

The Rosenlund Catalogue: a GIS database of Quaternary zoological fauna in Denmark

Kristian K. Kjeldsen¹ , Kim Aaris-Sørensen², Anne B. Gotfredsen³ , Pernille Bangsgaard³ , Kasper L. Hansen³ , Kristian M. Gregersen⁴ , and Kurt H. Kjær^{2,3} 

¹Department of Glaciology and Climate, Geological Survey of Denmark and Greenland, Copenhagen, Denmark; ²Natural History Museum of Denmark, University of Copenhagen, Copenhagen, Denmark; ³Globe Institute, University of Copenhagen, Copenhagen, Denmark; ⁴Royal Danish Academy – Architecture, Design, Conservation, Copenhagen, Denmark

Abstract

The Rosenlund Catalogue presents a digitised, Geographical Information System (GIS) data set of the Quaternary zoological fauna curated at the Natural History Museum of Denmark. The data set derives from the Quaternary Zoological Central Register and comprises 20 315 taxonomic entries linked to 6481 accessions collected between 1814 and 2022 across Denmark. Each entry is associated with contextual metadata including a journal number, locality (parish, district, county), excavation year, find context, dating method and chronozone classification. Spatial referencing is based on the pre-1970 parish division and georeferenced using ETRS89/UTM Zone 32N. The original relational database structure, consisting of linked contextual and taxonomic tables, was extracted, cleaned and migrated to interoperable formats (.xlsx and .gpkg). The resulting data set provides nationwide spatial coverage and standardised taxonomic and stratigraphic information. These data support research and heritage management applications in Quaternary zoology, archaeology, biostratigraphy, palaeoenvironmental reconstruction, and long-term biodiversity change.

Tabular abstract

Geographical coverage	Denmark
Temporal coverage	Quaternary. Original data were collected 1814–2022.
Subject(s)	Quaternary zoology
Data format(s)	Data table of Quaternary zoological fauna, with spatial information of the find locations. Data table provided in .xlsx format. Point and polygon feature data provided as geopackage (.gpkg) files with attribute tables. The data consist of: The entire database archive in .xlsx and .gpkg formats ('Rosenlund_v2p8 All'); the 'Rosenlund_v2p8' database in .gpkg format specific to the each of the Danish archaeological jurisdiction areas, identified through the suffix; the onshore archaeological jurisdiction areas in .gpkg format ('Arkæologiske Ansvarsområder 2023'); the offshore archaeological jurisdiction areas in .gpkg format ('Marinarkæologi Vest (MAV) Ansvarsområde' and 'Vikingskibsmuseet Ansvarsområde'); Division of Danish parishes (Stednr. and sognekommuner) including offshore areas in .gpkg format ('Parish Stednr Sognekommuner incl sea').
Sample collection and analysis	Digitisation and GIS processing of historic data
Parameters	Zoological Museum's Quaternary Zoological Collection journal number, and spatial information for the parish, district, county.
Related publications	Kjeldsen <i>et al.</i> 2026. https://doi.org/10.22008/FK2/B7G0PK
Potential application(s) for these data	Studies of faunal history and biodiversity change, human–animal interactions, climate and environmental reconstructions and biostratigraphy.

***Correspondence:** Kurtk@sund.ku.dk

Received: 25 Mar 2026

Revised: 02 Sep 2026

Accepted: 02 Sep 2026

Published: 28 Oct 2026

Keywords: quaternary; zooarchaeological fauna; Denmark; geographical information system

Abbreviations

BP: before present
DKC: Det Kvartærzoologiske Centralregister (Quaternary Zoological Central Register)
DOS: Disk Operating System
GIS: Geographical Information System
ICS: International Commission on Stratigraphy
IUGS: International Union of Geological Sciences
Z.M.K.: Zoological Museum København (Copenhagen)
ZM: Zoological Museum

GEUS Bulletin (eISSN: 2597-2154) is an open access, peer-reviewed journal published by the Geological Survey of Denmark and Greenland (GEUS). This article is distributed under a [CC-BY 4.0](#) licence, permitting free redistribution, and reproduction for any purpose, even commercial, provided proper citation of the original work. Author(s) retain copyright.

Edited by:

Harold Lovell (University of Portsmouth, UK)

Reviewed by:

Youri van den Hurk (University Museum of Bergen, Norway), Sofie Folsach Hellerøe (Aarhus University, Denmark)

Funding: See page 5

Competing interests: See page 6

Additional files: See page 7

1 The Danish Quaternary zoological fauna collection

The Quaternary zoological fauna collection at the Natural History Museum Denmark, part of the University of Copenhagen (formerly the Zoological Museum [ZM]), Denmark, constitutes one of the most comprehensive national collections of archaeological and geological vertebrate remains in Europe. The scientific study of Quaternary vertebrate remains in Denmark formally began in 1814 with Professor Johannes H. Reinhardt, who initiated the systematic recording of zoological material. This followed the *Oldsagskommissionen* in 1807, which, by law, introduced the systematic registration of antiquities and the collection of artefacts in Denmark, including bones. From this initiative emerged several key institutions, including the Museum of Nordic Antiquities (later the National Museum of Denmark) and the Natural History Museum Denmark, as well as the parish boundaries (*Sognebeskrivelsen*), which form the basis for the present-day parish (*sogn*) and district (*herred*) system. Following Reinhardt's death in 1845, Japetus Steenstrup continued and expanded this work, actively promoting the development of a national collection of subfossil and archaeological bone material. The subsequent merging of the Natural History Museum and the university collections under the University of Copenhagen consolidated responsibility for Quaternary zoological studies within the then ZM. Since the mid-19th century, the majority of faunal remains from the Kingdom of Denmark, including Iceland (until 1944), the Faroe Islands and Greenland have been submitted to the museum for identification and curation. Curator H. Winge should be credited with initiating a systematic registration procedure that formed the backbone of the collection's documentation. This system was further developed by conservator Ulrik Møhl Hansen, who introduced the journal numbering system under curator Magnus Degerbøl in the 1940s. Later, curator K. Aaris-Sørensen and collection manager K. Rosenlund implemented an electronic registration system in the late 20th century, formalised in the Quaternary Zoological Central Register (DKC; Det Kvartærzoologiske Centralregister) database.

The collection currently comprises between 10 and 15 million individual specimens including both morphologically distinct and indeterminable bone fragments, which are related to 6481 separate accessions submitted to the collection. Here, we define an accession as an incoming archaeological or geological find or collection that has been given a journal number – referred to as the Z.M.K. (Zoological Museum København; i.e. Copenhagen) number. An accession can include a single find consisting of one specimen or a large find with numerous specimens. From all accessions, some 20 315 individual entries have been determined to species

level or to a higher taxonomic level typically to genus or family and registered together with their respective metadata (Table 1).

The earliest data entry relates to material submitted in 1770, while the most recent entries date to 2022. The collection includes material recovered from archaeological excavations, geological exposures, peat bogs and wetlands, marine contexts, and stray finds from fields and construction activities. Find contexts span from the previous interglacials, including the Cromer-complex, Holstein and Eemian covering up to c. 850 000 year old material through the last Weichselian glaciation into the Holocene and more recent historical times. The material forms the empirical basis for research into faunal history and biodiversity change, human–animal interactions, climate and environmental reconstructions as well as biostratigraphy.

The temporal and spatial development of the Quaternary zoological collection in Denmark from the early 19th century to the present ($N = 6481$) is shown in Fig. 1 and demonstrates a gradual expansion from the scattered early records to the dense nationwide coverage of today. Looking at the annual accumulation of registrations, the modest activity in the 19th century is followed by strong growth in the mid- and late 20th century. Exploration of peat during the Second World War, while Denmark was occupied, increased the accession many fold to the collection. Key methodological and administrative milestones such as systematic accession protocols, Winge's registration system, introduction of journal numbers (Curator Degerbøl) the establishment of the DKC database and later GIS implementation are indicated along the timeline (Fig. 1). Altogether, this timeline highlights how institutional development and research intensity shaped the growth of the collection over more than two centuries.

2 Data registration and structure

To document and manage the collection an electronic database system was developed. The DKC was formalised in the 1990s and originally operated using Paradox 4.5 for DOS. The database consists of two linked tables and associated forms and macros (Tables 2 and 3).

Table 1 Summary of accessions associated with each identification level.

Identification level	No. of records (<i>n</i>)	Share (%)
Species-level binomial (e.g. <i>Capreolus capreolus</i>)	14 726	73.0
Slash taxa – two alternatives (e.g. <i>Capra hircus/Ovis aries</i>)	892	4.4
Uncertain (cf., indet.)	1421	7.0
Genus only	1319	6.5
Higher taxon (family/order level)	1957	9.6
Total	20 315	100.0

indet.: indeterminate.

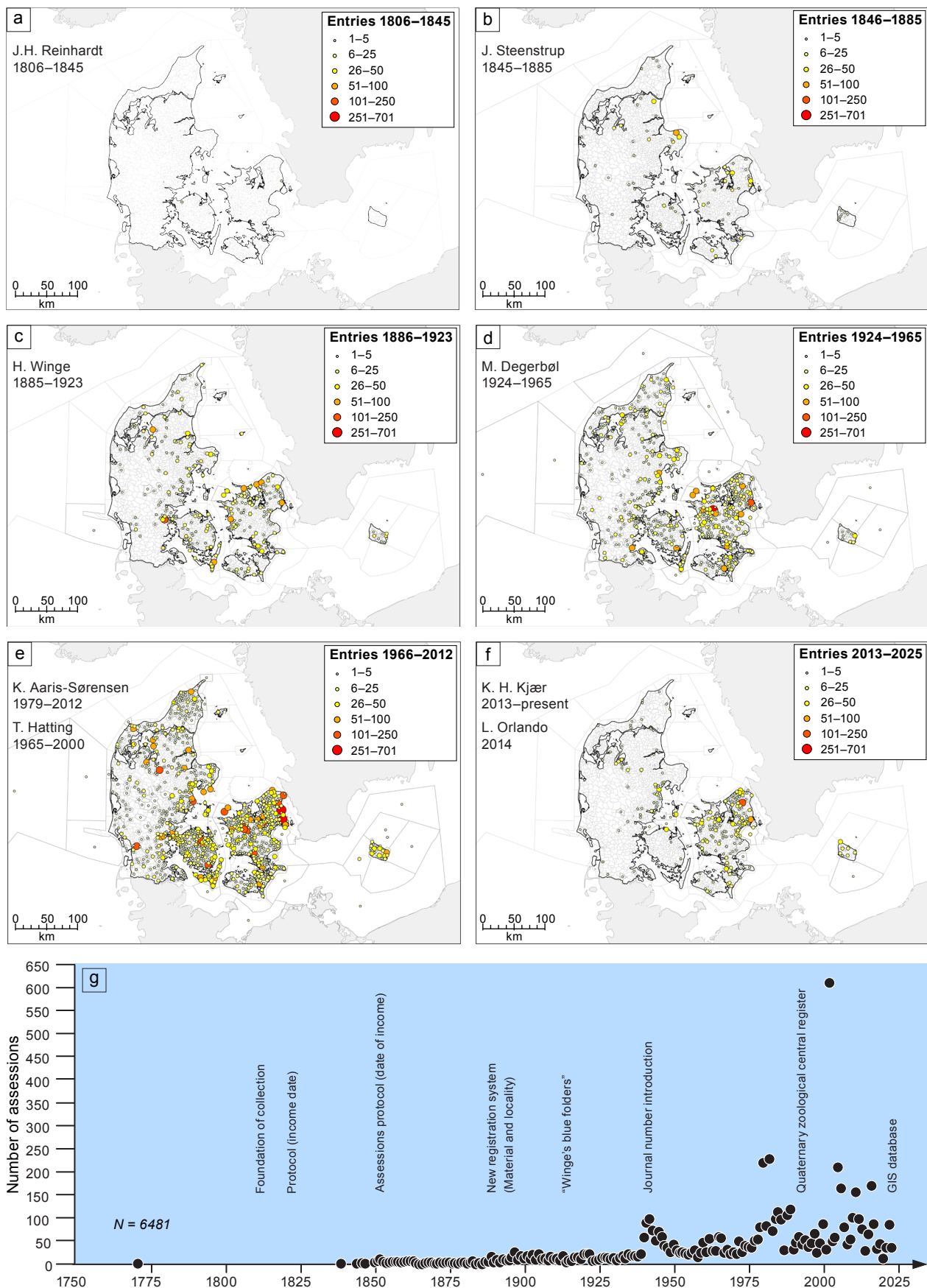


Fig. 1 The temporal and spatial development of the Quaternary zoological collection in Denmark from the early 19th century to the present ($N = 6481$ entries). **Upper panels:** geographical distribution of finds during successive curatorial periods. **Lower panels:** annual accumulation of registrations.

Table 2 Overview of the DKCFUND database containing contextual and administrative metadata.

Field Name	Description
<i>Z.M.K. (Key Field)</i>	Zoological Museum's Quaternary Zoological Collection journal number.
<i>Sort.nr.</i>	Sorting number based on Z.M.K. number, formatted as: Year-Three-digit sequence (e.g. 7/1946 becomes 1946-007).
<i>Fremmed nr.</i>	External journal numbers from other museums. Includes a two-three letter institution code and the journal number.
<i>Lokalitet</i>	Location, using the parish division before April 1, 1970, as in Trap: Denmark (1953–1972).
<i>Sogn</i>	Parish
<i>Herred</i>	District
<i>Amt</i>	County
<i>UTM</i>	UTM coordinates (Z, E, N)
<i>Opbevares</i>	Physical storage location
<i>Indkommet</i>	Date of entry or registration
<i>Udgravet</i>	Excavation year(s)
<i>Fundforhold</i>	Description of find context: A – Archaeological, M – Field or bog (non-archaeological context/geological sediments)
<i>Datering</i>	Dating method: A: Archaeological-cultural. G: Geological-stratigraphic. P: Pollen analysis. C: C-14 dating
<i>Kronozone</i>	Chronozone classification based on Mangerud <i>et al.</i> (1974)
<i>Diverse</i>	Miscellaneous, including publication status, photographs, replicas, and project associations

Z.M.K.: Zoological Museum Copenhagen.

Table 3 An overview of the DKCART database containing taxonomic information.

Field Name	Description
<i>Z.M.K. (Key Field)</i>	Links to the corresponding Z.M.K. entry in the DKCFUND table.
<i>Art</i>	Species identification
<i>Artsnr.</i>	Species number
<i>Bemærkninger</i>	Notes

Art (Species) covers identification to the nearest possible taxonomic level. Blanks in the column ART refer to material that has not been identified or unidentifiable specimens. Z.M.K.: Zoological Museum Copenhagen.

The DKCFUND table (Table 2) contains contextual and administrative metadata for each registered lot. Key fields are in Danish and include *Z.M.K.* (journal number), *Sort.nr.* (year and running number), *Fremmed nr.* (external journal numbers), *Lokalitet* (locality), *Sogn* (Parish), *Herred* (District), *Amt* (county) and *UTM coordinates*, *Opbevares* (storage location), *Indkommet* (registration date), *Udgravet* (excavation year(s)), *Fundforhold* (archaeological or non-archaeological context), *Datering* (dating method), *Kronozone* (chronozone classification following Mangerud *et al.* 1974), and *Diverse* (miscellaneous information).

The DKCART table (Table 3) contains taxonomic identifications linked to each find via the Z.M.K. key field. It includes fields for *Art* (species), *Artsnr.* (species number), and *Bemærkninger* (remarks). This relational structure allows separation of contextual metadata from taxonomic data and supports multi-table queries. Importantly, the data set preserves historical catalogue terminology and therefore requires further taxonomic standardisation before analytical use.

The Holocene subdivisions and their approximate age before present (BP) according to Mangerud *et al.* (1974) and the current International Commission on Stratigraphy (ICS) are compared in Table 4.

3 Data processing

To improve accessibility and interoperability, the original DKC database was extracted to Excel, processed and cleaned, and linked to spatial data in ArcGIS Pro (ESRI n.d.) and QGIS (QGIS n.d.) software. As of 1 September 2025, the processed data set contained 20 315 individual entries, of which 19 607 (96.5%) contained spatial information.

Spatial referencing is based on parish (*Sogn*), district (*Herred*), and county (*Amt*), following the parish-municipality divisions pre-01 April 1970, which provide each of these three levels with a unique place number (in Danish *Stednummer*; Stednummerfortegnelse 1961). These differ from the church parishes (in Danish *kirkesogne*), and thus from here on 'parish' refers to the parish-municipalities. Parish centroid coordinates were extracted in ETRS89/UTM Zone 32N (EPSG:25832) and linked to database entries using Excel's XLOOKUP function. The use of parish ensures that any samples excavated, also those prior to the use of modern geodetic instruments, could systematically be provided with a spatial location or at least an estimate of the origin. As a measure of uncertainty associated with each find location – the centroid of a given parish – the maximum distance from the centroid to the edge of the specific parish is provided in the column '*Max-Dist*'. Standardised naming conventions for localities

Table 4 Chronozones used in the database and relationships with present-day nomenclature.

Chronozones (Mangerud <i>et al.</i> 1974)	Subdivision	Climatic and biostratigraphic subdivision of the Holocene epoch	Formal Subdivision of the Holocene series/epoch (IUGS)	Aligned Approx. Age (yrs BP)
Subatlantic	Late	Subatlantic	Meghalayan	2000–present ^a
Subatlantic	Middle	Subatlantic	Meghalayan	2500–2000
Subatlantic	Early	Subatlantic	Meghalayan	3000–2500
Subboreal	Late	Subboreal	Meghalayan	4200–3000
Subboreal	Middle	Subboreal	Meghalayan	5000–4200
Subboreal	Early	Subboreal	Meghalayan	5700–5000
Atlantic	Late	Atlantic	Northgrippian	7000–5700
Atlantic	Middle	Atlantic	Northgrippian	7600–7000
Atlantic	Early	Atlantic	Northgrippian	8200–7600
Boreal	Late	Boreal	Greenlandian	9200–8200
Boreal	Early	Boreal	Greenlandian	9700–9200
Preboreal	Late	Preboreal	Greenlandian	10 200–9700
Preboreal	Early	Preboreal	Greenlandian	11 700–10 200
Younger Dryas	Late Weichselian	Late Weichselian		12 900–11 700
Bølling-Allerød	Late Weichselian	Late Weichselian		14 700–12 900
Oldest Dryas	Late Weichselian	Late Weichselian		17 000–14 700

a: present refers to 2026. Based on Table 5 from Mangerud *et al.* (1974), proposing finer chronozone subdivisions. Blytt-Sernander classification is refined by Mangerud *et al.* (1974) and Walker *et al.* (2018, 2019). BP: Before present. IUGS: International Union of Geological Sciences.

and museum acronyms ensure consistency across decades of data entry that were preserved during GIS migration. The same applies if individual addresses or geographic coordinates are provided in the original database.

As a quality control measure the location for each entry was assessed and spellings, for example, for parish, district and county names were corrected or streamlined. Where these details were missing entirely, but other spatial information allowed identification of the location, for example, a placename or address, then these details were added. In the absence of specific locality data, these records have been assigned to the Natural History Museum Denmark, more specifically to the former ZM (University of Copenhagen, Denmark), which serves as the reference location in the data set. For easier identification of these entries, they are marked by 'Yes' in the column '*Home_Coord*', while 'No' indicates that the parish location is known. Unknown find locations (i.e. 'Yes' in the '*Home_Coord*' column) comprised 3.5% of the entries in the database at the time of publication.

An example of a possible output resulting from the GIS migration is shown in Fig. 2. The relatively large proportion of entries clustered in central Copenhagen, eastern Denmark, reflects specimens for which precise geographical information was not available at the time of registration. The maps demonstrate both the nationwide coverage of the data set and regional clustering, particularly in eastern Denmark, reflecting excavation intensity and preservation potential of bone material.

The administrative boundaries for Danish archaeological museums cover land and coastal waters – the latter are associated with The Viking Ship Museum (*Vikingskibsmuseet*) in the east and *Marinarkæologi Vest (MAV)* in the west (Fig. 3). For more information on the museums, the user is referred to the Agency for Culture and Palaces website (Slots- og Kulturstyrelsen 2026). In addition to the nationwide online data, we have provided subsets according to each of the administrative boundaries within the database.

4 Dedication to Knud Rosenlund (1946–2024)

This catalogue is dedicated to the memory of Knud Rosenlund (08 March 1946–25 January 2024), whose life and work are inseparably interwoven with the history of the Quaternary Zoological Collections and the DKC. Knud's generosity, intellectual sharpness, and distinctive sense of humour left an enduring mark on colleagues and collaborators alike. Through six decades of dedicated service, he contributed not only to the growth and reputation of the collections, but to the collegial spirit that sustains scholarly work.

Acknowledgements

The authors would like to thank Nils A. Thomsen for assistance with cleaning the GIS migration data. They also thank the two reviewers, Youri van den Hurk and Sofie Folsach Hellerøe, whose comments improved the manuscript.

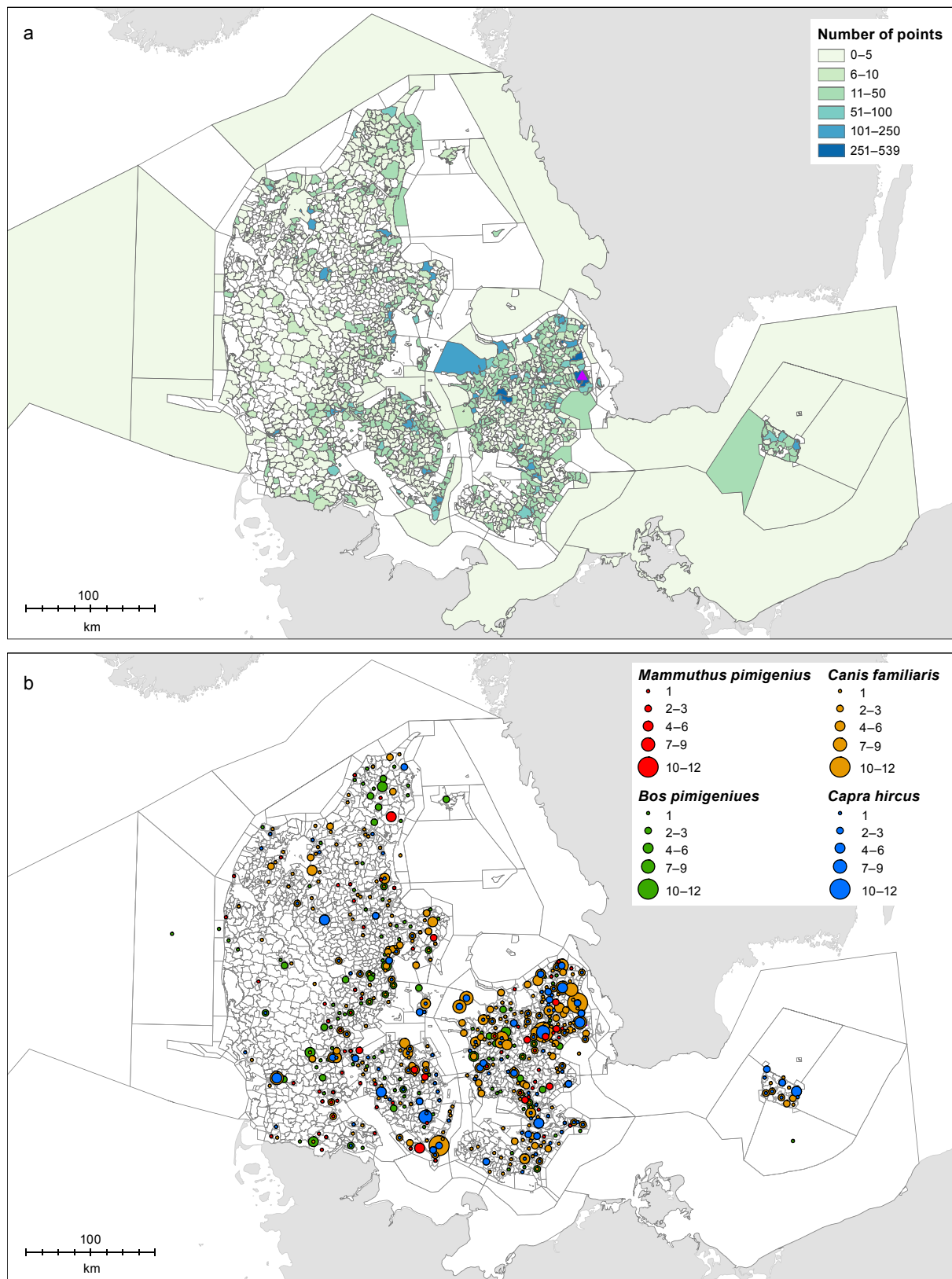


Fig. 2 Spatial distribution of the Quaternary zoological dataset across Denmark. The upper panel shows the total number of registered entries aggregated by parish, displayed as graduated colours representing cumulative counts per parish (ETRS89 / UTM Zone 32N). Darker shades indicate higher concentrations of finds. Purple triangle mark the Zoological museum and depository for the Quaternary zoological collection. The lower four panels present the spatial distribution of selected major taxa groups (e.g. *Bos primigenius* (aurochs); *Canis familiaris* (domestic dog); *Capra hircus* (domestic goat); *Mammuthus primigenius* (woolly mammoth), with proportional red circles illustrating the number of records per locality.

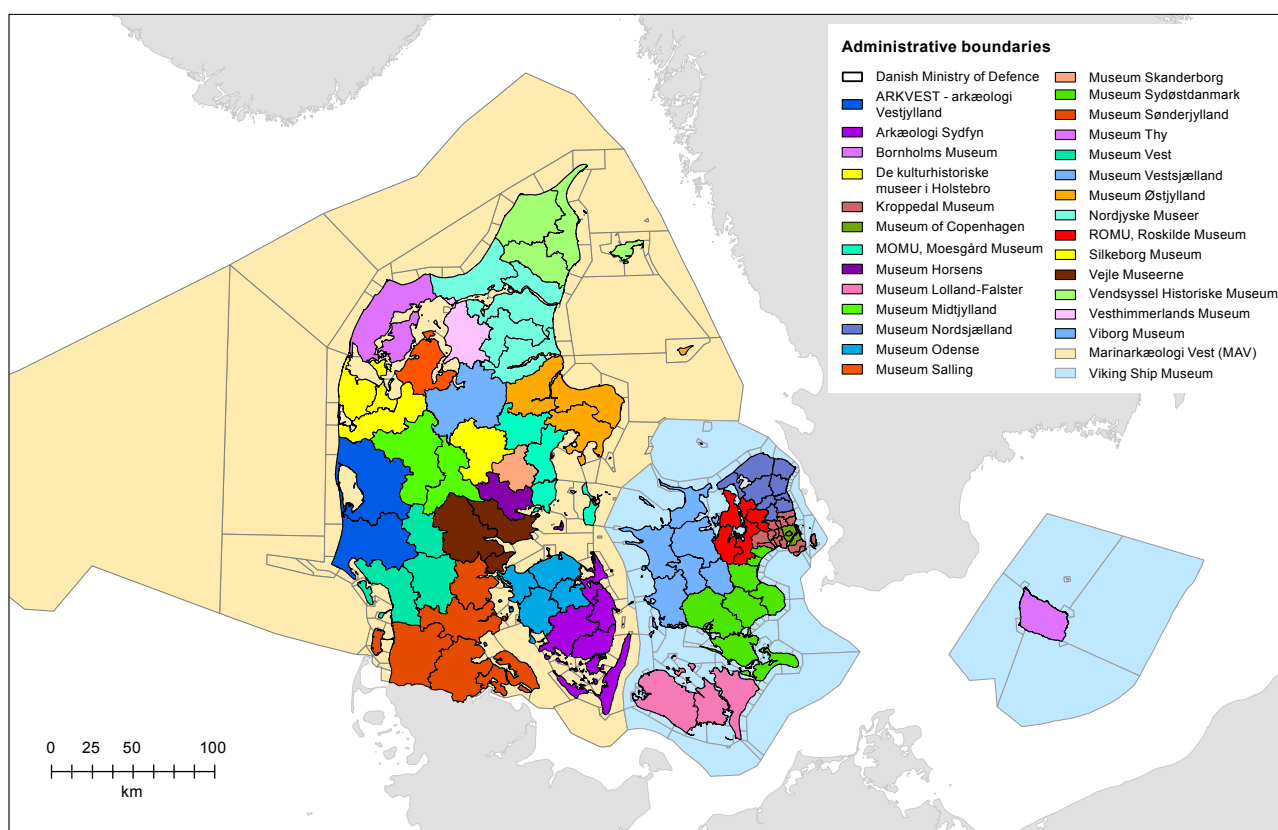


Fig. 3 Administrative boundaries for Danish archaeological museums, including domains covering coastal waters.

Additional information

Funding statement

This study was supported by ArchaeoScience core facility at the Globe Institute.

Authors' contributions

Kurt H. Kjær initiated the study and Kristian K. Kjeldsen designed the GIS migration. All authors contributed to writing, review & editing (critical review of the manuscript; refinement of language and structure; substantive feedback on interpretations; review and input on figures, tables and supplementary materials). All authors approved the final manuscript.

Competing interests

The authors declare that they have no competing interests.

Additional files

The entire data set including a readme-file are available at: <https://doi.org/10.22008/FK2/B7G0PK>

References

- ESRI. n.d.: ArcGIS Pro (all versions). ESRI. <https://www.arcgis.com>. (accessed October 2026).

Kjeldsen, K.K., Aaris-Sørensen, K., Gotfredsen, A.B., Bangsgaard, P., Hansen, K.L., Gregersen, K.M. & Kjær, K.H. 2026: Data for the Rosenslund Catalogue – A GIS database over the Quaternary zoological fauna in Denmark. GEUS Dataverse. V1. <https://doi.org/10.22008/FK2/B7G0PK>

Mangerud, J., Andersen, S.T., Berglund, B.E. & Donner, J.J. 1974: Quaternary stratigraphy of Norden, a proposal for terminology and classification. *Boreas* **3**(3), 109–128. <https://doi.org/10.1111/j.1502-3885.1974.tb00669.x>

QGIS. n.d.: QGIS Geographical Information System (all versions). QGIS Association. <https://www.qgis.org> (accessed October 2026).

Slot- og Kulturstyrelsen. 2026: <https://slks.dk/omraader/kulturarv/arkaeologi-fortidsminder-og-diger/arkaeologi/ansvarsomraader-og-kontakt> (accessed March 2026).

Stednummerfortegnelse. 1961: Nationalmuseet 1. afdeling, Copenhagen: Statens Lokalmuseumstilsyn.

Trap: Danmark. 1953–1972: 5th edition. Copenhagen: G.E.C. Gads Forlag. <https://trap5.lex.dk> (accessed October 2026).

Walker, M. *et al.* 2019: Formal subdivision of the Holocene Series/Epoch – IUGS. Episodes **41**(4), 213–223. <https://doi.org/10.18814/epiiugs/2019/019016>

Walker, M.J.C. *et al.* 2018: Formal subdivision of the Holocene Series/Epoch: A discussion paper by the Subcommittee on Quaternary Stratigraphy (International Commission on Stratigraphy). *Journal of Quaternary Science* **33**(4), 253–263. <https://doi.org/10.1002/jqs.3097>