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# Library collection deterioration: a study at the University of Illinois at Urbana-Champaign

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## Research Notes

### Library Collection Deterioration: A Study at the University of Illinois at Urbana-Champaign

Tina Chrzastowski, David Cobb,  
Nancy Davis, Jean Geil, and Betsy Kruger

*A survey of bound items in the bookstacks of the University of Illinois library at Urbana-Champaign was conducted following the methodology used in the 1979 survey of the Green Library stacks at Stanford University. A reliable random sampling technique was used. The survey found that 37.0% of the items at Illinois are seriously deteriorated (paper is embrittled), 33.6% are moderately deteriorated (paper is becoming brittle), and 29.4% are in good condition (paper shows no signs of deterioration). The total cost of the survey was \$1,845.45 (excluding permanent staff salaries). The methodology can be adapted by other libraries for collection condition surveys.*

In 1959, publication of the results of W.J. Barrow's research on paper deterioration included the estimation that most twentieth-century printed books may have a shelf life of only fifty years or less.<sup>1</sup> Now, thirty years later, the reality of this sobering prediction is becoming painfully obvious to libraries and other cultural institutions worldwide. Recently a renewed emphasis on preservation has been apparent in the library literature, as well as at

professional conferences.

The collections of all institutions, from the largest research libraries to small museums, historical societies, and public libraries, are vulnerable to deterioration. The problem of progressive decay crosses all media to affect virtually all types of library material, including photographs, microprint publications, sound recordings, and computer tapes, among others; but paper deterioration is of particular significance to any collection condition study, and has been the focus of several surveys in recent years.

The results of a study conducted in 1979 in Stanford's Green Library stack collection appeared in 1982,<sup>2</sup> followed by the publication in 1985 of a massive survey of book deterioration at Yale University,<sup>3</sup> and in 1987 the results of a preservation study conducted in 1985 at the Syracuse University libraries.<sup>4</sup> Sample sizes of these three studies were 400, 36,500, and 2,548, respectively; they yielded results indicating levels of embrittlement ranging from 12% (Syracuse) to 37.1% (Yale).

Armed with this information and aware

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of growing concerns regarding its own collections, the preservation committee of the University of Illinois Library at Urbana-Champaign recommended in 1987 that a modest survey be performed similar to that previously conducted at Stanford University. As in the Stanford study of its Green Library stacks, the preservation committee at Illinois chose to survey the collections in the bookstacks of the university library. With holdings of 5.3 million volumes, this section of the library is the most representative of the total collections. Although the bookstacks also house the government documents collection and the Asian library, these specialized holdings were not included in the study. As in the Stanford survey, unbound items were excluded from the statistical sample.

The survey objective was to gain insight on the deterioration of the library collection by providing specific data as to the condition of three distinct elements: paper, bindings, and boards and covers. A paper fold test was also performed. While not as comprehensive in scope as the Yale or Syracuse surveys, this survey can be reproduced by other libraries at minimal cost.

### METHODOLOGY

The survey's sample size was derived from a table of sample sizes for selected confidence levels and tolerances presented in M. Carl Drott's article, "Random Sampling: A Tool for Library Research."<sup>5</sup> Sample sizes shown in Drott's table are valid for surveys of over 30 items but less than 10% of the population. The population of books in the University of Illinois at Urbana-Champaign bookstacks is estimated at 5.3 million volumes. Using Drott's table, the sample size was set at 384 items. This would allow a 95% confidence level and a 5% tolerance level.

Tolerance and confidence are two types of error measures. Drott defines tolerance as "a measure of the accuracy of our result" and confidence as "a measure of how certain one is that the true answer lies within the limits stated in this tolerance." To state at a 95% confidence level that 37% (plus or minus 4%) of books surveyed at

Illinois are in poor condition means that there is a 1 chance in 20 (5%) that the actual percentage of surveyed books that are in poor condition is greater than 41% or less than 33%.

### *Preparing the Sample*

The validity of the survey depended on random selection of items to be surveyed. Sets of random numbers for selecting each item by floor, range, column, shelf, and book were computer generated. For each item, 1 random number was assigned for floor, 6 for range, column and book, and 2 for shelf. These multiple options prevented a large number of rejects due to disparate shelving situations.

### *Criteria and Grading*

This study closely paralleled the methodology of a similar study performed at Stanford University in 1979.<sup>6</sup> Books were evaluated according to three separate criteria: condition of paper, binding condition, and the condition of the boards and covers. Paper condition was given twice the weight of binding or cover and boards in the final scoring. Paper is weighted by two since it represents the intellectual portion of the book and its deterioration is of prime concern to the library.

Each book was evaluated for paper discoloration, tears, missing pieces, and rough edges. In addition, each item was given a paper fold test, which was used along with the evaluation score to determine the paper condition in the study. The last numbered page was selected to insure that actual text pages were tested rather than fly leaves. A maximum of six folds was used for this survey. The severity of these characteristics determined the score each book was given for paper condition.

Binding condition was scored by the quality of the stitching at the spine and how well the pages adhered to it. The boards and covers were scored by examining the outer portion of the book and the inner hinges where the boards are attached to the text block.

The combined grading of these categories was used to determine the overall score for each volume. Detailed grading

procedures are found in the Stanford study.<sup>7</sup>

### WORKSHOP

Eleven students from the university's graduate school of library and information science were hired for the study. A workshop was held to train these surveyors to conduct the study and complete the survey forms. Emphasis was placed on the method for locating the materials to be evaluated using maps and random numbers, criteria for evaluating a book, and how to apply the grading system and compute the overall score. A tour of the library stacks was included; a pretest to grade sample books completed the training. Survey supervisors attended the pretest session to meet the students and observe their training.

### THE UIUC SURVEY

Due to well-trained surveyors and a tested, well-documented methodology, the survey was completed as planned and on schedule.

#### *The Survey Form*

The survey form (Appendix A) was designed to collect all the required data in an easy, progressive way. At the head of the survey form were the random numbers used to locate the book for evaluation; a line identifying the call number allowed supervisors to review the surveyors' work.

Rejects from the survey were few, numbering only 22; the survey form required a reason for rejection and these items were later reviewed by supervisors. All rejects were the result of stack areas that did not meet the requirements of the random numbers; that is, there were too few ranges, columns, shelves, or books.

The evaluation portion of the survey form required surveyors to simply circle the values given to each category. A final, overall score was the last item to be completed, and concluded the form.

#### *Survey Day*

Survey forms were pre-sorted by floor in order to reduce the distance and time

between each item. Each surveyor was given 50 survey forms but was instructed to stop once 40 forms had been completed. In addition, each student had full written instructions and floor maps. All questions were to be referred to the supervisor on duty for that floor. Only a few questions were asked of the supervisors; to reduce labor costs for future surveys, we recommend only one supervisor be scheduled to handle all surveyor questions.

Over 90% of the surveyors finished the required 40 forms the first day (5.5 survey hours). All forms were completed by noon the second day.

### RESULTS OF THE SURVEY

Table 1 summarizes the data obtained in the survey. The data indicate (at a 95% confidence level and a 5% tolerance level) that of the random sample of 384 books in the stacks:

29.4% are in good condition (weighted average = 0);

33.6% are in moderate condition (weighted average = 1);

37.0% are in poor condition (weighted average = 2).

As in the Stanford survey, the overall weighted averages at Illinois (0 = 29.4%, 1 = 33.6%, 2 = 37.0%) correspond closely with the paper condition scores (0 = 32.0%, 1 = 31.0%, 2 = 37.0%; see table 2). This is because, at both institutions, the condition of the paper was given twice the weight of binding or cover and boards in the final scoring. Binding showed extensive deterioration in 4.7% of books sampled, and boards and covers showed extensive deterioration in 8.3% of books sampled.

Table 2 compares the results of the survey of the University of Illinois library bookstacks with those of the Stanford survey of their Green Library stacks. Illinois' methodology closely duplicated Stanford's, making comparisons generally valid: 29.4% of Illinois' sample and 32.8% of Stanford's were in good condition; 33.6% of Illinois' and 40.8% of Stanford's were in moderate condition; and 37.0% of Illinois' and 26.5% of Stanford's were in poor condition.

The survey showed that, at the Univer-

TABLE 1  
LEVELS OF DETERIORATION OF TOTAL SAMPLE (N = 384)

	Condition of Paper			Condition of Binding			Condition of Boards and Covers			Weighted Average		
	0 Good	1 Moderate	2 Poor	0 Good	1 Moderate	2 Poor	0 Good	1 Moderate	2 Poor	0 Good	1 Moderate	2 Poor
Number of titles	123	119	142	272	94	18	191	161	32	113	129	142
Percent of titles	32.0%	31.0%	37.0%	70.8%	24.5%	4.7%	49.7%	41.9%	8.3%	29.4%	33.6%	37.0%

TABLE 2  
UNIVERSITY OF ILLINOIS (1988) AND STANFORD (1979):  
COMPARATIVE LEVELS OF DETERIORATION

	University of Illinois (n = 384)			Stanford University (n = 400)			Percent Change U of I		
	0 Good	1 Moderate	2 Poor	0 Good	1 Moderate	2 Poor	0 Good	1 Moderate	2 Poor
Weighted average	29.4%	33.6%	37.0%	32.8%	40.8%	26.5%	-3.4	-7.2	+10.5
	(113)	(129)	(142)	(131)	(163)	(106)			
Condition of paper	32.0%	31.0%	37.0%	33.3%	40.3%	26.5%	-1.3	-9.3	+10.5
	(123)	(119)	(142)	(133)	(161)	(106)			
Condition of binding	70.8%	24.5%	4.7%	70.8%	25.5%	3.8%	0	-1	+ .09
	(272)	(94)	(18)	(283)	(102)	(15)			
Condition of boards and covers	49.7%	41.9%	8.3%	56.3%	36.3%	7.5%	-6.6	+5.6	+0.8
	(191)	(161)	(32)	(225)	(145)	(30)			

sity of Illinois, paper conditions are poor in 37% of the collection, as contrasted with 26.5% at Stanford. Because paper is given twice the weight of the other criteria, the condition of paper has a greater impact on the overall level of deterioration; as a result, the proportion of books with a weighted average score of "poor" is identical to that for poor paper conditions at both Illinois and Stanford. Environmental factors probably account for most of this difference. Central Illinois is subject to high heat and humidity in summer and to frequent temperature fluctuations throughout the year. In contrast, Stanford enjoys a moderate coastal climate with only mild temperature fluctuations throughout the year. The stacks of both libraries are partially air-conditioned—Stanford in 1980 and Illinois in 1982. Less immediately obvious factors, such as use and age of materials, may also play a role in the higher rate of deterioration at Illinois. The impact of the nine-year time span between the two surveys is probably marginal.

Weighted averages equalling 2 for binding were 4.7% and 3.8% for Illinois and Stanford respectively, and weighted averages equalling 2 for boards and covers were, respectively, 8.3% and 7.5%. Conditions of binding at both institutions were strikingly parallel. The percentage of books with boards and covers in good condition was higher at Stanford (56.3% vs. 49.7%).

Table 3 shows the distribution of weighted averages by date group. For date groups with fewer than 100 samples (1850-99 and pre-1850) statistically valid conclusions cannot be drawn. Of books published after 1950, 9.4% are in poor con-

dition. This figure jumps to 67.7% for books published between 1900 and 1949, supporting the Barrow estimate that books published in the twentieth century have only a 35- to 50-year life span. These findings roughly support Stanford's, which found 6.2% of books published between 1950 and 1979 and 44.6% of those published between 1900 and 1949 to be in poor condition. Table 4 displays these comparative findings.

In conclusion, the survey results are sobering: 70.6% of the books sampled evidenced some degree of deterioration. Moderate deterioration was evident in 33.6% and extensive deterioration in 37.0%. Of books judged to be in poor condition, paper condition was the overriding factor. In general, the University of Illinois' survey results parallel the findings at Stanford, although paper deterioration is more extensive at Illinois.

It is possible to submit these results to standard statistical testing using the chi square formula.<sup>8</sup> Specifically, we tested table 2 for its summary findings. We defined our null hypothesis as: the state of deterioration of the sampled books is independent of whether they are located at the University of Illinois or Stanford University libraries. Applying the chi square formula

$$\chi^2 = \sum \frac{(fo-fe)^2}{fe}$$

and a degree of freedom of 2 ( $df = 2$ ) we reached the following results:

Weighted average	$\chi^2 = 10.18$
Condition of paper	$\chi^2 = 11.59$
Condition of binding	$\chi^2 = .49$
Condition of boards and covers	$\chi^2 = 3.35$

If the variables are independent we

TABLE 3  
LEVELS OF DETERIORATION  
OF TOTAL SAMPLE (N = 384) BY DATE GROUP

Date Group	Total	0 Good	1 Moderate	2 Poor
1950-	191	103 (53.9%)	70 (36.6%)	18 (9.4%)
1900-49	141	10 (7.1%)	44 (31.2%)	87 (67.7%)
1850-99	41	0 (0.0%)	10 (24.4%)	31 (75.6%)
Pre-1850	11	0 (0.0%)	5 (45.5%)	6 (54.5%)

**TABLE 4**  
UNIVERSITY OF ILLINOIS (N = 384) AND STANFORD UNIVERSITY (N = 400)  
COMPARATIVE LEVELS OF DETERIORATION BY DATE GROUP

Date Group	Total Titles		Good Condition 0		Moderate Condition 1		Poor Condition 2	
	UI	Stanford	UI	Stanford	UI	Stanford	UI	Stanford
1950-1979	174 (45.3%)	210 (52.5%)	89 (51.1%)	120 (57.1%)	67 (38.5%)	77 (36.7%)	18 (10.3%)	13 (6.2%)
1900-1949	141 (36.7%)	112 (28.0%)	10 (7.0%)	8 (7.1%)	44 (31.2%)	54 (48.2%)	87 (61.7%)	50 (44.6%)
1850-1899	41 (10.7%)	47 (11.7%)	0 (0.0%)	1 (2.1%)	10 (24.3%)	11 (23.4%)	31 (75.6%)	35 (74.5%)
1800-1849	11 (2.9%)	12 (3.0%)	0 (0.0%)	2 (16.7%)	5 (45.4%)	9 (75.0%)	6 (54.5%)	1 (8.3%)

would expect the chi square statistics to be lower than 5.99, the critical value for chi square with  $df = 2$  and a 95% confidence level. Therefore, we cannot reject the null hypothesis for binding and boards and covers. The higher values for weighted average and condition of paper suggest the null hypothesis to be void. One explanation, as we have mentioned, is the environmental differences which may have led to higher deterioration percentages at the University of Illinois.

#### COSTS OF THE SURVEY

Costs for this survey were kept to a minimum due to administrative constraints and through the use of permanent staff. Most of the preparation for the survey was performed by permanent members of the library's staff or by a graduate assistant assigned to the preservation committee. The seven permanent faculty members on the committee spent an estimated 191.5 hours on the project, an average of 27.6 hours each. This estimated time includes a survey pre-test, 42.5 hours of survey supervision, report writing, and committee meetings. The graduate assistant spent an estimated 100 hours on the project. Eleven graduate library school students (including one alternate) were hired to perform the survey at a rate of \$6.00 per hour; student and graduate assistant labor costs totaled \$1,573.00.

Programming and computer services were donated by a professional member of the library's staff, while computer analysis was completed by a free-lance programmer for \$150. Miscellaneous supplies were provided by the university library, and copying costs totaled \$122.45. The total cost of the survey was \$1,845.45, excluding permanent staff salaries.

Including the cost of permanent professional salaries (median hourly salary at Illinois is \$13.75) increased the actual cost of the survey by \$2,633.13, to \$4,478.58. Labor costs could have been reduced with greater use of students or non-academic staff. Our experience showed that professional time on the survey could have been reduced significantly by having fewer survey supervisors. For example, professional labor costs could have been reduced

by 18% by using only one supervisor on the day of the survey.

### CONCLUSION

This survey of the condition of materials in the bookstacks of the University of Illinois library has yielded data for the purpose of making informed decisions for annual budgeting and other aspects of preservation planning. The information will also be essential in documenting the case for increased administrative support for library preservation.

At the same time, it would be a mistake to assume that this study necessarily mirrors the condition of the university library collections in their entirety. In the interest of obtaining data on binding, as well as covers and boards, unbound materials were excluded; among the latter are some of the most severely deteriorated items in the bookstacks. Some heavily-used genres (such as printed music and maps) do not fall within the scope of the survey. On the other hand, the percentage of older materials is considerable higher in the general bookstacks than is typical in most departmental libraries.

It has been demonstrated that useful results can be gained quickly and at minimal cost using trained student assistants. As in similar studies elsewhere, there may be small but unavoidable variations in the

manner in which different surveyors apply the measurement criteria. This risk can be considerably minimized by running a pilot study to bring unforeseen difficulties to light, and by conducting a well-planned instructional workshop to offer surveyors hands-on experience in evaluating volumes under the close supervision of project planners.

Having completed this collection survey, the preservation committee has established baseline data for future studies. These could involve the utilization of a new sample, or rechecking the same titles. The study could also be repeated in the undergraduate library, other departmental libraries, or with categories of special materials excluded from the original survey (such as maps, printed music, or some collections of foreign imprints).

Following the lead of Buchanan and Coleman's 1979 study at Stanford,<sup>9</sup> condition data has now been gathered for several major university library collections. In order for valid statistical comparisons to be drawn, it is recommended that other institutions conduct condition surveys utilizing the methodology reported here. As more precise information becomes available regarding the extent of library collection deterioration, it is hoped that the preservation issue will be duly recognized as an impending national crisis.

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## APPENDIX A: SURVEY FORM

(Circle which random numbers were used to locate the book.)

REJECT reason: \_\_\_\_\_

FOLD TEST number of folds: 1 2 3 4 5 6  
 score: 0 1 2

CALL #: \_\_\_\_\_

SHORT TITLE: \_\_\_\_\_

DATE OF PUBLICATION: \_\_\_\_\_

PLACE OF PUBLICATION: 1 2 3 4 5 6 7  
 write place of publ. here \_\_\_\_\_

## EVALUATION

(Circle one in each category.)

A. PAPER	0	1	2
B. BINDINGS	0	1	2
C. BOARDS/COVERS	0	1	2
SCORE	0	1	2

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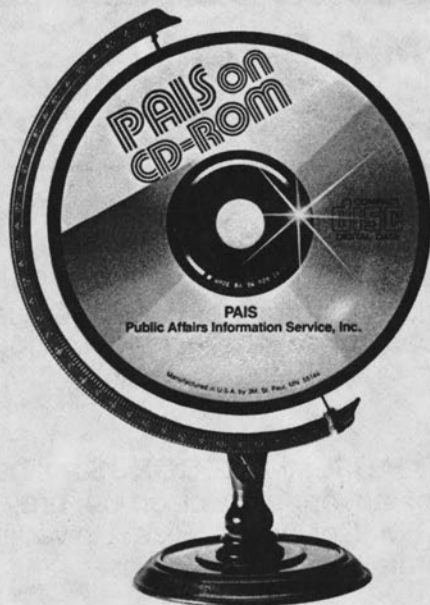
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