

More on Early ENSOs: Evidence from Australian Documentary Sources

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Abstract

Early documentary records of the British colony of New South Wales, Australia, have been examined for evidence of droughts. The years of occurrence of these early droughts were compared with the chronologies of El Niño-Southern Oscillation (ENSO) events, as determined by Hamilton and Garcia (1986) and Quinn et al. (1978) from documentary evidence of northern Peruvian rainfall. Most droughts were associated with ENSO events, and vice versa, confirming the relationship found in many studies using more-recent instrumental data. The study demonstrates the stability, over a long period, of the correlation between Australian droughts and ENSOs.

1. Introduction

Several studies have demonstrated that El Niño-Southern Oscillation (ENSO) events usually coincide with low rainfall over eastern Australia (e.g., McBride and Nicholls, 1983; Williams et al. 1986; Ropelewski and Halpert, 1987). However, this relationship has so far only been examined using data from after the middle of the nineteenth century. Williams et al. (1986), for instance, only used data from 1877 onwards, as did Ropelewski and Halpert (1987). McBride and Nicholls (1983) only used 1932–1974 data. Confirmation of the relationship between ENSO events and Australian droughts using evidence from an earlier period would demonstrate the stability of this association.

New South Wales, later to become one of the states of the Commonwealth of Australia, was colonized by Britain in 1788. Conventional meteorological observations were rather fragmentary before the middle of the 19th century, but much documentary material exists from the early decades of the colony. Some of these documentary sources were examined for evidence of droughts, and a drought chronology was prepared. A comparison of this chronology with the chronologies of ENSO events prepared by Hamilton and Garcia (1986) and Quinn et al. (1978), shows a strong correlation.

Hamilton and Garcia (1986) surveyed historical sources concerning Peruvian rainfall. They then prepared a chronology of ENSO events from 1531 to 1841 from these sources. Conventional barometric-pressure data from tropical stations after 1841 could be used to identify ENSO events. Hamilton and Garcia assumed that heavy rain between February and April over northern Peru indicated an ENSO event. The study of Hamilton and Garcia complements that of Quinn et al. (1978).

One Australian documentary source was relied upon especially in this study; the reports of governors of the colony of New South Wales to the colonial secretary in London. These reports, especially in the early decades of settlement, were

expansive descriptions of all events of major importance to the new colony. The young colony was vulnerable to climatic fluctuations such as droughts, so it is no surprise that climate and climatic fluctuations are often mentioned in these reports. The reports have been published by the Government of Australia in a series of volumes titled *Historical Records of Australia*. The volumes relating to the period from 1788 to 1841 (Series I, volumes I-XXI) have been examined and all references to drought noted. A drought chronology prepared by Jevons (1859), mainly from newspaper reports, was also examined. In this chronology, Jevons does not mention some of the early droughts mentioned in the governors' reports.

Three potential problems exist when comparing a chronology of droughts prepared in this way to the ENSO chronologies. Firstly, the early settlers knew little about what to expect from the Australian climate. There may have been discrepancies, therefore, between their perceptions of what constituted a drought, and late-twentieth-century perceptions. Secondly, over the period examined there was a series of governors, and each may have had a different perception of drought. Finally, although studies have indicated that eastern-Australian droughts tend to coincide with ENSO events, this relationship is weaker on the coast than inland (McBride and Nicholls, 1983). British settlement was confined to the coast prior to 1813, so a relationship between droughts and ENSO events might not have been easily detected before this year. As will be seen, a good relationship does exist between eastern-Australian droughts and ENSO events in the chronologies, suggesting that these potential problems were not significant.

2. Evidence of Australian droughts 1788–1841.

The first indication of a drought after the establishment of the colony in 1788 is in a letter from Governor Phillip to the Right Honourable W. W. Grenville on 4 March 1791:

From June until the present time so little rain has fallen that most of the runs of water in the different parts of the harbour have been dried up for several months, and the run which supplies this settlement is greatly reduced, but still sufficient for all culinary purposes . . . I do not think it probable that so dry a season often occurs. Our crops of corn have suffered greatly from the dry weather.

On 5 November 1791 Phillip continued:

Our crops of last year greatly failed us from a long drought, very little rain falling from the beginning of July 1790, to August 1791.

The summer of 1796–97 was noted as dry, with many fires that destroyed much of the harvested crops. There was no

mention of a poor harvest; this suggests that the drought was not severe.

This was not the case with the next drought, described by Governor Hunter to the Duke of Portland on 1 May 1799:

. . . a most tedious and unfortunate drought. I can scarcely say we have had a shower of rain for the last ten months. Our maize crops have completely failed us from that cause, and this will occasion a great reduction in our stock of swine. The wheat harvest has not turn'd out more than one-third of what . . . we had a right to have expected had the season been moderately favorable. The whole country has been in a blaze of fire, our pasturage for a time destroy'd, and the streams of fresh water almost exhausted.

The next mention of drought is in a letter on 1 March 1804 from Governor King to Lord Hobart:

I am sorry to say that during the last and present year we have experienced the greatest drought, with severe blight, which has much reduced our crops, altho' there is not the most distant appearance of any real want, except for our increasing stock of swine, which will suffer by a partial failure of the maize crop . . . The cattle have not escaped the great inconvenience of this continued dry weather, which has not only dried up all the native grasses, but also most of the streams and ponds in the neighbourhood, in so much that the Government herds are driven many miles off to feed . . . However, I hope some very fine rains which fell for the first time on the 24th February, will not only remove the cattle's present inconvenience, but also encourage the settlers in sowing a greater quantity of wheat than the want of these rains would have enabled them to.

After this there was a break of nearly a decade before drought is noted again in the reports to the colonial secretary. Jevons (1859), however, noted a drought between late 1810 and early 1811 that apparently destroyed the maize crop. No mention of effects on other crops was made, and the rivers were flowing strongly in July 1810 and March 1811, indicating that the drought was short.

The next drought would last considerably longer, Governor Macquarie wrote to Earl Bathurst on 19 January 1814:

. . . during what is naturally our wet season, in the winter and spring of the last year, no rain whatever having fallen to refresh the earth, it became so parched and burned up, that almost all vegetation ceased, and a great part of the wheat and other grain, which had been sown, perished in the ground, and the small portion, which did grow, came up so blighted by the heat and drought together, that the produce will not probably, throughout the Colony, average 8 bushels to the acre, which is not more than the third part of what is the usual increase. Another most unfortunate circumstance has attended the extraordinary drought. The ponds and even the rivers, which in other seasons have supplied water enough for the use of the cattle, totally failed on this occasion, and the consequence has been that an alarming mortality has taken place, not only in the herds belonging to the Crown, but also among those of the settlers at

large . . . This total inversion of the natural order of the seasons has necessarily excited much alarm, as the consequences, if not averted by a speedy resort to external supplies, must at least terminate in the heavy calamity of very great scarcity, both of animal feed and of grain, if not in an actual famine.

Macquarie ordered 250 tonnes of wheat from Bengal to avert the famine. The drought continued, but on 12 December 1814, Macquarie reported that "the unusual continuance of dry weather, which we have experienced here, has finally given way to some very seasonable falls of rain."

This was not, however, the end of the drought, which continued in 1815. Macquarie, again to Earl Bathurst on 18 March 1816:

There is now, I am happy to say, every reason to expect that we shall have more favorable seasons for the time to come, as we have lately had very copious and seasonable falls of rain throughout every part of the Colony, which were greatly wanted, the lands everywhere being quite parched and burnt up affording neither grass nor water for the poor famished cattle, which were dying in hundreds 'till this favorable change took place in December last.

Jevons (1859) noted minor droughts in early 1818 and early 1820. Macquarie did not mention the 1818 drought, but he did report the 1820 drought, noting that this drought only affected the maize crop, other crops being "unusually productive."

After this, no references to drought appear in the reports to the colonial secretary for nearly a decade, even though there are reports in other documentary sources of a drought in 1823–24 (Jevons, 1859), which appears to have ended in September 1824.

Not until a letter from Governor Darling to Sir George Murray on 21 November 1829 is there a further reference to drought in the reports from the governors:

The appearance until lately was most unpromising, the crops from want of rain having generally afforded but little prospect of returning the quantity of seed put in the ground. A providential change has now taken place, rain having recently fallen in abundance.

Jevons (1859) describes this drought as "a fearfully dry period during the years 1827, 28 and 29." He also suggested that the drought started late in 1826.

The last drought prior to 1841 occurred between 1836 and 1839 and was described by Sir George Gipps in a letter to Lord John Russell on 10 December 1840, as "calamitous." According to a quotation in Jevons (1859), from some time previous to July 1838 up to several months after May 1839, "not a drop of rain fell in Sydney." Other comments by Jevons suggest that the drought started in 1837 and was already severe by early 1838. Heavy rains in October 1839 broke the drought.

3. Early Australian droughts and ENSO

The citations presented above provide a chronology of droughts in the colony of New South Wales between 1788 and 1841.

The dates of these droughts as determined from the documentary sources, are listed in Table 1. Also listed in this table are the years of major ENSO events as determined by Hamilton and Garcia from their survey of Peruvian rainfall. The list of ENSO events prepared by Quinn et al. (1978), which lists weaker events as well as strong events, is also included. It was assumed that when Quinn et al. (1978) list successive years as ENSO events, this is really a single event spanning two years.

Between 1788 and 1841 (see Table 1) there was a strong tendency for Australian droughts to coincide with ENSO events, namely: All four of the strong ENSO events listed by Hamilton and Garcia (1986) coincided with droughts. Of the ten ENSO events listed by Quinn et al. (1978), eight coincided with droughts. Only three of the eleven drought periods did not coincide with an ENSO event. These droughts were all before 1813, when settlement was limited to the coast, where the relationship with ENSO is weaker. Of the 30 years without drought, only two were ENSO years.

Two approaches were used to test the null hypothesis: "El Niño events do not coincide with eastern Australian droughts." The first approach used the binomial distribution. Drought was noted in 26 of the 54 years examined (i.e., 48 percent). Hamilton and Garcia (1986) listed four El Niño events all of which coincided with Australian droughts. Using the binomial probability distribution, the probability of this happening under the null hypothesis is 0.053. A similar analysis for the Quinn et al. chronology produced an even-lower probability.

The second test of the null hypothesis is based on the multiresponse randomized-block permutation procedure (MRBP) suggested by Mielke (1984) and is less dependent on assumptions about distributions than is the test with the binomial distribution. Advantage is taken of the pairing of drought years (Table 1) and the 54-year period is divided into 27 pairs. The first pair was 1788–89; the last was 1840–41. Fourteen pairs (28 years) had no drought or El Niño. Of the other thirteen

pairs (Table 1), eight had drought and El Niño (according to the Quinn et al. chronology), three pairs had drought but no El Niño, and two pairs had an El Niño but no drought. Application of MRBP leads to rejection of the null hypothesis at the 0.01 level (the probabilities for the Quinn et al. chronology and the Hamilton and Garcia chronology are 0.0074 and 0.0011, respectively).

The two statistical tests both suggest a strong coincidence between Australian droughts and El Niño events between 1788 and 1841. This confirms the association found on recent, instrumental data (e.g. Ropelewski and Halpert, 1987).

4. Conclusions

Comparison of a chronology of Australian droughts between 1788 and 1841, compiled from documentary sources, with chronologies of heavy rainfall events in northern Peru, compiled from documentary sources by Hamilton and Garcia (1986), and Quinn et al. (1978), indicates a strong relationship between the two. This confirms a correlation previously observed using instrumental, post-1841, data. The relationship between ENSO events and Australian droughts apparently has existed for at least two centuries.

Acknowledgment. Paul Mielke kindly performed the MRBP test and commented on the description of the test.

References

TABLE 1. Australian droughts and ENSO events 1788–1841. Dots indicate nonoccurrence of specific phenomena. Neither drought nor an ENSO event was experienced during the 28 unlisted years.

Australian drought	ENSO event according to:	
	Hamilton & Garcia	Quinn et al.
1790–91	1791	1791
1796–97	.	.
1798–99	.	.
1803–04	1804	1803–04
1810–11	.	.
1813–15	1814	1814
1817–18	.	1817
1819–20	.	1819
	.	1821
1823–24	.	1824
1826–29	1828	1828–29
	.	1832
1837–39	.	1837

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