

Evidence for unusually wet 19th Century summers in the eastern Prairies and northwestern Ontario

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Abstract: Archival accounts indicate that at least 20 “wet summers”, accompanied by high streamflow and high lake levels, occurred from 1800 to 1870. All but one fell within two intervals, 1824-1834 and 1849-1861, during which virtually every summer was “wet”. These wet summers contributed to high water levels in Devil’s Lake and Moon Lake in North Dakota and provided the antecedent conditions for the large floods of the 19th century. Dendroclimatic evidence from southern Alberta has been interpreted as indicating dry conditions there, suggesting that a dichotomy between the eastern and western prairies similar to that of 2000 may have persisted historically for intervals of as long as a decade.

Introduction

The extraordinary rain and violent storms of June and July, 2005, in southern Manitoba were national news events which produced unusually severe conditions on a number of fronts: widespread standing water on fields which ruined crops, water levels on rivers and lakes which were extreme for the season, dramatic displays of lightening, and swarms of mosquitoes. Although such conditions have occurred in some other years within the instrumental period (notably in 1993), they are unusual. Written records from the pre-instrumental period 1800 to 1870, however, contain numerous descriptions of similar or even more severe summer rainfall in the region from eastern Saskatchewan to northwestern Ontario. This paper summarizes these descriptions and relates them to the general 19th century hydrometeorology of the prairies identified in other studies.

The “data” for the paper consists of eye-witness accounts in historical materials. In many years, the “raininess” of the season can be inferred

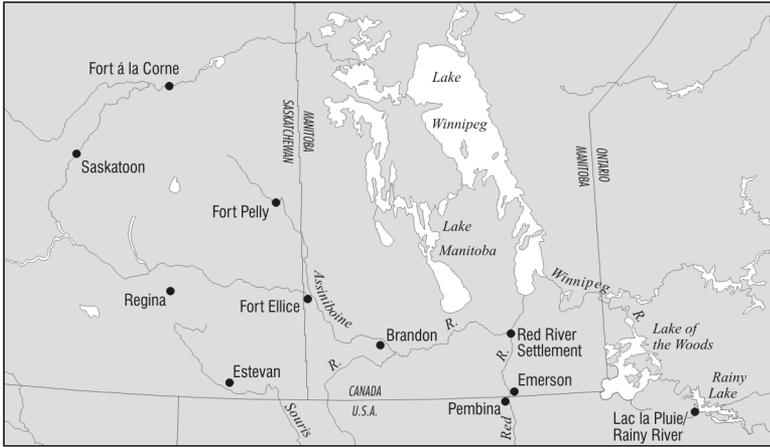


Figure 1: Location map.

from the number of days on which rain was mentioned, accompanied by some comments about its intensity and/or duration, or commentary on how abnormally wet the season was. In other cases, the amount of rain may be inferred from descriptions of water levels in rivers, lakes or sloughs, where the testimony of the observers or the timing of the rise indicate that the levels resulted from rainfall rather than the lingering effect of spring snowmelt. High water levels were particularly noteworthy in northwestern Ontario because of their detrimental effect on the wild rice crop, an important food source in the region; in other cases, crops on land were drowned by standing water from heavy rains. Summer bankfull or overbank flows in rivers are significant because of their rarity in the instrumental period. Unusually high water in larger lakes and rivers indicates that wet conditions prevailed over a broad (perhaps basin-wide) area rather than merely in the vicinity of the observer.

Because the argument is based entirely on written documents, the actual words of the observers are crucial to an appreciation of the conditions they experienced. Thus they have been reproduced in as much detail as space permits, but in many years, they are only a portion of the available commentary. The majority of the materials come from post journals and other fur trade documents in the Hudson's Bay Company Archives or diaries and letters in the Manitoba Archives. To avoid a proliferation of references at the end of the paper, the information from post journals or diaries is cited in the text by post or diarist name and year but is listed only once in the references, rather than for each year. File numbers in the Hudson's Bay Company Archives are prefixed by HBCA,

those in the Public Archives of Manitoba by PAM. Individual archival files referred to only once in the text or separately published works are listed in the normal fashion.

Descriptions and Conditions

1806: Alexander Henry's journal (Coues 1965) contains abundant descriptions of very wet conditions in the Red River region of southern Manitoba in the summer of 1806. On June 26, he reported the water in the Red River to be "*extraordinarily high [from the] continued storms*" (ibid, 281) and on July 7,

the travelling was tedious from the heavy rains... In many places we found several feet of water; every little hollow formed a pond and every rivulet appeared like a river. Our horses often sunk up to their knees in mud, and at times had water up to their bellies...The water [in the Red] was very high...[while attempting to cross to the east side of the river, he] found the country almost entirely overflowed (ibid, 285-6).

Such conditions continued throughout the summer. In August, Henry reported that

[August 13] this summer's extraordinary rain, having overflowed the low country, has caused the buffalo to resort to the high lands southward... [August 14] We found a great quantity of water, and for a long distance our horses had it up to their bellies... This road used to be firm and good but the continued rain of the summer has altered the face of almost everything, and there is now mud and water knee deep. (ibid, 420-21)

1824: David Thompson canoed from Fort William to Lake of the Woods and back from June 16 to September 6. He recorded rain, much of it hard, on 46 of the 82 days and on a number of the other days observed rain, thunder or lightning at a distance. Throughout the trip he encountered high water, beginning on June 28 when he wrote "*Water is high...all the rivers and lakes are now very high*" (Thompson 1824). On July 22 and 24, he found Rainy River "*uncommonly high*" and "*all inundated*" (ibid). At Lake of the Woods on July 26, he observed "*all low overflowed land*"

and on July 29 “*water in the grass 5 ft deep*”. In late August, J.D.Cameron reported that the Winnipeg River was “*exceptionally high*” and “*amazingly high*” at the Pinawa portage (Lac la Pluie Journal 1824/25). Because of the high water “*the rice crop has entirely failed all over the country*” and the fishery failed as well (Lac la Pluie Journal 1824/25). The wet weather extended into Manitoba and eastern Saskatchewan. On August 4, the Fort Pelly Journal reported “*the meadows being so full of water, it is a difficult job to get the hay dried*” (Fort Pelly Journal 1824/25) and on August 15, “*continued rains for some time past made the waters of the River rise five feet above its usual height*”, and on the 18th “*the waters of the river continue rising so much, that they nearly reach the top of the bank*”, and still on August 21, “*the rains still continued pouring and the river rising more and more.*” (Fort Pelly Journal 1824/25). On September 2 at Red River “*the weather continues wet, which has caused the [Red] River to raise considerably*” (Red River Journal 1824/25) and rain (frequently heavy) was reported at Red River on 11 days from September 1-16. The Annual Report for the Lac la Pluie District reported “*the high flood of the summer continuing till September- the rice crop was so far injured that the natives of the district could not procure a sufficiency for their consumption.*” (Lac la Pluie Journal 1824/25).

1825: On June 20 the Red River Journal reported that wood which had been left on the bank of the Red River was “*now in danger of being carried off by the extraordinary inundation of the river, caused by the late continued heavy rains*” (Red River Journal 1824/25). On July 11, the Red River journal reported “*the floods in the [Red] River continue high*” (ibid). On July 30, the Company was “*unable to get the rafts unloaded the beach being still covered with twelve feet of water*” (ibid). Abundant rain continued into September; on September 23, “*owing to the late heavy rains, both rivers have risen considerably*” (ibid). This rainfall must have been very widespread to cause both the Red and Assiniboine Rivers to rise and this is confirmed at Fort Pelly where “*the very high water in summer destroyed all our crops of potatoes and barley and carried off one half of our establishment*” (McDonell 1826). The wet conditions also extended into northwestern Ontario. At Rainy River, August was rainy, water levels were high, and “*the barley failed... owing to the ground on which it was sown, being too long covered with water from the heavy rains in the early part of the summer*” (Lac la Pluie Journal 1825/26). Complaints about the water levels there and comments about rising water continued throughout the fall into early December. This wet summer provided the antecedent conditions for the disastrous Red River flood of 1826 (see below).

1827: At Rainy Lake on May 18 *“from the late heavy rains, the water has risen so high-no sturgeon can be hooked.”* (Lac la Pluie Journal 1826/27). June was dry at Red River but July, August and September were very wet. On August 31, the Red River journal reported that *“since the 14th scarcely a day has passed without heavy rains, [the] crops are in part rotted on the ground”* (Red River Journal 1826/27). Several comments at the end of the summer indicate widespread, very wet conditions for much of the summer and into early fall.

[September 13]: *This summer was the most rainy and most disagreeable of any summer within my recollection. One fourth of our time at least was lost by rain from [York] Factory to this place. The portages in [the Winnipeg River] were in an abominable state... These heavy rains will certainly spoil our wheat...*

[September 18]: *Continued rains since my arrival [on September 13] [October 5]: Hardly a day passes but what we have had rain sometimes all day... ”*

[November 30]: *The river is now so very high there is no keeping a net fair in the water.* (Lac la Pluie Journal 1827-28)

[September 8]: *Heavy showers of rain every day.*

[September 20]: *Not a day passes without heavy rains...The rivers are greatly swollen by the late rains, as much so, as after the ice went off in the spring, and it is even a difficult matter to go on horseback from one end of the Settlement to the other; the face of the country is so entirely covered with water..* [September 30]:

scarcely a dry day has been experienced since [Sept. 20]. (Red River Journal 1826/27)

1828: After a wet July, rain fell on a minimum of 14 days in August at Red River, damaging the crops: *“a tolerable [barley] crop, except on the low ground which was much destroyed by the water standing on it after the frequent heavy rains.”* (Cochran Journal, August 15). On August 22, Cochran reported: *“The most awful night I ever witnessed... The rain which fell...being now standing on the ground...to a depth of three inches.”* (ibid). At Brandon House, high water on October 7 frustrated attempts at fishing: *“...several attempts at erecting fish weirs in the Rapid River, which unfortunately proved unsuccessful owing to the unusual height of the waters- The same result...in the Assiniboine River”* (New Brandon

House 1828/29). On October 31, the Lac la Pluie journal summarized the summer precipitation:

The water was again extremely high above [Lake Winnipeg] particularly within the American Territories, from which not a grain of rice was procured... The rains were [so] incessant all summer in this quarter that it injured us in [the] crop of potatoes... it is impossible to mow hay in the water... (Lac la Pluie Journal 1828/29)

1830: The wet weather in this year was mainly in May and early June when crops in the Red River Settlement were damaged or destroyed by abundant rain and flooded fields. On July 29, Rev. William Cochran wrote

This spring the whole of the people in my neighbourhood have suffered severely from the heavy rains which fell in May. In the beginning of May, the rain fell in such abundance that the whole surface of the plains was a sheet of water. This obstructed every kind of agriculture for upwards of ten days... After we had sown the wheat and planted the potatoes, the rain fell in such profusion that the ground was perfectly deluged. This continued till it destroyed a large portion of the wheat and most of the potatoes... Since the 15th of June, we have had only one slight shower. (Cochran 1830).

At Rainy Lake on May 26, “*the water is rising so high-we may be assured there will be no rice*” (Lac la Pluie Journal 1829/30) and on May 20, “*the water is now higher than the high-water year. There will be no rice this year*” (ibid). Although rain was less frequent in July at Rainy River, water levels remained high until late in the month at least; on July 28, the journal reported that “*where they mowed last year there is three foot of water*” (Lac la Pluie Journal 1830/31).

1831: Evidence for excessive rainfall in this summer comes only from the Fort Pelly journal; northwestern Ontario experienced a dry summer. On June 28 at Fort Pelly, “*nearly all the gardens below are destroyed by the high waters [of the Assiniboine]*” (Fort Pelly Journal, 1831/32). On July 2, “*the ground is so completely drenched with water that nothing can be done to [the potatoes]...the hay ground is also covered with water*”

(ibid) and again on the 19th, “*all the former hay ground is covered with water*” (ibid), causing the reporter to comment on the 23rd “*this is a remarkable summer for rain*” (ibid). On July 9, “[a man] says that the rivers are so high that he had difficulty to cross” (ibid). On July 23, “*raining most of the day... the river [being] so high... there is no possibility of making a barrier*” (ibid). Wet weather continued at least until August 20: “*the rest of us carrying the hay that was lately cut to dry ground as the late rains had almost set it afloat*” (ibid).

1832: On June 14 at Red River, Cochran reported “*heavy and incessant rains are falling in this neighbourhood. The ground is deluged, the wheat and barley look sickly and many potatoes which are planted on wet soil are rotting.*” (Cochran Journal) and these conditions continued into July: “*The whole season has been unfavourable. We had heavy falls of rain & hard frost up to the 20th of May... About the 10th of June heavy and constant rains commenced.*” (ibid). At Fort Alexander at the mouth of the Winnipeg River, on August 25, “*this summer has been ... all along uncommonly cold and rainy... All the low grounds where the hay used to be made is entirely overflowed*” and the “*more than usually violent current*” of the Winnipeg River exhausted the boat crews (Lac la Pluie Journal 1832/33). At Rainy Lake, torrential frequent rain and dangerously high water were reported from May 11 into June. On May 13 there was “*now six feet of water running through the mill*” (Lac la Pluie Journal 1831/32) and after falling somewhat, the water was rising again on May 28. A winter food shortage was anticipated because “*from the height of the water not a grain of rice grew up in any part of the District*” (Lac la Pluie Journal 1832/33).

1833: The Fort Pelly region had a wet summer as the post journal comment for September 7 indicates “*from the heavy and constant rain during the summer this part of the country may be said to have been under water in several places*” (Fort Pelly Journal 1833/34). At Red River, Cochran reported on September 28 that “[north winds] brought such a torrent of rain upon us, as I have never before witnessed, the plains are deluged, and the creeks run as deep as in the spring.” (Cochran Journal). A comment at Rainy Lake in 1834 (see below) suggests it may have been very wet there as well.

1834: The Assiniboine and Red River basins were relatively dry but northwestern Ontario had a very wet summer. On May 28 at Rainy Lake, “*These two days we have had very heavy rains... without intermission. The river has risen very high... The fields are all overflowed*” (Lac la Pluie

Journal 1833/34). The water was “*uncommonly high*” on June 14 and very heavy rain was reported in the Lac la Pluie journal almost continuously throughout June and most of July, raising fears of failure of the field and rice crops, as the following extracts illustrate:

June 7: We have had a great deal of rain during the week. The river still rising. Our fields appears like fish pond. June 28: hardly a day in this week but what we have had rain and that in large quantities, July 12: The weather since the 4th has been rainy...The field of barley is drowned...there is now not the least hopes of getting any [rice] in Lake of the Woods nor in Lake la Pluie, July 19: ...not a single day has passed during this week but what we have had rain, & at times very heavily, July 26: had a great quantity of rain during the week with thunder & lightning (Lac la Pluie Journal 1834/35). By August 2 in the lake all [was] overflowed (ibid).

J. D. Cameron summarized the season as follows:

The writer reached Fort Francis on the 13th of September 1834, when he found the water excessively high from Lake Winnipeg to Lac la Pluie; and continued so to Fort William. The consequence was a complete failure of rice throughout the country. This had occurred in three successive summers. The farm did not yield much in consequence of heavy rains toward the end of May and the greater part of...June. (Lac la Pluie District Report 1834/35)

1849: The summer of 1849 in the Red River valley and northern Minnesota may have been the wettest in the entire 19th Century. The weather conditions have been discussed in detail by Blair and Rannie (1994) and Rannie and Blair (1995); the following quotations are only a very small part of the commentary available from the Red River Settlement and the Woods Expedition traveling from Saint Paul, Minnesota, to Pembina.

June 26, Red River Settlement: The water is extraordinarily high... all the rivers are inundated. They say that Pembina is drowned and it is believable from the height of the water here. There is already

grain in the water and it doesn't appear to have decided to lower yet. (Provencher 1849a)

July 6: *The prairies [were] so bad from the drenching rains that had just fallen we were scarcely able to get along. Little drains that usually contain no water, were now almost swimming... (Woods 1850, 13)*

July 17: *Starting at 12 M, over a level prairie on which the water stood from two inches to two feet deep almost the entire way...we reached Maple River... but the water being much higher now, the bridge had disappeared. There had been such torrents of rain... that the little branches that ordinarily furnish barely a sufficiency of water to allay the thirst of a travelling train were now swimming. (ibid, 16)*

August 1: *...having been out since the 6th of June, we arrived at Pembina, and found the Red River and the Pembina River with about twenty feet rise in them, and overflowing their banks. (ibid, 18)*

August 26: *When the expedition first reached Pembina [on August 1], the incessant rains for weeks previous had caused all the rivers to overflow their banks. (Pope 1850, 34)*

August 28, Red River Settlement: *the water has been so high all summer that there was no way to communicate with Pembina except by water... [the Woods party] visited [M. Belcourt's] post at Pembina and they had to leave because there was no appearance of a harvest at Pembina; the water covered the fields. (Provencher 1849b)*

1851: On July 15 at Red River, Provencher reported “*already for fifteen days it has been raining, the water [on the Red] rises and rises*” (Provencher 1851a). By July 21, “*the abundant rain [had] done damage to the grain. The water rises continually and could destroy the crop on the low ground; already this is the case at White Horse Plain*” (Provencher 1851b). White Horse Plain is on the Assiniboine River west of Winnipeg and flooding there indicates that the Assiniboine basin was also receiving abundant rainfall. The abundant rain extended to south-central Minnesota. On the lower Minnesota River, Frank Mayer reported on July 7 that “*this is an unusually rainy season & we are almost daily visited by storms of wind & rain...*” (Heilbron 1932, 177) and found the Minnesota River to be “*higher than it has been for years*” (ibid, 190). On

August 31 at Lac qui Parle, Minnesota, Riggs wrote "*it was one of the very wet summers in Minnesota, when the streams were flooded all the summer through.*" (Riggs 1880, 139).

1853: June and early July were very rainy at Red River. From May 28 to July 16, rain was reported on 25 of the 50 days in the Cowan Diaries or the Winnipeg Journal and was frequently described as "heavy", "deluge", "great". Apart from complaints about mosquitoes and a minor comment about wet ground, however, this rain seems not to have affected water levels or crops.

1854: The evidence in this year comes entirely from eastern Saskatchewan and western Manitoba. On June 22 at Fort Pelly they were "*getting no fish from the basket owing to the river [being] so high.*" (Fort Pelly Journal 1853-54). From mid-June to mid-August, rain fell on about 40% of the days at Fort Pelly and the rivers remained high at the end of July. On a trip to Fort Ellice, Charles Pratt wrote on June 30 "*I [tried] to cross the [Whitemud River] but I could not, the water so high. I was afraid that we should drown.*" (Pratt Journal) and when he reached the junction of the Assiniboine and Qu'Appelle Rivers on July 18 he found "*the rivers very high...got over with great difficulty*" (ibid). Four days later south of Fort Pelly "*...the Assiniboine was so high that it overflowed its banks in some places*" (ibid).

1855: Donald Gunn recorded an astonishing 43.6 inches (1107 mm) of rain at Lower Fort Garry from June through September (June- 10 inches, July- 14.6 inches, August- 12.5 inches, September-6.5 inches) (Dawson 1859). Such an amount cannot be easily accepted at face value and there are unfortunately few other documents from that period to confirm or discredit it. On June 19, James Settee at Shoal River near the mouth of Swan River reported a rainy month with "*rains in this month as frequent as I have ever observed both last summer and this which keeps the waters high*" (Settee Journal). At Red River Abraham Cowley noted some thunderstorms and on July 7, when Gunn recorded 3 3/8 inches (86 mm), Cowley "*left [his] wife & family at St. Andrews the road being so very heavy owing to the great rains which have fallen today*" (Cowley Journal). Perhaps most importantly, 10.5 inches (267 mm) were recorded at Lac qui Parle in southern Minnesota in August (United States Patent Office 1861) which compares favourably with Gunn's 12.5 inches at Lower Fort Garry (the other months were not reported at Lac qui Parle). Whatever the exact amount may have been, Gunn's data and the Swan River and Minnesota reports suggest a wet summer over a broad region.

1856: At Fort Pelly on June 12, the rivers were observed to be “*very high owing to this continual rain.*” (Fort Pelly Journal 1855-57) and by June 30 at Red River “*the unusual quantity of water which poured into every stream caused serious injury to many of the bridges*” (Oliver 1914, 423). Henrietta Black reported that July at Red River “*...was extremely wet. Our hay ground in the parks, and everywhere else, was drowned.*” (Black 1856). In late July and August, Charles Pratt travelled from Red River to the Qu’Appelle River and found high water in all the rivers along his route. On July 30, “*... the Little White Mud River... gave [him] no little trouble for its waters being high*” (Pratt Journal). When he reached the Qu’Appelle on August 11, he was surprised to find it in flood and after several days’ delay in crossing the river on August 16 “[he] *couldn’t commence building [a mission on the Qu’Appelle] the waters being so high.*” (ibid).

1857: On his trip from Fort William to Red River in June, John Palliser encountered abundant rain and high water in northwestern Ontario. After leaving Fort William, he reported on June 20 “*the whole country was at this time flooded by the continued rains*” (Spry 1968, 62). Further west, the party “*left the north shore of Lac la Croix by paddling over a tract of flooded land, pushing our way through the branches of submerged trees until we arrived at a group of lakes at a distance to the north.*” (Spry 1968, 72). At Portage du Bois on Lake of the Woods, they “*found the lake waters so much above their usual level that we were able to sail right over [the portage]*” (Spry 1968, 100). When Palliser reached Pembina on July 24, he found the Red River to be “*about five feet above its usual level*” (Spry 1968, 100). In August Henry Youle Hind followed Palliser through northwestern Ontario and encountered high water along the whole route. Near Fort William, “*the Kaministiquia River was higher than... had ever been known before at that season of the year.*” (Hind 1860a, 31) and near Fort Francis “*the extraordinary height of the water...was seen by the lodge poles of former Indian encampments... [which] were under water to the depth of one or even two feet.*” (Hind 1860a, 88). On the Winnipeg River, the wild rice crop was drowned, and fishing was difficult. In western Manitoba, Palliser described Whitewater Lake near Boissevain as “*a large lake...said to be of very recent origin. It has no outlet and until 5 years ago water was never known to lodge permanently in this place*” (Spry 1968, 117).

1858: Henry Youle Hind (1860a,b) reported rain on 44% of the days of his expedition from Fort Garry (June 15) to Fort a la Corne on the Saskatchewan River (August 8). His accounts are discussed in detail in Rannie (2006) but the following are representative: near Estevan “*the almost daily*

thunderstorms ...replenished the marshes and small ponds [which provide] an abundant supply of water” (Hind 1860a, 305), at Fort Ellice “*we have had seventeen thunderstorms in twenty-three days; nearly all were of a violent character, with hail, heavy rain and boisterous winds”* (Hind 1959), and at Fort Qu’Appelle, “*not a day passed without lightening, thunder and generally violent rain of half an hour’s duration”* (Hind 1860a, 312). It is not clear that rainfall amount was above normal but the number of storms and days with rain was greater than modern normals.

1860: On June 17 at Red River, Abraham Cowley observed “*a very great quantity of rain has fallen, the valley in our field was so filled with water that it produced quite a rapid current”* (Cowley Journal). On June 28, the Nor’Wester newspaper in the Red River Settlement reported

the present has been a rainy month...[with] showers throughout at short intervals...The water has risen steadily during the present month, and is now higher than at any time previous this year... [The mail carriers from Lake of the Woods] found much of ... their route almost impassable- the streams being all swollen into little rivers by the late rains, and the morasses so flooded with water that their men frequently sunk therein up to their breasts. If the wet weather continues much longer, the potato crop will suffer... The water has risen steadily during the present month and is now higher than at any time previous this year (Nor’Wester June 28).

The rains continued into July at Red River: “*the first half of July... has been a continuance in an aggravated form of the same wet season...”* (Nor’Wester July 14) and in northwestern Ontario: “[*carrying mail from Fort William and Fort Francis] Mr. McVicar found the rivers greatly swollen by the heavy rains, and he and his party were compelled to swim several of them with the mail bags on their backs.”* (Nor’Wester July 28). On August 31, Samuel Taylor at Red River wrote “*I hear many people say that they never remember such a summer for rain...”* (Taylor Diary).

1861: This was the year of the third largest of the great 19th Century spring floods of the Red River and comments about standing water must be interpreted with this in mind. Nevertheless, there is evidence that the summer was wet. On July 1, the Nor’Wester newspaper noted “*we have had very rainy weather during the past three weeks. The crops are*

suffering somewhat... Very few will be able to commence haymaking at the usual date, July 20, on account of the immense lakes still covering the back pastures" (Nor'Wester July 1). It is unlikely that much standing water from the spring flood would have remained until this late date and it is assumed to have resulted from the rain the newspaper reported. At Fort Pelly, rain was recorded on 14 days from June 1 to July 7; eleven of these were heavy falls (Rannie 2001). At Red River, Samuel Taylor reported heavy thunderstorms on six days in June and on August 31, he referred to the "*wonderfully rainy fore part of the summer*" (Taylor Diaries).

With less confidence, isolated comments from some other years may also be interpreted as indicating unusually heavy rainfall for part of the summer. For example, on August 13, 1814, Peter Fidler observed "*water rising fast in the [Red] river these 4 days from rains in the Upper Country*" (Fidler 1814) and on September 13, 1869, the Nor'Wester newspaper noted "*there has been heavy rains somewhere up the country. The Red River has risen [this week] some two feet, and we learn that almost all the bridges which crossed the small streams between [here] and Georgetown have been carried away*" (Nor'Wester, September 13). A substantial rise in the stage of the Red River in August or September is unusual and must indicate widespread abundant rainfall in the basin upstream. In 1870, Colonel Garnet Wolseley encountered frequent rain on his regiment's trip from Fort William to Fort Garry: "*it has rained upon forty-five days out of ninety-four that have passed by since we landed at Thunder Bay and upon many occasions every man has been wet through for days altogether*" (Wolseley 1870, 20).

Discussion

Interpretation of "data" of the sort presented above is a subjective matter and readers' interpretations of individual years may differ from the writer's. Most convincing are the years in which commentary on rainfall is combined with observations of high water at a season when water levels are normally relatively low. Even allowing for some disagreement about the interpretation of individual years, however, the number of wet summers from 1800-1870 is remarkable. Most striking is their concentration into two time periods, 1824-1834 and 1849-1861, in which nearly every summer was wet (Figure 2). These are almost identical to the "*pronounced wet intervals in the late 1820s and 1850s*" which St. George and Nielsen (2002, 103) identified from dendroclimatic reconstructions in southern Manitoba.

In half of the years, the comments come from at least two of the three regions (eastern Saskatchewan/western Manitoba, the Red River valley



Figure 2: Years with wet summers.

and northwestern Ontario), indicating that the wet conditions were widespread. In several of the years where only one region is represented, the spatial extent may be more a reflection of the availability of records than an indication that the rainfall didn't occur in other regions. Furthermore, even in those years, references to high water levels in lakes and rivers indicate that the rainfall was not a localized phenomenon.

The climatic sensitivity of river regimes in the Prairies and Great Plains has been noted by several writers (Karl and Riebsame 1989; Zaltsberg 1990; Knox 1993; Rowe et al. 1994; Ashmore and Church 2001) who have demonstrated that comparatively small changes in precipitation may produce disproportionately large changes in streamflow. Most have focussed on spring flood potential or annual runoff but their conclusions may apply equally to summer runoff. In 1993, for example, July and August rainfall was 200% or more of normal throughout the region and produced discharges more than an order of magnitude greater, particularly in August when bankfull conditions were approached or exceeded in most streams. At Emerson, the mean August discharge of the Red River was almost ten times the upper quartile August mean discharge and even exceeded the upper quartile monthly means during the peak flow months of April and May (Figure 3). The exceptional June-July rainfall in 2005 produced an equally severe but even broader summer peak (Figure 3). Many of the 19th century comments suggest similarly severe conditions and 1993 and 2005

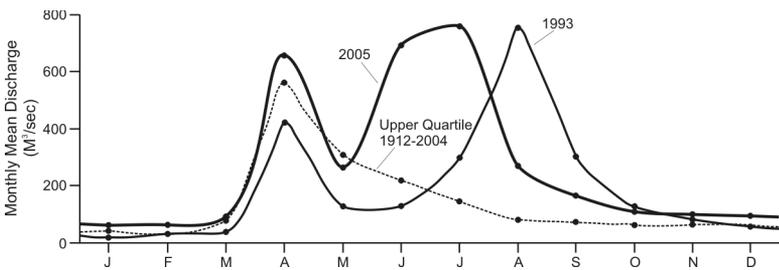


Figure 3: Monthly mean discharges in 1993 and 2005 and upper quartile of monthly mean discharges 1912-2004, Red River at Emerson.

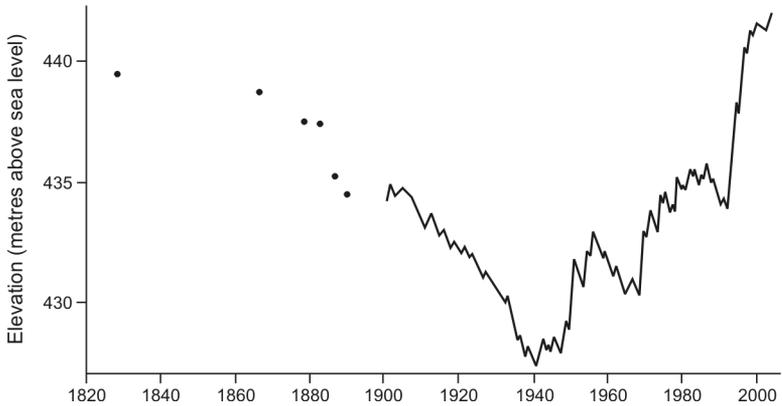


Figure 4: Water levels, Devils Lake, ND.

offer possible portraits of the river regimes which dominated the periods 1824-1834 and 1849-1861.

The incidence of wet summers with high runoff proposed in this paper contributes to the understanding of many aspects of the 19th century regional hydroclimate. For example, Clark (1988) used the charcoal content of varves in Demming Lake in northern Minnesota to infer forest fire frequency over the past 700 years. From a substantial peak in the late 1700s (indicating a high fire frequency), his charcoal index fell to the lowest values in the entire sequence (and thus a very low fire frequency) during the time period considered here.

The response of regional lake levels to augmented summer runoff is reflected in the history of Devils Lake, ND (Figure 4). The lake was high at the beginning of surveyed records in 1867 (Figure 4) and probably even higher in 1830 (Upham 1895). After 1867, the lake fell almost continuously to a minimum of 427.1 m in 1940 and although it recovered after 1940, the mid-19th century levels were not reached again until the spectacular recent rise caused by the succession of wet summers beginning in 1993.

The longest lake and proxy climate record in the region is the 2300-year diatom-based salinity record reconstructed for Moon Lake, ND (Laird *et al.* 1996). The period 1800-1860 had the lowest salinity in the entire record (Figure 5) and included a freshwater interval from 1820 to 1835. The high 19th century levels of Moon Lake and Devils Lake would be expected from the precipitation/runoff regime suggested in this paper. The commentators often reported summer lake and river levels to be high, sometimes dramatically so. Runoff from the numerous spring floods, especially those of 1826 and 1852, would have compounded the summer

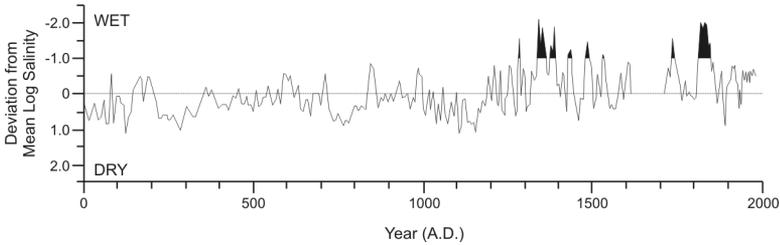


Figure 5: Diatom-based salinity reconstruction, Moon Lake, ND (redrawn from Laird et al. 2005).

rainfall and make the high water levels of Moon Lake and Devils Lake even more understandable.

Saturated ground and reduced available basin storage in the previous fall provide important preconditions for spring floods in the region. On the Red River, the very large floods of 1826, 1852, and 1861 were all preceded by wet summers and high water levels in rivers, lakes, swamps and depressions which otherwise might have provided storage for snowmelt in the following spring. The importance of this in the genesis of the disastrous 1826 flood (the largest in more than 200 years of record) was recognized by Ross who was an eye-witness to the event: “*The previous year had been unusually wet; the country was thoroughly saturated. The lakes, swamps, and rivers at the fall of the year were full of water...*” (Ross 1856, 106). Other floods on the Red River in 1815, 1825, 1828, and 1850 (Rannie 1998) and on the Assiniboine River in 1825, 1826, 1829, and 1852 (Rannie 2001) were also preceded by wet summer/fall conditions in the previous year. As a flood-forming factor, this may have been relatively more important in the 19th century when the landscape normally offered greater storage potential than its modern, intensively-drained, counterpart.

The archival evidence for very wet intervals on the eastern prairies from 1824-1834 and 1849-1861 is compelling but they do not appear in dendroclimatologic reconstructions from the western prairies. June-July precipitation for Medicine Hat reconstructed from tree-rings in the Cypress Hills show an unremarkable sequence of above and below median years from 1824-1834 and “*a period of prolonged drought [from] 1851-1864, when only two years had June-July precipitation above the median*” (Sauchyn 2005, 29). The only first-hand accounts from the western prairies during this period are those of John Palliser in 1858 and 1859. Palliser certainly experienced very dry conditions in Alberta, particularly in 1859, but the excessive rainfall on the eastern prairies reported by Henry Youle Hind in 1858 (see above) is normally overlooked and there is no compelling

evidence for severe drought on the eastern prairies in 1859 (Rannie 2006). Such a disparity between eastern and western prairies is unusual but a dramatic example occurred in 2000 when severe drought in southern Alberta coincided with much above normal precipitation in the eastern prairies and northwestern Ontario. The reconstructed precipitation record for Medicine Hat suggests that such a dichotomy between eastern and western regions persisted for decade-length intervals in the early and mid-19th century.

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