Bicycle Parking and Weather Conditions in Winnipeg
Analysis of a parking survey conducted for Bike Winnipeg
June 28, 2013

Bike Winnipeg (formerly Bike to the Future) has conducted counts of commuter cyclists each spring for the past seven years and provided a report and analysis of the results each year.[1] These reports have shown a strong relationship between weather conditions and the numbers of commuter cyclists. Following the completion of the 2011 report it was felt that the spring counts were not fully capturing the impact of weather on cycling. As a result another type of survey was launched in the fall of 2011 in which individuals and organizations were asked to systematically record the numbers of bicycles parked where they work or go to school throughout the year on a weekly basis. The numbers of parked bicycles could then be related to weather conditions throughout the year, rather than depending on counts done in the spring during relatively good weather.

Bike Counting Methods

Volunteers were requested to assist in the survey through the Bike to the Future email list and other personal contacts. Several people offered to provide counts at their workplace, where they attended school, or locations that were convenient to their weekly travel schedule. Some counts covered only part of a year and excluded the winter months. These were not used in the analysis. The result was that counts were done on a consistent basis throughout much or all of the year at eight locations. The locations and their characteristics are shown in the table below.

The counts used in this analysis were all done during weekdays, usually Tuesday, Wednesday or Thursday at a consistent time of day, usually around midday or early afternoon. These times were seen as those that would best reflect routine commuter-type use of the facilities and would best reveal normal patterns and the impact of weather conditions. Where it was reported, data for Saturdays, Sundays or holidays was not used. Some locations are also affected by special events, notably Red River College where there is an influx of students in September, and the Forks Market where special events often take place, attracting many visitors. At Red River College the number of parked bicycles more than doubled between August and September 2012, but still the overall parking patterns throughout the year reflected weather conditions. At the Forks Market the timing of the counts used in the analysis largely avoided major events that generally take place on weekends or evenings. (There is often temporary bicycle parking set up for special events at the Forks, but this temporary parking was not included in our survey.) While none of the counts for the Forks Market used in this analysis approached 100% of the capacity of the bike racks surrounding that building, the counts done in evenings and on weekends (that were not used) have occasionally exceeded the bike rack capacity.

Most of the bicycle parking facilities were outdoors in public places, but two were indoor for employees or in a parkade.

[1] The most recent report **Commuter Cycling in Winnipeg, 2007–2012** can be downloaded from www.biketothefuture.org..

Weather Data

Two measures of weather conditions were used in the analysis – average daily temperature, and total daily precipitation. Weather data was obtained from Environmental Canada's web site for the Forks. Data on average wind speed was not available. Data on the maximum speed of gusts was also collected from the web site but has not yet been analyzed. For some dates, Environment Canada did not provide temperature and/or precipitation data, but in most of these cases alternative sources of data were found from other reporting locations in Winnipeg (Winnipeg airport or Charleswood reporting stations).

Locations and Characteristics of Bike Parking Survey
September 2011 – April 2013

Organization	Location	Type of Parking	Survey Period	Number of Counts*	Estimated Capacity	Average Count
Red River College	Exchange District	several racks adjacent to the college - outdoor	Oct 2011 – Dec 2012	93	56	13.2
Université de St Boniface	200 Ave. de la Cathedrale	2 bike cages in parking lot	Sept 2011 – Sept 2012	46	15	9.5
Dental College	Bannatyne East of Tecumseh	bike cage - indoor	Sept 2011 – Dec 2012	94	40	17.1
Manitoba Hydro	360 Portage Ave	Bike cage for employees – indoor parkade	Feb 2012 – Apr 2013	166	150	27.2
The Forks Market	Forks Market Building	bike racks around the building	May 2012 – Apr 2013	54	35	7.0
Can. Wheat Board	423 Main St	bike rack - outdoor	Sept 2011 – July 2012	46	35	14.1
Man. Telephone System	181 Pioneer	bike rack - outdoor	Sept 2011 – July 2012	46	50	18.2
Fairmont Hotel	Portage & Main	bike rack - outdoor	Sept 2011 – July 2012	46	10	2.3
TOTAL				**673**	**391**	**109**

* Number of counts used in the analysis, generally mid-week counts – see text.

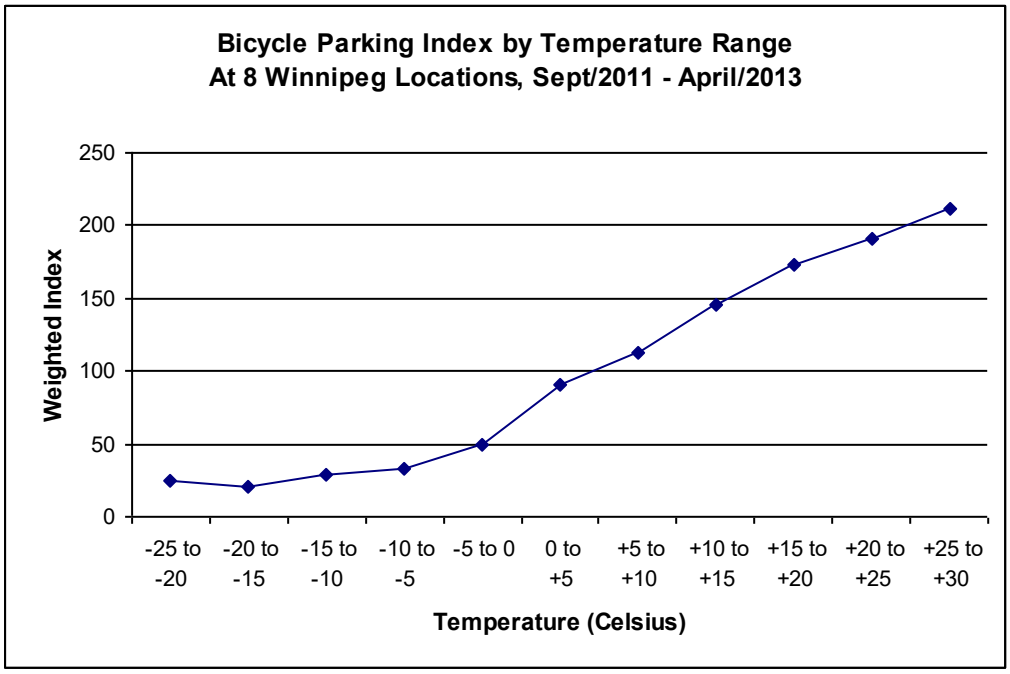
Time Period

The survey received data over a period of 20 months, but the time period varied between 10 and 15 months for the different locations. All of the counts included at least one full winter as well as counts done in spring, fall and summer. The winter of 2011-12 was unusually mild and the spring of 2012 came early. On the other hand the winter of 2012-13 was unusually cold and long and snowy, with sub-zero temperatures dominating during most of April, 2013. Therefore the survey period included a wide range of weather conditions and provided a good opportunity to look at the relationships between weather and bicycle use.

Analysis

A database was created, organized by date, showing the bicycle parking counts for each date at each location, along with the average temperature in degrees Celsius, and the amount of precipitation in millimetres. The average number of bicycles parked per location was used as a reference point. This was converted to an index by dividing the number of bicycles on a given day by the average number for that location over the whole time period to determine how much above or below average the count was. This also makes the counts comparable between locations with larger and smaller numbers of bicycles.

After reviewing the number of observations in the data base and the distribution of observations in terms of weather conditions, temperature categories were defined as five degree temperature ranges: 0–5, 5-10, 10-15, etc. Bicycle parking index values were calculated by summing all of the counts for the days that fell within the temperature range, divided by the sum of the average counts that would be expected for those counts and locations. The results of this analysis are shown in the following graph.



When the temperature is below -5° the index ranges between 21 and 34; that is, the number of parked bicycles is between 21% and 34% of the averages at the locations counted. As the temperature increases from -5° to +30°, the index increases steadily to 211, indicating that when temperatures are in the upper 20s the number of parked bicycles is more than double the average. For the set of locations and time periods used in this analysis the average level seems to be reached at about +5 degrees Celsius.

Precipitation

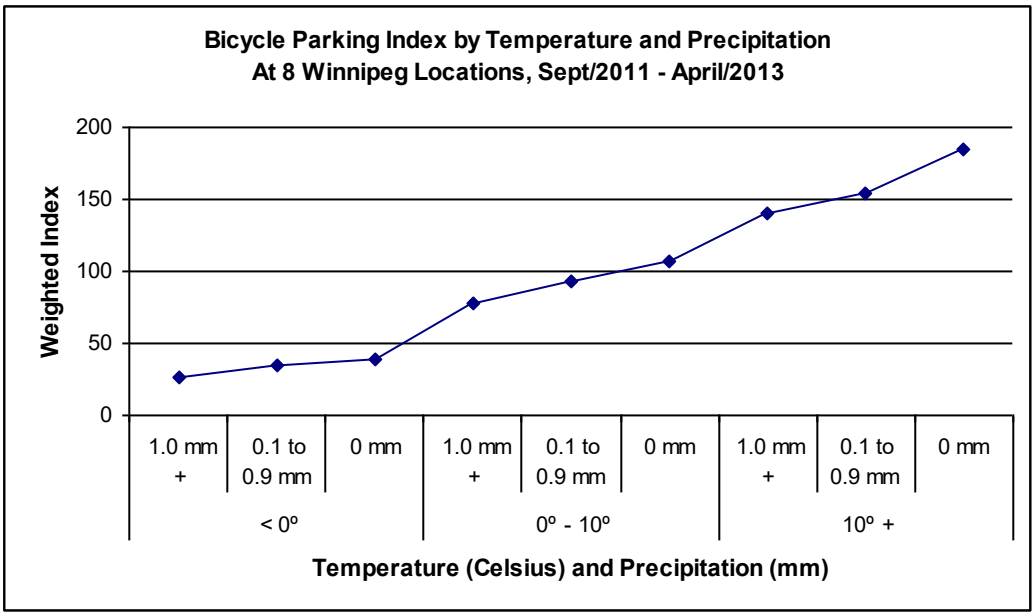
We also looked at the relationship between the amount of precipitation and numbers of parked bicycles. Because temperature has such a strong impact we created three broad temperature categories:

Less than 0°
0° to +10°
10° or higher

Within each of these temperature categories we looked at the relationship between the amount of precipitation and the index of parked bicycles. Three categories of precipitation were used:

No precipitation
0 to 0.9 mm
1 or more mm

As expected the index of parked bicycles consistently decreased as the amount of precipitation increased. When the relationships were examined from lowest to highest temperature categories and from highest to lowest precipitation amounts, it was found that the index was higher for higher temperatures, even when there were greater amounts of precipitation. (See graph.)



Conclusions

These findings are based on a limited sample and time period. Still, they include 673 observations with a wide variety of weather conditions. Both temperature and precipitation affect numbers of commuter cyclists, as reflected in the numbers parked at the locations surveyed. At the coldest temperatures the number of cyclists is about 20% - 35% of the average, while at the warmest temperatures the number of cyclists is more than 200% of the average. In other words, on the coldest days the number of commuter cyclists is about 10% of the number on the warmest days.

Precipitation is also an important factor. When the days with precipitation of at least 1 mm are compared to those with no precipitation, numbers of parked bicycles are reduced by 24% to 33%, depending on the temperature range. Taking both factors into account, the number of parked bicycles in sub-zero weather with precipitation of at least 1 mm is 14% of the number parked in warm weather without precipitation.

All-in-all it is surprising that the effects of temperature and precipitation are not larger. It might be expected that cycling in temperatures below -15° would be minimal, but as reflected in the numbers of parked bicycles there is a significant minority of cyclists prepared to travel to work or school in such cold weather. With encouragement, in the form of bike routes that are well maintained and cleared in winter, the numbers of winter cyclists can be expected to increase.

Comments on this analysis are welcome and may be addressed to Jeremy Hull:
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