A METHOD FOR EVALUATING THE USE OF LIVING PLANT COLLECTIONS IN PUBLIC HORTICULTURAL INSTITUTIONS

by

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ABSTRACT

Most public horticulture professionals realize the importance of living plant collections, but few have more than a general idea of how much these collections are used. As funds become tighter, public horticulture professionals will constantly seek ways to maximize the return from all aspects of their organization--including their collections.

This research involved surveying staff at three public gardens and arboreta, and determining how much each institution used its collections in its programs during fiscal year 1992-1993. The three institutions were the Arnold Arboretum, Longwood Gardens and the Morris Arboretum. The research method consisted of staff interviews and data collection at each of the institutions to document how pertinent activities and programs used the living collections. These uses were then summarized and compared with the institution's mission statement.

Results will be valuable to public horticulture professionals who are interested in maximizing the use of their institution's collections. The method of evaluation and the case studies presented in this paper will provide these professionals with tools and information to duplicate the research in their own institution. It will provide these professionals with the means necessary to make good decisions regarding the collections at their institutions.

INTRODUCTION

Living plant collections are what make public horticulture institutions unique and different from other cultural institutions. It is the living plant collections that form the core of most public gardens and arboreta,[1] whether as the essential elements of an estate once belonging to a gentleman gardener, or a group of plants gathered in one place by people intent on studying the flora of the world.

Most public horticulture professionals realize the importance of their institution's collections, but how many have more than a general idea how much these collections are used? With ever-tightening budgets, directors are forced to take a critical look at how funds are allocated. A careful analysis of how much collections are used in the institution's programs can be a valuable management tool. This analysis can help justify the allocation of additional resources toward maintaining and expanding plant collections and can expose areas of weakness where collections are underutilized. The research presents one method for public garden administrators to both quantify and qualify the use of their collections.

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[1] Both public gardens and arboreta will hereafter be represented by the term "public garden" in this paper.

Collections uses can be grouped into three main divisions; "...research or evaluation, education, and display..."[2] By grouping collections uses into these three divisions, analyzing the programs within the divisions, and comparing the results with the mission of the institution, this research identifies the strengths and weaknesses of the plant collections usage in three institutions: the Arnold Arboretum of Harvard University, Longwood Gardens and the Morris Arboretum of the University of Pennsylvania.

Although most institutions may not collect all of the data suggested in this methodology the collections use analysis presented here is adaptable for use by administrators at any public garden or arboretum. Information gained from the available data will reveal important information about an institution's use of its plant collections.

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[2] Edward R. Hasselkus, "Maximizing the Use of Collections," The 1984 Longwood Program Seminars 16 (1984): 17.

Chapter 1

METHODS

All of the programs for each institution were grouped into three divisions: Visitor Services, Education and Research. These three divisions correspond to the three divisions of plant collections usage as described by Hasselkus.[3] The Visitor Services division contains programs which provide the casual visitor with an interesting and informative trip through the garden, the Education division contains programs which teach students in a structured learning environment, and the Research division contains programs which further scientific knowledge. Figure 1.1 graphically depicts the system used to classify the institutions' programs.

As can be seen in Figure 1.1, the three divisions were further broken down into program groups, which are sets of similar programs all related to the central goal of their division.[4] For example, the division of Visitor Services was broken down into two program groups: Wayfinding and Interpretation. Wayfinding is the program group containing all programs that assist visitors in navigating the garden or arboretum, such as

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[3] Hasselkus 17. In this research, "visitor services" correlates to display as described by Hasselkus, "education" correlates to education, and "research" correlates to research or evaluation.

[4] "Divisions," "program groups," and "programs" are collective terms used in this paper to describe the different categories of data.

directional maps and signs. Interpretation is the program group containing all programs that provide information to the visitor about the things he or she encounters in the garden or arboretum, such as plant name labels. All programs that relate to visitor services were placed into one of these two program groups. Each program group is fully described in Chapter 2: Procedures.

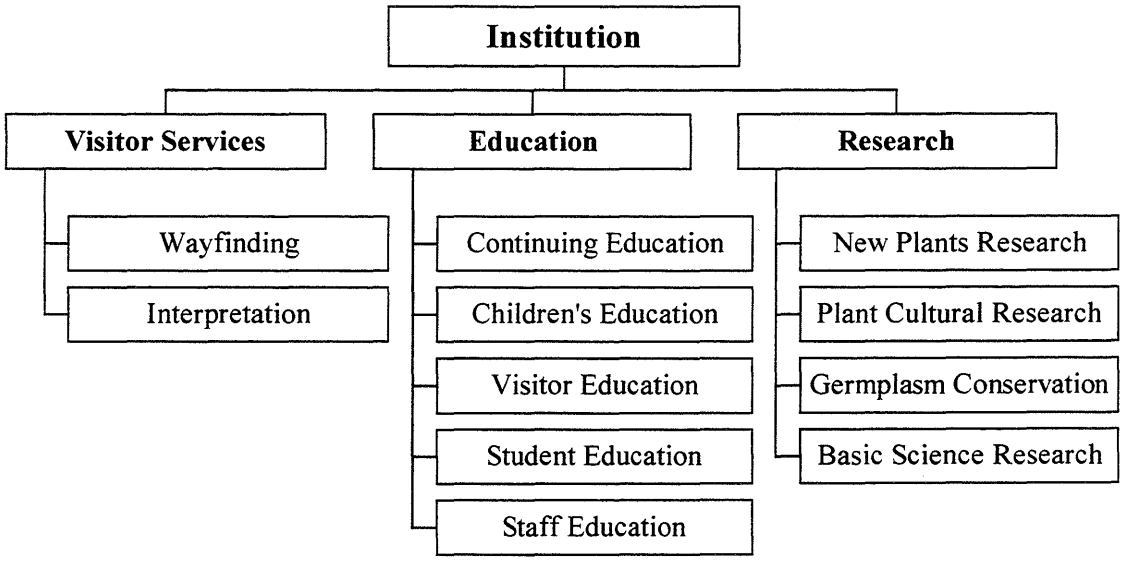

Figure 1.1: Program Classification System for Plant Collections Use.

To quantify collections use, each program was rated on a scale of 1, 2, or 3, where a rating of 1 was assigned to programs which did not use the collections, a rating of 2 was applied to programs which had some use of the collections (but not more than 50% of the information or activities used the collections) and a rating of 3 was applied to programs

which used the collections for the majority of information or activities. See Table 1.1: Program Ratings.

Table 1.1: Program Ratings.

Program Rating	Use of Collections
1	NO use of collections
2	1-50% use of collections
3	51-100% use of collections

The second step was to calculate within each program group the percentage of programs which received each of the three program ratings. For example, the number of programs rated 1 was calculated as a percentage of the total number of programs in that program group. This calculation was then repeated for programs rated 2 and 3. This analysis reveals the specific makeup of each program group. Figure 1.2: Program Rating Percentage Calculations, illustrates the equation used.

$$\frac{\text{number of programs rated 1}}{\text{total number of programs}} = \text{\% of programs rated 1}$$

$$\frac{\text{number of programs rated 2}}{\text{total number of programs}} = \text{\% of programs rated 2}$$

$$\frac{\text{number of programs rated 3}}{\text{total number of programs}} = \text{\% of programs rated 3}$$

Figure 1.2: Program Rating Percentage Calculations.

The third step was to create the overall rating for the program group. The overall rating was an average of the ratings for each of the programs in the program group. See Figure 1.3: Program Group Average Calculation., for the equation used in this calculation. The program group was then assigned to one of three broad categories, depending on the average rating.

$$\frac{[(\#\text{ programs rated 1}) \times 1] + [(\#\text{ programs rated 2}) \times 2] + [(\#\text{ programs rated 3}) \times 3]}{(\text{total number of programs})}$$

$$= \text{Program Group Average}$$

Figure 1.3: Program Group Average Calculation.[5]

Category A contained groups with a Program Group Average of 1 to 1.66, indicating that the program group had low use of the collections. Category B contained program groups with a Program Group Average of 1.67 to 2.33, indicating that the program group had average use of the collections. Program groups with a Program Group Average from 2.34 to 3 had high use of the collections, and were placed into category C. These ratings permitted quick identification of the level of collections use in the program group. See Table 1.2: Program Group Ratings.

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[5] This equation is reproduced in Appendix A: Frequently Used Calculations.

Table 1.2: Program Group Ratings.

Rating	Program Group Average	Use of Collections
A	1 - 1.66	Low Collections Use
B	1.67 - 2.33	Average Collections Use
C	2.34 - 3	High Collections Use

The fourth step was to create an overall rating for each division. Each of the program group averages were averaged to provide a Division Average. Figure 1.4 shows the calculation for the Division Average. A Division Rating was then assigned based on the Division Average, as shown in Table 1.3. Division Rating I was assigned to a division with a Division Average of 1 to 1.66, indicating that the division had low use of the collections. Division Rating II was assigned to a division with a Division Average of 1.67 to 2.33, indicating that the division had average use of the collections. Division Rating III was assigned to a division with a Division Average of 2.34 to 3, indicating that the division had high use of the collections. The division ratings provided a way to quickly identify the collections use for the division.

$$\frac{\text{(sum of all program group averages)}}{\text{(Total \# of program groups)}}$$

$$= \text{DIVISION AVERAGE}$$

Figure 1.4: Division Average Calculation[6]

[6] This equation is reproduced in Appendix A: Frequently Used Calculations.

Table 1.3: Division Ratings.

Rating	Division Average	Use of Collections
I	1 - 1.66	Low Collections Use
II	1.67 - 2.33	Average Collections Use
III	2.34 - 3	High Collections Use

To complete the analysis of each institution, it was essential to put the collections use levels into the larger context of the institutions overall activities and mission. This qualitative analysis provided information on whether the level of collections use was appropriate to the institution.

This final step in analyzing each division involved researching answers to general questions about the division. These answers provided information about the amount of institutional resources allocated to the division, the goals of the division, and other topics specific to each program group. This information was important as it provided a context to the quantitative information calculated in the previous steps.

This chapter has presented the general methodology for analyzing collections use, and portions of this chapter will be frequently referred to throughout the paper. The following chapter, Procedures, describes specifically how the methodology was applied to each of the program groups.

Chapter 2

PROCEDURES

The information for the case studies was gathered through staff interviews, appropriate brochures, reports and other written documentation from each institution. Contact people at each institution helped to identify key staff members to interview.

Staff members appropriate to each division were interviewed. Information was gathered pertaining to one fiscal year, 1992-1993. Specific interview questions are listed with the appropriate divisions, later in this chapter. During the interviews, verbal data was gathered, and documented where possible.

Some of the information necessary for a complete evaluation of an institution's collections use was not available. Either the institution had not collected the data, or data was collected in a format which made it impossible to convert it into the format necessary for this research. For example, staff salaries were rarely collected in a useable format. Often, salaries and benefits were tracked as part of the budget for a department or unit. Since the divisions in this research did not necessarily follow the organizational structure of the institutions studied, it was impossible to determine the total salaries for the divisions. In these situations, only the available and pertinent information was used.

Institutional Overview

An institutional overview was necessary to provide a context for the data analysis. The information gathered in the overview helped determine where the institution's collections use should be directed, whereas the division analysis showed where the collections use actually was directed. The main data points gathered for the institutional overview were the mission statement, the expense budget and a list of staff positions.

The mission statement for a garden or arboretum describes or states the most important functions of the institution. The researcher obtained a copy of the current mission statement from each institution and determined each institution's main functions.

The total expenses for fiscal year 1992-1993 acted as a baseline for comparing the budgets of the three divisions (visitor services, education, and research). If the budget for fiscal year 1992-1993 was either not available or not a representative budget, the previous year's expense figures were substituted.

For each institution, a list of staff positions and their full time equivalents was obtained. This allowed the total number of staff members to be compared to the staff levels of different divisions.

Visitor Services

For the purposes of this research, the Visitor Services division was the set of programs which helped make the grounds of the institution navigable and informative to the casual visitor. Visitor services programs acted as an interface between the institution and the casual visitor. These programs directed visitors through the grounds, helping visitors to find the garden areas or parts of the collections they wished to see, and

provided information about aspects of the plants, garden areas and other topics relevant to the institution.

Visitor Services programs used the collections by directing visitors to various parts of the collections, or by providing information to the visitor about the collections as a whole or certain elements of the collection. Visitor Services programs that did not use the collections typically included those that directed the visitor to other facilities, including gift shops and restrooms. Other Visitor Services programs that did not use the collections included those that provided information about events and facilities not related to the collections, such as a cultural event or historic building on the grounds.

Visitor Services Program Groups

There are two program groups included in the Visitor Services division: Wayfinding and Interpretation. The Wayfinding program consisted of all of the programs which helped visitors navigate the garden or arboretum. The Interpretation program group contained the set of programs that provided information to the visitor about the things he or she encountered in the garden or arboretum.

Wayfinding. The programs in the Wayfinding program group included directional signs inside and outside the garden, directional maps, murals, and scale models, to name a few. Each Wayfinding program was evaluated to determine how the collections were used.

First, all of the Wayfinding programs at the institution were listed, as in Table 2.1: Sample Table for Wayfinding Program Analysis. Then, the quantity of elements that

made up each program at the institution was determined. For fixed items, such as signs and models, the number of each sign or model was counted or approximated. For brochures and maps that were distributed to visitors, the quantity distributed in fiscal year 1992-1993 was obtained. To determine the number of brochures used, it was sometimes necessary to find out the number of brochures that were last printed, and divide this by the number of years which they lasted or were expected to last.

Table 2.1: Sample Table for Wayfinding Program Analysis.

#	**Name of Wayfinding Program**	**Quantity of Elements**	**Availability (.25, .50, .75, or 1)**	**Use of Collections (1, 2, or 3)**
1	Directional signs	15	1	1
2	Guide map	10,000/year	.5	2
3	Garden area signs	28	1	3

Another important data point for evaluating Wayfinding programs was the portion of the visitors who had access to each program. An exact number was rarely available, so an estimate of 25%, 50%, 75% or 100% was used. For example, for the program of Guide Maps, if Guide Maps were only available on the weekends, and approximately 50% of the visitors came on weekends, then the availability of the guide map would be 50%.

Each program was then rated based on how much it used the collections, as described in the Methods Chapter and depicted in Table 1.1, page 5.

After determining the quantity of each element, its availability to visitors and its use of the collections, the researcher determined the overall rating for the Wayfinding program group of visitor services. First, the total number of Wayfinding programs available at the institution was determined by adding the numbers in the availability column. Then the percentage of programs rated 1, 2 and 3 were determined using the Program Rating Percentage Calculations described in Figure 1.2: Program Rating Percentage Calculations, on page 5.

The example in Table 2.1 illustrates a fictitious garden with three different types of Wayfinding programs: directional signs outside the institution (ranked 1, with an availability of 1), a guide map (ranked 2, with an availability of .5), and signs at the entrance to each garden area (ranked 3, with an availability of 1). The total number for Wayfinding programs is 2.5 (1 + .5 + 1). The Program Rating Percentage calculations would be:

1s = 40% (1 component out of 2.5 total),
2s = 20% (.5 components out of 2.5 total),
3s = 40% (1 component out of 2.5 total).

The next step was to determine an average and then an overall rating for the Wayfinding program group. Using the calculations described in Figure 1.3, a Program Group Average was calculated. For the example above, the calculation was:

$$\frac{[(\text{rating 1 x 1 element}) + (\text{rating 2 x .5 elements}) + (\text{rating 3 x 1 element})]}{2.5} = 2.$$

The Program Group Rating was then assigned, based on the criteria in Table 1.2: Program Group Ratings. In the above example, the Program Group Average, 2, was in the range of 1.67 to 2.33, leading to a rating of B: Average Collections Use.

Interpretation. Common Interpretation programs included plant labels, exhibits, informational brochures, self-guided tours, and information desks. The Interpretation programs were evaluated in the same manner as the Wayfinding programs. Each program was listed, and the quantity and availability of each program was determined. Finally, each program was rated as illustrated in Table 1.1: Program Ratings. Table 2.2: Sample Table for Interpretation Program Group Analysis, illustrates the program analysis for a fictional garden's Interpretation program group.

Table 2.2: Sample Table for Interpretation Program Group Analysis.

#	**Name of Interpretive Program**	**Quantity of Elements**	**Use of Collections (1, 2, or 3)**	**Availability (.25, .50, .75, or 1)**
1	Plant Accession Labels	90% of collections	3	1
2	Champion Trees Self-Guided Tour	1,000/yr.	3	.25
3	Information Desk	N/A	2	.50

As with the Wayfinding program group, the next step in the analysis of the Interpretation program group was to determine an average and an overall rating for the program group. This was accomplished in the same manner as the Wayfinding program group. For the example in Table 2.2, the total number of Interpretation elements was

1.75, which was determined by adding the numbers in the Availability column. The Program Rating Percentage Calculations would be:

1s = 0%,
2s = 29% (.5 of 1.75)
3s = 71% (1.25 of 1.75)

The Interpretation program group as a whole was rated as to how much it used the collections in the same manner as the Wayfinding program group. The ratings of the different Interpretation programs were averaged, taking into consideration the availability of each element. For the example above, the calculation is:

$$\frac{[(\text{rating } 2 \times .5 \text{ elements}) + (\text{rating } 3 \times 1.25 \text{ elements})]}{1.75} = 2.71$$

Finally, the Interpretation program group was assigned an overall rating of A, B, or C, using the criteria discussed in Table 1.2: Program Group Ratings, page 7. In the above example, the Interpretation program group is rated C, since its average, 2.71, fell between 2.34 and 3.

Visitor Services Overview

The overview for the Visitor Services division provided insight into some general Visitor Services issues. The researcher obtained pertinent goal statements dealing with Visitor Services, and obtained a brief history of the Visitor Services efforts at the institution. The following list of questions was then used to develop an overview of the Visitor Services efforts at the institution:

- What is the acreage of the institution and how much of this area is accessible to the general public?
- What percent of the collections are located in areas that are open to the public?
- How many people visit the institution annually? How do they use it? A visitor survey is an excellent resource for determining how visitors use the garden or arboretum.
- What facilities are available for visitors? Include such facilities as a visitor center, gift shop and restrooms.
- What are the annual expenses for Visitor Services?
- How many staff people work on Visitor Services programs? What is the full-time equivalent number of staff people?

Education

For the purposes of this research, the Education division was the set of programs which provided structured learning opportunities for various audiences. These programs instructed audiences such as schoolchildren, adults, and staff in a variety of locations, including lecture halls, classrooms, and the grounds of the institution.

Education programs used the collections by teaching students and visitors about specific plants or other aspects of the collections. Education programs that did not use the collections conveyed information not related to the collections, for instance a lecture about a different institution or a botany class which did not use plants from the collections as examples.

Education Program Groups

The Education division programs were divided into five program groups: Continuing Education, Children's Education, Visitor Programs, Student Education, and Staff Education.

Continuing Education. The Continuing Education program group consisted of all the programs which provided in-depth and structured educational experiences for the adult public. Examples of Continuing Education programs include classes, workshops, and lectures.

To analyze how the Continuing Education program group used the collections, all of the Continuing Education programs offered in fiscal year 1992-1993 were listed on an evaluation sheet similar to Table 2.3: Sample Table for Continuing Education Programs.

Table 2.3: Sample Table for Continuing Education Programs.

#	Name of Continuing Education Program	Number of Attendees	Use of Collections
1	Botany for Horticulturists	25	1
2	Practical Pruning	10	3
3	Winter Watercolors	17	2

The number of attendees at each program was listed if available. Each program was evaluated to determine whether it utilized the collections at the institution. This evaluation was done through interviews with the staff person in charge of Continuing Education, interviews with the course instructors and reading the course descriptions in

newsletters or brochures. The criteria for rating Continuing Education programs was slightly different than described in Table 1.1, page 5. Each program was rated 1 if the program did not use the collections, 2 if the program was enhanced by the collections or 3 if the program depended on the collections. Table 2.4 (following page) further describes the ratings for Continuing Education classes.

Children's Education. The Children's Education program group was comprised of programs designed to educate school-aged or younger children or school teachers about various topics appropriate to the institution. The programs may be on-site or off-site, and can include, for example, instructional programs based on school curricula, instructional tours and children's gardening programs.

Visitor Education. The Visitor Education program group contained those programs that involve the casual visitor in a more structured way than the orientation methods, but less structured than continuing education. Often, Visitor Education programs did not require preregistration or the payment of a special fee, whereas Continuing Education programs did. Visitor Education generally contained such programs as garden tours, demonstrations and special events.

To analyze the Visitor Education program group, each program was listed, the number of attendees was listed if available, and each program was evaluated based on how much information in each program was about the collections. The programs were then rated using the criteria illustrated in the Methods chapter, on page 5. For example, a historic house tour or a musical recital generally had no information about the collections

Table 2.4: Explanation of Rating System for Education Programs.

Rating	Rating Title	Rating Description	Typical Program Types
1	Program did not use the collections	The program did not use the collections for examples, specimens or any other aspect of the instruction. The program would not have to be changed at all if it were offered at a non-horticultural site.	field trips to other gardens; many landscape design courses; lectures about flora or ecosystems not represented in the collections; gardening techniques lecture-only classes; some basic science classes
2	Program was enhanced by the collections	The program was not directly relevant to the collections or plants in the collections, but may have used the collections as material to enhance or illustrate points. These programs could still be offered without access to the collections, but would have to be slightly changed.	botanical illustration or arts and crafts classes that use specimens from the collections; wildlife walks; tours of multiple gardens of which the collections of the host institution are one (but not the main one); many pest control classes; some basic science classes
3	Program depended on the collections	These programs related directly to the living collections. They could not be offered if there was no access to the collections.	tours or walks through the collections; lectures about an aspect of the collections; plant materials classes that include plants in the collections and include a walk or lab involving the collections; gardening techniques classes which involve an aspect of touring through or working in the collections

and would be rated 1, a nature walk that conveyed some information about the collections would be rated 2, and most of the information conveyed in a garden tour would be about the collections so it would be rated 3.

Student Education. The Student Education program group contained programs which provided extended, practical training for people who wanted to gain in-depth learning and experience in horticulture and related fields. The most common student programs were internships.

To determine how the student programs use the collections, each student program that was offered in fiscal year 1992-1993 was listed. Each program was evaluated to determine what percentage of the program's activities used the collections, and was rated according to the criteria in the Methods chapter, page 5.

Staff Education. The Staff Education program group included staff training and in-service, and other programs designed to educate staff members about work-related issues.

To determine how the Staff Education program used the collections, all of the different programs offered in fiscal year 1992-1993 were listed. Each program was rated in the same manner as the Continuing Education programs as described on page 19.

Education Overview

The overview for the Education division provided insight into overall education issues. The researcher obtained pertinent goal statements dealing with education

programs, and obtained a brief history of the educational efforts at the institution. The following list of interview questions was then used to further develop an overview of education programs at the institution:

- What facilities are available for education programs? Include classroom space, greenhouse or other growing space.
- How many staff people work on educational programming, and what is the full-time equivalent of staff time spent on educational programs?
- What are the total educational expenses for fiscal year 1992-1993?

Research

For the purposes of this paper, the Research division was defined as containing those programs which were scientific investigations completed by staff members to study or discover facts. Programs ranged from controlled scientific studies to those somewhat less rigorous.

Research programs which were completed by people other than staff members were not considered in the overall rating for the Research division. Since the goal of this evaluation method was to provide information for administrators to make decisions about how the collections of their institution could be better used, and the use of the collections by outside researchers is largely uncontrollable, non-staff research projects were not considered relevant to the evaluation of collections use by the institution.

Research programs used the collections by undertaking studies on plants in the collections or on topics that directly impacted the collections. Research programs did not

use the collections if they consisted of studies of plants not in the collections, or if they were studies of topics that were non-plant related.

Research Program Groups

For this paper, Research was divided into four program groups: New Plants, Plant Culture, Germplasm Conservation and Basic Science.

New Plants. The New Plants program group included those programs which worked to obtain or develop new plants and/or distribute them. Typical programs include plant exploration trips, ornamental plant breeding programs, and exchange programs with local nurseries.

New Plants programs were grouped under three general areas to facilitate analysis. These areas: plant exploration, plant breeding and selection and plant introduction and distribution were each evaluated for their collections use based on slightly different criteria. Plant exploration programs were evaluated based on whether the current collections were consulted to help draw up a list of plants to be collected. Plant breeding and selection programs were evaluated based on how many of the plants used for breeding stock were accessioned into the collections. Plant introduction and distribution programs were evaluated for collections use based on how many of the distributed plants were accessioned or propagated from accessions.

Plant Culture. The Plant Culture program group consisted of projects designed to evaluate and/or improve an aspect of growing a type of plant. These include projects to

determine flower initiation factors of a plant or to evaluate disease resistance, for example.

To analyze how the Plant Culture program group used the collections, those in progress in fiscal year 1992-1993 were listed. Each project was evaluated to determine what portion of the research depended upon the living plant collections at the institution, then was rated according to Table 1.1, page 5.

Germplasm Conservation. Germplasm conservation in public gardens consists of programs to maintain plant or plant propagule holdings either *in situ* or *ex situ*. The purpose is to preserve those plants in danger of extinction for eventual reintroduction to the wild.

To determine how much the collections are used for a germplasm repository, the researcher determined the percent of the collections which were considered important because of the germplasm they represented, whether they were officially designated a germplasm repository by an outside source. A plant in the collections was considered an important germplasm resource if there was institution-wide, board-level support to maintain the plant (or propagations of it) in perpetuity for the purpose of preserving its germplasm.

If the percent of an institution's collections that was considered a germplasm repository was 0, then the germplasm repository program was rated A. If the percent of the collections that was considered a germplasm repository was 1-50, the program was rated B, and if the percent was over 50, the program was rated C.

Basic Science. The Basic Science program group contained programs completed by staff members which attempt to reveal scientific principles, including but not limited to botanical or taxonomic research. Each project underway in fiscal year 1992-1993 was listed, then evaluated based on what portion of the plants, if any, used in the research were accessioned into the collections. The projects were then rated based on Table 1.1, page 5.

Research Overview

As with Visitor Services and Education, the overview for the Research division provided insight into overall research issues. The researcher obtained pertinent goal statements dealing with research programs, and obtained a brief history of the research efforts at the institution. The following list of interview questions was then used to further develop an overview of research programs at the institution:

- Are research projects chosen based on the content of the collections, or are research projects chosen independently of the institution's collections?
- What facilities are available for research projects? Do they include laboratory, greenhouse and other growing spaces?
- How many staff people work on research projects, what is the full-time equivalent of staff time spent on research?
- What are the total research expenses for the past fiscal year?

Summary and Conclusion

In order to complete the analysis of each institution's collections use, the information from the three divisions was summarized. The divisional averages and the divisional overview information for Visitor Services, Education, and Research were compared with the institution overview information.

For each division, the percentage of the budget allocated to that division was calculated. This calculation yielded a percentage for each division. These three percentages did not add up to 100 percent, since portions of the budget used for such things as maintenance costs and general administration were not included in the divisions.

For each division, the staff percentages were calculated in the same manner as the budget. Like the budget calculations, the resulting three percentages did not total up to 100 percent.

The information in the general questions for each division was summarized, emphasizing information which could explain the results in that division's analysis.

Finally, all of this information was compared with the mission statement of the institution. A conclusion was drawn regarding whether the collections use as determined through the preceding analysis was in line with the mission statement.

The following three chapters contain the case studies from the Arnold Arboretum, Longwood Gardens and the Morris Arboretum. The case studies show how the method described in the current and previous chapter can be applied to various institutions, and what the method can reveal about their collections use.

Chapter 3

ARNOLD ARBORETUM CASE STUDY

Institutional Overview

The Arnold Arboretum of Harvard University was established in 1872 in Jamaica Plain, Massachusetts. The grounds were designed by Frederick Law Olmsted, and it is part of Boston's Emerald Necklace.[7]

The mission of the Arnold Arboretum indicates three major activities:

> (1) to develop, curate, and maintain a well-documented collection of living woody plants from around the world that are hardy to the Boston area;
>
> (2) to study these plants and their relatives and associates in nature through the maintenance of a herbarium and library and through directly related research in botany and horticulture;
>
> (3) to provide instruction in botany, horticulture, dendrology, and other fields related to the living collections...[8]

The first point establishes the importance of the collections at the Arnold Arboretum. The second aspect of the mission relates to research, and the third to education.

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[7] Staff of the Arnold Arboretum, "The Living Collections of the Arnold Arboretum: General Information & Statistics," unpublished report, The Arnold Arboretum of Harvard University, 1993.

[8] Harvard Corporation, "The Mission of the Arnold Arboretum," Arnoldia 49.1 (1989): 2.

The Arnold Arboretum's total expenses in fiscal year 1991-1992 were $3,909,810.[9] Fiscal year 1992-1993 expenses were not used here because they contain extraordinary costs for building renovation. There were 72 total staff members at the Arnold Arboretum in 1992.[10]

Visitor Services

Visitor Services Program Groups

The Arnold Arboretum runs programs in the Visitor Services program groups of Wayfinding and Interpretation.

Wayfinding. Wayfinding at the Arnold Arboretum is currently implemented through directional signs, "You are Here" signs and guide maps. All of the Wayfinding programs were available to 100% of the visitors in fiscal year 1992-1993. See Table 3.1 for a summary of Wayfinding programs. The Arnold Arboretum is a National Historic Landmark, as the only fully executed arboretum designed by Frederick Law Olmstead, and upright signs are kept to a minimum to preserve the appearance of the landscape.[11] Directional signs that are imbedded in the pathways are currently under development. Current directional signs include road and entrance signs which are rated 1, since they

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[9] Robert E. Cook, The Director's Report: Arnold Arboretum 1991-1992, ([Jamaica Plain], n.d.) 22.

[10] Cook, The Director's Report, 30-31.

[11] Christopher Strand, personal interview, 27 January 1994.

contain no information about the collections. There are two "You are Here" signs rated 3, since they contain over 50% of their information about the collections.

Table 3.1: Summary of Wayfinding Programs at the Arnold Arboretum.

No.	Name of Wayfinding Program	Number of Elements	Availability	Use of Collections
1	Directional Signs	N/A	1	1
2	"You are Here" Signs	2	1	3
3	Guide maps	1,000/ month in 1992-93	1	3

There is a guide map of the Arnold Arboretum currently available for sale in the visitor center. Free guide maps were available in a kiosk near the entrance to the grounds when the Hunnewell Building, which serves as the visitor building, was closed for renovation from September 1992 to September 1993. During this time, 1,000 maps per month were used.[12] The guide map is rated 3 because it contains primarily (over 50%) information about the collections.

There are a total of three Wayfinding programs at the Arnold Arboretum, as listed in Table 3.1. The Program Rating Percentage Calculations, as shown in Figure 3.1, show that 33% of the Wayfinding programs do not contain information about the collections, no Wayfinding programs are rated 2, and 67% contain mostly (over 50%) information about the collections. Figure 3.2 graphically depicts these percentages.

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[12] Strand, 27 January 1994.

$$\frac{\text{number of programs rated 1}}{\text{total number of programs}} = \frac{1}{3} = 33\% \text{ programs rated 1}$$

$$\frac{\text{number of programs rated 2}}{\text{total number of programs}} = \frac{0}{3} = 0\% \text{ programs rated 2}$$

$$\frac{\text{number of programs rated 3}}{\text{total number of programs}} = \frac{2}{3} = 67\% \text{ programs rated 3}$$

Figure 3.1 : Arnold Arboretum Wayfinding Programs Percentage Calculations

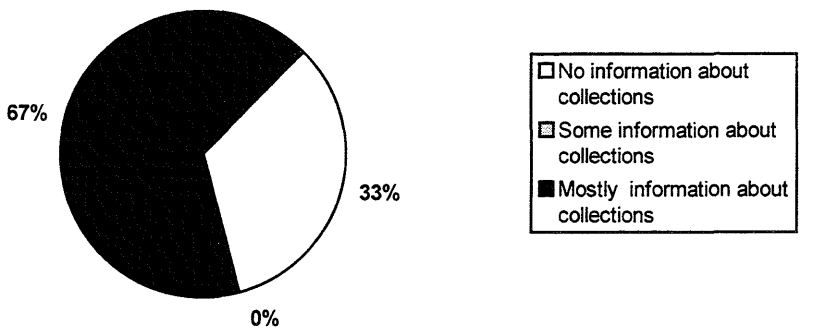

Figure 3.2: Arnold Arboretum Wayfinding Programs Use of Collections.

Averaging the ratings of the three Wayfinding programs yields an average of 2.33. This leads to a rating of B for the Wayfinding program group, which indicates that it uses the collections a moderate amount.

Interpretation. Interpretation at the Arnold Arboretum is implemented through plant identification labels, trunk labels, and temporary exhibits. Table 3.2 shows a summary of the Interpretation programs at the Arnold Arboretum. Over 95% of the collections have plant identification labels, which are zinc or aluminum embossed tags.[13] Approximately 75% of accessioned trees have metalphoto trunk labels which are for display purposes.[14] Plant identification labels and trunk labels are available to 100% of the visitors, so have an availability of 1. Both of these Interpretation programs contain mostly (over 50%) information about the collections, and are rated 3.

Table 3.2: Summary of Interpretation Programs at the Arnold Arboretum.

	Name of Interpretive Program	**Number of Elements**	**Availability (.25, .50, .75, or 1)**	**Use of Collections (1, 2, or 3)**
1	Plant Accession Labels	95% of collections	1	3
2	Trunk Labels	75% of trees	1	3
3	Temporary Exhibits	N/A	0 for fiscal year 1992-1993	N/A

Temporary exhibits are located in the exhibition hall in the Hunnewell Building. During most of the 1992-93 fiscal year, the Hunnewell Building was closed for renovation, and did not contain exhibits. Therefore, the availability of exhibits in fiscal year 1992-93 was zero. Before the Hunnewell building was closed for renovation,

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[13] Stephen Spongberg, personal interview, 28 January 1994.

[14] Spongberg, 28 January 1994.

temporary exhibits were in place for approximately four months each, and generally consisted of photography or painting exhibits containing works that had the collections as their subject. [15]

In fiscal year 1992-1993, there were a total of two interpretation programs available at the Arnold Arboretum. Both, or 100%, of these programs contained mostly information about the collections and were rated 3. See the column "Use of Collections" in Table 3.2 Since both of the programs were rated 3, the average for interpretation program group is 3, and the rating is C (high use of the collections).

Visitor Services Overview

Of the 265 acres occupied by the Arnold Arboretum, approximately 230 (87%) are open to the public. The areas not open to the public include two tracts of land that were purchased for collections expansion. These areas may be open to the public in the future.[16] All of the living collections are located in the areas open to the public.

Approximately 250,000 people visit the Arnold Arboretum per year.[17] Since the Arnold Arboretum is part of the Boston public parks system, many of these visitors use the grounds as a park, for walking dogs, running, or similar recreational uses. Visitor facilities include an exhibition space and gift shop in the Hunnewell Building. Portable restrooms are located at the entrance to the arboretum.

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[15] Strand, 27 January 1994.

[16] Richard Schulhof, personal interview, 27 January 1994.

[17] Schulhof, 27 January 1994.

The three visitor services staff include the Assistant Shop Manager, the Shop and Visitor Services Manager, and the Visitor Services Staff Assistant. The total budget for public outreach at the Arnold Arboretum is approximately $500,000. [18] This includes both education programs and visitor services.

Visitor Services Summary

The annual expense figure for visitor services at the Arnold Arboretum is not available, but visitor services constitute a portion of the approximately $500,000 budget for public programs.[19] That budget contains both the Education and Visitor Services divisions, and takes into consideration staff salaries and benefits. Three (4%) of the 72 staff work on Visitor Services programs.

The Arnold Arboretum has programs in both of the Visitor Services program groups. Fifty percent of the groups are rated B, and the other 50% are rated C. The average for Wayfinding is 2.33, and the average for Interpretation is 3. The average of the two program groups is 2.67, so the overall division rating is III. These ratings show that the Visitor Services division at the Arnold Arboretum has a high use of the collections.

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[18] Schulhof, 27 January 1994.

[19] Richard Schulhof, telephone interview, 5 April 1994.

Education

The Arnold Arboretum has programs in four of the five Education program groups. These include: Continuing Education, Children's Education, Visitor Education and Student Education.

Continuing Education. Programs and Events schedules are printed twice per year: Spring and Summer, and Fall and Winter. Continuing Education programs at the Arnold Arboretum run year-round.

From September 1992 through August 1993, there were 126 course offerings at the Arnold Arboretum, with a total of approximately 450 sessions. See Ratings, page 100, for a complete list of the Arnold Arboretum course offerings during fiscal year 1992-1993. Courses are offered in the areas of botany, ecology, gardening, landscape design, plant and garden history, plant identification, professional development, propagation, and special events. Most of the Arnold Arboretum's adult education classes are driven by the mission "the botany and horticulture of woody plants"[20] and the classes which do not have the collections as their driving force are either basic science courses, which are within the mission, or courses designed to raise funds for the other more mission-based courses.[21] Classes range from single-session lectures to eight and nine session intensive classes. There were approximately 2,000 adult attendees in fiscal year 1992-1993.[22]

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[20] Robert E. Cook, foreword, Programs and Events/Fall and Winter 1992/93, The Arnold Arboretum of Harvard University, [1992], inside front cover.

[21] Marcia Mitchell, personal interview, 27 January 1994.

[22] Mitchell, 27 January 1994.

Courses are taught both by arboretum staff and outside professionals. Some courses are offered in cooperation with the New England Wild Flower Society in Framingham, MA.

The 126 courses were rated according to the criteria explained in Table 2.4: Explanation of Rating System for Education Programs on page 19, and the ratings are listed along with the course titles in Table B. 1, page 98. The ratings are summarized in Figure 3.3: Arnold Arboretum Continuing Education Program Rating Percentage Calculations.

$$\frac{\text{number of programs rated 1}}{\text{total number of programs}} = \frac{85}{126} = 67\% \text{ programs rated 1}$$

$$\frac{\text{number of programs rated 2}}{\text{total number of programs}} = \frac{11}{126} = 9\% \text{ programs rated 2}$$

$$\frac{\text{number of programs rated 3}}{\text{total number of programs}} = \frac{30}{126} = 24\% \text{ programs rated 3}$$

Figure 3.3: Arnold Arboretum Continuing Education Program Rating Percentage Calculations

As indicated in Figure 3.3, 85 (67%) of the 126 courses offered in 1992-1993 did not use the collections at the Arnold Arboretum. These 85 courses included basic science courses, landscape design courses, gardening techniques classes, and some plant materials classes. Eleven courses (9%), including mainly arts and crafts classes and some horticultural techniques classes, were enhanced by the collections. Thirty courses (24%), which include mainly plant identification classes and some special lectures, could not

have been offered without the collections. See Figure 3.4: Arnold Arboretum Continuing Education Programs Use of Collections.

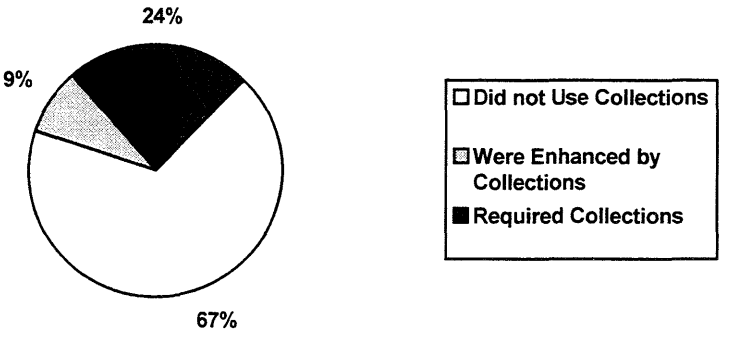

Figure 3.4: Arnold Arboretum Continuing Education Programs Use of Collections.

Averaging the ratings of the classes leads to a program group average of 1.56. This average falls within the range 1 - 1.66, so the program groups is rated an A (low use of the collections).

Children's Education. There are two Children's Education programs at the Arnold Arboretum, Field Study Experiences and LEAP (LEarning About Plants) Teacher Workshops. See Table 3.3 for a summary of the programs. There are 50 volunteer guides assisting with the Children's Education programs.[23]

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[23] Diane Syverson, personal interview, 28 January 1994.

Field Study Experiences consist of four seasonally based sessions which are tied to the Boston public school system curriculum, targeting children in grades 3 through 6. The program was begun in 1983, and attracts 3,000 children annually.[24] This program depends on the living collections, and is rated 3.

LEAP workshops are teacher training workshops directed at urban and suburban public school teachers. They teach the LEAP curriculum developed in the 1980's at Cornell University in Ithaca, NY, which "introduces children to the living world and emphasizes the special role that plants play in living communities."[25] The goals of the program are: to promote the teaching of science in schools, to give teachers the necessary skills to feel comfortable teaching science, and to promote the LEAP curriculum.[26] Fifty-two teachers participated in the two week workshops in fiscal year 1992-1993.[27] According to the criteria explained in Table 2.4, the LEAP workshops are enhanced by the collections at the Arnold Arboretum, but do not rely on them, and are rated 2.

Table 3.3: Summary of Children's Education Programs at the Arnold Arboretum.

	Name of Program	**Number of Attendees**	**Use of Collections (1, 2, or 3)**
1	Field Study Experiences	3,000 students/yr.	3
2	LEAP Workshops	52 teachers/yr.	2

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[24] Syverson, 28 January 1994.

[25] Programs and Events/Fall and Winter 1992/93, The Arnold Arboretum of Harvard University, [1992], 6.

[26] Syverson, 28 January 1994.

[27] Syverson, 28 January 1994.

Fifty percent of the two programs in Children's Education are rated 2, and 50% are rated 3. This leads to an average of 2.5. Children's Education at the Arnold Arboretum is rated C, with a high use of the collections.

Visitor Education. There are two Visitor Education programs offered at the Arnold Arboretum: guided tours and Lilac Sunday. See Table 3.4 for a summary of these programs.

The Arnold Arboretum offers free tours on Sundays during the spring and fall, and group tours are available by appointment year-round. Tours are given by volunteers and Arboretum staff and generally contain mostly information about the collections, so are rated 3. There is one major event at the Arnold Arboretum: Lilac Sunday. This event occurs on the third Sunday in May and attracts approximately 10,000 to 15,000 people.[28] Most of the activities in this event use the collections, so Lilac Sunday is rated 3.

Table 3.4: Summary of Visitor Programs at the Arnold Arboretum.

	Name of Program	**Number of Attendees**	**Use of Collections (1, 2, or 3)**
1	Guided Tours	N/A	3
2	Lilac Sunday	10-15,000	3

[28] Schulhoff, 5 April 1994.

There are a total of two Visitor Programs at the Arnold Arboretum. Both are rated 3, since they rely heavily on the collections. The overall rating for visitor programs is C, since the average is 3.

Student Education. In 1993, twelve Horticultural Trainees were accepted for internships in horticultural maintenance, greenhouse and nursery operations and plant records. Internships last from ten to sixteen weeks through the summer.[29] Each internship relies on the collections, and so each receives a rating of 3. The Horticultural Trainee program is rated C, since the average of the program ratings is 3.

Staff Education. The Arnold Arboretum does not offer in-house Staff Education programs. Employees are encouraged to participate in training sessions held by Harvard University, the University of Massachusetts Extension, and other applicable programs.[30]

Education Overview

Education programs began at the Arnold Arboretum with Charles Sprague Sargent. He and the other staff of the then new Arnold Arboretum toured people around the Arboretum to teach them about the collections. These walks expanded to include indoor lectures, and became the foundation for the present education program. The

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[29] Julie Coop, telephone interview, 5 April 1994.

[30] Schulhoff, 5 April 1994.

education programs expanded greatly during the 1980s, but have been somewhat reduced recently to avoid overtaxing the Arboretum's resources.[31]

Classroom space for education programs include a lecture hall and headhouse space on the grounds of the Arboretum, and one space at the Case Estates in Weston, Massachusetts. A total of 146 students can be accommodated at one time in the available spaces. There is no outside growing space or greenhouse space available for education programs, but the Adult Education Manager is interested in renting greenhouse space off the grounds in the near future.[32]

The total budget for public outreach (including education and visitor services at the Arnold Arboretum) is approximately $500,000, including salaries. There are six staff members who work on education programs, with a full time equivalent of five.[33]

Education Summary

The annual expense budget for the division of education at the Arnold Arboretum is not available, but it represents a portion of the approximately $500,000 budget for public outreach. The budget contains both education and visitor services, and takes into consideration staff salaries and benefits. Five (7%) of the 72 staff work on education programs.[34]

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[31] Marcia Mitchell, personal interview, 27 January 1994.

[32] Mitchell, 27 January 1994.

[33] Schulhoff, 5 April 1994.

[34] Schulhoff, 5 April 1994.

The Arnold Arboretum has programs in four education program groups: continuing education, schoolchildren education, visitor programs, and student education. The percent of program groups rated A is 25%, none are rated B, and 75% of the program groups are rated C. The rating averages for each program group are:

continuing education = 1.56
schoolchildren education = 2.50
visitor programs = 3.00
student education = 3.00

This averages to a 2.52 divisional average, which falls into the divisional rating category of III. This indicates that the Education division at the Arnold Arboretum has a high use of the collections in its programs.

Research

Research Program Groups

While the Arnold Arboretum does sponsor research projects, most of them are completed informally by members of the staff using only a small portion of their time.[35] Detailed information about these research projects was not available.

New Plants. There is no information on plant exploration trips during fiscal year 1992-1993.

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[35] Robert E. Cook, telephone interview, 5 April 1994.

There is no formal plant breeding or selection process at the Arnold Arboretum. Individual staff members may engage in plant breeding or selection activities through their individual research interests.

The Arnold Arboretum has two programs in plant distribution: distribution through the annual plant sale, and distribution through propagule requests. Plant introductions by the Arnold Arboretum are done when a staff person finds a superior plant during the course of his or her activities. When plants are ready to be introduced, they are promoted through an article in Arnoldia, and distributed to the Friends of the Arboretum through the annual plant sale.[36]

The Arnold Arboretum honors written requests for propagules of plants in the collections which are not generally available commercially, and which are not being stock-increased for release by the Arnold Arboretum. The Arnold Arboretum charges a fee to those requesting propagules, except if they are requests from other not-for-profit botanical institutions. Propagules are sent labeled with the Arnold Arboretum accession number, name, and complete source information from the BG-Base files.[37]

In fiscal year 1992-1993, the Arnold Arboretum sent out 146 shipments of requested plant materials, totaling 770 items. Fifty-two of these shipments were to sister institutions.[38]

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[36] Spongberg, 28 January 1994.

[37] Spongberg, 28 January 1994.

[38] Thomas Ward, personal interview, 27 January 1994.

Both of the New Plants programs at the Arnold Arboretum were rated 3, since the plants which are distributed are all accessioned plants or propagules of accessioned plants. Therefore, the New Plants program group average is 3, and the Program Group Rating is C, high use of the collections.

Plant Cultural Research. There is no formal plant cultural research program at the Arnold Arboretum. Individual staff members may engage in plant cultural research projects through their individual research interests. There was no information available on the research projects in progress during fiscal year 1992-1993. This program group could not be rated.

Germplasm Conservation. The collections policy of the Arnold Arboretum states that the Arnold should grow "all species and infraspecific taxa"[39] of "woody plants hardy to the Boston area."[40] Furthermore, the Arboretum "aspires to grow three accessions of each taxon, each from a known provenance of wild origin."[41] As of June 10, 1992, the Arnold Arboretum collections contained 12,336 accessions of 5,968 taxa, with a total of 6,713 individual plants.[42] Accession information is maintained in a computer database.

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[39]Taxa are defined for the purpose of this paper as different kinds of plants, at species rank or below.

[40] J. Alexander, et al., "Plants for the Twenty-first Century: A Long Range Plan," unpublished report, The Arnold Arboretum of Harvard University, 1991, 97.

[41]Alexander, et al., 97.

[42] Living Collections Department of the Arnold Arboretum, Inventory of Living Collections, (Jamaica Plain, MA: The Arnold Arboretum of Harvard University, 1992) 2.

The Arnold Arboretum has 574 plants[43] representing 204 accessions of 20 taxa which are official germplasm collections for the Center for Plant Conservation (CPC).[44] This represents approximately 1.6% of all accessions.

If a plant in the collections is in danger of dying or being destroyed, its usefulness as a germplasm resource is evaluated. If the collection and provenance data is sufficient, then the plant is repropagated. The propagation is then replanted into the collections.[45] Considering this, nearly 100% of the Arnold Arboretum's living collections can be considered a germplasm resource. The germplasm conservation program at the Arnold Arboretum is rated 3 since over 50% of the collections are a germplasm resource.

Basic Science Research. There are large, grant-funded basic science research projects based in facilities in Cambridge, Massachusetts which are administered by the Director of the Arnold Arboretum. These projects generally focus on tropical and Asian botany, and do not use the collections at the Arnold Arboretum.[46]

Individual staff members at the Arnold Arboretum in Jamaica Plain may also engage in basic science research, based on their individual research interests.

A list of the basic science research projects underway during fiscal year 1992-1993 was not available. There was not enough information to rate this program group.

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[43]This does not include seed batches, stuck cuttings, and other propagules.

[44] Ward, 27 January 1994.

[45] Ward, 27 January 1994.

[46] Cook, 5 April 1994.

Research Overview

The Research division at the Arnold Arboretum consists of large, grant-driven research in areas such as Tropical Botany, and small, staff run projects funded through the Arnold Arboretum. The Director of the Arnold Arboretum is responsible for the administration of the large grant-driven projects, although they are based in Cambridge, MA. The staff-run projects are based on the interests of the individual staff members and it is up to the individual staff members to complete them in their spare time. These projects are funded through the Arnold Arboretum, and the budgets are generally small. Information about individual research projects was not available, but Appendix C shows the publications which have arisen from research (both grant-driven research and small Arboretum funded research projects) by Arnold Arboretum staff in 1991 and 1992.[47]

The budget for research at the Arnold Arboretum is funded through grants totaling $300,000 to $400,000 per year, as well as a small amount of seed money from the institution's endowment.[48]

Research Summary

The research division budget of approximately $500,000 per year is approximately 13% of the overall institution's budget. There were ten research positions on the Arnold Arboretum staff in fiscal year 1992-1993. These staff are all based in Cambridge. There

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[47] Cook, Robert E. The Director's Report: Arnold Arboretum 1991-1992, ([Jamaica Plain], n.d.) 27-29.

[48] Cook, 5 April 1994.

are also three research affiliates and four research affiliates emertiae.[49] Jamaica Plain staff who complete small research projects are not included in this calculation, since they each spend a small amount of their time on research.

Possibly the most accurate way to summarize the research uses of the collections at the Arnold Arboretum is to group research into two broad groups. The large grant-driven projects which focus on tropical botany comprise the first group, and are rated A, since they use the collections only minimally. The second group of research projects are the small Jamaica Plain staff run projects, which may involve new plants research, plant culture or basic science.[50] These research projects often depend on the collections, although no specific data are available.

Without more detailed information, it would be speculation to rate the research division as a whole.

Summary and Conclusion

The Visitor Services division of the Arnold Arboretum has a divisional average of 2.67, and is rated in group III. The Education division has a divisional average of 2.52, and a divisional rating of III. The Research division was not rated as a whole.

The Visitor Services and Education divisions together use 13% of the institutional budget, while the Research division uses approximately 13% of the total institutional budget.

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[49] Cook, 5 April 1994.

[50] Cook, 5 April 1994.

Visitor Services staff represents 4% of the total staff, while the Education division represents 7% of the total staff. The Research division staff is approximately 18% of the total staff, not including the time spent on individual small research projects completed by staff members.

The Division Ratings indicate that the Arnold Arboretum uses the collections to a high degree in their programs. However, at the Program Group level, there were some areas where the collections seem to be underutilized. The Continuing Education Program group, for instance, had a rating of only 1.66, with 67% of the programs rated 1, since they did not use the collections. Although many of these programs were basic science courses which are supported by the mission, a greater focus on using the collections of the institution for these programs would certainly enhance the Continuing Education Program Group.

The Plant Cultural Research and the Basic Science program groups were problematic, as they could not be rated. This prohibited a complete analysis of the Research division. This was unfortunate, considering that the Research division at the Arnold Arboretum represented a significant portion of the budget, 13%, and the staff, approximately 18%.

Chapter 4

LONGWOOD GARDENS CASE STUDY

Institutional Overview

The Mission of Longwood Gardens states:

> Longwood Gardens is dedicated to preserving the spirit and beauty of the early twentieth century gardens of Pierre S. du Pont. Longwood is a display garden promoting the art and enjoyment of horticulture for the public, while providing opportunities for research and learning. We are committed to excellence, good management, and fiscal responsibility.[51]

Longwood does not officially maintain collections. However, as a "...display garden..." Longwood does maintain plant holdings to help fulfill the three main goals of promoting the art and enjoyment of horticulture for the public (horticultural display), research, and education. For convenience, this paper will refer to Longwood Gardens plant holdings as collections.

Longwood Gardens' annual operating budget is approximately $16,000,000.[52] There are 255 total staff at Longwood Gardens; 181 of those are full time staff.[53]

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[51] Longwood Gardens, Treetops to Tunnelbottoms: About Our Organization. (Kennett Square, PA: Longwood Gardens, Inc., 1992) 16.

[52] Frederick Roberts, personal interview, 1993.

[53] Longwood Gardens, 47-109.

Visitor Services

Visitor Services Program Groups

Longwood Gardens conducts programs in both Visitor Services program groups, Wayfinding and Interpretation.

Wayfinding. The Wayfinding program group contains 14 programs, listed in Table 4.1, including directional signs, guide maps, events information, a multi-image presentation, and a scale model.

Table 4.1: Summary of Wayfinding Programs at Longwood Gardens.

No.	Name of Wayfinding Program	Number of Elements	Availability	Use of Collections
1	Road and Entrance Signs	N/A	1	1
2	Outdoor Directional Signs	N/A	1	1
3	Indoor Directional Signs	N/A	1	1
4	Large Garden Maps	3	1	2
5	"You Are Here" Maps	14	1	2
6	General Guide Map	400,000/yr.	1	2
7	Plant Trail Brochures	70,000/yr.	1	3
8	Festival Guides	175,000	.25	1
9	Events Bulletin Boards	5	1	1
10	Restaurant Bulletin Boards	3	1	1
11	Schedule of Events	400,000/yr.	1	2
12	Bloom Highlights Brochure	15,000	1	3
13	Multi-Image Presentation	4/yr.	1	3
14	Scale Model	1	1	3

Directional signs consist of road and entrance signs, outdoor ivy leaf signs, and indoor conservatory signs. These signs were available to all of the visitors in fiscal year

1992-1993, and so have an availability of 1. These signs are rated 1, since they contain no information about the collections.

Guide maps include three large garden maps, fourteen "You are Here" maps throughout Longwood's formal gardens, the general guide map printed in English and six other languages, plant hunt brochures, and festival guides. All but the festival guides are available to all visitors. The festival guides are available to approximately 25% of the visitors to Longwood Gardens.[54] The large garden maps, the "You are Here" maps, and the general guide map contain some (less than 50%) information about the collections. Four hundred thousand copies of the general guide map were printed in fiscal year 1992-1993.[55] There were three different plant hunt brochures printed during fiscal year 1992-1993, totaling 70,000 brochures.[56] All three types of brochures had primarily (over 50%) information about Longwood's collections. There were two types of festival guides printed in fiscal year 1992-1993, with a total of 175,000 brochures printed.[57] The festival guides had no information about the collections.

Events information is publicized at Longwood through five events bulletin boards, three restaurant bulletin boards, the schedule of events, and the bloom highlights brochure. All of these programs are available to 100% of Longwood's visitors. The events and restaurant bulletin boards have no information pertaining to the collections.

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[54] Betsey Ney, personal interview, December 1993.

[55] Ney, December 1993.

[56] Ney, December 1993.

[57] Ney, December 1993.

The schedule of events, which was printed twice in fiscal year 1992-1993 with a total of 400,000 printed,[58] has some (less than 50%) information about the collections. The bloom highlights brochure, of which 15,000 were printed in fiscal year 1992-1993,[59] contained mostly (over 50%) information about the collections.

The multi-image slide presentation is a three minute free presentation that operates continuously in the Visitors Center during open hours, and so is available to all visitors. The presentation highlights events in the garden and is changed by the photographer four times per year.[60] It contains mostly (over 50%) information about the collections.

The scale model is located in the Visitor Center and is available to all visitors. It contains some information about the collections.

Of the fourteen different Wayfinding programs utilized by Longwood Gardens, there is a total availability of 13.25. Of these, 5.25 programs (40%) contain no information about the collections, 4 (30%) contain some (less than 50%) information about the collections, and 4 (30%) contain mostly (over 50%) information about the collections. Figure 4.1 graphically depicts these percentages.

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[58] Ney, December 1993.

[59] Ney, December 1993.

[60] Ney, December 1993.

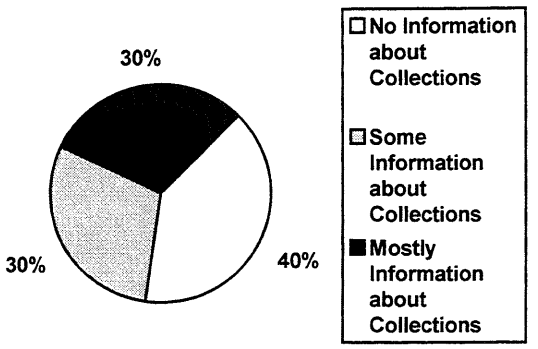

Figure 4.1: Longwood Gardens Wayfinding Programs Use of Collections.

Completing the Program Group Average Calculation (see Figure 1.3, page 6) leads to an average of 1.91. This indicates a rating of B for the Wayfinding program group. Longwood Gardens uses its collections a moderate amount in its Wayfinding program group.

Interpretation. The Interpretation program group of Visitor Services at Longwood Gardens is implemented through plant identification labels, story labels, Idea Garden booklets and handouts, weekend information service, self-guided tour booklets and plant fact sheets.[61] See Table 4.2 for a summary of Interpretation programs.

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[61] Longwood Gardens, 70-71.

Table 4.2: Summary of Interpretation Programs at Longwood Gardens.

	Name of Interpretive Program	Number of Elements	Use of Collections	Availability
1	Brass Accession Tags	80% of collections	3	1
2	Metalphoto Display Labels	75% of plant groupings	3	1
3	Story Labels	500-1000	3	1
4	Idea Garden Handouts	206,925	3	1
5	Weekend Information Service	over 4,000 questions	2	.5
6	Interpretive Booklets	N/A	3	1

There are two types of plant identification labels at Longwood Gardens. Eighty percent of the plants in the collections have an embossed brass accession label. Metalphoto display labels are on approximately 30% of the plants in the collections, and 75% of the plant groupings have at least one metalphoto display label.[62] There is a higher percentage of labels in the more formal areas at Longwood Gardens. Both types of plant identification labels contain mostly (over 50%) information about the collections.[63]

Story labels, or interpretive signs, are metalphoto labels with extended descriptions about particular plants, garden areas, gardening techniques, temporary or permanent exhibits, or other topics. Many of these signs change throughout the year, and at any given time, there are approximately 500 to 1,000 signs located throughout the

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[62] Robert Herald, personal interview, December 1993.

[63] Plant labeling program is not accounted for with the Visitor Services programs, so budget and staff figures for Visitor Services do not reflect those for plant labeling.

garden.[64] All of the metalphoto signs at Longwood are fabricated in-house. These signs contain mostly (over 50%) information about the collections.

Idea Garden handouts are one-page sheets with in-depth information about a particular area in the Idea Garden. These are placed in mailboxes in the Idea Garden and are free to visitors. There were 206,925 handouts printed in fiscal year 1992-1993.[65] The handouts contain mostly (over 50%) information about the collections.

The weekend information service is the main information service for visitors at Longwood. The booth is located in the Main Conservatory and is staffed on many weekend and holiday afternoons. In the 1992 calendar year, 621 (16%) questions related to the collections at Longwood, out of over 4,000 total questions.[66] Therefore, the Weekend Information Service provides some (less than 50%) information about the collections.

Self-guided tour booklets, Idea Garden booklets, and plant fact sheets are for sale in the Museum Shop. (The appropriate plant fact sheet is distributed free of charge with each plant purchased.) These were developed by Longwood staff, and all contain mostly (over 50%) information about the collections. These booklets are generally printed in quantities to last several years.

Of the six Interpretation programs employed at Longwood Gardens, there is a total availability of 5.5. Five-tenths of the programs (9%) contain some (less than 50%)

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[64] Ney, December 1993.

[65] Ney, December 1993.

[66] Ney, December 1993.

information about the collections, and five (91%) contain mostly (over 50%) information about the collections. See Figure 4.2. The program group average is 2.90, which leads to a program group rating of C, high use of the collections.

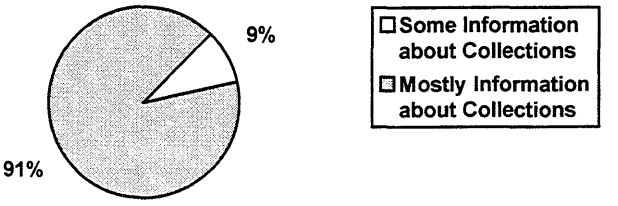

Figure 4.2: Longwood Gardens Interpretation Programs Use of Collections.

Visitor Services Overview

Approximately 80 (7.6%) of the 1,050 acres owned by Longwood Gardens, Inc. are in formal gardens and are open to the public.[67] Areas that are not open to the public include mainly the arboretum area, buffer areas around the main gardens and employee housing. Longwood Gardens has approximately 11,000 plant accessions, of which 8,500 (77%) are located in areas open to the public.[68] In fiscal year 1992-1993, 738,286 people visited Longwood Gardens.[69] When asked on a visitor survey to select the reasons they visited Longwood Gardens, 28.9% chose the response "to see specific garden areas or

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[67] Ney, December 1993.

[68] Herald, December 1993.

[69] Ney, December 1993.

plants." In answering this question, visitors could choose up to three responses out of 11 options, or write in their own response.[70]

The budget for Visitor Services is not available, since the Visitor Services division as defined for this research contains programs administered by several different departments at Longwood Gardens.

There are two Visitor Education Specialists who each spend approximately 60% of their time on Visitor Services.[71] Guided tours are coordinated by two full-time staff and approximately 15 part-time tour guides. Visitor facilities include the Visitor Center and the Terrace Restaurant, as well as five restroom sites on the grounds (not including those in the Visitor Center).

Visitor Services Summary

Longwood Gardens has programs in both of the program groups of Visitor Services. One program group (50%) was rated B, average use of the collections, and one program group (50%) was rated C, with a high use of the collections. The average ratings for the program groups were 1.91 and 2.90, which yield a divisional average of 2.40. This divisional average falls into a divisional rating of III, high use of the collections.

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[70] Randi Korn and Associates, Visitors to Longwood Gardens: A Year-long Visitor Survey, (n.p.: n.p., 1993) 15-16.

[71] Ney, December 1993.

Education

Education Program Groups

Longwood Gardens conducts programs in five Education program groups; Continuing Education, Children's Education, Visitor Education, Student Education and Staff Education.

Continuing Education. The Continuing Education Program at Longwood "offers in-depth horticultural learning to the public and Longwood employees, students and volunteers."[72] Continuing Education prints class brochures twice per year (Spring and Fall). In fiscal year 1992-1993, 27,000 of these brochures were printed.[73]

In fiscal year 1992-1993, Longwood Gardens held 35 Continuing Education classes, with a total of 4,418 attendees. Longwood staff, students, or volunteers comprised 774 of the attendees, and 3,644 were members of the public.[74] See Appendix B for a complete list of Continuing Education Courses offered in fiscal year 1992-1993. Continuing Education classes range from one session Dessert Lectures on various topics to the five or six session Certificate of Merit in Ornamental Plants classes, which lead to a formal Certificate of Merit upon completion. Courses are offered in the areas of botanical

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[72] R. William Thomas, "Educational Programs at Longwood Gardens," unpublished report, Longwood Gardens, Inc., 1993, 1.

[73] Ney, December 1993.

[74] "Data Summary A: Continuing Education, Fall 1992," unpublished report, Longwood Gardens, Inc., 1992; "Data Summary A: Continuing Education, Spring 1993," unpublished report, Longwood Gardens, Inc., 1993.

illustration, botany, crafts, floral design, Integrated Pest Management (IPM), landscape design, plant identification and use, pruning, propagation, and special lectures. Instructors for the courses are Longwood employees and outside professionals.

According to the criteria explained in Table 2.4, nine (26%) of these classes did not rely on Longwood's plant collections in any way, 11 (31%) of the classes were enhanced by the collections, and the final 15 (43%) classes could not have been offered without Longwood's collections. See Figure 4.3: Longwood Gardens Continuing Education Courses Use of Collections The classes that did not rely on the collections were all one-session evening lectures. The classes which were enhanced by the collections but did not depend on them were several-session classes that dealt with specialized horticultural or related topics, including: botany, landscape design, flower arranging, Bonsai techniques, and others. More than half of the classes which depended upon Longwood's collections were Certificate of Merit classes, and the rest were multiple-session classes dealing with special topics.

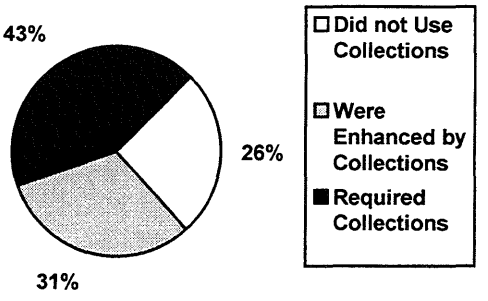

Figure 4.3: Longwood Gardens Continuing Education Courses Use of Collections.

Averaging the ratings of the courses using the Program Group Average Calculation leads to an average of 2.17 for the program group. This average falls into the range for the program group rating B (1.67 to 2.33). Continuing Education at Longwood uses the collections a moderate amount.

Children's Education Programs. The Children's Education program group at Longwood Gardens contains one program, guided tours. In fiscal year 1992-1993, 11,753 schoolchildren had guided tours through Longwood Gardens.[75] Guides are part-time employees of Longwood Gardens. Children's guided tours depend on the collections, and the program is rated 3, so the program group is rated C.

Visitor Education. There are two visitor programs at Longwood Gardens: garden tours and gardening demonstrations.

Garden tours are given by appointment for groups who visit Longwood. There are 15 part-time tour guides. In fiscal year 1992-1993, 3,941 adults participated in guided tours at Longwood Gardens. The majority of these (2,275 people) visited during April, May and June.[76] Garden tours generally contain mostly information about the collections, and the program is rated 3.

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[75] "Group Visits Statistics, 1 October 1992 through 30 September 1993," unpublished report, Longwood Gardens, Inc., 1993, 1.

[76] "Group Visits Statistics" 1.

Gardening demonstrations are informal "How To..." sessions taught by staff gardeners in the gardens. They are held in the afternoons, about once every two weeks, from January through October. There were 21 gardening demonstrations held in 1993 (calendar year) at Longwood Gardens, attended by 1,093 people.[77] Gardening demonstrations contain mostly information about the collections, and the program is rated 3.

Table 4.3: Summary of Visitor Programs at Longwood Gardens.

	Name of Program	**Number of Attendees**	**Use of Collections (1, 2, or 3)**
1	Guided Tours	3,941	3
2	Gardening Demonstrations	1,093	3

The two Visitor Education programs at Longwood Gardens are each rated 3. The program ratings average to 3, which leads to the overall rating of C, high use of the collections, for the program group.

Student Programs. The Student Programs at Longwood "offer practical educational training for future professionals in horticulture and related fields."[78]

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[77] Betsey Ney, "1993 Gardening Demonstration Schedule," unpublished report, Longwood Gardens, Inc., 1993, 1.

[78] R. William Thomas, "Educational Programs at Longwood Gardens" 2.

There are three different student programs run by the Education Division. These programs include the Professional Gardener Training Program (PGTP), the International Gardener Training Program (IGTP), and the College Internship Program. A fourth program, residing at Longwood under the Director's office, is the Longwood Graduate Program in Public Horticulture Administration. See Table 4.4 for a summary of Student Education Programs at Longwood Gardens.

Table 4.4: Summary of Student Education Programs at Longwood Gardens.

	Name of Student Program	**Students, F.T.E.**	**Use of Collections**
1	Professional Gardener Training Program	12	3
2	International Gardener Training Program	4.5	3
3	Internship Program	13.5	3
4	Longwood Graduate Program in Public Horticulture Administration	10	2

The PGTP accepts 12 students biannually, the IGTP accepts 4 to 5 students at a time, and the Internship Program contains 13 to 14 students at a time. All of these programs use the collections for most of their activities, and are each rated 3. The Longwood Graduate Program contains up to 10 students at a time, and some, but less than 50%, of the students' activities use the collections at Longwood Gardens. The Longwood Graduate Program is rated 2.

The average of the ratings of the four student education programs is 2.75, which falls within the range of a C rating for the program group. The Student Education program group has a high use of the collections.

Staff Education Programs. The purpose of staff training at Longwood is to "build a visitor-oriented team that will best serve the public."[79] There are four staff training programs at Longwood: new employee orientation, horticulture department in-service, maintenance department in-service, and special lectures. There were no special lectures offered in fiscal year 1992-1993 at Longwood Gardens. See Table 4.5 for a summary of Staff Education Programs at Longwood Gardens.

Table 4.5: Summary of Staff Education Programs at Longwood Gardens.

	Name of Staff Education Program	**Use of Collections**
1	New Employee Orientation	2
2	Horticulture Department In-service	2
3	Maintenance Department In-service	1

The New Employee Orientation was held on July 13 and 14 in 1993. New Employee Orientation has some, but less than 50% information about the collections, so is rated 2.

Horticulture Department In-service was held on seven dates during January and February in fiscal year 1992-1993. All staff are allowed to attend if they are interested in the topic, and guests from other institutions are sometimes invited. There were a total of twelve lectures on various topics, including one lecture with mostly (over 50%) of the information about Longwood's collections. The other eleven lectures had no information

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[79] Longwood Gardens, Treetops to Tunnelbottoms 66.

about Longwood's collections. Horticulture Department In-service has some, but less than 50% information about the collections, so is rated 2.

Maintenance Department In-service is held from April through November, and may consist of lectures, demonstrations, workshops, field trips, seminars, or conferences. There were a total of 44 sessions during fiscal year 1992-1993, none of these sessions dealt with Longwood's collections, so the program is rated 1.

Sixty-six percent of the three staff training programs at Longwood Gardens during fiscal year 1992-1993 used the collections for some of the information, and are rated 2. Thirty-three percent of the programs in the program group are rated 1, since they had no information about the collections. The program ratings average to 1.67, which leads to a program rating of B, average use of the collections.

Education Overview

During Pierre du Pont's life there were a few informal educational programs held at Longwood Gardens. Education was formally implemented in 1955, when the first Education Division Head was hired.[80] Currently, the Education Division of the Services Department is primarily responsible for education programs at Longwood, as well as many of the programs under the division of visitor services (as defined for this research), the library, the label shop, and the photographer. The educational mission was developed by the Education Division Manager, and although it has not been approved by the

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[80] Thomas, 30 November 1993.

trustees, it follows closely the mission and charter of Longwood Gardens. The Educational Mission of Longwood is as follows:

> Preserve the spirit and beauty of Longwood through making visits as pleasant, interesting, and informative as possible. Encourage the art and enjoyment of horticulture through programs for amateur and professional gardeners, school and youth groups, plant societies, and horticultural students.[81]

There are seven full-time staff, and one part-time volunteer who work on programs in the education division (as defined for this research). In addition, there are instructors employed for classes as needed.

The total budgeted expenses for Longwood Gardens' Education Division in fiscal year 1992-1993 were $1,710,300, which includes: salaries (of full time and part time staff and students), benefits, operational expenses, and equipment purchases.[82] This figure includes the budget for not only the Education division as defined for this research, but part of the budget for the Visitor Services division, and the budget for the library, photographer, and label shop. This constitutes approximately 9.5% of Longwood Gardens' total budget for fiscal year 1992-1993.

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[81] Thomas, 18 November 1993.

[82] "Longwood Gardens, Inc. FY '93 Budget/ Education," unpublished worksheet, Longwood Gardens, Inc., [1993?].

There are five main spaces used for Education programs, including the Auditorium, the *Acer* and *Betula* classrooms, the Ballroom, and the Lower Level of the Terrace Restaurant. These five spaces have a total of 747 available seats. Education programs, however, can be carried out anywhere that is necessary. Although there is no greenhouse space specifically designated for education programs, space can be designated as needed, as long as it does not interfere with crop production or display. The only outdoor growing areas designated specifically for education purposes are the student gardens, which are located outside of the formal gardens.

Education Summary

Seven full time staff, 15 part-time staff (tour guides) and one half-time volunteer work on Education programs in the five program groups.[83] This is 4% of the full time staff at Longwood Gardens.

Longwood conducts programs in each of the five program groups in the Education division. None of the program groups are rated A (low use of the collections), 40% of the program groups are rated B (average use of the collections), and 60% of the program groups are rated C (high use of the collections). The ratings and rating averages for each program group are:

Continuing Education = B = 2.17
Schoolchildren Education = C = 3
Visitor Programs = C = 3
Student Education = C = 2.75
Staff Education = B = 1.67

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[83] Thomas, 30 November 1993.

The divisional average, which is the average of the program group averages, is 2.52. This indicates a divisional rating of III. The Education division at Longwood Gardens has a high use of the collections.

Research

Research Program Groups

Longwood Gardens conducted research programs in two of the four Research program groups in FY 1992-3.

New Plants. New Plants consists of three programs: Plant Exploration, Plant Breeding and Selection, and Plant Introduction and Distribution. New Plants occupies approximately 5,800 square feet of greenhouse space and 1.5 acres of outdoor growing areas.[84] Plants can be acquired through either collecting trips to other gardens or the wild, or through breeding projects at Longwood.

In fiscal year 1992-1993, Longwood Gardens staff went on three collecting trips.[85] For all of these, the plants that were collected were based on the current collections, so the program is rated 3.

In fiscal year 1992-1993, there was one plant breeding project in progress at Longwood Gardens, the purpose of the project was to develop superior forms of yellow-

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[84] Robert Armstrong, personal interview, 24 November 1993.

[85] Armstrong, 24 November 1993.

flowering *Clivia miniata*.[86] The Clivia project uses only plants accessioned in the collections at Longwood, so the plant breeding program is rated 3.

In 1993, there were 17 plant taxa on the list for distribution to the trade and sister institutions.[87] Ninety-one public gardens, arboreta, and nurseries are included in the distribution. All of the plants on distribution are propagated from plants accessioned into the collections, so the plant introduction and distribution program at Longwood is rated 3.

All of the programs in this group are rated 3, so the program group average is 3. The rating for New Plants is C, high use of the collections.

Plant Cultural Research. Of the eleven cultural research programs in progress at Longwood during fiscal year 1992-1993, ten use the collections for all or most of the research. One does not use the collections. See Table 4.6, page 67 for a list, description and use ratings of cultural research programs.

The rating average for the Plant Cultural Research programs is 2.82, which indicates a rating of C for the program group. The Plant Cultural Research program group at Longwood Gardens has a high use of the collections.

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[86] "Minutes [of the] Research Steering Committee, 12 July 1993" Longwood Gardens, Inc., 1993, 2.

[87] Armstrong, 24 November 1993.

Table 4.6: Plant Cultural Research Programs in progress at Longwood Gardens during fiscal year 1992-1993.[88]

Project Title	Project Head	Project Description	Use
Resistance of Hemlocks to woolly adelgid aphid	Dr. Bruce Steward	Evaluate various Tsuga species for possible resistance.	3
Pachysandra resistance to Volutella leaf blight	Dr. Bruce Steward	Evaluate cultivars of Pachysandra terminalis for resistance to Volutella leaf blight.	3
Asarums	Dr. James Ault	Evaluate the cold-hardiness of various Asarum species.	3
Boxwood trials	Dr. Robert Armstrong	Evaluate Buxus sempervirens cultivars.	3
Camellia hardiness trials	Dr. Robert Armstrong	Evaluate C. oleifera hybrids and C. japonica for hardiness in Southeastern PA.	3
Echium (biennial) flower initiation study	Dr. James Ault	Determine cultural requirements necessary for Echium flower initiation.	3
Eupatoriums	Mr. Rick Darke	Assemble a collection of Eupatorium species and cultivars for potential planting at Longwood.	3
Moss trial	Dr. Robert Armstrong	Determine the optimum method for establishing moss.	1
Ornamental grass trial	Mr. Rick Darke	Evaluate grasses for potential planting at Longwood.	3
Perovskia	Mr. Rick Darke	Determine the cause of lax growth in Perovskia.	3
Rose Trial	Dr. Robert Armstrong	Evaluate rose spp. and cv.'s for potential landscape use.	3

[88] "Minutes [of the] Research Steering Committee" 1-3.

Germplasm Conservation and Basic Science Research. Longwood Gardens does not maintain collections for the purposes of germplasm conservation,[89] and did not support basic science research projects during fiscal year 1992-1993.

Research Overview

Research was first conducted formally at Longwood Gardens in 1959, by the Director and the Geneticist. The goal of research at Longwood is to support and enhance plant displays through exploration and crop improvement.[90] The Research division is staffed by four full time staff and one seasonal employee. Three volunteers each work 1/2 to 1 1/2 days per week. In fiscal year 1992-1993, there were no non-staff researchers conducting research at Longwood. The annual budget for research is approximately $250,000[91] per year, which is approximately 1.6% of Longwood's total budget.

Research Summary

Longwood Gardens has programs in two of the five program groups of the research division: new plants research and plant cultural research. Both of these program groups (100%) are rated C. The ratings and rating averages for the program groups are:

New Plants = C = 3
Plant Cultural Studies = C = 2.82

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[89] Frederick Darke, personal interview, November 1993.

[90] Armstrong, 24 November 1993.

[91] Armstrong, 24 November 1993. This figure includes salaries, but not overhead.

These average to 2.91, the Research division average for Longwood Gardens. This indicates a divisional rating of III, high use of the collections.

Summary and Conclusion

The Visitor Services division of Longwood Gardens has a divisional average of 2.40, the Education division has a divisional average of 2.52, and the Research division has a divisional average of 2.91; all have a divisional rating of III.

The Education division at Longwood Gardens uses about 9.5% of the institutional budget. The Education division runs most of the programs in the Education division as defined by this research, and also runs some of the Visitor Services programs as defined in this research. The Research division uses approximately 1.6% of the total institutional budget.

The staff of the Visitor Services division is approximately 3% of the total staff. The staff of the Education division is approximately 4% of the total staff. The Research division staff is approximately 2% of the total staff.

The division ratings indicate a high level of collections use in Longwood's programs. The budget and staff percentages, though they are rough estimates, indicate that the amount of institutional resources devoted to creating and running these programs is small compared to the overall expense budget and staff level. This may be appropriate based on the mission of Longwood Gardens, which suggests the primary objective is to preserve the gardens of the former du Pont estate. The bulk of the budget and staff, it would stand to reason, should be used for developing and maintaining the gardens, rather than creating and running programs to use the collections.

Chapter 5

MORRIS ARBORETUM CASE STUDY

Institutional Overview

The Mission of the Morris Arboretum states:

> The Morris Arboretum is a Victorian garden and university arboretum that integrates science, art, and the humanities. The Arboretum conducts three major activities: horticultural display, professional and public education, and botanical and horticultural research. As the official arboretum of the Commonwealth of Pennsylvania, the Morris Arboretum provides research and outreach services to state agencies, institutions, and Pennsylvania citizens.[92]

The Morris Arboretum's mission states the main activities of the Morris Arboretum are: horticultural display, education, and research. It is in these areas which the collections should be used.

The fiscal year 1992-1993 expenses for the Morris Arboretum were $2,480,314.[93]

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[92] "IMS General Operating Support Grant Application, Morris Arboretum," unpublished report, The Morris Arboretum of the University of Pennsylvania, 1993, 1.

[93] "IMS General Operating Support Grant Application" 3-4.

Visitor Services

Program Groups

The Morris Arboretum operates programs in both the Wayfinding and Interpretation program groups.

Wayfinding. Wayfinding at the Morris Arboretum is implemented through directional signs and guide maps. See Table 5.1 for a summary of Wayfinding programs at the Morris Arboretum.

Table 5.1: Summary of Wayfinding Programs at the Morris Arboretum.

	Name of Wayfinding Program	Availability	Use of Collections
1	Entrance Signs	1	1
2	Directional Signs	1	2
3	"You Are Here" Map	1	3
4	Guide Map	1	2

Current directional signs include entrance signs, directional signs within the arboretum, and a "You are Here" map. The entrance signs have an availability of 1 since they are available to all of the visitors. They contain no information about the collections, so are rated 1. The directional signs within the arboretum, also with an availability of 1, are rated 2, since less than 50% of the information is related to the collections. The "You are Here" map contains mostly information about the collections, so is rated 3, again, with an availability of 1.

There are several versions of the guide map, and at least one is available to all visitors, so the availability is 1. Some (less than 50%) of the information in the guide map pertains to the collections, so the guide map is rated 2.

There are four different Wayfinding programs utilized by the Morris Arboretum, with a total availability of 4. Twenty-five percent of the programs contain no information about the collections, 50% contain some information about the collections, and 25% contain mostly information about the collections. See Figure 5.1: Morris Arboretum Wayfinding Programs Use of the Collections.

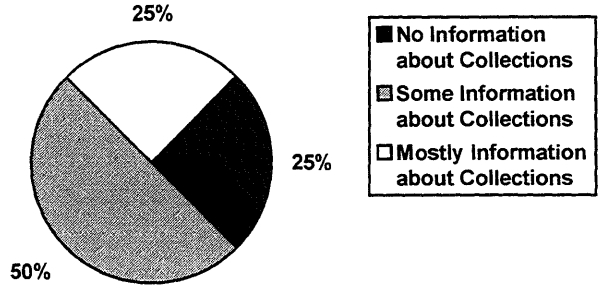

Figure 5.1: Morris Arboretum Wayfinding Programs Use of Collections.

Averaging the Wayfinding program ratings leads to an average of 2. This indicates a program group rating of B, moderate use of the collections.

Interpretation. The collections at the Morris Arboretum are interpreted through plant identification labels, exhibits, and self-guided tours. See Table 5.2 for a summary of Interpretation programs.

Table 5.2: Summary of Interpretation Programs at the Morris Arboretum.

	Name of Interpretation Program	Number of Elements	Availability	Use of Collections
1	Embossed Accession Tags	98-99%	1	3
2	Metalphoto Labels	limited	1	3
3	Panel Exhibits	6	1	3
4	Self-Guided Tours	up to 6	1	3

Ninety-eight to 99% of the collections are labeled with metal embossed accession tags, with the exception of the plants located in the natural areas. The policy at the Morris Arboretum is to label all plants, including any volunteer plants which are not removed.[94] There are currently a "limited"[95] number of metalphoto labels on plants, and the staff at the Morris Arboretum is planning on using more of them. Accession tags and metalphoto labels contain mostly (over 50%) information about the collections, with an availability of 1.

There are six long-term panel display exhibits which interpret various aspects of the Morris' activities and collections.[96] These panel-display exhibits generally have mostly (over 50%) information about the collections. The exhibits are available to all visitors, so have an availability of 1.

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[94] Rick Lewandowski, personal interview, 13 January 1994.

[95] Lewandowski, 13 January 1994.

[96] "IMS General Operating Support Grant Application" 20.

The Morris Arboretum staff develops self-guided tours to complement special events or exhibits.[97] In 1993, a Medicinal Tree Tour was developed to complement a symposium on medicinal plants which was held at the Morris Arboretum. Up to six other self-guided tours are developed per year by arboretum staff.[98] All of these self-guided tours have more than 50% of their information about the collections. Self guided tours are available to all visitors, so they have an availability of 1.

Of the four interpretation programs at the Morris Arboretum, there is a total availability of 4. All of the interpretation programs at the Morris Arboretum have a rating of 3, since they contain mostly information about the collections. The interpretation program group at the Morris Arboretum is rated C (high use of the collections).

Overview

Of the 166 acres owned by the Morris Arboretum, approximately 90 acres (54%) are open to the public. Most of the land which is not open to the public is located adjacent to the Arboretum at the 70 acre research farm known as Bloomfield.[99]

The budget and staff levels for the Visitor Services division at the Morris Arboretum were not available, as Visitor Services is not budgeted separately from Education and Horticulture.

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[97] Jan McFarlan, personal interview, 24 January 1994.

[98] McFarlan, 24 January 1994.

[99] Lewandowski, 13 January 1994.

Visitor Services Summary

The Morris Arboretum has programs in both of the Visitor Services program groups. Fifty percent of the groups are rated B, and 50% are rated C. The ratings are:

Wayfinding = B = 2
Interpretation = C = 3

These average to 2.5, which is the divisional average for Visitor Services at the Morris Arboretum. This indicates a divisional rating of III, high use of the collections.

Education

Continuing Education Programs. There were a total of 76 Continuing Education programs during fiscal year 1992-1993, with a total of 941 attendees.[100] See Appendix B for a complete list of course offerings. These programs can be grouped into two areas: Adult Education and Programs for Professionals. The Adult Education courses fall under the following categories: arts and crafts, guide training, horticulture, landscape design, and special interest. Classes range from single-session lectures to eight-session courses in landscape design, botanical illustration, and other subjects. Students who complete the required courses in the Landscape Design series (four required courses and six elective courses) receive a Certificate of Completion. Courses are taught by Arboretum staff and

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[100] "Education Department/Income Produced by Course/Fall 1992," unpublished report, The Morris Arboretum of the University of Pennsylvania, 1993; "Education Department/Income Produced by Course/Spring 1993," unpublished report, The Morris Arboretum of the University of Pennsylvania, 1993.

outside professionals. Programs for Professionals are courses designed for Urban Foresters and Horticulturists, and consist of one to three sessions each. They address topics in arboriculture, woody plants and business techniques. Courses are taught by the Outreach Horticulturist on the arboretum staff, staff Horticulturists and occasionally by outside instructors.

According to the criteria explained in Table 2.4, 41 (53%) of the 76 courses did not use the Morris Arboretums' collections. These courses were primarily field trips to other gardens, landscape design courses, arts and crafts courses, and some plant identification courses. Ten (15%) of the classes were rated 2, since they were enhanced by the collections, and included art classes and some pruning courses. The final 25 (32%) classes depended upon the collections, and included woody plants classes, guide training classes, and tours through the Morris Arboretum. Many of these classes had a hands-on component, where students were working with the collections. See Figure 5.2.

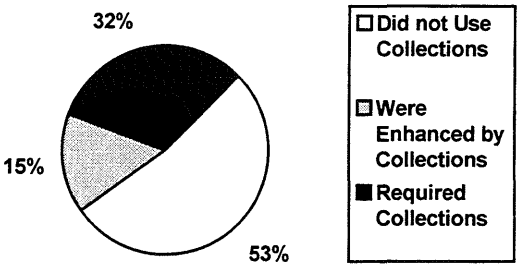

Figure 5.2: Morris Arboretum Continuing Education Programs Use of Collections.

The average of the program ratings is 1.79. This average falls within the rating group B (1.67 to 2.33). Continuing Education at the Morris Arboretum uses the collections a moderate amount.

Children's Education. Approximately 3,700 schoolchildren per year attend tours of the Morris Arboretum.[101] There are two special program weeks that attract approximately 1,000 of these children. The two programs center around Tu B'shevat (Jewish Arbor Day celebration, held in January or February) and Arbor Week (held in April). The programs are divided into an indoor component run by Arboretum staff and a tour of the grounds by a volunteer.[102] Both Children's Education programs are rated 3, since they depend on the collections according to the criteria explained in Table 2.4. The Children's Education program group at the Morris Arboretum is rated C, since the average of the program ratings is 3.

Visitor Education. Guided arboretum tours are given every Saturday and Sunday afternoon, and are free with admission. More than 50% of the information in these tours is about the collections, so the Guided Arboretum Tours are rated 3. There are a total of about 60 volunteers who act as tour guides. Training for volunteer guides consists of eight weekly sessions designed to acquaint the guides with the Arboretum's collections, organization, and history as well as providing the trainees with basic botanical

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[101] McFarlan, 24 January 1994.

[102] McFarlan, 24 January 1994.

information. The guides then attend monthly meetings and regular ongoing training programs.[103]

The only Visitor Education program at the Morris Arboretum are guided tours, which have a rating of 3. The Visitor Education program group average is therefore 3, and the Visitor Education program group is rated C (high use of the collections).

Student Education. The internship program at the Morris Arboretum was begun in 1979, and consists of one-year internships in one of seven areas: Arboriculture, Education, Flora of Pennsylvania, Horticulture, Plant Propagation, Plant Protection, or Urban and Community Forestry.[104] In fiscal year 1992-1993, there were eight interns (one of whom is shared half time with the Academy of Natural Sciences). The internship program uses the living collections for most of the information and activities, so is rated 3.

The one program in the Student Education program group at the Morris Arboretum is rated 3, so the program group is rated C, high use of the collections.

Education Overview

The Morris Arboretum was originally set up as part of the University of Pennsylvania Botany Department, and as such has always had educational programs in some form. In 1932, the Arboretum was officially opened to visitors, in 1973 a guide

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[103] McFarlan, 24 January 1994.

[104] McFarlan, 24 January 1994.

program began, and in the early 1970's a Coordinator of Education was hired for public educational programming. Currently, most educational programs are developed and implemented through the Education Department. Arboretum staff also teach classes at the University of Pennsylvania.

The Education Department is staffed with one full-time staff member, one full time intern, and a secretary who works half time. All of these staff members spend over 75% of their time on education programs. One other full-time staff member spends approximately 50% of his time on education programs.[105]

The budget, not including staff salaries or overhead, for the Education Department is approximately $43,000.[106] This is approximately 1.5% of the Morris Arboretum's total budgeted expenses.

There are three classrooms, space in the headhouse, and one lab available for education programs. These spaces allow for a maximum of 145 students at a time. There is no greenhouse space or outside growing areas available for educational programs. However, many of the classes offered involve hands-on gardening work in the collections.

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[105] McFarlan, 24 January 1994.

[106] McFarlan, 24 January 1994.

Education Summary

The annual expenses for the Education division, $43,000, does not include salaries, so it is difficult to meaningfully compare this number to the overall budget. There are the equivalent of three full time staff members working on Education programs.

The Morris Arboretum has programs in four of the five program groups under the division of education: Continuing Education, Children's Education, Visitor Education, and Student Education. Seventy-five percent of the program groups have a C rating (high use of the collections), and 25% have a B rating (average use of the collections). The ratings and rating averages for each program group are:

Continuing Education = B = 1.79
Children's Education = C = 3
Visitor Programs = C = 3
Student Education = C = 3

The average of these is 2.70, so the divisional rating for Education at the Morris Arboretum is III.

Research

New Plants. New Plants research at the Morris Arboretum includes three programs: plant exploration, the *Index Seminum*, and nursery distribution.

Plant exploration is conducted by the Director and the Curator, who each spend about 5% of their time on plant exploration. Funding for the expenses incurred through plant exploration is from outside sources, but staff salaries for time spent on plant

exploration are part of the Arboretum's budget.[107] Current collections are used to focus plant explorations, therefore the plant exploration program was rated 3, according to the criteria described in Chapter 2: Methods.

There is no active program for plant breeding and selection at the Morris Arboretum. Individual staff members may engage in plant breeding and selection activities according to their own interests.

Plant introduction and distribution at the Morris Arboretum is through an *Index Seminum*, i.e. seed list, and through nursery distribution. An *Index Seminum* is produced every two years and supports the Morris Arboretum's research on the Flora of Pennsylvania. The seed lists include primarily wild collected seed from documented stands of plants native to Pennsylvania.[108] The *Index Seminum* program is rated 1, since it does not use plants in the collections.

Distribution to nurseries is a program for selection and distribution of superior cultivars from the Morris Arboretum collections. The Morris Arboretum staff work with local nurseries in cooperative ventures to promote promising plants by naming, registering, and propagating specimens to be used by the nurseries as stock plants.[109] This program uses only plants from the collections, and is therefore rated 3.

One (33%) of the programs in this program group is rated 1, and 2 (66%) are rated 3. The average for the program group is 2.33, which leads to a rating of B.

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[107] Lewandowski, 13 January 1994.

[108] Lewandowski, 13 January 1994.

[109] Lewandowski, 13 January 1994.

Plant Cultural Research. Plant Cultural Research is primarily conducted at the Morris Arboretum through the IPM program. The IPM program's projects include IPM technique trials and small research projects, the Plant Clinic, and the Southeastern Pennsylvania IPM Research Group. See Table 5.3 for a summary of Plant Cultural Research projects at the Morris Arboretum.

Table 5.3: Summary of Plant Cultural Research Projects at the Morris Arboretum.

	Name of Research Program	Use of Collections
1	IPM Technique Trials	2
2	Small Research Projects	2
3	Plant Clinic	2
4	Southeastern Pennsylvania IPM Research Group	3

The IPM technique trials and small research projects are conducted on the plant collections at the Morris Arboretum and other institutions primarily by the Botanist/Plant Pathologist and the Curator of Living Collections. A complete list of projects in progress during fiscal year 1992-1993 is not available, however, projects generally used the collections for either part or all of the research. For example, a project which evaluated the cold-hardiness of *Magnolia grandiflora* in the Southeastern Pennsylvania area used the Morris Arboretum collections for all of the research.[110] Another project in progress during fiscal year 1992-1993 evaluated *Tsuga* spp. for woolly adelgid resistance. This project used the Morris Arboretum collections for part of the research, and the collections of other area gardens for part of the research in order to evaluate a statistically significant

[110] Lewandowski, 13 January 1994.

sample of trees.[111] Both the IPM technique trials program and small research projects use the collections for part of the research, and so are rated 2.

The Plant Clinic is an outreach tool for diagnosis and treatment advice on plant disease problems. The Clinic receives between 50 and 200 telephone calls per month, depending on the time of year.[112] This program uses the collections for some of the information, so is rated 2.

The Southeastern Pennsylvania IPM Research group consists of 17 to 18 institutions which collect data that is needed to make recommendations for IPM programs. These data include the occurrence of specific events in pest life cycles, degree-day information, and concurrent phenological events.[113] This project depends on the collections for most or all of the research, so is rated 3.

Three (75%) of the programs in this program group are rated 2, and one (25%) is rated 3. The average for the program group is 2.25, which leads to a rating of B, moderate use of the collections.

Germplasm Conservation. The holly collection at the Morris Arboretum is recognized by the National Holly Society as an official collection. The collection is

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[111] Lewandowski, 13 January 1994.

[112] Ann Rhoads, personal interview, 13 January 1994.

[113] Rhoads, 13 January 1994.

evaluated annually for National Holly Society's standards.[114] There are no other collections which are recognized by an outside organization at this time.

The collections policy of the Morris Arboretum states that the "Morris Arboretum presently has strength in the following botanical groupings: *Acer*, *Magnolia*, *Ilex*, and *Hamamelidaceae*. Priority is given to refining and building these taxa."[115] This policy shows board support for the maintenance of the above horticultural collections. Other collections deemed important by the Curator include *Tsuga* and native *Rhododendron* species.

Priority is given to growing "wild-collected species of documented origin."[116] Complete records for all accessioned plants at the Morris Arboretum are maintained on BG-Base, and can be easily accessed.

Over 50% of the taxa at the Morris Arboretum belong to the botanical groupings: *Acer*, *Magnolia*, *Ilex*, and *Hamamelidaceae*. This leads to a rating of 3 for the Germplasm Conservation program at the Morris Arboretum, and a rating of C for the Germplasm Conservation program group.

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[114] Lewandowski, 13 January 1994.

[115] "Morris Arboretum Collection Policy," unpublished report, The Morris Arboretum of the University of Pennsylvania, 1988, 2.

[116] "Morris Arboretum Collection Policy," 1.

Basic Science Research. There were two major Basic Science Research projects at the Morris Arboretum during fiscal year 1992-1993: the Flora of Pennsylvania, and the SmithKline Beecham pharmaceutical testing project.

The Flora of Pennsylvania project was begun in 1932 to document and study the native and naturalized flora of Pennsylvania. Data has been collected on wild populations of Pennsylvania native plants, and computerized for approximately the past 10 years. In 1993, the annotated checklist and atlas Flora of Pennsylvania was published as the culmination of Phase I of the project. The next phase involves publishing a field guide to Pennsylvania flora.[117] This research project does not use the collections, and is rated 1.

The Morris Arboretum is currently working on a project with the pharmaceutical company SmithKline Beecham to test all of the plants in the collections for possible pharmaceutical value.[118] This program uses the Morris Arboretum collections for all of the research, and is rated 3.

One (50%) of the Basic Science Research projects is rated 1, and one (50%) is rated 3. The rating average for the program group is 2. This leads to a rating of B, moderate use of the collections.

Research Overview

The bulk of the research done at the Morris Arboretum is through the Botany Department, although other staff members also engage in research projects. Research

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[117] Rhoads, 13 January 1994.

[118] Lewandowski, 13 January 1994.

programs were initiated in 1933, and consisted of forest pathology research. The Flora of Pennsylvania project was initiated soon after.[119]

The Botany Department is staffed with the full-time Botanist/Plant Pathologist, a full-time Plant Protection intern, and a half-time Flora of Pennsylvania intern. The two interns spend over 75% of their time on research. The Botanist/Plant Pathologist also teaches classes for the interns and courses at the University of Pennsylvania.[120]

The budget for the Botany Department in fiscal year 1992-1993 was $131,513, which includes materials, salaries and benefits.[121] This is approximately 5% of the Morris Arboretum's fiscal year 1992-1993 budget.

There is one main lab area for research; it is approximately 251 to 500 square feet. There are no special indoor or outdoor planting areas set aside for research projects, but such space has not been necessary for the research projects. Some research projects are conducted directly on plants in the collections.[122]

Research Summary

The Morris Arboretum has programs in four program groups in the Research division: New Plants Research, Plant Cultural Research, Germplasm Conservation, and

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[119] Rhoads, 13 January 1994.

[120] Rhoads, 13 January 1994.

[121] Rhoads, 13 January 1994.

[122] Rhoads, 13 January 1994.

Basic Science Research. Three of the program groups (75%) are rated B, and one (25%) is rated C. The ratings and rating averages for the program groups are:

New Plants = B = 2.33
Plant Cultural Research = B = 2.25
Germplasm Conservation = C = 3
Basic Science Research = B = 2

These average to 2.40, which is the divisional average for research at the Morris Arboretum. This indicates a divisional rating of III, high use of the collections.

Summary and Conclusion

The Visitor Services division of the Morris Arboretum has a divisional average of 2.50, and is rated in group III. The Education division has a divisional average of 2.69, and a divisional rating of III. The Research division has a divisional average of 2.40, and a divisional rating of III.

The budget and staff levels for the divisions at the Morris Arboretum were not summarized due to incomplete data. The budget and staff levels were not available for visitor services, and the budget for education did not include salaries.

Three of the four program groups in the Research division are rated B: moderate collections use, which is low compared with the other program groups evaluated. However, the Morris Arboretum's mission states that, in addition to the three major activities of the Arboretum: display, education and research, the Morris Arboretum is the Official Arboretum of the Commonwealth of Pennsylvania. As such, the Morris Arboretum provides research and outreach services throughout Pennsylvania. Many of the research programs with low collections use ratings are directly related to this role. An

example is the Flora of Pennsylvania Research Project, which is rated 1. This program does not use the Morris Arboretum collections, but does help fulfill the Morris' mission.

Chapter 6

SUMMARY AND CONCLUSIONS

Summary of Case Study Results

Results discussed in this section are summarized in Table 6.1: Summary of Case Study Results. All three case studies revealed a rating of III, high collections use, for all three divisions, when all three divisions were assigned an overall rating. One division, Research at the Arnold Arboretum, was not rated due to insufficient data.

At the program group level, there was a wider distribution of ratings, with one program group at the Arnold Arboretum receiving a rating of A, low collections use, eight program groups receiving a rating of B, moderate collections use, and seventeen program groups receiving a rating of C, high collections use. Two program groups were not rated due to insufficient data, and four program groups were not analyzed because the institutions did not run programs pertinent to those program groups.

The three institutions studied often received similar ratings for the same program groups. For instance, all three institutions received ratings of C for their Interpretation program group, Children's Education program group, Visitor Education program group, and Student Education program group.

None of the institutions studied received a C rating for their Continuing Education program group, in fact this is the program group which received the only A rating in one

of the case studies. Likewise, the Wayfinding program group received a B rating in each of the case studies.

Table 6.1: Summary of Case Study Results.

Division **Program Group**	**Arnold Arboretum Ratings**	**Longwood Gardens Ratings**	**Morris Arboretum Ratings**
Visitor Services	**III: 2.67**	**III: 2.40**	**III: 2.50**
Wayfinding	B: 2.33	B: 1.91	B: 2.00
Interpretation	C: 3.00	C: 2.90	C: 3.00
Education	**III: 2.52**	**III: 2.52**	**III: 2.70**
Continuing Education	A: 1.56	B: 2.17	B: 1.79
Children's Education	C: 2.50	C: 3.00	C: 3.00
Visitor Education	C: 3.00	C: 3.00	C: 3.00
Student Education	C: 3.00	C: 2.75	C: 3.00
Staff Education	No Programs	B: 1.67	No Programs
Research	**Not Rated**	**III: 2.91**	**III: 2.40**
New Plants	C: 3.00	C: 3.00	B: 2.33
Plant Cultural Research	Not Rated	C: 2.82	B: 2.25
Germplasm Conservation	C: 3.00	No Programs	C: 3.00
Basic Science Research	Not Rated	No Programs	B: 2.00

Conclusions

Programs and Program Groups

One of the difficulties with the method of analysis as presented in this paper was in determining the relative size of each program. For example, in the Longwood Gardens case study, items that were analyzed as a single program were as diverse as: the 500 to 1,000 story labels in the collections, all 14 "You are Here" maps, the series of 21 gardening demonstrations, each continuing education class, the Professional Gardener

Training Program and the ornamental grass trial. This problem was somewhat compensated for in the Visitor Services division, where each program was rated for its availability to the visitors as well as its use of the collections. However, in the other two divisions, there was no such measure available to equate the programs.

This could have lead to anomalies when averaging the ratings of the programs, since the programs were not necessarily of similar scope. A relatively small program with a high rating could skew the results of a program group containing larger programs with low ratings. For example, the Morris Arboretum Wayfinding program group, which contained four programs, had one small program--one "You are Here" map--with a rating of 3. The other three programs--entrance signs, directional signs and the guide map--were larger programs, but were weighted the same as the smaller program. The three larger programs were rated lower. The one small program in this case could have caused the program group rating to be higher than it should be in reality.

In order to obtain meaningful averages, the programs needed to be averaged based on some commonality. A method to equalize the programs based on the budget and staff levels for each program could have helped solve this problem, however, these numbers would have been impossible to obtain in any of the institutions studied. In the institutions studied in this research, budgets for each program were not tracked individually, they were part of the larger budgets for their department. Likewise, staff time per program was not tracked at any of the institutions. In light of this problem, the program group averages must be considered flawed to some extent.

Divisions

The consistently high division ratings could be due to one of two different scenarios. Either the institutions studied use their collections an exceptional amount in their programs, or the method employed was not sufficient to distinguish the amount of collections use at the division level. Further study would be necessary to determine which situation exists. For example, an institution with a heavy program emphasis on something other than the living plant collections, such as a zoo, could be analyzed. If the results of the analysis yielded high division ratings, the method described in this research is not sufficient to distinguish the amount of collections use at a division level.

This lack of ability to distinguish the amount of collections use could be a result of the problem of equating the relative size of the various programs, as discussed in the previous section, or could be a result of an incorrect numerical breakdown of the program group ratings and the division ratings. The analysis of many public horticulture institutions could lead to a more accurate rating system of Below Average, Average, and Above Average, where the institutions were rated against each other instead of against an arbitrary rating system.

Unless such further research is completed, a high division rating does not necessarily connote that the division effectively uses its collections. However, a division rating of II or I should be seen as revealing a significant problem in the institution's collections use.

Applications

Even considering the problems described in the above sections, this method of analyzing programs for their use of the living plant collections at public horticulture institutions can be a useful management tool. It could be most useful for the middle manager in charge of developing and running a series of closely related programs, such as an Adult Education Manager, a Visitor Services Specialist, or a Research Coordinator, to name a few examples. The program rating systems shown in Table 1.1: Program Ratings, and described in more detail for each program group in Chapter 2: Procedures, provides such individuals with the means to make an unbiased analysis of the programs they administer.

Instead of fitting these programs into the program groups as defined in this research, the manager could then determine a collections use average for all the programs he or she administers, leading to an average rating for the manager's own programs. This average, compared with the institution's mission and the manager's overall programming goals, will be a tool for the manager to gauge if the programs he or she is running are sufficiently dependent on the institution's collections.

REFERENCES

"Advisory Board of Managers Official Meeting Minutes, 24 July 1991." Unpublished meeting minutes. The Morris Arboretum of the University of Pennsylvania, 1991.

Alexander, J., et al. "Plants for the Twenty-first Century: A Long Range Plan." Unpublished report. The Arnold Arboretum of Harvard University, 1991.

Armstrong, Robert. Personal interview. 24 November 1993.

Cook, Robert E. Telephone interview. 5 April 1994.

- - -. The Director's Report: Arnold Arboretum 1991-1992. [Jamaica Plain, MA]: n.p., n.d.

Coop, Julie. Telephone interview. 5 April 1994.

Darke, Frederick. Personal interview. November 1993.

"Data Summary A: Continuing Education, Fall 1992." Unpublished report. Longwood Gardens, Inc., 1992.

"Data Summary A: Continuing Education, Spring 1993." Unpublished report. Longwood Gardens, Inc., 1993.

Del Tredici, Peter. Personal interview. 28 January 1994.

"Education Department/Income Produced by Course/Fall 1992." Unpublished worksheet. The Morris Arboretum of the University of Pennsylvania, 1993.

"Education Department/Income Produced by Course/Spring 1993," Unpublished worksheet. The Morris Arboretum of the University of Pennsylvania, 1993.

"Group Visits Statistics, 1 October 1992 through 30 September 1993." Unpublished report. Longwood Gardens, Inc., 1993.

Harvard Corporation. "The Mission of the Arnold Arboretum." Arnoldia. 49.1 (1989): 2.

Hasselkus, Edward R. "Maximizing the Use of Collections." The 1984 Longwood Program Seminars: Concerning Collections. 16 (1984): 16-20.

Herald, Robert. Personal interview. December 1993.

"IMS General Operating Support Grant Application." Unpublished report. The Morris Arboretum of the University of Pennsylvania, 1993.

Koller, Gary. Personal interview. 27 January 1994.

Korn, Randi and Associates. Visitors to Longwood Gardens: A Year-long Visitor Survey. n.p.: n.p., 1993.

Lewandowski, Richard. Personal interview. 13 January 1993.

Lighty, Richard W. "Toward a More Rational Approach to Plant Collections." The 1984 Longwood Program Seminars: Concerning Collections. 16 (1984): 5-9.

Living Collections Department of the Arnold Arboretum. Inventory of Living Collections. Jamaica Plain, MA: The Arnold Arboretum of Harvard University, 1992.

Longwood Gardens. Treetops to Tunnelbottoms: About our Organization. Kennett Square, PA: Longwood Gardens, Inc., 1992.

"Longwood Gardens, Inc. FY '93 Budget/EDUCATION." Unpublished worksheet. Longwood Gardens, Inc., [1993?].

McFarlan, Jan. Personal interview. 24 January 1994.

Meyer, Paul W. "A Case for Plant Exploration." The Public Garden. 2.1 (1987): 6-8.

"Minutes [of the] Research Steering Committee, 12 July 1993." Unpublished meeting minutes. Longwood Gardens, Inc., 1993.

Mitchell, Marcia. Personal interview. 27 January 1994.

"Morris Arboretum Collection Policy." Unpublished report. The Morris Arboretum of the University of Pennsylvania, 1988.

Ney, Betsey. Personal interview. December 1993.

- - -. "1993 Gardening Demonstration Schedule," Unpublished report. Longwood Gardens, Inc., 1993.

Pastore, Carla L. Woody Plant Introduction Programs. Thesis. University of Delaware, 1988.

Programs and Events/Fall and Winter 1992/93. Jamaica Plain, MA: The Arnold Arboretum of Harvard University, [1992].

Programs and Events Spring/Summer 1993. Jamaica Plain, MA: The Arnold Arboretum of Harvard University, [1992].

Rhoads, Ann. Personal interview. 13 January 1994.

Roberts, Frederick. Personal interview. November 1993.

Sacci, Christopher F. "The Role and Nature of Research at Botanical Gardens." The Public Garden. 6.3 (1991): 33-35.

Scheid, David T. "Displays and Collections." The Public Garden. 2.3 (1987): 14-15, 26.

Schulhof, Richard. Telephone interview. 5 April 1994.

- - -. Personal interview. 27 January 1994.

Simon, Stuart J. "Using the Living Collection as an Educational Resource--A German View." AABGA Bulletin. (1977): 42-45.

Smith, Nigel J. H. "Botanic Gardens and Germplasm Conservation." University of Hawaii Harold L. Lyon Arboretum Lecture Number Fourteen. University of Hawaii Press: Honolulu. 1986.

Spongberg, Stephen. Personal interview. 28 January 1994.

Staff of the Arnold Arboretum. "The Living Collections of the Arnold Arboretum: General Information & Statistics." Unpublished report. The Arnold Arboretum of Harvard University, 1993.

Strand, Christopher. Personal interview. 27 January 1994.

Syverson, Diane. Personal interview. 28 January 1994.

Taylor, Roy L. "Is a Plant Introduction Program Right for Your Garden? An Expert Suggests Gardens Look Before They Leap." The Public Garden. 2.4 (1987): 14-16.

Thomas, R. William. Personal interview. 30 November 1993.

- - -. Personal interview. 18 November 1993.

- - -. "Educational Programs at Longwood Gardens." Unpublished report. Longwood Gardens, Inc., 1993.

Walters, Terrence W. "The Changing Nature of Botanical Garden Collections: The Cycad Case." The Public Garden. 7.2 (1992): 35.

Ward, Thomas. Personal interview. 27 January 1994.

Zuk, Judith D. "Confessions of a Collections Advocate." The 1984 Longwood Program Seminars: Concerning Collections. 16 (1984): 21-26.

APPENDIX A

FREQUENTLY USED CALCULATIONS:

Program Rating Percentage Calculations:

$$\frac{\text{number of programs rated 1}}{\text{total number of programs}} = \text{\% of programs rated 1}$$

$$\frac{\text{number of programs rated 2}}{\text{total number of programs}} = \text{\% of programs rated 2}$$

$$\frac{\text{number of programs rated 3}}{\text{total number of programs}} = \text{\% of programs rated 3}$$

Program Group Average Calculation:

$$\frac{[(\text{\# programs rated 1}) \times 1] + [(\text{\# programs rated 2}) \times 2] + [(\text{\# programs rated 3}) \times 3]}{(\text{total number of programs})}$$

= Program Group Average

Division Average Calculation:

$$\frac{(\text{sum of all program group averages})}{(\text{Total \# of program groups})}$$

= DIVISION AVERAGE

APPENDIX B

CONTINUING EDUCATION PROGRAMS

Table B. 1: Arnold Arboretum Adult Education Classes and Use Ratings.[123]

No.	Course Title	Use Rating
	Fall/Winter 1992	
1	Advanced Flower and Fruit Morphology	1
2	The Arnold Arboretum - Evolution of a Plan	3
3	Boston's Emerald Necklace	2
4	Careers in Horticulture: A Discussion Forum	1
5	The Conifers	3
6	Designing with Woody Plants	1
7	Effective Foliage Color in the Landscape	1
8	Extending the Seasons	3
9	Flora of New England: Section A	1
10	Flora of New England: Section B	1
11	Fundamentals of Garden Design	1
12	Fundamentals of Gardening 1: Section A	1
13	Fundamentals of Gardening 1: Section B	1
14	Fundamentals of Gardening 1: Section C	1
15	Fundamentals of Gardening 1: Section D	1
16	Fundamentals of Gardening 1: Section E	1
17	Fundamentals of Gardening 2: Section A	1
18	Fundamentals of Gardening 2: Section B	1
19	The Fungi	1
20	Gardening Through the Ages with Penelope Hobhouse	1
21	Gardens to Visit in New England	1
22	Herb Gardens	1
23	Herbaceous Perennials for the Professional Landscaper	1

[123] Programs and Events: Fall and Winter 1992/93; Programs and Events: Spring/Summer 1993, The Arnold Arboretum of Harvard University, [1992].

Table B.1 continued.

No.	Course Title	Course Rating
24	The History of Medicinal Plants	1
25	Holiday Wreaths Made from Arboretum Plants: Section A	2
26	Holiday Wreaths Made from Arboretum Plants: Section B	2
27	Implementing a Professional IPM Program	1
28	Introduction to Botany: Section A	1
29	Introduction to Botany: Section B	1
30	Introduction to Woody Plant Identification	3
31	The Italianate Garden in New England	1
32	Looking at Trees	3
33	Maintaining the Landscape 1	1
34	Maintaining the Landscape 2: Section A	1
35	Maintaining the Landscape 2: Section B	1
36	The Natural Shade Garden with Ken Druse	1
37	North American Terrestrial Orchids	1
38	Perennials for Shaded Spots	1
39	Plant Communities of New England	1
40	Plant Selections for the Autumn Garden	1
41	Plant Systematics	1
42	Plants as Elements of Garden Architecture	1
43	Practicum: Creating and Keeping a Garden	3
44	Preparation for MNA Certificate Examination	1
45	Propagation 1	3
46	Propagation 2	3
47	Pruning: Basic Techniques Workshop	3
48	Pruning Small Trees and Shrubs	3
49	Renovating the Garden	1
50	Selection and Siting	1
51	Stress and Disease in Trees and Shrubs	1
52	Wild Foods in Autumn	2
53	Winter Interest in the Naturalistic Garden	1
54	The Woodland Garden	1
	Spring/Summer 1993	
55	A Gardeners World of Bulbs	1
56	Advanced Propagation: Choice and Challenging Plants	3
57	Apple Tree Pruning -- Demonstration	1
58	Apple Tree Pruning -- Hands-on Workshop	1
59	Building the Garden -- A Design Process	1
60	Children's Guide Training	3
61	Conservation Biology of Tropical Rainforests	1
62	Crabapples: Greatest Hits	3

Table B.1 continued.

No.	Course Title	Course Rating
63	Designing the Meadow Garden	3
64	Designing with Bold Textures and Forms	1
65	Designing with Herbs	1
66	Dividing Perennials	3
67	Dividing Perennials	3
68	Docent Training Program	3
69	Evaluating "Hazard" Trees	3
70	Flora of Israel	1
71	Flower and Fruit Morphology	1
72	Foliage Perennials	1
73	Framework Trees of the New England Landscape	2
74	From Leaf to Leaf	3
75	Fundamental for the '90s	1
76	Fundamentals for the '90s	1
77	Fundamentals for the '90s	1
78	Fundamentals of Garden Design	1
79	Garden Paving: The Hardscape	1
80	Gardening with Vines and Ground Covers	1
81	Green Emigrants: Plants that Changed the Gardens of the World	1
82	Growing On: How to Keep from Killing Seedlings and Rooted Cuttings	2
83	History of Medicinal Plants	1
84	History Underfoot at the Arnold Arboretum	3
85	Identification of Pests and Diseases	1
86	In Good Taste: The Gardens of the John Gardner Coolidges	1
87	Introduction to Arboriculture	1
88	Introduction to Botany	1
89	Introduction to Botany	1
90	Introduction to Suburban Landscape Design	1
91	J.C. Raulston on Hardiness	1
92	Japanese Irises	1
93	Looking at Trees: A Key to Identification	3
94	Lower Maintenance Gardening	1
95	Maintenance of the Perennial Garden	1
96	Managing Shade	3
97	Moving the Garden	1
98	New England's Native Woody Plants	3
99	New Plants in Yankee Soil: A Brief Overview of Introductions from Eastern Asia	3

Table B.1 continued.

No.	Course Title	Course Rating
100	Noah's Garden	1
101	On-site Sketching for Landscape Designers	2
102	Ornamental Grasses	1
103	Perennial Combinations for Summer	1
104	Photographing Plants and Gardens with Ken Druse	1
105	Photography Workshop with Ken Druse	2
106	Plant Selections for the Spring Garden	1
107	Plant Systematics	1
108	Plants for Garden Use: Ground Covers	1
109	Principles of Ecology	1
110	Propagation III	2
111	Pruning: Basic Techniques Workshop	3
112	Roses at the Arnold Arboretum	3
113	Searching for Wild Edibles	2
114	So You Want to Restore a Garden?	1
115	Soil: The Secret of All Good Gardening	1
116	Stress and Disease in Trees and Shrubs	1
117	Subshrubs for the Border and Herb Garden	1
118	Summer Flowering Shrubs	3
119	The Birds of April	2
120	The Radical Underground: An Introduction to the Biology of Roots	1
121	The Tree Peony	3
122	Viburnums in Flower and Fruit	3
123	Vines	1
124	Wild Rhododendrons: A Global Tour	1
125	Woodland Garden Workshop	1
126	Woody Plants for the Professional Landscaper	3

Table B.2: Longwood Gardens Adult Education Classes, Use Ratings and Number of Attendees..[124]

No.	Title	Use Rating	Number of Attendees
1	A Garden in Good Order	1	140
2	Bonsai for Beginners	2	41
3	Botany for Gardeners II	2	56
4	Conifers	3	237
5	Deciduous Flowering Shrubs	3	220
6	Designing Your Garden with Flowers	3	226
7	Flower Arranging	2	43
8	Four Seasons at the Sir Howard Hillier Gardens	1	238
9	Gardening Through the Ages	1	317
10	Growing Orchids at Home	3	73
11	Hardy Spring and Fall Blooming Bulbs	3	152
12	Landscape Plant Problems & Pests	2	58
13	Landscaping with Roses	1	170
14	Ornamental Vines	3	119
15	Plant Illustration	2	34
16	Pruning Basics	3	77
17	Rock Gardening	2	45
18	Small Flowering Trees -- Week long course	3	40
19	Annuals & Biennials	3	177
20	Botany for Gardeners I	2	50
21	Deciduous Trees	3	240
22	Designing with Native Plants	1	160
23	Flower Arranging	2	43
24	Fundamentals of Landscape Design	2	198
25	Gardening with Ferns	3	40
26	Gardens of the National Trust for Scotland	1	153
27	Gardens of Whitemarsh Hall	1	112
28	Holiday Decorations	3	108
29	Making a Habit of Restoration	1	152
30	1993 International Horticultural Exhibition at Stuttgart	1	81
31	Ornamental Grasses	3	169
32	Perennial Plants II	3	239
33	Plant Problems & Pests	2	47

[124] "Data Summary A: Continuing Education, Fall 1992;" "Data Summary A: Continuing Education, Spring 1993."

Table B.2 continued.

No.	Title	Use Rating	Number of Attendees
34	Propagating Native Perennials	2	75
35	Pruning Basics	3	88

Table B. 3: Morris Arboretum Continuing Education Course Offerings, Use Ratings and Number of Attendees.[125]

No.	Title	Use Rating	Number of Attendees
	Fall 1992		
1	Antique Roses for Small Gardens	1	0
2	Arboretum Classics: Trees in Greek & Roman Literature	2	9
3	Arboretum Guide Training	3	8
4	Beyond Chrysanthemums: Ornamental Grasses to Enliven the Garden	1	8
5	Botanical Drawing	2	15
6	Botanical Painting	2	7
7	Capture Summer's Beauty with an Herb and Spice Wreath	1	23
8	Celebrate Giving Thanks: Create an Original Wall Decoration	1	5
9	Constructing the Landscape	3	11
10	Cottage Gardening: Easy Perennials, Biennials & Roses	1	17
11	Evaluating Trees for Hazards	3	15
12	Fall Lawn Care	1	12
13	Fall Wildflowers: Nature's Beautiful Late Bloomers	2	6
14	Flower Gardens in Fall—Planning for Extended Bloom	3	12
15	Friends of Awbury Trip	1	1
16	Greenways: Corridors for Recreation and Wildlife	1	11
17	Growing Orchids in Your Home or Greenhouse	1	19
18	Herbal Cosmetics: Experience Luxurious Fragrances and Velvet Smooth Textures	1	11
19	Holiday Decorations I: Centerpieces	2	17
20	Holiday Decorations II: Wreaths	2	53
21	Hollies: Versatile Plants in Today's Landscapes	3	0
22	Ikebana: Oriental Flower Arranging	1	6
23	Landscape Design Studio	1	10
24	Landscape Improvements: Building Walls, Decks and Paving	1	0

[125] "Education Department/Income Produced by Course/Fall 1992;" "Education Department/Income Produced by Course/Spring 1993."

Table B.3 continued.

No.	Title	Use Rating	Number of Attendees
25	Naturalizing Your Property for Low Maintenance	1	11
26	Perennials: Glory of the Season	1	47
27	Perennials for Landscape Professionals	1	8
28	Propagating Perennials: Multiplying Your Garden Favorites	3	8
29	Pruning: What the Homeowner Needs to Know	3	21
30	Refining the Garden Space	3	12
31	The Arboretum of the Barnes Foundation: A Guided Autumn Tour	1	21
32	The Cutting Garden: Bringing the Outside In	1	23
33	Tour With the Director	3	13
34	Trees: Building a Framework for the Landscape	3	0
35	Wave Hill & the Sculpture Gardens at PepsiCo	1	20
36	How Much is a Tree Worth? An Update	1	9
37	Maintaining Tree Health	1	19
38	Pruning Conifers	3	18
39	Pruning Deciduous Trees	3	15
40	Refining Your Climbing Skills	2	16
	Spring 1993		
41	Arboretum Guide Training	3	8
42	Botanical Drawing Section A	2	9
43	Botanical Drawing Section B	2	0
44	Botanical Painting	2	13
45	Chanticleer Foundation	1	16
46	Conquer the Winter Blahs	3	0
47	Cottage Gardening: Easy Perennials, Biennials and Roses	1	23
48	Creating a Simpler, More Attractive Home Landscape	1	11
49	Diagnosing Pests and Diseases	1	12
50	Diversifying the Landscape	3	6
51	Garden Design with Antique Roses	3	0
52	Hedgleigh Spring	1	34
53	Henry Foundation	1	15
54	Ikebana: Oriental Flower Arranging	1	7
55	Landscape Design Studio	1	12
56	Longview Farm: The Perfect Country Garden	1	20
57	Mapping and Site Analysis	1	10
58	Patterns in Paving	1	13

Table B.3 continued.

No.	Title	Use Rating	Number of Attendees
59	Perennials—A Step Beyond the Average	1	23
60	Plant Trees that Impress Your Grandchildren	3	0
61	Pressed Flower Workshop	1	8
62	Propagating Perennials	3	9
63	Pruning: What the Homeowner Needs to Know	3	3
64	Soil, Mulch & Compost: Simple Techniques for a Better Garden	1	0
65	Starting from Scratch	3	18
66	The Natural Approach	1	10
67	Training and Selection of Espaliers	1	10
68	Unconventional Annuals	1	19
69	Water Gardening	1	23
70	Welkinweir Preserve	1	25
71	Winter Tree ID	3	13
72	Practical Rigging for Arborists	2	5
73	Pruning Shrubs	3	15
74	Sell More... Sell More Easily	1	13
75	Tree Cabling and Bracing	2	1
76	Tree Protection During Construction	3	0

APPENDIX C

ARNOLD ARBORETUM STAFF PUBLICATIONS

Table C. 1: Published Writings of the Arnold Arboretum Staff in 1991 and 1992. [126]

No.	Author	Title
1	Alexander, J.H.	Relatedness of Mycoplasmalike organisms associated with ash yellows and lilac witches'-broom.
2	Alexander, J.H.	Lilacs and the Arnold Arboretum.
3	Ashton, P.S.	A future perspective for botanical gardens in Asia.
4	Ashton, P.S.	The state of dipterocarp research at the Fourth Round Table Conference.
5	Ashton, P.S.	Toward a regional classification of the humid tropics in Asia.
6	Ashton, P.S.	Conservation of rare trees in tropical rain forests: A genetic perspective.
7	Ashton, P.S.	Species richness in plant communities.
8	Ashton, P.S.	The structure and dynamics of tropical rain forest in relation to tree species richness.
9	Beach, J.H.	Client/server database architecture, networks, and biological databases.
10	Beach, J.H.	A relational data model for botanical collections.
11	Boufford, D.E.	*Circea* L.
12	Boufford, D.E.	Typification of *Vernonia tenuifolia* Small and *V. jamesii* Torrey & Gray (Compositae).
13	Boufford, D.E.	An analysis of the flora of the Fanjing Shan Mountain Range, northeastern Guishou, China.
14	Boufford, D.E.	Harvard Herbaria begin use of type specimen database.
15	Boufford, D.E.	Urticaceae: Nettle family.
16	Co, L.	Botanical exploration in Palanan wilderness, Isabella Province, The Philippines: First report.
17	Cook, R.E.	The director's report of the Arnold Arboretum.
18	Cook, R.E.	Review of *Clonal growth in plants: Regulation and function*, ed. J. van Groenendael and H. de Kroon.

[126] Cook, The Director's Report, 27-29.

Table C.1 continued.

No.	Author	Title
19	Cook, R.E.	Review of *Pioneer ecologist: The life and work of Victor Ernest Shelford, 1877-1968.*
20	Del Tredici, P.	Natural regeneration of *Ginkgo biloba* from downward growing cotyledonary buds (basal chichi).
21	Del Tredici, P.	The *Ginkgos* of Tian Mu Shan.
22	Del Tredici, P.	The "Hope of Spring" magnolia finally flowers in Boston.
23	Dirr, M.A.	*Cephalataxus harringtonia.*
24	Dirr, M.A.	*Clethra alnifolia.*
25	Dirr, M.A.	*Corylopsis.*
26	Dirr, M.A.	*Forsythia.*
27	Dirr, M.A.	*Halesia carolina.*
28	Dirr, M.A.	*Hydrangea macrophylla.*
29	Dirr, M.A.	*Stewartia.*
30	Dutton, B.E.	On the typification of seven names in *Anemone* (Ranunculaceae) proposed by Linnaeus.
31	Howard, R.A.	Bibliography of Bassett Maguire.
32	Howard, R.A.	*Buckleya*--the oldest cultivated plant in the Arnold Arboretum.
33	Howard, R.A.	Edible fruit in the [Acton] Arboretum.
34	Howard, R.A.	Bassett Maguire--An annotated biography.
35	Howard, R.A.	A revision of *Casimirella*, including *Humirianthera* (Icacinaceae).
36	Kellogg, E.A.	Why study mistletoes?
27	Kellogg, E.A.	A grass-lined maize storage pit and early maize horticulture in central Connecticut.
28	Kellogg, E.A.	The families and genera of vascular plants.
29	Kellogg, E.A.	Restriction site variation in the chloroplast genome of the monogenomic Triticeae.
30	Kellogg, E.A.	Tools for studying the chloroplast genome in the Triticeae (Gramineae): and *Eco* RI map, a diagnostic deletion, and support for *Bromus* as an outgroup.
31	Kim, K.-J.	Intergeneric and interspecific relationships of the lilacs (*Syringa*--Oleraceae) using chloroplast and nuclear ribosomal DNA data: Abstract.
32	Koller, G.L.	The bare essentials.
33	Koller, G.L.	Little used perennials and ground cover varieties.
34	Koller, G.L.	Propagating techniques.
35	Koller, G.L.	Exotic errors.
36	Koller, G.L.	*Forsythia* x *intermedia* 'Gold Leaf'.
37	Koller, G.L.	Ground covers for the garden designer.
38	Koller, G.L.	Native dictates.
39	Koller, G.L.	*Securinega suffruticosa.*

Table C.1 continued.

No.	Author	Title
40	Lafrankie, J.V.	Large-scale long-term research and forest management in tropical Asia.
41	Lafrankie, J.V.	Portraits of the rainforest [book review].
42	Nicholson, R.G.	A Far Plateau.
43	Spongberg, S.A.	Poisonous plants: Deck the halls.
44	Spongberg, S.A.	Cultivar registration at the Arnold Arboretum.
45	Spongberg, S.A.	The "Hope of Spring" magnolia finally flowers in Boston.
46	Stevens, P.F.	George Bentham and the Kew rule.
47	Stevens, P.F.	*Lacandonia schismatica*: A challenge to some recent series of floral morphogenesis.
48	Wen, J.	Phylogenetic and phytogeographic studies on eastern Asian and eastern North American disjunct taxa: Integrating morphological and chloroplast DNA data.
49	Wen, J.	On the typification of Linnean species of *Aralia* (Araliaceae).
50	Wood, C.	*Journal of the Arnold Arboretum.*