Carleton College Deer Hunt Group

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Introduction

The Carleton College Cowling Arboretum or "Arb" for short is an 880-acre set of land that was created by Donald J. Cowling and Harvey E. Stork in the 1920's.[1] Professor Stork and Superintendent of Grounds Blake Stewart began to develop the land in order to promote restoration efforts.[2] The Arboretum became a place for restoration practices, education, conservation, and recreation for not only the students of Carleton but also the residents of the Northfield area.[3] Nancy Braker, director of the Arboretum, has decided that the local population of white-tailed deer threatens the Arb's restoration goals, and as such should be reduced through hunting. There are many stakeholders in the decision to hold the hunt, and so the issue deserves careful consideration.

In order to justify holding the hunt, the ecological impact of the deer browse must exceed the moral cost of taking the deer's lives. The decision may be as simple as putting the negative environmental impacts on one side of the scale, the negative impact on the deer's welfare on the other, and deciding which side tips most. This decision making mechanism is reminiscent of utilitarian theory which calls for making choices in the hope to incur the greatest good for the greatest number. While there is scientific literature on the ecological impacts of deer, those impacts have not been quantified in the Arb, nor has the hunt's effect on the impacts been quantified. It is therefore difficult to recommend holding a hunt, knowing that hunted deer undeniably feel pain, but not knowing the extent to which hunting them actually mitigates ecological impact of the deer population at large.

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[1] Cowling, 2
[2] Cowling, 2
[3] Cowling, 2

From Thanksgiving until December 31st there are on average 34 permits issued[4] yearly since 1998 that allows hunters to bow hunt deer in the approximated 400 acres of land in the lower Arboretum (figure1).[5] The hunt is constrained to the Lower arboretum due to the Upper Arboretum being within Northfield city limits and trying to file for those permits is very difficult. The hunt was brought about when Arboretum staff began to notice the large amounts of deer in the area and high levels of deer browse on restoration plantings, especially on young trees.[6] With the hunt in place it prevents the deer from having a desire to stay in the Arboretum due to a lack of safety in the area for the deer. Because deer get accustomed to the area and stay long after the hunting season if there are not measures in place to deter them from the area the deer will just stay long past the winter.[7] Braker will continue to renew the hunts indefinitely because the success she sees from it is worth it.[8]

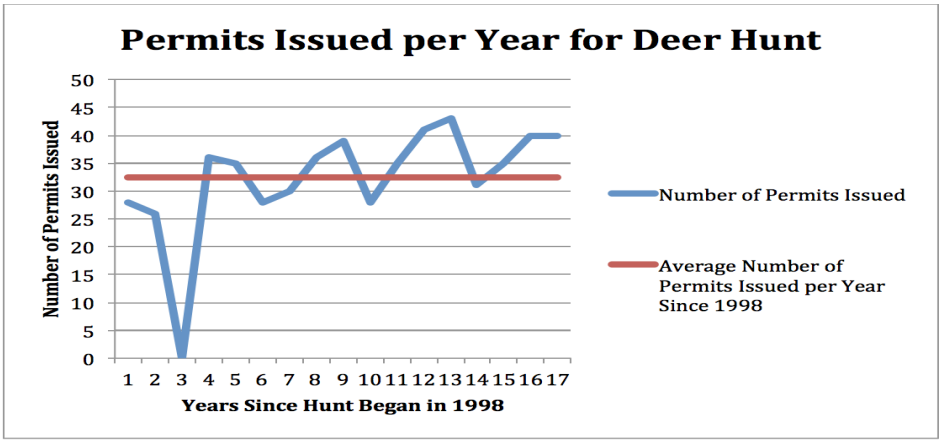

Figure1. By collecting the data given to us by Carleton College it can be seen how many permits on average were issued to hunters for the hunt. It is important to note that there was no hunt during the third year of the hunt

[4]Braker, 2016
[5]CarletonArbArcheryHuntBorder
[6] Braker, 2016
[7] Braker, 2016
[8] Braker, 2016

These hunters on average have harvested 9 deer yearly since the hunt has been allowed (figure2). This has been a recurring practice since 1998 until the present except for the year 2000 because it was the year that they took off to reevaluate how well this practice was going. The college has shown a preference on handing permits to hunters who have proven to be successful in previous hunts in the Arboretum.[9] However, before a hunter is allowed to hunt an antlered deer in the arboretum in order to promote Carleton College's goals of reducing the local deer population the hunters must first harvest an antler-less deer from the Arboretum.[10]

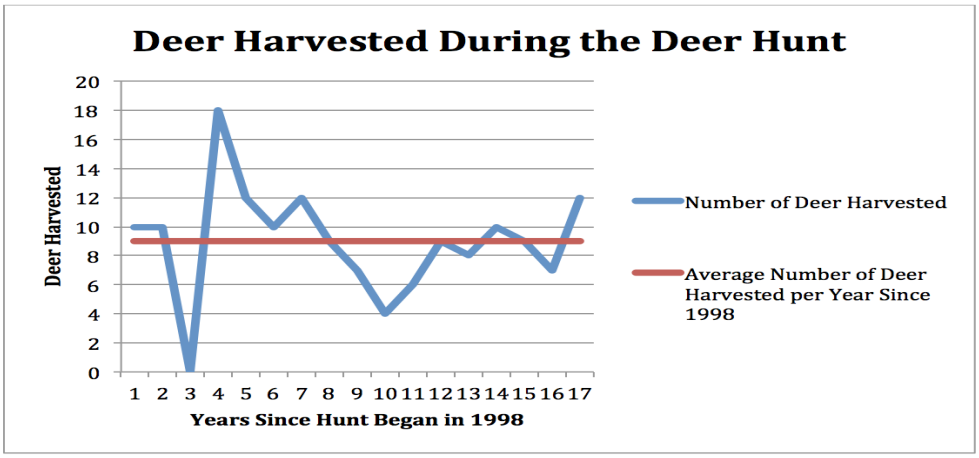

Figure2. By collecting the data given to us by Carleton College it can be seen how many deer were harvested on average for the hunt. It is important to note that there was no hunt during the third year of the hunt

The white-tailed deer (Odocoileus virginianus), also known as the whitetail, is a medium-sized deer native to the United States, Canada, Mexico, Central America, South America, and several other places.[11] In the in the 19th century hunting deer was a sport, necessity, pest control, and etc. People saw deer as a certainty that would be

[9] Cowling, 1
[10] Cowling
[11] Zimmermann, 1780, Mammals of the World

around for centuries to come. People never hesitated to shoot a deer dead, and that is why the deer population was lessened by an extreme amount by the end of the 19th century.[12] Wildlife managers worked hard in the early 20th century to devise and enforce bag limits, short hunting seasons, and buck only hunts in order to protect the recovering herds.[13] While the wildlife services wanted to revitalize the populous, they did not expect the deer's birth rate to be as explosive as it was. Deer quickly became a major pest due to overpopulation versus limited resources. Deer are now known to have a huge ecological effect on many different ecosystems. They mostly gorge themselves on twigs, leaves, shoots of woody plants and mossy vines.[14] They are known to eat grass, but only the newest and most succulent. Deer populate rapidly and can completely devastate a forest.[15] During the winter the amount of shrubbery is very sparse and the deer are forced to go without much food. This is why the female deer does not usually give birth until the summer months of May or June, when the vegetation returns. Fawns, baby deer, are born hungry and the forest becomes a feast for them. Deer consume all of the nutrients that they can so that it can replenish and stock up on food for the coming winter.[16] Deer are known to crowd out their food competitors, which are goats, sheep, and other game animals. Deer tend to eat all

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[12] Yarrow, Greg. "Extension Forestry & Natural Resources." *Fact Sheet 34: White-tailed Deer Biology and Management : Extension : Clemson University : South Carolina*. Clemson University Cooperative Extension's Forestry & Natural Resources Team, May 2009. Web. 2.

[13] Waller et. al, 1997, pg. 217 *The White-Tailed Deer: A Keystone Herbivore.*

[14] Yarrow, Greg. "Extension Forestry & Natural Resources." *Fact Sheet 34: White-tailed Deer Biology and Management : Extension : Clemson University : South Carolina*. Clemson University Cooperative Extension's Forestry & Natural Resources Team, May 2009. Web. 2.

[15] Perigo, Maria Eugenia. "The Effect of Overgrazing and Deforestation on a Population of Gray Brocket Deer (Mazama Gouazoubira) in the Arid Area of the Chaco Region of Córdoba." *The Effect of Overgrazing and Deforestation on a Population of Gray Brocket Deer (Mazama Gouazoubira) in the Arid Area of the Chaco Region of Córdoba.* The Rufford Foundation, Mar. 2008. Web.

[16] Perigo, Maria Eugenia. "The Effect of Overgrazing and Deforestation on a Population of Gray Brocket Deer (Mazama Gouazoubira) in the Arid Area of the Chaco Region of Córdoba." *The Effect of Overgrazing and Deforestation on a Population of Gray Brocket Deer (Mazama Gouazoubira) in the Arid Area of the Chaco Region of Córdoba.* The Rufford Foundation, Mar. 2008. Web.

forest life until it is nearly completely depleted before leaving the area causing deforestation, which is the leading cause of Climate Change. In a study done by Brinkman, Todd J., Christopher S. Deperno, Jonathan A. Jenks, Brian S. Haroldson, and Robert G. Osborn 77, a group of 66 adults and 11 young, female deer were charted and followed in northern Minnesota. There were test was conducted spring 2001 and 2002 as well as autumn 2001. Due to the lack of migration monitoring in autumn 2002 the dispersion of spring 2002 can not be determined. For each season the mean dispersion, and migration are charted. It was found first found that the two major factors within migration is snowfall and temperature.[17] The deer hunt is done in the winter so to see the possible effects that the deer would have on the forest it would be best to use the spring results, because if the deer were not killed then the possible distances of the deer would be known. When the snowfall reaches around 35-40 cm or the temperature reaches around 19 degrees Fahrenheit it triggers migration.[18] The study concluded that there was an average separation of 71.3 km distance, for migratory deer, between them with a single female deer going 205 km in a straight line.[19] The female deer separates from the pack and can create rather find a place that would be habitable for them and their offspring. Still the question is would the deer still have the ability to eat away the forest to an ecologically detrimental point. With this vast amount of dispersal space it would be very rough for the deer to completely devastate a forest, especially one as small as the arb.

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[17] Brinkman et al, 2005, pg. 1099 *Movement Of Female White-Tailed Deer: Effects Of Climate And Intensive Row-Crop Agriculture*

[18] Brinkman et al, 2005, pg. 1101 *Movement Of Female White-Tailed Deer: Effects Of Climate And Intensive Row-Crop Agriculture*

[19] Brinkman et al, 2005, pg. 1102 *Movement Of Female White-Tailed Deer: Effects Of Climate And Intensive Row-Crop Agriculture*

Moral Obligations Towards Deer

There is a growing consciousness concerning human impact on animal welfare today; it is becoming more popular to attribute moral significance to the effects of our actions towards animals. Singer notes that while it is less popular today to openly advocate against the moral consequences our actions have for animals, a perceived lack of responsibility continues to this day and is frequently acted upon.[20] That is, no longer are many people promoting the moral irrelevance of causing harm to animals, but nevertheless deliberately causing harm to animals is commonplace and accepted. Attempts to evaluate the moral relevance of actions towards animals against the economic gains from those actions, serve as efforts to ameliorate potential sources of this type of cognitive dissonance. Singer continues by suggesting that wild animals are typically valued only when they are directly or tangentially valuable to humans, and this value principally stems from the animal's creation of recreational opportunities for humans. Singer suggests that often wild animals are considered only as valuable as the money that can be extracted from their use. However, this is surely the mere surface of how animals are valued by people, including those who are not particularly adamant about animal rights. Smith suggests that it's preposterous to suppose society *only* views animals as commodities; if this were so, giving affection to one's pet would be seen as ridiculous.[21]

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[20] Singer, 2003, Page 56

[21] Smith, Page 80: Similarly, people would be sort of concerned if someone were to coo over their refrigerator: a simple commodity.

However, Smith recognizes that the commodification of animals generally leads to the prioritization of human economic goals over the welfare of the animals.[22] This economic conceptualization of the value of animals is characteristic of state game management systems. That is, a deer is as valuable to the Minnesota DNR as the sale price of a hunting license.[23] Questioning whether the economic advantages of exploiting certain animals justify the reduced welfare from the exploitation is an important moral task. It is reasonable to question whether the revenue from hunting license sales are worth the hunted animals' lives. Similarly, it is reasonable to question whether the good will in the Northfield community that the hunt produce for Carleton, one of Braker's reported benefits of the hunt, justify taking lives. In order to be morally grounded in deciding to host the hunt, the economic and ecological benefits of hosting the hunt, along with the welfare costs of hosting the hunt, must be substantiated, and the former must definitively outweigh the latter.

The principle opposition to hunting deer is concern for the welfare of the sentient animals that are hunted. That is, human reservations about hunting come from the recognition of pain substantially similar to human-felt pain in the hunted animal, along with the admission of feeling sympathy for that animal. There is a tendency in public discourse and philosophical thought alike to discredit the authority emotions ought to have in moral decisions; this general refusal to accept the validity of emotions includes sympathy for animals. John Fisher suggests this doubt about the substantiality of

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[22] Smith, Page 87: "When animals are treated as consumer goods and subject to the norms of the marketplace, economic efficiency supersedes consideration, and animal welfare suffers." Smith here is discussing the mass production of animals in agriculture, but the general principle applies to wild populations of animals as well.

[23] Doris, Lin: Lin discusses the general trend state wildlife management agencies to keep wildlife populations high in the interest of garnering economic gain from those populations.

emotions towards animals might be because of the idea that when we feel sympathy for animals, we are *mistakenly* thinking of those animals as more human than they truly are.[24] While it may be true that there are circumstances when it is inappropriate to attribute human-like perceptions to animals (it may be erroneous to feel pity for the penguin who must sit in the cold all day, since penguins do not feel certain temperatures like humans do),[25] it is undeniable that deer feel something similar to human pain during the minutes it takes them to die after being fatally wounded from the hunter's arrow. Discrediting the emotion of sympathy toward deer simply because it is an emotion is thus an inappropriate dismissal of valid concerns about the ethics of hunting.

It may be reasonable, however, to dilute any perceived moral obligation towards the welfare of deer if one believes that deer are unable to reciprocate in mutually beneficial relations with humans, that is, they are unable to engage in a "mutual accommodation of interests" with humans.[26] This is a contractionist argument, stemming from the idea that moral obligations between parties can only come from engagement in social contracts. These "contracts" (however hypothetical) are based on a "negotiated balance of interests of the parties."[27] Along a contractionist line of thought, even though deer are sentient, their relation to humans as wild animals may prevent them from being able to live at peace with human interests. In other words, the deer's interest in eating tree buds and bark conflicts with the human interest of preserving the

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[24] Fisher, Page 228: " Sympathy for animals, wild or domestic, is typically thought to be problematic because it rests upon a faulty analogy between human and nonhuman animals: we feel sympathy for animals because we mistakenly think of them as humans."
[25] Fisher, Page 232, Uses this short example of the "miserable" penguin, that is, who probably isn't quite miserable at all.
[26] Anderson, Page 287
[27] Anderson, Page 285

aesthetic and ecological benefits of ecosystems, and so there is no framework to hold humans accountable to the welfare of the deer. In critique of this contractualist theory, it is reasonable to question whether reciprocity is a necessary precondition for a moral agent to be compelled to respect an animal's rights. Sentience itself may be a sufficient qualification to deserve welfare protections.[28] Additionally, it is not clear that by simply existing, deer are "in a permanent state of of war" with human interests, as Anderson implies is required to warrant aggression from humans.[29] Perhaps there is a way to mediate the deer's interests in surviving the winter (which requires both not being shot and consuming some vegetation) with the human interests of preserving ecosystems. Further, perhaps there are methods to mitigate the deer's impact on ecosystems such that their welfare is not called into question to achieve the ends of human recreation. In order to decide what methods should be used, if any, the actual ecological impact of the deer must be quantified.

Weighing the Ecological Impact

It is well known that an area overpopulated with deer can easily devastate an ecosystem. The problem that many people seem to have is what method we should employ to reduce the deer population and then maintain that level. The most popular method used is hunting, but that is not the only option available. Terry Messmer, Louis

[28] Anderson, Page 286 brushes this argument off by suggesting it doesn't take into consideration the relation between the animal with rights and the moral agent so bound. Arguably, an animal will feel physical pain equivalently regardless of its relation to the person who causes that pain, and so the moral obligation on the human's part to mitigate this pain is not affected by relation.

[29] Anderson, Page 288: She discusses the inherent inability of mediating the interests of "vermin" - pests like rodents, with interests of humans. However, she does

Cornicelli, Daniel Decker, and David Hewitt did a study where they measured the likeability of several different types of deer pest control. They did the experiment by sending surveys to government's different agricultural/ wildlife agencies as well as the general public, home owners who live near a forest near densely populated deer areas, and resource users. They also sent out surveys to non-government agricultural/ wildlife agencies as well as animal activist groups. It was documented that the general public was the hardest and least responsive group so the data from that response group may be skewed. The survey listed a seven different types of deer management techniques, (public education, controlled hunting, immunocontraception, fencing, live-capture-relocation, compensation, and sharpshooting), survey takers were asked to rate the type of technique from one to five.[30] One being extremely agreeable and five being extremely un-agreeable. All groups were in agreement about on public education as a priority and that compensation for damage done to grounds by deer is not a good technique, there was a slight divide when it came to hunting in a controlled environment not enough to show any statistical difference.[31] They also found that while 76% (38 states) only 21 states (42%) implemented specific programs to handle the deer pest problem. Even more shockingly only 6 states talked with the public when creating the specific technique of deer management.[32] Many communities when asked thought that

[30] Stakeholders and Deer Management Messmer et al. 361
[31] Stakeholders and Deer Management Messmer et al. 362
[32] Stakeholders and Deer Management Messmer et al. 364

immunocontraception was the best option, besides public education, but still desired a quicker solution, hunting over relocation of deer, than the least lethal option. Carleton College sent out a survey to its populous and one of the questions that was said, “About 40 permits are given yearly to bow hunt in the lower arboretum over winter break, starting from Thanksgiving until December 31st. Do you agree that deer hunting should be held in the Cowling Arboretum?” The survey takers were asked to answer the strongly agree, strongly disagree, agree, disagree, and neither agree nor disagree. The overall agreement level from the responses was 43%, while the overall disagreement percentage was only 26%. This follows the trend found in the Messmer et al study. The results could mean that while people of Carleton do care for less lethal and more morally agreeable method, the technique that yields the most visible result is the one that they wish to stick with. This could be strong justification for the school board as to why the think the winter break deer hunt should continue. A possible problem with them using this information is the vast amount of people who neither agreed nor disagreed. 28% of people found themselves stuck in the middle of this survey question. The large amount of people caught in the middle could be an effect of the framing of the question, lack of different options, lack of information, or rushing to finish the survey. If they were to sway to one side or the other it could mean total justification from a stakeholder or a massive amount of lost ground in their argument.

Hunting is justified as a response to overabundant deer populations. That is, it is claimed that the ethical good that rights the wrong of causing pain and suffering to sentient beings is the reduction of deer populations to directly reduce deer-caused widespread vegetation change. There are two principle assumptions to this thought process. The first is that deer are "naturally" overabundant, and that it is up to human managers to reduce their population densities. The second is that hunting deer will substantially affect plant abundance and distribution, and that these effects are justified and positive.

Deer may be considered to be overabundant if they are so populous as to depress densities of other economically or aesthetically important species, or cause ecosystem destruction. It is important to note that overabundance is a value judgment[33] not a scientific term that has a definite meaning. Decisions about deer population size, whether it is too high, or too low, are made based on human judgments about the purposes to which deer could best be applied. The Minnesota DNR, the agency responsible for managing the deer population in the state, uses public survey data to determine whether deer population goals should be set to either increase or decrease local populations. Northfield is on the southern border of deer hunting permit area 339, where the DNR has set a goal of a 25% increase in the deer population for the next 3-5

[33] Cote, 2004, Page 114: "Overabundance is a value judgment that has a clear meaning only when placed
in a specific context…"

years (2018-2020).[34] It is clear that on the state level, deer are managed explicitly for the purposes of human enjoyment.[35] While large densities of deer may have negative impacts on the ecosystem, the DNR is more often concerned with increasing deer densities so as to increase hunter satisfaction, than it is worried that "overabundant" deer populations are already inflicting unacceptable damage to ecosystems. If the deliberate infliction of pain and suffering on sentient animals is justified with claims of ecological protection, that justification falls away in every permit area where the DNR recommends a population increase.

Carleton College does not set deer population goals for the region, but as a respectable institution in southern Minnesota, it has a voice that can be reflected through its management decisions. If Carleton were principally concerned with the ecological impacts of deer, and it were also concerned with the welfare of the sentient animals that are hunted, it would consider providing some portion of the public input the DNR reoccurringly seeks for each permit area. If Carleton has reason to believe that deer browse in the Arb is excessive due to a high local and regional population of

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[34] DNR, 2016, Page 38 of the document "Minnesota Deer Population Goals" for block 5: "After reviewing biological and social data for this permit area, the deer advisory team recommended a population increase of 25%. Factors considered in the team's discussion included available habitat, harvest levels, hunter success and satisfaction rates, previous goals, native plant communities, predation concerns, and more. Public comment collected in spring 2015 showed that approximately 70% of commenters supported or were okay with the team's recommendation. The Department decided to manage for an increased deer population in recognition of the advisory team recommendation, the range of stakeholder desires, and public support for an increase." Reading the summary for the management decision of each permit area, it becomes obvious that deer are managed first so that hunters feel they have sufficient recreation opportunities, and ecology is considered only as a limiting factor to the production of those opportunities.

[35] Kheel, Page 394: "While hunters claim to be responding to nature's unfortunate excesses, the game management journals reveal another story. For example, according to an article in the Journal of Wildlife Management. 'The primary management plan has been the one directed at increasing the productivity of the whitetail deer through habitat manipulation and harvest regulation… to produce optimum sustained deer yields… and hunter satisfaction.' In short, holist hunters are intent on 'managing' animals so that sufficient numbers will remain for them to kill."

deer,[36] the most effective way to address the regional population of deer would be to address the population controls at a regional level. Since deer are highly mobile, even if the Arb hunt were to reduce the local population, if the regional population remains high, immigration into the Arb will likely negate the hunt's local effect. By holding a local hunt and justifying it on ecological grounds while failing to advocate for a reduction in regional population levels, it is apparent that Carleton values the economic benefits of hunting deer before considering the deer's welfare. If anything, the moral basis of an ecological justification for holding the Arb hunt falls into question.

The second assumption, that hunting directly reduces deer impacts on vegetation, is not misguided so much as it is a simplification of the issue. It is tempting to think of the relationship between deer populations and plant populations linearly, like figures Figure 3 a or b. This thought suggests that hunting deer will directly and proportionally reduce browsing pressure, and consequently increase plant abundance. However, the relationship displayed in figure c is perhaps the most accurate model of the browsing pressure and plant abundance relationship. This figure represents the potential of browsing pressure to cause an ecosystem

[36] Cowling 1, "The active management of the Arboretum's deer herd is *a response to a very high population both locally and throughout the region.*[emp added]"

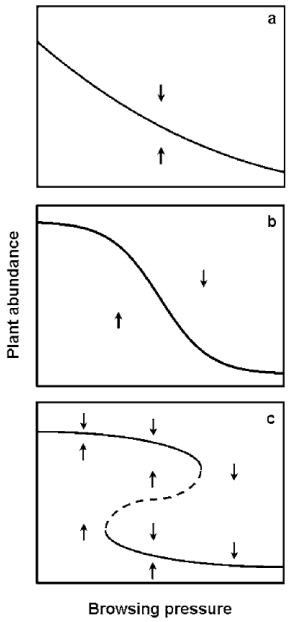

Figure 3:[37] *Hypothetical relationships between browsing pressure and plant abundance.*

to switch between "alternative stable states,"[38] which are somewhat recursively defined as distributions and densities of plant populations that are not easily reversible simply by changing browsing pressure in the short term. Consider the section of Figure 3 c with high browsing pressure. It is not clear that allowing *some* hunting will cause a substantial change in the plant ecology; hunting may not produce the change necessary to flip to other stable states. If hunting's effect is minimal in this way, is it yet ecologically justified?

It is further questionable whether hunting substantially affects browsing pressure locally, that is, if it measurably affects local populations of deer. While it is not logical to assume that hunting deer will cause the population to increase, there is doubt that

[37] Cote, 2014, Page 131: "**Figure 2** Three hypothetical relationships between the abundance of a foraging plant and deer browsing pressure."
[38] Cote, 2014, Page 19.

hunting philopatric females significantly reduces local populations.[39] Sport hunting of males can be assumed to have even less of an effect. While deer may be encouraged to emigrate from the Lower Arb during the hunt, anecdotal evidence suggests they may simply move to the Upper Arb and cause the same or more yet more concentrated amount of ecological damage there.[40] Further, the most obvious benefit of the hunt for vegetation Nancy Braker could think of was increased survivability of seedlings planted for reforestation projects. Braker commented that even when though hunt is held, individual seedlings still need to be protected. Young trees are protected with a hard plastic sleeve for the first couple of years, and the terminal bud is capped until it is above the browse line (6ft). There has not been a survey to confirm or quantify the hunts' effect on seedling survival, although Braker mentioned it as a personal observation in interview. While a higher percentage of seedlings may survive the winter due to the hunt, if this is the only substantial benefit to restoration practices the deer hunt creates, it is questionable whether the extra effort required to plant a few more seedlings justifies taking lives.

Undoubtedly, as big players in the game, deer have an ecological impact on the Arb. Some of Dan Hernández's work characterizing that impact has been studying herbivory damage to plants inside and outside of deer exclosures, fenced plots that keep out deer. His personal observations suggest that deer preferentially munch on

[39] Cote, 2014, Page 133: "We also have more to learn about sport hunting. We cannot yet predict, for example, how local hunting of philopatric females influences subsequent local deer densities." Note that there is doubt that hunting even philopatric females will reduce local densities – it is even more doubtful that hunting antlered deer, which is often the primary goal of sport hunting, will reduce local populations. Males are not the limiting factor for population increase, females are.
[40] Davis, 2010, Page 21.

certain legume species, like *Desmodium*, while leaving others alone.[41] While it is likely selective herbivory has impacts on the greater ecosystem, the ripple effects are not well known.[42] It's all well and good to know that certain species are more prevalent without deer pressure, but it is important to note that no deer herbivory pressure is no more "natural" than intense pressure,[43] and that exclosure studies are binary treatments that only give insight into what an area would look like in the total absence of deer.[44] Moreover, it is not necessarily true that allowing some hunting will bring forth *substantial* change to the relative abundance of preferred species,[45] even though this may be widely believed within management circles.

Additionally, the effect of holding the hunt seasonally (only in winter, for a two week period) may reduce any ecological benefit of the hunt. In interview, Hernández mentioned that the prairie plants he studied are dormant in the winter, the season when the deer hunt is thought to have the greatest protective effect on plants in the Arb by causing emigration. Since they are dormant when the deer are being encouraged to emigrate, these plants are not affected directly by hunting-reduced winter browsing

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[41] Nisi, Page 118.

[42] Nisi, Page 119: "Herbivory on legume species may alter plant community composition, and consequently N mineralization and cycling, by reducing or eliminating species that contribute nitrogen to the ecosystem through fixation. However, relative rates of N fixation among legume species in our study are unknown."

[43] Humane Society of the United States

[44] Cote, 120: "exclude deer from study plots is
a venerable experimental approach (Daubenmire 1940). Despite all the insights
that exclosure studies bring to our understanding of deer-forest interactions, they
are limited to binary treatments: They allow researchers to infer what alternate
trajectory a site would take in the absence of deer."

[45] In interview, Hernández states that the plants which he has noted deer prefer, like *Desmodium*, are long-lived prairie plants, and that they survive single browse events. That is, individual plants aren't necessarily killed after a deer eats a part of the plant one time. He suggests that heavy deer browsing could reduce the populations of these species over time, which is logical, but there is no data quantifying the distribution of these plants in the Arb, nor the deer population's effect on this distribution. Additionally, see the discussion on the minimal effects of small-scale hunting to induce a change in alternate stable states above.

pressure. The only impact the hunt may have on warm-season browsing pressure, the seasons when plants besides those available in winter are browsed (plants besides trees like those planted for the reforestation project), is that the hunt may reduce the "overall deer population"[46] and subsequently reduce the browsing pressure in the warmer seasons. We have to question, however, exactly how much of an effect taking something like 10 deer in the Arb a year has on the "overall" deer population, again bearing in mind that hunting males is not known to reduce local populations, and that the Minnesota DNR, the agency that manages regional deer populations, has goals to increase the regional population around Carleton College. It becomes clear that there is little data to substantiate the claims that the hunt is necessary on ecological grounds.

Ecology of Fear

With the lack of predators in the Arb the deer can set their level of apprehension much lower and focus mostly on feeding[47]. Without the worry of a predator coming to attack it while it forages for food they can maximize the amount of food they intake[48]. Predators have shaped the behavior of their prey[49] and knowing this could lead to practices in which there is no need to hunt deer. Creating a system the deer cannot maximize their foraging time would be an ideal solution to the problem. Even though it could be argued that the hunters in the area are taking over that role of instilling fear among the deer and they are only there 2 weeks out of the year so even then the

[46] When Hernández said "overall deer population" he was likely referring to the regional population, as opposed to the local population.
[47] Brown el al. 1999
[48] Brown et al. 1999
[49] Brown et al. 1999

results of the fear they cause could only be minor and create added negative effects to the deer in the area.

Top down and Bottom up limitations

An alternative to the hunt would be the possibility of reintroducing wolves to the area. One of the main reasons the hunt is in use is for maintaining deer populations due to a lack of predation. The timber wolves that would normally be seen in the area are no longer here. This is largely in part that in the 1800s and early 1900s there was large scale trapping, hunting, and poisoning by Euro-Americans and a concerted effort at predator eradication by federal agencies that greatly reduced gray wolf and cougar ranges in the US[50]. The relevance of having deer in the area can be seen from the study done by Eric Post where he documented the relationships that wolves had with local species. He found that, "just two or three wolf packs indirectly control tree community organization by regulating moose numbers in 544-km2 Isle Royale, Michigan." [51].

Studies like the Post performed are set out to explain a top down relationship that explains the balance of ecosystems. Generally this top down relationship is capable of describing what would happen when you take out the apex predator in a certain ecosystem ultimately changing the relationship between primary consumers and primary producers[52]. Any indirect effects that can be seen from the removal of predators on producers are considered trophic cascades[53]. Therefore it can be concluded that since humans have altered the species evenness of where the Arb is currently located

[50] Beschta et al. 2009
[51] Post et al. 1999
[52] Beckerman et al. 1997
[53] Beckerman et al. 1997

that in order to prevent these trophic cascades from happening people need to occupy the trophic level that the wolves once held and in this respect it means that the hunt is necessary. However, if the goal is to return the Arb to its pre European state than that would entail introducing predators into the area.

The issue with introducing predators is that the Arb is too small to contain a pack of wolves. It is also important to know that even though it makes sense that people should occupy the trophic level that wolves once held the science behind providing top down herbivore limitation has not been widely reported[54]. In turn it would not provide the most amount of happiness for all parties to continue the hunt. Now there is another approach that coincides very well with this top down approach that is controlled solely by producers. It is known as the bottom up limitation that unlike the top down approach where carnivores could determine the amount of trophic efficiency, the producers that are in the area set the limits on all other organisms[55]. In turn it could provide the area with benefits that could provide great

As White described in his paper if there was a set of producers that provided a large amount of nutrients and were readily available they would be decimated rather quickly. It is for that reason that plants have developed in many ways to detract herbivores from consuming them even lessening the amount of tissue that can be processed by herbivores. In turn although herbivores can eat the producers it is dependent on what responses the producers have developed to reduce the amount of herbivory that happens. When this happens the trophic cascade here is the relationship shared between the producer and the carnivores. These producers in turn set a limit on

[54] Bechsta et al. 2009
[55] White, 1978

the herbivores in the area, which sets a limit on the carnivores that are also found[56]. The possibility of having Arb staff place plants that have developed ways to combat the amount of herbivores in the region could provide the most amount of benefits to all in the region preventing the need to have the hunt and would allow for a maximization in happiness from all parties except the hunters who only derive their happiness from the suffering of another being.

Recommendation

After reviewing the scientific literature, policy on deer management, and alternative options, we recommend conducting an alternating year study of the effects of the amount of deer browse experienced when Carleton College hosts a deer hunt in the Arb and when they don't. Withholding the hunt on a yearly basis, and studying changes in the distribution of vegetation, including deer-preferred vegetation, can lean insight into the hunts efficacy. We note that it is ethical to question the continuance of holding a deer hunt if there has not been a demonstrated need to do so, as confirmed by ecological study in preference over anecdotal evidence. If the college can create these studies it could either promote the need to have the hunt or lessen the amount of times needed to hold the hunt. With harder evidence of the effects deer have in the arboretum there could be an easier approach f justifying the deer hunt, however as the situation is right now the hunt is very difficult to justify without having the evidence needed to back it up.

[56] White, 1978

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