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ABSTRACT

Lafayette Park, a 3.0 hectare national park located across the street from the White House in Washington D.C., has had a gray squirrel (Sciurus carolinensis) density as high as 50 animals/hectare. In recent years this large population caused significant damage to mature trees and other vegetation. In keeping with the legislative mandate to protect and preserve the historic landscape in Lafayette Park, the National Park Service implemented a squirrel management program following an Integrated Pest Management (IPM) approach. The population was studied and monitored to determine the ecological bases for high squirrel numbers. Action was taken through a program of squirrel relocation and habitat modification to reduce available den sites. These programs were coordinated to minimize impact on the existing population, and continued monitoring has been used to evaluate efficacy. The implications of this program for resolving people-wildlife conflicts in urban environments are discussed.

INTRODUCTION

Although wildlife diversity often suffers in urban areas, those species which are found may occur at high population densities (Schinner & Cawley 1974; Goszczynski 1979; Harris & Rayner 1986). This can lead to undesirable situations, such as increased damage to the environment, competition which excludes desirable species, or to stress and overcrowding within a given population. Where wildlife populations come into close contact with humans, public health problems can become issues as well.

While these concerns would seem to make it important that high urban wildlife populations be prevented, competitive and sometimes contradictory interests can work to keep this from happening. Traditional

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wildlife management is often not possible in urban areas. Hunting and trapping are reasonably viewed as dangerous to humans or domestic pets, and other lethal controls are likely to be inhibited because of public concern for the welfare of both target and nontarget species. Responsibility for wildlife may be shared by a variety of authorities, such as local humane societies, animal control agencies, parks and recreation departments, and public health offices, between which communication and coordination may be inefficient. As a result, urban governments may limit their wildlife management practises to reacting to localized crisis situations and lack long-term planning for wildlife in either its positive or negative senses.

The management of the gray squirrel (Sciurus carolinensis) population in Lafayette Park, Washington, D.C., reflects many of the problems and concerns that arise in dealing with urban wildlife species. Since the 1940s squirrels have been reported to be a nuisance and concern because of damage they caused to park vegetation. In 1977 squirrel density in the park was said to have exceeded 31.3 animals/hectare, and squirrels were blamed for over $4,500 damage to annual plants and trees. An attempt to reduce the damage led to the relocation of squirrels to other areas in the city. This program was criticized by both private citizens and animal welfare groups, and adverse media attention was sufficient to cause its cancellation. Criticisms were leveled against the NPS for not demonstrating that squirrels were responsible for the damage to vegetation, for lacking population data to validate the assumption that the squirrel population was excessively large, and for proposing relocation, an undemonstrated management alternative, as the only option for squirrel control.

A subsequent study found the Lafayette Park gray squirrel population at a far greater density than reported elsewhere (Manski et al. 1981). Intensive provisioning by the public was implicated as one of the main factors responsible for this. Also contributing was the presence of a large number of nestboxes and tree dens. One result of the study was to provide specific recommendations for managing the population, the implementation of which began in 1985. This paper evaluates these actions in relation to the Lafayette Park squirrel population ecology and discusses the implications for other programs aimed at resolving people-wildlife conflicts in urban environments.

We are grateful to park managers C. O'Hara and A. Calhoun for their support and help in implementing the squirrel management program. Drs. W. Anderson and R. Hammerschlag have provided scientific support and input to planing as well as numerous insights into the special problems encountered during the management program. Cyndee and Bruce Archer are thanked

for coordinating efforts to place squirrels with rehabilitators. Many volunteers have assisted in squirrel workups and censuses and their help is gratefully acknowledged.

STUDY AREA

Lafayette Park, a 3 hectare (7.5 acre), formally landscaped urban park, is located across Pennsylvania Avenue from the White House in Washington, D.C. This land, obtained by George Washington in 1791 from an apparently reluctant owner, was intended to become part of the White House grounds. Thinking this might make the president's grounds seem too royal, Thomas Jefferson authorized use of the area as a public park. The earliest definitive landscaping plan for the Park is the 1853 plan of Andrew Jackson Downing. The most recent was approved by President Kennedy in 1962 (Olszewski 1964).

As part of the National Park system, Lafayette Park has been managed since 1933 with the primary purpose of protecting and preserving the historic landscaping themes established by Downing. The park is listed on the National Register of Historic Places and all management activities are guided by NPS policies relating to cultural resources management and the National Historic Preservation Act.

Lafayette Park is surrounded by heavily used streets. Approximately half of the park is comprised of turf; brick walkways make up another 34 percent; about ten percent occurs as formal flower beds. Nearly thirty species of introduced and native trees and shrubs grow in the park, with oaks predominating. Many of the trees have particular historic and aesthetic value because of their size, form, and old age. Details concerning the plantings and layout of the park can be found in Olszewski (1964) and Manski et al. (1981).

MANAGEMENT ACTION

Management of the Lafayette Park squirrel population commenced in 1985 after discussions with the feeders indicated that over 75 pounds of peanuts were being distributed each week. Using established censusing techniques (Manski et al. 1981), monitoring of squirrel numbers in August indicated that population levels were commensurate with earlier years (Table 1). Since the situation had not changed, and management remained concerned about continued damage to park vegetation, a one-time effort to reduce the squirrel population to a level from which other management practices could be implemented was planned. The Humane Society of the United States (HSUS) and the Washington Humane Society (WHS) were involved in planning discussions to resolve potential conflicts before implementation of any actions.

Relocation:

The Manski et al. (1981) study had recommended euthanasia rather than relocation as a means of reducing the population, due

Table 1. Lafayette Park Gray Squirrel Census Data 1980-87.

Date	Counts	Mean # Squirrels	Stnd Dev	Date	Counts	Mean # Squirrels	Stnd Dev
1980				1986			
Jan	4	63.5	23.0	Jan	8	21.0	5.8
Mar	7	55.7	18.1	Feb	4	16.5	1.0
Apr	4	68.8	13.5	Mar	8	26.3	5.9
May	4	106.0	4.5	Apr	12	29.4	8.1
Aug	5	92.4	19.9	May	12	37.4	5.8
Sep	2	120.5	3.5	Jun	12	44.8	6.4
1981				Jul	8	31.8	12.0
Jul	5	150.6	62.5	Aug	12	34.9	9.1
Aug	3	102.7	37.0	Sep	12	42.2	7.8
Oct	4	140.0	32.5	Oct	12	50.3	13.9
Dec	6	122.6	18.3	Nov	12	60.8	4.1
1982				Dec	12	41.8	10.2
Jan	3	88.0	25.4	1987			
Mar	3	82.0	7.0	Jan	12	12.7	6.7
May	4	119.8	8.1	-- 17 squirrels removed --			
Jun	3	122.0	17.4	Feb	8	14.9	6.6
Aug	2	115.0	11.3	Mar	12	16.5	2.5
Oct	4	137.3	3.1	Apr	12	21.8	4.3
1985				May	12	32.3	6.0
Aug	8	102.8	11.1	Jun	12	23.6	3.2
Sep	12	121.2	23.2	Jul	12	27.7	3.3
Oct	8	104.6	13.8	Aug	12	24.8	10.3
-- 78 animals relocated --				Sep	12	30.7	5.5
Nov	8	63.9	8.1	Oct	12	32.1	3.6
Dec	4	46.8	5.0	Nov	12	30.8	4.1

to the uncertainties surrounding the fate of both the relocated squirrels and the resident animals in areas to which squirrels might be moved. The actual choice of relocation as the management option reflected the realization that public opinion would be strongly against euthanasia and would likely lead to the program being interrupted again. Relocation was planned to coincide as closely as possible with the period for dispersion among gray squirrels (Flyger & Gates 1983). The fortuitous occurrence of an unusually abundant mast crop aided the decision to relocate squirrels.

The goal of the relocation was to remove at least half of the population. Relocation sites at least two miles distant were surveyed the week before the first date chosen to move squirrels. Thirty-two sites totaling over 500 hectares of deciduous forest were identified. Since we were unable to determine squirrel densities in relocation areas, an effort was made to select wooded tracts dominated by oak and beech, with close access to sources

Table 2. 1985 Squirrel Relocation. Adult males are identified by having descended testis and pigmented scrota. Adult females are identified by having pigmented and enlarged teats. Two squirrels captured and examined were not relocated.

	October 17	October 24	Total
Total Squirrels Relocated:	40	38	78
Captured Squirrels:			
Adult Males	11	12	23
Adult Females	11	21	32
Breeding	6	7	13
Nonbreeding	5	13	18
Unknown Status	0	1	1
Subadult Males	8	3	11
Subadult Females	11	3	14
Total Male	19	15	34
Total Female	22	24	46

of water. The mature woodlands chosen met general requirements for good gray squirrel habitat (Flyger & Gates 1983; Williamson 1983; McPherson & Nilon 1987).

Forty squirrels were moved between 10:30 pm and 4:30 am on October 17th and another 38 on October 24th (Table 2). The squirrels were caught as they slept in nestboxes, examined after being anesthetized, and held in wire mesh transfer cages (52x16x15 cm). At the release sites these cages were propped against tree trunks and opened, encouraging the squirrels to take refuge in the trees. No more than six squirrels were released at any one site, the average being three. The relocated squirrels were distributed so that an average of 4.25 hectares of good squirrel habitat was available for each.

Post-relocation Population Changes:

With this removal of 78 squirrels in October 1985, approximately 60 squirrels remained in Lafayette Park (Table 1). Between November 1985 and February 1986 this population declined to fewer than 20 animals, a further drop of approximately 75 percent. Part of this decrease can be explained by known mortality. Dead squirrels began to be observed by park maintenance personnel with some regularity beginning in December 1985. These early deaths went unreported, however. Seven carcasses were eventually submitted to the United States Fish and Wildlife Service's National Wildlife Health Center (NWHC). Chlorophacinone, the active ingredient in a rodenticide used in Lafayette Park to control Norway rat (Rattus

norvegicus) populations, was identified in the stomach contents of two squirrels. However, because of the presence of blood clots in these animals' hearts, cause of death could not be positively attributed to Chlorophacinone poisoning.

Also isolated from a number of the carcasses submitted was the pathogenic bacterium, Erysipelothrix rhusiopathia. Klebsiella pneumoniae was isolated from a liver abscess in one other squirrel. The presence of Erysipelothrix had previously not been recorded for tree squirrels, and was cause for concern given its human pathogenicity. An effort was made subsequently to collect and incinerate all squirrel carcasses found, and to ensure proper handling of these by collectors. Local public health officials were notified and closer than usual monitoring of the population occurred.

Recruitment from two litters and possible immigration caused a four fold increase in the park squirrel population by the fall of 1986 (Table 1). However, a dramatic decline was noted in December 1986 suggesting a process similar to the decline of the previous winter. Reports of dying and dead squirrels were again received at the park; 35 dead squirrels were collected between December 26, 1986 and February 14, 1987.

Three adult males were submitted to NWHC for examination, and a fourth was examined by the National Zoological Park's (NZP) Department of Pathology. All animals showed signs of fighting and wounding, with obvious skin infections and subcutaneous lesions. The general diagnosis was septicemia from infected bite wounds due to intraspecific conflict. Streptococcus sp. and Staphylococcus sp. were cultured from all three. Salmonella typhimurium was cultured from the liver and intestine of one animal. A fecal sample from the animal examined by the NZP indicated numerous coccidia and strongloyides eggs.

The number of deaths, condition of the remaining squirrels, indications that further mortalities would occur, and clear suggestion of stress and overcrowding led to agreement between the park managers and humane society representatives that a further population reduction was mandated. On February 14th seventeen squirrels were taken at night from nestboxes and examined under anesthesia: four adult males, five adult females (one with week-old young), six subadult females, and two subadult males. All were in poor condition, with apparent bite wounds and numerous suppurating skin lesions which had left some animals with large hairless areas. Since it appeared unlikely that any would survive removal to natural areas at that time of year, these squirrels were placed with professional wildlife rehabilitators. The rehabilitators held the squirrels in outdoor cages for the remainder of the winter,

placing some on antibiotic therapy, and giving all shelter and adequate diets. All of the rehabilitated squirrels regained apparent good health and were released early in the spring as natural foods became available. None were returned to the park. No further deaths of squirrels remaining in the park were confirmed until a single animal was found in April. The squirrels remaining in the park which had shown skin lesions and wounding appeared to recover fully.

Nestbox and Den Tree Removals:

Following the second relocation period in October 1985, six of the 18 nestboxes in the park were removed. A gradual removal of additional boxes then occurred, and when squirrels gnawed through the wire supports and boxes fell from trees they were not replaced. By January 1986 there were ten boxes, and by April of that year two more had come down, to bring the total to eight. Between then and February 1987 two more removals occurred, leaving the six boxes which remained through September 1987.

Den trees were removed as they died, since dead trees were perceived as hazards to people and were inconsistent with the aesthetics of the park. Five known den trees in all were removed following October 1985: four in August, 1986 and one in December, 1986.

Provisioning:

Repeated attempts to achieve a reduction in supplemental peanut feeding were frustrated as the two major feeders continued to express concern for the welfare of the squirrels. One of these feeders, unable to visit the park, hired a street person to store and distribute peanuts. Only after the second population crash in 1987 was a voluntary reduction in feeding achieved, after one feeder remained in ill health and the second had retired and no longer wished to make the long journey into town. Between February and April 1987 the total weekly feeding of peanuts was reduced from 75 to 25 pounds. In April responsibility for all feeding was assumed by the Park Service. By June the amount of peanuts provided had been reduced from 25 to ten pounds per week. The squirrel population remained fairly stable through the summer, varying between 25 and 30 animals (Table 1).

DISCUSSION

By documenting the ecological bases underlying the squirrel population problem in Lafayette Park and implementing a management program aimed at long-term habitat modification, the park managers have been following an Integrated Pest Management (IPM) approach to problem solution. IPM was introduced into the National Park Service in 1979 as a decision making process with four major components: monitoring, establishing thresholds, acting, and evaluating (Ruggiero 1986). The implementation of IPM for squirrels in Lafayette Park arose because of the

management objective of maintaining the historic landscaping themes of Andrew Jackson Downing. Allowing the presence of squirrels at the extraordinary population densities found in the early 1980s was not an acceptable management alternative. While we remain uncertain as to exactly how many squirrels the park can support before unacceptable damage occurs, the management objective continues to be to seek that balance where the positive values of having squirrels outweighs the damage they sometimes do.

The central issue in regard to the Lafayette Park squirrel problem has been the role of the feeders, their actions and responsibilities, and the influence they have had. Manski et al. (1981) established that provisioning was an important proximate factor in supporting the high squirrel population. Before there could be a lasting reduction in the population, there had to be a significant decrease in the amount of food provided by the public to squirrels. Despite repeated attempts, a cutback in feeding was not achieved until well after other management actions had been implemented. In effect, a major component of the proposed management program was undermined by a few well meaning but ill-advised individuals.

In a survey of American attitudes towards animals, Kellert and Berry (1980) found urbanites to have great concern and empathy for the welfare of individuals, but lacking in a broader understanding of issues that pertain to populations. In Lafayette Park we encountered the quintessential expression of this; individuals who fed squirrels out of concern for their well-being inadvertently enhanced the squirrel's vulnerability to the many environmental, social and demographic processes which regulate population density.

Although well intended, we view the effect of large-scale provisioning on the Lafayette Park squirrel population as having been negative. One major problem with artificially maintaining the high squirrel density through provisioning was that other important habitat components, such as den sites, became limiting. During the winter, this apparently became critical, as many squirrels could not secure adequate shelter and birthing dens. Contributing to this was the high level of maintenance practiced in the park, which led to the removal of leaf litter that otherwise might have been used by squirrels to rebuild nests throughout the winter.

Although we employed relocation as a management tool, we continue to have deep concern for the impacts of this procedure on both released and resident squirrels. Research is clearly mandated to determine the many factors and processes which might influence using relocation as a management action, and the consequences which these actions might have

for both humans and wildlife alike.

Questions still remain concerning the Lafayette squirrel population and its future, and management is now and will be for some time an active concern. Monitoring will continue for changes in the squirrel population that may shed some light on the population dynamics of the squirrels in this urban park. Supplemental feeding by the NPS will be gradually phased out, and nestboxes will continue to be removed. When necessary we will use contacts with local rehabilitators to remove diseased or stressed squirrels. Finally, a most significant component of the squirrel management program in Lafayette Park will be continued evaluation, as we strive to learn about the many factors which affect population dynamics in this small urban park.

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