Received: 4 January 2023 | Revised: 18 July 2024 | Accepted: 10 August 2024

DOI: 10.1002/gdj3.272

Geoscience Data Journal | RMetS | WILEY

DATA ARTICLE

The Irish drought impacts database: A 287-year database of drought impacts derived from newspaper archives

Eva Jobbová[1] | **Arlene Crampsie**[2] | **Conor Murphy**[3] | **Francis Ludlow**[1] | **Robert McLeman**[4] | **Csaba Horvath**[3] | **Natascha Seifert**[3] | **Therese Myslinski**[3] | **Laura Sente**[4]

[1]Department of History & Trinity Centre for Environmental Humanities, School of Histories & Humanities, Trinity College, Dublin, Ireland

[2]School of Geography, University College Dublin, Dublin, Ireland

[3]Irish Climate Analysis and Research UnitS (ICARUS), Department of Geography, Maynooth University, Maynooth, Kildare, Ireland

[4]Department of Geography and Environmental Studies, Wilfrid Laurier University, Waterloo, Ontario, Canada

Correspondence
Eva Jobbová, Department of History & Trinity Centre for Environmental Humanities, School of Histories & Humanities, Trinity College, Dublin 2, Ireland.
Email: jobbove@tcd.ie

Funding information
Irish Research Council, Grant/Award Number: COALESCE/2019/43; European Research Council, Grant/Award Number: 951649

Abstract

Understanding of past droughts has been mostly shaped by meteorological data, with relatively less known about the human aspects of droughts, their socio-economic impacts, as well as choices people make in response to droughts in different environmental and socio-political contexts. The lack of data that systematically record and categorize drought impacts is an important reason for this disparity. In this paper, we present an Irish drought impacts database (IDID) containing 6094 newspaper reports and 11,351 individual impact records for the island of Ireland, covering the period 1733–2019. Relevant articles were identified through systematic searching of the Irish Newspaper Archives, and recorded impacts were categorized using a modified version of the classification scheme employed by the European drought impact inventory (EDII). Drawing on the wealth and diversity of content provided by the newspapers, the IDID database provides information on the documented temporal and geographical extent of drought events, their socio-economic and political contexts, their consequences, mitigation strategies employed and their change over time. The IDID also facilitates analysis of long-term patterns in drought incidence, individual impact categories, as well as detailed insight into the impacts of individual drought events over nearly three centuries of Ireland's history. In addition, by allowing an examination of the coherence between meteorological records and identified impacts, it advances our understanding of the influences that contemporary economic, political, environmental and societal events had on the human experience, perception and impact of droughts. This new open-access database, therefore, provides

Dataset details Identifier: https://doi.org/10.5281/zenodo.721612

Creator: Jobbova et al.

Title: Irish Drought Impacts Database v.1.0 (IDID)

Publication year: 2022

(Version): 1

opportunities for improving understanding of drought vulnerability and is an important step in developing greater capacity to cope with and respond to future droughts on the island of Ireland.

KEYWORDS
drought, impact database, Ireland, newspapers

1 | INTRODUCTION

Droughts are complex and often slow-onset hazards that can impact a range of sectors (Dai, 2011). They lack a universal definition, with their perceived incidence dependent upon the scale of departure from regionally varying climatic norms, and with a range of sectoral impacts across different spatial and temporal scales that can also influence their identification (Van Loon, 2015). Droughts in the summer of 2018 and spring of 2020 exposed high levels of vulnerability and unpreparedness in Ireland, particularly in the agricultural and urban water supply sectors (Falzoi et al., 2019; Wilby & Murphy, 2019). Studies have shown that recent decades, in which drought events have been rare, are anomalous and under-represent the frequency of historical droughts in Ireland, prompting some to describe drought as Ireland's 'forgotten hazard' (Murphy et al., 2017; Noone et al., 2017). Better understanding of the socio-economic impacts of past droughts is key to building greater capacity to cope with and respond to future droughts (Bachmair et al., 2016, 2018). However, this task is made challenging by the lack of datasets systematically recording drought impacts for the island.

This challenge is not unique to Ireland. Wilhite et al. (2007) noted that few studies have sought to identify the complexity of drought impacts at local, regional and national scales, and that databases documenting impacts by region or sector are few. One exception of particular note is the initiative by the US National Drought Mitigation Centre (NDMC) to track these impacts through a web-based drought impact reporting (DIR) tool launched in 2005. Moreover, Wilhite and Glantz (1985) called for additional focus on the economic, political and human aspects of drought, beyond assessments focused exclusively on empirical meteorological/hydrological data. Recently, studies have sought to develop drought impact datasets to help unpick the complexity and human impacts of droughts. Most notable have been efforts to create a European drought impact inventory (EDII) (Stahl et al., 2016) which compiled over 5000 reports on the environmental, economic or social impacts of droughts across a variety of sectors, drawing from media, government reports and scientific research, among other sources. EDII provides information on drought location, timing and a description of impacts and response measures. One of the EDII's contributions to research on drought impacts is providing researchers with the resources to develop greater understanding of recent drought impacts and the vulnerability of specific sectors across a range of countries (e.g. Bachmair et al., 2018; Blauhut et al., 2016; Ionita et al., 2017; Sutanto et al., 2020). Other drought impact databases exist for specific regions, including for the Danube watershed (Jakubínský et al., 2019), Alpine regions (Stephan et al., 2021) and Korean Peninsula (Kim et al., 2011; Park et al., 2022).

The aforementioned databases (with the exception of the DIR tool) draw upon newspaper reports from recent decades to identify drought impacts. Newspaper reports provide valuable details about the physical characteristics of drought events (e.g. duration, spatial extent, severity) and their socio-economic, cultural and political impacts (Brázdil et al., 2018). Ireland is fortunate in having some of the world's longest running newspapers, with past issues of more than 100 different newspapers digitized and available through the Irish Newspaper Archives (https://www.irishnewsarchive.com/). Previous studies have leveraged this archive to investigate the socio-economic impacts of specific drought events. For example, Murphy et al. (2017) used newspaper reports to identify the cultural and social impacts of selected drought events from the 19th and 20th centuries, while Noone et al. (2017) used newspaper reports to verify the occurrence of drought events in historical precipitation records (Noone et al., 2016). Murphy et al. (2020) also used newspaper records to examine the impacts of a drought event in 1765. These studies, like those elsewhere (e.g. Dayrell et al. (2022) in the UK and Lee et al. (2019) for Korea), highlight the utility of newspapers as a resource for understanding the socio-economic impacts of droughts.

In this paper, we describe the Irish drought impacts database (IDID). To create the IDID, we systematically searched the Irish Newspaper Archives (see Section 2) and identified more than 6000 drought-related articles published between 1733 and 2019. While newspapers often contained references to drought in other countries, we restrict our analysis to the island of Ireland reports. These were analysed, categorized and summarized using a modified version of the EDII scheme, creating a rich spatial

and temporal account of the socio-economic impacts of drought across the island. It is our hope that this database will assist future interdisciplinary drought research. The remainder of this paper is structured as follows. Section 3 details the methodological framework employed to categorize and develop the database. Section 4 summarizes database access and potential uses of the IDID. Section 5 provides a critical reflection on database limitations, before concluding in Section 6.

2 | THE IRISH NEWSPAPER ARCHIVES

The Irish Newspaper Archives (INA) is a fully searchable online database (https://www.irishnewsarchive.com/) containing the largest extant digital archive of historic Irish newspapers dating from 1733 to present. It is not an exhaustive repository of every Irish newspaper published, but offers a temporally and spatially representative sample of Irish local and national newspapers that continues to evolve as new titles are added. The INA currently consists of over six million pages of newspaper content from over 100 titles. Figure 1 shows the number of titles available *per* year. In the earliest years, there are fewer titles, and these often have a national focus. With time, the combined effects of improved printing technology and rising demand from a more literate population led to a larger and more diverse newspaper range across Ireland (Barnard, 2014). The number of included newspapers reached its long-term average in the late 19th Century rising to a first peak in the 1910s, before declining slightly and remaining relatively stable from the 1930s until the 2010s. The number of included newspapers started to rise again during the last decade, peaking in 2018. In Figure 2, circles with lighter pink shading show the total number of newspapers available *per* county in the INA at the time of our survey, both with local and national coverage, and darker red circles the number of local newspapers, specifically. The spatial distribution of local newspapers – which tend to have the most precise reports about local and regional weather events – varies significantly in the INA. For example, while County Kerry has 17 local newspapers in the INA, other counties, such as Clare, Roscommon and some of the Northern Ireland counties (Antrim, Armagh, Down) have no local newspapers in the INA. National newspapers in the INA provide wider coverage for the Republic of Ireland than for Northern Ireland, with County Dublin having the greatest overall coverage (see Table S1).

3 | DEVELOPING THE IRISH DROUGHT IMPACTS DATABASE

3.1 | Methodological framework

Using the INA's optical character recognition keyword search feature, we trialled a broad selection of keyword combinations to determine the optimal method for identifying drought-related newspaper reports and found that the terms 'drought' and 'droughts' (as opposed to 'dryness', 'dry spell', etc.) proved most effective across all time periods. Searches were run across all titles for a given year and returns were reviewed to discard irrelevant articles (e.g. those referring to the surname 'Drought' or using the term 'drought' metaphorically, such as a sports team's 'drought' in winning matches). Through this strategy, we ultimately identified 6094 articles making explicit reference to weather-based drought. An examination of the initial returns highlighted their potential to establish not only a chronology of drought events but also detailed drought impact information for multiple sectors across the island.

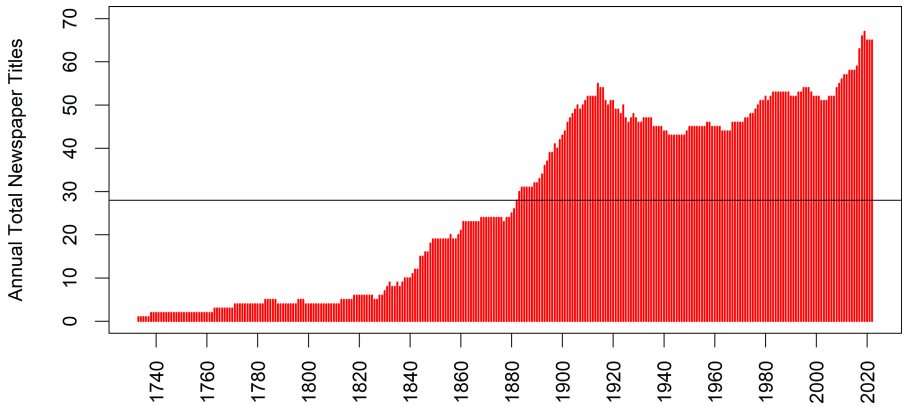

FIGURE 1 Annual number of titles included in the Irish Newspaper Archive 1733–2019 at the time of survey. The black line represents the whole period average.

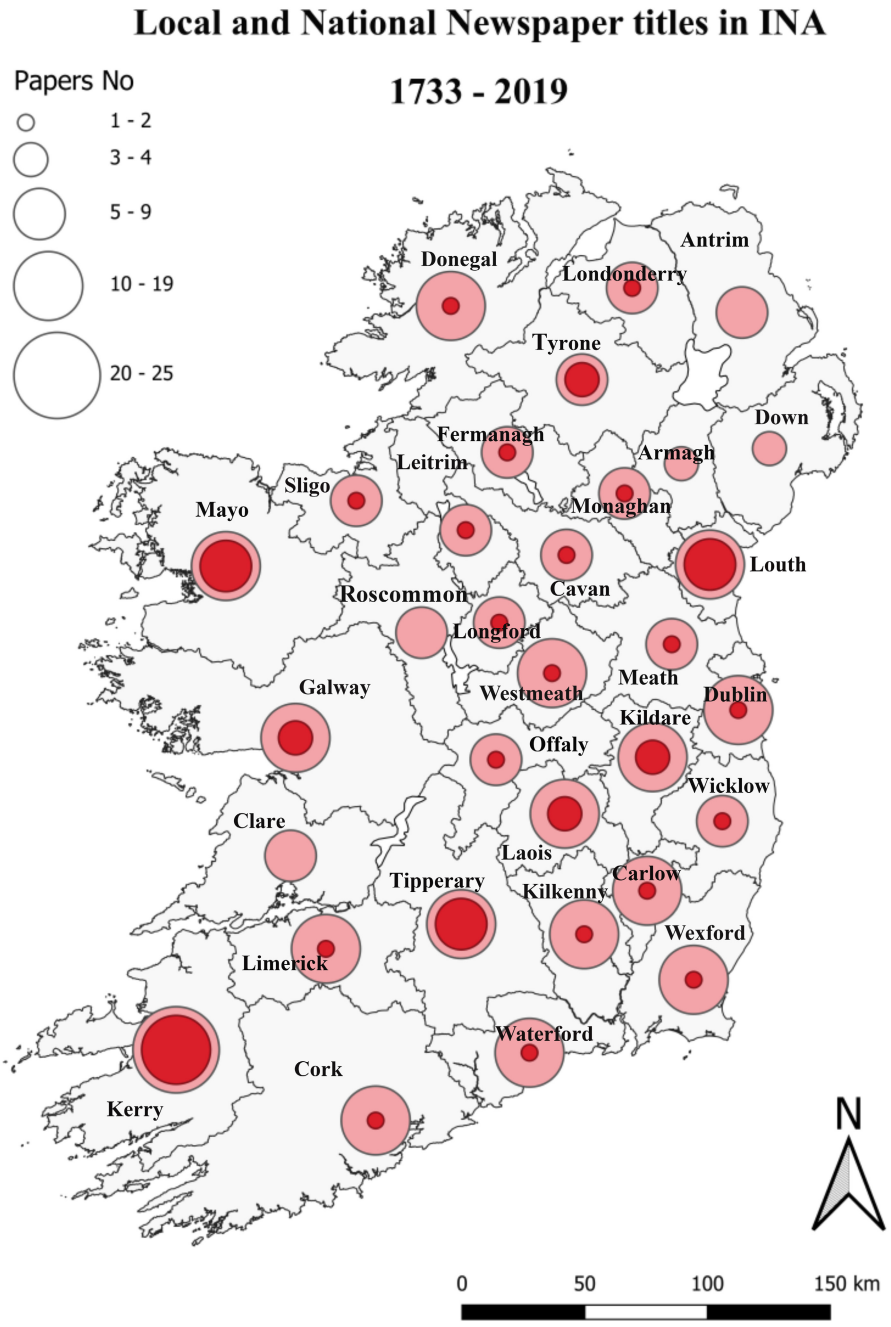

FIGURE 2 Total number of local and national newspaper titles *per* county in the Irish Newspaper Archive 1733–2019 (circles with lighter pink shading), and number of local newspapers *per* county (red circles). The underlying data are provided in Table S1.

To expedite data capture and facilitate sharing, we took the EDII template (Stahl et al., 2012) and adapted it to account for the nature of the newspaper data and the specificities of the Irish context. This included the addition of fields to record granular-level spatial and temporal information, along with a unique referencing system to facilitate future analysis. The resultant database comprises 17 fields as outlined in Table 1, with Figure 3 providing a screenshot of the database as it appears to the user.

Location details were classified according to the Eurostat Nomenclature of Territorial Units for Statistics Level 2 (NUTS2) regions; however, it is worth noting that since 2021, the six counties of Northern Ireland could now be classified as TLN0 under the International Territorial Levels (ITLs) system now in use in the UK. In addition to this, we captured county location. Irish county boundaries have remained largely unchanged through the period of interest and were also, until recently, the administrative unit for the provision of public water supplies. A large amount

TABLE 1 Fields included in the IDID with explanatory notes on field content. Fields unique to the IDID are in italics and adapted EDII fields are underlined. The rest of the fields were adopted from the EDII in their original form.

Field name	Description
ID	Each newspaper report is assigned its own unique numeric ID
Duplicate Reference	Where a newspaper report contains information requiring multiple entries, a duplicate reference is assigned to facilitate analysis (see Section 3.2)
Location 1 (Local)	The most specific local information identifiable from the report – multiple locations can be included provided they are within the same county
Location 2 (*County*)	The county, a report refers to. The county network is widely used in Ireland for data collection as a mid-size spatial entity with clearly defined boundaries
Location 3 (NUTS2)	The NUTS2 region, a report refers to
Information Source	As this database is entirely based on the Irish Newspaper Archive, the source for all is 'Newspaper Article'
Source Reference	The title of the newspaper, the report comes from
Date of Publication	The publication date of the report in the form YYYYMMDD to facilitate sorting and searching
Description	A quote from or summary of the newspaper report
Impact Category	One of the 15 impact categories as defined by EDII
Type of Impact	One of the subcategories or types of impact as defined by EDII
Associated Impacts	Additional impact information related to a drought event including information not covered by EDII and secondary or indirect impacts
Response Measure	Information on response measures included in the report
Timing of Impact	Details of the year and month in which a drought impact occurred (as reported in the information source). Entries are in the format YYYY.MM
Timing of Drought	Details of the year and month when a drought was recorded (as reported in the information source). Entries are in the format YYYY.MM
Duration of Drought	Free text field allowing qualitative and quantitative information about the duration of a drought event to be recorded
Notes	Any additional notes

of place-based information was typically included in each newspaper account, making it impractical to add a row for each unique place name (as *per* the EDII template), and therefore, the 'Location 1 (Local)' field has been adapted to list all places named within an individual county. For temporal details, only timing and duration of the impact are required in the EDII, but we found that additional temporal details could be mined from the newspaper records. These were captured by including fields to note the newspaper publication date (a key referencing aid), and the timing and duration of the drought. Additional relevant information was entered into the 'Notes' field where applicable.

Dropdown menus and help text were created (using Excel macros) to facilitate data input by multiple users and to minimize recording errors. Publication dates were recorded in the format *yyyymmdd*, while other dating fields with less specific information were completed in the format *yyyy.mm*, with these formats used to facilitate searching and sorting. These are detailed in the tab 'Instructions for data input'.

3.2 | Data input

Data were entered in the IDID in chronological order from the earliest to the most recent, and unique identifiers were assigned to each newspaper article. Key indicative content was entered in the description field as either a direct quote or as an adapted summary for longer articles. The remaining fields were completed based upon a careful reading of the data contained in the newspaper reports, which could

ID	Duplicate Reference	Location 1 (Local)	Location 2 (County)	Location 3 (NUTs2)	Information Source	Source Reference	Date of publication (ymd)	Description [quote]
31	a	Malahide; Balbriggan	Dublin	IE06-Eastern and Midland	Newspaper Article	Freemans Journal	17881127	"The astonishing drought of the weather, at this season of the year, is likely to be very injurious to the feed corn in the ground; the earth is so parched, that the wheat cannot spring, and will be in a very weak situation to resist the winter's frosts; manufacturesrs are also very much injured by the want of water; the paper-mills near town are scarcely able to work, and the reservoirs at the different cotton-mills at Mallahide and Balbriggen, are almost dried up, being supplied only from little brooks that cannot exist for any time without rain."
31	a	Malahide; Balbriggan	Dublin	IE06-Eastern and Midland	Newspaper Article	Freemans Journal	17881127	"The astonishing drought of the weather, at this season of the year, is likely to be very injurious to the feed corn in the ground; the earth is so parched, that the wheat cannot spring, and will be in a very weak situation to resist the winter's frosts; manufacturesrs are also very much injured by the want of water; the paper-mills near town are scarcely able to work, and the reservoirs at the different cotton-mills at Mallahide and Balbriggen, are almost dried up, being supplied only from little brooks that cannot exist for any time without rain."

Impact category	Type of Impact	Associated Impacts	Response measure	Timing of impact (Year.Month)	Timing of Drought (Year.Month)	Duration of Drought	Notes
C1_Agriculture and Livestock farming	Reduced productivity of annual crop cultivation, damage to crop quality or crop failure due to dieback, premature ripening, drought induced pest infestations or diseases etc.	wheat cannot spring and might freeze in the ground if winter won't be mild		1788.11	1788.11		
C4_Energy and Industry	Restriction / disruption of industrial production process (due to a lack of process water and/or environmental legislation/restrictions for discharges into streams)	paper and cotton mills barely working for lack of water		1788.11	1788.11		

FIGURE 3 Screenshot of completed entries within the database. This example shows one newspaper article with two different impact categories.

be complex and highly descriptive. A single newspaper article might provide details about drought impacts in multiple locations, as shown by this example:

> The unusually dry spell during the past few weeks has caused anxiety in a number of centres throughout the country, where the drought has resulted in a shortage of water. In North Tipperary there has been considerable drought, and the water has been rationed in Thurles since the middle of last month. The same is true of Co. Carlow. The town supply of Carlow has been reduced to one hour in the morning and one hour in the evening. In Laoighis the drought has been fairly severe, and country people have had to draw water for long distances for days past, while in Portlaoighis, the town supply is cut off during the night. While the Carrick-on-Shannon supply is normal the surrounding country is much in need of water. Even the [River] Shannon is much lower than usual for the time of year.
>
> (Irish Independent, 26th Sept 1952)

We felt it was expedient for searching, coding and analysis purposes to create additional rows for a given

article when it had any of the following: references to multiple impact categories, types of impacts, county locations, months of drought impact and references to different drought events. A simple 'a' through 'e' notation scheme was used in the column adjacent to the reference ID number, labelled as the 'Duplicate Reference' column in Figure 3, to alert the user to the reasons for which a single article occupies multiple rows in the database (see Table 2). For example, the ID number for the above quote from the Irish Independent is 4327 and the record appears on nine separate rows in the database, with notations in the Duplicate Reference column a, b, c and d reflecting the multiple impact categories, types of impacts, counties and months of drought impact contained in the article.

3.3 | Categorizing drought impacts

Drought impacts are categorized according to the EDII template (Stahl et al., 2012), which records negative environmental, economic or social effects of drought and in which the 'Impact Category' is subdivided into 'Type of Impact' (subcategory). Table S2 provides a summary of the 15 impact categories and associated impact types. Where the EDII database did not have an appropriate classification for historically specific impacts (e.g. financial impacts preventing payment of rent and leading to farmers surrendering or being evicted from their properties), these were recorded in the 'Associated Impacts' field. This field also includes supplementary impact details, for example, noting 'mills not working for lack of water' alongside the 'Restriction or disruption of industrial production processes' impact type. Not all impacts aligned neatly with only one category. Where multiple categories could have been selected, decisions were reviewed to ensure consistency and minimize mixed classification throughout the database. Reports detailing the impact of water shortages on flax production offer one such example. These could have been categorized under either the 'Public Water Supply' impact category and 'Local water supply shortage' subcategory; 'Agriculture and Livestock Farming' and 'Lack of irrigation water'; or 'Energy and Industry' and 'Restriction or disruption of industrial production process'. However, as flax production and processing for onward sale was undertaken primarily on farms, we decided to record this as 'Agriculture and Livestock Farming' and 'Other', with additional details being provided in the 'Associated Impacts' column. Reports mentioning droughts but not specifying the impacts were also recorded. While these records are not categorized, they are included in the database, and any relevant details are provided in the 'Associated Impacts' column.

3.4 | Impact location information

Irish local newspapers tend to cater to readerships within well-defined geographic areas. It is, therefore, possible to infer a drought's location even if precise details are absent. Where a report describes a drought event within an unspecified part of the newspaper's catchment area, the Location 1 (Local) field was left as Unclear', but the Location 2 (County) and Location 3 (NUTS2) were completed, reflecting the newspaper's base county. Thus, reports of droughts in the *Monaghan Argus* newspaper were given the locational identification of County Monaghan when there was no more precise information. Where a drought was reported in articles from national or regional newspapers that serve areas larger than a single county,

TABLE 2 Explanation of the duplicate reference field. Each newspaper article is assigned a letter (a through e) to identify why it is being repeated in the database.

Duplicate reference notation	Assigned where multiple ... are mentioned	Further explanation
a	Impact Categories	Where a newspaper article refers to multiple impact categories (based on the 15 categories provided by the EDII), these are recorded on separate rows
b	Types of Impact	The EDII provides a detailed list of subcategories for each impact category. These are referred to as impact types. Where a newspaper article contains details of multiple 'types of impact', these are recorded on separate rows
c	Counties	Where a newspaper article includes information related to impacts in multiple counties (Location 2), these are included in separate rows
d	Months	Where a newspaper article refers to the impacts that are being sustained over a number of months each month is recorded on a separate row (note this applies only to timing of impacts not to timing of drought or its duration)
e	Drought Events	Where a newspaper article makes reference to more than one drought event, each event is recorded on a separate row

but without a specific location reported, then the County and NUTS2 fields were set to 'Unclear'. Where possible, we tried to distinguish between reports claiming a drought was countrywide and those related to specific provinces (e.g. 'Unclear [Munster]'). National and regional newspapers published from Dublin and Cork tend to also report on local events alongside news from other parts of the country, meaning that reports of droughts in those two counties may be overrepresented in the IDID relative to other counties (Figure 4). This should be kept in mind in conducting any island-wide analysis.

3.5 | The timing of droughts and their impacts

Four temporal fields are found in IDID. 'Timing of drought' records the specific start and end dates of drought events where such information is available, while 'Duration of drought' provides a qualitative description where precise dates are not identifiable. 'Timing of impact' refers to the time period in which an identified impact is felt, as distinct from the timing of the drought event as a whole. Impact timings can often lag behind the onset and/or conclusion

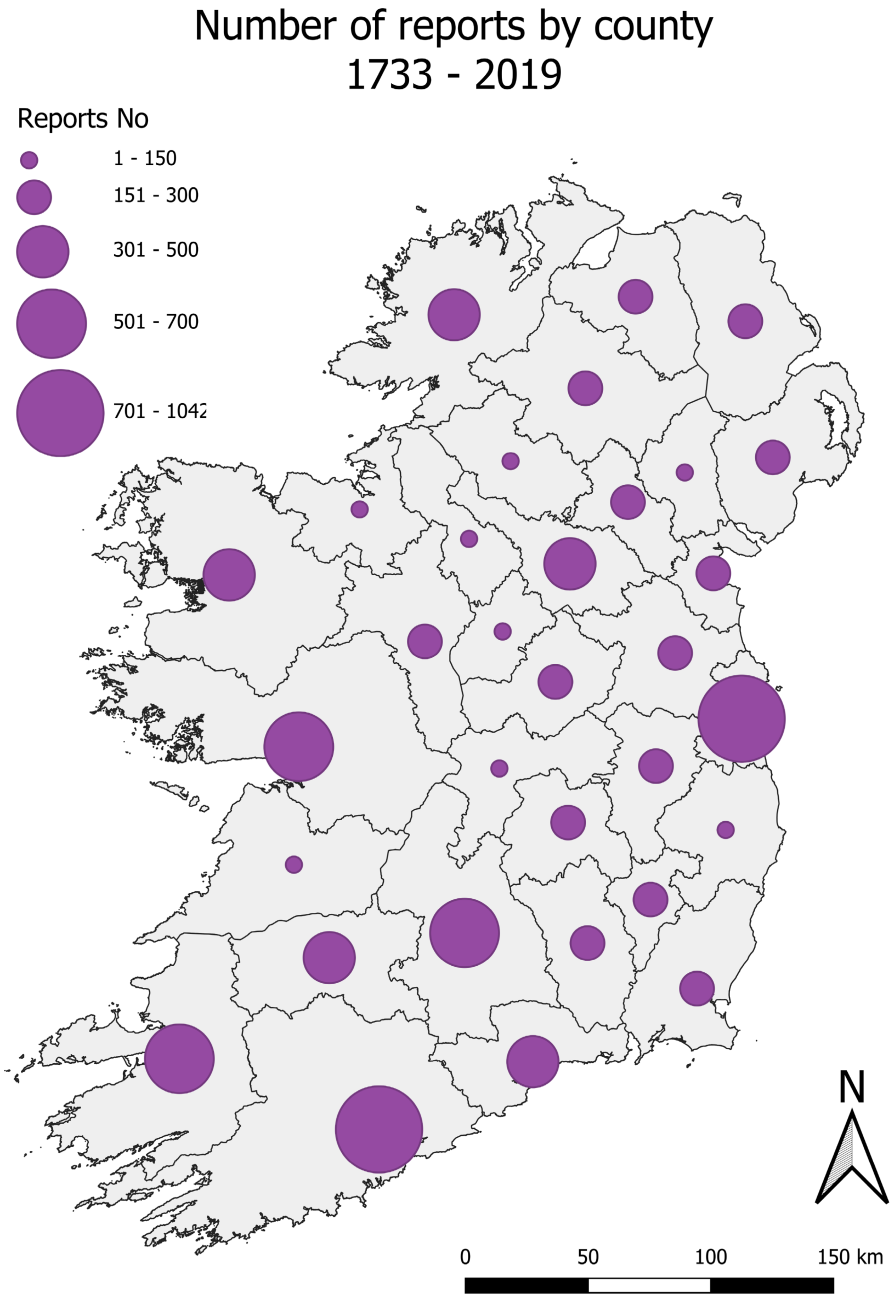

FIGURE 4 Number of drought impacts reported in individual counties. Note that the circle sizes are not on a linear scale. The underlying data are provided in Table S3.

of a drought, such as when a short-lived spring or early summer drought affects harvests, leading to higher commodity prices. 'Date of publication', while acting as a reference point for the newspaper articles, also offers insights into the relative newsworthiness of a drought and/or its impacts. The first newspaper accounts of a drought usually only appear after a longer spell of dry weather raising concerns about potential water shortages and/or agricultural impacts.

These temporal data were extracted from INA through detailed analysis of the language and structure in each newspaper article and required interpretation of often ambiguous descriptions such as 'owing to the great continuous drought which is prevailing' or '... the long drought has been felt considerably on the meadows'. When an article referred to an ongoing drought or drought impact, the timing was recorded using the month the article was published, except when a report was published at the start of a month and referred to a continuous drought, 'recent drought' or stated that, 'impacts are felt from the recent drought'. In these instances, the previous month is used to define the timings. This was not applied to obviously immediate impacts, for example, poor prices achieved at a fair on a specified day at the start of the month. To facilitate temporal data analysis of drought impacts, in cases where an impact was noted as taking place over several months, each month has been recorded in a separate row in the 'Timing of impact' field. 'Timing of drought', however, is recorded on a single row as a date range (e.g. 1893.05–1893.07) and will require separate manipulation before further analysis.

4 | DATASET ACCESS AND UTILITY

4.1 | Access

The IDID Version 1.0 is freely accessible as an Excel Macro-Enabled Workbook file (xlsm) from Zenodo open data repository (CERN) – https://doi.org/10.5281/zenodo.7216126; Creators: Jobbova et al., 2022. Any future updates will be reflected in the version number.

4.2 | Understanding temporal variability in drought impacts

The database allows for a general examination of the impacts of droughts in Ireland's history as well as for discerning patterns in individual impact categories and their change over time. Although some variation through time (independent of total source numbers) in the internal consistency of newspaper reporting can be expected and is an important consideration when interpreting trends based upon historical reporting (Ludlow, 2012), the volume and relative stability of the number of published newspapers (particularly post-1900, indicated by the red lines in Figure 5) is likely to make the identification of key drought impacts through IDID generally robust.

Figure 5 plots the annual number of impact reports for selected impact categories over the period 1733 to 2019. Agriculture and Livestock (category C1) is the most frequently reported impact category, followed by Public Water Supply (C7). Impacts on Freshwater Ecosystems (C9), Aquaculture and Fisheries (C3) and Terrestrial Ecosystems (C10) are also frequently reported. Notable temporal trends are evident. There is a decreasing trend in the number of reports for Agriculture and Livestock over time, perhaps associated with increased mechanization of agriculture and other changes that lessened drought vulnerability in this sector; however, the decreasing newsworthiness of agriculture is likely also a factor. By contrast, public water supply impacts increase over the same period partially linked to the development of a formal public water supply infrastructure. Temporal variability in individual impact categories may also reflect changing societal perception and vulnerability to drought impacts. For example, reports of impacts under the categories of Tourism and Recreation, Soil System, Forestry and Wildfires have grown over recent decades. Further research into changes in drought perception and vulnerability in Ireland can help to explain the changing nature of the IDID drought impact data by placing it in its historical and social context.

4.3 | Understanding the spatial variability of drought impacts

The detailed location information provided by the IDID can facilitate exploration of the spatial distribution of impacts across the island. As an example, the location (by county) of reports for the top four impact categories are mapped in Figure 6. It is clear that drought impacts vary spatially by biophysical conditions such as topography, soils, land cover, moisture availability and poor access to water. Agriculture and livestock impacts tend to be most frequently reported in the east and south of the island (Munster and Leinster regions), which are generally associated with well-drained soils and a higher proportion of arable land than the midlands, west and northwest. Public Water Supply impacts tend to be most dominant for major urban centres which rely heavily on surface water resources for potable supplies. Notable

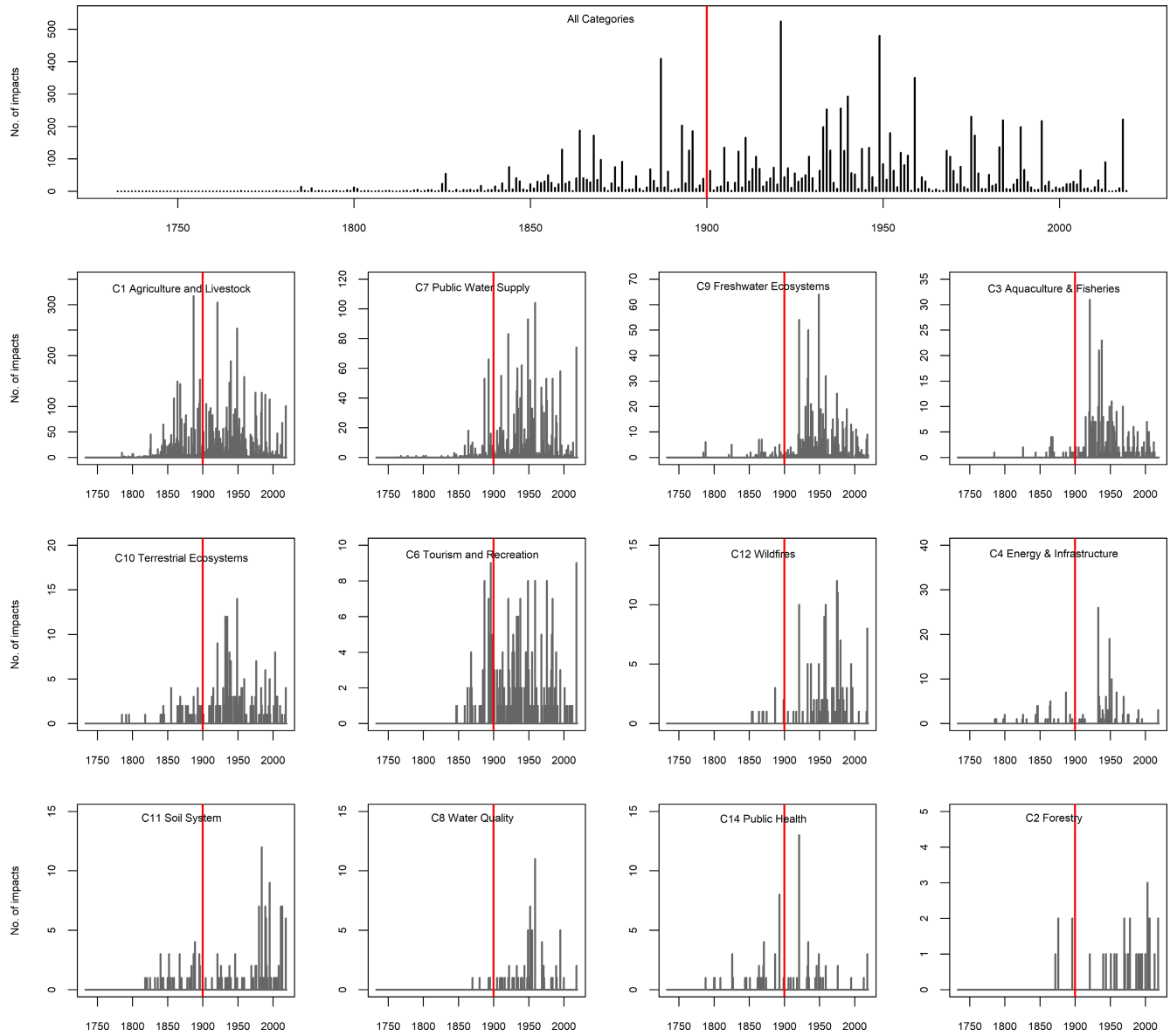

FIGURE 5 Number of impacts recorded *per* year for all drought impact categories in the IDID database for 1733–2019 (top wide panel), together with annual reports for specific impact categories (succeeding panels). The vertical red line indicates the transition to a more stable number of titles in the Irish Newspaper Archive post-1900 (see Figure 1).

are the high instances of reporting for Dublin, Cork, Limerick and Galway. Also of interest is the large number of public water supply impacts in the northwest, which generally has less permeable soils and poorly productive aquifers, making public water supplies heavily dependent on surface water resources. This contrasts with the midlands, where public water supplies make greater use of groundwater, and where the frequency of reporting in this impact category is consequently lower. Freshwater Aquaculture and Fisheries impacts tend to be most dominant in coastal counties in western and northern locations, which are synonymous with Atlantic salmon fishing, while Freshwater Ecosystem Impacts are reported across the island.

4.4 | Impacts of individual drought events

Previous studies of drought impacts in Ireland and elsewhere are often based heavily on meteorological data. While useful for identifying deficits and evaluating drought characteristics, meteorological data are not necessarily informative for understanding impacts on society, the economy and environment (Bachmair et al., 2016), with many studies highlighting the challenges and complexities of linking drought metrics and impacts (e.g. Van Loon, 2015). The IDID offers new opportunities to (i) link drought impacts and metrics; (ii) characterize drought events by their impacts; (iii) examine the coherence between rainfall

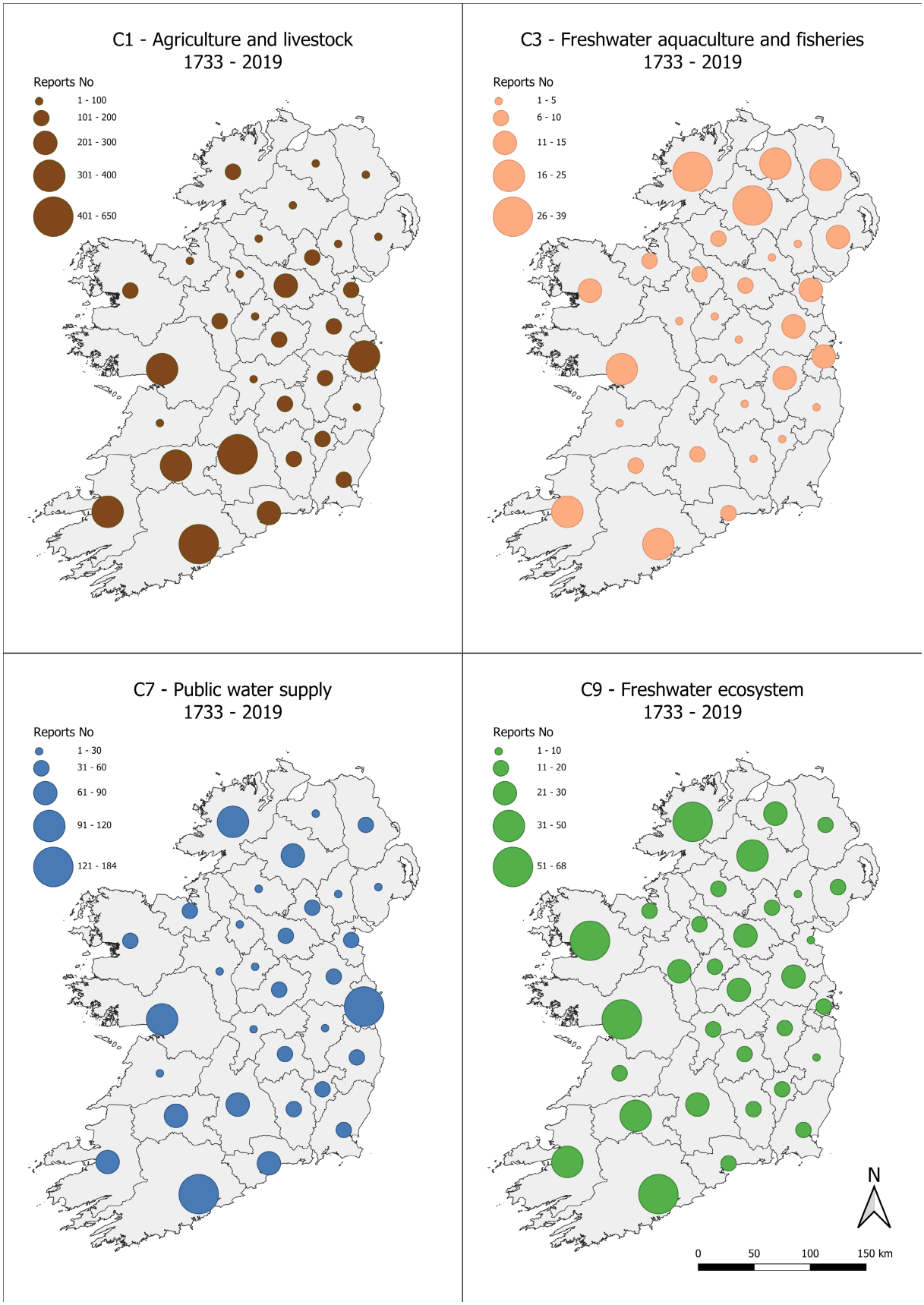

FIGURE 6 Spatial distribution of reported impacts for the four most frequent impact categories in the IDID over the period 1733–2019. Circle size represents the number of impacts in each category for individual counties. Note that the circle size varies for each impact depending on the number of reports. Counties without circles have no relevant data. The underlying data are provided in Table S3.

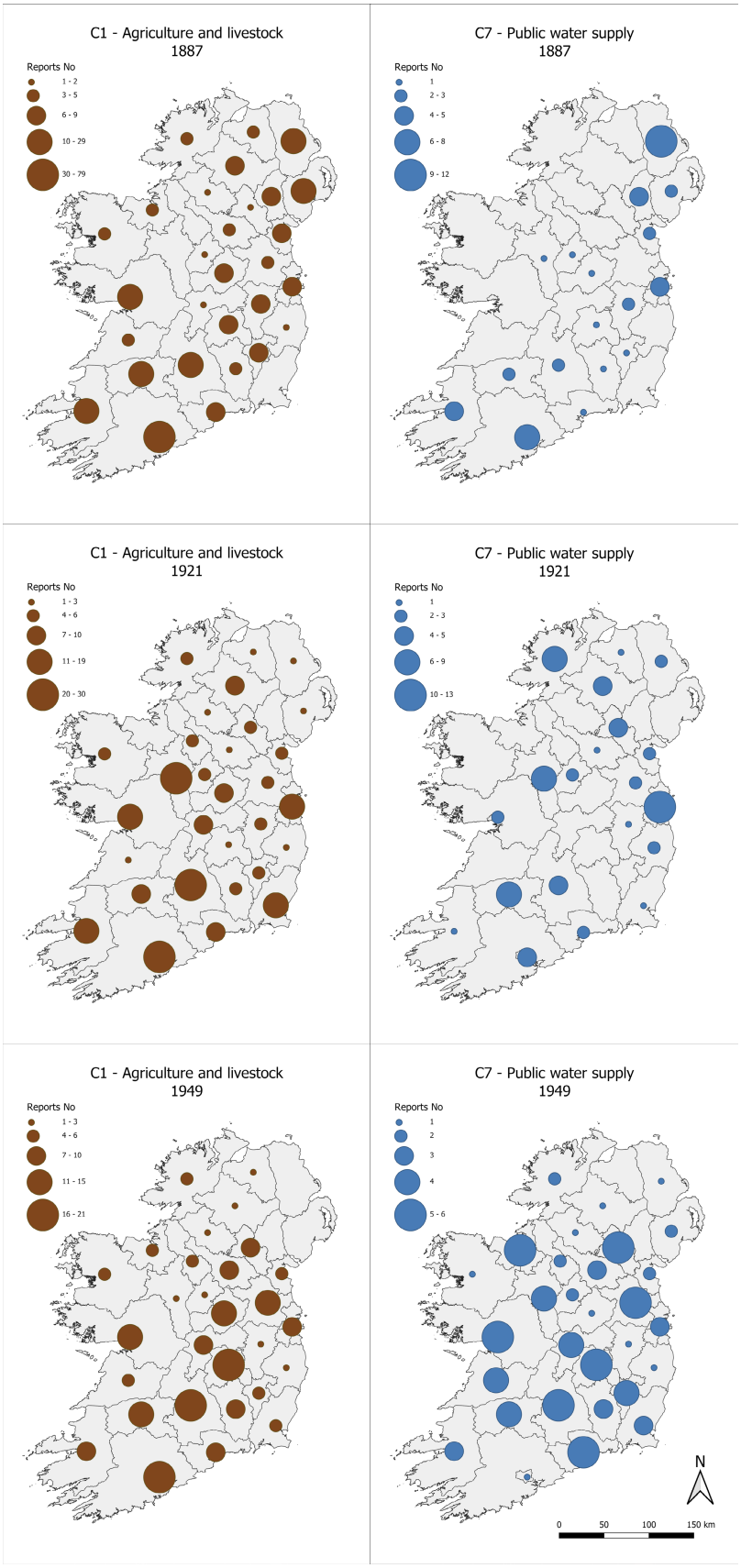

FIGURE 7 Most frequent impact categories in drought events with the highest number of reports of impacts recorded for the period 1733–2019 (1887, 1921 and 1949). Note that the circle size varies for each impact depending on the number of reports. Counties without circles have no relevant data. The underlying data are provided in Table S4.

deficits and identified impacts and (iv) to identify events for which impacts have been greater (or lesser) than might be expected from meteorological records alone.

As an example, we identify the three most impactful drought years in the IDID as 1887, 1921 and 1949. Figure 7 maps the spatial distribution of the two most

frequently cited impact categories (Agriculture and Livestock and Public Water Supply) for each of these years. Both 1887 and 1921 already feature prominently as major drought events in previous assessments of historical drought in Ireland (Murphy et al., 2020; Noone et al., 2017). Drought in 1887 has been identified as one of the most intense events over the past 150 years in Ireland (Noone et al., 2017), resulting in widespread crop failure. This event, which commenced in spring and reached its pinnacle in the summer of 1887, was most extreme in the east and south of the country (Barrington, 1888). Figure 7 shows that the distribution of reported impacts closely matches the spatial distribution of precipitation deficits, with impacts for both agriculture and water supplies being most abundant south of a line running from Belfast to Kerry, contiguous with the most extreme precipitation deficits noted by Barrington (1888). By comparison with agricultural impacts, water supply pressures in 1887 were not as significant, with impacts mostly reported for Cork, Dublin and for the linen industry in the northeast, which was reliant on hydropower from surface water resources. The fingerprint of drought impacts in 1921 is more widespread. Noone et al. (2017) note this event as beginning in the west and midlands in spring, and extending to all parts of the island by summer 1921. This is borne out by the IDID reports at the time, with widespread reporting of agricultural and livestock impacts across the country (Figure 7). The long duration of the 1921 drought resulted in widespread water restrictions with many counties, especially Dublin, reporting concerns about water provision.

While 1949 ranks in the top 3 years for impacts in the IDID, it does not appear in the top 10 most extreme drought events in previous assessments, pointing to the need to understand why impacts were so severe for this event. Figure 7 indicates that agriculture and livestock impacts were greatest in the east and southeast, while public water supply impacts were widely reported across the island. Reports from the IDID indicate that conditions were already dry by April 1949, with frosts persisting until the end of May. In June little rainfall was recorded and by the end of June, serious water shortages were reported in multiple counties, with water cuts and rationing in place by July in Waterford, Meath, Laois, Offaly, Kilkenny, Wexford, Louth and Tipperary. While rain was reported later in July, it did little to help water shortages in some places with rationing continuing. Crops were affected, and news articles reported increases in the price of vegetables, deficiency in milk production and reports of low fish catches and fish kills in large numbers. The disparity between meteorological records and impacts highlights a key potential value of the IDID in advancing understanding of socio-economic impacts to identify and understand drought events that have had larger impacts than might have been expected, given the meteorological or hydrological severity of the event, opening opportunities for better understanding drought vulnerability.

4.5 | Anatomy of drought events and adaptive responses

A key strength of the IDID is the detailed information that can be extracted for individual drought events. Taking the 1893 drought, one of the more impactful droughts in the 1800s, as a case study, the database contains 176 unique newspaper articles and 214 individual impact records across the island (see Table S5). In addition to aiding understanding of key impacts in different regions, such detail allows an evaluation of the progression from drought onset to impacts, often a challenging aspect of drought to determine. For the 1893 drought, there is an evident gap between the commencement of drought conditions, described as 'a lack of precipitation', and reporting of impacts (Figure 8). Thus, while reports retrospectively highlight a lack of precipitation from the beginning of March, articles mentioning the drought and its impacts only start to appear towards the end of April and beginning of May (e.g. 'The long drought, which has lasted, with scarcely a break, for fifty-eight days, has not yet shown any sign of giving way' *Evening Herald*, 29 April 1893; 'Owing to the great drought the water in all the Kerry rivers, and the Lakes of Killarney, is far below the average at this time of the year. Some parts of the rivers are almost dried up' *Evening Herald*, 6 May 1893).

In addition, droughts and/or their impacts can be recorded weeks or months after the end of the drought event. Impacts of the 1893 drought were reported in June 1894 ('The price of store stock continues to harden in consequence of the number slaughtered last year before they were properly fattened owing to the drought' *Kerry Weekly Reporter*, 9 June 1894). Furthermore, drought events with serious consequences imprint a cultural memory for long periods and are often recalled during later drought events. For example, an article from 1894 refers back to a drought in 1826. 'The season 1893 was like that of the famous 1826.... Of that distant period of scarcity in food for stock it was said: "there was no hay made, and none wanted! That is to say, the hayricks were very small, but they sufficed for the greatly reduced requirements of the succeeding winter"' *Ballinrobe Chronicle*, 14 July 1894. These cases have been captured and detailed in the IDID as separate impacts.

The IDID can also facilitate an understanding of adaptive responses to specific droughts and how these

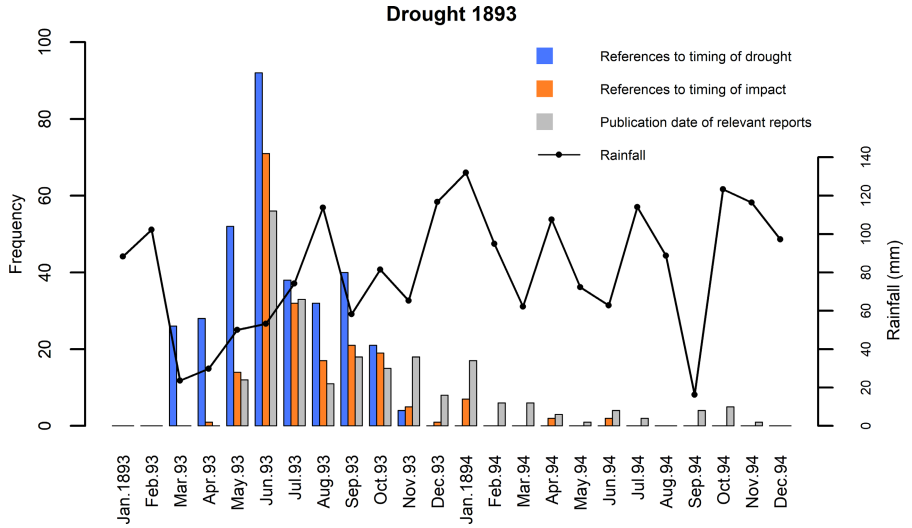

FIGURE 8 The bars represent number of reports referencing the 1893 drought in the IDID by date of article publication (grey bars), with the number of references to the timing (blue bars) and impacts (orange bars) of the drought as discerned from the details in these reports. The black line represents the monthly precipitation values derived using available stations from the island of Ireland Precipitation Network (Noone et al., 2017). This case exemplifies the complexity of the reporting of droughts and their impacts. Reports begin only several weeks or even months into the drought, coinciding with the first notable increase in the timing of impact references in May 1893, and they continue long after drought termination. The multiple references to the onset of drought conditions in March 1893, therefore, derive from reports printed in articles at least two (and in some cases many more) months later as the duration, intensity and impacts of the drought rendered it increasingly newsworthy.

have changed over time. For 1893, mitigation strategies may be roughly divided for the purpose of discussion here into three categories: agricultural, hydrological and other. Agricultural responses include different irrigation and fertilization strategies, replanting, foods used as a substitute for grass or hay, and rehousing or reducing stock. According to reports, in May, farmers in Waterford fed cattle with corn meal and in June in Kerry, they had to resort to feeding animals with tree leaves. In July 1893, a farmer from Tipperary wrote to a newspaper asking for advice about what to plant as a substitute food for cattle, and in August, another article from the same county stressed the importance of growing autumn catch crops (fast-growing crops grown between successive plantings of a main crop). At the state level, the Board of Agriculture suggested using silage stocks to help with feeding animals in the face of scarcity. On the Aran Islands, the situation was so serious after the drought that priests resorted to raising money to help the poor, and in April 1894, a grant was requested to either assist the islanders buying seed potatoes for planting the following year, or to give them relief work (e.g. road or boat slip construction).

In response to water supply shortages, whether domestic, public or industrial, records often describe restrictions to public supply, warnings to decrease usage, penalties and prosecutions for wasting water, bans on watering gardens or streets, use of water directly from the rivers or lakes, digging of new wells and improving infrastructure. In June 1893, water supply in Dublin was limited to two hours in the morning and two in the afternoon. In September, newspapers issued warnings that unless rain fell in the next five days, the Vartry water supply to Dublin city would be exhausted and filtered canal water would be used instead. In October, the impending closure of breweries and distilleries was announced, threatening the jobs of 'thousands of workmen' (*Evening Herald*, 24 October 1893). Similar problems with low water supply were reported in Waterford, where public fountains were locked, and in Wicklow water was strictly limited to domestic use. Other responses included importation of supplies or restrictions on exports, regulating prices, prayers for rain or even unusual attempts at innovation. For example, at the end of September 1893, a letter to a newspaper called for weather modification experiments in Dublin (including explosion of dynamite over Phoenix Park to force rain from clouds), and by the end of October, the Archbishop ordered prayers for rain in all churches in the Dublin diocese.

Drought events have a long history of creating windows of opportunity that lead to adoption of new technologies and/or infrastructure (e.g. see Ludlow and Manning (2016, 2021) for a case from Ancient Egypt, or Jobbová (2021), Downey and Jobbová (2011) for ancient and modern Maya case studies). Thus, as captured in the IDID, in April 1893, Dublin City Council insisted on the immediate adoption of water metering systems to monitor wastage. A report from the end of 1894 noted that as a

consequence of the 'water failure of 1893' a new independent water supply for south Dublin was proposed (*Evening Herald*, 13 November 1894). Furthermore, the IDID can be used to track adaptive learning, for instance, where coping strategies used during 1893 were recommended by the Board of Agriculture during the 1896 drought through leaflets offering advice to cultivate crops suitable for providing food for stock based on experience during 1893.

5 | LIMITATIONS

Newspaper coverage varies both temporally and spatially, and for the period 1733 until the 1840s is much sparser than subsequent years. There are short-term fluctuations in newspaper coverage in some periods even after the 1840s, such as during the two World Wars. Geographical representation in historical newspaper records varies, with some counties, especially Dublin and Cork, being more represented than others. The relative frequency of newspaper drought reports *per* county should, therefore, not be interpreted as solely representing actual drought severity, frequency or vulnerability in a geographical sense. The Irish Newspaper Archives used to create this database include past issues for a small number of newspapers in the six counties of Northern Ireland, with the number of digitized newspapers available for the Republic of Ireland being notably higher. Therefore, the IDID is likely to under-report historical socio-economic impacts in Northern Ireland, representing an opportunity for expanding the database in future iterations as more titles are periodically added to the INA, or accessed through other means. The current version of the IDID is chiefly the product of an Irish Research Council (IRC) COALESCE project – 'Irish Droughts: Environmental and Cultural Memories of a Neglected Hazard', funding for which ceased in 2022. However, we recognize that the database can be enhanced with additional material (e.g. from British newspapers or when the INA is updated) and we plan to update the IDID in the future.

In developing the database, we endeavoured to identify the geographical and temporal dimensions of drought events to the extent possible given the information available in the source article. The fact that an entry indicates that a drought occurred at a given time and place does not mean that it only occurred then and there; it may well be that the event and its impacts had larger spatial and/or temporal dimensions. Similarly, there may have been past drought events that were underreported or not reported upon at all by newspapers of the time; omissions are, therefore, possible. Finally, Irish newspapers have at times also reported on serious drought events in other countries, but such articles are not currently included in this database, which is limited only to droughts in Ireland.

6 | CONCLUSIONS

This paper presents a drought impact database for the island of Ireland drawing upon newspaper reports and an adaptation of the impact classification scheme employed by the EDII. The database contains reference to >6000 individual newspaper articles and includes >11,500 individual impact records, covering the period 1733–2019. The IDID provides information on the temporal and geographical extent of drought, together with the socio-economic and political context of drought events, their consequences and the mitigation strategies adopted. The database allows the identification of drought events, long-term patterns in drought impacts and offers detailed insight into the impacts of individual drought events. In addition, spatially specific data provide an opportunity for further exploration of differential vulnerability of various geographical locations, which may vary depending upon biophysical conditions and socio-ecological factors, allowing identification of socio-economic sectors, groups and land use types that have been most impacted by droughts in Ireland. The IDID, therefore, offers a new open-access tool for multi-disciplinary investigation and understanding of drought on the island of Ireland, and its use is highly encouraged.

ACKNOWLEDGEMENTS

The authors acknowledge the contribution of the anonymous reviewers in helping to improve our manuscript. We also thank the Irish Newspaper Archives for compiling such an extensive and important resource, without which this work would not have been possible. Open access funding provided by IReL.

FUNDING INFORMATION

The authors acknowledge funding from the Irish Research Council (COALESCE/2019/43). E.J. and F.L. acknowledge additional support from European Research Council grant no. 951649.

CONFLICT OF INTEREST STATEMENT

The authors have no conflict of interest to disclose.

OPEN RESEARCH BADGES

This article has earned Open Data and Open Materials badges.

DATA AVAILABILITY STATEMENT

The derived Irish Drought Impacts Database is freely available from the following link: https://doi.org/10.5281/zenodo.7216126.

ORCID

Eva Jobbová https://orcid.org/0000-0001-7116-9637
Arlene Crampsie https://orcid.org/0000-0003-3633-9164
Conor Murphy https://orcid.org/0000-0003-4891-2650
Francis Ludlow https://orcid.org/0000-0003-0008-0314
Robert McLeman https://orcid.org/0000-0001-9593-1606
Csaba Horvath https://orcid.org/0000-0002-6478-6992

REFERENCES

Bachmair, S., Stahl, K., Collins, K., Hannaford, J., Acreman, M., Svoboda, M. et al. (2016) Drought indicators revisited: the need for wider consideration of environment and society. *WIREs Water*, 3(4), 516–536. Available from: https://doi.org/10.1002/wat2.1154

Bachmair, S., Tanguy, M., Hannaford, J. & Stahl, K. (2018) How well do meteorological indicators represent agricultural and forest drought across Europe? *Environmental Research Letters*, 13, 34042. Available from: https://doi.org/10.1088/1748-9326/aaafda

Barnard, T. (2014) The impact of print in Ireland, 1860-1800: problems and perils. In: Mc Elligott, J. & Patten, E. (Eds.) *The perils of print culture: book, print and publishing history in theory and practice*. London: Palgrave Macmillan, pp. 96–117. Available from: https://doi.org/10.1057/9781137415325

Barrington, R.M. (1888) The drought of 1887, and some of its effects on Irish agriculture. *Journal of the Statistical and Social Inquiry Society of Ireland*, 9, 223–247. http://hdl.handle.net/2262/6122

Blauhut, V., Stahl, K., Stagge, J.H., Tallaksen, L.M., Stefano, L.D. & Vogt, J. (2016) Estimating drought risk across Europe from reported drought impacts, drought indices, and vulnerability factors. *Hydrology and Earth System Sciences*, 20, 2779–2800. Available from: https://doi.org/10.5194/hess-20-2779-2016

Brázdil, R., Kiss, A., Luterbacher, J., Nash, D.J. & Řezníčková, L. (2018) Documentary data and the study of past droughts: a global state of the art. *Climate of the Past*, 14, 1915–1960. Available from: https://doi.org/10.5194/cp-14-1915-2018

Dai, A. (2011) Drought under global warming: a review. *WIREs Climate Change*, 2(1), 45–65. Available from: https://doi.org/10.1002/wcc.81

Dayrell, C., Svensson, C., Hannaford, J., McEnery, T., Barker, L.J., Baker, H. et al. (2022) Representation of drought events in the UK: contrasting 200 years of news texts and rainfall records. *Frontiers in Environmental Science*, 10, 760147. Available from: https://doi.org/10.3389/fenvs.2022.760147/full

Downey, S. & Jobbová, E. (2011) Ethnographic and Ethno-historical investigations; Climate stress in Cayo and Toledo districts, Belize. In: Iannone, G., Swake, S., Awe, J. & Reader, P. (Eds.) *Archaeological investigations in the north Vaca plateau, Belize. Progress report of the thirteen*. Peterborough: Field Season, Social Archaeology Research Program, Department of Anthropology, Trent University, pp. 176–189.

Falzoi, S., Gleeson, E., Lambkin, K., Zimmermann, J., Marwaha, R., O'Hara, R. et al. (2019) Analysis of the severe drought in Ireland in 2018. *Weather*, 74, 368–373. Available from: https://doi.org/10.1002/wea.3587

Ionita, M., Tallaksen, L.M., Kingston, D.G., Stagge, J.H., Laaha, G., Van Lanen, H.A. et al. (2017) The European 2015 drought from a climatological perspective. *Hydrology and Earth System Sciences*, 21, 1397–1419. Available from: https://doi.org/10.5194/hess-21-1397-2017

Jakubínský, J., Bláhová, M., Bartošová, L., Steinerová, K., Balek, J., Dížková, P. et al. (2019) Repository of drought event impacts across the Danube catchment countries between 1981 and 2016 using publicly available sources. *Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis*, 67, 925–938. Available from: https://doi.org/10.11118/actaun201967040925

Jobbová, E. (2021) *The Maya and Environmental stress from past to present: human response and adaptation to climate change in the Maya lowlands Oxford*. BAR Publishing.

Jobbová, E., Crampsie, A., Seifert, N., Myslinski, T., Sente, L., Murphy, C. et al. (2022) *Irish drought impacts Database v.1.0 (IDID) (v.1.0.)*. [Data set]. Zenodo. https://doi.org/10.5281/zenodo.7216126

Kim, D.W., Byun, H.R., Choi, K.S. & Oh, S.B. (2011) A spatiotemporal analysis of historical droughts in Korea. *Journal of Applied Meteorology and Climatology*, 50(9), 1895–1912.

Lee, J.W., Jung, C.G., Chung, J.H. & Kim, S.J. (2019) The relationship among meteorological, agricultural, and in situ news-generated big data on droughts. *Natural Hazards*, 98, 765–781. Available from: https://doi.org/10.1007/s11069-019-03729-7

Ludlow, F. (2012) Assessing non-climatic influences on the record of extreme weather events in the Irish annals. In: Duffy, P.J. & Nolan, W. (Eds.) *At the anvil: essays in honour of William J. Smyth*. Dublin: Geography Publications, pp. 93–133.

Ludlow, F. & Manning, J.G. (2016) Revolts under the Ptolemies: a paleoclimatic perspective. In: Collins, J.J. & Manning, J.G. (Eds.) *Revolt and resistance in the ancient classical world and the near east: the crucible of Empire*. Brill: Leiden, pp. 154–171.

Ludlow, F. & Manning, J.G. (2021) Volcanic eruptions, veiled suns, and Nile failure in Egyptian history: integrating hydroclimate into understandings of historical change. In: Erdkamp, P., Manning, J.G. & Verboven, K. (Eds.) *Climate change and ancient societies in Europe and the near east: diversity in collapse and resilience*. London: Palgrave Macmillan, pp. 301–320.

Murphy, C., Noone, S., Duffy, C., Broderick, C., Matthews, T. & Wilby, R.L. (2017) Irish droughts in newspaper archives: rediscovering forgotten hazards? *Weather*, 72, 151–155. Available from: https://doi.org/10.1002/wea.2904

Murphy, C., Wilby, R.L., Matthews, T., Horvath, C., Crampsie, A., Ludlow, F. et al. (2020) The forgotten drought of 1765–1768: reconstructing and re-evaluating historical droughts in the British and Irish isles. *International Journal of Climatology*, 40, 5329–5351. Available from: https://doi.org/10.1002/joc.6521

Noone, S., Broderick, C., Duffy, C., Matthews, T., Wilby, R.L. & Murphy, C. (2017) A 250-year drought catalogue for the Island of Ireland (1765–2015). *International Journal of Climatology*, 37, 239–254. Available from: https://doi.org/10.1002/joc.4999

Noone, S., Murphy, C., Coll, J., Matthews, T., Mullan, D., Wilby, R.L. et al. (2016) Homogenization and analysis of an expanded long-term monthly rainfall network for the Island of Ireland (1850–2010). *International Journal of Climatology*, 36, 2837–2853. Available from: https://doi.org/10.1002/joc.4522

Park, C.K., Kam, J., Byun, H.R. & Kim, D.W. (2022) A self-calibrating effective drought index (scEDI): evaluation against social drought impact records over the Korean peninsula (1777-2020).

Journal of Hydrology, 613(A), 128357. Available from: https://doi.org/10.1016/j.jhydrol.2022.128357

Stahl, K., Blauhut, V., Kohn, I., Acácio, V., Assimacopoulos, D., Bifulco, C. et al. (2012) *A European drought impact report inventory (EDII): design and test for selected recent droughts in Europe*. DROUGHT-R&SPI Technical Report No. 3, pp. 23. Wageningen: Wageningen Universiteit.

Stahl, K., Kohn, I., Blauhut, V., Urquijo, J., De Stefano, L., Acácio, V. et al. (2016) Impacts of European drought events: insights from an international database of text-based reports. *Natural Hazards and Earth System Sciences*, 16, 801–819. Available from: https://doi.org/10.5194/nhess-16-801-2016

Stephan, R., Erfurt, M., Terzi, S., Žun, M., Kristan, B., Haslinger, K. et al. (2021) An alpine drought impact inventory to explore past droughts in a mountain region. *Natural Hazards and Earth System Sciences*, 21, 2485–2501. Available from: https://doi.org/10.5194/nhess-21-2485-2021

Sutanto, S.J., Weert, M.V.D., Blauhut, V. & Van Lanen, H.A. (2020) Skill of large-scale seasonal drought impact forecasts. *Natural Hazards and Earth System Sciences*, 20, 1595–1608. Available from: https://doi.org/10.5194/nhess-20-1595-2020

Van Loon, A.F. (2015) Hydrological drought explained. *Wiley Interdisciplinary Reviews: Water*, 2, 359–392. Available from: https://doi.org/10.1002/wat2.1085

Wilby, R.L. & Murphy, C. (2019) Decision-making by water managers despite climate uncertainty. In: *The oxford handbook of planning for climate change hazards*. Oxford: Oxford University Press.

Wilhite, D.A. & Glantz, M.H. (1985) Understanding: the drought phenomenon: the role of definitions. *Water International*, 10, 111–120. Available from: https://doi.org/10.1080/02508068508686328

Wilhite, D.A., Svoboda, M.D. & Hayes, M.J. (2007) Understanding the complex impacts of drought: a key to enhancing drought mitigation and preparedness. *Water Resources Management*, 21, 763–774. Available from: https://doi.org/10.1007/s11269-006-9076-5

SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

How to cite this article: Jobbová, E., Crampsie, A., Murphy, C., Ludlow, F., McLeman, R., Horvath, C. et al. (2024) The Irish drought impacts database: A 287-year database of drought impacts derived from newspaper archives. *Geoscience Data Journal*, 11, 1007–1023. Available from: https://doi.org/10.1002/gdj3.272