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Programme & Abstracts

Museum am Rothenbaum – Cultures and Arts of the World (MARKK),

Hamburg, Germany

24 – 26 November 2026

8th International Swan Symposium

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Hosted by

NABU - The Nature and Biodiversity Conservation Union of Germany

IUCN-SSC Swan Specialist Group



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Welcome

It is our great pleasure to welcome you to the 8th International Swan Symposium, held from 24 to 26 November 2026 at the Museum am Rothenbaum (MARKK) in Hamburg, Germany.

This symposium continues a long tradition of bringing together scientists, conservation practitioners, wildlife managers and dedicated volunteers who share a common interest in the biology and conservation of the world's swans. On behalf of NABU (Nature and Biodiversity Conservation Union of Germany) and the IUCN SSC Swan Specialist Group, we extend a warm welcome to all participants who have travelled from across Europe, Asia and North America to contribute their expertise and experience.

The programme of this year's symposium reflects both the remarkable progress that has been made in swan research and the considerable conservation challenges that remain. The oral presentations and posters cover a wide range of topics, including migration ecology and movement behaviour, habitat use, breeding biology, population monitoring, climate change impacts, protected area effectiveness and emerging threats from infrastructure and pollution. Together with new insights on innovative applications of telemetry and other new technologies, they highlight how advances in scientific methods are deepening our understanding of swan populations throughout their annual cycle and across international flyways.

Several contributions focus on the conservation of declining populations, particularly the Bewick's Swan, while others document encouraging recovery and expansion in species such as the Trumpeter Swan, Mute Swan and Whooper Swan. Many studies demonstrate the value of long-term monitoring, international collaboration and citizen science, while others showcase the growing contribution of GPS telemetry, remote sensing and novel analytical approaches to answering long-standing ecological questions. Collectively, the work presented here underlines the importance of evidence-based conservation and the need for coordinated action across national borders.

Swans have long served as emblematic species of wetlands and aquatic ecosystems. Their conservation depends not only on the protection of key habitats, but also on broader efforts to address environmental change, maintain ecological connectivity and promote coexistence between people and wildlife. The diverse research presented at this symposium illustrates the interconnected nature of these challenges and the opportunities for collaboration among researchers, conservation organisations, governments and local communities.

We hope that the symposium will provide an inspiring forum for scientific exchange, lively discussion and the development of new partnerships. Beyond the formal sessions, we encourage participants to take advantage of opportunities to share ideas, establish

collaborations and strengthen the international network of swan researchers and conservationists that has been built over many decades.

Finally, we would like to thank all authors, speakers, poster presenters, members of the Scientific Committee, organisers, funders and volunteers whose efforts have made this symposium possible. Your commitment to advancing swan research and conservation is greatly appreciated.

We wish you a productive and enjoyable symposium and a pleasant stay in Hamburg.

Götz Eichhorn, Sabine Beninde, Frauke Mohrwinkel & Dominic Cimiotti
Michael-Otto-Institut im NABU, Germany

Julia Newth & Eileen Rees
IUCN SSC Swan Specialist Group, UK



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Programme

24.11.2026, Tuesday

09:15 - 10:00	Registration & Poster Installation
10:00 - 10:30	Words of Welcome
	SESSION: CONSERVATION
10:30 - 10:50	Julius Morkūnas, Dmitirjs Boiko, Monika Pelėdienė & Rasa Morkūnė - **Seasonal flight patterns of Whooper Swans and their implications for wind turbine collision risk**
10:50 - 11:10	Jayden L. Jech & Adam K. Janke - **Trumpeter Swan *Cygnus buccinator* recovery is supported by agricultural water quality conservation efforts on private lands in Iowa, USA**
11:10 - 11:30	Coffee Break
	SESSION: POPULATIONS
11:30 - 11:50	P. Clausen, R.D. Nielsen, J. Sterup, C.L. Pedersen, H.M. Thomsen & A.D. Fox - **60 years of swan numbers in Denmark – with a conservation update**
11:50 - 12:10	Hans-Joachim Augst - **Current Population Trends of the Bewick's Swan (*Cygnus columbianus bewickii*) in Schleswig-Holstein in the age of climate change**
12:10 - 12:30	Vladimir Mladenov & Ralitsa Georgieva - **Recent numbers of migrating and wintering Bewick's (*Cygnus columbianus bewickii*) and Whooper (*Cygnus cygnus*) Swans in the Burgas Lakes complex, Bulgaria**
12:30 - 13:30	Lunch Break
13:30 – 14:00	Poster Session
14:00 - 14:20	Tohar Tal, Bart A. Nolet, Tom S.L. Versluijs, Judy Z. Shamoun-Baranes, Goetz Eichhorn, Sabine Urban & Hans Linssen - **Low breeding propensity in a declining Arctic-breeding swan revealed by telemetry data**
	SESSION: HUNTING & LEAD POLLUTION
14:20 - 14:45	J.L. Newth, K. A. Wood & R. L. Cromie - **Phasing out lead: progress in ammunition and fishing tackle**
14:45 - 15:05	Nellissa Stalenhoef & Sherri Cox - **Bad to the bone? Evaluating bone lead in Trumpeter Swans in vivo using portable x-ray fluorescence spectrometry**
15:05 - 15:20	Julia Newth, Eileen Rees - **Update and discussion regarding IUCN Swan Specialist Group**
15:20 - 15:50	Coffee Break
15:50 - 16:10	Elmira Zaynagutdinova, Aleksei Kozlov, Alexander Markelov & Sonia Rozenfeld - **Assessing the exposure of migrating Bewick's Swans to spring hunting in Northwest Siberia, Russia**

	SESSION: SPACE USE
16:10 - 16:30	Hans Linssen, E. Emiel van Loon, Judy Z. Shamoun-Baranes, Lisa Vergin, Jutta Leyrer & Bart A. Nolet - **Comparing tracking data and resighting data for inferring population ranges and areas of low observation effort**
16:30 - 16:50	S.A. Kouzov, A.V. Kravchuk, D.A. Rodionov & E.V. Abakumov - **Climatic constraints on the northward expansion of the Mute Swan (*Cygnus olor*) in the Western Palearctic**
16:50 - 18:00	Bewick's Swan Expert Group Meeting

25.11.2026, Wednesday

	SESSION: SPACE USE
09:20 - 09:40	Ivonne R. Romero - **State-dependent habitat selection in wintering Trumpeter Swans**
09:40 - 10:00	Radosław Włodarczyk, Jacek Betleja, Grzegorz Kiljan & Włodzimierz Meissner - **Endogenous versus environmental factors affecting body condition in the Mute Swan (*Cygnus olor*) during winter**
10:00 - 10:20	Rasa Morkūnė, Martynas Bucas & Julius Morkūnas - **Macrophyte habitat selection and recreational disturbance of moulting Mute Swans in the largest Baltic Sea lagoon**
10:20 - 10:40	Jeff Black - **Mute swan behaviour and space use of Gloucester and Sharpness Canal, England, during brood-rearing and moult**
10:40 - 11:00	Coffee Break
	SESSION: MIGRATION
11:00 - 11:20	Hans Linssen, E. Emiel van Loon, Götz Eichhorn, Judy Z. Shamoun-Baranes, Sarah A. Sonsthagen, Sabine Urban, Robert E. Wilson & Bart Nolet - **Family life, cultural inheritance and range shift in Bewick's Swans**
11:20 - 11:40	Sabine Urban, Hans Linssen, Bart Nolet & Götz Eichhorn - **Identification of key stopover areas and migration corridors of the rapidly declining Bewick's Swan (*Cygnus columbianus bewickii*) population wintering in NE/NW Europe**
11:40 - 12:00	Tetsuo Shimada, Kan Konishi, Guozheng Li, Guodong Shi & Hiroyoshi Higuchi - **Swan Project: Public bird migration tracking and citizen science**
12:00 - 12:30	Poster Session
12:30 - 13:30	Lunch Break
13:30 - 13:50	Kane Brides, Kevin A. Wood, Sverrir Thorstensen, Stephen Vickers, Ólafur Einarsson, Catrin Eden, Dmitrijs Boiko, Kees Koffiberg, Axel Degen, Bjarke Laubek, Didier Vangeluwe, Graham McElwaine, Maria Wieloch, Leho Luigujõe, Julius Morkūnas, Yulia Bogomolova, Preben Clausen, Fanjuan Meng, Lei Cao & Eileen C. Rees - **When flyways meet: combining long-term ringing records and GPS telemetry reveals low levels of connectivity between Icelandic and Northwest Mainland European Whooper Swan *Cygnus cygnus* populations**

13:50 - 14:10	Stephen H. Vickers, Kane Brides, Sverrir Thorstensen, Kevin A. Wood, Ketill Þór Thorstensen, Ólafur Einarsson, Eileen C. Rees, Fanjuan Meng & Lei Cao - **Limited but highly variable protected area use by Icelandic Whooper Swan (*Cygnus cygnus*) across the annual cycle** SESSION: SPECIES INTERACTION
14:10 - 14:30	Kevin A. Wood, Grace Clarke, Beth Gray, Phoebe Ham, Holly Hitchins, Rebecca Lacey, Ellie Machiani, Nigella Marx, Jake Scales, Rowen Wang, Eleanor Wyeth & Paul E. Rose - **New tools for old problems: using remotely collected data from webcams to investigate interactions between swans and other waterbirds.**
14:30 - 14:50	S.A. Kouzov, V.M. Khaitov, E.M. Koptseva, A.V. Kravchuk, Yu.I. Gubelit & E.V. Abakumov - **Spatial trophic niche differentiation in sympatric swan species (*Cygnus* spp.) in the Baltic Sea coastal zone**
14:50 - 15:20	Coffee Break
14:50 – 15:20	Closing remarks/spare slot/break
16:00 - 18:00	Bewick's Swan Expert Group Meeting

26.11.2026, Thursday

Excursion to the UNESCO Schaalsee Biosphere Reserve and **Banquet**

08:45	**Boarding** at MARKK – Museum am Rothenbaum, Hamburg
09:00	Departure
10:00–12:00	**Guided tour of the Pahlhuus Visitor Centre** and the moorland nature trail in Zarrentin.
12:00 – 14:00	**Birding on different parts of the Schaalsee region**: Swans, geese, ducks and more! *We will bring some binoculars and spotting scopes, but please feel free to bring your own as well.*
15:00–16:45	**Visit to Lübeck Christmas Market** *Time to explore the traditional Christmas market on your own, have a snack and enjoy the festive atmosphere.*
16:45	Boarding in Lübeck
17:00	Departure
Appr. 18:00	Arrival at MARKK, Hamburg
18:00-20:30	**Free Time** *Participants are welcome to explore the museum's exhibitions (free admission) or explore Hamburg a little. Those who wish to do so may also visit the restaurant earlier and just relax.*
20:30	**Symposium Dinner / Banquet**, Venue: MARKK, Hamburg

Expected end: approx. 23:00

Poster Session (Tuesday & Wednesday)

Radosław Włodarczyk & Julia Charuba - **Weather-driven variation in the breeding success of Mute Swans (*Cygnus olor*) in central Poland**

Krzysztof Dudzik & Grzegorz Sobczak - **Sex-biased natal dispersal and strong breeding site fidelity contribute to the spatial organization of an expanding Whooper Swan population**

Martha Jordan & Kimberly Cashon-Smith **- Swan neck deformities in Trumpeter and Tundra Swans in North America**

Vladimir Mladenov, Ralitsa Georgieva, Kiril Bedev & Plamena Gospodinova - **Leg loops as an effective method for trapping Bewick's (*Cygnus columbianus bewickii*) and Whooper (*Cygnus cygnus*) Swans in Bulgaria**

Shilong Bi & Lizhi Zhou - **Spatio-temporal dynamics of the wintering Tundra Swan (*Cygnus columbianus*) population in shallow, hydrologically-regulated lakes of the Yangtze-Huaihe river basin**

Sabine Urban, Hans Linssen, Bart A. Nolet & Götz Eichhorn **- Protected areas and infrastructure avoidance jointly shape winter space use in Bewick's Swans**

Abstracts

POSTER (1)

Weather-driven variation in the breeding success of Mute Swans (*Cygnus olor*) in central Poland

Radosław Włodarczyk & Julia Charuba

University of Łódź, Poland

This study investigated the effects of weather conditions on the breeding performance of a mute swan (*Cygnus olor*) population in central Poland during 1999-2021. The timing of egg laying was significantly influenced by mean winter temperature. Hatching success was affected by average daily precipitation during the laying period and by its interaction with temperature. Furthermore, temperature during the first four weeks after hatching significantly influenced breeding success, with a nonlinear (quadratic) relationship observed. Fledging success also varied with hatching date. These findings demonstrate that multiple weather variables regulate key reproductive parameters in mute swans and suggest that climate-driven changes in temperature and precipitation patterns may adversely affect breeding performance. Overall, the study highlights the strong influence of weather conditions on avian breeding ecology.

POSTER (2)

Sex-biased natal dispersal and strong breeding site fidelity contribute to the spatial organization of an expanding Whooper Swan population

Krzysztof Dudzik (1)(2), Grzegorz Sobczak (3) & Łukasz Jankowiak (1)

(1) Department of Ecology and Anthropology, Institute of Biology, University of Szczecin, Poland; (2) Eagle Conservation Committee, Świętokrzyskie Region, Poland; (3) Polish Society for the Protection of Birds, Birdlife Poland

The breeding range of the Whooper Swan (*Cygnus cygnus*) has expanded considerably across large parts of Europe during recent decades. However, little is known about how natal dispersal, breeding dispersal, and breeding site fidelity contribute to the spatial organization of newly established populations because such information requires long-term monitoring of individually marked birds. We investigated these processes together with age at first breeding in a recently established and expanding population in southern Poland. Between 2003 and 2026, we monitored the breeding population and marked 217 cygnets (up to 2023) and 16 breeding adults (up to 2025). Analyses of natal dispersal and age at first breeding were based on 36 recruited individuals, while breeding site fidelity and breeding dispersal were assessed from 139 consecutive breeding records obtained from 37 marked birds. The mean natal dispersal distance was 41.4 km (range 0-331 km). Natal dispersal was strongly male-biased, with males dispersing approximately four times farther from their natal sites than females. Age at first breeding did not differ between sexes, and most individuals initiated breeding in their fifth or sixth calendar year of life. Natal philopatry was rare (8.3% of recruited birds). In contrast, breeding site fidelity was exceptionally strong: 92.1% of consecutive breeding records involved no change of breeding territory, and breeding dispersal occurred in only 7.9% of breeding attempts. Moreover, 93.0% of breeding attempts without territory change occurred within 1 km of the previous nest location. Our results suggest that natal dispersal and breeding site fidelity play complementary roles in the spatial organization of an expanding Whooper Swan population. These findings indicate that population expansion can occur without substantial reorganization of established breeding territories.

POSTER (3)

Swan neck deformities in Trumpeter and Tundra Swans in North America

Martha Jordan & Kimberly Cashon-Smith

Northwest Swan Conservation Association

Over the past 50 years of swan observations in western Washington, United States, there have been rare sightings of Trumpeter and Tundra Swans (*Cygnus buccinator* and *Cygnus columbianus*) with a neck abnormality that is a sharp angular kink, or a rounded curve. The curves have been in various directions and placement along the neck. Over the past 4 years we have observed an increase in the number of Trumpeter Swans in western Washington that have these anomalies. There is one report for a Tundra Swan. During the winter of 2025-2026, in western Washington, we observed at least 6 individual swans in the Skagit Valley and one in the Snoqualmie Valley. At least three swans returned from previous year sighting. In eastern Washington, one Trumpeter Swan and one Tundra Swan were seen. Other than a misshapen neck, the swans appear to be coping well with their abnormalities, including the more than 2500 miles migration each way. Finding these deformed swans is random as they move around a large geographical area. Most observations have been made by people out bird watching and/or taking photographs. Recent information indicates that this deformity has been observed across North America in both Trumpeter and to a lesser extent, Tundra Swans. The cause of these deformities is currently unknown. Speculation includes injury, nutrition issues, toxins, and genetics that results in scoliosis pre-hatch. It is highly unlikely this condition is the result of an injury. We are working on gathering additional sightings from North America and seeking information from veterinarians, biologists, researchers and the general public regarding the cause of this condition and increasing frequency.

POSTER (4)

Leg loops as an effective method for trapping Bewick's (*Cygnus columbianus bewickii*) and Whooper (*Cygnus cygnus*) Swans in Bulgaria

Vladimir Mladenov (1), Ralitsa Georgieva (1), Kiril Bedev (2) & Plamena Gospodinova (1)

(1) Bulgarian Society for the Protection of Birds, Bulgaria; (2) Bulgarian Academy of Sciences, Bulgaria

In 2009, we launched a color-ringing project focusing on Bewick's (*Cygnus columbianus bewickii*) and Whooper (*Cygnus cygnus*) swans. To facilitate this research, we designed a custom leg-loop trap specifically for these species. The traps have proven highly effective, with a success rate of one to four birds captured during almost every attempt. Furthermore, this method is significantly cheaper, simpler, and safer for the birds compared to more traditional techniques, such as cannon netting. In this poster, we detail the design of our leg loops and share our field experience in deploying them.

POSTER (5)

Spatio-temporal dynamics of the wintering Tundra Swan (*Cygnus columbianus*) population in shallow, hydrologically-regulated lakes of the Yangtze-Huaihe river basin

Shilong Bi (1)(2)(3) & Lizhi Zhou (1)(2)(3)

(1) School of Resources and Environmental Engineering, Anhui University, Hefei, China; (2) Anhui Province Key Laboratory of Wetland Ecosystem Protection and Restoration (Anhui University), Hefei, China; (3) Anhui Shengjin Lake Wetland Ecology National Long-term Scientific Research Base, Dongzhi, China

Elucidating the spatio-temporal dynamics of wintering waterbirds in shallow, hydrologically-regulated lakes is a core prerequisite for evaluating the efficacy of regional wetland ecological restoration and formulating scientific conservation strategies. Based on synchronous waterbird survey data collected in January from 2016 to 2026 in Anhui Province, China, this study analyzes the interannual evolution, spatial distribution patterns, and response mechanisms of the wintering Tundra Swan (*Cygnus columbianus*) population to environmental and anthropogenic drivers. The results indicate that over the past decade, the wintering Tundra Swan population in this region has exhibited a highly significant restorative growth trend (Spearman $r = 0.945$, $P < 0.01$), with abundance increasing nearly ten-fold. Spatially, the population has gradually shifted from a highly aggregated state centered on a few core lakes to a diversified, northward-expanding pattern, dispersing distinctly from the Yangtze River basin to the Huaihe River basin. During the wintering period, the habitat utilization of Tundra Swans exhibits a sequential dynamic, transitioning from initial high aggregation to subsequent spatial dispersion. Temporally, population abundance exhibits a unimodal pattern with a distinct mid-winter peak, driven by the recession of water levels and the subsequent exposure of food resources during the dry season. However, extreme meteorological events, such as droughts and floods, have disrupted the normal periodic hydrological rhythms of these shallow wetlands, leading to severe food scarcity and triggering sharp population declines in specific years. It is particularly alarming that during the late wintering period, driven by the declining carrying capacity of natural lakes, the population's reliance on artificial agricultural habitats, such as lotus ponds, where birds increasingly forage on crop residues, has drastically increased. This phenomenon exposes the underlying vulnerability that the ecological functions of some natural wetlands remain incompletely restored. Ultimately, this study reveals the active adaptation strategies of wintering Tundra Swans to complex environmental changes, providing critical scientific evidence for fine-scale wetland hydrological regulation, habitat network restoration, and sustainable species conservation at the watershed scale.

POSTER (6)

Protected areas and infrastructure avoidance jointly shape winter space use in Bewick's Swans

Sabine Urban (1), Hans Linssen (2)(3), Bart A. Nolet (2)(3) & Götz Eichhorn (1)

(1) Michael-Otto-Institut im NABU, Germany; (2) University of Amsterdam, The Netherlands; (3) Netherlands Institute of Ecology, The Netherlands

Humans not only modify landscapes by altering habitat composition but also by introducing transportation and energy infrastructure that may constrain animal movement. In northwestern Europe, wintering areas of migratory waterbirds increasingly overlap with dense networks of roads, power lines, and wind turbines. In order to assess direct effects of infrastructure on waterbird space use one needs to take indirect effects of their habitat preferences into account. Here, we combined resource selection and step selection analyses of more than 5.6 million GPS locations from 104 Bewick's swans (*Cygnus columbianus bewickii*) wintering in Germany to quantify habitat selection across spatial scales, and assess responses to roads, power lines, and wind turbines.

Bewick's swans exhibited pronounced diel shifts in habitat use, selecting arable lands and grasslands during daytime while relying strongly on wetlands, inland waters, and protected areas at night. Habitat selection patterns were highly consistent across both landscape-scale and movement-scale analyses, indicating that habitat composition is the primary determinant of winter space use. Responses to infrastructure were localized and infrastructure-specific. During fine-scale movement decisions, Bewick's swans consistently avoided roads within approximately 250–500 m and, most strongly, high-voltage power lines within approximately 500 m, with effects remaining detectable up to 1 km. Interestingly, apparent avoidance of wind turbines largely disappeared after accounting for habitat preferences.

These findings demonstrate that behavioural responses to infrastructure depend strongly on habitat context and that overhead power transmission lines impose a greater constraint on winter habitat use than wind turbines. The combination of strong selection for protected wetland habitats (as roost site) and avoidance of nearby infrastructure highlights the importance of maintaining low-disturbance landscapes around key wintering sites and provides an evidence base for spatial planning and mitigation in increasingly human-dominated environments.

TALK (1)

Seasonal flight patterns of Whooper Swans and their Implications for wind turbine collision risk

Julius Morkūnas (1)(2), Dmitirjs Boiko (3), Monika Pelėdienė (2) & Rasa Morkūnė (1)

(1) Marine Research Institute, Klaipeda University, Lithuania; (2) Costal research and planning institute, Lithuania

The rapid expansion of wind energy across Europe has increased concerns about collision risk for migratory birds. Whooper Swans (*Cygnus cygnus*) undertake long-distance migrations and may encounter numerous wind farms along their flyways. Understanding seasonal variation in flight behaviour is essential for assessing collision risk evaluating wind energy planning.
This study investigated the annual flight patterns of Whooper Swans, focusing on seasonal changes in flight altitude and speed and their implications for potential collisions with wind turbines.
At the end of July in Latvia, close to Lithuania border, one adult female and two juvenile Whooper Swans were equipped with GPS-GSM transmitters programmed to record location, altitude, and flight speed at 1-second intervals when bird is at flight and battery levels exceeded 50%. Flight behaviour was monitored throughout migration, wintering, breeding, incubation, and juvenile-rearing periods.
The tagged swans remained near the breeding grounds until the first frosts before migrating across the Baltic Sea to wintering areas in Poland and Germany, with several stopovers in Poland and a final wintering site near Lübeck, Germany. Spring migration followed a similar route with stopover sites in Lithuania. Flight altitude varied seasonally, averaging 50-60 m during winter but increasing to 85-100 m during migration and the breeding period. Flight activity was lowest in June and July, when breeding adults remained with their offspring, and juveniles where mounting resulting in reduced flight speeds. The highest flight speeds were recorded during migration and wintering
Seasonal differences in flight behaviour suggest that collision risk with wind turbines is greatest during migration, when Whooper Swans fly at altitudes overlapping the rotor-swept zone of modern wind turbines. These findings highlight the importance of incorporating season-specific flight behaviour into collision risk assessments and wind farm planning.

TALK (2)

Trumpeter Swan *Cygnus buccinator* recovery is supported by agricultural water quality conservation efforts on private lands in Iowa, USA

Jayden L. Jech & Adam K. Janke

Iowa State University, USA

Land use change and agricultural intensification have contributed to loss of wetlands and freshwater surface water impairments across Iowa, USA. Such changes were one reason for the extirpation of Trumpeter Swans (*Cygnus buccinator*) in Iowa by the late-1800s. Their reintroduction was fueled by early releases on wetlands restored primarily on publicly held land. However, their recovery there is constrained by the fact that a majority of Iowa's land is held in private ownership (~97%) and used for agriculture. Promisingly, several state and federal conservation programs have supported the implementation of nutrient treatment wetlands, primarily on privately owned land, with the primary goal of improving water quality across the agricultural landscape. Our research explores how these novel wetland systems are supporting Trumpeter Swan range expansion and population growth and what wetland characteristics best support their use. We monitored ~80 nutrient treatment wetlands over two years to determine Trumpeter Swan presence and productivity using unmanned aircraft systems (UAS). During 2025, 21 (~25%) of wetlands supported Trumpeter Swan broods. Of the 113 cygnets enumerated on our first encounter with broods on nutrient treatment wetlands, 106 (~93%) survived to fledging (~100 days since hatch). Large wetlands with presence of muskrat-constructed structures and native emergent vegetation increased odds of Trumpeter Swan use of nutrient treatment wetlands. Designing and managing these wetland systems to support Trumpeter Swans provides unique conservation opportunities on private lands to support range expansion and population growth across an agricultural landscape.

TALK (3)

60 years of swan numbers in Denmark – with a conservation update

P. Clausen, R.D. Nielsen, J. Sterup, C.L. Pedersen, H.M. Thomsen & A.D. Fox

Department of Ecoscience, Aarhus University, Denmark

Swans have been counted systematically in Denmark since 1965, when the Game Biology Station in Kalø launched coordinated waterfowl counts in the country. The first nationwide count, which combined land-based counts (near-coastal and inland areas) with aerial counts (larger fjords and archipelagos as well as more open sea areas in the Baltic Sea and in Kattegat between Sweden and Denmark) was carried out in the winter of 1968. Since then, a total of 17 nationwide midwinter counts has been conducted, the latest in 2023 – as well as eight counts of moulting waterbirds, the latest in the summer of 2025. Annual counts are also available from selected International Waterbird Census sites since 1987. The winter of 2026 was also planned as a nationwide count, but due to unforeseen problems with permits to fly low, the implementation was postponed – and the focus of the few aerial counts that could be carried out was therefore on areas that are intended to be counted annually. For the monitoring of swans, this fortunately meant that the vast majority of areas regularly used by swans were covered in January-February 2026.

The most recently published data from 2018-23 (Denmark's reporting to the EU Birds Directive Article 12) show that the wintering populations in the country are around 53,000-63,000 Mute Swans (*Cygnus olor*), 55,000-61,000 Whooper Swans (*Cygnus cygnus*) and 700-1,900 Bewick's Swans (*Cygnus columbianus bewickii*). In the summer of 2018, there were 69,000 moulting Mute Swans. The lecture here briefly describes developments in the populations over the past 60 years, but the focus is on the current protection status of the species in the country. Here, the most recently processed data from 2020-2023 shows that while around 80% of Mute Swans were found in EU Special Protections Areas (SPAs) and with around 70% in areas designated for the species, the percentages for Whooper Swans (15-28 in SPAs, with 11-24% in areas designated for the species) and Bewick's Swans (17-58 in SPAs, with 4-55% in areas designated for the species) were lower. I will reveal the reasons for these differences in the talk. Data from the last three winters 2024-2026 and summer 2025 are currently undergoing final processing and analysis but will be published around the 8th International Swan Symposium, where the updated data will be included.

TALK (4)

Current population trends of the Bewick's Swan (*Cygnus columbianus bewickii*) in Schleswig-Holstein in the age of climate change

Hans-Joachim Augst

Schleswig-Holstein Ornithological Society, Germany

In Schleswig-Holstein, in northern Germany, migrating and wintering Bewick's swans have been monitored for a long time, so that since the winter of 1992/93 - and particularly through comprehensive synchronized counts since 2016/17 (usually 10 per winter) - we have more precise phenological data that allow us to analyse the potential effects of climate change on population trends.

There are at least four hypotheses regarding how migratory birds can reduce phenological mismatches in response to climate change. Two of these apply to the Bewick's swans in Schleswig-Holstein:
1. Wintering closer to the breeding grounds:
1.a Increase in the maximum numbers of the wintering population in Schleswig-Holstein,
1.b Increase in Schleswig-Holstein's share of the northeastern/northwestern European population of the Bewick's swan;
2. Earlier start of migration:
2.a Earlier first observations in the fall each year in Schleswig-Holstein,
2.b Earlier occurrence of the peak of the wintering population in late winter in Schleswig-Holstein each year.
Two further hypotheses cannot be answered at the Schleswig-Holstein level, but there is evidence elsewhere that this could also be the case:

- Faster migration speed,
- Shift of breeding areas toward the pole.

Further effects are conceivable, e.g., an earlier departure from Schleswig-Holstein in spring.

TALK (5)

Recent numbers of migrating and wintering Bewick's (*Cygnus columbianus bewickii*) and Whooper (*Cygnus cygnus*) Swans in the Burgas Lakes complex, Bulgaria

Vladimir Mladenov & Ralitsa Georgieva

Bulgarian Society for the Protection of Birds, Bulgaria

Both swan species have been the subject of targeted monitoring within the Burgas Lakes complex in Bulgaria from 2011 to 2026. During this period, significant fluctuations in the abundance of both species were observed, with a particularly remarkable increase in Bewick's Swan numbers. Previously considered a rare species in Bulgaria – with only sporadic records of up to a few dozen birds – its abundance has recently surged, exceeding 1,000 individuals. As part of this monitoring program, we also gathered data on brood size, foraging habitat preferences, and roosting sites.

TALK (6)

Low breeding propensity in a declining Arctic-breeding swan revealed by telemetry data

Tohar Tal (1), Bart A. Nolet (1)(2) Tom S.L. Versluijs (3)(4), Judy Z. Shamoun-Baranes (1), Götz Eichhorn (5), Sabine Urban (5) & Hans Linssen (1)(2)

(1) University of Amsterdam, The Netherlands; (2) Netherlands Institute of Ecology, The Netherlands; (3) NIOZ Royal Netherlands Institute for Sea Research, The Netherlands; (4) University of Groningen, The Netherlands; (5) Michael-Otto-Institut im NABU, Germany

The Western Palearctic population of Bewick's Swans has experienced one of the most alarming population declines among migratory waterbirds, dropping from approximately 30,000 individuals in 1995 to less than 13,000 in 2020. Low reproductive output has been identified as the primary driver, yet a fundamental question remains: which components of the reproductive cycle are responsible? We analysed GPS-tracking and accelerometer data from over 60 adult female Bewick's Swans collected across 8 years to separately quantify breeding propensity (the decision to breed or not) and nesting success (completing incubation). Our results show that earlier arrival at the breeding grounds increases the odds of attempting to breed, and that nesting success responds slightly positively to earlier snowmelt, suggesting a moderate beneficial effect of the climate change-induced advancement of spring onset. However, the proportion of females attempting to breed remained consistently low throughout the entire study period. Furthermore, we compared our telemetry-derived breeding estimates with winter juvenile counts which revealed that at least a third of hatchlings die before their first winter. Overall, our findings suggest that low breeding propensity may be a key driver of poor reproductive output and that factors other than climatic conditions impact this propensity. We propose several next steps that could help further elucidate the population dynamics of Bewick’s Swans to effectively address the flyway-level decline.

TALK (7)

Phasing out lead: progress in ammunition and fishing tackle

J.L. Newth, K. A. Wood & R. L. Cromie

Wildfowl & Wetlands Trust, Slimbridge, UK

Lead is a neurotoxin with no known safe level of exposure. Despite decades of evidence on its health impacts, its use in fishing tackle and ammunition persists. Over 38,000 tonnes of lead gunshot and 4,800 tonnes of lead fishing tackle (sinkers and lures) are released annually into the European environment, contaminating soils and waterways. This toxic legacy impairs the health of wildlife, domestic animals and people. An estimated one million waterbirds die each year in Europe from lead ammunition poisoning alone (Andreotti et al. 2018), while lead poisoning accounts for around a quarter of migratory swan deaths in the UK (Newth et al. 2013). Swan species are susceptible to ingesting discarded lead shot and fishing weights as they often forage in habitats where coarse fishing and shooting take place. They may also deliberately select lead shot, or mistake for grit, to aid the mechanical digestion of vegetation in their gizzard. With non-toxic alternatives widely available, restricting the use of lead in recreational shooting and fishing is the most effective solution. A ban on the sale and use of lead fishing weights in the UK in 1987 was associated with an increase in the mute swan (*Cygnus olor*) population (Wood et al. 2019). In Denmark, compliance with the 1996 ban on the use and possession of lead shot remains high (95%) (Kanstrup & Balsby, 2019). Elsewhere in Europe, however, progress has been slower due to socio-political barriers and resistance from the lead and shooting industries. Nevertheless, momentum for wider restrictions has increased in recent years, with conservation, public health, animal welfare and food retail organisations, alongside members of the hunting and angling communities and politicians, calling for a comprehensive ban on lead ammunition and fishing tackle. Here, we review recent regulatory developments in the UK and EU that are expected to substantially reduce lead poisoning in waterbirds across Europe.

TALK (8)

Bad to the bone? Evaluating bone lead in Trumpeter Swans in vivo using portable x-ray fluorescence spectrometry

Nellissa Stalenhoef (1)(2) & Sherri Cox (1)(2)

(1) University of Guelph, Canada; (2) National Wildlife Centre, Canada

Environmental lead contaminants, particularly lead ammunition and fishing tackle, represent an international health risk to free ranging birds. Trumpeter swans are predisposed and sensitive to lead poisoning. Although the majority of lead is stored in bone long term and chronic lead exposure is known to have detrimental health effects, there is limited information available on the significance of bone lead free ranging birds given that current methods of measuring lead levels in vivo use blood samples. This research uses portable x-ray fluorescence spectrometry (pXRF) to measure bone lead levels in free ranging trumpeter swans in the field and those presented to wildlife rehabilitation centres to estimate total body lead levels in trumpeter swans in South-Central Ontario and determine the health effects of bone lead. A study using pXRF was performed to determine detection limits and in vivo feasibility of the device. A field study was subsequently performed to estimate cumulative lead exposure, including 75 trumpeter swans in the field during the banding season (November 2025 - April 2026) and 22 trumpeter swans presented to wildlife rehabilitation centres. Preliminary results suggest low lead levels in apparently healthy trumpeter swans, although lead poisoned swans in wildlife rehabilitation centres have higher lead levels. This is the first study quantifying bone lead levels in free ranging waterfowl in North America in vivo and suggests that pXRF is a valuable tool for both determining the health effects of bone lead and monitoring conservation efforts.

TALK (9) - cancelled

Probing for embedded shot and ingested lead in Bewick's Swans: new evidence from Germany

Götz Eichhorn (1), Sander Moonen (2), Axel Degen (3) & Aaron J. Specht (4)

(1) Michael-Otto-Institut im NABU, Germany; (2) Wageningen Environmental Research, The Netherlands; (3) Lower Saxony Ornithological Society, Germany; (4) Purdue University, USA

Since its peak in the mid-1990s, the NE/NW European population of Bewick's Swan has declined markedly to 11,100 individuals (37% of former numbers). At the same time, an eastward shift in winter distribution has increased its occurrence in Germany. In response, the project "Bewick's Swan: Conservation concept for an endangered migratory bird species in Germany (2021-2026)" was initiated and investigates, among other, factors contributing to morbidity and mortality. Here we present results from two winters of fieldwork on live-captured Bewick's Swans, focusing on two key anthropogenic threats: (i) injury from shotgun pellets (crippling), and (ii) exposure to toxic lead (Pb). Embedded shot, detected by radiography, indicates non-lethal shooting, but also highlights the scale of this issue and suggest potentially substantial but largely undetected direct mortality. Ingested Pb is dissolved in the gizzard, enters the bloodstream, and is subsequently distributed to soft tissues before being deposited in bone. Importantly, blood Pb reflects a snapshot of acute recent exposure, whereas bone Pb constitutes a long-term record of accumulated contamination. Acute poisoning from ingestion of larger Pb quantities can cause rapid death, whereas chronic low-level exposure is likely more widespread, leading to physiological and behavioural impairments that increase morbidity. We quantified Pb levels in whole blood (11.1±7.7 µg/dL) to assess recent exposure. In a subsample, we additionally measured bone Pb (15.6±4.9 µg/g) in vivo using portable X-ray fluorescence (pXRF). This non-destructive technique enables the assessment of long-term Pb accumulation in living birds under field conditions, providing a powerful tool for conservation-oriented monitoring. Our study provides new evidence into the role of hunting-related injury and lead contamination as ongoing threats to Bewick's Swans.

TALK (10)

Assessing the exposure of migrating Bewick's Swans to spring hunting in Northwest Siberia, Russia

Elmira Zaynagutdinova (1), Aleksei Kozlov (1), Alexander Markelov (1) & Sonia Rozenfeld (2**)**

(1) Swan and Duck Study Group of the Northern Eurasia, Russia; (2) Severtsov Institute of Ecology and Evolution, Russian Academy of Sciences, Russia

Hunting affects animal populations through direct mortality and behavioural disturbance. This impact can also extend to non-target species. Spring hunting, which occurs immediately prior to the breeding season, exerts stronger demographic effects than autumn hunting. This is particularly critical for swans, which are characterized by lifelong monogamy and a capital breeding strategy.
Recreational spring hunting exists in Russia. Although swans are not a game species in Russia, they could suffer from waterfowl hunting and poaching, especially in the sparsely populated and remote areas of the North, where there is virtually no hunting control.Since the opening dates of the spring hunting season across different regions of the Russia are established independently by local authorities and vary each year, the total period that birds spend in hunting areas is difficult to determine, meaning hunting can accompany birds throughout their entire migration. In the Yamalo-Nenets Autonomous Okrug (YNAO), hunting opens sequentially across three zones for 10 days each. To determine how much time Bewick's Swans (*Cygnus bewickii*) spend in areas with open hunting, we analyzed the movements of birds equipped with GPS transmitters within the YNAO and compared their migration timing with the regional spring hunting periods.
The spring migration tracks of 39 individuals were analyzed for 2015-2021. Bewick's Swans arrived in the YNAO on May 17 on average and spent 23 days on average in the region. The birds stayed in areas with open hunting for 7 days on average, which accounted for 27% of their total spring migration time in the region. Birds make 2.23 stopovers on average, while in hunting zones, they made 0.68 stops on average. The birds spent 18 days on stopovers on average. In areas with open hunting, they spent 6 days on average. The overall intra-individual correlation between observations was found to be low.
To minimize the threats of poaching and disturbance, it is necessary to optimize or completely ban spring hunting and establish a network of protected areas with a disturbance-free regime along the entire migratory route.

TALK (11)

Comparing tracking data and resighting data for inferring population ranges and areas of low observation effort

Hans Linssen (1)(2), E. Emiel van Loon (1), Judy Z. Shamoun-Baranes (1), Lisa Vergin (3)(4), Jutta Leyrer (3)(5) & Bart A. Nolet (2)

(1) University of Amsterdam, The Netherlands; (2) Netherlands Institute of Ecology, The Netherlands; (3) Michael-Otto-Institut im NABU, Germany; (4) Aarhus University, Denmark; (5) BioConsultSH, Germany

Large-scale space use and geographical ranges of animal populations are traditionally based on sightings of (marked) animals, but recent technological developments have presented GPS tracking as an alternative method. Tracking devices are however much more expensive than traditional marks, rings or collars, leading to datasets that typically consist of much fewer individuals. We study how GPS tracking data and citizen science resighting data of marked individuals compare as alternative sources for inferring range size. We calculated Bewick's swan range sizes from a wealth of GPS tracking and resighting data during winter, the period of the year when both data types are abundant. We examined the effect of the number of individuals and the total number of spatial records (either resightings or GPS fixes) on the inferred range size. Moreover, we combined GPS tracks with resightings of the same individuals to empirically determine spatial variation in resighting rates. Tracked individuals generated records across an area 1.5-2 times larger than individuals that were merely resighted. Moreover, any given number of daily GPS records (rather than GPS-tracked individuals) yielded an area 1.5 times larger than that same number of resighting records. A small number of GPS-tracked individuals (~20) was sufficient to yield a larger range size compared to much higher numbers of resighted individuals (well over 400). Spatial variation in resighting rates corresponded well with the differences in range size from the two data types, indicating that spatial gaps in observer effort can hamper range estimations. When combined with resighting data, tracking data can be used to indicate areas of low observer effort. Although citizen science resightings are essential for collecting various types of biological information, we show that GPS tracking presents a highly efficient alternative to traditional marking for assessing large-scale space use and population ranges, requiring far fewer individuals to be used.

TALK (12)

Climatic constraints on the northward expansion of the Mute Swan (*Cygnus olor*) in the Western Palearctic

S.A. Kouzov, A.V. Kravchuk, D.A. Rodionov & E.V. Abakumov

Saint Petersburg State University, Russia

Since the mid-20th century, the Mute Swan (*Cygnus olor*) population has grown steadily, with its breeding range expanding northward. However, over the past three decades, this expansion has slowed considerably despite continued population growth, suggesting climatic constraints. Earlier studies proposed a 180-day ice-free period as a critical threshold. This hypothesis has never been statistically tested, and the proposed limit appears underestimated, as it neglects the time required for pre-breeding preparation, nest construction, and the accumulation of post-fledging energy reserves for migration by cygnets. We hypothesize that the actual limit likely falls between 215-230 ice-free days. To test this, we mapped Mute Swan nesting records on inland water bodies across Russia for 2015-2024. Climatic variables: ice-free period duration, ice melt dates, mean annual temperature, and mean July and January temperatures, were obtained from 136 meteorological and hydrological stations. Climate maps were constructed using ArcGIS and Golden Software Surfer. Threshold values were calculated using GLM (R Core Team, 2022). Analyses were conducted separately for four regions: Northwestern Russia, Central Russia, the Volga-Ural region, and Western Siberia. Detailed results for the first two regions are currently available. Our models show that nesting probability drops below 5% when the ice-free period is under 224 days and when water bodies become ice-free after April 20. Nesting becomes virtually impossible (probability <1%) in areas where the ice-free period is ?213 days and ice melt occurs later than April 27. These findings align well with our preliminary theoretical calculations. Notably, for the Volga-Ural and Western Siberian regions, these figures differ slightly from Northwestern and Central Russia, which may be attributable to population-level differences.

TALK (13)

State-dependent habitat selection in wintering Trumpeter Swans

Ivonne R. Romero

Cal Poly Humboldt (formerly Humboldt State University), California, USA

The Lower Skagit Valley (LSV) in northwest Washington State supports the highest concentrations of wintering trumpeter swans (*Cygnus buccinator*) in the contiguous United States. Once a complex mosaic of wetlands, the LSV is now largely occupied by industrial agriculture and urban development. Despite known use of agricultural land by trumpeter swans, the effects of proximal landscape features in habitat selection remain understudied. The objectives of this study were to 1) quantify behavioral state-specific habitat selection for trumpeter swans wintering in the LSV and, 2) produce spatially explicit maps of predicted foraging habitat quality to aid the prioritization of management efforts. Using a two-stage Hidden Markov Model-informed integrated step selection function framework (HMM-iSSF), state-specific habitat selection was modeled from GPS telemetry data of 15 swans wintering in the LSV during 2023-2024. State-specific iSSFs were fit using a mixed-effects modeling framework where random effects of individual swans were included to account for intraspecific variability in selection. Foraging swans showed clear hierarchical selection for freshwater subtypes, selecting strongest for riverine habitats. Foraging swans also showed the greatest tendency to concentrate near drainage channels, ditches, and stream margins. Agricultural land showed no consistent population-level foraging selection despite substantial individual variation. Resting swans showed reversed hierarchical selection of freshwater subtypes, preferring lakes/ponds over riverine habitat. Resting swans also preferred to settle at a moderate distance from water edges, which is consistent with roosting on open water. Forage habitat quality maps confirmed concentrated foraging value along river corridors and croplands in close proximity to natural and managed drainage features. These results demonstrate that foraging and resting swans rely on functionally distinct freshwater resources. They suggest that conservation actions which emphasize water management, and the protection of riverine and lacustrine habitats may yield greater benefits for overwintering trumpeter swans than crop-focused programs alone.

TALK (14)

Endogenous versus environmental factors affecting body condition in the Mute Swan (*Cygnus olor*) during winter

Radosław Włodarczyk (1), Jacek Betleja (2), Grzegorz Kiljan (3) & Włodzimierz Meissner (4)

(1) University of Łódź, Poland; (2) Upper Silesian Museum, Poland; (3) Międzyzdroje, Poland; (4) University of Gdańsk, Poland

We analysed age-, sex-, and region-related variation in winter body condition of mute swans (*Cygnus olor*) in coastal and inland areas differing in winter severity, where birds had constant access to supplementary feeding. Body condition varied with age, region, and season, but not sex. Adults had higher condition than juveniles (with immatures intermediate), though this differed among regions. Swans wintering inland were in better condition than those in coastal areas. Body condition declined through winter across all regions, more steeply in inland adults, while juveniles showed similar declines between regions. Despite widespread feeding, clear spatial, seasonal, and age-related differences persisted, indicating that both intrinsic and environmental factors shape winter energy reserves.

TALK (15)

Macrophyte habitat selection and recreational disturbance of moulting Mute Swans in the largest Baltic Sea lagoon

Rasa Morkūnė, Martynas Bucas & Julius Morkūnas

Marine Research Institute, Klaipeda University, Lithuania

Moult is a critical event in the annual cycle of waterfowl, as species like the Mute Swan (*Cygnus olor*) undergo a complete post-breeding moult that renders them flightless for six to eight weeks. During this vulnerable period, birds require habitats that provide both adequate food resources and security from disturbance. In the Curonian Lagoon Lithuania (south-eastern Baltic Sea), increasing recreational pressures overlap with vital staging areas, yet knowledge regarding habitat use remains limited. This study integrated visual observations, GPS-GSM telemetry from ten tagged individuals, and submerged macrophyte mapping to analyze how swan distribution depends on habitat characteristics and anthropogenic activities.

The results identified the most important moulting grounds as shallow areas (<1-metre depth) featuring high-density coverage of submerged vegetation, specifically dominated by charophytes and pondweeds. Telemetry data confirmed this preference, showing that 86% of GPS locations were in depths under one meter. While swans also utilized reedbeds for concealment, deeper habitats (1-2 m) were less favored due to the higher energy required to reach vegetation.

Crucially, the study found that mute swans exploited only half of the most suitable habitat areas available for feeding. The remaining suitable areas were largely unexploited due to disturbance from kiteboarding and boating. During the peak moult period (July-August), swan abundance was significantly lower in proximity to disturbance sources, with maximum abundances recorded 3 km from navigation channels and 6 km from kiteboarding spots. These findings suggest that recreational activities displace swans to suboptimal habitats. To ensure effective biodiversity conservation, we recommend implementing seasonal restrictions on kiteboarding and boating in waters shallower than 1 m during July and August. This research provides essential data for managing human activities in sensitive estuarine ecosystems.

TALK (16)

Mute Swan behaviour and space use of Gloucester and Sharpness Canal, England, during brood-rearing and moult.

Jeff Black

Cal Poly Humboldt (formerly Humboldt State University), California, USA

Functional riparian habitats provide essential nourishment and respite for many non-human and human communities. Restored rivers and constructed canals may provide natural assets in the form of enhanced biodiversity while offering opportunities for human recreation. Canal boating and living fulltime in canal boats is popular along Britain's inland waterways. Nature agency guidelines for canals call for maintenance of emergent and submerged vegetation for wildlife benefit. Mute swans are perhaps the most conspicuous user of aquatic vegetation and any offer of supplemental food in these shared habitats. I describe how mute swans (n = 85) on the Gloucester and Sharpness Canal, England (circa 1827) made use of natural and human-provided foods during brood rearing and moult. This canal runs 26 km adjacent areas with natural area designations (Ramsar and SSSI) through farmland before entering Gloucester City. Pairs with young (n = 11) and non-breeder (n = 12) locations and behaviours were recorded. Activity (feeding, loafing, preening, sleeping, swimming) was determined on first sight and 1-3 additional intervals (3-5 min) before proceeding along the towpath to the next territory. Feeding was further categorized by food type (aquatic vegetation or supplemental food) and depth of food (surface, head/neck submerged, up ending). An additional feeding category included cueing (waiting) at a supplemental food source, and occurrences of supplemental feeding were recorded. An index of potential opportunities to receive food from humans (boats and houses) was attributed to each swan territory throughout the water course. Number of boats/homes ranged from many to none. Observations of swan distribution and behaviour indicted that the canal was used to complete a full suite of daily activities during this critical flightless phase in the annual cycle, including foraging on aquatic vegetation and capitalising on supplemental food offered by humans sharing the canal. I comment on the underused role of mute swans as potential flagship species.

TALK (17)

Family life, cultural inheritance and range shift in Bewick's Swans

Hans Linssen (1)(2), E. Emiel van Loon (1), Götz Eichhorn (3), Judy Z. Shamoun-Baranes (1), Sarah A. Sonsthagen (4), Sabine Urban (3), Robert E. Wilson (5) & Bart Nolet (1)(2)

(1) University of Amsterdam, The Netherlands; (2) Netherlands Institute of Ecology, The Netherlands; (3) Michael-Otto-Institut im NABU, Germany; (4) U.S. Geological Survey, Nebraska, USA; (5) University of Nebraska-Lincoln, USA.

Cultural inheritance of movement patterns, through social learning from older generations, occurs across the animal kingdom. At the same time, many populations are shifting their ranges in response to environmental change. How cultural inheritance drives or constrains these shifts remains unclear. We investigated this by quantifying extended parental care and wintering site fidelity across age groups in the Bewick's swan, a family-living migratory waterbird whose wintering range is rapidly shifting under a warming climate. Using tracking and genetic data of 55 adult and juvenile migratory Bewick's swans, including 12 families, we quantified variation in family bond duration and identified the causes and consequences of family separation. Subsequently, we measured age-specific fidelity to wintering sites and displacement between winters. Families typically remained intact until the second half of the offspring's first spring migration, when juveniles were nearly one year old. Earlier separation occurred only following disturbance on the wintering grounds and resulted in delayed migration and substantially reduced survival (38% versus 82%). Young birds showed fidelity to their parental wintering sites during their second and third winters, indicating some degree of cultural inheritance of space use. At the same time, those birds up to their third winter displayed greater year-to-year variability than adults and, as a result, were primarily responsible for driving the ongoing range shift observed across the population. Together, these findings demonstrate that prolonged family associations provide critical opportunities for social learning and are vital for successful migration and survival. Moreover, innovation by young individuals can interact with cultural inheritance in shaping wintering site choice, advancing our understanding of population responses to climate change.

TALK (18)

Identification of key stopover areas and migration corridors of the rapidly declining Bewick's Swan (*Cygnus columbianus bewickii*) population wintering in NE/NW Europe

Sabine Urban (1), Hans Linssen (2)(3), Bart Nolet (2)(3) & Götz Eichhorn (1)

(1) Michael-Otto-Institut im NABU, Germany; (2) University of Amsterdam, The Netherlands; (3) Netherlands Institute of Ecology, The Netherlands

Understanding migratory connectivity and the spatial distribution of key stopover sites is essential for the effective conservation of long-distance migratory waterbirds. Using high-resolution GPS tracking data from more than 100 Bewick's Swans (*Cygnus columbianus bewickii*), comprising over 200 spring and autumn migration events collected between 2017 and 2025, we provide an updated assessment of migration routes, timing, route fidelity and stopover importance across the East Atlantic Flyway.
Through delineation of individual migration corridors using Dynamic Brownian Bridge Movement Models (dBBMMs). Noticeable seasonal differences emerged between spring and autumn migration events. Spring migration follows comparatively narrow and temporally constrained migration corridors. Autumn migration, on the other hand, is spatially more diffuse and exploratory but converges at a limited number of important staging areas. The analyses further identified key stopover sites that were used by a disproportionately large share of migrating individuals and quantify the relative importance of different countries along the flyway. We further examine the consistency of migration corridors among years and individuals to further assess route fidelity.
These findings provide an evidence base for flyway-scale conservation planning under the AEWA framework and illustrate how long-term GPS tracking can be used to identify and prioritise critical sites throughout the annual cycle.

TALK (19)

Swan Project: public bird migration tracking and citizen science

Tetsuo Shimada (1), Kan Konishi (2), Guozheng Li (3), Guodong Shi (3) & Hiroyoshi Higuchi (4)

(1) The Miyagi Prefectural Izunuma-Uchinuma Environmental Foundation, Japan; (2) Hamatombetsu Lake Kutcharo Waterfowl Observatory, Japan; (3) Druid Technology Co., Ltd, China; (4) Keio University, Japan

In the 1990s, satellite tracking became possible, enabling researchers to track bird migration over time. With further technological advancements, it became possible to track migration patterns in near real time over many years, leading to dramatic progress in migration research. Researchers have also made information on migratory routes and destinations publicly available, contributing to a deeper public understanding of bird migration. Since 2023/2024, we succeeded not only in tracking migration routes but also in capturing visual perspectives along their journeys. Here, we first provide an overview of the technological advancements that enabled this achievement, and then present the actual images captured by the swans, discussing their scientific significance as well as their value for public outreach. These findings serve as valuable resources for advancing the conservation of the target species and their habitats.

TALK (20)

When flyways meet: combining long-term ringing records and GPS telemetry reveals low levels of connectivity between Icelandic and Northwest Mainland European Whooper Swan *Cygnus cygnus* populations

Kane Brides (1), Kevin A. Wood (1), Sverrir Thorstensen (2), Stephen Vickers (3), Ólafur Einarsson (2) Catrin Eden (4), Dmitrijs Boiko (5), Kees Koffijberg (6), Axel Degen (7), Bjarke Laubek (8), Didier Vangeluwe (9), Graham McElwaine (10), Maria Wieloch (11), Leho Luigujõe (12), Julius Morkūnas (13), Yulia Bogomolova (14), Preben Clausen (15), Fanjuan Meng (16), Lei Cao (16) & Eileen C. Rees (17)

(1) WWT, UK; (2) Iceland Whooper Swan Study Group, Iceland; (3) Biomathematics and Statistics Scotland, UK; (4) Waterbird Colour-marking Group, UK; (5) Latvian National Museum of Natural History, Latvia; (6) SOVON, the Netherlands; (7) Osnabrück, Germany; (8) Sæby, Denmark; (9) Royal Belgian Institute of Natural Sciences, Belgium; (10) Irish Whooper Swan Study Group, UK; (11) Polish Academy of Science, Poland; (12) Estonian University of Life Sciences, Estonia; (13) Marine Research Institute, Lithuania; (14) Nature Reserve Nenetsky, Russia; (15) Aarhus University, Denmark; (16) Chinese Academy of Sciences, China; (17) Wildfowl Press, UK

Connectivity between biogeographically distinct migratory populations can influence gene flow, population dynamics and the interpretation of population trends, yet the frequency and mechanisms of cross-flyway movements remain poorly understood. The Iceland, UK/Ireland and Northwest Mainland European (NWME) flyway populations of the Whooper Swan (*Cygnus cygnus*) are generally regarded as discrete, although occasional movements between them have been documented through ringing records. We combined > 50 years of ringing, resighting and recovery data with recent GPS tracking to quantify connectivity between these flyway populations and describe the movements underpinning it.

Ringing data for > 18,000 Whooper Swans ringed in 17 European countries showed that only 172 individuals (0.94%) were subsequently recorded outside the nominal range of their assigned flyway population, with no significant directional bias between the Icelandic and NWME populations. To investigate these movements in greater detail, we tracked 56 Whooper Swans tagged in northern Iceland during summer 2024. Two individuals wintered in the Netherlands, providing the first detailed GPS documentation of movements from Iceland to mainland Europe. Their 2,178-2,344 km autumn migrations involved extensive sea crossings, prolonged staging within Britain, and return migrations to Iceland the following spring, including one direct 1,861 km transoceanic flight completed in 84 hours. One individual returned to the same Dutch wintering area the following winter, demonstrating repeated use of a site within the NWME flyway. Updated colour-ring analyses identified a further 25 Icelandic-ringed Whooper Swans wintering in the Netherlands, principally in Friesland.

Together, these complementary datasets demonstrate that connectivity between the Icelandic and NWME Whooper Swan populations currently occurs at a low but measurable level. While the long-term ringing dataset quantifies the rarity of these exchanges, GPS tracking provides the first detailed insight into the migratory routes, staging behaviour and winter site fidelity underlying population overlap or interchange. Current levels of interchange are unlikely to bias international population estimates, but continued monitoring will be important for determining whether connectivity between these populations varies as both populations continue to increase.

TALK (21)

Limited but highly variable protected area use by Icelandic Whooper Swan *Cygnus cygnus* across the annual cycle

Stephen H. Vickers (1)(2), Kane Brides (2)(3), Sverrir Thorstensen (4), Kevin A. Wood (3), Ketill Þór Thorstensen (4), Ólafur Einarsson (5), Eileen C. Rees (6), Fanjuan Meng (7)(8) & Lei Cao (7)(8)

(1) Biomathematics and Statistics Scotland, Edinburgh, UK; (2) Waterbird Colour-marking Group, Tewkesbury, UK; (3) Wildfowl & Wetlands Trust, UK; (4) Akureyri, Iceland; (5) Selfoss, Iceland; (6) Holywell House, Derbyshire, UK; (7) Research Center for Eco-Environmental Sciences, Chinese Academy of Sciences, China; (8) University of Chinese Academy of Sciences, China

Protected areas form the cornerstone of biodiversity conservation, yet their effectiveness for and utilisation by long distance migratory species, such as the Icelandic breeding population of Whooper Swans *Cygnus cygnus*, remains uncertain. We quantified the extent of protected area utilisation throughout the entire annual cycle using GPS tracking data from 47 individuals tagged in Iceland (~1,000,000 raw fixes, regularised to hourly positions with state-space models). Behavioural states of individuals at each hourly position were inferred with hidden Markov models, to identify encamped, exploratory, and migratory movements. We then quantified spatial overlap of hourly regularised locations and modelled space-use estimates (identified via kernel density estimation) with protected areas. 32.2% of regularised hourly locations occurred within protected areas, while the 0.95 kernel density space-use isopleth had 26.2% overlap. However, individual overlap was highly variable, ranging from 0-100% in some cases. Our results highlight that current protected area networks offer only partial coverage of Whooper Swan annual distributions, with the large majority of time spent in unprotected areas that may pose greater risk to populations. Our findings demonstrate how GPS tracking data can be used to assess species use of protected area networks at large spatial scales, to inform species conservation.

TALK (22)

New tools for old problems: using remotely collected data from webcams to investigate interactions between swans and other waterbirds.

Kevin A. Wood (1), Grace Clarke (2), Beth Gray (2), Phoebe Ham (2), Holly Hitchins (2), Rebecca Lacey (2), Ellie Machiani (2), Nigella Marx (2), Jake Scales (3), Rowen Wang (2), Eleanor Wyeth (2) & Paul E. Rose (1)(2)

(1) Wildfowl & Wetlands Trust, UK; (2) University of Exeter, UK; (3) University Centre Sparsholt College, UK

Remote data collection methods offer reduced disturbance and environmental impacts, greater accessibility, and the facilitation of citizen science programmes. Here, we provide an overview of our recent research, in which we used webcams at two wetlands sites in the UK, to investigate numerical and behavioural interactions between swans and other waterbirds. Our research focused on the three swan species present in the UK during winter: Bewick's Swans (*Cygnus columbianus bewickii*), Mute Swans (*C. olor*), and Whooper Swans (*C. cygnus*). Firstly, we assessed aggression among 14 waterbird species over three winters, demonstrating that aggression typically involved conspecifics rather than heterospecifics. Secondly, we assessed how different swan species trade-off time spent on mutually exclusive behaviours such as aggression, foraging, and resting. Thirdly, we assessed waterbird behavioural responses to changing swan densities. We show that even at the highest swan densities recorded in our study system (182 ind./ha), the times spent by waterbirds on aggression, preening, and resting behaviours typically remained within the ranges reported previously, suggesting that any impacts of swans on waterbird behaviour were limited. Fourthly, we assessed the numbers of waterbirds forming commensal associations with swans. In total, we recorded nine waterbird species associating with the three swan species. The numbers of commensal waterbirds remained stable within, but varied between, our two study winters. Numbers of commensal waterbirds per swan were significantly higher for Bewick's Swans, compared with Mute and Whooper Swans, but did not differ between adults and cygnets. Detected behavioural changes suggested that waterbirds gained important feeding benefits from associations with swans. Our presentation highlights the range of ecological questions that can be answered using remotely collected data from webcams. We reflect on both the benefits, and the challenges, of using webcams in research on swans and other waterbirds.

TALK (23)

Spatial trophic niche differentiation in sympatric swan species (*Cygnus* spp.) in the Baltic Sea coastal zone

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Trophic niche differentiation among sympatric swan species is a key ecological focus. Since the 1940s, the Mute swan (*Cygnus olor*) has extensively colonised the Baltic Sea coasts, unlike other Palearctic swans. Our prior faecal analysis revealed dietary differences between this species and the Whooper (*C. cygnus*) and Bewick (*C. columbianus bewickii*) swans. This study assessed interspecific differences in feeding biotope use based on water depth and distance from shore during spring migration. We analysed 2006-2015 data from migratory counts along the Kurgalsky Peninsula. Results showed highly significant spatial differences among the three species throughout spring, both before and after ice breakup. The Mute swan was the most ecologically segregated. Its key advantage is ability to foraging at depths exceeding 1.5 m (up to 25 m) – conditions inaccessible to the other species. This reflects a dual strategy: benthic grazing and surface-filter feeding, removing depth constraints and expanding its foraging area up to 10-12 km offshore. This advantage is most pronounced pre-ice breakup, when deep offshore zones (2-12 km) become ice-free first, while Whooper and Bewick swans later concentrate only in coastal shallow-water polynyas. Spatial separation between these latter species, though significant, was less pronounced. The Whooper's preference for shallower nearshore sites is attributed to its reed rhizome-based diet, whereas part of the Bewick's diet included macroalgae. Mute swans surface-feeding in in waters remote from the coast with great depths was also observed during brood-rearing and moulting. For cygnets, accessing offshore waters is facilitated by parental transport and brooding on the adult's back, alongside assistance in retrieving food. The pronounced neck curvature in Mute swans likely represents a morphological adaptation for surface foraging. These traits probably evolved during the Miocene speciation of ancient swans in eutrophic marine shallows, as indicated by specialised, flightless *Annakacygna* fossils, which exhibit even more extreme adaptations.

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