Assisted Colonization of the Minnesota Dwarf Trout Lily into the Cowling Arboretum

Audrey Lothspeich, Il Shan Ng, Mauricio Gonzalez, Tyler O'Keefe
Carleton College
ENTS 215: Environmental Ethics
November 22, 2014

Introduction

The Minnesota dwarf trout lily is an endangered plant species that is endemic to Rice and Goodhue counties of southern Minnesota. A sister species to the common white trout lily, the dwarf plant is incredibly inept at propagating itself: it reproduces solely through underground runners, which in turn can form only when the plant flowers in the early spring (Morley, 175).[1] The newly grown plants also suffer from low genetic variation, due to their asexual method of reproduction, and so are particularly vulnerable to environmental stress (Banks, 181). These weaknesses have led to the species' precipitous decline amid development, increased foot traffic, soil erosion and floods, which easily threaten the plant by destroying its habitat (*Minnesota Dwarf Trout Lily*). In response, Carleton is considering the assisted colonization of the plant into the Cowling Arboretum as a strategy to forestall the plant's imminent extinction. Such an endeavor would involve transplanting members of existing populations, located sparsely along the Cannon and Zumbro rivers, into the Cowling Arboretum and nursing these newly established colonies. Assisted colonization, however, is an inherently controversial topic among ethicists and scientists alike. The peculiar physical and reproductive frailty of the dwarf trout lily further complicate the debate about its assisted colonization. In this paper, we discuss the ethics of whether Carleton should carry out the proposed assisted colonization of the dwarf trout lily. We argue that feasibility concerns and a compromise of the arboretum's current state outweigh the value-oriented justification for the plant's assisted colonization, and conclude that Carleton should not pursue the project.

[1] The dwarf trout lily can, in fact, also reproduce sexually through seeds. However, the level of seed production is so low that the plant virtually reproduces only through vegetative propagation. For the details, see Banks, 187.

Before delving into assisted colonization, our question must be contextualized through a survey of the dwarf trout lily's unique properties. The dwarf trout lily is a small forest wildflower that is virtually confined to 600 acres of woodland habitat that lies on the banks of the Cannon River watershed and its tributaries in Goodhue, Rice and Steele Counties in Minnesota, at an elevation of between 960 to 1000 feet (USFWS). The plant is a close relative of the white trout lily; biologists suggest that, based on the glacial history of Minnesota and genetic similarity between the two, the dwarf plant had speciated from its white counterpart no more than 9,000 years ago (Pleasants and Wendel, 1136). Unlike most other flowering plants, the dwarf trout lily reproduces exclusively through vegetative runners. A flowering individual occasionally produces a new underground bulb from which an offspring will grow. Since this mode of reproduction is asexual, an entire colony of the plant may essentially be composed of genetically-identical clones. Kathleen Welfen's explains, "Being an endemic species with vegetative reproduction…the dwarf trout lily is crippled in both its ability to disperse and its ability to adapt genetically, unlike seed reproducers that have the opportunity for sexual reproduction" (7). A lack of genetic variability makes the dwarf trout lily very vulnerable to such environmental stressors as soil pathogens and flooding. Biologists also believe that the plant's sole dispersion mechanism involves the uprooting of individuals by floodwater and their subsequent settling downstream. The plant is thus unable to disperse itself autonomously. These weaknesses, together with its persistently sparse population, predispose the plant to a very certain path of extinction amid disruptive human activity and climate change. Among the chief anthropogenic threats to the dwarf trout lily are: new housing developments and the expansion of farmland which fragment the plant's habitat, trampling due to increased recreational use of its native range, and the spread of invasive species like the common buckthorn. Recent nearly snowless winters have also led to crashes in the number of dwarf trout lily colonies (Weflen, 8), while increased flooding disables its sole dispersal strategy by carrying uprooted individuals too far downstream.

While all this may provide good reasons to save the dwarf trout lily from extinction, rashly appealing to assisted colonization is ill-advised. Our poor understanding of its success rates and side-effects has prompted critics to liken assisted colonization to a game of "ecological roulette," one capable of producing "myriad unintended and unpredictable consequences" (Ricciardi 248, 252). Most of the scientific objection towards assisted colonization revolves around the risk of the relocated species becoming invasive, and thus disruptive to its new ecosystem. Other fears include the introduction of maladapted genotypes by the relocated species, or possible hybridization between the relocated species and other organisms, both of which affect the integrity of receiving ecosystems (Minteer and Collins, 1802). Though the dwarf trout lily is known to hybridize on occasion with its white counterpart, there is little evidence to suggest that this hybridization could negatively influence the plant's new habitat. Further, the plant's poor reproductive capability ironically makes it highly non-invasive, and so the above scientific caveats are hardly applicable to the project in question.

Counterarguments to the qualms about assisted colonization are mostly ecologically motivated. From this perspective, protecting species from extinction — especially those that we endanger through our own actions — is an essential act of conservation. Some argue that the risks created by assisted colonization must be weighed against the risk of inaction. As Aldo Leopold wrote in *A Sand County Almanac*, "To keep every cog and wheel is the first precaution of intelligent tinkering" (190). According to him, each species has a unique niche that is vital to the workings of its ecosystem. Loss of species, regardless of how insignificant we may perceive them to be, can potentially upset ecosystem balance and in turn threaten other forms of life. Minteer and Collins argued that the unprecedented challenges posed by climate change demand a more interventionist approach beyond traditional conservation strategies, and advocated assisted colonization as a candidate "new age" strategy (1802). Essentially, proponents of assisted colonization see it fit for the desperate situation at hand, despite its scientific uncertainties.

In this paper, we consider the ethical dimension of assisted colonization. First, we explore various claims about the value of species, and discuss whether these values justify assisted colonization both in general and in the case of the dwarf trout lily. We then turn to virtue ethics and examine the consequences of assisted colonization on the naturalness of the arboretum. We then complete our argument against the assisted colonization of the dwarf trout lily by describing the feasibility concerns surrounding the project's implementation.

The Value of Species

According to prevailing thought, species possess both intrinsic and extrinsic value which may justify our efforts to preserve them (Russow, 211). Ronald Sandler, in a recent paper, identified three types of intrinsic values – interest-based intrinsic value, valuer-dependent intrinsic value, and intrinsic objective value – and two types of extrinsic values – ecological value and instrumental value (425). In his view, some of these values do not make good reasons for species preservation, let alone assisted colonization, while some justify species preservation but not assisted colonization. We expound on the theory behind each value and subsequently discuss whether each value justifies assisted colonization in general and in the case of the dwarf trout lily.

Interest-based Intrinsic Value

Interest-based intrinsic value, according to Sandler, is intrinsic value that exists by virtue of the species' interest (425). Any student of the literature on species preservation immediately finds this concept problematic. Indeed, there is much opposition to the view that species possess interests. Peter Singer, a well-known utilitarian, had asserted early on that species "do not have interests above and beyond the interests of the individual animals that are members of the species" (203). Lilly-Marlene Russow echoes this concern by saying that "it is simply not clear that we can make sense of talk about the interests of a species in the absence of beliefs, desires, purposeful action, etc" (209). Sandler offers two criteria with which we may judge whether species have interest. Firstly, for a species to have interests, it must be a goal-directed system; that is, species have to tend towards such goals as maintaining population size, out-competing ecological rivals and improving genetic fitness (426). Ostensibly, this seems to be the case. The dwarf trout lily, for example, has learnt how to flower early in the spring in order to reproduce well before it gets completely shaded by surrounding regrowth (*Minnesota Trout Lily Preserve*) – what seems like a coordinated effort to propagate its shrinking populations. This "group strategy," however, is really just a by-product of the individual plants pursuing their own ends of reproducing quickly. There is no particular organization among individual plants that serves to promote the goal of maintaining population size. Thus, as Sandler subsequently argues, that individuals are goal-directed does not necessarily give rise to a goal-directed system, and on this basis species cannot have interests. The second criteria is that for a species to have interests, the reason why its members function as they do, or are coordinated in the manner they are, must be that such behavior promotes the goals of the species (Sandler, 426). Species do not fulfil this second criteria either. As argued earlier, individual dwarf trout lilies flower early to ensure their own reproductive success, and not the reproductive success of their kind. In other words, explanations for why individual members are adapted the way they are do not appeal at all to the overall good of the species. Therefore, species fail to satisfy both criteria and cannot be said to possess interests.

Further, the above argument takes for granted that individual organisms have interests. Raymond Frey challenged this assumption in a highly controversial paper, much to the woe of animal rights activists. He argued that since non-humans do not possess linguistic ability, they are unable to formulate beliefs and hence desires, which in turn leads to their incapacity for interests (235). Though his conclusion remains highly disputed, it does suggest that there is reason to believe that even if species were treated as individual organisms, as opposed to collections or systems, they fail to demonstrate that they possess interests that are necessary to being accorded interest-based intrinsic value. That species do not have interest-based intrinsic value, then, means that appeals to such value cannot justify species preservation, let alone assisted colonization.

Valuer-dependent Intrinsic Value

Next, we consider valuer-dependent intrinsic value, which, according to a detailed account by Robert Elliot, is value which species possess by virtue of being valued by humans for what they are, rather than for their uses (139). This definition immediately sets valuer-dependent intrinsic value apart from instrumental value (value that stems from usefulness to humans). J. Baird Callicott goes further to distinguish it from existence value (utility derived from knowing that a species exists), since the two are frequently thought to be the same, by arguing that the latter arises from personal preferences about species (43). To illustrate, two people might value the dwarf trout lily by virtue of what it is, not necessarily because they like the plant, and thus accord it equal valuer-dependent intrinsic value. One of the two might, on the other hand, not care if the plant went extinct because he does not desire enough for the plant to continue existing. Callicott accurately observes that existence value is often expressed in economics through monetary figures; the person who prefers to keep the dwarf trout lily in existence would be willing to pay more dollars for its preservation. In contrast, as he argued, "To accord something intrinsic value, on the other hand, is to declare that it . . . should not be subject to pricing of any kind" (43). Valuer-dependent intrinsic value is thus a distinct form of value from existence value. It is also the more stable form of value, since it stems from "well-established aspects of an individual's worldview and often constitutes a person's most cherished ideals" (Sandler, 427), rather than from preferences which may be short-lived.

At this point, valuer-dependent intrinsic value seems like a good justification for species preservation and thus assisted colonization. However, we find this type of value extremely vague, since it does not, by definition, pinpoint what exactly about species we regard as valuable. This ambiguity poses a problem when we discuss whether or not such value will be preserved through assisted colonization. Thus, while we acknowledge valuer-dependent intrinsic value as a potential justification for assisted colonization, we look to a more specific form of intrinsic value that may yield us a more substantial discussion.

Intrinsic Objective Value

This other value is intrinsic objective value, which Sandler defines as value that exists whether or not humans do the valuing (429). Though there are numerous accounts on the intrinsic objective value of species, the most prominent ones derive from Holmes Rolston's description of such value as the sum worth of evolutionary processes that had shaped, and continue to shape, a particular species (270). Rolston sees species as being imbued, by default, with intrinsic value that results from their having a productive evolutionary and ecological history, and argues that extinction "shuts down" the evolutionary processes which generate such value (723). Since intrinsic objective value specifies what about species we find valuable, it resolves the weakness that valuer-dependent intrinsic value had. Thus, intrinsic value is, among the kinds of values we have explored so far, the least problematic justification for species preservation. We now discuss whether such intrinsic objective value justifies assisted colonization as well.

Sandler, in another recent paper, made a case against assisted colonization by arguing that it fails to preserve the intrinsic objective value of species. This value, he describes, "is dependent upon evolutionary and ecological situatedness" (10). The basis of this value is therefore situatedness, which can be taken to mean the set of ecological and environmental conditions that together stimulate the evolution of a species and thus give it value. Sandler asserts that since assisted colonization removes a species from its historical habitat, it nullifies the basis on which the species can be said to possess intrinsic objective value (10). Thus, while the physical body of the species is preserved, its value has been lost in the shift to a novel ecosystem. On this basis, Sandler concludes that the intrinsic objective value of species cannot justify assisted colonization, since assisted colonization fails to preserve such value.

The dwarf trout lily, at first glance, does not seem like an exception. It is thought to have speciated some 9000 years ago from the common white trout lily, which in turn had emerged as a species following the deglaciation of mid-eastern America. The plant currently makes its home on the shaded ravines of the Cannon and Zumbro rivers that span Rice and Goodhue counties of Minnesota (Banks, 10). Its roots are adapted to the alluvial and well-drained soil on which it grows best, and have evolved to deal with the steep gradients to which the plant is confined

(Banks, 23). Botanists even suggest that it has learned to flower early in the spring well before the surrounding plants regain their leaves and block out the sun (*Minnesota Trout Lily Preserve*); an adaptation which Rolston will attribute to creativity in circumventing environmental stress (254). These ecosystemic properties, along with those that gave rise to the parent white trout lily, constitute the situatedness which has moulded the dwarf trout lily into a species and thus given it the intrinsic objective value we perceive. Invoking Sandler's conclusion, to relocate the dwarf trout lily would be to erase its situatedness and thus its intrinsic objective value.

Sandler's argument however, appears to assume that the new location to which a species will be transplanted (henceforth called the recipient ecosystem) is necessarily different from the species' original habitat. His persistent use of the word "novel" in describing recipient ecosystems implies his belief that assisted colonization unquestionably introduces a species into an environment where the same set of ecosystemic properties, through which the species had evolved, is absent (10). This is not necessarily the case, and may be completely false when considering the relocation of the dwarf trout lily into Carleton's Cowling Arboretum.

Firstly, the arboretum flanks the Cannon River, which is a known habitat of the dwarf trout lily. According to Nancy Braker, the director of the Cowling Arboretum, any attempt at assisted colonization of the plant into the arboretum will have to situate the plant on the banks of the same river, because the plant has not been found to thrive in isolation from it (or the Zumbro River). Since the prospective habitat in the arboretum and all present habitats along the Straight, Cannon and Little Cannon River are within the same county (and along the same river), the intervening short distance should not introduce significant differences in ecology or geology. There is reason, then, to believe that the recipient ecosystem for the dwarf trout lily will not be too dissimilar to its donor ecosystem.

Secondly, the plant's sister species, the common white trout lily, is native to Cowling Arboretum, which indicates the habitability of the arboretum to the dwarf plant. In virtually all of its present colonies, the dwarf trout lily is found coexisting with the common white trout lily, interspersed among the latter (Morley, 170). Given that the white version reproduces far more aggressively than the dwarf does, and that both reproduce *in situ* through vegetative runners, the dwarf plants are almost always found contained within a dense colony of white ones. Taken together, these suggest that the dwarf plant does not generally grow in spatial separation from the white one. Adding the fact that the dwarf had descended directly from the white version, we can conjecture that for no significant period of time in its evolutionary timeline did the dwarf plant grow in isolation from its white counterpart. The implication, then, is that both plants had shared the same situatedness for the majority, if not all, of the dwarf trout lily's existence. Since the white version is known to be native to the arboretum, it follows that the ecosystemic properties which had shaped the dwarf trout lily are as present in the arboretum as they are in any of the plant's current colonies. In a sense, native populations of white trout lilies "mark" the locations where the basis for the dwarf's intrinsic value may be preserved.[2]

Lastly, the lack of robustness of the dwarf trout lily leads to deliberate care in selecting recipient ecosystems that best mimic donor sites. Due to the plant's poor reproductive capabilities, it has a tendency to be crowded out by surrounding growth, which includes the white trout lily. The plant also thrives only on loamy soil due to its high nutrient demand for the energy intensive development of both flowers and runners during its reproduction season (Morley, 175). Further, its asexual method of reproduction means that all members of a

---

[2] Of course, this does not apply to the full range of the white trout lily, since the white plant is known to be more reproductively successful than the dwarf and so can adapt better to environmental differences. However, within the context of Goodhue county, the claim is a reasonable one to make.

population are essentially clones; barring mutations, an entire colony would have the same traits, which leads to low genetic variation and hence poor adaptability to environmental stress (Banks, 86). These weaknesses imply that any attempt at relocating the plant cannot be done successfully without meticulous consideration of such variables as soil type and nutrient density, surrounding plant species, possible pathogenic bacteria and a host of other risk factors. Every effort will be made to ensure that the chosen recipient ecosystem closely resembles the plant's present habitat. Of course, this means once again that the recipient ecosystem will bear much of the situatedness of the plant's natural range.

Sandler might refute the above argument by adding that situatedness includes not only an ecosystem's historically established properties, but also its absolute location in space. Though he does not explicitly mention so in his works, he may consider two otherwise identical ecosystems as different simply because they exist at different locations on the earth; much as identical twins, though outward facsimiles of each other, are regarded by society as two different persons because each exists as a separate body. If absolute location is necessary to situatedness, then clearly assisted colonization, which changes the absolute location of a species, fails to preserve the species' intrinsic value.

Does this matter though? Sandler and similar opponents of assisted colonization seem too fixated on what intrinsic value a species has earned up until the present – a symptom of the backward-looking tradition that uses the past as a reference point. What they fail to consider is the intrinsic value that a species will continue to earn, if it were given the chance to. Since we cannot judge when a species ceases to be subjected to environmental stress – to merely exist is to grapple with the environment in a productive way – we cannot arbitrarily delimit the period of time in which a species is gaining value. Thus, we cannot say that a species will cease to gain value after relocation. Take, then, the case in which we choose to carry out assisted colonization of the dwarf trout lily. Even if the plant, eviscerated of its intrinsic value, were to persist merely as a valueless shell upon relocation, there is nothing that stops it from continuing on its evolutionary trajectory to gain new intrinsic objective value. Thus, we sacrifice present intrinsic value for future intrinsic value (which we know will exist). Conversely, if we were to leave the plant as it is, its imminent extinction guarantees not only that all of its present intrinsic value will be lost, but also that it will not have a chance to gain future intrinsic value. The former case at least preserves the possibility of the plant gaining new value; the latter preserves nothing by extinguishing the plant's future in its entirety.

Moreover, since intrinsic objective value is value that is independent of human preferences and attitudes, the question of whether or not the relocated plant will be subjected to the same situatedness arguably becomes morally irrelevant. Consider the extreme case, in which the relocated plant were to take on a completely different evolutionary trajectory, as a result of a completely different situatedness, and hence gain value that is "different" from the value it once had in its original habitat. Since such intrinsic value is not defined by our judgements and attitudes towards it, we cannot say that this "new" value is inferior to, or even different from the "old" one. We essentially have no say on the quality of the value, and hence no basis on which to argue that a different situatedness will diminish the value of the relocated plant.[3] Since situatedness has no effect on the future value of the plant, it can be deemed as irrelevant to the value arguments and thus overall ethical analysis of this project. Assisted colonization can then be considered successful as long as it sustains the species regardless of how novel its new habitat

[3] This point is acknowledged in the forward-looking tradition which allows for multiple evolutionary trajectories and endpoints in conservation. For a good exposition of this tradition, see Choi, Young D. "Restoration Ecology to the Future: A call for New Paradigm." *Restoration Ecology* Vol. 15, No. 2 (2007): 351-353.

is. That is not to say, however, that we should completely disregard situatedness. Though it is ethically insignificant, it remains scientifically crucial. To ensure successful relocation, we would still have to select recipient ecosystems that best mimic the donor ones (particularly so for the dwarf trout lily), but for biological reasons, rather than an ethical one.

Our analysis thus far rests on the claim that species have intrinsic objective value due to its being historically situated in unique ecological conditions. This claim remains highly disputed. Sandler, in another paper, questions why being so situated necessarily imbues species with intrinsic objective value, on top of the ecological and instrumental value that arises through productive interactions with the environment (429). He fears that we may be double-counting such extrinsic value and imputing it mistakenly as intrinsic value. Given the shaky nature of our working assumption, we move on to consider whether assisted colonization can be justified by values other than those of the intrinsic kind, namely, the ecological and instrumental values mentioned by Sandler.

Ecological Value

Ecological value is the value which a species has by virtue of its contribution to the integrity, health or stability of the ecosystem it is in (Sandler, [value…] 425). An appeal to the fundamental goal of assisted colonization easily shows why ecological value cannot, at least in theory, justify relocating a species. The primary motivation for assisted colonization, according to prevailing conservation ideals, is the preservation of endangered species, and not the amelioration of some ecological problem in the recipient ecosystem (Sandler, [value…] 425). Therefore, whether or not the dwarf trout lily has any ecological value to offer to its potential new habitat is an irrelevant consideration.

A case, however, can be made for the ecological value that a species may offer both to ecosystems beyond its own and to future ecosystems it may become a part of. As Rolston succinctly notes, "[a]n ecosystem is often transitional and unstructured" (Rolston, 252). Indeed, members of an ecosystem come and go, and ecosystems are not mutually exclusive, let alone clearly delimited from one another. The ecological value of the dwarf trout lily, therefore, should still be considered for its contribution to the larger biotic sphere. In other words, though the dwarf trout lily is not being transplanted as a remedy for an ecological problem in the target habitat, we should nonetheless discuss whether the dwarf trout lily contains any ecological value that justifies its preservation. Biologists, for instance, have suggested that the dwarf trout lily plays an important role in forest ecology by capturing soil nutrients in the early spring, and returning them in a bio-available form, just in time to support surrounding growth (*A Flower Named for a Fish*). The plant also provides food, in the form of nectar, to at least one species of bees that pollinates its flowers (Banks, 85). These are, as Leopold would argue, some of the plant's unique ecological contributions which we should strive to preserve.

Are these contributions truly unique? A comparison of the dwarf trout lily to its white counterpart easily challenges the rhetoric that the dwarf plant occupies a unique niche in its habitat. To begin with, the dwarf trout lily is biologically very similar to the white version. Superficially, the two species are so similar that they are sometimes almost indistinguishable. Because both plants bear identical leaves, they can only be distinguished from each other during a brief window in the spring when they flower. During this time, the dwarf trout lily can be recognized by its significantly smaller flowers, which are about the size of a dime. Otherwise, it can only be told apart from the white version by being dug up; the dwarf trout lily reproduces mainly through a system of vegetative runners, whereas the white trout lily does not. The act of distinguishing between the two plants is further complicated by the fact that few individuals flower during any given year, and that the dwarf plants are often found thinly interspersed among the white ones. This near resemblance between the two plants means that the white version is likely to perform a similar ecological role to that of dwarf plant, which reduces the uniqueness of the dwarf plant's ecological contribution.

The plant's small population also makes its contributions not only non-unique but also arguably insignificant. Due to its inability to propagate itself effectively, the plant suffers from persistently low numbers, which means that it would comprise a very small part of any ecosystem. Thus, even if the plant were to possess an undiscovered trait that sets it apart from the white version, the resulting ecological contribution would be insignificant. In other words, any role that the dwarf trout lily plays in its habitat can be fulfilled much more effectively by its more numerous white counterpart. On this basis, the dwarf plant's ecological value is clearly not as indispensable as Leopold might suggest it to be.

Finally, it should also be noted that the two sister species are able to cross-breed and form viable offspring, which in turn are capable of reproducing through the mechanisms employed by both species. This arises from the genetic similarity between the two species, and has already been documented in several colonies of dwarf trout lilies. Because the dwarf trout lily itself is less prolific than its hybrid offspring, a future in which all dwarf individuals have been subsumed as hybrids is a distinct possibility (Banks, 85). This might be especially true for the initial batch of dwarf plants used to begin the assisted colonization, since newly relocated plants presumably need some time to adapt to new soil conditions prior to reproducing. Should the relocated dwarf plants hybridize, any unique traits the species may have would potentially be lost in the genome of the hybrid offspring. This implies that any of the plant's unique ecological value preserved through assisted colonization might only be short-lived.

Clearly, the dwarf trout lily does not have much to contribute in terms of ecological value — it is too similar to another existing species and too limited in its reproductive capabilities. It could, however, exert negative impacts on the arboretum, and essentially possess negative ecological value. A risk of the introduction of any non-native species to a habitat is that the species itself might harm the ecosystem (by becoming invasive) or that the species may bring something harmful with it (such as a disease or parasite) (Ricciardi and Simberloff, 249-250). Such risks are low in the case of the dwarf trout lily. Its aforementioned reproductive weakness makes it unlikely to become invasive, and the similarity of its native range to the arboretum makes slim the possibility of it harboring a disease or parasite completely foreign to the arboretum. However, as Sandler notes, the absence of harm to a recipient ecosystem is not a sufficient justification for any assisted colonization project (425). That a species possesses no negatives cannot help its case if it offers no ecological value to begin with. Thus, while the dwarf trout lily will be relatively harmless in ecological terms to its new habitat, it should not be brought into the arboretum on this merit alone.

Instrumental Value

We have drawn on a significant amount of ethical literature to justify species preservation. While intrinsic objective value appears to suffice as a justification, it is problematic in that it does not explain why we choose to save some endangered species and not others. As a concept, it does not allow us to compare the evolutionary histories of two species and decide which species possesses greater intrinsic value. In other words, we need to explore a type of value that appeals precisely to our preferences as valuers of species. This type of value is instrumental value, defined by Sandler as value which a species possesses by virtue of its usefulness to humans (425). Lilly-Marlene Russow, in her paper "Why Do Species Matter," offers a powerful interpretation of such instrumental value. She explains that our duties to endangered species must be based upon a consistently ascribed conceptual value – a value that allows us to discern among our duties to various endangered species. This value, she argues, must be the aesthetic value of species. Russow defines a species' aesthetic value as a broad metric that ultimately measures our desire to experience their sighting again in the future. She writes:

> Aesthetic value is interpreted rather loosely; most of us believe that the world would be a poorer place for the loss of bald eagles in the same way it would be poorer for the loss of the Grand Canyon or a great work of art (Russow, 212).

There are three strengths to this theory of aesthetic value that must be recognized. Firstly, it provides a criteria applicable to all species - both animals and plants. Secondly, it allows us to develop a consistent approach in determining what endangered species we are most committed to saving. This is a critical component of value-oriented arguments which we feel is lacking in many ethical perspectives, such as the philosophy of "reverence to all life" that seeks to value all life forms equally and indiscriminately. Lastly, it allows for equal consideration of a species' past history and future significance. The loose definition of aesthetic value allows us to encompass both past and future values with no specific bias toward either of the two. However, like all theories, Russow's is not without its opposition.

Critics of Russow often point out her theory's seemingly anthropocentric stance, namely the act of ranking species based on their aesthetic value to humans. This is undoubtedly a controversial stance, and Russow herself acknowledges this. However, unless one adheres to the philosophy of "reverence to all life", the extinction of some species is inevitable and, in some cases, even desirable, since it opens up new ecological niches for future species (Russow, 212). While we recognize the anthropocentric nature of the theory of aesthetic value, we find it equally important to consider a realistic, comprehensible and consistent framework by which we can measure the value of species. Thus, we assume, for the sake of discussion, that the aforementioned instrumental value is in fact aesthetic value, and that aesthetic value partly justifies species preservation through assisted colonization.

We now examine whether the dwarf trout lily has aesthetic value that makes it worth saving, and believe this to be the case for three reasons: its unique reproductive mechanism, its historical importance to the greater Northfield area, and its visual-aesthetic properties.

As mentioned earlier, the dwarf trout lily relies solely on a highly inhibitive reproductive process to propagate itself. Its underground bulb propagation system drastically reduces the volume and frequency of the plant's reproduction making the mere existence of this plant especially rare and unique. The plant is also historically important to the greater Northfield community as it is endemic to the Cannon and North Zumbro rivers of Rice, Goodhue, and Steele counties of southeastern Minnesota. Finally, the plant possesses unique visual aesthetic properties (Banks, 10). The dwarf trout lily distinguishes itself by the very small size of its flowers, but even more unique, is the low probability of the plant flowering which makes the sighting of its dime-sized flowers that much more special. Thus, if analyzed purely on the basis of our duty to endangered species, there is enough evidence to justify the assisted colonization of the Minnesota dwarf trout lily.

Human Intervention and Naturalness

So far, we have established that the assisted colonization of the dwarf trout lily may be justified by the plant's intrinsic objective value and aesthetic value. We now turn to a virtue ethics approach to analyze whether carrying out the project would align well with the merit of preserving naturalness in both the dwarf trout lily and the arboretum.

As is true of all species we know today, the dwarf trout lily is a product of the pressures and interspecies relationships specific to the environment in which it had evolved. Had the ancestors of modern species been placed within a different ecological context, the species they would have developed into would be nothing like the ones we see today. Thus, our current conception of species is closely linked to the species' native environment. As previously noted, the arboretum is not part of the native range of the dwarf trout lily (Braker). Because the arboretum is outside the context in which the dwarf trout lily had formed, individuals moved there would lose their continuity — the relational and historical aspect of the species – even as their physical bodies are being preserved. From an abstract point of view, relocation of the dwarf trout lily has lowered its worth by uprooting it from its historical context. In the same way a Scottish castle would have less meaning if viewed in Disneyland rather than in its place of origin, some significance of the dwarf trout lily as the product of a unique evolutionary rite of passage is lost (Elliott 381-384).

Some ethicists, such as Eric Katz, find the loss of naturalness greater problem. By domineering the course of nature and imposing our own will on which plant species will live within the arboretum, we are in a sense destroying what is natural about the arboretum (Katz, 390-397). Nature is commonly regarded as what is left free of human influence, such that ecological interactions run their course independently of mankind. Therefore, by colonizing a species that would not otherwise have reached the arboretum, we have made the arboretum an unnatural place. However, there is a gradation between natural and unnatural rather than a perfect dichotomy. Using the above definition of nature, both a state park and cityscape would be considered unnatural changes to the land. That being said, the extent to which the two landscapes have been modified by humans is obviously different. Thus, some landscapes are more unnatural than others. If it is one's intent to preserve nature (especially as a habitat for native species), it stands to reason that the modifications that alter nature should be minimized to allow for a more genuine and less unnatural ecosystem. From this ethical standpoint, then, it can be concluded that assisted colonization should generally be avoided unless the species being preserved is particularly valuable.

Beyond the abstract ethical argument, this idea of destroying nature is further illustrated in the practical challenges of colonizing the plant. The dwarf trout lily is a very fragile species, which is why it is threatened by human activity in the first place. This means that the plant would have to be actively protected to ensure its long term preservation upon relocation. As an example, Nerstrand Big Woods State Park is presently managing a colony of the dwarf trout lily. In order to protect the species from soil disturbance and erosion, the park had to construct a massive boardwalk over the colony, set up stringent restrictions on the amount of traffic surrounding the area, and even control the flow of nearby rivers through small dams and other modifications (Sather, 7). These all represented major changes to the natural state of the park, imposed for the sake of the one species being protected. Should we introduce the dwarf trout lily into the Cowling Arboretum, similar modifications would have to be made to protect the plant from disturbance. In fact, the arboretum's situation may be further complicated by the work of the arboretum crew. The strict requirement that the soil around the plant not be disturbed would interfere with ongoing attempts at removing invasive Buckthorn from the arboretum. Thus, assisted colonization of the dwarf trout lily would not only entail turning the arboretum into a more unnatural place than it already is, but also interfere with other ongoing projects in the arboretum.

A survey conducted on the Carleton student body suggests that a further deterioration of the arboretum's naturalness might be faced with much student concern. As Carleton students are a user of and thus stakeholder in the well-being of the arboretum, we decided to find out what Carleton students perceived was the main function of the arboretum through a survey administered by our environmental ethics class. The results (Graph 6 in the appendix) show a very strong consensus (42% of responders) that Carleton students value the arboretum primarily as a natural place for human appreciation. Thus, any alteration of the natural state of the arboretum that would be necessary to support the dwarf trout lily may be met with resistance from our students who clearly value the arboretum's naturalness.

Feasibility of Implementation

The work involved in assisted colonization that would make the arboretum more unnatural also presents feasibility issues. As mentioned earlier, the establishment of a colony at Nerstrand Big Woods State Park required the construction of a large boardwalk, fencing, and dams in order to protect the dwarf trout lily from foot traffic and erosion from flooding (Sather, 5). Should the dwarf trout lily be brought into the Cowling Arboretum, similar protections would have to be erected in a process likely to be both expensive and time-consuming. Furthermore, successful colonization of the plant would likely require the college to hire someone properly trained in care of the plant, or train existing arboretum workers in the plant's care, thus incurring additional costs. At present, the arboretum employs full-time arboretum directors that have backgrounds in botany and horticulture, but who are not specialized in rare plant propagation. Otherwise, the arboretum employs a large cohort of amateur student workers. Without anyone properly trained in the plant's management, the success of the project might be unlikely, which in turn exposes both the college and the workers involved to a great deal of liability (Braker).

The challenges noted above, however, assume that assisted colonization of the dwarf trout lily has been approved of both by authorities and relevant stakeholders. In reality, merely attempting to make assisted colonization a possibility poses great difficulty to the arboretum staff. In order to relocate the plant, several permits would need to be obtained, including permits from the state to collect the seeds of a federally-listed plant and transport them elsewhere, as well as permits to claim and move samples of the plant. The arboretum staff would also have to obtain permission from the board of trustees and other Carleton College administrators, as taking on such a project would impose much accountability on the institution to both state and federal laws (Braker). However, having the requisite permits is not enough to guarantee that the arboretum will manage to obtain initial samples of the plant to even begin the colonization process. Potential sources of plant samples are mainly state parks trying their hardest to maintain their own colonies of the plant, such as Nerstrand Big Woods State Park. Because the plant's population is difficult enough to preserve on their own lands, potential donors would be unlikely to part with individuals of their own colonies unless they are convinced of the arboretum's ability in successfully colonizing the plant. This further adds to the necessity of the protections mentioned earlier, and also means that should the project fail, we are accountable not only to laws but also to the donors of the initial plant samples. Even if the initial relocation is successful, the arboretum would have taken on a commitment towards the long term survival of the plant - a responsibility that might last indefinitely (Braker). For these reasons, we argue that the project is in itself highly unfeasible, and that these practical challenges be weighed against any value that the dwarf trout lily may possess, in considering its assisted colonization.

Conclusion

So far, we have explored various ethical claims about the value of species. We found intrinsic objective value a satisfactory justification for species preservation, and clarified against Sandler that assisted colonization does in fact preserve this form of intrinsic value. We then discussed ecological and instrumental value as alternative justifications for assisted colonization, and found only the latter acceptable. Our discussion of value ended with the conclusion that the dwarf trout lily possesses sufficient intrinsic objective value and aesthetic value to justify its relocation. We then turned to virtue ethics for potential counterarguments, and found that the human interference made necessary by the project would have the undesirable effect of diminishing the arboretum's naturalness – a consequence to which both ethicists and possibly the Carleton student body would object. A number of implementation challenges also make the project highly unfeasible, and in turn a protracted responsibility which Carleton will have to bear should it pursue the project. In view of these feasibility concerns and the effect that the project would have on the current state of the arboretum, we conclude that while the dwarf trout lily possesses some intrinsic and aesthetic value, these values are not worth preserving through an attempt at assisted colonization into the Cowling Arboretum. Our conclusion, however, does not imply that we are against *all* attempts at assisted colonization of the plant. We are aware of other ongoing projects that have successfully relocated the dwarf trout lily and created stable colonies, such as the one in the Minnesota Landscape Arboretum, and are inclined to be in favor of such projects as long as they can justify the drastic changes that have to be made to their lands and overcome the accompanying challenges of implementation. After all, we believe that, given the capacity to, the dwarf trout lily has value worth preserving. We have chosen to err on the side of caution in the case of the Cowling Arboretum simply because we find it too ill-equipped to undertake such a project, and would prefer not to introduce changes to the arboretum that would further compromise its naturalness.

Works Cited

"A Flower Named for a Fish." *Friends of the Cacapon River, n.d.* Web. 8 Nov. 2014.

Banks, Jo Ann. "Biosystematics of Erythronium propullans gray and sympatric populations of Erythronium albidum Nuttall (Liliaceae)." MS thesis. University of Wisconsin, La Crosse, 1978.

Braker, Nancy. Personal interview. 25 Sept. 2014.

Callicott, J. Baird. "Chapter 4. Explicit and Implicit Values." *The Endangered Species Act at Thirty, Conserving Biodiversity in Human-Dominated Landscapes Volume 2*. Ed. J.

Michael Scott, Dale D. Goble and Frank W. Davis. Washington DC: Island Press, 2006. 36-48.

Elliot, Robert. "Intrinsic Value, Environmental Obligation and Naturalness." *The Monist* 75.2 (1992): 138-160.

Frey, Raymond G. "Rights, Interests, Desires and Beliefs." *American Philosophical Quarterly* 16.3 (1979): 233-239.

Katz, Eric "The Big Lie: Human Restoration of Nature" *Environmental ethics: an anthology*. Malden, MA: Blackwell Pub., 2003. 390-397. Print.

Leopold, Aldo. *A Sand County Almanac*. New York: Ballantine, 1970.

"Minnesota Dwarf Trout Lily (*Erythronium propullans*) Fact Sheet." *U.S. Fish & Wildlife Service*, 16 Jul. 2014. Web. 8 Nov. 2014.

"Minnesota Trout Lily Preserve." *The Nature Conservancy, n.d.* Web. 8 Nov. 2014.

Minteer, Ben A., and James P. Collins. "Move it or lose it? The ecological ethics of relocating species under climate change." *Ecological Applications*, 20.7 (2010): 1081-1084.

Morley, Thomas. "Flowering Frequency and Vegetative Reproduction in *Erythronium albidum and E. propullans,* and Related Observations." *Bulletin of the Torrey Botanical Club*, 109.2 (1982): 169-175

Pleasants, John M., and Jonathan F. Wendel. "Genetic diversity in a clonal narrow endemic, Erythronium propullans, and in its widespread progenitor, Erythronium albidum." *American Journal of Botany* (1989): 1136-1151.

Ricciardi, Anthony, and Daniel Simberloff. "Assisted colonization is not a viable conservation strategy." *Trends in Ecology & Evolution* 24.5 (2009): 248-253.

Rolston, Holmes III. "Duties to Ecosystems." *A companion to A Sand County Almanac*. Ed. J. Baird Callicott. Madison, Wisconsin: University of Wisconsin Press, 1987. 246-274.

Rolston, Holmes III. "Duties to Endangered Species." *BioScience* 35.11 (1985): 718-726.

Russow, Lilly-Marlene. "Why do species matter?." *Environmental Ethics* 3.2 (1981): 101-112.

Sandler, Ronald L. "Climate Change and Ecosystem Management." *Ethics, Policy & Environment* 16.1 (2013): 1-15.

Sandler, Ronald L. "The value of Species and the Ethical Foundations of Assisted Colonization." *Conservation Biology* 24.2 (2009): 424-431.

Sather, N. "Minnesota Dwarf Trout Lily: An Endangered Minnesota Wildflower." Minnesota Department of Natural Resources, 1 Jan. 1990. Web. 3 Nov. 2014.

Schwartz, Mark W., and Tara G. Martin. "Translocation of imperiled species under changing climates." *Annals of the New York Academy of Sciences* 1286.1 (2013): 15-28.

Singer, Peter. "Not for Humans Only." *Ethics and Problems of the 21st Century*. Ed. K. E. Goodpaster and K. M. Sayre. Notre Dame, Indiana: University of Notre Dame, 1979.

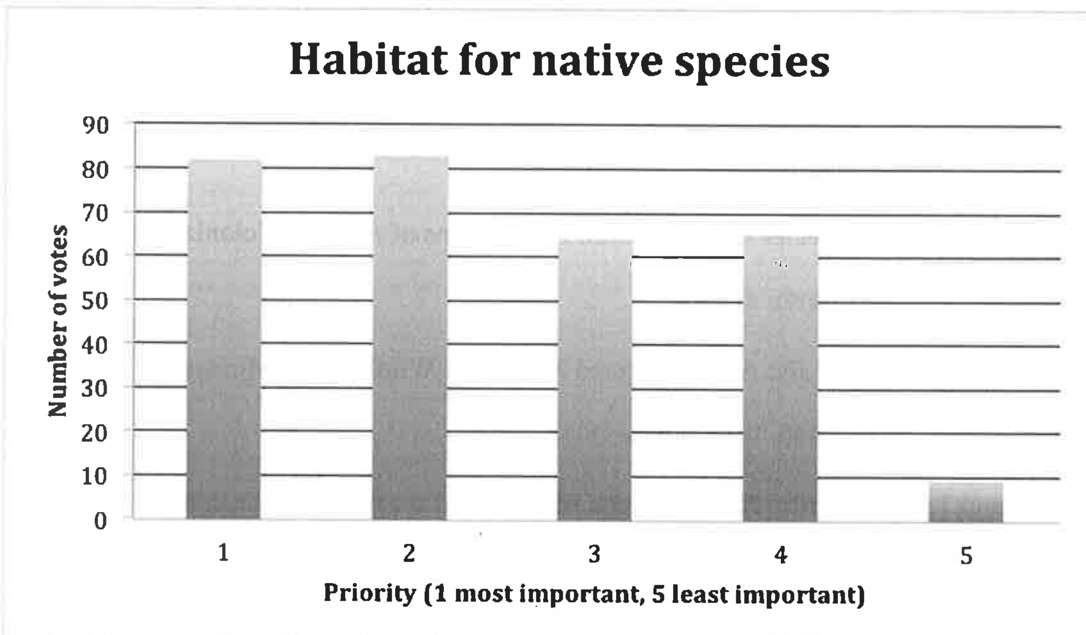
U.S. Fish and Wildlife Service. "Endangered Species: Minnesota Dwarf Trout Lily." U.S. Fish and Wildlife Service, 2011. Web. 20 October 2014.

Weflen, Kathleen. "The Crossroads of Climate Change." *Minnesota Conservation Volunteer, January-February* (2001).

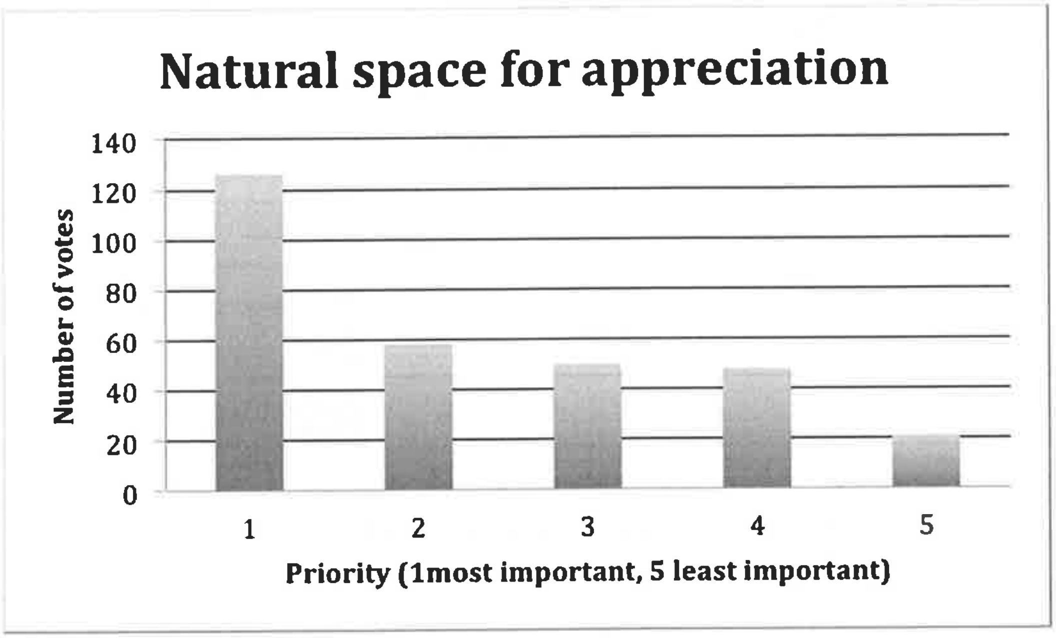
Appendix

Our Environmental Ethics (ENTS 215) class conducted a survey to determine how the values of Carleton students compare to those of other Millennials in academic institutions across the United States. Our group used this survey also to find out what the Carleton student body perceived was the main function of the arboretum. 800 students (200 from every class) were randomly selected to complete the survey, with 365 actually completing the survey. Our survey question received 305 responses, which was a large enough randomized sample to accurately represent the greater Carleton student body. Our results are shown below.

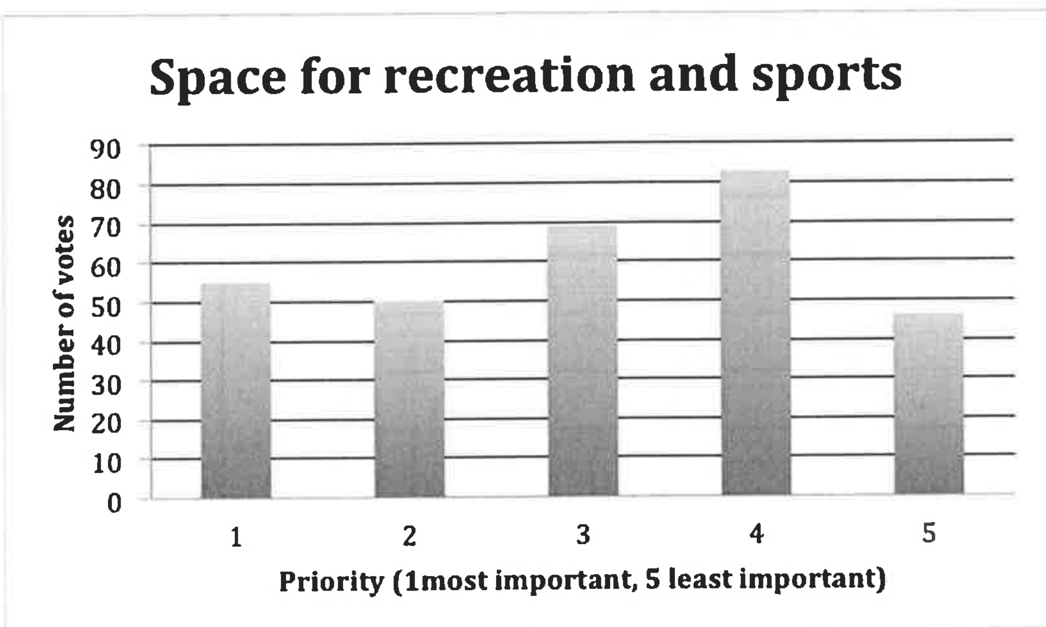
Graph 1 shows our students' perception of the arboretum as a habitat for native species.



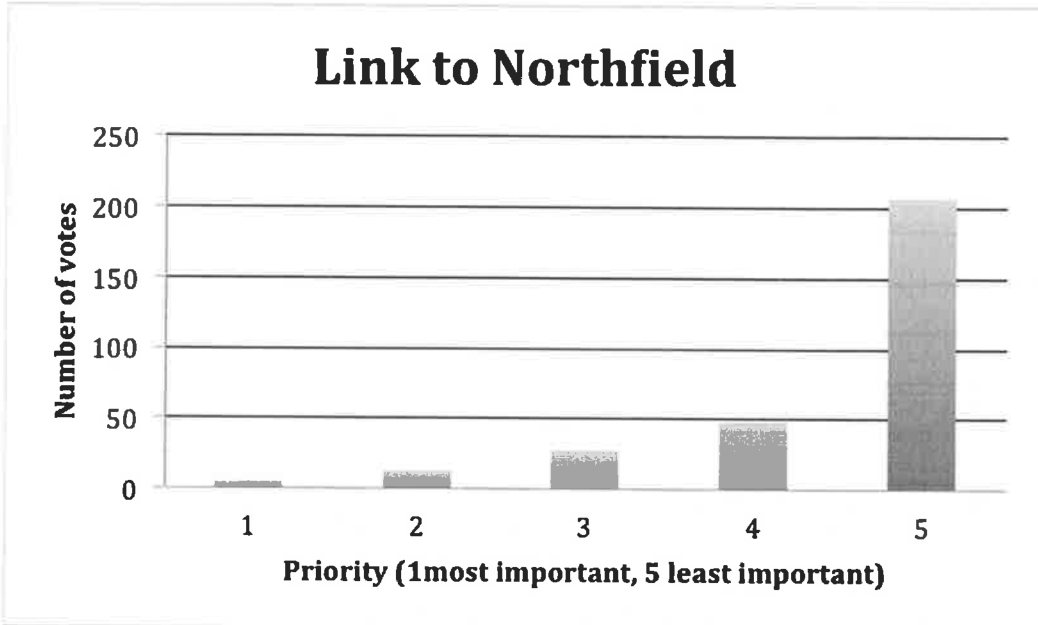
Graph 2 shows our students' perception of the arboretum as a natural space for human appreciation



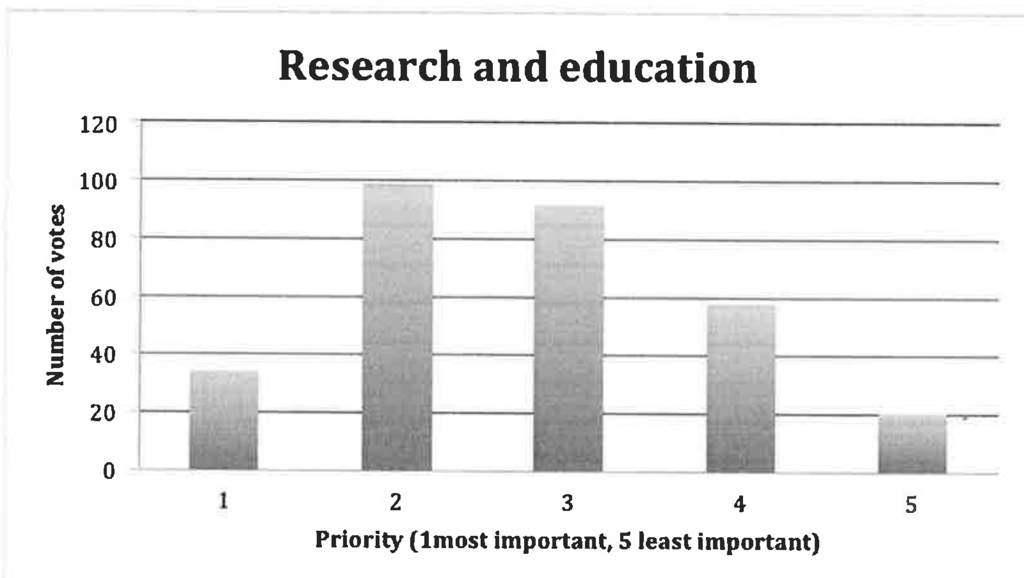
Graph 3 shows our students' perception of the arboretum as a space for recreation and sports



Graph 4 shows our students' perception of the arboretum as a link to the Northfield community



Graph 5 shows our students' perception of the arboretum as a site for research and education



Graph 6 is a compilation of first place votes amongst the five functions of the arboretum.