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Strucke ^{C}14 Sweden: A Radiocarbon Dataset of Archaeological Contexts in Sweden

DATA PAPERS

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ABSTRACT

This dataset represents the largest available compilation of radiocarbon dates from archaeological contexts in Sweden, comprising 30,287 entries. Here, we describe the data and the compilation process, and highlight the dataset's research potential. The dataset is being integrated into Swedigarch, the national infrastructure for digital archaeology in Sweden, and will be periodically updated over time with additional records.

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(1) OVERVIEW

CONTEXT

Each year, several hundred or even thousands radiocarbon dates are obtained from archaeological investigations in Sweden. The results are typically published in printed or digital reports, but they have not been systematically archived in a national database for reuse. Several regional efforts to collect radiocarbon dates have previously been undertaken in Sweden. These include Friman & Lagerås [1], comprising 6,647 dates from the Scania region, Hatlestad et al. 2021, comprising 1,037 dates [2], among others. The dataset presented in this paper is the most extensive compilation to date, with 30,287 entries from across all of Sweden.

The project was initiated by Ulf Strucke in the early 1990s and, since 2022, has been carried out in collaboration with the Swedish National Infrastructure for Digital Archaeology (Swedigarch). The dataset is currently available via Zenodo (https://doi.org/10.5281/zenodo.10966331) and will be integrated into Swedigarch through the Strategic Environmental Archaeology Database (SEAD) at Umeå University. This integration will support Linked Open Data solutions within the broader digital infrastructure developed by Swedigarch. Making radiocarbon data FAIR (findable, accessible, interoperable, and reusable) provides significant research potential, particularly when linked to archaeological contexts and associated finds. A long-term objective is to establish digital workflows that make newly generated radiocarbon data immediately accessible and interoperable upon completion of excavation projects in Sweden. Researchers who wish to contribute to the dataset are welcome to contact the authors or the SEAD laboratory at Umeå University.

SPATIAL COVERAGE

The dataset covers a geographic area corresponding to Sweden's national borders. The decimal degree coordinates of the minimum-bounding box are given in the geographic coordinate system WGS 84.

Northern boundary: +67.919657
Southern boundary: +55.3432
Eastern boundary: +23.9705
Western boundary: +11.154336

The spatial distribution of the dataset shows clear variation in sampling intensity across Sweden (Figure 1A). This primarily reflects the fact that the large majority of excavations in Sweden are conducted as development-led archaeology, which is concentrated in densely populated areas of southern Sweden (Figure 1B).

TEMPORAL COVERAGE

The temporal range of dated archaeological contexts in the dataset spans approximately from the Mesolithic to the early modern period, from 9978 BC to AD 1852 (median probability dates within the 2σ calibrated ranges). The dataset also includes radiocarbon samples collected during archaeological excavations that cannot be linked to human activity. These include very old Palaeolithic dates, ranging from 46,000 to 12,000 BC, which can be filtered out using the 'assessed_relevant' field (see Table 2). The chronological distribution of dates in the dataset shows a pronounced peak corresponding to the Iron Age (Table 1). Additionally, the dataset contains 578 samples that have not been calibrated, usually due to missing or erroneous information.

(2) METHODS

The dataset was primarily compiled from published archaeological reports containing radiocarbon dating results. A more formalised effort began in September 1999, when Ulf Strucke implemented the first version of the dataset through a Microsoft Access database. The initial focus was on results from the radiocarbon laboratory at the Swedish Museum of Natural History (*Naturhistoriska riksmuseet*) in Stockholm, which ceased operations in 1998. The database architecture was based on an earlier database of wood anatomical investigations developed by Strucke. Recognising the research value of a comprehensive overview of Swedish radiocarbon dates, Strucke continued expanding the collection with the intention of making it openly accessible. In 2022, this initiative was resumed as part of the Swedigarch infrastructure.

STEPS

The dataset builds on the Access database compiled by Strucke over the years, which includes radiocarbon data from both published and unpublished archaeological investigations across Sweden. This legacy dataset was enriched through a systematic review of the Swedish National Heritage Board archives. Both the digital *Arkivsök* system and the physical holdings of the Antiquarian Topographic Archive (*Antikvariska Topografiska Arkivet*, ATA) were consulted. Additional publications reporting radiocarbon dates were also consulted and incorporated, for example, *Excavations at Helgö VIII – The Ancient Monument* [3]. The compiled data were subsequently transferred to the Swedigarch module at Uppsala University, where quality control and metadata enrichment were carried out.

Data collection between 2022 and 2026 was organised into parish-level subsets, in which Strucke both verified the legacy entries and collected new data. Parishes were selected to achieve representative geographic coverage of Sweden while also accounting for the regional variation in the density of archaeological investigations.

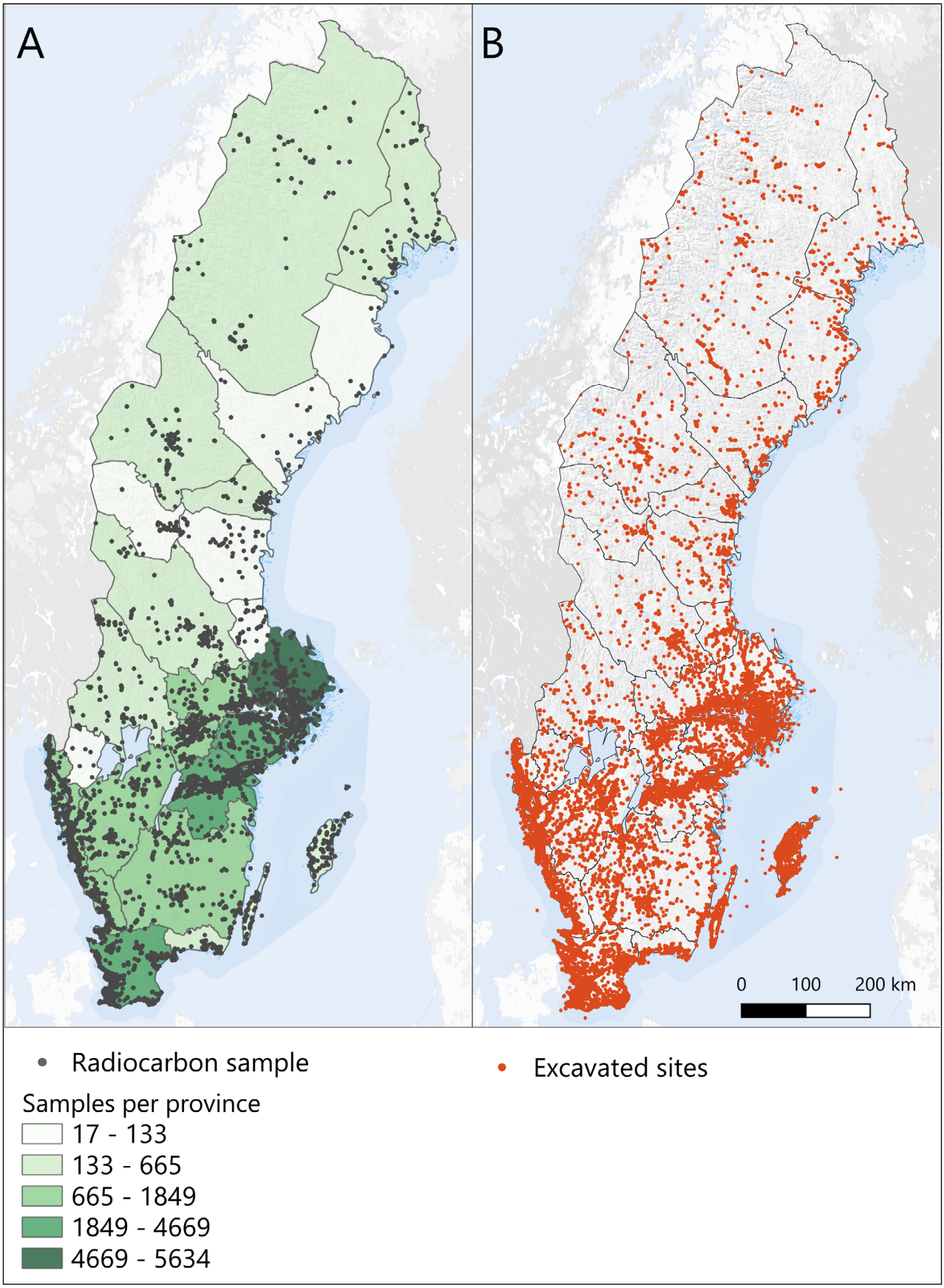


Figure 1 (A) Spatial distribution of the 30,287 radiocarbon samples in the dataset, grouped by province (Swedish: *landskap*). Each sample is represented by a grey dot. **(B)** Sites excavated according to the Swedish Historical Environment Record. Together, these maps illustrate the close spatial relationship between the distribution of radiocarbon samples and archaeological excavations in Sweden. Data from Swedish National Heritage Board (*Kulturmiljöregistret*). Background map copyright *Lantmäteriet* (*Topoweb nedtonat*).

PERIOD	NUMBER OF DATES	%
Palaeolithic (50,000–10,000 BC)	25	0.1
Mesolithic (10,000–4000 BC)	1,511	5.1
Neolithic (4000–1700 BC)	2,386	8.0
Bronze Age (1700–500 BC)	4,699	15.8
Iron Age (500 BC–AD 1050)	14,995	50.5
Middle Ages (AD 1050–1523)	3,864	13.0
Early modern period (AD 1523–1950)	2,229	7.5
Total	**29,709**	**100**

Table 1 Distribution of calibrated radiocarbon dates by archaeological period.

The parishes that underwent the more intensive data collection phase during 2022–2026 are listed in the accompanying file named "*reviewed_parishes.csv*". For these parishes, the dataset is estimated to provide near-complete coverage of published radiocarbon dates, although the level of coverage varies between parishes and completeness cannot be guaranteed. The dataset also contains radiocarbon samples from other parishes, but for those, data collection should be regarded as incomplete, and additional published radiocarbon dates are likely to exist.

QUALITY CONTROL

Quality control procedures included the identification and removal of duplicate entries, the correction of missing or inconsistent values, the standardisation of field names, and the addition of metadata. The software OpenRefine was used to identify and correct spelling errors and data inconsistencies. The Swedish National Heritage Board's archive was used to crosscheck information about site id, project id, and publication details. For crosschecking information about the radiocarbon data, both the registry of the Tandem Laboratory at Uppsala University and the registry of the now-closed laboratory of the Museum of Natural History in Stockholm were used. Samples originating from the Tandem Laboratory and the Museum of Natural History make up approximately 60 and 12 percent of the dataset, respectively.

Entries lacking key information, such as radiocarbon measurements or archaeological site identifiers, were retained in the dataset, as the documentation that a sample was analysed is informative in itself. In the future, the missing information may be identified and added to the dataset. Similarly, the very early Palaeolithic dates (46,000 – 12,000 BC) that cannot be connected to human activity were also retained, as these dates might still be of importance to the stratigraphic understanding of a site.

Coordinates were also added for each date. The vast majority of dates are assigned the coordinates of the centroid of the archaeological site from which the sample was collected. Samples that cannot be linked to a registered site instead have the coordinates of the parish centroid. In the future, this spatial precision can be refined, as the dataset also contains information about the sampled archaeological context. A long-term aim is to link the Strucke ^{c}14 dataset to other open datasets, such as archaeological geodata in the Swedigarch resource AGES (Archaeological Geodata from Excavations and Surveys). This would enable more detailed analyses and new research opportunities.

While every effort has been made to minimise errors, the dataset may still contain inaccuracies. We would appreciate it if users informed us of any errors they identify so that these can be corrected in future versions of the dataset.

CONSTRAINTS

Although this dataset represents the most comprehensive compilation of radiocarbon data from archaeological contexts in Sweden to date, it does not constitute a complete register. This is due to several factors: the accessibility of archaeological reports varies significantly across regions and time periods; not all parishes in Sweden have yet undergone the more intensive data collection phase; and some radiocarbon data remain unpublished or contain missing information. The dataset is intended to be continuously updated, with additional entries over time.

The radiocarbon samples have been compiled from a wide variety of sources from the late 1950s to the present. Consequently, there is considerable variation in both data quality and the amount of available information. For example, the standard error for radiocarbon dating is typically around ±30 years today, whereas it was often ±100 years or more during the early decades of radiocarbon dating. Furthermore, because conventional radiocarbon dating often required charcoal samples of 4 grams or more, many of the older samples consisted of multiple wood species, making it more difficult to assess the extent to which the so-called old-wood effect may have influenced the radiocarbon date.

(3) DATASET DESCRIPTION

The dataset consists of a CSV table containing 37 fields. The table includes standard fields for radiocarbon data, archaeological site and context information, publication details, and other metadata (see Table 2). While most field names are in English, some are in Swedish to retain the conceptual clarity, such as "uppdragsnummer". The textual information in the cells is mainly in Swedish. This includes, for example, site and context type, sampled material, and general comments. The original language was retained to preserve the integrity of the data. However, the aim is to release a separate version of the dataset, translated into English, in the near future. Cells with missing or unavailable information are left blank.

FIELD NAME	DESCRIPTION
socken	Historic parish.
place_name	The place name of the area. Usually a village or farm name, or a property designation.
raa_id	Swedish National Heritage Board site ID, legacy version.
site_type	The type of archaeological site (swe: *Lämningstyp*).
site_id	Swedish National Heritage Board site ID, current version (swe: *Lämningsnummer*).
uppdragsnummer	Swedish National Heritage Board archaeological project ID.
landskap	The province in Sweden.
lab_id	Unique sample identifier from the analysing lab.
c14_age_bp	Radiocarbon years BP.
c14_error	One standard deviation (1σ) of the radiocarbon age measurement, in years.
$d^{13}C$	Stable carbon isotope ratio (δ13C).
pMC	Percent Modern Carbon.
pMC_error	One standard deviation (1σ) of the percent Modern Carbon measurement.
c14_data_status	Describes whether any radiocarbon data is missing or erroneous.
comment	General comment, usually about sample data quality.
assessed_relevant	Assessment in the archaeological report of whether the radiocarbon date corresponds to the intended archaeological context. *J* indicates correspondence between sample and context. *N* indicates that the sample dates a completely different event (e.g., redeposited material, contamination or a natural event). *X* indicates that the report contains conflicting information regarding contextual correspondence.
material	Material sampled.
species	Taxonomic identification of the sampled material.
context_id	Identifier of the sampled archaeological context.
context_type	Archaeological context/feature type.
northing_3006	Northing coordinate. EPSG: 3006 (SWEREF 99 TM)
easting_3006	Easting coordinate. EPSG: 3006 (SWEREF 99 TM)
longitude	Longitude (EPSG: 4326).
latitude	Latitude (EPSG: 4326).
location_precision	Describes the spatial precision represented by the coordinates. Values are: *exact sample position*, *archaeological site*, and *parish*.
cal_68_min	Earliest boundary of the 68.3% calibrated age range in calendar years. Negative numbers = BC years, positive numbers = AD.
cal_68_max	Latest boundary of the 68.3% calibrated age range in calendar years. Negative numbers = BC years, positive numbers = AD.
cal_95_min	Earliest boundary of the 95.4% calibrated age range in calendar years. Negative numbers = BC years, positive numbers = AD.
cal_95_max	Latest boundary of the 95.4% calibrated age range in calendar years. Negative numbers = BC years, positive numbers = AD.
median_cal_year	Median calibrated calendar year derived from the cumulative calibrated probability distribution.
calibration_method	The method, software, and curve used to calibrate.
calibration_status	Values are: *calibrated*, *not yet calibrated*, or *cannot be calibrated*.
author	Author(s) of the publication.
publication_year	Year of publication.
title	Title of publication.
journal	Journal or series.
place_of_publication	Publication place.

Table 2 Description of the fields in the dataset.

CALIBRATION

The radiocarbon dates were calibrated using R v.4.6.0 and RStudio [4] within the *rcarbon* package v.1.5.0 [5]. The IntCal20 calibration curve was used, as it is the current international standard for terrestrial Northern Hemisphere radiocarbon dates [6]. Dates that could not be reliably calibrated were excluded, such as dates older than 55 cal kBP, which exceeds the temporal extent of the IntCal20 calibration curve, and dates lacking radiocarbon error estimates or containing invalid error values (e.g., negative values).

Calibrated probability distributions were summarised using the highest posterior density (HPD) intervals. For each radiocarbon determination, the median calibrated date and the highest probability ranges corresponding to the 68.3% (1σ) and 95.4% (2σ) confidence intervals were calculated. The minimum and maximum calendar-year values contained within each 1σ and 2σ HPD interval were extracted and recorded in the dataset as the 'min' and 'max' calibrated age ranges. For readability and standardisation, calibrated calendar years are represented numerically using signed calendar years, where negative values denote BC dates and positive values denote AD dates.

OBJECT NAME

StruckeC14_Sweden.csv
reviewed_parishes.csv

DATA TYPE

Secondary data compiled and processed from archaeological reports.

FORMAT NAMES AND VERSIONS

.csv

CREATION DATES

The dataset was created between 1999 and 2026.

DATASET CREATORS

Ulf Strucke, Sakarias Lindgren, Daniel Löwenborg.

LANGUAGE

Swedish and English

LICENSE

Creative Commons License CC-BY 4.0: https://creativecommons.org/licenses/by/4.0/

REPOSITORY LOCATION

The dataset is hosted on the following webpage:

> Strucke, U. (2026). Strucke C14 Sweden [Dataset]. Uppsala University. https://doi.org/10.5281/zenodo.10966331

PUBLICATION DATE

First uploaded as restricted on Zenodo on April 12, 2024. Updated and published on October 28, 2026.

(4) REUSE POTENTIAL

By compiling radiocarbon dates that were previously dispersed across grey literature, PDF reports, and unpublished lists, and by systematising their associated metadata, the Strucke ^{c}14 Sweden dataset provides a foundation for building a chronological framework for Swedish archaeology. At present, the dates are primarily linked to archaeological site identifiers and archaeological investigation identifiers. Future development will extend these connections to individual archaeological features and to other linked open data resources within the infrastructure for Swedish digital archaeology. Planned development of Swedigarch includes linked open data functions for research resources through the heritage aggregator *K-samsök*, hosted by the Swedish National Heritage Board. This will allow combined queries of C14 dates with other data from excavations, such as geodata, finds, and results from analyses. Furthermore, integration with international infrastructures such as ARIADNE, as well as with other published radiocarbon datasets (such as the NERD dataset [7]), will support large-scale analysis of human activity through time.

Since the late 1980s, and increasingly over the last decade, summed probability distributions (SPDs) of calibrated radiocarbon dates have been used as proxies for human population and demographic trends [1, 8, 9, 10, 11]. The strengths and limitations of this approach have been extensively debated [12, 13, 14, 15, 16, 17]. Högberg et al. [17] emphasise that demographic patterns inferred from such analyses may reflect not only past population dynamics but also archaeological practices, sampling strategies, and research priorities. In the Strucke C14 Sweden dataset, the overall spatial distribution largely reflects where development-led excavations have taken place rather than necessarily the underlying spatial distribution of past human activity (Figure 1B).

While radiocarbon data are valuable in themselves, their full analytical potential emerges when they are linked to archaeological features, artefacts, environmental records, and other cultural heritage data within FAIR infrastructures. Such links can help researchers contextualise the evidence, better understand potential biases, and explore new research questions. For instance, Hatlestad [18] uses a preliminary version of this dataset to explore human adaptive responses to climate change in the past. The high spatio-temporal resolution of the data makes it possible to investigate risk-management and socioeconomic strategies that vary both chronologically and regionally.

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COMPETING INTERESTS

The authors have no competing interests to declare.

AUTHOR CONTRIBUTIONS

Sakarias Lindgren: Conceptualisation; Data Curation; Validation; Visualisation; Writing – Original Draft; Writing – Review & Editing.

Daniel Löwenborg: Conceptualisation; Project Administration; Funding Acquisition; Writing – Review & Editing.

Ulf Strucke: Conceptualisation; Investigation; Data Curation; Writing – Review & Editing.

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