
City of Belvedere Deer Study

BELVEDERE, MARIN COUNTY, CALIFORNIA

Prepared For:

City of Belvedere Deer Committee
450 San Rafael Avenue
Belvedere, California 94920

Contact:

Jeff Dreier
dreier@wra-ca.com

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APPENDIX A PUBLIC OPINION QUESTIONNAIRE

Introduction

Based on public concerns regarding increasing conflicts with deer and their behavior, the City of Belvedere established a Deer Committee. The purpose of the Committee was to further investigate the concerns voiced by individuals in the community, and to explore appropriate population management approaches if deemed necessary and/or desirable.

WRA was contracted by the City of Belvedere to provide an outside source of information and analysis regarding deer biology and population management techniques. This report summarizes the results of a public opinion questionnaire and literature review, and presents deer population management approaches to be considered by the Belvedere Deer Committee.

Black-tailed Deer Life History

During most of the year Black-tailed Deer travel alone or in small groups. The social system consists of clans of females that are related to each other by maternal descent and bucks that are not related. Bucks assert their dominance by taking various threat postures and flailing their front hooves. Also, bucks of unequal size, particularly yearlings and two-year olds, often engage in protracted sparring matches during which they push their antlers together and twist their heads. These engagements are not fights and actually result in social bonding (BC Ministry of Environment, Lands, and Parks 2000).

Deer communicate with the aid of scents or pheromones that come from several glands. In the weeks leading up to the late-summer through autumn mating (rutting) period, bucks increase their displays of dominance and indirect threats. A dominant buck typically circles a rival with deliberate steps, back arched, head low, and tail flicking. The subordinate buck frequently bolts away. Bucks also display dominance by violently thrashing the bushes with their antlers. During the rutting season between September and December, mature bucks of equal size engage in serious head-to-head fights. Bucks are capable of breeding as yearlings, but older, dominant bucks do most of the mating. Most does breed as yearlings and drop their first fawn on about their second birthday. Females advertise their receptiveness and tend to cluster around the largest bucks. Courtship consists of a tending bond in which a buck keeps other bucks away from the does until they mate or until another buck displaces him. Following the rut, bucks have lost weight and some have wounds or broken antlers, and they tend to hide and rest (BC Ministry of Environment, Lands, and Parks 2000).

After a gestation period of six to seven months, fawns are born from late-April through June (Zeiner et al. 2006). At this time, the does drive away their offspring of the previous year and seek a secluded place to give birth. The white-spotted fawn relies on its coloration, lack of scent, and silence for protection. Does leave fawns hidden while they forage in the vicinity, returning occasionally to nurse them. Twin fawns are the rule, though young does often have only one, and triplets occur once in a while. Typically, does produce offspring throughout life, and more than 90 percent of them give birth every year. This is a prolific species which can double its population in a few years under favorable conditions. Normally, 45 to 70 percent of the fawns die, and few Black-tailed Deer live more than eight to ten years. Predation, starvation, and hunting are the main causes of death (BC Ministry of Environment, Lands, and Parks 2000).

Deer in urban areas usually become habituated to the presence of humans when they are exposed to predictable, non-negative encounters with humans (Happe 1982); however, when females have fawns, they instinctively become aggressive toward perceived threats. Black-tailed Deer/Mule Deer have been reported to be aggressive toward people and pets not only in Belvedere (Appendix A), but also in other communities (Urie 2008). Black-tailed Deer females are known to be aggressive in the defense of their young. Does will also respond to fawn distress calls even if it is not their fawn, and have been documented responding to the distress calls of White-tailed Deer (*Odocoileus virginianus*) fawns (Lingle et al. 2005).

Study Area

The City of Belvedere is located adjacent to the southern portion of the Tiburon Peninsula in Marin County. The community consists of four areas: Belvedere Island, Lagoon, West Shore, and Corinthian Island. The majority of residents live on Belvedere Island.

Habitat

Dense residential development affording little or no tree or shrub cover is characteristic of the Lagoon, West Shore, and Corinthian Island areas of the City of Belvedere. Lagoon and West Shore lots are heavily fenced. Belvedere Island, although nearly completely developed, has larger residential lots providing space for trees, gardens, and other landscaping. This vegetation provides food and cover for deer throughout most of the year; landscaping water features and irrigation runoff provide surface water for deer. Deer require about three quarts of water per day (Zeiner et al. 2006) Possible supplemental feeding by a few residents could also provide another food source for deer (Feeding deer violates California Fish and Game Code 251.3 and Marin County Ordinance 8.04.226).

Many residents of Belvedere Island have constructed fencing to exclude deer from their plantings. As this became more and more common over the years, deer likely began to focus their activities in areas where food and water were more accessible.

Deer Population

The number of Black-tailed Deer in Belvedere is unknown. The dense vegetation, development, and topography of the community contribute to conditions that make an accurate population count difficult, if not infeasible.

All populations change in abundance through time. Most changes are just random fluctuations, increases or decreases varying about an average abundance. Depending on the scale of these variations, particularly over short time periods relative to the life span of an organism, populations may appear more or less stable. However, if the population size is observed closely, it will be seen to vary. If the trend is consistently upward, the species may become a pest. If a downward trend is maintained, the population will go extinct. The deer population in Belvedere is affected by resource availability, immigration, emigration, mortality, and reproduction.

Rivalry for resources by members of a species intensifies as the population grows and becomes crowded. In Belvedere, food availability for deer has been gradually reduced as more and more physical barriers have been constructed to exclude deer from

landscaping. This has resulted in more deer being concentrated around unfenced lots, and may have resulted in deer starting to eat plants they previously avoided. Habituated deer also may have become more aggressive to people in the residential environment of Belvedere as they seek out food and water resources. Widespread evidence of deer movement, specifically well-worn deer trails, indicate that deer are regularly moving about Belvedere Island in search of food, water, and shelter.

Reports of deer crossing Tiburon Boulevard indicate that immigration and emigration are occurring between the Tiburon Peninsula and Belvedere Island. Similarly, deer have been observed crossing Raccoon Strait between Angel Island and Belvedere Island. It is unknown to what degree immigration and emigration are affecting the Belvedere deer population, but this factor should be considered when evaluating population management measures.

Deer within Belvedere do not experience predation. The primary causes of mortality likely include collisions with vehicles, injuries, starvation, and old age. Under natural conditions, normally 45 to 70 percent of the fawns die, and few Black-tailed Deer live more than eight to ten years. It is unknown what percentage of Belvedere fawns die, but few have been reported to the Marin Humane Society (MHS). Table 1 provides MHS data regarding numbers of dead deer reports in Belvedere.

Month	2007	2008
January	No calls	No calls
February	No calls	No calls
March	No calls	1 dead young deer – 38 Lagoon Rd. 1 injured deer – 1 West Shore Rd.
April	1 injured adult, ran off – 49 Belvedere Ave.	No calls
May	No calls	No calls
June	1 sick fawn delivered to Wildcare – 19 Belvedere Ave.	1 dead young adult – 7 Fern Dr. 1 dead adult – 296 Beach Rd. 1 dead adult – 65 West Shore Rd.
July	1 dead male – 18 Eucalyptus Ave.	1 dead fawn – 240 Bayview Ave.
August	No calls	1 injured young adult – 322 San Rafael Ave. 1 fawn trapped in fence – 440 Golden Gate Ave. 1 dead – 22 Golden Gate Ave. 1 dead – 322 San Rafael Ave
September	No calls	1 dead young adult – 111 Golden Gate Ave.
October	No calls	1 deer trapped in fence – 206 Bella Vista Rd.
November	1 dead male – 22 Golden Gate Ave.	1 dead – Laurel and Bayview
December	1 injured male, euthanized – 160 Bella Vista Rd.	No calls
Total deer calls	5	14
Dead	2	10
Injured or Trapped	2	4
Sick	1	0

The increase in reports of dead deer between 2007 and 2008 may reflect (1) that the deer population increased (either through immigration or increased fawn survival) with a corresponding increase in the number of deaths; or (2) that the deer population experienced increased mortality in response to a decrease in resource availability.

Methods

A questionnaire was developed to gather opinions and observations from the residents of Belvedere. A literature review was conducted by WRA to (1) identify other communities that reported deer issues and the methods employed to resolve those issues; and (2) the effectiveness of various population management approaches.

Questionnaire

To evaluate homeowners' perceptions and attitudes toward deer and deer damage in Belvedere, an electronic and mail questionnaire (Appendix A) was developed and sent to each household in Belvedere (approximately 1,000 households). The questionnaire was modified from a survey of deer damage conducted by West (1998) in Blacksburg, Virginia. The questionnaire consisting of 28 questions addressed opinions, vehicle damage, other property damage, and deer damage control and prevention measures. The purpose of the questionnaire was to also determine where the deer population was perceived as an issue.

Literature Review

WRA conducted literature and internet searches in an effort to identify where similar situations occurred and how they were resolved. The California Department of Fish and Game (CDFG) and U.S. Fish and Wildlife Service internet web sites were also searched for existing policies regarding deer management in urban areas. WRA also searched for information related to Lyme disease. Dr. Dale McCullough of the University of California, Berkeley was contacted regarding deer population monitoring in urban areas.

Results

Questionnaire

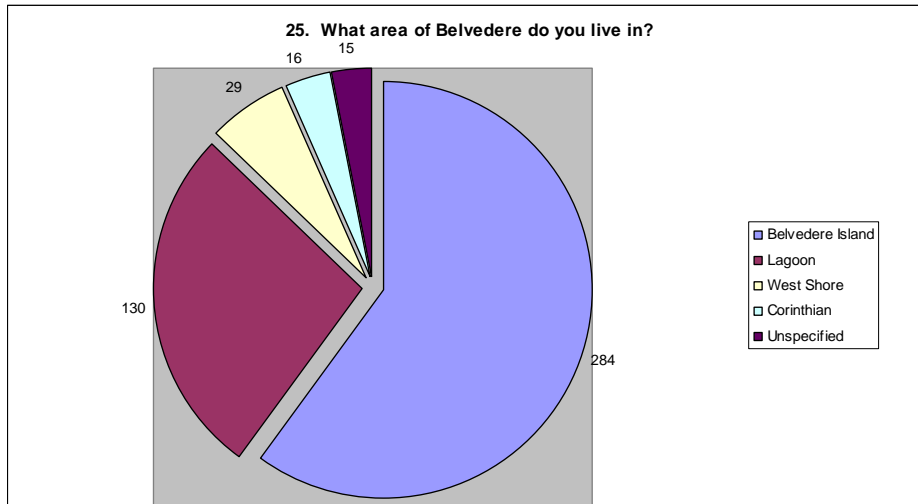
Approximately 1,000 questionnaires were mailed by the City of Belvedere to its residents. A total of 474 responses were received, reflecting significant public interest in the urban deer issue. Respondents occasionally indicated more than one answer in some questions, or did not answer some questions at all. In most cases, the number of responses to a question does not match the number of questionnaires returned; however, the sample size is adequate to determine public opinion within the City of Belvedere.

Sixty percent of the respondents live on Belvedere Island (Figure 1). Appendix A includes summaries of responses to each question. Some of the more relevant questions are summarized below.

Opinions Regarding Deer

Of the responses collected, 60 percent were from residents of Belvedere Island. When responses are totaled, the residents generally felt that deer were a problem that needed to be addressed; however, this was mainly the sentiment of Belvedere Island residents

Figure 1. Summary of Question 25.



as Corinthian Island, West Shore, and Lagoon residents generally either had no opinion, enjoy having deer around, or feel that deer have aesthetic value; although, even in these areas of the City, a significant number of respondents “worry about their appropriateness”.

Most Belvedere Island residents saw deer either daily or weekly, whereas residents of other areas reported seeing deer much less frequently. Most of the residents questioned have seen deer or evidence of deer on their properties, with the exception of Lagoon residents.

Yard damage and vehicle collision seem to be the primary concerns of all residents, although potential personal injury, pet injury, Lyme disease, and extensive fencing are also significant concerns.

Vehicle Damage

Seven percent of the respondents reported that they had experienced a vehicle collision with a deer while driving in Belvedere.

Property Damage

Substantially more deer-related damage to plantings was reported on Belvedere Island than elsewhere, and the damage was generally considered moderate to severe.

Most residents reported that deer damage was the same or higher in 2008 than in previous years, though many others did not know if there had been a change.

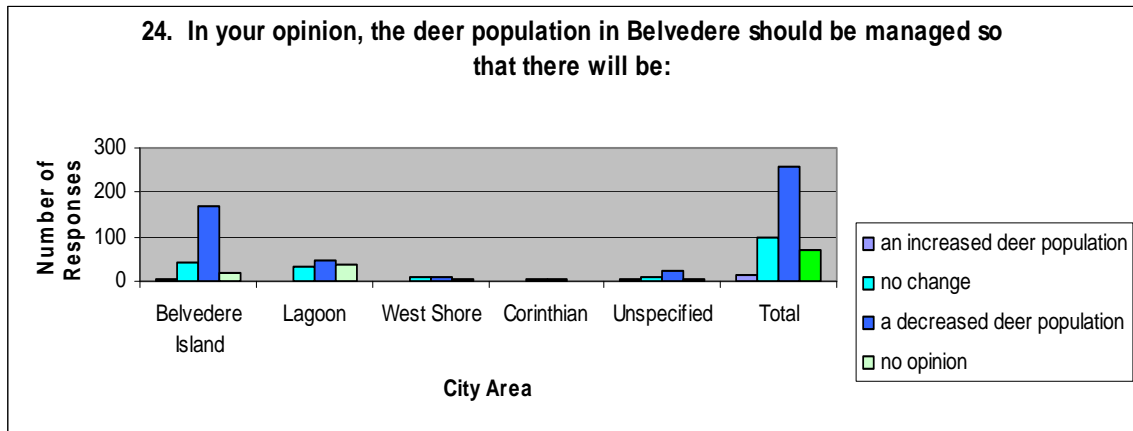
Lyme Disease

Lyme disease was not perceived as a significant potential issue by most residents of Belvedere. Lyme disease followed vehicle damage, yard damage, and personal injury as an area of most concern related to deer; on Belvedere Island, it ranked first in areas of least concern. The species of tick that carries Lyme disease in California is predominantly a parasite of small mammals and reptiles (UC IPM 2008). The presence of deer does not increase the chances of contracting the disease.

Deer Damage Control and Prevention Measures

Residents from all areas seem to agree that the deer population should be managed to decrease populations (Figure 2); however, most residents (71 percent on Belvedere Island and 78 percent of the City as a whole) are willing to pay little to nothing for deer control and damage prevention.

Figure 2. Summary of Question 24.



Residents have primarily used landscaping methods and/or physical barriers to prevent deer damage, and they report that other methods used, such as repellants and frightening devices, have low effectiveness.

Literature Review

The literature review found several sources of information from around the United States. The majority of sources were related to management of White-tailed Deer in the eastern United States, and in communities that contained more open space than that found in Belvedere. The population management options discussed in this report were found to be consistently discussed by local governments that were managing or considering the management of deer populations in their communities.

Population Management Options

When addressing deer problems in Belvedere, the advantages and disadvantages of all available deer management techniques must be evaluated. It is likely that a combination of management techniques will be necessary to achieve desired results (DeNicola et al. 2000). Residents should be made aware that suburban deer management objectives are achievable, but they are often difficult and costly. Deer control measures require community input, as well as considerable long-term planning and commitment. It should also be noted that the depredation permit, trap and translocation, and contraception options described in this section are controversial and may not be authorized by the California Department of Fish and Game, who must approve any program to be implemented.

Depredation Permit

The California Fish and Game Code classifies deer as game animals. CDFG has jurisdiction over deer and their management. If they are found damaging property or crops, land owners may request a depredation permit from the local game warden to shoot them, although this method is not generally recommended for problems around homes and gardens (UC IPM 2004). Depredation permits are issued on an individual property owner basis; however, they frequently come into conflict with local regulatory authority with respect to the discharge of a firearm. Most permits are issued in agricultural areas and rarely in urban areas (John Krause, CDFG biologist, pers. comm.). Traps and poisons of any kind are illegal and cannot be used.

California Fish and Game Code Section 4181.5 includes the following:

4181.5. (a) Any owner or tenant of land or property that is being damaged or destroyed or is in immediate danger of being damaged or destroyed by deer may apply to the department for a permit to kill those deer. The department, upon satisfactory evidence of that damage or destruction, actual or immediately threatened, shall issue a revocable permit for the taking and disposition of those deer for a designated period not to exceed 60 days under regulations promulgated by the commission.

(b) The regulations of the commission shall include provisions concerning the type of weapons to be used to kill the deer. The weapons shall be those that ensure humane killing, but the regulations of the commission shall provide for the use of a sufficient variety of weapons to permit the designation of particular types to be used in any particular locality commensurate with the need to protect persons and property. Firearms using .22-caliber rimfire cartridges may be used only when authorized by the director or his designee. No pistols shall be used. The caliber and type of weapon to be used by each permittee shall be specified in each permit by the issuing officer who shall take into consideration the location of the area, the necessity for clean kills, the safety factor, local firearms ordinances, and other factors that apply. Rifle ammunition used shall have expanding bullets; shotgun ammunition shall have only single slugs, or, if authorized by the department, 0 or 00 buckshot.

Advantages of the depredation permit, if issued include the following:

- May quickly reduce deer population

Disadvantages of the depredation permit, if issued include:

- “Lethal” – low public approval, highly controversial; likely to attract negative press coverage
- City of Belvedere does not allow discharge of firearms
- Permit not intended to be issued to individuals, not communities
- Significant agency regulatory process, unlikely to be authorized
- CDFG requires all other deer prevention methods to be attempted prior to depredation permit consideration
- In the unlikely event that CDFG considers issuing a community permit, it is likely that CEQA document preparation by City of Belvedere (as lead agency) would be required
- Significant safety concerns in dense urban area due to limited property access, and significantly reduced line-of-sight due to walls, fences, vegetation, and topography

- Because deer are immigrating to Belvedere from Tiburon Peninsula and Angel Island, a depredation permit would not be a long-term solution.

Trap and Translocation

Trap and translocation is another solution that is frequently considered when deer are an issue in urban areas. It can be a financial and logistical challenge, and generally results in poor survival of the relocated deer (Texas Parks and Wildlife 2008). CDFG was involved with two relocations where deer were monitored following release. At one confined area, Ardenwood Park in Alameda County, 29 deer were removed and relocated; one year later, at least 25 of them were verified dead, most by Mountain Lions (*Felis concolor*) (Mayer, et al. 1995). In the mid-1970's, the Angel Island deer herd relocation occurred. An over-population of deer originally estimated at about 150 deer in the island State Park was 100 animals over the presumed upper carrying capacity of approximately 50 animals. CDFG captured and removed 203 animals from the island to Sonoma County. Telemetry sampling revealed that within a year, 90 percent of these animals were deceased, most within 3 months of relocation. Despite these extensive relocation efforts, a sufficient number of deer remained on the island to permit an increase in the island's herd size to over 200 animals within 5 years in spite of an ongoing contraception program conducted by the San Francisco SPCA. Eventually, State Park rangers had to cull large numbers of deer from the island to obtain a viable balance of animals and habitat (Mayer, et al. 1995).

CDFG does not consider trapping and translocation to be acceptable options for urban deer management, primarily due to survivability concerns (John Krause, CDFG Biologist, pers. comm.)

Advantages of trapping and transferring deer to other areas include the following:

- "Nonlethal" -- high public approval
- No safety concerns

Disadvantages of relocation include:

- Costs of doing the job are extremely high
- Significant agency regulatory process, CDFG very unlikely to authorize
- Will likely require CEQA document preparation by City of Belvedere (probably as lead agency) with associated costs
- Up to 90% mortality for deer, controversial based on previous attempts elsewhere; may result in negative press coverage
- Because deer are immigrating to Belvedere from Tiburon Peninsula and Angel Island, a trap and translocation plan would not be a long-term solution.

Immunocontraception

Immunocontraception is a birth control method that uses the body's immune system to prevent pregnancy. It is the most common method of inducing infertility in deer (Kilpatrick and LaBonte 2007). The optimal goal of immunocontraception would be to result in a pattern of exponential attrition that would eventually eliminate the deer problem. Most recent extensive experimentation has been conducted with White-tailed Deer in the eastern United States. The major drawbacks, in addition to the labor-

intensive aspect of application, is that current techniques cannot effectively administer a single inoculation restricting conception, and the process must be repeated at intervals. The process of marking each treated animal and then relocating them for a successful new treatment is beyond the staff capabilities of most wildlife agencies. An effort to use this approach at Coyote Hills Regional Park in Alameda County over a two-year period resulted in an expenditure of over \$60,000 and minimal effective results (Elliot 1996).

Turner et al. (1992) successfully used porcine zona pellucida (PZP) vaccine as an immunocontraceptive for White-tailed Deer. Their vaccine was delivered remotely via syringe-darts; however, multiple booster injections were required. This requirement limits the practicality of using this contraceptive vaccine in free-ranging deer populations. Recent advancements in research with PZP have included microencapsulation of the booster vaccinations so that only one vaccination per year is required; however, results to date have not been favorable (Turner et al. 1996).

There are at least five published cases of field experiments in which PZP immunocontraception was applied to free-ranging White-tailed Deer populations (Warren 2000). Three of the studies concluded that PZP immunocontraception was time-consuming and costly (ranging from \$802 to \$1,100 per treated female) and that PZP immunocontraceptive vaccines ideally should be applied to isolated deer herds containing fewer than 100 females. The other two published field experiments on PZP immunocontraception were done using volunteers, so costs were much lower (less than \$50 per treated female). One of the field experiments observed no decline in the deer population after five years of treating females with PZP vaccine. They concluded, "First, a population decline cannot be effectively achieved unless zero fertility is the population goal—and can only be achieved if every female of reproductive age is vaccinated." (Warren 2000).

A three-year study (1997-1999) evaluating the effectiveness of PZP was conducted by the Humane Society of the United States in cooperation with the Connecticut Wildlife Division and University of New Hampshire. The study demonstrated that, even with good access to a relatively small and isolated free-ranging deer population (about 30 females), an adequate number of female deer could not be successfully treated to limit population growth (Kilpatrick and LaBonte 2007).

The advantages of immunocontraception include the following:

- Nonlethal -- high public approval
- Can be delivered remotely
- Deactivates if orally ingested by non-target animal
- Minimal safety concerns (except for hormone-based methods and lost darts)

Disadvantages of immunocontraceptive techniques to reduce deer populations include:

- Costs of training and doing the job can be very high; accuracy of remote delivery depends on equipment quality and user skill and experience
- No commercial source of vaccine
- Difficulty of vaccinating all females in dense residential environment
- Increased regulatory bureaucracy: CDFG, FDA, and Humane Society involved; as of May 2007, no fertility control agents have been federally approved for commercial use on free-ranging deer populations in the United States; the work would likely have to be performed as an experimental research project

- Will likely require CEQA document preparation by City of Belvedere (as lead agency) with associated costs
- Current contraceptive methods require boosters
- Less than 100% effective, especially in free-roaming deer populations
- Higher fawn survival of untreated females
- Because deer are immigrating to Belvedere from Tiburon Peninsula and Angel Island, an immunocontraception plan would not be a long-term solution

Deer Deterrents

Fencing

Fencing is an effective method used by many residents in Belvedere to exclude deer from their properties. However, other residents may perceive fence construction as a distraction from the aesthetics of their community. Other difficulties encountered with this option may include various rights-of-way that traverse the proposed fence line. In some cases, multiple ownership of proposed fence lines may also be an obstacle to fence construction.

The advantages of fencing include the following:

- Very effective in protecting plantings
- Little or no cost to the City of Belvedere

Disadvantages of fencing to reduce deer damage include:

- Excluded deer concentrate in unfenced areas to forage and find shelter
- Some residents find fencing to be an aesthetic issue
- Initial costs for fencing materials and installation are substantial
- Requires agreement and possible sharing of costs between adjacent landowners

Landscaping With Deer-Resistant Plants

Since deer can travel great distances to seek food and shelter, modifying their habitat to make it less desirable is usually impractical. Planting less-preferred plants or working as a community to plant them over large areas might be effective in reducing deer numbers in the area. Garden and landscape trees, shrubs, and vines often provide highly attractive browse, especially when new foliage is forming. Planting alternative attractive foods away from a garden will not prevent damage to more valued plants and may even make the whole area more attractive to deer (UC IPM 2004).

Deer do have certain food aversions. Various factors can make a plant resistant to deer. For example, many of the most resistant plants, such as oleander, are poisonous. In addition, plant preferences may vary depending upon the time of year and location. This may explain why residents report some ornamentals resistant to deer and others find the same plant attractive to deer. The repellent qualities of plants to deer is also related to the availability of other food. If there is a surplus of attractive native forage, ornamental plantings may remain untouched. If the naturally occurring food supply is low, there will be increasing pressure to browse in residential gardens. Under conditions of extreme food shortage, few plant species will be totally resistant to deer. A large deer population

also increases competition for forage, with the result that plants normally unpalatable to deer may be eaten (UC IPM 2004).

According to the Belvedere questionnaire results, the use of deer-resistant landscaping is widespread, but opinions regarding its effectiveness are varied. Some respondents indicate that the deer problem was completely eliminated, while others suggested that the use of deer-resistant plants was not effective.

The advantages of landscaping with deer-resistant plants include the following:

- Effective in protecting plantings in some cases
- Little or no cost to the City of Belvedere

Disadvantages of landscaping measures to reduce deer damage include:

- Deer may concentrate in areas where more palatable plants are used
- Not effective in some cases
- When other plants are not available, some deer may still forage on the less palatable plants
- Requires community-wide commitment to reduce availability of forage

Repellants

Numerous commercial deer repellants have been developed to prevent unwanted damage to commercial crops, residential gardens, and landscape plants. Unfortunately, the success of these substances in preventing deer damage has been limited. According to Belvedere questionnaire respondents, repellants were widely used but only moderately effective. The ability to deter deer browsing pressure on any particular plant by applying a repellant is dependent on deer densities and overall forage availability, plant species, and the amount of time passed since repellant application. Most successful attempts to deter deer with repellants typically occur with relatively low deer densities and frequently repeated repellant applications. It is important to note that total avoidance of repellants by deer is rare (Texas Parks and Wildlife 2008).

The advantages of employing commercial deer repellants include the following:

- Effective in protecting plantings in some cases
- Little or no cost to the City of Belvedere

Disadvantages of repellant use to reduce deer damage include:

- Deer may concentrate in areas where repellants are not used
- Varying degrees of effectiveness
- Costly and labor intensive for landowners; require multiple applications
- Requires community-wide commitment to reduce palatability of forage

Frightening and Other Control Methods

Noise-makers, motion-activated lights, silhouettes, and movement contraptions are often utilized in an attempt to repel deer. These techniques are mostly ineffective in Belvedere and elsewhere. Deer are extremely adaptable, and become habituated to these sights and sounds in a very short period of time. Furthermore, some of these

harassment techniques will have limited application within residential areas such as Belvedere where such loud noises are prohibited.

Sprinklers with motion detectors that release a spray of water when activated have proven to be very effective against deer and other wildlife. This device attaches to any standard garden hose. When it detects a deer's movement or body heat it sprays a 3-second burst of water. If the animal returns, the unit automatically activates again (Yockey 2008).

The advantages of employing frightening and harassment methods include the following:

- Effective in scaring off deer in some cases
- Little or no cost to the City of Belvedere

Disadvantages of frightening and harassment measures to discourage deer presence include:

- Deer may concentrate in areas where such measures are not used
- Not effective in some cases; deer become habituated to measures
- Noise-makers, and possibly motion-activated lights, are not feasible in an urban environment
- Automatic systems do not discriminate between deer and people

Monitoring the Belvedere Deer Population

Whether deer management becomes the responsibility of the City of Belvedere or remains with the homeowner, it is important to develop measurable long-term goals and objectives as part of a comprehensive deer management plan before implementing deer control measures. Objectives based on deer abundance could be evaluated with indicators such as frequency of deer-car collisions, dead deer count, number of reported deer complaints, or predetermined reductions in landscape damage. Standard deer survey techniques, such as survey transects and spotlighting, are considered inappropriate for Belvedere due to limited property access, and significantly reduced line-of-sight due to walls, fences, vegetation, and topography. It should be understood that the total elimination of the problem (or the deer herd) is neither practical nor achievable in most cases. Rather, the goal should be related to the reduction of deer-human conflicts to an acceptable level (DeNicola et al. 2000).

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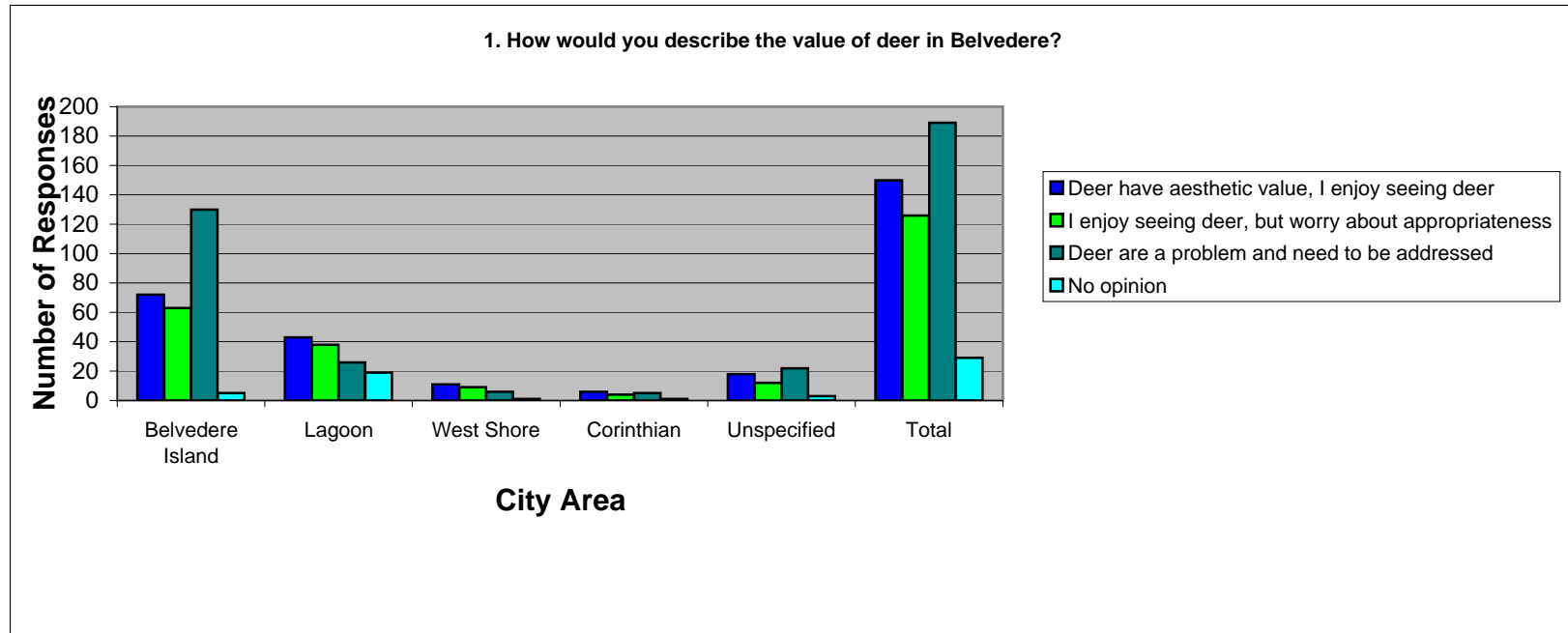
Zeiner, D. C., W. F. Laudenslayer, Jr., K. E. Mayer, and M. White. 2006. California's Wildlife, Volume I-III: Amphibians and Reptiles, Birds, Mammals. Mule Deer account. California Statewide Wildlife Habitat Relationships System, California Department of Fish and Game, Sacramento.

APPENDIX A

PUBLIC OPINION QUESTIONNAIRE

Approximately 1,000 questionnaires were mailed by the City of Belvedere to its residents. A total of 474 responses were received, reflecting significant public interest in the urban deer issue. Respondents occasionally indicated more than one answer in some questions, or did not answer some questions at all. These situations are apparent when reviewing the responses. In most cases, the number of responses to a question does not match the number of questionnaires returned; however, the sample size is more than adequate to provide statistically sound results that in turn can be used to determine public opinion within the City of Belvedere.

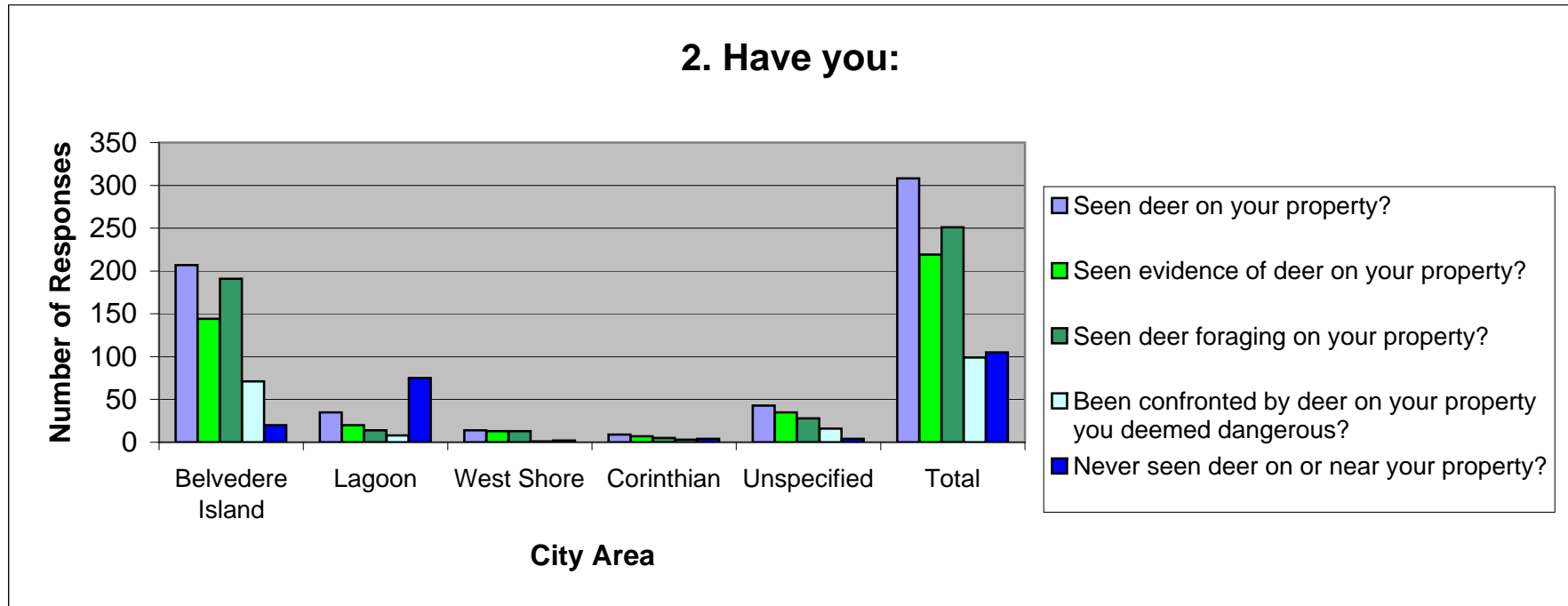
1. How would you describe the value of deer in Belvedere?



Number of Responses	Belvedere Island	Lagoon	West Shore	Corinthian	Unspecified	Total
Deer have aesthetic value, I enjoy seeing deer	72	43	11	6	18	150
I enjoy seeing deer, but worry about appropriateness	63	38	9	4	12	126
Deer are a problem and need to be addressed	130	26	6	5	22	189
No opinion	5	19	1	1	3	29
	270	126	27	16	55	494

Percentages	Belvedere Island	Lagoon	West Shore	Corinthian	Unspecified	Total
Deer have aesthetic value, I enjoy seeing deer	26.7	34.1	40.7	37.5	32.7	30.4
I enjoy seeing deer, but worry about appropriateness	23.3	30.2	33.3	25	21.8	25.5
Deer are a problem and need to be addressed	48.1	20.6	22.3	31.3	40	38.3
No opinion	1.9	15.1	3.7	6.2	5.5	5.8
	100	100	100	100	100	100

2. Have you:



2. Have you:

Seen deer on your property?

Seen evidence of deer on your property?

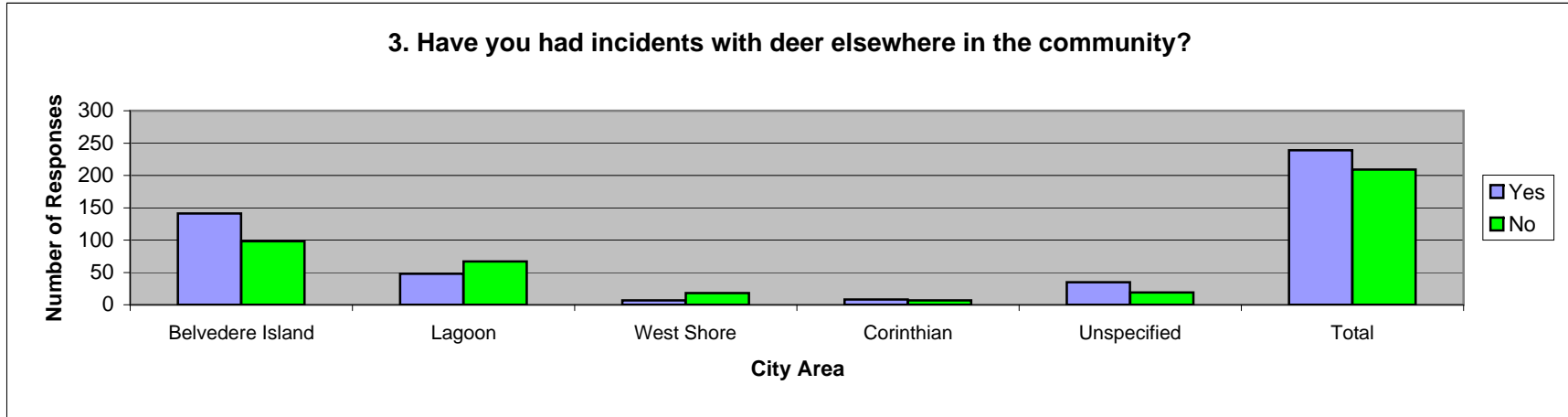
Seen deer foraging on your property?

Been confronted by deer on your property you deemed dangerous?

Never seen deer on or near your property?

	Belvedere Island	Lagoon	West Shore	Corinthian	Unspecified	Total
Seen deer on your property?	207	35	14	9	43	308
Seen evidence of deer on your property?	144	20	13	7	35	219
Seen deer foraging on your property?	191	14	13	5	28	251
Been confronted by deer on your property you deemed dangerous?	71	8	1	3	16	99
Never seen deer on or near your property?	20	75	2	4	4	105

3. Have you had incidents with deer elsewhere in the community?



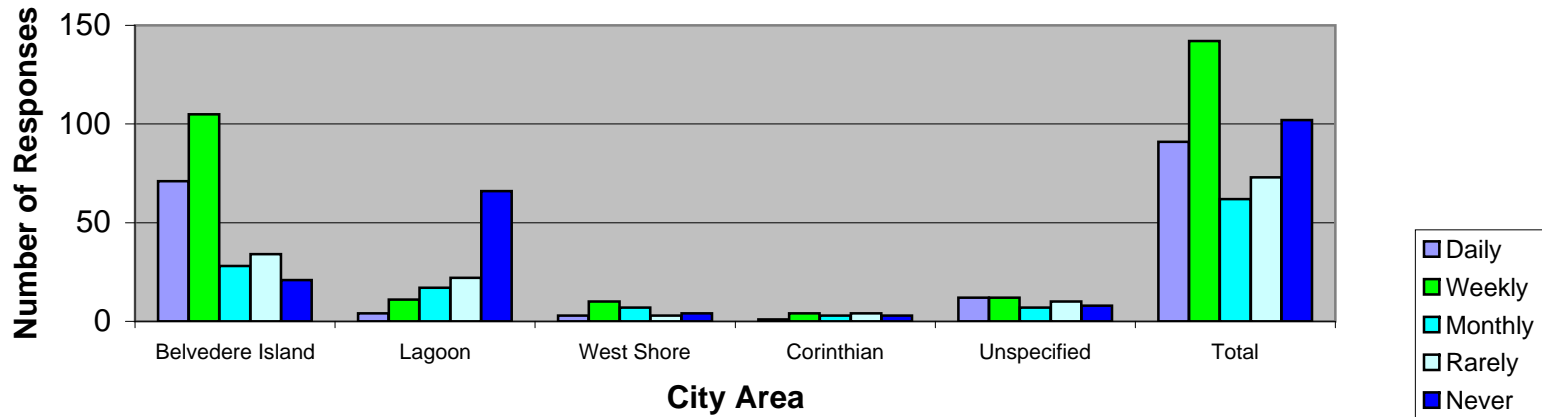
Number of Responses

	Belvedere Island	Lagoon	West Shore	Corinthian	Unspecified	Total
Yes	141	48	7	8	35	239
No	98	67	18	7	19	209
Total	239	115	25	15	54	448

Percentage

	Belvedere Island	Lagoon	West Shore	Corinthian	Unspecified	Total
Yes	59	41.7	28	53.3	64.8	53.3
No	41	58.3	72	46.7	35.2	46.7
Total	100	100	100	100	100	100

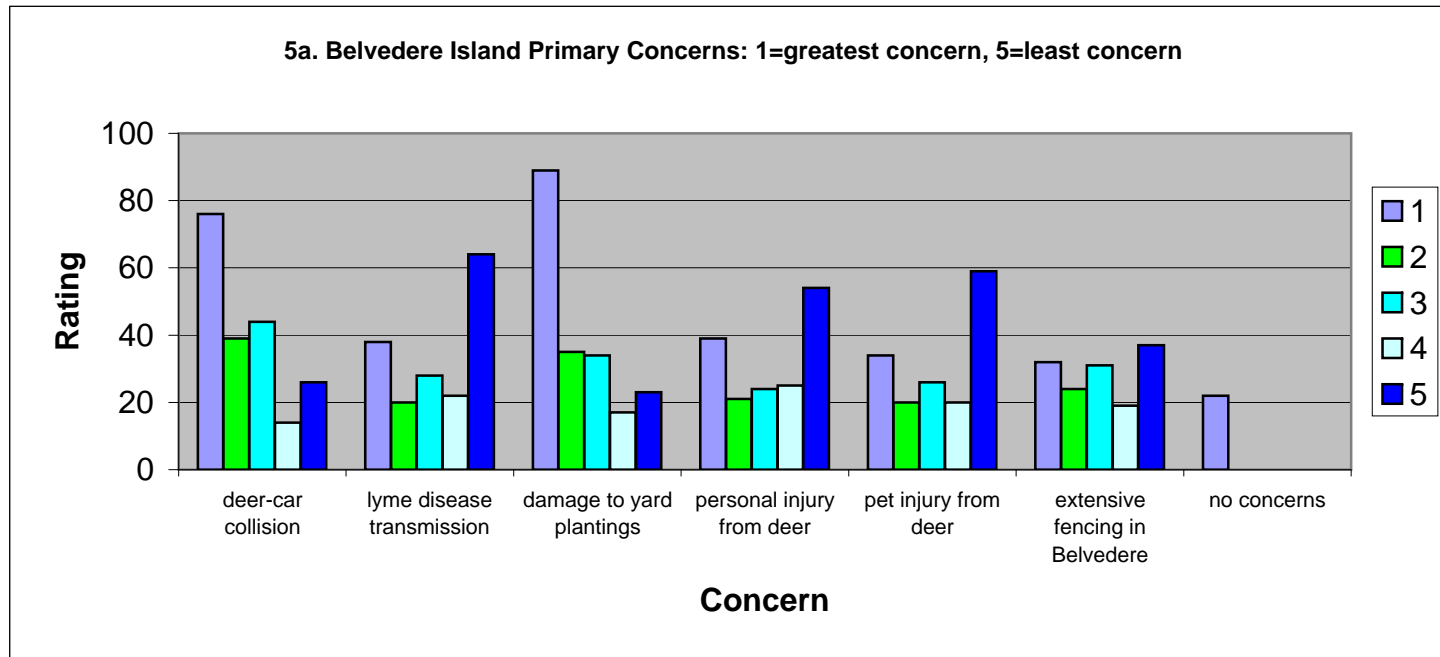
4. About how often do you see deer or new evidence of deer on your property?



Number of Responses	Belvedere Island	Lagoon	West Shore	Corinthian	Unspecified	Total
Daily	71	4	3	1	12	91
Weekly	105	11	10	4	12	142
Monthly	28	17	7	3	7	62
Rarely	34	22	3	4	10	73
Never	21	66	4	3	8	102
Total	259	120	27	15	49	470

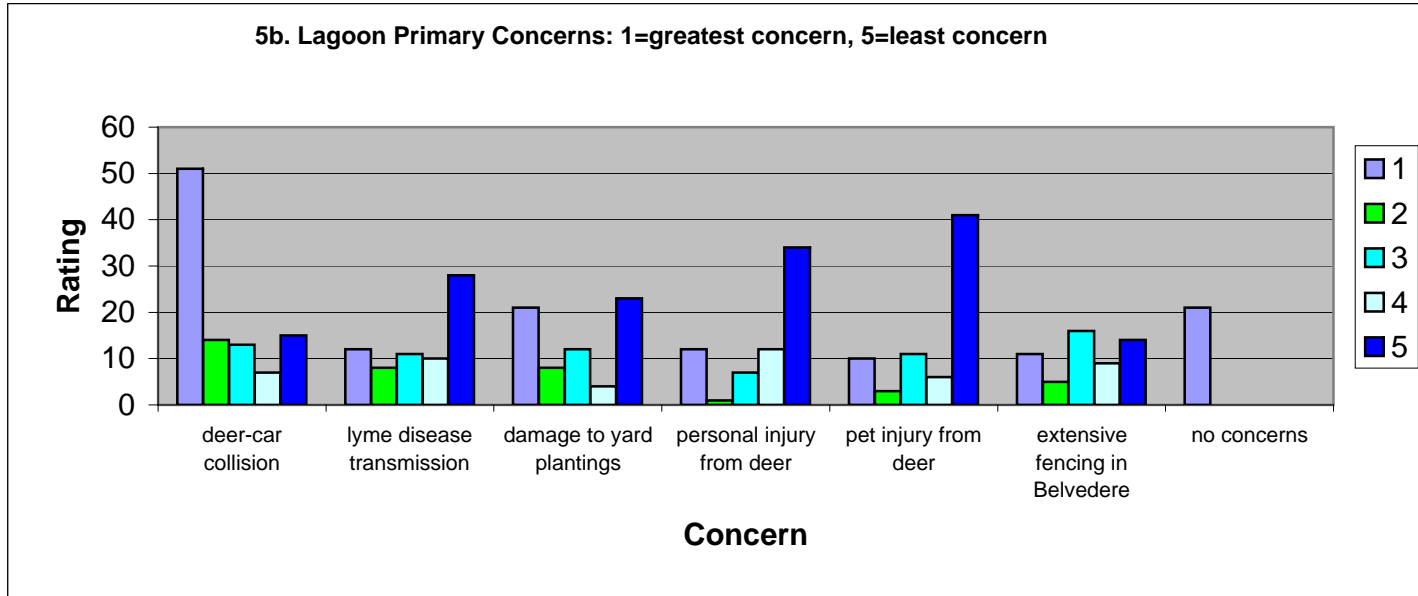
Percentage	Belvedere Island	Lagoon	West Shore	Corinthian	Unspecified	Total
Daily	27.4	3.3	11.1	6.6	24.5	19.4
Weekly	40.5	9.2	37	26.7	24.5	30.2
Monthly	10.8	14.2	25.9	20	14.3	13.2
Rarely	13.1	18.3	11.1	26.7	20.4	15.5
Never	8.2	55	14.9	20	16.3	21.7
Total	100	100	100	100	100	100

5. Please rate your primary concerns about deer from 1 to 5; 1=greatest concern, 5=least concern



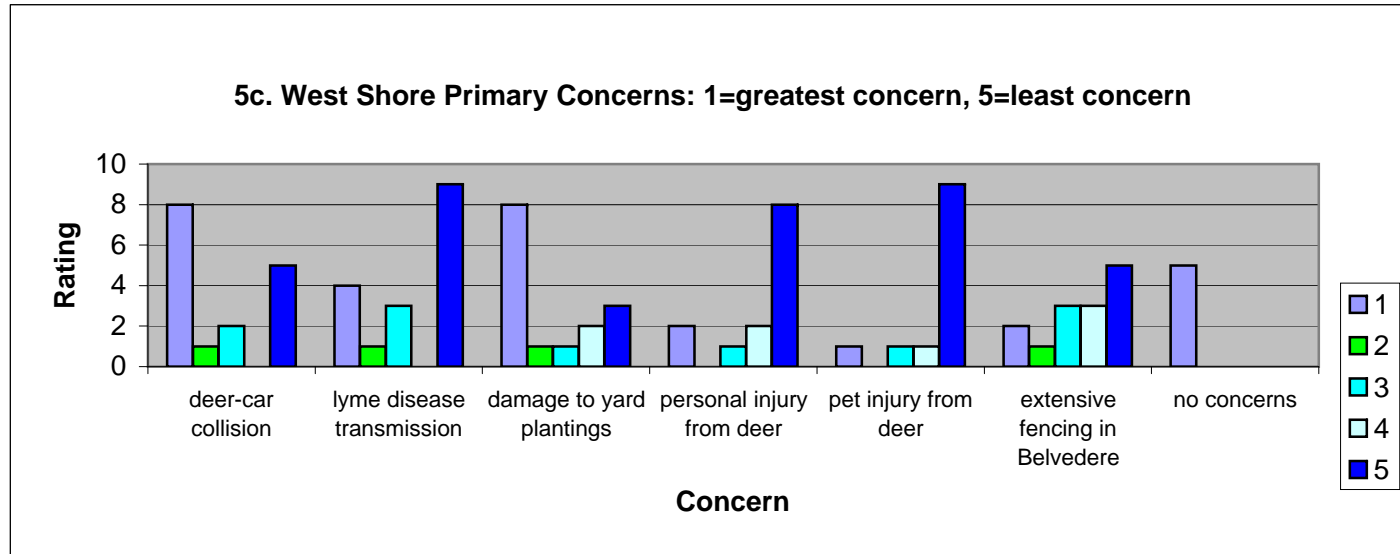
BELVEDERE ISLAND	Rating				
	1	2	3	4	5
deer-car collision	76	39	44	14	26
lyme disease transmission	38	20	28	22	64
damage to yard plantings	89	35	34	17	23
personal injury from deer	39	21	24	25	54
pet injury from deer	34	20	26	20	59
extensive fencing in Belvedere	32	24	31	19	37
no concerns	22				

5. Please rate your primary concerns about deer from 1 to 5; 1=greatest concern, 5=least concern



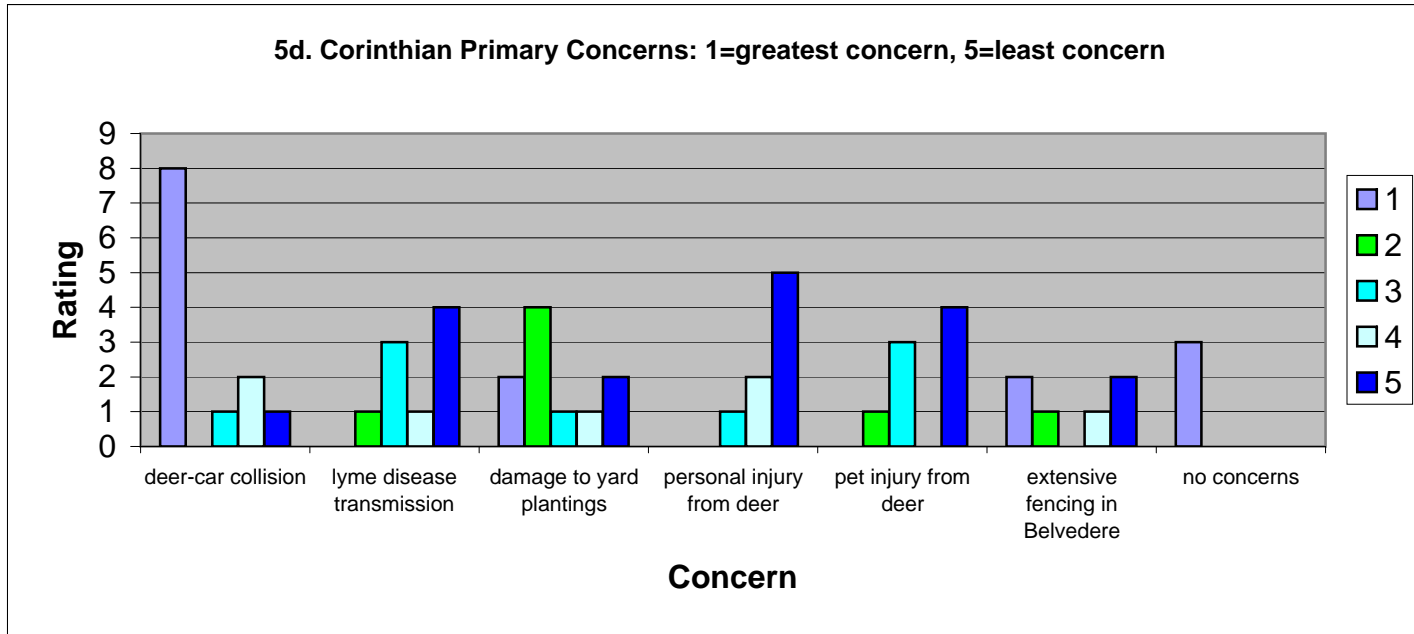
LAGOON	Rating				
	1	2	3	4	5
deer-car collision	51	14	13	7	15
lyme disease transmission	12	8	11	10	28
damage to yard plantings	21	8	12	4	23
personal injury from deer	12	1	7	12	34
pet injury from deer	10	3	11	6	41
extensive fencing in Belvedere	11	5	16	9	14
no concerns	21				

5. Please rate your primary concerns about deer from 1 to 5; 1=greatest concern, 5=least concern



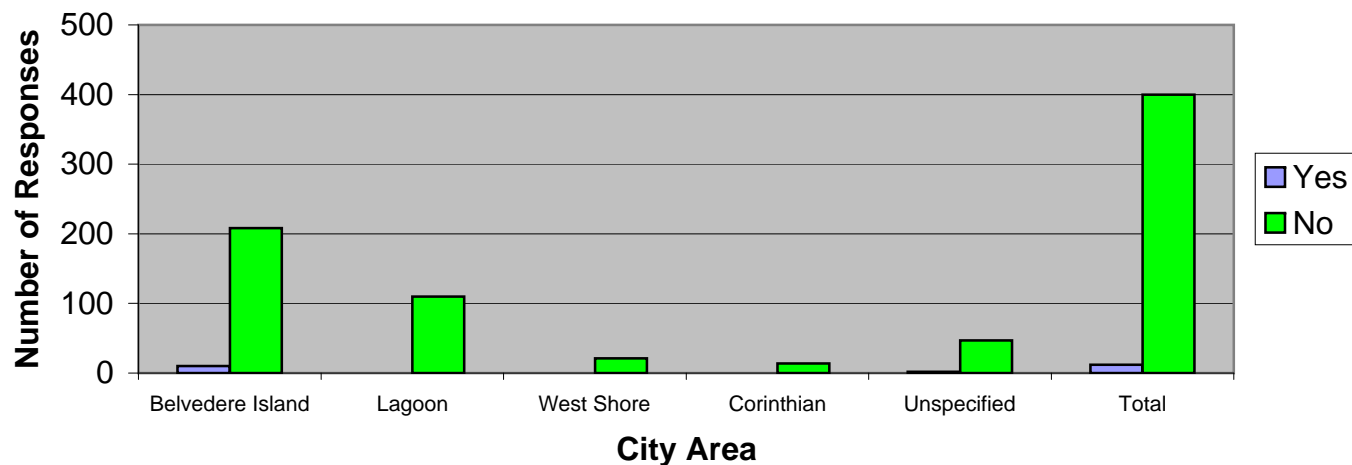
WEST SHORE	1	2	3	4	5
deer-car collision	8	1	2	0	5
lyme disease transmission	4	1	3	0	9
damage to yard plantings	8	1	1	2	3
personal injury from deer	2	0	1	2	8
pet injury from deer	1	0	1	1	9
extensive fencing in Belvedere	2	1	3	3	5
no concerns	5	0	0	0	0

5. Please rate your primary concerns about deer from 1 to 5; 1=greatest concern, 5=least concern



CORINTHIAN	1	2	3	4	5
deer-car collision	8	0	1	2	1
lyme disease transmission	0	1	3	1	4
damage to yard plantings	2	4	1	1	2
personal injury from deer	0	0	1	2	5
pet injury from deer	0	1	3	0	4
extensive fencing in Belvedere	2	1	0	1	2
no concerns	3	0	0	0	0

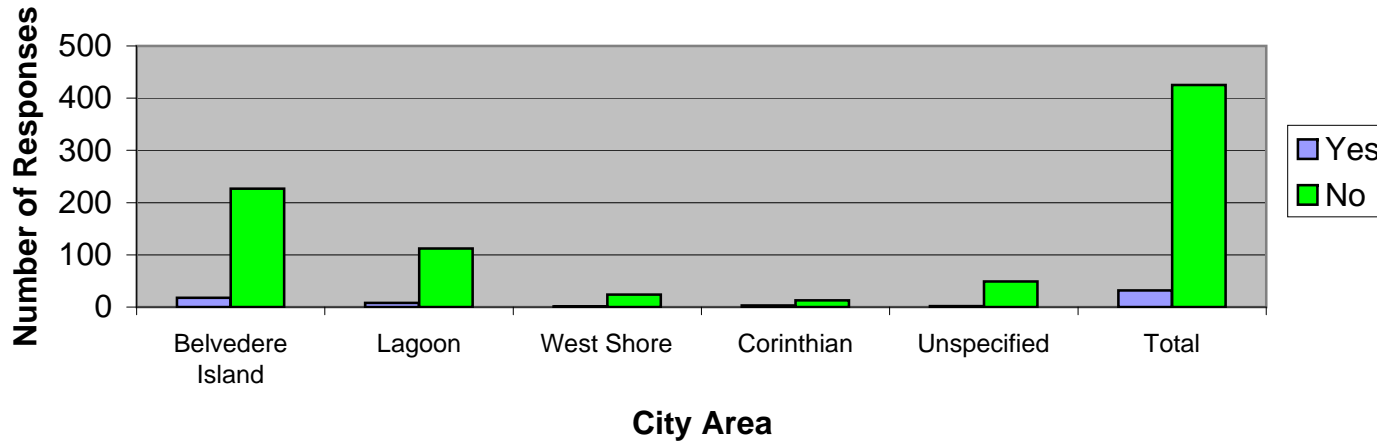
7. Have you or your pet ever been injured by a deer in Belvedere?



Number of Responses	Belvedere Island	Lagoon	West Shore	Corinthian	Unspecified	Total
Yes	10	0	0	0	2	12
No	208	110	21	14	47	400
Total	218	110	21	14	49	412

Percentage	Belvedere Island	Lagoon	West Shore	Corinthian	Unspecified	Total
Yes	4.6	0	0	0	4.1	2.9
No	95.4	100	100	100	95.9	97.1
Total	100	100	100	100	100	100

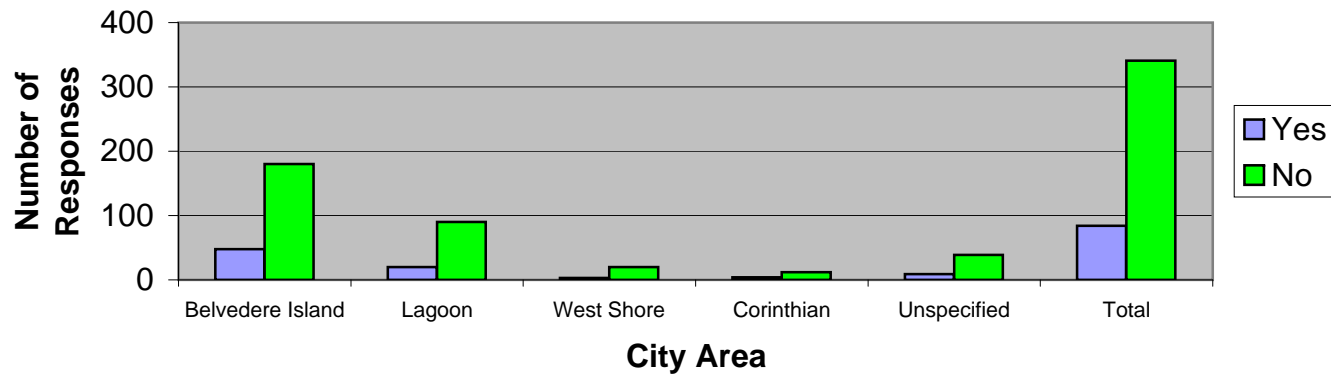
8. Have you experienced a vehicle collision with a deer while driving in Belvedere?



Number of Responses	Belvedere Island	Lagoon	West Shore	Corinthian	Unspecified	Total
Yes	18	8	1	3	2	32
No	227	112	24	13	49	425
Total	245	120	25	16	51	457

Percentage	Belvedere Island	Lagoon	West Shore	Corinthian	Unspecified	Total
Yes	7.3	6.7	4	18.8	3.9	7
No	92.7	93.3	96	81.2	96.1	93
Total	100	100	100	100	100	100

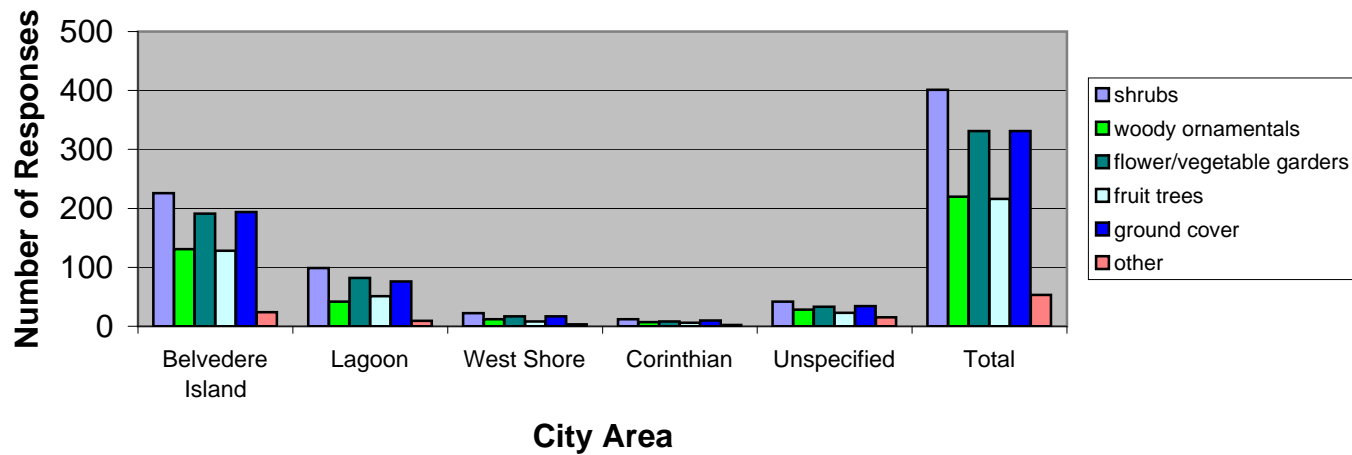
9. Do you know of anyone who has experienced a vehicle collision with a deer while driving in Belvedere??



Number of Responses	Belvedere Island	Lagoon	West Shore	Corinthian	Unspecified	Total
Yes	48	20	3	4	9	84
No	180	90	20	12	39	341
Total	228	110	23	16	48	425

Percentage	Belvedere Island	Lagoon	West Shore	Corinthian	Unspecified	Total
Yes	21	18.2	13	25	18.8	19.8
No	79	81.8	87	75	81.2	80.2
Total	100	100	100	100	100	100

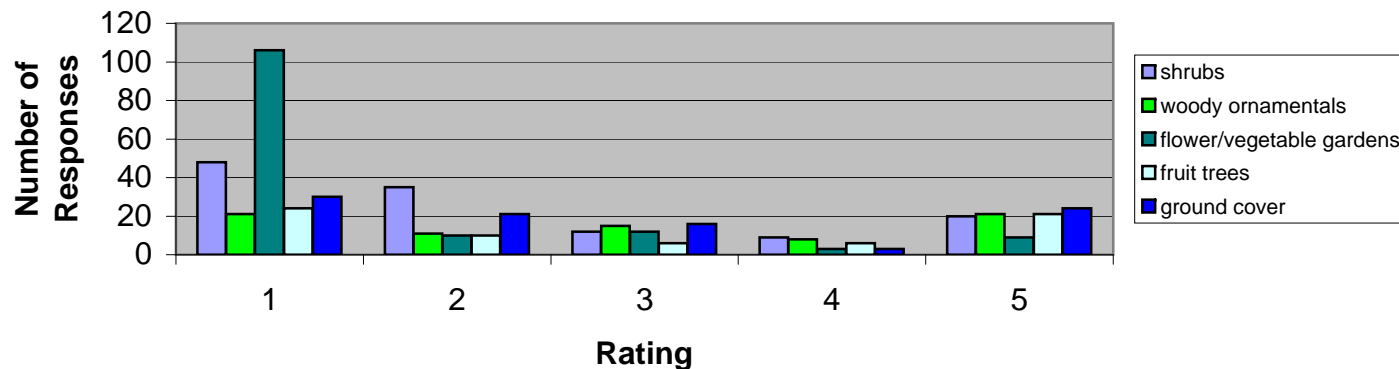
10. Which of the following types of plantings do you maintain on your property in Belvedere?



10. Which of the following types of plantings do you maintain on your property in Belvedere?

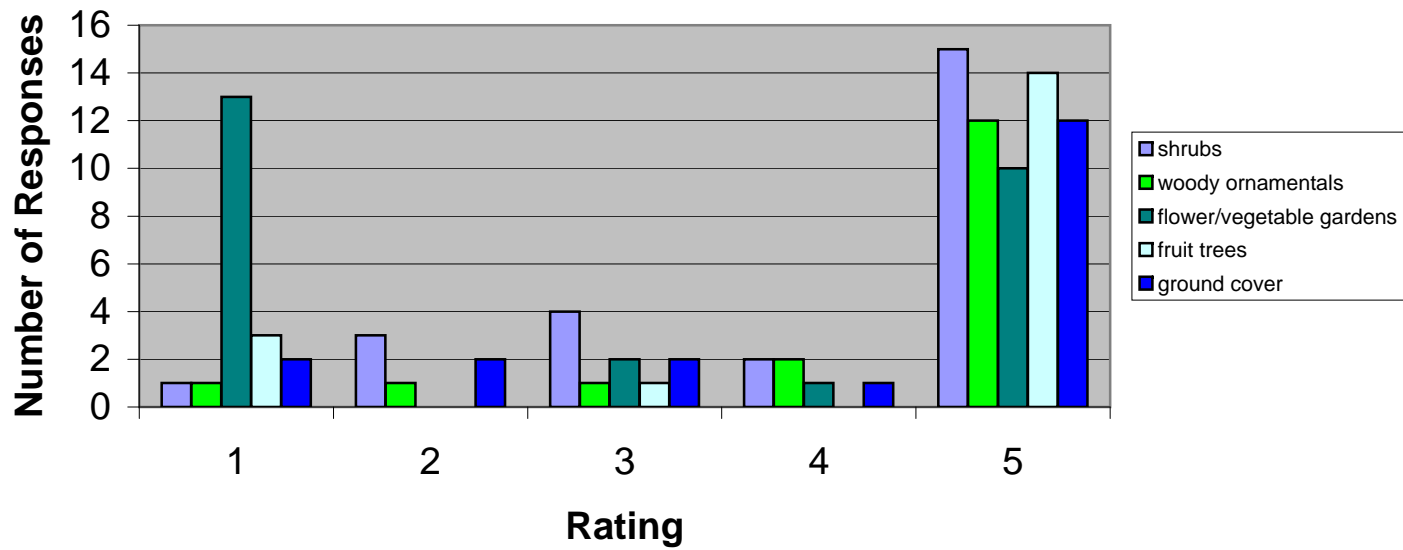
	Belvedere Island	Lagoon	West Shore	Corinthian	Unspecified	Total
shrubs	226	99	22	12	42	401
woody ornamentals	131	42	12	7	28	220
flower/vegetable gardens	191	82	17	8	33	331
fruit trees	128	51	8	6	23	216
ground cover	194	76	17	10	34	331
other	24	9	3	2	15	53

11a. (Belvedere Island) Of the plant types on your property, have any been damaged by deer? If so, rate from 1 to 5: 1=greatest damage, 5=least damage



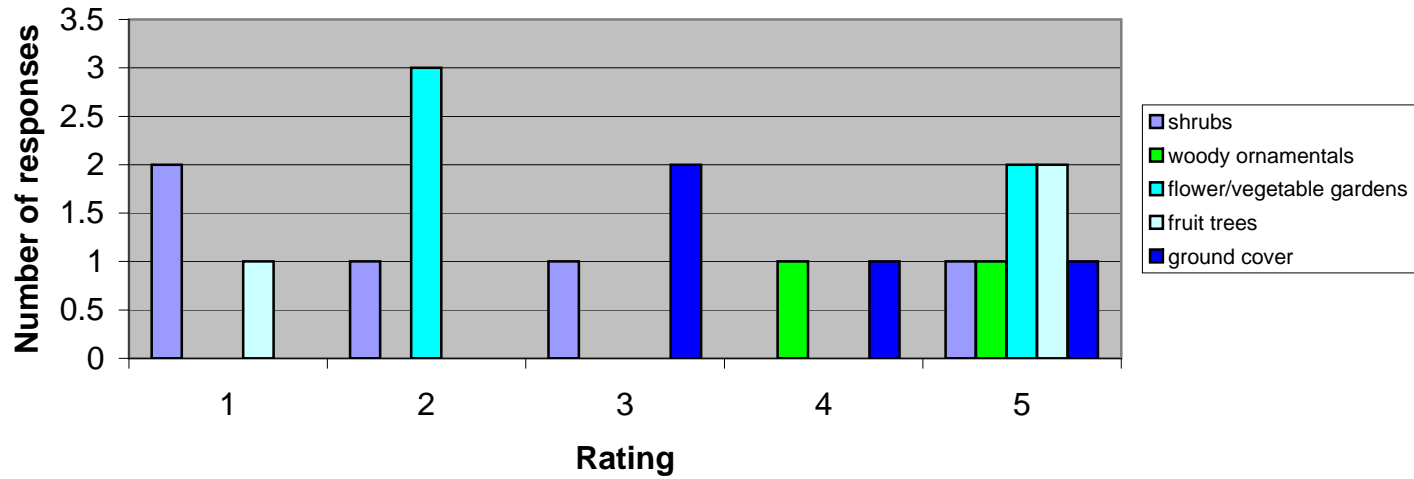
BELVEDERE ISLAND	Rating				
	1	2	3	4	5
shrubs	48	35	12	9	20
woody ornamentals	21	11	15	8	21
flower/vegetable gardens	106	10	12	3	9
fruit trees	24	10	6	6	21
ground cover	30	21	16	3	24

11b. (Lagoon) Of the plant types on your property, have any been damaged by deer? If so, rate from 1 to 5: 1=greatest damage, 5=least damage



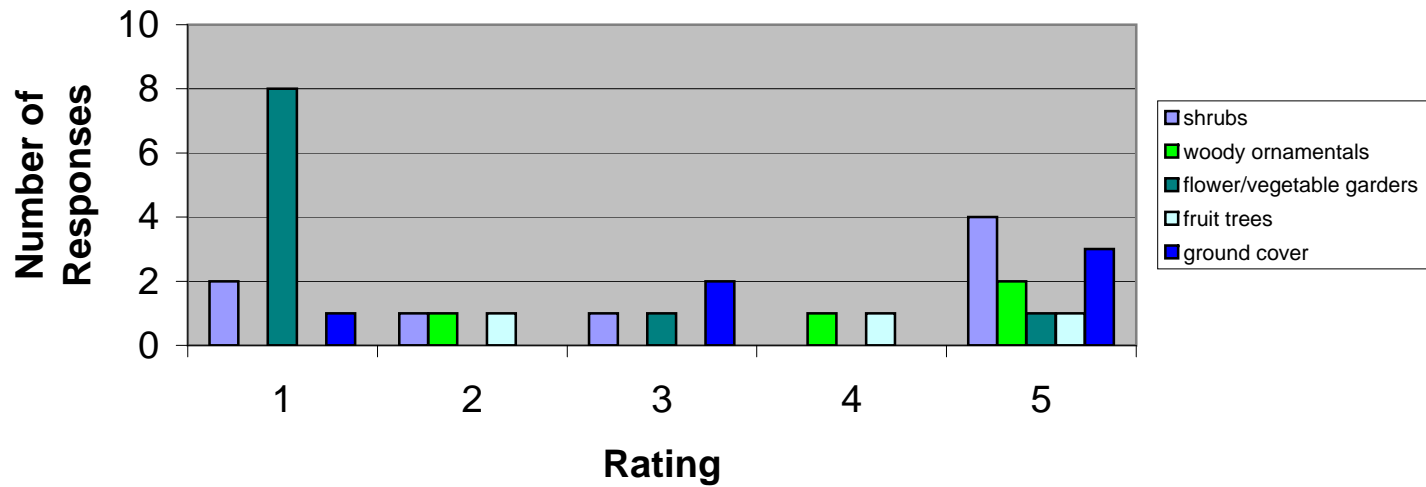
LAGOON	Rating				
	1	2	3	4	5
shrubs	1	3	4	2	15
woody ornamentals	1	1	1	2	12
flower/vegetable gardens	13	0	2	1	10
fruit trees	3	0	1	0	14
ground cover	2	2	2	1	12

11c. (Corinthian) Of the plant types on your property, have any been damaged by deer? If so, rate from 1 to 5: 1=greatest damage, 5=least damage



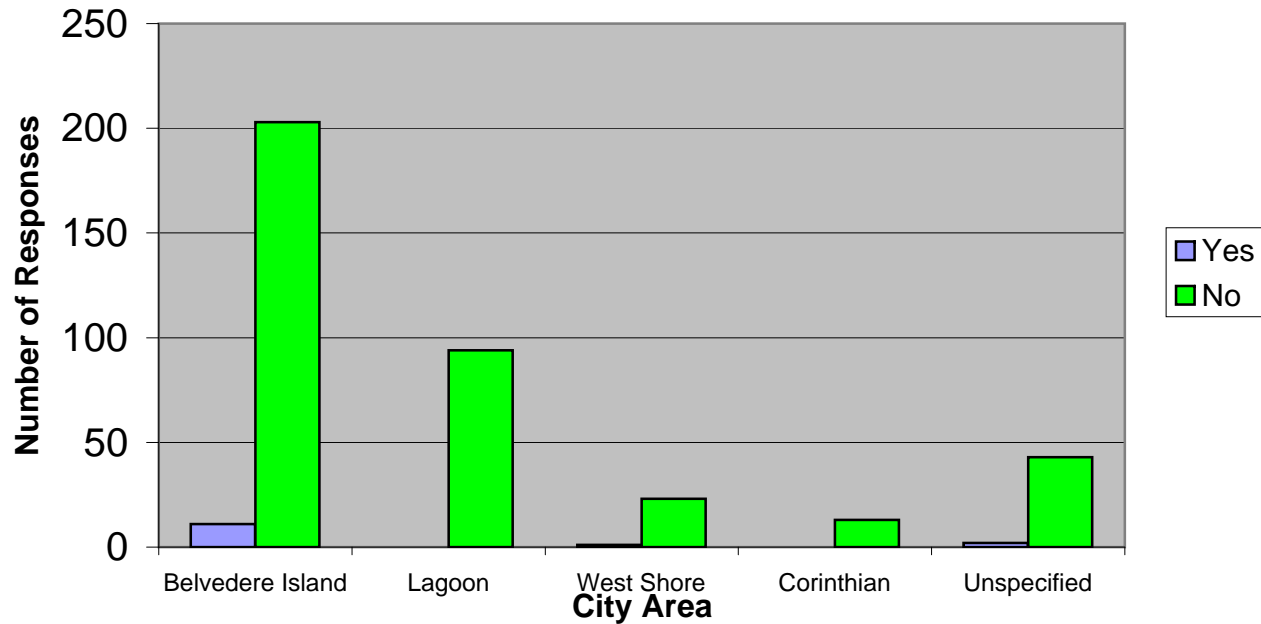
CORINTHIAN	Rating				
	1	2	3	4	5
shrubs	2	1	1	0	1
woody ornamentals	0	0	0	1	1
flower/vegetable gardens	0	3	0	0	2
fruit trees	1	0	0	0	2
ground cover	0	0	2	1	1

11d. (West Shore) Of the plant types on your property, have any been damaged by deer? If so, rate from 1 to 5: 1=greatest damage, 5=least damage



WEST SHORE	Rating				
	1	2	3	4	5
shrubs	2	1	1	0	4
woody ornamentals	0	1	0	1	2
flower/vegetable gardens	8	0	1	0	1
fruit trees	0	1	0	1	1
ground cover	1	0	2	0	3

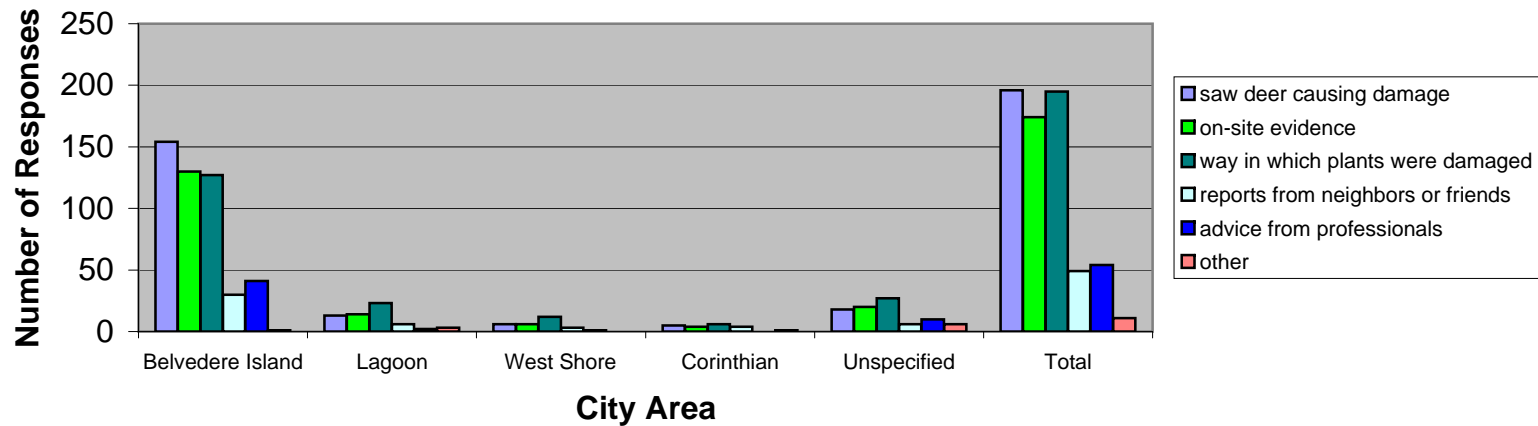
13. Did you report any deer-related property damage to any official?



Number of Responses	Belvedere Island	Lagoon	West Shore	Corinthian	Unspecified	Total
Yes	11	0	1	0	2	14
No	203	94	23	13	43	376
Total	214	94	24	13	45	390

Percentage	Belvedere Island	Lagoon	West Shore	Corinthian	Unspecified	Total
Yes	5.1	0	4.2	0	4.4	3.6
No	94.9	100	95.8	100	95.6	96.4
Total	100	100	100	100	100	100

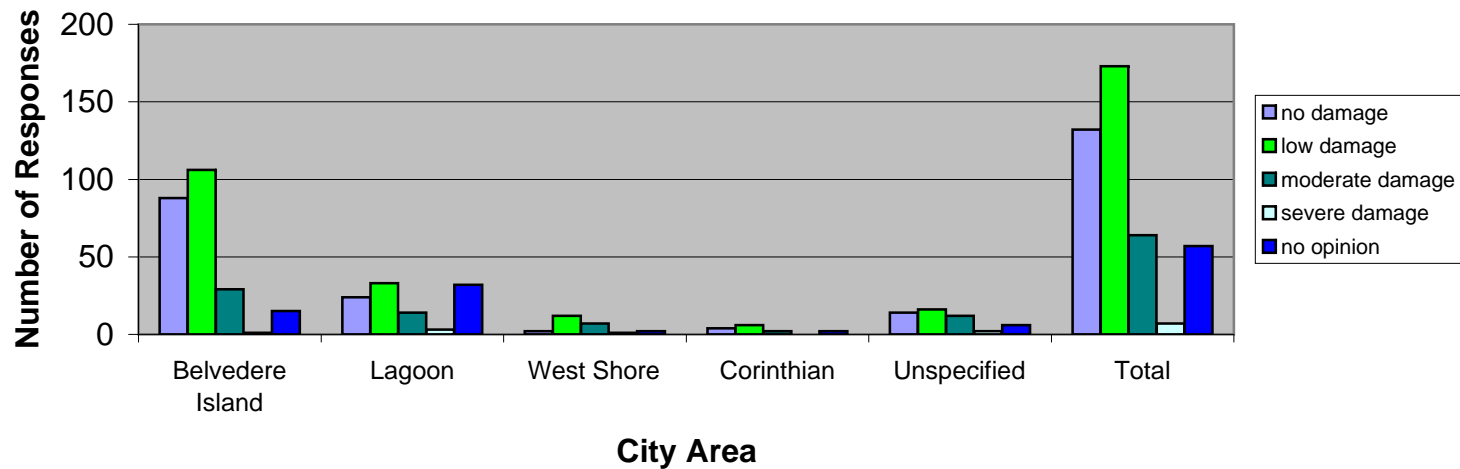
14. Which methods were used to determine that damage to plantings was caused by deer?



Number of Responses	Belvedere Island	Lagoon	West Shore	Corinthian	Unspecified	Total
saw deer causing damage	154	13	6	5	18	196
on-site evidence	130	14	6	4	20	174
way in which plants were damaged	127	23	12	6	27	195
reports from neighbors or friends	30	6	3	4	6	49
advice from professionals	41	2	1	0	10	54
other	1	3	0	1	6	11
Total	483	61	28	20	87	679

Percentage	Belvedere Island	Lagoon	West Shore	Corinthian	Unspecified	Total
saw deer causing damage	31.9	21.3	21.4	25	20.7	28.9
on-site evidence	26.9	23	21.4	20	23	25.6
way in which plants were damaged	26.3	37.7	42.9	30	31	28.7
reports from neighbors or friends	6.2	9.8	10.7	20	6.9	7.3
advice from professionals	8.5	3.3	3.6	0	11.5	7.9
other	0.2	4.9	0	5	6.9	1.6
Total	100	100	100	100	100	100

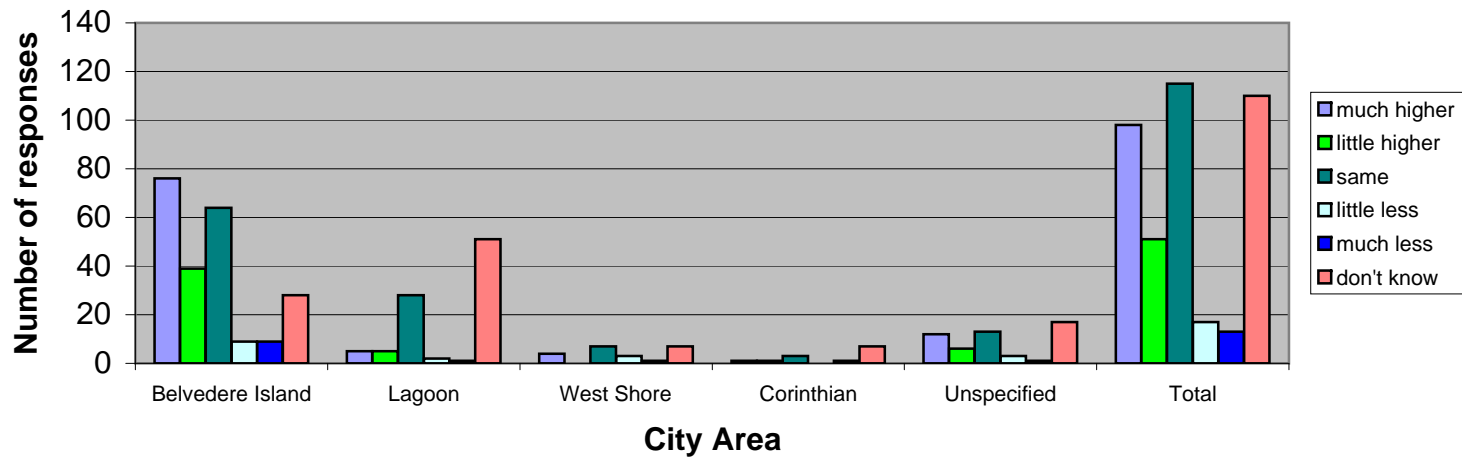
16. How much damage would you be willing to tolerate in the future?



Number of Responses	Belvedere Island	Lagoon	West Shore	Corinthian	Unspecified	Total
no damage	88	24	2	4	14	132
low damage	106	33	12	6	16	173
moderate damage	29	14	7	2	12	64
severe damage	1	3	1	0	2	7
no opinion	15	32	2	2	6	57
Total	239	106	24	14	50	433

Percentage	Belvedere Island	Lagoon	West Shore	Corinthian	Unspecified	Total
no damage	36.8	22.6	8.3	28.6	28	30.5
low damage	44.4	31.1	50	42.8	32	40
moderate damage	12.1	13.2	29.2	14.3	24	14.7
severe damage	0.4	2.9	4.2	0	4	1.6
no opinion	6.3	30.2	8.3	14.3	12	13.2
Total	100	100	100	100	100	100

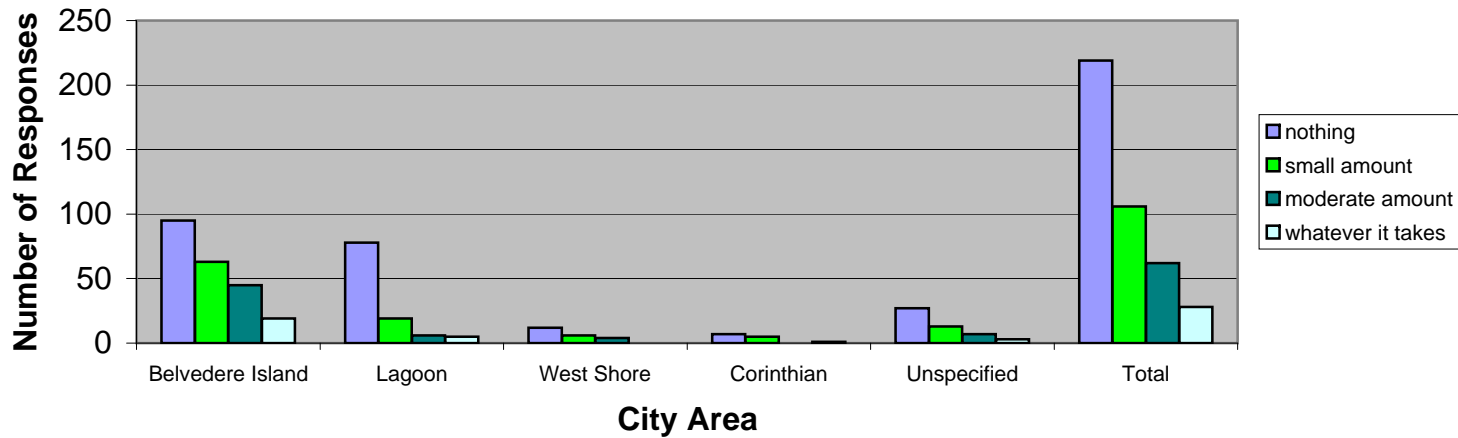
17. How would you compare damage during 2008 with last 5 years?



Number of Responses	Belvedere Island	Lagoon	West Shore	Corinthian	Unspecified	Total
much higher	76	5	4	1	12	98
little higher	39	5	0	1	6	51
same	64	28	7	3	13	115
little less	9	2	3	0	3	17
much less	9	1	1	1	1	13
don't know	28	51	7	7	17	110
Total	225	92	22	13	52	404

Percentage	Belvedere Island	Lagoon	West Shore	Corinthian	Unspecified	Total
much higher	33.8	5.4	18.2	7.7	23.1	24.3
little higher	17.4	5.4	0	7.7	11.5	12.6
same	28.4	30.4	31.8	23.1	25	28.5
little less	4	2.2	13.7	0	5.8	4.2
much less	4	1.2	4.5	7.7	1.9	3.2
don't know	12.4	55.4	31.8	53.8	32.7	27.2
Total	100	100	100	100	100	100

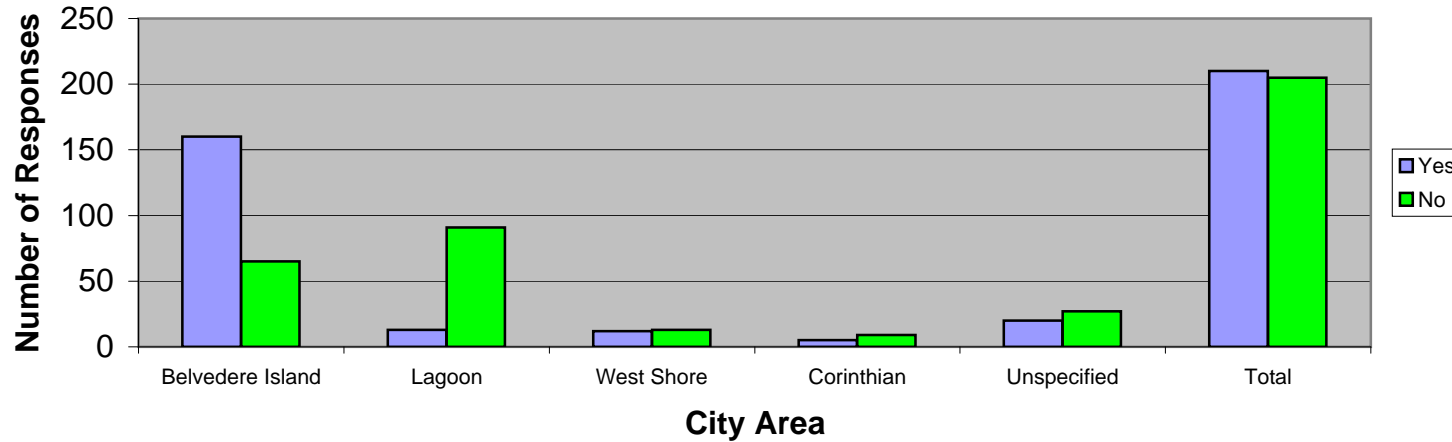
18. How much would you be willing to pay each year for deer damage control or prevention on your property?



Number of Responses	Belvedere Island	Lagoon	West Shore	Corinthian	Unspecified	Total
nothing	95	78	12	7	27	219
small amount	63	19	6	5	13	106
moderate amount	45	6	4	0	7	62
whatever it takes	19	5	0	1	3	28
Total	222	108	22	13	50	415

Percentage	Belvedere Island	Lagoon	West Shore	Corinthian	Unspecified	Total
nothing	42.8	72.2	54.5	53.8	54	52.8
small amount	28.3	17.6	27.3	38.5	26	25.5
moderate amount	20.3	5.6	18.2	0	14	14.9
whatever it takes	8.6	4.6	0	7.7	6	6.8
Total	100	100	100	100	100	100

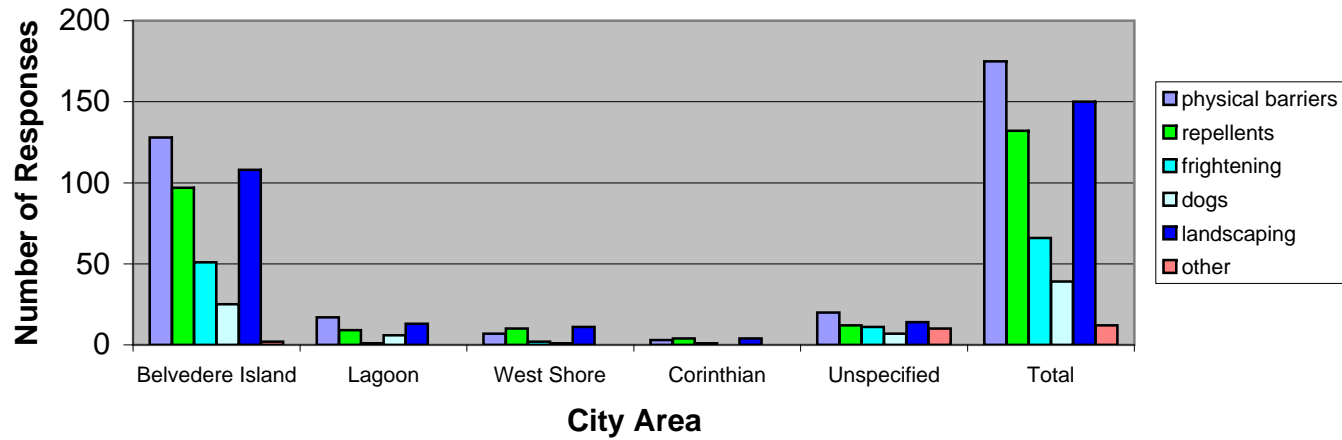
19. In 2008, did you use any methods to try to prevent deer from causing damage to your plantings?



Number of Responses	Belvedere Island	Lagoon	West Shore	Corinthian	Unspecified	Total
Yes	160	13	12	5	20	210
No	65	91	13	9	27	205
Total	225	104	25	14	47	415

Percentage	Belvedere Island	Lagoon	West Shore	Corinthian	Unspecified	Total
Yes	71.1	12.5	48	35.7	42.6	50.6
No	28.9	87.5	52	64.3	57.4	49.4
Total	100	100	100	100	100	100

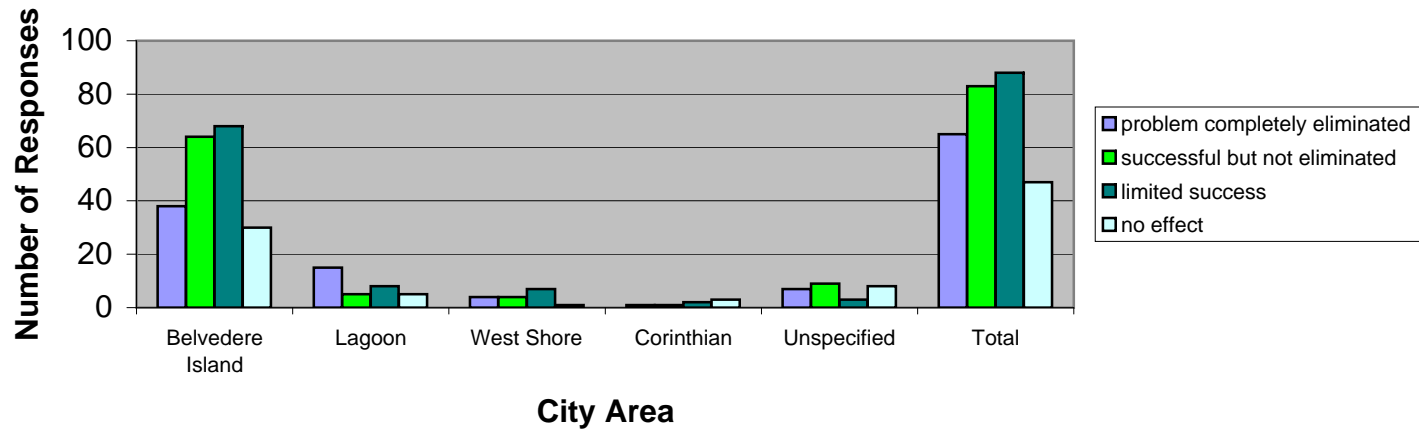
21. Which method or methods did you use?



Number of Responses	Belvedere Island	Lagoon	West Shore	Corinthian	Unspecified	Total
physical barriers	128	17	7	3	20	175
repellents	97	9	10	4	12	132
frightening	51	1	2	1	11	66
dogs	25	6	1	0	7	39
landscaping	108	13	11	4	14	150
other	2	0	0	0	10	12
Total	411	46	31	12	74	574

Percentage	Belvedere Island	Lagoon	West Shore	Corinthian	Unspecified	Total
physical barriers	31.1	37	22.6	25	27	30.5
repellents	23.6	19.6	32.3	33.3	16.2	23
frightening	12.4	2.1	6.5	8.4	14.9	11.5
dogs	6.1	13	3.1	0	9.5	6.8
landscaping	26.3	28.3	35.5	33.3	18.9	26.1
other	0.5	0	0	0	13.5	2.1
Total	100	100	100	100	100	100

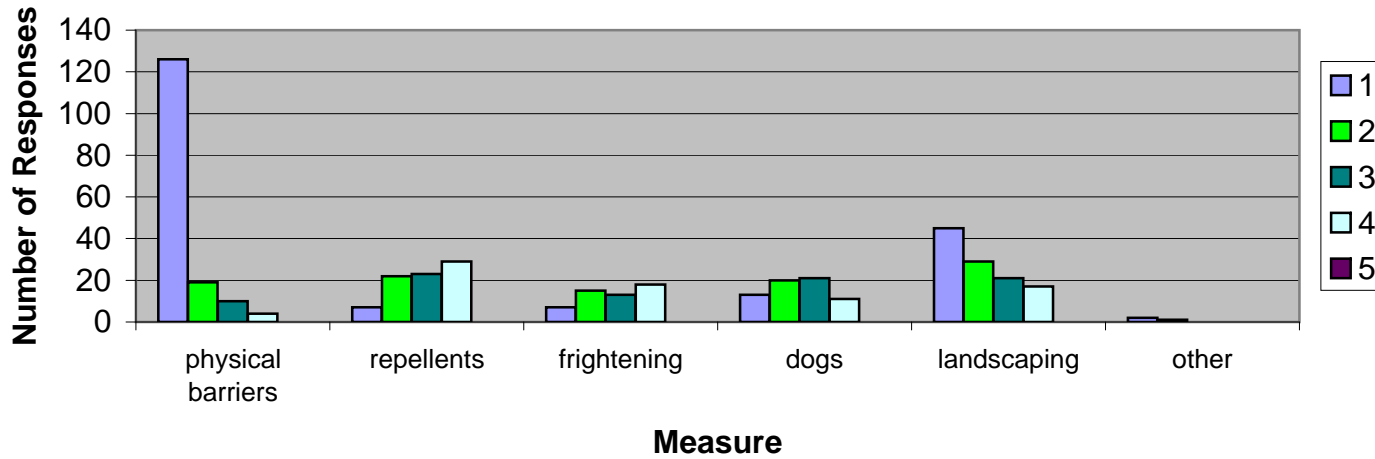
22. How would you rate the effectiveness of the method or methods you used?



Number of Responses	Belvedere Island	Lagoon	West Shore	Corinthian	Unspecified	Total
problem completely eliminated	38	15	4	1	7	65
successful but not eliminated	64	5	4	1	9	83
limited success	68	8	7	2	3	88
no effect	30	5	1	3	8	47
Total	200	33	16	7	27	283

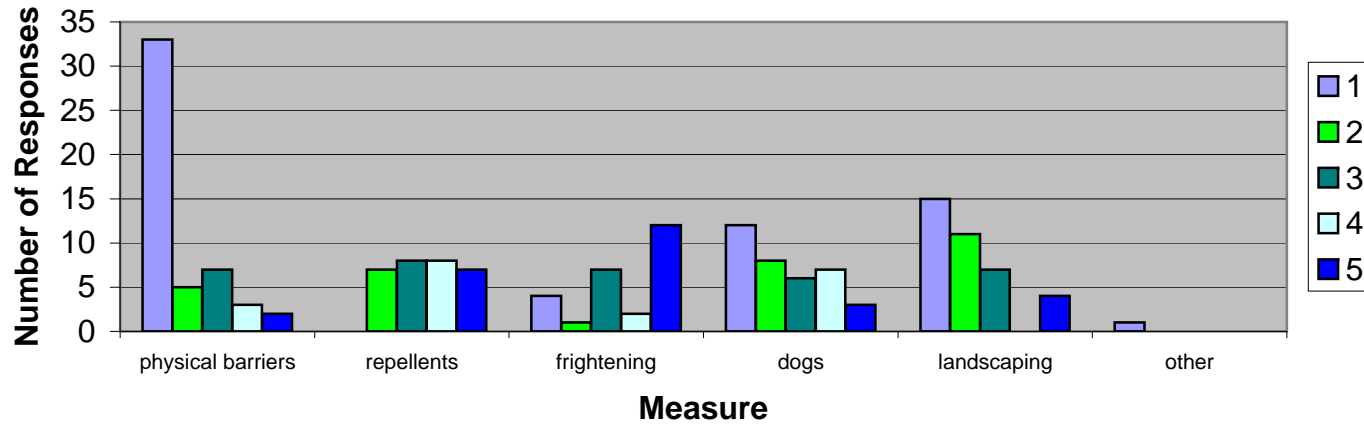
Percentage	Belvedere Island	Lagoon	West Shore	Corinthian	Unspecified	Total
problem completely eliminated	19	45.5	25	14.3	25.9	23
successful but not eliminated	32	15.2	25	14.3	33.3	29.3
limited success	34	24.1	43.8	28.5	11.1	31.1
no effect	15	15.2	6.2	42.9	29.7	16.6
Total	100	100	100	100	100	100

23a. (Belvedere) In general, how would you rate the effectiveness of the following deer control measures? 1=most effective, 5=least effective



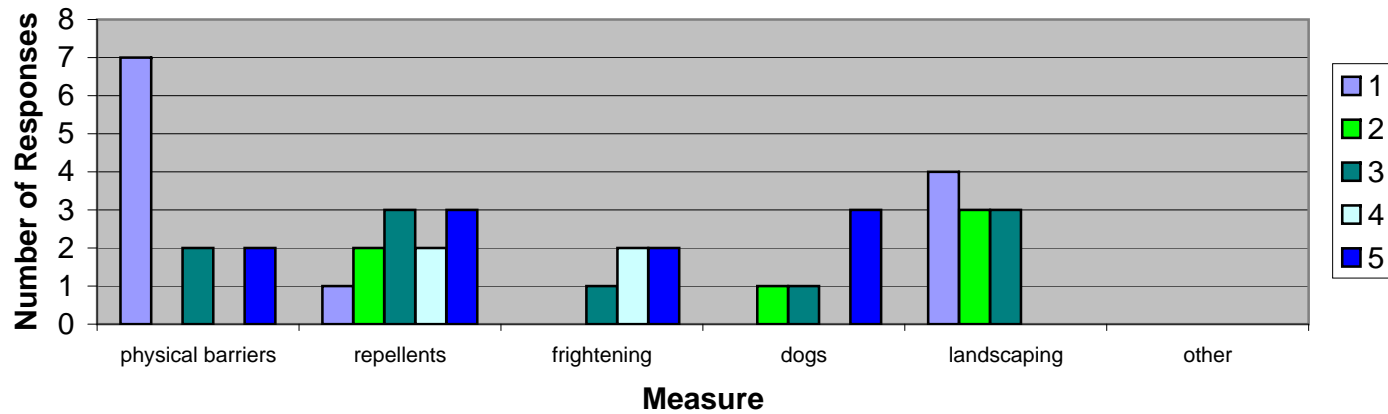
BELVEDERE	Rating				
	1	2	3	4	5
physical barriers	126	19	10	4	20
repellents	7	22	23	29	44
frightening	7	15	13	18	45
dogs	13	20	21	11	31
landscaping	45	29	21	17	29
other	2	1	0	0	0

23b. (Lagoon) In general, how would you rate the effectiveness of the following deer control measures? 1=most effective, 5=least effective



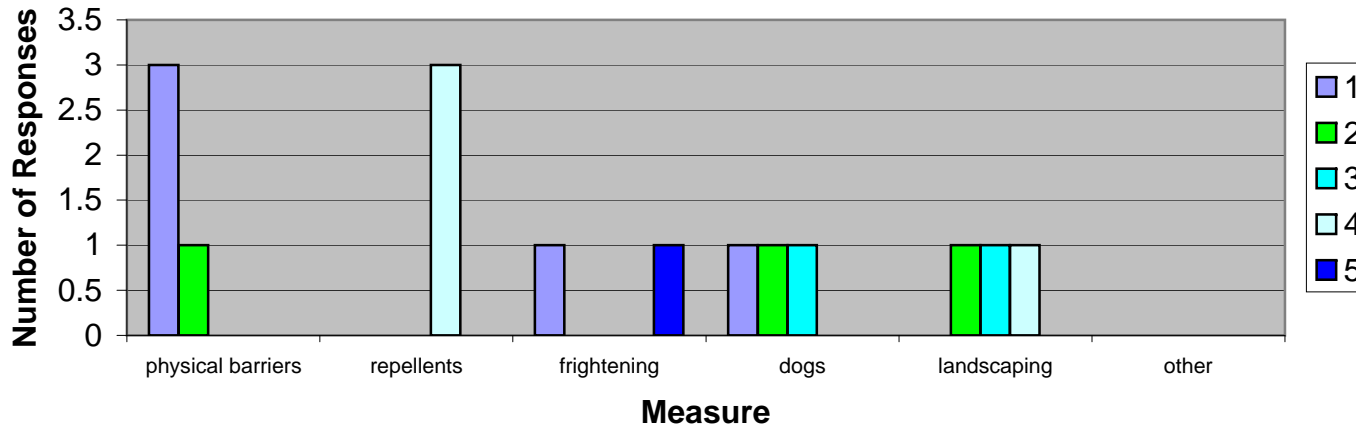
LAGOON	Rating				
	1	2	3	4	5
physical barriers	33	5	7	3	2
repellents	0	7	8	8	7
frightening	4	1	7	2	12
dogs	12	8	6	7	3
landscaping	15	11	7	0	4
other	1	0	0	0	0

23c. (West Shore) In general, how would you rate the effectiveness of the following deer control measures? 1=most effective, 5=least effective



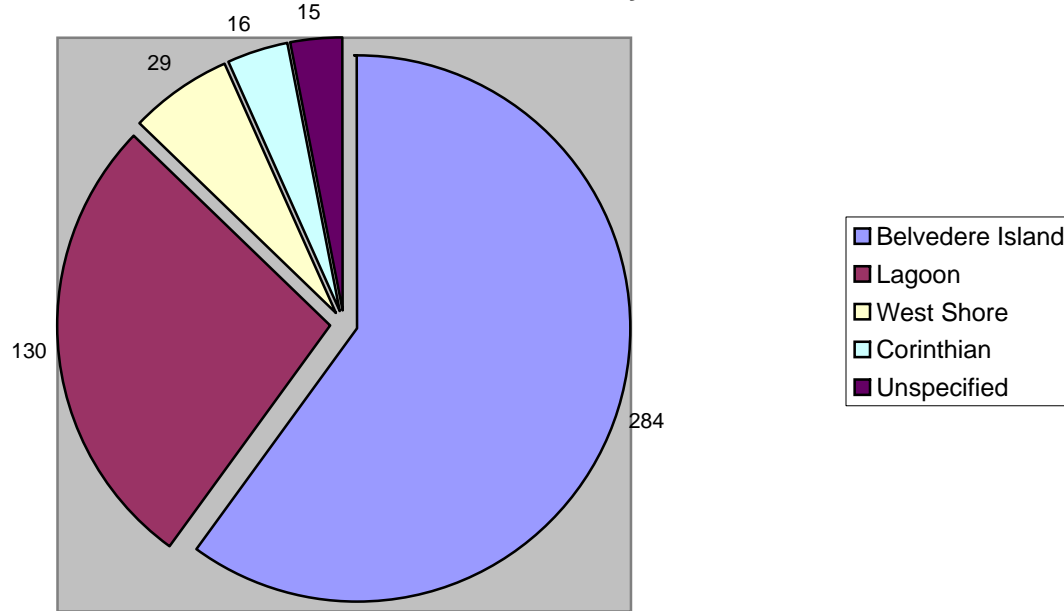
WEST SHORE	Rating				
	1	2	3	4	5
physical barriers	7	0	2	0	2
repellents	1	2	3	2	3
frightening	0	0	1	2	2
dogs	0	1	1	0	3
landscaping	4	3	3	0	0
other	0	0	0	0	0

23d. (Corinthian) In general, how would you rate the effectiveness of the following deer control measures? 1=most effective, 5=least effective



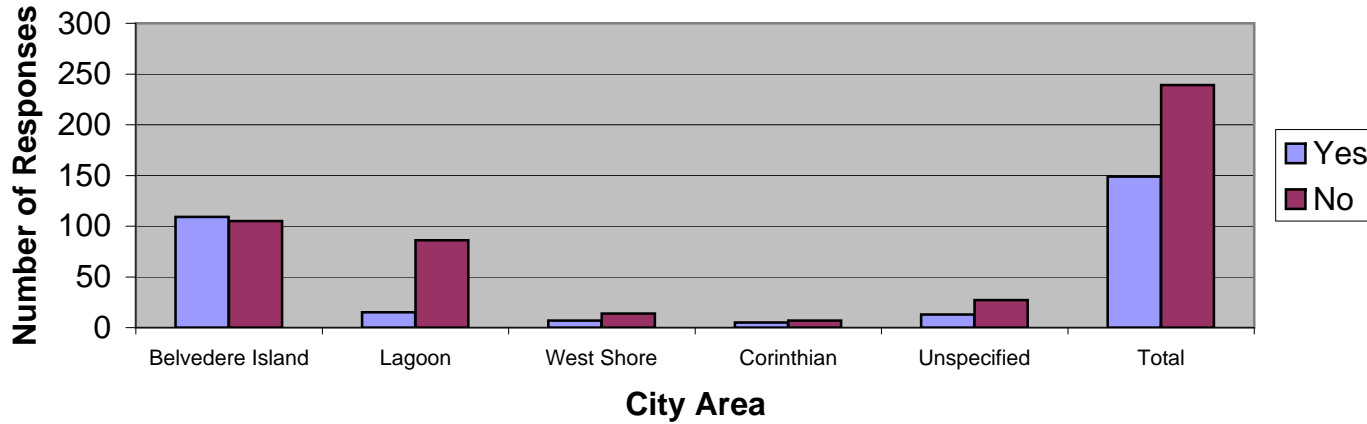
CORINTHIAN	Rating				
	1	2	3	4	5
physical barriers	3	1	0	0	0
repellents	0	0	0	3	0
frightening	1	0	0	0	1
dogs	1	1	1	0	0
landscaping	0	1	1	1	0
other	0	0	0	0	0

25. What area of Belvedere do you live in?



Belvedere Island	Lagoon	West Shore	Corinthian	Unspecified	Total
284	130	29	16	15	474
59.90%	27.40%	6.10%	3.40%	3.20%	100.00%

27. Would you be willing to voluntarily assist in a census study to estimate the deer population and distribution in Belvedere?



Number of Responses	Belvedere Island	Lagoon	West Shore	Corinthian	Unspecified	Total
Yes	109	15	7	5	13	149
No	105	86	14	7	27	239
Total	214	101	21	12	40	388

Percentage	Belvedere Island	Lagoon	West Shore	Corinthian	Unspecified	Total
Yes	50.9	14.9	33.3	41.7	32.5	38.4
No	49.1	85.1	66.7	58.3	67.5	61.6
Total	100	100	100	100	100	100