It is my pleasure here to take Botany as my special study, which was previously the knowledge of a few plants; today however the abundance of material has made it the most extensive of all the sciences.

Linnaeus
(Preface and Dedication to Species Plantarum 1753)

An Evaluation of the Rôles of Botanic Gardens in Recreation and Conservation

by

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ABSTRACT

Botanic gardens in the United Kingdom have a number of different origins and their ownership and financial status is diverse. Most are funded and managed through Universities though some are run by National or Local Government or by charitable or private organizations. Whilst they share a number of characteristics they are diverse in location, aims, objectives and facilities provided. As a consequence of changing economic and social conditions there is growing financial pressure such that a number have closed in the last decade and several are threatened with closure.

The research sets out to evaluate the overall costs and benefits of botanic gardens.

Their financial costs and revenues are analysed and compared with the costs of managing other urban green space. It is shown that the labour intensive nature of botanic gardens makes them much more expensive to run than Local Authority grounds.

The role of botanic gardens in research and higher education is examined by literature review, analysis of published data and interviews with directors and others and shows that the gardens role in education and research is much less than formerly and that current botanical research relies on the gardens only to a small extent.

Their current role in the conservation of biodiversity is evaluated. It is shown that, while they have a role in conservation education, with current funding, species conservation on any meaningful scale, could not realistically be accomplished. Their value in public recreation is examined. A cluster analysis of 48 botanic gardens in the UK is used to select a representative sample of four gardens; Edinburgh, Cambridge, Westonbirt and Sheffield, for detailed study. The travel cost method of valuation is used to show that, while recreation benefits are real and previously uncalculated, the sums are much less than the running costs of the gardens. The interests and attitudes of visitors are examined and show that the gardens are of great social value to particular groups.

Finally, the diverse benefits of botanic gardens are contrasted with the pressures which are leading to a re–examination of their value and a case argued for a more coherent policy and an enlightened unified organization which will take account of the varied uses of botanic gardens and ensure that all current and future user groups are represented when funding is allocated.

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ABBREVIATIONS USED IN TEXT

FC	Forestry Commission
GLC	Greater London Council
MAFF	Ministry of Agriculture Fisheries and Food
AMC	Agricultural Mortgage Corporation
OPCS	Office of Population Censuses and Surveys
GHS	General Household Survey
BTA	British Tourist Authority
ETB	English Tourist Board
CC	Countryside Commission
IUCN(NR)	International Union for the Conservation of Nature and Natural Resources
WCN	World Conservation Union
FAO	Food and Agriculture Organization
RHS	Royal Horticultural Society
NCCPG	National Council for the Conservation of Plants and Gardens
WHO	World Health Organization
TPC	Threatened Plants Committee
BSBI	Botanical Society of the British Isles
WWF	Worldwide Fund for Nature
BGCS	Botanical Garden Conservation Secretariat
NERC	Natural Environmental Research Council
UGC	University Grants Council
UFC	University Funding Committee
DES	Department of Education and Science
NCC	Nature Conservancy Council
EN	English Nature
CVCP	Committee of Vice Chancellors and Principals
NHM	Natural History Museum
OAL	Office of Arts and Libraries
GDP	Gross Domestic Product
AABGA	American Association of Botanic Gardens and Arboreta
TCM	Travel Cost Method
CV	Contingent Valuation

CHAPTER 1
INTRODUCTION

1.1 Aims and Objectives

Currently in Britain botanic gardens are being closed. This is in part the consequence of a recession but it is also as a result of rationalization of public expenditure and changes in the teaching of botany in higher education.

Whilst the traditional role of the botanic garden in the teaching of botany is diminishing, potentially important roles in plant conservation and recreation are increasing. Environmental issues generally and species and habitat loss in particular are claiming greater public attention.

In a recreational context, garden visiting, including botanic garden visiting by the general public increases every year.

These environmental and recreational factors should have worked to the advantage of botanic gardens, but they seem not to have affected their perceived worth by their funding bodies or their funding bodies do not see it as their role to financially support the gardens.

The aim of the present research is to evaluate botanic gardens and question whether their future should be determined mainly by short–term financial issues or whether a wider range of issues and values should be taken into account.

1.2 Characteristics of Botanic Gardens

There are a number of definitions of botanic gardens because many of those which exist today have developed from gardens founded for different purposes. They do, however, have a number of common or shared characteristics which are distinctive. They are collections of plants assembled or latterly used for scientific study. The research carried out now is mainly into taxonomy though previously work might have been done on economic or medicinal plants. Some gardens also play a role in the conservation of endangered plant species. The gardens may or may not be open to the public and, generally, the plants are labelled.

1.3 The Nature of Values

In order to explore the value of botanic gardens it is first necessary to define value. The term has a number of definitions and uses.

1. Financial value is the price paid for a good or service for which there has to be a market. To achieve a "correct" valuation it must be a free market. The monetary price attached to the traded good or service is then its value. Free markets rarely exist in practice. Goods or services could also be exchanged for an equivalent amount of another commodity which could be priced.
2. Economic value is about supply and demand, the distribution of resources. A market does not have to exist to satisfy this demand and many resources are unpriced. Economics is usually concerned with the value, not of totalities, but of one unit more or less of a commodity – the marginal utility. Economic evaluation cannot therefore logically be used to value e.g. a whole species of plants or animals. Financial or economic evaluations are anthropocentric and consumer preferences are critically important.
3. A third use of the term value is in a social, moral or philosophical sense. Generally a price cannot be put upon this aspect of value. The Oxford English Dictionary defines this value as:

   'The relative status of a thing'.

In considering moral, social or philosophical values, items can have non–instrumental value, i.e. they do not need to provide any direct function or service to humans in order to be valuable. The value here is essential, inherent in the good or service in question. This type of value then defies pricing by financial or economic means.

1. Social, moral or philosophical evaluation assumes that people make rational decisions. Botanic gardens may have important roles to play in environmental education and wild species preservation but the public perception of the real risk of species loss may be faulty. Much work has been done on the mis–match between the statistical assessment of risks and the public perception and evaluation of the same risks (Ashby, 1980).
2. In cases where it is argued that an item is priceless, this may in fact mean the item is unique or irreplaceable, as with many great paintings or other works of art which are clearly priced at sales.
3. Ownership and property rights add subtleties to arguments over attempts to evaluate many public goods e.g. views. The idea of 'intrinsic beauty' is often included in descriptions of views or scenery with the implication that these are beyond evaluation. Some landscape values can however be assessed in other ways e.g. the cost to the Forestry Commission in lost revenue of planting woodland edges with (currently) non–commercial broadleaved trees or allowing some conifers to grow past their optimum felling age in order to produce a more diverse visual amenity in their plantations, or the choice of a particular route for a road scheme. The social amenity of the road is of greater value than the unspoilt landscape through which it travels, in the choice of final route however a more expensive route may be chosen so as to

occasion e.g. less visual intrusion (Price, 1978). Some aspects of landscape can therefore be valued by financial or economic means.

4. The rights attributed to animals add further complications to evaluation. Irrationalities occur in western views on animal rights where badgers and otters are now protected from being baited or hunted by law, but stags and foxes are not, and angling is one of the most popular leisure sports.

Over the last few decades three main approaches to project appraisal and resource evaluation have emerged as environmentalism has gained ground. These three represent stages between extreme anthropocentric and extreme ecocentric views (Turner 1991).

1. Conventional cost benefit analysis (CBA) normally involves a narrow measure of economic efficiency. This is based on a utilitarian ethical system which sets the ground rules for the comparison of gains and losses. The aim is to maximise net total utility. Equity considerations are not addressed explicitly. This approach is utilitarian and anthropocentric.
2. A modified 'extended' CBA allows for the introduction of the concept of intergenerational equity. It requires sustainable development which compensates the future for environmental damage being done now. Compensation requires the passing–on to future generations of a stock of natural assets no smaller than the stock in the possession of the current generation. This "constant natural assets" requirement produces modifications to the CBA approach by raising the implicit value of environmental impacts relative to "development". This moral imperative is not readily interpreted in terms of utilitarian gains and losses.

Traditional systems of ethics do not, in general, support the proposition that current generations have moral obligations to future people. For example, recent Rawlsian ethical philosophy (Rawls, 1972) advocates equal opportunity for all individuals and an acceptable standard of living for the least well off in society. Rawls views intergenerational equity in terms of the present generations' duty to save natural capital, a 'just' savings rate being one which improves the lot of each succeeding generation without undue hardship on any earlier generation.

3. In a radically modified CBA approach, economic analysis plays a secondary role to qualitative assessments of environmental impact.

Our system of evaluation is, in spite of the ecocentric viewpoint of some deep ecologists, largely anthropocentric, alterable over time and not entirely logical.

The benefits and values revealed in this work are as seen at the present time from a western, developed nation point of view. The ideas behind the philosophies of nature and scenic conservation today are outlined and examined by Aldridge (1989) who demonstrates the range of influences from ancient Greek philosophy to present day ideas of gene reservoirs which form the body of current beliefs and values.

The current contrast is between a modified CBA approach, which allows for sustainable intergenerational equity, recognising instrumental and intrinsic values and aiming for a state of 'constant natural assets' and a 'strong bioethics view' or 'deep ecology'. The 'constant natural assets' view believes in the rights of humans to exist at an acceptable standard of living, which involves using modified economic methods as a means of integrating economic efficiency and intergenerational equity. This stance has two 'incidental' effects: (1) it protects the environments of the poorest communities in the world who depend directly on these environments for fuel, water and food and (2) it protects the environments of animals and plants and, with them, scenic beauty.

The 'deep ecology' viewpoint rejects the 'constant natural assets' view because values are only protected as an incidental effect and not as a core aim of the philosophy. The outcome of adopting a 'deep ecological' stance would be protection of the environment at the expense of human rights to an acceptable standard of living. Non–growth is central to this view.

1.4 Structure of the Thesis

Chapter 2 briefly outlines the history, development and current status of botanic gardens, mainly in Britain. Chapter 3 describes the research methods used to evaluate botanic gardens. Chapter 4 examines the financial costs and revenues of botanic gardens and compares these with the costs of maintenance of local authority green space. Chapter 5 reviews the contribution of botanic gardens to research and education. Chapter 6 examines the role of botanic gardens in rare species conservation mainly by a literature review. In Chapter 7 the recreational Use Benefits of four botanic gardens are calculated using an Individual Travel Cost Method (ITCM). Visitors stated willingness to pay (WTP) for visits to botanic gardens is examined and both the consumer surplus calculated by the ITCM and the WTP are compared with the total running costs of the four gardens. Chapter 8 evaluates visitors preferences and attitudes by means of surveys of visitors based on the sample of four botanic gardens. Finally Chapter 9 discusses the overall results and draws conclusions.

CHAPTER 2
THE HISTORY AND DEVELOPMENT OF BOTANIC GARDENS

2.1 The Earliest Botanic Gardens

The development of botany and of botanic gardens did not proceed together. Botanic gardens were founded for the collection and study of plants of importance to mankind such as drugs and spices (Hill, 1915). Botany began in the old world with the description and classification of plants by the Greeks.

Ancient botanic gardens were not places of study, but gardens or enclosures where plants were kept, rather like living museums. The early gardens of China, Egypt, Greece and Mexico are briefly described.

2.1.1 China

The Chinese should be credited with being the real founders of botanic gardens. The semi–mythical emperor Shen–Nung in the 28th Century B.C. is considered to be the father of medicine and husbandry. He is said to have tested the medical qualities of herbs and to have discovered medicines to cure diseases.

The Han emperor Wu Ti (140–86 B.C.) collected and grew a wide range of food plants including banana, vine, saffron and orange as well as rare herbaceous plants and trees, from the furthest regions of the Chinese empire. He dispatched officers to the North Western frontiers of China who brought back reports on the produce of that region. (Hill 1915) Note 1.

2.1.2 Egypt

It is thought that the Egyptians understood cross fertilization and hybridisation (Holmes, 1905). It is possible that a few medicinal plants were brought from abroad and cultivated in Egypt, for there are sculptures existing which show that in the reign of Queen Haksasu specimens of the trees yielding frankincense were brought to

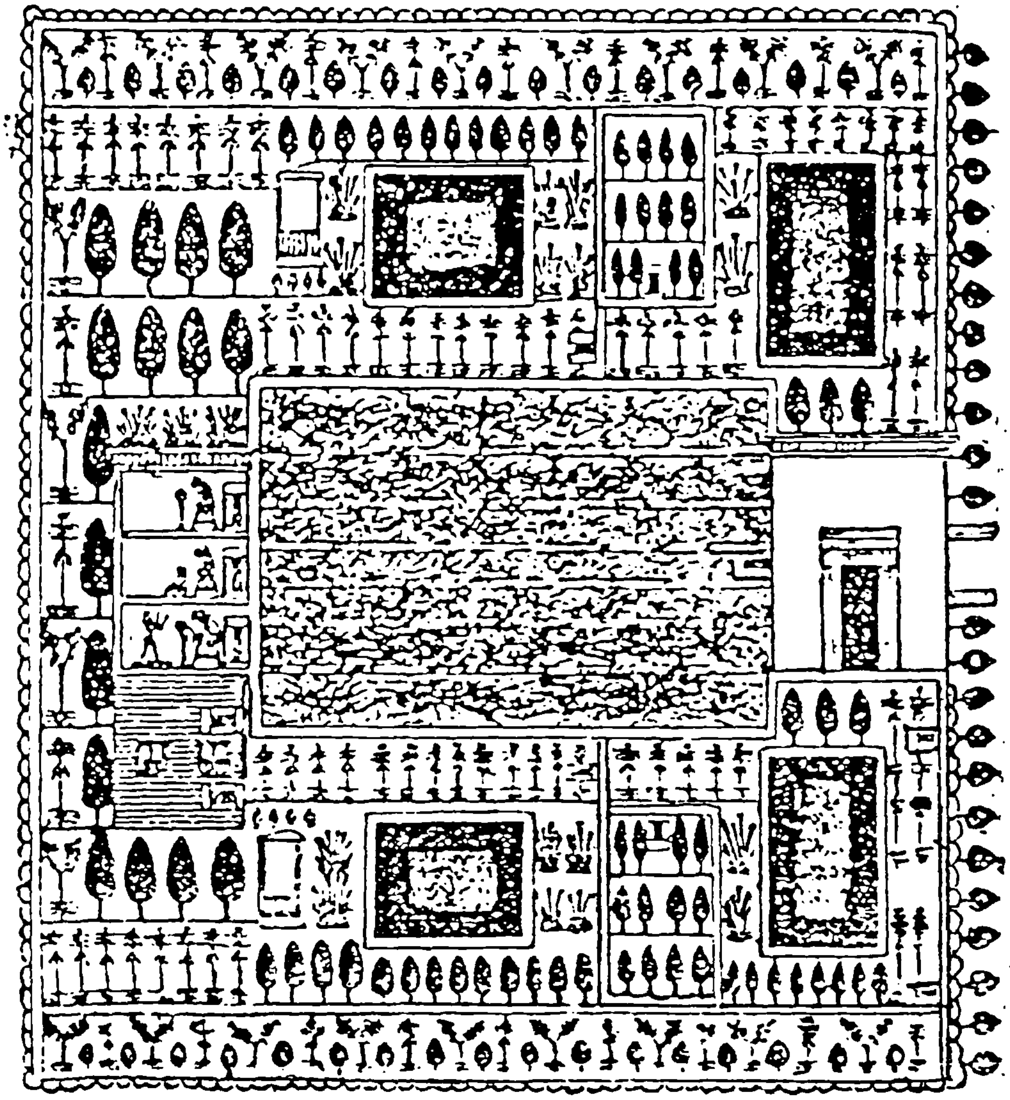


Fig. 2.1 A Royal Garden at the time of Thothmes III

(Source:- Holmes 1905)

Egypt from the land of Punt (probably S.E. Arabia) by ships. It may be that frankincense trees were valued on account of the fragrant resin, used as incense, obtained from them, and not for their medicinal properties.

Egyptian records indicate that considerable progress had been made in horticulture in the time of Thothmes III, about 1000 B.C. from which time we have the earliest drawing of a botanic garden (see Fig. 2.1). This garden was planned by Nekht, head gardener of the gardens attached to the Temple of Karnak. The representation shows an ordered garden with rows of date and doum palms and a vine pergola. Other gardens attached to the temple may have been used for the cultivation of crop plants rather than decorative ones.

2.1.3 Greece

Linnaeus names Hippocrates amongst the earliest of the Greeks who wrote on plants, but because he wrote of plants only in the interest of medicine, Linnaeus styles him: 'Father of Medicine', as did many early writers (Greene, 1909). Theophrastus Eresius, a native of Lesbos, who lived between 370–285 B.C. was considered the 'Father of Botany' by Sprengel: "celeberrimus autem omnium, verus rei herbariae pareas, Theophrastus fruit Eresius" (Sprengel, 1808) and 'the first of real botanists in point of time' by Linnaeus: "Primus rerorum botanicorum" (Haller, 1771).

Theophrastus' writings include references to about forty plants still used in medicine at the present day. This list, as given by Sprengel, includes medicinal products from India, Egypt and Cyrenaica. A knowledge of these plants probably dated from the Asiatic conquests of Alexander the Great. Theophrastus was a contemporary of Pliny in whose work on "Natural History" about 1000 plants are mentioned. Pliny does not speak of any part of a garden being set aside for medicinal plants. Many medicinal products were apparently imported from Asia and Africa and others were collected as required from wild plants in the localities in which they grew (Holmes, 1905).

Diogenes Laertius, writing in the 3rd Century A.D. tells us that Aristotle had a garden at Athens which Theophrastus owned after Aristotle's death, through the cooperation of his friend Demetrius of Phalerum (Diogenes Laertius v.39–41). Theophrastus bequeathed the garden to his friends (named) 'as may wish to engage jointly there in study' (Diogenes Laertius V.51–53). There is no mention of them studying botany, but Theophrastus wrote 'The History of Plants' and the 'Causes of Plants' – extensive studies of observations on plants – in which he mentions between 350–500 plants, only a small proportion of which were wild plants (Greene, 1909). Thus it would be an excusable mental leap to suggest that he used the plants in his garden as subjects of study.

To the Greeks we owe the foundation of our knowledge of the classification of plants which they collected and described from all available sources and kept as living specimens for reference, a practice common in plant taxonomy until the 18th century invention of the pressed herbarium specimen. The Greeks appear to have had little interest in plant cultivation for botanical or experimental purposes, though they grew many for medicines or food crops. Botany as a descriptive and taxonomic study flourished in the second wave of Greek enlightenment (the earlier wave did not consider plants as worthy of study). Diascorides wrote his famous descriptive herbal around AD77–78 of which it has been written:

> "within its own geographical range Diascorides' De Materia Medica has not fallen wholly into disuse, even in the twentieth century. In 1934 the Director of Kew, when visiting the Athos peninsula, met an officinal botanist Monk. On his excursions in search of "simples", this functionary carried with him, in a bulky black bag, four volumes in manuscript, described as having been copied from Dioscorides' original work. With the aid of these folios, he satisfied himself as to the names of his plants." (Arber, 1938)

The illustrations in Diascorides' herbal were extremely accurate and much copied by later herbalists.

2.1.4 The New World

Prescott (1843), in his work on the conquest of Mexico collated from original sources, includes some descriptions of gardens of the Aztecs. He includes accounts of their agriculture and crops including chocolate (afterwards introduced to Europe) and vanilla.

It would be obviously out of place to enumerate

> "all the variety of plants, many of them of medicinal value, which have been introduced from Mexico into Europe... The opposite climates embraced within the narrow latitudes of New Spain have given it, probably, the richest and most diversified flora to be found in any country on the globe. These different products were systematically arranged by the Aztecs, who understood their properties, and collected them into nurseries, more extensive than any then existing in the Old World. It is not improbable that they suggested the idea of those "gardens of plants" which were introduced into Europe not many years after the Conquest (of Mexico)." (Prescott, 1843)

Prescott suggests that the descriptions of Aztec gardens with their systematic arrangement provided the idea for the botanic gardens of Europe.

Describing the gardens of Montezuma's palace, Prescott says that:–

> "Extensive gardens were spread out around these buildings, filled with fragrant shrubs and flowers and especially with medicinal plants. No country has afforded more numerous species of these last than New Spain; and their virtues were perfectly understood by the Aztecs with whom medical botany may be said to have been studied as a science." (Prescott, 1843)

These gardens were largely damaged or destroyed by the Spanish Conquerors, except for parts of Chapoltepec which existed as a botanic garden until recent times and, although greatly changed, can now be seen as the major park in Mexico City.

Aztec lords or emperors created their pre–hispanic gardens, into which they introduced plants and animals from other regions of the country, especially plants of medicinal value. The gardens of Montezuma in Oaxtepec were enriched with tropical medicinal plants which could not be grown on the Mexican 'altiplano' (Vövides, 1978).

Brockway (1979) argues that the South American indians knew of, and used, the quinine producing bark of native trees long before the Spaniards reached South

America. Brockway also states that:–

> "Plant–based medicine was more highly developed among the Indians of the New World than it was in Europe at that time, and reports of new herbal cures stimulated European interest in herbal medicine and prompted the foundation of botanic gardens attached to medical schools."

2.1.5 Summary

The gardens of Mexico and China, in addition to their amenity purposes, served as medicinal gardens and the medical properties of the plants were studied, but the gardens of Egypt were probably for amenity and cropping purposes (Hill, 1915). The Greeks, by contrast did not appear to grow plants in gardens for amenity, medicinal or economic purposes but merely to have them at hand to describe.

These ancient gardens are now of mostly academic and historic interest and only Prescott's speculation credits them with influencing the foundation of the botanic gardens which we still have today.

2.2 Foundation of European Gardens

2.2.1 Monastic Gardens

The botanic gardens of Europe can be traced back to the physic gardens of the monastic institutions. In the time of Charlemagne (760–814 A.D.) several of these gardens are alluded to (Guérard, 1844). At the Abbey of St. Gall near Lake Constance the physic garden is shown on a plan as next to the doctors quarters with the fruit and vegetable gardens sited some distance away. Charlemagne ordained that a specified list of medicinal herbs was to be grown throughout his dominions. The 'hortus' or flower garden at St. Gall was separated from the 'herbularis' or physic garden. The details of this 9th Century garden are retained (Willis, 1848). This physic garden was the precursor of the physic gardens established in connection with monasteries throughout Europe. Throughout the dark ages the monasteries remained the custodians of knowledge and culture. When Universities were founded physic gardens were planted in association with their medical faculties, first in Italy and later in other parts of Europe.

Since the monasteries and Universities were generally situated in towns, their physic gardens were usually small and in Europe these ancient gardens, which have been gradually transformed into the botanic gardens of the Universities, are still to be seen.

Owing to the need to protect the doctor and the apothecary from unscrupulous drug sellers, the growing of simples in recognized physic gardens was originated. The simples or 'simplicia' were the herbs from which the apothecary prepared his medicines or 'remedia composita'.

2.2.2 The First University Gardens

The first botanic garden, as we would know it, was founded at Pisa in 1543, already well known as a centre of botanical learning at that time. The garden was moved a number of times. (Note 2) By contrast the second founded botanic garden,that at Padua in 1544 has not been moved and is still largely preserved in its original design on its original site. It is an excellent example of the type of geometrical garden illustrated in horticultural texts published at the end of the 16th and beginning of the 17th Century which dominated garden design on the continent for 200 – 300 years.

Following the foundations at Pisa and Padua, other gardens were created which still exist today, including Bologna 1547, Zurich 1560, Leiden 1577, Leipzig 1579, Paris 1597, Montpelier 1598, Heidelburg pre–1600, Strasburg 1620, Oxford 1621, Jena 1629, Uppsala 1657, Chelsea 1673, Berlin 1679, Edinburgh 1680, Amsterdam 1682 and Leningrad 1714. The Leningrad garden was founded as a medicinal or physic garden, though as a separate entity and not as part of a monastery or University.

John Ray visited Padua and Pisa very soon after their founding and reported that plants other than medicinal ones had been introduced to the Physic garden. This was due to the revival of interest in the plant world which took place in the mid 16th Century. A healthy rivalry developed between the various institutions to see which could show the greatest number of species in cultivation. The Paris garden, for example, had 1,800 specimens in 1636, 2,360 in 1640 and 4,000 by 1665 (Hill, 1915)

Lectures on simples were not at first accompanied by demonstrations upon living specimens but having the plants available in a definite garden led to demonstrations being given as separate classes. Both types of class were equally important.

University Botany at that time was ancillary to medicine. At Montpelier the same Professor taught human anatomy in winter and botany in summer. As late at 1773 anatomy, surgery and botany were taught by the same Professor at Jena. In the annals of the history of biology the most important monastic garden must be that of Brünn (now Brno) in Czechoslovakia where Gregor Johann Mendel (1822 – 84) was Abbot and carried out his experiments on the inheritance of characters in plants. His results, published in 1865 – 69, received little attention until about 1900 when their importance was recognised.

2.2.3 Botanic Gardens Attached to Universities in Britain

The first University Botanic Garden in England was founded at Oxford in 1621 by Lord Danby, one of the great adventurers of the Elizabethan age. He was exiled to France for a murder. In later life, he became an Earl, then a Knight of the Garter. (Note 3) The Oxford garden is still present on its original site today.

Jacob Bobart was given a 99 year contract as keeper of the garden for himself and his heirs, thus ensuring a continuity of interest in the garden. Initially the garden suffered a serious financial setback but this was overcome and the garden flourished under the Bobarts for 82 years. Morison became Professor in 1669. In collaboration with the younger Bobart he began a detailed Flora of Oxfordshire. This writing of local and other floras was to become one of the main functions of Botanic gardens. At that time live plants were grown from seed for taxonomic purposes. This raising of plants from seed gave them an insight into the processes of sexual reproduction, ideas which they shared with John Ray. This led them to use reproductive rather than the vegetative organs as the basis of classification and helped make explicit the, then, daring idea of genetic relationships.

Thus botany became a science in its own right within 120 years of the foundation of the first European Botanic Garden and the sciences of taxonomy and plant reproduction were added to the already existing functions of Botanic gardens which were the growing of medicinal herbs and collecting novelties.

In spite of having a botanic garden there were no lectures in botany at Oxford until Joseph Banks (1743 – 1820), then a student at Oxford, caused Israel Lyons, a Cambridge astronomer, botanist and author of a book on the Cambridge flora, to be brought to Oxford to give lectures on the subject to interested undergraduates (Hadfield, Harling and Highton, 1980).

Bobart followed Morison as Professor and Johann Dillen, a German botanist and skilled draughtsman came to work at Oxford. By his and other draughtsman's labours it became possible to establish the ideas on systematics of Ray, Morison and, later, Linnaeus. In 1840 Charles Daubeny became professor. He took up new ideas in plant science. Daubeny realized the value of Liebigs experiments with mineral fertilisers and tried them on plots at Oxford. Under his leadership the botanic garden along with the rest of botany entered the experimental phase already underway in Europe. His pupil John Lawes founded Rothamsted experimental station.

Unfortunately these developments did not continue. The craving for specialization in teachers, the demand for independence of Professors and above all the University's fear of expanding science prevented this. The Botanic garden therefore suffered a second setback when the teaching and research in Botany at Oxford fell into decay and the collaboration between Botany and medicine which could have been so creative remained static for another 80 years. In 1944 the garden was re–established and doubled in size. Taxonomy, hybridisation and selection in roses was undertaken. In 1954 a genetic garden was added with materials for both teaching and research not only into the results of, but also into the processes of, evolution. In 1969 an arboretum was donated (Darlington, 1971). Thus the development of botany can in part be traced by following the history of this garden.

The history of botany at Cambridge University starts with John Ray who entered the University in 1644. Finding no teacher of botany within the University he decided to fulfil the role himself. He established a tradition of 'herborising' or what would now be called 'field trips' into the surrounding countryside and in 1660 he published his 'Cambridge Flora'. Various attempts, through John Gerard and others, to found a botanic garden at Cambridge had failed and it was not until 1760 when Richard Walker, Vice Master of Trinity College, purchased a 5 acre plot bordering Free School Lane that Cambridge got its botanic garden.

In 1825 the botanic garden was taken over by John Stevens Henslow, who later numbered Charles Darwin among his pupils. Henslow's chief interest was in trees for which the 5 acre (2 Ha) site was unsuited. He persuaded the University to purchase it's current 40 acre (15 Ha) site, one and a quarter miles (2 km) from the city centre. The original planting of trees by Henslow was further developed by Richard Irvine Lynch, trained at Kew, who became curator in 1879; Lynch redesigned the water area and rock garden, creating the attractive garden which exists today.

As other Universities were founded and botany departments started they also created botanic gardens, but the new Universities, founded in the 1960's, generally did not have botanic gardens created with them.

2.2.4 First Private Gardens in England

Prior to the founding of the University of Oxford botanic garden there were privately owned physic gardens. The best known of these was John Gerard's garden in Holborn for which he wrote the Catalogue in 1596. Gerard also wrote the more famous Herbal. The Reverend William Turner (1510 – 1568), a tanner's son from Morpeth, who has been called 'The Father of English Botany' had a garden in Kew and afterwards a renowned garden at Wells, when he was Dean of the Cathedral. John Parkinson (1567–1650) herbalist to King James I and author of the book on garden plants 'Paradisi in sole Paradisus Terrestris' (pub. 1629) had a garden at Long Acre. Thomas Johnson had a garden at Snowhill. John Tradescant the elder (1570 1668), after travelling and collecting plants, including cos lettuce and other fruits and vegetables, founded his garden at Lambeth. He was appointed Keeper of His Majesty's garden at Oatlands in which post he was succeeded by his son, also John, in 1637. John Tradescant the younger was also a plant collector and went on at least three collecting expeditions to Virginia. He was assisted, in turn, by his son who predeceased him. Artefacts brought back by the Tradescants from their travels eventually formed the nucleus of the Ashmolean Museum at Oxford (Hadfield, Harling and Highton, 1980).

One of the most famous gardens in Britain also falls into the private category. This is Chelsea Physic Garden, founded in 1673, the second physic garden to be founded in England (Taylor 1990), as the garden of the Society of Apothecaries. The society itself was formed in 1617 to protect the apothecaries from unscrupulous drug sellers. The garden was founded to produce drug plants of known origin for the apothecaries use. When the ground was purchased and given to the Society by Sir Hans Sloane he made it a condition of the gift that 50 dried specimens of plants grown in the garden each year should be presented to the Royal Society and that each year they should be different plants, until the number reached 2,000. This direction was complied with until 1773 by which time 2,550 new species had been presented. The garden probably at one time contained the plants from the physic garden at Westminster, which had been well furnished by Hugh Morgan, Queen Elizabeth I's apothecary and also those from his private physic garden at Coleman Street.

The more recent private gardens of Britain which contain collections of note are too numerous to review but two are now botanic gardens open to the public. Ness which was the private garden of Arthur Kilpin Bulley, founded in 1898 (and which owes much of its plant collections to George Forrest, Frank Kingdom–Ward, R.E. Cooper, Reginald Farrer, E.K. Balls and other famous plant collectors of the early 20th Century), is now Liverpool University Garden (Hulme, 1983). Also of note is Westonbirt, which was part of the estate of Robert Stayner Holford. Planting began in 1826 with trees and shrubs collected from around the world. In 1956 it was handed to the Forestry Commission as an arboretum and research station (Young, 1987).

Horticultural Societies also own/have their own gardens. The Royal Horticultural Society's garden at Wisley and the Northern Horticultural Society's garden at Harrogate are privately owned by the two societies.

2.2.5 Public Gardens – Municipal Gardens

During the 19th Century botanic gardens were opened in most of the major industrial cities of the country under the auspices of Botanical Societies (Chadwick, 1966). Over the last 60 years many of these gardens have fallen into decline and been discontinued. These gardens were not originally public gardens. A few were handed over to local authorities as they were formed and their responsibilities broadened. The gardens were then opened to the public. In general these gardens had been created to display collections of plants only and this they continue to do. Some serve an educational purpose but they do not generally carry out research. Examples of such gardens are the Birmingham City botanic garden, Sheffield City botanic garden and the extensive Glasgow botanic garden. These municipal botanic gardens were separate from the municipal public parks which were gradually established by Local Authorities as open spaces and ornamental grounds following a Royal Commission in 1843. This Commission was set up to enquire into the state of large towns and populous districts with a view to improving the social conditions and the health of the inhabitants. The Commission recommended empowering the local administrative bodies to raise the necessary funds for the establishment and maintenance of public walks (Eul, 1964).

2.2.6 'Government' Gardens

In Britain these are The Royal Botanic Garden Edinburgh and its three outstations Logan, Dawyk and Benmore; The Royal Botanic Gardens Kew, and its outstation Wakehurst Place, and the Forestry Commission's arboreta at Westonbirt and Goudhurst. Edinburgh's history is typical. It started as a physic garden with a teaching role and now carries out taxonomic research and is responsible for many plant introductions mainly from the Himalayan regions. Along with Kew it offers a Horticultural Diploma course which is very highly regarded by employers. It also has one of the best botanical and horticultural libraries in the country.

Founded in 1670 by Dr Robert Sibbald and Dr Andrew Balfour, the RBG Edinburgh was never primarily concerned with economic or crop plants as was the later established garden at Kew. It started as a small garden at St Anne's Yard near Holyrood Palace for growing medicinal plants for teaching purposes. In 1676 Balfour and Sibbald took over the garden attached to Trinity Hospital. James Sutherland was placed in charge of both gardens and in 1695 was appointed Professor of Botany at the University and also took control of part of the Royal Garden at Holyrood. Four years later he became King's botanist to James I and finally in 1710 Regius Professor of Botany.

The garden as a teaching institution was used first for physicians and apothecaries and, by an act of the college, in 1695 Sutherland also undertook the teaching of the apprentices of the College of Surgeons.

This act is the first British document to use the term 'Botanic Garden' to describe the Physic garden at Trinity hospital, possibly to avoid confusion with the College's own physic garden. The gardens were moved in 1761 by John Hope who united the Town and Royal Garden and obtained a permanent income for the new Garden from the Crown. From 1820 – 30 the contents of the garden were again moved to their present site at Inverleith by William McNab, one of the leading horticulturists of his day.

In 1864 the Experimental Garden of the Royal Caledonian Horticultural Society was transferred to the botanic garden and in 1889 the garden came wholly under the control of the crown.

Edinburgh became a major centre for taxonomic research, especially on the plants of China and the Himalayas. This interest was supported by botanical exploration, particularly the expeditions to Western China from 1904 – 1932 of George Forrest who brought back many important horticultural plants as well as over 40,000 dried and living specimens for scientific research.

Edinburgh's three outstations were formerly private collections of note. They provide the RBG with more space for its tree and shrub collection and sites with a milder climate and greater rainfall than Edinburgh, thus better suited to the growth of many rhododendrons and conifers than Edinburgh. Additional work is done on the conservation of temperate rain forest conifers through a network of gardens in the South West of England (Page, 1991).

The invention of the herbarium specimen, and particularly the simple step of having each specimen mounted on a separate sheet of paper instead of bound in a book greatly assisted the classification of plants. That those who studied plants were centred on the botanic or medical departments of Universities meant that frequently the herbarium became associated with the botanic garden. The science of plant taxonomy was revived (Circa 1840) and due to the work of Jussieu, Ray, de Candolle and Linnaeus our present system of binomial classification in latin was developed and adopted as standard worldwide making the exchange of herbarium specimens, plant descriptions, plants and seeds across the world simple. The seed exchange system between botanic gardens has been going on for 160 years now.

Kew was a Royal garden begun about 1760 by Princess Augusta and extended in 1772 by George III who also chose Sir Joseph Banks as the Botanical adviser. Banks was one of the most famous of English botanists. He made three botanical voyages. He travelled first to Newfoundland then to Iceland, and he was sent as botanist with Cook on the 'Endeavour'. He made the first scientific study of Australia and is commemorated by the Australian genus *Banksia*. He was President of the Royal Society for 42 years. With six others he instituted what is now the Royal Horticultural Society in 1804. During his 48 years directing the garden, Banks established the practice of sending out plant collectors, a function and practice which continues today. Some of the collectors then became superintendants of botanic gardens in the Empire. Notably William Kerr who became superintendant of the botanic garden at Ceylon and Allan Cunningham who, in 1836, became superintendant of the botanic garden at Sydney. Kew's chief sphere of influence has been in economic botany collecting, cultivating and propagating plants which have altered history, e.g. cinchona, para rubber, sisal (Brockway, 1979; Hobhouse, 1985). After a period of decline , 1820 – 40, Kew was revived and became the centre of botanical trade with the growing empire.

As an offshoot from this work botanic gardens were founded in the countries to which plants were sent, to increase stocks and to provide a link between supplier and planter. Botanists trained at Kew went to run these gardens and frequently carried out research into the local flora e.g. Sir Stamford Raffles in Singapore.

Following the decline of the Empire, Kew still remained pre–eminent as a centre of taxonomic study and as a place to which new plant discoveries were, and still are, sent from all over the world.

At Kew one development which took place to keep pace with the developments occurring in plant science on the continent was the founding of the Joderell Laboratory in 1876. Britain was much slower than other European countries to take up the new laboratory based botanical studies but in the Joderell laboratory first anatomy and morphology then physiology and paleobotany were studied.

Kew now studies plant poisons, micropropagation requirements of many species, the physiology of seeds and storage requirements for the successful preservation of the seed gene bank. Many of the current botanical expeditions, which are now ecological and physiological as well as taxonomic, are arranged from or in collaboration with Kew, the Royal Society and the British Museum. Kew too suffered difficulties. The great collections amassed by Sir Joseph Banks and George III were in danger of being lost and the garden turned into a fruit and vegetable garden following their death and were only saved and converted from a private collection to a national one by a report to parliament and by the government providing funding.

Kew remains one of the greatest botanic gardens in the world though it's role in economic plant supply has greatly diminished. At Kew and its outstation, Wakehurst Place, gene banks are maintained (both in stored seed and in micropropagated plants in culture), of many plants of the world including those which are threatened with extinction.

Westonbirt and Goudhurst are arboreta controlled by the Forestry Commission. They are inherited collections of trees and shrubs, many of which are of known origin. The collections contain many rare species and mature specimens. They are thus deemed worthy of preservation.

2.3 Problems and Changes Faced by the European Gardens Through Time.

2.3.1 Changes and Developments

The reasons for founding the different Botanic Gardens vary according to the time and place in which they were established.

Individually, botanic gardens may or may not have changed and developed over the centuries, but collectively there has been a sequential change from the small informal physic garden of 16th Century Europe to the large informal nature reserves such as those which form part of some botanic gardens in such places as Indonesia, Cuba, North America and Australia.

A classic example of the changes which took place within a botanic garden can be seen in the history of the Komarov Botanical Institute in Leningrad. This garden was founded in 1714 by Peter the Great as a physic garden to supply medicinal plants for the armies needs. In 1824 after the Napoleonic war, it was reorganized as the Imperial Botanic Garden (Hill, 1915). In 1917 following the revolution, it was again reorganized as the Principal Botanic Garden of the U.S.S.R. In 1937 its stated interests were systematic, geographic and economic botany and the local flora (Gager, 1937). After the Second World War the work of the garden again changed and in 1969 its stated interests were plant introduction, mainly of ornamentals, compiling indices, directories and monographs of plants cultivated in the U.S.S.R, the selection and multiplication of the best stocks (Fletcher, Henderson and Prentice, 1969). Russian botany remained Lamarkian and 'acclimatization' of plants is a feature of most Russian botanic gardens. The Komarov garden also continued to grow medicinal plants and the U.S.S.R. pharmacopoeia still lists over 2000 medicinal plants. In 1975, in its own leaflet 'The Komarov Botanical Institute' the work of the garden is listed as including systematics, ecology, physiology and biochemistry. ✓

Thus in the history of one garden the changes taking place in the science of botany are demonstrated. These same changes in the emphases in botanical teaching from medicine to taxonomy to ecology then physiology and biochemistry have evidenced themselves in the history of most other gardens.

2.3.2 Botanic Gardens and Empire

The Russians had no overseas empire so their botanic gardens were not used for the growing and disseminating of plants of economic importance outside the U.S.S.R., (in contrast to those of Britain, France and the Netherlands. Botanic gardens were founded in the tropics by these three nations to support their empires.) The first was established by Britain on St. Vincent in 1764 in a desire to participate in the very lucrative spice trade, then a monopoly of the Dutch.

Captain Bligh, having survived the Mutiny on the Bounty, went back to the Pacific Islands to collect plants, including breadfruit, which he brought to St. Vincent. On later expeditions he brought nutmeg, cloves and other spices, then very valuable commodities. In 1815 the garden was moved to Trinidad. By 1815 there was a botanic garden on every West Indian island of importance. On some islands e.g. Jamaica, there were several. (These gardens served as centres for the distribution of economic plants and scientific and horticultural information.)

The tropical gardens of the East exercised their influence over a much more vast territory. Pre–eminent amongst these gardens was Buitenzorg, now Kebun Raya, Bogor in Indonesia, founded by the Dutch in 1817. This was described by Hill (1915), as "probably the most complete and extensive botanical establishment in the world", having various gardens, covering 1,100 acres equipped with laboratories, herbarium, museum and experimental and collecting stations. Gager (1937) reported that the economic depression had resulted in the virtual closing down of the garden in 1932. Ten years after Hills' report the curator was pensioned off and after another twelve years 'the most extensive botanical establishment in the world' was at a standstill.

Calcutta botanic garden (founded in 1786) and Peradeniya in Sri Lanka (then Ceylon), were intended to be sources of plants and information for the possessions of the East India company and centres to which exotic plants of economic interest could be imported for experimental cultivation and thence distributed. The introduction of tea to India was mainly carried out through the gardens as also was the introduction of mahogany, jute, sugar cane and the improvement of Indian cotton cultivation. The introduction of the potato:–

> "May be counted among its (the British Empire's) many benefits to the people of India" (Hill, 1915).

Calcutta was also instrumental in the introduction of cinchona (quinine) from South America to India via Kew. At Penang the East India Company started spice gardens to break the Dutch monopoly.

Unlike European gardens these tropical gardens covered large areas; Calcutta 273 acres; Baroda, India 1,200 acres; Bassein, 90 acres; Darjeeling, 45 acres; Poona, 60 acres; Saharanpur 168 acres; compared with the 2 acres or less of Italian botanic gardens. The sizes were different because of the different reasons for their founding.

North America has 38 Botanic Gardens, mentioned in the International Directory of Botanic Gardens IV (Henderson, 1983), the first having been founded in 1728. The American Association of Botanical Gardens and Arboreta has 315 member gardens in the U.S.A. and 15 in Canada. Many of these gardens are associated with University Departments of Botany or Agriculture or Colleges of Agriculture. A number are municipal and a number are supported purely by private subscriptions from members of the public or by endowment.

2.3.3 Summary

The tropical botanic gardens were intimately associated with the fortunes of the empires of which they were a part, with the history of plant introductions, with Captain Cook, with Captain Bligh and the Bounty, the collapse of the Brazilian rubber monopoly, the introduction of quinine and the relief of malaria in many parts of the tropics. Whilst cultivating the pharmaceutical crops of the world the gardens were also the guardians of the primary economic crops of the empires.

Following the Second World War and the breaking up of the Empires this role in economic botany was substantially over. The tropical gardens had been left to manage as best they could during the War, and in the case of Singapore and Malaya during occupation. Unlike earlier wars, the fighting did not stop so that some exotic plant might be brought through the lines to a waiting ruler as happened in the Napoleonic Wars when an English nurseryman was allowed free passage through the French lines to bring new plants to the Empress Josephine for her collection at Malmaison. Safe passage was also allowed at sea for four roses from China. These became the parents of our modern roses (Thames Television, 1983).

It was not only plants of immediate crop value which were introduced through botanic gardens. (Vast numbers of plants of ornamental and horticultural merit were introduced by collectors such as David Douglas, Sir Joseph Banks, Reginald Farrer, George Forrest, Frank Kingdon Ward and many others, whose exploits fill a library and the progeny of whose collections fill gardens, arboreta and forests. Many of these collectors worked for private individuals or syndicates as well as for botanic gardens and seeds and plants were divided on arrival in Britain, so the risk was spread.

This role of botanic gardens again diminished with the empire but remains to a small extent with RBG's Edinburgh and Kew, the Royal Society and the British Museum.

2.4 Botany and Medicine

Plants have formed the major part of mans medical treatments throughout history. Many early medicines were, and are still, effective. Spurious medicine, based on the doctrine of signatures, has long gone leaving only some colloquial names e.g. lungwort, as a reminder. Real advances in anatomy, the discovery of the human circulatory system and bacteria led to the treatment of the cause of illnesses rather than the symptoms.

The calling of pharmacist became gradually separated from that of the physician. At the end of World War II many doctors and veterinary surgeons still made up their own medicines. Many of the ingredients used were of plant origin.

The development of synthetic drugs radically changed Western medicine and its dependence on plant extracts. Treatments became more standardized. This development is reflected in the teaching of botany which was formerly taught to undergraduates in some medical schools as part of the first MB course. Thus the link between botany departments and medical faculties was weakened and botanic gardens declined in importance but recent concern over the loss of tropical rainforest and the plants of medical potential may mean a return of this connection.

Although many of the botanic gardens were initially founded for the growing and study of medicinal plants the arrangements for financing the venture were often poorly thought out. At Edinburgh the first keeper James Sutherland (1676) looked after the, then, two physic gardens, became Professor of Botany at the University and also took charge of part of the Royal Garden at Holyrood. These three jobs and his fees for teaching made him free of personal financial difficulties (Fletcher and Brown, 1970), the books and many of the plants being his own property. Eventually in 1761 the gardens obtained a permanent income from the Crown.

Similarly at Oxford University Garden and Chelsea Physic Garden the ground was provided but the funds necessary for staffing the garden were not and fees were raised from teaching. The financial arrangements for the smooth running of Oxford's garden took about 100 years to become organized (Darlington, 1971). Chelsea, as an independent institution founded in 1673 was moved from Westminster to Chelsea in 1676 and in 1722 the garden was deeded to the Society of Apothecaries. Around the end of the last Century the Chelsea Garden again suffered from financial difficulties and a new arrangement was made for its management. In return it took on new functions in teaching botany and the supply of botanical specimens. In the 1980s a financial crisis again arose due to changes in teaching. This led to the formation of The Chelsea Physic Garden Company which depends largely on the public in a number of ways for its finances.

2.5 Changes in Teaching and Research in Botany

As botany is no longer taught to medical students in their first year the number of plants supplied by botanical gardens for practical classes is substantially reduced.

As most botanic gardens are associated with University Botany Departments it would be logical to assume that it is the staff and students of these Departments who are most concerned with the research and teaching with which the gardens are associated.

An analysis of the UGC statistics for Universities in the UK shows that numbers of both undergraduate and postgraduate students in Botany have declined steadily both in real numbers and as a percentage of the total number of students during the last 20 years (see Figure 2.2).

Some course titles have been changed from botany to plant biology, reflecting the change in emphasis from the study of whole plants to more experimental studies. Current University courses, with smaller numbers of students, have a much greater emphasis on biotechnology, microbiology, biochemistry, genetic engineering and micro–propagation. These subjects require very little in the way of whole plant material.

Previous changes in the study of botany, such as the change from descriptive botany to anatomy, morphology and ecological adaptation, still required large amounts of plant material in variety. This was also true of plant classification as it developed to present day taxonomy. Early experiments in plant physiology, with large classes, made large demands for plants. So while the emphasis changed the need for botanic gardens remained. The beginnings of these changes were described

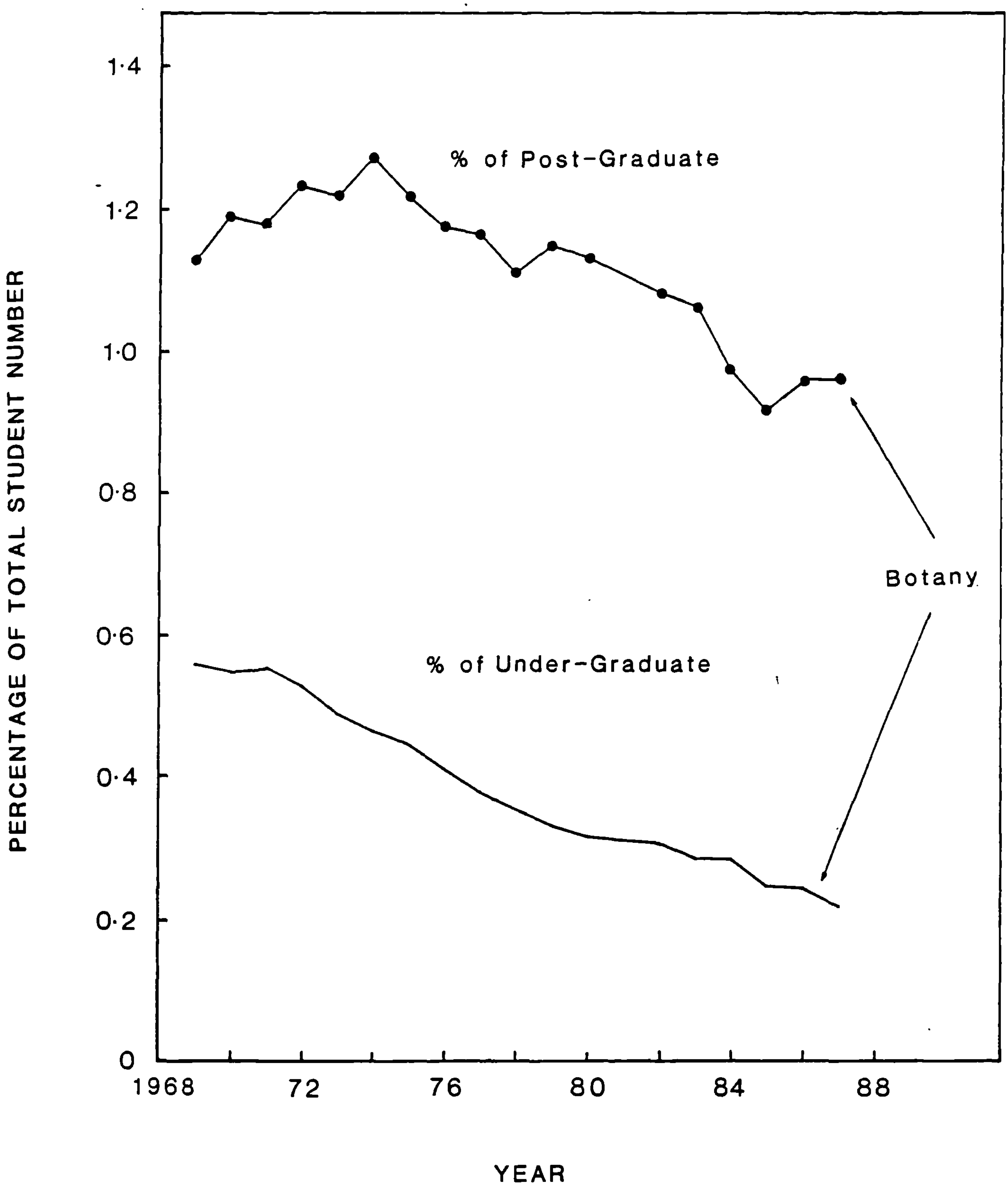


Fig. 2.2 Decline in Number of Botany Students during the last 20 years

by Shetler in 1969:

> "The problem of botanic gardens appears to be associated with the similar problems besetting all other aspects of classical botany and indeed biology.
> The traditional disciplinary approach to biology which has tended to partition it into plants and animals is giving way to the 'levels of organization' approach, which is topical and cuts across the classic groupings of organisms".

A series of articles appeared in 'Nature' and in 'Advancement of Science' between 1967 and 1971 on the changes necessary in botanical teaching and the 'poor image' of botany. The first, concerning "the role of plant science in the modern world" (Bennet–Clark, 1967), stresses that it was no longer merely taxonomy and plant collecting but a science of importance to agriculture in plant breeding and physiology. The second (Engledow, 1968), is again concerned with the poor image of Botany and its inability to attract students with a good knowledge of chemistry and physics. Engledow fails to remember that the choices for A–level pupils were maths, physics and chemistry or for potential biologists, botany, zoology and chemistry. In the 1960's it was not often an option that botany and physics could be studied together at A–level. Further reviews of "the state of botany today" (Brian, 1969) and "botany's future needs and potential" (Engledow, 1970) emphasised applied research topics of social value. The difficulties of small Departments with few staff trying to cover all subjects and the high cost of maintaining the staff:student ratios prevalent in these Departments are acknowledged. Brian (1971) defined plant science as including subjects ranging from ecology to molecular biology. He states that botany in schools is poorly taught, and warns of the difficulties which could be encountered in University Schools and Departments of Biological Sciences if the plant biology component was restricted to a few Universities only. His report was written in the expectation that student numbers would double during the 1970s. The numbers did double but the percentage of Botany students fell.

The effect of this decline in botany and its effect on Botanic Gardens has been described by Bruisma (1975):

> "Today the botanic gardens are no longer closed institutions... but their function in University teaching and research has been largely displaced by experimental work. The varied collections require a large amount of labour and cost relatively large amounts of money to maintain. In the Netherlands the situation is complicated by the prevailing economic conditions, but on the other hand public interest in plants has increased enormously and there is also a growing interest in the educational aspects at the sub–University level."

More recently a survey of the number of University staff in British botany and biology departments that teach whole plant botany illustrates the marked decline that has occured during the last 10 years (Thomas, 1991). A questionnaire was sent to University departments asking for information on individuals employed 15, 10 and 5 years ago and currently, who could be regarded as whole–plant botanists. Twenty departments replied. The number of whole plant botanists employed was roughly static at 82 between 15 and 10 years ago, but the number dropped to 68 five years ago, and to 43 today. Included in these figures, over the same period, the number of taxonomists fell from 39 to 27 to 22 today (Figure 2.3). It was further revealed that many of these 22 are not amongst the youngest members of staff. As University departments act independently of each other the time may not be far distant when there are no whole plant botanists or taxonomists left in Universities to teach future generations. This at a time when anything up to 100,000 species of plant are threatened with extinction by the end of the century. Many will become extinct without ever having been named by a Western botanist. Without any taxonomists the extent of the losses will never be known.

Taxonomic research is also carried out in Museums and the National botanic gardens as well as Universities, but there has been a reduction in botanists in the Natural History Museum from 56 ten years ago to 36 today.

This reduction in the number of whole–plant botanists is part of the same change which no longer requires herbaria or botanic gardens for current teaching needs.

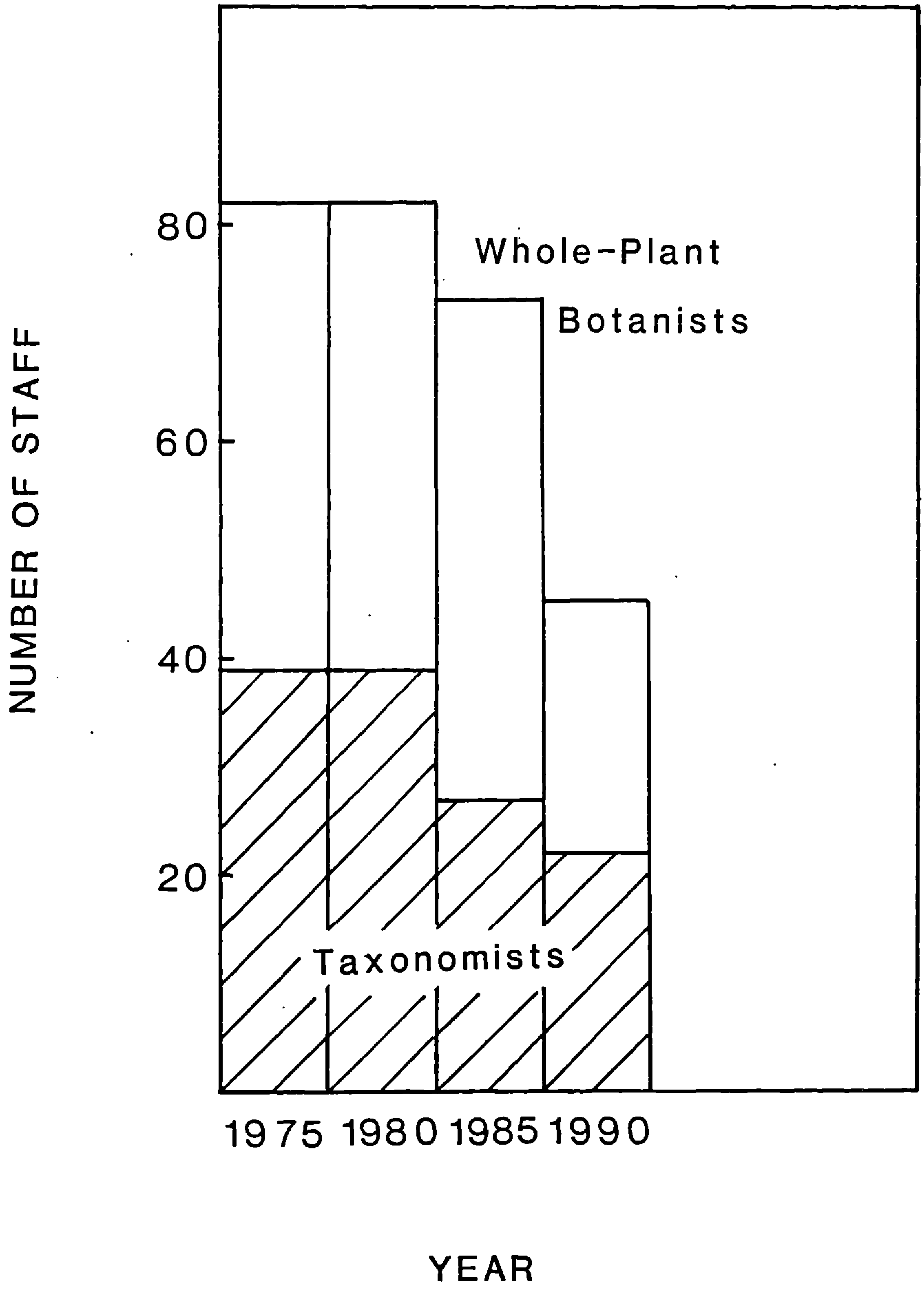


Fig. 2.3 Decline in the Number of Whole Plant Botanists and Taxonomists in Universities over the last 10 years.

With pressure on Universities to compete for students and to cut costs their individual decisions could result in an overall closure of most of the botanic gardens in the U.K. These issues are reviewed further in Chapter 9.

2.6 Current Financial Constraints

The previous examples reflect the financial difficulties of botanic gardens. In Britain, since Bruisma's paper in 1975, there have been two rounds of expenditure cuts by the U.G.C., then the funding body for Universities. The U.G.C. Annual Review for 1979–1980 reports 'a new situation':–

> "as a consequence of changes in government policy there will be falling resources for home students up to 1983–1984 and no undertaking beyond that' and 'the prospect of a decline in income due to a radical change in policy for charging fees for overseas students is likely to result in a reduction in the U.G.C. budget of £35 m. for 1979–1980."

This annual review is written in quite a different tone from those of previous years which were written in the expectation of funding continuing for all students with increases for inflation and increasing standards of equipment and facilities.

There has been a continual contraction of the U.K. University system since 1979 and a further round of cuts in 1985, more serious than those of 1981, has put further pressure on Universities to 'rationalize' small Departments. As a result, the University of Hull has given up its botanic garden (Chapters 4, 9). The University of St. Andrews has leased its Botanic Garden to the North East Fife District Council (Mitchell, 1987). Reading University has rationalized two previous gardens and now has one (Bisgrove, 1987). University College Cardiff has lost its botanic garden (Thomas, 1991).

Financial problems are not wholly recent nor confined to University Gardens. Chelsea Physic Garden had its recent problems (see p.65). Kew, which had became a great centre for botanical collection under Princess Augusta and subsequently George III and Sir Joseph Banks, was in danger of becoming a Royal orchard after their deaths in 1820 and Royal patronage for the botanical work of the garden was no longer forthcoming. It was saved by a report by Lindley to Parliament in 1840 saying that:

> "The wealthiest and most civilized country in Europe offers the only European example of the want of one of the first proofs of wealth and civilization."

Lindley recommended that Kew should be developed into a National Botanic Garden and Centre for Botanical Science for the Empire (Gilmour, 1944). Financed by the Government, Kew prospered from 1841 under its first Director, Sir William Hooker, until the present day. However a report in The Guardian in 1989 (Smith, 1989) says that the Government funding of Kew is to be reduced from £8m to £5m by the mid 1990's.

2.7 Horticulture and Botanic Gardens

Unlike some Russian and American botanic gardens (Fletcher, Henderson and Prentice, 1969), botanic gardens in Britain have not sought to show the best horticultural varieties. They have shunned horticultural hybrids and remained the home of the species – this is a consequence of their taxonomic work in describing new species and in writing floras. This purist attitude has meant that they have tended to ignore horticultural science and the great upsurge of interest in gardens and gardening, plant purchasing and garden visiting which has taken place amongst the British public. Market research organizations made glowing predictions in the early 1970's of a boom in leisure spending of around £16,000 million by the 1980's with an increase in spending on gardening from a steady 3–4% per annum to a higher 5% per annum (Morrell Publications, 1973).

In Britain the two gardens which do cater specifically to a horticultural rather than botanical interest are the Royal Horticultural Society's Garden at Wisley and the Northern Horticultural Society's Garden at Harrogate. Wisley does not consider itself to be a botanic garden *per se* (McMillan Browse, 1987).

In the U.K. the number of visitors to gardens has been increasing: there was a 52% increase in the number of visitors to gardens between 1976 and 1989 (Coopers and Lybrand Deloitte, 1991).

2.8 Gardens and the Public

Gardens have changed over the 4½ centuries since their beginning from the purely didactic to the more aesthetic, landscaped modern botanic gardens. Public visiting of the gardens has also increased during that time, not generally due to any major change of policy or initiative by the gardens.

Most of the botanic gardens do not have an admission charge so the gardens have little to gain financially by encouraging large numbers of visitors. They do gain local goodwill and, in a number of cases, practical help through Friends of the Garden schemes.

It may be that, should current government policies continue, the gardens will have to look to their public for support and may have to consider the potential market for themselves. They may also need to reassess their role in relation to horticulture, public amenity and public education.

Notes

Chapter 1

1. Hill in 'The History of Functions of Botanic Gardens' cites Bretschneider in his Botanicon Sinicum; published in the China Branch of the Royal Asiatic Society Journal N.S. 25: p.24, 1983 as his source for the Chinese being the founders of Botanic gardens. Bretschneider, in fact, does not so credit them. At the end of his 'Botanicon Sinicum' there is a section of general remarks by Dr. E. Faber. In his section on Chinese Names he remarks:

   > "The Chinese have never shown any inclination for exploring nature from a love of knowledge. No trace can be found of a scientific tendency in all they have written on plants. They have named many plants only because they could not do otherwise. Named among the ten thousand Chinese plants are such only as are in use among the people and which were in use long before a name was thought of".

   Thus Faber clearly assigns the Chinese knowledge of plants to be founded on recognition and utility and in no way to involve scientific curiosity, taxonomy or experimentation.

2. The botanic garden of Pisa, unlike Padua, but like many functional gardens since, was moved several times during its history. It was founded at the request of Luca Ghini on land belonging to the Medici's, next to the Convent of San Vito, near the Citadel and Arsenal. It was moved in 1563 due to the expansion of the Arsenal, to the eastern part of Pisa, near the home of Galileo Galilei. The garden remained there until 1591 when it was again uprooted and moved to its present location near the head office of the University.

   From 1554–1558 the garden was under the direction of Andrea Cesalpino, during which time it was described by the French botanist Belon as "flourishing and rich in rare plants".

3. Lord Danby was an Elizabethan adventurer. He was Sir Philip Sidney's page during his expedition to the Netherlands. Danby was exiled to France for a murder. He served as the model for the Romeo of Shakespeare. In later life, his youthful indiscretions forgotten, he returned to England and was made an Earl and Knight of the Garter and during this respectable phase of his life he founded the botanic garden at Oxford.

CHAPTER 3
RESEARCH METHODS

3.1 Introduction

The evaluation of goods or services can be carried out by three main methods:

1. Financial evaluation involving examinations of accounts and balance sheets, efficiency scrutinies and other measures such as Stock Market quotations.
2. Economic evaluation, involving techniques of hedonic pricing, travel cost methods and Contingent Valuation Techniques.
3. Social, moral and philosophical evaluation, involving the use of comparative social science methods, including questionnaire surveys and case studies.

Several of these methods were used in this study to evaluate various aspects of botanic gardens, and these are described in the following sections. A number of other techniques used in evaluation are discussed and their poential use examined but these were not used in the present research.

3.2 Financial Valuation

(a) Accounts and Balance Sheets

The financial status of botanic gardens was examined in this study by gathering all available data from the gardens themselves on their running costs and revenue in order to gain some direct financial measure of what is provided. Financial data for the maintainance costs of local authority green space was also examined.

(b) Efficiency Scrutinies

This technique is much used by government but has not so far been used on botanic gardens. In the years 1979–88 the Government instigated 329 efficiency scrutinies and multi–departmental reviews. Between 1979 and 1985 scrutinies within Central Government Departments identified opportunities to save £600 million a year and estimated that they were actually effecting savings of £330 million a year (Efficiency Unit, 1988).

The efficiency scrutinies carried out cover subjects ranging from relatively small areas of investigation such as 'Light vehicles in the Forestry Commission' (James, 1981) to scrutinies of whole services such as the Cartographic service and the Nature Conservancy Council (Efficiency Unit, 1988). Various Universities were studied in 1984. No museums or Botanic Gardens were scrutinised during that time but the Victoria and Albert Museum has been scrutinized since.

These efficiency studies are about obtaining value for money. They are about the perceived efficiency of a service or department and not about its benefits.

Savings were made in the running costs of many of the government departments studied. This meant a saving to the taxpayer (Efficiency Unit, 1988). What was not done was a cost–benefit analysis in which the cost to the taxpayer in unemployment benefit, loss of tax revenue and any loss of service which had to be paid for elsewhere was estimated.

(c) Valuation Through the Stock Exchange

The Botanic Garden Company Ltd was founded with the purpose of developing commercially the 'images, resources and assets of the botanic gardens of the world'. The aim is to bring about a revaluation of these assets by linking the conservation work of botanic gardens with the commercial and industrial markets that depend on plants. A development company based on the licensing and sustainable exploitation of plant resources could play a valuable role in translating these resources into various commercial and industrial markets. By this means, the company expects to develop a major new source of finance for botanic gardens and plant conservation.

> ......"The company will seek Stock Exchange (U.S.M.) Listing at the earliest possible opportunity. The aim is to capitalise on the potential in the world financial markets for a quotation in conservation–based shares.
>
> A public quotation would establish a direct financial connection between conservation resources and the industrial institutions would then be able to place a financial value on the intellectual property of the company and its assets and resources including, as with oil and property companies, various proven and unproved physical reserves. A Stock Exchange quotation would create a valuation in terms of a share price for a company with assets based on the development of plant genetic resources. It would also provide the basis for a capital revaluation of the botanic garden network" (Ross, 1990).

This valuation by the Stock Exchange method is possible but places more reliance on the Botanic Gardens ability to keep plants alive than would seem to be borne out in fact.

It may be, however, that this tangible and visible proof of interest in the plants would render them less susceptible to inadvertent loss.

3.3 Economic Values

As most botanic gardens have no entrance fee the price charged cannot be used to derive a value. In practice therefore other measures must be used to value these non–priced goods. Either (a) direct or (b) indirect methods of evaluation may be used.

(a) Direct or Use Methods of Valuation of Non–Priced Goods

These are the values which can be calculated from peoples' directly observed behaviour.

1. Hedonic Pricing Method

This method is reviewed briefly but the technique was not used in this study due to a lack of available data.

One value which can be calculated for a garden is the positive externality bestowed upon surrounding properties. The adjacent property values may be raised as a result of their position. An amenity value, the Hedonic Price, is estimated by comparing the prices of architecturally similar houses either near or far away from the garden. Although there are many factors determining house prices, there is a significant increment due to amenity value The increased price paid by a house purchaser for a property adjacent to such an amenity site is a directly revealed value of the site.

Examples would be houses in the Lake District, where houses in attractive settings with views of lakes and hills attract very much higher prices than houses of a similar type in relatively nearby industrial towns such as Workington or Millom.

Hedonic Pricing suffers from the difficulty of identifying exactly which variables affect the price. All significant variables must be identified and the correct proportion of any difference in price attributed to each.

Monetary values could, in theory, be ascribed to the positive externality bestowed by the botanic gardens in most of the city sites by finding the increase in property values adjacent to the gardens and counting the number of residences but difficulties would arise with a site like Westonbirt which lies in a rural situation.

The potential hedonic price of a botanic garden should not be underestimated. It is a value which has been given serious consideration in the USA for some time. Examples are cited in the case of the Dallas Arboretum by Gross and Weinstein (1987) where they state that the impact of an enhanced arboretum would undoubtedly raise business and residential property value in a residential market characterised by overbuilding and the erosion of property values. Other assessments of such values are to be found in an assessment of the effects of greenbelts on residential property values (Correll, Lillydahl and Singell, 1978), in the effect of a large urban park on real estate value (Hammer, Coughlin and Horn, 1974), in the valuation of urban parks using three valuation techniques including hedonic pricing (More, Stevens and

Allen, 1986), the influence of trees on residential property values in Athens, Georgia. (Anderson and Cordell, 1987) and in recent estimates of the price increment on house values due to the proximity of woodland (Garrod and Willis, 1991). Although results vary from area to area and subject to subject, all these studies show that typically the presence of an urban park, garden, or amenity site will raise the price of adjacent properties by approximately 5–10%, although this effect usually decays rapidly with distance from the site.

2. Travel Cost Method (TCM)

A modified method of this technique was used in the present research (Chapter 7).

This is the method usually used for measuring the demand for recreation sites. It assumes that the value of a recreational visit to an individual must be at least that of the costs incurred in visiting the site in terms of time, petrol, car running costs and, where applicable, any entrance or parking costs. The value to the visitor, over and above that for which they have paid in time and travel costs, is the consumer surplus.

The Travel Cost Method (TCM) was originally proposed by Trice and Wood in 1958, further developed by Clawson in 1959 as a method for estimating the demand for a recreation sites in the USA.

It has been widely applied since then to recreation and wildlife sites, mainly in the USA (Walsh, 1986), but also for forestry sites in Great Britain (Benson and Willis, 1990). It has been modified in various ways so that opportunity costs of leisure time are more accurately assessed.

At sites with no entrance fee the visitor incurs some costs in travelling to and from the garden. If the visitor walks to the garden the value of their time can be taken to represent the value of the garden to them.

There is current controversy over how the travel cost should be calculated. The travel cost method, if calculated not on the actual cost of a visit but on the costs which a visitor perceives, e.g. ignoring car running costs and counting petrol used as his/her only cost, then the estimate of the value per visit drops drastically.

In reworking a previous study of the value of forestry visits, using a petrol only cost, and using different aggregation assumptions, Willis and Garrod (1991) showed that the estimate of the value of a visit might drop from £2.00 to about £0.60 per visit. This obviously seriously depresses the total recreation value for recreation sites.

There are two main ways of applying the Travel Cost Method:–

(a) The Zonal Travel Cost Method

This method uses the number of trips per capita, or visit rate per capita, from zones at even distances from the site.

The distance traveled is used as a proxy for cost or price per trip to the recreation site. The cost is doubled to take account of the return trip. The number of trips per year is ascertained. The travel and time cost per mile is multiplied by the miles travelled and divided by the number of persons per vehicle, where applicable.

The value of respondent's time is calculated from their stated occupation (Department of the Environment, 1986) and the value of their leisure time is derived from this using standards propounded by the Department of Transport, (1987). The value of time of any children in the group is calculated as 25% of the adults whom they accompany. The costs of car travel are calculated using Automobile Association standards (Automobile Association 1989). A demand curve is thus derived of trips per capita from zones of varying distances from the site. The theory is that as distance, which is used as a proxy for price, increases so the demand for visits will fall.

(b) The Individual Travel Cost Method

The distinguishing feature of this approach is that the dependent variable in the demand function is the number of trips per year by individual users of a recreation site. This is an acceptable approach where most individuals take more than one trip per year. The objective is to estimate demand by the current population of participants.

The TCM was used in this study. It has been thoroughly tested over more than 25 years and found to be a reasonably accurate way to estimate empirical demand function and benefits of recreation. The aggregated zonal TCM was used first on the data obtained from the four botanic gardens in this survey. The extremely low per capita visit rate made this method of very little use for these sites. In addition, the fact that Westonbirt proved to be a site more used as a family outing than the other sites meant that when visitors came from greater distances, more people travelled in each car, thus reducing the costs per person. An individual TCM was therefore used. Using a Truncated Maximum likelihood method gave reasonable consumer surpluses for all sites except Sheffield. In the case of Sheffield many of the visits were part visit only, at least one other place being visited in the same trip. Theoretically if the quantity of visits depends solely upon the cost of getting to the garden there should be a straight line relationship between the two with the quantity depending upon the price, or the per capita visit rate depending on the costs of time and travel involved. A regression coefficient of 1 would be achieved. This is never entirely the case with any recreation site. A number of other variables which may contribute to the equation exist. Some of these are:–

(a) The income of the visitor which can be estimated, though not fully discovered in a questionnaire.

(b) The age of the visitor, and therefore their disposable leisure time, e.g. children in school holidays, retired people.

(c) The availability and attractiveness of alternative sites and their cost.

(d) The importance of the site to the visitor. This may be subjective and vary with each person.

The travel cost method has limitations; it requires a large amount of data and fully completed questionnaires. The method ascertains the value of a site to those who are present at the site. It takes no account of the members of the population who do not want to visit a botanic garden or who have never heard of one. The truncated maximum likelihood method avoids this problem of bias.

As the surveys were used to obtain much other data besides that needed to carry out a travel cost calculation, it was both practical and convenient to use this direct method of ascribing a monetary value to visits to botanic gardens.

(b) Indirect Methods

1. Contingent Valuation (CV)

This technique was used to measure the stated willingness to pay (WTP) for a visit to the botanic garden by visitors to it. This stated amount which visitors said they would be willing to pay may include not only the value of the current visit, but may include an element which visitors would consider went towards keeping the garden open for future visits. These are termed non–use values by economists, and include: option value; the existence value, the knowledge that it exists, and bequest value to ensure that the garden remained open for use by future generations.

a. Option Value

The value of knowing that sites exist for possible use in the future. This value can be assessed by asking people how much they would be willing to pay to retain the option of being able to make visits to a site at some time in the future. Option value is therefore measured by willingness to pay.

b. Existence Value

Although people may not have any intention of visiting a particular site it may still be of value to them to know that it exists. Examples might be sites which contained very rare plants or animals. This non–use in a person's lifetime can also be calculated using a willingness to pay method to find out the value.

c. Bequest Value

Bequest value is the amount an individual would be willing to pay to ensure that some particular good was available for future generations. Walsh (1989) says that it seems likely that existence and bequest values are based on altruistic motives, including benevolence towards the interests of friends, relatives and other people, a sense of responsibility to protect environmental quality, and an understanding of the inter–regional effects of environmental damages (Boyle and Bishop 1984). Existence and Bequest values may be positive, zero or negative.

Contingent Valuation Methods (CVM) are notoriously liable to bias, this being particularly dependent upon how the questions are framed and understood (Mitchell and Carson, 1989). The value or likely value of non–use values of sites such as botanic gardens should not be underestimated.

Bateman (1991), reporting on the evaluation of the wildlife habitat and preservation values of forestry states:–

> "...to date only small scale CVM (Contingent Valuation Measures) studies have been applied to U.K. forestry (Hanley and Common, 1987; Willis and Benson, 1989; Hanley, 1989). However, many much larger scale CVM studies have been completed elsewhere including Sweden (e.g. Kristrom, 1990), Norway (e.g. Sodal, 1989), the Netherlands (e.g. Oosterhuis et al., 1987) Italy (e.g. Merlo et al., 1990) and the USA (e.g. Walsh et al., 1990). All these studies came to the same very important conclusion that individuals value the external 'non–use' aspects of forestry (bequest of forest recreation plus

> continued existence of wildlife habitat) as being of similar or greater value than 'use' values such as recreation. A typical result is that found by Walsh et al., (1990) in the USA. Here, of the stated amounts that those interviewed said they were willing to pay for the preservation of forests, almost 30 per cent was to ensure that future generations could enjoy forest recreation (bequest value) and over 20 per cent was to preserve the wildlife habitat (existence value), i.e. over 50 per cent of bids were to preserve the 'non–use' value of forests. These results are typical of all the other CVM studies mentioned previously and indeed a small sample study of six forests in England and Wales in 1989 recorded an even heavier individual allocation of overall willingness to pay towards external 'non–use' items such as wildlife habitat (Willis and Benson, 1989)."

In the present study, respondents were asked:

> "There is no entrance fee here, but if there was, would you be willing to pay one?

and (if yes),

> "How much do you think is a reasonable charge?"
>
> 50p – £1.00
> £1.00 – £2.00
> £2.00 – £3.00
> More than £3.00?

This did produce some comparative results of visitors stated willingness to pay.

3.4 Social, Moral and Philosophical Valuation

3.4.1 Introduction

While financial and economic measures can be used to measure tangible benefits there also exist the very real intangible benefits which can only be measured by comparative social science methods. One of the functions of botanic gardens is in the conservation of species. It is impossible to place a monetary value on this or on much of the research work carried out in or in conjunction with gardens. It is also difficult to put a monetary value on the aesthetic and heritage aspects of a botanic garden. The social, moral and philosophical values attributable to botanic gardens were therefore explored in this study through:–

1. Literature review.
2. Discussions with curators and directors of botanic gardens.
3. Structured interviews carried out with visitors to botanic gardens to explore their attitudes towards some of the intangible attributes of the gardens. These interviews were incorporated in the questionnaire surveys carried out at four botanic gardens. Answers to some attitudinal and preference questions were assessed.

3.4.2 Survey Methods Used

In order to assess the direct use–value of botanic gardens to their visitors it was decided that the travel cost calculation would be one valid method of measuring the value. To gather all the information needed to carry out this calculation a sample of visitors would have to be questioned.

The Sample of Gardens

It was not possible to interview visitors to all Botanic Gardens so it was important that a sample of gardens should be chosen which was as representative as possible of all the gardens in the UK.

To do this all the information on all the U.K. Botanic Gardens in the International Directory of Botanic Gardens (Henderson, 1983), and the same information for any additional gardens which were described in Collins Guide to the Botanic Gardens of Britain (Young, 1989), was coded and used as the basis for the selection of the sample. The entries for the botanic gardens listed in the directory were gathered as responses to a questionnaire so all are of the same format with information under the same headings. The entries are thus comparable. The information entered is shown in Table 3.1.

Table 3.1

Table of the 48 botanic gardens in Britain from which the sample was taken

Garden	Run by:-	Area.Ha	Publications SL	G	S	P	Open	Entrance fee	Easy to get to	In tourist town/city	No.Glasshouses open to public
Aberdeen	university	4.4	1				6	0	1	0	3
Aberystwyth	university	10.0					1			0	1
Bath	municipal	2.8	0	0	0	0	6	0	1	1	0
Benmore	government	40.0	0	1	0	0	5	1	0	0	0
Birmingham City	municipal		0	1	0	0	6	0	2	0	4
Birmingham Univ	university	3.5	1	1	0	0	1		2	0	0
Bradford	municipal	0.8	0	0	0	1	6	0	2	0	0
Bristol	university	2.6	1	1	0	0	4	0	1	0	5
Cambridge	university	15.6	1	1	0	0	6	0	1	1	1
Cardiff	municipal	30.0	1	1	0	0	5			0	8
Coleraine	university	4.0					5			0	
Cork	university	13.0	1	0	0	0	4			0	0
Devizes	private	1.6				1	6		0	0	
Dundee	university	10.0	0	0	0	0	6	0	1	0	2
Durham	university	16.2	0	1	1	0	6	0	0	0	1
Edinburgh	government	25.0	0	1	1	0	6	0	2	1	6
Enfield	university	3.2	0	0	0	0	2			0	0
Englefield Grn	university	9.4	1	0	1	0	1			0	
Exeter	university		0	1	0	0	6	0	1	1	0
Glasgow	municipal	16.8	1	1	0	0	6	0	2	0	6
Godalming	nat.trust	39.0	0	1	0	0	6	0		0	0
Goudhurst	government	40.4	0	1	0	0	6	1	0	0	0
Harrogate	municipal	18.0	1	1	0	1	6	0	1	1	0
Hull	university	6.5	1	0	0	0	3	0	1	0	2
Kew	government	120.0	1	1	1	0	6	1	2	1	0
Kings Lynn	private	8.8	0	0	0	0	6		1	0	18
Leeds	university	0.8	1	0	0	0	1		2	0	13
Leicester	university	6.1	1	1	0	0	4	0	1	0	0
Liverpool	municipal	51.0	1	0	0	0	6	0	2	0	6
Logan	government	5.0	0	1	0	0	5	0	0	0	12
Chelsea	private	1.6	1	0	0	0	4	1	2	1	0
Sth London Bot.Ins	university	0.4	0	0	0	0	1	0	2	1	0
Loughborough	university	3.0	0	0	0	0	0		1	0	0
Ness	university	19.5	1	1	0	0	6	0	0	0	0
Newcastle	university	1.0	1	0	0	0	1	0	1	0	6
Oxford	university	2.0	1	1	0	0	6	0	1	0	0
Reading	university	5.5	0	0	0	0	1			0	7
Sheffield Univ	university	0.8	1	0	0	0	0			0	0
Southampton	university	4.5	0	0	0	0	6	0	1	0	3
St.Andrews	university	8.0	1	1	0	0	4	1	1	0	8
Swansea	private	1.5	1	0	0	0	6	0		0	6
Tresco	private	18.0	0	0	0	0	4	1	0	0	0
Wakehurst place	government	202.0	0	0	0	0		1	0	0	0
Westonbirt	government	200.0	0	0	0	0	6	0	0	0	0
Wisley	private	80.0	1	1	0	0	6	1	1	0	7
York	municipal	4.0	0	0	0	0	6	0	1	1	0
Manchester Fl.Moss	municipal	0.4	1	1	0	0	6	0	2	0	1
Sheffield City	municipal	7.6	0	1	0	0	6	0	2	0	1

KEY:- Publications
- SL = seed list
- G = guide book
- S = scientific publication
- P = popular publications

Open
- 0 = not open
- 1 = visit with permission of the director
- 2 = open 2-3 times a year
- 3 = open once a week
- 4 = open several days a week
- 5 = open every day in summer
- 6 = open every day

This data was subjected to a cluster analysis to minimise bias or preference in sample selection. This used a hierarchical method of clustering cases by computing the proximities between cases. The initial attempt to cluster the gardens failed as the data was incomplete for too many gardens. Therefore the date of founding was removed as being irrelevant to the current study. The number of taxa grown was removed as, above a certain number of taxa, all botanic gardens provide a much greater variety of plants than most parks or historic gardens. The presence of a herbarium or not and whether the gardens produced a seed list was removed as many have herbaria in the main research station, e.g. held at the RBG for Benmore, or in the University department to which the garden is attached.

With these variables removed the cluster analysis separated the remaining 41 gardens for which there was sufficient data into seven main groups based on the following criteria:–

1. The area (size) of the garden.
2. The status of the garden (who ran it).
3. How often the garden was open to the public.
4. If and how many glasshouses were open to the public.
5. Whether a guide book was published.
6. Whether an entrance fee was payable.
7. Whether the garden was easily accessible to the general public or not.

The membership of each cluster is shown in Table 3.2.

Table 3.2 Cluster Membership Clusters 1–7

1		2	
1.	Bath	7.	Cambridge
3.	Birmingham	9.	Durham
4.	Birmingham University *	10.	Edinburgh
5.	Bradford	12.	Exeter
6.	Bristol	13.	Glasgow
8.	Dundee	16.	Harrogate
11.	Englefield Gardens *	27.	Ness
17.	Hull	35.	Tresco
19.	Kings Lynn		
20.	Leeds *		3
21.	Leicester	2.	Benmore
23.	Logan	14.	Godalming
24.	Chelsea	15.	Goudhurst
25.	Southampton Bot. Inst. *		
26.	Loughborough *		4
28.	Newcastle *	22.	Liverpool
29.	Oxford		
30.	Reading		5
31.	Sheffield University	18.	Kew
32.	Southampton		
33.	St Andrews		6
34.	Swansea	36.	Wakehurst Place
39.	York	37.	Westonbirt
40.	Manchester Fl. Moss		7
41.	Sheffield City	38.	Wisley

* Not open to the public.

Groups 3–7 were treated together for the purposes of obtaining a sample garden because differences between these groups shown by the cluster analysis was very small indeed, whereas the difference between them and the other groups was large.

A number of factors influenced the choice of sample garden from within each group.

1. Whether the garden was open to the public.

and

2. If it was, were there sufficient visitors for it to be economical and practical to carry out the survey.

3. Whether the directors or curators were willing to allow a survey to be carried out.

This reduced the choice considerably, and finally Edinburgh and Cambridge were chosen as being in the same cluster, but also as having a number of different features such as who ran the gardens and their spatial separation from each other. The curators of both of these gardens were able and willing to supply what information they could on visitor numbers and running costs. Edinburgh and Cambridge could therefore be both compared and contrasted. The cluster technique could also be verified.

Sheffield City Council Botanic Garden belongs in a large cluster but contrasts well with Edinburgh and Cambridge in being small and situated in an industrial city. It is run as a municipal garden. Westonbirt Aboretum by contrast, in a very small cluster, is not in or near a large city. It is run by the Forestry Commission and covers a large area. Data on running costs was made available.

Table 3.3 shows the sample of sites and their main attributes.

Table 3.3

SAMPLE OF SITES

NAME	RUN BY	AREA	ENTRANCE FEE	OPENING TIMES	TYPE OF GARDEN	SITUATION	TOTAL RUNNING COST	VISITOR NUMBER
Royal Botanic Garden Edinburgh	Government	90 HA	No	Every Day	All	Edinburgh City Scotland	£4,476,000	750,000
University of Cambridge Botanic Garden	University of Cambridge	17.6 HA	No	Every Day	All	Cambridge City South England	£369,000	45,000
Westonbirt Arboretum	Government Forestry Commission	200 HA	Yes	Every Day	Arboretum only	Gloucestershire Rural Station	£406,000	185,000
City of Sheffield Botanic Garden	City of Sheffield	176 Ha	No	Every Day	All	Sheffield City Midland England		50,000

Validity of the Sampling Technique

Table 3.2 shows cluster membership. Westonbirt, Wisley and Wakehurst Place are markedly different from all the other gardens. They are all in rural situations and are very large. Benmore, Godalming and Goudhurst are also rural with substantial tree collections. It was envisaged that the type of visitors at these gardens would be similar groups of people out for a day trip.

Sheffield, in size, availability and attractions is similar to many of the other gardens classed with it in group 1. Many of them are municipal botanic gardens. (A number in that group are not open to the public so are not relevant to this study.)

There are, of course, some differences between all the gardens, even those in the same group.

That the visitor profiles are likely to be the same within each group can be deduced from the results obtained at Edinburgh and Cambridge. These two gardens are in the same group but have different funding authorities and are separated spatially.

The visitor profiles and other results obtained from these two gardens are very similar. This, and the fact that very different results were obtained at Sheffield and Westonbirt, suggest that the selection of gardens was valid and that the sample used in this study is representative of all or most aspects of botanic gardens which are open to the public in Britain.

3.4.3 The Sample of Visitors

In order to obtain a random sample of visitors to the garden the interviewer approached the first person seen after visitors had had time to go round the garden, but before they had mentally decided to leave the garden, and were thinking of the next thing they were going to do.

If the visitor was willing, and had been round the garden, the interviewer proceeded with the questionnaire. On completion of that interview, the interviewer approached the next person seen at random and carried out the next interview. In this way selection bias was, hopefully, removed. This same technique was used by interviewers in carrying out a previous visitor survey at the RBG Edinburgh (Recreation and Tourism Research Unit 1988) and at National Trust Gardens (Gallagher, 1983)

3.4.4 Questionnaires

Two methods were possible for obtaining the required answers. One was to have a self–filled in questionnaire and the other was to have a questionnaire filled in by an interviewer. The self–filled in questionnaire could produce a larger sample as interviewers would not be needed. However, problems of bias arise if questionnaires have to be left in one place for visitors, e.g. if a visitor centre is chosen then the sample will only be of those people who use the visitor centre. Additionally only those people interested or curious enough to pick up a questionnaire will be selected. There is no simple way of restricting the number of questionnaires. Self–filled in questionnaires may also have incomplete data. Missing data severely reduce the value of the questionnaire. This method was considered for Westonbirt Arboretum to sample visitors there throughout the year.

In the interests of accuracy of sampling and completeness of data it was decided, after studying the relevant literature (Moser and Kalton, 1971; Tourism and Recreation Research Unit, 1983) to carry out a questionnaire survey with an interviewer asking the questions and filling in the answers. This was expensive in time and person power but did result in a high proportion of fully completed questionnaires. The Recreation Site Survey Manual recommends that a minimum of 200 questionnaires should be filled in for each site over a period of 8 days. This was done at Edinburgh and Cambridge where surveys were carried out on eight consecutive days, in September 1988 in Edinburgh and July 1989 in Cambridge.

At Sheffield 310 questionnaires were completed in 1990. The survey was carried out over a period of the three months July, August and September with all days represented and more questionnaires filled in at weekends and on bank holiday Monday reflecting the greater number of visitors on those days.

At Westonbirt 414 questionnaires were filled in throughout the year from April to December 1990 with the sample stratified to be representative of the spread of visitor numbers throughout the year. More questionnaires were completed in October which has the highest visitor numbers. The stratification was based on Forestry Commission's visitor counts for the year 1988–89. The questionnaires were again also stratified to take account of all days and the greater visitor numbers at weekends.

It was found by piloting the questionnaire that about 20–30 questionnaires could be completed in one day by one interviewer.

3.4.5 Data Collected

The questionnaires were devised so that either Yes or No answers or a choice from a list could be selected. This was done to facilitate analysis. The questionnaires tried to elicit seven types of information.

1. Data required to carry out a travel cost method of evaluation of the visit.
2. Data on visitors willingness to pay for the visit.
3. Socio–economic data such as age and occupation, size of group, for comparison with other surveys.
4. Information on where visitors first heard about the garden.

5. Visitor's likes and dislikes in terms of what was present or absent from the garden.
6. What other things visitors liked doing as leisure pursuits.
7. Whether the gardens actually did provide public education as they hoped.

The first three questionnaires, those at Edinburgh, Cambridge and Westonbirt, were piloted and amendments to length and any ambiguous questions made.

The basic design of the questionnaire closely followed that of Benson, Willis and Mitchell (1989) in gathering travel cost information, and that of Gallagher (1983) for the socio–economic and attitudinal questions. Refinements were made to the questionnaires over the 3 year period and any questions which could not be answered or which were found to be irrelevant were omitted.

In addition to the four main surveys, two smaller scale questionnaires were carried out at Dublin and Bath. These tried to elicit more information on the visitors likes and dislikes, attitudes to gardens and open spaces, and socio–economic data. They did not seek to gather data for travel cost analysis. They were extremely useful in confirming that no large subject area had been omitted in the main surveys.

3.4.6. Analysis of Results

The answers to the questionnaires were coded and the results analysed using SPSSX, Statistical Package for Social Sciences (SPSSX, 1988). Curators and Directors of botanic gardens were interviewed at Edinburgh, Cambridge, Westonbirt and Sheffield.

CHAPTER 4

FINANCIAL COSTS AND REVENUE

4.1 Introduction

In considering the value of botanic gardens it is necessary to examine what is provided and at what cost. As some gardens both in the UK and on the Continent are being closed or are changing ownership and coming under increasing financial pressure from their current owners, it is important to establish a framework so as to evaluate whether these decisions are in the public interest.

For evaluation purposes it would be helpful to arrive at a 'typical' cost for running a botanic garden. It may be that there is a different 'typical' cost for each type of botanic garden and the uses to which it is put. The funding arrangements for gardens fall into four main categories:

1. University;
2. Private;
3. Municipal;
4. Governmental.

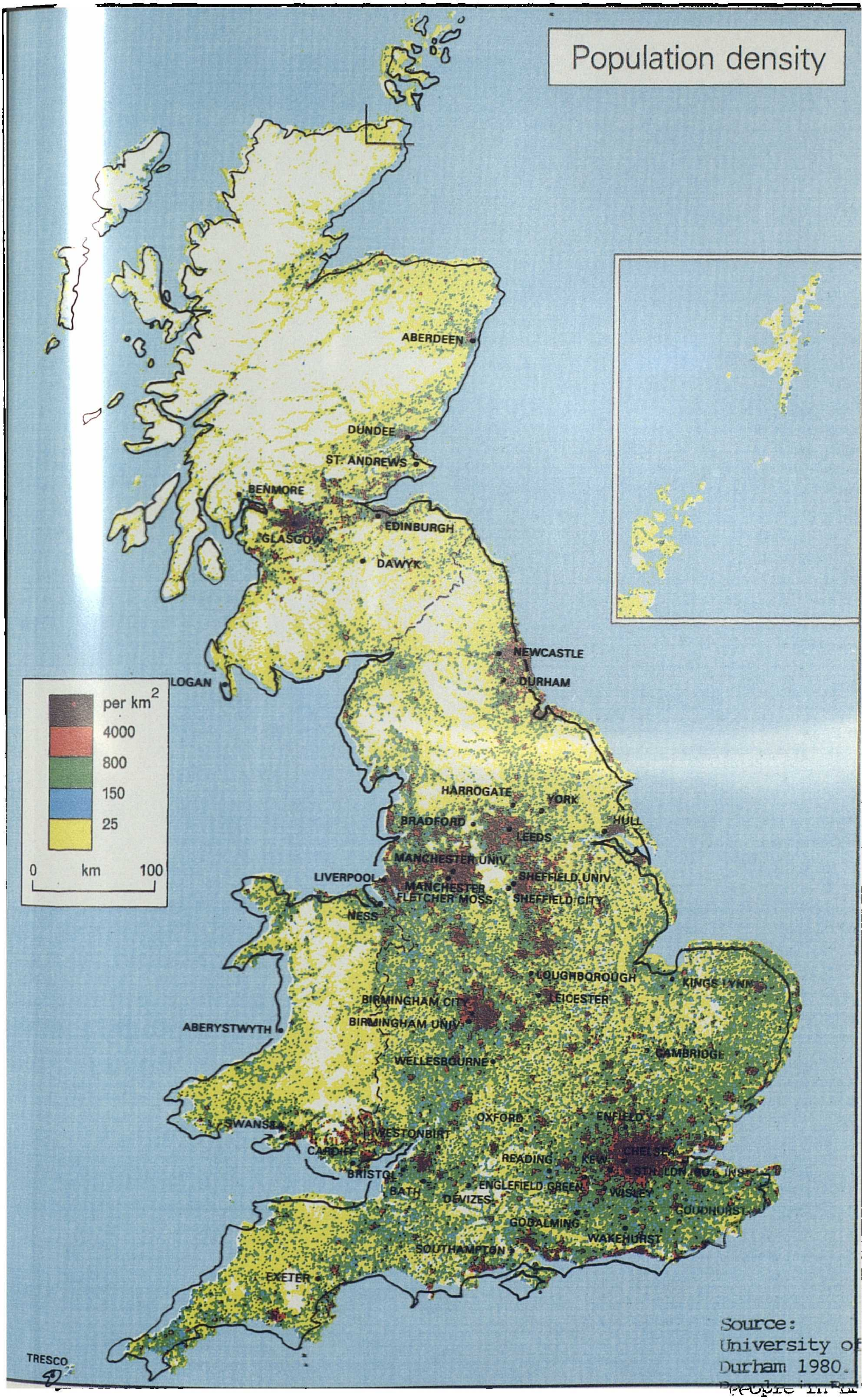
There are 48 Botanic gardens in the UK for which there is comparative data (Henderson, 1983; Young, 1987). These are shown on the accompanying map (Figure 4.1)

4.2 Type of Botanic Garden

4.2.1 University Gardens

University botanic gardens are usually attached to Departments of Botany or Biological Sciences which may fund all of the garden or, more usually, the main costs of these gardens are borne by the University centrally and included in the general running costs of the University i.e. the staff the buildings maintenance and energy costs are funded centrally. Property taxes are paid directly by the UFC.

[illegible] 48 Botanic Gardens.



Source:
University of
Durham 1980.
People in Britain
A Census Atlas

The Department which they mainly serve may be responsible for only a very small fraction of their costs. This division of funding sources creates some unusual conditions:–

1. It makes it difficult to obtain data on all the costs as many are inextricably mixed with other costs.
2. It makes decisions about their value and continued worth the responsibility of a very diverse body of people.

Additional revenue may be raised by 'Friends of the Garden' schemes, admission fees, plant sales, hire of premises and grants from the local tourist board e.g. Cambridge, Durham.

4.2.2 Private Gardens +

The private gardens of the herbalists are now no longer in existence. However, a few private botanical gardens exist such as Tresco, Devizes, the South London Botanical Institute, and Chelsea Physic garden. The funding of these is more straightforward. They are paid for by their owners and by entrance fees from the public.

Additional revenue may be raised by 'Friends' schemes and endowment interest. Chelsea, which is now a limited company, publishes very full accounts.

4.2.3 Municipal Gardens

These botanic gardens are generally ones which were founded by 'Botanical Societies' and which became too expensive for the Societies to maintain. They were taken over by local authorities and their running costs incorporated into Parks and Recreation Departments budgets.

+Private gardens means those which are financially supported by their own activities. It does not mean that they are gardens owned by a Private Individual.

Currently local government is trying to cost the maintenance of green space due to the advent of competitive tendering for horticultural work previously done by a direct labour force. Some local authorities cannot, as yet, cost the maintenance of single parks. However, global figures for various aspects of green space maintenance are available.

4.2.4 Central Government Gardens

These are represented by the Royal Botanic Gardens, Kew and its outstation Wakehurst Place, The Royal Botanic garden Edinburgh and its three outstations at Logan, Dawyk and Benmore, and the Forestry Commissions Arboreta at Westonbirt and Goudhurst, Kew and Edinburgh, under the National Heritage Act 1983 and the National Heritage (Scotland) Act 1985 respectively are directly funded by the Government and boards of trustees manage them. The staff of all four gardens come within the Civil Service. Kew and Edinburgh publish annual accounts in the House of Commons papers. Westonbirt raises substantial revenue from entrance fees. The income, however derived is used to run the garden by paying rates, rent, wages equipment and machinery costs, energy, printing advertising and the cost of horticulture courses.

4.3 Costs – Data

Sources of the Data

The costs of commercial horticultural enterprises can be assessed against a set of ADAS standards for various types of enterprise and their profitability examined. Botanic gardens are not geared to crop production so normal standards and trading accounts do not exist.

Initially 22 botanic gardens were asked for their data on land, labour and capital, and for details of their outputs and annual reports. Fourteen gardens replied. Three sent annual reports with financial accounts in them, 3 said they were not allowed to give any financial details. Two sent annual reports which were purely descriptive of the work which had gone on through the year. Several offered assistance and to answer specific questions. For a number of gardens, an accurate financial account is difficult as the gardens may be funded piecemeal, e.g. buildings and maintenance through one budget, staff wages through another and research and teaching through yet another.

Data was collected from as wide a range of gardens as possible and includes:

1. Gardens where visitor surveys were subsequently carried out, Edinburgh, Cambridge and Westonbirt.
2. A garden not open to the public, Newcastle University's garden.
3. A private garden open to the public, Chelsea Physic garden.
4. Gardens for which published accounts are available, Edinburgh, Kew, Chelsea.
5. Gardens for which estimates of expenditure could be made with reasonable accuracy due to the co–operation of their curators and directors, Cambridge, St Andrews and Ness.
6. Gardens where the information on expenditure was accurate and made available by personal communication, e.g. Newcastle and Westonbirt.
7. A horticultural research station with no amenity work was included for comparison. This was Horticultural Research International, (HRI) Wellesbourne.

A summary of the main features of the gardens for which costs were obtained is shown in Table 4.1.

Table 4.1 Summary of the main features of the gardens for which costs were obtained and used in comparisons.

Garden	Funding Authority	Size Ha.	Visitor No.	Entrance Fee	Display Glasshouses	Plant Collection Water Garden	Research Done	Visitor Survey
RBG Edinburgh	Government	104	750,000	No	Yes	Yes	Yes	Yes
RBG Kew	Government	120	1.2m.	Yes	Yes	Yes	Yes	No
Westonbirt	Government FC	200	185,000	Yes	No	No	No	Yes
Cambridge	University	15.6	45,000	No	Yes	Yes	Yes	Yes
Newcastle	University	1.0	1,000	No	Yes	Yes	Yes	No
Ness	University	19.5	120,000	Yes	Yes	Yes	Yes	No
St. Andrews	Local Authority	8.0			Yes	Yes	Yes	No
Wellesbourne	Government	191	0	No	No	No	Yes	No
Sheffield	Local Authority	7.6	50,000	No		Yes	No	Yes
Chelsea	Private	1.6	16,000	Yes	Yes	Yes	Yes	No

Costs can be classified under 2 major headings.

1. Land and capital.
2. Labour and other recurrent costs.

1. <u>Land</u>

This is not valued in any of the accounts. The 1947 Town and Country Planning Act and subsequent legislation required the drawing up of land use plans under the following broad headings: Residential; Industrial; Hospital/Education; Private Open Space; Public open Space; Nursery Garden.

Botanic gardens were originally classed as private open spaces, thus they were not part of the amount of open space provision which had to be planned for and provided as part of the planning laws. This affects the theoretical value of the land.

Two approaches to land valuation can be examined. First there is the method used by the Department of Transport during cost benefit analysis; this procedure, used to select routes for the building of new roads, favours proposals which run through green open spaces in towns and cities. It favours this method because of the low cash value placed upon green space by the district valuer (Adams, 1989). Second, land can be valued at the next most valuable use for which the local Planning Authority would give planning permission. (The possibility that planning permission would be given for more valuable uses such as offices or business parks exists but it is more likely that permission would be granted at all city sites for high cost housing.) For all of the sites examined, except Westonbirt and Wellesbourne, this was therefore assumed to be residential development. The idea that botanic gardens can be valued in terms of the residential development value of their land is supported by Holmes (1905) who said:–

> "A few years ago the Apothecaries company found it impracticable to supply the necessary funds to keep it (Chelsea Physic Garden) up, and as under these conditions the grounds would have reverted to the Cadogan family, and probably soon have become a prey to the builder, the responsibility of it's upkeep was undertaken by the London Parochial Charities, and only last year it started on a new lease of life, as a place for the practical teaching of Botanical Biology."

St. Andrew's garden was being considered as a site to be sold off for residential development by the University (Young, 1987) but was subsequently leased by East Fife District Council. Hull University have submitted residential development plans for the botanic garden to Beverley District Council on three occasions but have lost appeals against refusal at public enquiries (see also Chapter 9).

It should be noted that part of the value of a particular residential area is conferred by having a botanic garden there. Botanic gardens potentially offer a positive benefit in terms of increasing the value of the surrounding houses, the Hedonic Price. This positive externality would be lost on development.

The notional values of the land at each of the gardens has been estimated (Table 4.2). These estimates for city sites are based solely on the experienced guesses of a developer and a planner because no published data exists. The estimate for Westonbirt and Wellesbourne are derived from MAFF/AMC series current agricultural land prices 1989.

The position of these gardens can be seen on the map Figure 4.1 (see Footnote 2).

Table 4.2

Garden	Area	Price Per Ha £	Total Potential Capital Value of Garden £
Chelsea	1.6ha	12.5m	20.0m
Cambridge	15.6ha	2.7m	42.1m
Edinburgh	24.8ha	2.5m	62.0m
Newcastle	1.0ha	1.2m	1.2m
Sheffield	7.9ha	1.5m	11.9m
Kew	120ha	15m	1800.0m
Westonbirt	200ha	5,200 + house	1.0m
			.1m
			= 1.1m
Wellesbourne	190ha		1.0m

Although none of the accounts include the value of land, where it is owned, there is the possibility of an opportunity cost. The land may have restrictive covenants on it. In the case of Newcastle it is rented.

It should perhaps be noted that although parks and botanic gardens occupy city centre sites, experimental grounds rarely do. The two horticultural' gardens at Wisley and Harrogate also occupy sites which, when they were founded, were away from built up areas. It is possible that their owners could now consider selling these and moving to sites with lower land values as they are now within 'commuter areas'.

2. Labour

For a normal horticultural enterprise using ADAS efficiency standards labour would account for about $\frac{1}{3}$ of the cost of production. Gross margin analysis of an enterprise will generally show whether the cost of one of the inputs, including labour, is too high.

As botanic gardens, even those which produce some revenue, are not profit making enterprises gross margin analysis would be inappropriate unless an alternative 'value' can be placed upon the outputs of a botanic garden.

What can be examined are:–

1. Average number of staff per hectare.
2. Staff costs per hectare.
3. The salary costs as a percentage of the total running costs.
4. Total costs per hectare.
5. Where they can be separated out, the costs attributable to the 'garden' or amenity part of the garden can be examined.

These can be compared with costs for local authority parks maintenance from published works (Parker and Bryan, 1989).

The number of staff employed in glasshouse work and the proportion of the total costs attributable to glasshouse heating and maintenance are relevant. Glasshouses are more costly in terms of manpower and energy to run than outdoor plantings. However very few of the gardens were able to give me these separate costs so they were not included.

In the case of commercial or most other amenity horticultural enterprises the rates of pay for staff would be at Agricultural wages level with increments for levels of craft skills, and, in some cases, piece work rates or bonus payments in local authority amenity horticulture.

The labour costs from the National Botanic Gardens includes Directors and Scientific Officers of various grades. University Botanic Gardens have staff paid on Technicians salaries with, in addition, in some cases academic salaries. These labour costs are greatly in excess of agricultural wages and make labour costs/ha much higher than other amenity horticultural rates.

Source of Cost Data

The data included in the tables of costs was obtained from published accounts in the case of Kew, Edinburgh and Chelsea with additional data on staff numbers and their distribution from the Curators of Edinburgh and Chelsea. For all other gardens data was provided by Curators or Chairmen of 'Friends'. Only an estimate of total costs was obtainable for Sheffield. A summary of the costs data obtained can be seen in Table 4.3. The data for an 'hypothetical botanic garden of 20 ha is included in the Table 4.4. This was derived from landscape maintenance figures as described below.

Table 4.3

Running costs of gardens all at 1989 prices

	St.Andrews	Ness	Chelsea	Cambridge	Edinburgh	Newcastle	Westonbirt	Sheffield	Kew	Hypothetical Garden	Wellesbourne
Size	8 Ha.	19.5 Ha	1.6 Ha	15.6Ha	104 Ha	1 Ha	200 Ha	7.6 Ha	120 Ha	20 Ha	191 Ha
No. of staff	7	36	8	34	201	4	27.5		480	15	190
Salaries	£76,900	£236,768	£78,468	£300,000	£2,547,340	£49,364	£252,000		£6,697,318	£105,980	£3,000,000
Total - salaries (Other costs)	£50,000	£157,851	£53,434	£69,071	£1,928,207	£28,249	£154,000		£6,902,139	£211,960	£4,000,000
Total Costs	£126,888	£394,619	£131,902	£369,071	£4,475,547	£77,613	£406,000		£13,599,457	£317,940	£7,000,000
Salaries/Staff No.	£10,986	£6,577	£9,808	£8,823	£12,673	£12,341	£9,164		£13,952	£7,065	£15,789
Other costs/ Staff No.	£7,143	£4,384	£6,679	£2,031	£9593	£7,062	£5,600		£14,379	£14,131	£21,053
Total - salaries / area	£6,250	£8,095	£33,396	£2,302	£18,540	£28,249	£770		£57,518	£10,598	£19,576
Salaries / area	£9,612	£12,142	£49,042	£19,230	£24,493	£49,364	£1,260		£13,952	£5,299	£19,570
cost / Ha.	£15,861	£20,237	£82,438	£23,658	£43,034	£77,612	£2,030		£113,328	£15,897	£36,649
Salaries as % of total costs	60.6%	60.0%	59.99%	81.1%	56.9%	63.6%	62.0%		49.25%	33.3%	43.0%
Total Costs	£126,888	£394,619	£131,902	£369,071	£4,475,547	£77,613	£406,0001		£13,599,457	£317,940	£7,000,000

4.4 Hypothetical Botanic Garden

In order to further examine the costs of botanic gardens an imaginary 20ha garden was devised. The features in the garden were derived from plans and layouts of existing gardens.

The running costs of this garden were then calculated using expected standard local authority figures for maintenance of various types of landscaping (Parker and Bryan, 1989).

Items such as rock gardens and water features were calculated from the nearest type of landscaping described. All maintenance items are aggregated for a year.

Table 4.4 shows this hyppothetical garden and its maintenance costs.

Table 4.4 Hypothetical Botanic Garden Annual Maintenance Costs Breakdown. 20ha

Item	Area	Costed As:–	Time/Year
High amenity lawn	.18ha		7.2 man days
Meadow	.2ha		5.2 hours
Amenity grass and trees	8ha		120 man days
Amenity woodland	4ha		20 man days
Herbaceous border	.24ha		564 hours
Roses	.06ha		82.8 hours
Specimen shrubs	.46ha		460.8 hours
Hedges	2100m		64 hours
Rock garden	.6ha	as herbaceous	1410 hours
Rhododendrons	.4ha	as specimen shrubs	384 hours
Herb garden	.12ha	as herbaceous	282 hours
Pergola and Rose walk	.09ha		124.2 hours
Heather garden	.16ha	as herbaceous	376 hours
Native plants	.16ha	as herbaceous	376 hours
Water areas (bulked)	.25ha	as herbaceous	600 hours
Experimental area	.56ha	as herbaceous	1316 hours
Willow collection	.6ha	as specimen shrubs	576 hours
Paved/hard surface (includes litter collection)	.5ha		691.5 hours
Glasshouses and frames	.28ha		3 man years
Tea rooms/toilets/patios	.5ha		691.5 hours
Paths	.5ha		691.5 hours
Picnic area	.5ha	as hard standing	1880.9 hours
Herbaceous ground cover	.5ha	as herbaceous	1175 hours
Car Park and surrounds	.93ha	as hard standing	1286.2hours

Total time required per year, converted to man years	= 15.14
∴ Salary costs @ £7,000 pa = 15.4 x £7,000	= £105,980
Additional administrative on–costs and machinery costs	= £211,960
Total cost	= £317,940

The costs of running the real gardens and the hypothetical garden can be seen in Table 4.3.

The mean salary cost as a percentage of total costs (Table 4.3) is 59.6% (range 43%–81%). The exeption is the hypothetical garden, where the labour costs are 33.3%.(Table 4.4). This figure is dubious as most botanic gardens have 60% of their costs attributable to labour as also do local authorities (see Table 4.5).

4.5 Local Authority Grounds Maintenance

For comparative purposes the costs of running botanic gardens can usefully be compared with the costs of Local Authority grounds maintenance.

Table 4.5 shows a Local Authority Grounds Maintenance budget.

Table 4.5 Example of a Grounds Maintenance Budget, Local Authority

Grounds Maintenance Budget 1987/88			
Expenditure			
Employees including area managers and foreman		£	%
Wages and salaries, etc.		2,472,500	
Training		21,700	
Allowances		25,300	
	Sub–total	2,519,500	63.0
Premises and depots			
Maintenance and improvement		36,600	
Services		21,400	
Furniture and fittings		5,500	
Rent and rates		31,200	
Loan charges		12,000	
	Sub–total	106,700	2.7
Supplies and services			
Equipment		2,500	
Consumable materials		325,500	
Protective clothing		12,000	
Contract services/fees		115,000	
	Sub–total	455,000	11.4
Transport and machinery			
Running costs		400,000	
Renewals Fund contributions		260,000	
Additional machinery		20,000	
	Sub–total	680,000	17.0
General office/depot expenses			
Head office staff		220,700	
Telephones, post advertising, etc.		18,100	
	Sub–total	238,800	6.0
	Total	4,000,000	

Source: Parker and Brian, 1989

The figures in Table 4.5 were based on the direct works organisation at Kent County Council. The staff there maintain 2023 hectares spread over 1300 different sites (Parker, 1991).

Thus £317,940 would appear to be the cost of salaries for maintaining a 20ha botanic garden with the additional costs of administration, machinery, chemicals, petrol, tools, safety equipment, etc. This figure is attributable to the amenity part of the garden and not to any educational or research element. This figure is approximate only but the size of the hypothetical garden is very similar to Ness gardens which is 19.5ha (see Table 4.3). The number of staff at Ness is 36 compared with the 15.4 at the hypothetical garden.

If a larger garden was used as the hypothetical model, increases would occur mainly in the lower maintenance, lower cost areas such as greater area of woodland or Arboretum, and greater areas of rough grass with trees. It is unlikely that items such as herbaceous borders and rose pergolas would increase in proportion to the size of the garden. The converse would occur with a smaller garden.

An example of this can 'economy of scale' be seen in Table 4.5 where the costs of the Royal Botanic Gardens, Edinburgh are listed together with those costs thought to be attributable to public amenity only. This has then been further divided to separate the number of staff at the very varied high amenity site in Edinburgh, including glasshouses, from those of the outstations which have less varied and lower maintenance plantings, where the increase in size due to the outstations does not produce a proportional increase in staff costs. The number of staff and therefore the running costs are much higher at Edinburgh despite Dawyk being the same area as Edinburgh and the Younger botanic garden at Benmore being larger.

Table 4.6 Estimated staff number on amenity side at RBG Edinburgh and its Outstations.

	Royal Botanic Garden, Edinburgh	Younger Botanic Garden	Logan Botanic Garden	Dawyk Arboretum
Size	25ha	44ha	10ha	25ha
Staff		CURATOR		
Assistant	4	1	1	1
Garden	8	1	1	1
Constables	9	0	0	0
Special gardeners	4	4	2	1
Gardeners I	18	4	0	0
Gardeners II	5	1		
Assistant gardeners	8	0	2	0
Lavatory Attendants	4	1	1	1
Night Patrolman	4	0	0	0
Handyman, Messanger, Handyman	1	0	0	0
	65	10	7	4

Of the total grant in aid received by Edinburgh, £1.9 million was spent on the Edinburgh Garden and £1.6 million spent on Research. The rest of the grant in aid, £1.0 million, was spent on the outstations.

The total running costs of the gardens was then examined in relation to the area of the garden. The running costs per hectare are shown in Table 4.7.

Table 4.7 Running Costs Per Ha of the Gardens

Garden	Area ha	Staff Number	Total Costs/ha	Salaries as % of Total
Newcastle	1.0	4	£77,613	63.6%
Chelsea	1.6	8	£82,438	60.0%
Sheffield	7.6		£17,105	
St Andrews	8.0	7	£15,861	60.6%
Cambridge	15.6	34	£23,658	81%
Ness	19.5		£20,237	60%
Edinburgh	104	201	£43,034	56.9%
Edinburgh	104	86	£12,893	61.63%
Amenity only				
Kew	120	480	£113,328	49.25%
Westonbirt	200	27.5	£2,030	62%
Hypothetical	20	15	£15,897	33.3%
HRI Wellesbourne	191	190	£36,649	43%

There is no simple relationship between size and cost, either total cost or cost per ha. What can be seen from Table 4.7 is that, generally, the smaller the garden the higher the costs per unit area.

What is interesting is that Westonbirt, being an aboretum and having mainly trees and rough grass and having the lowest costs per ha., still has 62% of its costs attributable to labour.

The results of the survey of University Botanic Garden costs and staffing levels carried out by Gledhill (1990) suggest that most gardens have one technician per one and a half acres (0.6 ha). By comparison, in local authority work, 270 staff maintain an area of 2023 ha. spread over 1300 different sites. (Parker 1991). That is one staff member to every 7.5 ha. A comparison of the labour requirements per unit area for all the gardens and for local authority work is shown in Table 4.8.

Table 4.8 Staff Number per ha at the Various Gardens

	Size	Staff Number	Staff/ha	Glasshouses
Newcastle	1	4	4.0	Yes
Chelsea	1.6	8	5.0	Yes
Sheffield	9.6			
St Andrews	8	9	1.125	Yes
Cambridge	15.6	34	2.18	Yes
Ness	19.5	36	1.8	Yes
Hypothetical	20	15	0.75	Yes
Edinburgh + Research	104	201	1.9	Yes
Edinburgh – Research	104	86	0.8	Yes
Kew	120	480	4.0	Yes
Westonbirt	200	27.5	0.14	No
Local Authority	2023	270	0.13	No
Wellesbourne Research Station	191	190	0.99	Yes

The very small gardens and those where the research is included have the highest ratio of staff per hectare. In the two cases of Westonbirt and the Local Authority which have large areas and no glasshouses, there is a smaller labour requirement. Neither of these have any research.

The Research Station only, where there is no amenity cost also has a high labour requirement. The work is all research. Both Edinburgh and Ness have glasshouses open to the public. Westonbirt Arboretum, with no glasshouses, an area of 200ha and a staff of 27.5, averages one member of staff to 7.3 ha. This is very similar to the local authority figure, and the costs per ha. at Westonbirt and the local authority are almost identical (£2030 and £1977). Thus the staff costs on a single site, only low maintenance features:– trees and rough grass, compares with the local authority figures for a variety of types of work carried out on multiple sites. Therefore, the quantity of labour per unit area in botanic gardens is high.

4.6 Cost Other Than Salaries

This, for the purpose of the current exercise, is taken as total costs minus labour. From it can be abstracted:– Administration (for some cases), Rates, Water

Table 4.9

Running costs of gardens - Costs other than salaries at 1989 prices

	St.Andrews	Ness	Chelsea	Cambridge	Edinburgh	Newcastle	Westonbirt	Sheffield	Kew	Hypothetical Garden	Wellesbourne
Size	8 Ha.	19.5 Ha	1.6 Ha	15.6Ha	104 Ha	1 Ha	200 Ha	7.6 Ha	120 Ha	20 Ha	191 Ha
No. of staff	7	36	8	34	201	4	27.5		480	15	190
Salaries	£76,900	£236,768	£78,468	£300,000	£2,547,340	£49,364	£252,000		£6,697,318	£105,980	£3,000,000
Cleaning			£2,724			£624					
Administration											
Insurance			£2,501			£5436					
Rates						£900					
Water rates	£1,022					£500					
Maintenance	£12,597		£7,667								
Horticcultural expenses			£2,376			£500					
Telephone	£900					£300					
Energy	£15,178		£5,139	£40,725		£11,439	£10,000				
Depreciation			£7,954			£9,000					
Total - salaries = Other costs	£50,000	£157,851	£53,434	£69,071	£1,928,207	£28,249	£154,000		£6,902,139	£211,960	£4,000,000
'Other' costs per Ha	£6,250	£8,095	£33,396	£2,302	£18,540	£28,249	£770		£57,518	£10,598	£19,576
Salaries as % of total costs	60.6%	60.0%	59.99%	81.1%	56.9%	63.6%	62.0%		49.25%	33.3%	43.0%
Other costs as % of total costs	39.4%	40.0%	40.01%	18.9%	43.1%	36.4%	38.0%		50.75%	66.7%	57.0%
Total Costs	£126,888	£394,619	£131,902	£369,071	£4,475,547	£77,613	£406,0001		£13,599,457	£317,940	£7,000,000

rates, Maintenance, and energy. The breakdown of the data obtainable from the gardens is shown in Table 4.9.

What is evident is that some gardens have very detailed accounts whereas costs at others are not separated at all. The figures obtainable were not directly comparable due to the many accounting methods and different cost headings.

Only Newcastle was able to supply a figure for rates although several places were able to supply water rates costs, probably because the gardens are metered separately. Only two places had a separate cost for maintenance showing the difficulty of obtaining true running cost figures.

Five places were able to supply, at least an estimate of, energy costs which may indicate that this is an area of expenditure which has been examined more closely recently as costs at botanic gardens have come under scrutiny.

At Edinburgh and Kew, with their own research establishments, much of the total running costs were attributable to research. In places such as Ness and Cambridge the costs are so interwoven that trying to separate them would have been meaningless.

4.7 Revenue

Revenue is derived from:–

Grant in aid or Subvention
Entrance Fees
Funds raised by
Friends schemes
Bequests
Endowment interest
Donations
Profit on sales
Rent of premises

The money to support botanic gardens therefore comes to them in a number of ways but they are all funded directly or indirectly by the taxpayer or community charge payer as follows:–

Table 4.10

Revenue gained by gardens (1989 figures)

	St.Andrews	Ness	Chelsea	Cambridge	Edinburgh	Newcastle	Westonbirt	Sheffield	Kew	Hypothetical Garden	Wellesbourne
Size	8 Ha.	19.5 Ha	1.6 Ha	15.6Ha	104 Ha	1 Ha	200 Ha	7.6 Ha	120 Ha	20 Ha	191 Ha
Total Costs	£126,888	£394,619	£131,902	£369,071	£4,475,547	£77,613	£406,000		£13,599,457	£317,940	£7,000,000
Revenue :-	/					/		/		/	£7,000,000
Entrance Fees		£56,000	£18,151	£10,000	£16,737		£150,000		£116,817		
Retail outlet			£9,648								
Rents			£16,260		£11,455		£5,000		£66,699		
Other sales							£10,000				
'Friends'			£10,803	£13,908							
Endowment interest			£83,409	£74,000	£41,261						
Grants			£10,000	£5,400					£142,451		
Donations			£56,058						£63,876		
'Other'			£37,036		£92,068				£210,267		
Total Revenue		£290,268	£185,307	£265,763	£368,047		£245,000		£218,102		
Surplus			£53,405								
Deficit				£103,308	£4,107,500		£161,000		£12,188,176	£317,940	

(Source :- Published accounts and data supplied by curators or directors)

1. Government Institutions such as the Royal Botanic Gardens which receives their grant in aid directly from the Exchequer under the National Heritage Act 1983 and National Heritage (Scotland) Act 1985. Westonbirt arboretum is run by the Forestry Commission and is funded by them. It raises substantial revenue from entrance fees (see Table 4.10).
2. University Botanic Gardens are funded by the University Funding Committee, formerly the University Grants Committee, mainly through their parent institution. The U.F.C. pays the property tax directly. Additional revenue may be raised by 'Friends' of the garden schemes, admission fees, plant sales, hire of premises and grants from the Tourist Board, e.g. Cambridge and Durham.
3. Municipal Gardens such as Sheffield, Birmingham, Bath and Glasgow are funded through the Local Authority. Generally the funding is via the Recreation Department of the Council.
4. Private Gardens are supported by entrance fees from the public, e.g. Tresco, with the possibility of additional revenue raised by 'Friends' schemes and endowment interest as at Chelsea Physic Garden.

The income, however derived, is used to benefit the garden by paying rates, rent, wages, equipment and machinery costs, energy costs and maintenance, printing and advertising costs and the cost of horticulture courses.

A summary of income figures obtained are shown in Table 4.10. Sales income and entrance fees vary substantially.

Only Chelsea makes a financial profit, this being due to endowment interest and donations rather than from entrance fees. At Westonbirt about 60% of the costs are offset by revenue which is largely derived from entrance fees. Increasing financial pressures have caused most gardens to explore methods of offsetting their costs and examining income generating activities including:–

1. Introduction or increase in entrance fees.
2. Starting 'Friends of the Garden' schemes. In these 'Friends' support the garden through (a) help in the garden or (b) raising money for the garden.
3. Retail sales of plants or books.
4. Sale of refreshments.
5. Hiring out of premises.

Summary

In most cases the difference between costs and income is so large that it is not likely that these conventional methods of fund raising will be able to cover the costs.

Footnote 1

Letters were written to the Curators or Directors of the following gardens:

Fletcher Moss Garden, Millgate Lane, Wilmslow Road, Didsbury, Manchester.

Department of Botany, The University, Cutbush Lane, Shinfield, Reading, RG6 2AS

National Botanic Gardens, Glasnevin, Dublin.

Cruikshank Botanic Garden, University of Aberdeen, St Machar Drive, Aberdeen

Royal Botanic Gardens, Edinburgh.

Botanic Gardens, University of Liverpool, Ness, Neston, Wirral, Cheshire.

Chelsea Physic Garden, 66 Royal Hospital Road, London, SW3.

Royal Horticultural Society Gardens, Wisley, Ripley, Woking, Surrey.

Royal Botanic Gardens (Kew), Wakehurst Place, Ardingly, Sussex.

Botanic Garden, The University of Cambridge.

Botanic Gardens, Department of Biology, Building 44, The University, Southampton.

Botanic Garden, Glasgow.

University Botanic Gardens, St Andrews, Fife, Scotland.

Botany Department, The University, Hull.

Botany Department, Trinity College, Dublin.

Replies were received from all the above with varying amounts of information from full account to letters stating they were not Botanic Gardens.

The following were also written to but did not reply:

Botany Department, The University, St Machar Drive, Aberdeen.

Botany Department, University College, Aberystwyth, Wales.

Botany Department, The University, Manchester.

University of Bristol Botanic Garden, North Road, Leigh Woods, Bristol 8.

Botanic Supply Unit, University of London, Elm Lodge, Englefield Green, Surrey.

Botanic Gardens, Rose Lane, Oxford.

Footnote 2 Land Valuation Estimates

	£Millions /ha	
Chelsea	12.5m	
Cambridge	2.7m	
Edinburgh	2.5m	
Newcastle	1.2m	
Sheffield	1.5m	
Kew	15.0m	
+ Westonbirt	0.005m	
+ Wellesbourne	0.005m	per ha

+Source MAFF/AMC Series, Current agricultural land prices, England and Wales vacant possession sales.

The land values given in the text are estimated based on the area in which the garden is situated. See map Figure 4.1.

Efforts were made to improve the accuracy of the land price estimates given here. There is no register or published account of residential land valuation in Britain. Enquiries were made of the National Housebuilders Federation, the District valuer and a land agents firm.

If prices are known they are confidential due to the value of the information. For a proper valuation it would be necessary to get the residual land valuations over a period of ten years to take account of inflation, recession and other factors affecting the price of land. Some economy of scale or quantum effect would probably occur in the case of Kew.

The best answers available were a confirmation that the estimates included here were of the correct order.

A number of factors affect the value of land:–

1. The state of the economy
2. Interest rates
3. A demographic change in population.
4. Planning law and policies.
5. Unforseen major developments, e.g. new motorways, airports.

There are also many other scenarios which would alter these figures. Currently however, many botanic gardens occupy sites in the expensive city centre areas. Frequently this has been for historic reasons. Even given substantial changes in demand, income and population the sites would still remain of relatively high value.

CHAPTER 5

BENEFITS: RESEARCH, EDUCATION AND AMENITY

5.1 Introduction

Some of the current problems faced by botanic gardens, in terms of questions as to their value, arise because only their financial costs and revenues are explicitly costed and examined.

In addition to the priced benefits, which in the case of botanic gardens where no entrance fee is charged are relatively small, there are the unpriced benefits or values. These values are both internal to the garden and external benefiting society generally.

The usual stated aims of botanic gardens are research, education and public amenity. Many directors and curators also add conservation, which is discussed in Chapter 6, whilst several are open to the public, generating recreational benefits (Chapters 7and 8).

Chapters 5, 6 and 7 will examine the unpriced benefits from botanic gardens and examine ways in which these may be valued or assessed as non–priced public goods.

5.2 Internal Benefits

5.2.1 Research

It is difficult to quantify the value of research, especially basic scientific and taxonomic research carried out in botanical gardens.

However, a garden benefits from its own research in that continued funding is becoming ever more dependent upon the number and quality of the papers, publications and books such as floras produced as a result of work carried out either in or using plant material grown by the garden

Consideration is currently being given to measuring research in universities by citation indices, i.e. the number of other papers which quote any given research paper. Papers which are in refereed journals score more highly than non–refereed ones (Cozzens, 1990). This method, whilst attempting the very difficult task of quantifying research, has many flaws and citation indices are controversial. For example, 'new' or obscure topics will be little cited regardless of potential. Poor work will be frequently cited as an example of such. University departments with a large throughput of research students working on a similar theme perpetuate their high citation rating by the numbers of interested researchers involved (Collins, 1991). Whilst recognizing that publications have a place in measuring the volume of output of research, how they should be counted is subject to debate.

Other possible measures reviewed by Collins (1991) are:

a) Esteem indicators, e.g. editorship of journals, Chairmanship of relevant committees, and

b) Peer review, which was felt to be a better indicator of research worth than the quantitative measurements of publications (Collins, 1991).

At Edinburgh and Kew a major part of the income is spent on the research effort of the gardens in the form of salaries, library facilities, herbarium upkeep and scientific equipment. This equals 53% of the Grant in Aid at the Royal Botanic Garden Edinburgh.

The National Botanic Gardens come within the Civil Service where peer review has been a recognized method of assessing individual's worth for many years.

Quantitative methods may work better for comparing University Departments than for assessing an individual Research Station. Thus the fate of University Botanic Gardens may be assessed by the measures used to evaluate the research output of the Departments to which they belong. This will increasingly be the case as funding of Departmental research is gradually transferred from the University Funding Committee to the five Research Councils. The science budget is the sum allocated annually by the Secretary of State for Education to the Research Councils via the Advisory Board for the Research Councils. The division of funds by the U.G.C., and now the U.F.C., was done mainly on the size of Departments and student numbers. Research Council money is allocated, on application from individuals or research groups, for particular research projects or topics. Thus selectivity will increase because the increase in the science budget for 1991–92 is below the rate of inflation. Scientific equipment tends, in any case, to be very expensive and in many instances increases in price above the rate of inflation (House of Lords Select Committee on Science and Technology, Third Report, 1991).

The Government, through the Department of Education and Science (D.E.S), steers the general thrust of research by targeting specific research areas with funding through the Research Councils. Taxonomy is not high on the D.E.S.' list of priorities. Herbaria and gardens will therefore not be high on the list of equipment for funding.

5.2.2 Teaching/Training

Diploma courses run by the gardens are practical work orientated. This provides the gardens with an increased skilled labour force as these students must put into practice what they are taught. The quality of the course or training is reflected in the number of applicants for subsequent courses. On Diploma courses the students are paid a minimum wage the course includes lectures for one day a week. The costs and benefits of these courses are therefore very difficult to separate. A sum of money is allocated to the horticulture course from the grant in aid. The amount of skilled labour available to maintain the gardens to a very high standard is greatly increased. There are usually 36–40 students in the garden at Edinburgh.

5.3 External Benefits

When founded, the benefits of botanic gardens must have been more clearly perceived. When medicine relied more upon herbal remedies, and diseases were commonplace, the value of a physic garden would have been self–evident. These physic gardens made no pretension to beauty but were purely functional, carrying out educational and sometimes medicinal crop production functions. Although this function has disappeared, issues of species conservation may remake the connection in future (Chapter 6).

5.3.1 Economic Impact of Botanic Gardens on Their Local Area

Two recent American studies (Dolinar, 1987; Gross and Weinstein, 1987) give accounts of ways in which a public garden may contribute to the local economy. Dolinar (1987) estimates contributions made to the local economy by the buying of supplies locally and the wages of staff generated and spent locally. The spending and re–spending of the gardens initial expenditure is known as the multiplier effect. (Indirect effects occur as the money spent by the garden is paid to suppliers and is re–spent by the recipients to buy their own supplies of goods or services. Induced effects are created as those working in all the affected industries receive their wages and salaries and spend them in the local economy. Together, the indirect and induced effects constitute a 'multiplier' that reveals the true significance of a gardens spending. Cultural organizations typically have multipliers in the range of 1.15 to 2.5, indicating that each dollar spent directly in support of gardens will generate from \$0.15 to \$1.50 in additional local spending.)

Public gardens also attract visitors to an area and money spent by the visitors has a multiplier effect. For example, the Philadelphia Flower show put visitor spending at \$1.69 million over the 8 day event. The Dallas Arboretum and Botanical Society calculated its 1987 visitor spending, with multiplier effects, at \$4.4 million (Dolinar, 1987).

These figures look relatively small beside the information that the Missouri Botanical Garden employs nearly 230 people with an annual budget of around $7.5 million (Rausch, 1990), and even that is much smaller than Kew's 330 employees and £8 million 1988 annual budget. The multiplier effect of Kew could therefore produce gross benefits of up to £20 million.

Cultural assets in the environment, including public gardens, are counted as helping to create a positive community image in an economy which has shifted to a service base in which jobs follow people instead of the other way round. Thus any community sufficiently attractive to draw people to live there also draws the jobs and thus the wealth.

In order to estimate a garden's local economic impact four things are required: 1. A specific time period, usually a year. 2. Budget and visitor spending information for that time period. 3. A specific geographic area over which to measure the impact. 4. A mathematical model of the areas economy (Dolinar, 1987).

In Britain the economic impact of tourism on a local economy was assessed in Tayside by the Tourism and Recreation Research Unit (1975). This study estimated that one local job was created for every 1000 tourist days per year in the Bed and Breakfast or Hotel trade, one for every 3000 tourist days per year in Camping and Caravaning and one for every 10,000 days per year of tourist day visiting.

On current visitor levels at the four botanic gardens examined in this study, the number of additional jobs likely to be contributed by Edinburgh and Cambridge are 15 jobs in Bed and Breakfast or 1 job attributable to day visitors. In Sheffield the garden is likely to contribute towards ½ a job in Bed and Breakfast or Hotel trade and ½ a job attributable to day visits. Westonbirt would contribute to 37 jobs in Bed and Breakfast and towards 10 jobs related to day visitors.

However, the gardens do not necessarily contribute to the creation of the whole of these jobs as tourists enjoy the gardens only as part of a larger trip. The exception would be day visitors to Westonbirt where that is the sole purpose of their trip. Some of this benefit is internalized at Westonbirt by the catering facilities and shop being on the premises.

Jeffrey (1990) has estimated the tourism related employment totals and changes from 1981–1987 in districts of Yorkshire, including Sheffield, where in 1981 2.0% of the employment was tourist related (a total of 4290 jobs); in 1987 it had risen only slightly to 2.1% or 4308 jobs. It is to this figure that Sheffield Botanic Garden contributes.

The benefit of wages paid directly to employees at the gardens is important in the local economy. The value depends upon the state of the local labour market. In areas of high unemployment wages paid and money spent by a garden with its multiplier effect and employment wealth and profits from tourism and its multiplier are more important than in areas of low unemployment.

At Cambridge staff costs are about £299,000 per annum, at Edinburgh £2,546,000 and at Westonbirt £232,440. Using a conservative multiplier of 1.5, this gives a total benefit of £3,819,000 from Edinburgh £448,500 from Cambridge and £348,660 from Westonbirt to their local economies.

5.3.2 Education

Education is provided by the gardens either in their contribution to tertiary education, where applicable, in the provision of diploma courses as at Edinburgh and Kew, or in training schemes as at Cambridge. Many gardens also provide non–vocational day or evening classes.

In cost benefit analyses applied to higher education, the costs are relatively easily determined. The calculation of social benefits is complex and most rely on the calculation of social rates of return which are based on the direct measurable economic benefits to the individual of education as evidenced in increased earnings accruing from additional educational qualification or years of schooling. This method may be reasonable if: (i) Earnings are an adequate reflection of the marginal social products of labour, (ii) If education is the sole or major determinant of earnings and (iii) If external benefits are negligible.

The social rate of return method, whilst having limitations, does provide a method whereby various types and levels of education can be compared and valued.

The results of these calculations show that the social returns to part–time and vocational qualifications far exceed those to full–time and academic courses and that financial returns on postgraduate qualifications are lowest of all (Pyle, 1979).

It is possible that the social rate of return on the Kew and Edinburgh diploma courses, the training courses at Cambridge and elsewhere might prove to be in startling contrast to the full–time academic courses which they support. Social rates of return calculations could therefore be carried out for any garden which contributes to a vocational course.

The contribution to tertiary education by botanic gardens is now much reduced as whole plant biology, anatomy and taxonomy have been substantially superceded by biochemistry, cytotaxonomy and genetic engineering which require much less in the way of plant material and a much smaller input to the courses from plant taxonomists.

5.3.3 Library Facilities

The presence and availability of the specialized libraries and herbaria associated with botanic gardens should also be considered amongst the educational benefits of botanic gardens.

The library at the Royal Botanic Garden Edinburgh is available for use by anyone on request. It is one of the most comprehensive botanical and horticultural libraries in the world.

5.3.4 Research Benefits

The main current research of botanic gardens is into plant taxonomy. The 1988–89 report from the Royal Botanic Garden Edinburgh for example, cites the major areas of research emphasis as being the flora of the South West of Asia; the montane and alpine regions of the Sino–Himalayan zone, the New World tropics, the fungi, lichens, mosses and ferns in Britain and throughout the world, and cultivated plants of temperate areas. Work continued on the floras of Arabia, Bhutan and Turkey.

This work of classifying plants is not the type of work about which Horizon programmes are made or for which Nobel prizes are given. It is the basic naming of plants and grouping them in their families using a recognized worldwide system of classification and nomenclature.

From this work there follows the ecology of plant communities. On the basis of this taxonomic work, plants with particular disease resistance or containing a particularly useful chemical can be sought from amongst related species. Unfortunately, taxonomic work is slow and species are being lost in the wild even before they have been classified in the herbarium.

At Cambridge, in addition to taxonomic work, experimental work is carried out into various aspects of woodland ecology, and plant material is provided in quantity for physiological work on wheat and pineapple.

Although the costs of these pieces of research are (relatively) easy to determine in terms of labour and overheads their financial value is much more difficult to assess. In many cases an immediate benefit cannot be seen but may arise in the future, as has happened with very old herbarium specimens. For example, small fragments of tissue of known age have been used to determine the composition of the air at the time the plant was growing and hence to estimate the rate of increase in greenhouse gases and the rate of global warming.

At Liverpool, Sheppard and Clarke carried out extensive genetic studies of swallowtail butterflies which led to an understanding of blood grouping. This in turn led to 'The Liverpool Treatment' of the Rhesus hemolytic problem. Battersby worked out the bio–synthesis of alkaloids, which had an impact on the pharmaceutical industry. Bradshaw produced commercially important strains of lead–resistant grasses. These grasses helped in 'greening' polluted land (Hulme, 1987). At Newcastle upon Tyne, Ranson (1989) working on *Kalanchoe crenata,* discovered crassulacean acid metabolism, a more efficient metabolic pathway found in succulent plants subject to long periods of drought. The possibility of using genetic transfer to produce drought resistant crops can now be envisaged. The plants for all this experimental work were grown in botanic gardens but they need not have been. They could have been produced in any garden or nursery.

In 1987, scientists at the Joderell Laboratory at Kew in collaboration with St. Mary's Hospital London, found that castanospermine, a chemical found in the seed pods of an Australian leguminous tree *Castanospermine australe* showed signs of controlling the growth of HIV without damaging human cells (Tyms, *et al.*, 1987). Following this, taxonomists (using the Herbarium) were able to identify near relative of *Castanospermine,* seven *Alexa* species from South America with similar seed pods. Plant collectors sought these *Alexa* in the tropical rainforest and brought seed back. *Alexa* plants have also proved to contain a chemical which controls the growth of HIV (Nash *et al.*, 1988).

All botanic gardens which produce plants used in research contribute in part to discoveries like these, the economic benefits of which can only be assessed in the very long term.

5.3.5 Plant Production

5.3.5.1 Historical

The earlier use of botanic gardens for the cultivation and multiplication of stock plants of crops of economic importance had very tangible benefits. Kew in particular assisted in ensuring the wealth derived from the British Empire (Hobhouse, 1985). Some of the crops with their importance and impact are shown in Table 5.1.

Botanic gardens were instrumental in the growing on, bulking–up and dissemination of these and other crop plants throughout the world. The botanic gardens of Holland and France were also involved.

It might be possible to put monetary values on the imports from India, Ceylon, the West Indies, and Africa. These values, however, become so intricately involved with the non–priced costs and benefits of the changes in the way of life of the people of Britain and the Empire, seen clearly only with hindsight and in historical perspective, that it is almost useless to try to do this.

5.3.5.2 Current Plant Production

Economic plants

A semblance of this previous benefit of botanic gardens remains as in the Limbe Botanic Garden in the Cameroon. This garden, under the direction of a botanist from Kew, is growing–on seedling mahogany trees. Mahogany has been largely felled in the area for timber and to clear the forests for agriculture. Unfortunately, there is currently nowhere to replant the mahogany trees raised.

In the Korup National Park to the North of Limbe, the Korup project supported by the World Wide Fund for Nature (WWF) assists with the study of plants for their medicinal properties. The Centre for the study of Medicinal Plants in the Cameroons is instrumental in this (Q.E.D., B.B.C 2, 1990).

It is estimated that half of the worlds remaining species are in what remains of the rainforest. This is disappearing at such a rate that if plants of medicinal value are to be found they must be found quickly. The pressures on the rainforest and the effects are too well known to need reiterating here. Botanic gardens role in plant conservation is considered further in Chapter 6.

Table 5.1

Source and Distribution of Crops of Economic Importance and their Impact

CROP	FROM	BY	VIA	TO	IMPACT
Rubber	South America	British	Kew	East Indies	1. The foundation of Britain's rubber industry in 1905 2. coincided with the first production motor car in 1908
Tea	China	British	India, botanic garden 1848	India and Ceylon	1. Removed Chinese monopoly. 2. Produced cheap tea. 3. Britain became a world producer of tea. 4. Built the Empire. 5. Lost America.
Coffee	Ethiopia and the Middle-East	Dutch	Java and Amsterdam botanic garden \	-Brazil Columbia Martinique l Jamaica	1. Created South American coffee industry. 2. Cleared rain-forest. 3. Created near-monopoly and monoculture.
Cocoa	South America S.America	Dutch Africans	Curacao	Ceylon W.Africa	1. Created chocolate industry. 2. Created African chocolate industry. 3. Prevented monopoly and creation of plantations.
Cotton	Egypt	British		W.Indies India America	1. Not a near monopoly 2. Product which supported the industrial revolution 3. Increased trade. 4. Supported by slavery.
Sugar	Widespread	mainly British & Dutch		America Africa	1. Created and supplied European desire for sugar. 2. Increased shelf-life and variety of food-stuffs by preserving. 3. Sustained by slavery.
Spices	The Moluccas Ceylon	Dutch	Pamplemousse botanic garden	East & West Indies	1. Very highly priced commodity. 2. Preserved food. 3. Important monopoly.

Table 5.1 contd.

CROP	FROM	BY	VIA	TO	IMPACT
Quinine	S.America	British	Kew India	India British colonies e.g.West Indies & Africa	1. Sustained the British Raj in India. 2. Enabled the Panama canal to be built with less loss of life. 3. Sustained British troops in 2 World Wars 4. Deprived India of it's supply which left no treatment for 1.5 million people in Ceylon & caused famine in Bengal and Assam. 5. Enabled British to colonise Africa. 6. Destruction of subsistance farming in India Africa and West Indies 7. Improved medical and transport facilities in India.

5.3.6 Horticultural Plants

Many plants are introduced to botanic gardens from botanically little known areas of the world. Primarily these plants are used in taxonomic research. Seed is also collected and plants of horticultural merit are introduced to other botanic gardens, private gardens and commerce as was done by earlier plant collectors.

Botanic gardens also benefit from plant collections made by groups of amateur horticulturists e.g. the Alpine Garden Society which sells shares in an expedition to an area to its members and divides the seed collected amongst the contributors. Botanic gardens may send one of their staff as a member of the expedition.

This interaction between botanic gardens and interested amateurs or nurserymen has always been a feature of plant collecting. It continues today to their mutual advantage.

The trees in botanic gardens and arboreta provide a demonstration of native and introduced species suitable, or unsuitable for garden, street, landscape scheme or forestry crops. The Royal Botanical Gardens, Hamilton, Ontario continues to accumulate Canadian introductions and a recent plant introduction program has been started, in association with the nursery trade and landscape architects, to encourage the wider use of such trees (Paterson, 1985).

5.3.7 Heritage

Conservation of the garden itself.

Whilst botanic gardens could be said to represent the antithesis of 'natural' in the plant world, they are not easily replaced. They represent and are part of a nations history, heritage and culture, in much the same way as museums and art galleries, from which they differ in containing many specimens which are not only old but also living.

These gardens represent man's acquisitive nature and our collection oriented society. Plants, introduced by the collectors who first gathered propagules in the wild, still thrive today. Many are the source material from which introductions were made into horticulture. Collectively the plants in a garden represent its history and the history of the work of the collectors, scientists, horticulturists and gardeners who have been associated with it. In many cases the trees are larger and older than those which are represented in public open spaces, visually they have more in common with historic gardens or gardens associated with stately homes.

Whilst these gardens are not natural they are unique in the associations of plants and man which they represent. Therefore an element of irreversibility ought to be employed in any cost benefit calculations into their value. Pearce, Markandya and Barbier (1989) suggest that in sustainable development, future generations must not inherit less capital wealth than the current generation inherited. Capital wealth encompasses both man–made capital and environmental capital. Botanic gardens must represent some of each type. In trying to assess how the future could be compensated for a loss caused in the present, the irreversibility of replacing the first introductions of particular species must be taken into account. It is not sufficient that a solely monetary value be placed upon the land on which they are growing.

Many aspects of a botanic garden are non–substitutable. Fischer and Krutilla (1985) further enhance the value of a non–substitutable item or irreversible action by defining option value, in their model, as:–

> "the gain from being able to learn about future benefits that would be precluded by development (of an area), if one does not develop in the current period";

in other words the gain from retaining the option to preserve or develop in the future. In the assumptions of their model, option value is non–negative. A monetary figure could be put upon some aspects of this concept in option, existence and bequest values, i.e. using a Contingent Valuation Method. This method is more fully described in Chapter 3.

5.3.8 Public Amenity

Public amenity is quoted by most Directors or Curators as one of the functions of a botanic garden, although not the most important one. Public amenity means to give pleasure to the general public. It is enjoyed either from a purely aesthetic point of view or by a combination of attributes engendered by the plant collections, e.g. peace and quiet, wildlife habitat, relaxing atmosphere or by informing the visitor. It improves the quality of life of the population.

The 1848 Public Health Act and the 1947 and subsequent Town and Country Planning Acts recognized the benefits of open space. The Planning Acts went so far as to put a size on open space provision by suggesting standards which relate acreage to population, e.g. the ultimate open space standard for the Greater London Council (G.L.C.) area, adopted by that authority in 1945, was 4 acres per 1,000 population plus 3 acres per 1,000 outside the administrative county (G.L.C., 1968). This amount of space was not at that time, nor has it since been, provided but the standards were a measurable value placed upon urban open space.

This standard measured the area of space provision but did not measure the quality of the space. Aesthetics were not part of the standard either in scenery, freedom from noise or many other attributes. Local bylaws have imposed some conditions conducive to the provision of a clean and peaceful open space whilst local Recreation Departments have looked after the aesthetics.

Developed first for health reasons the parks were laid out often alongside, but separate from, playing fields.

Surveys of the use of open space (G.L.C., 1968) revealed that parks needed to be a minimum of 20 ha in extent to be effective in attracting many people from a distance greater than one mile. In a survey in Dublin in 1974 (Boylan, 1989) it was revealed that 40% of respondents engaged in some outdoor activity on Sunday afternoons and 20% on Saturday afternoons. 'Going for a walk' was the most popular activity. Amongst the conclusions common to these and other surveys is the recommendation of a hierarchy of parks in terms of size to cater for the varying needs of the community.

Boylan (1989) questions the future direction of parks asking whether it is enough simply to provide facilities. Welch (1975, 1977 and 1986) believes that a greater range of activities should be encouraged in public parks and that this can be cost effective. He suggests that as horticulture is recreation and the Royal Horticultural Society is the largest voluntary group of its kind in the world, and most newspapers and magazines have a gardening column, the public would respond favourably to promotions in parks such as open days, plant identification competitions, guided walks, or even gardening classes.

Sheffield Parks Department does arrange such events in its botanic garden and Newcastle City Recreation Department organizes guided walks in Jesmond Dene and visits to its nursery. Many other botanic gardens provide some of the facilities suggested by Welch.

By the very nature of botanic gardens they provide diversity of plant form. The variety seen in the garden is part of their *raison d'etre*. This is in contrast to many parks which rely upon bedding schemes or rose or shrub beds to provide summer colour and thereby forgo some of the variety of botanic gardens.

Some botanic gardens were designed by landscape architects e.g. Kew and Edinburgh, on sites which were chosen for the garden; they thus have some advantages over parks in the matter of aesthetics. In several cases they have the advantage of greater age, with mature trees and a greater succession of plantings. Several are large enough to attract people from greater distances than neighbourhood parks.

Although not counted, as a public park, botanic gardens are included in local attractions guide and as such form an integral part of the open space provision in cities, and therefore ought to be designed, planned, managed and valued as such.

In gardens which are open to the public there may be a charge, which provides a tangible benefit to the garden.

What the public gain from the amenity is one or several intangible benefits. Although aesthetics are not a necessary part of an amenity they tend to go together in public amenity gardens, to a greater or lesser extent.

The history of the founding of the first public parks is thoroughly documented in 'The Park and the Town' (Chadwick, 1966).

5.3.9 Public Education

Public education on an informal level takes place in most botanic gardens. It may be only having the plants labelled, which enables people to buy the same plant through a nursery or garden centre or it may be the provision of booklets on tree trails, as at Westonbirt, or on the chronology of introduction of cultivated plants or British rare and endangered species or plants of fen habitats at Cambridge.

Elaborate indoor exhibits are staged at Edinburgh on the rainforest or other topics relevant to conservation of ecosystems and species diversity.

In Solvan in the USA, the city has planted a drought tolerant example garden or xeriscape. The garden is open free to the public every day and a species list is available. The aim of this is to encourage the citizens to plant drought tolerant species in their home landscapes and thus save water (Old Mission Xeriscape). These 'one message' plantings may have more impact than many faceted collections.

5.3.10 Urban Nature Reserves

The increasing cost of urban green space maintenance together with the increased pressure on the country's diminishing wildlife habitats from agriculture, forestry and industrial development has led both Local Authorities and the Nature Conservancy Council (now English Nature) to seek solutions to some of their problems in the foundation and promotion of urban nature reserves. Local Authorities see this as a means of reducing the maintenance costs of green space and indeed of securing additional green space by making a condition of granting planning permission for e.g. for some extractive or landfill operations, that the area should be returned to a conservation after–use. English Nature see these sites not only as additional areas for wildlife, but as an alternative attraction for those interested in wildlife which will help to alleviate the increasing public pressure on wildlife sites adjacent to cities. To this end English Nature and various Local Authorities have prepared wildlife conservation strategies and have produced a number of booklets advising on the creation of wildlife sites (G.L.C., 1984 & 1985). The use people make of these wildlife sites has been examined in a number of studies (Harrison, Limb and Burgess, 1987; Nature Conservancy Council and Millward, 1988; Harrison, Limb and Burgess, 1986).

The maturity of botanic gardens, the amount of cover and food sources provided together with their quiet environments, which frequently incorporate water features, form extremely varied, though artificial, wildlife habitats. From a horticultural point of view they are very 'managed' but are not cropped each year. Many of them thus provide a habitat for birds and small mammals such as the grey squirrel. Ironically, this wildlife interest is at variance with the horticultural interest since pigeons and squirrels are vermin and cause much damage to plants.

5.3.11 Garden Visitors

Botanic gardens are still seen by their Curators primarily as places of scientific research and study. Public visiting is secondary and, as with museums, they were not originally open to the public.

Kew was not open to the public until 1841 when 9000 visitors were allowed. When Joseph Hooker took over the Directorship of the garden, he and a landscape designer began to make the gardens more attractive and to encourage the public to visit. Between 1844 and 1888 the Palm House was built and between 1860 and

1898 the Temperate House. In 1848 there were 64,000 visitors, in 1849 124,000 and half a million in 1865. This enlightened attitude was not, however, universal.

The gardens at Sheffield were run by private subscription and stayed firmly shut to working men and women except on special and occasional open days. In 1852 an attempt was made to have it opened one day a week but the attempt failed (Young, 1989). A Manchester park and zoo was thrown open to the public on the day of Queen Victoria's coronation to divert the public from joining a rebellion by Chartists (Chadwick, 1966). For whatever reason the public visit gardens, numbers have steadily increased over the years and the number of gardens which are opened to the public increases. Botanic gardens have advantages for the visiting public which many parks do not have in that they have display glasshouses open all year round, so inclement weather is less of a deterrent to visitors. The recreational benefits of botanic gardens are discussed in detail in Chapters 7 and 8.

5.3.12 Botanic Gardens and Horticulture

British botanic gardens have never aspired to be primarily places of horticultural interest. They use horticultural techniques to grow specimens of botanical interest but have largely disregarded the increasing interest in gardening and have left this to the Royal Horticultural Society and the Northern Horticultural Society and their two gardens at Wisley and Harlow Car.

This is not the case with foreign botanic gardens which make the cultivation, testing and display of horticultural plants one of their main functions. This is particularly true of Russian and American botanic gardens. It is possible that Britain, slow to change, is clinging to the historic roles of botanic gardens whereas foreign gardens have leant more towards 'popular demand'.

An alternative view is expressed by Byrd (1989):–

> "In a 1972 publication 'The Perspective Role of an Arboretum' the Institute for the Study of Human Affairs at Columbia University found in a survey of more than 150 arboreta and botanic gardens in the United States that: "Most... do not have research programs". This finding suggests a serious erosion of purpose or perhaps a need for re-definition or re-examination of the objectives of these gardens as centres for rigorous study. It may also be a consequence of what L.A.S. Johnson, the Director of the Royal Botanic Gardens at Sydney, Australia, has described as the burden of "worldwide intellectual mediocrity that characterized systematic botany and botanic gardens' development in the first half of the 20th Century."

In America the attracting of the public to botanic gardens is seen as of much more importance than it is in Britain. Landscape designers are commissioned to design gardens with the particular purpose of attracting and interesting visitors (Posner, 1989). Two firms in particular in America are pre-eminent in the field of landscape garden design, Environmental Planning and Design (EPD) of Pittsburgh and Jones and Jones of Seattle. Botanic garden entry is not free at all gardens in the U.S.A. (Brooklyn Botanical Garden Record, 1986).

The views of Rausch, one of the partners in E.P.D., on the value of botanic gardens (Rausch, 1990) are more wide ranging and much more visitor orientated than those of the Curators of botanic gardens in Britain. One garden which E.P.D. helped to design was the Bloedel Reserve which is:

> "dedicated to providing an environment wherein our visitors may receive emotional (and not necessarily intellectual) stimulation." (Brown, 1990)

Ulrich (1981) showed that there was a consistent pattern for natural scenes to have more positive influences on emotional states, including reduction of stress levels, than urban scenes. Botanic gardens, along with other parks, provide such natural scenes within urban areas and so may have an as yet unmeasured value. Instruments used for measuring 'quality of life' are currently too crude for measuring the value of a botanic garden in improving the mental state of garden visitors (Kind, 1989). It may be an interesting value and could be investigated further when a more sensitive method is developed.

CHAPTER 6
CONSERVATION OF SPECIES

6.1 Preservation of Endangered Species

It is generally stated by Directors and Curators of botanic gardens that conservation of species is one of the roles of botanic gardens. It is entirely reasonable that the general public should hold the view that this is a function which botanic gardens are carrying out. Species preservation is one aspect of conservation of biological diversity. Biological diversity is the natural stock of genetic material within an ecosystem. It may be determined by the actual number of genes existing within the system. Genes determine the particular characteristics of a given organism. The greater the variety of genetic material the greater the variety of organisms which exist or will exist in the future.

The usual unit of analysis in studies of biodiversity is the number of existing species. Extinction is itself a natural process. Species show a natural longevity of one to ten million years. It is not any specific stock of species which is necessary to maintain biological diversity, but rather the general stock; the actual constituents of that stock have always varied with time.

The problem of biological diversity arises when the rate of extinction of species far exceeds the rate of creation. At the present time, with species being made extinct by habitat changes and removal caused by man, there is a potential threat to the entire global biology.

The current stock of biological diversity is the result of several billion years of, mostly, low frequency mutation and extinction. This has given us a legacy which cannot be recreated in shorter lengths of time. In this respect biological diversity is one of the stocks of "ancient capital" which cannot be replaced once destroyed. In economic terms it is an "exhaustible resource". It is estimated that about half the world's species are contained in the remaining tropical forests, and much of the attention on the current rate of extinction is therefore focussed on these regions (Swanson, 1991).

Species loss at the current rate affects man because:–

1. Species related to plants of current economic importance may exist which contain genes which would endow current crops with attributes which would increase yields for the same cost in a number of possible ways.
2. Species are components of ecosystems which provide the physical and biological supports for human life in e.g. climate control, water regulation, soil maintenance, waste disposal, cycling of nutrients. Some of these services of ecosystems are not substitutable at all and for others the costs of substitution are likely to be high.
3. Loss of diversity of species reduces the range of biological aesthetics available to the human race.
4. Some of the concern for species loss is of a religious or ethical nature (Fisher and Krutilla, 1985).

Species loss is an irreversible process and it is difficult to see how substitutability could be calculated for loss of a species.

It is doubtful whether extended cost benefit analyses are applied to any of the activities which result in species loss. It is more likely that capital–wealth calculations only are attempted. This is borne out by the observation that the rate of conversion of natural habitat to agricultural land is over 17% per decade while the real value of the agricultural commodities produced on this land had declined to 62% of its 1960 value by 1987 (International Monetary Fund 1988, World economic Outlook 1988 Washington DC).

The increased production has been to supply an already saturated market. Meanwhile, a number of studies have demonstrated that the value of the products of natural habitats is greater than the value of its product if it were converted to another use.

Table 6.0 The Comparative Value of Natural Habitat Production

Country	Natural Habitat Use & Value	Alternative Use & Value
Kenya	Wildlife Tourism (much higher)	Cattle Ranching
Zimbabwe	Wildlife Production Z$4.20/ha	Cattle Ranching Z$3.58/ha
Malaysia	Forest Production $2455/ha	Intensive Agric. $217/ha
Peru	Forest Production $6820/ha	Clear–cut $1000/ha

Sources: Zimbabwe – Child (1984); Kenya – Western (1984); Malaysia – Watson (1988); Peru – Peters *et al.* (1989).

6.2 Rate of Species Loss

There is a great deal of uncertainty about the seriousness of the threat of species loss but some figures generally agreed upon illustrate the rate of loss; in the United States over 500 species are known to have become extinct since 1600, or between one and two per year. By contrast over a 3000 year span during the Pleistocene period, a period of glaciation when many individuals died, fewer than 100 species were lost in North America (Opler, 1971). About two thirds of recent losses in America have been in Hawaii due to the clearing of forests for cropland and the introduction of exotic species.

Some biologists believe that 1000 species are disappearing worldwide each year and that this rate may have reached 10,000 annually by the end of the 1980's (Myers, 1981). By one estimate, as many as a million of the current 5 to 10 million species could be gone by the year 2000 (Myers, 1983). These figures are conjectural but losses on anything like this scale would be catastrophic.

Noting that about 66% of the vascular plant species occur in the tropics, Raven (1976) estimated that at least 50000 tropical vascular species will have reached threatened status or become extinct by the end of the century. Oceanic islands are particularly vulnerable, as in the case of the Hawaiian Islands, where as much as one half of the unique native flora is listed as endangered or now of doubtful status. The floras of Mediterranean climates where there now exist perhaps as many as 12000 local endemic species, are also seriously at risk. Certain temperate floras are in equal hazard.

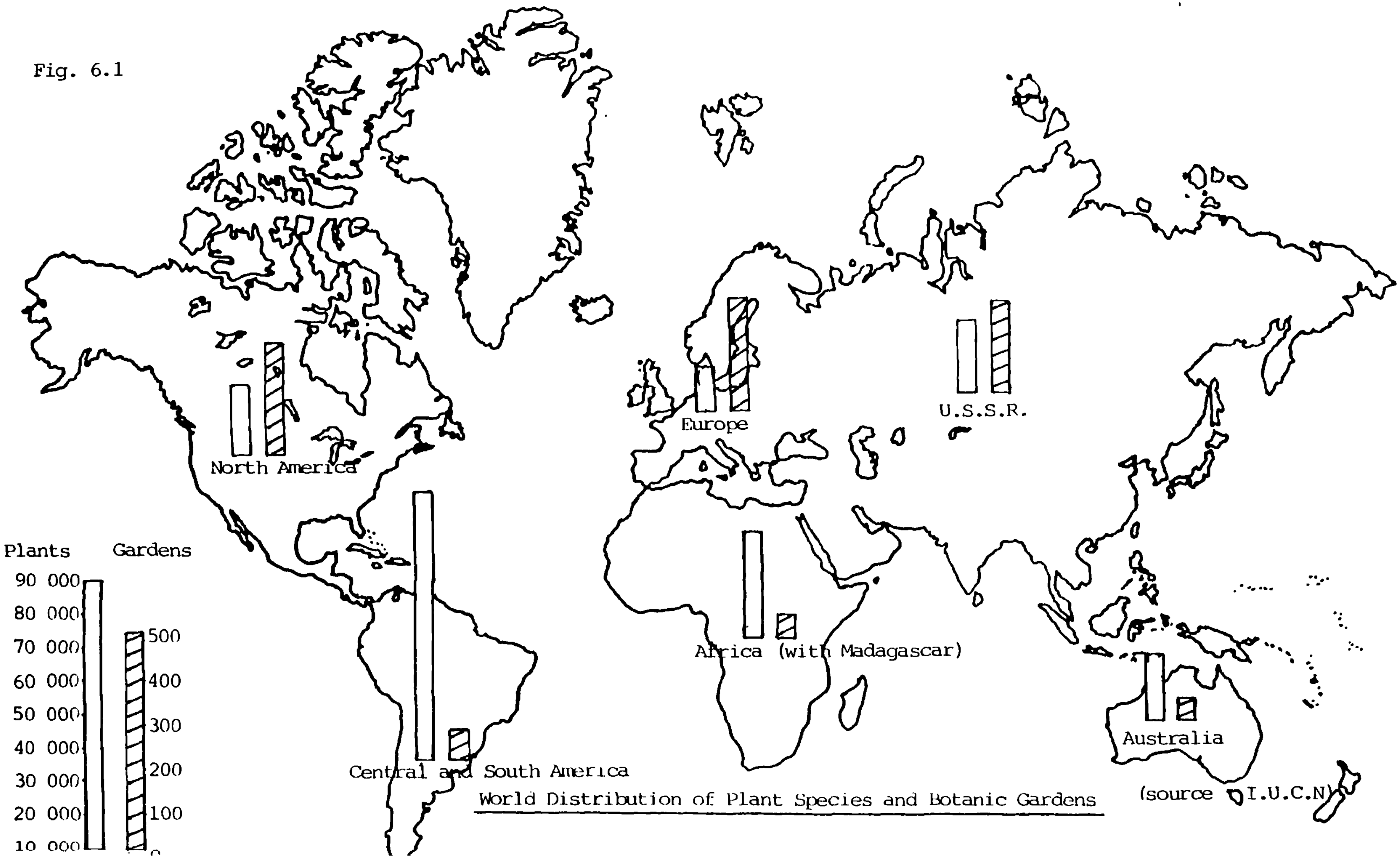
The International Union for Conservation of Nature and Natural Resources (IUCN) was founded in 1948 by Julian Huxley. The IUCN founded a Threatened Plants Committee (TPC) which is funded from the World Wide Fund for Nature (WWF). The Threatened Plants Unit of the World Conservation Monitoring Centre was set up in 1980. This Centre has developed an overview database of the conservation status of over 57000 taxa. It has identified 22000 of these taxa as being threatened at the world level. The Centre exists to maintain data and monitor the decline of plant diversity, resources and habitats and to provide the relevant information to International Conservation and Development Committees.

6.3 Botanic Gardens Role in Species Preservation

One of the chief incalculable benefits of botanic gardens should be that they are places where plants threatened with extinction are preserved, at worst like a living zoo, at best as a viable gene pool.

Figure 6.1 shows the world distribution of plant species and of botanic gardens. There is an inverse relationship between the location of the greatest number of species and the location of the greatest number of gardens. Central and South America having the largest number of species, and losing them faster than anywhere else, but having the smallest number of gardens. The number of gardens is however not the relevant factor, but what the gardens are doing towards conserving the local or other floras threatened with extinction.

Fig. 6.1



World Distribution of Plant Species and Botanic Gardens

(source I.U.C.N)

Six international conferences on the issue of botanic gardens and plant conservation have been held since 1975. Kew held conferences in 1975 ('Conservation of Threatened Plants') and 1978 ('Survival or Extinction'). The International Union for the Conservation of Nature (IUCN), now renamed the World Conservation Union (WCN) held a conference at Kew in 1985. The International Botanic Gardens Conservation Congress held their first conference in Las Palmas in 1987 entitled 'Botanic Gardens and the World Conservation Strategy' and a second conference in Réunion in 1989 entitled 'Tropical botanical gardens: their role in conservation and development'. Finally, Kew held the latest conference 'From Specimen to Habitat Management' in 1991.

Lucas (1978) suggested that botanic gardens were under–utilized in the growing of endangered plants or as quarantine stations for moving them round the world. Earlier, Heslop–Harrison (1976) stressed that conservation policies must be based primarily on conservation *in situ*. Together with Shaw, Curator of the Royal Botanic Garden Edinburgh, he suggested that botanic gardens have a role in conservation in gathering, propagating, disseminating and preserving rare and threatened plants. Heslop–Harrison stated that the commitment must be continual and open–ended and the aim must be to return them to the wild as has happened in a few instances. He recognized, however, that for many species the only future is likely to be in cultivation. He also suggested that

> "In taking up the challenge of developing the living collections for their manifold potential functions in conservation, botanic gardens can find for themselves a new and purposeful role, at a time when economic pressures are growing and their traditional functions in teaching and taxonomic research are coming under question".

Various speakers at the 1975 and 1978 conferences suggested that botanic gardens should engage in conservation, chiefly by rationalizing their existing collections to make room for threatened species. Some anomalies soon become apparent in evaluating such suggestions. For example, Henderson (1973) Regius Keeper Royal Botanic Garden Edinburgh, says that only 10% of the plants in the

Royal Botanic Garden are of known wild origin. The origins of the other 90% are unknown. Shaw (1973) Curator at Edinburgh, suggests that reducing replication might make a 5% difference in the space available which is hardly sufficient for 20000 taxa. Stearn (1973) on the other hand, appealed to botanic gardens not to throw out their 'rubbish' as he had once come across the last individual of a taxa being thrown out of a botanic garden and twice found that botanic gardens had lost the last specimen in cultivation. Thus, if there is a clearing out, it is quite likely that some rare specimens will be made extinct in the enthusiasm for making room for new rarities. Many of the rare species are not attractive to the public in a horticultural sense. The European Botanic Gardens Conservation Project was started to find out what threatened plants are already in botanic gardens. On the European list there are nearly 2000 plants classed as rare or threatened. Of these, 481 were found to be in cultivation. The 'attractive' wild plants were in cultivation, 213 of the 481 were in one garden (Lucas, 1979).

Most U.K. botanic gardens hold some rare or threatened native plants. These are listed in 'Rare Vascular Plant Species in Cultivation in the British Isles'. Some are held as research material, other gardens may hold the national collection of some species under the NCCPG (National Council for the Preservation of Plants and Gardens) scheme. These almost always contain some species which are rare.

6.4 Botanic Gardens: International Collaboration

In addition to the six International Conservation Conferences mentioned earlier, the International Association of Botanic Gardens have held conferences of their various divisions throughout the world and in America the Centre for Plant Conservation was begun in 1984. It is based at the Missouri Botanic Garden and coordinates efforts to prevent the extinction of the rarer members of the flora of the United States. It works through, and coordinates, the efforts of 20 botanic gardens. The Centre is funded by private donations.

The Botanic Garden Conservation Secretariat developed out of the IUCN/WWF Plant Conservation Programme, following the International Conference 'Botanic Gardens and the World Conservation Strategy' at Las Palmas in 1987. The Botanic Garden Conservation Secretariat produced a comprehensive strategy document in 1989 'The Botanic Gardens Conservation Strategy'. The document sets out ways in which existing and new botanic gardens should undertake the role of conserving the world's flora. The aim is to encourage a coordinated method of plant conservation based on the documentation of collections and the exchange of information between member gardens.

Each botanic garden is to monitor its own local flora and vegetation, especially endangered species, and these gardens are to work within a national framework, these within a regional framework. The garden should also act as an information centre and clearing house for conservation matters as well as undertaking practical conservation activities.

It is an idealized strategy. Even gardens within the U.K. cannot afford the annual subscription to the Botanic Gardens Conservation Secretariat and in order that gardens in the developing world should be able to become members the BGCS has had to start a sponsorship drive.

The data base, it is hoped, can be computerized and made available from one garden to another by computer access. Many, U.K. botanic gardens have not got their accessions on a computer data base, although some gardens have as well as some of the gardens in the developing world.

The strategy, unfortunately, is aimed mainly at gardens and not at those who fund gardens, such as governments, universities, municipalities etc.

Until the importance of conservation and botanic gardens' role in it is accepted as an appropriate task by the funding authorities there is little hope that the strategy document will be much more than a model of what could have been done. The strategy outlines the contribution that botanic gardens can make to achieving what the

World Conservation Strategy identifies as the three main objectives of living resource conservation:

> To maintain essential ecological processes and life support systems.
>
> To preserve genetic diversity.
>
> To ensure that the utilization of species and ecosystems is sustainable.

The strategy is ambitious and more optimistic than realistic. For this reason it may be more dangerous to the aims of conservation than it is a help. It gives the impression that more can be achieved more quickly with current resources than is realistic.

To put this in context consider the following. In Britain 51 species of wildflowers are threatened with extinction and 19 have already been lost since records began (Walters, 1985). Britain also has a relatively small flora, c.2000 species and about 48 botanic gardens. A list of 'Rare Vascular Plant Species in Cultivation in the British Isles' is kept on an *ad hoc* basis. The Biological Records Centre and the IUCN's Conservation Monitoring Centre produced the fourth edition of this list but were unable to keep it up. A fifth edition was prepared by the Conservation Propagator at the University of Cambridge Botanic Garden, a post funded by the Nature Conservancy Council now English Nature. Between the production of the 4th edition in 1978 and the 5th edition in 1983 there was a substantial drop in the number of rare species held in cultivation (Morgan, 1988). The 6th edition of the list has been prepared at Chelsea Physic Garden as English Nature no longer fund the Conservation Propagators post at Cambridge. The post was held by Miss. V. Morgan who said that the species were not intrinsically difficult to grow but that the:

> "Careful and painstaking record keeping and administration required to maintain a conservation collection as a quality scientific resource has proved too expensive for most botanic gardens in the recent cutbacks. In practice, collections have only survived in gardens where a particular member of staff has bothered to look after them on their own initiative e.g. Ness, Swansea and previously Bristol." (Morgan, 1988 Pers. Comm.)

With 48 botanic gardens in Britain, we are not able to conserve the endangered elements of the British flora as living specimens. Botanic gardens and conservation movements would do better to put pressure upon governments.

6.5 Problems in Foreign Botanic Gardens

Bovey (1991) illustrates the difficulties faced by botanic gardens in Africa and outlines the prerequisites for their sustained existence. There are 55 botanic gardens and arboreta in Africa, Madagascar and the West Indian Islands. These are historically urban, state–owned and in poor condition because they exist as relics of their former use when the countries were colonies. It is unrealistic to expect local Governments to pay for the upkeep of anachronisms. After more than 2 years experience in Africa Bovey felt that it might be possible to keep 3, 4 or 5 gardens throughout that continent. He estimated that:–

1. This needed high profile European botanic gardens to be responsible for sponsoring these African gardens by their reputation.
2. A large financial input from industrial sponsors is required.
3. The prime sites of biological importance must be identified.
4. It is vital that the choice of site for a garden should be in an area of political stability with available sympathetic sponsors.

Bovey (1991) emphasises the necessity for the botanic gardens of the developed world to commit themselves to training staff for tropical botanic gardens in phases, over a period of 20 years.

This more clearly illustrates the state of tropical botanic gardens than might be imagined from the Botanic Gardens Conservation Strategy of the Botanic garden Conservation Secretariat.

Beyer (1991) stresses that there have now been a number of conferences on the issue of botanic gardens and conservation since 1975. At the first conference resolutions were drawn up and the task identified. The plight of tropical floras, especially island floras like those of Madagascar and Hawaii were shown up, plans were made to take threatened species into botanic gardens but nothing was ever said about what was to happen to the propagules produced as a conservation measure in the long term. No final home has been identified for them to be returned to.

The second Kew conference in 1978 repeated the interest in tropical floras but there was no indication that there had been any effect of the first conference. Following the 1978 meeting the Botanic Garden Coordinating Body and a Conservation Monitoring Centre at Kew were set up to provide data.

In 1989 the International Union for the Conservation of Nature drew up a draft strategy for botanic gardens role in conservation. There have been no or few initiatives to turn it into an achievement. Beyer states that, in spite of these conferences, botanic gardens have not managed to slow down the rate of loss of endangered species, there has been no increase in the number of botanic gardens in the tropics to slow down species loss – there are now fewer gardens than in 1975. There are no reintroduction programmes involving multidisciplinary efforts working in the third world.

Currently many botanic gardens in the tropics are in decline. Hill (1905) wrote of Bogor Botanic Garden that it was "the most complete botanic garden in the world". This garden is now going to be reinstated after it had fallen into disuse during and since the last world war.

6.6 Recent Realizations of the Scale of the Problem

At the 1991 Kew Conservation Conference 'From Specimen to Habitat Management' there was less emphasis on the ability of botanic gardens to conserve even the endangered part of the worlds flora as growing plants for a number of reasons.

1. There are too many species (c.250,000) of known higher plants world wide.
2. 99% of the worlds flora is uncollected.
3. What has been collected and is already in botanic gardens is generally from too narrow a genetic base, being from too few individuals and frequently from only one location.
4. Much material already in botanic gardens is a clone. It is possible that it was poor or aberrant material which was a curiosity when it was collected.
5. At Kew there are 2,000 rare and endangered taxa including:

    20 species extinct in the wild.

    327 endangered species.

    451 vulnerable species.

    220 species which may be in danger.

What should be done with these museum pieces? They cannot currently be returned to the wild. To consider some plant groups as a whole:–

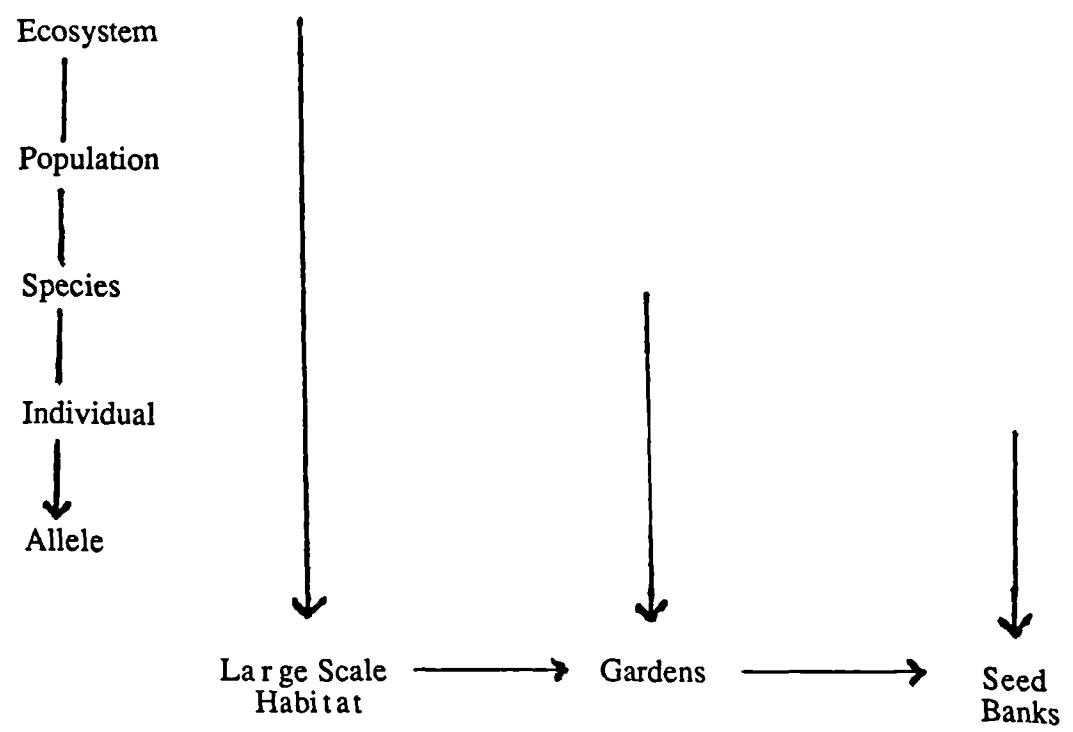
Of the 662 conifer species in the world, 232 are vulnerable or threatened. Three of those which are extinct in the wild are well known in cultivation: Monkey puzzle *Araucaria araucana*, Japanese umbrella pine *Sciadopitys verticillata* and Lebanon cedar *Cedrus libanii*.

Ten per cent of the ferns, which are the second largest plant group, are thought to be in danger of extinction or serious genetic erosion over the next 20–40 years, mostly in the tropics. Many ferns are native to tropical rainforests which are one of the ecosystems most susceptible to damage.

6.7 Realistic Roles for Botanic Gardens

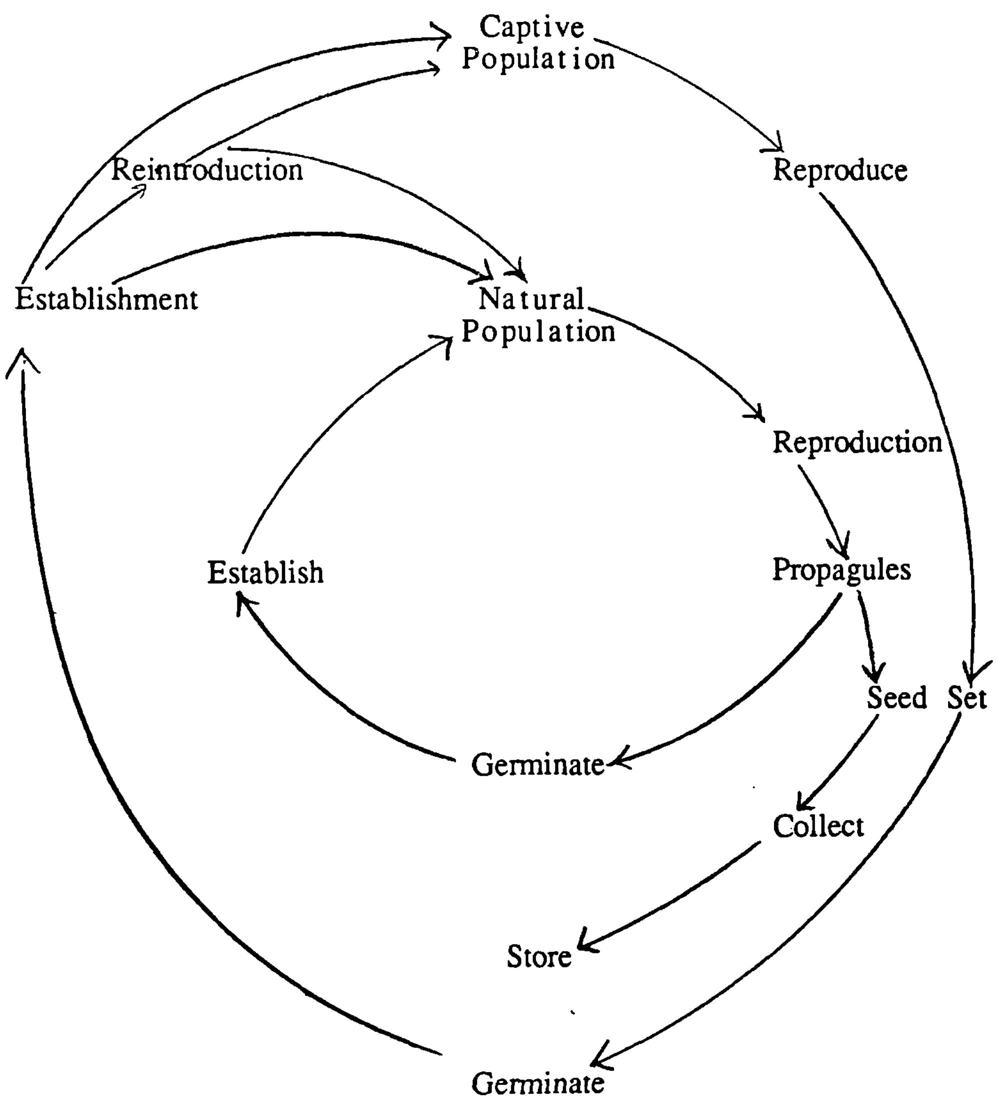
Falk (1991), Director of the Centre for Plant Conservation, resolves part of the dilemma of botanic gardens by explaining that they cannot carry out all the necessary steps in plant conservation. They should concentrate on those they can do well. He illustrates this graphically, showing how the preservation of an ecosystem, which in turn will preserve the species within it can only be preserved by expensive large scale habitat conservation.

Figure 6.2 Botanic Gardens Place in Species Preservation



The role of gardens is further down the scale, preserving individuals and alleles. A number of preservation measures are needed. He suggests that with their specialist ability in propagation and growing techniques gardens and arboreta should be a flow-through system for bulking up populations for reintroductions, for instance, to a reserve.

Figure 6.3 Flow-Through System for Bulking up Rare Species in Botanic Gardens



This would be a realistic expectation of what a botanic garden could do, especially one in the locality or in a homoclime of the reintroduction site.

Another role of botanic gardens in conservation and in horticulture is suggested by Winter (1991). He demonstrates that attractive native plants which are becoming rare or endangered through human pressure on their habitats and pressure from over–picking can be rescued by botanic gardens producing some of these plants and introducing them to the local horticultural trade as is done at the National Botanical Institute Kirstenbosch, South Africa.

6.8 Ownership and Fair Return

This of course does not save the unattractive species or those with specific requirements. It also raises another question: currently in horticulture $30,000,000 a year are made from Saintpaulia's but none of this money is returned to Namibia where the plant originated (Cunningham, 1991).

Similarly, *Catharanthus roseus* the rosy periwinkle, was found to be the source of potent cytotoxic agents vinblastine and vincristine used to treat malignant diseases such as Hodgkin's disease, leukaemia and some types of cancer (Hollman *et al.*, 1989). This plant came to Chelsea Physic Garden from the 'Jardin des Plantes' in Paris and was distributed to other gardens in the 18th Century (Taylor, 1990). It is now one of the most important of the medicinal plants. No direct benefit has accrued to Madagascar where it came from.

Botanic gardens' involvement in economic and ethno–botany is the key to justifying botanic gardens survival in Africa. They must act as 'honest brokers' in the distribution of plants from the area in which they grow to the rest of the world and ensure an honest financial return for their home state. This requirement is built into the conditions of Wakehurst's seed collection effort.

6.9 Reintroductions

Maunder (1991) states that Kew has 2,000 taxa which the IUCN considered rare or endangered and that plant reintroductions are a conservation tool. To his knowledge there are 190 reintroduction projects in 18 countries covering 20 plant families worldwide. Information about these reintroductions is not freely available. There are no detailed accounts of the horticultural activities assisting the reintroduction such as the weeding regime and pre–planting measures. *He questions how success* should be measured, whether it was the ability to establish an individual or a population. He also questions whether some reintroductions should rightly be claimed as such. For example the Bermuda cedar *Juniperus bermudiana,* an endemic, was wiped out by a weevil in the 1960's. A few seedlings survived and from these resistant specimens were developed and reintroduced to Nonesuch Island in Bermuda. Maunder questions whether that could be classed as a true reintroduction. If the Café Maron *Ramosmania heterophylla* propagated at Kew from cuttings of the last tree had succeeded in Rodrigues it would be a sterile clone. If *Encephalartos woodii,* a cycad extinct in the wild, were reintroduced into the wild it would exist as one sex and one clone. A number of herbaceous flowering plants have been reintroduced but it is as yet too early to say whether they will establish viable, self–perpetuating populations. So far there are no accounts of woody plant reintroductions regenerating.

On specific reintroduction programmes Olwell (1991), the Manager for Conservation Programs for the American Centre for Plant Conservation, gives an account of attempts to establish a new colony of *Pediocactus knowltonii* in N.W. New Mexico. The project cost $100,000 but has not yet been a success. It was, however, a well documented and monitored experiment yielding important information for subsequent trials.

6.10 Successful Projects

In individual countries there are examples of successful species or habitat protection. e.g. Mexico, where there are 20–30,000 plant species, of which 15% are endangered. 400 are listed in the IUCN Red Data Book. Efforts to encourage the local people to protect the rare Cycads from thieves and rescue the seeds from being eaten by rodents and grow them on as a cash crop have so far proved successful (Vövides, 1991). In Brazil deforestation is now at $\frac{1}{3}$ of its 1987 level because the subsidy for cattle production was removed. Pressure was put on the government, not only from other countries but from within Brazil by people who derived a living from forest products such as the rubber tappers and Brazil nut collectors. There are now extractive reserves. In Venezuela tree felling is prohibited in the Amazon region and some areas of natural vegetation have been declared National monuments (Prance, 1991).

Other efforts to reduce species loss have also had some success. One, the Sainsbury's Orchid Project at Kew, is one small step. Of Britain's 51 species of orchid, ten are endangered and are protected by the Wildlife and Countryside Act, 1981. The project has succeeded in growing many of the rare British orchids in tissue culture. The Orchid Project was supported by Kew, English Nature and Lady Sainsbury initially. It has now been endowed with £1,000,000 to continue its work indefinitely.

The rarest of the British orchids *Cypripedium calceolus* the lady's slipper orchid, which exists as a single plant in Yorkshire, has still proved difficult to cultivate. Some species have been reintroduced into the wild (Pain, 1991). Orchids are rare chiefly because of man's disturbance of their habitat. For the Orchid Project to be considered a success the plants will have to be grown and multiply in a natural habitat. This stage has yet to be accomplished. This project has cost £1,000,000 for 10–11 species in a developed country, with legal safeguards for its wildlife. This project has set a standard for conservation projects which is being followed throughout the world but less glamorous subjects may fare less well.

Tissue culture techniques can be used in the developed world but when it will be possible to apply them in the Third World is a matter of some conjecture. The people there have more immediately pressing needs than the conservation of endangered species.

Currently the only realistic method of preserving species is as seed thus ensuring genetic diversity. Seed banks need not be attached to botanic gardens. There is a justification for them being so as the increased number of biologists associated with a botanic garden should add to the pool of knowledge of what is being lost, identification of species and interchange of other relevant knowledge.

Two very important advances have taken place over the last 20–30 years in plant handling and storage. One is the discovery and development of plant tissue culture followed by micro–propagation, where numerous individual plants can be kept growing on sterile media in containers in a suitable growing environment for years, using a relatively small space. It relies on good record keeping, constant technical assistance and an uninterrupted electricity supply.

The other advances are in seed storage methods. Many species can be preserved as seed in deep freezers and remain viable for up to 200 years. This too relies on good record keeping and electricity. With seed storage, a much wider gene pool can be preserved in a small area than with micropropagation.

Objections have been raised to this seed storage over long periods on the grounds that it halts the natural evolutionary processes and also removes selection pressures. The size of the gene pool required to be truly representative is also a question of debate. It must of course differ for each species.

Some of these arguments lose validity in the face of wholesale habitat destruction and what may be second best may be all there is.

Neither of these methods require a botanic garden, they require a botanical laboratory and a place to grow on the plants to maturity occasionally.

The monetary costs of carrying out these techniques on much of the world's threatened flora would be relatively small. Both techniques are needed as it is probably impossible to get seed in many cases (Corner, 1946) but material for micropropagation or tissue culture may be more easily obtained.

The benefits may never be measurable but can only be estimated from the known benefits derived from plants until now. If only material aspects of conservation are considered, genetic engineering adds yet another dimension, now enabling us to move genes from one plant to another, so that the whole plant need not be of value, but only one attribute.

Kew's seed bank is situated at Wakehurst Place in Sussex where 8,300 collections are held, representing 3,500 species from 180 families, mainly from the arid and semi–arid tropics, the Mediterranean and British Isles flora. Less than 5% are of rare or endangered species. Wakehurst employs two seed collectors who collect from threatened habitats. The collecting and storage Unit has an associated Seed Physiology Research Unit.

Unfortunately, the area from which most species are being lost is the wet tropics. The seed from species in these regions is frequently of very short viability. Research work is going on into how to preserve these recalcitrant seeds. Currently the only way of preserving these species is *in situ* or *ex situ* in tissue culture. Each species requires slightly different methods for *in vitro* culture. Kew has a Micropropagation Research Facility at Wakehurst.

The cost of this conservation effort is, relatively, tiny. £400,000 a year divided 50/50 between the Seed Collection and the Research Section (Smith, 1991).

There are very few other seed storage facilities in the world for wild plant seed, there is one at Cordova and one in Madrid.

Kew was to have had five seed collectors but this has not come about due to cost cutting. It may be that it is Kew's reputation worldwide which managed to achieve even the current small budget.

6.11 <u>Costs of Conservation Efforts</u>

To put this into a financial perspective and counting only the 22,000 plant species currently known to be endangered and supposing that every botanic garden in the world was able to care for endangered species, each garden would have to care for 14 or 15 species each.

If 10 species of orchids in Britain are preserved at a cost of £1,000,000 which is £100,000 per species or, *Pediocactus knowltonii* at \$100,000 = c£70,000 (albeit that neither piece of expenditure has, as yet, produced self–sustaining populations in the wild), then the cost of preserving and attempting to reintroduce the 22,000 endangered plants would be between £1,500,000,000 and £2,200,000,000.

Kew, to reintroduce the 20 species which they hold and know to be extinct in the wild would have to spend £2,000,000. For the 327 endangered species, £32,700,000 for the 451 vulnerable species, £45,100,000 and for the 220 species which may be in danger £22,000,000. The 50 endangered species of British plants would cost £5,000,000. These figures would have to be found in addition to the gardens current budget. In world monetary terms these are small sums and in relation to defense budgets they are insignificant, but in relation to botanic gardens' budgets they are unrealistically large.

An example of the real financial constraints in the U.K. are demonstrated by the species recovery programme which is a new initiative by English Nature. In 1991 it is concentrating its efforts on 9 species – five plants and four animals. They have a £100,000 budget for this (Farrell, 1991). This is far less than the budget for orchid recovery or the *Pediocactus* programme, however that is only for 1991.

It is a tiny expenditure when 50 British plant species are thought to be in danger of extinction, the number of endangered or vulnerable species is 144 and 317 species are considered nationally rare (Perring and Farrell, 1983). [Some of the nationally rare species were always nationally rare being of very limited distribution.]

It would appear that too little is being spent too late to have any real effect.

The cost of maintaining rare or endangered species as seed in a seed bank is much less. The Kew seed bank is comprised of c.8200 accessions representing c.3480 species. Dividing the number of species collected by the cost of the trip then each collection costs about £193. It's maintenance and storage costs £13 per year and it's distribution costs are estimated at £2.80 per year, there being a 50% chance of any species being requested per year. (Seeds are available free on request for research.) (Smith, 1991)

As only around 5% of these seeds are of rare or endangered species then attributing all the costs of collection and processing to the rare species only equals £3860 (£193 × 20) and their maintenance £260 per year (£13 × 20). [Without the 'rare' species the facility was less likely to have been funded. A large proportion of the other species banked are Leguminosae and Gramineae, amongst which are many relatives of crop plants and medicinal plants, including Castanospermum and Alexa.] The yearly cost of maintenance and storage of rare species is then £316 per species on average (£13 + £2.80 × 20).

What is thereby achieved is rare species preservation in a gene bank in, literally, suspended animation. It has not preserved the plant *in situ.* It's habitat has not been preserved. It does provide a means of buying time until the ecological and horticultural problems associated with the plant are solved. There still remains the problem of human pressure on all habitats.

These problems have been solved for some animal reintroductions. For reintroduction of mammals in America it was partially solved by offering compensation to farmers for damage done by the reintroduced predator, the red wolf. There have been no claims (Wilson, 1991).

In setting up the elephant reserves in India, villages were moved. New land for farms was given and money to replace their houses. In the long term this may be financially cost effective as foreign currency from tourism will probably pay for this many times over. Money from ecotourism has vastly exceeded the amount which was previously obtained from big game hunting in Africa.

The introduction of Przewalski's horse into parts of Mongolia may prove more problematic due to the large areas required. Various political upheavals may also affect this proposed reintroduction.

6.12 Habitat Preservation

The conservation of species can only realistically be achieved by conserving their habitat. If botanic gardens give the public the impression that they can save species in gardens or, more dangerously, give developers and politicians the impression that this can be done it would be better if they declared now that they cannot do this, even if it meant the demise of the botanic gardens.

6.13 Botanic Gardens Rôle in Education

The role of botanic gardens in conservation could be considered to be chiefly educational. They have the range of plants with which to illustrate species diversity. The importance of this diversity must be stressed as, so far, it is not known what plants are being lost and no one knows what plants may turn out to have direct value to humans in the future.

Kew alone has 1,300,000 visitors a year and worldwide the botanic gardens have 150,000,000 visits a year (Botanic Gardens Conservation Secretariat, 1989).

If education through and by botanic gardens, increases awareness and exerts political pressure to conserve habitats and species *in situ*, then they will play a valuable rôle. The evidence so far would seem to suggest that although there is a rôle for botanic gardens in conservation they have not yet fulfilled it. As Ian Beyer pointed out, botanic gardens must fulfill their role or the world will not forgive them (Beyer, 1991).

If talk about saving plants as specimens in botanic gardens diverts attention from species loss or makes the public think that having botanic gardens is an insurance policy against species loss then it is irresponsibly counter–productive.

The species we have now are the capital stock which should be handed on to future generations. In the case of species there is no equitable trade–off.

Whilst the IUCN and the WWF perceive botanic gardens as important centres of conservation, the perception that many curators and directors have of their gardens' rôle differs from that. In his survey of the staff of botanic gardens Dixon (1991) sent a questionnaire to 57 gardens in the British Isles. He received 34 completed replies (60%). Only 38% of these 34 gardens (i.e. 14) considered that any aspect of conservation was a function of their garden, 12 thought that it was a function of other gardens but 9 thought it was not a function of any garden.

Herein would appear to lie a dangerous discrepancy. The IUCN and the WWF are able to advertise their mission that botanic gardens should have a rôle in conservation, meanwhile many botanic gardens themselves, whilst not considering conservation to be one of their functions do not have a means of conveying this publicly.

In Dixon's surveys of the general local population and visitors to Oxford botanic garden, only 27% and 34% respectively thought that conservation of flora was a function of botanic gardens. This may be a reflection of what these people have observed in Oxford botanic garden or botanic gardens generally. If so, the public have formed a much more accurate picture of what is happening in botanic gardens in conservation than the literature produced by the Botanic Garden Conservation Secretariat portrays. It is of course, no function of the BGCS to list gardens where no conservation effort is being made. It remains a fact that these are the silent majority.

In the same survey, only 17 gardens thought that education of the general public was one of their own functions, 10 thought it was the function of other gardens and 4 that it was not the function of any garden. Very few of the public or the visitors to the Oxford botanic garden thought that education of the public was a function of botanic gardens. If this is a generally held attitude, and not restricted to Oxford, then even the rôle of gardens in conservation is limited.

CHAPTER 7
ECONOMIC RECREATION BENEFITS

7.1 Introduction

Recreational activities are generally chosen by the participants who expect to derive a 'benefit' from the activity. The value of this benefit to a participant, in economic terms, is partly reflected by the amount which a participant is willing to pay to enjoy the activity. Where there is a fee e.g. an entrance fee to a botanic garden, this can be said to be the price or economic value of the benefit to the participant. The entrance fee is not all of the 'price' the cost of travel and the cost of time in getting to and from the recreation site, in this case a botanic garden, are also part of the 'price'. In return the participant, or consumer of the benefit, derives enjoyment from the visit. Generally the value of the amount of enjoyment exceeds the monetary price paid by an amount calculated as the 'consumer surplus'. This is calculated by gathering data on the amount paid by a sample of at least 200 visitors to a site and plotting the amount paid per visit against the number of 'units' or visits undertaken. Generally, the greater the price, the fewer visits are made and the amount paid equates with distance travelled.

The Travel Cost Method of calculating consumer surplus generated by recreation trips was first suggested by Trice and Woods (1958) but subsequently developed and expanded by Marion Clawson (1959).

For the present research data for these calculations was collected in the questionnaire survey of visitors to four botanic gardens. For details of the survey design see the Chapter on Methodology, Chapter 3. A preliminary publication of these calculations has been made (Garrod, Pickering and Willis, 1991).

Of the four gardens surveyed only Westonbirt had an entrance charge which has been introduced in the last 20 years. The entrance fee is £1.80 per person with a reduction for children, O.A.P.'s and a season ticket is available. The entrance fee had been increased in the year the survey was carried out. Visitors were asked whether they thought that the entrance fee was too expensive, about right or too low, with the following results.

Table 7.1 Entrance Fee

	N.
Too expensive	63
About right	325
Too low	20

Thus £1.80 appears to be an appropriate charge for a site of this type.

7.2 Travel Cost

Initially it was hoped that a zonal Travel Cost Method could be used to calculate the value of a visit to the four botanic gardens to their visitors.

This method uses visitors observed behaviour in terms of distance travelled, time spent in travelling, and money spent on transport and entrance fees, if any, to calculate a value to the visitor for a trip.

The zonal travel cost method aggregates the visits to a site from zones at increasing distance from the site and uses these to calculate a per–capita visit rate for each zone. The per–capita visit rate can be plotted against distance travelled to the site.

The cost of visiting a site increases with distance as travel and time costs increase. It is assumed that, in general, the cost of visiting a site is the main determinant of visit frequency.

Plotting the quantity of trips made per year against the price per trip should produce a graph showing decreasing demand for trips with increased cost of making the trip.

The sum of the amounts over and above what the visitors have actually spent on trips to the botanic gardens is the consumer surplus. This is the value to society of trips to the botanic garden and give a measure of the value of the garden above that which the visitors have paid.

The TCM takes socio–economic data of the consumers into account in order to evaluate the value of their leisure time. Time costs were estimated at the Department of Transport (1987) standard average values of 43% of earnings. Car running costs were estimated at £0.35 per mile, which figure takes account of the cost of petrol plus fixed costs such as depreciation, road tax, insurance and service costs (Automobile Association, 1989). This approach has been adopted in previous travel–cost studies, in one of which a survey confirmed that such estimate of full car running costs are close to the costs which respondents themselves estimate for their trip (Willis and Garrod, 1991).

The zonal travel cost method has produced acceptable measures of consumer surplus for recreation trips in the USA (Clawson and Knetsch, *1966*; *Hendon, 1981)* and in the U.K. (Willis and Benson, 1989). The attempt to apply a zonal travel cost method to the data obtained in these 4 surveys failed. This was due mainly to the very low per capita visit rate for each of the zones around the three urban sites.

The method might have proved successful if visitors had been asked for the distance from home to garden in smaller units e.g. ¼ of a mile. As the gardens were at least ¼ of a mile across at their longest axis this may have been counter productive. The accuracy of population estimates in ¼ mile zones would also be questionable.

Against normal expectations of recreational behaviour, some of the very frequent visitors to Edinburgh came from quite large distances, thus visit rate did not fall with increasing cost.

At Westonbirt where visitors travelled from greater distances another difficulty became apparent. Whereas local visitors might visit in groups of one or two those who came from greater distances made the trip a family outing, this greatly reduced the cost per person by reducing the per–capita cost of car travel.

As the more usual method of measuring recreational benefits failed to produce meaningful results, the data was examined by Dr K.G. Willis and Mr G.D. Garrod of the ESRC Countryside Change Initiative and an Individual Travel–Cost Method was used.

7.3 Individual Travel Cost Method

In their Individual Travel Cost Method Willis and Garrod used the Truncated Maximum Likelihood Method (Maddala, 1983) to avoid the problem of over estimate of consumer surplus due to the data having been gathered only from visitors to botanic gardens, non–visitors not being observed.

The individual travel cost method (ITCM) states that the number of visits made by an individual to a site is a function of a variety of factors including: the cost of travel to gain access to the site, plus any entrance fee; the socio–economic characteristics of the individual; the attributes of the site in terms of the range of attributes or activities available at the site and the quality of those activities; and the price of access to substitute sites.

Categorical variables for visit frequency and visit length variables at Edinburgh and Cambridge and categorical variables for income were converted to approximate integer variables using a random number based simulation. From the Individual Travel Cost Method a Marshallian Consumer Surplus is estimated.

7.4 Individual Travel–Cost Method Results

The TML method was used to fit ITCM models to the data from each site. Because the purpose of this study was to estimate the recreational benefits for visitors to each site, the prime consideration in the choice of each model was its ability to generate a defendable estimate of consumer surplus. For each model four functional forms were investigated; the double log; the semi–log (dependent); the semi–log (independent); and the linear Previous ITCM studies of recreation sites (e.g. Willis and Garrod 1990; Willis and Garrod 1991) have also investigated these functional forms, finding, in each case that only the linear specification generated consumer surplus estimates which were in any way acceptable. This study confirmed those findings. Whilst this form has certain problems, particularly when it comes to the aggregation of results, it generally gives reasonable single visit consumer surplus estimates. [The double–log form generated infinite consumer surplus, while the semi–log (dependent) gave single visit consumer surplus estimates in excess of those which might be considered reasonable e.g. Edinburgh £37.91 and Cambridge £15.35. The semi–log (independent) form which has previously been rejected on the grounds that it often suffers from heteroskedastistic disturbances was estimated for this case. The results based on TML implied that the CS at all sites is negligible (though the biased OLS estimates, shown for comparison in Table 7.2 did look more reasonable).

Rejecting the possibility of negligible consumer surplus, as suggested by the semi–log (independent) model, being generated by visitors to each site left the linear form. The ITCM linear model estimates for each botanic garden are shown in Table 7.3 with estimates based on OLS again included for comparison.

Only the travel cost coefficient for Sheffield was not statistically significant at any meaningful level. The Cambridge travel cost coefficient was significant at the 1% significance level, while the coefficients for Edinburgh and Westonbirt were both significant at the 16% significance level.

Table 7.2 Individual Travel–Cost Method Estimates Derived from the Semi–Log (Independent) Model

Garden	OLS Travel Cost Coefficient	OLS Consumer Surplus £	Truncated Maximum Likelihood Travel Cost Coefficient	Truncated Maximum Likelihood Consumer Surplus £
Edinburgh	–2.6871 (–1.71)	1.03	–10.4527 (– 3.25)	0.00
Sheffield	–5.7594 (–1.58)	11.39	–37.8718 (– 1.59)	0.00
Cambridge	–6.0765 (–4.98)	2.10	–19.6013 (– 6.06)	0.02
Westonbirt	–7.7321 (–2.51)	1.79	– 9.8718 (– 2.26)	0.00

Table 7.3 Individual Travel Cost Method Estimates Derived from the Linear Model

Garden	OLS Travel Cost Coefficient	OLS Consumer Surplus £	Truncated Maximum Likelihood Travel Cost Coefficient	Truncated Maximum Likelihood Consumer Surplus £
Edinburgh	–0.1576 (–1.07)	3.17	–0.5501 (–1.40)	0.91
Sheffield	–0.1017 (–0.40)	4.92	–0.2232 (–0.11)	2.24
Cambridge	–0.3574 (–2.92)	1.40	–1.4456 (–3.03)	0.35
Westonbirt	–0.3045 (–1.48)	1.64	–1.9470 (–1.59)	0.26

These estimates of consumer surplus were interpreted as the welfare benefit gained from each visitors first visit of the year to a specific garden and did not take into account the benefits derived from any subsequent visits. The results of a simple robustness analysis for the ITCM estimates at each site are detailed in Appendix 1.

The consumer surplus in the preceding Table 7.3 were derived from all individuals in the survey. No differentiation was made between first time visitors who are mostly visiting the garden on someone else's recommendation but do not know what to expect and visitors who had visited previously.

As the ITCM relies on the hypothesis that travel cost to and from the site can be used as an estimate of an individual's willingness to pay (WTP) to visit the site it seemed reasonable to estimate a consumer surplus derived from visits by consumers who had visited the garden before.

In this way expectations based on second hand or no experience which might bias the result could be removed.

Separate ITCM models, with all first time visitors excluded from the analysis, were evaluated for each site. The results are shown in Table 7.4. While the consumer surplus estimates for Cambridge and Westonbirt were subject to only small changes, there was a large reduction in value at Edinburgh and an even larger reduction at Sheffield.

Whether the reductions in value at Edinburgh and Sheffield were the result of the removal of an upward bias caused by first–time visitors over estimating their willingness to pay to visit an unfamiliar garden, or whether they were simply due to a reduction in observations of long distance/high travel cost visitors who might only ever visit occasionally required re–examination of the data.

Table 7.4 Individual Travel Cost Method Estimates Derived from Linear Model with First–Time Visitors Excluded

Garden	Travel Cost Coefficient	Consumer Surplus £
Edinburgh	–0.9220 (–1.04)	0.54
Sheffield	–0.55127 (–0.34)	0.91
Cambridge	–1.8892 (–2.42)	0.26
Westonbirt	–1.2712 (–2.83)	0.39

At the three urban gardens the majority of first–time visitors lived within 5 miles, the greatest proportion being 78.79% at Edinburgh with smaller proportions living over 50 miles away (7.58% at Edinburgh, 16.67% at Cambridge and 6.25% at Sheffield). The reverse was true at Westonbirt where only 13.19% of first time visitors lived within 5 miles and 17.36% lived over 50 miles away. This may well be due to Westonbirt's location with relatively few people living within five miles but having several major centres of population at 50 miles distance.

Table 7.5 Comparison of Consumer Surplus from ITCM Derived from Linear Model Including and Excluding First–Time Visitors

Garden	Consumer Surplus Including First Time Visitors £	Consumer Surplus Excluding First Time Visitors £
Edinburgh	0.91	0.54
Sheffield	2.24	0.91
Cambridge	0.35	0.26
Westonbirt	0.26	0.39

The data demonstrated that the majority of observations removed related to local visitors with relatively low travel costs. However, the exclusion of a large number of single visits at low cost may have enabled the linear model to achieve a better fit of the data than would otherwise have been possible and may have provided more accurate estimate of consumer surplus.

More research is needed before any firm conclusions can be drawn as to the validity of this claim.

7.5 Aggregation of Consumer Surplus Estimates Derived from the ITCM

It has often been argued that the actual functional relationship between individual visits and travel cost is non–linear. If this were so, and a convex functional form provided a better fit of the data than the linear, then Willis and Garrod (1991) have shown that the single visit estimates shown in Table 7.5 i.e.

Edinburgh	£0.91
Sheffield	£2.24
Cambridge	£0.35
Westonbirt	£0.26

are lower–bound estimates of consumer surplus per visitor per year. Using this result and given the assumption that the underlying functional form was indeed convex, the single visit consumer surplus estimates generated in this study can be used to calculate aggregate lower–bound figures for the yearly consumer surplus generated by the visitors to each garden.

Total yearly visits to the gardens were approximately

750,000 at Edinburgh
45,000 at Cambridge
50,000 at Sheffield
and 185,000 at Westonbirt.

Dividing these by the mean number of visits per individual as observed in the sample survey gave an estimate of the total yearly number of visitors to each garden.

7.6 Aggregate Lower Bound Yearly Consumer Surplus

Multiplying these figures by the estimated consumer surplus for a single visit gave lower–bound aggregate consumer surplus estimates as shown in Table 7.6 below.

Table 7.6 Aggregate Lower–Bound Yearly Consumer Surplus Estimates

Garden	Visits Per Year	Mean Visits Per Head	Visitors Per Year	Consumer Surplus Per Single Visit (£)	Total Consumer Surplus (£)
Edinburgh	750,000	20.27	36,993	0.91	33,664
Sheffield	50,000	29.27	1,708	2.24	3,826
Cambridge	45,000	15.41	2,920	0.35	1,022
Westonbirt	185,400	14.90	12,446	0.26	3,236

These figures were based on the benefits derived by each visitor from their first visit of the year, and represent the very lowest possible estimates of the recreational benefits which were derived from each garden.

7.7 Upper Estimates of Aggregate Total Recreational Benefits

Most visitors make more than one visit in a year so a clearer idea of the magnitude of the overall recreational benefits would be gained if an upper estimate was derived. The assumption of a convex functional form, as well as conventional economic theory, suggested that each marginal visit, after the first, was likely to provide a benefit less than or equal to that derived from the first visit. Thus, estimating the aggregate benefit of each marginal visit as equivalent to that of the first visit, gave a reasonable idea of the magnitude of the upper estimates of the total recreational benefit; however, the actual upper estimates may be higher because an underlying convex functional form implies an under–estimate of benefit for respondents making only a single yearly visit to a garden (Willis and Garrod 1991). These upper estimates of aggregate total recreational benefits were:

Edinburgh	£682,500
Sheffield	£112,000
Cambridge	£ 15,780
Westonbirt	£ 48,204

7.8 Comparison of the Aggregate Welfare Benefits Derived from the ITCM with the Grant in Aid Received by the Gardens:–

Table 7.7

Garden	Grant in Aid	Aggregate Lower Bound CS Estimate	Possible Aggregate Upper Estimate CS Estimate
Edinburgh	£4,107,500	£33,664	£682,000
Cambridge	£267,600	£1,022	£15,780
Sheffield	£130,000	£3,826	£112,000
Westonbirt	£161,000	£3,236	£48,204

It is probable that the consumer surplus lies between the lower bound estimate and the possible aggregate upper bound estimate. From Table 7.7 it will be seen that the consumer surplus then falls far short of the grant in aid received by the gardens except in the case of the possible aggregate upper estimate as Sheffield, however the travel cost coefficient at Sheffield was not statistically significant at any level.

7.9 Contingent Valuation/Willingness to Pay an Entrance Fee

In order to test respondents perceived value of their visit in monetary terms visitors were asked whether they would be prepared to pay an entrance fee, whilst assuring them that there was no intention of introducing such a charge. If visitors indicated that they would be willing to pay an entrance fee they were then asked how much they though would be a realistic charge. The questions were asked to assess visitors appreciation of the garden. Similar questions are used as part of the Contingent Valuation Technique (CVT) which is often used in recreation demand surveys to elicit consumers WTP to use or gain access to a site.

The CVT suffers from biases (Walsh, 1986). It is based on respondents' stated intentions and not observed behaviour. If offers the opportunity for strategic answering by respondents if they feel that their answers might affect public decisions. They may respond in ways to maximise the likelihood of a preferred policy. Individuals may overstate true willingness to pay in order to gain a desired change or understate values in order to prevent a change they oppose.

A dilemma clearly exists in how to strategically answer a CVM for botanic gardens. If too low a value is chosen will the garden be closed and thus unavailable, if too high a value will that charge be levied?

The hypothetical market should be clearly defined as to time period and method of payment. The questions should be structured in such a way as not to threaten the respondents with a reduction in welfare benefit.

Notwithstanding the fact that the questions asked in this survey are far from ideal or complete for carrying out a CVM, the answers provide some interesting comparisons: (Table 7.8).

Table 7.8 Willingness to Pay to Gain Access to a Garden

Garden	Willingness to Pay an Entry Fee %	Realistic Entry Fee (Mean £)	ITCM Estimates	Standard Deviation
Edinburgh	93.0	0.760	0.91	0.693
Sheffield	72.6	0.499	2.24	0.313
Cambridge	87.8	0.677	0.35	0.536
Westonbirt†	100.0	1.800	0.26	–

†(Westonbirt charges an entrance fee of £1.80. The charge is lower for children, senior citizens and season ticket holders.)

Whilst the estimate of entry fee were considerably lower than the £1.80 charge already levied at Westonbirt they were, in the cases of Edinburgh and Cambridge, not dissimilar to the ITCM estimates.

7.10 Aggregate Recreational Benefits

An estimate of aggregate recreational benefits was obtained from examining the aggregate estimates of WTP derived by multiplying the hypothetical per visit entry fees shown in the preceding table by the total estimated yearly number of visits to each site.

The possibility of biases means that these aggregate estimates cannot usefully be compared with the aggregate estimates of benefit derived from the ITCM.

Table 7.9 Aggregate Yearly Willingness to Pay Based on Contingent Valuation Question

Garden	Visits Per Year	Entry Charge Per Visit (£)	Total WTP (£)
Edinburgh	750,000	0.760	569,833
Sheffield	50,000	0.499	24,941
Cambridge	45,000	0.677	30,479

7.11 Comparison of both Estimates With Grant–in–Aid

Comparing both sets of estimates (Tables 7.7 and 7.9) with the total grant–in–aid for the four gardens shows that neither the ITCM nor the CVT estimates of net welfare benefits from recreation exceeded the grants which make up the differences between operating costs and revenues at these sites. None of the benefit measures could be shown to offset more than a small proportion of the total grant–in–aid made to each garden (except Sheffield). For example, it would be necessary for a welfare benefit of over £5 per visit to be generated at Edinburgh to completely offset all costs.

If, however, the 47% or £1.9m of the grant in aid attributable to the amenity part of the garden only were taken into account then, on present visitor levels it would only be necessary to generate a welfare benefit of £2.60 per visit to equal this expenditure.

If the possible upper CS estimate is correct then just over four times as many visitors would need to be attracted, i.e. over 3,000,000 per year. If the lower bound is correct then 57 times as many visitors are required, or 42,750,000 visits. This would be equal to 25% of all leisure day trips, lasting over three hours, made in great Britain in 1988/89 (OPCS 1991).

If the CVM is correct this too would require about four times as many visits. It is possible that this could be achieved with garden visiting increasing in popularity in the U.K. There was a 52% increase in the number of visitors to gardens between 1976 and 1989 (Coopers and Lybrand Deloitte, 1991). A much increased advertising and marketing effort should increase the number of visitors to the RBG much more rapidly than that.

Introduction of an entrance fee, if that were possible, could initially reduce the number of visitors, as happened at the British Museum and the Natural History Museum (Table 7.10).

Table 7.10

	Million Visitors			
	1981	1986	1988	1989
Science Museum*	3.8	3.0	2.4	1.1
Natural History Museum†	3.7	2.7	1.4	1.5

*Admission charges introduced in 1989.

†Admission charges introduced in April 1987.
Source: British Tourist Authority in Social Trends 21.

At Kew the attendance figures remained steady at 1.1 million per year from 1984–1986 when an entrance fee was first introduced (CSO, 1988) then started to rise again, in spite of a large increase in entrance fee.

In Edinburgh a large percentage of visitors to the garden are local and repeat visits by these people account for most of the welfare benefit. If a charge were introduced the number of these visitors might be greatly reduced and not made up for so quickly as at attractions in London.

At Cambridge the lowest increase in visitor number necessary would appear to be 8 times the current number. The £5,400 received from the City Council however is recovered 3 fold under the possible aggregate upper CS estimate and 4 fold if the CVM of willingness to pay is correct. Thus the City's contribution is amply justified.

At Sheffield where the running costs are £130,000 p.a. the possible aggregate upper CS estimate of £112,000 is not far short of the costs. The lower bound estimate however falls far short of this. It should also be noted that the figures for Sheffield were not found to be statistically significant at any level.

The total WTP estimate of welfare benefit also falls far short of the running costs. As with Cambridge the visitor number here is relatively small. At Sheffield and Cambridge a survey designed to calculate the true consumer surplus derived from a specially designed CVM taking into account any peculiarities of the site revealed by this survey would be an interesting further line of research.

Westonbirt would require 3.5 times as many visitors if the upper estimate were to equal the grant in aid. The arboretum is large enough for this but its situation makes such an increase unlikely as the local population is not large enough to generate the high number of repeat visits which greatly contribute to the total visit numbers.

It should also be reiterated here that these estimates are only the recreational or use values of the gardens. As such they form only part of the total economic value for each garden. Non–use values to the public are not included. The option value, individuals valuation of their option to use the gardens some time in the future. The existence value, individuals valuation of the knowledge that the gardens continue to exist, and the bequest value individuals valuation of the knowledge that the garden remains as an asset for future generations, could be a substantial part of the economic value of the garden.

APPENDIX 1

Details of the results of a simple robustness analysis for the ITCM estimates at each site. In this analysis the coefficients of the travel–cost variables were compared when all other significant variables in the model were left out in turn. This process gave some idea of the magnitude of the errors which might occur if any important explanatory variables had been omitted from the model. It can be seen that as well as being highly sensitive to the specification of functional form the travel–cost coefficient was also quite sensitive to variable selection. This result may raise some doubts about the usefulness of the consumer–surplus estimates which have been generated by this study.

Simple Robustness Analysis

Sheffield:

Variable			
Constant	–269.77 (–3.80)	–258.60 (–4.84)	–863.88 (–8.18)
TC_{ij}	–0.2232 (–0.11)	–0.9558 (–0.03)	–0.0665 (–0.03)
N_{ij}	–42.042 (–2.52)	–20.792 (–2.31)	–
LEN_{ij}	33.965 (1.68)	–	36.525 (0.85)

Westonbirt:

Variable		
Constant	–81.490 (–2.07)	–352.20 (–6.18)
TC_{ij}	–1.9470 (–1.59)	–1.2949 (–0.92)
LEN_{ij}	–32.554 (–4.93)	–

Edinburgh:

Variable						
Constant	-49.485 (–2.92)	44.854 (3.34)	-80.539 (–4.01)	-53.072 (–3.22)	-147.10 (–6.02)	-97.446 (–5.06)
TC_{ij}	-0.5501 (–1.40)	-0.9856 (–1.37)	-0.3645 (–0.89)	-0.5150 (–1.37)	-0.0339 (–0.08)	-0.3743 (–1.24)
LEN_{ij}	-7.1690 (–2.04)	-25.251 (–4.35)	-3.6191 (–0.97)	-6.1290 (–1.84)	-3.9441 (–0.95)	–
N_{ij}	-19.085 (–7.17)	-21.405 (–3.35)	-14.306 (–3.78)	-19.310 (–8.92)	–	-17.252 (–7.78)
$HORT_i$	19.869 (1.47)	57.287 (2.60)	23.001 (1.72)	–	31.359 (1.91)	15.822 (1.16)
$PSOC_i$	12.957 (1.30)	-1.0678 (–0.06)	–	14.061 (1.51)	8.3889 (0.64)	12.139 (1.13)
PR_{ij}	107.65 (7.73)	–	126.93 (8.22)	113.26 (8.24)	161.76 (8.21)	132.78 (8.34)

Cambridge:

Variable					
Constant	-37.718 (–1.96)	10.040 (0.75)	-43.841 (–2.19)	-143.90 (–4.67)	-54.908 (–2.82)
TC_{ij}	-1.4456 (–3.03)	-1.5954 (–4.50)	-1.5254 (–3.10)	-0.7960 (–1.55)	-1.5408 (–3.12)
LEN_{ij}	-6.7806 (–1.48)	-11.400 (–1.97)	-5.5946 (–1.22)	-5.9662 (–0.99)	–
N_{ij}	-15.225 (–3.59)	-20.457 (–3.95)	-15.177 (–3.54)	–	-15.192 (–2.91)
$ENJOY_{ij}$	0.2862 (2.36)	0.5557 (3.54)	–	0.3856 (2.32)	0.2590 (2.11)
PR_{ij}	67.421 (4.64)	–	76.897 (5.14)	121.99 (5.38)	72.981 (4.77)

(t–statistics in brackets)

Notes

1. The people over 60 appear to favour more solitary leisure pursuits has been reported in:–

   'Evaluating Urban Parks and Recreation', 1981, by William S. Hendon, Praeger, New York

   citing

   'Leisure Activities Among the Middle Aged', Havinghurst, Robert J., American Journal of Sociology LXII, Sept 1957, pp152–162.

CHAPTER 8

SOCIAL RECREATION BENEFITS

8.0 Introduction

This chapter examines, in 8.1 trends in garden and countryside visiting as outdoor leisure pursuits. 8.2 briefly describes the sample of gardens, at which visitor surveys were carried out. In 8.3 the accessibility and size of the gardens is examined together with ways in which this affects the type of visitors. 8.4 describes the facilities provided by the gardens in terms of garden features, wildlife, ease of parking and compares these with the attractiveness of alternative visits. The Marketing Strategy of the gardens is examined in 8.5. The visitors who choose to use the gardens are examined in 8.6 in terms of their age, sex socio–economic status and the size and type of group in which they visit the garden. Comparisons are made between garden visitors and visitors to other outdoor attractions. 8.7 examines what the visitors get from the garden in terms of informal, incidental education and amenity. In 8.8 the importance of the various garden features to the visitors are assessed both the tangible attractions deliberately made and maintained and the intangible attractions which arise as a result of what has been provided. 8.9 describes the social aspects to botanic gardens both formal and informal. Finally, in 8.10, the comparative attractiveness of the garden is discussed and visitors preferences in choice of other outdoor leisure pursuits is examined.

8.1 Trends in Leisure Visits

Surveys of botanic garden visitors have been carried out by Neilson (1983), Dixon (1991), Royal Botanic Garden Edinburgh (1988), Kew (1987) and Westonbirt.

The surveys at the Royal Botanic Garden Edinburgh, Kew and Westonbirt were carried out to discover the visitors preferences for various parts of the garden. Neilson's survey explored the potential of botanic gardens for recreation as a special form of urban park. Dixon examined the extent and potential for environmental education in botanic gardens. Results from these surveys have been compared with results obtained in the current survey where appropriate.

Of the 48 botanic gardens in Britain, 37 are regularly open to the public. Altogether the 48 comprise an area of 1094.1 ha of which 1050 ha are available to the public. The area of urban parks and open spaces, maintained by District Councils is 132,000 ha (source:– Municipal Yearbook 1990). Botanic gardens therefore cover an area equal to 0.8% of that of urban parks and thus represent a greater area for outdoor recreation than is often realized.

The Royal Botanic Garden, Kew ranks 9th in Great Britain amongst the most popular tourist attractions charging an admission, with 1.2 million visitors in 1989. Garden visiting generally is a popular leisure activity in Great Britain. Stapeley Water Gardens in Cheshire ranks 8th in the list of attendances at the most popular tourist attractions with free admission, with 1.3 million visitors in 1989, an increase of 0.3 million on 1988 figures (Source:– British Tourist Authority in Social Trends 21, 1991).

In 1983 Gallagher estimated that there were about 2,000 historic gardens open to the public of which 50% were private gardens, 30% were National Trust properties, whilst 7% were owned by public authorities. At all of these an admission fee was payable. 75% of the gardens open to the public are associated with country houses.

The British Tourist Authority lists 153 gardens which had a minimum of 5,000 visits in 1990 in the U.K. The total number of visits to these gardens was 8,714,232. In 1989 the number of visits was 8,139,454, an increase of 2% from 1989 to 1990. Many of the gardens which do not have an entrance fee are not included as the visits were not counted e.g. Sheffield City Botanic Garden. 33 of the gardens listed charged no admission (British Tourist Authority/National Tourist Board, 1991).

The number of gardens open on one or more Sundays in summer under the National Gardens Scheme is 2,500. This scheme, started in 1927 to raise money for medical charities, raises over £1 million annually. In addition the Red Cross hold garden opening days in some areas. These gardens are in addition to those regularly open to the public.

An estimate of visitor numbers to these historic gardens and gardens associated with historic houses gardens based on data gathered by Janette Gallagher and the English Tourist Board 'Sightseeing in 1981' gave an annual figure of 22.5 million visits.

A survey of leisure day visits carried out for the Department of Employment and the English Tourist Board, defined such visits as those lasting 3 hours or more and with a round trip distance of 20 miles or more. One per cent of these visits, 6 million, were to a historic or stately home. Many of these have gardens associated with them (Gallagher, 1983). Two per cent of visits, or 14 million, are to a park, garden or common (Dodds, 1989). However, this definition of leisure day visit would exclude 82% of the Royal Botanic Garden, Edinburgh's 900,000 visits per year, 68% of visits to Cambridge Botanic Garden, 22% of Westonbirt's and 88.5% of Sheffield's.

If this pattern represented all parks and gardens then 65% of all parks and garden visiting would not come into the category of 'leisure day visits'. Thus the 14 million visits in the DOE/ETB 1989 survey may equal only 35% of park and garden visiting.

The total visit number can therefore be estimated as 40 million. This number is likely to be far too small in view of the fact that Hazelhead Park in Aberdeen, alone, had 4 million visits in 1974 (Welch, 1975).

The probable under estimate is also due to botanic gardens drawing visitors from greater distances than parks, thus putting more of their visits into the leisure day visit category, as this current work demonstrates.

The General Household Survey No 16 (OPCS, 1986) shows a marked decline in visits to the countryside between 1977 and 1986. The trends in the relevant activities are listed below.

Table 8.1

	1977	1980	1983	1986
	Average Number of Occasions of Participation Per Adult Per Year			
Open Air Outings				
Visits to Parks	1.7	1.8	1.6	1.6
Visits to Countryside	2.3	2.0	1.2	1.1
Sightseeing				
Historic buildings/ sites/towns	2.9	3.8	3.0	3.7

Source: GHS 16, 1986, Chap. 13, Leisure.

The Countryside Commission carried out a comprehensive National Survey of Countryside Recreation in England and Wales in 1984. This was followed by comparable surveys each year until 1988 (Countryside Commission, 1988).

Countryside visits in 1985 – 1988 showed a marked decline compared with 1984, thus continuing the trend shown in the GHS figures in Table 8.1. Benson and Willis (1990) suggest that this latter decline is most likely a reflection of the influence of the weather rather than major changes in socio–economic factors.

The trend does not hold true for visits to historic buildings or sites, nor for visits to botanic gardens, where numbers of visitors increase steadily each year regardless of the weather. Two examples of this trend are shown below:–

Table 8.2 Westonbirt Visitor Numbers 1982–1989

1982/83	156,275
1983/84	156,992
1984/85	186,237
1985/86	180,493
1986/87	185,176
1987/88	156,765
1988/89	185,351

Source: Angus, H. pers. comm. 1989

Table 8.3 Edinburgh Botanic Garden Visitor Numbers 1985–1990

1985/86	746,016
1987/88	
1988/89	>750,000
1989/90	914,748

Source: Annual Accounts, Royal Botanic Garden Edinburgh

It is in this context of increasing popularity with the general public and an increasing national awareness of environmental issues that the current investigation was carried out.

This chapter will examine the results obtained from the surveys carried out at four botanic gardens. In particular, the study will examine:–

(a) Differences at the four sites will be compared in relation to what they provide for the visitor.

(b) The characteristics of the current visitors to botanic gardens will be investigated to explore to whom the gardens are currently of value.

(c) What the gardens provide for their visitors will be reviewed to explore what the attraction of the gardens is currently.

(d) What the value of the visit to the gardens is to their visitors in terms of social welfare benefit will be discussed and this will be compared with total running costs of the garden.

8.2 The Sample of Gardens

Of the four gardens at which the main visitor surveys were carried out, two (Edinburgh and Cambridge) came within the same group in the cluster analysis but were both funded through different channels. As such the results with regard to visitor profile and preferences should have been similar at these two places.

The other two, Sheffield and Westonbirt, were each from individual groups in the cluster analysis and different from the group containing Edinburgh and Cambridge. Thus they provide widely differing parts of the spectrum of botanic gardens in terms of visitor profiles and preferences.

This sample covers the range of different types of botanic gardens in Britain. The sites are compared in Table 8.2.1.

Table 8.2.1 Major Differences and Similarities of the Four Sites

	Edinburgh	Cambridge	Sheffield	Westonbirt
Size	25 ha	16 ha	7.5 ha	200 ha
Situation	Urban	Urban	Urban	Rural
Tourist City	Yes	Yes	No	No
Entrance Fee	No	No	No	Yes
Visitor Centre	Yes	Yes – Part time	Not at present	Yes
Cafe	Yes	No	No	Yes
Guide Book	Yes	No	No	Yes
Map Available	Yes	Yes – Sometimes	No	Yes
Stated Aims	Research Education	Research Education		
	Public Education	Public Education	Public Education	Public Education
	Public Amenity	Public Amenity	Public Amenity	Public Amenity
Funding Body	Government	University	Local Authority	Government (F.C.)
Visitor Number p.a.	750,000	45,000	50,000	184,000

8.2.1 Source of the Gardens Funding and How This Affects What is Provided For the Visitor.

The funding source for the garden determines to some extent what is provided and the emphasis attached to various items.

8.2.1.1 Edinburgh

Funded by the government for research and education. Plant groups into which taxonomic research is being carried out, e.g. *Ericaceae* and other plants from the Sino–Himalayas are well represented in the garden plantings. The horticultural diploma course has c.36–45 students who work in the gardens 4 days per week. Thus a sufficiently wide variety of horticultural activities are needed to support the course.

3.2.1.2 Cambridge

Funded by the University for research and education. Plant groups such as Geraniums and Alchemillas are well represented. The native British flora, in particular the endangered species, are displayed. The garden is on its present large site because of the interest in trees of Professor J. Henslow, a former Professor of Botany. His collection remains today.

8.2.1.3 Westonbirt

Funded by the Forestry Commission for public education and public amenity. The main aims of the Government's Forestry policy for Great Britain are:

> "The sustainable management of our existing woods and forests. A steady expansion of tree cover to increase the many, diverse benefits that forests provide."

This policy includes delivering public benefits and states:

> "We are determined that the public benefits that forestry can offer will be realised in good measure". (Forestry Commission, 1991)

That the Forestry Commission funds Westonbirt as an area of public recreation is evident from the proportion of its space and time devoted to catering for visitors. The Forestry Commission's commitment is mainly in providing information for the visitors via a Visitor Centre, audio visual presentations, guidebooks and the employment of an Education Officer.

8.2.1.4 Sheffield

Funded by the Local Authority as an amenity solely for the local tax payers, it cares for the plantings collected by the original botanical society and caters for the horticultural interests of the public very directly and not incidentally. It has a programme of shows, exhibitions, talks and demonstrations for the public throughout the year. It has an Educational Officer who arranges these. It does not carry out research so its plantings are not a reflection of this. It has a small part of the garden devoted to a Friends of the Earth garden. Sheffield much more resembles some of the American botanic gardens in acknowledging and catering for the public's horticultural interests.

8.2.1.5 Discussion

Visitor Centres were started at:

Westonbirt	c.1978
Edinburgh Exhibition Hall	1970
Cambridge	1989
Sheffield	1972
	closed 1987

The four gardens are all 'attractively' laid out and landscaped. For teaching and research there is no intrinsic requirement for this type of arrangement.

It is a matter of debate whether this 'attractive' landscaped layout is any more expensive to maintain than having plants laid out in rows in regular beds, which is a possible arrangement if the aims of a garden are teaching and research only.

The public visitor would probably not, however, see this as a particularly pleasing place to visit. There might therefore be a future financial loss and there would be a net social loss if gardens were laid out on purely didactic lines as is sometimes advocated.

8.3 Nature of the Garden

8.3.1 Location

Whilst the funding of the gardens may be incidental to their location, other costs are not.

8.3.2 Costs Associated with Location

As seen in Chapter 4 on Costs, the opportunity cost of the ground which they occupy is related to location. The opportunity cost has changed since the gardens were founded as cities have expanded and some have prospered more than others.

As botanic gardens do not come under the heading of green space which must be provided under the Town and Country Planning Acts the pressures to justify the occupation of the space by a garden and not for housing or commercial development are increased.

The location of the 48 botanic gardens in Britain can be seen on the map, Figure 4.1. Those open to the public are shown in Figure 8.3.0

8.3.3 Accessibility

The accessibility of the gardens to visitors also varies with location; whilst Edinburgh, Cambridge and Sheffield are close to city centres, Westonbirt is in the country and not on a regular public bus route.

8.3.4 Size

The size of the garden is relevant both to its cost in its location and also to its value as a garden in its situation. Edinburgh at 25 ha, Cambridge at 16 ha and Sheffield at 7.5 ha provide substantial areas of green space available to the public in densely populated cities.

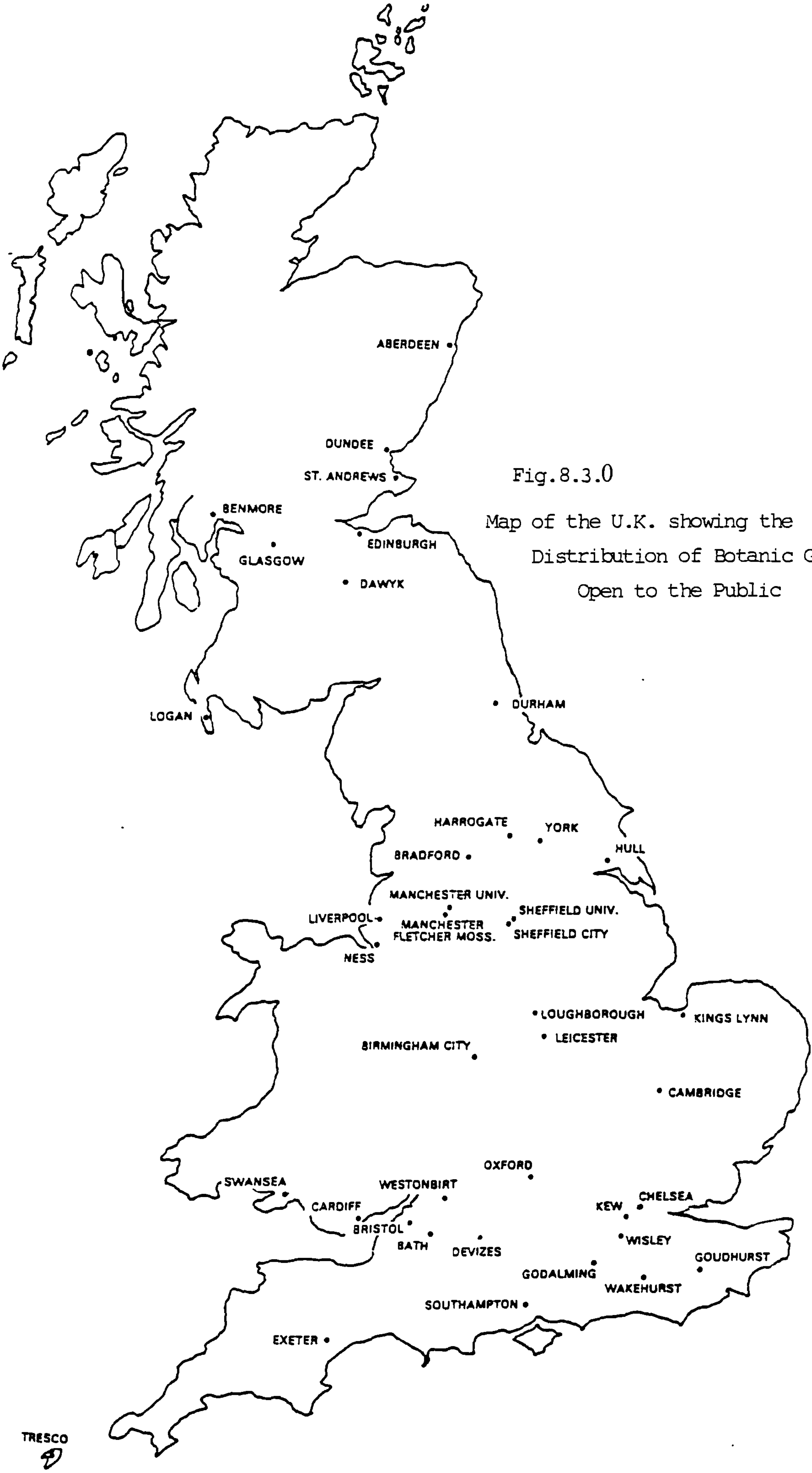


Fig.8.3.0

Map of the U.K. showing the Distribution of Botanic Gardens Open to the Public

8.3.5 Maturity

The maturity and layout of the gardens is important in separating the garden visitor from the city. These three gardens have trees and shrubs sufficiently well grown to ensure that views of cityscapes are blocked or reduced.

8.3.6 Green Space Provision in the Locations

The fewer options available in the choice and accessibility of green space in cities, the more important becomes that which exists. This is illustrated by Chelsea Physic Garden which had to restrict access to its 2 ha garden due to excessive wear and tear by visitor pressure.

Table 8.3.1 shows the relative sizes of the gardens and the population of the cities in which they are situated along with the area of municipal recreation grounds.

Table 8.3.1

Garden	Recreation Ground Area	Botanic Garden Area	Population of City	Recreation Ground Per Head of Population Ha	Visitor No.
Edinburgh	760 ha[2]	25 ha	419,187	.0018	750,000
Cambridge	128 ha[1]	16 ha	91,070	.0014	45,000
Westonbirt	NA	200 ha	4,498	N/A	184,000
Sheffield	4399 ha[1]	7.5 ha	477,257	.0092	50,000

[1]Source Municipal Yearbook 1990–91.
[2]Park I, 1991 pers. comm.

Table 8.3.1 does not tell the whole story of green space provision. Edinburgh's 760 ha does not include the areas administered for Lothian Regional Council, such as Holyrood, nor the many golf courses (Park, 1991).

An examination of the O.S. 1:25,000 scale maps also shows that Cambridge visitors have substantial areas of green space available to them which belong to the University.

Although Sheffield has the greatest area of municipal recreation grounds it also has the most densely built–up area around the garden.

The results from the survey demonstrate some of these locational differences.

Statistical Tests

The answers to the questions which were asked at all four gardens showed differences which were found to be statistically significant at the 99.9% level when subjected to the Chi–squared test.

Comparisons between answers obtained at each site

8.3.7 Previous use of the garden by the visitors

Whether the respondent had visited the garden previously or not was asked to ascertain whether the garden was attracting new visitors.

Table 8.3.2 Previous Visit

Garden	No	%	Yes	%
Edinburgh	66	32.7%	136	67.3%
Cambridge	60	30.0%	140	70.0%
Westonbirt	144	35.4%	263	64.6%
Sheffield	32	10.4%	277	89.6%
			P = <0.001	

Edinburgh, Cambridge and Westonbirt are attracting over 30% of new visitors. These presumably form a substantial part of the reported increase in visitors to gardens each year and shows that this increasing visitor level is not just due to the same visitors going more often. The lowest percentage of new visitors are recruited at Sheffield.

8.3.8 Size of Space Provided Compared with Distance Travelled to Use it

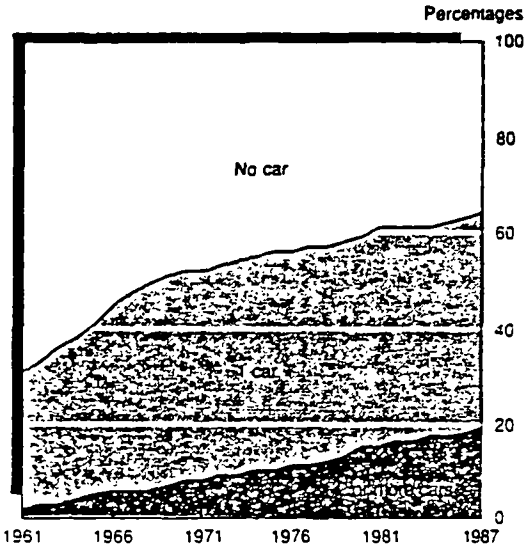
The Greater London Council, GLC, (1968) survey on the demand for open space concluded that there was a distinction between the requirement for green space within $\frac{3}{4}$ of a mile of home and for that over 2–5 miles from home, thus generally not within walking distance.

1. It suggests that parks of 2–9 acres are all equally effective at satisfying demand from a $\frac{1}{4}$ of a mile radius zone and that local parks should be 5 acres in size.
2. There was a second form of demand for spaces of 50 acres or more to provide sufficient attraction for people to travel $\frac{3}{4}$ – 1 mile on foot.
3. The report further suggests that in order to satisfy particular demands parks had to be 150 acres in size to draw visitors from a distance of greater than 2–5 miles.

Although car ownership (Figure 8.3.1), disposable income (Figure 8.3.2) and leisure time (Figures 8.3.3, 8.3.4, 8.3.5) have increased since 1968, (Social Trends 20, 1989) enabling people to travel further, more easily than they could in 1968, botanic gardens appear to be an attraction to people which encourages them to visit from greater distances, than might be supposed from the size of garden. Visitors travel greater distances to visit the gardens in this survey than was found to be the case with parks in the GLC survey.

Fig.8.3.1 Households with and without regular use of a car[1]

Great Britain



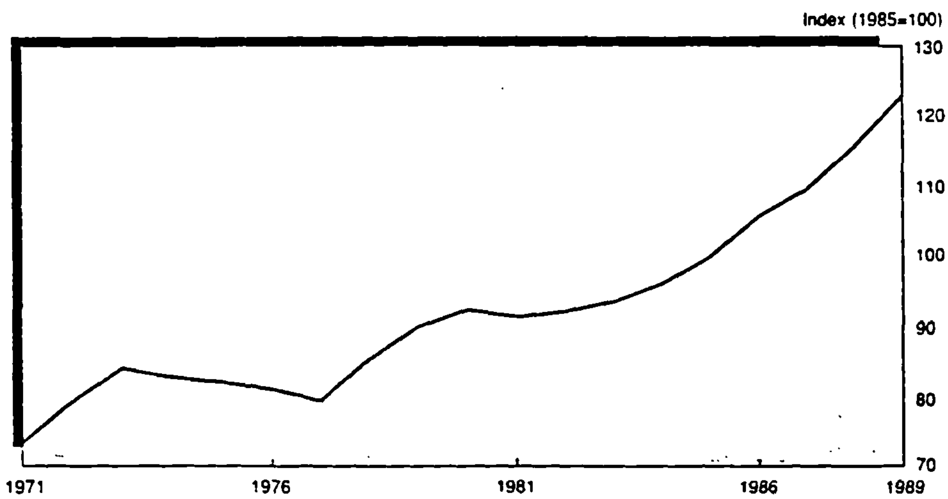
[1] Includes light vans

Source: Department of Transport

Social Trends 20, © Crown copyright 1990

Fig. 8.3.2 Real household disposable income per head

United Kingdom



Source: Central Statistical Office

Social Trends 21, © Crown copyright 1991

Availability of Leisure Time

Weekly hours of work and paid holidays[1]: full time manual employees

Fig.8.3.3 *United Kingdom*

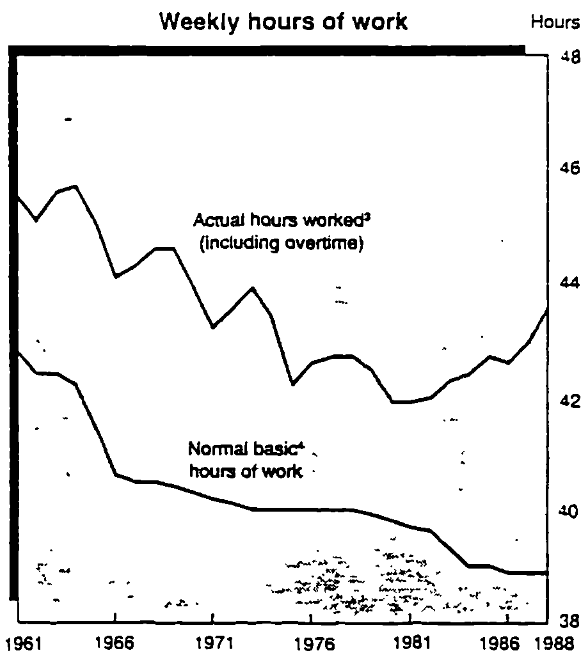
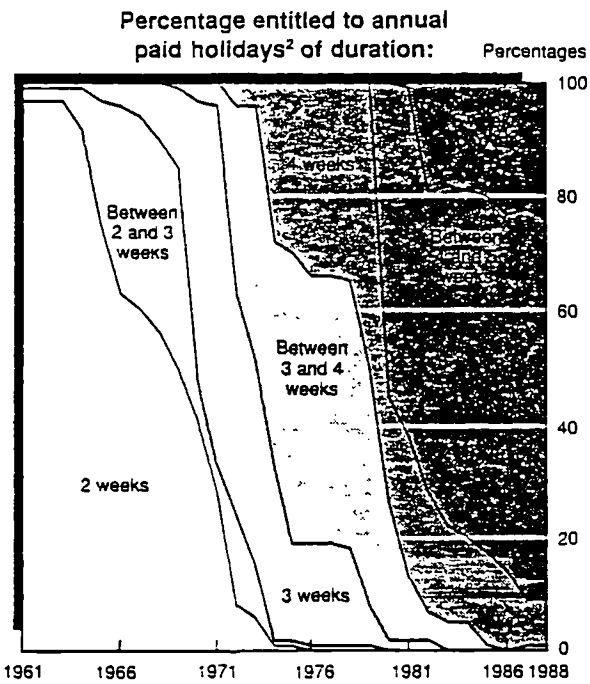


Fig.8.3.4



1 Under the Wages Act, 1986 (and similar legislation in Northern Ireland) Wages Councils are no longer empowered to fix holidays. Employees covered by Wages Councils are excluded from the 1987 and 1988 holiday figures which are not therefore directly comparable with earlier ones.

2 The information relates to basic entitlements in national collective agreements or Wages Council Orders.

3 By manual employees in October of each year.

4 The information relates to basic hours in national collective agreements or Wages Council Orders.

Source: Department of Employment

Fig.8.3.5 Availability of Leisure by sex and employment status (1988)

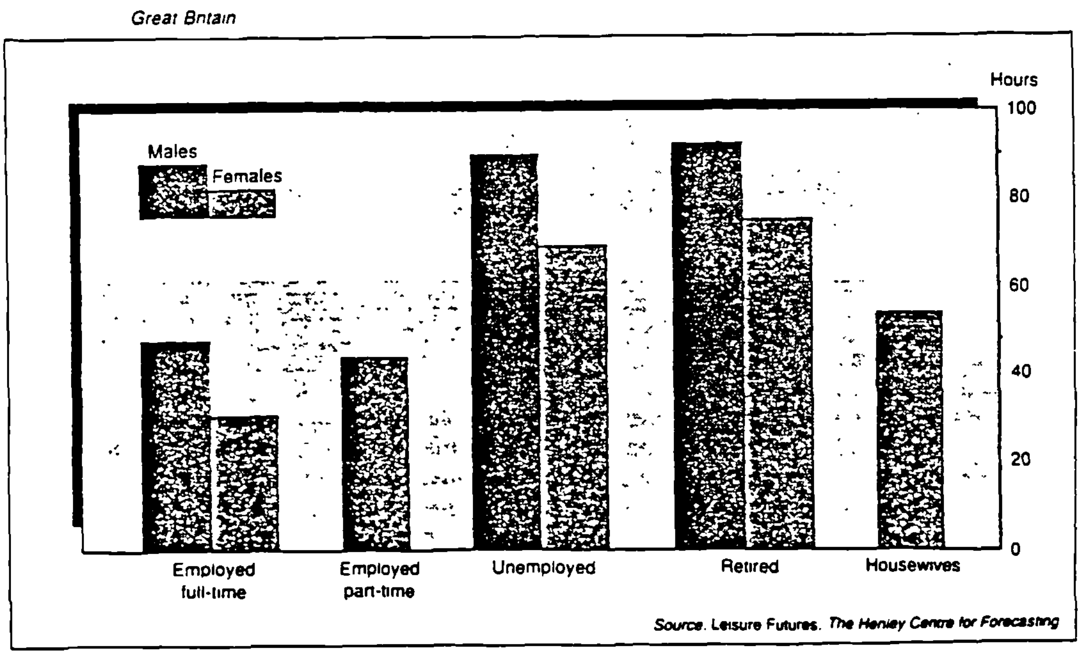


Table 8.3.3 Distance Travelled from Home or Holiday Address to Visit this Garden

Garden	< 1m	1–2m	2–5m	>5m	N.
Edinburgh	56 28%	50 25%	46 23%	48 24%	200
Cambridge	74 38.3%	28 14.5%	24 12.2%	67 34%	197
Westonbirt	8 2.0%	15 3.7%	29 7%	348 87%	400
Sheffield	114 40.0%	51 17.9%	54 19%	65 23%	284
[1]GLC Parks 10–49 Acres	83%	10%	3%	4%	627
[1]GLC Parks 150+ Acres	61%	16%	14%	9%	1933
				P = <0.001	

[1]*Source*: GLC Research Paper No. 2, 1968

For travel to Westonbirt it is necessary for most people to travel more than one mile as there are only 680 residents within a one mile distance of the garden.

What was not examined in the GLC survey was the distance travelled for a first visit as compared with a repeat visit.

For a first visit the individual does not know what is available at the garden, for repeat visits it may be assumed that they go for what is there. Visit patterns by those who have previously visited the gardens were found in this survey to show a greater similarity with the GLC survey than first visits. At Cambridge, Westonbirt and Sheffield, more first time visitors came from further away. Tables 8.3.4 and 8.3.5 show that twice as many of the visits, which were made by people who had visited previously, were made by people who lived within one mile of the garden at Edinburgh and Sheffield.

Table 8.3.4 <u>No Previous Visit % of Respondents</u>

	Home–Garden Distances				
Garden	0–1 miles	1–2 miles	2–5 miles	>5 miles	N
Edinburgh	15.2	36.4	27.3	21.2	66
Cambridge	33.3	13.3	10.0	43.3	60
Westonbirt	2.1	2.9	5.7	89.3	140
Sheffield	21.4	14.3	21.4	42.9	28
				P = < 0.001	

Table 8.3.5 <u>Had Previously Visited % of Respondents</u>

	Home–Garden Distances				
Garden	0–1 miles	1–2 miles	2–5 miles	>5 miles	N
Edinburgh	34.3	19.4	20.9	25.4	134
Cambridge	40.2	15.2	13.6	31.4	132
Westonbirt	1.9	4.2	8.1	85.8	260
Sheffield	42.2	18.4	18.8	20.7	256
				P = < 0.001	

8.3.9 <u>Accessibility and Mode of Transport</u>

The location of the garden determines its availability in terms of ease of access.

<u>Mode of Transport</u>

Visitors were asked whether they had come to the garden on foot, by public transport (bus or train) or by their own transport (car or motorcycle).

In the case of Westonbirt, where the respondent's answer was 'bus', the bus was a tour coach and not the public service bus. Many school parties and groups from Gardening Societies, Womens Institutes and other organisations came to

Westonbirt in a hired coach for an outing to see the autumn colours or spring blossom.

Table 8.3.6 Mode of Transport % of Respondents

Garden	On Foot	Bus/Train	Car/Motorcycle	N
Edinburgh	31.2	18.8	50.0	202
Cambridge	39.8	10.4	49.8	201
Westonbirt	1.5	7.1	91.4	406
Sheffield	42.9	9.4	47.7	210
			P = <0.001	

Parking facilities may be a limiting factor at city botanic gardens or may become so in the future. There were complaints from visitors to Cambridge about the difficulty of finding a place to park. Westonbirt, in the country with no public service bus, had 91% of respondents arriving by car, as would be expected from its situation. Visiting here is thus restricted to those with access to a car. The other 3 gardens had about 50% car travellers. Sheffield had more visitors arriving on foot than anywhere else.

Although all 3 gardens are on public bus routes, the high level of bus travellers at Edinburgh may be due to the fact that Edinburgh has a free bus pass system for pensioners, whereas at Cambridge the pass is not free but only at a reduced rate. Bus travel in Cambridge is relatively expensive. At Sheffield the bus pass is heavily subsidised so bus and foot travellers account for more than 50% of the visitors.

Greater access to a car (see Figure 8.3.1) means that visits to Westonbirt, along with many other countryside visits, is becoming increasingly available to a wider public.

Table 8.3.7

Frequency of Garden Visits.

Number of Visitors going:-

Garden	Less than once a year	More than once a year	Less than once a month	More than once a month	Less than once a week	More than once a week	N.
Edinburgh	21.1	16.3	12.2	9.8	13.3	26.8	123
Cambridge	31.8	23.7	5.2	14.8	5.9	18.5	135
Westonbirt	48.9		33.2	4.6	3.1	10.3	262
Sheffield	26.8		33.7	13.7	6.9	18.9	291

P = <0.001

8.3.10 Visit Frequency as a Measure of the Gardens Importance in that Location

The frequency of visiting gives a good measure of the value of a garden. If it is worth visiting often it presumably has greater appeal than alternatives or else alternatives are less available in some areas than others.

Visit Frequency: All Visitors

There are significant differences in the frequency of visiting at the gardens. Edinburgh, Cambridge and Sheffield have similar patterns but at Westonbirt a much higher percentage of people visit less than once a year and the lowest percentage visit more than once a week. The garden with most 'more than once a week' visitors is Edinburgh, making Edinburgh a place used more by the same group of people than any of the other gardens. Visits and visitors are more synonymous at Westonbirt.

Table 8.3.8 Visit Frequency % of Respondents

Garden	Less than 1x/year	More than 1x/week	N
Edinburgh	44.1	55.9	59
Cambridge	63.2	36.8	68
Westonbirt	82.6	17.4	155
Sheffield	58.6	41.4	133
		P = <0.001	

The over 60 age group has the smallest percentage visiting any of the gardens less than once a year and the highest percentage visiting any of the gardens more than once a week.

Edinburgh	1	Most frequently revisited
Sheffield	2	
Cambridge	3	↓
Westonbirt	4	Least frequently revisited

A number of factors may be responsible for this:

1. The attraction of the garden.
2. The cost of getting there, in time and money.
3. The availability of other sites.
4. The dilution of the local population by tourists.
5. The 'convenience' of the garden in terms of nearness to the visitors home.

8.3.11 Visit Length

Significant differences were found in the length of visits at the four sites as shown in Table 8.3.9.

Table 8.3.9 % of Respondents

	Visit Length					
Garden	<1 hour	1–2 hrs	2–3 hrs	3–4 hrs	>4 hrs	N
Edinburgh	26.0	42.5	19.0	7.0	5.5	200
Cambridge	21.3	41.1	26.4	7.1	4.1	197
Westonbirt	7.1	29.7	32.2	16.7	14.3	407
Sheffield	73.1	18.8	3.2	2.9	1.9	309
					P = <0.001	

The gardens are ranked below for length of visit.

Sheffield	1	Most short visits
Edinburgh	2	
Cambridge	3	↓
Westonbirt	4	Fewest short visits

Westonbirt, to which most visitors have to travel some distance, and pay an entrance fee, has only 7% of visitors who stay less than an hour. By comparison 73% of Sheffield's visits were of less than 1 hour with only 2% of visits lasting more than 4 hours as compared with 14% at Westonbirt. Visit lengths are similar at Edinburgh and Cambridge.

The short length of visits to Sheffield also reflects the small size of the garden. It takes much less time to go round it and see everything, compared with the very large area of Westonbirt. These figures for Mode of Transport, visit frequency and length of visit can be related to the location of the garden, with that at Sheffield having a very high value in its immediate vicinity.

8.3.12 Distance Travelled

Distance travelled from home or holiday address to visit the garden.

Table 8.3.10 Distance in Miles % of Respondents

Garden	1–10 miles	10–20 miles	20–50 miles	>50 miles
Edinburgh	84.0	4.5	6.5	50
Cambridge	69.9	6.7	14.5	8.8
Westonbirt	27.0	29.5	29.0	14.5
Sheffield	91.2	4.2	2.1	2.5

P = <0.001

As would be expected from the previous tables, by far the greatest number of Sheffield's visitors come from within 10 miles and the majority of Westonbirt's from 10–50 miles.

This would affirm Sheffield's importance as a local asset. For Edinburgh and Cambridge, if the tourist and holiday visitors are removed from the tables, the extent of their value to the local population can be seen:–

Table 8.3.11 Visitors Coming from a Home Address

Garden	Distance Travelled 0–2 miles	% Respondents 2–5 miles	>5 miles	N
Edinburgh	52.6	18.0	29.3	133
Cambridge	42.5	12.4	45.1	113
Westonbirt	3.4	7.1	89.5	323
Sheffield	59.4	21.1	19.5	261
				P = <0.001

The attraction of the four gardens to those people from holiday addresses is also significantly different:

Table 8.3.12 Visitors Coming from a Holiday Address

Garden	Distance travelled 0–2 miles	% Respondents 2–5 miles	>5 miles	N
Edinburgh	56.3	29.7	14.1	64
Cambridge	70.3	12.2	17.6	74
Westonbirt	14.3	9.5	76.2	84
Sheffield	42.9	–	57.1	21
				P = <0.001

These differences may be due entirely to the location of the garden. Holiday visitors going to Westonbirt must travel a substantial distance due to the lack of places to stay in the immediate vicinity. They may be making a day visit from a larger centre like Bath, Bristol or Cheltenham. The other three sites have much more accommodation available within the cities.

8.3.13 Visit Frequency and Distance Travelled

The distance people lived from the garden governed their visit frequency when all the gardens were treated together.

Table 8.3.13 %

All Site Visit Frequency	Distance of Home from Garden <1 mile	1–2 miles	2–5 miles	% of Respondents >5 miles	% N
Less than once a year	12.0	12.0	11.0	65.0	28.7 200
More than once a year 2–6/yr	18.8	16.7	20.8	43.8	6.9 48
Less than once a month 6–12/yr	21.2	14.0	13.5	51.3	27.7 193
More than once a month 12–18/year	50.0	15.0	17.5	17.5	11.5 80
Less than once a week 18–50/yr	39.1	19.6	21.7	19.6	6.6 46
More than 1x/week	53.5	13.2	20.9	12.4	18.5 129
Col. Tot. %	202 29.0	97 13.9	109 15.6	289 41.5	697 Total

P = <0.001

Examining the gardens individually, however, the results showed a poor correlation at Edinburgh between frequency of visit and the distance the visitors lived from the garden. There were significant correlations at Cambridge, Westonbirt and Sheffield, see Table 8.3.14.

Edinburgh attracts more very frequent visitors from distances greater than five miles. It does not, therefore, conform to the expected pattern of visit rate decreasing with distance. Therefore the cost of the visits for those people who travel more than 5 miles each way is high, placing a higher value on visits to Edinburgh than the other gardens. 2.5% of Edinburgh's visitors visit more than once a week from distances greater than 5 miles.

of Home from Garden No. of Respondents

Garden		0–2 miles	2–5 miles	>5 miles	N.
Edinburgh	Visit less than 1×/year	10	4	12	26
	Visit more than 1×/week	20	7	5	32
				P=<0.039	
Cambridge	Visit less than 1×/year	17	5	20	42
	Visit more than 1×/week	21	3	0	24
				P=<0.001	
Westonbirt	Visit less than 1×/year	7	4	131	124
	Visit more than 1×/week	6	11	9	26
				P=<0.001	
Sheffield	Visit less than 1×/year	26	17	28	71
	Visit more than 1×/week	40	7	4	51
				P=<0.001	

8.3.14 Total Visitor Numbers

The value of the garden should be reflected in the total number of people using the gardens, but only 200–300 visitors a day go to Sheffield in the summer.

Table 8.3.15 Visit and Visitor Numbers Per Year

	Visits Per Year	Visitors Per Year*
Edinburgh	750,000	36,993
Cambridge	45,000	2,920
Westonbirt	185,400	12,446
Sheffield	50,000	1,708

*Visitors per year figure derived from visits per year to the garden divided by the visit frequency of the respondents.

8.3.15 Visitor Capacity of Sites

The lack of use or the under–utilization can be confirmed by asking the visitors if they found the garden 'crowded' (which would thus diminish its attraction for many), 'had surprisingly few people' or 'just the right number'.

Table 8.3.16 % Respondents Finding the Garden

Garden	Was Crowded	Had Surprisingly Few People	N
Edinburgh	2.5%	52.5%	202
Cambridge	2.6%	55.5%	191
Westonbirt	17.2%	82.7%	163
Sheffield	1.9%	55.2%	310
			P = <0.001

Clearly even having the gardens situated in these large cities has not resulted in them being used to such an extent that crowds deter people from visiting.

The apparent discrepancy between the two significantly different results obtained from Westonbirt are due to the time at which the question was asked. If asked in April–May or October then a number of people found the site crowded. In October up to 20,000 car loads of visitors per day arrive and the people concentrate in the Acer glades and other areas of broadleaved trees where the autumn colour is best.

The answer 'surprisingly few people' was obtained at other times of the year and is the answer most usually obtained in these surveys.

8.3.16 Summary

Either there is a genuine lack of attractiveness of botanic gardens to the public or the public do not know about them. This will be examined in Section 8.5. The figures for visit numbers were real counts only at Edinburgh and Westonbirt. At Cambridge they were estimated by the Curator (Orriss, 1990). At Sheffield the interviewer for the survey estimated the total number of people present in the garden on each of the survey days. This method was suggested by the Garden Superintendent as he expected a steady, regular number of visitors all year round with only a slight decrease in winter. No significant differences were found in group size on different days.

1. The location affects the capital costs of the garden.
2. Location affects the accessibility of the garden.
3. The accessibility affects the mode of transport and distance to travel and therefore the cost of using the facility.
4. In the case of some gardens in rural areas, e.g. Westonbirt, but also Bedgebury, Wakehurst Place, Logan, Benmore and Dawyk, visits are substantially limited to car owners or those with access to a car.
5. The type of garden in that location appears to provide a different attraction for which it is worth travelling a greater distance than to an urban park.

6. The accessibility, visit frequency and visit length indicate that, regardless of size, the gardens at Edinburgh, Cambridge and Sheffield are important attractions in their locality.
7. Edinburgh draws 'frequent' visitors from greater distances than would have been expected from previous surveys of parks and open spaces.
8. Visitor numbers to gardens open to the public and botanic gardens is increasing whilst visitor numbers to the countryside are falling.
9. Visitor numbers to botanic gardens, in general, are still low. The sites have adequate capacity for more visitors at most times of the year.
10. There are differences between first time visitors and others. First time visitors are prepared to travel further for their visit, even to small sites. Repeat visiting more nearly resembles visiting patterns found in the GLC Survey of park visiting (1968).
11. This separation of first time and repeat visitor profiles might throw greater light on peoples preferences as ascertained by other surveys.
12. The two types of visit were also examined in the travel cost analysis in Chapter 7. These again produced differing results.

8.4 The Facilities of the Gardens

In order to assess the attraction of the garden to those who do visit it is necessary, initially, to examine what is provided at each site.

On this depends the gardens current visitor profile.

8.4.1 Size

The most obvious initial difference between the gardens is the size:

Edinburgh	25 ha
Cambridge	16 ha
Westonbirt	200 ha
Sheffield	7.5 ha

8.4.2 Attractions – See Table 8.4.1

They are not different sized versions of the same thing. The gardens at Edinburgh, Cambridge and Sheffield are highly maintained ornamental gardens with a range of attractions.

Edinburgh and Cambridge are most similar to each other having large ponds/ water features, rock gardens, various plant collections and glasshouses. Edinburgh and Sheffield have some attractive buildings housing exhibitions. Cambridge and Westonbirt have custom built wooden Visitor Centres.

The grounds at Westonbirt, although having some shrubs, are essentially comprised of an Arboretum, some plantation woodland and downland.

Table 8.4.1 Summary of Main Facilities of the Four Gardens

Size	Edinburgh 25 ha	Cambridge 16 ha	Westonbirt 200 ha	Sheffield 7.5 ha
Visitor Centre	√	part time	√	No
Cafe	√	part time	√	No
Glasshouses	√	√	No	No
Herbaceous Plant Collections	√	√	No	√
Trees	√	√	√	√
Rock Garden	√	√	No	√
Roses	√	√	No	√
Seats	√	√	Not many	√
Birds	√	√	√	√
Squirrels	√	√	No	√
Pond	√	√	No	Very small
Car Parking	√	Difficult	√	√
Bus Service	√	√	No	√
Dogs Allowed	No	No	No	√
Games Allowed	No	No	No	No
Bicycles Allowed	No	No	No	No

8.4.3 The Wildlife

Most noticeably grey squirrels and pigeons, although interesting and attractive to the visitor are very destructive to plants. These are covertly culled at Cambridge and Edinburgh but treated as vermin at Westonbirt as in other forestry situations.

8.4.4 Car Parking/Transport

Plenty of car parking space is available at Westonbirt. From its location this would have to be so if it were to attract any visitors.

There is adequate parking at Edinburgh and Sheffield in the adjoining streets. Parking is much more difficult in Cambridge where the streets outside the garden are used for parking by commuters working in Cambridge or travelling to London from the nearby station.

Edinburgh, Cambridge and Sheffield are served by regular public city bus services.

8.4.5 Dogs

People are allowed to take their dogs to Westonbirt and Sheffield, but not to Edinburgh or Cambridge. Dogs must be kept on a lead at Sheffield. To a large extent this reflects the nature of the place.

At Edinburgh and Cambridge uncontrolled dogs could cause a great deal of damage amongst herbaceous plants, chasing ducks, squirrels etc. At Westonbirt they can do relatively little damage in the forest situation. The areas in which dogs are allowed has now been restricted at Westonbirt so that they are kept away from the Cafe and Visitor Centre.

Sheffield's botanic garden is run by the Recreation Department which allows dogs in all the other parks. It may be difficult for them to decide that dogs should be banned from one particular park. Public pressure for dog free areas may make this possible, though children's play areas will receive first priority.

At Westonbirt 22% of the groups (n=92) interviewed had a dog with them. Of these 21% thought that there should be dog free areas. 35% of those groups without a dog thought that there should be dog free areas. Even the dog owners appreciated that it was not appropriate to take their dogs everywhere. Conversely, 65% of groups with no dog with them did not seem to think that dog free areas was an important item.

Although the number of groups with dogs was not counted at Sheffield there were a number of complaints about the presence of dogs.

8.4.6 Visit in Relation to Alternatives

It is pertinent to examine whether people have come to the garden for what the garden provides, or whether some other visit would have been at least as satisfactory. If so, what are the alternatives which would have provided the 'nearest' satisfaction?

8.4.6.1 Alternative Visit

At all four gardens 25% of visitors said that if the botanic garden had been unavailable they would not have gone on an alternative visit (Table 8.4.2)

This may be a genuine preference for the botanic garden. It could be because an alternative was too far away but this is unlikely as Westonbirt is a long way from any large centre of population.

How they would have spent their time instead will be examined later.

Table 8.4.2 Alternative Visit % of Respondents

	Yes	No	N.
Edinburgh	76.7%	23.3%	202
Cambridge	68%	32%	201
Westonbirt	71%	29%	407
Sheffield	75%	25%	308

There is a significant difference in the place chosen as an alternative by those from the various sites.

The choices offered were a garden, a park or 'other' with the place or type of place stated. The results were:

Table 8.4.3 % of Respondents

Site	Garden	Choice: Park	Other	Historic Building	N.
Edinburgh	16	27.7	65	Included in Other	155
Cambridge	19	16	68	Included in Other	132
Westonbirt	39	29	30	33	290
Sheffield	6	47	35	6.6	231

8.4.6.2 A Garden as an Alternative

The 40% of those visiting Westonbirt who chose a garden as an alternative compared with much lower percentages at the other gardens may be a reflection of the need to have access to a car to make such a visit as well as of the high number of National Trust and other gardens available in the area.

Information on places to visit in and around Sheffield (Sheffield Tourist Board) includes Chatsworth and Hardwick Hall. Access to a car would be necessary to visit these places. That 6% at Sheffield choose a garden as an alternative may be due to their choice being a real place rather than an imagined one. It is unlikely that the answer means that visitors at Sheffield do not like gardens.

8.4.6.3 A Park as an Alternative

The 47% of Sheffield visitors choosing a park as an alternative reflects that this is what there is and would confirm the visitors choice as being a real one.

There are several very good parks in Sheffield which would have been quite easily accessible to some of the visitors. Many named a specific park of their choice.

Most of the Sheffield visitors who chose a park as an alternative would have had to travel further to get there, so the botanic garden may have been their second choice, or the park was perhaps not sufficiently attractive for them to travel the extra distance.

8.4.6.4 Other Attractions as an Alternative

At Edinburgh, historic buildings were quite often suggested as an alternative visit. In the surveys at Westonbirt and Sheffield they were offered as a separate choice from 'Other'. They are seen as a real alternative to the garden visit but why this should be so is a subject for further investigation. The GLC in their 1971 recreation survey (GLC, 1981) considered visits to (London) parks, to countryside open space, to towns and villages and to stately homes to be closely related informal outdoor pursuits.

Although only 6% of Sheffield's visitors chose a garden as an alternative to the present trip, the possibility that they did not like gardens was removed when respondents were asked if, and how many, other gardens they had visited in the last year.

8.4.7 Number of Other Gardens Also Visited in the Last Year

There are marked differences between the sites as regards the visiting of other gardens. Almost all of the respondents at Sheffield had been to another garden in the last year whereas, of the respondents at Cambridge and Edinburgh only 50–60% had been to another garden.

Table 8.4.4 % of Respondents

Garden	No of Other Gardens Visited in the Last Year: 0	1 – 10	10 – 20	> 20	No.
Edinburgh	48.5	46.5	3.0	2.0	202
Cambridge	40.2	51.1	6.0	2.7	184
Westonbirt	13.5	73.5	9.9	3.1	393
Sheffield	2.4	51.2	26.8	19.5	309
				P = <0.001	

Respondents at Sheffield had not only visited other gardens in the last year they had visited substantial numbers of gardens.

This contrasts with the visitors at Westonbirt, who although they had visited other gardens in the last year, had visited only between one and ten.

The half of the visitors at Edinburgh and Cambridge who did visit other gardens also visited relatively few.

This could indicate that the facilities provided at Edinburgh and Cambridge are much more attractive than most of the other gardens. It could also indicate that these botanic gardens are more accessible.

8.4.8 Number of Other Botanic Gardens Visited in the Last Year

Table 8.4.5 % of Respondents Who Have Visited Other Botanic Gardens in the Last Year

Garden	% of Respondents who have visited another botanic gardens in last year	% of Respondents who have visited more than one other botanic garden in last year
Edinburgh	35	19
Cambridge	25	7.5
Westonbirt	34.5	21
Sheffield	25	14

This number of visits by the visitors to these four gardens represents about 5,400,000 visits to botanic gardens (not necessarily all in Britain).

Total botanic garden visiting must far exceed this. Total worldwide annual botanic garden visits are estimated to be 150,000,000 (IUCN, 1989).

8.4.8.1 Visitors Attracted by Other Botanic Gardens

Whether botanic gardens are an attractive feature in themselves and having seen one encourages people to visit others was tested by looking at those who had not visited the current garden before and seeing if they had visited other botanic gardens and if so, how many.

The following results were obtained:

Table 8.4.6

Garden	Number of people not having been to the current botanic garden before but having visited >1 botanic garden in the last year No.	% of Respondents
Edinburgh	20	10%
Cambridge	7	3%
Westonbirt	26	6%
Sheffield	4	1.3%

For these 57 people at least, a visit to one botanic garden was a sufficiently attractive experience to induce them to visit others. That a higher percentage occurred at Edinburgh and Westonbirt may reflect the fact that they are better known.

At Edinburgh 26 people had visited no other gardens except 1 or more botanic gardens in the last year. 11 of these had never been to Edinburgh before whereas 16 had. The 16 may be regular local visitors but the 11 would seem to be interested only in visiting botanic gardens. These 11 or 5% of the visitors are only representative of the interest in botanic gardens amongst botanic garden visitors. It is not a representation of the interest in botanic gardens from amongst the population as a whole.

In his survey of visitors to the Oxford Botanic Garden and of the general population of Oxford, Dixon (1991) discovered that only 14% of his sample of the general population of Oxford had never visited Oxford Botanic Garden and only 5% had never visited a botanic garden at all. In Oxford, which has an easily accessible botanic garden, 33% of his population sample were considered as non–users, i.e. those who had not visited a botanic garden for more than 2 years. If this is representative of other cities then there must be a very high percentage of infrequent users (<once per year). Knowing why they visit so infrequently might prove essential to the future of 'marketing' of gardens.

What would be of great interest would be a survey of people who have been to a botanic garden once only and asking them what they liked or disliked about the garden and why they had never visited again.

8.4.9 Summary

1. The gardens are not different sized versions of the same thing.
2. Car parking is available, at all gardens, though increasingly difficult at Cambridge.
3. Westonbirt and Sheffield allow dogs into the garden. 22% of visiting groups take their dog at Westonbirt but some feel it is inappropriate to take it to all parts of the garden. 65% of people without dogs do not seem to mind the presence of them.
4. 75% of visitors would have gone on an alternative visit if the garden had been unavailable. For these people there is a substitute in alternative parks, gardens, historic buildings or other places.
5. Seeing historic buildings or museums as a substitute for a botanic garden by a substantial number of visitors presents a new line of investigation.
6. Visitors appear to have a real destination in mind as an alternative choice rather than an imaginary one.
7. The garden in which they were interviewed would seem to provide all that visitors want in 48% of cases at Edinburgh and 40% of cases at Cambridge, in that these people had been to no other garden in the last year. This was only true of 13.5% at Westonbirt and 2.4% at Sheffield which is smaller and has a smaller range of facilities.
8. 25% – 35% of visitors had been to at least one other botanic garden in the last year. This probably indicates that the visitors differentiate between parks and botanic gardens and seek to visit botanic gardens.
9. Further investigations on the attitudes of the population in general as regards botanic garden visits are necessary to establish dissatisfactions.

8.5 Marketing Strategy

8.5.1 Introduction

This section will examine:

1. Why or if the gardens should market themselves to the public.
2. How the visitors first heard about the garden.
3. What improvements could be made in the marketing of the garden.
4. The percentage of foreign visitors.
5. The benefit of tourism to the towns in which the botanic gardens are situated.

As the purpose of Edinburgh and Cambridge is research and teaching and their funding is allocated for this purpose, there is no incentive to the gardens to attract greater numbers of visitors who actually increase the costs of running the garden. However, it is recognized that the money to support the gardens comes from the taxpayer and thus, indirectly, the taxpayer has a right to see what they have paid for.

Not being open to the public, or if the public chose not to come, would not alter the reasons for the existence of Edinburgh and Cambridge but would negate those of Westonbirt and Sheffield.

Not having visitors at Edinburgh and Cambridge is not, in reality, an option. The Royal Botanic Garden Edinburgh is the city's third largest tourist attraction and the University Botanic Garden at Cambridge is on the Tourist Board list of attractions. The city gives a grant of £5,400 p.a. towards the gardens upkeep.

It would also probably be difficult to motivate the gardens staff to maintain the high standards seen if there were no visitors to appreciate the work.

8.5.2 Advertising

Gardens themselves do very little in the way of advertising compared with places which rely on entrance fees to survive, such as National Trust gardens and gardens associated with some stately homes open to the public.

The Tourist Boards advertise all four gardens in their literature. Edinburgh produces a leaflet which was available at the Glasgow Garden Festival and is also available at the three Royal Botanic Gardens outstations at Dawyk, Benmore and Logan. (Amongst 35 different tourist leaflets at a University Hall of Residence in Edinburgh in September 1988 there were none for the Royal Botanic Garden.) Cambridge does not advertise. Westonbirt produces its own leaflet which it distributes to other tourist attractions and hotels in the south west. It sometimes advertises through other Forestry Commission Shops/Visitor Centres. Sheffield produces its own leaflet and programme of events throughout the year and this is distributed via libraries and information centres within Sheffield.

8.5.3 Where Visitors First Heard of the Garden

This was asked to test whether the current marketing was successful and to discover how, if necessary, this could be improved.

Table 8.5.1 Sources of Information

How respondents found out about the garden	Edinburgh No.	Edinburgh %	Cambridge No.	Cambridge %	Weston. No.	Weston. %	Sheffield No.	Sheffield %
Word of Mouth	168	84	145	73	313	76.3	203	67.0
Newspaper	2	1	–	–	9	2.2	1	0.3
Radio/TV	3	1.5	–	–	15	3.7	4	1.3
Leaflet or Book	4	2.0	35	17.5	21	5.1	10	3.3
Other mostly:								
Driving/Walking Past	48	23.8	22	11	45	11.0	77	25.4
Michelin Guide	20	10.0	–	–	–	–	–	–
Map	11	5.4	–	–	5	1.2	5	1.7

(All percentages do not add to 100 because of multiple answers by some respondents.)

Very few visitors had seen any advertisement for the gardens. Most heard about them through 'word of mouth'. At Edinburgh the Michelin Guide and the Map of the city were important. At Westonbirt, having driven past and seen the large Forestry Commission sign provided sufficient advertising to cause some people to return and visit at some future date. At Sheffield and Edinburgh about 25% of the visitors had found the garden by walking past.

The mere 5% who found out about Westonbirt from a notice, leaflet or book must raise a question about whether the leaflets which Westonbirt does produce and sends out each year are being directed to a receptive audience or could they be better used in some other place. As the majority (76%) of visitors to Westonbirt hear about it by 'word of mouth' and only 5% read about it in a book or leaflet, the leaflets might be better distributed locally or conversely Westonbirt should actively advertise overseas so that people would know about it before they arrived and could make arrangements to include it in a tour or hire–car trip. The usual advertising media of leaflets, notices, radio, TV and newspapers appear to have very little effect on visiting.

By contrast in a study of historic garden visiting (Gallagher, 1983) visitors found out about the garden from the following sources:

Table 8.5.2

Source	% of All Visitors	% of Local Visitors	% of Non–Local Visitors
Word of Mouth	58	56	43
Newspaper	3	3	2
Radio/TV	1	–	2
Handbook	15	16	14
Tourist Info & Publication	8	5	12
Road Sign	13		

(Those who said 'don't know' or 'have known for years' have been included in 'word of mouth' here.)

The historic gardens in Gallagher's survey depend upon entrance fees for their upkeep so a much higher percentage of visitors had heard about the garden through advertising than was the case with botanic gardens.

The 12% non–local visitors finding out about the gardens from Tourist Information or publications in Gallagher's survey would seem to support the Countryside Commission surveys findings about non–local visitors arriving at definite destinations (Countryside Commission, 1985) and differs from the four surveys in the current work.

The Countryside Commission Recreation Survey 1985 found that nearly two thirds of all trips are to visit somewhere specifically because it is in the countryside rather than ...

> "a convenient place to take place in a particular activity. These trips, when from home, are split equally between places which have been singled out for a visit and those chosen more at random."

Tourism produces revenue for an area, not just for the garden, so having a botanic garden present has an effect on the local economy if it attracts tourists.

Whether the gardens did this or not was explored by asking whether respondents travelled from home or from a holiday address.

8.5.4 Origin of Visitors

The answers are summarised below:

Table 8.5.3 Percentage of Respondents who Travelled from Home or from a Holiday Address

Garden	Home	Holiday Address	N.
Edinburgh	67.8	32.2	199
Cambridge	62.1	32.9	195
Westonbirt	78.6	21.4	412
Sheffield	91.4	8.6	304
		P = <0.001	

The 32% visiting from a holiday address at Edinburgh or Cambridge would seem to confirm the idea that Edinburgh and Cambridge are tourist cities whereas Sheffield is not. Although Westonbirt advertises to tourists, only 21% of its visitors come from a holiday address.

That those who are visiting from a holiday address are more likely to have chosen a specific place to visit than those travelling from home was found to be the case in the National Countryside Recreation Survey (Countryside Commission, 1985), but was not found to be the case in this survey when this question was asked at Westonbirt (see Table 8.5.4).

This may, in part, explain the number of people who found out about the garden while driving past.

Table 8.5.4 Westonbirt – Visit Specifically to Visit This Garden

	No	Yes	N.
Came from a home address	3.2	96.8	313
Came from a holiday address	11.9	88.1	84
			P = <0.003

8.5.5 Distance from Home if on Holiday i.e. Foreign Visitors

To check whether the 'on holiday' visitors have travelled from any great distance, which may indicate whether they are on a trip abroad rather than e.g. from within Britain, the respondents were asked how far away their home was.

Table 8.5.5 Respondents From Distances Greater Than 400 Miles

	Number	% of Total	N.
Edinburgh	33	16.3	202
Cambridge	18	8.9	201
Westonbirt	8	1.9	407
Sheffield	1	0.3	308

The visitors from distances greater than 400 miles are likely to be 'foreign' visitors. Eleven of these 'foreign visitors' at Edinburgh were students as were four of those at Cambridge. Student visitors would be unlikely to add significantly to the invisible earnings of the cities, but they may recommend that their family and friends visit the gardens if they should visit the area.

Any increase in advertising and marketing would have to have some benefit for the gardens in terms of financial return. The return could either be social user benefits such as consumer surplus which would increase with increasing visitor numbers where an entrance fee could not be charged, or it could be a direct financial benefit derived by introducing an entrance fee.

8.5.6 Entrance Fee

The costs of achieving this return would have to be calculated against the costs of collecting it. Initially there might well be a reduction in visitor numbers as happened at the British Museum and the National History Museum (British Tourist Authority, 1991) when a charge was first introduced. Social benefit would be lost with this decrease in numbers, and would have to be set against financial benefits gained.

There would be a need for some form of season ticket or pass to be introduced for the very frequent visitors.

To test whether the Westonbirt visitors would have paid more, they were asked whether they thought the charge was too high, about right or too low. 80% of the respondents at Westonbirt though that the entrance charge was about right.

8.5.7 Willingness to Pay an Entrance Fee

There is no entrance charge at the other three sites and at these the respondents were asked, if there was an entrance fee, would they be willing to pay one, and if so, what did they think would be a reasonable charge.

Table 8.5.6 Willingness to Pay an Entrance Fee % of Respondents

Garden	No	Yes	N
Edinburgh	7.0	93.0	200
Cambridge	12.2	87.8	164
Sheffield	27.4	72.6	303
		P = <0.001	

If this is a reflection of the publics value of the three gardens then the three must be ranked 'most valued', Edinburgh followed by Cambridge then Sheffield. This order, however, also places them in order of size and amenities provided.

The respondents were also asked what they considered would be a reasonable charge. Again, significantly different answers were obtained at the three sites.

8.5.8 Estimated Reasonable Entrance Fee

Table 8.5.7 Estimated Reasonable Entrance Fee % of Respondents

Garden	0–50p	51p–£1	Over £1.01	N
Edinburgh	44	35	21	179
Cambridge	44	40	16	141
Sheffield	56.5	40	3.5	216
			P = <0.001	

This follows the same pattern as that on willingness to pay an entrance fee with a greater percentage at Edinburgh willing to pay more and the greatest percentage at Sheffield willing to pay least.

Garden visitors were divided into those travelling from home or from a holiday address in order to see if there was a difference in willingness to pay an entrance fee. No significant difference was found at any of the sites individually. When replies from all sites were aggregated the visitors from a holiday address were more willing to pay an entrance fee but this difference was only significant at the 98% level.

Similarly the two groups were examined to see if the amount they were willing to pay as an entrance fee was greater if they were visiting from a holiday address. This was found to be the case at Edinburgh but not at Cambridge or Sheffield.

The Edinburgh results were:

Table 8.5.8 How Much Would be a Reasonable Charge % of Respondents

	Up to 50p	51p–£1	> £1.01	N.
Travelled from Home	55.1	33.9	11.0	118
Travelled from a Holiday Address	20.7	37.9	41.4	58
				P = <0.001

The origin of holiday visitors was examined to see whether foreign tourists would be more willing to pay an entrance fee and if so would they have been willing to pay more than those on holiday from Britain, but no difference in this respect was found between these visitors.

It would be of interest to know if the same group of people would have given the same answers at the other sites, i.e. is it the garden or the people who produce the results? Does it reflect the disposable income of the visitors to the site or is it a reflection on the site itself, either size or attractiveness?

8.5.9 Summary

1. Most gardens do very little advertising which comes to the attention of their visitors.
2. Most visitors, 80%, heard about the garden by 'word of mouth' as compared with 58% of visitors to Historic Gardens where entrance fees paid for the upkeep.
3. Gardens could improve their marketing by using the media available in newspapers, radio, T.V. and gardening papers to carry articles about themselves.

4. Apart from Westonbirt, the gardens do very little advertising and Westonbirt's advertising may be to the wrong audience in that its advertisements are placed in hotels and places where there would be foreign tourists who would need to hire a car to visit. The majority of Westonbirt's visitors travel from home so advertising to them there might be more productive.
5. 12%–14% of Edinburgh and Cambridge visitors in summer are foreign tourists. These add to the invisible earnings of the country. Only 2% of all Edinburgh visitors found out about the garden from a leaflet, book or notice whilst far more, 17.5%, found out by this method at Cambridge. In spite of advertising in hotels and through Tourist Information Centres only 9 visitors to Westonbirt came from abroad.
6. An increase in visitors, whether paying or nonpaying, would increase the value of the gardens in terms of social welfare benefits.
7. Many of the foreign visitors were students and their 'word of mouth' advertising might prove invaluable.
8. Contrary to the Countryside Commission Recreation Survey, visitors from holiday addresses visiting Westonbirt were more likely to have arrived there without having set out with the specific intention of visiting. Possibly more large roadsigns such as that at the entrance to Westonbirt would attract visitors passing by.

8.6 The Consumers

8.6.0 Introduction

To examine the current visitor group to botanic gardens and put this in context with consumers of other outdoor informal recreation pursuits it is necessary to examine the general pattern of this type of recreation use.

The GLC carried out a Recreation Study published in 1981. An examination of this study is particularly relevant as three of the botanic gardens are also situated in cities and form part of the available recreation experience in urban areas.

Table 8.6.0 from that study shows the participation rate in various leisurepursuits.

Of particular relevance is 54% of the sample visiting London parks and 29% visiting gardens open to the public. The young rather than the old and men rather than women are the chief beneficiaries of recreation pursuits. It is noted that recreation may become more home–based with advancing age and that women may have more leisure pursuits at home than men. Home based leisure was not examined in the GLC survey (1981). Participation in all pursuits was greater for higher income and socio–economic groups and for those who owned a vehicle regardless of socio–economic group. Participation also increased with increasing age of completion of education.

Participation in 'informal outdoor activities', of which many took place outside London, contrasts with other activities examined. The other activity groups are:– 'sport, either as a spectator or participant' and 'entertainment and social activities' The decrease in participation rate and frequency with age is less pronounced. Men show lower participation rates and teenagers show a relatively low participation rate in comparison with other major groups of activities.

There is less variation in participation rates between the different sex, age and family status groups. The implication is that informal pursuits are more dependent on the family unit than are sporting activities or entertainment and social and cultural activities. It is postulated that the social context in which such visiting and sightseeing activities take place may be even more important than the pursuit itself. Participation rate and frequency is again related to income and socio–economic group.

A more recent survey of Leisure Day Visits in Great Britain 1988/89 (Dodd 1990) provides a very thorough and comprehensive survey but unfortunately 65% of visits to botanic gardens do not come within 'leisure day trips' as defined in this survey. Those which do are some of the visits to the more rural botanic gardens like Westonbirt, Wakehurst place, Bedgebury and other gardens such as Wisley.

Janette Gallagher's work on visitors to historic gardens (1983) is comparable with visits to Westonbirt both in cost of entrance fee, distance travelled and the need for access to a car.

The gardens management all claim public education and amenity as part of their function. The data on age and socio–economic grouping from the four gardens was examined to see how this compared

(a) between gardens studied,

(b) with the national population,

(c) with visitor profiles from public parks,

(d) with data obtained from National Trust gardens,

(e) with data from forest recreation sites.

(d) and (e) had been mentioned as possible 'next best' alternative visits to the current one or other places to which the visitors liked to go.

Table 8.6.0

Recreation pursuits with the highest levels of participation

	Pursuits	Participants as % of the sample	Estimated number of Londoners participating + or - 100,000*	Median days particip-ation per annum	Type of recreati provision - resource or facility - and type of provider
1	Visiting Seaside	65	3,336,000	6	Resource
2	Eating Out	59	3,015,000	12	Facility (Comm)#
3	Pubs, Clubs	58	2,960,000	30	" "
4	Cinema	58	2,957,000	6	" "
5	Visiting London Parks	54	2,761,000	6	Facility (Public)
6	Visiting Countryside Open Space	51	2,609,000	10	Resource
7	Visiting Towns and Villages	40	2,050,000	4	Resource
8	Theatre	39	2,011,000	3	Facility (Comm)
9	Visiting Stately Homes	39	2,013,000	2	Resource
10	Dancing, etc.	39	1,968,000	6	Facility (Comm)
11	Zoos, Wildlife Parks	38	1,937,000	1	Facility (Mixed)
12	Visiting Rivers and Canals	30	1,511,000	3	Resource
13	Visiting Gardens Open to Public	29	1,491,000	2	Facility (Mixed)
14	Visiting Museums	28	1,437,000	2	Facility (Public)
15	Fetes, etc.	24	1,246,000	2	Facility (Mixed)
16	Outdoor Swimming	23	1,151,000	8	Resource
17	Visiting Soccer Matches	22	1,134,000	9	Facility (Comm)
18	Indoor Swimming	22	1,114,000	8	Facility (Public)
19	Concerts	21	1,055,000	3	" "
20	Temporary Exhibitons	20	1,030,000	1	Facility (Comm)

* Approx confidence limits of + or - 2% at a confidence level of 99%

#Comm = Commercial

(Source:- GLC 1981 Report No.19)

8.6.1 The Age Structure of the Current Visitor Population

Table 8.6.1 Age Groups of Respondents at the Four Gardens

		Age Group	Percentage			
	Under 16	16–25	25–35	35–45	45–60	Over 60
Edinburgh	1.1	23.6	19.1	18.5	23.0	14.6
Cambridge	6.5	17.5	22.1	9.7	20.8	23.4
Westonbirt	2.0	6.2	22.7	16.6	22.5	30.0
Sheffield	2.6	21.9	24.8	20.3	8.4	21.6

P = <0.001

The age groups in the table above do not fully represent the age distribution within the visiting population. They are the ages of the person answering the questionnaire therefore children tend to be under–represented as, in family groups, generally one of the parents answered. The percentage of under 16's in the visiting groups interviewed is shown below. The greater % in the upper age groups at Westonbirt may also reflect the fact that it can only be reached by car and has an entrance fee. The older working people may be better able to afford to visit Westonbirt.

8.6.1.1 Under 16's in the Survey

Table 8.6.1.1 Visitors in Survey Under 16 years

Garden	No.	%
Edinburgh	44	10.9
Cambridge	83	18.1
Westonbirt	298	22.9
Sheffield	170	25.0

The very low percentage of under 16 year old's at Edinburgh could be due to the garden being opposite a large park with playing facilities and wherand bikes are allowed.

The percentage of respondents in each age group alters depending upon whether the visit on which they were interviewed is a first visit or not.

8.6.1.2 Age Groups of First Time Visitors

Table 8.6.1.2 Percentage of Respondents

Garden	Under 16	16–25	25–35	35–45	45–60	Over 60	N
Edinburgh	1.6	35.5	19.4	22.6	17.7	3.2	62
Cambridge	10.4	18.8	27.1	6.3	18.8	18.8	48
Westonbirt	2.1	5.7	22.9	18.6	25.7	25.0	140
Sheffield	-	12.5	37.5	28.1	6.3	15.6	32

P = <0.001

The over 60 age groups have had more time in which to do their first visit but there is a markedly higher percentage in the older age groups amongst the repeat visitors as shown below.

8.6.1.3 Age Groups of Repeat Visitors

Table 8.6.1.3

Garden	Under 16	16–25	25–35	35–45	45–60	Over 60	N
Edinburgh	0.9	17.2	19.0	16.4	25.9	20.7	116
Cambridge	4.8	17.1	20.0	11.4	21.9	24.8	105
Westonbirt	1.9	6.2	23.0	15.2	21.0	32.7	267
Sheffield	2.9	23.5	23.5	19.5	8.7	22.0	277

P = <0.001

This may be just that it takes time to get round to doing everything in life. It would be interesting to know at what age the over 60 year old visitors first came to the garden.

There is likely to be a connection with the amount of leisure time the older visitors have at their disposal and also that botanic garden visiting, whilst requiring participants to be mobile, and relatively fit does not require them to indulge in the amount of physical activity exertion needed for sports participation.

8.6.1.4 Discussion

There are statistically significant differences between the age distribution of the respondents at the sites, whether they had been there previously or not, with Westonbirt having fewer younger visitors and Sheffield more. Younger people may have less money for transport and entrance fees and so smaller numbers appear amongst the respondents at Westonbirt.

For all gardens there is marked bimodal distribution in the ages of visitors with very few visitors in the 40–50 year age group, compared with the distribution of the general population and the ages of visitors at other gardens.

8.6.1.5 Age Groups of the Population of Britain

The age distribution of the enumerated population for persons of all ages usually resident in Britain is as follows:–

Table 8.6.1.5 Age Group

	Under 16	Under 21	21–29	30–39	40–49	50–59	Over 60 Yrs
Percentage	22.48	30	14	14	11	11	20

Source: OPCS 1981 Census Figures in Annual Abstract of Statistics, HMSO 1983.

8.6.1.6 Age Groups of Visitors to National Trust Gardens

Janette Gallagher, in her survey of visitors to National Trust gardens, found that the age structure of visitors was:–

Table 8.6.1.6 Percentage in Each Age Group

	0–16	16–20	21–30	31–40	41–50	51–60	61+ Yrs
Historic Gardens	19	6	15	17	14	12	17
Botanic Gardens	39		18	10	4	12	17

Those visiting botanic gardens, by contrast, have a similar number of visitors in the 0–16 years, far fewer in the 30–50 age groups but the same number in the over 50 age groups. Less than a quarter of the visitors to the gardens are under 16. As there are only 22.8% of the population under 16 years, the number of under 16's at Sheffield and Westonbirt are as would be expected in a cross–section of the population but at Edinburgh the under 16's are poorly represented.

The bylaws in effect at most botanic gardens prohibit bicycles and ball games and none of the gardens provide a childrens play area. This extremely passive form of informal outdoor leisure may have very limited appeal for children, at least for any length of time.

It should be noted that many of the children entered in 'under 16's' were actually 'under 2' and at Edinburgh, in particular, the garden was a place where very young children were taken in prams by parents or guardians.

8.6.1.7 Adults Accompanied by Children

As might be expected there were more children accompanied by an adult female than an adult male at all the gardens.

Table 8.6.1.7

	Groups of Males + Children	No.	Groups of Females + Children
Edinburgh	4		11
Cambridge	12		20
Westonbirt	30		36
Sheffield	19		43

The highest percentage of groups with females and children was at Edinburgh where frequently the children were in prams or pushchairs. The visitor survey of the Royal Botanic Garden (Centre for Leisure Research, 1988) counted 11% of the groups of adults with children as being adults with babies (under 4 years).

6.1.8 Visit Frequency by Age Group

Visit frequency was found to be similar for age groups 1–5 at Edinburgh Cambridge and Westonbirt whereas Sheffield has far fewer people visiting less than once a year and far more visiting more than once a week in age groups 1–5, that is under 60 years old.

In the over 60 years old age group Edinburgh has more visitors going more than once a week than any of the other 3 gardens, and Westonbirt has more over 60's visiting less than once a year.

Table 8.6.1.8 Age Group Over 60

	Visit Frequency	% Respondents	
Garden	Less than 1x/Year	More than 1x/week	N.
Edinburgh	29.2	41.7	17
Cambridge	38.2	23.5	21
Westonbirt	60.6	10.6	74
Sheffield	31.7	20.6	33

There are a number of blocks of housing for old people near the botanic garden in Edinburgh and several of the visitors said that they had moved house when they retired especially to be near the botanic garden.

That Westonbirt should have so few over 60's visiting less than once a year may be due to cost.

8.6.1.9 Summary

1. There is a marked bimodal distribution in the age groups of visitors to all sites, with the lowest number of visitors in the 35–45 year old group.
2. By contrast a greater percentage of historic garden visitors occurred in the 30–50 age group (Gallagher, 1983).
3. The percentage of visitors under 16 years old is below the percentage in the population at large, i.e. 22.48% (OPCS Census data, 1981) at Edinburgh and Cambridge but similar to that in the general population at Westonbirt and Sheffield.
4. Significantly more people in the over 60 age group are repeat rather than first time visitors.
5. At Edinburgh more people in the over 60 age group go more than once a week than at any other garden.
6. At Edinburgh a high percentage of the groups visiting were comprised of a female and child or children.

8.6.2 Sex of Visitors in the Survey

Note

The questionnaire gathered the age and sex of the respondent. It additionally gathered the sex of all the adult members of the group to which the respondent belonged.

Table 8.6.2.1 Adult Visitors in Survey

Garden	No. M.	No. F.	% M.	% F.
Edinburgh	150	209	37.22	51.86%
Cambridge	149	226	32.5	49.34%
Westonbirt	399	606	30.62	46.51%
Sheffield	216	294	31.76%	43.23%

Dixon (1991) found that 54% of the visitors to Oxford Botanic Garden were female.

Table 8.6.2.2 Adults in the Survey, % Males, Females and Children by Site

Garden	% Males	% Females	% Children	N.
Edinburgh	37.22	51.86	10.9	403
Cambridge	32.5	49.34	18.1	458
Westonbirt	30.62	46.51	22.9	1203
Sheffield	31.76	43.23	25.0	680
UK Population			22.48	

Only Edinburgh and Cambridge have a level of under 16's visiting below the national level of children in the population.

8.6.2.1 Percentage of Males and Females at Each Site Compared with % in U.K. Population and Oxford Botanic Garden

Table 8.6.2.3

Garden	No. M.	No. F.	% M.	% F.
Edinburgh	150	209	41.78	58.22
Cambridge	149	226	39.73	60.27
Westonbirt	399	606	39.70	60.30
Sheffield	216	294	42.35	57.65
UK Population			49	51
Oxford			46	54

This survey also found that there was a higher level of participation by females than by males in botanic garden visiting. It was higher than the percentage of females in the U.K. population would suggest if botanic garden visiting was equally attractive to males and females. Amongst the respondents male and females were not evenly distributed throughout the age groups.

More females under 45 than males under 45 visited the four gardens when all the figures were aggregated. More males than females in the 45–60 age group visited and equal numbers of males and females over 60.

The results are not consistent for all four gardens however, and a breakdown of males and females by age group for each site is shown below.

8.6.2.2 Sex of Respondents of Various Age Groups

Table 8.6.2.4 Sex of Respondents of Various Age Groups

		No. of Respondents in Each Age Group						
Garden		Under 16	16–25	25–35	35–45	45–60	Over 60	N
Edinburgh*	M	1	30	21	16	26	17	111
	F	1	11	11	14	11	6	54
Cambridge	M	3	8	17	10	16	19	73
	F	7	19	17	4	16	15	80
Westonbirt	M	5	11	32	32	43	55	178
	F	3	13	57	33	44	64	224
Sheffield	M	2	22	41	24	12	30	131
	F	6	47	36	39	14	37	179

*Interviewer bias at Edinburgh

Table 8.6.2.5 Total Number of Respondents of Each Sex at the Four Gardens

Age Group	Under 16	16–25	25–35	35–45	45–60	Over 60	Total
M	11	17	111	82	97	121	411
F	17	90	121	90	85	122	525

There are 14%–30% (average of 22%) more female than male visitors to the botanic gardens.

8.6.2.3 Historic Garden Visitors

This ratio of female to male visitors is slightly higher than the ratio found by Janette Gallagher in her survey of visitors to National Trust gardens where she found:

Table 8.6.2.6

	Percentage		
Sex	All Visitors	Weekend Visitors	Weekday Visitors
Male	47	47	54
Female	53	53	46

8.6.2.4 Participation in Outdoor Pursuits by Sex

The GLC recreation study found a 2–5% higher level of participation by females than by males in outdoor informal pursuits generally. It is possible that the difference is due to the difference in nature of the trips. Visiting a National Trust garden usually means an outing involving the family group or couple, whereas the city centre botanic garden can be visited by women, on foot with very small children, or as part of a longer days outing on foot.

This idea is borne out by the data which shows that slightly more females visit the gardens at Cambridge and Sheffield on foot than men.

8.6.2.5 Forest and Woodland Visiting

The General Household Survey (1987 Table 6.2.3) reports that a higher percentage of those who visit forests and woodlands for pleasure or recreation are men.

Table 8.6.2.7 % Who Visit Forests or Woodlands n=19516

Men	57%
Women	52%
% of those asked	54%

This contrasts particularly with the findings at Westonbirt, essentially a forest site, where

224 respondents were women and
178 were men,

and in the total of the groups at Westonbirt

606 were women and
399 were men.

Clearly Westonbirt does not fit in with the perception of forest or woodlands as held by the general population. The explanation for this may be to be found in the fact that at Westonbirt far more women than men said they would have chosen a park as an alternative if Westonbirt had not been available for visits.

The botanic gardens, including Westonbirt arboretum may be being considered as safe places to go.

8.6.2.6 Group Composition by Sex by Site

There are differences in the composition of groups at each site as shown in the table below.

Table 8.6.2.8 Number of Males in Group by Site

	Percentage of Groups			
Garden	Group with 0 males	Group with 1 male	Group with 2 males	Group with more than 2 males
Edinburgh	39.1	53.0	5.9	2.0
Cambridge	42	45.8	9.5	3.0
Westonbirt	8.4	73.3	16.2	2.1
Sheffield	36.8	56.9	5.3	1.0

Table 8.6.2.9 Number of Females in Group by Site

	Percentage of Groups			
Garden	Group with 0 females	Group with 1 female	Group with 2 females	Group with more than 2 females
Edinburgh	24.3	52.0	18.8	5.0
Cambridge	22.4	50.7	21.9	5.0
Westonbirt	2.5	59.7	31.1	6.7
Sheffield	29.7	49.7	16.0	4.6
			P = <0.001	

8.6.2.7 Visit Frequency by Sex

It was found that men visit more frequently than women at Edinburgh, Westonbirt and Sheffield. This may be due to preference but could also be due to the greater amount of leisure time available to men (see Figure 8.3.5).

8.6.2.8 Availability of Leisure by Sex

Figure 8.3.5. Leisure Time in a Typical Week: By Sex and Employment Status, 1988 illustrates the amount of leisure time available to people during a typical week in 1988. Of all the categories of people shown in the chart, retired men had the most leisure time with 92 hours per week, followed by unemployed men with 90 hours per week. The corresponding figures were women were 75 hours for those retired and 69 hours for those unemployed, an increase of 7 hours since 1987. Women in full–time employment enjoyed 31 hours of leisure time per week, whilst similarly employed men spent 48 hours at leisure. It is generally regarded that women enjoy less leisure time because they spend more time on essential activities such as house cleaning, everyday cooking and shopping for essentials, although they spend less time in paid employment.

8.6.2.9 Summary

1. 22% more females than males visit botanic gardens in total.

   In particular, more females under 45 visit than males.

   The total ratio of females : males is slightly higher than that found amongst visitors to historic gardens.

2. A particular difference is found at Westonbirt where 606 visitors were female and 399 male.

   The General Household Survey (1987) found that less women than men visited forests or woods for recreation. Presumably some features of Westonbirt make it perceptually different from general woodland or forest visiting.

3. Other Gardens Visited

   19% more men had been to another garden of any kind in the last year.

4. Other Botanic Gardens

   By contrast, twice as many women had been to two or more botanic gardens in the last year.

5. Botanists

   There were more women botanists than men in this survey.

6. Frequency of Garden Visiting

   Men visit the botanic gardens in this survey more frequently than women and go to more other gardens generally.

   Botanic gardens may be found to be of particular social value to women.

8.6.3 Income Groups of the Respondents or the Main Wage Earner in the Respondents Family

8.6.3.1 Income Groups of Participants in Leisure Activities

Participation in outdoor informal recreation, as with other leisure activities, has been studied both in Britain (GLC, 1981 and Countryside Commission, 1985) and more widely in the USA (Walsh, 1986). Participation was found to increase with income, socio–economic status, car ownership and by increased age of final education.

8.6.3.2 Social Class of Visitors to National Trust Gardens

Janette Gallagher's study of visitors to historic gardens produced the following table for social class of visitors (major wage earners). The majority of visitors were drawn from the professional and intermediate classes A/B.

Table 8.6.3.1 Social Class of Respondents (Major Wage Earners)

Class	Garden Visiting Project %	Country House Project %	GB Population as a Whole
A	18	19	16
B	45	38	
C_1	16	17	21
C_2	10	18	35
D	8	7	28
E	3	–	

Although the gardens and country houses in the above surveys charged an entrance fee and car ownership or access to a car was a pre–requisite for those visits the same could not be said of the botanic gardens in Edinburgh, Cambridge or Sheffield where entrance is free, they are all in the city centre and all on bus routes, so the requirement for disposable income is not there.

By contrast Westonbirt is much more like the houses and gardens in Gallagher's survey not being on a bus route and charging an entrance fee.

8.6.3.3 Income Groups of Respondents in This Survey

The income groups of the respondents to the questionnaire at the four gardens was as follows.

Table 8.6.3.2 Income Groups Categories % of Respondent

Garden	1	2	3	4	5	6	7	8	9	10	11	N
Edinburgh	20.3	5.0	7.9	18.8	18.8	11.9	7.4	4.5	3.5	0.5	0.5	202
Cambridge	5.0	4.4	10.6	13.3	12.2	13.3	12.8	11.1	2.8	3.3	1.1	180
Westonbirt	4.5	1.8	9.8	14.9	19.1	15.6	8.6	11.8	7.3	4.8	1.8	397
Sheffield	20.6	7.1	15.8	13.5	11.6	11.3	10.0	3.2	2.3	4.5	0	310

P = <0.001

In the current work income groups were divided into 12 categories:–

Group	Wage/Salary		
1	£0	–	£2,499 p.a.
2	£2,500	–	£4,999
3	£5,000	–	£7,499
4	£7,500	–	£9,999
5	£10,000	–	£12,499
6	£12,500	–	£14,999
7	£15,000	–	£17,499
8	£17,500	–	£19,999
9	£20,000	–	£24,999
10	£25,000	–	£29,999
11	£30,000	–	£40,000
12	more than £40,000		

Respondents were asked what their job was. The wage/salary was then ascertained by looking up the job in the Department of Employment New Earnings Survey (1986). The salaries were adjusted each year for increases in R.P.I.

This method had the advantage of ensuring an answer whereas asking respondents how much they earned or how much the main wage earner in the family earned would not always be answered.

This method also elicited the employment of the respondent and the main wage earner in the family. The percentage of professional, white collar or manual workers could be ascertained and the number who were students or unemployed.

8.6.3.4 Students

Numbers in the lowest income group 1 are due mainly to the number of students visiting the garden, Edinburgh, Cambridge and Sheffield are university cities and all three were surveyed in summer vacation. In Edinburgh and Cambridge this resulted in a larger proportion of foreign students visiting than would have appeared in an all year round survey.

In Sheffield the garden is near the university and the survey began there before university term ended, but after the exams had been completed, so extra students visited.

Apart from that it can be seen that botanic garden visiting is an occupation of the higher income groups. This is most marked at Westonbirt arboretum where the entrance charge and car travel may have an effect.

8.6.3.5 Other Activities Participated in by the General Population, by Income Group (GHS, 1987)

These activities were mentioned as a possible alternative visit or other place which they enjoyed visiting, by the respondents in this survey.

8.6.3.5.1 Forest Visiting for Pleasure or Recreation by Those Over 16 by Socio–Economic Group %

Professionals	Employers/ Managers	Intermed. & Junior Non–Manual	Skilled Manual & Non–Professional	Semi–Skilled Manual	Unskilled Manual	Full Time Students	Total 9 of Popu
78%	66%	63%	52%	42%	32%	56%	54%

8.6.3.5.2 Visitors to Historic Buildings/Stately Homes

> "Visits to museums, historic buildings, galleries, stately houses (in previous months) averaged 8% with the highest participation by professionals and the lowest participation by unskilled manual workers though the association with income is less clear and the gradient according to income is less steep than according to socio–economic group". (General Household Survey)

8.6.3.5.3 Countryside Visiting

Countryside visiting was found in the Countryside Commission Survey: 1984, to be linked to social class. 'B' Class households (professional and higher managerial) are almost three times as likely to visit the countryside as 'E' Class (people on minimum income and unemployed).

8.6.3.6 Summary

1. The income groups from this survey do not directly correlate with the SEG used in the General Household Survey. Nevertheless botanic garden visiting is an activity largely of the professional and higher income groups as is forest visiting for pleasure and visiting historic gardens, historic buildings, museums, galleries, stately homes and the countryside, as shown in surveys by Gallagher, 1983 and the General Household Survey, 1987 and the Countryside Commission, 1984.
2. Many of the visitors in the lower income groups were university students.
3. The number of unemployed amongst the visitors was below the national average, so the increased leisure time enforced on the unemployed is not used to any extent in visiting botanic gardens.

8.6.4 Size and Composition of Visiting Groups

8.6.4.1 Number of People in Each Group

Botanic garden visiting is frequently an activity of single people or two person groups. Very few groups are of more than four people see Table 8.6.4.1.

Table 8.6.4.1 Number of People in Group

Garden	% of Groups With This Number of People in Them 1	2	3–4	>4
Edinburgh	32.7	47.5	16.3	3.5
Cambridge	45.5	31.5	17.5	5.5
Westonbirt	8.8	48.5	30.7	11.8
Sheffield	37.8	30.7	25.3	6.1
				P = <0.001

Few of the groups at Edinburgh, Cambridge or Sheffield had children in them.

Table 8.6.4.2 The percentage of groups with no children in them was then examined

Garden	Groups with no Children
Edinburgh	85%
Cambridge	82%
Westonbirt	25.75%
Sheffield	69%

8.6.4.3 Westonbirt Differences

It can be seen from the above two tables that Westonbirt is significantly different from the other three gardens in having only 9% of single person groups and in having only 26% of groups with no children in them it is therefore quite different from the other gardens in being a place where groups of people drive to. More people drive greater distances to visit here than to any of the other gardens and a greater proportion of visitors stay for longer at this garden.

8.6.4.4 Family Groups

The results were examined to see if adult and child groups came on particular days or were more frequent at particular gardens.

No significant difference was found as to the day when one adult and child/children visited. It was not affected by Monday to Friday, being school days.

At Sheffield there were differences in the group composition by day. Although there was very little difference in the occurrence of males with children and females with children on weekdays, very few single adults and children came at weekends. On Saturdays and Sundays there was a preponderance of males and females and children – presumably family groups. At Westonbirt the groups tended to be male and female and children on all days. Total group size was unaffected by which day it was.

Table 8.6.4.3 Number of Groups Comprise of Adult Male(s) and Adult Female(s) and Child/Children by day

Garden	Sun	Mon	Tues	Wed	Thur	Fri	Sat	N.
Edinburgh	6	1	3	–	–	1	2	13
Cambridge	7	1	1	3	4	2	3	21
Westonbirt	5	9	6	3	9	4	15	51
Sheffield	9	6	–	5	2	1	13	36

The total number of groups which may be families is not large, about 5–10% of all groups interviewed. The largest number of such groups occurs on Saturdays at Westonbirt and Sheffield.

It is notable that so few groups appear to be families.

8.6.4.5 Single Person Groups

Groups of One Person and Groups of More than One Person

The data was examined to see if there were differences between groups of one person, who were then, unquestionably, the person who had chosen the visit and larger groups of 2 or more people. Groups of more than one person include the person who has chosen the visit but the questionnaire was not necessarily answered by that person.

A large number of people did visit on their own, as shown below:–

Table 8.6.4.4

Garden	Total No. of Visitors in Survey	No. in Groups of One	% of All Visitors
Edinburgh	403	55	13.6
Cambridge	458	63	13.75
Westonbirt	1303	35	2.7
Sheffield	684	112	16.4

8.6.4.6 Sex of single visitors

Table 8.6.4.5

Garden	Total No.	No. of Males	% Males	No. of Females	% Females
Edinburgh	55	39	71	16	29 *
Cambridge	63	25	40	38	60
Westonbirt	35	13	37	22	63
Sheffield	112	61	54.5	51	45.5

*Interviewer bias at Edinburgh

Showing a higher percentage of single female visitors at Cambridge and Westonbirt.

There are many places of outdoor informal recreation where a person would not feel it was wise to go alone and this is particularly true of females alone. This level of single person visits could reflect the security of the botanic gardens. A benefit which cannot be attributed to all outdoor recreation sites. The age distribution of the single visitors differs from that of the respondents from multi–person groups.

8.6.4.7 Age Groups of 1 Person Groups and Larger Groups

Table 8.6.4.7

		% of Respondents					
		Under 16	16–25	25–35	35–45	45–60	Over 60
Edinburgh	1 Person Groups	2.0	22	20	8	20	28.0
	1+Person Groups	0.8	25	19.2	23.3	23.3	8.3
Cambridge	1 Person Groups	6.9	19.0	17.2	6.9	19.0	31.0
	1+Person Groups	6.4	17.9	24.4	10.3	21.8	19.2
Westonbirt	1 Person Groups	2.9	11.4	5.7	17.1	14.3	48.6
	1+Person Groups	2.0	5.4	24.5	16.3	23.4	28.5
Sheffield	1 Person Groups	3.6	24.1	18.8	15.2	6.3	32.1
	1+Person Groups	2.2	20.1	29.3	23.4	9.8	15.2

The single person groups show a much higher percentage, almost double, the number of people in the over 60 age group, for which there may be a number of reasons. Therefore botanic gardens perform a role in providing for the solitary leisure pursuit of the over 60's. They may have been widowed or retired with different interests from their spouse.

Many of them live near the garden and walk to it as can be seen from Table 8.6.4.8.

Table 8.6.4.8 Distance Travelled by One Person and Multiple Person Groups

		0–2m	2–3m	3–10m	10–50m	>50	N
Edinburgh	1 Person Groups	62.1	12.1	18.2	6.1	1.5	66
	1+Person Groups	48.5	6.0	25.4	13.4	6.7	134
Cambridge	1 Person Groups	57.6	8.2	9.4	15.3	9.4	85
	1+Person Groups	48.6	1.9	15.0	26.2	8.4	107
Westonbirt	1 Person Groups	11.8	17.6	17.6	50.0	2.9	34
	1+Person Groups	4.5	2.5	17.1	59.9	16.0	357
Sheffield	1 Person Groups	68.3	6.7	19.2	4.8	1.0	104
	1+Person Groups	51.5	10.7	26.6	7.7	3.6	169

P = <0.005

8.6.4.9 Mode of Transport

The difference in mode of transport was only significantly different at Sheffield where twice as many single person groups arrived on foot as came by car.

8.6.4.10 Visit Length

The difference in visit length between groups of one and larger groups was not significantly different.

8.6.4.11 Single Visitors and Previous Visits

The differences suggested that the one person groups might be people who lived locally and used the garden as a local park or walk on a regular basis.

This idea was checked against the data to find out whether all these people had visited the garden previously or not. More single people had been to no other garden in the last year. Despite the indications of the previous figures it was found that about one third of these single visitors had not been to the garden before, except at Westonbirt.and Sheffield.

Table 8.6.4.8 Single Person Groups % of Single Visitors

Garden	No Previous Visit	Previous Visit	N
Edinburgh	27.3%	72.7%	66
Cambridge	38.3%	74.4%	90
Westonbirt	2.9%	88.2%	34
Sheffield	.9%	91.0%	111

However more of the visits by single person groups are by people who have visited previously as opposed to being on a first visit. Possibly having been taken with others on a previous visit, *these single people found that it would be a* pleasant place to return to, or having taken others there, visitors found that their companions were unwilling to go with them on a repeat visit. It is not possible to tell from the data available, but it may be connected with the age of the single visitors. People may continue to visit the garden in their retirement after their families have grown up and left.

There is a significant difference between Sheffield and the other gardens in that groups of more than one were more likely to have been on a previous visit.

Table 8.6.4.9 Groups of More Than One Person

Garden	% of Groups of More Than One No Previous Visit	Previous Visit	N
Edinburgh	35.3	64.7	136
Cambridge	33.9	66.1	109
Westonbirt	37.9	62.1	359
Sheffield	10.9	89.1	184

The percentage of single person groups who have visited previously is higher for all gardens than for groups of more than one. (see Table 8.6.4.8).

8.6.4.12 Visit Frequency by Group Size

There were differences in visit frequency at all sites between groups of one and groups of more than one person: but the significance level was low except at Westonbirt. Table 8.6.4.10.

8.6.4.13 Dog Ownership

At Westonbirt dogs are allowed and many visitors bring their dogs to walk in this large estate. Most come by car, the regular single visitors are mainly dog owners who live nearby. The presence of the dog with the large number of single females may account for some of the 'safeness'.

8.6.4.14 Single Visitors With a Professional Interest

As might be anticipated a slightly greater number of professional gardeners, botanists and horticulturists came on their own to all the gardens.

8.6.4.15 Things Most Enjoyed

An examination of the features most enjoyed by groups of one or more showed that equal percentages of each group liked the same things. The exception

Table 8.6.4.10 Frequency of Visits by 1 person or more than 1 person groups

Garden		Less than 1x/year	More than 1x/year	Less than 1x/month	More than 1x/month	Less than 1x/week	More than 1x/week	N.
Edinburgh	1 person gp	19.2	30.0	40.0	25.0	29.4	63.6	46
	>1 person gp	80.8	70.0	60.0	75.0	70.6	36.4	77
							P=0.0098	
Cambridge	1 person gp	48.8	25.0	28.6	65.0	62.5	64.0	65
	>1 person gp	51.2	75.0	71.4	35.0	37.5	36.0	107
							P=0.016	
Westonbirt	1 person gp	6.5		7.1	50.0	16.7	36.0	30
	>1 person gp	93.5		92.9	50.0	83.3	64.0	221
							P=<0.001	
Sheffield	1 person gp	25.3		33.0	48.7	47.4	55.6	107
	>1 person gp	74.7		67.0	51.3	52.6	44.4	171
							P=0.0035	

was the alpines at Edinburgh where more single people enjoyed these. This could be explained by the Royal Botanic Garden, Edinburgh's close association with the Scottish Rock Garden Society which holds its meetings at the garden. Edinburgh has, arguably, the best alpine garden and collection of alpine plants on show to the public in Britain. More single people went for the peace and quiet, except at Sheffield.

At Cambridge and Sheffield more went for the relaxing atmosphere.

8.6.4.16 Summary

1. The total number of family groups is not large – only 5–10% of groups interviewed.
2. These groups come in greatest numbers on Saturdays and Sundays.
3. 3%–16% of groups are single people.
4. A higher percentage of single females visit at Cambridge and Westonbirt.
5. Single person groups contain twice as many people in the over 60 age group as respondents in multi–person groups.

   This would suggest that botanic gardens are one of the ways in which the solitary leisure pursuit of the over 60's is catered for. The high level of single older person and single female visiting suggests a level of personal security felt which may not be provided by other outdoor recreation sites.

   This also confirms findings by Neilson (1983) that botanic gardens provide a 'safe' environment for the elderly, disabled or people visiting on their own.

   Visiting London parks was found in the GLC Survey to be the activity of a higher proportion of single people than married, though the study does no say whether they went in groups of one or more.

   Group size and composition was similar at Edinburgh and Cambridge, Sheffield and Westonbirt differed from these and from each other.

An investigation of urban park use by 'older' people (55–65 yrs and those over 65) in America found that park use was often a regular part of the life of these people. These visitors payed much longer visits than was found in the current work to be the case with botanic garden visitors (3–5 hours). Much of this extended visiting time however depended on the presence and opening hours of a day centre in the park.

About half of the park visitors described the park as having benefited them in a positive mental or emotional way. Most of the positive responses described the park as a very important agent contributing to a positive change which had great personal meaning in the respondents life. Some of this positive change was exemplified by expression such as "a better outlook", "soothed", "like living when I get home", "healthier", "beautiful" (Godbey and Blazey, 1983). Very many of the respondents at the botanic gardens also volunteered positive comments at the end of the questionnaire.

The value of botanic gardens in their contribution to the mental wellbeing of their visitors should not be underrated.

The therapeutic value of botanic garden visiting was mentioned by visitors in Neilson's survey (1983).

8.7 What the Current Garden Visitors Get from the Garden

8.7.0 Introduction

Botanic gardens attached to universities and research stations state research and education amongst their aims. All botanic gardens state public education and amenity amongst their aims.

8.7.1 Educational Use

This section will examine to what extent the gardens are used for education of an informal nature by the public.

8.7.1.1 Interest by Professionals

It is important to know whether the gardens are visited by other professional botanists, horticulturists, gardeners or foresters, and in particular, whether these people come on repeat visits, as this should give an indication of how well the garden fulfills its role. Amongst the visitors, the percentage with a professional interest is shown in Table 8.7.1.1

Table 8.7.1.1 Percentage of Respondents who Trained as:

	Botanist	Scientist	Horticulturist	Gardener	Forester	No.
Edinburgh	3	15	2.6	2.1	N/A	44
Cambridge	6.4	0.5	1.5	3.5	N/A	22
Westonbirt	2.2	N/A	2.2	1.2	1.0	27
Sheffield	1.3	N/A	1.3	1.3	N/A	12

Showing a higher level of those with a professional interest than would be expected in the general population. The percentage of professionals who had previously visited was the same as for all visitors, while frequency of visiting was somewhat higher as shown below.

Table 8.7.1.2 Visited More Than Once a Week

	Professional	Non Professional
Edinburgh	21.4%	16.6%
Cambridge	5.3%	15.0%
Westonbirt	13.0%	6.8%
Sheffield	44.4%	18.1%

The term 'scientist' used at Edinburgh was too wide, and included doctors and engineers, so this term was dropped. Foresters were included as a group at Westonbirt.

Conclusion

The gardens are appreciated by those with a professional interest and are sufficient of an attraction to occasion not only repeat visits but generally a higher frequency of visiting by those with a professional interest.

8.7.1.2 Amateur Interest in Gardening

A BBC leisure survey carried out in 1974 found that 48% of men and 35% of women in Britain list gardening amongst their home based leisure pursuits. Sillitoe (1969) concludes from his survey that the proportion of leisure time used for gardening, when gardening was cited as the chief pursuit, was 12% for men and 7% for women.

An increase in participation in gardening as a leisure pursuit between 1977 and 1987 is recorded in the General Household Survey (1987).

Table 8.7.1.3 Percentage Participating in the 4 Weeks Before Interview

Persons aged 16 or over	1977	1980	1983	1986	1987
Gardening	42	43	44	43	46

Source: Sillitoe (1969)

With 49% of men participating and 43% of women. The participation rate by age group increases to 57% at age 69. Thus the notion that the British are a race of gardeners would seem to be borne out in fact.

Individuals with an interest in gardening are frequently members of a plant or garden society. As there are membership fees and other expenses associated with this (Pickering, 1980) membership is a measure of the amount of interest in plants and gardens.

8.7.1.3 Membership of Plant or Garden Societies

Respondents at Edinburgh, Cambridge and Westonbirt were asked whether they were members of plant or garden societies with the following results.

Table 8.7.1.4 % of Respondents Who Were Members of Plant or Garden Societies

Garden	
Edinburgh	15.4%
Cambridge	15.8%
Westonbirt	23.7%

This possibly represents the same level of membership as in society as a whole, particularly as many people included membership of the National Trust in the above answers. There are 2,000 local Horticultural Societies affiliated to the Royal Horticultural Society and 107,000 individual members (Coopers, Lybrand and Deloitte, 1991). There are approximately another 2,000 general gardening clubs (Industrial Newspapers Ltd, 1975).

The above may well be an underestimate of garden society membership as specialist societies alone number far in excess of the 240 in Parson's list (Industrial Newspapers Ltd., 1975) the National Chrysanthemum Society has around 1,500 affiliated societies (Gosling, S.G., 1980) and the National Rose Society has 40,000 members.

8.7.1.4 Plant or Garden Magazines Read

About 25% of respondents said that they read plant or garden magazines, but so many qualified this answer by saying that they read other peoples magazines that it was felt that this could not be counted as a real investment in their interest in plants and gardens.

8.7.1.5 Conclusion

Botanic garden visitors are no more likely to be member of plant or garden societies than other members of the public so it would appear that botanic garden visiting is not particularly an activity of amateur plants persons or gardeners.

8.7.2 Public Education

8.7.2.1 Educational Nature of the Visit

Respondents were initially asked whether they had found their visit educational or informative and had it been a pleasure.

During the initial survey at Edinburgh so many respondents insisted that their visit had been for pleasure only, that the question was re–phrased to ask whether their visit had been educational, informative, a pleasure or was it for pleasure only.

Many, of course, answered that it was educational and a pleasure or informative and a pleasure.

The question was only asked at Edinburgh and Cambridge as questions about the facilities were asked at Westonbirt and about the respondents other interests at Sheffield.

The results are complex.

Table 8.7.2.1

Garden	Visit Educational	Visit Informative	Visit a Pleasure	Visit for Pleasure Only
Edinburgh	41.5%	41.9%	50%	57.3%
Cambridge	25.8%	39.4%	37.4%	60.6%

Over half said their visit was for pleasure only.

A large proportion of the visitors found their visit educational or informative, thus the gardens would appear to be fulfilling their role of public education.

Amongst visitors to Oxford Botanic Garden, Dixon (1991) found that 35% cited education as one of their reasons for visiting. Only 27% of his sample however, thought that education was restricted to those with a specific interest such as botanists and students.

8.7.2.2 Additional Information

In order to establish whether visitors wanted more information or education and of what type various suggestions were presented in a list containing many non–educational items and visitors were asked to choose whether they would like any of these provided with the following results:–

Table 8.7.2.2 Number of Respondents Choosing Additional Information

Item	Site Edinburgh	 Cambridge
Labels with more information	23.8%	17.0%
Information sheets or maps	25.2%	16.3%
Talks	8.4%	N/A
Demonstrations	8.4%	N/A
Someone to ask questions of	23.3%	8.7%

The requirement for education would appear to be quite large at Edinburgh.

The item 'labels with more information' generally meant that respondents wanted an English name as well as the Latin name. As the gardens curatorial staff explain there are numerous English names for the same plant in some cases and in other case there is no English name. It is possibly a rather purist view by the gardens. A name in English is more easily remembered by the non–specialist and enables them to look for the plant in garden centres or in a book.

Some visitors wanted other information such as the age of trees or date of planting which would be of interest and practical relevance to their choice of plant for the home garden.

The requests for information sheets or maps was a very valid one. There are information sheets and maps available at both gardens, but they are neither easily available nor obvious. Simple slot machines prominently displayed at the main entrances would be a major improvement instead of visitors having to try, without a map, to find the visitor centre to buy a map. This again relates to poor marketing and self–advertisement in situations where the gardens have not previously had to market themselves.

The main complaints from visitors in Neilson's survey (1983) was about the difficulty of finding the way round a large site and requests for more labelling of trees and plants.

Talks and demonstrations were asked for by only 9% of visitors at Edinburgh. There is a programme of talks and demonstrations at Sheffield. Edinburgh has a permanent exhibition hall with topical demonstrations and Westonbirt has an audio–visual presentation and other static demonstrations in it visitor centre. Sheffield's programme is possibly the most relevant being interactive. Edinburgh and Cambridge have now started conducted walks.

8.7.2.3 Questions Raised

23% of visitors to Edinburgh and 9% of those at Cambridge wanted someone to ask questions of, which shows at least that the gardens stimulate questions and provide material which arouses curiosity. Respondents said that they found the gardens staff helpful when they did ask them questions.

8.7.2.4 Implications for Cost

This does however raise the matter of the cost of having visitors to the garden. Having staff time devoted to answering questions, whilst it fulfills one of the gardens roles, cannot be ignored when estimating the cost of having visitors in the garden, and is an item which must be budgeted for. The percentage of staff time taken up in this way is not known.

If a person were provided to answer questions of a casual nature they would probably have to be constantly available around the garden itself. There are already education officers at Edinburgh and Westonbirt but visitors would have to go and look for them. They also have a schedule of more formal education to follow.

8.7.2.5 Choice of Garden at Sheffield Because of a Talk or Exhibition

At Sheffield visitors were asked, in a list of possible reasons for choosing the garden for this visit and not some other place, whether they had chosen it for a talk or exhibition. 207 or 66.8% of visitors listed this as one of the reasons for choosing the garden. This indicates a very high level of interest in the education which is provided for the public at Sheffield.

8.7.2.6 Knowledge of Scientific Work Done by the Gardens

Visitors to Edinburgh and Cambridge were asked whether they knew if any scientific work was carried out in connection with the garden. About half of the visitors knew that there was, leaving half unaware of the primary purpose of the garden. This, in spite of the fact that the herbarium and private glasshouses are within the walls of the botanic garden at Edinburgh, though screened with plantings as are the experimental sections of Cambridges' garden.

In 1991 the new Regius keeper had a path put in connecting garden and buildings. Previously people attending lectures in the building could not reach it from the garden but had to go in by a separate gate.

Perhaps there should be more interaction between the research part of the garden and the public side. Obviously having the public wandering through experimental areas is not conductive to good research, but a display in the visitor centre relating to current research efforts might be effective in promoting the idea that the gardens are places where work is actually going on and not just ornamental displays. The plants on display to the public are generally not experimental plants.

8.7.2.7 <u>Discussion</u>

1. This segregation of education and amenity would seem to be at the heart of the dilemma facing botanic gardens. Should they try to inform the public of the work they do or continue to keep the public education and amenity separate?

   Are the general public likely to want to know about plant taxonomy or might they question its relevance?

2. Possibly the two roles should be entirely separated rather than each having to justify the other as they become further and further removed from one another.

   Some gardens, like Westonbirt and Sheffield, have made the choice. The Forestry Commission Research Division does not carry out research at Westonbirt, and Sheffield botanic garden carries out no research though both these gardens engage in public education.

3. It would appear that the gardens do provide for public education but that the information may not be in the form, nor as freely available as the public would like.

4. The cost of the public education given on an ad hoc basis is unknown as opposed to the salary and costs of education officers which are known and can be accounted for.

   Edinburgh, Sheffield and Westonbirt have education officers who liaise with schools and other interested groups, and provide talks and exhibitions. It is the informal public education and information which is less satisfactory and less well organised.

5. Much time and effort is spent in botanic gardens labelling plants. These one–off specialised labels are very expensive to produce. Gardens curators and directors believe they are providing information and wish to do so. Perhaps botanic gardens in Britain should become more aware of the research work on labelling and interpretation carried out by museums and galleries and by botanic gardens in America.

8.7.3 Public Amenity

One of the stated aims of the garden is in providing public amenity. One measure of whether the gardens had fulfilled this role was to ask visitors how important they through the design or layout of the garden was in attracting visitors.

8.7.3.1 Importance of Garden Design

This question was asked at Edinburgh and Cambridge.

At Edinburgh 86.5% of visitors rated design as very important or important and at Cambridge 91.7%

At Edinburgh many visitors went on to explain that the design was important because it enabled the garden to hold many more people than was apparent, due to shrubs hiding areas and path arrangements, etc. The design and layout were attributes which people had noticed and appreciated the look, and the implications, of.

8.8 What the Visitors get from the Garden Amenity

This is comprised of two parts.

8.8.1 Conscious or Deliberate Provision for Visitors

The things which are consciously provided by the gardens for their visitors.

8.8.2 Incidental Provision for Visitors

Things which visitors get from the garden which are not consciously provided but which are incidental to the provision by the garden

8.8.3 Repeat Visits

That there is something worth going to the gardens for is seen by the number of repeat visits. That a relatively small number of people in total go to the gardens raises some questions:

(a) Do they provide only for a very narrow audience?

(b) Do insufficient people know what is there?

(c) Could the same thing be provided at less cost in some other way?

8.8.4 Facilities Provided – Deliberate Provision

All the gardens provide toilets and washing facilities, paths and seats at Edinburgh, Cambridge and Westonbirt there are visitor centres although the one at Sheffield is currently closed. There are glasshouses at Edinburgh and Cambridge for displays of plants to the public.

All the gardens are walled or fenced and have opening and closing hours to increase the security of the places. Police are provided at Edinburgh. A set of bylaws are in force at all the gardens. In part, it is these bylaws which make the gardens different from other green space either urban or rural The bylaws discourage children who wish to play games. The gardens are therefore quiet, staid places. This may be why so many single older people go there.

All of the gardens allow people to walk on the grass, which was a feature much appreciated at Edinburgh. The grass in the gardens is closely mown, 3 times/week in Edinburgh, so it dries very quickly. The walking surfaces are very good, except at Westonbirt where the paths become muddy after rain.

8.8.4.1 The Glasshouses

Both Edinburgh and Cambridge have ranges of glasshouses open to the public. Those at Edinburgh are much more extensive than those at Cambridge. This is reflected in the 44% of respondents at Edinburgh choosing 'glasshouses' as a feature most enjoyed as against 27.4% at Cambridge. Additionally, the weather during the Cambridge survey was much hotter than during the Edinburgh survey so less people would be inclined to go into a glasshouse.

8.8.4.2 Outdoor Plant Collections

The alpines and herbaceous border were chosen by about 10% of visitors at Edinburgh and Cambridge, though rather more, 19% chose the herbaceous border at Cambridge where they are laid out in extensive order beds.

8.8.4.3 Trees

Although 'trees' was not on the original list of things most enjoyed at Edinburgh so many of the respondents listed it under 'other' that it was included for Cambridge and Sheffield where it was chosen by the following number of people.

Table 8.8.4.1

	No. of People Choosing Trees	% Total N.
Edinburgh	28.7%	204
Cambridge	24.9%	210
Sheffield	88.4%	310

Edinburgh and Cambridge have much more extensive areas of trees than Sheffield, but it is at Sheffield that trees are one of the most important features.

In an investigation into the emotion people experience in suburban parks it was found that pleasure increased with increasing tree density and decreased with increasing understorey vegetation. The results of this work suggest that designers and managers have some control over the emotional experience of park users (Hull and Harvey, 1989). This is supported by the number of people choosing 'birds and other wildlife' in this work and careful choice and siting of tree and shrub collections should benefit both visitors and wildlife.

8.8.4.4 Pond

The pond was chosen by 37% of respondents at Cambridge and only 19% at Edinburgh. This may again be a reflection of the warm weather at Cambridge. Both gardens have the ponds near one of the main entrances though it is slightly more obvious at Cambridge.

8.8.4.5. Buildings

Visitors to Edinburgh and Cambridge were offered 'buildings' as one of the features they might have enjoyed. The different answers reflect the different types of building available to the public.

Table 8.8.4.2

	No. of People Choosing Buildings	% Total N.
Edinburgh	20.3%	202
Cambridge	9.0%	201

Edinburgh has the historic Inverleith house which houses the sales area and exhibitions in addition to the glasshouses. There is also the herbarium building but this not open to the public. Cambridge has a new wooden visitor centre which was only open for the sale of maps, cards and books for a few hours a day, in addition to the glasshouses.

At Westonbirt 'Visitor Information Centre' was substituted for buildings as it is the only building available to the public. Westonbirt has a wooden visitor centre which houses the exhibits and sales area. 56% of the respondents at Westonbirt chose the Visitor Information Centre as a feature most enjoyed. When the other questions relating to the visitor centre at Westonbirt are examined, 336 of the 414 visitors had been to or intended to go into the Visitor Centre.

312 said the Visitor Centre was easy to find.
299 found it attractive.
168 thought the exhibition was good or very good.
65 who had watched the Audio Visual presentation found it good or very good.
171 thought the bookshop good or very good.

It would appear that it is the contents of the building that the visitors to Westonbirt, at least, are choosing. This may reflect the amount of effort devoted by the various gardens to public information/education. Edinburgh has a good public exhibition area at one end of the glasshouse range but it was poorly signposted and inconspicuous. The exhibitions are now better advertised.

8.8.4.6 General Attractiveness

The high gardening standard was chosen as a feature most enjoyed by about half of those asked as was the 'general attractiveness' at Edinburgh, Cambridge and Westonbirt. General attractiveness was cited by 96% of the visitors to Sheffield as one of the reasons for choosing the garden.

The high cost of providing this standard of maintenance would seem to be justified particularly at Sheffield. The exact numbers choosing 'general attractiveness' were:

Table 8.8.4.3

	Percentage Choosing General Attractiveness	N.
Edinburgh	47.5%	202
Cambridge	36.3%	201
Westonbirt	67.1%	413
Sheffield	95.8%	310

'General Attractiveness' is not entirely a matter of maintenance. It is a combination of attractively laid out and maintained surroundings with features which people like to see. It was most chosen at Westonbirt in the winter, a time when the coloured leaves and blossom are not in evidence. General attractiveness must also be relative to what is usually seen.

8.8.5 Incidental Provision

8.8.5.1 Peace and Quiet and Relaxing Atmosphere

The 'peace and quiet' and the 'relaxing atmosphere' were the features most chosen by respondents at all gardens.

Table 8.8.5.1 % of Respondents Choosing:

Garden	The Peace & Quiet	The Relaxing Atmosphere	N.
Edinburgh	60.9	59.4	202
Cambridge	63.7	46.3	201
Westonbirt	72.6	66.6	413
Sheffield	87.4	89.0	310

Well over half of the respondents, and almost 90% at Sheffield, chose the garden because of these two attributes. In part, the relaxing atmosphere may be generated by the security of the gardens.

Peace and quiet are not essential to a relaxing atmosphere for everyone, many people go to discotheques, football matches, or motor cycles racing for relaxation. That peace and quiet and the relaxing atmosphere were both chosen by the same people in this survey though, shows that peace and quiet contribute to a relaxing atmosphere for this clientele. These are attributes of the garden which are not provided intentionally by the staff. They are produced as a result of what is there and the type of people who use the gardens.

It would be of great interest to carry out further research into the level of choice of these features by visitors to other urban parks or other gardens such as National Trust gardens. These features appear to be most important at Sheffield, which again emphasises the importance of the social value of that garden in that situation.

Provision of similar surroundings with trees, general attractiveness, peace and quiet and relaxing atmosphere might prove very difficult to reproduce.

8.8.5.2 The Birds and Other Wildlife

This was chosen by the third largest number of people at Edinburgh, Cambridge and Sheffield.

Table 8.8.5.2

Garden	Percentage of People Choosing Birds & Other Wildlife	Total No.
Edinburgh	48.5	202
Cambridge	49.8	201
Westonbirt	35.6	413
Sheffield	84.8	310

Again this is most important at Sheffield, and probably reflects the need for mature habitats of the type provided by the garden in an industrial city, rather than that there is a greater amount of birds or other wildlife here than at any of the other gardens. The lower numbers of people choosing birds and other wildlife at Westonbirt may be due to the rural setting where birds and wildlife are commonplace.

Westonbirt has significantly more people than Edinburgh or Cambridge saying that peace and quiet and relaxing atmosphere were features they enjoyed most.

8.8.6 Discussion

The items which is is most expensive to provide, the heated glasshouses, are not chosen as much as some of the things which are incidental to the provision of a botanic garden, e.g. the birds and other wildlife.

The trees are very important to the visitors at Sheffield as was the high gardening standard and the general attractiveness. The question was asked in a slightly different way at Sheffield:–

"Why did you choose this garden today and not some other place?"

With a list to choose from, whereas at Edinburgh, Cambridge and Westonbirt the visitors were asked which feature of the garden they enjoyed most. The answers at Sheffield are probably more positive in that almost all the respondents had been to the garden before and these were the features of the garden which attracted them to make this visit.

The complete list of features enjoyed or reasons for choosing the garden derived from each survey are shown in Table 8.8.6.

8.8.7 Possible Improvements

1. The current clientele would appreciate some relatively minor changes which would improve the educational nature of their visit.
2. The visitor centre and its exhibits is a very important attraction at Westonbirt and provides a medium for explaining the work of the Forestry Commission. It is sited near the car park and well sign posted.
   Edinburgh and Cambridge have visitor centres but they are poorly sited. This poor siting is aggravated by the non–availability of maps or guide books at the gates.
3. As the visitor centres have the retail outlets within them it would make economic sense to try to ensure that they were easy to find.
4. The retail sales to the estimated 12,446 visitors at Westonbirt generates £30,000 profit. Theoretically then, Edinburgh with three times as many visitors could generate £90,000 profit.
5. Comments about 'labels with more information' and 'someone to ask questions of' must be addressed seriously. Both are expensive items but they are ways in which botanic gardens differ from other gardens and parks.
6. 66.8% of Sheffield's visitors listed a special talk or exhibition as one fo their reasons for choosing the garden. Possibly this type of programme of events held throughout the year could usefully be taken up by other gardens.

What features of the garden did you enjoy most % respondents | Why did you choose this garden today and not some other place % respondents

	EDINBURGH		CAMBRIDGE		WESTONBIRT		SHEFFIELD	
	Chosen	Not Chosen	Chosen	Not Chosen	Chosen	Not Chosen	Chosen	Not Chosen
Glasshouses	44.1	55.9	27.4	72.6	NA		NA	
Specific plant collection	5.0	95.0	13.4	86.6	NA		NA	
Trees	28.7	71.3	24.9	75.1	NA		88.4	11.6
Pond	9.4	90.6	37.3	62.7	NA		NA	
Herbaceous heather garden	9.4	90.6	18.9	81.1	NA		NA	
Buildings	20.3	79.7	9.0	91.0	NA		NA	
Information Centre	NA		NA		55.9	44.1	NA	
High gardening standard	42.1	57.9	NA		NA		53.3	41.7
The peace and quiet	60.9	39.1	63.7	36.3	72.6	27.4	87.4	12.6
The birds & other wildlife	48.5	51.5	49.8	50.2	35.6	64.4	84.8	15.2
General attractiveness	47.5	52.5	36.3	63.7	67.1	32.9	95.8	4.2
Relaxing atmosphere	59.4	40.6	46.3	53.7	66.6	33.4	89.0	11.0
Conifers	NA		NA		32.8	67.2	NA	
Acers	NA		NA		NA		NA	
Rhododendrons	NA		NA		NA		NA	
Nearer home	NA		NA		NA		57.1	42.9
No games allowed	NA		NA		NA		57.1	42.9
The variety of plants	NA		NA		NA		87.7	12.3
Had a limited amount of time	NA		NA		NA		44.8	54.2
For information	NA		NA		NA		68.4	31.3
For a change	NA		NA		NA		72.6	27.4
For a talk/exhibit	NA		NA		NA		66.8	33.2

8.8.8 What Makes the Garden Different From Other Gardens the Visitors Have Been To?

This question was asked by providing respondents at Edinburgh and Cambridge with a list of things which might be different from other gardens or parks with the following answers:–

Table 8.8.8 % Respondents Choosing as Different:–

Item	Edinburgh N=202	Cambridge N=201
The variety of plants	40.1	10.4
Presence of unusual plants	24.3	7.5
Glasshouses open to the public	21.8	3.5
No entrance fee	19.3	7.5
The labelling	23	7.0
Other	54.5	16.4

Under 'other' at Edinburgh,

25 people said 'the larger size',
20 'the high gardening standard',
5 'the view',
4 'able to walk on the grass',
2 'no dogs allowed'.

Under 'other' at Cambridge the most frequently mentioned thing was having a garden this size so near the city centre.

8.8.8.1 Conclusion

Very many visitors thought that the gardens were different and were able to pick out reasons for the differences and suggest other things which separated these two botanic gardens from other gardens they visited. If the features listed in Table 8.8.8 are the differences between botanic gardens and other gardens then part of the greater costs of running botanic gardens is explained as all of them are relatively expensive to provide.

8.8.9 Causes of Frequent Visiting

The items people had chosen as things they most enjoyed were cross–tabulated against visiting frequency to try to find out what the particular attractions of the gardens might be. The peace and quiet was found to be correlated at the 94% significance level at Cambridge and at the 99% level at Westonbirt. The birds and other wildlife showed a significant correlation at the 92% level at Edinburgh and 94% level at Cambridge.

The frequency of visiting was affected by distance from home to the garden. Significantly so at the 99% level at Cambridge, Westonbirt and Sheffield but only at the 97% level at Edinburgh.

As so many tests were done in this analysis only those significant at the 99.9% level can be considered absolutely valid.

Thus of the items investigated only the distance from home to the garden affected frequency of visiting with those living nearer visiting more often. All the features of the garden are equally important to those from all distances. No difference was found in the features chosen as important in groups from different distances from the garden.

8.9 Social Provision

Many gardens provide a social element for the visitors. A 'Friends of the Garden' scheme is in existence at many botanic gardens, including Sheffield and Cambridge. The existence of 'Friends of the Garden' societies have shown a large increase in number over recent years (Neilson, 1985). Kew now has such an organisation.

Originally started by the gardens to assist them in their financial difficulties these groups of friends soon organize themselves into a social group with meetings, lectures, outings and visits to each others home gardens. The initiating botanic garden provides a meeting place and a primary raison d'étre. The 'Friends' groups provide interests, education, plants and company for the members and in return the gardens receive financial help, though this is usually given for a specific project which is of interest to the visitors. Money is not given to support the research or formal teaching role of the garden. Friends schemes may fund staff posts in the garden or Friends may help directly with the gardening themselves, as at Ness (Broadbent, 1990).

The gardens also provide a venue for other events. At Sheffield displays or exhibitions by various specialist plant societies are put on. At Edinburgh the Scottish Rock Garden Society and the Scottish Branch of the Botanical Society of the British Isles meets and there are exhibitions, usually, of plant related paintings and literature.

The gardens are also places which are visited by social groups organised for other reasons, e.g. Womens Institutes, Flower Clubs, Horticultural Societies, on an informal basis.

On a more formal basis schools and university groups visit the gardens ostensibly for educational reasons, in many cases.

A number of visitors to the gardens volunteered the information that they had come there to meet friends. In an informal way, many people felt a strong social link with the garden. This occurred mainly with the regular visitors. Many memorial benches had been presented to the gardens at Edinburgh and Cambridge. Westonbirt had been offered many memorial trees but had got round the problem of numerous trees of unknown provenance by offering to dedicate a tree which they planned to plant. The gift and it's commemorative details to be entered in a book kept in the office.

The value of this feeling of belonging and continuity should not be disregarded when valuing botanic gardens. This idea is carried further in the leaving of bequests to the gardens. Some bequests are plant collections which may provide problems in terms of space and management. Other bequests are financial and do much to support the upkeep of the gardens. One of the largest of these must be the Cory fund at Cambridge which provides the funding for one–third of the gardens staff (Oriss, 1990). These bequests should be a reflection of what the donor has received from the garden in intangible benefits or the extent to which the donor valued the garden in some way.

In an analysis of reasons for urban park use Hayward and Weitzer (1984) found that social activities such as being with friends or family and observing other people were important reasons for park visiting. The social reasons followed the desire for physical activity and the enjoyment of nature in importance.

Amongst the social benefits of outdoor recreation Kelly (1978) found that family interaction is a major element in leisure and central to the leisure and life satisfaction of most adults:

> "The outdoor context provides special opportunities for interaction freed from many of the routines and obligations of at–home interaction."

Outdoor recreation, for the most part, involves getting away from pressures and other people with selected companions. The outdoor resource provides a context for the development and enhancement of those primary relationships in ways that make the experience especially valued (Field and O'Leary, 1973).

Burgess, Harrison and Limb (1988) in their study of the meanings and importance of urban green space to its users found that open spaces are:–

> "Seen and experienced holistically, as embedded in the built environment rather than isolated from it. Parks and open spaces are replete with personal and social meaning. They provide a context for social interaction, they serve as tangible reminders of childhood and memories of community life, they offer 'gate ways' of opportunity for people to escape for a while from the stresses of urban life. The value of green spaces is not to be measured in physical terms: the sum total of acreage or facilities do not provide any indication of the social and symbolic meanings associated with them."

This degree of personal attachment for a green space was frequently observed amongst garden visitors. Many of those at Edinburgh and Sheffield in particular, The gardens are more allied to the 'defensible space' of Newman (1973) and Coleman (1985).

8.10 Comparative Attraction of the Gardens

8.10.1 Introduction

Whereas the surveys carried out at Edinburgh and Cambridge were very similar in questionnaire content, changes only being made where a question had proved ambiguous or irrelevant at Edinburgh, to provide a base line of data for comparison, further investigations were undertaken in the Westonbirt and Sheffield questionnaires.

The attraction of the garden was explored by asking at all gardens whether the visitors would have gone somewhere else if the garden had been unavailable for a visit. The following results were obtained:–

Table 8.10.1

	Alternative Visit		
Garden	No	Yes	N.
Edinburgh	22.5%	77.5%	200
Cambridge	32.0%	68.0%	194
Westonbirt	28.7%	71.3%	407
Sheffield	25.0%	75.0%	308

The percentages of people saying that they would have gone on an alternative visit were very similar for all gardens, c. 75% (range 68.0% – 77.5%).

Visitors to Sheffield and Westonbirt were asked whether their trip was <u>just</u> to visit that garden and whether it was <u>specifically</u> to visit that garden. There were significant differences between the answers received to these questions at the 2 gardens.

Table 8.10.2 Is Your Trip Just to Visit this Garden?

	No	Yes	N.
Westonbirt	15.9%	84.1%	409
Sheffield	68.1%	31.9%	307
		P = <0.001	

Table 8.10.3 Is Your Trip Specifically to Visit this Garden?

	No	Yes	N.
Westonbirt	5.0%	95.0%	399
Sheffield	13.9%	86.1%	302
		P = <0.001	

Westonbirt appears to have many more people doing a one–purpose trip with 95% going specifically to visit the garden and 84.1% going only to the garden and nowhere else on their trip.

By comparison, whilst 86.1% of Sheffileds visitors, again the large majority, had the visit to the garden as the main purpose of the trip, only 31.9% of Sheffield's visitors visit the garden only. They take the opportunity to visit other places in the same trip.

A difference in the trips to Westonbirt and Sheffield is indicated. Westonbirt is, generally, further from home and the visits to it are longer. People usually make it a special visit. This should make a travel cost calculation easier to carry out for Westonbirt. However visitors take many people in their car, thus reducing the cost per head.

At Sheffield, whilst the garden is the main part of the visit, 68% of people went to other places as well. The garden at Sheffield is smaller and would not take so long to see. This multiple–purpose visit made a travel cost calculation very difficult at Sheffield, as only part of the travel and part of the value could be attributed to the garden.

That the difference between the percentage of visitors going specifically to visit the garden at both Westonbirt and Sheffield is small shows that the gardens are of almost equal importance in this context despite differences in size and distance. This is supported by the answers to the question 'Did you arrive here by chance?' where no significant difference was found between the two gardens. 90.5% of Westonbirt visitors and 86.8% of those at Sheffield had not arrived by chance.

Quite a number of visitors to both gardens had learnt of its existence by chance, but on this visit at least 90% had intended to visit the garden.

As so many of Sheffield's visitors were on outings where the visit to the botanic garden was only a part it was pertinent to enquire where else the visitors were going. The following answers were obtained.

8.10.2 Additional Places Visited on the Same Trip

The places where visitors at Sheffield would have gone in addition to their visit to the botanic garden are shown in Table 8.10.4.

Table 8.10.4

Additional Visit	No.	%
Nowhere else	74	23.9
Work, School or University	66	21.3
Don't Know	1	0.3
Shopping	42	13.5
Touring, Sightseeing	24	7.7
A Building or Monument	7	2.3
A Town or Village	11	3.5
Sport, Pub, for a Meal, Visit Friends/Family	63	20.3
Other	22	7.1

Only 13.5% were combining this visit with other tourist attraction, whereas 55% combined it with normal daily events, such as work, school, sport, visiting friends or family or shopping, which would indicate that visiting this garden was a normal part of everyday life for more than half the visitors, and not some special event. It could be thought that as the garden in Sheffield is so central, many more visits would be people wandering through by chance.

It would be interesting to ask visitors to parks and other sites if they had arrived by chance.

8.10.3 Visitors Who Would Not Have Gone on an Alternative Visit if the Garden Had Been Unavailable

25% of visitors to all 4 gardens said they would not have gone on an alternative visit. At Sheffield this answer was further examined by asking these people what they would have done instead.

Of the 77 people who would not have gone on an alternative visit:–

Table 8.10.5

13%	10 would have spent their time going for a walk.
37.7%	29 would have spent the time at home relaxing.
19.5%	15 would have spend the time working at home.
43%	33 would have done something other than this.

Although these visitors did not find another park or garden a sufficient attraction to be an alternative visit, they would not, apparently, have used their time in any way which would enable a value to be put upon their visit, except that a visit to the botanic garden would seem to be the only visit worth their expending the time and energy on. Perhaps these are the people on whom a travel cost analysis should be done and not the whole sample.

The GLC Recreation Study (1981) found that only 28% of Londoners had home based leisure pursuits which were 'more important' to them than the three types of pursuit listed in Table 8.10.5. Those who participated least in activities outside the home did not, usually, have compensating home based pursuits which were more important to them. Relaxing or working at home should not therefore be considered as of less importance than outdoor recreation.

The 25% choosing home leisure as an alternative to a different visit choose it as a genuine alternative to which as much importance is attached as to going to a park or garden or any of the other places chosen as an alternative visit.

If 75% of visitors would have made a satisfactory visit to some other place it raises some questions about the value of this particular place, though the satisfaction would presumably have been less.

8.10.4 Visitors Preferences for Other Types of Outdoor Recreation

To further investigate the consumers, to find out what type of person liked visiting botanic gardens, the visitors to Sheffield botanic garden were asked what other types of places they liked to go to by presenting them with a list comprised of urban and rural situations and asking them to choose 3, or state Other.

The answers were not ranked.

Table 8.10.6

	No.	%
Countryside	222	71.6
Historic Buildings	107	34.5
Places of Local Interest	79	25.6
Concerts	73	23.5
Garden Centres	73	23.5
Woods/Forests	102	32.9
Museums/Art Galleries	101	32.6
Shopping Centre	61	19.7
Parks	77	24.8
Swimming Baths	66	21.3
Sports Centre	46	14.8
Other	12	4.2

The countryside was by far the most chosen. It was chosen by 71.6% of the visitors as a place they also liked to visit. 87 of this 71.6% (28.1%) also chose woods. 102 people chose woods or forests. 87 of these also chose countryside. 15 only chose woods or forests and not countryside.

The places chosen as those which visitors to Sheffield botanic garden also like to visit were compared with results from four other surveys (see Table 8.10.7).

1. The GLC Recreation Survey (1981) was a survey of a sample of London residents. It asked what percentage of the interviewees had participated in any of the list of activities in the last year.

   This survey most nearly resembles the current work as participation within a year was ascertained, and the sample were city dwellers as were the majority of those interviewed at Sheffield.

2. The General Household Survey, Leisure Survey, asked a large sample of the general population whether they had participated in a wide range of activities in the four weeks before interview.

3. The Countryside Commission Countryside Recreation Survey, 1984 (CCP 201, 1985) asked a national sample about participation in countryside recreation, but included two urban activities: park and seaside resort visiting.

4. The Countryside Commission Compendium of Recreation Statistics 1984–1986 with 1988 addendum (CCD 16, 1987), asked the interviewees the sort of things they liked to do when they go out, all were leisure activities away from home.

   In this respect the survey was similar to the Sheffield one – exploring peoples stated preferences.

Table 8.10.7 Comparison of results from 6 Surveys

	Sheffield Survey	GLC Recreation Survey	GHS 1986	National Countryside Recreation Survey	Compendium of Recreation Statistics	Leisure Day Visits 1988/89
Countryside	71.6	51.0	3.0	51.0	18.0	9.0
Historic Buildings	34.5	39.0	9.0	3.0	6.0	3.0
Places of Local Interest	25.6					0.3
Concerts	23.5	21.0			8.0	4.0
Garden Centres	23.5	16.0				
Woods/Forests	32.9					
Museums/Art Galleries	32.6	28.0	4.0			
Shopping Centres	19.7	54.0	4.0	20.0	5.0	6.0
Parks	24.8	22.0	9.0		7.0	2.0
Swimming Baths	21.3					3.0
Sports Centres	14.8					5.0
Other	12.0					

5. The OPCS Leisure day visits in Great Britain 1988/89 was a survey carried out of trips of more than 3 hours in duration and more than 10 miles in each direction. Most trips to botanic gardens do not come into this category, particularly those at Sheffield. The survey is of trips which the interviewees had chosen to make, and contained many of the choices presented to the Sheffield respondents

Many of the surveys included visiting friends or relatives or going to the pub, restaurant or wine bar. These are the most frequent outings and account for 40–50% of all outings.

As can be seen from the table, there are a wide range of answers depending on who devised the questionnaire and for what purpose.

The GLC Recreation survey shows similarities to the Sheffield survey in the percentage of respondents liking historic buildings, concerts, museums, art galleries and swimming baths. The GLC survey had far more, 54% interviewees, having visited a park, whilst far more Countryside Commission interviewees had visited the countryside in the last month.

In the GLC survey equal numbers had visited the countryside or London parks in the last month; whereas at Sheffield botanic garden three times as many respondents chose the countryside as a place they liked visiting as chose parks. The GLC survey does not state whether it is the same people who visit parks as go to the countryside. More available time and access to a car by more people might have resulted in a higher percentage having visited the countryside. (The survey took place in 1971.)

Demographic differences and the time between the two surveys no doubt affects the answers to some extent. There are however striking differences in the percentages choosing countryside, especially as the Sheffield visitors also had woods and forests listed in addition and chosen by 32.9%.

In Table 8.10.6 only 25% of visitors at Sheffield chose parks as a place where they also liked to visit which must cast doubt upon their use as a substitute for botanic gardens. Parks were, however, chosen as an alternative visit if the present visit had been unavailable by:–

Edinburgh	21.7%
Cambridge	15.7%
Westonbirt	24.3%
Sheffield	46.8%

Here 47% of Sheffield's visitors chose a park as an alternative visit but only 25% listed it as a place they also liked to go.

Parks were relatively little cited as a place they also liked to visit by either those who would have gone on alternative visits or those who would not.

Table 8.10.8 Places the Respondents Liked Visiting

Alternative Visit if Botanic Garden Unavailable	Countryside Chosen	Parks Chosen	N.
No	81.8%	19.5%	77
Yes	69.1%	26.8%	231

It would appear that botanic gardens are used by a different clientele from parks.

Even fewer visitors chose garden centers as places they liked going to. Many gardeners and non–gardeners like visiting garden centres even if only to look at the plants. Only 25% of botanic garden visitors chose this as one of the 3 places they liked going to whereas even in 1971 16% of the GLC sample chose this. This and answers relating to what things people had most enjoyed in the botanic gardens, together with the low numbers belonging to plant or garden societies would seem to indicate that botanic gardens do not appeal only or even mainly to gardening enthusiasts.

It is interesting to note that of those who would not have chosen an alternative visit if the garden had been unavailable, 82% cited the countryside as a place which they also liked to visit. These people possible see the botanic garden as surrogate countryside and for them it may be that a much less expensive alternative to the botanic garden could be found.

88.4% of visitors to Sheffield chose trees in the question on why they chose this garden today and not some other place. That 32.9% of these visitors selected woods and forests as one of the 3 types of places they liked to visit is then hardly surprising. This 88.4% compares with 25% at Edinburgh and Cambridge.

That historic buildings are chosen by 33% of Sheffield visitors and 39% of the GLC interviewees is a similar answer to that obtained at Edinburgh from visitors asked where they would go for an alternative visit.

The swimming baths were chosen by a similar number to those in the GLC survey but more than found by the GHS survey or the CC survey. Possibly having asked whether people had participated in the last month made the difference or it may be that swimming baths are more available in London and Sheffield.

8.10.5 Summary

1. Gardens provide a focus around which various social activities can be centred.

   The 'Friends of the Garden' schemes are the chief vehicles for this. In some cases they raise substantial financial support for the gardens. They may also assist in other activities which improve the facilities of the garden, such as by running the café and retail outlet and conducting guided walks.

2. The gardens may be centres where specialist plant societies can hold an exhibition.
3. They are places which group outings can visit.
4. 25% of visitors would not have chosen an alternative place to visit if the garden had been unavailable. Upon investigation it transpired that these people would have remained at home doing household jobs or relaxing. Some would have gone for a walk. A visit to another park or garden was not considered to be of equal value in time and effort spent.
5. Whereas visitors to Westonbirt frequently go for a day's outing with the family, 24% of visitors to Sheffield combine a garden visit with other everyday work or shopping activities.
6. Other places respondents liked to visit were the countryside, chosen by 71.6%. Historic buildings, chosen by 34.5% with woods and forests and museums and art galleries chosen by 33%.
7. Although 47% of Sheffield's visitors chose a park as an alternative visit if the garden was unavailable, only 25% of them listed it as a place they also like to go. They may well be differentiating between what they are able to do and what they would like to do for a visit.
8. Botanic gardens would appear to have a different clientele from parks.
9. Of the general population 20% chose a park as a destination for outside recreation which agrees with the 25% of visitors at Sheffield saying they liked visiting parks.

Notes

1. That people over 60 appear to favour more solitary leisure pursuits has been reported in:–

   'Evaluating Urban Parks and Recreation', 1981, by William S. Hendon, Praeger, New York.

   citing

   'Leisure Activities Among the Middle Aged', Havinghurst, Robert J., American Journal of Sociology LXII, Sept 1957, pp152–162.

CHAPTER 9

DISCUSSION AND CONCLUSIONS

This thesis has examined a large number of the benefits of botanic gardens. The benefits may be internal, benefiting the garden itself or external benefiting society as a whole. These benefits may be financial or social. They are very diverse and possibly benefit a wider section of the community than is realised by those who fund botanic gardens.

These benefits are summarised in Table 9.1 below.

Table 9.1 Internal Benefits

Source	Benefit	Comments
Entrance Fees	Positive	Where charged they offset the requirement for Grant–in–Aid or Subvention.
Funds raised by Friend's Schemes	Probably Positive	Money raised for new capital projects which would not have been possible by other means. May need a change of staff to those who enjoy public relations work.
Bequests	Positive	Enhances the finances and the reputation of the garden. Disadvantages may occur in conditions attached to bequest.
Endowment Interest	Positive	Financial benefit. Represents a ± stable source of income.
Donations	Positive	Financial benefit. Disadvantage may be conditions attached.
Profit on Sales	Positive	Financial gain. Requires enlargement of entire operation to produce and/or market material.
Rent of Premises	Positive	Financial gain. Makes multiple use of grounds or buildings. Public liability insurance required. May have to rearrange collections to ensure research is untouched.
Research	Positive	Indirect financial gain. More or better publications ensure funding. Rated by citation indices or other measures.

Table 9.1 (continued)

Source	Benefit	Comments
Training	Positive	Indirect. Ensures trained staff and quality of work. Reputation of training enhances gardens viability.
Plants	Positive	Ensures garden stock is replenished. New introductions and collections for work on floras ensure gardens reputation and continued material for research.

External Benefits

Source	Benefit	Comments
Employment and Gardens Budget Spent Locally	Positive	Financial benefit to local community. Multipliers 1.15 to 2.5.
Tourism	Positive	Financial benefit to local community in money spent and jobs created + multiplier. Effects much larger for larger gardens or those in tourist cities.
Education	Positive	Indirect financial. Social rates of return.
Training	Positive	Probably greater for Diploma courses and other training than for contribution to tertiary education.
Research	Positive	Non–financial. Basic research into plant taxonomy + facilities for some other research.
Plant Production	Positive	Non–financial and indirect financial if newly introduced plants ever become commercially grown. Much smaller impact than formerly.
Recreation	Positive	Non–financial if no entrance charge. Non–use values also exist: Option, Existence and Bequest demands. Social benefits in provision of outdoor leisure pursuit for particular groups of people.
Amenity	Positive	As above.
Wildlife	Positive	As above.
Increased Property Values	Positive	Financial benefits on values of land and property.

Table 9.1 (continued)

Source	Benefit	Comments
Heritage	Positive	Social benefit. History of plant introductions. Specimen trees.
Conservation	Negative	Negative because apart from Kew and a few other gardens the conservation effort is far less than is needed to sustain even the British flora. The claim hides the lack of conservation.

One of the tangible ways in which botanic gardens are assessed is by their running costs. In this thesis data on the running costs of a number of botanic gardens has been gathered. This shows these costs to be very much higher than the costs of maintenance of local authority green space.

In both instances the costs of labour are around 63% of the total costs, but the amount of labour per hectare employed in botanic gardens is very much higher than that for local authority green space.

It is this very high running cost which must be balanced against the social and other benefits of botanic gardens.

The high labour costs are partly reflected in the very high standards of maintenance, in the diversity of plant material, and the large number of people required to care for glasshouse plants.

In a number of gardens the high cost of maintenance is due to the employment of garden staff on technician grades instead of craftsman gardener grades, which increases labour costs by 60–100%. There is a balance to be struck between a real requirement for an interest in the plantings and the level of maintenance required from those who look after the plants. Part of the peace and quiet and the security of the gardens may be provided by having wardens, park attendants or police as at Edinburgh. The presence of more staff about the gardens may be equally effective in preserving the atmosphere of the garden.

Botanic gardens provide many benefits in research, education, amenity and conservation. These are reviewed in Chapters 5 and 6. Some of the value in social recreation can be quantified and two methods of estimating this value are described for four botanic gardens in Chapter 7.

Many of the features of botanic gardens which make them valuable as a recreational resource cannot be measured in this way. This value to the public is examined in Chapter 8. The main points are summarised here.

The botanic gardens in the U.K. are not all the same. There are differences between the smaller municipal gardens like Sheffield, the larger urban gardens attached to Universities or Research Stations like Edinburgh and Cambridge and the very large rural gardens like Westonbirt. The accessibility of the gardens affects the mode of transport, the cost of getting there and the frequency of visits by any individual and the length of the visit. The more accessible the garden, the more likely it is to be visited frequently for short visits. In contrast to parks, botanic gardens, especially Edinburgh, are visited more frequently from greater distances.

Visits to historic gardens and botanic gardens are increasing annually compared with visits to the countryside, where the number of visits is falling. In spite of this total, visitor numbers to most botanic gardens are still well within the capacity of the gardens and an increase in visitor numbers would increase the gardens viability either directly, financially through entrance fees, or as a contribution to social benefits.

Most gardens do very little advertising or marketing. 80% of visitors heard about the garden by word of mouth compared with 58% at historic gardens where an entrance fee is paid.

Pressure on gardens to increase the revenue which they raise themselves probably means that they will have to increase their marketing. Some professional marketing could prove to be cost effective as currently maps of the garden and handbooks are often available in the Garden Visitor Centres, but a map is necessary to find the Visitor Centres at some gardens!

Botanic gardens do not currently appeal to all members of the population. Very few of the visitors are under 16. There are fewer people in the 30–50 year age groups at botanic gardens than at historic gardens. Of those who visit more than once a week, twice as many occur in the over 60 age group than in other age groups.

There are 22% more females than males amongst botanic garden visitors, especially in the under 45 age groups. Frequently women and children visit together. Although more women go to more botanic gardens, individual men visit more frequently.

Only 5–10% of the groups who visit are families. 14% of visitors came on their own, except at Westonbirt where only 3% came alone.. At Westonbirt and Cambridge over 60% of these lone visitors were females.

There are twice as many single person groups in the over 60 age range than multiple 'groups'.

Botanic gardens would then seem to have a particular social recreational value for women and for those over 60, especially as a visit on their own. It may imply a greater degree of security in these places than at many other outdoor recreation sites.

The visitors are largely professional people from higher income groups. Their economic profile is similar to visitors to historic gardens and buildings, museums, art galleries and the countryside. The few low income visitors are mainly students; the unemployed and low income groups are poorly represented amongst the visitors.

Thus, relatively few people visit the gardens and these are not a cross section of the general population. Initial marketing should probably be targeted at the socio–economic and age groups from amongst whom the current garden visitors are drawn to increase the numbers of those people visiting; this would probably be easier than trying to make the gardens appeal to younger people.

It is not, in fact, necessary that botanic gardens should appeal to everyone. Many gardens have education programmes for schools, as one of their primary functions is said to be education. School groups may visit but school children do not appear to pay subsequent visits on their own.

Perhaps botanic gardens will never have universal appeal, but this should not be a matter of concern.

Visitors were not any more likely to be members of plant or garden societies than members of the general population, so an interest in horticulture is not necessarily an incentive to visit a botanic garden. Only half the visitors knew that the gardens at Edinburgh and Cambridge had any involvement in research. Over half the visitors said that they went for pleasure only. 40% said that they had found their visit informative or educational. So the gardens are playing a role in informal education.

Visitors said that the most attractive features of the garden were the peace and quiet, the relaxing atmosphere and the birds and other wildlife. These things are a consequence of the special characteristics of a botanic garden. The general attractiveness and the high gardening standard were also important.

75% of visitors would have gone on another visit if the garden had not been available. For 25%, a visit to another park or garden was not seen as a suitable substitute.

Over 40% of visitors to Edinburgh and Cambridge had not been to any other garden in the last year, which suggests a high degree of satisfaction with the gardens. 25–35% of visitors had been to at least one other botanic garden in the last year. Botanic gardens are well spread out throughout the country so this would indicate that people are prepared to travel substantial distances to visit another botanic garden. Botanic gardens therefore do not appear to perform the same function as parks. They appear to be an attraction similar to stately home gardens or the countryside. It is possible that they represent an improved, valued substitute countryside at a convenient distance from home for many people. The trees, wildlife and water features provide much in common with countryside visits.

Accessibility, or nearness to home, was found to be the most important single feature in attracting visitors. Westonbirt, with a very small local population provides a focus for a day–out visit for people from adjacent large centres of population.

Summary

Botanic gardens therefore have a social value which is different from other outdoor attractions. They appeal to a restricted group of people rather than to the population generally. This may be a particular social value especially to elderly and single visitors.

There is scope for increasing visitor numbers probably by attempting to increase the number of local visitors from the same age groups and social economic groups as at present and not by trying to change the appeal of the gardens to include e.g. under 16 year olds.

A professional marketing exercise might prove cost effective.

Because there are so many diverse benefits and botanic gardens are of value to so many different interest groups a reappraisal of their entire role to society is timely. Currently decisions on their future are being taken by those who have a limited and possibly anachronistic interest in them. Whilst a number of gardens are being closed, garden visiting by the general public increased 52% between 1986 and 1989, with 14 million trips per year being made to a park, garden or common (Dodd, 1989). This total is estimated to be 2% of all leisure day trips that last three hours or more and have a round trip mileage of 20 miles or more. This does not include the much higher level of garden visiting which takes place for shorter periods and from shorter distances.

The number of visitors to botanic gardens in the UK is around 5 million per annum (Coopers and Lybrand Deloitte, 1991). Visitor numbers to individual botanic gardens increase each year, whether there is a charge, as at Kew, Ness and Westonbirt or not, as at Edinburgh. Kew gardens is amongst the 10 most popular tourist attractions in Great Britain charging admission (Table 9.2).

Table 9.2 Millions of Visits to Kew Gardens

	1981	1986	1988	1989
Kew Gardens	0.9	1.1	1.2	1.2

Source: British Tourist Authority, in Social Trends, 21.

In a survey of botanic gardens Dixon (1991) estimated the following figures for annual numbers of visits to 30 UK botanic gardens (Table 9.3).

Table 9.3

No. of Visitors	No. of Gardens
< 5,000	7
6,000 – 10,000	5
11,000 – 50,000	6
51,000 – 100,000	2
> 100,000	10

This could represent 2½ – 3½ million visitors rather than the 5 million estimated by Coopers, Lybrand Deloite.

At gardens where there is a charge there is an incentive to advertise and thus increase the visitor numbers. Additionally the Forestry Commission, which administers 2 arboreta open to the public, states in its Forestry Policy document (September 1991) that Forestry is now entering a new phase in which increasing emphasis is placed on social and environmental as well as economic benefits. Financial support for woodlands now requires that clear benefits should be delivered to the community at large. The Forestry Commission have long been aware of the social value of forest recreation and are well used to the concept of placing monetary values on the unpriced benefits of forestry (Bateman, 1991; Willis and Benson, 1989). A method for placing a value to the public on the various environmental features in commercial forests has been devised by Benson (1992). Whilst worldwide concern is being expressed over the rate of species loss, both plant and animal, shrinking funds at the Royal Botanic Gardens Kew will mean that new conservation initiatives will have to rely on private money according to Kew's director Professor Ghillean Prance (Gee, 1990).

Concern over any real commitment to conservation must be felt when the figures produced from Thomas' survey of the number of taxonomists or whole plant biologists currently in post in Universities is compared with the numbers five years ago (Thomas, 1991). However, Thomas' survey may not be wholly representative in that he only wrote to Departments which did not openly emphasise their lack of interest in taxonomy. Some departments which were circulated did not reply, therefore results were only obtained from concerned individuals or Departments.

The concern is more general than taxonomy. It extends to UK Science Policy generally and to all Biology teaching and research in universities. The Royal Society is currently completing a major enquiry

> "into the policies and actions needed to ensure the well being of scientific research over the next decade... .
>
> Over the last 10–15 years there have been major structural changes in the conduct of, and framework for, scientific research in the UK. The proportion of general national expenditure on research and development financed by Government expenditure on the science base has declined steadily from 0.35% of GDP in 1981 to 0.28% now:
> 1200 permanent science and engineering posts in Universities have been lost since 1979, while the proportion of Science and Technology staff on short term contract posts has risen from 25% to 42%. The president will lead a broadly based committee of Fellows of the Society who will conduct the enquiry. (Royal Society 1991)"

As part of the last rationalization in universities following the Jarratt report 'The Development of Higher Education into the 1990's' (UK Parliament, May 1985) departments were merged and facilities rationalised. The teaching of biology in universities was further examined in the Southwood report. This was the report of a committee set up

> "To consider features of the field of biological sciences as represented in British Universities and to advise the Universities Grants Committee on the way in which the biological sciences may best be covered by one or more rationalisation reviews and the appropriate criteria for consideration." (Southwood, 1989)

As a result of this report Biology Departments were merged to make viable units. 'Rationalisation' took place with the loss of some botanic gardens e.g. Hull and Cardiff.

There is sufficient concern nationally about the state of systematics and taxonomy for there to have been set up a House of Lords Select Committee on Systematic Biology Research during the Parliamentary session 1990–91. The Select Committee has collected written evidence from UK and foreign institutions covering museums, universities, government department, botanic gardens, interested societies and industrial firms. It also invited additional verbal evidence.

This Sub–Committee was set up largely in response to the great concern expressed by the biological sciences community when the Natural History Museum (NHM) published it's new corporate plan for 1990–95.

The plan was drawn up in response to a change in funding for curation and research when responsibility for the NHM was transferred from the Department of Education and Science (DES) to the Office of Arts and Libraries (OAL). The results of the changes to the scientific users was that various sections of the museums collections were placed on a maintenance basis only, due to reductions in staff levels amongst research and curatorial staff. Concern was world wide, as historically many of the collections within the museum had been made in various parts of the British Empire and the collections deposited in the British Museum. The material contains many of the type specimens of species.

On questions of general concern in systematics the Select Committee considered

1. What was the use of systematic biology?
2. Is the level of UK research appropriate?
3. Is the UK research in the right areas?
4. Is the current "institutionalised" base of much of the research appropriate?
5. If research is to be continued, who pays?
6. Is teaching adequate?

Other matters of national policy, the need for reference collections and who should pay for UK research and curation in systematic biology, were also addressed. The Royal Botanic Garden, Kew, amongst others, submitted written and verbal evidence to the Committee.

The Committee received "a considerable volume of evidence" attesting to the decline of systematic biology research in the United Kingdom; the decline of the teaching of systematic biology in the Universities; and the increasing average age of the practitioners. As much of the evidence was anecdotal the Committee needed to obtain hard facts on which to base any recommendations. In order to get these facts they sent a questionnaire on 23 July 1991 to 139 institutions and organisations asking for information on spending on and manpower engaged in systematic biology (excluding teaching) for 1980, 1985 and 1990. The questionnaire yielded results which confirmed Thomas' findings.

One example of the increase in use of taxonomic work, which has been sent to the Select Committee in response to its questionnaire, is that from International Horticultural Research at Wellesbourne, Warwickshire. The amount of systematics used has steadily increased from 0.9 of a person year in 1980 to 1.2 person years in 1985 to 3.1 person years in 1990 (Wood, 1990). This increase in level of use of systematics refers to new work and new people employed to carry out this new work, not more work given to older taxonomists.

The type of work is that relating to beans which requires the botanist to be able to identify beans in Africa and their relationships with other members of a large plant family.

If the present trend in reduction of teaching of systematics and taxonomy continues there will be no teachers to teach the botanists employed in research stations. Similarly with a continued increase in the rate of species loss and a need to identify what is present and what is being lost and why, both taxonomists and botanic gardens are needed.

The general conclusion was that research in systematic biology, which underpins most other biological research, was found to be at a dangerously low level. Universities had put forward submissions for funding from the research councils for more 'glamorous' subjects. In real terms funding of the museums and the Royal botanic gardens for systematic research had declined.

The Committee's report recommended that £1,000,000 a year for five years should be allocated for systematic biology research to try to reverse the trend (UK Parliament, House of Lords Select Committee II, Systematic Biology Research Report, Jan 28th 1992).

It remains to be seen whether the £5,000,000 is allocated. The effectiveness of this measure will depend upon taxonomists themselves putting forward dynamic new proposals for ongoing research. The selection of proposals for funding will be the critical part of the process. If successful, there should be a revival in taxonomy and systematics and possibly in the fortunes of botanic gardens.

It is important for the conservation of plants and especially of habitats and species diversity that botanical collections should remain as a teaching tool for future botanists, not only those who will become taxonomists and the plant collectors of the future, but also those who will be the ecologists, physiologists and genetic engineers.

The best way to learn plant taxonomy and plant form and adaptation is by seeing the plants frequently, as gardeners and garden designers do. Relationships between plants can be seen by familiarity with a large amount of plant material.

Whilst many plant collections in botanic gardens may currently be of little use in conservation due to their narrow genetic base, yet they are valuable as visual aids for use at the macroscopic and microscopic level.

It has been suggested that gardens are not essential to the study of taxonomy, that for this only herbaria and libraries are needed (Matthew, 1987). Others have gone further and suggested that the major part of herbarium collections should be disposed of leaving only the type specimens and written descriptions (Clifford, Rogers and Dettman, 1990). Whilst Clifford et. al. carry things much too far, it is true that much taxonomic and systematic work is carried out on herbarium specimens alone. This work however is restricted. It cannot lead on to hybridization, breeding experiments, transgenic mutations, ecological research or population dynamics.

For any research into what a plant does rather than what it is, living material is required. Even a knowledge of what it is is limited without examination of populations, and those in different environments.

With too much introspection taxonomy may become, increasingly, a study of what we used to have rather than an exploration of what we have still to find. Hence botanic gardens should be maintained as a constant reminder to taxonomists to look at live plants and to the public to show them the diversity that we currently know of.

Since 1987, when St Andrews botanic garden was leased to Fife Council, the University of Hull has disposed of its botanic garden, Cardiff has lost its garden, and in 1991 Bristol is losing its botanic garden. London University has recently tried to obtain planning permission for redevelopment of the 21 acre garden at Egham in Surrey.

In 1988 the Curator of the University of Bristol Botanic Garden sent round a questionnaire to all botany departments asking about their garden and glasshouse facilities, number of staff and the costs involved. The response to the questionnaire was varied, but the results made it apparent

> "that large undertakings such as Ness and Liverpool and Strathclyde council–run gardens and Glasgow City council garden were above the state at which garden viability becomes controversial".

[This was not entirely true as Liverpool City substantially lost its botanic garden in the 1980's due to the financial difficulties of the city.]

> "Departments which had only glasshouse facilities (Southampton, etc) had adequate technical staff and the facility appeared to be secure."
> "Reading and Oxford have started 'Friends of the Garden' scheme to increase financial viability and outside interest."
> "With departments becoming cost centres the gardens' technical staff have been seen in most places as disproportionately expensive."

The survey suggested that most gardens had about one technician per one and a half acres. Freezing of posts had caused a general reduction in staffing.

> "The continuing problem is that of the national decline in botany as a single subject. Whole plant botany attracts little research funding outside the two Royal Botanic Gardens, going mainly to Cambridge and Sheffield." (Gledhill, 1990)

As Universities make decisions on how they will allocate the funds allotted to them by the UFC without any reference to the decisions of other Universities, it may happen that many more botanic gardens will be lost in what is seen to be a cost cutting exercise. In Universities which have a debt then the possibility of capitalising on under utilized assets is very attractive.

With the changes in the dual support system for research through the UFC and the five Research Councils, entailing a greater proportion of research funding being allocated through the research councils, the necessity for sound research projects in whole plant biology projects of importance to mankind will attract greater funding at the expense of other disciplines.

It is time that taxonomists and whole plant biologists looked critically at their research and questioned its importance in terms relative to that being carried out in other disciplines. For example:

a. Projects which will screen many members of a plant family for particular chemicals;
b. Experiments which will identify plants with drought resistance or salt tolerance in families related to food crops may help to identify a gene or part of a chromosome which could be incorporated in a crop plant;
c. Searching for or breeding perennial species of annual grain crops, thus preventing soil erosion and reducing the depletion of organic matter in the soil at harvest;
d. Investigations into why plants are becoming extinct. Not all are being threatened by man's activities.
e. How common weed species thrive whilst endangered species decline; Could their special requirements be safeguarded?

The answer to some of the problems besetting whole plant botany lie in the lack of imaginative research which would attract funding from the Research Councils. It is only through the Research Councils that postgraduate research on any scale will be funded. There can surely be little need currently to investigate the minutiae of some well known British genera in order to split a species yet further, when there are hundreds of species as yet unidentified?

Without active input from taxonomists the operation of the U.K. Science budget will inexorably select against taxonomy and with it botanic gardens. Plant breeding experiments were carried out by Mendel in a small garden. Very few such experiments are now carried out in botanic gardens. Most are considered as 'applied' and conducted at research stations.

An over exalted view of 'pure' science may mean that it is too rarified to sustain. The situation is, however, not all one of decline.

The recommendation for the allocation of funding for a short time to revive research in systematics and taxonomy may, if carefully directed, reverse the trend.

With regard to botanic gardens, there is a current plan to develop a new National Botanic Garden for Wales, at a very considerable cost. The cost will not be borne by the Government, however. The garden is to incorporate a research function with the aim of carrying out research of international importance. In conjunction, and not as a subsidiary to it, the botanic garden is to provide for public education and amenity in a number of ways. This will not be a garden where the public are allowed in as an afterthought, but a garden especially designed to attract the public and to provide amenity and education for them. It is considered as a tourist attraction and the financial benefits from this are estimated and incorporated in the plan. The funding of the research depends upon the visiting public (Thomas, 1991).

In the botanic gardens which were investigated in this study, the public were considered as the main reason for their existence by two gardens, Sheffield and Westonbirt, and as secondary by Edinburgh and Cambridge. All the gardens provide substantial social benefits, although all the benefit was unpriced in three cases. The unpriced benefit could be very greatly increased in the case of Cambridge and Edinburgh if they were to advertise and cater in a more positive way for the public.

What many members of the public wanted additionally at botanic gardens in this survey were light refreshments and plant sales. Both of these raise revenue. Westonbirt is going to start selling plants this year. Ness already has a plant sales area. This can be done by the gardens themselves or a franchise sold.

Recently a financial market value was put upon a botanic garden when Hull University vacated their gardens upon the rationalization of their biological sciences departments.

> "A consequence of this move is the release of a valuable site, the sale of which with planning permission for housing would realise about £800,000 (less the £75,000 budgeted for the move)". (MacBryde, 1991)

The ramifications of the planning application were not straightforward but the Planning Inspector's decision to refuse planning permission was based, mainly, on the insertion of high density housing in an area of semi–detached housing and that more of the botanically important collections of trees would be felled than was stated in the planning application. The inspector envisaged this happening as many of the trees would end up in small, private gardens. He concluded that

> "both the processes of building construction in the short term and the needs and reasonable expectations of future residents in the long term would combine to put their (the trees) survival at great and avoidable risk."

The University, in the current financial climate saw £725,000 "to allow a number of badly needed and worthwhile projects to be funded" as a more worthwhile exchange. The botanic garden, comprising 6.5 ha, was not all the land to be used but it was central to the scheme. The opposition came from the local Borough Council, the Cottingham Conservation Society and The National Council of Conservation of Plants and Gardens. Those interested in the plants have suggested setting up a trust to care for the remaining plantings. The sum necessary to do this has not been calculated. Legal costs and expert witness costs were circa £2,000 (Raine, 1991). The report does not rule out any future development, only the current proposal.

Bristol University has also divested itself of its botanic garden. That was a garden where the conservation of the endangered native flora of the South West of England was being actively carried out. Clearly, this is a most unsatisfactory position for conservation. Some overall scheme for the botanic gardens of Britain must be arrived at before much more time passes in order that continuity can be planned. Prance (1991) suggested that a special research body should be appointed to oversee 'biodiversity'. Asked if a separate body within the National Environmental Research Council (NERC) would not be sufficient. Professor Prance agreed that this would be quite acceptable. A central funding body, overseeing all botanic gardens is necessary, similar to the Arts Council or the museums.

It is possible that the decision might be that only the, currently, two National Botanic Gardens should be supported. It should be emphasised that they should be supported with sufficient funds to carry out their work in research, teaching, conservation and amenity. Personnel 'skilled in these few areas' should not be required to devise money making schemes to enable the gardens to keep going. There are many skilled and trained people who could carry out the marketing and fund raising better and more cost effectively since there would not be the added opportunity cost of lost research or conservation effort.

Possibly, there should be an allocation of funds to each garden, independently of the current funding body. It may be that each garden would have to make a case for funding on the basis of any of the many aspects of botanic garden work:– public amenity, conservation, research, public education, but all should be considered as valid reasons for the existence of a botanic garden. That one area of teaching is currently suffering a decline should not be a reason for closing a garden and depriving its other users of the social benefits derived from it.

Indeed, in Dixon's (1991) survey of botanic gardens replies received from the staff of 34 botanic gardens produced the following results on what the staff considered were the most important functions of botanic gardens.

Table 9.4 <u>What do you think are the most important functions of botanic gardens?</u>

	Respondents garden n=34 %	Botanic gardens in general, if different n=17 %
Amenity/recreation	61.76	10.53
Education:		
General public	52.94	63.16
Students	44.12	0
Conservation of flora	38.24	63.16
Reference Collection	23.53	0
Research	26.47	21.05
Other	8.82	0

The functions of botanic gardens as perceived by visitors to Oxford botanic garden and by a sample of the general population of Oxford in this survey is shown below.

Table 9.5 <u>% of Respondents</u>

Perceived Function	Visitor Sample N = 93	Local Community Sample N = 103
Conservation of flora	34	27
Display of exotic unusual species	51	41
Education of botanists or other specialists	11	10
Education of general public	16	21
Horticultural Research	23	32
Recreational facility	26	39
Don't know	–	5

The visitors and general publics perception of the functions of botanic gardens differs quite markedly from the gardens own perception of their function. In no case, however is the existence of the garden thought to depend solely on its use for academic research.

Thus if decisions as to the future of gardens continue to be made on these grounds alone then the other clearly perceived uses will also be lost. Hence the need for the decision making to be done by those with a much broader remit.

As to who should pay for botanic gardens raises more questions. As the Hull case shows, the local residents and national interested plants–persons are seen as having a valid input into the fate of a botanic garden. It has not been seen as only the business of the owner of the garden to dispose of it as they wished. Existence and bequest values have been recognised. What has not been clarified is who is currently responsible for paying for these. Society in some form must bear the cost.

If the 21 acres of London University's garden had planning permission for house building it is estimated (Gale, 1991), that the University would receive, or could use it as collateral to borrow, £$\frac{3}{4}$ million per acre. Currently (1992) the demand for housing is low, but after the recession the demand may again increase and the University may find itself in a position of needing to raise this money. Objections to the disbandment of the Hull botanic garden were raised by various parts of 'society', they were sustained by the Planning Inspector working on behalf of 'society' through the Secretary of State for the Environment.

The cost of having to sustain the botanic garden would have to be borne by the University which is substantially supported by 'society'. Unfortunately, it may have to be supported at a cost of some other part of the University's proposed activities. As garden closures have now happened in different locations throughout Britain over the last 5 years it is time for a national policy, since it is society in one way or another which pays for the upkeep of University and Municipal gardens, and it is the loss of a social welfare benefit which occurs if they are closed.

The location map in Chapter 4 shows the density of population adjacent to each botanic garden. The gardens are nearly all adjacent to large centres of population, thus their potential for increased social welfare benefit is already present.

Whilst currently the gardens cater for a rather restricted section of the population, the ideas being put forward for attracting visitors to the National Botanic Garden of Wales are formulated to appeal to a much wider section of the community. They will not, of course, appeal to everyone.

A reappraisal of their worth to the general public and a re–definition of their roles might lead to much wider support for botanic gardens in times of increasing financial stringency.

The future for botanic gardens in the U.K. is still far from clear. It is probable that a number which belong to University Departments and which are not open to the public will close either to save staffing costs or to realise the capital invested in the site.

Some municipal botanic gardens may gradually decline if pressure on local government finances continues.

For other gardens to continue several things are probably necessary:

1. A clear separation of the horticultural and the research element in the gardens.
2. A clear representation within the gardens of the type of research carried out in association with the gardens, but an end to the idea that all the plants in a garden are used for research.
3. An acceptance that plants within a botanic garden should be of known wild origin and a policy of replacement undertaken – even if long term. Alternatively, a clear acceptance of an interest in horticulture.
4. An acceptance that recreation is a legitimate provision by botanic gardens and that they have a valuable role to play in this.
5. Professional marketing of the recreation supplied by the gardens to interested groups. A wish to prove their usefulness in education to school children is understandable and schools links should continue for

formal educational visits. Attempts to attract most children to botanic gardens in their free time may be a waste of effort and ultimately may prove counter–productive if the gardens are altered and still prove unattractive to children and meanwhile current visitors are discouraged.

6. There appears to be a real requirement for 'someone to ask questions of', though the best way of providing this is difficult to envisage.

7. The current method of funding botanic gardens through research grants and universities can only result in the further reduction of an important part of our heritage and the gradual erosion of these, usually beautiful, places which will reduce our stock of social assets. Placing botanic gardens under a more suitable umbrella organisation such as the Office of Arts and Libraries might prove a much more satisfactory method of clarifying botanic gardens positions and determining their future than the present ad hoc system.

8. The role of botanic gardens in conservation of rare species should be clarified. Probably their greatest contribution would be in establishing the best methods of propagating rare species. Most have the staff and facilities to do this. They may not have the facilities for maintaining large numbers of rare species but adequate record keeping of propagation methods tried and equipment used is a resource which probably only botanic gardens have.

Finally, it is important that some of these matters are addressed soon. Ten more years of indecision and gradual erosion could see most of the U.K. botanic gardens either closed or greatly reduced. They provide too many benefits which would be lost for that to be allowed to happen.

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