TABMON – real-time acoustic biodiversity monitoring across Europe

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Abstract:

1. Ecological surveys are often fragmented, costly, and limited in scale, leading to large and long-standing knowledge gaps which threaten our ability to properly safeguard biodiversity.

2. Passive Acoustic Monitoring (PAM) has promised to deliver automated biodiversity monitoring, but networks are rarely deployed on scales that can offer truly novel insights due to scalability and standardisation challenges around collecting, managing, analysing, and sharing data.

3. Here we present the Transnational Acoustic Biodiversity Monitoring Network (TABMON), a standardised deployment of 97 autonomous sensors across Norway, Netherlands, France and Spain along a continental bird migration route. Audio is recorded continuously, uploaded in near real-time, and analysed with expert-validated artificial intelligence models to deliver Essential Biodiversity Variables compatible with established European monitoring efforts.

4. TABMON offers a blueprint for ambitious deployments of autonomous sensors that traverse national boundaries to transform biodiversity assessment and reporting globally.

Keywords: acoustics, big data, biodiversity monitoring, sensors

1. Introduction

Obtaining reliable biodiversity data across large spatial and temporal scales remains a major challenge. Despite decades of research documenting substantial biodiversity knowledge gaps[1,2], these deficiencies persist due to the high financial and logistical demands of traditional field surveys, the need for specialised taxonomic expertise, and the fragmented nature of existing monitoring efforts[3]. Across Europe, biodiversity observation continues to suffer from pronounced taxonomic, spatial, and temporal biases[4,5], with many habitats and species groups poorly represented and national programmes operating with limited coordination[6]. Such heterogeneity in methods and coverage impedes the operationalisation of Essential Biodiversity Variables (EBVs) and constrains the integration of biodiversity information across borders and biogeographical regions[7]. Addressing these challenges requires the establishment of scalable and standardised observation frameworks capable of delivering reliable biodiversity data at continental scales. Recent advances in digital sensing technologies and autonomous monitoring approaches[8] offer a promising path forward by enabling cost-effective, high-frequency, and spatially distributed biodiversity data streams that can bridge existing monitoring gaps and strengthen Europe's capacity for coordinated, real-time biodiversity assessment.

Among emerging technologies for large-scale biodiversity observations, passive acoustic monitoring (PAM) has become a leading approach owing to its ability to detect multiple taxa simultaneously, the low cost of sensors, and the growing capabilities of automated processing pipelines[9]. Although numerous PAM studies have generated valuable insights at local or short-term scales[10], applications delivering consistent data across large spatial or temporal extents remain rare. Key barriers include equipment and maintenance costs, data management complexity, and slow uptake of standardised protocols[11]. Distributed citizen-science projects have helped expand spatial coverage[12,13], but they often introduce delays in data processing, risks to data quality, and high coordination demands. In contrast, networked autonomous recorders powered by off-grid sources (e.g., solar) and capable of near real-time data transmission provide a scalable alternative[14]. Coupled with imperfect but deployable[15] artificial intelligence (AI) for automated species identification, such systems enable rapid, standardised, and high-throughput analysis of large acoustic datasets (e.g., SAFE Acoustics[16], Sound of Norway[17]). Although requiring higher initial investment, they support long-term, low-maintenance deployments, near real-time quality control, and streamlined data integration. Together, these innovations position PAM as a practical foundation for standardised, continuous, and continent-scale biodiversity monitoring.

Here, we describe the design, deployment and data pipeline of TABMON; a Transnational real-time Acoustic Biodiversity MOnitoring Network deployed across four European countries along a large latitudinal gradient (97 sites spanning a latitudinal gradient of 3,649 km). With TABMON, we aim to: (i) push scalability limits by deploying the first standardised real-time passive acoustic monitoring network across multiple European countries and biomes, (ii) deliver new expert annotated datasets and tailored machine learning models for acoustic identification of European birds, and (iii) fill spatiotemporal and taxonomic gaps in our understanding of the breeding behaviour and migration timing of birds across Western Europe[18].

2. Sampling design

To ensure data consistency, the TABMON consortium standardised deployment protocols through a preparatory workshop gathering 15 participants with diverse expertise (e.g. field ecologists, bird experts and computer scientists). This allowed us to establish guidelines for site selection, sensor configuration, and metadata recording while also allowing flexibility where full standardisation was not feasible (Supplementary Material: TABMON sites metadata).

The network spans Norway, the Netherlands, France and Spain, covering a latitudinal gradient of 3,649 km (Varanger in Finnmark, Norway to Delta del Ebre in Catalonia, Spain) and a longitudinal gradient of 3,539 km (Pasvik in Finnmark, Norway to Mas de Melons in Catalonia, Spain). The network encompasses representative landscapes along major bird migration routes in Western Europe and includes habitats of importance to both diurnal and nocturnal species. In total, we selected 97 sites (49 in Norway, 18 in the Netherlands, 12 in France and 18 in Spain; Figure 1), where autonomous acoustic sensors were deployed between January and April 2025 and will stay out until January 2027, covering two complete annual migration cycles. Metadata collection protocols were refined during a one-day workshop. For each deployment, field teams record GPS coordinates, deployment date, microphone height, and a brief description of the local landscape and vegetation type using an online spreadsheet (Supplementary Material: Deployment form).

A combination of ecological and logistical criteria were applied to site selection. Even though we selected some sites specifically for studying night active species, we prioritized locations along known migration flyways and chose representative habitat types (forests, wetlands, scrublands etc.) across countries and latitudes to maximize the likelihood of recording overlapping species communities. Additionally, we considered accessibility, cellular network coverage, and proximity to partner institutions or trusted local contacts, who could intervene in the event of equipment failure. Several deployments were co-located with established areas of high activity from citizen scientists and bird monitoring sites, such as breeding bird surveys, long-term point counts or bird ringing stations, to facilitate cross-validation and model-based integration of acoustic detections with conventional monitoring methods.

Sites, defined by the GPS coordinates where the devices were deployed, were grouped into clusters of two to five devices. Each cluster represents a geographical unit (e.g., island, peninsula, protected area) encompassing suitable habitats for detecting migrant passerines or nocturnal birds, such as stop-over and breeding areas. Clusters facilitate logistical planning for device deployment and maintenance, and data from multiple sites within a cluster can be combined to address gaps in case a device goes offline for a prolonged period of time (providing redundancy). In the TABMON network, the mean distance between devices within a cluster is 6.11 km, ranging from 273 meters (Utsira) to 54km (Trondelag). Separating devices by >100m prevents the same bird vocalisation from being recorded on multiple devices, while larger distances occur in expansive natural areas, such as in northern Norway. In highly anthropogenic landscapes, where birds have fewer habitat options, clusters may cover smaller areas, as seen in the Netherlands.

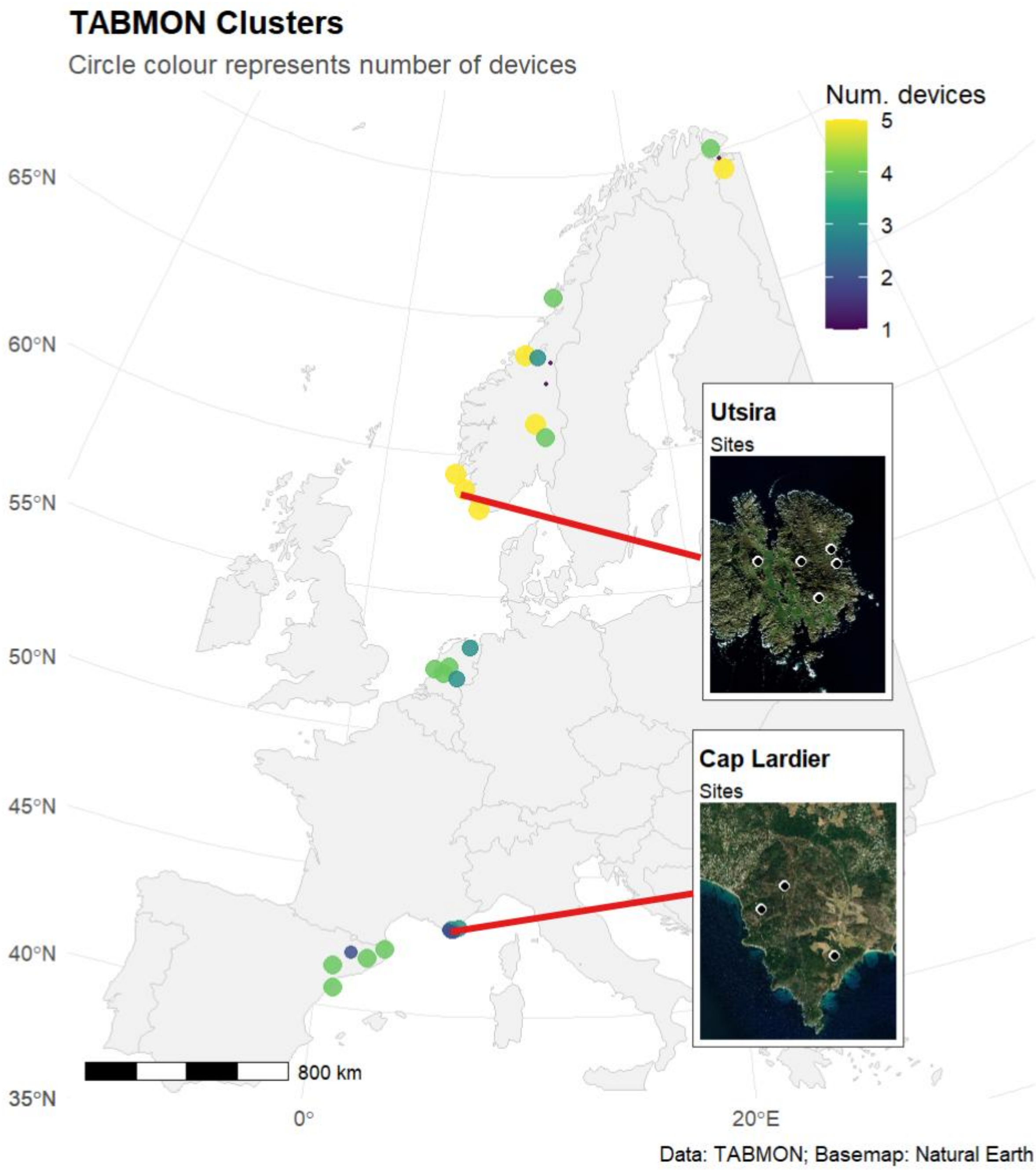

Figure 1. Locations of the TABMON clusters spanning Norway, Netherlands, France, and Spain with circle color representing the number of devices within clusters. Small dark blue circles represent single devices. Inset maps represent a detailed view of the Utsira and Cap Lardier clusters.

3. Sensors and off-grid power

At each site, we deployed a Bugg device[14] which transmitted near real-time, compressed audio data over a 4/5G mobile internet connection. Each unit recorded 5-minute monochannel audio files continuously (24 h per day) at a sampling rate of 44.1 kHz to capture the full range of audible bird vocalizations. MP3 variable bit rate (VBR0) compression was required as most mobile networks do not have sufficient bandwidth to support continuous uncompressed audio transmissions.

Each Bugg was powered by an external lithium battery charged by a solar panel, enabling continuous recording when local conditions allowed (Figure 2). For instance, daylight and temperature limited autonomous operation in Norway to roughly mid-February through mid-October, whilst devices in Spain record year-round. Power-system specifications differed between countries according to site accessibility, resource availability, and local equipment availability (details provided in Supplementary Material: Sensors and off-grid power- material per country).

To limit setup-related bias, consistency in device deployments across all sites was prioritised. Where possible, devices were deployed at a height of 2 m (using trees or poles)[19]. However, in some cases, devices were placed higher (i.e. up to 4.5 m, to limit vandalism and theft risks, damages from grazing animals, snow or vegetation coverage) or lower (i.e. minimum 0.9m, to limit wind exposure). Bugg devices were primarily oriented with microphones facing towards the habitat of interest. When strong winds could interfere with recording, the orientation was adjusted to reduce exposure (i.e. opposite to prevailing wind direction). In dense habitats with limited sunlight (e.g. forests), devices were typically installed along south-facing edges or in clearings, directed toward the target habitat. On sloped terrain or where obstacles restricted deployment, the Buggs were positioned towards the most open area. Devices were mounted in an upright position whenever possible, with a slight upward or downward tilt when installed at a non-standard height or when placed on a slope.

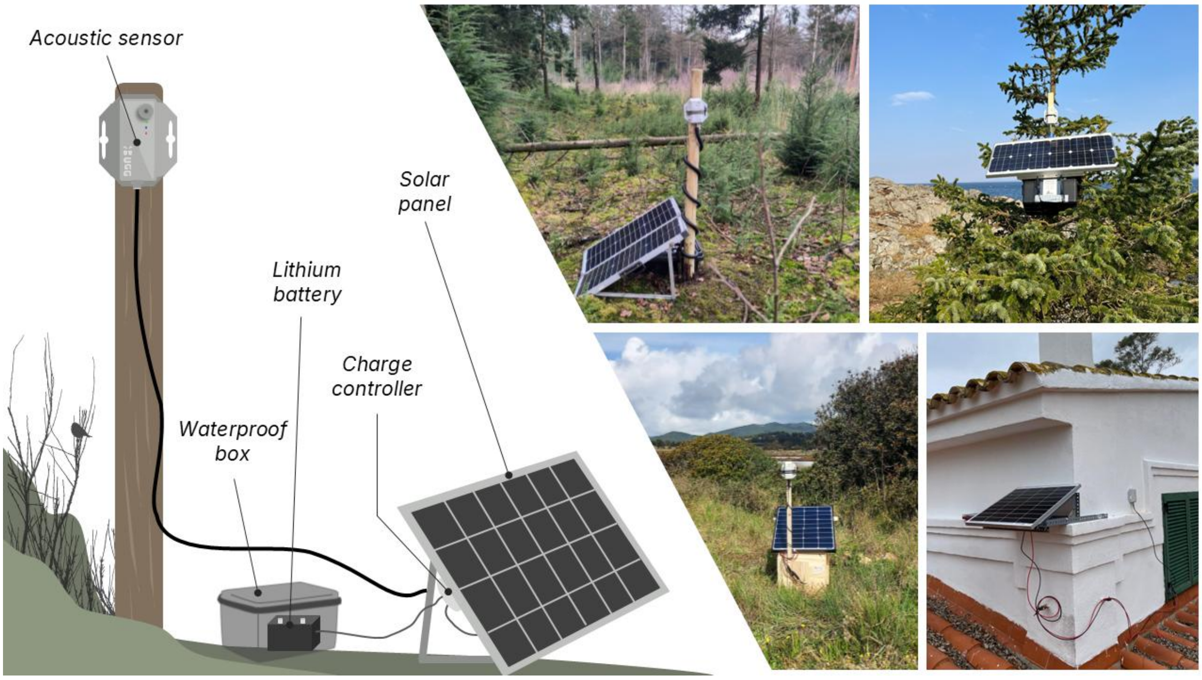

Figure 2. Schematic view of the Bugg deployment set up (left-hand side) and example deployment pictures (right-hand side).

4. Data ingestion and analysis pipeline

4.1. Infrastructure and servers

Immediately after recording, files are uploaded to Google Cloud, where they are automatically transferred once per day onto a storage bucket hosted by the Norwegian Infrastructure for Research Data (NIRD: [NIRD — Sigma2 documentation]) to reduce costs of data storage. Given its flexibility in access policy, the NIRD bucket serves as the primary entry point for the consortium, providing partners with direct access to the recordings as well as the metadata. The NIRD bucket is mounted as S3-compatible storage, which allows both

(i) our TABMON dashboard to visualize network status and data availability, and (ii) partners to directly access raw recordings for quality checks or independent analysis.

For long-term stability and computationally intensive tasks, the entire dataset is copied once per month to a dedicated server at the University of Toulon (LIS server), where access is more restricted than on the NIRD bucket. This LIS server acts as the archival repository for TABMON and hosts most of the large-scale analysis (Figure 3).

4.2. Acoustic analysis

Given the very large volume of audio produced by continuous recording, we employ an automated analysis pipeline. The pipeline utilizes the BirdNET[20] model, which is able to identify over 6500 bird species based on their vocalizations and has proven useful for European bird monitoring[21]. We executed BirdNET (v2.4) via the AvesEcho service[22], and optimized the pipeline for parallel execution across multiple GPUs. AvesEcho filter takes the longitude and latitude of the recorder, the coordinates are converted to a MGRS coordinate extracting both time zone and latitudinal band. This rectangle is used to clip the EBBA2 occurrence map[23] (i.e. where species have been reported to breed) which is used to filter BirdNET predictions.

Each 5-minute audio file is split into 3-second segments without overlap and processed by BirdNET with a sensitivity of 1. The model outputs a confidence score for each prediction, which ranges from 0.01 (very low model certainty in the identification) to 1 (very high model certainty). Model uncertainty was also included and is calculated as the binary entropy of model confidence over the predicted classes.

Predictions and metadata are stored in a database composed of Parquet files, enabling efficient compression and fast column access. DuckDB enables SQL-based querying of these files, and a FastAPI interface provides access to the data. The data pipeline and export interface are open-source and available on GitHub.

4.3. Active sampling for expert annotation

Each country in TABMON aims to employ experts to annotate about 500 three-second BirdNET detections per month, creating a large dataset of labelled clips across the project representing the variation in seasons, biomes, and countries. We ultimately aim to use this labelled data to improve model performance on European species for which BirdNET is less accurate. Furthermore, expert labelled data can help us evaluate the impact of domain-shift between sites, seasons and devices, caused by variation in background noise, microphone degradation and species distribution[24–27]; insights which can be integrated into downstream ecological analyses of data.

To extract the most value from the finite annotation budget, TABMON implements an active learning pipeline in which expert annotation, model retraining, and resampling are conducted iteratively. Active learning prioritizes clips that are most informative, i.e. clips that maximize information gain and improve model performance the most[25]. Our pipeline offers an API with multiple query options, allowing access to BirdNET confidence scores, uncertainty estimates, and associated metadata. To reduce false-positives, our preliminary analysis indicates that sampling samples with a confidence of over 0.2 yield the most informative samples. Combined with diversification across predicted species, this improves adaptivity and reduces the risk of including redundant samples[24]. Because model predictions can be multi-label and unevenly distributed across species, we ensure that annotation batches are diverse and balanced by uniformly sampling over predicted classes. We are also testing complementary strategies such as stratification across spatial and temporal gradients, embedding-based clustering methods[28].

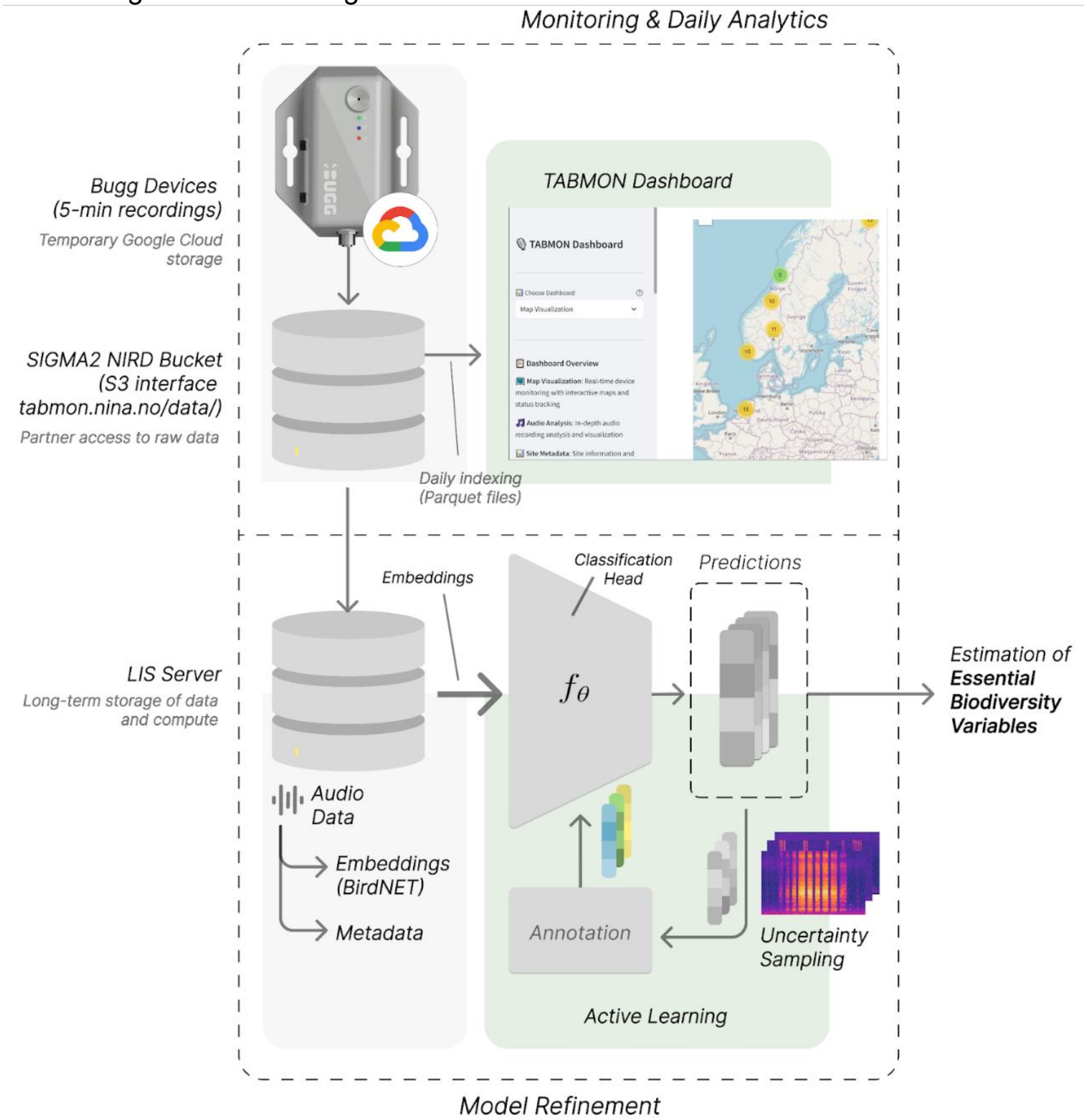

Figure 3. The TABMON data ingestion and analysis pipeline. Audio is uploaded in near real-time from Bugg devices in the field to a Google Cloud Storage bucket. Data is then transferred to a Norwegian Infrastructure for Research Data (NIRD) server, where it can be accessed by partners and visualised through a dashboard. Data is copied to the University of Toulon's LIS server for long-term archival storage and analysis. Active learning is used to extract 500 three-second BirdNET detections per country per month, which is annotated by experts to create a validated labelled dataset for model refinement and evaluation.

5. TABMON dashboard: accessing network status and metadata

The publicly accessible TABMON dashboard (https://tabmon.nina.no) provides a secure and user-friendly interface for exploring the network's deployment, operational status, and accumulated data. Built in Streamlit and deployed through Docker containers, the dashboard interfaces directly with the NIRD S3 bucket. To keep the dashboard synchronized with ongoing recordings, all files stored on NIRD are indexed daily. This process extracts files metadata (i.e. device ID, country, site, file size) and writes it to a consolidated parquet file.

The interface is designed to serve both technical partners and the broader research community. An interactive map presents the geographic distribution of the 97 Bugg sensors deployed across the four countries, with device-level indicators showing operational status and cumulative data volumes. For each sampling site, users can access a dedicated panel displaying site metadata, including photographs, deployment details, and habitat information, alongside summaries of recording effort and storage volumes (Figure 4).

By consolidating these features, the dashboard provides transparency on network performance and facilitates collaboration among consortium partners. It represents the main entry point to the TABMON infrastructure, allowing the consortium to monitor sensor uptime and track accumulation of audio data.

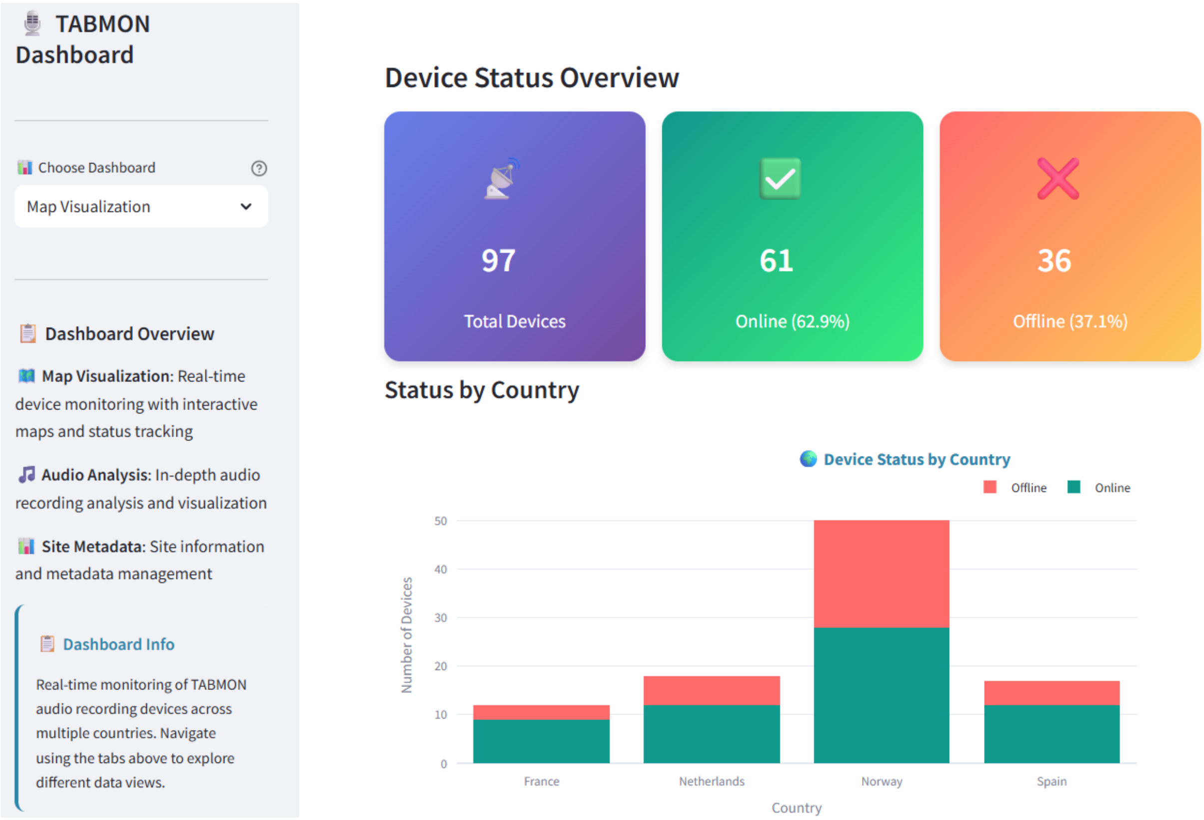

Figure 4. Screenshot of the dashboard User Interface. The user can select between three panels: Map Visualization to get a description of site location and online status as well as an overview of the existing dataset, Site Metadata to display the specific sites information including microphone heights and pictures and Audio Analysis which displays information related to the amount of data collected at a specific site.

6. Data sharing and downstream ecological insights

The primary goal of TABMON is to address gaps in the monitoring of avian biodiversity. Birds are taxonomically well studied, responsive to environmental change and some species are highly vocal, making them ideal sentinels for biodiversity monitoring[27]. TABMON focuses on avian occurrence and phenology, with a particular emphasis on cryptic or night-active species which are vocally active but are difficult to monitor with conventional schemes (e.g. owls, rails)[29], and on vocal migratory species whose behaviour and phenological timing are still relatively poorly understood[18]. While it will not be possible to share the raw audio due to data privacy considerations, we are committed to sharing BirdNET detections and expert annotations publicly for the wider ecological community to use.

TABMON data can be used to derive species occurrences, either through automated recognizers such as BirdNET[30] or via expert annotation. This provides opportunities to update distribution maps in remote locations when integrating acoustic data to other types of survey data (e.g. citizen science observations, expert surveys) and to compare field-derived estimates of bird densities with the number of vocalizations[31]. Moreover, TABMON explores how detections from acoustic devices can be integrated into existing online platforms of EU-wide bird monitoring projects such as Ornitho (e.g. https://www.ornitho.cat/), Nocmig (https://nocmig.com/) or Trektellen (https://trektellen.org/). Because sensors operate continuously, TABMON also enables phenological analyses, such as estimating spring arrival and autumn departure of migrants, monitoring shifts in breeding activity, or capturing the timing or shifts of dawn chorus events[32]. Such measures have proven to be sensitive indicators of ecological response to climate change[26,33].

Beyond single-species questions, deep learning based classifiers allow assessment of the vocal avian community composition and diversity, which can serve as proxies for ecosystem health and disturbance impacts[34]. By harmonizing metadata and workflows across countries, these products can be expressed as Essential Biodiversity Variables (EBVs), feeding directly into wider European efforts to monitor and report on biodiversity[35].

7. Key costs of the TABMON sensor network

One of the largest barriers to wider uptake of autonomous monitoring is the significant cost of deploying and maintaining sensor networks[36]. Whilst a full economic analysis is beyond the scope of this paper, here we outline a few key considerations and trade-offs.

The unique choice to use networked sensors affects TABMON's costs in several ways. Compared to non-networked sensors, connected devices are more expensive (e.g., ~€1000 per Bugg vs ~€130 per AudioMoth) and require SIM cards with monthly network costs (€1.89-12.52 for 40GB+ monthly). Additionally, each device is connected to its own off-grid solar power system incurring a one-off cost of €300-400. However, the chosen sensor and power delivery systems significantly reduce the operational workload and costs associated with battery replacement, SD card collection, and device maintenance visits, an essential consideration for TABMON given the wide geographic distribution of sites and the difficulty of accessing many locations.

Beyond our choice for automated data submission, there are also the usual costs of collecting, managing, and analysing large datasets. The network of 97 sensors can upload over 110GB of audio daily, all of which incurs both networking costs (i.e. egress fees, as data is moved between servers or cloud providers) and storage costs. As a reference, we pay ~€200 monthly to transfer 2TB of data from Google Cloud to our NIRD bucket and €100 / TB / year for data storage on NIRD. In total, the average cost of the network is €1350 per Bugg for deployment, plus €150 per Bugg per year for data transfer and storage. Additionally, computational costs accumulate depending on the complexity of analyses used. Much of our pipeline is hosted in subsidised research infrastructure, but commercial cloud offerings would be more expensive. Finally, when skilled volunteers are not available, ornithologists must be paid to annotate BirdNET predictions to ensure that TABMON delivers reliable biodiversity insights throughout its deployment (approximately 1€ per three-second annotations).

The sensor network also carries an environmental cost. The production of the sensor and its power supply system is estimated to result in a carbon footprint of 970 kg CO_2e per Bugg, while data transfer, storage, and processing contribute an additional 37 kg CO_2e per Bugg per year (Supplementary Material: Carbon footprint of the material).

8. Discussion

TABMON demonstrates that real-time, continent-scale acoustic biodiversity monitoring is technically feasible. By deploying a harmonized network of 97 autonomous recorders from the Arctic to the Mediterranean, we provide the first working example of a transnational passive acoustic monitoring system that continuously generates biodiversity data across multiple European biomes. This approach moves acoustic monitoring beyond small-scale or short-term applications, illustrating how digital sensing, automated analysis, and shared data infrastructures can together deliver scalable, high-resolution biodiversity observations.

8.1. Integrating real-time acoustics into continental biodiversity monitoring

TABMON establishes a methodological template for harmonizing autonomous acoustic monitoring across borders. The combination of standardized deployment protocols, centralized data ingestion, and open-source analytical pipelines enables reproducible, comparable, and rapidly accessible biodiversity information. These characteristics address long-standing issues of fragmentation among national monitoring programmes[37], help to operationalize EBV workflows at a European scale[7], and support global biodiversity reporting frameworks based on regional observation systems[38]. The integration of near real-time data transmission with cloud-based processing further enables immediate quality control and adaptive sampling, opening the door to “digital observatories” for biodiversity.

8.2. Methodological lessons and challenges at scale

Operating at continental scale exposed substantial logistical and technical challenges, from limited daylight and freezing temperatures constraining solar-powered devices in northern regions to connectivity and equipment interference challenges in more populated southern areas. These contrasts highlight the need for a flexible monitoring architecture that combines networked, solar-powered sensors in remote sites with lower-cost, periodically serviced units where access is easier. While real-time connectivity reduces maintenance effort and enables automated performance monitoring of digital sensors, it also increases the cost of power and data transmission[39] —trade-offs that future advances in low-power electronics and edge computing are likely to mitigate. Targeted improvements in future will come from adaptive schemes for subsampling, reducing and transmitting data.

Considering the analysis stage, the integration of active learning and expert annotation within TABMON helps to make automated recognition into a scalable strategy despite diverse acoustic and environmental conditions[28,40], providing an adaptable blueprint for future large-scale acoustic or multimodal biodiversity networks. Manual data annotation will continue to be a limiting factor, irrespective of other technical improvements—thus active learning strategies will remain essential for calibrating detectors.

8.3. Toward integrated and multimodal biodiversity observatories

The infrastructure developed through TABMON provides an expandable platform for integrating data from traditional monitoring schemes with sensor-based biodiversity observations[7]. Future extensions could couple acoustic sensors with automated camera traps, insect imagers, or eDNA samplers to capture multiple trophic levels and ecological processes[8,41]. Such multimodal networks could support new EBVs on community composition, phenology, and ecosystem function[42]. Equally, linking TABMON outputs to existing European initiatives—such as the EuroBirdPortal, LTER-Europe, or the Digital Twin of Nature—would enable dynamic, high-frequency reporting of biodiversity trends, directly informing conservation policy and environmental forecasting.

8.4. Conclusions

By demonstrating a functional, harmonized, and real-time acoustic monitoring network across Europe, TABMON bridges the gap between conceptual frameworks for continental biodiversity observation and their technical realization. Its methodological advances—in standardized protocols, automated pipelines, and active learning workflows—provide a foundation that can be readily adopted, scaled, and adapted by other research communities. As biodiversity monitoring enters the era of continuous digital observation, TABMON exemplifies a practical blueprint and a scientific foundation for building continental-scale infrastructures to track biodiversity dynamics via *in situ* sensors.

9. Author contribution

B Cretois, C Rosten, S Sethi, W D Kissling, D Stowell, L Brotons, G Bota, D Villero, R Marxer, and H Glotin contributed to the conceptualization of the project. J Wiel, C Rosten, B Cretois, C Barile, C Bernard, G Bota, L Brotons, C Pérez-Granados, D Villero led the field deployment of the monitoring devices. J Wiel, W D Kissling, C Barile, and C Bernard led the metadata collection and standardization. C Bernard, B McEwen and B Cretois contributed to the design of the analytic pipeline, TABMON dashboard and website. B Cretois led the manuscript writing with input and revisions provided by all coauthors.

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Supplementary material

Deployment form

This document is linked to the Google Form “Bugg deployment form”. Use it to fill the form appropriately (e.g. how to measure device height? How to take the pictures?)

Metadata

Country

In which country is the deployment taking place?

DeploymentID

deploymentBeginDate_countryCode_deploymentNumber_DeviceID (e.g. 20250224_NO_1_7ft35sm)

This standardised ID will refer to each individual deployment.

- deploymentBeginDate: 20250224
- countryCode: FR = France, NL = Netherlands, NO = Norway, ES = Spain,
- deploymentNumber: to identify the number of the deployment (increment per country). *E.g.: for the 4th deployment in Spain, the deploymentNumber should be: 4.*
- DeviceID: copy paste the DeviceID field.

Cluster

Name of the cluster the device is being deployed in.

Site

The name, or an identification of the site (within the cluster) the device is being deployed at.

Active

Tick TRUE.

If the current deployment consists in *replacing/moving* a Bugg, or any situation that needs a new deploymentID, making a pre-existing one obsolete, remember to change the previous deploymentID to “FALSE” (= this deployment is no longer active), and to indicate date and time at which you ended the deployment (‘deploymentEndDate’ and ‘deploymentEndTime’ columns). Do this directly in the Bugg deployment form (response) table. See “New Deployment ID” section below for more details.

deploymentBeginDate

Date of deployment.

deploymentBeginTime

Write the time at which you started the device. **Please make sure you DO NOT use local time but UTC!** https://www.utctime.net/

Latitude

Geodetic datum should be WGS84. If you’re using Google Maps on your phone, it is the default. Verify if you are using any other app/device, make sure it is set to WGS84. Latitude in decimal degrees, *e.g.* 52.370216.

Longitude

See above.

Coordinates_uncertainty

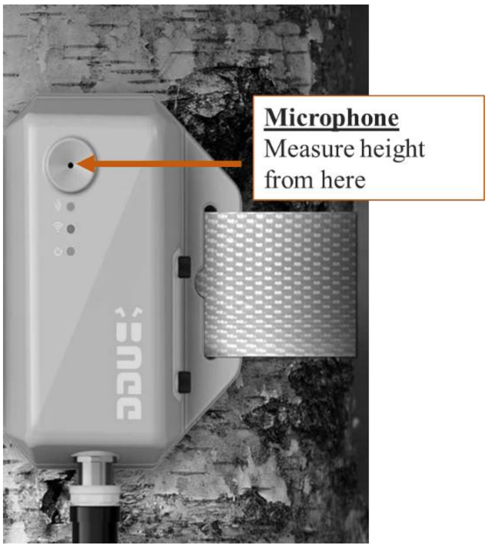
Write the uncertainty of the position, in meters. Hand-held GPS will give you this value. If using phone GPS : 20 m. If using localisation on satellite images : 1 m

GPS_device

What device did you use to record the position of the device? *E.g.* Garmin 63r, Samsung Galaxy S24 with Google Maps

DeviceID

Last digits of the serial number.
If your device RPiID is: 100000007ft35sm, please write: 7ft35sm.
The serial number of the Bugg can be found on the back of the device (see the picture attached on the right). If your device does not have a sticker (older Bugg version), you can find this number in the Google bucket and file name.



Microphone_height

In cm.
Measure the height of the microphone (see picture to see where the microphone is located). When possible, aim for a minimum height of 2 meters.

Microphone_direction

Placing your compass above the Bugg to get the general direction towards which the microphone is pointing. Select direction from the drop-down menu.

Habitat

Select which habitat you are deploying the device in. If it does not fit any of the categories, select ‘Other’ and specify.

Comments:
Write here anything you find relevant.

Photos

To have a visual representation of the surrounding environment, **7 pictures** should be taken for each deployment. Take the following pictures (in landscape format):

- 4 pictures of the surroundings, standing 2 metres away from Bugg. Keep the Bugg in the picture frame: **(i)** in the same direction as the microphone (*front)*, **(ii)** the right of the microphone direction (*right)*, **(iii)** the left of the microphone direction (*left)*, **(iv)** the back of the microphone direction (*back)*.
- **(v)** 1 picture pointing upward (towards the sky), taken from the top of the device (*up)*. **(vi)** 1 picture pointing downward (towards the ground), taken from the device height (*down*).
- **(vii)** 1 picture of the device itself, ~5 metres away (*device).*

Rename the pictures as follows: deploymentID_Direction.
Get the DeploymentID from the form.
Direction {front, back, left, right, up, down, device}
E.g.: **NO_1_7ft35sm_front**

New deploymentID for a same site

A new deploymentID can be generated in the three following cases:

- The settings are changed in the config.json
- The device is replaced by another one
- The device is moved a few meters away from the initial location

DeploymentID: YYYYMMDD_COUNTRYCODE_NUMBER_DeviceID

Example 1: The device is replaced by another one. The country code and the number are the same. The date and the DeviceID are updated
ex: 20241003_NO_1_gdtesjx → 20250426_NO_1_7ft35sm

Example 2: The settings are changed or the device is moved a few meters away. The country code, the number and DeviceID remain the same. The date is updated.
ex: 20241003_NO_1_gdtesjx → 20250426_NO_1_gdtesjx

Supplementary Material

Off-grid power setups per country

The principle is to power the Bugg using a solar panel and a battery. The equipment is mounted in the field and left outdoors for up to two years. It must be robust and capable of withstanding harsh weather conditions. Each country adopted the most suitable solution for the solar panel kit components and the supporting structure.

Caution: Battery choice is critical. Extreme temperatures (>40 °C in Spain and <–20 °C in Norway) significantly reduce battery life. Consult a professional when selecting batteries.

General documentation can be found on the Bugg website.

The following tables list the cost *per device*.

Norway

The solar panel was mounted on a custom aluminium frame and hung on a tree, with the battery box strapped to the same frame.

Description	Product	Price (NOK) inc. VAT	Price (€ = 0.086*NOK)) inc. VAT
Solar panel kit	Sparelys.no		
Solar panel	Solcellepanel 55Watt, Sunenergy 67x54cm, mono	955	82
Solar panel cables	Strømkabel 1x6mm², Solarkabel MC4 skjøtekabel, 1m	149	13
Charge controller	EP Solar ViewStar VS1024AU, laderegulator 10A	545	47
Battery cable	Batterikabel med sikringholder, 2x2,5mm², 0,5m, Ringkabelsko	99	9
Fuse	Flatstiftsikring, 15amp, blå	7	0.6
Lithium battery	Lithium Batteri: LiFePo4 12V 24Ah, H, Bluetooth	2145	185
Aluminium frame			
Aluminium profile 25x25x1,5/4m (or 30x30x3 for more robust frame)	Profil Aluminium Vinkel (P-208193) | Byggmax	90	8
Lashing straps 2.5m x2	Smart 365* lastebånd, 2 pk | Obsbygg.no	36	3
Wing nuts x2	304 Stainless Steel Nuts M4 M5 M6 M8 M10 - Temu Norway	6	0.5
Battery box	Batteriboks, 295 x 195 x 245 mm - Biltema.no	119	10
Cable tie x6	Strips 8,7x523, svarte - Biltema.no	9	0.8
Total		**4160 NOK**	**358 €**

VAT rate: 25%

Subscription for one SIM card: Telia 40GB+, 12€ per month.

France

The solar panel was mounted on a custom aluminium frame and hung on a tree, with the battery box held by the same frame.

At sites without suitable trees, an alternative setup was used: a wooden box placed on the ground replaced the aluminium frame.

Description	Product	Price (€) inc. VAT
Solar panel	Mono 50W Black 12V Monocrystalline Solar Panel Photovoltaic Solar Panel	39
Charge controller	EPEVER® 20A Contrôleur de charge solaire MPPT	95
Lithium battery	ECO-WORTHY 12V 30Ah LiFePO4 Rechargeable Lithium Battery	94
Battery box	Iris Ohyama, Airtight Storage Box, 20 L	13
Aluminium frame	Custom-made by a metalworker	150
Straps	2 x 25 mm straps STROXX	17
SD card	SanDisk Ultra microSDXC UHS-I memory card 256 GB+	25
Cable connector	Male/Female Solar Photovoltaic Connector with Solar Cable 4mm²-6mm²	1
Cable	Oududianzi Cable Solaire 6mm2 30m black + 30m red	3.3
Total		**445 €**

VAT rate: 20%

Subscription for one SIM card:

- Orange network: SOSH 100 Go, 9.99€ per month
- SFR network: Lebara 120 to 250 Go, 5.99 to 7.99 € per month

Netherlands

Sensors were strapped to wooden poles (preferably untreated). The battery and cables were stored in a waterproof box placed at the foot of the poles, on the ground.

At sites with reliable network connection, 128 GB SD cards were used; at sites with limited connection, 256 GB SD cards were preferred.

Description	Product	Price (€) inc. VAT
Solar panel	Solar panel 60W 12V Mono EnjoySolar, with charge controller and cable	133
Lithium battery	Ecobat AGM Deep Cycle battery 12V 24Ah EDC12-24-2	73
Battery cable		11
Fuse	30A (manually added)	0.48
Battery box	Dribox - IP55 Weatherproof Outdoor Electrical Connection Box	34
Wooden pole	Round chestnut wood garden pole, 12cm diameter, 200cm+ height	15
Straps	Wildlife Monitoring Solutions - Treestraps for trailcameras, 1.8m	5

SD card	Samsung EVO Select MicroSD card, UHS-I U3, 128/256GB	27
Total		**299 €**

VAT rate: 21%

SIM card subscription: Oddido.

Spain

Devices were installed either on the ground or on existing structures (e.g., field houses, concrete bases). The battery box was positioned beneath the solar panel, with the charge controller and cables protected inside.

The budget reflects the unit price of each device, including standard installation materials. Additional items (e.g., wooden stakes) were occasionally used but are not included in the budget.

Description	Product	Price (€) inc. VAT
Solar panel	Victron energy BlueSolar Monocrystalline solar panel - 12 V - 55 W (SPM040551200), with with MC4 connectors (male & female, 1000V, 4–6 mm², Stäubli)	101.3
Solar panel frame	Solar panel mounting frames with galvanized supports and dark-grey angles, supplied with all essential hardware — screws, washers, studs, clamps, perforated tape, threaded rods, and metal cable glands — ensuring a secure, durable, and field-ready installation	22.1
Lead gel battery	Lead Gel Battery 12V / 33.0Ah Upower UP	86.5
Battery cable	Battery connection cables: single-core, multi-stranded solar cable (4 mm²) in black and red	13.1
Charge controller	PWM Solar Charge Controller (12/24V – 20A), supplied with connection cables, tubular copper terminals, protective fuses, cable glands, and MC4 connectors (male & female) for secure battery and solar panel integration.	58.9
Fuse	Battery-to-Solar Regulator Connection Cables with 30A Fuse	29.0
Battery box	Waterproof Hard Case 350 x 220 x 182 mm	47.8
SD card	SanDisk Extreme PRO 256GB SD card	47.2
Total		**406.0**

VAT rate: 21%

Subscription for one SIM card: Vodafone unlimited data, 1.98€ per month through the university contract.

Supplementary Material: Carbon footprint of the material

Carbon footprint for one BUGG and its power supply system:

Description	Emission factor (EF) source	quantity	unit	EF	EF unit	Emissions (kg CO_2e)
Bugg device	Nacres IE21 - Sound reception, recording or reproduction equipment	1000	€	0.83	kg CO_2e/€	830
Solar panel	Nacres TB11 - Energy : power supply equipment	60	€	0.46	kg CO_2e/€	27.6
Charge controller	Nacres TB11 - Energy : power supply equipment	54	€	0.46	kg CO_2e/€	24.8
Battery	Nacres TB13 - Energy : batteries and rechargeable battery assemblies	86	€	0.64	kg CO_2e/€	55
SD card	Nacres IA23 - Small supplies for external data storage	27	€	0.33	kg CO_2e/€	8.9
Battery box + Miscellaneous	Nacres RA23 - Hardware - other miscellaneous workshop supplies	60	€	0.44	kg CO_2e/€	26.4
					Total	**972.8**

Yearly footprint of data transfer, storage and processing per BUGG (438 GB/year):

4G connection (SIM card)	Nacres II02 - Telecom: consumption, subscriptions mobile telephony	100	€	0.16	kg CO2e/€	16
Data transfer (google bucket)	Nacres IA32 - Systems for data storage and backup	43	€	0.33	kg CO2e/€	14.2
Data storage (NIRD)	Nacres IA32 - Systems for data storage and backup	3.6	€	0.33	kg CO2e/€	1.2
Data backup (LIS, UTLN)	Nacres IA32 - Systems for data storage and backup	3.6	€	0.33	kg CO2e/€	1.2
Data processing (LIS, UTLN)	Green Algorithms calculator	230	hGPU	0.021	kg CO2e/ hGPU	4.8
					Yearly total	**37.4**

Carbon footprints of purchases are estimated using the PER1p5[1] database. Goods are classified in categories according to the French system for accountability in research (NACRES) and assigned corresponding monetary emission factors (EFs) expressed in kg CO_2e per euro. Item prices are averaged across countries. The EF uncertainties for these categories range from 20 % to 70 %. Carbon footprint of data processing is estimated using the Green Algorithm calculator[2], which provides emissions factors in kg CO_2e per GPU-hour. Processing a 5 minute audio file with BirdNET takes approximately 8 sec on a single NVIDIA A100 GPU. All computations are carried out on the LIS cluster in France, where electricity generation is predominantly low-carbon. In countries relying on high-carbon electricity, equivalent computations could emit up to 15 times more CO_2e.

[1]*ESTEVEZ-TORRES, André; DE PAEPE, Marianne; MARIETTE, Jérôme; JEANNEAU, Laurent; AUMONT, Olivier, 2024, "Purchases emissions in research 1point5 (PER1p5) emission factors", https://doi.org/10.57745/HZNS3S, Recherche Data Gouv, V1*

[2]*Lannelongue, L., Grealey, J., Inouye, M., Green Algorithms: Quantifying the Carbon Footprint of Computation. Adv. Sci. 2021, 2100707. https://doi.org/10.1002/advs.202100707*

Supplementary Material
TABMON Site Metadata

In the table below, only a subset of the columns are presented. Please refer to the Supplementary material "Deployment form" to see a comprehensive list of the metadata collected at each site.

The columns deploymentID, deploymentGroups, locationName, deploymentStart, deviceHeight, deviceHeading, and habitat are expressed as suggested in the Camtrap DP standard adapted to bioacoustics.

Country	deploymentID	deploymentGroups	locationName	deploymentStart	deviceHeight	deviceHeading	habitat	EUNIS_habitat
France	20250611_FR_10_e9e2754	Cap Lardier	Prairies	2025-06-11T09:45:00Z	200	180	Forest	G - Woodland, forest and other wooded land
France	20250611_FR_12_adf57530	Cap Lardier	Octopus	2025-06-11T12:30:00Z	200	225	Forest	G - Woodland, forest and other wooded land
France	20250611_FR_11_d396add6	Cap Lardier	Gache	2025-06-11T11:00:00Z	300	270	Forest	G - Woodland, forest and other wooded land
France	20250603_FR_9_22858ce8	Porquerolles	Oustaou	2025-06-03T09:00:00Z	200	180	Forest	I - Arable land and market gardens
France	20250603_FR_8_b62a0387	Porquerolles	Lagunes	2025-06-03T12:45:00Z	260	180	Wetland	G - Woodland, forest and other wooded land

France	20250528_FR_6_cc187286	Port-Cros	Palud	2025-05-28T08:45:00Z	200	225	Forest	G - Woodland, forest and other wooded land
France	20250528_FR_7_5b05fe12	Port-Cros	Manoir	2025-05-28T10:00:00Z	400	180	Forest	I - Arable land and market gardens
France	20250926_FR_7_5b05fe12	Port-Cros	Manoir	2025-09-26T10:00:00Z	350	180	Forest	I - Arable land and market gardens
France	20250514_FR_4_39645e17	Salins des Pesquiers	Salins des Pesquiers North	2025-05-14T11:30:00Z	100	90	Salins	J - constructed, industrial and other artificial habitats
France	20250507_FR_5_3331e641	Salins des Pesquiers	Salins des Pesquiers South	2025-05-07T10:30:00Z	100	90	Salins	J - constructed, industrial and other artificial habitats
France	20250310_FR_1_688a86aa	Vieux Salins	Vieux Salins Center	2025-03-10T08:45:00Z	100	180	Salins	J - constructed, industrial and other artificial habitats
France	20250310_FR_2_6b3c38e6	Vieux Salins	Vieux Salins East	2025-03-10T09:30:00Z	100	180	Salins	I - Arable land and market gardens
France	20250310_FR_3_c1405178	Vieux Salins	Vieux Salins West	2025-03-10T10:20:00Z	100	180	Salins	I - Arable land and market gardens
Netherlands	20250130_NL_1_8f06b854	Amsterdamse Waterleidingduinen	van Limburg Stirumvallei X14	2025-01-30T11:31:00Z	100	90	Scrubland	E - Grasslands and land dominated by forbs, mosses or lichens

Netherlands	20250130_NL_2_6174ecbe	Amsterdamse Waterleidingduinen	Zilkerpad X9	2025-01-30T13:02:00Z	100	90	Scrubland	E - Grasslands and land dominated by forbs, mosses or lichens
Netherlands	20250130_NL_3_de594337	Amsterdamse Waterleidingduinen	Zeeveld Zuid X5	2025-01-30T13:54:00Z	100	90	Scrubland	E - Grasslands and land dominated by forbs, mosses or lichens
Netherlands	20250130_NL_4_9a2290fc	Amsterdamse Waterleidingduinen	Zeeveld Nord X1	2025-01-30T15:05:00Z	100	90	Scrubland	E - Grasslands and land dominated by forbs, mosses or lichens
Netherlands	20250226_NL_3_de594337	Amsterdamse Waterleidingduinen	Zeeveld Zuid X5	2025-02-26T08:25:00Z	105	90	Scrubland	E - Grasslands and land dominated by forbs, mosses or lichens
Netherlands	20250206_NL_10_30d19c18	Hoge Veluwe	Noordoostelijk van Schaarsbergen X2	2025-02-06T11:23:00Z	100	90	Forest	G - Woodland, forest and other wooded land
Netherlands	20250206_NL_11_63c64349	Hoge Veluwe	Noordoostelijk van Schaarsbergen X3	2025-02-06T14:15:00Z	100	90	Forest	G - Woodland, forest and other wooded land
Netherlands	20250206_NL_9_438d2740	Hoge Veluwe	Noordoostelijk van Schaarsbergen X1	2025-02-06T10:30:00Z	101	90	Forest	G - Woodland, forest and other wooded land
Netherlands	20250204_NL_5_cfc291d3	Loenderveen	Waterleidingplas D4	2025-02-04T11:13:00Z	94	315	Wetland	J - constructed, industrial and other artificial habitats
Netherlands	20250226_NL_5_cfc291d3	Loenderveen	Waterleidingplas D4	2025-02-26T14:11:00Z	96	180	Wetland	J - constructed, industrial and other artificial habitats

Netherlands	20250204_NL_6_3b425ce9	Loenderveen	Waterleidingplas D3	2025-02-04T12:00:00Z	100	180	Wetland	E - Grasslands and land dominated by forbs, mosses or lichens
Netherlands	20250204_NL_7_fb104ba8	Loenderveen	Waterleidingplas D2	2025-02-04T12:35:00Z	102	270	Wetland	E - Grasslands and land dominated by forbs, mosses or lichens
Netherlands	20250204_NL_8_44e6e23b	Loenderveen	Waterleidingplas D1	2025-02-04T13:09:00Z	104	135	Wetland	E - Grasslands and land dominated by forbs, mosses or lichens
Netherlands	20250226_NL_8_44e6e23b	Loenderveen	Waterleidingplas D1	2025-02-26T15:05:00Z	104	90	Wetland	E - Grasslands and land dominated by forbs, mosses or lichens
Netherlands	20250226_NL_6_3b425ce9	Loenderveen	Waterleidingplas D3	2025-02-26T14:30:00Z	106	135	Wetland	E - Grasslands and land dominated by forbs, mosses or lichens
Netherlands	20250401_NL_16_9d07fc31	Onlanden	Onlanden (1)	2025-04-01T12:24:00Z	120	0	Wetland	E - Grasslands and land dominated by forbs, mosses or lichens
Netherlands	20250401_NL_17_3a46c646	Onlanden	Onlanden (2)	2025-04-01T13:20:00Z	132	45	Wetland	E - Grasslands and land dominated by forbs, mosses or lichens

Netherlands	20250401_NL_18_6383061a	Onlanden	Onlanden (3)	2025-04-01T15:16:00Z	132	225	Wetland	E - Grasslands and land dominated by forbs, mosses or lichens
Netherlands	20250217_NL_12_498873b2	Oostvaardersplassen	Drempel D4	2025-02-17T09:40:00Z	100	0	Wetland	C - Inland surface waters
Netherlands	20250217_NL_13_d593cb78	Oostvaardersplassen	Drempel D3	2025-02-17T10:20:00Z	102	0	Wetland	C - Inland surface waters
Netherlands	20250217_NL_14_f0dc521c	Oostvaardersplassen	Drempel D2	2025-02-17T12:08:00Z	103	45	Wetland	E - Grasslands and land dominated by forbs, mosses or lichens
Netherlands	20250225_NL_12_498873b2	Oostvaardersplassen	Drempel D4	2025-02-25T11:20:00Z	187	0	Wetland	C - Inland surface waters
Netherlands	20250225_NL_15_d7a35b3c	Oostvaardersplassen	Drempel D1	2025-02-25T12:35:00Z	188	180	Wetland	E - Grasslands and land dominated by forbs, mosses or lichens
Netherlands	20250225_NL_13_d593cb78	Oostvaardersplassen	Drempel D3	2025-02-25T11:34:00Z	197	45	Wetland	C - Inland surface waters
Netherlands	20250225_NL_14_f0dc521c	Oostvaardersplassen	Drempel D2	2025-02-25T13:15:00Z	199	45	Wetland	E - Grasslands and land dominated by forbs, mosses or lichens
Norway	20250224_NO_27_932ef8d5	Hamar	RotliaN	2025-02-24T13:35:00Z	230	0	Forest	G - Woodland, forest and other wooded land

Norway	20250224_NO_28_3e481576	Hamar	Nokleby	2025-02-24T15:17:00Z	230	225	Forest	G - Woodland, forest and other wooded land
Norway	20250228_NO_34_3c94309d	Hamar	Akersvika	2025-02-28T09:45:00Z	230	180	Wetland	I - Arable land and market gardens
Norway	20250225_NO_30_6a306e76	Hamar	Feltstasjon	2025-02-25T18:15:00Z	235	0	Grassland	I - Arable land and market gardens
Norway	20250225_NO_29_1920e8d5	Hamar	Valetjerne	2025-02-25T16:20:00Z	250	180	Forest	G - Woodland, forest and other wooded land
Norway	20250224_NO_26_11d0c4a2	Hamar	Rotlia naturreservat	2025-02-24T11:40:00Z	300	90	Forest	G - Woodland, forest and other wooded land
Norway	20250324_NO_37_5bc534f0	Jaeren	Alvevatnet	2025-03-24T09:50:00Z	185	270	Wetland	E - Grasslands and land dominated by forbs, mosses or lichens
Norway	20250324_NO_8_3e07ce56	Jaeren	Maleneset	2025-03-24T13:30:00Z	210	135	Grassland	E - Grasslands and land dominated by forbs, mosses or lichens
Norway	20250324_NO_39_941752da	Jaeren	Orre	2025-03-24T15:15:00Z	230	270	Grassland	E - Grasslands and land dominated by forbs, mosses or lichens
Norway	20250324_NO_38_29eb3e1b	Jaeren	Bore	2025-03-24T10:50:00Z	240	180	Grassland	G - Woodland, forest and other wooded land

Norway	20250324_NO_36_c7289269	Jaeren	Grudavatnet	2025-03-24T08:40:00Z	310	270	Wetland	E - Grasslands and land dominated by forbs, mosses or lichens
Norway	20240524_NO_8_1717d9df	Jaeren	Maleneset	2024-05-24T15:50:00Z	210	135	Grassland	E - Grasslands and land dominated by forbs, mosses or lichens
Norway	20240525_NO_9_fbe52d2c	Jaeren	OrreNHaugen	2024-05-25T08:10:00Z	NA	NA	Forest	G - Woodland, forest and other wooded land
Norway	20250226_NO_5_2e9f4594	Lillehammer	Svartevjua	2025-02-26T12:50:00Z	230	315	Forest	C - Inland surface waters
Norway	20250227_NO_4_94dc95d8	Lillehammer	Gropmarka1	2025-02-27T13:40:00Z	230	90	Forest	G - Woodland, forest and other wooded land
Norway	20250227_NO_32_20069731	Lillehammer	Gropmarka2N	2025-02-27T17:45:00Z	230	135	Wetland	D - Mires, bogs and fens
Norway	20250226_NO_31_d51cd90c	Lillehammer	Gausa	2025-02-26T09:48:00Z	250	0	Forest	G - Woodland, forest and other wooded land
Norway	20250227_NO_33_2b0e29ef	Lillehammer	Gropmarka2S	2025-02-27T18:50:00Z	250	315	Wetland	D - Mires, bogs and fens
Norway	20240516_NO_4_d2b4d01e	Lillehammer	Gropmarka1	2024-05-16T09:20:00Z	NA	NA	Forest	G - Woodland, forest and other wooded land
Norway	20240516_NO_5_9b099eff	Lillehammer	Svartevjua	2024-05-16T12:25:00Z	NA	NA	Farmland	I - Arable land and market gardens

Norway	20250325_NO_7_5a6ba752	Lista	Slevdalsvannet	2025-03-25T14:50:00Z	170	180	Wetland	G - Woodland, forest and other wooded land
Norway	20250325_NO_6_b91151a3	Lista	Listafuglestasjon	2025-03-25T11:00:00Z	185	270	Scrubland	E - Grasslands and land dominated by forbs, mosses or lichens
Norway	20250325_NO_40_cdfb50bf	Lista	Steinodden	2025-03-25T12:10:00Z	210	180	Forest	G - Woodland, forest and other wooded land
Norway	20250325_NO_41_d88bc03a	Lista	Havnehagen	2025-03-25T17:40:00Z	215	90	Forest	G - Woodland, forest and other wooded land
Norway	20240325_NO_42_7e4b3d4f	Lista	Listastrendene	2025-03-25T19:25:00Z	225	135	Scrubland	G - Woodland, forest and other wooded land
Norway	20240521_NO_6_18bff2d2	Lista	Listafuglestasjon	2024-05-21T15:30:00Z	NA	NA	Scrubland	E - Grasslands and land dominated by forbs, mosses or lichens
Norway	20240522_NO_7_27dd31af	Lista	Slevdalsvannet	2024-05-22T06:20:00Z	NA	NA	Wetland	G - Woodland, forest and other wooded land
Norway	20250508_NO_52_6e4b733f	Pasvik	Skogfoss	2025-05-08T12:30:00Z	195	0	Scrubland	G - Woodland, forest and other wooded land
Norway	20250506_NO_43_6adeac32	Pasvik	Loken	2025-05-06T12:34:00Z	220	90	Forest	G - Woodland, forest and other wooded land

Norway	20250506_NO_44_f1c1b1bb	Pasvik	Skoytnes	2025-05-06T12:35:00Z	225	0	Forest	G - Woodland, forest and other wooded land
Norway	20250508_NO_50_2f22097	Pasvik	Gjokbukta	2025-05-08T08:20:00Z	235	0	Forest	G - Woodland, forest and other wooded land
Norway	20250508_NO_51_a1d0792e	Pasvik	Tjaerebukta	2025-05-08T09:55:00Z	235	180	Scrubland	D - Mires, bogs and fens
Norway	20250130_NO_1_eb289bed	Trondelag_1	Auran	2025-01-30T17:45:00Z	220	270	Forest	I - Arable land and market gardens
Norway	20250130_NO_25_179e153c	Trondelag_1	Tautra fugletarn	2025-01-30T14:20:00Z	255	90	Wetland	I - Arable land and market gardens
Norway	20250130_NO_24_4cb16fa2	Trondelag_1	Tautra farm	2025-01-30T10:30:00Z	310	90	Forest	G - Woodland, forest and other wooded land
Norway	20240315_NO_1_c27ff1cf	Trondelag_1	Auran	2024-03-15T17:30:00Z	NA	NA	Forest	I - Arable land and market gardens
Norway	20250116_NO_19_889bef22	Trondelag_2	Leinora	2025-01-16T12:27:00Z	205	180	Scrubland	I - Arable land and market gardens
Norway	20250123_NO_23_8ac55f2f	Trondelag_2	Litlvatnet	2025-01-23T17:30:00Z	210	90	Forest	G - Woodland, forest and other wooded land
Norway	20250123_NO_20_1b36a79e	Trondelag_2	Austraatt	2025-01-23T10:30:00Z	214	0	Forest	G - Woodland, forest and other wooded land

Norway	20250123_NO_22_dc98ad82	Trondelag_2	GrandefjaeraN	2025-01-23T14:00:00Z	222	135	Grassland	I - Arable land and market gardens
Norway	20250123_NO_21_22f9afc5	Trondelag_2	GrandefjaeraS	2025-01-23T11:20:00Z	225	180	Scrubland	G - Woodland, forest and other wooded land
Norway	20240424_NO_2_212924f2	Trondelag_3	Fossvatna	2024-04-24T10:30:00Z	NA	NA	Wetland	D - Mires, bogs and fens
Norway	20240424_NO_2_5c75764d	Trondelag_3	Fossvatna	2025-10-03T10:30:00Z	NA	NA	Wetland	D - Mires, bogs and fens
Norway	20240515_NO_3_2efa67ae	Trondelag_4	Roroes	2024-05-15T12:57:00Z	NA	NA	Forest	I - Arable land and market gardens
Norway	20250323_NO_35_c27ff1cf	Utsira	Gjenvinningstasjon	2025-03-23T13:10:00Z	135	180	Coastal	H - Inland unvegetated or sparsely vegetated habitats
Norway	20250323_NO_10_93be5da2	Utsira	Sjoarskogen	2025-03-23T10:50:00Z	190	270	Forest	F - Heathland, scrub and tundra
Norway	20240526_NO_11_6e4b733f	Utsira	Austre Plantning	2024-05-26T14:40:00Z	215	225	Coastal	H - Inland unvegetated or sparsely vegetated habitats
Norway	20250323_NO_11_3b0c3815	Utsira	Austre Plantning	2025-03-23T14:00:00Z	215	225	Coastal	H - Inland unvegetated or sparsely vegetated habitats
Norway	20240526_NO_12_d642707c	Utsira	Svehojen	2024-05-26T15:45:00Z	240	225	Forest	I - Arable land and market gardens

Norway	20250323_NO_13_e848f182	Utsira	Herberg	2025-03-23T08:25:00Z	254	90	Forest	E - Grasslands and land dominated by forbs, mosses or lichens
Norway	20240526_NO_10_a1d0792e	Utsira	Sjoarskogen	2024-05-26T13:20:00Z	NA	NA	Forest	F - Heathland, scrub and tundra
Norway	20240526_NO_13_cc849698	Utsira	Herberg	2024-05-26T17:15:00Z	NA	NA	Forest	E - Grasslands and land dominated by forbs, mosses or lichens
Norway	20250507_NO_48_bc777b7b	Varanger	Varangerbotn river	2025-05-07T13:45:00Z	150	180	Scrubland	G - Woodland, forest and other wooded land
Norway	20250507_NO_45_826cbf6b	Varanger	Jakobselv skispor	2025-05-07T09:25:00Z	190	0	Scrubland	G - Woodland, forest and other wooded land
Norway	20250507_NO_49_77d75946	Varanger_alone	Neiden	2025-05-07T15:55:00Z	195	225	Scrubland	G - Woodland, forest and other wooded land
Norway	20250507_NO_47_4c5b600e	Varanger	Varangerbotn naturreservat	2025-05-07T12:45:00Z	200	45	Scrubland	G - Woodland, forest and other wooded land
Norway	20250507_NO_46_eb07ec0c	Varanger	Jakobselv river	2025-05-07T10:40:00Z	240	225	Scrubland	G - Woodland, forest and other wooded land
Norway	20250514_NO_15_e0269ed6	Vega	Holandsosen	2025-05-14T10:54:00Z	150	45	Wetland	G - Woodland, forest and other wooded land

Norway	20250513_NO_14_b6b6bc4b	Vega	Igeroya	2025-05-13T18:13:00Z	320	180	Forest	G - Woodland, forest and other wooded land
Norway	20250514_NO_18_35ae2bd7	Vega	Kjellarhaugen	2025-05-14T12:08:00Z	320	180	Forest	G - Woodland, forest and other wooded land
Norway	20250514_NO_17_82b4e1aa	Vega	Ylvingen	2025-05-14T14:08:00Z	350	225	Forest	G - Woodland, forest and other wooded land
Norway	20250514_NO_16_c7226535	Vega	Horn	2025-05-14T17:08:00Z	400	225	Forest	G - Woodland, forest and other wooded land
Spain	20250320_ES_6_2d00da80	AiguamollsEmporda	Cortalet	2025-03-20T11:47:00Z	100	180	Wetland	I - Arable land and market gardens
Spain	20250516_ES_6_4035de5	AiguamollsEmporda	Cortalet	2025-05-16T00:00:00Z	100	180	Wetland	I - Arable land and market gardens
Spain	20250320_ES_7_1c1dcfe8	AiguamollsEmporda	Rogera	2025-03-20T14:20:00Z	120	0	Wetland	B - Coastal habitats
Spain	20250320_ES_8_613266b	AiguamollsEmporda	Palau	2025-03-20T16:53:00Z	120	45	Wetland	I - Arable land and market gardens
Spain	20250320_ES_5_55dc62ae	AiguamollsEmporda	Mata	2025-03-20T10:29:00Z	140	135	Wetland	I - Arable land and market gardens
Spain	20250219_ES_1_b5812468	Delta del Ebre	Canal Vell	2025-02-19T09:00:00Z	100	180	Wetland	I - Arable land and market gardens

Spain	20250311_ES_3_8e7fead8	Delta del Ebre	L'alfacada	2025-03-11T09:20:00Z	105	270	Wetland	D - Mires, bogs and fens
Spain	20250311_ES_4_49da8233	Delta del Ebre	La tancada	2024-03-11T11:45:00Z	108	180	Wetland	D - Mires, bogs and fens
Spain	20250219_ES_3_8e7fead8	Delta del Ebre	L'alfacada	2025-02-19T12:20:00Z	250	180	Wetland	I - Arable land and market gardens
Spain	20250219_ES_2_36308864	Delta del Ebre	Buda	2025-02-19T11:00:00Z	350	90	Wetland	I - Arable land and market gardens
Spain	20240513_ES_14_7a8e9437	Mas de Melons	Vall de la cisterna	2025-05-13T10:00:00Z	100	90	Scrubland	E - Grasslands and land dominated by forbs, mosses or lichens
Spain	20240513_ES_15_502aab6b	Mas de Melons	La estrella	2025-05-13T10:53:00Z	100	315	Grassland	F - Heathland, scrub and tundra
Spain	20240513_ES_16_ad15e51b	Mas de Melons	Roquisa	2025-05-13T12:00:00Z	100	180	Scrubland	I - Arable land and market gardens
Spain	20250701_ES_17_2d00da80	Mas de Melons	Cabana l'Era	2025-07-01T10:50:00Z	200	90	Grassland	I - Arable land and market gardens
Spain	20250411_ES_12_c5a44da9	Osona	Can Talaia	2025-04-11T10:31:00Z	100	180	Agroforest farmland	I - Arable land and market gardens
Spain	20250411_ES_11_91d7198e	Osona	Collell	2025-04-11T09:48:00Z	170	180	Farmland	I - Arable land and market gardens

Spain	20250411_ES_10_a88572f	Osona	Colomer	2025-04-11T08:51:00Z	400	0	Farmland	I - Arable land and market gardens
Spain	20250411_ES_13_f1a26bc9	Osona	Vilacís	2025-04-11T11:37:00Z	450	0	Farmland	I - Arable land and market gardens
Spain	20240325_ES_9_379e35d4	Solsones	EDAR	2025-03-25T10:00:00Z	150	90	Wetland	I - Arable land and market gardens
Spain	20250130_ES_18_2550e55	Solsones	Castellvell	NA	NA	NA	Agroforest farmland	J - constructed, industrial and other artificial habitats