

Historical distribution of managed honeybee colonies (*Apis mellifera*) in 18th-century Spain: A standardized dataset (v1: Cáceres)

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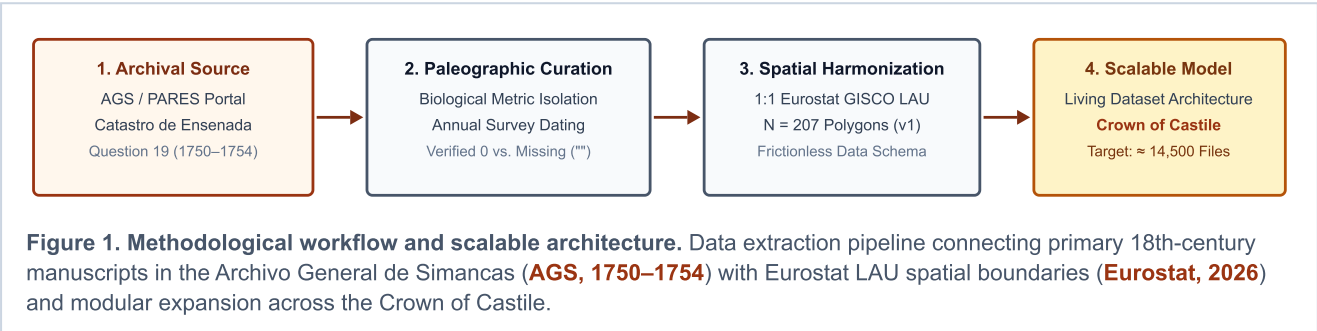
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ABSTRACT

Long-term historical baselines of insect pollinators prior to industrial agriculture remain exceptionally scarce across Europe. Here we present a spatially harmonized, municipality-level dataset of managed honeybee colonies (*Apis mellifera*) in the current province of Cáceres (Extremadura, Spain) between 1750 and 1754 (Rollán-González, 2026). Extracted paleographically from Question 19 of the *Respuestas Generales* of the *Catastro de Ensenada* (AGS, 1750–1754), the dataset covers $N = 207$ Local Administrative Units (Eurostat GISCO_ID / lau_code) and records 165,387 live colonies across 201 validated localities. Critically, this release (v1: Cáceres) serves as a validated proof-of-concept and methodological blueprint engineered to scale modularly across the entire Crown of Castile (approximately 14,500 historical files), providing an open-access resource for historical macroecology and paleoclimatic modeling.

1. BACKGROUND & SUMMARY

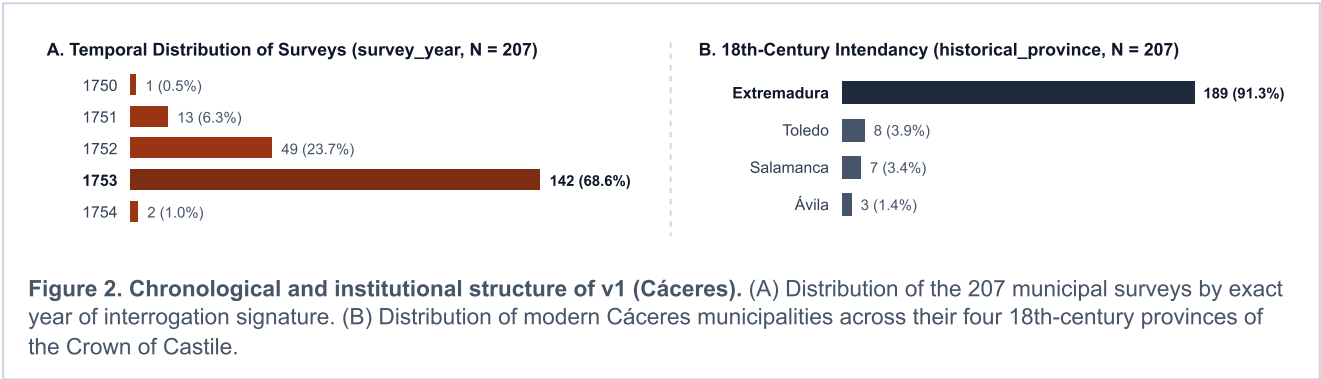
Reconstructing pre-industrial pollinator distributions is essential for understanding long-term agroecosystem resilience, land-use transitions, and insect declines. In mid-18th-century Spain, the fiscal census promoted by the Marquis of Ensenada (*Catastro de Ensenada*, 1750–1754) interrogated every locality of the Crown of Castile under a strict 40-question legal protocol (AGS, 1750–1754). Specifically, Question 19 required local authorities and experts to declare whether managed beehives existed within the municipal territory, their exact physical count, and their ownership. While this archival corpus represents one of the richest pre-industrial biogeographical surveys in Europe, its paleographic complexity and jurisdictional fragmentation have prevented its integration into modern Geographic Information Systems (GIS).



2. METHODS: PALEOGRAPHIC EXTRACTION & SPATIAL CURATION

Primary data collection was executed between May and June 2026 via direct paleographic reading and manual transcription of digitized manuscripts hosted on the *Portal de Archivos Españoles* (PARES) from the *Archivo General de Simancas* (AGS, 1750–1754). To preserve raw archival fidelity while ensuring direct spatial interoperability with modern vector cartography (Eurostat, 2026; IGN, 2026; MAP, 2008), five standardization rules were established:

- 1. Isolation of the primary biological metric (total_hives):** Only the absolute physical count of live managed beehives (recorded regionally as *corchos*, *vasos*, *dijos*, or *trovos*) was extracted, summing both secular and ecclesiastical holdings and discarding monetary valuations or honey/wax yield estimates. Across the 201 municipalities with valid numerical counts in v1 (Cáceres), a total of **165,387 colonies** were recorded (mean = 822.82; SD = 1,774.50; median = 300; interquartile range = 803; min = 0; max = 19,428 in the municipal district of Cáceres).
- 2. 1:1 spatial unification of historical annexes and depopulated settlements (lau_code):** Where a current municipality encompasses historical hamlets (*pedanías*), private estates (*cotos redondos*, *dehesas*), or depopulated villages surveyed in separate 1750–1754 files—such as *Alcántara y su pedanía Estorninos*, *Brozas y Araya*, *Cabañas del Castillo con Retamosa*, *Roturas y Solana*, or *Cañaveral con El Arco y Grimaldo*—their hive counts were summed into the single parent row (`lau_code`). Full historical traceability is preserved by listing all aggregated entities in `historical_name` and concatenating all PARES file signatures in `primary_source_reference`.
- 3. Disaggregation of supra-municipal historical jurisdictions:** Conversely, when a single 18th-century jurisdiction spanned multiple modern municipalities—such as *La Campana de Albalat* (comprising *Casas de Miravete*, *Higuera de Albalat*, and *Romangordo*), the *Concejo de La Mata* (*Millanes*, *Navalmoral de la Mata*, and *Peraleda de la Mata*), or the shared jurisdiction of *Piornal* and *Cabrero*—each current municipality was assigned its specific disaggregated count from the original manuscript while retaining the shared matrix archival reference.
- 4. Annual temporal resolution (survey_year):** The exact calendar year of legal formalization was extracted from the opening folio of each interrogation (1750: 1 entity; 1751: 13; 1752: 49; 1753: 142; 1754: 2), enabling annual alignment with high-resolution paleoclimatic reconstructions such as Palmer Drought Severity Index (PDSI) series or 18th-century thermal anomalies.
- 5. Strict control of verified zeros versus missing values:** Localities where experts explicitly declared the total absence of beehives are coded as 0 (7 municipalities: *Baños de Montemayor*, *La Garganta*, *Gargantilla*, *La Granja*, *Huélaga*, *Santibáñez el Alto*, and *Villasbuenas de Gata*). Where original folios are missing, damaged, or omit numerical counts in Question 19, the cell is left strictly empty (""), 6 municipalities: *Campo Lugar*, *Navas del Madroño*, *Pedroso de Acim*, *Perales del Puerto*, *San Martín de Trevejo*, and *Torrejoncillo*), mathematically separating verified biological absence from missing data.



Repository Architecture & Open Access Files (Rollán-González, 2026): Hosted on Zenodo under a CC BY 4.0 license (Global concept DOI: [10.5281/zenodo.23620650](https://doi.org/10.5281/zenodo.23620650); v1 DOI: [10.5281/zenodo.23620651](https://doi.org/10.5281/zenodo.23620651)). The release comprises three synchronized files: (1) `ROLLAN_Api_Baseline_v1_caceres.csv` (primary tabular matrix, 207 rows × 9 columns, plain-text UTF-8 without BOM, comma-delimited, LF line breaks); (2) `datapackage.json` (and `schema.json` descriptor under the international Frictionless Data specification); and (3) `README.md` (methodological documentation adapted from the Cornell University template).

3. DATA RECORDS & VARIABLE CODEBOOK

Each row in `ROLLAN_Api_Baseline_v1_caceres.csv` represents a unique modern municipality in the province of Cáceres ($N = 207$) linked 1:1 to its Eurostat LAU polygon. Table 1 defines the nine standardized columns governing the dataset:

Variable	Data Type	Description & Value Format	Analytical Function & Usage Notes
<code>id</code>	String	Sequential 7-character alphanumeric identifier (<code>ID00001</code> to <code>ID00207</code>).	Internal primary key: Immutable record identifier preserved across append-only updates.
<code>lau_code</code>	String	Eurostat GISCO Local Administrative Unit code (<code>ES_10001</code> to <code>ES_10219</code> ; <code>ES_</code> + 5-digit INE code).	Spatial join key: Links 1:1 with Eurostat <code>GISCO_ID</code> shapefiles; prefix protects leading zeros.
<code>current_name</code>	String	Official 21st-century municipality name in UTF-8 (e.g., <code>Abadía</code> , <code>Alcántara</code> , <code>Cáceres</code>).	Modern administrative label: Enables rapid lookup and cross-checking with IGN/INE gazetteers.
<code>current_province</code>	String	Modern administrative province name (<code>Cáceres</code> across all 207 rows in v1).	Provincial partitioning filter: Segments records by contemporary province as new versions are added.
<code>historical_name</code>	String	Literal 1750–1754 manuscript toponym, specifying parenthetical disambiguations and unified annexes.	Paleographic & aggregation traceability: Documents merged hamlets or shared historical jurisdictions.
<code>historical_province</code>	String	18th-century Crown of Castile province/intendancy (<code>Extremadura</code> , <code>Toledo</code> , <code>Salamanca</code> , <code>Ávila</code>).	Institutional context: Reflects Old Regime fiscal demarcation and archival book series in AGS.
<code>survey_year</code>	Integer	Exact calendar year of legal interrogation formalization (<code>1750</code> to <code>1754</code>).	Annual temporal alignment: Corrects census asynchrony for annual paleoclimatic cross-analysis.
<code>total_hives</code>	Integer	Total physical count of live managed beehives (Question 19). <code>0</code> = verified absence; <code>""</code> = missing datum.	Primary biological metric: Direct pre-industrial pollinator abundance indicator free of fiscal distortion.
<code>primary_source_reference</code>	String	AGS signature and PARES digitized image range (<code>AGS_CE_RG_L[Book]_[Start]-[End].jpg</code> ; semicolon-separated).	Direct documentary audit: Guarantees full reproducibility against digitized PARES folios.

Encoding of missing values and modern municipal coverage: Missing numerical values in `total_hives` are represented strictly by empty cells (two consecutive commas `,` , without spaces or text strings such as `"NaN"` or `"NULL"`), ensuring seamless ingestion in R, Python/pandas, SQL, QGIS, and ArcGIS. Municipal coverage is limited to the 207 modern municipalities of the province of Cáceres, as defined by the 2011 administrative boundary file (INEC-2011) and the 2011 administrative boundary file (INEC-2011).

4. TECHNICAL VALIDATION & ANALYTICAL LIMITATIONS

To ensure long-term interoperability in macroecological and historical GIS workflows, the dataset underwent strict structural verification alongside an explicit assessment of historical source constraints:

- **Automated structural & topological validation:** Dataset integrity is verified programmatically using the Frictionless Data specification (`datapackage.json` / `schema.json`), enforcing data types, range bounds, and zero-null constraints on spatial keys. Each `lau_code` matches 1:1 with a unique polygon in the official Eurostat LAU boundaries (**Eurostat, 2026**) and IGN gazetteers (**IGN, 2026**), reflecting that the 207 municipalities belonged to four historical provinces in 1750: Extremadura (189), Toledo (8), Salamanca (7), and Ávila (3).
- **Fiscal concealment (lower-bound bias):** Given the fiscal purpose of the *Catastro de Ensenada*, local householders had a structural incentive to under-declare productive assets. Values in `total_hives` must therefore be interpreted analytically as the **guaranteed minimum threshold** of managed colonies per municipality.
- **Geometric boundary approximation & foraging buffer:** While unifying depopulated settlements and historical annexes ensures municipal correspondence, exact parcel boundaries have experienced adjustments since 1750. For macroecological modeling, users are advised to apply spatial smoothing or regular grid aggregation (10×10 km or 50×50 km), noting that the mean foraging radius of *Apis mellifera* (≈ 3 km) biologically buffers minor boundary shifts.
- **Wild colonies & single-coder extraction:** The census records managed fixed apiaries exclusively, excluding wild colonies. Because paleographic reading and neighborhood summations were executed by a single researcher without double-blind replication, a residual risk of human transcription error remains, mitigated by full folio-level PARES indexing in `primary_source_reference`.

5. SCALABILITY TO THE CROWN OF CASTILE ($N \approx 14,500$) & COLLABORATION

Manually transcribing the remaining $\approx 14,500$ local surveys recorded across the Crown of Castile requires a coordinated collective effort. This first release (`v1: cáceres`) acts as the **validated methodological proof-of-concept** for a cumulative *Living Dataset*. Historians, ecologists, university students, and citizen scientists are invited to collaborate by contacting the principal investigator (`info@aimarollan.com` or `aimarollan@gmail.com`) to coordinate the territorial assignment of a historical district or modern province and avoid duplication. Contributors adhering to the standardized 9-column template, the primary-data philosophy, the strict distinction between verified zeros (`0`) and missing values (`""`), and PARES citation formatting will be formally recognized as co-authors under the **CRedit** taxonomy (*Data Curation*) in subsequent cumulative versions (Table 2).

Release Stage	Geographic Scope	Target Units (N)	Validation Status & Governance Protocol
v1 (Current)	Province of Cáceres	$N = 207$ LAU	Validated Proof-of-Concept Model: 165,387 hives; Frictionless Data verified (Rollán-González, 2026).
v2 – v3 (Planned)	Badajoz & Salamanca	Modular append	Regional Expansion: Cross-border historical intendancy completion (Extremadura & Salamanca).
Full Baseline	Crown of Castile	$N \approx 14,500$ files	Crowdsourced Living Dataset: Territorial assignment & CRedit co-authorship in Zenodo (10.5281/zenodo.23620650).

6. DECLARATIONS: AUTHORSHIP, FUNDING, COMPETING INTERESTS & AI USE

AUTHOR CONTRIBUTIONS (CREDIT) Aimar Rollán-González: Conceptualization, Methodology, Investigation, Resources, Data Curation, Formal Analysis, Validation, Project Administration, Writing – original draft, Writing – review & editing.	FUNDING STATEMENT This project was developed autonomously and was entirely self-funded by the principal investigator, without grants, fellowships, or financial support from any external public, commercial, or non-profit agencies or institutions.
COMPETING INTERESTS The author declares no competing financial, institutional, or personal interests (conflict of interest) that could have appeared to influence the empirical curation or publication of this Data Descriptor.	DATA & METADATA AVAILABILITY All primary data (.csv), Frictionless Data validation schemas (.json), and documentation (README.md) are permanently archived on Zenodo under a CC BY 4.0 license (10.5281/zenodo.23620650).

DECLARATION OF GENERATIVE AI AND AI-ASSISTED TECHNOLOGIES IN THE WRITING PROCESS

During the preparation of this manuscript, the author used generative artificial intelligence tools exclusively to assist in translating the methodological documentation from Spanish into academic English and adapting the prose syntax to the formal structure of a scientific Data Descriptor. **No empirical data, colony counts, archival signatures, historical toponyms, or statistical metrics were generated, altered, or hallucinated by AI**; all primary dataset records derive strictly from manual paleographic transcription by the author. After utilizing this linguistic assistance, the author thoroughly reviewed, verified against the primary documentation, and edited the entire manuscript, and assumes full legal and scientific responsibility for the integrity and authorship of the publication.

7. REFERENCES

- Rollán-González, A. (2026). Historical distribution of managed honeybee colonies (*Apis mellifera*) in 18th-century Spain: A standardized dataset (v1: Cáceres) [Data set]. Zenodo. <https://doi.org/10.5281/zenodo.23620651> (Global concept DOI: <https://doi.org/10.5281/zenodo.23620650>).
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