence of regular winter censuses since 1981. The comparison between the censuses of 2021 and 2024 (with and without shooting in open waters) showed that the number of wintering birds increased by only 4.94% in January (N=119,939 birds), but the winter peak even decreased by -9.10% and the average number over the winter season by -4.19%. The intensity of shooting cormorants made only in fish farms during the winters 2022-23 and 2023-24 had again no effect in distribution changes of populations in local administrative areas (départements) at the national scale since the last national census of 2021 (Spearman correlation $r = 1.114$, $R^2 = 1.3\%$), the trend of population (decrease, levelling off or increase of number of Cormorants) being similar with shooting (N=52 départements) or without (N=43). These results confirm the inefficiency of the shooting to regulate large cormorant populations.

6. Cormorants in Switzerland: population trends and political implications

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Since the first breeding record in 2001, the population of breeding cormorants in Switzerland has increased steadily, while the winter population has remained almost unchanged for about 30 years. Most breeding occurs at Switzerland's largest lakes, primarily within protected areas. Especially the growth in the breeding population, combined with a decline in commercial fishing yields – caused by numerous factors – has sparked increasing calls for population management. However, legal barriers to intervention remain significant. To address this, guidelines have been developed to outline the options and limitations for managing cormorants within the existing legal framework. These guidelines were created through a multi-stage dialogue involving the federal government, cantonal authorities, fisheries, nature conservation associations, and scientific institutions. They are intended to support authorities and practitioners in navigating the conflict between fisheries, cormorants, and biodiversity.

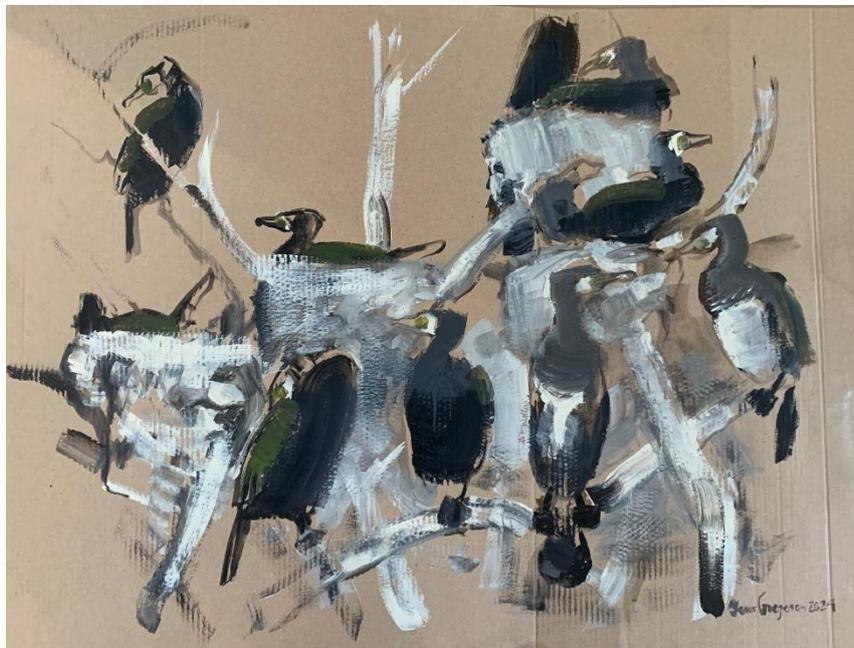
7. On the development of winter cormorant populations in Rhineland-Palatinate, Germany

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Around 1900, the cormorant became extinct in Rhineland-Palatinate. In the 1950s to 1970s, there were isolated sightings of cormorants. The first night roost appeared in the winter of 1982/83, and the first brood appeared in 1991. Since the winter of 1994/95, there has been continuous night roosts counts once a month from September to April. Initially, there were few night roosts along the Rhine and Moselle rivers. From 1996/97 onwards, more and more night roosts became available also on tributaries and other water bodies. The winter average, i.e. the average number of cormorants counted per month throughout Rhineland-Palatinate, has been between 2,000 and 2,500 individuals since 2012/13. The winter maximum, i.e. the maximum number of individuals counted during a counting weekend in Rhineland-Palatinate, is usually between 3,000 and 4,000 individuals in the same period. A cormorant regulation has been in place in Rhineland-Palatinate since 2009. Cormorants may be shot if they cause economic damage or if there are existing fish protection programmes. So far, no impact on the cormorant population has been observed as a result of the culling.



8. Management of cormorants in Sweden

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As a consequence of an increased cormorant population in Sweden, new policies and the management of the cormorant have developed. In 2023, the Swedish environmental protection agency (SEPA) established a management plan for cormorants stating:

- The favorable conservation status of the great cormorant is maintained in Sweden.
- The negative impact of predation by the great cormorant is minimized in areas of particular importance for the conservation of fish stocks, with a particular focus on areas that are protected from fishing throughout all or part of the year under fisheries legislation.
- The extent of damage to fishing gear and damage to catches in gear caused by great cormorants has decreased.
- Knowledge and dialogue about the role of great cormorants in the ecosystem at the regional, national, and international levels has increased.

In 2024, the Swedish parliament decided that large predators (seals and cormorants) in the Baltic Sea should be incorporated in an ecosystem-based management allowing for regulatory measures of these predators. The management of cormorants in Sweden is regionalized where the County administrative boards (CAB) are responsible for allowing derogations on cormorants. The trend for these derogations is larger quotas and an increased number of permissions for hunting during spring. For several years, CAB in Stockholm has allowed derogations in form of hunting at cormorant colonies during breeding season. However, experiences indicate that this approach can cause colonies to relocate, creating new conflicts and complicating management. New trials are therefore being planned where egg oiling possibly will be used as a primary management measure combined with selective tree felling to stimulate ground nesting.

9. Cormorant management in Bavaria – current situation

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In 1996, the Bavarian state government introduced a species protection law exemption ordinance (AAV; “cormorant ordinance”, amended on 16.07.2008) – granted throughout Bavaria and recently extended until 16.07.2027. This allowed a shooting permit for cormorants. Against the background of The Bavarian State Parliament decision of 07.05.2009 “Aid for the fishing industry and endangered fish stocks”, the Governments have issued additional General Administrative Orders (AV) which have more extensive regulations than the “cormorant ordinance” on a territory-specific basis (e.g. the possibility of shooting young birds all year round, shooting regulations in protected areas and, under certain conditions, the possibility of preventing new breeding colonies). In order to support the affected persons, two cormorant managers and voluntary cormorant advisors appointed by the State Office for the Environment are available.

10. Protecting the Great Cormorant under the EU Birds Directive and managing conflicts

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As with all bird species that occur in the wild in the EU, the Great Cormorant (*Ph. carbo sinensis*) is protected under the EU Birds Directive, which requires by its Article 5 that Member States establish a general system of protection prohibiting, among other things, their deliberate killing, capture, destruction of nests and eggs or taking eggs from the wild, as well as deliberate disturbance, particularly during nesting and rearing seasons.

In recent decades, the Great Cormorant population has grown significantly across Europe, attributed to the protection provided by the Birds Directive and the expansion of aquaculture which offers abundant feeding grounds. Consequently, this population increase has led to local conflicts with fishing activities, including aquaculture and recreational angling, and is alleged to impact certain protected or endangered fish species.

Article 9 of the Birds Directive allows Member States to grant exceptions from the general system of protection provided by Article 5, under certain conditions and for certain reasons, such as preventing serious damage to fisheries or to protect fauna and flora. Most derogations issued by Member State administrations concerning cormorants involve culling, justified mainly by the need to prevent serious damage to fisheries. The Member States that approve and implement most of the derogations for culling and egg oiling include France, Sweden, Denmark, Germany, Hungary, Lithuania, Czechia and Poland. In 2023, an estimated 90,000 to 95,000 cormorants were culled, and roughly 13,400 eggs were oiled.

Over the years, the European Commission has provided targeted guidance on the application of derogations concerning cormorants, co-financed research projects to study cormorant population dynamics and migration patterns, to facilitate conflict resolution or assess the impacts of predation and offered a comprehensive overview of preventive and other measures to address the conflicts^a.

^aAll information is available through the following website:

https://environment.ec.europa.eu/topics/nature-and-biodiversity/birds-directive_en

Session 2 - Keynote

11. There's too much confusion: microscopes and binoculars give no relief – the diet of Great Cormorants (*Phalacrocorax carbo*) in Scottish rivers as a starting point for wider thoughts of birds, fishes, and people

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The stomach contents of Great Cormorants (*Phalacrocorax carbo*) sampled recently (2019-20) from four Scottish Salmon (*Salmo salar*) rivers were examined. The overall aim was to derive the proportion (mass, number) of each fish species in the diet, the estimated length frequencies of Salmon consumed, and to make comparisons with an earlier (1990's) study. Current work was carried out against the background of long-term changes in fish abundance and/or community structure in Scottish rivers and heightened concern over the decline of the nation's wild Salmon and the environmental and man-made pressures faced by this iconic and economically important fish species. Similar situations occur all over Europe and beyond – wherever people want to catch, eat, or protect fishes. The complexity of interactions between birds, fishes, people, and the wider environment can be confusing and, although the current research did not examine the impact of Cormorants on the fish, it inevitably led to thoughts on that issue and to a considerable body of work exploring essential perspectives on so called 'cormorant-fishery problems' across Europe and how they might be relieved.

These explorations, at a variety of temporal and spatial scales, were undertaken by two international research networks (2000-2012) that gathered scientific knowledge, policy and local experience relating to cormorant-fisheries conflicts in a variety of fishery types across Europe and the Middle East. This EU-funded work involved up to 30 countries and comprised a network of almost 70 interdisciplinary researchers including natural and social scientists, fisheries scientists and representatives, and ecologists engaged in policy making and implementation. In addition, around 170 other experts discussed locally-specific issues with the network.

As with all things, the Devil is in the detail when considering Cormorants eating fish – and the temptation is to focus on the particular detail of what Cormorants (considered devilish by some) caught and ate one winter's morning on one stretch of a Scottish river. However, as well as zooming in on data like this, carefully collected over many years, the aim here is to concurrently zoom out and try to think about the wider context and to consider some of the other vital details - from the twin perspectives of fishes and the people who are interested in them.

Cormorants are opportunistic, generalist predators able to forage successfully in a diverse variety of aquatic habitats - often heavily-impacted by human activities - and for which we have quantitative data on numbers, distribution, and ecology from field observations and standardised counts. However, this research provides knowledge about just one of the three major elements of interest, other things to think about include:

Fishes - how many and where are they? Sampling and counting; changes in status and distribution; habitat use and changes in quality and quantity; effects of biotic and abiotic factors; fish behaviour, age-structure, growth, survival, population dynamics and regulation; the relative role of natural predation and potential compensatory responses; overexploitation; aquaculture and fisheries management goals; fish movement and (re)introductions.

People – changing the environment, catching things, and competing for resources; values and cultures - conservation issues and not just eating fish; quantifying damage and impact; quantifying and evaluating management actions to inform future ones.

Looking to the future, the need for sound data on fish ecology as well as reliable fishery data at a larger scale is a prerequisite before cause and effect can be determined in relation to local or regional declines in fish populations. We should be aware of pursuing the wrong arguments and using Cormorants as scapegoats based on their visual presence in the landscape. As Cormorants move easily across ecosystems, so too do many fishes (when not constrained) but we should understand that they are also often viewed through the non-biological frames of local perception, cultural heritage, economics, and human choices. There is a shared common aim across Europe to restore sustainable, naturally functioning aquatic ecosystems, full of healthy fish communities. In working towards this, we should perhaps also think carefully about the relative roles (and likely ultimate effectiveness) of any plans aiming to actively manage cormorants as but one element in much broader - but at present largely lacking – large-scale fishery management plans. Our commonly expressed ambitions towards fully-functioning landscapes and waterscapes at the ecosystem scale would result in more resilience - against predators but also against environmental threats such as climate change.



Session 2

12. Long-term Great Cormorant (*Phalacrocorax carbo*) diet data as a tool for understanding fish-bird interactions in Danish coastal ecosystems (1980-2024)

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Many marine and coastal species of birds depend on fish and information on their diet may be used to understand the state of local ecosystems. At Aarhus University we have compiled a unique dataset covering 1980-2024, documenting the diet of Great Cormorants (*Phalacrocorax carbo*). The data are based on regurgitated pellets collected at colonies across Denmark, mainly during the breeding season (April-June). This long-term dataset makes it possible to study predator-prey relationships in coastal waters. Case studies from the colonies at Vorsø in Horsens Fjord and Melsig in Limfjorden illustrate: (i) temporal change in diet composition over four decades; (ii) spatial contrasts between North Sea and Kattegat/Baltic coastal habitats; and (iii) derivation of prey size and biomass from bony remains (otoliths and skeletal elements) using species-specific regressions. Methodological limitations were determined from the ongoing work. Digestive erosion affects which fish remains are recovered, resulting in conservative (minimum) estimates of prey size and mass and under-representation of small or fragile taxa. Consequently, biomass reconstructions can be skewed by the overabundance of durable remains. Even with these limitations, pellet-based diet studies are highly valuable. They can: (a) serve as indicators of local coastal fish status in the vicinity of breeding colonies; (b) refine estimates of avian predation pressure; (c) reveal potential patterns of regional prey depletion; (d) infer prey preferences conditioned by accessibility; and (e) when combined with colony counts and chick survival, provide an integrated view of how local cormorants and fish populations are performing. By connecting seabird diet with fish community data over more than 40 years, this study demonstrates how long-term monitoring can inform our understanding of marine biodiversity and food-web dynamics.



13. Comparison of the diet and prey characteristics of Great Cormorants (*Phalacrocorax carbo sinensis*) in rivers and reservoirs during the migration and wintering period

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The population of Great Cormorant (*Phalacrocorax carbo*) in Central Europe has rapidly increased in recent decades, with high numbers also observed in late autumn and winter. The aim of study was to compare the diet of Great Cormorant in different habitats during migrating and wintering period. The study was conducted in a submontane river, two lowland rivers, and two submontane reservoirs in southern Poland. Samples included pellets from roosts in lowland rivers and one reservoir, and stomach contents from birds shot in the submontane river and another reservoir. Both pellets analysis and stomach content examination were performed to estimate species composition and fish size. The diet of Great Cormorants included from 8 to 12 species in the studied sites. The most numerous species in the Cormorant's food were perch (*Perca fluviatilis*) in the lowland rivers and one submontane reservoir, roach (*Rutilus rutilus*) in the other submontane reservoir, and chub (*Squalius cephalus*) in the submontane river. By biomass, the highest shares were perch in one lowland river, roach in one reservoir, pikeperch (*Sander lucioperca*) in another lowland river, and chub in the submontane river and the nearby reservoir. Generally, chub and pikeperch consumed were larger in length and biomass compared to roach and perch. Fish consumed by Cormorants were larger in the submontane river compared to those in other habitats. These results suggest that Great Cormorants hunted larger individual prey in the submontane river, while in other habitats they mainly preyed on smaller fish that aggregate in schools. Cluster analysis revealed a strong similarity in the diet of Great Cormorants from the lowland rivers, while diets in the submontane river and in the adjacent reservoir formed a distinct group separate from the other habitats. Overall, Great Cormorants show different dietary patterns depending on the habitat they occupy during migration/wintering seasons.



14. Diet composition of great cormorants in a fish protection area on the Swedish west coast

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Great cormorants (*Phalacrocorax carbo*) in Sweden have increased rapidly in numbers and geographical distribution since the 1980s. As a result, they are often blamed for reducing populations of commercially important fish species or hindering their recovery. To assess the contribution of protected fish species to their diet and to evaluate protective hunting as a management measure, we investigated the diet composition of shot cormorants in a fish-protection area on the Swedish west coast collected from 2018 to 2023. Results from stomach contents of hunted birds were contrasted to pellet samples for a comparison of the methods. Goby (Gobiidae) was the most frequently occurring prey family, whereas codfish (Gadidae) contributed the most to total biomass. Both prey abundance and biomass proportions varied across years and sampling areas, although only minor significant differences were detected. Codfish biomass was significantly higher in pellets than in stomach samples, while several other species appeared underrepresented in pellets. This indicates that pellet-only analyses may overestimate the importance of codfish in the cormorant diet. Species-level identification among codfish was possible for 30% of otoliths. Among these, whiting (*Merlangus merlangus*) dominated (75%), followed by Atlantic cod (*Gadus morhua*, 23%). Thus, although codfish constitute a substantial component of the cormorant diet, the protected Atlantic cod is not the primary gadid species consumed. This finding potentially reduces the perceived role of cormorants in hindering Atlantic cod recovery. Overall, our results show that codfish are an important prey group for cormorants in the 8-fjords area, but the specific impact on protected Atlantic cod appears more limited than previously assumed. Further research is needed to quantify the species-specific effects on local fish stocks and to evaluate the effectiveness of protective hunting as a management tool to support cod population recovery.



15. Are cormorants eating all the fish? A reality check using long-term data from Estonia

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Understanding how great cormorant population dynamics relate to trends in fish abundance and fisheries yields is crucial for evidence-based management and reducing human-wildlife conflict. Using long-term Estonian monitoring data, I examined whether interannual changes in cormorant abundance are associated with variation in fish abundance in coastal fish surveys. In parallel, I assessed whether regional trends in cormorant numbers correspond to changes in commercial fish landings. I hypothesised that if cormorants cause substantial top-down pressure on fish populations, we would observe negative correlations between cormorant abundance and both overall catch per unit effort (CPUE) in monitoring surveys and commercial landings. Alternatively, a lack of such relationships would indicate that fish population dynamics and fisheries yields are shaped predominantly by other ecological processes and human factors. Preliminary results support the latter interpretation. Cormorant abundance shows no consistent negative association with CPUE or commercial landings. These findings suggest that broad-scale patterns in Estonian fish communities and fisheries production are not primarily driven by cormorant predation pressure, highlighting the importance of considering multiple ecological and socio-economic drivers in management decisions.

16. Great Cormorants as natural indicators and control agents of invasive round goby

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Great cormorants are generalist predators, typically consuming the most abundant fish species in their foraging areas. In this context, we evaluated the ecological significance of a newly established cormorant colony on the Lithuanian Baltic Sea coast, specifically its impact on fish communities and fishery catches. Analysis of regurgitated pellets, along with stable isotope analysis of cormorant feathers and blood, and prey fish muscle tissues, consistently revealed that benthic round goby was the dominant prey item. Since the round goby has been an invasive species in the Baltic Sea since 2002 and now locally dominates coastal fish communities, our results suggest that cormorants have successfully incorporated this invader into their diet. The colony has established itself along boulder coastlines where round goby densities are high. Great cormorants consume substantial quantities of round goby throughout their entire breeding period, from April to October. Consequently, they exploit this invasive species far more continuously than coastal fishers, whose harvests are limited due to marine conservation regulations. This 10-year-old colony plays a significant role in both supporting fishery management and monitoring changes in fish communities along the Baltic Sea coastal zone. Furthermore, our findings suggest that cormorants could serve as effective, naturally occurring indicators of the distribution and abundance of invasive species.

17. Cormorants do it better: Cormorant pellets as natural monitors of coastal fish diversity

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Monitoring coastal fish assemblages requires methods capable of capturing long-term ecological trends and species across diverse habitats. We present a unique, multi-method assessment of coastal fish communities by evaluating the use of great cormorant (*Phalacrocorax carbo*) pellets as a complementary monitoring tool alongside two fisheries-independent methods: Trawl Surveys (TS) and Baited Remote Underwater Video (BRUV) in a fish protection area on the Swedish west coast. We used a unique, spatially overlapping, decade-long time series (2014-2024) of cormorant diet and TS to compare interannual variability and long-term patterns. TS provides standardized demersal fish data but is limited to deep soft-bottom habitats and cannot sample shallow, or structurally complex habitats. Cormorant pellets, in contrast, integrate cormorant foraging across a broad habitat mosaic capturing cryptic, structure-associated, and otherwise inaccessible species. In 2024, BRUV surveys added a complementary, non-invasive visual snapshot, detecting several mobile species not recorded by TS. Both pellets and BRUV consistently showed the highest family richness, whereas TS detected fewer families due to gear selectivity and habitats accessible to trawling. Importantly, pellet analysis and BRUV align with the 3R principles (Replacement, Reduction, Refinement) in ecological monitoring. Pellets replace more intrusive sampling, and both methods reduce destructive effort while refining fish community assessments across previously unsampled habitats. However, pellets need to be combined with information on cormorant movements and feeding areas to understand the area of fish monitoring that the diet data represents. Together, our results highlight cormorant pellets as a powerful, cost-effective, and ethically non-invasive long-term monitoring tool that, when integrated with TS and BRUV surveys, substantially improves ecosystem-wide assessments of coastal fish communities.



18. Cormorant census on selected trout-grayling fisheries: realistic estimate of predation pressure and the role of other fish-eating predators

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Great cormorants (*Phalacrocorax carbo*) are believed to cause significant and in some cases even fatal losses to rheophilous fish stocks. Within the ProtectFish project (Horizon Europe – RIA, No. 101134976, 2024-2028) the presence of cormorants and other fish-eating predators has been monitored on four stretches of two rivers, Střela and Svatava, in West Bohemia, Czech Republic. Both rivers have been known for suffering from the predation pressure of wintering cormorants. The continuous monitoring took place from early November 2024 to late April 2025 using camera traps. Three traps were installed in each river stretch (i.e. 12 in total), monitoring ca. 70 m of the river each (sector) and taking snapshots at a frequency of one per minute. Traps were set to operate from dawn to dusk, i.e. they were primarily focusing on visual predators. The results were recalculated to minutes of cormorant/fish-eating predator presence on each particular river sector. In total, 97,303 snapshots were analyzed, 39,724 in case of Svatava and 57,579 in case of Střela Rivers. Altogether, cormorant spent 110 minutes on monitored river sectors (all on Svatava River), grey heron (*Ardea cinerea*) 5,250 minutes (4,656 on Svatava, 594 on Střela), great egret (*Egretta alba*) 1,005 minutes (992 on Svatava, 13 on Střela), goosander (*Mergus merganser*) 2,464 minutes (all on Svatava) and kingfisher (*Alcedo atthis*) 55 minutes (all on Střela River). Although preliminary results, they clearly show that at least for selected rivers and their stretches 1) great cormorant is not the most important fish-eating predator (contributing to ca. 1% of predator time in a sector), 2) the difference in predator river use is enormous (8,222 minutes on Svatava vs. 662 minutes on Střela). The study represents the first attempt to reconstruct the real predation pressure of great cormorants on Central-European trout-grayling fisheries.



19. Great Cormorant as Model Species for Biomonitoring of Heavy Metal Pollution in Kopački Rit (Croatia)

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Avian apex predators such as the Great Cormorant (*Phalacrocorax carbo*) serve as valuable bioindicators for assessing pollution load and ecological integrity in freshwater ecosystems. From 2023 to 2025, we investigated heavy metal and metalloids accumulation, biomarker responses, and trophic dynamics in Great Cormorant nestlings from Kopački Rit Nature Park, a major floodplain of the Danube River. Whole blood samples from ten nestlings per year were analysed for chromium (Cr), cadmium (Cd), mercury (Hg), lead (Pb), arsenic (As), and selenium (Se) using inductively coupled plasma-mass spectrometry (ICP-MS). To evaluate the physiological responses to pollutant exposure, biochemical parameters were measured, including the concentrations of reactive oxygen species (ROS), total proteins, reduced glutathione (GSH), as well as enzyme activities of acetylcholinesterase (AChE), carboxylesterase (CES), glutathione S-transferase (GST), and glutathione reductase (GR). Although overall metal(loid) concentrations were low, interannual and individual variations in biomarker profiles indicated subtle oxidative and metabolic adjustments, suggesting potential sublethal stress. Comparative trophic analysis between Prussian carp (*Carassius gibelio*), a key prey species, and Great Cormorant blood revealed distinct element-specific pathways: Hg exhibited biomagnification, whereas As and Se displayed biodilution patterns. These findings demonstrate that metal(loid)s in wetland food webs depend strongly on biogeochemical cycling and species-specific physiology. By integrating pollutant, biomarker, and trophic data, our results underscore the ecological relevance of the Great Cormorant as a sentinel species for tracking heavy metal(loid) exposure and physiological effects in complex aquatic ecosystems. The results highlight the importance of long-term, multi-tier monitoring frameworks to detect emerging pollutant trends and assess their ecological consequences in dynamic floodplain environment.

20. The management of the Great cormorant in the upper Adriatic Sea: equilibrium reached?

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After a period of 15 years dedicated to the study of the behavioural ecology and the interactions with the fishery and aquaculture activities in the territory of Friuli Venezia Giulia Region, showing that the Great cormorant is not a limiting factor for the productive activities, the management of the species is nowadays focused on the protection of specific spots. Namely, a number of traditional extensive fish farms (fishing valli) in the coastal range and a set of important fish areas within the inland network of freshwaters. Our preliminary results highlight an effective defence from cormorants' impact both fish-production areas as well as within riverine restocking and breeding grounds for threatened fish species (i.e. *Salmo marmoratus* and *Thymallus thymallus*). Nonetheless, from a socio-economic and cultural perspective, much institutional efforts have been constantly dedicated to recognising cormorants as ecosystem indicators and not as a pest species. This long-term approach, together with encouraging results from the defence of key areas, conveyed to a local (stable?) equilibrium between the institutions deputed to cormorant management and the stakeholder orchestra, with particular reference to fishers, anglers and aquaculture managers.



Evening talk

21. 50 years obsession with the world of Cormorants

Jens Gregersen^{2*}

In this presentation I will talk about how it became a real obsession for me to live in (or at least very close by) a Cormorant colony. In the 1960s the Great Cormorant was a rare bird due to human persecution – the Cormorant had almost disappeared from Europe, only a few colonies existed. The island of Vorsø, located in a Danish fjord was one of the few European breeding sites in the 1950s and 1960s.

Having been absent since the middle of the 1800s the Cormorant came back to the island of Vorsø in 1944. At that time it was very rare to experience a dense colony of Cormorants. It was a surprise to many to see a seabird forming a colony in trees. The nests did make magical visible impressions of light, painted totally white in contrast to the surroundings on this island of wild forest.

Cormorants caught my attention in the 1960s when I was young - the view of the Vorsø colony and the atmosphere of the colony stayed sharp in my mind. At that time I could not foresee that this bird would become an important part of my life and that the Cormorants on Vorsø would become my closest neighbours. I got the opportunity to work on the island as an illustrator and artist. This offered me the opportunity to follow the life in the colony. Very soon I could see that it was possible to observe each nest in the trees, some of which had up to 25 nests each. It was exciting and a challenge, and after the establishment of a field station ringing of Cormorants started and we started to collect data related to a number of different subjects.

We experienced that the colour-ringed birds returned to the colony and that we could follow individual birds from year to year. At some point almost 10% of all the birds appearing in the colony were ringed. I managed to develop an almost personal relation to many of the colour-ringed Cormorants - many of the birds were faithful to their home colony and the tree where they were nesting and roosting.

All this went on for decades. I have now lived on the island for many years and I am still there, but since 2025 the Cormorants are gone. So many aspects of what was going on in the Cormorant colony and Cormorant world continued to surprise me. Back in the 1970s nobody in Denmark would have foreseen that the Danish breeding population would grow from a few hundred pairs in one colony to 40,000 breeding pairs 25 years later.

My story is that I was a part of a huge effort of research and fieldwork which ruled the days of my life over many years. The Cormorant was right from the start an important part of my artwork. I try to use some of my drawings to tell this somewhat unusual co-existence with Cormorants.

² At a very young age, Jens Gregersen started as a birdwatcher always bringing his sketchbook. Immediately after getting an education as an advertising artist, he became a professional bird counter, also taking on tasks as a nature illustrator. Already in 1975, he published his first artbook – based on a year of daily bird counts at the nature Tipperne in west Denmark. Some years later he became ‘addicted’ to Cormorants and to the colony at the island of Vorsø. His breaks from life on Vorsø have been allocated to Cormorant sites in Europe and counting of breeding waders throughout the Arctic. His drawings can be enjoyed in the many wonderful books he has published over the years.

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Thursday 5 February

Session 3

22. Development of the breeding population of cormorants in the Baltic Sea region

Thomas Bregnballe^{1*}, Jacob Sterup¹, Christof Herrmann², Jan Kieckbusch³, Szymon Bzoma⁴, Gennady Grishanov⁵, Yuliya Grishanova⁵, Mindaugas Dagys⁶, Karlis Millers⁷, Meelis Leivits⁸, Sergei Kouzov⁹, Kim Jaatinen¹⁰, Mikola Aleksii¹⁰, Kjell Larsson¹¹ & Karl Lundström¹²

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There is a continued interest in updates on the development of the breeding populations of Great Cormorants in Europe. We describe the overall patterns of development of the Baltic Sea breeding population with emphasis on the development since 2012. At the Pan-European count in 2012 the countries surrounding the Baltic Sea hosted in total 167,700 breeding pairs, and the region constituted the most important breeding area in Europe for the continental sub-species. At that time the highest numbers were recorded in Sweden, Denmark, Poland and Germany. For more than 35 years up until 2012, these countries had - together with The Netherlands - constituted the core breeding area for the continental sub-species in Europe. Already before 2012 numbers had stabilized in the western part of the Baltic Sea (i.e. Denmark, Germany, Poland and Sweden) as well as in some of the major breeding areas further east in the Baltic Sea (e.g. Kaliningrad, Lithuania, Estonia). However, the counts conducted since then have documented that while numbers have remained fairly stable in Denmark, Germany and Poland, the species has resumed its expansion in Sweden (an increase from app. 40,600 breeding pairs in 2012 to around 75,000 breeding pairs in 2023) as well as in Estonia and Lithuania. Numbers in Finland stabilized after 2015. Overall, the Baltic Sea population of cormorants has increased by more than 60,000 breeding pairs since 2012.

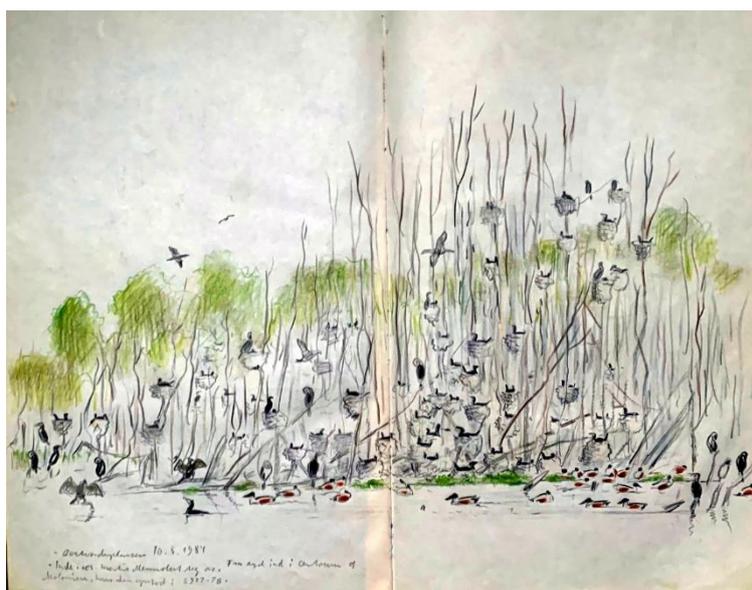
23. Long-term population trends and spatial distribution of breeding Great Cormorants (*Phalacrocorax carbo sinensis*) in the Russian part of the Gulf of Finland

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Over the past decade, the Great Cormorant (*Phalacrocorax carbo sinensis*) has become the most numerous breeding waterbird species in the Russian Gulf of Finland, with its population stabilizing at 11,500-12,500 breeding pairs. The species was first recorded nesting in 1994. The most intensive population growth occurred from 2000 (1,090 pairs) to 2015 (10,480 pairs). In subsequent years, the number of breeding Great Cormorants varied from 9,270 pairs (2018) to 11,974 pairs in 2019. By 2024-2025, the population is estimated to have reached approximately 12,000-12,500 pairs. A significant spatial redistribution has taken place within the region. Two of the oldest and largest colonies - on Dolgy Reef Island (1,580 pairs in 2006) and Kivimaa Island (1,305 pairs in 2006) - were abandoned in 2014 and 2021, respectively. Over the last ten years, birds have also disappeared from seven other smaller colonies. The colony on Bolshoy Kosoy Island experienced a drastic decline (from 1,060 pairs in 2020 to 120 pairs in 2023). In recent years, the primary breeding sites have been the islets off the coast of the Kurgalsky Peninsula (approximately 3,500-4,000 pairs) and the Seskar archipelago (up to 4,700-5,300 pairs). Additionally, during the last decade, the species' breeding range has notably expanded northeastward within the study area, towards the Berezovye Islands archipelago. Seven new colonies have emerged here, hosting 1,566 breeding pairs in 2023. Evidence of further eastward dispersal includes the first colony discovered by N.V. Lapshin in 2020 on Pargo Island along the eastern coast of Lake Ladoga. According to local fishermen, another colony is believed to exist near the western shore of Lake Ladoga, not far from the mouth of the Burnaya River.



24. Pan-European counts of breeding and wintering cormorants in 2027

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The most recent Pan-European count of breeding colonies of Great Cormorants took place in 2012 and wintering cormorants were counted at night roosts throughout Europe in January 2013. The counts were coordinated by the project 'Cormorant counts in the Western Palearctic' which was led by the IUCN/Wetlands International Cormorant Research Group and the European Commission funded project 'CorMan'. There is now a widespread interest in an updated overview of the size and distribution of Europe's cormorants both when they are in their breeding areas and when they are in their wintering areas. The aim is to cover as many countries in Europe as possible. Some Member States do already have regular counts of their breeding colonies, and some countries even have well organized winter counts of their night roosts. But there are also countries that do not manage to monitor their cormorant colonies at a regular interval. Furthermore, most European countries do not have systems for counting cormorants at night roosts in winter. We describe the plans for organising the counts and the subsequent collation of data. We will also inform about the possibilities we foresee for supporting countries that see the workload associated with these counts as a major challenge.



Friday 6 February

Session 4 – Keynote

25. Shags in a changing world: what can we learn from long-term studies?

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Like all cormorant species, the European shag has a physiology that is designed for cost efficient foot propelled diving, but may give rise to vulnerabilities under certain environmental conditions, in particular extreme weather events. Given future predictions of ocean warming and increased frequency and severity of storms, there is growing concern about the well-being of the species. A critical question is therefore the extent to which it can adapt to a changing world. The shag exhibits plasticity in diet, foraging, migration and timing of breeding in relation to environmental conditions. It presents other characteristics that may confer resilience to future climate change, such as a high reproductive rate and selection on and heritability in migratory behaviour. However, current evidence regarding population health is not positive. There have been marked declines in many shag populations across much of the range, linked to widespread mortality during winter storms, so its future status remains highly uncertain. Shags also face other challenges – although to date comparatively unaffected by HPAI, they are hosts to other parasites, and their coastal habits result in high exposure to legacy and emerging contaminants.

In this talk, I will summarise the research UKCEH has undertaken in collaboration with many other organisations over the last 50 years on the drivers of change in diet, foraging behaviour, migration ecology and population dynamics of shags breeding on the Isle of May, south-east Scotland. Our research has used a range of techniques, from traditional observations of breeding performance, to state-of-the-art instrumentation to understand foraging ecology. Our colour-ringing programme has generated >100,000 sightings of >20,000 individuals, allowing us to relate migration strategy to breeding success and survival probability. I will synthesise our understanding of their behavioural ecology, life history and population dynamics, consider the future resilience of a species experiencing rapid climate change and assess opportunities for conservation management to ensure its long-term health. I will conclude with general perspectives on how long-term studies can aid the future conservation of shags and related species.

Session 4

26. Diet of the European shag (*Gulosus aristotelis*): Novel information on the feeding ecology of a species recently colonising the Swedish west coast

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The European shag (*Gulosus aristotelis*) has recently established breeding colonies along the Swedish west coast. Despite growing numbers of breeding and post-breeding shags, as well as increasing geographical distribution, diet of shags in Swedish waters remains unknown. This study presents results from analysis of otoliths recovered from pellets in two breeding colonies in the Skagerrak. The results are compared to the diet of great cormorants (*Phalacrocorax carbo*) from two nearby colonies. Diet composition differed between the two species and indicates possible niche separation. In general, cormorants consumed larger and more benthic fish species compared to the diet of shags. The shag diet was characterized by the importance of sandeels (*Ammotyidae*), whereas the cormorant diet differed with a pronounced contribution of gobies (*Gobiidae*) and flatfish (*Pleuronectidae*). Species of codfish (*Gadidae*) and wrasses (*Labridae*) dominated the diet in both shags and cormorants. Within each species, diet composition did not differ between the two study locations.



27. Non-breeding population size and movements of Mediterranean Shags in the Adriatic Sea

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The Mediterranean Shag *Gulosus aristotelis desmarestii* is an endemic subspecies of the European Shag, restricted to the Mediterranean and Black Sea, and listed in Annex I of the EU Bird Directive (2009/147/EC). The Adriatic population breeds almost entirely along the eastern coast of Croatia, with the largest and most numerous colonies occurring in the northern and central Adriatic. The Adriatic population is the only recently evolved partial migratory population of the Mediterranean Shag. Its migratory behaviour has evolved since the 1980s, when shags from northern and central Adriatic started to spend the non-breeding period (May – December) in the Gulf of Trieste and Venice Lagoon, Italy. Colour ringing of breeding shags began in Croatia in 2005, and since then a total of 1,570 individuals have been ringed. Within the Gulf of Trieste, 622 resightings have been recorded, along with 470 in the Venice area. These recoveries indicate strong site fidelity to non-breeding areas. This recently evolved migratory behaviour is considered to represent movements between available nesting sites along the Croatian coast and favourable foraging sites in the northernmost Adriatic. To understand the size and distribution of the non-breeding population, coordinated censuses were undertaken in 2020, 2021 and 2024 in the Adriatic (Italy, Slovenia and Croatia). Overall, an estimated winter population of around 5,000 individuals was counted annually, with the largest numbers found in Italy. Most of the birds (69%) were roosting on mussel farms. One fifth of the shags were counted in Croatia, probably representing the non-migratory population. Regular census of non-breeding shags in the Gulf of Trieste between 2010 – 2022 showed a strong decline (- 44.7%). Although the Venice population showed an increase, the overall population seems to be declining. To fully understand the reasons behind this decline, additional research on both the breeding and non-breeding populations is essential.

28. Colonisation Dynamics and Range Expansion of the Pygmy Cormorant (*Microcarbo pygmeus*) in Italy: A 30 Year Assessment (1994–2023)

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The Pygmy Cormorant experienced a marked numerical decline and a progressive contraction of its range during the second half of the 19th century. This negative trend began to reverse globally in the mid 1990s. In Italy, sightings of isolated individuals, pairs, and small groups became increasingly regular from the late 1970s onward, especially in late autumn and winter along the Adriatic coast. Although sporadic breeding was documented in the early 1980s, the species re established stable nesting in the country only in the 1990s. Definitive breeding was confirmed in July 1994 at Punta Alberete (PA), a few kilometres north of Ravenna, where three active nests and 13 fledged young were recorded.

Following this recolonization, the population nucleus in the Ravenna area expanded rapidly. In the main settlement zone of the southern Po Delta, the number of active nests rose from fewer than 10 in 1994–1997 to around 90–100 in 2002, and then to between 560 and 720 in 2004–2005. By 2013, the species remained largely concentrated in the original settlement areas, corresponding to the coastal wetlands of the northeastern Adriatic. A small number of breeding sites—located in wetlands north of Ravenna and in the Venice–Caorle lagoon system—accounted for roughly 80% of the national population. Some colonies showed exceptional growth, with Punta Alberete alone reaching 900 nests in 2013. At that time, five major sites (PA, Cave di Gaggio e Caomaggiore, Valle Dogà, and Po di Maistra) supported more than 75% of all breeding pairs in Italy.

Over the past ten to fifteen years (1994–2023), the species' range expansion has accelerated, likely driven by increasing intraspecific competition and deteriorating conditions in traditional breeding areas. Pygmy Cormorants began dispersing away from the Adriatic coast, colonizing inland wetlands. Key developments include:

- **Inland colonization:** small satellite nuclei formed near coastal colonies and gradually expanded into inland wetlands, such as the Valli di Ostellato (2013) and Valle Santa (2015) in the Ferrara area and Canalnovo (2013) in the Rovigo area;
- **Northern Plains:** the species moved upstream along the hydrographic network, establishing itself in heronries across the Venetian, Lombard, and Piedmont sectors of the Po Plain;
- **Central and Southern Italy:** the species crossed the Apennines, with nesting recorded at Lake Montepulciano (2016–2018) and in the Lazio region (2021). Further south, colonization occurred at Lago di Conza (AV) in Campania, likely involving individuals dispersing along the Ofanto River from colonies in the Foggia area. The southernmost recent breeding event was documented in the Cosenza area (Calabria) in 2022.

In the present work, we present the most up-to-date data on the distribution and population size of the Pygmy Cormorant in Italy, together with an assessment of its conservation status and potential future trends in range expansion.

29. Long-term GPS tracking reveals behavioural differences between breeder and nonbreeder Great Cormorants

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Investigating local movements of the species is essential for studying population dynamics and addressing interactions with human activities. Unfortunately, most research focuses on breeding Great Cormorants, overlooking parts of the population. We used tracking devices to examine the spatial behaviour and foraging movements of adult breeding and nonbreeding Great Cormorants between 2018 and 2024 from three colonies along the Lithuanian coast (SE Baltic Sea). We assessed variations in home ranges, habitat use, and foraging trips between breeders and nonbreeders, both within and among colonies. The Great Cormorant forages across the entire Lithuanian coast of the Baltic Sea and in the Curonian Lagoon. Spatial segregation is either complete or partial among colonies, likely to avoid competition for fish resources. Breeders select three habitat types: sea, lagoon and land. Each colony has a specific foraging ground, creating a sea-lagoon gradient of habitat use that reflects environmental heterogeneity. Nonbreeders select five habitat types, including ponds and rivers, with a common preference for land habitat. It indicates broader habitat selection and flexible foraging choices. No significant difference in home range extension is shown between statuses, but nonbreeders could have three times larger home ranges than breeders. Breeders and nonbreeders forage at similar distances (11 km) from the colony, but nonbreeders take longer trips during the breeding season. This suggests shared foraging areas, but micro-scale resource partitioning within colonies with enhanced exploratory behaviour among nonbreeders. This study offers new insights into the spatial behaviour of the Great Cormorant, highlighting significant differences between breeders and nonbreeders. It underscores the importance of considering different life stages when describing population spatial dynamics.

30. Movement Diversity in an Inland Breeding Population of Great Cormorants: Management Implications from GPS Tracking

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Conflicts between cormorants and fisheries exemplify the challenges of balancing sustainable resource use with biodiversity conservation. The substantial increase in the global population of the Great Cormorant (*Phalacrocorax carbo*) over recent decades, coupled with climate-driven changes in European migration patterns, underscores the need for detailed movement data. Such information is essential for stakeholders to prioritise management goals and support evidence-based decision-making. Although inland fisheries are often perceived as particularly affected by cormorant foraging, several inland breeding populations have recently shown moderate declines, likely influenced by population-control measures and raising important conservation concerns. In the Carpathian Basin, these trends have become evident over the past decade. To investigate habitat use and movement behaviour, we deployed GPS-GSM transmitters on 28 Great Cormorants (5 adults, 23 fledglings) from a breeding colony at Lake Balaton, Hungary, between 2021 and 2023. To date, these devices have yielded more than 300,000 GPS locations. Our results reveal considerable individual variation in both habitat use and migration strategies. While some birds remained near the breeding area year-round, others travelled as far as northern Africa. Foraging patterns were similarly diverse: certain individuals relied heavily on fishponds, whereas others predominantly used natural or semi-natural habitats such as riverine ecosystems, highlighting the importance of context-specific best-practice management. A notable proportion of transmitters stopped sending data shortly after deployment. Only three provided data for more than one year. Field evidence and movement records strongly suggest that most transmission cessations were associated with bird mortality, with shooting identified as the most likely – and in several cases confirmed – cause.



31. Changes in migration patterns of Baltic Sea Cormorants

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Ringling of Cormorants in the Baltic Sea started already during the 1930s, when the species was on the verge of extinction. From 1932 until 1937, Richard Stadie ringed an unknown number of Cormorants with Radolfzell rings, mainly on the small island Pulitz, but some also at lake Jassener See (Jezioro Jasien, today Poland) and Pagdanzig (today Pakotulsko, Poland). These birds produced 172 recoveries, which give a quite detailed picture of migration and wintering of western Baltic Cormorants at that time. After World War II, starting in 1957, Cormorant ringling was continued in the colony Niederhof with Helgoland rings, from 1965 onwards with Hiddensee rings. When the Cormorant colonized inland lakes during the 1960s, the ringling activities were expanded to these sites as well. In 2009, a colour ringling programme was launched. Hence, the available ringling data from the German Baltic coast allow the analysis of migration behaviour for a period of about 90 years. In Denmark, ringling was started in 1940, but in the beginning only in low numbers. It was intensified by the mid-1970s. Hence, there is a comprehensive data material available for describing migration pattern of Cormorants of the western Baltic Sea area. The results indicate strong changes during the last decades:

- Until the 1980s, three migration directions could be distinguished: (1) South-East – to the Adriatic Sea, up to Turkey; (2) South – via Italy, Sardinia/Corse to North Africa, (3) West – to the Netherlands, France, Spain, occasionally to Great Britain.
- With the start of the growth of the Baltic Cormorant population and expansion to the north-east during the 1980s, migration destinations changed: western Baltic Cormorants abandoned the south-eastern migration route; the areas at the Adriatic Sea became occupied by birds from the central and northern Baltic Sea.
- Wintering in the Baltic Sea started at the beginning of the 1980s, with increasing numbers since then (with some temporary declines after harsh winters);
- The proportion of birds migrating to the south declined, the same did the migration distance of this route; recoveries from North Africa are missing from recent years;
- The proportion of birds migrating to the west increased, without significant trend of the migration distance;
- Starting during the 1980s, an increasing proportion migrated only short distances (<500 km, not assignable to any migration direction);
- The most recent development is an increasing proportion of non-migratory birds (winter records <100 km to the ringling/hatching site).

Hence, the growth of the Baltic Sea Cormorant population from less than 3.000 bp in 1970 to about 220.000–250.000 bp currently resulted in a range expansion now covering the whole Baltic Sea area, as well as in a re-distribution of wintering sites: Wintering areas formerly occupied by birds from the western Baltic nowadays are occupied by birds from the central and northern Baltic. Climate change is obviously an important factor for the expansion of the regular wintering areas to more eastern and northern areas, including the western and central Baltic Sea.

32. Evolution of the breeding and wintering population of Great Cormorant in Belgium, a small country with contrasted environmental conditions and cormorant-fisheries conflict management choices

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Great Cormorant (*Phalacrocorax carbo*) wintering and breeding populations are closely monitored in Belgium through the collaboration of numerous volunteer field ornithologists. “Apparently occupied nests” are counted annually in most breeding colonies, and coordinated roost counts are conducted twice each winter. In addition, International Waterbird Counts are carried out four to six times per winter in most wetlands.

Following the initial establishment of the species in 1990 and a subsequent period of rapid increase, the wintering population of Great Cormorants has remained globally stable for the past 20 years. In contrast, the small breeding population continues to show a slight increase. This apparent overall stability masks substantial local dynamics, including marked changes in site occupancy and an increasing spatial dispersion of roosts and colonies, which are now generally smaller in size.

Lethal control under derogation from the EU Birds Directive is permitted in certain river sectors and fishponds; however, similar changes in local distribution are observed throughout the country, including in areas without management measures. Alterations in aquatic ecosystems may partly explain the distribution changes.

Considering 35 years of regular winter and summer presence of Great Cormorants in Belgium, we further hypothesize the existence of a learning-driven process leading to gradual population dispersal. This process may result in an optimization of the distance between colonies or roosts and available foraging resources.

33. Population explosion of the Great Cormorant in the Lake Baikal basin

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At the northern limit of its range, the population size of the Great Cormorant *Phalacrocorax carbo sinensis* is unstable. In the late 20th century, hydrological changes in Asia enabled the species to recolonize Lake Baikal. Over a 32-year period (1988–2020), its regional conservation status shifted from "extinct" to fully recovered. A rapid population increase triggered conflict, with locals and authorities accusing the birds of damaging fisheries and forests. This has resulted in illegal shooting and nest destruction, an issue raised in the Parliament of Buryatia. According to 2024 monitoring data, 48,300 Great Cormorants were recorded in the Republic of Buryatia. Of these, 26,3 thousand (54,5%) were breeding, 6,6 thousand (13,7%) were non-breeding, and 15,4 thousand (31,9%) were fledglings. The largest colonies were located in the Selenga Delta (7,760 individuals), Chivyrkui Bay (1,720–8,800), and North Baikal (3,528). Shifts or complete disappearance of colonies due to anthropogenic pressure were noted. The total population in 2024 decreased by approximately 3% compared to 2021. The decline was primarily due to a reduction in fledglings (21,4%) and non-breeding birds. In May 2023, the Supervisory Service authorized population control, citing excessive numbers and potential damage. A cull of 3,000 birds was planned, but after shooting 2,548, the program was halted a year later as ineffective. There is a proposal to amend regulations to allow population control when damage to aquatic biological resources occurs (currently only damage to wildlife and habitats is stipulated). Direct culling is currently permitted in 13 Russian regions. Mongolia also employs culling to protect fish stocks. In 2012, 3,200 cormorants were destroyed on Lake Terkhiin-Tsagaan, a Ramsar-listed wetland. Alternative non-lethal control methods exist, such as acoustic and light deterrence, nest disturbance, and partial egg removal. However, these methods are seldom used by authorities due to their labor-intensive nature. Lethal control has proven ineffective, highlighting the need for comprehensive, science-based solutions to this transboundary issue.



34. Change in the timing and duration of breeding season of Great Cormorant (*Phalacrocorax carbo sinensis*) in Kopački Rit Nature Park (Croatia)

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Following regional extinction due to persecution, Great Cormorant *Phalacrocorax carbo sinensis* have started nesting again in the Kopački Rit Nature Park in 1970 and their breeding population exponentially increased until late 1980s. At that time their breeding season started in April and lasted until June to mid-July. Ten years later their breeding season had shifted a month earlier and started by the beginning of March. In 1999 cormorants started breeding by mid-February and since 2018 breeding starts already during January. Earliest breeding attempts have been recorded on 02.01.2025, 06.01.2023, 07.01.2018, 15.01.2021, 15.01.2022, 22.01.2020, and 27.01.2024. These shifts in the start of the breeding season are most likely related to the mild winters due to global warming that are more common in the past two decades. In addition to the early start of nesting, their breeding season has also extended well into the summer. Nests with nestlings were recorded on 30.06.2022, 06.07.2018, 27.07.2021, 20.08.2025, 22.08.2024, 22.09.2019, and 22.09.2024. While the prolonged breeding season is probably related to the availability of food in the vicinity of the colony, the origin of these late nesters is still a mystery.

35. Seasonal Population Dynamics and Breeding Phenology of Great Cormorants (*Phalacrocorax carbo*) at an Inland Urban Reservoir in South Korea

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Recent population growth and breeding expansion of Great Cormorants (*Phalacrocorax carbo*) have become an increasing management concern in South Korea. To examine annual abundance dynamics and breeding phenology, I monitored a major colony at Seoho Reservoir in Suwon from September 2023 to April 2025. The population showed a clear seasonal pattern: numbers increased from mid-winter and peaked at over 4,500 individuals in May, including visible young-of-the-year that had already reached substantial size. After the breeding peak, the population sharply decreased to approximately 200 individuals in summer, then increased again to around 1,200 by autumn, followed by a decline to about 500 individuals in December. Breeding activities began as early as January, with incubation occurring mainly during February-March and fledging observed from April to June. Counts were consistently higher during the late afternoon compared with morning or midday, suggesting daily movement between roosting and foraging areas. This research represents the first continuous multi-season dataset for an urban breeding colony of Great Cormorants in South Korea and provides essential baseline information for future ecological assessment and management planning.

36. Management of cormorant numbers and conflicts in the US

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The double-crested cormorant (*Nannopterum auritum*; hereafter cormorant) is the most abundant cormorant species in North America (N. Am.). As of 2025 the total N. Am. cormorant population is estimated at 921,567 birds (USFWS 2025). This estimate is likely conservative as little data exists for cormorants over large areas of Canada. Approximately 61% of the population is composed of the *N. a. auritum* subspecies in the Mississippi/Central flyway. The Atlantic Flyway comprises ~29% of this subspecies with an additional 2% of the *N. a. floridanus* subspecies in Florida. The remainder of the population occurs outside the Atlantic and Mississippi flyways. Breeding Bird Survey data indicate that the N. Am. population has increased during 1966–2019 (2.5% annual growth), although growth varies substantially on a regional basis. Cormorants are implicated in several conflict issues typically revolving around impacts to aquaculture, sport-fisheries, insular habitats, and co-nesting species. Due to these conflicts cormorants have been subject to management, including culling, for decades. Government authorized take of cormorants began in the 1980's and has continued to evolve to the present day. In the 1980's cormorant management was regulated by issuance of a depredation permit from the U.S. Fish and Wildlife Service (USFWS) mostly dispensed to aquaculturists. From 1998 to 2015 Depredation Orders (DO's) were in effect that liberalized the ability to lethally take cormorants to address conflict issues. These DO's were vacated by lawsuit in 2016 and replaced by a special cormorant depredation permit in 2021. Policy now requires that permit holders must demonstrate failure of non-lethal methods, annual permit renewal and reporting, and the USFWS must reassess the cormorant population every 5 years. In addition, the USFWS has developed a Potential Take Limit model that places a cap on lethal take that is intended to maintain the cormorant population at or above current levels.



P1. Loss of avian biodiversity on small Baltic islands after the establishment of Great Cormorant breeding colonies: revelations from a 62-year dataset

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Breeding colonies of the continental subspecies of the great cormorant (*Phalacrocorax carbo sinensis*) have expanded rapidly in Europe over the past half-century. To assess the impact of cormorant breeding colonies on bird biodiversity, we utilized annual monitoring datasets of breeding bird communities from 261 islands in the northeastern Baltic Sea, along the Estonian coast, spanning the period from 1960 to 2022. We found that Shannon's diversity index values for breeding birds were significantly negatively related to the establishment of cormorant breeding colonies. The effect of cormorants became even more evident as Shannon's diversity index values began to recover to the initial level after cormorants evacuated the islands. The most negatively affected species were the European herring gull (*Larus argentatus*), the common gull (*Larus canus*), and the 25 velvet scoter (*Melanitta fusca*), whereas the most positively affected species was the mute swan (*Cygnus olor*). Results indicate considerable competition between the Great Cormorant and other species for breeding habitats on these islands, highlighting the impact that highly abundant colonial bird species have on the biodiversity of small islands in the marine environment.



Photo : © Steffen Ortmann

P2. Great Cormorant as Model Species for Biomonitoring of Heavy Metal Pollution in Kopački Rit (Croatia)

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Avian apex predators such as the Great Cormorant (*Phalacrocorax carbo*) serve as valuable bioindicators for assessing pollution load and ecological integrity in freshwater ecosystems. From 2023 to 2025, we investigated heavy metal and metalloid accumulation, biomarker responses, and trophic dynamics in Great Cormorant nestlings from Kopački Rit Nature Park, a major floodplain of the Danube River. Blood samples from ten nestlings per year were analysed for chromium (Cr), cadmium (Cd), mercury (Hg), lead (Pb), arsenic (As), and selenium (Se) using inductively coupled plasma-mass spectrometry (ICP-MS). To evaluate the physiological responses to pollutant exposure, biochemical parameters were measured, including the concentrations of reactive oxygen species (ROS), total proteins, reduced glutathione (GSH), as well as enzyme activities of acetylcholinesterase (AChE), carboxylesterase (CES), glutathione S-transferase (GST), and glutathione reductase (GR). Although overall metal(loid) concentrations were low, interannual and individual variations in biomarker profiles indicated subtle oxidative and metabolic adjustments, suggesting potential sublethal stress. Comparative trophic analysis between Prussian carp (*Carassius gibelio*), a key prey species, and Great Cormorant blood revealed distinct element-specific pathways: Hg exhibited biomagnification, whereas As and Se displayed biodilution patterns. These findings demonstrate that metal(loid)s in wetland food webs depend strongly on biogeochemical cycling and species-specific physiology. By integrating pollutant, biomarker, and trophic data, our results underscore the ecological relevance of the Great Cormorant as a sentinel species for tracking heavy metal(loid) exposure and physiological effects in complex aquatic ecosystems. The results highlight the importance of long-term, multi-tier monitoring frameworks to detect emerging pollutant trends and assess their ecological consequences in dynamic floodplain environment.



Photo : © Thomas Bregnballe

P3. How to catch adult Great Cormorants: field experience from tree nesting colonies

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Great Cormorants in Europe nest in a wide range of habitats, from rocky, vegetation-free islands to forests. Capturing adult breeders is relatively straightforward when nests are built on the ground; however, the task becomes much more challenging when birds nest in treetops. These difficulties can limit the inclusion of Great Cormorants in scientific studies. In Lithuania, where all cormorants nest in trees, most colonies are situated along the western coast of the country, near the shores of the Curonian Lagoon and the Baltic Sea. Across three different colonies - each differing in landscape and tree composition (pines, alders, and willows) - we tested multiple methods for capturing breeding cormorants between 2018 and 2025. We employed a wide range of techniques, including foothold traps, mist nets, whoosh nets, cannon nets, night lighting, gillnets, noose poles, and noose traps placed directly on nests. Capture success varied among colonies while the most effective method for cormorants nesting 4–10 m high in alder and willow trees was the use of mist nets. For birds nesting in tall pine trees, the most successful approach was cannon netting at a roosting site near the colony. Cannon nets also proved effective at a roosting site in the alder-dominated colony. Other methods were far less efficient, in some cases resulting in the capture of only a single bird. The most appropriate capture technique depends on a combination of factors: colony location, nest height, tree species used for nesting, and the spatial structure of the colony. These factors can make the capture process either highly efficient or extremely challenging. We also provide descriptions of methods found to be ineffective. This information will be valuable for researchers planning field studies on this ecologically significant species.



Photo : © Per Vindis

P4. Reducing Seal and Cormorant Predation to Understand Fish Stock Recovery - A Government-Mandated Research Initiative Led by the Swedish University of Agricultural Sciences (SLU)

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Populations of great cormorants, grey seals and harbour seals have increased in many parts of the Swedish coast, coinciding with declines in several key fish stocks. To strengthen the scientific foundation for management, SLU has been tasked by the Swedish government to assess how reduced predation from these top predators influences the recovery of coastal fish populations. The study consists of four integrated components: (1) large-scale time-series analyses combining predator census data with long-term coastal fish monitoring; (2) evaluation of a predation reduction programme in the 8-Fjords area in Bohuslän, focusing on cod. Independent fish monitoring, PIT-tagging, and acoustic telemetry are used to evaluate effects on fish populations; (3) studies in Stockholm and Östergötland that investigate predation effects and predator-induced behavioural changes in pike populations within and around no-take zones; and (4) assessment of cormorant predation on sea trout smolt in the Dalälven River system using PIT-tag recoveries from colonies and analyses of returning adults during and after predation reduction. The project integrates ecological, behavioural, and management perspectives in collaboration with national and regional partners. The findings will provide essential insight into whether and under what conditions reduced predation can promote fish stock recovery, thereby supporting adaptive and ecosystem-based management of seals, cormorants, and coastal fisheries.



Photo : © Per Vindis

P5. Reactions to a returning predator: How White-tailed Eagles influence Cormorant breeding habits

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Several European countries have seen a notable increase in their populations of White-tailed Eagles. This is also true in the Baltic Sea where White-tailed Eagles have increased their depredation pressure on several archipelago bird species. In particular groups of immature eagles tend to congregate in areas seeing less human activity. But many of these islands also serve as breeding sites for ground-nesting Cormorants. Having followed the increasing intensity of interactions between the White-tailed Eagles and breeding Cormorants over the last 20 years, we have now learned that eagles can affect Cormorants in several ways. When White-tailed Eagles visit a colony, they often cause significant disturbance, driving adult Cormorants away from their nests and leaving eggs and small chicks exposed to predation by large gulls. In addition, some eagles also prey directly on Cormorant chicks and in some cases also on eggs. Furthermore, we have now an increasing amount of evidence from Finland and Denmark that documents how ground-nesting Cormorants attempt to mitigate the increased risks posed by the occurrence, disturbance and predation of White-tailed Eagles. Specifically, there has been a recent decline in the proportion of Cormorants nesting on the ground on small islets in the outskirts of the archipelagos, coupled with an increase in tree-nesting. We interpret this as an 'adaptation' to the increased presence of White-tailed Eagles since Cormorants nesting in trees appear to be less affected by eagle activity.

P6. Using drones to monitor nest numbers and breeding success in cormorant colonies

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The size of a cormorant colony is usually determined by counting the number of apparently occupied nests. These counts are usually carried out easily and with high precision at sites where cormorants breed on the ground. However, where cormorants nest in trees and shrubbery it easily becomes difficult to locate all nests by observing from the ground. Furthermore, breeding birds are usually flushed from their nests when people walk inside the breeding colonies which in some cases leads to an increase in the risk that eggs and chicks are predated by gulls or crows. We have introduced drones as a supplementary tool to count some of the cormorant colonies located in Denmark and Sweden. This has given us some experience about pros and cons of using drones for nest monitoring. We have also tested whether drones would be a better tool for monitoring breeding success than more traditional methods.

P7. Breeding performance in Great Cormorants: Factors of importance for spatiotemporal variation in Danish waters

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Cormorants are capable of breeding in many different types of environments partly because they are capable of breeding on the ground as well as in trees and are able to forage on a wide variety of fish species and sizes. Nonetheless, cormorants are central place foragers relying on having access to available resources of fish within a certain distance of their breeding colony. Cormorants have a high wingload and are forced to cut down on the daily number of foraging flights if the distance they have to fly increases due to deteriorating food conditions near to their breeding colony. Prolonged periods with a low feeding frequency of chicks will often lead to increased mortality among the youngest of the chicks in a brood. We followed the breeding performance of cormorants in several colonies in Denmark over a series of years and found some marked differences and changes. We also experienced that not only food availability plays a major role for chick production but also the arrival of a new predator - the White-tailed Eagle - has impaired the breeding success in a number of colonies.

P8. Managing Great Cormorant colonies in the Baltic Sea region: Actions taken and lessons learned

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Several of the countries around the Baltic Sea have introduced actions in colonies in attempts to reduce numbers of breeding cormorants and decrease the predation on fish in areas where the species is in continuous conflict with fisheries and/or in conflict with protection of endangered fish species. Some colonies are managed not because of conflicts with fish-fisheries interest but because of damage to valuable trees or other habitats. The legal actions taken include shooting and scaring of birds in or near to breeding colonies, oiling of eggs, pricking of eggs, removal of nesting trees and removal of nests. We describe how the approach taken has varied among the countries and how the intensity of actions has changed over the years. We give examples illustrating some of the variation observed in the short-term and long-term effects of the actions taken in attempts to manage cormorant numbers at a local or regional level. Unfortunately, there is usually very little follow-up in terms of documentation of the effectiveness of the measures taken with respect to the lowering of the conflict or the recovery of fish populations/increased fishery yields.

P9. Using long-term Cormorant diet data to understand fish–bird interactions

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Many marine and coastal species of birds depend on fish and information on their diet may be used to understand the state of local ecosystems. At Aarhus University we have compiled a unique dataset covering 1980–2024, documenting the diet of Great Cormorants (*Phalacrocorax carbo*). The data are based on regurgitated pellets collected at colonies across Denmark, mainly during the breeding season (April–June). This long-term dataset makes it possible to study predator–prey relationships in coastal waters.

Case studies from the colonies at Vorsø in Horsens Fjord and Melsig in Limfjorden illustrate: (i) temporal change in diet composition over four decades; (ii) spatial contrasts between North Sea and Kattegat/Baltic coastal habitats; and (iii) derivation of prey size and biomass from bony remains (otoliths and skeletal elements) using species-specific regressions.

Methodological limitations were determined from the ongoing work. Digestive erosion affects which fish remains are recovered, resulting in conservative (minimum) estimates of prey size and mass and under-representation of small or fragile taxa. Consequently, biomass reconstructions can be skewed by the overabundance of durable remains. Even with these limitations, pellet-based diet studies are highly valuable. They can: (a) serve as indicators of local coastal fish status in the vicinity of breeding colonies; (b) refine estimates of avian predation pressure; (c) reveal potential patterns of regional prey depletion; (d) infer prey preferences conditioned by accessibility; and (e) when combined with colony counts and chick survival, provide an integrated view of how local cormorants and fish populations are performing.

By connecting seabird diet with fish community data over more than 40 years, this study demonstrates how long-term monitoring can inform our understanding of marine biodiversity and food-web dynamics.



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P10. Diet of Great Cormorants (*Phalacrocorax carbo*) in the Øresund Region: A hotspot for post-breeding cormorants

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The Øresund region has become an increasingly important foraging area for migratory and overwintering great cormorants (*Phalacrocorax carbo*), and it hosts the highest concentrations of post-breeding cormorants observed in Sweden during autumn. At the same time, several local fish stocks, including cod (*Gadus morhua*), have declined in recent years. At the same time, the invasive round goby (*Neogobius melanostomus*) has increased in the area. Despite the high abundance of cormorants, information on their diet and foraging ecology in Øresund has remained surprisingly limited. We analysed pellets and stomach contents collected in 2023-2024 from three colonies spanning the region: Krapperup (north), Gråen (central), and Peberholm (south). Cormorants predominantly consumed codfishes (25% of prey abundance, of which 61% was cod), flatfishes (23%), and gobiids (18%). Within the gobiids, the round goby occurred regularly, demonstrating that cormorants both exploit and act as bioindicators of invasive species. Diet composition differed significantly between sites and years, primarily driven by variation in codfishes and flatfishes, suggesting that spatial and temporal changes in prey availability influence cormorant foraging behavior. Compared to historical data from the 1990s, the current diet shows a marked shift, with herring largely absent and eel now only a minor component. These findings provide updated baseline data on cormorant diet in the Øresund region and highlight the value of diet analyses for monitoring native and invasive fish species, assessing ecosystem change, and informing fisheries management and ecosystem modeling.



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P11. Changes in the size of the Great Cormorant breeding colony on the Golem Grad Island, Lake Prespa, North Macedonia: Overview of the colony counts in the period 2010-2025

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This poster presents long-term data on the Great Cormorant (*Phalacrocorax carbo*) colony on Golem Grad Island, Lake Prespa, North Macedonia, based on nest counts conducted between 2010 and 2025. The monitoring series reveals substantial interannual fluctuations in colony size, with total nest numbers ranging from 785 nests in 2012 to a peak of 1,643 nests in 2023. Periods of strong colony growth (2013-2016 and 2020-2023) are followed by notable declines, including the drop observed in 2024-2025. Variation in the proportion of active versus inactive nests - most inactive nests recorded in 2019 and 2024 - suggests an interplay of many factors, i.e. changes in breeding success, adults/juvenile survival rate, disturbances, habitat conditions, colony redistribution on the island, diseases and fluctuation in the food source. The nests are found primarily on Greek Juniper (*Juniperus excelsa*), a protected and slow-growing species sensitive to prolonged nesting pressure. Previous studies show that cormorant colonies can cause significant habitat degradation, including heavy tree defoliation (Ishida, 1996) and long-term floral withering and decay (Klimaszuk & Rzymiski, 2016). As cormorants consume 350-700 g of fish per bird per day (Emmrich & Düttmann, 2011), understanding colony size is also vital for assessing potential interactions with local fisheries, a key consideration in lake management planning. This 15-year dataset highlights the importance of regular colony counts for interpreting population trends, evaluating ecological impact, and guiding management decisions for both the species and its nesting habitat. Additionally, the authors recognize the need to expand the monitoring of the environmental factors that are potentially underpinning the colony size fluctuations.



Photo : © Torben Andersen

P12. The management of the Great cormorant in the upper Adriatic Sea: equilibrium reached?

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After a period of 15 years dedicated to the study of the behavioural ecology and the interactions with the fishery and aquaculture activities in the territory of Friuli Venezia Giulia Region, showing that the Great cormorant is not a limiting factor for the productive activities, the management of the species is nowadays focused on the protection of specific spots. Namely, a number of traditional extensive fish farms (fishing valli) in the coastal range and a set of important fish areas within the inland network of freshwaters. Our preliminary results highlight an effective defence from cormorants impact both at fish-production areas as well as within riverine restocking and breeding grounds for threatened fish species (i.e. *Salmo marmoratus* and *Thymallus thymallus*). Nonetheless, from a socio-economic and cultural perspective, much institutional efforts have been constantly dedicated to recognise cormorants as ecosystem indicators and not as a pest species. This long-term approach, together with encouraging results from the defence of key areas, conveyed to a local (stable?) equilibrium between the institutions deputed to cormorant management and the stakeholder orchestra, with particular reference to fishers, anglers and aquaculture managers.

P13. Recent developments of Great Cormorant population in Estonia

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The Great Cormorant was extinct as a breeder in Estonia until it began re-establishing colonies in 1983. The growth stabilized after 2006 between 10-15 000 pairs. Since 2015 a new period of rapid growth began. According to the full census of the 2025 breeding season, the breeding population now exceeds 47000 pairs.

P14. Breeding population of Great Cormorants in Czechia

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Great Cormorant has been a breeding species in Czechia regularly since the 1980s. In South Moravia, the first breeding colony (32 pairs) was established on Nové Mlýny Water Reservoirs in 1982. The number of breeding pairs at this site peaked in 1991 (612 pairs) but decreased in subsequent years, probably due to falling of some dead trees (nesting sites) and the effect of shooting in both the pre- and post-breeding period. South Bohemia also represents an important breeding region, where the first breeding was recorded in 1983. Afterwards, numbers increased, culminating in 2005 and 2006 (217 and 219 pairs). Recently, the number of breeding pairs in South Bohemia fluctuated between 185 and 201 pairs in 2000- 2024. Finally, a lower number of pairs (162 nests) was recorded in this region in 2025. The breeding population of Great Cormorants in Czechia is quite productive, with an annual mean production of between 3.3 and 3.6 fledglings per nest. The regulation includes the shooting and flushing of Cormorants, mostly during non-breeding periods. Moreover, the damages caused by cormorants to fish stocks in commercial fishponds are compensated by the regional government.

P15. Cormorant predation in a grayling stream in the Austrian foothills - Insights from PIT-tagging

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We investigated the effects of cormorant predation on fish communities in the Lower Traun River and its tributaries, the Ager and Alm Rivers, between Gmunden and the confluence with the Alm River in Upper Austria. Fish were tagged with passive integrated transponders (PIT-tags) in 2019 and 2020 and later searched for at four cormorant roosting sites. Three main questions were addressed: (1) the extent of predation based on tagged and consumed fish, (2) spatial variation in predation pressure across roost sites, and (3) cormorant preferences for specific fish species or sizes. More than 12,800 fish, both stocked and wild, were tagged in the rivers Alm, Traun and Ager. Tagging took place in summer and autumn 2019, with searches in the following winters. The recovery rate of PIT tags was about 10%. Consumed fish ranged from 12 to 44 cm, with stocked brown trout and rainbow trout being the most commonly consumed species. Relative predation was highest on grayling, especially those between 25 and 35 cm. Predation rates adjusted for detection limits suggested a removal rate of around 40% for grayling, compared to 20-30% for perch and pike. Wild fish experienced slightly higher predation pressure than stocked fish. Lower cormorant numbers in the second season were associated with a reduced impact on fish populations. Spatial analysis showed that predation pressure decreased with distance from roosting sites. Our results confirm that cormorants exert significant pressure on fish populations, especially grayling, in the Lower Traun region. This persistent predation threatens the recovery of already weakened grayling stocks, indicating a likely further ecological decline without management intervention.

P16. Managing Great Cormorant impacts in Italy: Policies and practices under the EU Birds Directive

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Since the early 1980s, the sharp increase in Great Cormorant numbers across Italy has raised growing concerns among stakeholders in fisheries, aquaculture, and recreational angling. Fish farmers were the first to report significant socio-economic impacts of cormorant predation, including higher operating costs, revenue losses, and reduced employment. Anglers subsequently expressed concerns about declining catches, reduced catchability, and the perceived ineffectiveness of restocking programs. More recently, attention has shifted also toward the effects of cormorant predation on already diminished populations of rare or localized fish species, as well as on assemblages of native fish.

Recent estimates indicate that Italy hosts a few thousand breeding birds and approximately 80,000 wintering cormorants distributed across the Peninsula and major islands, representing the third-largest wintering population in Europe. As in most European countries, cormorants and their habitats are protected under national legislation and EU directives. Consequently, any potentially harmful actions—such as habitat modification, egg destruction, nest removal, or shooting—may only be authorized under Article 9 derogations of the EU Birds Directive. These derogations require evidence of serious damage caused by cormorants and demonstration that non-lethal “ecological” measures are either inapplicable or ineffective.

In Italy, the derogations can be issued by the 19 Regional administrations and two Autonomous Provinces, following a mandatory, though non-binding, scientific assessment by ISPRA, the national advisory body to the Ministry for the Environment. Although Italy lacks a unified national cormorant management strategy, most—but not all—regions affected by conflicts have developed multi-annual management plans that meet the Birds Directive requirements for authorizing lethal control. Activities are reported annually to ISPRA for evaluation, and then to the Environmental Ministry, which is responsible for reporting applied derogations to the EU.

Nowadays, although eight regional administrations allow cormorant shooting, the number of cormorants legally shot in Italy remains relatively low compared to the number of cormorants counted in winter, where most conflicts arise, and control activities carried out in other EU countries.

At present, although eight regional administrations authorize cormorant shooting, the number of birds legally culled in Italy remains relatively low compared with the wintering population—when most conflicts occur—and with control efforts implemented in other EU countries.

This presentation outlines recent changes in management policy in relation to cormorant distribution and conflict intensity, with particular attention to shooting and other measures used to regulate population size under Birds Directive derogations. The overview includes the current distribution and nature of conflicts, the range of mitigation measures adopted, and an assessment of reported culling activities.

P17. Great Cormorant Wintering in Italy: Population Expansion and Monitoring Constraints

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Since the rapid expansion of the continental population of the Great Cormorant (*Phalacrocorax carbo*), Italy has become one of the main wintering areas for birds originating from central-western and northern Europe, including colonies from the Netherlands, Scandinavia, the Baltic states, Germany, and Poland.

During the late 1980s and 1990s, wintering birds were largely concentrated in a limited number of highly productive areas, notably coastal lagoons in Sardinia, Sicily, the north-eastern Adriatic, Tuscany and Apulia, as well as the large rivers of the Po Plain and sub-alpine lakes. These sites, characterised by high fish availability and mild climatic conditions, hosted most of the wintering population, which was estimated at up to 13,000 individuals in 1987. At that time, birds were still grouped in a limited number of roosts, making population counts relatively easy. For example, in January 1993, about 6,800 cormorants wintered within the approximately 92,000-hectare mosaic of wetlands of the Po Delta and Venice lagoons, concentrated in just 11 roosts.

Over the last three decades, further population growth and major changes in spatial distribution have occurred, both at regional and local scales, with important implications for monitoring and management. In January 2001, the Italian population was estimated in about 60,000 birds, with 48,200 cormorants counted in 169 roosts. The last national coordinated census of night roosts, conducted in January 2013 within the EU CORMAN project, reported more than 77,000 birds distributed across 378 sites, indicating a strong increase in abundance and a marked dispersion of roosts.

Despite the relevance of the species in terms of fisheries interactions and management conflicts, Italy still lacks a dedicated and coordinated national monitoring programme for the Great Cormorant. The species is currently surveyed mainly within the framework of the mid-January International Waterbird Census (IWC), but delays in data reporting, validation and publication are often limit the availability of timely, up-to-date and comprehensive information at regional and national scales.

In this contribution, we present updated data from selected wintering areas and compare recent figures with historical records. Rather than providing a complete national assessment, our aim is to illustrate how the overall “picture” of Great Cormorant wintering in Italy has changed in recent years, and to highlight the challenges of achieving effective national-scale monitoring under current constraints in dedicated personnel and resources.

P18. Bridging the Gap: Updating the breeding status and distribution of the Great Cormorant (*Phalacrocorax carbo*) in Italy

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In Italy, the Great Cormorant is a widespread and common waterbird, occurring from the Alpine region in the north to Sicily in the south. The species occupies a broad range of aquatic habitats, including coastal waters, brackish lagoons, rivers and lakes in the Alps and Apennines, as well as natural and artificial water bodies, channels, and aquaculture facilities. Increasing interactions with fish-related stakeholders have led to its frequent perception as a pest species and to the adoption of several regional management plans, some of which include population control measures.

Despite its relevance for management and its suitability for census work as a large colonial breeder, Italy still lacks a coordinated, long-term monitoring programme at the national scale. The most recent comprehensive census, carried out in 2012 within the framework of the EU CORMAN project, recorded 48 breeding colonies and an estimated 3,914 occupied nests (range: 3,865–4,016) across 11 of the 20 Italian regions. Although this represented an 82% increase compared with the 2,142 nests recorded in 2006, the Italian breeding population remained small in comparison with those of several other European countries and constituted only a fraction of the approximately 80,000 individuals counted at winter roosts in Italy in January 2013.

Since that census, new breeding colonies have been established in areas previously unoccupied by the species, resulting in an expansion of the breeding range and a likely increase in the number of nesting birds. This ongoing expansion may have relevant ecological and biogeographical implications and may alter the spatial and temporal patterns of conflict with fisheries and other stakeholders. In this study, we update current knowledge on the size and distribution of the Italian breeding population using the most recent available data and discuss the results in view of a future coordinated national census of breeding colonies.

P19. Population development of European shag (*Gulosus aristotelis*) and great cormorant (*Phalacrocorax carbo*) on the Swedish west coast

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From being a rare visitor, the European shag (*Gulosus aristotelis*) became increasingly common off the northern Swedish west coast during the 1990s. The first breeding was confirmed in 2004, and since then the breeding population has grown rapidly to at least 1,500 pairs. A few decades earlier, the great cormorant (*Phalacrocorax carbo*) underwent a similar development. The first breeding on the west coast was recorded in 1994. Following an increase up until 2020, the breeding numbers have stabilised at approximately 10,000 breeding pairs. Breeding shags occur along much of the west coast, but a clear majority breed in the Väderöarna Archipelago. Cormorant colonies are more evenly distributed along the coastline. Outside the breeding season, shags nowadays greatly outnumber cormorants in exposed coastal areas. Kosterhavet Marine National Park has supported 3,000-5,000 shags each autumn over the past ten years, representing almost half of all shags present in Swedish waters at that time. In contrast, autumn numbers of cormorants have declined over the same interval, from roughly 900 to about 400 individuals. Among cormorants, the Atlantic subspecies *P. c. carbo* predominates during this period, by far surpassing the continental subspecies *P. c. sinensis*. The most recent national census of the great cormorant in Sweden, conducted in 2023, recorded nearly 75,000 breeding pairs. The previous survey, undertaken during the pan-European census in 2012, documented just over 40,000 breeding pairs - an increase of more than 85% over the eleven years. The population development of the cormorant along the Swedish west coast probably mirror the national trajectory quite well (a comprehensive synthesis of regional monitoring data is currently underway).



Photo : © Torben Andersen

P20. Foraging movement and habitat use of the Mediterranean Shag during the breeding season in the Adriatic Sea

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Shags, like other seabirds, are central-place foragers during the breeding season and are often used as indicators of marine ecosystem health. Understanding their foraging distribution and habitat preferences is therefore essential. The Mediterranean subspecies of the European Shag (*Gulosus aristotelis desmarestii*), which breeds in the Adriatic Sea, remains understudied, particularly with respect to foraging movements during breeding and habitat use. To address this gap, we conducted a GPS-tracking study on 22 breeding individuals from a colony in the Adriatic Sea, Croatia. Foraging metrics were comparable to those reported for Atlantic populations of the nominate subspecies, with a median maximum distance from the colony of 4.81 km and a maximum recorded distance of 24.45 km. No significant differences were found between sexes in movement metrics or spatial distribution. Shags predominantly foraged in seagrass meadows and, to a lesser extent, in infralittoral algal communities on rocky substrates, typically at depths between 10 to 20 m. Further studies across additional colonies are needed to assess foraging ranges and habitat preferences throughout the Adriatic Sea and to provide a robust scientific basis for the designation of Marine Special Protection Areas (SPAs) and the effective conservation of the Mediterranean Shag in Croatia.

P21. Monitoring Cormorant populations at Skadar Lake: Insights from IWC Counts of Pygmy (*Microcarbo pygmaeus*) and Great (*Phalacrocorax carbo*) Cormorants

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Skadar Lake, a key wetland in the Western Balkans, hosts significant breeding and wintering populations of waterbirds, including cormorants. Using standardized International Waterbird Census (IWC) data collected over recent decades, we analyzed population trends of Pygmy Cormorant (*Microcarbo pygmaeus*) and Great Cormorant (*Phalacrocorax carbo*). IWC counts reveal marked differences in population dynamics between these species, which highlight the contrasting ecological niches and habitat dependencies of the two species.

P22. Pygmy Cormorant: An expanding waterbird species in Czechia

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The Pygmy Cormorant *Microcarbo pygmeus* was a rare vagrant bird species in Czechia, occurring especially in the autumn migration period. Up to 2020, there were only 3 records of single individuals by the mid-winter (January) International Waterbird Census, i.e., in 2004, 2006, and 2007. The expansion of this species started in July 2021, when a few flocks were recorded in various regions of the country. Since January 2022, the Pygmy Cormorant has been a regularly wintering species, which was recorded in 3 sites (89 individuals) in 2022, 1 site (97 individuals) in 2023, 9 sites (274 individuals) in 2024, and 10 sites (752 individuals) in 2025. The first breeding was recorded in the Middle Lake of Nové Mlýny Water Reservoir in 2022, with 60-120 breeding pairs confirmed annually. The poster will also include an analysis of bird watchers' data, especially. Seasonal and regional pattern of the distribution of Pygmy Cormorants in Czechia.



Photo : © Steffen Ortmann

P23. Migration dynamics of Pygmy Cormorant (*Microcarbo pygmaeus*) and variation in flight corridors to roost along the Danube River in Novi Sad

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The Pygmy Cormorant is a common species in south-eastern Europe and especially numerous during the non-breeding period in the vicinity of large water bodies. In Serbia, dozens of Pygmy Cormorant roosts are known during the wintering period, but few of them are located in the (sub)urban areas of big cities. In Novi Sad, Pygmy Cormorants fly over the city in the evening, following the Danube River as a corridor, and roost at the old sand pits on the northern edge of the city (45°18'04.4"N, 19°50'36.7"E). The aim is to monitor the number of Pygmy Cormorants systematically from November to April in the long term. Here are described results from the first year of monitoring during the wintering season 2024-2025. Pygmy Cormorants were systematically counted every ten days (decade) from November to April for two hours in the evening. Counting was conducted from two points following the two different flight corridors (upstream and downstream from the Danube). Pygmy Cormorants gather in greater numbers at the roost from the end of September (465 individuals at one point), reaching the maximum numbers in February (a maximum of 737 individuals was recorded on 28.2.2025). A strong decrease in the number is recorded in the first decade of March. At the end of March (second and third decade), Pygmy Cormorants changed their roost and flight on the opposite side, more downstream, probably closer to the breeding colonies. Also, it was noticed that there was a strong variation in the number of Pygmy Cormorants between the corridors and between corridors and decades. Continuous monitoring is essential for improving our understanding of how certain waterbirds respond to rapid changes in urban ecosystems caused by the urbanization.



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P24. Status of the Pygmy Cormorant (*Microcarbo pygmaeus*) in Austria

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Until 2006, the Pygmy Cormorant was a rare visitor in Austria outside the breeding season. In 2007, breeding began for the first time in the reed beds of Lake Neusiedl in Burgenland. Later, this colony increased to a maximum of 358 pairs in 2015. After that, the number of breeding pairs declined again, and by 2023 the breeding site was no longer occupied. In the same year, a small colony of three breeding pairs was established on the Lower Inn in Upper Austria, which continued to grow in numbers until 2025 up to 13 pairs.

Since the breeding colonies were established, the Pygmy Cormorant can be seen in Austria all year round. At least three larger roosts are known to exist in eastern Austria. Regular counts have been carried out at a roost in Seewinkel/Burgenland since July 2024. In December 2024 a maximum number of over 1,200 individuals was recorded here. This also represents the largest gathering known from Austria to date.



Photo : © Kim Billedgaard

P25. The breeding population of Great Cormorants in the Azov-Black Sea region with emphasis on 2021

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The size and distribution of the breeding population of Great Cormorant (*Phalacrocorax carbo*) along the northern coast of the Black Sea and the Sea of Azov have changed markedly over the last 60 years. From only a few hundred breeding pairs in the mid-20th century, numbers increased dramatically, peaking at over 61,000 pairs in 2008, primarily due to population growth in the Azov–Black Sea region, which accounted for more than 87% of Ukraine’s total population. Despite a subsequent decline, the population remained relatively high through the late 2010s. However, a sharp decrease in both population size and the number of active colonies during 2016–2018 prompted an updated assessment in 2021. Field surveys across key regions (Odesa, Mykolaiv, Kherson, Zaporizhzhia, and Donetsk) and literature reviews for other areas revealed 23 confirmed and 4 probably inhabited colonies, alongside 43 uninhabited and 2 probably uninhabited former colonies. The breeding population was estimated at 31,683–33,733 pairs, with the Obytchna Spit colony alone comprising 63% of the total. Mainland Ukraine likely supported no more than 2,500–3,000 pairs. Spatial dynamics indicate a long-term decline in Danubian colonies and a continued increase in Azov Sea colonies. Currently, available data indicate a tendency toward a decline in the size of the breeding population of the species in Ukraine; however, the Russian invasion since 2022 has severely restricted field research. As of 2025, 20 of 27 known colonies in the Azov–Black Sea region are located in temporarily occupied areas or in close proximity to areas where fieldwork is impossible at the moment due to the current situation. Consequently, we have no updated assessment of status of these colonies. The findings underscore the need for continued monitoring and conservation efforts despite the challenging geopolitical conditions.



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