Application form NWO – Open Science Fund – 2023

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Section 1b – Details of the team members

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Section 2 - Public summary

English public summary

Increasing transparency and reproducibility are key objectives of Open Science. To support an open and transparent research landscape, **CoreBirds** will link datasets, analytical codes, and publications resulting from long-term studies of wild bird populations. We will build upon an already existing database and network of researchers (SPI-Birds), and will create a library of peer-reviewed codes. This will greatly stimulate reuse of code, enhance the transparency of scientific outputs and thereby broaden the potential user base of SPI-Birds. Once implemented, this working model will encourage other research communities in the long tail of life sciences to close their research life cycle.

Word count (max 100): 100

Dutch public summary
Open Science heeft als kerndoelen het verhogen van transparantie en reproduceerbaarheid van onderzoek. We gaan hieraan met **CoreBirds** bijdragen door datasets, analytische codes en publicaties te integreren, waarbij we langetermijnstudies van vogelpopulaties als onderzoeksveld gebruiken. Daarbij bouwen we voort op een al bestaande database en netwerk van onderzoekers (SPI-Birds). Door het opzetten van een bibliotheek van gepeerreviewde codes geven we een belangrijke impuls aan de herbruikbaarheid van code en de transparantie van wetenschap, en verbreden we de SPI-Birds' gebruikersgroep. We stimuleren hiermee ook andere onderzoeksgemeenschappen in de 'long tail' van levenswetenschappen om hun onderzoekscyclus te sluiten. Word count (max 100): 96

Section 3 – Project proposal

3.1 The details of proposal

Proposed project title and acronym	***CoreBirds: Connecting Open Research outputs in the Ecology of Birds***
Project duration (in months)	12 months
The project will primarily address	Open platforms or tools
The project will secondarily address	FAIR workflows and interoperability standards
Relevance for a specific discipline	22.40.00 Ecology 22.60.00 Zoology

3.2 The vision for your project (Criterion: Alignment with the aim of the Call for proposals)

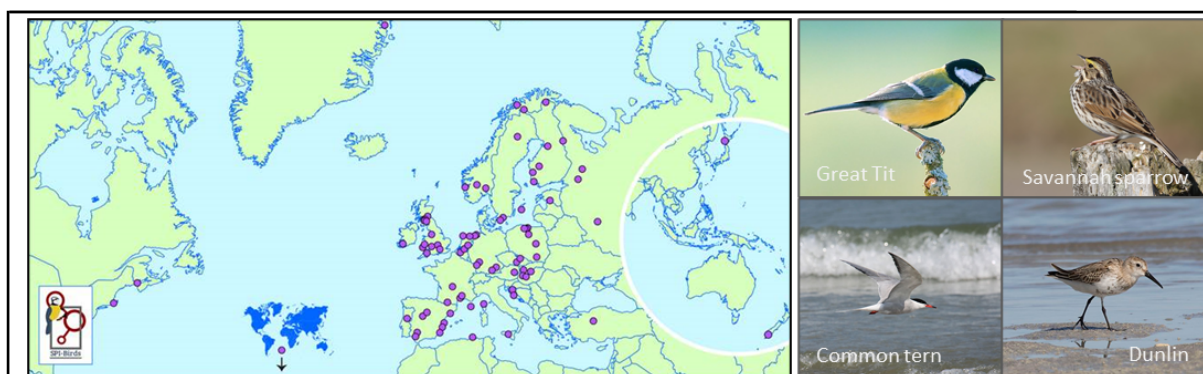| Vision |
|---|
| Closing the research life cycle by connecting different types of outputs (raw data, processed data, codes for data processing and analysis, publications) is a central goal of Open Science, yet is rarely accomplished [1-2]. This is especially the case in fields like ecology [3-4], in which long-term observational data have been collected and analysed, often opportunistically and without coordination between researchers.

Our vision is to develop a FAIR and transparent research landscape of datasets, codes and publications that are connected by digital identifiers and rich metadata. These aims will contribute to the reproducibility of scientific findings, and allow accessible reuse of data and code by other researchers. While we base our work on a specific community (see below), we will highlight the potential broader application of our standards and protocols by other communities.

Our project will build upon the existing effort of SPI-Birds Network and Database (www.spibirds.org). SPI-Birds is a global and growing network of long-term observational data on individually-marked breeding birds, and currently includes data from 114 study sites across 25 countries, representing more than 200 populations of 33 different species (Figure 1). The breadth of geographic areas and habitats offers enormous opportunities for examining how birds exposed to diverse conditions respond to environmental stressors. However, the lack of (meta)data standards and low code reproducibility slow scientific progress towards answering important research questions, such as how species respond to climate change or disease outbreaks [5]. |

Figure 1. *The current geographic range of SPI-Birds and examples of species coverage*

Aims and alignment with the call
To achieve our vision of closing the research life cycle, we have two aims:

(1) Create a library of data processing and analytical codes, and implement a peer review process. These codes will be fitted to existing SPI-Birds standardised data, ensuring that the codes themselves are also standardised and applicable to any other SPI-Birds dataset.

(2) Broaden the range of active and potential SPI-Birds contributors and users by increasing metadata interoperability and organising workshops on the use of SPI-Birds' data and code libraries.

Such an open ecosystem of data and associated code meets the aim of the call by addressing the topics of reproducibility and reusability of research, and integrating workflows for FAIR research outputs. It further stimulates wider adoption of Open Science practices among researchers.

Open Science impact
Reusability of research software and code is gaining traction. **CoreBirds** will be at the forefront of initiatives to aid these goals in ecology. Once implemented, **CoreBirds** will provide an example of how different research outputs can be managed and integrated to contribute to more transparent and reproducible science, which may be replicated by adjacent research communities.

Word count (max 450): 442 words

3.3 Project plan (Criterion: Feasibility of the project plan)

Activities and methods
The groundwork for **CoreBirds** is the SPI-Birds Network & Database, developed since 2019 and hosted by NIOO-KNAW. SPI-Birds has already developed a common FAIR data standard for long-term bird studies collecting individual-level data [6], recently updated to align with Darwin Core [7]. As a grassroots initiative with an existing platform and established research community, SPI-Birds is well-positioned for this proposal, making it plausible that we are able to move beyond the state of the art in Open Science.

To meet our first aim, we will conduct two tasks:

Task 1.1 Establish the code library
We will develop a library of data processing and analytical codes implemented in GitHub. The codes will be documented, searchable and linked to datasets (hosted at SPI-Birds) and resulting publications. These codes will be applied to standardised SPI-Birds data so workflows developed for one dataset can be used on others. The codes will also be archived on Zenodo, ensuring referenceability through versioned DOIs. All codes will be annotated, allowing clear understanding of all data processing and analytical steps. Initially, we will populate the library with codes to answer several key questions in evolutionary ecology that are within the expertise of the team members. After the library is set up, the user community can search, use, and extend existing codes, or submit new codes.

Task 1.2 Implement a code peer-review process
Codes submitted to the library will be peer-reviewed within the community. Initially, we will test and review codes within the project team and a small number of users. Later, peer review will involve a larger community (as showcased in the workshop).

Our second aim will be achieved in two tasks:

Task 2.1 Extend the metadata fields to incorporate information and links to a range of other ecological and biological databases. Specifically, we will refine and expand metadata on environmental attributes, using both user-provided data (e.g., vegetation) and automated import from external data sources (e.g., climate, https://www.worldclim.org, or high-resolution land cover, https://land.copernicus.eu).

Task 2.2 Expand the user base by organising workshops on data and library use
The workshops will also highlight the potential application of our reproducible workflows in other research communities. One suitable venue for a workshop is the semi-regular Hole-Nesting Birds meeting, which includes many active and potential SPI-Birds contributors.
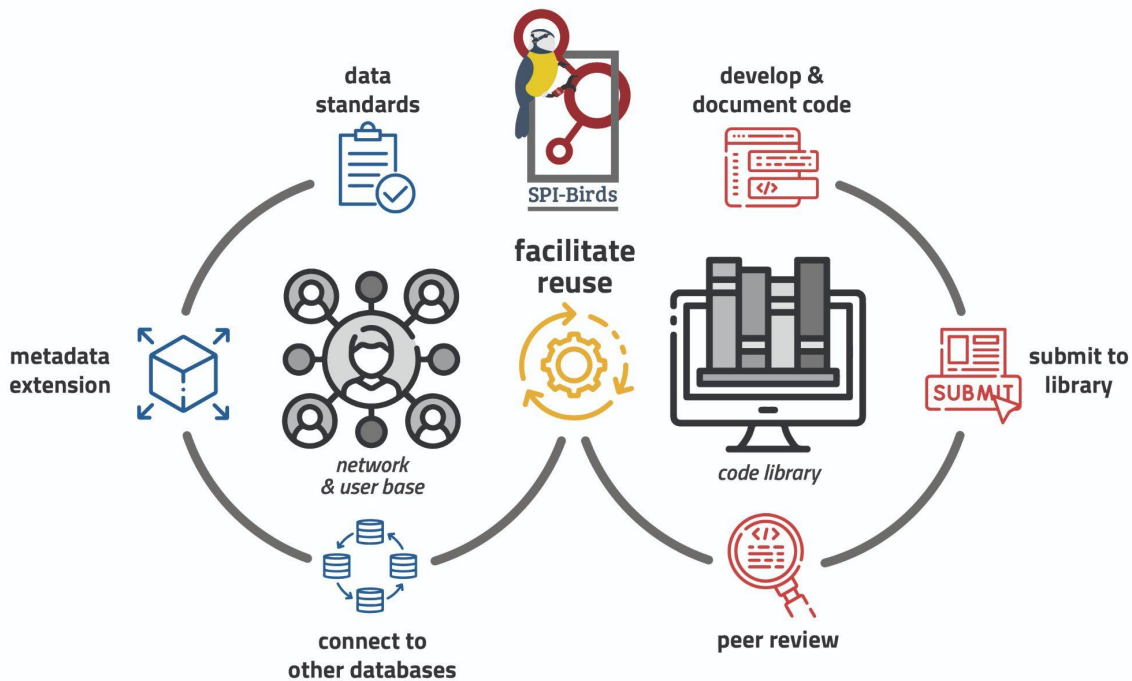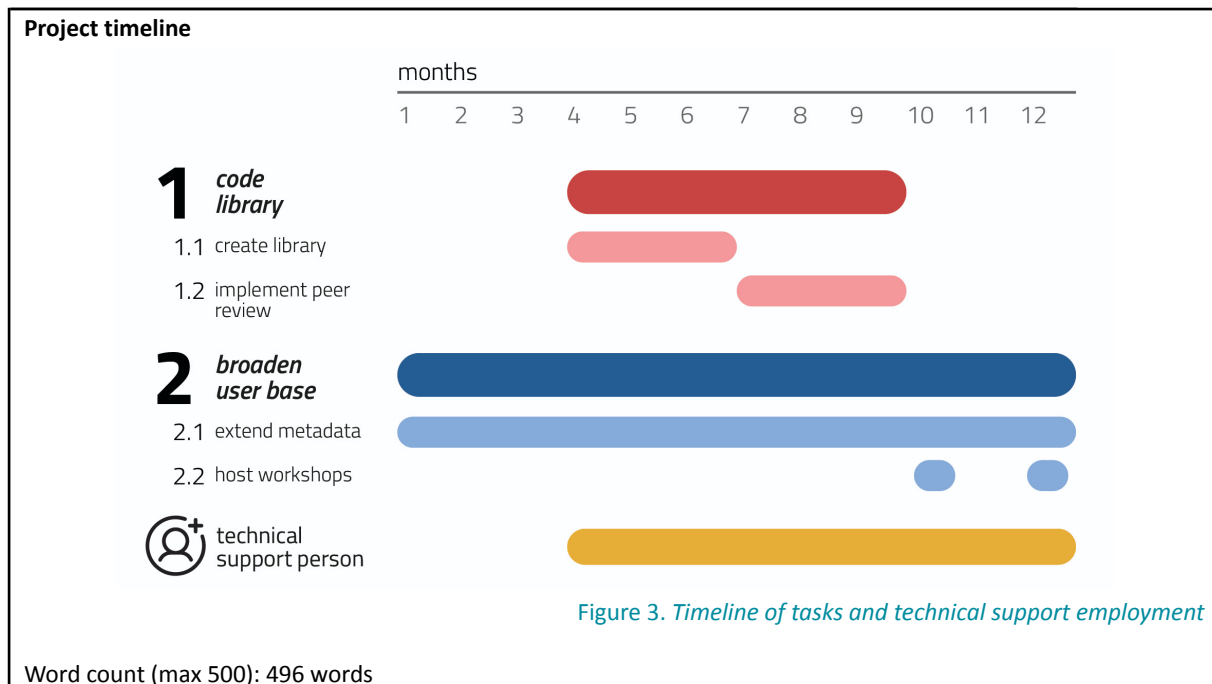

Figure 2. *Overview of aims and tasks of CoreBirds*

Dissemination
The code library will be openly available on GitHub. Project outcomes will be disseminated to the research community through a methodological publication in a scientific journal, through presentation at a conference, and via two workshops (task 2.2). The first workshop will be aimed at those working on similar data, within-community reproducibility and code review. The second workshop will facilitate the use of the data and library by a larger community. Project updates will be disseminated via social media and the existing SPI-Birds Newsletter (published bi-annually).

Project timeline

months

1 2 3 4 5 6 7 8 9 10 11 12

1 *code library*

1.1 create library

1.2 implement peer review

2 *broaden user base*

2.1 extend metadata

2.2 host workshops

technical support person

Figure 3. *Timeline of tasks and technical support employment*

Word count (max 500): 496 words

3.4 Project roles and expertise (Criterion: Feasibility of the project plan)

We will address these tasks with an interdisciplinary team of ecologists, Open Science experts, and experts in data science and computer science. The applicants include the co-founders of the SPI-Birds Network & Database (MEV, AC, SJGV) and current SPI-Birds developer (SJGV). Team members are expert in various areas of ecology, including population ecology (MEV, SJGV, JBB, [8]), evolutionary ecology (MEV, AC, [9]), seasonality (MEV, JBB, [10]), spatial ecology (MEV, SJGV, [11]), as well as meta-science (AC, [12]), data management (AC, SJGV, JBB, [13]), and Open Science practices (all). The experiences of the applicants in developing SPI-Birds standards, as well as their large network of interdisciplinary collaborators, will be key to the success of this project.

We seek funding for a short-term contract position (see section 3.5) for someone with expertise in data management and Open Science, including version control (Git/GitHub), reproducible reports (markdown/Quarto), data integration, data standards, and metadata schema/ontologies. Together with the project team, this person will build on the existing SPI-Birds data and metadata standards, as well as implement analytical codes that have already been created for SPI-Birds data.

Before the position is filled, the team will acquire codes already developed for use on SPI-Birds data, so that the technical support person has a set of codes to test and populate the library with. In addition, SJGV and JBB will make an inventory of metadata attributes, so that the technical support person can directly implement them in SPI-Birds' metadata standard from the outset.

Word count (max 250): 250 words

3.5 Budget table

Type of costs	Short description	Costs in euros
Personnel	9-month technical support personnel (1.0 FTE)	€ 45.560
Dissemination	Organisation of two workshops for potential users	€ 3.500
Travel	Presenting at conferences in the Netherlands	€ 900
Total request from NWO		*€ 49.960*

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3.6 Budget justification (Criterion: Feasibility of the project plan)

Personnel: We have allocated part of our budget to hire a technical support person on a 9-month contract position on salary scale 10.1 (3.098 euro per month + employer costs), which is consistent with the anticipated educational background (MSc or equivalent) and experience level. The calculation is based on the NWO's formula for calculating staff costs, and includes base monthly salary for the targeted pay scale (as of July 2022), holiday and end-of-year bonuses, and mark-ups. Given the expertise and the hands-on involvement of the project team we estimate that a 9-month position within the 12-month project duration will be sufficient for the technical support person.

Dissemination: Estimate of costs associated with organising and hosting two workshops (one at NIOO-KNAW and the second potentially in conjunction with a larger conference), including costs of audio/video equipment, refreshments, and other materials. This budget item will also cover other knowledge mobilisation costs.

Travel: Estimates for travel and registration costs associated with presentation of the knowledge outputs at local and/or national conferences. We anticipate that this budget will cover the costs of two national conferences.

Word count (max 200): 184 words

Section 4 – Open Science track record of the applicant

I am driving FAIR and Open Science practices in ecology in a number of ways. I have several publications on new Open Science related methods and community standards (three papers in Nature Ecology & Evolution: [12,14,15]). In my publications I have always strived to provide open access to data (I have deposited >40 datasets related to my publications in data repositories). I am one of the founders of SPI-Birds (https://www.spibirds.org, [6]) for which Antica Culina and I were awarded the "Dutch Data Incentive Prize for the Medical and Life Sciences" 2020 by Research Data Netherlands. SPI-Birds makes data on long-term populations of individually-marked birds FAIR by providing metadata on these studies and by building population-specific pipelines transforming datasets as stored by data contributors into a standard format, greatly facilitating meta-analysis on a large set of studies [11,16]. Furthermore, I am the lead PI of LTER-LIFE (www.lter-life.nl), a FAIR and Open Research infrastructure that aims to enable ecologists to create Digital Twins of entire ecosystems. Overall, I am well embedded in the Open Science community and made contributions to the development of resources and tools, enabling ecologists to carry out Open Science practices.

Word count (max 200): 199

Section 5 – Data management (Criterion: Feasibility of the project plan)

5.1 Will this project involve re-using existing research data?
Yes: Are there any constraints on its re-use?

The project will use the datasets already hosted at SPI-Birds. SPI-Birds is principally a metadata hub and currently does not serve as a primary data repository for most of the relevant data. As a result, data reuse depends on the data contributor who hosts the original data. However, an increasing number of data contributors has been making their data open thanks to continuous efforts and education provided by the applicants of this proposal. In its development stage, the **CoreBirds** will use the subset of the datasets that are either open or for which permission for use has been obtained from the data contributors (among those seven datasets managed by the applicant's institution NIOO-KNAW). Data contributors retain custody of the data and, following the SPI-Birds Data Access Policy, "data user[s] agree not to redistribute original data and documentation without permission from the [originator]". As the founders and maintainers of SPI-Birds, we do not anticipate any difficulties in accessing data for this project. Data contributors will be invited as full collaborators on any outputs that include their data.

5.2 Will data be collected or generated that are suitable for reuse?
No: Please elaborate

This proposal is focused on the reuse of existing long-term data that have been collected and made suitable for reuse under FAIR principles, and does not generate new data *per se*. Any derivative datasets (e.g., summary information, analytical outputs), as well as any data used in the analyses underlying scientific outputs will, when possible, be shared in their entirety. Data will be archived in open access data repositories (e.g., Zenodo) and referenced in the corresponding output. Data sharing will always comply with the SPI-Birds Data Access Policy. To ensure reproducibility, any code or other scripts produced for extracting, processing, and analysing the data will always be shared in an openly accessible format and linked with the archived datasets.

5.3 After the project has been completed, how will the data be stored for the long-term and made available for the use by third parties? Are there possible restrictions to data sharing or embargo reasons? Please state these here.

Datasets have already been collected and made FAIR via SPI-Birds Network and Database. Data are hosted at NIOO-KNAW and backed up daily. Datasets are either stored under open licence, or they can be requested by potential users. In the latter case, the request is sent to the data contributor who can set conditions to data use. So far, all the requests for data use have been approved. All metadata are open, and thus all populations can be found, and their access options are clearly stated.

5.4 Will any costs (financial and time) related to data management and sharing/preservation be incurred?
No: All the necessary resources (financial and time) to store and prepare data for sharing/preservation are or will be available at no extra cost.

Section 6 – Software sustainability (Criterion: Feasibility of the project plan)

6.1 Will software be generated during the project?
Yes: Please answer questions 6.2, 6.3, 6.4 and 6.5

6.2 How will the software be licensed and be made available for re-use?

Data processing and analytical codes will be available in our library on GitHub and archived on Zenodo under the Creative Commons Attribution 4.0 International licence (CC BY 4.0; https://creativecommons.org/licenses/by/4.0/).

6.3 What measures are needed to make the software appropriate for long-term (re-)use by third parties?

The library requires a moderator who i) handles the submission of new codes and new versions of codes, ii) searches for experts to peer review submissions and updates, and iii) checks whether codes require an update when dependencies (e.g., software packages) have been modified. Within **CoreBirds** these tasks will be under the responsibility of the technical support person (to be hired). In the long term, the SPI-Birds team of coordinators and developers that currently manage SPI-Birds Network and Database will take over this role.

6.4 How large do you expect the community that will potentially use the software to be, and do you expect outside contributors to the software?

The data hosted at SPI-Birds has a long history in facilitating large collaborations and comparative analyses in ecology and evolution. Now embodied as the SPI-Birds Network, we envision that this group of researchers will capitalise on the development of a library of standardised data processing and analytical codes, which lowers the threshold to take up extensive collaborative scientific projects even more. This community also has a strong foothold in developing new theories and mathematical models, tested using the rich data they collect, which we anticipate being submitted to the code library. Further, the large number of records of individual birds make SPI-Birds Database a rich source of intraspecific biodiversity, a currently underdeveloped and generally underappreciated dimension of biodiversity. As SPI-Birds continues to grow, especially geographically and taxonomically, we expect biodiversity and conservation scientists also among the wide range of users of the code library.

6.5 What expertise do you expect to be needed to make the software appropriate for long-term re-use by third parties? Is this expertise available?

We expect that the bulk of codes submitted to the library will be developed in R, which is the leading coding language used by researchers in ecology. As the codes will be submitted and peer reviewed by members of the user community themselves, we envision that the accessibility and adaptability of the codes is safeguarded. In addition, we will encourage users to provide feedback, communicate bugs in codes and/or submit code revisions through GitHub's issue feature and other resources [3]. At the same time, the SPI-Birds team will moderate the library and call for code updates, e.g., when dependencies are updated.

Section 7 – Literature references

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By submitting this form, I declare that:

I and all the individuals involved in this proposals satisfy the nationally and internationally accepted standards for scientific conduct as stated in the Netherlands Code of Conduct for Research Integrity (The Universities of the Netherlands): **Yes**

The research organisation has been informed of this grant application and the research organisation accepts the grant conditions of this programme: **Yes**

The team members named in this form have read and agreed with the submission of this proposal and have agreed with their role and intended contribution to the project, should this be awarded: **Yes**

I have completed this application form truthfully: **Yes**