



5 December 2025

**Computational Historical Ecology –
a novel research programme and its application in
Green Belt research**

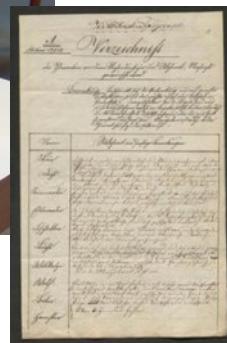
Malte Rehbein, Wolfgang Goederle



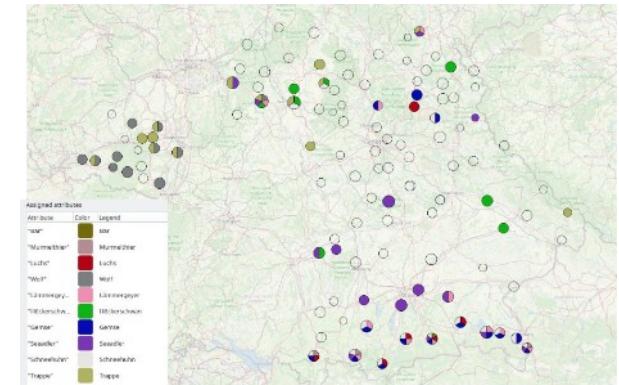
Working definition:
to utilize **computation** to inform the present from the past
about **ecological questions**



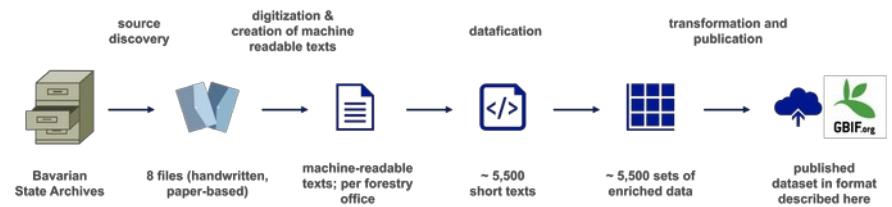
„archives of societies“



ID	OfficeName	District	SpeciesName	BinOccurrence	Date
E_00001	Deggendorf	Niederbayern	Bar	0	1845
E_00002	Deggendorf	Niederbayern	Dachs	1	1845
E_00003	Deggendorf	Niederbayern	Steinmarder	1	1845
E_00004	Deggendorf	Niederbayern	Edelmarder	1	1845
E_00005	Deggendorf	Niederbayern	Fischotter	1	1845
E_00006	Deggendorf	Niederbayern	Luchs	0	1845
E_00007	Deggendorf	Niederbayern	Wildkatze	0	1845
E_00008	Deggendorf	Niederbayern	Wolf	0	1845
E_00009	Deggendorf	Niederbayern	Biber	1	1845
E_00010	Deggendorf	Niederbayern	Hamster	0	1845
E_00011	Deggendorf	Niederbayern	Murmeltier	0	1845
E_00012	Deggendorf	Niederbayern	Wildschwein	0	1845
E_00013	Deggendorf	Niederbayern	Edelhirsch	1	1845
E_00014	Deggendorf	Niederbayern	Damhirsch	0	1845
E_00015	Deggendorf	Niederbayern	Reh	1	1845
E_00016	Deggendorf	Niederbayern	Gämse	0	1845
E_00017	Deggendorf	Niederbayern	Lammergeier	0	1845
E_00018	Deggendorf	Niederbayern	Steinadler	0	1845
E_00019	Deggendorf	Niederbayern	Seeadler	0	1845
E_00020	Deggendorf	Niederbayern	Fischadler	1	1845
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E_00023	Deggendorf	Niederbayern	Alpendohle	1	1845
E_00024	Deggendorf	Niederbayern	Steinkrähe	0	1845
E_00025	Deggendorf	Niederbayern	Nachtigall	0	1845
E_00026	Deggendorf	Niederbayern	Mauerspecht	0	1845
E_00027	Deggendorf	Niederbayern	Auerhuhn	1	1845
E_00028	Deggendorf	Niederbayern	Birkhuhn	0	1845
E_00029	Deggendorf	Niederbayern	Haselhuhn	1	1845
E_00030	Deggendorf	Niederbayern	Schneehuhn	0	1845
E_00031	Deggendorf	Niederbayern	Fasan	1	1845
E_00032	Deggendorf	Niederbayern	Trappe	0	1845



CHE's aim:
to support the process from
historical source to scientific data;
automated and on scale



Die Kenntnis der geographischen Verbreitung des *Phasianus* und Sammeln des Vogels - von wissenschaftlichen Standpunkts aus, gefahr - risch empfohlen, daß die in finanziärer Hinsicht bestreitbaren Umsätze, Litera. St. im B., von verein. Dr. Hoffmanns aufgefüllt werden.

Die unbewohnten Hallen fahrlässig verlassen zu können,
um die Vorlage der aufgefüllten Dynamik möglichst zu befreien.

München am 13. August 1845.

In
die Königliche Bibliothek

S. S. Stimaugan.

Die gewerkschaftliche Verbannung
der Frei- und Fliegenden
in Bayern bestanden. —

Christian Winckel
der Journal-Paketkier.

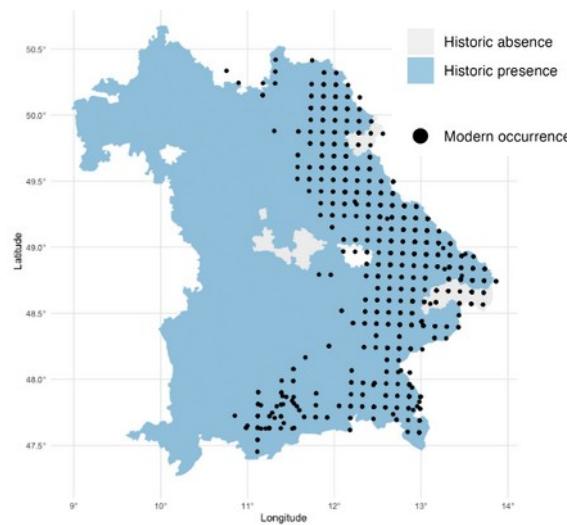
Nicolaus von Kienlin
Verzeichniss

A.
Addition: 12,613.

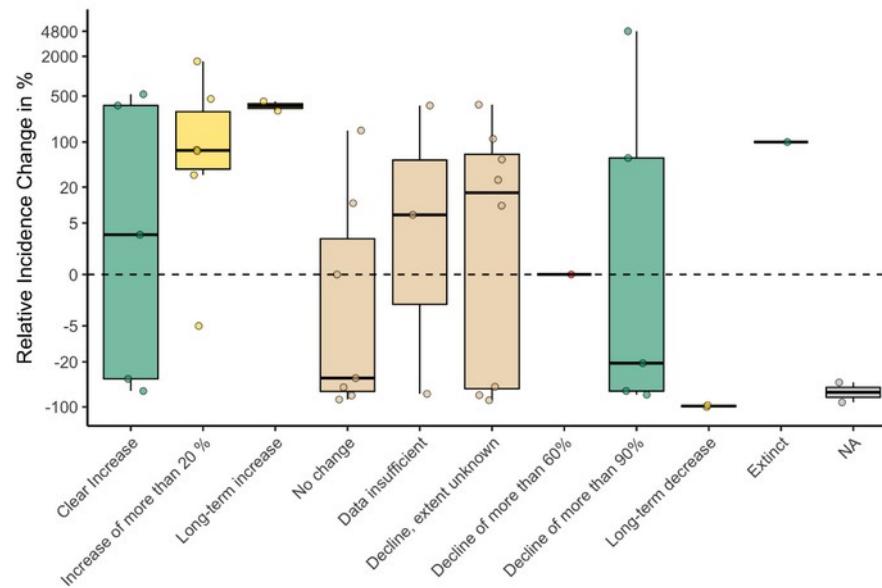
der Ueberreden, von dem Hofkantonsjäger zum Adjunkt, Kriegsamt
gezogen ist.

Sommerzeit. Lassen wir sie. Die Verhinderung muss auf zweierlei
Weise geschehen; es ist vor mir selbst, dass ich Collegen in
Ressorten, die eingetragen sind, und die einzige Lösung ist dies
zu tun, wie ich Ihnen erzähle, welche wir in England sehr häufig
im Winter anwenden, es ist sehr einfach, dass die zwei Parteien
gegenseitig nach dem einen - Bezugshabern ist es auf, es ein
Gesetz, welche es sehr einfach ist. -

Why CHE? The Ecological Dimension



European otter (*Lutra lutra*)

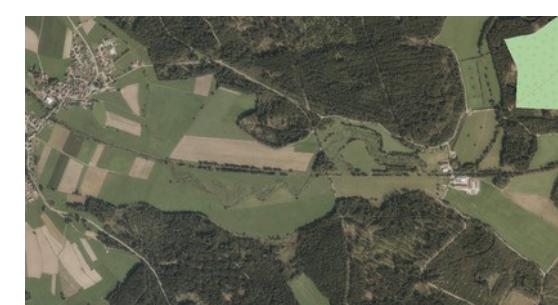


Relative incidence change across long-term trend categories from Red Lists

Ricarda Huter, Where the Wild Things Went: A Historic Comparison of Species Distributions in Bavaria between 1845 and today, Master Thesis, Univ. Jena, superv.: Thore Engel, Aletta Bonn, 2025.



“Since the drainage of the Pfrentschi-weiher (pond), the ducks have become very rare.”



Rehbein, Malte. „From Historical Archives to Algorithms: Reconstructing Biodiversity Patterns in 19th Century Bavaria“. *Diversity* 17, 20265: 315. <https://doi.org/10.3390/d17050315>

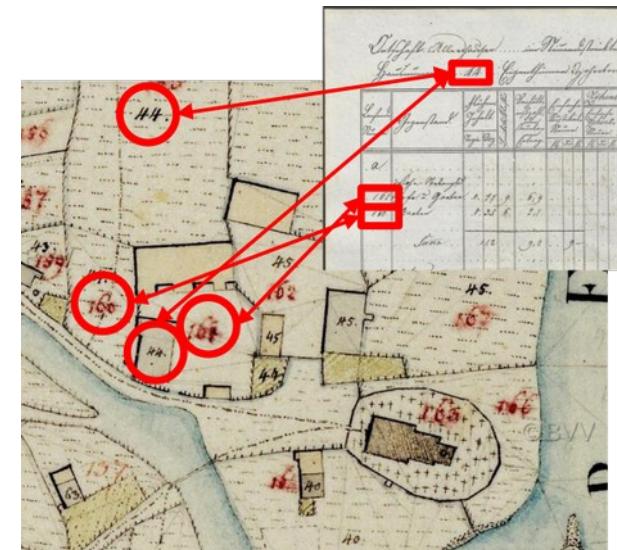
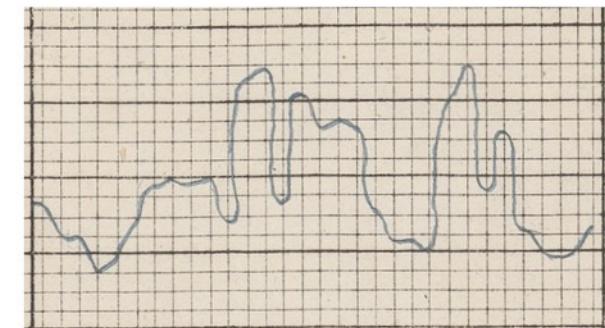
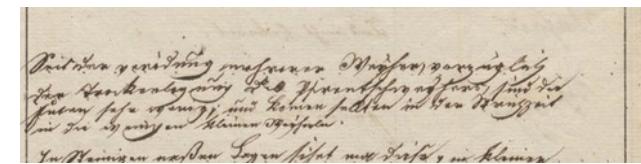
Why CHE: The Historical Science Dimension

Perspectives:

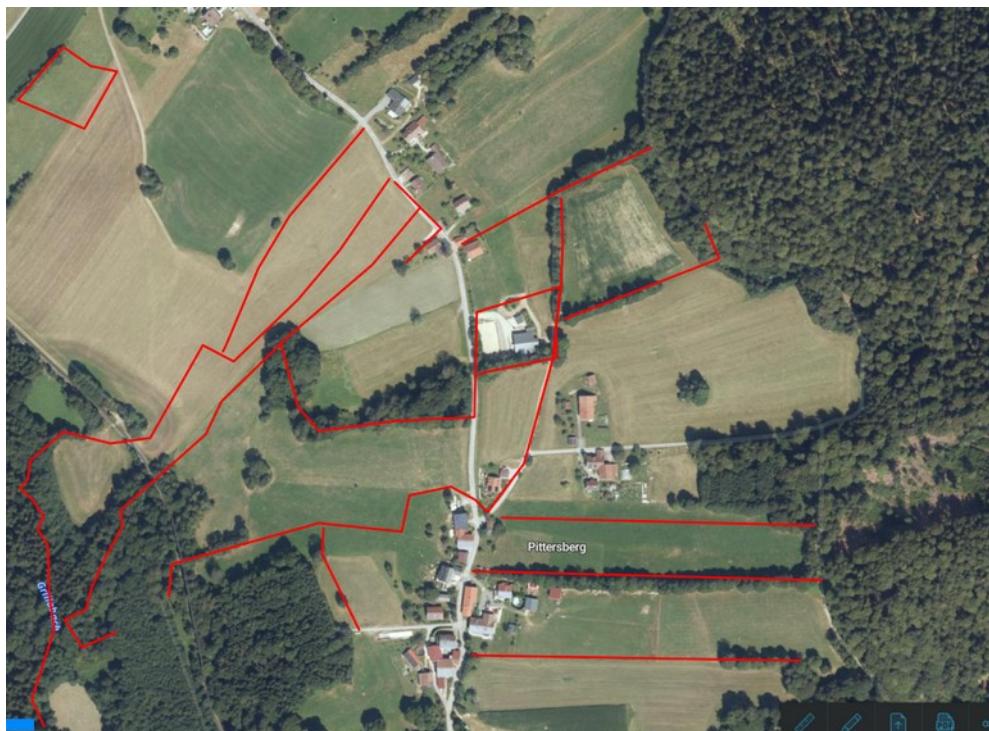
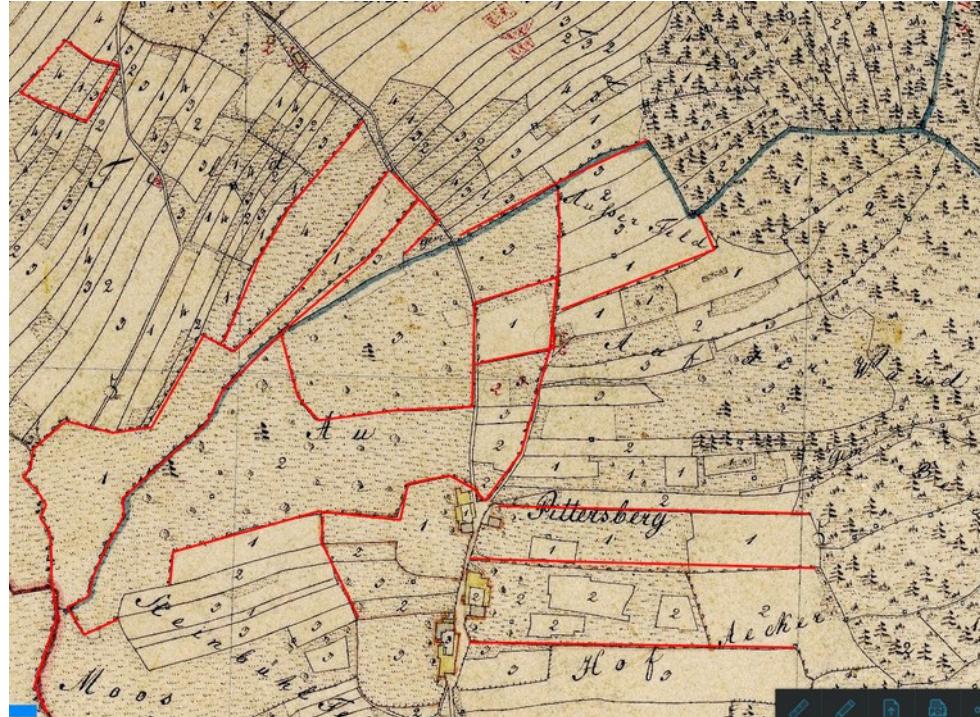
- Bring in the human, human-nature-relation: human agency towards nature; non human agency in history
- Provide historical baselines; fill data gaps; create long time-series

Challenges:

- diverse and complicated old artefacts
- types: prose, maps, imagery, structured (but typed or handwritten data), digital data in formats or on carriers not used anymore, etc.
- difficult to find and to understand: old script, old language, old metrics, ...; shift in meaning, shift in baseline
- often created for a different purpose; tradition: partly systematic, partly accidental
- information/data only indirect; often only proxies for answering questions that we are asking (e.g. day of grape harvest, blossoms for climate)
- often incomplete, error-prone
- record linkage major challenge
- **alignment with modern data challenging**
- all this **requires: source criticism, historical understanding, contextualization, and interpretation**
- **not machine readable**



Land Use (Change) Along the Green Belt



Challenges:

- abundance of sources: „piles of files“
- high complexity

Methods employed:

- semantic filtering, NLP, LLM for Discovery
- digitization
- extraction of raw data -> OCR, HTR, layout detection
- classification / regression
- NLP, LLM: estimation of historical baselines, of attitudes towards nature, of human-nature-interaction from historical prose texts
- computer vision based datafication / vectorization of historical maps
- ...



Quantification of Biodiversity from Historical Survey Text with LLM-based Best-Worst Scaling

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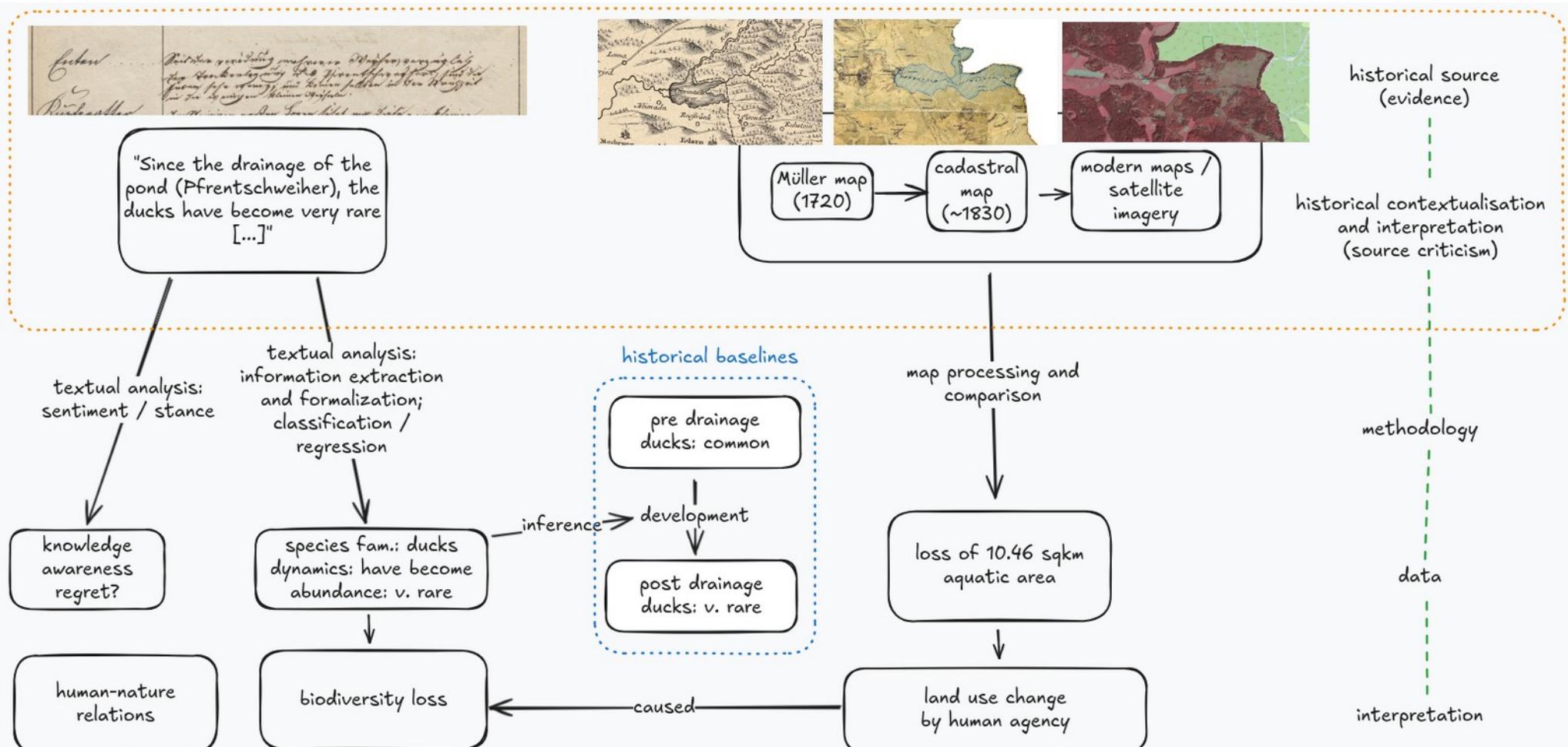
Abstract

In this study, we evaluate methods to determine the frequency of species via quantity estimation from historical survey text. To that end, we formulate classification tasks and finally show that this problem can be adequately framed as a regression task using Best-Worst Scaling (BWS) with Large Language Models (LLMs). We test Minstral-8B, DeepSeek-V3, and GPT-4, finding that the latter two have reasonable agreement with humans and each other. We conclude that this approach is more cost-effective and similarly robust compared to a fine-grained multi-class approach, allowing automated quantity estimation across species.

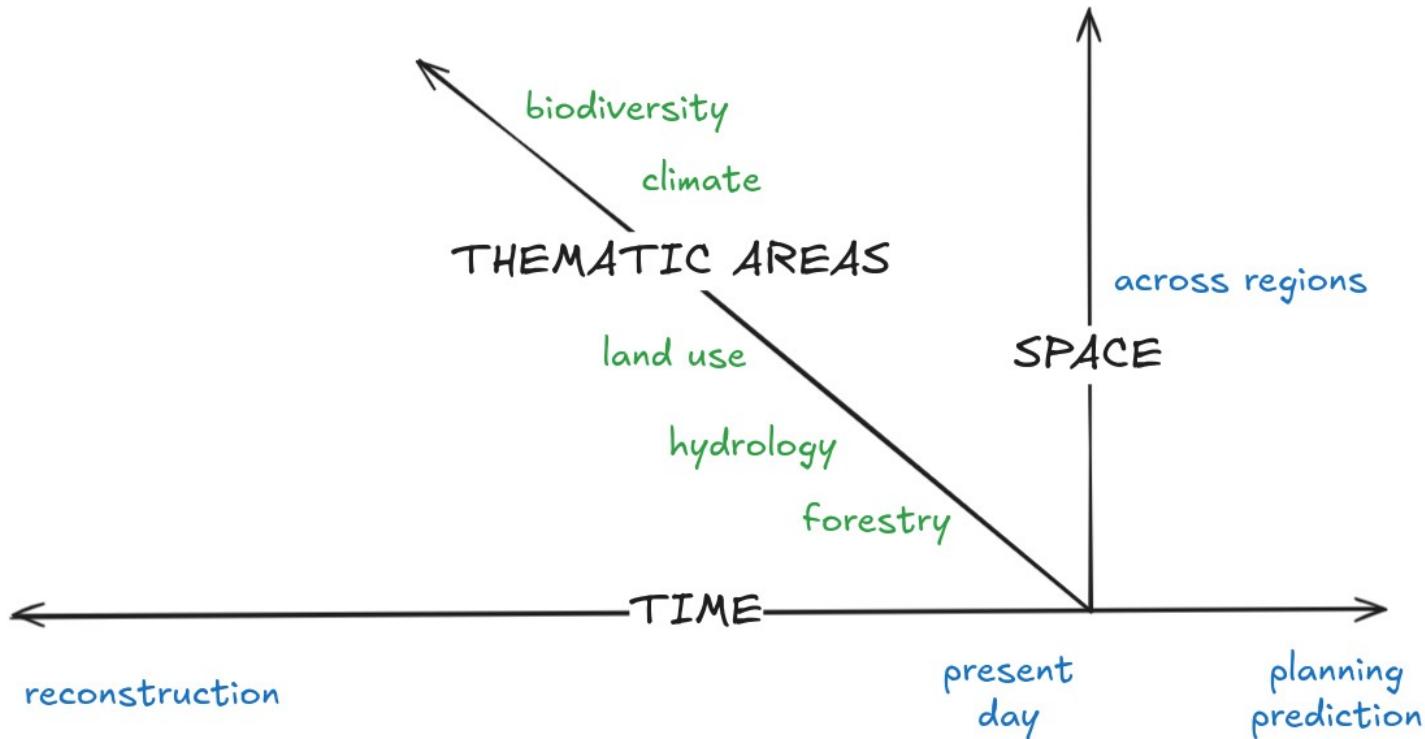
Natural history collections and records from the archives of societies present valuable opportunities to extend data further back in time (Johnson et al., 2011; Brönimann et al., 2018). Such sources are rich, but typically unstructured and require sophisticated extraction tools to produce meaningful quantitative information. Recent advances in NLP have shown promising potential for retrieval-based biodiversity detection from (mostly scientific) literature (Kommneni et al., 2024; Langer et al., 2024; Lücking et al., 2022).

This paper focuses on evaluating methods for biodiversity quantification from semi-structured historical survey texts. To achieve this, we test tasks to distill meaningful metrics from textual information found in survey records. A particular focus lies on the feasibility of Best-Worst Scal-

Conceptual Framework



CHE is a multidisciplinary research agenda to develop generally applicably and scalable computer-supported methodology ("macroscope") for historical ecology



<https://che.hypotheses.org/>