Overview

Short Name: GloBAM

Title: Towards monitoring, understanding and forecasting global biomass flows of aerial migrants

Project Summary Uneditted:

Every year, trillions of migratory insects and birds, encompassing thousands of tons of animal biomass, move through the air within, across, and among continents. Migrants represent a powerful yet underappreciated dimension of biodiversity as they connect distant ecosystems, alter nutrient and energy flow, food-web topology and stability, and provide a multitude of services and disservices to human economy, agriculture and health. Many migrant populations have declined alarmingly and their aerial and terrestrial habitats have changed dramatically, particularly from rapid climate change, increased urbanization and massive extensions of artificial light and wind energy installations. With GloBAM, we maded a major step forward in characterizing and quantifying the biomass flows of aerial migrants from regional to continental scales in Europe and North America and over time-scales from days to years from existing continental-scale networks of weather radars. In a quest for the indirect and direct drivers of movements and migrant abundances, we related the timing (phenology), intensity and spatial patterns of movements to a suite of relevant atmospheric, climatic and landscape/habitat variables: We showed how changes in climatic conditions influenced the phenology of migration, how weather influenced flight conditions and how human-induced habitat changes, such as artificial light and wind energy installations impacted patterns of migration. Using a suite of theoretical approaches, we developped scenarios of potential future changes in these drivers to project how this may impact migration in the future, and estimate the implications of mass migrations for biomass and nutrient flows as important ecosystem functions. In the current biodiversity crisis, in which migratory animals are particularly hard-hit monitoring aerial biomass flows and projecting their future changesare highly relevant for a broad range of stakeholders in agriculture, conservation, health, aviation safety, sustainable energy and to address scientific and societal challenges alike.

Project Information

Acronym: GloBAM

Title: Towards monitoring, understanding and forecasting global biomass flows of aerial migrants

Start: [*not provided*]

End: [*not provided*]

[*not provided*]: [*not provided*]

Website:

Project Summary:

Every year, trillions of migratory insects and birds, encompassing thousands of tons of animal biomass, move through the air within, across, and among continents. Migrants represent a powerful yet underappreciated dimension of biodiversity as they connect distant ecosystems, alter nutrient and energy flow, food-web topology and stability, and provide a multitude of services and disservices to human economy, agriculture and health. Many migrant populations have declined alarmingly and their aerial and terrestrial habitats have changed dramatically, particularly from rapid climate change, increased urbanization and massive extensions of artificial light and wind energy installations. With GloBAM, we maded a major step forward in characterizing and quantifying the biomass flows of aerial migrants from regional to continental scales in Europe and North America and over time-scales from days to years from existing continental-scale networks of weather radars. In a quest for the indirect and direct drivers of movements and migrant abundances, we related the timing (phenology), intensity and spatial patterns of movements to a suite of relevant atmospheric, climatic and landscape/habitat variables: We showed how changes in climatic conditions influenced the phenology of migration, how weather influenced flight conditions and how human-induced habitat changes, such as artificial light and wind energy installations impacted patterns of migration. Using a suite of theoretical approaches, we developped scenarios of potential future changes in these drivers to project how this may impact migration in the future, and estimate the implications of mass migrations for biomass and nutrient flows as important ecosystem functions. In the current biodiversity crisis, in which migratory animals are particularly hard-hit monitoring aerial biomass flows and projecting their future changesare highly relevant for a broad range of stakeholders in agriculture, conservation, health, aviation safety, sustainable energy and to address scientific and societal challenges alike.

Project Keywords:

aeroecology; animal migration; climate change; artificial light; wind energy; remote sensing; radar; birds; insects

Project Audience and User Groups:

1. Aviation (civilian flight operator company and military operator (Air forces); airport safety and air traffic operators. 2. General public and birdwatchers 3. Wind energy producers. 4. Scientific field: Ecologists and Epidemiologists 5. Poultry industry 6. building owners and managers associations and international downtown associations

Project Locations:

[BEL, FIN, NLD, CHE, USA]

Other Websites and/or Tools:

http://birdcast.info http://alert.birdcast.info/lightsout http://alert.birdcast.info/usgs http://www.enram.eu https://aloftdata.eu/ https://www.meteo.be/services/birdDetection/#/?lang=en

Partner Collaboration

Is your project building on a collaboration that is: Existing
Number of partners existing in this collaboration prior to the start of this project: 5
Number of new partners added to this collaboration since the start of this project: 0

Participating Organizations

ID	Organization	Type	Participation Type	Active	City	Country
30638	Cornell Lab of Ornithology	Foundation	Awarded Organization	Yes	Ithaca	USA
30634	Finnish Meteorological Institute	Government	Awarded Organization	Yes	Helsinki	FIN
30637	Research Institute for Nature and Forest	Government	Awarded Organization	Yes	Brussels	BEL
30633	Swiss Ornithological Institute	National NGO	Awarded Organization	Yes	Sempach	CHE
30635	University of Amsterdam	Academic, Training and Research	Awarded Organization	Yes	Amsterdam	NLD
30636	University of Exeter	Academic, Training and Research	In-Kind Partner Organization	Yes	Penryn Cornwall	GBR

Organization 30638 - US

Name: Cornell Lab of Ornithology
Acronym: US
Type: Foundation (TypeID 60)

Participation Type: Awarded Organization

Active: Yes

Website: https://www.birds.cornell.edu/home/
Address Line 1: 159 Sapsucker Woods Rd
Address Line 2:
PO Box:
City/Town: Ithaca
State/Province/Region: NY
Postal/ZIP code: 14850
Country: USA

Incoming Funds from This Organization

Category	Cumulative Value (K€)
Commitment/Obligation:	0 K€
Received to Date:	0 K€

In-Kind Contributions

Category	Cumulative Value (est. K€)
Consumables:	0 est. K€
Dissemination:	0 est. K€
Employment Costs:	0 est. K€
Equipment:	0 est. K€
Laboratory Time:	0 est. K€
Onboard Ship Time:	0 est. K€
Overheads:	0 est. K€
Supercomputer Time:	0 est. K€
Travel:	0 est. K€

Other:	0 est. K€

Organization 30634 - FMI

Name: Finnish Meteorological Institute
Acronym: FMI
Type: Government (TypeID 10)

Participation Type: Awarded Organization

Active: Yes

Website: https://ilmatieteenlaitos.fi/
Address Line 1: Erik Palm&#65533;nin aukio 1
Address Line 2: 00101 Helsinki
PO Box: 503
City/Town: Helsinki
State/Province/Region:
Postal/ZIP code: 00560
Country: FIN

Incoming Funds from This Organization

Category	Cumulative Value (K€)
Commitment/Obligation:	222 K€
Received to Date:	7 K€

In-Kind Contributions

Category	Cumulative Value (est. K€)
Consumables:	0 est. K€
Dissemination:	0 est. K€
Employment Costs:	0 est. K€
Equipment:	0 est. K€
Laboratory Time:	0 est. K€
Onboard Ship Time:	0 est. K€
Overheads:	0 est. K€
Supercomputer Time:	0 est. K€
Travel:	0 est. K€
Other:	0 est. K€

Organization 30637 - INBO

Name: Research Institute for Nature and Forest
Acronym: INBO
Type: Government (TypeID 10)

Participation Type: Awarded Organization

Active: Yes

Website: http://www.inbo.be
Address Line 1: Havenlaan 88 bus 73
Address Line 2:
PO Box:
City/Town: Brussels
State/Province/Region: Brussels Capital Region

Postal/ZIP code: 1000
Country: BEL

Incoming Funds from This Organization

Category	Cumulative Value (K€)
Commitment/Obligation:	0 K€
Received to Date:	0 K€

In-Kind Contributions

Category	Cumulative Value (est. K€)
Consumables:	0 est. K€
Dissemination:	0 est. K€
Employment Costs:	0 est. K€
Equipment:	0 est. K€
Laboratory Time:	0 est. K€
Onboard Ship Time:	0 est. K€
Overheads:	0 est. K€
Supercomputer Time:	0 est. K€
Travel:	0 est. K€
Other:	0 est. K€

Organization 30633 - SOI

Name: Swiss Ornithological Institute
Acronym: SOI
Type: National NGO (TypeID 22)

Participation Type: Awarded Organization

Active: Yes

Website: www.vogelwarte.ch/en
Address Line 1: Seerose 1
Address Line 2:
PO Box:
City/Town: Sempach
State/Province/Region:
Postal/ZIP code: 6203
Country: CHE

Incoming Funds from This Organization

Category	Cumulative Value (K€)
Commitment/Obligation:	0 K€
Received to Date:	0 K€

In-Kind Contributions

Category	Cumulative Value (est. K€)
Consumables:	0 est. K€
Dissemination:	0 est. K€

Employment Costs:	80 est. K€
Equipment:	200 est. K€
Laboratory Time:	0 est. K€
Onboard Ship Time:	0 est. K€
Overheads:	0 est. K€
Supercomputer Time:	0 est. K€
Travel:	0 est. K€
Other:	0 est. K€

Organization 30635 - NL

Name: University of Amsterdam
Acronym: NL
Type: Academic, Training and Research (TypeID 80)

Participation Type: Awarded Organization

Active: Yes

Website: https://ibed.uva.nl/
Address Line 1: Institute for Biodiversity and Ecosystem Dynamics
Address Line 2:
PO Box: 94240
City/Town: Amsterdam
State/Province/Region:
Postal/ZIP code: 1090GE
Country: NLD

Incoming Funds from This Organization

Category	Cumulative Value (K€)
Commitment/Obligation:	0 K€
Received to Date:	0 K€

In-Kind Contributions

Category	Cumulative Value (est. K€)
Consumables:	0 est. K€
Dissemination:	0 est. K€
Employment Costs:	0 est. K€
Equipment:	100 est. K€
Laboratory Time:	0 est. K€
Onboard Ship Time:	0 est. K€
Overheads:	0 est. K€
Supercomputer Time:	0 est. K€
Travel:	0 est. K€
Other:	0 est. K€

Organization 30636 - UK

Name: University of Exeter
Acronym: UK
Type: Academic, Training and Research (TypeID 80)

Participation Type: In-Kind Partner Organization

Active:	Yes
Website:	https://biosciences.exeter.ac.uk/staff/profile/index.php?web_id=Jason_Chapman
Address Line 1:	Daphne du Maurier Building
Address Line 2:	University of Exeter
PO Box:	
City/Town:	Penryn Cornwall
State/Province/Region:	
Postal/ZIP code:	TR10 9FE
Country:	GBR

Incoming Funds from This Organization

Category	Cumulative Value (K€)
Commitment/Obligation:	0 K€
Received to Date:	0 K€

In-Kind Contributions

Category	Cumulative Value (est. K€)
Consumables:	0 est. K€
Dissemination:	0 est. K€
Employment Costs:	0 est. K€
Equipment:	0 est. K€
Laboratory Time:	0 est. K€
Onboard Ship Time:	0 est. K€
Overheads:	0 est. K€
Supercomputer Time:	0 est. K€
Travel:	0 est. K€
Other:	0 est. K€

Funding Awards

ID	Funding Agency	Awarded Organization	Committed Funds	Received Funds
55848	aka	FMI	198 K€	198 K€
55884	FWO	INBO	150 K€	150 K€
55860	NSF	US	160 K€	160 K€
55872	NWO	NL	211 K€	211 K€
55836	SNSF	SOI	565 K€	565 K€

Award 55848 - aka to FMI

Funding Provider: aka
Awarded Organization: FMI
Commitment/Obligation: 198 K€
Received to Date: 198 K€

In-Kind Contributions

Category	Cumulative Value (est. K€)
Consumables:	0 est. K€
Dissemination:	0 est. K€
Employment Costs:	0 est. K€
Equipment:	0 est. K€
Laboratory Time:	0 est. K€
Onboard Ship Time:	0 est. K€
Overheads:	0 est. K€
Supercomputer Time:	0 est. K€
Travel:	0 est. K€
Other:	0 est. K€

Award 55884 - FWO to INBO

Funding Provider: FWO
Awarded Organization: INBO
Commitment/Obligation: 150 K€
Received to Date: 150 K€

In-Kind Contributions

Category	Cumulative Value (est. K€)
Consumables:	0 est. K€
Dissemination:	0 est. K€
Employment Costs:	0 est. K€
Equipment:	0 est. K€
Laboratory Time:	0 est. K€
Onboard Ship Time:	0 est. K€
Overheads:	0 est. K€
Supercomputer Time:	0 est. K€
Travel:	0 est. K€
Other:	0 est. K€

Award 55860 - NSF to US

Funding Provider: NSF

Awarded Organization: US
Commitment/Obligation: 160 K€
Received to Date: 160 K€

In-Kind Contributions

Category	Cumulative Value (est. K€)
Consumables:	0 est. K€
Dissemination:	0 est. K€
Employment Costs:	63 est. K€
Equipment:	3 est. K€
Laboratory Time:	0 est. K€
Onboard Ship Time:	0 est. K€
Overheads:	0 est. K€
Supercomputer Time:	10 est. K€
Travel:	0 est. K€
Other:	0 est. K€

Award 55872 - NWO to NL

Funding Provider: NWO
Awarded Organization: NL
Commitment/Obligation: 211 K€
Received to Date: 211 K€

In-Kind Contributions

Category	Cumulative Value (est. K€)
Consumables:	0 est. K€
Dissemination:	0 est. K€
Employment Costs:	0 est. K€
Equipment:	0 est. K€
Laboratory Time:	0 est. K€
Onboard Ship Time:	0 est. K€
Overheads:	0 est. K€
Supercomputer Time:	0 est. K€
Travel:	0 est. K€
Other:	0 est. K€

Award 55836 - SNSF to SOI

Funding Provider: SNSF
Awarded Organization: SOI
Commitment/Obligation: 565 K€
Received to Date: 565 K€

In-Kind Contributions

Category	Cumulative Value (est. K€)
Consumables:	0 est. K€
Dissemination:	0 est. K€
Employment Costs:	0 est. K€
Equipment:	0 est. K€

Laboratory Time:	0 est. K€
Onboard Ship Time:	0 est. K€
Overheads:	0 est. K€
Supercomputer Time:	0 est. K€
Travel:	0 est. K€
Other:	0 est. K€

Other Resources

Other In-Kind Donations:	Satellite data from NASA and Colorado School of Mines on light pollution; data from USGS on avian influenza; development hours from programming and development team at Cornell Lab of Ornithology for web and app support and development.
Resources Leveraged:	USA: existing BirdCast collaborations with radar and citizen scientist networks, computer infrastructure for data management and analysis; datasets from previous National Science Foundation projects and publications; additional support from Leon Levy Foundation, US Geological Survey, National Fish and Wildlife Foundation, NASA, Marshall Aid Commemoration Commission, Edward W Rose Postdoctoral Fellowship; support from private anonymous donors; collaborations with New York City Audubon, Chicago Audubon, Fatal Light Awareness Protection program, American Bird Conservancy, Houston Audubon Society, Oxford University, Colorado State University, University of Massachusetts; data management and infrastructure are supported by Cornell University, Suomi NPP satellite; Amazon Web Services; Google Cloud Services; Microsoft Research EUROPE: for weather radar data analysis we rely on data freely provided by OPERA or by individual meteorological institutes. For developing forecast modelling we utilized the ECMWF ERA5 data freely available. High performance computing costs were funded in part by other projects.

Stakeholder Involvement

Benefits of Stakeholder Involvement: 1. Stakeholders from meteorological institutes were involved in the original framing of the project, through discussions and joint meetings. Interaction with stakeholders and understanding of their needs was also used to define some of the project aims 2. Data was provided by meteorological institutes 3. Through different subprojects and associated project meetings were organized with stakeholders on the national level to discuss how ecological knowledge or tools developed in the study could be beneficial for their needs and to understand what those needs are. 4. In the Netherlands partners have been involved in discussions related to the implementation of policy in regards to wind energy curtailment. Project team members attend the european weather radar user group meetings to disseminate challenges and usage of weather radar for biodiversity monitoring

Stakeholder Involvement: We included representative stakeholders (users) from various sectors to the design of the project and interacted regularly with them in project meetings. We have found that dissemination on a national level often works very effectively where each partner can efficiently target the right stakeholders and communicate in ways directly suitable for those stakeholders, being aware of national challenges and ambitions is important for success. In some cases presentations should also be given in the country's native language to increase impact. In future projects, we would likely add a staff member who is exclusively responsible for stakeholder engagement.

Open Access for Stakeholders: Most

Open Access Elaboration: Stakeholders can find information about our project on our project website (https://globam.science/). This includes contact information, members, publications, meetings, datasets and outreach. Announcements and meeting summaries are provided via the news section of the website and Twitter. We released software written for the project as open source (e.g. https://github.com/adokter/bioRad), published data collected during the project as open data (see the data management plan), and favour open access journals for our publications. Additionally, we developed innovative vizualisation tools that are publicly available on web platforms and more tailored services to specific stakeholders. In the US, we have made available applied knowledge through alerting apps and email programs for dynamic conservation of nocturnally migrating birds.

List of Stakeholders

ID	Organization	Size	Active	Locations
30656	Agroscope Swiss centre of excellence for agricultural research	10 thousand	Yes	Switzerland;
30651	Air Navigation Services Finland Oy	100	Yes	Finland;
30653	Birdlife Suomi	1 thousand	Yes	Finland;
30643	Eneco	1 thousand	Yes	Netherlands (the);
30646	Federal Office of Meteorology and Climatology MeteoSwiss	100	Yes	Switzerland;
30650	Finavia	1 thousand	No	Finland;
30652	Finnair	1 thousand	Yes	Finland;
30649	Finnish Air Force	1 thousand	Yes	Finland;
30642	Gemini Windpark	1 thousand	Yes	Netherlands (the);
30648	German Aerospace Center (DLR)	1 thousand	Yes	Germany;
30654	LUOMUS	10	No	Finland;
30640	Rijkswaterstaat	1 thousand	Yes	Netherlands (the);
34212	Royal Meteorological Institute of Belgium (RMI)	100	Yes	Belgium;
30641	Royal Netherlands Air Force	1 thousand	Yes	Netherlands (the);
30644	Royal Netherlands Meteorological Institute (KNMI)	1 thousand	Yes	Netherlands (the);
30655	Suomen Hy&#65533;tyuuli Oy	100	Yes	Finland;
34213	Swedish Meteorological and Hydrological Institute (SMHI)	1 thousand	Yes	Sweden;
30647	Swiss Bird Radar - Bird radar solutions	100	Yes	Switzerland;
30639	Troo Trax	100	No	Canada;
30645	WindForS Wind Energy Research Cluster	1 thousand	Yes	Germany;

Stakeholder [*not provided*] - Agroscope Swiss centre of excellence for agricultural research

Organization: Agroscope Swiss centre of excellence for agricultural research

Active:	Yes
Website:	https://www.agroscope.admin.ch/agroscope/en/home/about-us/agroscope.html
Street:	Reckenholzstrasse 191
PO Box:	
City/Town:	Z&#65533;rich
State/Province/Region:	
Postal/Zip code:	8046
Country:	CHE
Size:	10 thousand
Locations:	Switzerland;
Level of Involvement in Design:	None
Implementer:	false
Stakeholder Sectors:	Public Sector - National Government
Received Funding:	false
Funding Sources:	
Referenced in Outputs:	false
If yes, please describe how:	

Stakeholder [*not provided*] - Air Navigation Services Finland Oy

Organization:	Air Navigation Services Finland Oy
Active:	Yes
Website:	https://www.ansfinland.fi
Street:	NA
PO Box:	PL 157
City/Town:	Vantaa
State/Province/Region:	
Postal/Zip code:	01531
Country:	FIN
Size:	100
Locations:	Finland;
Level of Involvement in Design:	Low
Implementer:	true
Stakeholder Sectors:	Public Sector - National Government
Received Funding:	false
Funding Sources:	
Referenced in Outputs:	false
If yes, please describe how:	

Stakeholder [*not provided*] - Birdlife Suomi

Organization:	Birdlife Suomi
Active:	Yes
Website:	https://www.birdlife.fi/
Street:	Annankatu 29 A 16
PO Box:	

City/Town:	Helsinki
State/Province/Region:	
Postal/Zip code:	00100
Country:	FIN
Size:	1 thousand
Locations:	Finland;
Level of Involvement in Design:	Low
Implementer:	true
Stakeholder Sectors:	Voluntary Sector - National NGO
Received Funding:	false
Funding Sources:	
Referenced in Outputs:	true
If yes, please describe how:	Acknowledgements of publications, conference contributions etc.

Stakeholder [*not provided*] - Eneco

Organization:	Eneco
Active:	Yes
Website:	https://www.eneco.nl/
Street:	NA
PO Box:	
City/Town:	
State/Province/Region:	
Postal/Zip code:	NA
Country:	NLD
Size:	1 thousand
Locations:	Netherlands (the);
Level of Involvement in Design:	None
Implementer:	false
Stakeholder Sectors:	Private Sector - Other
Received Funding:	false
Funding Sources:	
Referenced in Outputs:	false
If yes, please describe how:	

Stakeholder [*not provided*] - Federal Office of Meteorology and Climatology MeteoSwiss

Organization:	Federal Office of Meteorology and Climatology MeteoSwiss
Active:	Yes
Website:	https://www.meteoswiss.admin.ch/home.html?tab=overview
Street:	Chemin de l'A�rologie
PO Box:	
City/Town:	Payerne
State/Province/Region:	
Postal/Zip code:	1530
Country:	CHE

Size:	100
Locations:	Switzerland;
Level of Involvement in Design:	None
Implementer:	false
Stakeholder Sectors:	Public Sector - National Government
Received Funding:	false
Funding Sources:	
Referenced in Outputs:	false
If yes, please describe how:	

Stakeholder [*not provided*] - Finavia

Organization:	Finavia
Active:	No
Website:	https://www.finavia.fi
Street:	NA
PO Box:	PL 50
City/Town:	Vantaa
State/Province/Region:	
Postal/Zip code:	01531
Country:	FIN
Size:	1 thousand
Locations:	Finland;
Level of Involvement in Design:	Low
Implementer:	true
Stakeholder Sectors:	Public Sector - National Government
Received Funding:	false
Funding Sources:	
Referenced in Outputs:	false
If yes, please describe how:	

Stakeholder [*not provided*] - Finnair

Organization:	Finnair
Active:	Yes
Website:	https://www.finnair.com/
Street:	NA
PO Box:	PO Box 15
City/Town:	
State/Province/Region:	
Postal/Zip code:	NA
Country:	FIN
Size:	1 thousand
Locations:	Finland;
Level of Involvement in Design:	Low
Implementer:	true

Stakeholder Sectors:	Public Sector - National Government
Received Funding:	false
Funding Sources:	
Referenced in Outputs:	false
If yes, please describe how:	

Stakeholder [*not provided*] - Finnish Air Force

Organization:	Finnish Air Force
Active:	Yes
Website:	https://ilmavoimat.fi
Street:	NA
PO Box:	PL 30
City/Town:	TIKKAKOSKI
State/Province/Region:	
Postal/Zip code:	41161
Country:	FIN
Size:	1 thousand
Locations:	Finland;
Level of Involvement in Design:	Medium
Implementer:	true
Stakeholder Sectors:	Public Sector - Military
Received Funding:	false
Funding Sources:	
Referenced in Outputs:	false
If yes, please describe how:	

Stakeholder [*not provided*] - Gemini Windpark

Organization:	Gemini Windpark
Active:	Yes
Website:	https://www.geminiwindpark.nl/
Street:	NA
PO Box:	
City/Town:	
State/Province/Region:	
Postal/Zip code:	NA
Country:	NLD
Size:	1 thousand
Locations:	Netherlands (the);
Level of Involvement in Design:	None
Implementer:	false
Stakeholder Sectors:	Private Sector - Other
Received Funding:	false
Funding Sources:	

Referenced in Outputs:	false
If yes, please describe how:	

Stakeholder [*not provided*] - German Aerospace Center (DLR)

Organization:	German Aerospace Center (DLR)
Active:	Yes
Website:	https://www.dlr.de/dlr/en/
Street:	NA
PO Box:	
City/Town:	
State/Province/Region:	
Postal/Zip code:	NA
Country:	DEU
Size:	1 thousand
Locations:	Germany;
Level of Involvement in Design:	None
Implementer:	false
Stakeholder Sectors:	Public Sector - National Government
Received Funding:	false
Funding Sources:	
Referenced in Outputs:	false
If yes, please describe how:	

Stakeholder [*not provided*] - LUOMUS

Organization:	LUOMUS
Active:	No
Website:	http://www.luomus.fi
Street:	NA
PO Box:	PL 17
City/Town:	Helsinki
State/Province/Region:	
Postal/Zip code:	00014
Country:	FIN
Size:	10
Locations:	Finland;
Level of Involvement in Design:	Low
Implementer:	false
Stakeholder Sectors:	Public Sector - National Government
Received Funding:	false
Funding Sources:	
Referenced in Outputs:	true
If yes, please describe how:	Acknowledgements of publications, conference contributions etc.

Stakeholder [*not provided*] - Riikuntantaat

Stakeholder [*not provided*] - Rijkswaterstaat

Organization:	Rijkswaterstaat
Active:	Yes
Website:	https://www.rijkswaterstaat.nl/
Street:	NA
PO Box:	
City/Town:	
State/Province/Region:	
Postal/Zip code:	NA
Country:	NLD
Size:	1 thousand
Locations:	Netherlands (the);
Level of Involvement in Design:	None
Implementer:	false
Stakeholder Sectors:	Public Sector - National Government
Received Funding:	false
Funding Sources:	
Referenced in Outputs:	false
If yes, please describe how:	

Stakeholder [*not provided*] - Royal Meteorological Institute of Belgium (RMI)

Organization:	Royal Meteorological Institute of Belgium (RMI)
Active:	Yes
Website:	https://meteo.be
Street:	Avenue Circulaire 3
PO Box:	
City/Town:	Brussels
State/Province/Region:	
Postal/Zip code:	1180
Country:	BEL
Size:	100
Locations:	Belgium;
Level of Involvement in Design:	Low
Implementer:	false
Stakeholder Sectors:	[Community/Individual - General Public, Public Sector - Military, Public Sector - National Government]
Received Funding:	false
Funding Sources:	
Referenced in Outputs:	true
If yes, please describe how:	As co-author.

Stakeholder [*not provided*] - Royal Netherlands Air Force

Organization:	Royal Netherlands Air Force
Active:	Yes
Website:	https://english.defensie.nl/organisation/air-force

Street:	NA
PO Box:	P.O. Box 8762
City/Town:	Breda
State/Province/Region:	
Postal/Zip code:	4820 BB
Country:	NLD
Size:	1 thousand
Locations:	Netherlands (the);
Level of Involvement in Design:	None
Implementer:	true
Stakeholder Sectors:	Public Sector - Military
Received Funding:	false
Funding Sources:	
Referenced in Outputs:	false
If yes, please describe how:	

Stakeholder [*not provided*] - Royal Netherlands Meteorological Institute (KNMI)

Organization:	Royal Netherlands Meteorological Institute (KNMI)
Active:	Yes
Website:	www.knmi.nl
Street:	NA
PO Box:	Postbus 201
City/Town:	De Bilt
State/Province/Region:	
Postal/Zip code:	3730 AE
Country:	NLD
Size:	1 thousand
Locations:	Netherlands (the);
Level of Involvement in Design:	Low
Implementer:	false
Stakeholder Sectors:	Public Sector - National Government
Received Funding:	false
Funding Sources:	
Referenced in Outputs:	false
If yes, please describe how:	

Stakeholder [*not provided*] - Suomen Hy&#xF;tytuuli Oy

Organization:	Suomen Hy&#xF;tytuuli Oy
Active:	Yes
Website:	http://hyotytuuli.fi
Street:	Pohjoinen Rautatiekatu 13
PO Box:	PL 305
City/Town:	PORI
State/Province/Region:	

Postal/Zip code:	28601
Country:	FIN
Size:	100
Locations:	Finland;
Level of Involvement in Design:	Low
Implementer:	false
Stakeholder Sectors:	Private Sector - Private Sector Partners
Received Funding:	false
Funding Sources:	
Referenced in Outputs:	false
If yes, please describe how:	

Stakeholder [*not provided*] - Swedish Meteorological and Hydrological Institute (SMHI)

Organization:	Swedish Meteorological and Hydrological Institute (SMHI)
Active:	Yes
Website:	https://www.smhi.se/en/
Street:	Folkborgsv&#65533;gen 17
PO Box:	
City/Town:	Norrk&#65533;ping
State/Province/Region:	
Postal/Zip code:	60176
Country:	SWE
Size:	1 thousand
Locations:	Sweden;
Level of Involvement in Design:	Medium
Implementer:	false
Stakeholder Sectors:	[Community/Individual - General Public, Public Sector - National Government]
Received Funding:	false
Funding Sources:	
Referenced in Outputs:	false
If yes, please describe how:	

Stakeholder [*not provided*] - Swiss Bird Radar - Bird radar solutions

Organization:	Swiss Bird Radar - Bird radar solutions
Active:	Yes
Website:	https://www.swiss-birdradar.com/home.html
Street:	Technoparkstrasse 2
PO Box:	
City/Town:	Winterthur
State/Province/Region:	
Postal/Zip code:	8406
Country:	CHE
Size:	100
Locations:	Switzerland;

Level of Involvement in Design: None
Implementer: true

Stakeholder Sectors: [Private Sector - Private Sector Partners, Public Sector - National Government]

Received Funding: false
Funding Sources:

Referenced in Outputs: false
If yes, please describe how:

Stakeholder [*not provided*] - Troo Trax

Organization: Troo Trax

Active: No

Website: https://www.troo.com/aviation/

Street: 43 Auriga Drive
PO Box:
City/Town: Ottawa
State/Province/Region: Ontario
Postal/Zip code: K2E7Y8
Country: CAN

Size: 100
Locations: Canada;

Level of Involvement in Design: None
Implementer: false

Stakeholder Sectors: [Private Sector - Private Sector Partners, Public Sector - Local Government, Public Sector - Military, Public Sector - National Government, Public Sector - Resource Managers]

Received Funding: false
Funding Sources:

Referenced in Outputs: false
If yes, please describe how:

Stakeholder [*not provided*] - WindForS Wind Energy Research Cluster

Organization: WindForS Wind Energy Research Cluster

Active: Yes

Website: https://www.windfors.de/en/home/

Street: Allmandring 5b
PO Box:
City/Town: Stuttgart
State/Province/Region:
Postal/Zip code: 70569
Country: DEU

Size: 1 thousand
Locations: Germany;

Level of Involvement in Design: None
Implementer: false

Stakeholder Sectors:	Private Sector - Private Sector Partners
Received Funding:	false
Funding Sources:	
Referenced in Outputs:	false
If yes, please describe how:	

Personnel and Organization Changes

Personnel and/or Organization Changes: One postdoc (Thomas Mason) in the Swiss team had taken on a permanent position and therefore, left the project earlier than planned and was replaced by Marie Perennes.

Privacy Policy Understanding

Privacy Policy Understood: true

Personnel

ID	Name	Highest Level of Education	Organization	Role(s)	Active	Planned Effort (in person months)	Actual Effort (in person months)	City	Country
30616	Bauer, Silke	Doctoral or equivalent level	Swiss Ornithological Institute	Consortium Lead	Yes	12	15	Sempach	CHE
30618	Chapman, Jason	Doctoral or equivalent level	University of Exeter	In-Kind Collaborator	Yes	5	3	Penryn Cornwall	GBR
30622	Desmet, Peter	Masters or equivalent level	Research Institute for Nature and Forest	Partner PI	Yes	10	8	Brussels	BEL
30620	Dokter, Adriaan	Doctoral or equivalent level	Cornell Lab of Ornithology	Team Member	Yes	14	20	Ithaca	USA
30626	Farnsworth, Andrew	Doctoral or equivalent level	Cornell Lab of Ornithology	Partner PI	Yes	12	12	Ithaca	USA
30631	Haest, Birgen	Doctoral or equivalent level	Swiss Ornithological Institute	Team Member	Yes	36	45	Sempach	CHE
30623	Koistinen, Jarmo	Masters or equivalent level	Finnish Meteorological Institute	Partner PI	Yes	8	8	Helsinki	FIN
30630	Kranstauber, Bart	Doctoral or equivalent level	University of Amsterdam	Team Member	Yes	30	36	Amsterdam	NLD
30621	Leijnse, Hidde	Doctoral or equivalent level	University of Amsterdam	Stakeholder Representative	Yes	2	2	Amsterdam	NLD
30628	Liechti, Felix	Doctoral or equivalent level	Swiss Ornithological Institute	Team Member	Yes	6	6	Sempach	CHE
30617	Mason, Thomas	Doctoral or equivalent level	Swiss Ornithological Institute	Team Member	Yes	36	23	Sempach	CHE
30625	M&#65533;kinen, Terhi	Doctoral or equivalent level	Finnish Meteorological Institute	In-Kind Collaborator	No	6	6	Helsinki	FIN
30627	Nilsson, Cecilia	Doctoral or equivalent level	Swiss Ornithological Institute	Fully Self-Financed Collaborator	Yes	18	12	Sempach	CHE
30632	No&#65533;, Nicolas	Bachelors or equivalent level	Research Institute for Nature and Forest	Team Member	Yes	6	4	Brussels	BEL
30629	Nussbaumer, Raphael	Doctoral or equivalent level	Swiss Ornithological Institute	Postdoc	Yes	18	18	Sempach	CHE
34364	Perennes, Marie	Doctoral or equivalent level	Swiss Ornithological Institute	Team Member	Yes	20	23	Sempach	CHE
34365	Rojas Tito, Ariel	Masters or equivalent level	Swiss Ornithological Institute	Graduate Student	Yes	12	15	Sempach	CHE
30619	Shamoun-Baranes, Judy	Doctoral or equivalent level	University of Amsterdam	Partner PI	Yes	6	6	Amsterdam	NLD

30624	Weisshaupt, Nadja	Doctoral or equivalent level	Finnish Meteorological Institute	Team Member	Yes	36	45	Helsinki	FIN

Person 30616 - Bauer, Silke

Family Name: Bauer
First Name: Silke
ORCID: 0000-0002-0844-164X

Primary Organization: Swiss Ornithological Institute
Other:
Contact Point: true

Active: Yes
Planned Effort: 12
Actual Effort to Date: 15

Research Area(s): []

Highest Academic Level: Doctoral or equivalent level
Year Academic Level Obtained: [*not provided*]
Academic Level Discipline: Ecology
Areas of Expertise:

Past Collaborator: Yes

Roles: Consortium Lead

Person 30618 - Chapman, Jason

Family Name: Chapman
First Name: Jason
ORCID: 0000-0002-7475-4441

Primary Organization: University of Exeter
Other:
Contact Point: false

Active: Yes
Planned Effort: 5
Actual Effort to Date: 3

Research Area(s): []

Highest Academic Level: Doctoral or equivalent level
Year Academic Level Obtained: [*not provided*]
Academic Level Discipline: Ecology
Areas of Expertise:

Past Collaborator: Yes

Roles: In-Kind Collaborator

Person 30622 - Desmet, Peter

Family Name: Desmet
First Name: Peter

ORCID: 0000-0002-8442-8025

Primary Organization: Research Institute for Nature and Forest
Other:
Contact Point: true

Active: Yes
Planned Effort: 10
Actual Effort to Date: 8

Research Area(s): [C100, I260, I300]

Highest Academic Level: Masters or equivalent level
Year Academic Level Obtained: 2005
Academic Level Discipline: Biology
Areas of Expertise: biodiversity informatics; data management; software development

Past Collaborator: Yes

Roles: Partner PI

Person 30620 - Dokter, Adriaan

Family Name: Dokter
First Name: Adriaan
ORCID: 0000-0001-6573-066X

Primary Organization: Cornell Lab of Ornithology
Other:
Contact Point: false

Active: Yes
Planned Effort: 14
Actual Effort to Date: 20

Research Area(s): []

Highest Academic Level: Doctoral or equivalent level
Year Academic Level Obtained: [*not provided*]
Academic Level Discipline: Ecology
Areas of Expertise:

Past Collaborator: Yes

Roles: Team Member

Person 30626 - Farnsworth, Andrew

Family Name: Farnsworth
First Name: Andrew
ORCID: 0000-0002-9854-4449

Primary Organization: Cornell Lab of Ornithology
Other:
Contact Point: true

Active: Yes
Planned Effort: 12

Actual Effort to Date: 12

Research Area(s): []

Highest Academic Level: Doctoral or equivalent level

Year Academic Level Obtained: [*not provided*]

Academic Level Discipline: Ecology

Areas of Expertise: aeroecology, meteorology, migration

Past Collaborator: No

Roles: Partner PI

Person 30631 - Haest, Birgen

Family Name: Haest

First Name: Birgen

ORCID: 0000-0002-8739-6460

Primary Organization: Swiss Ornithological Institute

Other:

Contact Point: false

Active: Yes

Planned Effort: 36

Actual Effort to Date: 45

Research Area(s): [C150, C180, C340, G310, I260, I320]

Highest Academic Level: Doctoral or equivalent level

Year Academic Level Obtained: [*not provided*]

Academic Level Discipline: Computer science

Areas of Expertise:

Past Collaborator: No

Roles: Team Member

Person 30623 - Koistinen, Jarmo

Family Name: Koistinen

First Name: Jarmo

ORCID: 0000-0003-3667-2071

Primary Organization: Finnish Meteorological Institute

Other:

Contact Point: true

Active: Yes

Planned Effort: 8

Actual Effort to Date: 8

Research Area(s): []

Highest Academic Level: Masters or equivalent level

Year Academic Level Obtained:	[*not provided*]
Academic Level Discipline:	Science of aquatic and terrestrial environments not elsewhere classified
Areas of Expertise:	meteorology; weather; remote sensing
Past Collaborator:	Yes
Roles:	Partner PI

Person 30630 - Kranstauber, Bart

Family Name:	Kranstauber
First Name:	Bart
ORCID:	NA
Primary Organization:	University of Amsterdam
Other:	
Contact Point:	false
Active:	Yes
Planned Effort:	30
Actual Effort to Date:	36
Research Area(s):	[]
Highest Academic Level:	Doctoral or equivalent level
Year Academic Level Obtained:	[*not provided*]
Academic Level Discipline:	Ecology
Areas of Expertise:	
Past Collaborator:	No
Roles:	Team Member

Person 30621 - Leijnse, Hidde

Family Name:	Leijnse
First Name:	Hidde
ORCID:	0000-0001-7835-4480
Primary Organization:	University of Amsterdam
Other:	
Contact Point:	false
Active:	Yes
Planned Effort:	2
Actual Effort to Date:	2
Research Area(s):	F760
Highest Academic Level:	Doctoral or equivalent level
Year Academic Level Obtained:	[*not provided*]
Academic Level Discipline:	Others in physical sciences
Areas of Expertise:	
Past Collaborator:	Yes

Roles: Stakeholder Representative

Person 30628 - Liechti, Felix

Family Name: Liechti
First Name: Felix
ORCID: 0000-0001-9473-0837

Primary Organization: Swiss Ornithological Institute
Other:
Contact Point: false

Active: Yes
Planned Effort: 6
Actual Effort to Date: 6

Research Area(s): []

Highest Academic Level: Doctoral or equivalent level
Year Academic Level Obtained: [*not provided*]
Academic Level Discipline: Ecology
Areas of Expertise:

Past Collaborator: Yes

Roles: Team Member

Person 30617 - Mason, Thomas

Family Name: Mason
First Name: Thomas
ORCID:

Primary Organization: Swiss Ornithological Institute
Other:
Contact Point: false

Active: Yes
Planned Effort: 36
Actual Effort to Date: 23

Research Area(s): []

Highest Academic Level: Doctoral or equivalent level
Year Academic Level Obtained: [*not provided*]
Academic Level Discipline: Ecology
Areas of Expertise:

Past Collaborator: No

Roles: Team Member

Person 30625 - M◆kinen, Terhi

Family Name: M◆kinen
First Name: Terhi
ORCID: 0000-0001-9489-8154

Primary Organization: Finnish Meteorological Institute
Other:
Contact Point: false

Active: No
Planned Effort: 6
Actual Effort to Date: 6

Research Area(s): []

Highest Academic Level: Doctoral or equivalent level
Year Academic Level Obtained: [*not provided*]
Academic Level Discipline: Computer science
Areas of Expertise:

Past Collaborator: No

Roles: In-Kind Collaborator

Person 30627 - Nilsson, Cecilia

Family Name: Nilsson
First Name: Cecilia
ORCID: 0000-0001-8957-4411

Primary Organization: Swiss Ornithological Institute
Other:
Contact Point: false

Active: Yes
Planned Effort: 18
Actual Effort to Date: 12

Research Area(s): []

Highest Academic Level: Doctoral or equivalent level
Year Academic Level Obtained: [*not provided*]
Academic Level Discipline: Ecology
Areas of Expertise:

Past Collaborator: Yes

Roles: Fully Self-Financed Collaborator

Person 30632 - No, Nicolas

Family Name: No
First Name: Nicolas
ORCID: 0000-0002-9503-4750

Primary Organization: Research Institute for Nature and Forest
Other:
Contact Point: false

Active: Yes
Planned Effort: 6
Actual Effort to Date: 4

Research Area(s): [I300, I320]

Highest Academic Level: Bachelors or equivalent level
Year Academic Level Obtained: 2003
Academic Level Discipline: Software engineering
Areas of Expertise: software development; data management; server administration

Past Collaborator: No

Roles: Team Member

Person 30629 - Nussbaumer, Raphael

Family Name: Nussbaumer
First Name: Raphael
ORCID: 0000-0002-8185-1020

Primary Organization: Swiss Ornithological Institute
Other:
Contact Point: false

Active: Yes
Planned Effort: 18
Actual Effort to Date: 18

Research Area(s): []

Highest Academic Level: Doctoral or equivalent level
Year Academic Level Obtained: [*not provided*]
Academic Level Discipline: Physical geographical sciences
Areas of Expertise:

Past Collaborator: No

Roles: Postdoc

Person 34364 - Perennes, Marie

Family Name: Perennes
First Name: Marie
ORCID: 0000-0002-9264-9450

Primary Organization: Swiss Ornithological Institute
Other:
Contact Point: false

Active: Yes
Planned Effort: 20
Actual Effort to Date: 23

Research Area(s): []

Highest Academic Level: Doctoral or equivalent level
Year Academic Level Obtained: [*not provided*]

Academic Level Discipline: Ecology
Areas of Expertise:

Past Collaborator: No

Roles: Team Member

Person 34365 - Rojas Tito, Ariel

Family Name: Rojas Tito
First Name: Ariel
ORCID:

Primary Organization: Swiss Ornithological Institute
Other:
Contact Point: false

Active: Yes
Planned Effort: 12
Actual Effort to Date: 15

Research Area(s): []

Highest Academic Level: Masters or equivalent level
Year Academic Level Obtained: 2021
Academic Level Discipline: Electrical engineering
Areas of Expertise: wind energy production

Past Collaborator: No

Roles: Graduate Student

Person 30619 - Shamoun-Baranes, Judy

Family Name: Shamoun-Baranes
First Name: Judy
ORCID: 0000-0002-1652-7646

Primary Organization: University of Amsterdam
Other:
Contact Point: true

Active: Yes
Planned Effort: 6
Actual Effort to Date: 6

Research Area(s): []

Highest Academic Level: Doctoral or equivalent level
Year Academic Level Obtained: 2003
Academic Level Discipline: Ecology
Areas of Expertise:

Past Collaborator: Yes

Roles: Partner PI

Person 30624 - Weisshaupt, Nadja

Family Name:	Weisshaupt
First Name:	Nadja
ORCID:	0000-0003-4510-4121
Primary Organization:	Finnish Meteorological Institute
Other:	
Contact Point:	false
Active:	Yes
Planned Effort:	36
Actual Effort to Date:	45
Research Area(s):	[]
Highest Academic Level:	Doctoral or equivalent level
Year Academic Level Obtained:	[*not provided*]
Academic Level Discipline:	Ecology
Areas of Expertise:	
Past Collaborator:	Yes
Roles:	Team Member

Student Involvement

Number of Primary / Secondary:	0
Number of Undergraduate:	0
Number of Graduate:	6
Number Receiving Belmont Forum and Biodiversa Support:	None
Number Involved in /Transdisciplinary Study:	Some
Student Locations:	[NLD, SWE, CHE]

Postdoctoral Fellow(s) Involvement

Number of Postdoctoral Fellows:	6
Number Receiving Belmont Forum and Biodiversa Support:	All
Number Involved in Transdisciplinary Study:	Some
Post Doc Locations:	[BEL, FIN, NLD, CHE, USA]

Transdisciplinary Aspects

Transdisciplinary First-Timers: 0

Factors Influencing Student and Postdoctoral Involvement

Factors influencing your decision on student inclusion:	The analyses required staff with previous experience in the analyses of radar data; therefore, we had opted for scientists at the postdoctoral level. However, once the project was in full swing, we also defined (smaller) subprojects, in which we involved students at the MSc stage.

Capacity Building Activities

Capacity Building Activities: All postdocs regularly participated in national and international conferences and workshops and all students involved in GloBAM subprojects were fully integrated into our respective workgroups and encouraged to participate in scientific discussions, journal clubs and courses in workgroups and institutes. GloBAM students and their projects are: - An engineering student mapped wind energy installations across Europe and developed a risk map for bird migration (SOI) - A computer science student Haritha Jayaraman developped tools for existing filtering of weather radar data and worked on implementing new filtering techniques (UvA) - An earth Science MSc student used weather radar data and visual observations to investigate the responses of birds to fireworks (UvA). - A biology student investigated insect detection with specialized radars (SOI) - Members of SOI and UvA not funded by this project but doing related research attended the International Radar Aeroecology Conference (June 2022) to present and discuss research

Collaborations

Internal Collaboration Status: We planned several meetings both with the entire consortium and with subgroups - all of which planned for 2019 were held (see list of meeting) but since early 2020 all in-person meetings and particular the exchanges of postdocs between labs had been halted (or postponed) due to the COVID pandemic. In 2022, personal meetings had resumed and we organized an international conference and final project meeting in Davos, Switzerland. In addition to personal meetings and emails, we use collaboration tools such as Slack and Zoom for remote discussions and information.

Collaboration with Other Projects Funded by the BiodivScen call: We have currently no specific collaborations with other projects funded through this BiodivScen call but have been in touch with the team of "Future BirdScenarios" for the joint production of policy briefs.

Collaboration with Projects and Researchers not Funded by the BiodivScen call: All research groups within the GloBAM consortium have extensive collaborations with other national and international researchers and labs, only the most relevant of which we explicitly mention in the following: FIN: - Finnish Museum of Natural History (Aleksi Lehikoinen, Heidi Bj&#65533;rklund) for information and advice as to data provision and data processing. - Birdlife Suomi: discussion of project and objectives, provision of bird data. - Matti Horttanainen (data management, Finnish Meteorological Institute) provided land use data - Janne Yll&#65533;sj&#65533;rvi (Aviation weather services) provides weather data USA: - Colorado State University, University of Massachusetts on bird migration and radar data analysis; - multiple high schools and undergraduate institutions; - Houston Audubon Society and Dallas Zoo to promote dynamic conservation in Texas; - USGS to forecast biosecurity risks for avian influenza CH: collaborations with - Swiss Centre of Excellence for Agricultural Research (Agroscope) on detection and identification of insect movements with radars; - University of Basel "weObserve" Integrating citizen observers and high throughput sensing devices for big data collection, integration and analysis - InnoSuisse-project (with industry partner) - Advances in radar technology and improvement of classification algorithms - Durham University and British Ornithologist's Union (BOU) in development and application of dynamics bird migration models UvA - Royal Netherlands Meteorological Institute (KNMI) for improving methodology and access to weather radar data, - Royal Netherlands Air Force (NLAF) for access to local bird radars and some preliminary comparative analysis among systems. - Rijkswaterstaat - ministry of infrastructure and water management - Gemini windpark - Bureau Waardenburg (ecological consultants) - NIOZ (Netherlands Institute for Sea Research)

Value of Consortium

Transnational Value: Yes, the project actively linked to national meteorological offices and international meteorological organisations as the use of weather radars provides knowledge to the meteorological community to improve their own data products.

Result Enabled By Consortium: With this large international project, our links to meteorological community were tightened and we continue to lobby for the mutli-disciplinary use of weather radar data. Furthermore, our project has become a showcase within EuropaBON - The Europa Biodiversity Observation Network that aims at standardizing and integrating data streams to support policy. Thus, as our project is transdisciplinary and transnational, we can only use the great potential of weather radar data with a strong consortium with international visibility and recognition - which we would not have without Biodiversa funding GloBAM.

Interdisciplinary

Impact on other Disciplines: Yes

Transdisciplinary Approach: Yes

Elaboration on Transdisciplinary Benefits: GloBAM explicitly relied on data and expertise from meteorology and was thus transdisciplinary from the start. During the project, our ties to the meteorological community became stronger as we noticed changes to meteorological data policies would threaten the capacity of weather radars to provide long-term and large-scale biodiversity monitoring. Likewise, the analyses of radar data requires expertise from data science, machine learning and big data approaches such as deep learning, and the interpretation of results requires advanced ecological knowledge.

Transdisciplinary Impact on HR and Training: The project involved students and postdocs from ecology, meteorology, information and data science that worked together in a transdisciplinary approach. One notable subproject involved an engineering student from the wind energy sector who worked on identifying mitigation scenarios for a sustainable expansion of wind energy that maximizes energy production while minimizing bird collision with wind energy infrastructure.

Objectives

Objective 1 Fulfillment: 5

Objective 1: Retrieve biological information from (weather) radar networks, and quantify biomass flows of aerial migrants (birds and insects) in Europe and North America. Develop an automated, open-access data infrastructure for archiving and accessing information on biomass flows.

Objective 2 Fulfillment: 5

Objective 2: Identify functional relations between patterns in biomass flows and a suite of relevant external variables, particularly focusing on influences of weather and climate, but also on variables with a human dimension such as land use, artificial light and wind energy installations

Objective 3 Fulfillment: 5

Objective 3: Analyse current distributions in these external variables and develop scenarios of their potential future changes

Objective 4 Fulfillment: 4

Objective 4: Combine relations between biomass flows and external variables and future projections of external variables for an assessment of their consequences on aerial migrants.

Objective 5 Fulfillment: 4

Objective 5: Assess the role of migrants in shaping community structure and ecosystem functioning (and thus, biodiversity).

Overall Fulfillment: 4

Overall Explanation: We have already reached most of our initial aims but some results remain to be published. Furthermore, the insect part of our project fledged into a large sub-project that involved some existing and new partners from across Europe and employed dedicated smaller-scale radars for an improved taxonomic resolution.

Project Management

Project Management Approach: Our original suggested project management approach: WP-leaders constitute the steering committee that coordinate the entire project and oversee the setup, work and progress within individual WPs. The steering committee held monthly meetings and organized annual meetings with the entire consortium with the primary aims of a) informing other partners of progress with regard to overall project aims, b) discussing unforeseen deviations from the time-plan and c) defining and coordinating how to achieve the next milestones and deliverables. These meetings took place as scheduled but changed to online meetings during the pandemic. Meeting dates and places: 1. Kick-off meeting, hosted by partner 1 (Swiss Ornithological Institute), 2. progress meeting (online), Oct 2020, 3. progress meeting (online), July 2021, 4. progress meeting (online), March 2022, 5. Final meeting, Davos Switzerland, July 2022. In the progress meetings, we discussed particularly: - review the overall progress of the project (coordinator); - review the scientific progress within postdoc projects and identify synergies (postdocs); - identify potential deviations from time schedule or in the accomplishment of milestones and deliverables and discuss solutions (WP leaders); - coordinate administrative (contractual or financial) details (coordinator and WP leader); - coordinate subsequent steps and communication among project participants (all); - coordinate individual partner and joint project outreach and communication activities (coordinator and WP leaders). WP leaders were responsible for the day-to-day supervision of postdoctoral scientists employed at their institutes. As the postdoc-projects typically contribute to several WPs, we needed regular coordination and frequent communication between all members of the consortium to ensure that, e.g. solutions to related challenges were shared with the entire group. Therefore, we use specific project management tools (e.g. Trello and Slack), which were setup and maintained by the coordinator and where questions, requests and answers could be viewed by all project-participants in an informal manner. We also organised thematic exchanges within subgroups, e.g. for issues related to retrieval of radar data and classification algorithms, and postdocs will visit other labs for collaborative sub-tasks, e.g. a thematic exchange for the synthetic questions in WP5. Examples are coding sprints and data meetings - see https://globam.science/meetings/ for an overview of all meetings. Furthermore, the interdisciplinary and big-data nature of this project required adequate e-science infrastructure. We set up a virtual lab on a cloud infrastructure to facilitate collaboration between teams, reduce time associated with transfer and processing of massive amounts of data, and ensure repeatability and data integrity. The steering committee also coordinated the promotion and dissemination of the project, including engagement with stakeholders (see above). To this end, we set up a dedicated website (WP1), which updated regularly. The website is open to all interested parties, and features results and data as they become available. Our project management approach has worked very well (under the circumstances). We have early established a remote collaboration platform (slack) in addition to the regular and ad-hoc meetings of entire consortium and subgroups.

Project Status: In general, GloBAM progressed according to the original work plan, with one complication being the quality of the European weather radar data due to recent changes in filtering algorithms set by the national meteorological offices (see below). We have reached the milestones and produced the deliverables according to plan, with some modifications as to their delivery dates. Furthermore, some of our postdocs started their positions only several months after project starting date. This was not a problem per se as we created the individual postdoc projects relatively independently, i.e. everyone can work within their own subproject. The COVID pandemic had made collaboration more difficult, especially since we planned extended work visits of the postdocs to the other labs, and set hurdles to most team members as they have been faced with additional family obligations. We have therefore applied for a cost-neutral extension of our project until December 2022. We were also grateful to our home institutions for providing additional funding for postdoc salaries beyond the original end date. As most postdocs continue to be involved in this and related activities and research, there is still substantially more output expected (>15 more papers) in the course of 2023.

Monitoring, Evaluation, and Learning: An unforeseen and unfortunate complication have been the changes in OPERA (European weather radar network) data processing, which appeared to filter out a considerable proportion of the biological signal. Although we have been in contact with the meteorological community for years, there is still little acknowledgement of the importance of monitoring aerial biomass flows and the added value to weather radars that an ecological use of their data may have in the meteorological community. Even more frustrating is that these changes have not been communicated. Fortunately, we noticed the problems relatively early, discussed potential solutions within the consortium and could develop an alternative plan namely to re-analyse raw data to ensure they are of sufficient quality. Although re-processing data will cost time and might not cover the entire European continent (and thus, result in smaller coverage than we envisaged originally), we were able to reach our project aims with this modification.

Issues and Changes

Issues: An unforeseen and unfortunate complication have been the changes in OPERA (European weather radar) data processing, which appeared to filter out a considerable proportion of the biological signal. Although we have been in contact with the meteorological community for years, there is still little acknowledgement of the importance of monitoring aerial biomass flows and the added value to weather radars that an ecological use of their data may have. Even more frustrating is that these changes have not been communicated. An issue has been the limited in-person contact among members from different subprojects during the pandemic, which has made interactions between labs more difficult.

Risks: Related to the data issues outlined above, differences in quality of weather radar data among countries and among years remains an issue of concern. However, since we are aware of this problem, the project team is developing an agreed course of action that ensures sustainable use of weather radar data.

Changes: There have been no major changes in the project's work plan, only slight adjustments in schedule for some of the deliverables and milestone as several team members only started their positions some months after project start.

Needs: The issues with European weather radar data outlined above once more emphasize that the use of weather radar data beyond meteorological purposes needs a more 'official' approach (top-down), probably at the European level. Although we can solve these issues for the data that we use in GloBAM, this highly depends on efforts of individual researchers, which may not have the capacity and resources to devote time to this after our project ended. The use of meteorological data by ecologists (and beyond) is truly transdisciplinary but doomed if there is no awareness in the meteorological community. Therefore, we work towards a sustainable, long-term solution to this issue but so far there is not a sufficient recognition in the meteorological community for the value of this transdisciplinary endeavour. We think that an approach at the European level would be needed, perhaps engaging a more powerful organisation than a group of researchers. As important steps towards a solution, we have published a letter in Science and in the leading meteorological journal (Bulletin of the American Meteorological Society) to call for a better recognition of weather radar data beyond meteorology. Furthermore, for increased visibility of our needs, GloBAM has been included as a showcase in EuropaBON the Europa Biodiversity Observation Network. Moreover, the World Meteorological Organisation has already included a statement about the value of meteorological data beyond meteorology in the recently updated data policy.

Additional Comments

Additional Comments:

Key Findings and Unexpected Outcomes

Major Accomplishments: - We developed new methods, which was also implemented in open source software packages, to extract high resolution spatial information on migration from weather radar polar volume data - We developed methods for spatial interpolation of data to created gridded datasets of bird migration - We developed and implemented automated data processing pipelines. - We retrieved biological information from weather surveillance radar networks in Europe and North America using methods we have previously initiated and continued to develop that employ advanced data science methodology such as machine learning and deep learning and statistical analyses. - We quantified biomass flows of aerial migrants, and described how these biomass flows are related to external variables, particularly weather and climate, land use, and artificial light. - We initiated assessments of consequences of changes in population dynamics of aerial migrants, developed and pursued specific activities for dissemination of the project?s outputs, knowledge transfer and involvement of stakeholders/policy-makers, and continued our research to quantify biomass flows of aerial migrants, particularly birds, and created a unique tool to access these data on a nightly basis at scales from the county and state levels to the continental level. - We quantified bird migration (traffic rate, direction, speed, altitude) from radar and investigated important drivers of changes to migration patterns of birds, such as climatological variables, expansions of built environments and human activities, and in relation to aerial-terrestrial ecosystem interconnectivity.

Key Findings: GloBAM aimed to monitor and to forecast movements of aerial migrants with a primary goal of better understanding these movements in relation to population trajectories, human activities, ecosystem interconnections, and global flows of biomass. Our research addressed challenging and pressing biodiversity issues, studying migratory animals' patterns of movements and their responses to climatic and land-use changes, light pollution, and wind energy development. We have provided with this project a strong foundation to assist in developing a) standard long-term and large-scale monitoring of aerial migrations; b) policies regarding artificial light; c) forecast models to support mitigation procedures for wind energy installations; and d) policies for conservation of crucial (aerial) habitat, core locations and time-periods that are essential for sustaining migratory populations.

Unexpected Outcomes: Unfortunately, we discovered in the course of the project that weather radar data quality provided via a centralized server (baltrad) had declined significantly for several countries during the duration of the project, we took immediate action through policy papers, specialized memos and communication with meteorological organisations but the problems have not been solved in a sustainable manner. As the identification of insects in weather radar signals remains a challenge, we have initiated a pilot study with dedicated (mobile) small-scale radars that we placed along a gradient across Europe. This has already provided surprising insights into insect numbers and movements.

Research Challenges

Changes to Research Approach: There were no major deviations in research approach.

Problems or Delays: Data quality, data availability, heterogeneity and lack of harmonization are still major hurdles for radar aeroecology on the continental scale.

Impact on Expenditures: These did not impact expenditures, but more time has to be invested in improving data products resulting in slower scientific progress

Project Outputs

ID	Output Category	Title	Description	Languages
11279	Other Output - Datasets or Data Hubs	BirdScan Community Reference Dataset ...	This repository contains the reference dataset of labelled (or otherwise useful) echo samples acquired with a BirdSca...	en
11224	Other Output - New Collaborative Project - Mainly European	KappaFlu - UNDERSTANDING THE CONNECTI...	This is a new Horizon Europe project, which will start in 2023 and use results, methodology and insights from GloBAM.	en
11225	Other Output - New Collaborative Project - Mainly European	Move in Europe - Quantifying INsect b...	This project is a spin-off of GloBAM and targets the large-scale (European) movements of insects.	en
11220	Other Output - New Product and/or Service	Migration Dashboard - vizualisation tool	Authors: Carlsen A, Taylor L, Schloss M, Wolf H, Dokter A	en
11209	Other Output - Software	bioRad 0.5.0. R package	Authors: Dokter AM, Desmet P, Van Hoey S, Kranstauber B, Spaaks J, Veen L, Verlinden H, Leijnse H	en
11210	Other Output - Software	bioRad 0.5.1. R package	Dokter AM, Desmet P, Van Hoey S, Kranstauber B, Spaaks J, Veen L, Verlinden H, Leijnse H	en
11211	Other Output - Software	bioRad 0.5.2. R package	Authors: Dokter AM, Desmet P, Van Hoey S, Kranstauber B, Nilsson C, Spaaks J, Veen L, Verlinden H, Leijnse H	en
11216	Other Output - Software	bioRad 0.6.0. R package	Authors: Dokter AM, Desmet P, Hoekstra B, Kranstauber B, Leijnse H, Nilsson C, No N, Nussbaumer R, Spaaks J, Van Hoe...	en
11217	Other Output - Software	bioRad 0.6.1. R package	Authors: Dokter AM, Desmet P, Hoekstra B, Kranstauber B, Leijnse H, Nilsson C, No N, Nussbaumer R, Spaaks J, Van Hoe...	en
11218	Other Output - Software	bioRad 0.6.2. R package	Authors: Dokter AM, Desmet P, Hoekstra B, Kranstauber B, Leijnse H, Nilsson C, No N, Nussbaumer R, Spaaks J, Van Hoe...	en
11278	Other Output - Software	birdscanR: Migration Traffic Rate Cal...	R-package for analyses of data of birdscan small-scale radars: Extract data from Birdscan MR1 sql databases and proce...	en
11212	Other Output - Software	CROW 1.0. Vizualization tool	Authors: No N, Reyniers M, Van Hoey S, Desmet P	en
11213	Other Output - Software	CROW 1.1. Vizualization tool	Authors: No N, Reyniers M, Van Hoey S, Desmet P	en
11214	Other Output - Software	CROW 1.2. Vizualization tool	Authors: No N, Reyniers M, Van Hoey S, Desmet P	en
11221	Other Output - Software	CROW 1.3. Vizualization tool	Authors: No N, Reyniers M, Van Hoey S, Desmet P	en
11215	Other Output - Software	starsTileServer 0.1.0. R package	Author: Kranstauber B	en
11219	Other Output - Software	starsTileServer 0.1.1. R package	Author: Kranstauber B	en
11223	Other Output - Software	VPTS CSV. Data exchange format	Authors: Desmet P, Dokter AM	en
11222	Other Output - Software	vptstools (pre-release). Python package	Authors: Van Hoey S, No N, Desmet P	en
11226	Other Output - Symposiums	3rd International Radar Aeroecology C...	GloBAM organized the 3rd International Radar Aeroecology Conference in Davos, Switzerland.	en
11194	Presentation - Conference - Oral Presentation	Aerial and terrestrial biomass flows ...	Authors: Nussbaumer R et al.	en
11207	Presentation - Conference - Oral Presentation	Analyzing long-term changes in noctur...	Author: Dokter A. et al.	en

8537	Presentation - Conference - Oral Presentation	Automating Acoustic Monitoring of Noc...	Authors: Farnsworth A, Lostanlen V, Salamon J, Horton KG, Van Doren B, Dokter AM, Nilsson C, Kelling S, Bello JP	en
10515	Presentation - Conference - Oral Presentation	Beneficios y retos de usar ciencia ci...	The oral presentation was about ongoing GloBAM work as well as the general use of weather radar in radar ornithology,...	es
10518	Presentation - Conference - Oral Presentation	Bin-based polarimetric echo classific...	Author: Koistinen J et al. The demand for biomass monitoring by weather radars at various spatial scales requires ...	en
8535	Presentation - Conference - Oral Presentation	bioRad: biological analysis and visua...	Authors: Desmet P, Dokter AM, Spaaks JH, Van Hoey S, Veen L, Verlinden L, Nilsson C, Haase G, Leijnse H, Farnsworth A...	en
8526	Presentation - Conference - Oral Presentation	Blowin' in the wind: Migratory fl...	Author: Nilsson, C.	en
8528	Presentation - Conference - Oral Presentation	Coping with a dynamic aerial environment	Author: Shamoun-Baranes, J.	en
8534	Presentation - Conference - Oral Presentation	Decline and population dynamics of No...	Author: Dokter, A.	en
8524	Presentation - Conference - Oral Presentation	Decline and survival of North America...	Authors: Dokter AM, Rosenberg KV, Blancher PJ, Sauer JR, Smith AC, Smith PA, Stanton JC, Panjabi A, Helft L, Parr M, ...	en
11208	Presentation - Conference - Oral Presentation	Detecting population changes in birds...	Author: Dokter A et al.	en
11191	Presentation - Conference - Oral Presentation	Fireworks disturbance across bird com...	Authors: Hoekstra B et al.	en
11188	Presentation - Conference - Oral Presentation	From data to action: BirdCast perspec...	Author: Farnsworth A et al.	en
11183	Presentation - Conference - Oral Presentation	Global movements under global changes	Authors: Bauer S, Shamoun-Baranes J	en
11204	Presentation - Conference - Oral Presentation	How birds interact with and connect a...	Author: Shamoun-Baranes J et al.	en
11205	Presentation - Conference - Oral Presentation	How radar aeroecology can contribute ...	Author: Shamoun-Baranes J et al.	en
8523	Presentation - Conference - Oral Presentation	How to manage and publish biodiversit...	Author: Desmet, P.	en
11196	Presentation - Conference - Oral Presentation	Identifying fine-scale flight behavio...	Authors: van Erp J et al.	en
11193	Presentation - Conference - Oral Presentation	Incorporating seasonal differences in...	Authors: Kranstauber B et al.	en
11192	Presentation - Conference - Oral Presentation	Integrating deep learning with mechan...	Authors: Lippert F et al.	en
11201	Presentation - Conference - Oral Presentation	Interactions of animals with their en...	Authors: Kranstauber B	en
11186	Presentation - Conference - Oral Presentation	Macro-demography of North Americaðs m...	Author: Dokter A	en
11187	Presentation - Conference - Oral Presentation	Macro-demography of North Americaðs m...	Author: Dokter A	en
10656	Presentation - Conference - Oral Presentation	Migration through the troposphere	Author: Shamoun-Baranes J During migration, birds may transverse oceans, deserts, cities, forests and mountains. M...	en
8527	Presentation - Conference - Oral Presentation	MistNet: Measuring historical bird mi...	Authors: Sheldon D, Lin T-Y, Winner K, Bernstein G, Mittal A, Dokter AM, Horton KG, Nilsson C, Van Doren B, Farnswort...	en
8520	Presentation - Conference - Oral Presentation	Monitoring, understanding and forecas...	Authors: Bauer S on behalf of full GloBAM team Presentation at the World Biodiversity Forum 2020, Davos, Switzerland...	en

8531	Presentation - Conference - Oral Presentation	New insights from monitoring local bi...	Author: Liechti, F.	en
11206	Presentation - Conference - Oral Presentation	Observing and modeling regional migra...	Author: Kranstauber B et al.	en
11184	Presentation - Conference - Oral Presentation	On the radar: offshore wind turbine c...	Authors: Bradaric M, Shamoun-Baranes J	en
8532	Presentation - Conference - Oral Presentation	Phenology of nocturnal avian migratio...	Authors: Horton KG, La Sorte FA, Sheldon D, Lin T-Y, Winner K, Bernstein G, Maji S, Hochachka W, Farnsworth A	en
10517	Presentation - Conference - Oral Presentation	Polarimetric echo classification for ...	Weather radars provide amongst others measurements of radial velocities of targets. Radial velocities are reliable as...	en
11202	Presentation - Conference - Oral Presentation	Quantifying insect biomass and activi...	Authors: Haest B et al.	en
11199	Presentation - Conference - Oral Presentation	Quantitative monitoring of migratory ...	Authors: Schmid B, Nussbaumer R, Dokter AM	en
11195	Presentation - Conference - Oral Presentation	Recent achievements and future challe...	Author: Liechti F	en
8529	Presentation - Conference - Oral Presentation	Revealing patterns of nocturnal migra...	Authors: Nilsson C, Dokter AM, Verlinden L, Shamoun? Baranes J, Schmid B, Desmet P, Bauer S, Chapman J, Alves JA, Step...	en
11181	Presentation - Conference - Oral Presentation	Seasonal differences essential for ac...	Authors: Kranstauber et al.	en
11182	Presentation - Conference - Oral Presentation	Simultaneous monitoring of the aerial...	Authors: Haest B, Schmid B, Hertner F, Kleger D, Sapir N, Werber Y, Liechti F	en
8530	Presentation - Conference - Oral Presentation	Small scale radar can provide deep in...	Author: Liechti,F.	en
11189	Presentation - Conference - Oral Presentation	Spatiotemporal movements of insects a...	Author: Haest B et al.	en
10516	Presentation - Conference - Oral Presentation	Synergies between citizen science and...	Author: Weisshaupt N. The talk was about the use of citizen science bird observations in combination with weather ra...	en
11200	Presentation - Conference - Oral Presentation	The application of weather radar for ...	Authors: Kranstauer B et al.	en
8536	Presentation - Conference - Oral Presentation	The grand challenges of migration eco...	Authors: Bauer S, Shamoun-Baranes J, Nilsson C, Farnsworth A, Kelly J, Reynolds D, Dokter AM, Krauel J, Pettersson L,...	en
11197	Presentation - Conference - Oral Presentation	The impact of hydrometeors on bird mi...	Authors: Weisshaupt N et al.	en
10657	Presentation - Conference - Oral Presentation	Towards a data-infrastructure formon...	Authors: Shamoun-Baranes J & Bauer S The migrations of birds, bats and insects are relevant for a diverse arra...	en
8525	Presentation - Conference - Oral Presentation	Towards monitoring, understanding and...	Authors: Shamoun-Baranes J, Chapman J, Desmet P, Farnsworth A, Koistinen J, Bauer S	en
8533	Presentation - Conference - Oral Presentation	You've Got A New Light Shining In...	Authors: Farnsworth A, Horton KG, Nilsson C, Van Doren B, Dokter AM, Moscardi C, Dobler G Applications of weather ...	en
11231	Presentation - Media (Film/TV/Video)	Radar telt vogels boven Artis	Radio interview and article with Judy Shamoun-Baranes about our Letter in Science addressing the changes in meteorolo...	nl
11190	Presentation - Poster	Climatic drivers of Bracken Cave (USA...	Authors: Haest B et al.	en
11185	Presentation - Poster	CROW: Visualize bird migration in you...	Author: Desmet P	en
11198	Presentation - Poster	Dealiasing of radial velocities based...	Authors: Weisshaupt N et al.	en

8539	Publication - Internet Publication	Image sequence of bird migration Neth...	Example of vertically integrated bird density for different time slices through the night of 18-19 October 2017 over ...	en
8540	Publication - Internet Publication	Interactive visualisation of bird mig...	Author: Nussbaumer et al. This interactive map displays the nocturnal bird migration of Autumn 2016 based on data ...	en
11144	Publication - Journal - Article	A Gaussian Mixture Model to Separate ...	Recent and archived data from weather radar networks are extensively used for the quantification of continent-wide bi...	en
11276	Publication - Journal - Article	A place to land: spatiotemporal drive...	Migrating birds require en route habitats to rest and refuel. Yet, habitat use has never been integrated with passage...	en
11141	Publication - Journal - Article	Animal migrations: spectacular and sp...	Silke Bauer and Andrew Farnsworth consider the wonders of animal migration and the challenges migrant animals face.	en
11138	Publication - Journal - Article	Anthropogenic Illumination as Guiding...	Migrant birds rely on environmental and celestial cues for navigation and orientation during their journeys. Adverse ...	en
11134	Publication - Journal - Article	Bayesian classification of non-meteor...	The latest established generation of weather radars provides polarimetric measurements of a wide variety of meteorolo...	en
11142	Publication - Journal - Article	Bird strikes at commercial airports e...	Aircraft collisions with birds span the entire history of human aviation, including fatal collisions during some of t...	en
8521	Publication - Journal - Article	Broad-Scale Weather Patterns Encounte...	The dynamic weather conditions that migrating birds experience during flight likely influence where they stop to rest...	en
11277	Publication - Journal - Article	Broad-Scale Weather Patterns Encounte...	The dynamic weather conditions that migrating birds experience during flight likely influence where they stop to rest...	en
11146	Publication - Journal - Article	Challenges and benefits of using unst...	Millions of bird observations have been entered on online portals in the past 20 years either as checklists or arbitr...	en
11148	Publication - Journal - Article	Climatic drivers of (changes in) bat ...	Climate change is drastically changing the timing of biological events across the globe. Changes in the phenology of ...	en
11147	Publication - Journal - Article	Combining citizen science and weather...	The study of large-scale animal mass movements requires suitable large-scale sampling methods. Weather radar (WR) has...	en
8516	Publication - Journal - Article	Decline of the North American avifauna	Species extinctions have defined the global biodiversity crisis, but extinction begins with loss in abundance of indi...	en
11271	Publication - Journal - Article	Drivers of fatal bird collisions in a...	Millions of nocturnally migrating birds die each year from collisions with built structures, especially brightly illu...	en
11137	Publication - Journal - Article	Ensemble predictions are essential fo...	Accurate predictions of the abundance of migrating birds are important to avoid aerial conflicts of birds, for exampl...	en
8519	Publication - Journal - Article	Environmental variability, reliabilit...	The timing of migration and migratory steps is highly relevant for fitness. Because environmental conditions vary bet...	en
11136	Publication - Journal - Article	Favorable winds speed up bird migrati...	Wind has a significant yet complex effect on bird migration speed. With prevailing south wind, overall migration is g...	en
8515	Publication - Journal - Article	Geostatistical Approach to Estimate H...	Quantifying nocturnal bird migration at high resolution is essential for (1) understanding the phenology of migration...	en
8518	Publication - Journal - Article	High-Resolution Spatial Distribution ...	Weather radars provide detailed information on aerial movements of organisms. However, interpreting fine-scale radar ...	en
11135	Publication - Journal - Article	Learning to predict spatiotemporal mo...	Weather radar networks provide wide-ranging opportunities for ecologists to quantify and predict movements of airborn...	en
11139	Publication - Journal - Article	Meteorological Data Policies Needed t...	Weather radar networks have great potential for continuous and long-term monitoring of aerial biodiversity of birds, ...	en
11274	Publication - Journal - Article	Near-term ecological forecasting for ...	Near-term ecological forecasting has the potential to mitigate negative impacts of human modifications on wildlife by...	en
8517	Publication - Journal - Article	Phenology of nocturnal avian migratio...	Climate change induced phenological shifts in primary productivity result in trophic mismatches for many organisms1,2...	en

11273	Publication - Journal - Article	Predicting bird-window collisions wit...	Up to 1 billion birds die annually in the U.S. from window collisions; most of these casualties represent migratory n...	en
11143	Publication - Journal - Article	Quantifying year-round nocturnal bird...	To understand the influence of biomass flows on ecosystems, we need to characterize and quantify migrations at variou...	en
11275	Publication - Journal - Article	The role of artificial light at night...	Artificial light at night (ALAN) and roads are known threats to nocturnally migrating birds. How associations with AL...	en
11140	Publication - Journal - Article	The role of artificial light at night...	Aim Artificial light at night (ALAN) and roads are known threats to nocturnally migrating birds. How associations ...	en
11228	Publication - Journal - Editorial Comment	Bright lights, big pity	Bird collisions on buildings, artificial light, migration	en
11145	Publication - Journal - Letter	Weather radars' role in biodivers...	Letter to Science requesting a reversal of changes to meteorological data polices, which render weather radar data al...	en
11229	Publication - Newspaper - Article	Changes to European Meteorological Da...	Newspaper article based on our letter in Science about the changes in meteorological data policies.	en
11230	Publication - Newspaper - Article	De trekvogels dreigen te verdwijnen u...	Newspaper article taking up our Science letter	nl
8538	Publication - Newspaper - Article	Muuton seuranta s��tutkilla	N/A	fi
11227	Publication - Newspaper - Article	The race to save 1 billion feathered ...	Quantification of migrating bird numbers and the threats they are facing due to artificial light and other factors. P...	en

output [*not provided*] - BirdScan Community Reference Dataset (1.0.0)

Title: BirdScan Community Reference Dataset (1.0.0)

Category: Other Output - Datasets or Data Hubs

Estimated Audience Size: 1000

Citation: https://doi.org/10.5281/zenodo.5734961

External ID:

Sensitivity: Not Public

Elaboration on Sensitivity: Dataset available on request

Locations: []

Languages: en

Partners Participating in the Output: [*not provided*]

Stakeholders Referenced: Yes

Referenced in Outputs: No

If yes, please describe how: :

Transdisciplinary: Yes

Description / Summary: This repository contains the reference dataset of labelled (or otherwise useful) echo samples acquired with a BirdScan MR1 radar. This dataset enables classification of the radar echoes acquired with a BirdScan MR1 into a number of biological groups of interests (as well as the removal of non-biological targets).

output [*not provided*] - KappaFlu - UNDERSTANDING THE CONNECTIVITY AND DYNAMICS OF AVIAN INFLUENZA IN WILD BIRDS, POULTRY, AND THE ENVIRONMENT

Title:	KappaFlu - UNDERSTANDING THE CONNECTIVITY AND DYNAMICS OF AVIAN INFLUENZA IN WILD BIRDS, POULTRY, AND THE ENVIRONMENT
Category:	Other Output - New Collaborative Project - Mainly European
Estimated Audience Size:	10000
Citation:	Not yet available
External ID:	
Sensitivity:	Immediately Public
Elaboration on Sensitivity:	
Locations:	[]
Languages:	en
Partners Participating in the Output:	[*not provided*]
Stakeholders Referenced:	Yes
Referenced in Outputs:	Yes
If yes, please describe how: :	
Transdisciplinary:	Yes
Description / Summary:	This is a new Horizon Europe project, which will start in 2023 and use results, methodology and insights from GloBAM.

output [*not provided*] - Move in Europe - Quantifying INsect biomass, abundance, activity and MOVEment patterns across EUROPE

Title:	Move in Europe - Quantifying INsect biomass, abundance, activity and MOVEment patterns across EUROPE
Category:	Other Output - New Collaborative Project - Mainly European
Estimated Audience Size:	1000
Citation:	Not yet available
External ID:	
Sensitivity:	Not Public
Elaboration on Sensitivity:	
Locations:	[]
Languages:	en
Partners Participating in the Output:	[*not provided*]
Stakeholders Referenced:	Yes
Referenced in Outputs:	Yes
If yes, please describe how: :	
Transdisciplinary:	Yes
Description / Summary:	This project is a spin-off of GloBAM and targets the large-scale (European) movements of insects.

output [*not provided*] - Migration Dashboard - vizualisation tool

Title:	Migration Dashboard - vizualisation tool
Category:	Other Output - New Product and/or Service

Estimated Audience Size: 100000

Citation: https://dashboard.birdcast.info

External ID:

Sensitivity: Immediately Public
Elaboration on Sensitivity:

Locations: []

Languages: en

Partners Participating in the Output: [*not provided*]

Stakeholders Referenced: Yes

Referenced in Outputs: No
If yes, please describe how: :

Transdisciplinary: Yes

Description / Summary: Authors: Carlsen A, Taylor L, Schloss M, Wolf H, Dokter A

output [*not provided*] - bioRad 0.5.0. R package

Title: bioRad 0.5.0. R package
Category: Other Output - Software
Estimated Audience Size: 10000

Citation: https://github.com/adokter/bioRad/releases/tag/0.5.0

External ID:

Sensitivity: Immediately Public
Elaboration on Sensitivity:

Locations: []

Languages: en

Partners Participating in the Output: [*not provided*]

Stakeholders Referenced: No

Referenced in Outputs: No
If yes, please describe how: :

Transdisciplinary: Yes

Description / Summary: Authors: Dokter AM, Desmet P, Van Hoey S, Kranstauber B, Spaaks J, Veen L, Verlinden H, Leijnse H

output [*not provided*] - bioRad 0.5.1. R package

Title: bioRad 0.5.1. R package
Category: Other Output - Software
Estimated Audience Size: 10000

Citation: https://github.com/adokter/bioRad/releases/tag/0.5.1

External ID:

Sensitivity: Immediately Public
Elaboration on Sensitivity:

Locations: []

Languages: en

Partners Participating in the Output: [*not provided*]

Stakeholders Referenced: Yes

Referenced in Outputs: No
If yes, please describe how: :

Transdisciplinary: Yes

Description / Summary: Dokter AM, Desmet P, Van Hoey S, Kranstauber B, Spaaks J, Veen L, Verlinden H, Leijnse H

output [*not provided*] - bioRad 0.5.2. R package

Title: bioRad 0.5.2. R package
Category: Other Output - Software
Estimated Audience Size: 10000

Citation: https://github.com/adokter/bioRad/releases/tag/0.5.2

External ID:

Sensitivity: Immediately Public
Elaboration on Sensitivity:

Locations: []

Languages: en

Partners Participating in the Output: [*not provided*]

Stakeholders Referenced: Yes

Referenced in Outputs: No
If yes, please describe how: :

Transdisciplinary: Yes

Description / Summary: Authors: Dokter AM, Desmet P, Van Hoey S, Kranstauber B, Nilsson C, Spaaks J, Veen L, Verlinden H, Leijnse H

output [*not provided*] - bioRad 0.6.0. R package

Title: bioRad 0.6.0. R package
Category: Other Output - Software
Estimated Audience Size: 10000

Citation: https://github.com/adokter/bioRad/releases/tag/0.6.0

External ID:

Sensitivity: Immediately Public
Elaboration on Sensitivity:

Locations: []

Languages: en

Partners Participating in the Output: [*not provided*]

Stakeholders Referenced: No

Referenced in Outputs:	Yes
If yes, please describe how: :	
Transdisciplinary:	Yes
Description / Summary:	Authors: Dokter AM, Desmet P, Hoekstra B, Kranstauber B, Leijnse H, Nilsson C, No N, Nussbaumer R, Spaaks J, Van Hoey S, Veen L, Verlinden H

output [*not provided*] - bioRad 0.6.1. R package

Title:	bioRad 0.6.1. R package
Category:	Other Output - Software
Estimated Audience Size:	10000
Citation:	https://github.com/adokter/bioRad/releases/tag/0.6.1
External ID:	
Sensitivity:	Immediately Public
Elaboration on Sensitivity:	
Locations:	[]
Languages:	en
Partners Participating in the Output:	[*not provided*]
Stakeholders Referenced:	No
Referenced in Outputs:	Yes
If yes, please describe how: :	
Transdisciplinary:	Yes
Description / Summary:	Authors: Dokter AM, Desmet P, Hoekstra B, Kranstauber B, Leijnse H, Nilsson C, No N, Nussbaumer R, Spaaks J, Van Hoey S, Veen L, Verlinden H

output [*not provided*] - bioRad 0.6.2. R package

Title:	bioRad 0.6.2. R package
Category:	Other Output - Software
Estimated Audience Size:	10000
Citation:	https://github.com/adokter/bioRad/releases/tag/0.6.2
External ID:	
Sensitivity:	Immediately Public
Elaboration on Sensitivity:	
Locations:	[]
Languages:	en
Partners Participating in the Output:	[*not provided*]
Stakeholders Referenced:	No
Referenced in Outputs:	Yes
If yes, please describe how: :	
Transdisciplinary:	Yes

Description / Summary:	Authors: Dokter AM, Desmet P, Hoekstra B, Kranstauber B, Leijnse H, Nilsson C, No N, Nussbaumer R, Spaaks J, Van Hoey S, Veen L, Verlinden H

output [*not provided*] - birdscanR: Migration Traffic Rate Calculation Package for Birdscan MR1 Radars (0.1.0)

Title:	birdscanR: Migration Traffic Rate Calculation Package for Birdscan MR1 Radars (0.1.0)
Category:	Other Output - Software
Estimated Audience Size:	1000
Citation:	https://doi.org/10.5281/zenodo.7326820
External ID:	
Sensitivity:	Immediately Public
Elaboration on Sensitivity:	
Locations:	[]
Languages:	en
Partners Participating in the Output:	[*not provided*]
Stakeholders Referenced:	Yes
Referenced in Outputs:	No
If yes, please describe how: :	
Transdisciplinary:	Yes
Description / Summary:	R-package for analyses of data of birdscan small-scale radars: Extract data from Birdscan MR1 sql databases and process them to Migration Traffic Rates.

output [*not provided*] - CROW 1.0. Vizualization tool

Title:	CROW 1.0. Vizualization tool
Category:	Other Output - Software
Estimated Audience Size:	10000
Citation:	https://github.com/inbo/crow/releases/tag/v1.0
External ID:	
Sensitivity:	Immediately Public
Elaboration on Sensitivity:	
Locations:	[]
Languages:	en
Partners Participating in the Output:	[*not provided*]
Stakeholders Referenced:	Yes
Referenced in Outputs:	No
If yes, please describe how: :	
Transdisciplinary:	Yes
Description / Summary:	Authors: No N, Reyniers M, Van Hoey S, Desmet P

output [*not provided*] - CROW 1.1. Vizualization tool

Title:	CROW 1.1. Vizualization tool
Category:	Other Output - Software
Estimated Audience Size:	10000

Citation: https://github.com/inbo/crow/releases/tag/v1.1

External ID:

Sensitivity: Immediately Public
Elaboration on Sensitivity:

Locations: []

Languages: en

Partners Participating in the Output: [*not provided*]

Stakeholders Referenced: No

Referenced in Outputs: No
If yes, please describe how: :

Transdisciplinary: Yes

Description / Summary: Authors: No N, Reyniers M, Van Hoey S, Desmet P

output [*not provided*] - CROW 1.2. Vizualization tool

Title: CROW 1.2. Vizualization tool
Category: Other Output - Software
Estimated Audience Size: 10000

Citation: https://github.com/inbo/crow/releases/tag/v1.2, https://doi.org/10.5281/zenodo.4629449

External ID:

Sensitivity: Immediately Public
Elaboration on Sensitivity:

Locations: []

Languages: en

Partners Participating in the Output: [*not provided*]

Stakeholders Referenced: No

Referenced in Outputs: Yes
If yes, please describe how: :

Transdisciplinary: Yes

Description / Summary: Authors: No N, Reyniers M, Van Hoey S, Desmet P

output [*not provided*] - CROW 1.3. Vizualization tool

Title: CROW 1.3. Vizualization tool
Category: Other Output - Software
Estimated Audience Size: 10000

Citation: https://github.com/inbo/crow/releases/tag/v1.3, https://doi.org/10.5281/zenodo.7372679

External ID:

Sensitivity: Immediately Public
Elaboration on Sensitivity:

Locations: []

Languages: en

Partners Participating in the Output: [*not provided*]

Stakeholders Referenced: Yes

Referenced in Outputs: No
If yes, please describe how: :

Transdisciplinary: Yes

Description / Summary: Authors: No N, Reyniers M, Van Hoey S, Desmet P

output [*not provided*] - starsTileServer 0.1.0. R package

Title: starsTileServer 0.1.0. R package
Category: Other Output - Software
Estimated Audience Size: 10000

Citation: https://cran.r-project.org/src/contrib/Archive/starsTileServer/

External ID:

Sensitivity: Immediately Public
Elaboration on Sensitivity:

Locations: []

Languages: en

Partners Participating in the Output: [*not provided*]

Stakeholders Referenced: No

Referenced in Outputs: Yes
If yes, please describe how: :

Transdisciplinary: Yes

Description / Summary: Author: Kranstauber B

output [*not provided*] - starsTileServer 0.1.1. R package

Title: starsTileServer 0.1.1. R package
Category: Other Output - Software
Estimated Audience Size: 10000

Citation: https://cran.r-project.org/package=starsTileServer, https://bartk.gitlab.io/starsTileServer

External ID:

Sensitivity: Immediately Public
Elaboration on Sensitivity:

Locations: []

Languages: en

Partners Participating in the Output: [*not provided*]

Stakeholders Referenced: No

Referenced in Outputs: Yes
If yes, please describe how: :

Transdisciplinary: Yes

Description / Summary:	Author: Kranstauber B

output [*not provided*] - VPTS CSV. Data exchange format

Title:	VPTS CSV. Data exchange format
Category:	Other Output - Software
Estimated Audience Size:	10000
Citation:	https://github.com/enram/vpts-csv
External ID:	
Sensitivity:	Immediately Public
Elaboration on Sensitivity:	
Locations:	[]
Languages:	en
Partners Participating in the Output:	[*not provided*]
Stakeholders Referenced:	No
Referenced in Outputs:	No
If yes, please describe how: :	
Transdisciplinary:	Yes
Description / Summary:	Authors: Desmet P, Dokter AM

output [*not provided*] - vptstools (pre-release). Python package

Title:	vptstools (pre-release). Python package
Category:	Other Output - Software
Estimated Audience Size:	10000
Citation:	https://github.com/enram/vptstools
External ID:	
Sensitivity:	Immediately Public
Elaboration on Sensitivity:	
Locations:	[]
Languages:	en
Partners Participating in the Output:	[*not provided*]
Stakeholders Referenced:	No
Referenced in Outputs:	No
If yes, please describe how: :	
Transdisciplinary:	Yes
Description / Summary:	Authors: Van Hoey S, No N, Desmet P

output [*not provided*] - 3rd International Radar Aeroecology Conference

Title:	3rd International Radar Aeroecology Conference
Category:	Other Output - Symposiums
Estimated Audience Size:	100

Citation: https://globam.science/irac-2022/

External ID:

Sensitivity: Immediately Public
Elaboration on Sensitivity:

Locations: []

Languages: en

Partners Participating in the Output: [*not provided*]

Stakeholders Referenced: Yes

Referenced in Outputs: Yes
If yes, please describe how: :

Transdisciplinary: Yes

Description / Summary: GloBAM organized the 3rd International Radar Aeroecology Conference in Davos, Switzerland.

output [*not provided*] - Aerial and terrestrial biomass flows of migratory birds across the US

Title: Aerial and terrestrial biomass flows of migratory birds across the US
Category: Presentation - Conference - Oral Presentation
Estimated Audience Size: 100

Citation: https://globam.science/irac-2022/#programme

External ID:

Sensitivity: Immediately Public
Elaboration on Sensitivity:

Locations: [CHE, USA]

Languages: en

Partners Participating in the Output: [*not provided*]

Stakeholders Referenced: Yes

Referenced in Outputs: Yes
If yes, please describe how: :

Transdisciplinary: Yes

Description / Summary: Authors: Nussbaumer R et al.

output [*not provided*] - Analyzing long-term changes in nocturnal bird migration using the NEXRAD weather radar archive

Title: Analyzing long-term changes in nocturnal bird migration using the NEXRAD weather radar archive
Category: Presentation - Conference - Oral Presentation
Estimated Audience Size: 100

Citation: Cloud Forum 2019 at Cornell University Ithaca

External ID:

Sensitivity: Immediately Public
Elaboration on Sensitivity:

Locations: USA

Languages: en

Partners Participating in the Output: [*not provided*]

Stakeholders Referenced: Yes

Referenced in Outputs: Yes

If yes, please describe how: :

Transdisciplinary: Yes

Description / Summary: Author: Dokter A. et al.

output [*not provided*] - Automating Acoustic Monitoring of Nocturnally Migrating Birds: BirdVox and the Integration of Citizen Science and Radar Data to Enhance Evolving Paradigms

Title: Automating Acoustic Monitoring of Nocturnally Migrating Birds: BirdVox and the Integration of Citizen Science and Radar Data to Enhance Evolving Paradigms

Category: Presentation - Conference - Oral Presentation

Estimated Audience Size: 1000

Citation: AGU Fall Meeting 2019 (AGU 100), San Francisco, United States, 9-13 December 2019

External ID:

Sensitivity: Immediately Public

Elaboration on Sensitivity:

Locations: USA

Languages: en

Partners Participating in the Output: [*not provided*]

Stakeholders Referenced: Yes

Referenced in Outputs: Yes

If yes, please describe how: : in the acknowledgments and slide templates

Transdisciplinary: Yes

Description / Summary: Authors: Farnsworth A, Lostanlen V, Salamon J, Horton KG, Van Doren B, Dokter AM, Nilsson C, Kelling S, Bello JP

output [*not provided*] - Beneficios y retos de usar ciencia ciudadana con radares meteorol�gicos en estudios de migraci�n

Title: Beneficios y retos de usar ciencia ciudadana con radares meteorol�gicos en estudios de migraci�n

Category: Presentation - Conference - Oral Presentation

Estimated Audience Size: 1000

Citation: N/A

External ID: https://youtu.be/qrxpl2yBP-o

Sensitivity: Immediately Public

Elaboration on Sensitivity:

Locations: ESP

Languages: es

Partners Participating in the Output:	[*not provided*]
Stakeholders Referenced:	Yes
Referenced in Outputs:	Yes
If yes, please describe how: :	BF & Biodiversa and other funding agencies were explicitly shown presentation slides (through logos), and explicitly written in acknowledgements.
Transdisciplinary:	Yes
Description / Summary:	The oral presentation was about ongoing GloBAM work as well as the general use of weather radar in radar ornithology, showing several examples of work from Spain and Finland, and potential fields of application.

output [*not provided*] - Bin-based polarimetric echo classification for spatially flexible aeroecological purposes in combination with citizen science

Title:	Bin-based polarimetric echo classification for spatially flexible aeroecological purposes in combination with citizen science
Category:	Presentation - Conference - Oral Presentation
Estimated Audience Size:	100
Citation:	https://globam.science/irac-2022/
External ID:	
Sensitivity:	Immediately Public
Elaboration on Sensitivity:	
Locations:	CHE
Languages:	en
Partners Participating in the Output:	[*not provided*]
Stakeholders Referenced:	No
Referenced in Outputs:	Yes
If yes, please describe how: :	
Transdisciplinary:	Yes
Description / Summary:	Author: Koistinen J et al. The demand for biomass monitoring by weather radars at various spatial scales requires reliable high-resolution target identification in a variety of environmental settings and for various types of migrations of aerial biota. Another challenge in using weather radars more effectively in ornithological research is the unknown species composition in the radar volume. In the present work, we show the application of a novel supervised Bayesian classification methodology based on polarimetric moments from C-band dual-polarisation weather radars in aeroecology supported by citizen science data. The key achievement of the methodology is the quantification of different types of aerofauna in each range gate at a spatial resolution of about 1 km. As a second important benefit the methodology simultaneously separates a range of meteorological and non-meteorological target types. The bin-based methodology allows for spatially more flexible high-resolution applications in a broader set of migration types compared to existing layer-based approaches. The method enables spatially distributed retrieval of bird and insect information also in cases when precipitation occupies parts of radar scan volumes. We compare the performance of the polarimetric methodology to established standard methods used in radar biology and discuss its extended potential for biodiversity monitoring in different types of migrations which unveil novel areas of application.

output [*not provided*] - bioRad: biological analysis and visualization of weather radar data

Title:	bioRad: biological analysis and visualization of weather radar data
Category:	Presentation - Conference - Oral Presentation
Estimated Audience Size:	1000

Citation: 2nd International Radar Aeroecology Conference, Zhengzhou, China, 21-24 September 2019

External ID:

Sensitivity: Immediately Public
Elaboration on Sensitivity:

Locations: CHN

Languages: en

Partners Participating in the Output: [*not provided*]

Stakeholders Referenced: No

Referenced in Outputs: Yes
If yes, please describe how: :

Transdisciplinary: Yes

Description / Summary: Authors: Desmet P, Dokter AM, Spaaks JH, Van Hoey S, Veen L, Verlinden L, Nilsson C, Haase G, Leijnse H, Farnsworth A, Bouten W, Shamoun-Baranes J

output [*not provided*] - Blowin' in the wind: Migratory flight and wind

Title: Blowin' in the wind: Migratory flight and wind
Category: Presentation - Conference - Oral Presentation
Estimated Audience Size: 1000

Citation: European Ornithologists Union 2019 Conference, Cluj-Napoca, Romania, 26-30 August 2019

External ID:

Sensitivity: Immediately Public
Elaboration on Sensitivity:

Locations: ROU

Languages: en

Partners Participating in the Output: [*not provided*]

Stakeholders Referenced: No

Referenced in Outputs: Yes
If yes, please describe how: :

Transdisciplinary: No

Description / Summary: Author: Nilsson, C.

output [*not provided*] - Coping with a dynamic aerial environment

Title: Coping with a dynamic aerial environment
Category: Presentation - Conference - Oral Presentation
Estimated Audience Size: 1000

Citation: 2nd International Radar Aeroecology Conference, Zhengzhou, China, 21-24 September 2019

External ID:

Sensitivity: Immediately Public
Elaboration on Sensitivity:

Locations: CHN

Languages: en

Partners Participating in the Output: [*not provided*]

Stakeholders Referenced: No

Referenced in Outputs: Yes
If yes, please describe how: : acknowledgements and slide templates

Transdisciplinary: No

Description / Summary: Author: Shamoun-Baranes, J.

output [*not provided*] - Decline and population dynamics of North America's migratory avifauna

Title: Decline and population dynamics of North America's migratory avifauna
Category: Presentation - Conference - Oral Presentation
Estimated Audience Size: 1000

Citation: 2nd International Radar Aeroecology Conference, Zhengzhou, China, 21-24 September 2019

External ID:

Sensitivity: Immediately Public
Elaboration on Sensitivity:

Locations: CHN

Languages: en

Partners Participating in the Output: [*not provided*]

Stakeholders Referenced: No

Referenced in Outputs: Yes
If yes, please describe how: :

Transdisciplinary: No

Description / Summary: Author: Dokter, A.

output [*not provided*] - Decline and survival of North America's migratory Avifauna determined by a weather radar network

Title: Decline and survival of North America's migratory Avifauna determined by a weather radar network
Category: Presentation - Conference - Oral Presentation
Estimated Audience Size: 1000

Citation: American Ornithological Society 2019 Annual Meeting, Anchorage, Alaska, United States, 26 June 2019

External ID:

Sensitivity: Immediately Public
Elaboration on Sensitivity:

Locations: USA

Languages: en

Partners Participating in the Output: [*not provided*]

Stakeholders Referenced: Yes

Referenced in Outputs: Yes

If yes, please describe how: :

Transdisciplinary: No

Description / Summary: Authors: Dokter AM, Rosenberg KV, Blancher PJ, Sauer JR, Smith AC, Smith PA, Stanton JC, Panjabi A, Helft L, Parr M, Marra PM

output [*not provided*] - Detecting population changes in birds and insects with radar: challenges and insights from the US

Title: Detecting population changes in birds and insects with radar: challenges and insights from the US
Category: Presentation - Conference - Oral Presentation
Estimated Audience Size: 1000

Citation: 2nd International Radar Aeroecology Conference, Nanjing, China

External ID:

Sensitivity: Immediately Public
Elaboration on Sensitivity:

Locations: CHN

Languages: en

Partners Participating in the Output: [*not provided*]

Stakeholders Referenced: Yes

Referenced in Outputs: Yes
If yes, please describe how: :

Transdisciplinary: Yes

Description / Summary: Author: Dokter A et al.

output [*not provided*] - Fireworks disturbance across bird communities

Title: Fireworks disturbance across bird communities
Category: Presentation - Conference - Oral Presentation
Estimated Audience Size: 1000

Citation: https://globam.science/irac-2022/#programme

External ID:

Sensitivity: Immediately Public
Elaboration on Sensitivity:

Locations: [NLD, CHE]

Languages: en

Partners Participating in the Output: [*not provided*]

Stakeholders Referenced: Yes

Referenced in Outputs: Yes
If yes, please describe how: :

Transdisciplinary: No

Description / Summary: Authors: Hoekstra B et al.

output [*not provided*] - From data to action: BirdCast perspectives on transforming bird migration science to conservation planning

Title: From data to action: BirdCast perspectives on transforming bird migration science to conservation planning

Category: Presentation - Conference - Oral Presentation
Estimated Audience Size: 100

Citation: https://globam.science/irac-2022/#programme

External ID:

Sensitivity: Immediately Public
Elaboration on Sensitivity:

Locations: CHE

Languages: en

Partners Participating in the Output: [*not provided*]

Stakeholders Referenced: Yes

Referenced in Outputs: Yes
If yes, please describe how: :

Transdisciplinary: Yes

Description / Summary: Author: Farnsworth A et al.

output [*not provided*] - Global movements under global changes

Title: Global movements under global changes
Category: Presentation - Conference - Oral Presentation
Estimated Audience Size: 100

Citation: https://globam.science/irac-2022/#programme

External ID:

Sensitivity: Immediately Public
Elaboration on Sensitivity:

Locations: CHE

Languages: en

Partners Participating in the Output: [*not provided*]

Stakeholders Referenced: Yes

Referenced in Outputs: Yes
If yes, please describe how: :

Transdisciplinary: Yes

Description / Summary: Authors: Bauer S, Shamoun-Baranes J

output [*not provided*] - How birds interact with and connect aerial, terrestrial and aquatic environments

Title: How birds interact with and connect aerial, terrestrial and aquatic environments
Category: Presentation - Conference - Oral Presentation
Estimated Audience Size: 1000

Citation: NWO Life conference

External ID:

Sensitivity: Immediately Public
Elaboration on Sensitivity:

Locations: NLD

Languages: en

Partners Participating in the Output: [*not provided*]

Stakeholders Referenced: Yes

Referenced in Outputs: Yes
If yes, please describe how: :

Transdisciplinary: Yes

Description / Summary: Author: Shamoun-Baranes J et al.

output [*not provided*] - How radar aeroecology can contribute to flight safety

Title: How radar aeroecology can contribute to flight safety
Category: Presentation - Conference - Oral Presentation
Estimated Audience Size: 10000

Citation: World Birdstrike Association, virtual conference

External ID:

Sensitivity: Immediately Public
Elaboration on Sensitivity:

Locations: []

Languages: en

Partners Participating in the Output: [*not provided*]

Stakeholders Referenced: Yes

Referenced in Outputs: Yes
If yes, please describe how: :

Transdisciplinary: Yes

Description / Summary: Author: Shamoun-Baranes J et al.

output [*not provided*] - How to manage and publish biodiversity data

Title: How to manage and publish biodiversity data
Category: Presentation - Conference - Oral Presentation
Estimated Audience Size: 100

Citation: BioDivERsa kick-off meeting and stakeholder workshop, Helsinki, Finland, 14-16 May 2019

External ID:

Sensitivity: Immediately Public
Elaboration on Sensitivity:

Locations: FIN

Languages: en

Partners Participating in the Output: [*not provided*]

Stakeholders Referenced: Yes

Referenced in Outputs: Yes

If yes, please describe how: :

Transdisciplinary: Yes

Description / Summary: Author: Desmet, P.

output [*not provided*] - Identifying fine-scale flight behaviour in 2D bird radar tracks: marine thermal soaring on the North Sea

Title: Identifying fine-scale flight behaviour in 2D bird radar tracks: marine thermal soaring on the North Sea
Category: Presentation - Conference - Oral Presentation
Estimated Audience Size: 100

Citation: https://globam.science/irac-2022/#programme

External ID:

Sensitivity: Immediately Public
Elaboration on Sensitivity:

Locations: CHE

Languages: en

Partners Participating in the Output: [*not provided*]

Stakeholders Referenced: Yes

Referenced in Outputs: Yes
If yes, please describe how: :

Transdisciplinary: Yes

Description / Summary: Authors: van Erp J et al.

output [*not provided*] - Incorporating seasonal differences in phenology is essential for accurate bird migration forecasts

Title: Incorporating seasonal differences in phenology is essential for accurate bird migration forecasts
Category: Presentation - Conference - Oral Presentation
Estimated Audience Size: 100

Citation: https://globam.science/irac-2022/#programme

External ID:

Sensitivity: Immediately Public
Elaboration on Sensitivity:

Locations: CHE

Languages: en

Partners Participating in the Output: [*not provided*]

Stakeholders Referenced: Yes

Referenced in Outputs: Yes
If yes, please describe how: :

Transdisciplinary: Yes

Description / Summary: Authors: Kranstauber B et al.

output [*not provided*] - Integrating deep learning with mechanistic modeling for spatio-temporal migration forecasts based on weather radar networks

Title:	Integrating deep learning with mechanistic modeling for spatio-temporal migration forecasts based on weather radar networks
Category:	Presentation - Conference - Oral Presentation
Estimated Audience Size:	100
Citation:	https://globam.science/irac-2022/#programme
External ID:	
Sensitivity:	Immediately Public
Elaboration on Sensitivity:	
Locations:	CHE
Languages:	en
Partners Participating in the Output:	[*not provided*]
Stakeholders Referenced:	Yes
Referenced in Outputs:	Yes
If yes, please describe how: :	
Transdisciplinary:	Yes
Description / Summary:	Authors: Lippert F et al.

output [*not provided*] - Interactions of animals with their environment

Title:	Interactions of animals with their environment
Category:	Presentation - Conference - Oral Presentation
Estimated Audience Size:	100
Citation:	International Max-Planck Research School
External ID:	
Sensitivity:	Immediately Public
Elaboration on Sensitivity:	
Locations:	DEU
Languages:	en
Partners Participating in the Output:	[*not provided*]
Stakeholders Referenced:	Yes
Referenced in Outputs:	Yes
If yes, please describe how: :	
Transdisciplinary:	Yes
Description / Summary:	Authors: Kranstauber B

output [*not provided*] - Macro-demography of North Americaðs migratory birds

Title:	Macro-demography of North Americaðs migratory birds
Category:	Presentation - Conference - Oral Presentation
Estimated Audience Size:	100
Citation:	https://globam.science/irac-2022/#programme
External ID:	

Sensitivity: Immediately Public
Elaboration on Sensitivity:

Locations: CHE

Languages: en

Partners Participating in the Output: [*not provided*]

Stakeholders Referenced: No

Referenced in Outputs: Yes
If yes, please describe how: :

Transdisciplinary: No

Description / Summary: Author: Dokter A

output [*not provided*] - Macro-demography of North America&#65533;s migratory birds

Title: Macro-demography of North America&#65533;s migratory birds
Category: Presentation - Conference - Oral Presentation
Estimated Audience Size: 100

Citation: https://globam.science/irac-2022/#programme

External ID:

Sensitivity: Immediately Public
Elaboration on Sensitivity:

Locations: CHE

Languages: en

Partners Participating in the Output: [*not provided*]

Stakeholders Referenced: No

Referenced in Outputs: Yes
If yes, please describe how: :

Transdisciplinary: No

Description / Summary: Author: Dokter A

output [*not provided*] - Migration through the troposphere

Title: Migration through the troposphere
Category: Presentation - Conference - Oral Presentation
Estimated Audience Size: 100

Citation: https://www.nern.nl/sites/default/files/Reader_2022_revised%20v3.pdf

External ID:

Sensitivity: Immediately Public
Elaboration on Sensitivity:

Locations: NLD

Languages: en

Partners Participating in the Output:	[*not provided*]
Stakeholders Referenced:	Yes
Referenced in Outputs:	Yes
If yes, please describe how: :	acknowledgement slide
Transdisciplinary:	No
Description / Summary:	Author: Shamoun-Baranes J During migration, birds may transverse oceans, deserts, cities, forests and mountains. Migration might require incredible feats of endurance or small nightly hops from one resting area to the next. During these migratory journeys birds must travel through the troposphere, a turbulent aerial environment where most of Earth?s weather occurs. This talk explores some of the strategies birds have for coping with and taking advantage of the daily, seasonal and regional dynamics of the troposphere. Individual tracking through bio-logging, measuring aerial fluxes with radar and simulation modelling are valuable tools for studying interactions between birds and the aerial environments they transverse during their migratory journeys. How birds utilize the aerial environment can shape migration routes as well as diurnal and seasonal timing of migration. Weather and circulation patterns can create barriers as well as corridors for migrants. Understanding how atmospheric dynamics influence migratory flights can also provide opportunities for reducing human-wildlife conflicts that occur in environment increasingly encroached by human activities.

output [*not provided*] - MistNet: Measuring historical bird migration in the US using archived weather radar data and convolutional neural networks

Title:	MistNet: Measuring historical bird migration in the US using archived weather radar data and convolutional neural networks
Category:	Presentation - Conference - Oral Presentation
Estimated Audience Size:	1000
Citation:	2nd International Radar Aeroecology Conference, Zhengzhou, China, 21-24 September 2019
External ID:	
Sensitivity:	Immediately Public
Elaboration on Sensitivity:	
Locations:	CHN
Languages:	en
Partners Participating in the Output:	[*not provided*]
Stakeholders Referenced:	No
Referenced in Outputs:	Yes
If yes, please describe how: :	
Transdisciplinary:	No
Description / Summary:	Authors: Sheldon D, Lin T-Y, Winner K, Bernstein G, Mittal A, Dokter AM, Horton KG, Nilsson C, Van Doren B, Farnsworth A, La Sorte FA, Maji S

output [*not provided*] - Monitoring, understanding and forecasting global biomass flows of aerial migrants

Title:	Monitoring, understanding and forecasting global biomass flows of aerial migrants
Category:	Presentation - Conference - Oral Presentation
Estimated Audience Size:	1000
Citation:	https://www.worldbiodiversityforum.org/index.html
External ID:	

Sensitivity:	Immediately Public
Elaboration on Sensitivity:	
Locations:	CHE
Languages:	en
Partners Participating in the Output:	[*not provided*]
Stakeholders Referenced:	Yes
Referenced in Outputs:	Yes
If yes, please describe how: :	
Transdisciplinary:	Yes
Description / Summary:	Authors: Bauer S on behalf of full GloBAM team Presentation at the World Biodiversity Forum 2020, Davos, Switzerland, 23-28 February 2020. Invited talk.

output [*not provided*] - New insights from monitoring local bird and insect movements year round by dedicated bird radar

Title:	New insights from monitoring local bird and insect movements year round by dedicated bird radar
Category:	Presentation - Conference - Oral Presentation
Estimated Audience Size:	1000
Citation:	2nd International Radar Aeroecology Conference, Beijing, China, 21-24 September 2019
External ID:	
Sensitivity:	Immediately Public
Elaboration on Sensitivity:	
Locations:	CHN
Languages:	en
Partners Participating in the Output:	[*not provided*]
Stakeholders Referenced:	No
Referenced in Outputs:	Yes
If yes, please describe how: :	
Transdisciplinary:	No
Description / Summary:	Author: Liechti, F.

output [*not provided*] - Observing and modeling regional migratory patterns of birds using meteorological radar

Title:	Observing and modeling regional migratory patterns of birds using meteorological radar
Category:	Presentation - Conference - Oral Presentation
Estimated Audience Size:	1000
Citation:	Netherlands Annual Ecology Meeting 2020
External ID:	
Sensitivity:	Immediately Public
Elaboration on Sensitivity:	
Locations:	NLD
Languages:	en
Partners Participating in the Output:	[*not provided*]

Stakeholders Referenced: Yes

Referenced in Outputs: Yes
If yes, please describe how: :

Transdisciplinary: Yes

Description / Summary: Author: Kranstauber B et al.

output [*not provided*] - On the radar: offshore wind turbine curtailment informed by nocturnal bird migration predictions

Title: On the radar: offshore wind turbine curtailment informed by nocturnal bird migration predictions
Category: Presentation - Conference - Oral Presentation
Estimated Audience Size: 100

Citation: https://globam.science/irac-2022/#programme

External ID:

Sensitivity: Immediately Public
Elaboration on Sensitivity:

Locations: CHE

Languages: en

Partners Participating in the Output: [*not provided*]

Stakeholders Referenced: Yes

Referenced in Outputs: Yes
If yes, please describe how: :

Transdisciplinary: Yes

Description / Summary: Authors: Bradaric M, Shamoun-Baranes J

output [*not provided*] - Phenology of nocturnal avian migration has shifted at the continental scale

Title: Phenology of nocturnal avian migration has shifted at the continental scale
Category: Presentation - Conference - Oral Presentation
Estimated Audience Size: 1000

Citation: 2nd International Radar Aeroecology Conference, Zhengzhou, China, 21-24 September 2019

External ID:

Sensitivity: Immediately Public
Elaboration on Sensitivity:

Locations: CHN

Languages: en

Partners Participating in the Output: [*not provided*]

Stakeholders Referenced: No

Referenced in Outputs: No
If yes, please describe how: :

Transdisciplinary: No

Description / Summary:	Authors: Horton KG, La Sorte FA, Sheldon D, Lin T-Y, Winner K, Bernstein G, Maji S, Hochachka W, Farnsworth A

output [*not provided*] - Polarimetric echo classification for high-resolution aerofaunal analyses

Title:	Polarimetric echo classification for high-resolution aerofaunal analyses
Category:	Presentation - Conference - Oral Presentation
Estimated Audience Size:	100
Citation:	https://globam.science/irac-2022/
External ID:	
Sensitivity:	Immediately Public
Elaboration on Sensitivity:	
Locations:	[CHN, FRA, DEU, CHE, USA]
Languages:	en
Partners Participating in the Output:	[*not provided*]
Stakeholders Referenced:	No
Referenced in Outputs:	Yes
If yes, please describe how: :	
Transdisciplinary:	Yes
Description / Summary:	Weather radars provide amongst others measurements of radial velocities of targets. Radial velocities are reliable as long as a certain target type does not exceed the maximum unambiguous velocity, so-called Nyquist velocity, determined for a given pulse repetition frequency (PRF). Velocities of targets exceeding this limit are folded and require corrective dealiasing. Many dealiasing approaches have been developed which work well for wide-spread targets with uniform direction and speed, such as rain or insects (passive wind tracers). However, in many operational sweeps with low PRF these methods do not work well for birds with spatially heterogenous directions and speeds. Also, interference between mixed target types may affect the outcome of dealiasing, e.g. insect or rain contamination in a bird sample. Bin-based polarimetric target classification can help reduce the risk of mixed velocities from different target classes in one volume, though it does not avoid mosaic aliased velocity patterns or the Nyquist dilemma. On the other hand, non-polarimetric interleaved dual-PRF sweeps will give much better velocity estimates although they lack polarimetric information. Here we propose a novel method using a combination of interleaved elevation sweeps of bin-based polarimetric classification and dual-PRF measurements to circumvent dealiasing during bird migration and to obtain radial velocities for the calculation of migration traffic rates.

output [*not provided*] - Quantifying insect biomass and activity patterns across Europe through a network of vertical-looking radars

Title:	Quantifying insect biomass and activity patterns across Europe through a network of vertical-looking radars
Category:	Presentation - Conference - Oral Presentation
Estimated Audience Size:	100
Citation:	British Ecological Society: Quantitative Special Interest Group Meeting
External ID:	
Sensitivity:	Immediately Public
Elaboration on Sensitivity:	
Locations:	GBR
Languages:	en
Partners Participating in the Output:	[*not provided*]

Stakeholders Referenced: Yes

Referenced in Outputs: Yes
If yes, please describe how: :

Transdisciplinary: Yes

Description / Summary: Authors: Haest B et al.

output [*not provided*] - Quantitative monitoring of migratory birds: novel perspectives using radar and citizen science

Title: Quantitative monitoring of migratory birds: novel perspectives using radar and citizen science
Category: Presentation - Conference - Oral Presentation
Estimated Audience Size: 1000

Citation: https://www.ebcc2022.ch/

External ID:

Sensitivity: Immediately Public
Elaboration on Sensitivity:

Locations: CHE

Languages: en

Partners Participating in the Output: [*not provided*]

Stakeholders Referenced: Yes

Referenced in Outputs: Yes
If yes, please describe how: :

Transdisciplinary: No

Description / Summary: Authors: Schmid B, Nussbaumer R, Dokter AM

output [*not provided*] - Recent achievements and future challenges in radar ornithology

Title: Recent achievements and future challenges in radar ornithology
Category: Presentation - Conference - Oral Presentation
Estimated Audience Size: 100

Citation: https://globam.science/irac-2022/#programme

External ID:

Sensitivity: Immediately Public
Elaboration on Sensitivity:

Locations: CHE

Languages: en

Partners Participating in the Output: [*not provided*]

Stakeholders Referenced: Yes

Referenced in Outputs: Yes
If yes, please describe how: :

Transdisciplinary: Yes

Description / Summary: Author: Liechti F

output [*not provided*] - Revealing patterns of nocturnal migration using the European weather radar network

output [*not provided*] - Revealing patterns of nocturnal migration using the European weather radar network

Title:	Revealing patterns of nocturnal migration using the European weather radar network
Category:	Presentation - Conference - Oral Presentation
Estimated Audience Size:	1000
Citation:	2nd International Radar Aeroecology Conference, Zhengzhou, China, 21-24 September 2019
External ID:	
Sensitivity:	Immediately Public
Elaboration on Sensitivity:	
Locations:	CHN
Languages:	en
Partners Participating in the Output:	[*not provided*]
Stakeholders Referenced:	No
Referenced in Outputs:	Yes
If yes, please describe how: :	
Transdisciplinary:	No
Description / Summary:	Authors: Nilsson C, Dokter AM, Verlinden L, Shamoun?Baranes J, Schmid B, Desmet P, Bauer S, Chapman J, Alves JA, Stepanian PM, Sapir N, Wainwright C, Boos M, Grska A, Menz MHM, Rodrigues P, Leijnse H, Zehtindjiev P, Brabant R, Haase G, Weisshaupt N, Ciach M, Liechti F

output [*not provided*] - Seasonal differences essential for accurate bird migration forecasts for conservation and flight safety

Title:	Seasonal differences essential for accurate bird migration forecasts for conservation and flight safety
Category:	Presentation - Conference - Oral Presentation
Estimated Audience Size:	1000
Citation:	Netherlands Annual Ecology Meeting 2022
External ID:	
Sensitivity:	Immediately Public
Elaboration on Sensitivity:	
Locations:	NLD
Languages:	en
Partners Participating in the Output:	[*not provided*]
Stakeholders Referenced:	Yes
Referenced in Outputs:	Yes
If yes, please describe how: :	
Transdisciplinary:	Yes
Description / Summary:	Authors: Kranstauber et al.

output [*not provided*] - Simultaneous monitoring of the aerial biomass flow of insects, birds and bats

Title:	Simultaneous monitoring of the aerial biomass flow of insects, birds and bats

Category: Presentation - Conference - Oral Presentation
Estimated Audience Size: 1000

Citation: https://www.worldbiodiversityforum.org/en/wbf-2022

External ID:

Sensitivity: Immediately Public
Elaboration on Sensitivity:

Locations: []

Languages: en

Partners Participating in the Output: [*not provided*]

Stakeholders Referenced: Yes

Referenced in Outputs: Yes
If yes, please describe how: :

Transdisciplinary: Yes

Description / Summary: Authors: Haest B, Schmid B, Hertner F, Kleger D, Sapir N, Werber Y, Liechti F

output [*not provided*] - Small scale radar can provide deep insight into aerial animal movements

Title: Small scale radar can provide deep insight into aerial animal movements
Category: Presentation - Conference - Oral Presentation
Estimated Audience Size: 1000

Citation: 2nd International Radar Aeroecology Conference, Zhengzhou, China, 21-24 September 2019

External ID:

Sensitivity: Immediately Public
Elaboration on Sensitivity:

Locations: CHN

Languages: en

Partners Participating in the Output: [*not provided*]

Stakeholders Referenced: No

Referenced in Outputs: Yes
If yes, please describe how: :

Transdisciplinary: No

Description / Summary: Author: Liechti,F.

output [*not provided*] - Spatiotemporal movements of insects across Europe, quantified using a vertical-looking radar network

Title: Spatiotemporal movements of insects across Europe, quantified using a vertical-looking radar network
Category: Presentation - Conference - Oral Presentation
Estimated Audience Size: 1000

Citation: https://globam.science/irac-2022/#programme

External ID:

Sensitivity: Immediately Public
Elaboration on Sensitivity:

Locations: CHE

Languages: en

Partners Participating in the Output: [*not provided*]

Stakeholders Referenced: Yes

Referenced in Outputs: Yes
If yes, please describe how: :

Transdisciplinary: No

Description / Summary: Author: Haest B et al.

output [*not provided*] - Synergies between citizen science and weather radar research

Title: Synergies between citizen science and weather radar research
Category: Presentation - Conference - Oral Presentation
Estimated Audience Size: 100

Citation: 'Developments in monitoring science' BOU zoom conference

External ID:

Sensitivity: Immediately Public
Elaboration on Sensitivity:

Locations: [FIN, GBR]

Languages: en

Partners Participating in the Output: [*not provided*]

Stakeholders Referenced: Yes

Referenced in Outputs: Yes
If yes, please describe how: : Use of logos and explicit mention of Belmont Forum, Biodiversa, and national funding agencies.

Transdisciplinary: Yes

Description / Summary: Author: Weisshaupt N. The talk was about the use of citizen science bird observations in combination with weather radar as used by the Finnish GloBAM partner.

output [*not provided*] - The application of weather radar for monitoring bird migrations and local movement

Title: The application of weather radar for monitoring bird migrations and local movement
Category: Presentation - Conference - Oral Presentation
Estimated Audience Size: 1000

Citation: https://bou.org.uk/conferences-and-meetings/

External ID:

Sensitivity: Immediately Public
Elaboration on Sensitivity:

Locations: GBR

Languages: en

Partners Participating in the Output: [*not provided*]

Stakeholders Referenced: Yes

Referenced in Outputs: Yes
If yes, please describe how: :

Transdisciplinary: Yes

Description / Summary: Authors: Kranstauer B et al.

output [*not provided*] - The grand challenges of migration ecology that radar aeroecology can answer

Title: The grand challenges of migration ecology that radar aeroecology can answer
Category: Presentation - Conference - Oral Presentation
Estimated Audience Size: 1000

Citation: 2nd International Radar Aeroecology Conference, Zhengzhou, China, 21-24 September 201

External ID:

Sensitivity: Immediately Public
Elaboration on Sensitivity:

Locations: CHN

Languages: en

Partners Participating in the Output: [*not provided*]

Stakeholders Referenced: Yes

Referenced in Outputs: Yes
If yes, please describe how: :

Transdisciplinary: Yes

Description / Summary: Authors: Bauer S, Shamoun-Baranes J, Nilsson C, Farnsworth A, Kelly J, Reynolds D, Dokter AM, Krauel J, Pettersson L, Horton KG, Chapman J

output [*not provided*] - The impact of hydrometeors on bird migration as observed by various remote sensing systems

Title: The impact of hydrometeors on bird migration as observed by various remote sensing systems
Category: Presentation - Conference - Oral Presentation
Estimated Audience Size: 100

Citation: https://globam.science/irac-2022/#programme

External ID:

Sensitivity: Immediately Public
Elaboration on Sensitivity:

Locations: CHE

Languages: en

Partners Participating in the Output: [*not provided*]

Stakeholders Referenced: No

Referenced in Outputs: Yes
If yes, please describe how: :

Transdisciplinary: Yes

Description / Summary: Authors: Weisshaupt N et al.

output [*not provided*] - Towards a data-infrastructure formonitoring and forecasting migration

Title:	Towards a data-infrastructure formonitoring and forecasting migration
Category:	Presentation - Conference - Oral Presentation
Estimated Audience Size:	100
Citation:	https://www.worldbiodiversityforum.org/resources/WBF2022_program.pdf
External ID:	
Sensitivity:	Immediately Public
Elaboration on Sensitivity:	
Locations:	CHE
Languages:	en
Partners Participating in the Output:	[*not provided*]
Stakeholders Referenced:	Yes
Referenced in Outputs:	Yes
If yes, please describe how: :	acknowledgement slide
Transdisciplinary:	Yes
Description / Summary:	Authors: Shamoun-Baranes J & Bauer S The migrations of birds, bats and insects are relevant for a diverse array of stakeholders from aviation safety, wind energy, habitat and bird conservation to human health. Radar networks have tremendous potential for monitoring these migrations and establishing the knowledge base for answering scientific questions as well addressing societal challenges that require real-time monitoring and forecasting migration. For example, radar-based monitoring is currently used as a decision support tool for military aviation in several countries and similar systems are being designed for wind energy to support curtailment procedures to reduce the impact on migratory birds. However, what is currently not resolved in Europe and most of the world is a data infrastructure that facilitates diverse applications. We describe the steps needed to develop an infrastructure with a data pipeline including data acquisition, a long term archive, processing and visualization tools and delivery of biodiversity products for diverse stakeholders. As a case study, we describe current pipelines for forecasting migration. We highlight the contrasting state of affairs in the US and in Europe and steps that are needed to work towards developing sustainable services. Our roadmap could be used by other countries around the world to work towards a global infrastructure for monitoring and forecasting migration flows.

output [*not provided*] - Towards monitoring, understanding and forecasting Global Biomass flows of Aerial Migrations (GloBAM)

Title:	Towards monitoring, understanding and forecasting Global Biomass flows of Aerial Migrations (GloBAM)
Category:	Presentation - Conference - Oral Presentation
Estimated Audience Size:	1000
Citation:	European Ornithologists Union 2019 Conference, Cluj-Napoca, Romania, 26-30 August 2019
External ID:	
Sensitivity:	Immediately Public
Elaboration on Sensitivity:	
Locations:	ROU
Languages:	en
Partners Participating in the Output:	[*not provided*]
Stakeholders Referenced:	Yes

Referenced in Outputs:	Yes
If yes, please describe how: :	
Transdisciplinary:	No
Description / Summary:	Authors: Shamoun-Baranes J, Chapman J, Desmet P, Farnsworth A, Koistinen J, Bauer S

output [*not provided*] - You've Got A New Light Shining In Your Eyes

Title:	You've Got A New Light Shining In Your Eyes
Category:	Presentation - Conference - Oral Presentation
Estimated Audience Size:	1000
Citation:	2nd International Radar Aeroecology Conference, Zhengzhou, China, 21-24 September 2019
External ID:	
Sensitivity:	Immediately Public
Elaboration on Sensitivity:	
Locations:	CHN
Languages:	en
Partners Participating in the Output:	[*not provided*]
Stakeholders Referenced:	Yes
Referenced in Outputs:	Yes
If yes, please describe how: :	
Transdisciplinary:	No
Description / Summary:	Authors: Farnsworth A, Horton KG, Nilsson C, Van Doren B, Dokter AM, Moscardi C, Dobler G Applications of weather surveillance radar to study behavioral ecology of nocturnally migrating birds in photo polluted skies.

output [*not provided*] - Radar telt vogels boven Artis

Title:	Radar telt vogels boven Artis
Category:	Presentation - Media (Film/TV/Video)
Estimated Audience Size:	100000
Citation:	https://www.bnnvara.nl/vroegevogels/artikelen/radar-telt-vogels
External ID:	
Sensitivity:	Immediately Public
Elaboration on Sensitivity:	
Locations:	[]
Languages:	nl
Partners Participating in the Output:	[*not provided*]
Stakeholders Referenced:	Yes
Referenced in Outputs:	Yes
If yes, please describe how: :	

Transdisciplinary: Yes

Description / Summary: Radio interview and article with Judy Shamoun-Baranes about our Letter in Science addressing the changes in meteorological data policies

output [*not provided*] - Climatic drivers of Bracken Cave (USA) bat migration phenology and demography

Title: Climatic drivers of Bracken Cave (USA) bat migration phenology and demography
Category: Presentation - Poster
Estimated Audience Size: 1000

Citation: https://globam.science/irac-2022/#programme

External ID:

Sensitivity: Immediately Public
Elaboration on Sensitivity:

Locations: CHE

Languages: en

Partners Participating in the Output: [*not provided*]

Stakeholders Referenced: Yes

Referenced in Outputs: Yes
If yes, please describe how: :

Transdisciplinary: No

Description / Summary: Authors: Haest B et al.

output [*not provided*] - CROW: Visualize bird migration in your browser

Title: CROW: Visualize bird migration in your browser
Category: Presentation - Poster
Estimated Audience Size: 1000

Citation: https://globam.science/irac-2022/#programme

External ID:

Sensitivity: Immediately Public
Elaboration on Sensitivity:

Locations: CHE

Languages: en

Partners Participating in the Output: [*not provided*]

Stakeholders Referenced: No

Referenced in Outputs: Yes
If yes, please describe how: :

Transdisciplinary: Yes

Description / Summary: Author: Desmet P

output [*not provided*] - Dealiasing of radial velocities based on interleaved dual-PRF measurements and bin-based polarimetric echo classification

Title: Dealiasing of radial velocities based on interleaved dual-PRF measurements and bin-based polarimetric echo classification

Category:	Presentation - Poster
Estimated Audience Size:	1000
Citation:	https://globam.science/irac-2022/#programme
External ID:	
Sensitivity:	Immediately Public
Elaboration on Sensitivity:	
Locations:	CHE
Languages:	en
Partners Participating in the Output:	[*not provided*]
Stakeholders Referenced:	No
Referenced in Outputs:	Yes
If yes, please describe how: :	
Transdisciplinary:	Yes
Description / Summary:	Authors: Weisshaupt N et al.

output [*not provided*] - Image sequence of bird migration Netherlands, Germany and Belgium (2017-10-18)

Title:	Image sequence of bird migration Netherlands, Germany and Belgium (2017-10-18)
Category:	Publication - Internet Publication
Estimated Audience Size:	1000
Citation:	https://uvaauas.figshare.com/articles/Image_sequence_of_bird_migration_Netherlands_Germany_and_Belgium_2017-10-18_/11365295/2
External ID:	doi.org/10.21942/uva.11365295.v2
Sensitivity:	Immediately Public
Elaboration on Sensitivity:	
Locations:	[]
Languages:	en
Partners Participating in the Output:	[*not provided*]
Stakeholders Referenced:	No
Referenced in Outputs:	Yes
If yes, please describe how: :	
Transdisciplinary:	Yes
Description / Summary:	Example of vertically integrated bird density for different time slices through the night of 18-19 October 2017 over the Netherlands, Germany and Belgium

output [*not provided*] - Interactive visualisation of bird migration in 2016 over Europe

Title:	Interactive visualisation of bird migration in 2016 over Europe
Category:	Publication - Internet Publication
Estimated Audience Size:	10000
Citation:	https://birdmigrationmap.vogelwarte.ch/

External ID:

Sensitivity: Immediately Public

Elaboration on Sensitivity:

Locations: []

Languages: en

Partners Participating in the Output: [*not provided*]

Stakeholders Referenced: No

Referenced in Outputs: No

If yes, please describe how: :

Transdisciplinary: Yes

Description / Summary: Author: Nussbaumer et al. This interactive map displays the nocturnal bird migration of Autumn 2016 based on data from the European network of weather radars. This map was generated using a novel geostatistical model presented in a scientific paper (/10.3390/rs11192233).

output [*not provided*] - A Gaussian Mixture Model to Separate Birds and Insects in Single-Polarization Weather Radar Data

Title: A Gaussian Mixture Model to Separate Birds and Insects in Single-Polarization Weather Radar Data

Category: Publication - Journal - Article

Estimated Audience Size: 10000

Citation: Nussbaumer R, Schmid B, Bauer S, Liechti F (2021) A Gaussian Mixture Model to Separate Birds and Insects in Single-Polarization Weather Radar Data. Remote Sensing 13(10): 1989. https://doi.org/10.3390/rs13101989

External ID: https://doi.org/10.3390/rs13101989

Sensitivity: Immediately Public

Elaboration on Sensitivity:

Locations: []

Languages: en

Partners Participating in the Output: [*not provided*]

Stakeholders Referenced: Yes

Referenced in Outputs: Yes

If yes, please describe how: : in the acknowledgments

Transdisciplinary: Yes

Description / Summary:	Recent and archived data from weather radar networks are extensively used for the quantification of continent-wide bird migration patterns. While the process of discriminating birds from weather signals is well established, insect contamination is still a problem. We present a simple method combining two Doppler radar products within a Gaussian mixture model to estimate the proportions of birds and insects within a single measurement volume, as well as the density and speed of birds and insects. This method can be applied to any existing archives of vertical bird profiles, such as the European Network for the Radar surveillance of Animal Movement repository, with no need to recalculate the huge amount of original polar volume data, which often are not available.

output [*not provided*] - A place to land: spatiotemporal drivers of stopover habitat use by migrating birds

Title:	A place to land: spatiotemporal drivers of stopover habitat use by migrating birds
Category:	Publication - Journal - Article
Estimated Audience Size:	10000
Citation:	https://doi.org/10.1111/ele.13618
External ID:	
Sensitivity:	Immediately Public
Elaboration on Sensitivity:	
Locations:	[]
Languages:	en
Partners Participating in the Output:	[*not provided*]
Stakeholders Referenced:	Yes
Referenced in Outputs:	Yes
If yes, please describe how: :	
Transdisciplinary:	No
Description / Summary:	Migrating birds require en route habitats to rest and refuel. Yet, habitat use has never been integrated with passage to understand the factors that determine where and when birds stopover during spring and autumn migration. Here, we introduce the stopover-to-passage ratio (SPR), the percentage of passage migrants that stop in an area, and use 8 years of data from 12 weather surveillance radars to estimate over 50% SPR during spring and autumn through the Gulf of Mexico and Atlantic coasts of the south-eastern US, the most prominent corridor for North America?s migratory birds. During stopovers, birds concentrated close to the coast during spring and inland in forested landscapes during autumn, suggesting seasonal differences in habitat function and highlighting the vital role of stopover habitats in sustaining migratory communities. Beyond advancing understanding of migration ecology, SPR will facilitate conservation through identification of sites that are disproportionally selected for stopover by migrating birds.

output [*not provided*] - Animal migrations: spectacular and spectacularly threatened.

Title:	Animal migrations: spectacular and spectacularly threatened.
Category:	Publication - Journal - Article
Estimated Audience Size:	100000
Citation:	Bauer S, Farnsworth A (2021) Animal migrations: spectacular and spectacularly threatened. Environmental scientist 30(3): 4-9. https://www.the-ies.org/environmental_scientist
External ID:	https://www.the-ies.org/environmental_scientist
Sensitivity:	Immediately Public
Elaboration on Sensitivity:	
Locations:	[]
Languages:	en

Partners Participating in the Output:	[*not provided*]
Stakeholders Referenced:	Yes
Referenced in Outputs:	Yes
If yes, please describe how: :	In BioScetch of authors
Transdisciplinary:	Yes
Description / Summary:	Silke Bauer and Andrew Farnsworth consider the wonders of animal migration and the challenges migrant animals face.

output [*not provided*] - Anthropogenic Illumination as Guiding Light for Nocturnal Bird Migrants Identified by Remote Sensing

Title:	Anthropogenic Illumination as Guiding Light for Nocturnal Bird Migrants Identified by Remote Sensing
Category:	Publication - Journal - Article
Estimated Audience Size:	10000
Citation:	Weisshaupt N, Leskinen M, Moisseev DN, Koistinen J (2022) Anthropogenic Illumination as Guiding Light for Nocturnal Bird Migrants Identified by Remote Sensing. Remote Sensing 14(7): 1616. https://doi.org/10.3390/rs14071616
External ID:	https://doi.org/10.3390/rs14071616
Sensitivity:	Immediately Public
Elaboration on Sensitivity:	
Locations:	[]
Languages:	en
Partners Participating in the Output:	[*not provided*]
Stakeholders Referenced:	Yes
Referenced in Outputs:	Yes
If yes, please describe how: :	In the funding statement
Transdisciplinary:	Yes
Description / Summary:	Migrant birds rely on environmental and celestial cues for navigation and orientation during their journeys. Adverse weather, such as heavy rain or fog, but also thick layers of low-level clouds, affect visibility and can challenge birds' ability to orientate. Therefore, birds typically favour certain meteorological conditions for migration. Photopollution from artificial lights outdoors and radiated from buildings is known to negatively affect nocturnal migrants' flight behaviour and trajectories, which may lead to collisions with human infrastructure. Positive effects of artificial light have been identified in some stationary birds, e.g., for extended foraging hours, though not during migration. In the present study, we show the effect of artificial light on the concentration and flight directions of migrating birds during overcast conditions in the peri-urban woodland in Southern Finland. Overcast conditions, by low-level clouds, prompted birds to migrate at low altitudes. Instead of spatially homogenous large-scale migration patterns, birds were observed to adapt their flight directions, in accordance with the artificial lights of the urbanized area. By using dual- and single-polarisation weather radar data we were able to study small-scale patterns of bird movements under the influence of low-level cloud layers. These cases show the remarkable capability of the existing weather radar networks to study bird migration.

output [*not provided*] - Bayesian classification of non-meteorological targets in polarimetric Doppler radar measurements.

Title:	Bayesian classification of non-meteorological targets in polarimetric Doppler radar measurements.
Category:	Publication - Journal - Article
Estimated Audience Size:	1000

Citation:	M&#65533;kinen T, Ritvanen J, Pulkkinen S, Weisshaupt N, Koistinen J (2022) Bayesian classification of non-meteorological targets in polarimetric Doppler radar measurements. JTECH 39(10): 1561&#65533;1578. https://doi.org/10.1175/JTECH-D-21-0177.1
External ID:	https://doi.org/10.1175/JTECH-D-21-0177.1
Sensitivity:	Immediately Public
Elaboration on Sensitivity:	
Locations:	[]
Languages:	en
Partners Participating in the Output:	[*not provided*]
Stakeholders Referenced:	No
Referenced in Outputs:	Yes
If yes, please describe how: :	Full acknolwedgement
Transdisciplinary:	Yes
Description / Summary:	The latest established generation of weather radars provides polarimetric measurements of a wide variety of meteorological and nonmeteorological targets. While the classification of different precipitation types based on polarimetric data has been studied extensively, nonmeteorological targets have garnered relatively less attention beyond an effort to detect them for removal from meteorological products. In this paper we present a supervised learning classification system developed in the Finnish Meteorological Institute (FMI) that uses Bayesian inference with empirical probability density distributions to assign individual range gate samples into 7 meteorological and 12 nonmeteorological classes, belonging to five top-level categories of hydrometeors, terrain, zoogenic, anthropogenic, and immaterial. We demonstrate how the accuracy of the class probability estimates provided by a basic naive Bayes classifier can be further improved by introducing synthetic channels created through limited neighborhood filtering, by properly managing partial moment nonresponse, and by considering spatial correlation of class membership of adjacent range gates. The choice of Bayesian classification provides well-substantiated quality estimates for all meteorological products, a feature that is being increasingly requested by users of weather radar products. The availability of comprehensive, fine-grained classification of nonmeteorological targets also enables a large array of emerging applications, utilizing nonprecipitation echo types and demonstrating the need to move from a single, universal quality metric of radar observations to one that depends on the application, the measured target type, and the specificity of the customers&#65533; requirements.

output [*not provided*] - Bird strikes at commercial airports explained by citizen science and weather radar data.

Title:	Bird strikes at commercial airports explained by citizen science and weather radar data.
Category:	Publication - Journal - Article
Estimated Audience Size:	100000
Citation:	Nilsson C, La Sorte FA, Dokter AM, Horton KG, Van Doren BM, Kolodzinski JJ, Shamoun-Baranes J, Farnsworth A (2021) Bird strikes at commercial airports explained by citizen science and weather radar data. Journal of Applied Ecology 58: 2029&#65533;2039. https://doi.org/10.1111/1365-2664.13971
External ID:	https://doi.org/10.1111/1365-2664.13971
Sensitivity:	Immediately Public
Elaboration on Sensitivity:	
Locations:	[]
Languages:	en
Partners Participating in the Output:	[*not provided*]

Stakeholders Referenced: Yes

Referenced in Outputs: Yes

If yes, please describe how: : in the acknowledgments

Transdisciplinary: No

Description / Summary: Aircraft collisions with birds span the entire history of human aviation, including fatal collisions during some of the first powered human flights. Much effort has been expended to reduce such collisions, but increased knowledge about bird movements and species occurrence could dramatically improve decision support and proactive measures to reduce them. Migratory movements of birds pose a unique, often overlooked, threat to aviation that is particularly difficult for individual airports to monitor and predict the occurrence of birds vary extensively in space and time at the local scales of airport responses. We use two publicly available datasets, radar data from the US NEXRAD network characterizing migration movements and eBird data collected by citizen scientists to map bird movements and species composition with low human effort expenditures but high temporal and spatial resolution relative to other large-scale bird survey methods. As a test case, we compare results from weather radar distributions and eBird species composition with detailed bird strike records from three major New York airports. We show that weather radar-based estimates of migration intensity can accurately predict the probability of bird strikes, with 80% of the variation in bird strikes across the year explained by the average amount of migratory movements captured on weather radar. We also show that eBird-based estimates of species occurrence can, using species' body mass and flocking propensity, accurately predict when most damaging strikes occur. Synthesis and applications. By better understanding when and where different bird species occur, airports across the world can predict seasonal periods of collision risks with greater temporal and spatial resolution; such predictions include potential to predict when the most severe and damaging strikes may occur. Our results highlight the power of federating datasets with bird movement and distribution data for developing better and more taxonomically and ecologically tuned models of likelihood of strikes occurring and severity of strikes.

output [*not provided*] - Broad-Scale Weather Patterns Encountered during Flight Influence Landbird Stopover Distributions

Title: Broad-Scale Weather Patterns Encountered during Flight Influence Landbird Stopover Distributions

Category: Publication - Journal - Article

Estimated Audience Size: 1000000

Citation: Clipp, H.L.; Cohen, E.B.; Smolinsky, J.A.; Horton, K.G.; Farnsworth, A.; Buler, J.J. Broad-Scale Weather Patterns Encountered during Flight Influence Landbird Stopover Distributions. Remote Sens. 2020, 12, 565. https://doi.org/10.3390/rs12030565

External ID: https://doi.org/10.3390/rs12030565

Sensitivity: Immediately Public

Elaboration on Sensitivity:

Locations: []

Languages: en

Partners Participating in the Output: [*not provided*]

Stakeholders Referenced: No

Referenced in Outputs: Yes

If yes, please describe how: : Funding acknowledgments

Transdisciplinary: Yes

Description / Summary:	The dynamic weather conditions that migrating birds experience during flight likely influence where they stop to rest and refuel, particularly after navigating inhospitable terrain or large water bodies, but effects of weather on stopover patterns remain poorly studied. We examined the influence of broad-scale weather conditions encountered by nocturnally migrating Nearctic-Neotropical birds during northward flight over the Gulf of Mexico (GOM) on subsequent coastal stopover distributions. We categorized nightly weather patterns using historic maps and quantified region-wide densities of birds in stopover habitat with data collected by 10 weather surveillance radars from 2008 to 2015. We found spring weather patterns over the GOM were most often favorable for migrating birds, with winds assisting northward flight, and document regional stopover patterns in response to specific unfavorable weather conditions. For example, Midwest Continental High is characterized by strong northerly winds over the western GOM, resulting in high-density concentrations of migrants along the immediate coastlines of Texas and Louisiana. We show, for the first time, that broad-scale weather experienced during flight influences when and where birds stop to rest and refuel. Linking synoptic weather patterns encountered during flight with stopover distributions contributes to the emerging macro-ecological understanding of bird migration, which is critical to consider in systems undergoing rapid human-induced changes.

output [*not provided*] - Broad-Scale Weather Patterns Encountered during Flight Influence Landbird Stopover Distributions

Title:	Broad-Scale Weather Patterns Encountered during Flight Influence Landbird Stopover Distributions
Category:	Publication - Journal - Article
Estimated Audience Size:	10000
Citation:	https://doi.org/10.3390/rs12030565
External ID:	
Sensitivity:	Immediately Public
Elaboration on Sensitivity:	
Locations:	[]
Languages:	en
Partners Participating in the Output:	[*not provided*]
Stakeholders Referenced:	Yes
Referenced in Outputs:	Yes
If yes, please describe how: :	
Transdisciplinary:	Yes
Description / Summary:	The dynamic weather conditions that migrating birds experience during flight likely influence where they stop to rest and refuel, particularly after navigating inhospitable terrain or large water bodies, but effects of weather on stopover patterns remain poorly studied. We examined the influence of broad-scale weather conditions encountered by nocturnally migrating Nearctic-Neotropical birds during northward flight over the Gulf of Mexico (GOM) on subsequent coastal stopover distributions. We categorized nightly weather patterns using historic maps and quantified region-wide densities of birds in stopover habitat with data collected by 10 weather surveillance radars from 2008 to 2015. We found spring weather patterns over the GOM were most often favorable for migrating birds, with winds assisting northward flight, and document regional stopover patterns in response to specific unfavorable weather conditions. For example, Midwest Continental High is characterized by strong northerly winds over the western GOM, resulting in high-density concentrations of migrants along the immediate coastlines of Texas and Louisiana. We show, for the first time, that broad-scale weather experienced during flight influences when and where birds stop to rest and refuel. Linking synoptic weather patterns encountered during flight with stopover distributions contributes to the emerging macro-ecological understanding of bird migration, which is critical to consider in systems undergoing rapid human-induced changes.

output [*not provided*] - Challenges and benefits of using unstructured citizen science data to estimate seasonal timing of bird migration across large scales

Title:	Challenges and benefits of using unstructured citizen science data to estimate seasonal timing of bird migration across large scales
Category:	Publication - Journal - Article
Estimated Audience Size:	10000

Citation:	Weisshaupt N, Lehikoinen A, M&#65533;kinen T & Koistinen J (2021) Challenges and benefits of using unstructured citizen science data to estimate seasonal timing of bird migration across large scales. PLOS ONE 16(2): e0246572. https://doi.org/10.1371/journal.pone.0246572
External ID:	https://doi.org/10.1371/journal.pone.0246572
Sensitivity:	Immediately Public
Elaboration on Sensitivity:	
Locations:	[]
Languages:	en
Partners Participating in the Output:	[*not provided*]
Stakeholders Referenced:	Yes
Referenced in Outputs:	Yes
If yes, please describe how: :	in the acknowledgments
Transdisciplinary:	Yes
Description / Summary:	Millions of bird observations have been entered on online portals in the past 20 years either as checklists or arbitrary individual entries. While several hundred publications have been written on a variety of topics based on bird checklists worldwide, unstructured non-checklist observations have received little attention and praise by academia. In the present study we tested the suitability of non-checklist data to estimate key figures of large-scale migration phenology in four zones covering the whole of Finland. For that purpose, we analysed 10 years of ornithological non-checklist data including over 400 million. individuals of 115 bird species. We discuss bird- and human-induced effects to be considered in handling non-checklist data in this context and describe applied methodologies to address these effects. We calculated 5%, 50% and 95% percentile dates of spring and autumn migration period for all species in all four zones. For validation purposes we compared the temporal distributions of 43 bird species with migration phenology from standardized long-term ringing data in autumn of which 24 species (56%) showed similar medians. In a model approach, non-checklist data successfully revealed latitudinal migration progression in spring and autumn. Overall, non-checklist data proved to be well suited to determine descriptors of migration phenology in Northern Europe which are challenging to attain by any other currently available means. The effort-to-yield ratio of data processing was commensurate to the outcomes. The unprecedented spatiotemporal coverage makes non-checklist data a valuable complement to current migration databases from bird observatories. The basic concept of the present methodology is applicable to data from other bird portals, if combined with local field ornithological knowledge and literature. Species-specific descriptors of migration phenology can be potentially used in climate change studies and to support echo interpretation in radar ornithology.

output [*not provided*] - Climatic drivers of (changes in) bat migration phenology at Bracken Cave (USA)

Title:	Climatic drivers of (changes in) bat migration phenology at Bracken Cave (USA)
Category:	Publication - Journal - Article
Estimated Audience Size:	10000
Citation:	Haest B, Stepanian PM, Wainwright C, Liechti F, Bauer S (2020) Climatic drivers of (changes in) bat migration phenology at Bracken Cave (USA). Global Change Biology. https://doi.org/10.1111/gcb.15433
External ID:	https://doi.org/10.1111/gcb.15433
Sensitivity:	Immediately Public
Elaboration on Sensitivity:	
Locations:	[]
Languages:	en

Partners Participating in the Output:	[*not provided*]
Stakeholders Referenced:	Yes
Referenced in Outputs:	Yes
If yes, please describe how: :	in the acknowledgments
Transdisciplinary:	No
Description / Summary:	Climate change is drastically changing the timing of biological events across the globe. Changes in the phenology of seasonal migrations between the breeding and wintering grounds have been observed across biological taxa, including birds, mammals, and insects. For birds, strong links have been shown between changes in migration phenology and changes in weather conditions at the wintering, stopover, and breeding areas. For other animal taxa, the current understanding of, and evidence for, climate (change) influences on migration still remains rather limited, mainly due to the lack of long-term phenology datasets. Bracken Cave in Texas (USA) holds one of the largest bat colonies of the world. Using weather radar data, a unique 23-year (1995–2017) long time series was recently produced of the spring and autumn migration phenology of Brazilian free-tailed bats (Tadarida brasiliensis) at Bracken Cave. Here, we analyse these migration phenology time series in combination with gridded temperature, precipitation, and wind data across Mexico and southern USA, to identify the climatic drivers of (changes in) bat migration phenology. Perhaps surprisingly, our extensive spatiotemporal search did not find temperature to influence either spring or autumn migration. Instead, spring migration phenology seems to be predominantly driven by wind conditions at likely wintering or spring stopover areas during the migration period. Autumn migration phenology, on the other hand, seems to be dominated by precipitation to the east and north-east of Bracken Cave. Long-term changes towards more frequent migration and favourable wind conditions have, furthermore, allowed spring migration to occur 16 days earlier. Our results illustrate how some of the remaining knowledge gaps on the influence of climate (change) on bat migration and abundance can be addressed using weather radar analyses.

output [*not provided*] - Combining citizen science and weather radar data to study large?scale bird movements.

Title:	Combining citizen science and weather radar data to study large?scale bird movements.
Category:	Publication - Journal - Article
Estimated Audience Size:	10000
Citation:	Weisshaupt N, Lehtiniemi T, Koistinen J (2020) Combining citizen science and weather radar data to study large?scale bird movements. Ibis. https://doi.org/10.1111/ibi.12906
External ID:	https://doi.org/10.1111/ibi.12906
Sensitivity:	Immediately Public
Elaboration on Sensitivity:	
Locations:	[]
Languages:	en
Partners Participating in the Output:	[*not provided*]
Stakeholders Referenced:	Yes
Referenced in Outputs:	Yes
If yes, please describe how: :	in the acknowledgments
Transdisciplinary:	No

Description / Summary:	The study of large-scale animal mass movements requires suitable large-scale sampling methods. Weather radar (WR) has been known to register biological targets since the 1960s. Arranged in large networks, radar is suitable to study regional to continent-wide dynamics of aerofauna and to respond to increasing human–wildlife conflicts in the air. Tools for the spatiotemporal validation of faunistic interpretations of WR measurements in situ are only sparsely available. Citizen science (CS) bird observation repositories established in the past 20 years have accumulated millions of entries of species-specific information well beyond their time of existence across vast areas. Together with other CS data sources, these databases can relieve the taxonomic shortcomings of WR and thus extend and refine the use of WR data. CS and WR data combined can efficiently provide large amounts of species-specific data in three dimensions in a short time at low or no cost. Species-specific data are particularly relevant to tackle loss of biodiversity, one of the greatest challenges in today's world. In this forum paper, we present features and qualities of ornithological CS and WR data, and their potential to provide unprecedented insights into regional to continent-wide aerial movements of birds. We aim to discuss specific fields of applications where maximum information yield is to be expected, which is otherwise inaccessible, and in which way combined approaches would support biological research and derived data products and services for stakeholders, e.g. in aviation and the general public as beneficiaries.

output [*not provided*] - Decline of the North American avifauna

Title:	Decline of the North American avifauna
Category:	Publication - Journal - Article
Estimated Audience Size:	100000
Citation:	Rosenberg KV, Dokter AM, Blancher PJ, Sauer JR, Smith AC, Smith PA, Stanton JC, Panjabi A, Helft L, Parr M, Marra PP (2019) Decline of the North American avifauna. Science 366(6461): 120-124. https://doi.org/10.1126/science.aaw1313
External ID:	https://doi.org/10.1126/science.aaw1313
Sensitivity:	Not Public
Elaboration on Sensitivity:	Journal embargo policy
Locations:	[]
Languages:	en
Partners Participating in the Output:	[*not provided*]
Stakeholders Referenced:	No
Referenced in Outputs:	Yes
If yes, please describe how: :	In the acknowledgements
Transdisciplinary:	Yes
Description / Summary:	Species extinctions have defined the global biodiversity crisis, but extinction begins with loss in abundance of individuals that can result in compositional and functional changes of ecosystems. Using multiple and independent monitoring networks, we report population losses across much of the North American avifauna over 48 years, including once-common species and from most biomes. Integration of range-wide population trajectories and size estimates indicates a net loss approaching 3 billion birds, or 29% of 1970 abundance. A continent-wide weather radar network also reveals a similarly steep decline in biomass passage of migrating birds over a recent 10-year period. This loss of bird abundance signals an urgent need to address threats to avert future avifaunal collapse and associated loss of ecosystem integrity, function, and services.

output [*not provided*] - Drivers of fatal bird collisions in an urban center

Title:	Drivers of fatal bird collisions in an urban center
Category:	Publication - Journal - Article
Estimated Audience Size:	10000
Citation:	https://doi.org/10.1073/pnas.2101666118
External ID:	
Sensitivity:	Immediately Public

Elaboration on Sensitivity:

Locations: []

Languages: en

Partners Participating in the Output: [*not provided*]

Stakeholders Referenced: Yes

Referenced in Outputs: Yes

If yes, please describe how: :

Transdisciplinary: No

Description / Summary: Millions of nocturnally migrating birds die each year from collisions with built structures, especially brightly illuminated buildings and communication towers. Reducing this source of mortality requires knowledge of important behavioral, meteorological, and anthropogenic factors, yet we lack an understanding of the interacting roles of migration, artificial lighting, and weather conditions in causing fatal bird collisions. Using two decades of collision surveys and concurrent weather and migration measures, we model numbers of collisions occurring at a large urban building in Chicago. We find that the magnitude of nocturnal bird migration, building light output, and wind conditions are the most important predictors of fatal collisions. The greatest mortality occurred when the building was brightly lit during large nocturnal migration events and when winds concentrated birds along the Chicago lakeshore. We estimate that halving lighted window area decreases collision counts by 11% in spring and 6% in fall. Bird mortality could be reduced by ?60% at this site by decreasing lighted window area to minimum levels historically recorded. Our study provides strong support for a relationship between nocturnal migration magnitude and urban bird mortality, mediated by light pollution and local atmospheric conditions. Although our research focuses on a single site, our findings have global implications for reducing or eliminating a critically important cause of bird mortality.

output [*not provided*] - Ensemble predictions are essential for accurate bird migration forecasts for conservation and flight safety

Title: Ensemble predictions are essential for accurate bird migration forecasts for conservation and flight safety

Category: Publication - Journal - Article

Estimated Audience Size: 10000

Citation: Kranstauber B, Bouten W, van Gasteren H, Shamoun-Baranes J (2022) Ensemble predictions are essential for accurate bird migration forecasts for conservation and flight safety. Ecological Solutions and Evidence 3 (3): e12158. https://doi.org/10.1002/2688-8319.12158

External ID: https://doi.org/10.1002/2688-8319.12158

Sensitivity: Immediately Public

Elaboration on Sensitivity:

Locations: []

Languages: en

Partners Participating in the Output: [*not provided*]

Stakeholders Referenced: Yes

Referenced in Outputs: Yes

If yes, please describe how: : in the acknowledgments

Transdisciplinary: Yes

Description / Summary: Accurate predictions of the abundance of migrating birds are important to avoid aerial conflicts of birds, for example, with aviation or wind power installations. Here we develop a predictive model, using bird migration intensity extracted from operational weather data. We compare baseline phenological models to models incorporating both local and remote weather conditions using an ensemble approach. Single models are compared to ensemble models (average prediction of top 10 models). The models were evaluated by omitting single years from our 10-year dataset. In general, we find that wind conditions, in addition to seasonal and diurnal dynamics, are key for accurate predictions. The spring and fall migratory seasons differ, both with respect to the selected environmental variables and the contribution of the environmental model compared to the phenological model. In fall, the accumulation of migrants due to strong headwinds is an important predictor of migration. Because of the lower daily variation in migration intensity in spring, the phenological model performs better compared to fall. In fall, weather conditions contribute more to accurate predictions of migration intensity than in spring. Overall, the ensemble approach produces more accurate predictions outperforming specific environmental models. We therefore recommend that ensemble models be used in operational settings such as flight planning to reduce bird aircraft collisions during intense bird migration.

output [*not provided*] - Environmental variability, reliability of information and the timing of migration

Title: Environmental variability, reliability of information and the timing of migration

Category: Publication - Journal - Article

Estimated Audience Size: 10000

Citation: Bauer S, McNamara JM, Barta Z (2020) Environmental variability, reliability of information and the timing of migration. Proceedings of the Royal Society B 287. https://doi.org/10.1098/rspb.2020.0622

External ID: https://royalsocietypublishing.org/doi/10.1098/rspb.2020.0622

Sensitivity: Public After Embargo

Elaboration on Sensitivity:

Locations: []

Languages: en

Partners Participating in the Output: [*not provided*]

Stakeholders Referenced: No

Referenced in Outputs: Yes

If yes, please describe how: : Acknowledgements contained funding statement

Transdisciplinary: No

Description / Summary: The timing of migration and migratory steps is highly relevant for fitness. Because environmental conditions vary between years, the optimal time for migration varies accordingly. Therefore, migratory animals could clearly benefit from acquiring information as to when it is the best time to migrate in a specific year. Thus, environmental predictability and variability are fundamental characteristics of migration systems but their relationship and consequence for migratory progression has remained unexplored. We develop a simple dynamic model to identify the optimal migration behaviour in environments that differ in predictability, variability and the number of intermediate stop-over sites. Our results indicate that higher predictability along migration routes enables organisms to better time migration when phenology deviates from its long-term average and thus, increases fitness. Information is particularly valuable in highly variable environments and in the final migration-step, i.e. before the destination. Furthermore, we show that a general strategy for obtaining information in relatively uninformative but variable environments is using intermediate stop-over sites that enable migrants to better predict conditions ahead. Our study contributes to a better understanding of the relationship between animal movement and environmental predictability?an important, yet underappreciated factor that strongly influences migratory progression.

output [*not provided*] - Favorable winds speed up bird migration in spring but not in autumn

Title: Favorable winds speed up bird migration in spring but not in autumn

Category: Publication - Journal - Article

Estimated Audience Size: 10000

Citation:	Nussbaumer R, Schmid B, Bauer S, Liechti F (2022) Favorable winds speed up bird migration in spring but not in autumn. Ecology and Evolution 12: e9146. https://doi.org/10.1002/ece3.9146
External ID:	https://doi.org/10.1002/ece3.9146
Sensitivity:	Immediately Public
Elaboration on Sensitivity:	
Locations:	[]
Languages:	en
Partners Participating in the Output:	[*not provided*]
Stakeholders Referenced:	No
Referenced in Outputs:	Yes
If yes, please describe how: :	In the acknowledgments
Transdisciplinary:	No
Description / Summary:	Wind has a significant yet complex effect on bird migration speed. With prevailing south wind, overall migration is generally faster in spring than in autumn. However, studies on the difference in airspeed between seasons have shown contrasting results so far, in part due to their limited geographical or temporal coverage. Using the first full-year weather radar data set of nocturnal bird migration across western Europe together with wind speed from reanalysis data, we investigate variation of airspeed across season. We additionally expand our analysis of ground speed, airspeed, wind speed, and wind profit variation across time (seasonal and daily) and space (geographical and altitudinal). Our result confirms that wind plays a major role in explaining both temporal and spatial variabilities in ground speed. The resulting airspeed remains relatively constant at all scales (daily, seasonal, geographically and altitudinally). We found that spring airspeed is overall 5% faster in Spring than autumn, but we argue that this number is not significant compared to the biases and limitation of weather radar data. The results of the analysis can be used to further investigate birds' migratory strategies across space and time, as well as their energy use.

output [*not provided*] - Geostatistical Approach to Estimate High Resolution Nocturnal Bird Migration Densities from a Weather Radar Network

Title:	Geostatistical Approach to Estimate High Resolution Nocturnal Bird Migration Densities from a Weather Radar Network
Category:	Publication - Journal - Article
Estimated Audience Size:	10000
Citation:	https://www.mdpi.com/2072-4292/11/19/2233
External ID:	
Sensitivity:	Immediately Public
Elaboration on Sensitivity:	
Locations:	[]
Languages:	en
Partners Participating in the Output:	[*not provided*]
Stakeholders Referenced:	No
Referenced in Outputs:	Yes

If yes, please describe how: : Project funding by BioDiversa explicitly mentioned in Acknoeldgement section

Transdisciplinary: Yes

Description / Summary: Quantifying nocturnal bird migration at high resolution is essential for (1) understanding the phenology of migration and its drivers, (2) identifying critical spatio-temporal protection zones for migratory birds, and (3) assessing the risk of collision with artificial structures. We propose a tailored geostatistical model to interpolate migration intensity monitored by a network of weather radars. The model is applied to data collected in autumn 2016 from 69 European weather radars. To validate the model, we performed a cross-validation and also compared our interpolation results with independent measurements of two bird radars. Our model estimated bird densities at high resolution (0.2° latitude°longitude, 15 min) and assessed the associated uncertainty. Within the area covered by the radar network, we estimated that around 120 million birds were simultaneously in flight (10°90 quantiles: 107°134). Local estimations can be easily visualized and retrieved from a dedicated interactive website. This proof-of-concept study demonstrates that a network of weather radar is able to quantify bird migration at high resolution and accuracy. The model presented has the ability to monitor population of migratory birds at scales ranging from regional to continental in space and daily to yearly in time. Near-real-time estimation should soon be possible with an update of the infrastructure and processing software.

output [*not provided*] - High-Resolution Spatial Distribution of Bird Movements Estimated from a Weather Radar Network

Title: High-Resolution Spatial Distribution of Bird Movements Estimated from a Weather Radar Network

Category: Publication - Journal - Article

Estimated Audience Size: 1000

Citation: Kranstauber B, Bouten W, Leijnse H, Wijers B-C, Verlinden L, Shamoun-Baranes J, Dokter AM (2020) High-Resolution Spatial Distribution of Bird Movements Estimated from a Weather Radar Network. Remote Sens. 12: 635. https://www.mdpi.com/2072-4292/12/4/635

External ID: https://www.mdpi.com/2072-4292/12/4/635

Sensitivity: Immediately Public

Elaboration on Sensitivity:

Locations: []

Languages: en

Partners Participating in the Output: [*not provided*]

Stakeholders Referenced: Yes

Referenced in Outputs: Yes

If yes, please describe how: : Full funding statement in respective section

Transdisciplinary: Yes

Description / Summary: Weather radars provide detailed information on aerial movements of organisms. However, interpreting fine-scale radar imagery remains challenging because of changes in aerial sampling altitude with distance from the radar. Fine-scale radar imagery has primarily been used to assess mass exodus at sunset to study stopover habitat associations. Here, we present a method that enables a more intuitive integration of information across elevation scans projected in a two-dimensional spatial image of fine-scale radar reflectivity. We applied this method on nights of intense bird migration to demonstrate how the spatial distribution of migrants can be explored at finer spatial scales and across multiple radars during the higher flying en-route phase of migration. The resulting reflectivity maps enable explorative analysis of factors influencing their regional and fine-scale distribution. We illustrate the method's application by generating time-series of composites of up to 20 radars, achieving a nearly complete spatial coverage of a large part of Northwest Europe. These visualizations are highly useful in interpreting regional-scale migration patterns and provide detailed information on bird movements in the landscape and aerial environment.

output [*not provided*] - Learning to predict spatiotemporal movement dynamics from weather radar networks

Title: Learning to predict spatiotemporal movement dynamics from weather radar networks

Category: Publication - Journal - Article

Estimated Audience Size:	10000
Citation:	Lippert F, Kranstauber B, Forr&#xf; PD, van Loon EE (2022) Learning to predict spatiotemporal movement dynamics from weather radar networks. Methods in Ecology and Evolution 1-16. https://doi.org/10.1111/2041-210X.14007
External ID:	https://doi.org/10.1111/2041-210X.14007
Sensitivity:	Immediately Public
Elaboration on Sensitivity:	
Locations:	[]
Languages:	en
Partners Participating in the Output:	[*not provided*]
Stakeholders Referenced:	Yes
Referenced in Outputs:	Yes
If yes, please describe how: :	In acknowledgements
Transdisciplinary:	Yes
Description / Summary:	Weather radar networks provide wide-ranging opportunities for ecologists to quantify and predict movements of airborne organisms over unprecedented geographical expanses. The typically sparse spatial distribution of radar measurements poses, however, a major challenge to spatiotemporal predictive modelling. We propose FluxRGNN, a recurrent graph neural network that is based on a generic mechanistic description of population-level movements across the Voronoi tessellation of radar sites. The resulting hybrid model capitalises on local associations between environmental conditions and animal density as well as on spatiotemporal dependencies inherent to the movement process. We applied FluxRGNN to make 72-h forecasts of nocturnal bird migration over Western Europe using simulated trajectories and measurements from the European weather radar network. For both datasets, FluxRGNN achieves higher predictive performance than baseline models based on environmental conditions alone. It effectively disentangles local take-off and landing dynamics from aerial movements and correctly predicts migration directions with an accuracy of 87%. Continental-scale forecasts of animal density and biomass fluxes have the potential to improve the impact and cost-effectiveness of wildlife management and conservation efforts. With FluxRGNN this becomes feasible for nocturnal bird migration. In the future, other migration systems could benefit from applying the proposed method to similar static sensor networks.

output [*not provided*] - Meteorological Data Policies Needed to Support Biodiversity Monitoring with Weather Radar

Title:	Meteorological Data Policies Needed to Support Biodiversity Monitoring with Weather Radar
Category:	Publication - Journal - Article
Estimated Audience Size:	10000
Citation:	Shamoun-Baranes J, Bauer S, Chapman JW, Desmet P, Dokter AM, Farnsworth A, van Gasteren H, Haest B, Koistinen J, Kranstauber B, Liechti L, Mason THE, Nilsson C, Nussbaumer R, Schmid B, Weisshaupt N, Leijnse H (2022) Meteorological Data Policies Needed to Support Biodiversity Monitoring with Weather Radar. Bulletin of the American Meteorological Society 103(4): E1234-E1242. https://doi.org/10.1175/BAMS-D-21-0196.1
External ID:	https://doi.org/10.1175/BAMS-D-21-0196.1
Sensitivity:	Immediately Public
Elaboration on Sensitivity:	
Locations:	[]
Languages:	en

Partners Participating in the Output:	[*not provided*]
Stakeholders Referenced:	Yes
Referenced in Outputs:	Yes
If yes, please describe how: :	In the acknowledgments
Transdisciplinary:	Yes
Description / Summary:	Weather radar networks have great potential for continuous and long-term monitoring of aerial biodiversity of birds, bats, and insects. Biological data from weather radars can support ecological research, inform conservation policy development and implementation, and increase the public?s interest in natural phenomena such as migration. Weather radars are already used to study animal migration, quantify changes in populations, and reduce aerial conflicts between birds and aircraft. Yet efforts to establish a framework for the broad utilization of operational weather radar for biodiversity monitoring are at risk without suitable data policies and infrastructure in place. In Europe, communities of meteorologists and ecologists have made joint efforts toward sharing and standardizing continent-wide weather radar data. These efforts are now at risk as new meteorological data exchange policies render data useless for biodiversity monitoring. In several other parts of the world, weather radar data are not even available for ecological research. We urge policy makers, funding agencies, and meteorological organizations across the world to recognize the full potential of weather radar data. We propose several actions that would ensure the continued capability of weather radar networks worldwide to act as powerful tools for biodiversity monitoring and research.

output [*not provided*] - Near-term ecological forecasting for dynamic aeroconservation of migratory birds

Title:	Near-term ecological forecasting for dynamic aeroconservation of migratory birds
Category:	Publication - Journal - Article
Estimated Audience Size:	10000
Citation:	https://doi.org/10.1111/cobi.13740
External ID:	
Sensitivity:	Immediately Public
Elaboration on Sensitivity:	
Locations:	[]
Languages:	en
Partners Participating in the Output:	[*not provided*]
Stakeholders Referenced:	Yes
Referenced in Outputs:	Yes
If yes, please describe how: :	
Transdisciplinary:	Yes

Description / Summary:	Near-term ecological forecasting has the potential to mitigate negative impacts of human modifications on wildlife by directing efficient action through relevant and timely predictions. We used the U.S. avian migration system to highlight ecological forecasting applications for aeroconservation. We used millions of observations from 143 weather surveillance radars to construct and evaluate a migration forecasting system for nocturnal bird migration over the contiguous United States. We identified the number of nights of mitigation required to reduce the risk of aerial hazards to 50% of avian migrants passing a given area in spring and autumn based on dynamic forecasts of migration activity. We also investigated an alternative approach, that is, employing a fixed conservation strategy based on time windows that historically capture 50% of migratory passage. In practice, during both spring and autumn, dynamic forecasts required fewer action nights compared with fixed window selection at all locations (spring: mean of 7.3 more alert days; fall: mean of 12.8 more alert days). This pattern resulted in part from the pulsed nature of bird migration captured in the radar data, where the majority (54.3%) of birds move on 10% of a migration season's nights. Our results highlight the benefits of near-term ecological forecasting and the potential advantages of dynamic mitigation strategies over static ones, especially in the face of increasing risks to migrating birds from light pollution, wind energy infrastructure, and collisions with structures.

output [*not provided*] - Phenology of nocturnal avian migration has shifted at the continental scale

Title:	Phenology of nocturnal avian migration has shifted at the continental scale
Category:	Publication - Journal - Article
Estimated Audience Size:	10000
Citation:	https://doi.org/10.1038/s41558-019-0648-9
External ID:	
Sensitivity:	Not Public
Elaboration on Sensitivity:	
Locations:	USA
Languages:	en
Partners Participating in the Output:	[*not provided*]
Stakeholders Referenced:	Yes
Referenced in Outputs:	Yes
If yes, please describe how: :	Acknowledgments
Transdisciplinary:	No
Description / Summary:	Climate change induced phenological shifts in primary productivity result in trophic mismatches for many organisms1,2,3,4, with broad implications for ecosystem structure and function. For birds that have a synchronized timing of migration with resource availability, the likelihood that trophic mismatches may generate a phenological response in migration timing increases with climate change5. Despite the importance of a holistic understanding of such systems at large spatial and temporal scales, particularly given a rapidly changing climate, analyses are few, primarily because of limitations in the access to appropriate data. Here we use 24 years of remotely sensed data collected by weather surveillance radar to quantify the response of a nocturnal avian migration system within the contiguous United States to changes in temperature. The average peak migration timing advanced in spring and autumn, and these changes were generally more rapid at higher latitudes. During spring and autumn, warmer seasons were predictive of earlier peak migration dates. Decadal changes in surface temperatures predicted spring changes in migratory timing, with greater warming related to earlier arrivals. This study represents one of the first system-wide examinations during two seasons and comprises measures from hundreds of species that describe migratory timing across a continent. Our findings provide evidence of spatially dynamic phenological shifts that result from climate change.

output [*not provided*] - Predicting bird-window collisions with weather radar

Title:	Predicting bird-window collisions with weather radar
Category:	Publication - Journal - Article
Estimated Audience Size:	10000
Citation:	https://doi.org/10.1111/1365-2664.13832

External ID:

Sensitivity: Immediately Public

Elaboration on Sensitivity:

Locations: []

Languages: en

Partners Participating in the Output: [*not provided*]

Stakeholders Referenced: Yes

Referenced in Outputs: No

If yes, please describe how: :

Transdisciplinary: No

Description / Summary: Up to 1 billion birds die annually in the U.S. from window collisions; most of these casualties represent migratory native species. Because this major mortality source likely contributes to the decline of the North American avifauna, mitigation tools are needed that accurately predict real-time collision risk, allowing hazards to be minimized before fatalities occur. We assessed the potential use of weather surveillance radar, an emerging tool increasingly used to study and to predict bird migration, as an early warning system to reduce numbers of bird-window collisions. Based on bird-window collision monitoring in Oklahoma, USA, we show that radar-derived migration variables are associated with nightly numbers of collisions. Across the entire night, numbers of collisions increased with higher migration traffic rate (i.e. numbers of birds crossing a fixed line perpendicular to migration direction), and migration variables for specific periods within the night were also related to nightly collisions. Synthesis and applications. Our study suggests that radar can be an invaluable tool to predict bird-window collisions and help refine mitigation efforts that reduce collisions such as reducing nighttime lighting emitted from and near buildings.

output [*not provided*] - Quantifying year-round nocturnal bird migration with a fluid dynamics model.

Title: Quantifying year-round nocturnal bird migration with a fluid dynamics model.

Category: Publication - Journal - Article

Estimated Audience Size: 10000

Citation: Nussbaumer R, Bauer S, Benoit L, Mariethoz G, Liechti F, Schmid B (2021) Quantifying year-round nocturnal bird migration with a fluid dynamics model. J. R. Soc. Interface 18: 20210194. https://doi.org/10.1098/rsif.2021.0194

External ID: https://doi.org/10.1098/rsif.2021.0194

Sensitivity: Immediately Public

Elaboration on Sensitivity:

Locations: []

Languages: en

Partners Participating in the Output: [*not provided*]

Stakeholders Referenced: Yes

Referenced in Outputs: Yes

If yes, please describe how: : In the acknowledgments

Transdisciplinary: Yes

Description / Summary: To understand the influence of biomass flows on ecosystems, we need to characterize and quantify migrations at various spatial and temporal scales. Representing the movements of migrating birds as a fluid, we applied a flow model to bird density and velocity maps retrieved from the European weather radar network, covering almost a year. We quantified how many birds take-off, fly, and land across Western Europe to (1) track bird migration waves between nights, (2) cumulate the number of birds on the ground and (3) quantify the seasonal flow into and out of the study area through several regional transects. Our results identified several migration waves that crossed the study area in 4 days only and included up to 188 million (M) birds that took-off in a single night. In spring, we estimated that 494 M birds entered the study area, 251 M left it, and 243 M birds remained within the study area. In autumn, 314 M birds entered the study area while 858 M left it. In addition to identifying fundamental quantities, our study highlights the potential of combining interdisciplinary data and methods to elucidate the dynamics of avian migration from nightly to yearly time scales and from regional to continental spatial scales.

output [*not provided*] - The role of artificial light at night and road density in predicting the seasonal occurrence of nocturnally migrating birds

Title: The role of artificial light at night and road density in predicting the seasonal occurrence of nocturnally migrating birds

Category: Publication - Journal - Article

Estimated Audience Size: 10000

Citation: https://doi.org/10.1111/ddi.13499

External ID:

Sensitivity: Immediately Public

Elaboration on Sensitivity:

Locations: []

Languages: en

Partners Participating in the Output: [*not provided*]

Stakeholders Referenced: Yes

Referenced in Outputs: Yes

If yes, please describe how: :

Transdisciplinary: Yes

Description / Summary: Artificial light at night (ALAN) and roads are known threats to nocturnally migrating birds. How associations with ALAN and roads are defined in combination for these species at the population level across the full annual cycle has not been explored. We estimated range-wide exposure, predictor importance and the prevalence of positive associations with ALAN and roads at a weekly temporal resolution for 166 nocturnally migrating bird species in three orders: Passeriformes (n = 104), Anseriformes (n = 27) and Charadriiformes (n = 35). We clustered Passeriformes based on the prevalence of positive associations. Positive associations with ALAN and roads were more prevalent for Passeriformes during migration when exposure and importance were highest. Positive associations with ALAN and roads were more prevalent for Anseriformes and Charadriiformes during the breeding season when exposure was lowest. Importance was uniform for Anseriformes and highest during migration for Charadriiformes. Our cluster analysis identified three groups of Passeriformes, each having similar associations with ALAN and roads. The first occurred in eastern North America during migration where exposure, prevalence, and importance were highest. The second wintered in Mexico and Central America where exposure, prevalence and importance were highest. The third occurred throughout North America where prevalence was low, and exposure and importance were uniform. The first and second were comprised of dense habitat specialists and long-distance migrants. The third was comprised of open habitat specialists and short distance migrants. Our findings suggest ALAN and roads pose the greatest risk during migration for Passeriformes and during the breeding season for Anseriformes and Charadriiformes. Our results emphasise the close relationship between ALAN and roads, the diversity of associations dictated by taxonomy, exposure, migration strategy and habitat and the need for more informed and comprehensive mitigation strategies where ALAN and roads are treated as interconnected threats.

output [*not provided*] - The role of artificial light at night and road density in predicting the seasonal occurrence of nocturnally migrating birds

Title: The role of artificial light at night and road density in predicting the seasonal occurrence of nocturnally migrating birds

Category:	Publication - Journal - Article
Estimated Audience Size:	10000
Citation:	La Sorte FA, Johnston A, Rodewald AD, Fink D, Farnsworth A, Van Doren BM, Auer T, Strimas?Mackey M (2022) The role of artificial light at night and road density in predicting the seasonal occurrence of nocturnally migrating birds. Diversity and Distributions 28(5): 992-1009. https://doi.org/10.1111/ddi.13499
External ID:	https://doi.org/10.1111/ddi.13499
Sensitivity:	Immediately Public
Elaboration on Sensitivity:	
Locations:	[]
Languages:	en
Partners Participating in the Output:	[*not provided*]
Stakeholders Referenced:	Yes
Referenced in Outputs:	No
If yes, please describe how: :	
Transdisciplinary:	No
Description / Summary:	Aim Artificial light at night (ALAN) and roads are known threats to nocturnally migrating birds. How associations with ALAN and roads are defined in combination for these species at the population level across the full annual cycle has not been explored. Location Western Hemisphere. Methods We estimated range-wide exposure, predictor importance and the prevalence of positive associations with ALAN and roads at a weekly temporal resolution for 166 nocturnally migrating bird species in three orders: Passeriformes (n = 104), Anseriformes (n = 27) and Charadriiformes (n = 35). We clustered Passeriformes based on the prevalence of positive associations. Results Positive associations with ALAN and roads were more prevalent for Passeriformes during migration when exposure and importance were highest. Positive associations with ALAN and roads were more prevalent for Anseriformes and Charadriiformes during the breeding season when exposure was lowest. Importance was uniform for Anseriformes and highest during migration for Charadriiformes. Our cluster analysis identified three groups of Passeriformes, each having similar associations with ALAN and roads. The first occurred in eastern North America during migration where exposure, prevalence, and importance were highest. The second wintered in Mexico and Central America where exposure, prevalence and importance were highest. The third occurred throughout North America where prevalence was low, and exposure and importance were uniform. The first and second were comprised of dense habitat specialists and long-distance migrants. The third was comprised of open habitat specialists and short distance migrants. Main conclusions Our findings suggest ALAN and roads pose the greatest risk during migration for Passeriformes and during the breeding season for Anseriformes and Charadriiformes. Our results emphasise the close relationship between ALAN and roads, the diversity of associations dictated by taxonomy, exposure, migration strategy and habitat and the need for more informed and comprehensive mitigation strategies where ALAN and roads are treated as interconnected threats.

output [*not provided*] - Bright lights, big pity

Title:	Bright lights, big pity
Category:	Publication - Journal - Editorial Comment
Estimated Audience Size:	100000
Citation:	https://www.science.org/content/article/radar-powered-forecasts-save-birds-deadly-city-lights
External ID:	
Sensitivity:	Immediately Public
Elaboration on Sensitivity:	
Locations:	[]
Languages:	en

Partners Participating in the Output: [*not provided*]

Stakeholders Referenced: Yes

Referenced in Outputs: No
If yes, please describe how: :

Transdisciplinary: No

Description / Summary: Bird collisions on buildings, artificial light, migration

output [*not provided*] - Weather radars' role in biodiversity monitoring

Title: Weather radars' role in biodiversity monitoring
Category: Publication - Journal - Letter
Estimated Audience Size: 1000000

Citation: Shamoun-Baranes J, Bauer S, Chapman JW, Desmet P, Dokter AM, Farnsworth A, Haest B, Koistinen J, Kranstauber B, Liechti F, Mason THE, Nilsson C, Nussbaumer R, Schmid B, Weisshaupt N, Leijnse H (2021) Weather radars? role in biodiversity monitoring. Science 372(6539): 248. https://doi.org/10.1126/science.abi4680

External ID: https://doi.org/10.1126/science.abi4680

Sensitivity: Immediately Public
Elaboration on Sensitivity:

Locations: []

Languages: en

Partners Participating in the Output: [*not provided*]

Stakeholders Referenced: Yes

Referenced in Outputs: No
If yes, please describe how: :

Transdisciplinary: Yes

Description / Summary: Letter to Science requesting a reversal of changes to meteorological data polices, which render weather radar data almost useless for biodiversity monitoring

output [*not provided*] - Changes to European Meteorological Data Policies Threaten Aerial Biodiversity Monitoring.

Title: Changes to European Meteorological Data Policies Threaten Aerial Biodiversity Monitoring.
Category: Publication - Newspaper - Article
Estimated Audience Size: 10000

Citation: https://finchannel.com/changes-to-european-meteorological-data-policies-threaten-aerial-biodiversity-monitoring/80593/world-2/2021/04/

External ID:

Sensitivity: Immediately Public
Elaboration on Sensitivity:

Locations: []

Languages: en

Partners Participating in the Output: [*not provided*]

Stakeholders Referenced: Yes

Referenced in Outputs: Yes
If yes, please describe how: :

Transdisciplinary: Yes

Description / Summary: Newspaper article based on our letter in Science about the changes in meteorological data policies.

output [*not provided*] - De trekvogels dreigen te verdwijnen uit de neerslagradar

Title: De trekvogels dreigen te verdwijnen uit de neerslagradar
Category: Publication - Newspaper - Article
Estimated Audience Size: 10000

Citation: https://www.nrc.nl/nieuws/2021/04/16/de-trekvogels-dreigen-te-verdwijnen-uit-de-neerslagradar-a4040097

External ID:

Sensitivity: Immediately Public
Elaboration on Sensitivity:

Locations: []

Languages: nl

Partners Participating in the Output: [*not provided*]

Stakeholders Referenced: Yes

Referenced in Outputs: Yes
If yes, please describe how: :

Transdisciplinary: Yes

Description / Summary: Newspaper article taking up our Science letter

output [*not provided*] - Muuton seuranta s��tutkilla

Title: Muuton seuranta s��tutkilla
Category: Publication - Newspaper - Article
Estimated Audience Size: 1000

Citation: https://www.birdlife.fi/sisalto/lehdet/linnut-12020

External ID:

Sensitivity: Immediately Public
Elaboration on Sensitivity:

Locations: FIN

Languages: fi

Partners Participating in the Output: [*not provided*]

Stakeholders Referenced: Yes

Referenced in Outputs: Yes
If yes, please describe how: :

Transdisciplinary: No

Description / Summary: N/A

output [*not provided*] - The race to save 1 billion feathered friends

Title:	The race to save 1 billion feathered friends
Category:	Publication - Newspaper - Article
Estimated Audience Size:	10000
Citation:	https://www.ozy.com/pg/newsletter/the-daily-dose/454195/
External ID:	
Sensitivity:	Immediately Public
Elaboration on Sensitivity:	
Locations:	[]
Languages:	en
Partners Participating in the Output:	[*not provided*]
Stakeholders Referenced:	Yes
Referenced in Outputs:	No
If yes, please describe how: :	
Transdisciplinary:	No
Description / Summary:	Quantification of migrating bird numbers and the threats they are facing due to artificial light and other factors. Publicizes the Lights Out initiative to reduce artificial lighting during nights of intense migration.

Outcome Area Ratings

What have been the main exploitable outcomes of the project?

Rating	Category
Major	1. Increased research capacity
Major	2. Improved scientific evidence base
Major	3. New method, data or technology
Moderate	4. New / improved product or service
Major	5. New technical process
N/A	6. New organisational process
Moderate	7. Better access to international networks / markets
Minor	8. Better understanding of other European cultures / issues
Major	9. Enhanced research network to compete for future European project funding
Major	10. better understanding of stakeholder needs
N/A	11. Other

Project Outcomes

ID	Category	Target
10653	Capacity building	Stakeholders and researchers
10648	Policy Effect	impact policy
10644	Societal Effect	Improvement of aviation safety and flight planning
8522	Societal Effect	Stakeholders and general public

outcome [*not provided*] - Capacity building Stakeholders and researchers

Category: Capacity building

Target: Stakeholders and researchers

Description: Organisation of the conference resulted in the exchange of ongoing research, novel technological developments and new insights shared across researchers with expertise in ecology, taxon specific knowledge, data science and stakeholders from radar technology and engineering, aviation, wind energy.

Examples: https://globam.science/irac-2022/

Benefits of a Transdisciplinary Approach: - has advanced stakeholder knowledge - has inspired interest in using data products produced by GloBAM

outcome [*not provided*] - Policy Effect impact policy

Category: Policy Effect

Target: impact policy

Description: Based on radar aeroecology expertise we have provided technical notes to the OPERA (operational network of weather radars in europe) to help improve data products in order to support biodiversity monitoring.

Examples: Discussions are still ongoing. However, two more general policy publications have been produces (see output)

Benefits of a Transdisciplinary Approach: Communication between meteorologists and ecologists is essential in order to discuss data policy and quality standards with meteorological institutes

outcome [*not provided*] - Societal Effect Improvement of aviation safety and flight planning

Category: Societal Effect

Target: Improvement of aviation safety and flight planning

Description: An ensemble of forecast models for nocturnal migration in the Netherlands was created to improve forecasts currently run by the Royal Netherlands Air Force to improve aviation safety. The model results have been transfered to the stakeholder, the model code will also be transferred so that it can be deployed in an operational setting.

Examples:	The older models on this system will be updated with new ensemble models: flysafe-birdtam.eu/
Benefits of a Transdisciplinary Approach:	Machine learning, ecology and computational tools for high performance computing are combined to develop the models. Communication with military and meteorological stakeholders has been essential when discussing implementation, understanding policy and human interaction with model results is therefore important.

outcome [*not provided*] - Societal Effect Stakeholders and general public

Category:	Societal Effect
Target:	Stakeholders and general public
Description:	We can currently forecast and analyze bird migration patterns from radar data on the fly, the sum total of 20 years of research. Relating bird migration data to weather observations, we can produce BirdCast models capable of forecasting nights of major migration up to 16 days in advance, as well as create real-time estimates of migratory birds up which are easily accessible via web visualization tools. These critically important breakthrough were highlighted in publications in Science and Nature Ecology and Evolution in 2018. We can turn these forecasts into alerts that highlight when to request or require a particular action, in this case to eliminate non essential lighting.
Examples:	http://alert.birdcast.info/lightsout
Benefits of a Transdisciplinary Approach:	By incorporating machine learning with ornithology and meteorology as well as public outreach, we could translate science into dynamic conservation to implore and inspire people to turn off lights at night to protect migrating birds from the hazards of light pollution.

Data Management Plan

Last Updated: 2020-07-09

Data Outputs:	The produced data of long-term value are vertical profiles of aerial migrants. Vertical profiles contain the speed, direction and density of aerial migrants at different altitudes for a specific radar location and time, and form the source data for GloBAM specifically and aeroecological research in general.
Open Data Principles:	The produced (vertical profile) data is to be archived as open data in an online research repository such as Zenodo, where they receive a Digital Object Identifier (DOI). Zenodo metadata adheres to the FAIR principles (https://about.zenodo.org/principles/). The datasets is released under a Creative Commons Zero (CC0) waiver; formatted following open domain standards such as the ODIM bird profile specification; and documented with metadata describing their contributors, provenance, resolution, temporal and spatial coverage, and how to use these with open source software developed or contributed to by this project. To further increase interoperability of the produced data, we developed the VPTS CSV data exchange format (https://aloftdata.eu/vpts-csv/). It makes use of Frictionless Data standards and allows faster downloads and easier processing.
Responsible Data Personnel:	Peter Desmet (leader WP 1: data infrastructure) is responsible for the data publication and DMP. Open science lab for biodiversity (https://oscibio.inbo.be) Research Institute for Nature and Forest (INBO) Havenlaan 88 bus 73, 1000 Brussel Belgium peter.desmet@inbo.be
Data Management:	GloBAM has a WP1 "data infrastructure" to tackle the challenge of accessing, storing and processing the large volume of weather radar required for this project. US weather radar data are made publicly available by NOAA and a multi-year archive has already been processed to vertical profile data, which will be made available as open data by UMass Amherst in collaboration with Cornell University. European weather radar data are not publicly available, but GloBAM project members have access through a license agreement with the Operational Program for Exchange of Weather Radar Information (OPERA). The aim was to process 2 years of weather radar data from 70 radar stations, but we have processed an archive covering 6 years (2012-2017) and 107 radar stations. This was done on infrastructure managed by the University of Amsterdam. The (private) weather radar data are archived on tape there. The produced data are archived on cloud storage managed by INBO.
Post-Project Data Management:	The Research Institute for Nature and Forest (INBO) (WP1 leader) has been responsible for publishing the produced (vertical profile) data as open data. These data are currently archived on cloud storage managed by INBO. It contains 42 million files, covering 10 years and 151 European radars (number of radars grows over time) and is accessible at https://aloftdata.eu/browse/. It is part of an operational pipeline and is growing daily. To ensure long term archival, the produced data will also be deposited on zenodo.org, where it will be assigned a Digital Object Identifier (DOI). For better interoperability and faster downloads, we want to make use of the newly developed data exchange format VTPS CSV, but not all data have been converted to this format yet. We envision to finalize this by mid 2023. We also plan to describe the dataset in a data paper.
Data Reuse Restrictions:	The produced (vertical profile) data does not contain sensitive information and will be released under a Creative Commons Zero (CC0) waiver, which allows unrestricted use. As is expected in the scientific community, we will encourage (but not enforce) users to cite the data(set) when they use it.
Data Access and Security:	Through a license agreement, we are allowed to process the European weather radar data, but these cannot be shared with third parties. These data will therefore only be accessible to project members on infrastructure managed by the University of Amsterdams. However, the vertical profile data derived from these data can be shared with third parties. We have been and will continue to publish these as open data and waive any copyright under a Creative Commons Zero (CC0) waiver, so they can be used without restrictions.
Data Documentation:	The data are documented with metadata describing the contributors, provenance, resolution, temporal and spatial coverage, and how to use the data with open source software developed or contributed to by GloBAM members, such as the R package bioRad. The rules regarding reuse are covered by the associated license (CC0 waiver). The metadata will likely be formatted in the Zenodo metadata format, which adheres to the FAIR principles (https://about.zenodo.org/principles/). We also aim to describe the dataset in a data paper. Several of these task are currently finalized. The data itself will be formatted using a newly developed VPTS CSV data exchange format (https://aloftdata.eu/vpts-csv/). It is a convenience format based on Frictionless Data standards and the ODIM bird profile specification, which is an open standard created and used by the aeroecology community that follows conventions of the meteorological community.
Long-Term Support:	The project budget covers costs associated with hosting and processing the data during the project. The University of Amsterdam and the Research Institute for Nature and Forest (INBO) intend to maintain the infrastructure (processing and storage) after the project ends and are seeking funding to support this. The long-term accessibility of the produced data is not affected by this, as these will be deposited on Zenodo.org, which is free to use.

Extended Support

Support Beyond Project Funding:	false
Organizations Providing Funding:	N/A

Knowledge Gaps

Knowledge Gaps:	The main challenge has been the deteriorating quality of European weather radar data for aeroecological research due to increased filtering for meteorological applications. We wrote a letter and article (Shamoun-Baranes et al. 2021, Shamoun-Baranes et al. 2022) to urge the Operational Programme for the Exchange of Weather Radar Information (OPERA) and the European Commission to acknowledge the use of weather radars in biodiversity monitoring. Remote-sensing approaches for automated large-scale and long-term biodiversity monitoring will continue to become ever more important for identifying trends in abundances, relations to environmental variables and for assessing the effficacy of management measures and policy. The networks of weather radars can provide such monitoring but meteorological organisations worldwide need to recognize the value of these data and change data policies and data infrastructures accordingly. Furthermore, for increasing the (taxonomic) resolution of radar data, the combination of small-scale dedicated radars and weather radars would be a logical next step in harmonizing these approaches.

Open Data Requirements

Open Data Challenges and Opportunities:	The open policy requirement has not been an impediment to the project. The main challenge is to convince and support the European meteorological community to make their weather radar data available for aeroecological research. Ideally, weather radar data are open and unfiltered.