



Feasibility of Snail Farming as a Model for Small Urban Farms to Expand into Niche Markets for Increased Profitability

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Feasibility of Snail Farming as a Model for Small Urban Farms to Expand into Niche Markets for Increased Profitability

An Interactive Qualifying Project
Submitted to the Faculty of
WORCESTER POLYTECHNIC INSTITUTE
in partial fulfillment of the requirements for the
Degree of Bachelor of Science

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Date:
March 23rd, 2016

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Executive Summary

The most significant challenge for many small, urban commercial farms is becoming profitable after their initial investment and ongoing costs (Moyer, 2015). Many argue that this lack of profitability threatens the future of urban agriculture in the United States: “the lack of a steady and consistent stream of outside funding may be the single biggest procedural obstacle to the continued advancement of urban agriculture” (Kaufman, 2000, p. 59). The 2013 Farm Bill (a \$9 billion federally subsidized crop insurance program) highly favors large scale commodity farms in the United States (Teppert 2015). The Farm Bill does not typically benefit ninety percent of farmers who own small or intermediate-sized farms (farms whose annual profit ranges from \$10,000-\$250,000). As a result, these farmers must make the majority of their income from a source other than farming (Moyer, 2015). One such business struggling with financial success is Higher Ground Farm in Boston, Massachusetts.

Located in the Seaport District on top of the Boston Design Center, Higher Ground Farm (HGF) is a small, urban, rooftop farm conceived and created by John Stoddard. Stoddard’s vision for the farm is to provide a green space in Boston’s urban environment in order to: 1) produce healthy, local, seasonal food to sell at restaurants and farmer’s markets, 2) provide an opportunity for the local community to engage and learn about urban agriculture through volunteering and workshops, 3) provide environmental benefits to Boston’s urban ecosystem, and 4) make a profit from urban agriculture, while ensuring the farm meets quality, environmental, and animal welfare standards. HGF was launched in the spring of 2013 after Stoddard developed a business plan and blueprint for the farm (Kahn, 2013). Higher Ground Farm has a consistent demand for its produce and flowers by some of the best, high-end restaurants in Boston, including Neptune Oyster, Tres Gatos, and Coppa. HGF’s produce is in demand, and the farm has received much praise and acclaim from the community, city officials (like former Mayor Thomas Menino), and local restaurants. However, HGF is currently not making a profit (Metro, 2013; Boston Globe Editorial, 2013). As such, Stoddard, like 90% of small farmers, has to work a full time job in addition to the 20 hours of unpaid work at the farm

each week.

Higher Ground Farm is exploring new opportunities for generating income in order to expand the farm and become more profitable. One option that interests Stoddard is raising snails for escargot. Have you ever thought about commercially raising snails on a rooftop? Neither has any other urban farm in the United States. What Stoddard is attempting to do is a new innovation to both the urban and snail farming industries. Snails are a niche market product that is currently produced mostly outside of the US, typically in France and Italy. However, there are a handful of snail growers in the US, including Little Grey Farms in Washington, an emerging snail farm in upstate New York, and three snail farms in California, though these are all ground level, rural operations. Snail farming has the potential to generate \$50/pound, a significantly greater profit than Stoddard's crops, which sell for well below that.

Project Goal and Objectives

The goal of our project was to advise Higher Ground Farm on the feasibility of snail farming as a model for small urban farms to expand into niche markets for increased profitability. In order to attain this goal we set out to accomplish three main objects.

Objective 1: Research Best Practices for Heliciculture in New England

The first objective is to research best practices for heliciculture in New England. In order to answer the question of what constitutes best practices, we interviewed snail farmers in the United States and researched snail industry literature, primarily in Italy. Once we identified key participants in the U.S. snail industry, we used snowball sampling in order to identify additional participants. The goal of our interviews was to gain information about the following categories of best practices in heliciculture: snail feeding, mating, processing, and cleaning.

We also analyzed secondary sources in order to research best practices in heliciculture. Snail farming is an industry, albeit a small one in the United States, and as such it has developed its own literature. The industry is well developed in Europe, where prospective snail ranchers have access to the resources of the International Helicicultural Institute, located in Cherasco,

Italy (Istituto 2015). The Institute is an authority on the subject, conducting research in methodology and markets, and hosting annual conferences.

Essential to farming snails commercially is conducting the operation in accordance with relevant laws and regulations. Therefore, we have included these laws and regulations in the results section of this report, under “Best Practices for Heliciculture in New England”. Snails are regulated as agricultural pests by the United States Department of Agriculture (USDA), and as such, they fall under a specific set of restrictions. For HGF, relevant laws and regulations pertain to transporting the snails across state lines, processing the snails for sale, and selling the snails live or dead to a diverse customer base.

Objective 2: Snail Farming in the Context of Higher Ground Farm

Our second objective was assessing the viability of snail farming in the context of HGF, taking into account the unique attributes of the farm including: 1) the location of the farm, 2) environmental sustainability, and 3) ethical and animal welfare.

Higher Ground Farm’s location as an open rooftop by the sea brought seagulls to our attention as a unique predator to the snails of HGF. Predation by seagulls has the potential to result in the loss of a portion of the snail crop, leading to losses for our sponsor. To address this issue, we engaged in participant observation of the site, as well as conducted interviews with Stoddard on the subject. We determined that Stoddard’s existing practice of humanely removing the gull’s nests, coupled with a mesh or wire covering over the snail enclosures, would be sufficient to minimize the risks of predation imposed by the farm’s location.

Stoddard founded HGF on principles of environmental responsibility and sustainability, values that we strove to incorporate in our recommendations. In order to investigate ethically responsible methods of farming as they relate to snail ranching, we researched existing literature on animal welfare, as well as the farming of snails and other animals. To investigate the environmental impact on the farm, and to mitigate the impacts of adding heliciculture we conducted secondary research into this area. We determined that farming snails would have environmental benefits and that to minimize the impact Stoddard could make use of recycled

materials in the construction of the snail enclosures. We complemented this secondary research with semi-structured interviews with two local experts on animal welfare and ethics. The first expert we interviewed was Professor John Sanbonmatsu, a social theorist with experience in animal rights in the Philosophy Department at WPI, and the second expert was Dr. William Lynn, a Research Scientist at the George Perkins Marsh Institute of Clark University. We also asked our snail farming interview participants about ethical considerations in snail farming, focusing on ethics in best practices.

Our sponsor is interested in farming snails as a means to grow an animal protein with a small environmental footprint in the city. In order to investigate this, we collected data on snail farming and environmental sustainability during our interviews with ethicists and snail farmers and from researching secondary sources.

Objective 3: Gauge market conditions and logistics to assess financial viability

Our third objective was to gauge market conditions and logistics to assess financial viability. To meet our third objective, we researched product branding, pricing, and the Boston escargots market. We collected this data via interviews with business professors at WPI, snail farmer entrepreneurs, eleven Boston restaurants, and with secondary sources on business and farming.

Through semi-structured expert interviews, we determined that demand, pricing, and marketability were the most important factors to consider when evaluating the potential for economic success. The business connections and branding that Stoddard has created for HGF provide a foundation his expansion into this market. We identified Dr. Francis Hoy of WPI's Foisie School of Business as an expert contact due to his specialization in small business development and entrepreneurship. We conducted a semi-structured interview with Hoy, during which he recommended we proceed with a Business Model Canvas, which organizes pertinent information of the business as a way to plan for the future.

We also conducted a series of standardized interviews over the phone with two categories of Boston restaurant owners and chefs: 1) three chefs who are already buying produce from

HGF, and 2) eight restaurants that currently have escargots on the menu, but do not currently purchase products from HGF. Through these interviews we investigated whether customer demand can support the supply produced by HGF, and if they would prefer locally and ethically produced snails over canned, factory-farmed snails. We also collected data on price points and the desirability of a brand based on freshness, sustainability, and the local food movement.

Recommendations

1. **We recommend that Stoddard use *Helix Aspersa* in his farm.** These snails are found throughout the United States, including New England so foraging should be possible, however we suggest Stoddard begin his farm with snails purchased from a reputable dealer through legal channels, following all containment guidelines. This will allow a more rapid start to his farm and reduce the chance of the snails being diseased or affected by pesticides.
2. **We recommend Stoddard's enclosures contain live plants for the snails to feed on, as well as shallow water dishes and supplemental vegetable matter.** This will provide the snails with adequate nutrition. We found that overwintering snails in New England should pose no problem, provided that the snails be allowed to undergo normal hibernation and burrow into the soil approximately 3 inches. In order to slaughter snails in the most ethically sound manner, we recommend that the snails be placed in a low temperature environment, such as a refrigerator, prior to processing. □
3. **We suggest that Stoddard apply for the PPQ 526 permit regarding plant pest transport in order to begin his snail farming operation (USDA APHIS, 2015).** This is because snails are considered plant pests, a classification that prohibits transportation of potentially detrimental organisms to otherwise uncontaminated environments (USDA APHIS, 2015). The PPQ 526 permit will allow him to transport live snails across state borders, which will be greatly utilized during the growth period of the snail farm. He should be able to purchase live snails from snail providers anywhere in the U.S., given that the permit is complete by the time he wishes to make a transaction. As for housing

the snails, the farmer is responsible for maintaining a quarantined area for the snails to live in to ensure that they won't contaminate the surrounding environment. Stoddard wants the snails to live the most natural life possible, so we suggest using a solid wooden enclosure covered with fine mesh netting as a containment unit. This would provide natural lighting and climate in the enclosures while still preventing both young and adult snails from breaching the containment unit. ▢

4. **Boston area restaurants will be an opportune market for Stoddard.** Although we only identified ten Boston area restaurants as having snails on their menus, the data we received from them proved there to be a substantial market for snails. The amount of snails served in the orders these restaurants filled each week would be enough of a market demand for Stoddard to profit. From the data we collected, these restaurants averaged between 50-250 weekly orders of a half dozen snails, depending on the size of the restaurant. This equates to 300-1500 snails per week per restaurant at \$50/pound of snails. With the ability to raise 150-200 snails per square meter of space (Avagnina, 2012), and a pound of snails being roughly 100 snails, Stoddard would be able to see a return of \$50-\$100 per square meter of space. With HGF encompassing almost the area of a football field (55,000 square feet/~5,110 square meters), if all of that space was designated to snails, snail farming could generate revenue in the ballpark of \$250,000, the upper bound when classifying intermediate farms. In an attempt to conservatively estimate profits, designating only half of the total space would still generate around \$125,000 of revenue and leave half of a football field's area for whatever Stoddard decides to fill that space. Stoddard does not currently sell any products to these restaurants, which span from seafood restaurants to Italian Styled bistros. The interest these restaurants have in Stoddard's fresh local snails demonstrates the diversity and size of the market Stoddard could branch out into.
5. **The strong interest in fresh local snails from restaurants, coupled with Stoddard's extensive branding and business relationships will make the addition of snail farming very likely to succeed.** Three local restaurants who purchase produce from

Stoddard have agreed to purchase snails from Stoddard as he explores this new venture. Ten others restaurants who sell snails, but don't have an existing relationship with Stoddard, say they are interested in purchasing fresh, local snails from Stoddard in order to replace their existing canned snails from France and Italy. With this interest, the extensive branding and the low cost investment required in heliciculture, there is little risk for Stoddard in farming snails for sale in restaurants. In the event that there is not a sustained interest in snails from restaurants, Stoddard has multiple other potential markets in zoos, universities, and farmers' markets that our research has shown to be consistently interested in purchasing snails. □

6. **The average price for snails produced by domestic snail farms holds for Stoddard's snails and market.** After interviews with snail farms located in the United States and England, we observed the average price of one pound of locally produced snails to be fifty dollars per pound. This is between 164-250% more than Boston area restaurants currently pay per pound of canned snails. Although this is much higher than restaurants presently pay, 60% of the restaurants we contacted did not shy away from this number. The rest of the restaurants contacted either responded as being against the price or that they would consider it, but would need more information. Therefore, a larger group than those who responded affirmatively remarked that \$50 per pound seemed like a reasonable price for the differences in the product. With each pound of snails selling around \$50 per pound, heliciculture would become the most profitable branch of Higher Ground Farm's business and the decisive crop to maximize the profitability of any available space at the farm. □

Abstract

Urban farmers everywhere are experiencing difficulty becoming profitable and sustaining their businesses. Sponsored by John Stoddard, owner of Higher Ground Farm in Boston, Massachusetts, this project aims to assess the feasibility of adding heliculture, or snail farming, to his farm as a way to expand and increase profitability. Written in the context of Higher Ground Farm, this project also intends to serve as a more general model for urban farmers exploring heliculture or other niche markets.

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Chapter 1: Introduction

Urban agriculture is far from a new concept. Found in cities all over the United States, these green-spaces have been implemented for many decades, calling back to a time when many Americans grew their own food (Pollan, 2007). Today, urban agriculture is more popular than ever before as support and enthusiasm for environmentally friendly and ethically produced food steadily increases (Ackerman, 2011). The community support for these farms stem from the many societal and economic benefits to the cities in which they are found, including abatement of the urban heat island effect, volunteering and education opportunities, and a supply of fresh food. In addition to these benefits, urban agriculture provides an opportunity to rethink the way we produce, consume, and engage with our food. As one researcher notes:

Urban agriculture represents a tangible, accessible opportunity for city residents to become involved in issues of food provenance and food security and to reconnect with a food system that many feel is somehow out of their grasp... (Ackerman, 2011).

Despite resounding support for the urban food movement, there are still many challenges that these farms have to overcome in order to sustain and thrive. While some urban farms operate as nonprofit organizations, such as community gardens, this report focuses on for-profit, urban farms. These businesses face many unique obstacles, one of which is financial sustainability. The most significant challenge for many small, urban for-profit farms is to become profitable after their initial investment and ongoing costs (Moyer, 2015). For many urban, for-profit farms, “the lack of a steady and consistent stream of outside funding may be the single biggest procedural obstacle to the continued advancement of urban agriculture” (Kaufman, 2000, p. 59). One such business struggling with financial success is Higher Ground Farm.

Located in Boston, Massachusetts, Higher Ground Farm (HGF) is a small, urban, rooftop farm conceived and created by John Stoddard, who supports and embraces the local food movement. Before founding the farm, Stoddard recognized the difficulties and obstacles facing his endeavor and compiled a list of criteria necessary for feasibly installing and maintaining an urban farm on a building rooftop. Among these criteria were the need for a stable rooftop, at

least 25,000 square feet of farmable roof space, and access to a water supply on the roof. Shortly after Stoddard developed a business plan and blueprint for the farm, he found his current location on the rooftop of the Boston Design Center. His vision for the farm is to provide a green space in Boston's urban environment in order to: 1) produce healthy, local food to sell to restaurants and farmer's markets, 2) for people in the local community to engage and learn about urban agriculture through volunteering and workshops, 3) provide environmental benefits to the Boston community, and 4) work on the farm and expand the farm in an ethical manner that, in turn, separates Stoddard and his products from competition. HGF was launched in the spring of 2013 and continues to supply farm goods to local food markets and restaurants.

In addition to its commitment to quality consumer products, the farm offers many environmental benefits to the city such as the plant beds reducing rain runoff from the roof, cutting down on sewage overflow and saving the city from maintenance expenses (Landry, 2013). The plant life on the roof also aids in mitigating the aforementioned urban heat island effect. This effect revolves around the increase of atmospheric temperature in surrounding urban areas due to a high amount of reflected sunlight (Boston Globe Editorial, 2013). In addition to Stoddard's mindfulness of the environment, he highly values ethics and the ethical treatment of living things.

The ethics of the farm not only encompass the farming techniques and business practices but also the humane treatment of animals. This pertains to all aspects of heliciculture¹, as snails would be the first live crop of HGF, in addition to the animals Stoddard already interacts with such as seagulls and other birds. Humane treatment of animals has been a priority since the founding of the farm and also played a key role in Stoddard's decision to explore snail farming. John Stoddard is both aware of and proud of all of the environmental services Higher Ground



John behind the Higher Ground Farm booth at the farmers' market
// photo courtesy of John Stoddard

¹ heliciculture - snail farming

Farms provides to Boston. However, with only the profit he makes from the sale of produce, he does not currently have an income that would allow the farm to expand or open extensions of the farm in other spaces. While the environmental services of urban land put to agricultural use are valuable in and of themselves, the incorporation of multiple sites would allow for these effects to compound, producing a greater beneficial effect on the city.



Panorama of HGF with the Boston skyline in the background // photo courtesy of John Stoddard

Stoddard faces a problem common to small-scale farms: a lack of profitability (Ikerd, 2011). Produce has limited profit margin and also brings risks the farmer must take into account such as crop loss or wastage if they are not able to sell all of the crop. There is limited research on profit margins of fruits and vegetables at the farmers' market level, but an expert reports, "...an ordinary supermarket would need 12 to 14% [profit margin], and a counter-service grocer would want perhaps 20%." (Bowbrick², 1976). This expert goes further to report, "Most greengrocers know their overall percentage and absolute margin because they operate a cash business and have little carryover from week to week. Their weekly revenue minus their weekly purchases is their margin." (Bowbrick, 1976). This quote parallels significantly with Stoddard and HGF as his produce pricing also accounts for the work and resources that went into growing the food, not simply fluctuations with wholesale and retail pricing. Stoddard has found that he must find a way to make his business more profitable if he wants to achieve further goals for the farm. As a means of dealing with this problem, many small farmers have expanded or diversified into niche markets (Fraas, 2015). Large, commercial agricultural operations have an advantage over small farms in quantity of produce, which draws all of the market for businesses with a high

² Our research shows this to be a relevant and industry-standard report despite its publication date of 1976

enough demand. This seeming advantage of size, however, allows small farms to focus on smaller and niche markets. These markets encompass those too small to be served on a national or global industrial scale including restaurants, local markets, and populations with limited access to big supermarkets. An effective way to increase the profit margin of a farm is to introduce a high-profit product into the farm's portfolio (Drury, et al., 1996).

To this end, Stoddard has been investigating the possibility of incorporating snail farming into HGF. Over the course of this project, we have researched the best practices of heliciculture (specific to in New England and on a rooftop) in order to advise HGF on how to achieve financial viability using environmentally and ethically responsible snail farming techniques. With the information we provide, HGF will be able to determine the best course of action in incorporating snail farming into their business in order to make the urban farm a profitable venture.



Freshly harvested tomatoes ready for the farmers' market
// photo courtesy of John Stoddard

Additionally, our study resulted in general findings that can also be used as a guideline for other small, independent farmers to remain competitive and financially viable by expanding into a niche market. In New England, there are currently no snail farms established and our report will be particularly useful to prospective snail farmers. We consulted established snail

farmers and experts in the field of heliciculture to investigate the viability of snail ranching³ in the New England climate and the best and most ethical practices for raising snails. Using all gathered information, we have designed an informational pamphlet that provides snail farming recommendations for the New England area specifically to serve as an amendment to extant sources of information regarding the wider field of heliciculture. To further assist HGF and other prospective snail or niche product farms, we investigated the conditions and logistics of the Boston-area restaurant market regarding locally sourced snails to determine the interest and openness towards this new product. Ultimately, this project not only assists Higher Ground Farm in becoming more profitable, but also serves to support a novel business model expanding into a niche market to support struggling small-scale, for-profit farms.

³ Snail Rancher: The job title of a farmer who raises and sells snails, Snail Ranching: the job of a snail rancher

Chapter 2: Literature Review

Urban farms are becoming increasingly prevalent across the country as the appeal of fresh, locally-grown food and environmentally friendly organizations develop in urban areas (CLF, 2012). However, many urban farms struggle with profitability, which results in farm owners looking to diversify and expand into niche markets (Drury et. al, 1996). Stoddard, an urban farm entrepreneur, has asked our team to research the possibility of raising snails for escargot (cooked snails) as an additional source of income for HGF. We conducted a thorough literature review on economic and environmental benefits of urban agriculture, best practices of snail farming, the snail farming industry as it currently operates across the world, and the laws and regulations affecting snail farmers in the United States. Here, our review of relevant literature consists largely of peer reviewed articles and case studies of successful snail farms. Podcasts and magazine articles also proved useful for profiling key figures in the snail farming industry. Before we review the literature, we will introduce Higher Ground Farm, the site and sponsor of our project, and discuss the relevant stakeholders in the farm.

Site Description: Higher Ground Farm



Panorama of part of HGF // personal photo by authors

Higher Ground Farm is an urban farming operation in Boston, Massachusetts. The founder of the farm, John Stoddard, put the idea of Higher Ground Farm into reality in the spring of 2013. After over two years of searching, Stoddard found the ideal space on the rooftop of the Boston Design Center in Boston's Seaport District (Landry, 2013). This space provides HGF with water access, electrical access, perimeter walls, and sufficient structural integrity that can

manage the loads associated with the farm. Ideally, Stoddard wants to eventually develop HGF into a fully functioning farming enterprise with a greenhouse, CSA program, and a presence at Boston's farmer's markets (Landry, 2013). Higher Ground Farm is currently growing crops on about a half an acre of space, but has the potential to grow to cover the entire roof, which is over an acre in size. As noted in an article, "spread out over some 55,000 square feet, it will be the second-largest open-air rooftop farm in the world, and the first commercial one in Boston. (For some perspective, a football field is 57,600 square feet.)" (Kahn, 2013).

HGF grows a variety of vegetables, fruits, herbs, and flowers to sell in many different outlets, including a farmers' market within the Design Center, as well as local restaurants run by some of the best chefs in Boston. During an interview Stoddard says that he "plans to grow 50,000 or so pounds of fruits and vegetables each year, in a growing season that will last from May through November" (Kahn 2013). Apart from the benefits of a supply of fresh food becoming available to the community, the presence of Higher Ground Farm provides many benefits often associated with establishing urban agricultural operations, including reducing the heat island effect, reducing rainwater runoff, and increasing the city's aesthetics (de Zeeuw 2011).

Higher Ground Farm is exploring new opportunities for generating income in order to expand the farm and become more profitable. One option that interests Stoddard is raising snails for



Two WPI IQP Teams on a tour of HGF // personal photo by authors

escargot. No currently established farms have implemented a commercial snail farming business on a rooftop making what Stoddard is attempting to do a new innovation to both the urban and snail farming industries. Snails are a niche market product that are currently produced mostly outside of the US, typically in France. However, there are a handful of snail growers in the US,

including Little Grey Farms in Washington, as well as an emerging farm in New York and three in California, though these are all ground-level operations. Snail farming has the potential to generate a greater profit than Stoddard's crops. For example, while Stoddard sells his arugula for about \$12/lb, fresh snails in the US have been known to sell for up to \$50/lb making snails a valued addition to HGF's portfolio.

Stakeholders

In assessing our project's impact we have identified a number of important stakeholders, namely Stoddard, restaurants in Boston, Boston's urban environment, and other small-scale farms in New England looking to increase their profit-making opportunities. HGF is owned and operated by Stoddard, with help from a cadre of volunteer farm hands. Currently HGF is operating at, or near, a break-even profit margin; meaning all profit from produce sales are barely sufficient to cover the business's expenses. In Stoddard's case, these expenses do not include his labor, and as a result, he must maintain a day-job as well as his job as a farmer. In order for HGF, Stoddard's passion, to become a primary source of income and expand, something has to change.



Volunteers working at HGF // photo courtesy of John Stoddard

Restaurants can benefit from local, small-scale farmers as they provide fresh, niche food products that can give the restaurant an edge over its competitors. Fresher ingredients make better tasting food, and locally grown is in vogue now, making dealing with small-scale local farmers that much more appetizing to restaurants. HGF is currently servicing a number of restaurants in Boston, some of which have expressed interest in escargots, and around the city there are several restaurants with escargots already on the menu. Although there would be an increased price differential switching from canned snails, the aforementioned appeal for local snails would draw in new and recurring customers making the restaurant more profitable, in turn creating more demand for Stoddard's products.

Other local, urban farms would also benefit greatly from HGF becoming more profitable in this venture. With the interest growing for locally produced snails, other local goods would be looked upon with greater desire as the local food movement persists. This increasing presence of small, urban farms would encourage others to explore a business in farming over other possible areas and further grow the community of urban farmers in the Greater Boston Area.

Boston and the surrounding community is a stakeholder that would benefit greatly from urban farms expanding and becoming more profitable. On the economic side, new, urban farms and expanding, established farms would provide new and increasing job opportunities in the community (CLF, 2012). Growing business also spend more in their communities on supplies and resources, pay more in taxes and rent, and supply their respective communities with goods and services that were not available before the business' establishment.

Urban Farming: An Introduction

According to a study conducted by Kaufman and Bailkey in 2000, urban agriculture is “an innovative urban initiative, one that combines a valued product (fresh, nutritious food) with a process potentially rich in social benefits.” These farms appear in many different venues including deserted lots, old shipping containers, and on unused building rooftops, making productive use of space that would otherwise be unoccupied. With various vehicles of farming also comes a variety of styles for growing produce in an urban setting. Although Higher Ground

Farm was founded recently in 2013, Stoddard is not new to the urban agriculture industry thanks to his work with Health Care Without Harm, an organization devoted to providing local and sustainable food to hospitals. As such, he is well versed, not only in current methods of production of local food, but also in the wide range of benefits afforded by urban farms.

Traditional soil growing is a widely used method due to its ease of setup and a wealth of reference materials on these techniques, but more modern methods such as hydroponics⁴ and aquaponics⁵ are becoming more common as well, especially since these methods allow for the production of additional products, such as fish (Kaufman & Bailkey, 2000, p. 26). Urban farms are established for a multitude of reasons, unique to the needs of the community in which they reside. Many of them address a need providing fresh produce in communities where it is hard to come by (Matson 2012). Urban agriculture can also provide local jobs (Kaufman & Bailkey, 2000, p. 6). Unique urban farms are sprouting up across the country, “Now scattered across cities in different regions, the *raison d’etre* of each project can be traced to the motivation, drive and creative vision of its particular sponsor or group of sponsors” (Kaufman & Bailkey, 2000, p. 10).



Close-up of plant containers at HGF // photo courtesy of John Stoddard

With the advent of mass transit systems, refrigerated trucking, and supermarkets, citizens of the city have enjoyed more diverse food, available to them from all over the world. However, despite refrigeration and efficient transportation methods, produce experiences a loss of quality by the time it reaches the markets in urban areas (Vigneault et al. 2009). Small, urban farms

⁴ hydroponics - a method of growing plants without soil

⁵ aquaponics - incorporated farmed fish into hydroponics

benefit their communities by providing urban areas with freshly produced local foods, and, in a less obvious way, by stimulating the local economy. Many people find the idea of locally produced food appealing as it suggests a better quality product (Brain 2012). In addition, buying local produce means that the buyer knows exactly where their food is being produced as opposed to buying commercially at supermarket chains. By buying local, buyers are also giving money back to the community, which is highly appealing in the current market climate (Brain 2012).

While support from urbanites is encouraging for small, urban farm owners, it's hard to make a profit. In fact, most small farm owners make essentially all of their income from means other than their farm (Moyer 2015). Only commercial farms, which make up only 10% of all farms in the US, make a livable income off of the products their farms sell (Moyer 2015). That said, the Farm Bill passed in 2013, which is a federally subsidized crop insurance program worth at least \$9 billion, highly favors commercial farms (Teppert 2015). Many small and mid-size farms go without assistance from the federal government (Teppert 2015). Despite this hurdle, many entrepreneurs continue to try to bring locally produced foods to the tables of city dwellers in innovative ways, namely by utilizing niche markets. Stoddard's idea to bring local protein to urban areas in the form of snails could be a viable approach to becoming profitable by filling a unique need.

While urban farming initiatives have been successful in raising produce in the concrete jungle, urban protein sources pose more of a problem. Traditional meat animals like cows and pigs have not had a place in the city for decades, though chicken coops and aquaponics systems have had some success. Access to locally sourced protein remains a problem, and snails can be part of the solution. Snail meat is 13.4% protein by mass, on par with eggs (13.0%) and not much less than that of beef (18.8%), and contains nine of the ten essential amino acids (Instituto, 2015; Murphy, 2001). Snails can be raised on most vegetable matter and in very little space relative to other meat animals. Farming snails in the city could be one way of mitigating the food desert problem as well as establishing successful urban protein sources.

Environmental Effects of Urban Farms

In addition to providing urban areas with locally grown, farm fresh food, urban farms provide beneficial contributions to the environment. One specific, major impact of rooftop farms is the reduction of what is known as “the urban heat island effect”. This is a phenomenon in which urban areas experience higher average temperatures compared to suburban or rural areas (Yang, Wang, & Kaloush, 2013). Black or dark-colored rooftops, the largest contributor to this effect, absorb heat in the form of sunlight which in turn artificially increases the atmospheric temperature and in turn, the city’s temperature. Rooftop farms such as Higher Ground Farm would prevent the rooftops they’re located on from adding to the urban heat island effect mitigating the impacts of this phenomenon from the area surrounding HGF. Assuming a large enough percentage of rooftops were utilized as farm or garden space, the average temperature of urban areas could be reduced, effectively mollifying the effects of urban heat islands (Li et al., 2014). The Boston Design Center’s rooftop, where Higher Ground Farm is located, is coated in a black material, which absorbs and radiates heat. If the farm expanded, utilizing the entire acre of the roof, the building and city would receive further environmental benefits.

In addition to diminishing the urban heat island effect, urban farms reduce water pollution by absorbing storm water runoff. Various pollutants from rooftops and pavements are moved into large bodies of water via rainwater runoff, often altering the pH levels and interfering with the underwater ecosystem, contributing to water pollution (Berghage, 2009). With the establishment of a rooftop farm, much of the rainwater is absorbed by the plants and soil. This is especially apparent in the case of Higher Ground Farm, as it is located several meters away from a waterway, which drains into the Atlantic Ocean. In addition to cutting down on water pollution, reduced stormwater runoff lowers the total sewage volume as well, which in turn saves the city money by reducing risks associated with sewage overflow (VanWoert et al. 2005).

Escargot and Snail Farming

While the escargot is still relatively new to the culture of the United States, the history of snail consumption extends richly into the past in other countries. The earliest record of snails in cuisine dates back to 50 BC, where they were selectively bred and eaten in Rome (Murphy,

2001). It was likely the Romans that spread the consumption of snails throughout Europe until the practice eventually reached early France-- the country that is most commonly associated with escargot (Murphy, 2001).

To this day Italy and France are the major worldwide producers of escargots. The principle organization associated with snail farming is the International Helicicultural Institute, based in Cherasco Italy. Along with its monthly publication, in Italian, of *The Snail Breeding Journal*, the Institute also publishes a book (in Italian, French, and English) called *Snail Breeding* by Giovanni Avagnina. This book details the basics required for the industry of snail farming as it exists in Italy and France and is the authoritative text on the subject.

Typically, escargot is produced in Europe, where the demand is much higher, and imported into the United States. In most cases, snails produced overseas are canned for ease of transport and long-term storage. Most European snails are produced at what is known as an industrial or commercial scale, which refers to large operations, typically encompassing dozens of acres and producing many tons of snails per year (Avignina 2012). In the United States snail farming remains a small and specialized industry which operates at a cottage scale, smaller levels of production and acreage, which typically takes place on less than five acres of land. This means that the barriers to entry are higher in Europe than they are in the United States, and American snail ranchers can enter the market with relative ease.

There is a large variety of edible snail species, some prized for their size or flavor, and some preferred for their ease of cultivation. The most commonly farmed snail is *Helix aspersa*. This is because *H. aspersa* is a highly adaptable species that is able to thrive in a range of temperatures and habitats that most other species cannot, making them less risky to farm than other species. *H. aspersa* also holds an advantage over other species of snail in that it is a medium-sized snail that grows quickly. They reach sexual maturity (at which point they can be harvested) at two years of age in the wild, and have been reported to mature in as little as six months in an idealized farm setting. (Thompson, 2008). *Helix lactea* (also known as the “milk snail”) and *Helix pomatia* (the “Roman snail”) are widely regarded to have a better flavor than *H. aspersa*. While *H. lactea* is not often farmed, *H. pomatia* are the second most commonly grown snail in the escargot industry because of their preferred flavor and large size. Snails with

striped shells, such as *Helix hortensis* and *Helix nemoralis*, are perfectly edible and readily available in the wild in the New England region, but are not often cultivated, because these snails grow more slowly, are smaller at maturity, and are regarded by some to not taste as good compared to other species of snail (Thompson, 2008).

Snails can be housed in a variety of enclosures, ranging from specialized indoor pens, to large wooden crates, and even plastic tubs. Legally, snail enclosures are required to be made of a moisture-resistant material to avoid contamination by mold or pests (USDA APHIS, 2015). The enclosure must have a solid bottom that the snails cannot escape through, and should be located away from commercial agricultural and environmentally-sensitive areas (USDA, 2002). It is also necessary to secure a pen such that the snails cannot escape. This can be done in a number of ways, including covering the pen chicken wire, lining it with copper (snails will not cross copper because they do not like the taste-- they taste with their entire body), shaping the walls of the enclosure such that the snails larger shells cannot pass through (for example, a very sharp bend), or even installing an electric fence. While not necessary for the survival of the snails, it is recommended to fill containers with uncompacted soil that is fertilizer and pesticide free, and has been baked to kill off any organisms that may compromise the health of the snails (Thompson, 2008).

Snails are herbivores that can eat a large range of fruits, vegetables, and other plants. They prefer softer, moister, and younger leaves to dryer or older ones, and are known to reject food that they deem unsavory. It is recommended to feed snails fruit and vegetables, like carrots, cucumbers, apples, or cabbage, though the preferences of a particular herd may be variable. Alternatively, snails can be fed chicken feed with good results, particularly mixes for broiler chickens or layers. Mash for egg-laying hens is particularly useful for feeding in that it provides a source of calcium for the snails. Snails must be given a calcium supplement at least once a week. This can be in the form of crushed oyster shells, cuttlebone, milk powder, laying mash, specialized calcium supplement powders, or even provided in the soil. Calcium is necessary for shell development, but great care must be taken in ensuring that there are no harmful salts or chemicals in the supplement, as these can harm or kill snails, which are highly sensitive to chemical imbalances. Fresh water can be provided in a shallow dish, but if the water is too deep,

the snails may drown. As with any animal, the food and water of the snails must be changed frequently to avoid rotting (Thompson, 2008).

Laws and Regulations

Snails, aside from being delectable escargots, are agricultural pests and as such are regulated by the federal government. The United States Department of Agriculture (USDA) classifies snails and slugs as plant pests and requires a PPQ 526 plant pest permit to move snails across state lines; the importation of live snails into the US is strictly prohibited (USDA APHIS, 2015). While the establishment of a snail farm is considered a legitimate reason for authorization, written "State Agricultural Official concurrence" must be obtained before a permit will be issued (USDA APHIS, 2015). The USDA provides guidelines for snail containment, and stipulates that they must never be released into the environment. Guidelines include containment of snails in escape-proof enclosures, the disinfection of soil before removal from the site, as well as a number of suggested precautions and methodologies (PPQ, 2002). If the snails are canned prior to sale the FDA (Food and Drug Administration) regulates them as low-acid canned foods, requiring registration with the FDA and special precautions to be taken against botulinum infections (FDA, 2014).

At the state level we were unable to find any regulations pertaining to snails. However, in an effort to be certain of the laws governing snail farming and sale of snails to restaurants and consumers we contacted a number of officials at the Massachusetts Department of Agriculture. In 2013, however, the City of Boston passed Article 89, a zoning code that allows for urban agriculture within the city limits. Specifically, farmers are now allowed to grow and sell their products, including the keeping of animals within specially zoned areas of the city (Smith, 2013).

Stoddard will need to apply for the PPQ 526 permit regarding plant pest transport in order to begin his farm. Being able to transport live snails will be important if he wants to increase the volume of snails on his farm efficiently. Besides that, the largest hurdle Stoddard will encounter is constructing a containment unit for the snails that follows the USDA guidelines provided by the Animal and Plant Inspection Service (APHIS). Essentially, he will need a unit that will effectively prevent the snails from contaminating the surrounding environment.

Assuming the permit is in order and the containment unit fits all guidelines, Stoddard will be all set to start farming the snails. For more thorough explanations of the laws and regulations regarding snail farming in the US and how they affect our sponsor, consult the Laws and Regulations section of our Results.

Ethical Farming Techniques

Throughout our interactions with Stoddard from Higher Ground Farm, Stoddard has continued to express to us that one of his biggest concerns is raising snails in a humane way that allows them to live healthy, natural lives. While ethical farming techniques are often associated with the farming of chickens or large livestock, as these are animals generally regarded as sentient, snails are far more ambiguous with regards to what is considered happy and healthy living. Because of his dedication to the idea of ethical farming techniques, we investigated what might constitute animal welfare and responsible farming when it comes to the farming of snails.

In her article on sustainable and ethical salmon farming, Ingrid Olesen describes animal welfare as being a measurement of how well an animal is able to live under the conditions provided to it by its owners, encompassing emotional, mental, and physical aspects of the animal's well-being. Beyond keeping the animal healthy, the animal must not be denied any positive experiences it would normally gain in its natural life (Olesen et al., 2011). The degree to which these ethics can be applied to livestock are debated and are generally accepted to be dependent on the type of animal in question and the level of sentience associated with that animal. Additionally, if an animal is determined to have the ability to feel pain, it is the farmer's moral responsibility to ensure that the animal he is responsible for is not suffering (Olesen et al., 2011).

The sensation of pain is considered to be both a physical and a mental/emotional response. While nearly all creatures have the ability to perceive when their bodily tissues are being damaged, it is debated whether or not certain classes of animals truly feel either emotional or physical pain. It is widely regarded that all mammals and most vertebrates have the ability to experience pain based on both their altered behaviors when exposed to harmful stimuli and their complex brain and nerve structures (National Research Council, 2009). However, when it comes

to invertebrates, much less research has been conducted. Within the phylum *Mollusca*, alone, there is wide variation in brain complexity and structure—for example, the brain of a cephalopod (a squid, for example) is far different than the brain of a gastropod (like a snail), despite the fact that they are still relatively closely related. Further still, there is even a wide variety of behavior and neural composition within the class *Gastropoda*, which ranges from sea slugs to terrestrial snails (Crook & Walters, 2011). Therefore, to answer the question of how snails feel in response to stressful and harmful situations, only literature dealing directly with the study of terrestrial snails can be considered valuable.

One study conducted by Balaban and Chase (1991) explored whether or not edible snails could “feel” positively or negatively when different regions of the brain were stimulated. They found that the snails in their study did increase associated behaviors when one particular region of the brain was stimulated and refrained from repeating behaviors when another region of the brain was stimulated, suggesting that snails do have the ability to feel negatively about a situation or condition. While there is no way to know first-hand whether or not snails really do feel true pain, this finding does support the notion that snails can feel discomfort and change their behavior to avoid unpleasant feelings. Given this, it is the sponsor’s ethical responsibility to take as much care in raising snails as he would any vertebrate livestock if he wishes them to lead a natural, comfortable life. As such, he must be careful not to overcrowd the snails, which would provide a source of stress and increased disease in the population, or to deny them appropriate food, water, or shelter.

Selected Regional Case Studies

We delved into the following case studies in order to understand best practices of heliculture and their success as entrepreneurial businesses. Two cases we examined, Little Grey Farm and Mary Stewart’s snail farm, were chosen because they are the only large scale escargotierès⁶ in the United States. Their extensive knowledge on the logistics of owning and running a snail farm in the U.S. will be beneficial to Higher Ground Farm because the market for escargot in the United States has not yet been fully tapped. The information they can provide in

⁶ escargotierès - the french term for a snail farm

regards to U.S.-specific marketing strategies, American demand (and how to keep up with it), and navigation of federal laws regarding snail production will aid Stoddard in building a successful business. We analyzed two snails farms outside of the U.S., H&RH Escargots in England and an Australian snail farm, in order to gain some unique insight into various snail farming methods and business strategies employed outside of the United States. Studying H&RH Escargots will be useful in that its system most closely matches the production, marketing, and distribution methods that Higher Ground Farm wishes to incorporate into their budding snail-farming business. The Australian model allows us to study a farm that is still in its pilot run to see how they are achieving success, and will provide insight into strategies for recognizing and overcoming obstacles in starting up a new snail farm.

1. State of Washington, U.S.A.

Little Grey Farms, in Washington State, is the result of Ric Brewer's vision and determination. A "kindred snail soul," Brewer's passion for snails began when he tried escargot "on a dare" (Slow Blog 2013; Graber, 2015). He studied malacology, the study of mollusks, for over a decade, during which time he spent numerous years as the North American Species Survival Coordinator for an endangered species of snails, as well as working at the Seattle zoo (Graber, 2015). During his research, Brewer began to wonder if the United States had any official escargotierès and, upon further inquiry, discovered that none existed. Brewer's knowledge of snails combined with intensive studying of successful snail



Ric Brewer with one of his snails // photo courtesy of Ric Brewer

farms in various parts of the world, namely Australia, led to the conception of Little Gray Farms (Graber, 2015). Brewer's farming techniques show a passion and dedication for having his snails live as natural a life as possible, while still maintaining a successful and organized business, much like how Stoddard hopes to farm his snails.

His product is mass-produced, though instead of canning his snails, Brewer vacuum-packs them (Graber, 2015). That process allows the snails to remain as fresh as possible without becoming rubbery, which often occurs in snail products shipped from distant locations around the world. While much of his snail crop is established outdoors to maintain as natural an environment as possible part of the crop is housed in a large warehouse in order to discourage hibernation and allow for proliferation twice a year. In the wild, snails hibernate in response to incoming cold or hot seasons in order to keep warm or maintain moisture, burying themselves up to one foot underground and sealing their shell with a thick layer of mucous (Dees, 1970). While it is natural for them to do so, this period of hibernation takes a small toll on the production of escargot, as the snails do not reproduce during this time and, because they slowly burn off what little fat they have, hibernating snails are of lesser quality than active ones. The additional crop, created by preventing hibernation, generates a significant amount of revenue for Little Gray Farms, and could be something to consider for Higher Ground Farms. Brewer mentions that should one want to start up their own snail farm, commercial or otherwise, the most important factor is to "... know [snails] inside and out in order for [them] to be happy and healthy and successfully reproduce" (The Slow Blog, 2013).

2. Southern California, U.S.A.

Mary Stewart is a woman who runs a snail farm out of her home in Strathmore, California. Despite not having much of a presence online, she is one of the most well-known American snail ranchers, especially after a New York Times Article was published about her operation in 2012. While her operation is small, she raises enough snails to provide escargot to a number of restaurants, who believe that her snails are more tender and tasty than canned, French snails. Mary's snail of choice is *Helix aspersa*, a common choice among snail ranchers due to the speed and size of their growth (Thompson, 2008). This species of snail is extremely common

in California, so she was able to find her first breeding stock in the wild around her home. Her business grew from there.

While Mary is able to grow snails in relative bulk compared to the size of her farm, she treats her snails delicately and has an inherent sense for when something might be wrong with



Mary Stewart and her snail farm // photo © Stephanie Diani, The New York Times

her herds (Gordinier, 2012). According to her interview with the New York Times in 2012, it took her fifteen years to teach herself how to raise snails in the most efficient and correct way. She has learned what to feed them, what temperature to keep them at, and how to store them, as well as how to tell when they are stressed or overcrowded. Another skill she has developed that is particularly attractive to restaurants is thorough purging—cleaning out the snails prior to being cooked or packaged. While these are all very

useful aspects to successfully farming snails, because she had to learn all of this through experience alone, Mary insists on keeping her trade secrets to herself. Because of this, while we feel that her opinions and support would have been highly valuable to the purposes of this project, especially since she has been in the business for so long, we were unfortunately unable to get into contact with her.

3. Kent, England, U.K.

H&RH Escargots is a snail farm based in England. Self-described as “a mother and daughter farm based in rural East Kent, the Garden of England.” (Howard, 2015), this farm produces and sells snails all over the United Kingdom. H&RH was started by the duo in 2006. They did not set out, however, with dreams of an escargotiere but with hopes of starting a small,

traditional English farm when Helen Howard, the first “H” in H&RH, retired from her career as a biology teacher. Realizing, “... They didn't have the amount of land usually necessary for the more traditional farmyard animals, it seemed that snails were the perfect answer”(Trianon, 2012). Similar to Higher Ground Farm, H&RH experimented with crowd funding and received a lot of support from their local communities. Howard sells her snails to local restaurants as Stoddard plans to do, with much of these orders of 1-2 kilograms (2.2-4.4 lbs) at a time (Howard,



Helen Howard caring for her snails // photo © Gerry Warren, KentOnline

2015). Beyond local restaurants, she also ships her snails to some of the top restaurants in the United Kingdom and, drawing from her teaching background, has initiated many programs in local schools surrounding all aspects of heliculture.

A less obvious

consumer of H&RH's escargot are local zoos, commenting “...the slimy food [is] devoured by a range of animals including skinks, tegu, and monitor lizards” (McMichael, 2014).

Like many other helicultural operations, The Howards' snails of choice are the common garden snails, known as *Helix Aspersa*. Though the farm parallels many others in the choice of species, they are unique in the practice of shipping their snails to customers alive and in their shells. This practice is not allowed under the import laws of the United States and most other countries where escargotierès are found. She notes that “despite some interest from importers across the Atlantic, import laws prevent the transport of live snails” (Trianon, 2012). Helen and Higher Ground Farm also share philosophical sentiments with respect to how to raise the snails. Helen raises her snails outdoors, which is a mollusk equivalent of “free-range” livestock. This practice allows a more natural life cycle, as opposed to spending their whole lives in a

greenhouse or other enclosure. All of H&RH's educational programs are used "to raise awareness in the UK of snails as more than just a garden nuisance" (Trianon, 2012), which is something Stoddard is going to have to implement to have a successful snail operation in a place like Boston where snails are not all that common.

4. Australia

Snail farming in Australia is a relatively new phenomenon that has only begun to gain traction within the last fifteen years. Snail farming occurs along two economic models, the cottage farm and commercial farm, the principle difference being the quantity produced. However, within commercial snail farming, scale can vary widely from intermediately-sized farms of tens of thousands of snails per year to industrial-scale farms with millions of snails (Murphy, 2001). Australian snail ranchers aspire to establish a variety of commercial snail farms, though the industry is still in its infancy and, consequently, production of locally grown snails in Australia is almost exclusively produced at the cottage industry level (Murphy, 2001, Begg, 2006). A conscious effort was made to model the Australian helicicultural industry after the Italian model, where large plots of land are planted with forage crops and the snails are penned in with them, also known as the "free range" or "pasture production" method (Begg, 2003 pp. 3, 13). After two years of operation, a pilot snail farm has an output of approximately one thousand snails, which was viewed as a successful program as it confirmed the viability to the industry in Australia (Begg, 2006).

Summary

As shown in this literature review, snail farming and urban farming alone are well-entrenched concepts in communities all over the world. The possibility of combining the two, however, would be a radical new innovation. Snail farming takes place in varying regions and climates all over the world, proving that it could be feasible outdoors on a rooftop in the New England climate. Boston appears to have characteristics that could sustain and grow an urban farm practicing heliciculture, including a relatively dense source of potential consumers and little to no competition, as snails have not yet been produced locally in this area. Boston, being a large city, is also a prime candidate to receive all of the benefits urban agriculture has to

offer to its communities, such as the absorption of excess heat and stormwater runoff, reducing both the urban heat island effect and financial costs associated with flooding. Urban farms often struggle to break even because the time, money, and manpower that goes into growing and delivering enough produce to meet demand can easily approach the profit margins gained from those crops. Snails are a niche product that can yield a large profit to farmers at little expense of upkeep. Incorporating escargot into the production repertoire of HGF will help Stoddard achieve a means of making a stable profit and can help other urban farmers in a similar way.

Chapter 3: Methodology

The goal of our project was to advise Higher Ground Farm on the feasibility of snail farming as a model for small urban farms to expand into niche markets for increased profitability. Three main objectives were used to achieve this goal:

- Research best practices for heliculture in New England
- Assess viability of snail farming in the context of HGF
- Gauge market conditions and logistics to assess financial viability

We explore each of these objectives and the methodological strategies for data collection in greater depth below.

Objective 1: Research Best Practices for Heliculture in New England

In order to answer the question of what constitutes best practices, we interviewed snail farmers and researched snail industry literature. Experts were identified by performing internet searches for snail farms in the United States. Once we identified some key participants in the US snail industry, we used snowball sampling in order to identify additional snail ranchers as potential participants. Snowball sampling is a method by which known individuals indicate to the researchers others who might be useful in the research. We found there to be very few industrial-scale operations in the United States, whereas in Europe that scale is the norm. Those escargotieres we found in the United States exist at the scale of cottage industry. There are a total of six snail farms in the US. Because of the small number of snail farms in the U.S, we were able to achieve total population sampling, which is a means of sampling that captures the entire population, made possible in this case because the number of American Snail Ranchers is relatively small (Lund 2012). We requested semistructured phone interviews with all of our snail farmer participants that agreed to be interviewed participants that agreed to be interviewed. The goal of our interviews were to gain information about the following categories: feeding, purging, mating, cleaning, in order to understand best practices in heliculture.

For those who did not agree to an interview, we developed a survey (Appendix B), which we sent to them via email. The survey was developed using our interviews as a guide, with additional additional questions developed to fill in the gaps in our understanding of the snail

snail industry, and to provide current information on market trends. The survey covered the following topics: basic snail rearing techniques, overwintering, marketing, and difficulties in snail farming. We sent the survey to six participants, and we achieved a 100% response rate.

We also analyzed secondary sources in order to research best practices in heliculture. Snail farming is an industry, albeit a small one in the United States, and as such it has developed its own literature. The industry is well developed in Europe, where prospective snail ranchers have access to the resources of the International Helicultural Institute, located in Cherasco, Italy (Istituto 2015). The Institute is an authority on the subject, conducting research in methodology and markets, and hosting annual conferences. The Institute publishes an annual journal on snail farming, however only the latest issue is available to non-members, and it is in Italian. Therefore, we were unable to use this as a secondary source. However, we contacted the institute via email, and because one of their primary goals of the Institute is to educate prospective snail ranchers, they provided us with resources on snail farming, including the book *Snail Breeding*, by Giovanni Avagnina. We used these resources to understand the best practices primarily utilized in Europe.

While models of snail ranching have proven successful in warmer states, such as California and Washington, the cold, snowy New England climate was thought by our sponsor to potentially pose a challenge to farms hoping to harvest escargot. To address these concerns about a climate different from that of the typical escargotiere in France or Italy, we collected information from snail farmers and literature on the range of temperatures and general habitat suitable for snail production.

Essential to the ability to farm snails is conducting the operation in accordance with relevant laws and regulations, therefore we have included these in our Best Practices for Heliculture in New England, found in the results section. For HGF this pertains to transporting the snails across state lines, processing the snails for sale, and selling the snails to a diverse customer base. Snails are regulated as agricultural pests by the United States Department of Agriculture (USDA) and because of this they fall under a specific set of restrictions. Due to the classification of snails by the USDA, the literature they publish and the federal regulations that exist predominantly concerns the dealing with infestations and stopping the spread of invasive

species rather than their treatment as an agricultural product. We contacted the Massachusetts Department of Agricultural Resources (MDAR) to determine if any state laws exist that apply to snail farming. Gaining an understanding of the laws and regulations surrounding snail farming is crucial to Stoddard because it allows him to get a broader idea of how to conduct the business well within the bounds of the law.

Objective 2: Snail Farming in the Context of Higher Ground Farm

Our second objective is to identify best practices of snail farming considering the unique attributes of HGF, including the location of the farm, sustainability, and ethical considerations. HGF's foremost distinction and consideration is its location on a rooftop in an urban space. Because HGF is located on a rooftop in Boston this presents a specific set of conditions, which differ widely from those of the traditional snail farm, which are typically on the ground in more rural spaces. Being located on a rooftop in Boston allows HGF to minimize the farm-to-table distance, but it also means that no natural resources exist which are conducive to farming, and as such, they must be provided artificially. In order to understand the challenges of rooftop farming, and how they are advantageous or provide challenges for a heliculture business, we interviewed our sponsor on three different occasions, covering the following topics: Stoddard's vision for the future of his farm, his desired outcomes from working with us, what he saw as the challenges and roadblocks to running a successful snail farm, and what topics and information he wanted us to focus on in our research.

Stoddard founded HGF on principles of environmental responsibility and sustainability, values which we strove to incorporate in our recommendations. In order to investigate ethically responsible methods of farming as they relate to snail ranching, we researched existing literature on ethical farming and ethical snail farming, which we complemented with unstructured interviews with two local experts on animal welfare and ethics. The first expert we interviewed is Professor John Sanbonmatsu, a social theorist with experience in animal rights, in the Philosophy Department at WPI. The open-ended nature of the interview allowed us to explore important aspects of animal welfare as they relate to our project. The interview informed our second interview, both in terms of both content and in terms of the type of ethicist we chose to

speaking to. The second expert we interviewed was Dr. William Lynn, a Research Scientist at the George Perkins Marsh Institute of Clark University. Dr. Lynn's research focuses on the ethics of public policy as it relates to animals, the environment, and sustainability. Dr. Lynn provided us with a differing view of animal ethics that supplemented and rounded-out our research.

We also asked our snail farming interview participants about ethical considerations in snail farming, focusing on ethics in best practices. While we researched issues of animal welfare, snail welfare, ethics and best practices, we cannot categorically describe a set of best practices for ethical treatment of snails, as what is deemed to be ethical will depend greatly on ethics of the individual snail farmer. However, we have provided a guide that can help farmers best practices of snail farming, including the ethics of snail farming.

Environmental sustainability is seen as a benefit of producing and consuming snails over other protein sources, particularly animal sources, by our sponsor. In order to confirm this and investigate the extent to which the benefits extend we collected data on this during our interviews with ethicists and snail farmers and from secondary sources. The sustainability of raising snails is an important characteristic to our sponsor and one of the reasons he has chosen to pursue snail farming.

Objective 3: Gauge Market Conditions and Logistics to Assess Financial Viability

All of the contextual issues surrounding heliciculture at HGF play unique roles into Stoddard's ability to market and sell his products. To meet our third objective, we researched product branding, pricing, and the Boston escargots market. We collected this data via interviews with business professors and snail farmer entrepreneurs and with secondary sources on business and farming.

The results of the previous two objectives hinge on the outcome of gauging the market and assessing Stoddard's ability to enter and thrive in it. Through semi-structured expert interviews we determined that demand, pricing, and marketability were the most important factors to consider when evaluating the potential for economic success. The business connections and branding that John has created for HGF provide a foundation his expansion into this market. We identified Dr. Francis Hoy of WPI's Foisie School of Business as an expert

contact due to his specialization in small business development and entrepreneurship. Dr. Hoy is a Professor of Entrepreneurship and Innovation and Director of the Collaborative for Entrepreneurship and Innovation at WPI. We conducted a structured interview with Hoy, during which he recommended we proceed with a Business Model Canvas.

We conducted a series of standardized interviews over the phone with two categories of Boston restaurant owners and chefs: 1) three chefs who are already buying produce from HGF, and 2) eight restaurants that currently have escargots on the menu, but do not currently purchase products from HGF. A standardized interview is one in which the questions have been formulated ahead of time, forming a script for the interview (Berg 2012). The three chefs that have an existing relationship with HGF were selected using purposive sampling, as Stoddard pointed these chefs and restaurants out as having potential interest in fresh snails. The eight restaurants that currently have escargots on the menu were also selected using purposive sampling in order to determine the interest in the product from consumers and restaurateurs. Through these interviews we investigated whether customer demand can support the supply produced by HGF, and if they would prefer locally and ethically produced snails over canned, factory-farmed snails. We also collected data on price points and the desirability of a brand based on freshness, sustainability, and the local food movement. In order to identify restaurants that currently serve escargots, we researched Boston Restaurants with escargots on their menus, found through internet searches. Phone interviews, and not in person interviews, were chosen because they more convenient for chefs and restaurant managers. See Appendix A for our survey with restaurants who currently serve snails.

Data Management

Data management is important to protect the integrity of our research findings. The data was stored on a shared team drive. The surveys distributed to restaurant owners and chefs were handled professionally and discretely. We asked only for their basic information and withheld the information from the results if they did not want us to mention them. The interview data from restaurants has been kept as it may be helpful to Stoddard for future reference when HGF's snail production increases and he is able to service more restaurants. If they wanted to be kept

anonymous we recorded the answers from the survey and remove identifying markers. To maintain the most accurate interpretation and recollection of answers and data from the interviews, we debriefed and discussed following all of the interviews. We used direct quotes only if the interviewee allowed it and cited them in the writing. We did not allow anyone access to the data besides the group members.

Chapter 4: Results

Through assessment and interpretation of all of our collected data, we made discoveries and observations pertaining to all of our methodological objectives. We begin the presentation of our findings by exploring the best practices of heliculture. We then use these best practices as the background to assess snail farming in the context of HGF and delve in-depth into the ethics and laws regarding heliculture. After evaluating best practices of heliculture in general and in the context of Higher Ground Farm, we appraise the potential market and gauge market logistics Stoddard will have to navigate after the addition of snail farming. In concluding the logistical market analysis, we wrap up with our research and experience with the Business Canvas Model, which we developed to ease HGF's expansion into this niche market. Presenting these considerations and discoveries to Stoddard will allow him to make the most informed decisions possible in his exploration of heliculture.

Best Practices in Heliculture

We define best practices as those methods of conducting heliculture that our research we found to be the most highly regarded, effective, and time-tested. The best practices presented here also reflect the particular needs of our sponsor, including the location of his farm, the novelty of his enterprise, and the market he will be entering. Therefore the best practices in this case may be different than overall best practices for each aspect of snail farming, depending on the locality, needs, and philosophy of the farmer. Higher Ground Farm's location on a rooftop in Boston, MA presents a specific set of challenges, some of which are unique and thus have been addressed in a unique manner. Potential snail farmers seeking to use this report as a guide should keep this in mind and carefully consider the differences between their situation and that of our sponsor. Many of the resources cited throughout this report may be of help in those cases where the needs of the reader differ from the needs of the sponsor.

The research detailed in earlier sections of this report have guided the creation of this outline for what we consider Best Practices. As we consider them, the pertinent Best Practices are listed below, and then explained in detail in this section.

- Snail Species: *H. aspersa*

- ❑ Foraging vs. Purchasing
- ❑ Enclosures: Keeping the Snails Contained
- ❑ Overwintering: Natural Hibernation
- ❑ Feeding Supplements and Soil Conditions: Calcium and Plants
- ❑ Purging and Packaging: Clean, Contained, and Fresh

Snail Species

Many snail species are suitable for heliculture and make excellent escargots, choosing a specific variety relies on a number of factors, including life cycle, climatic adaptability, and commercial considerations. All these considerations were researched, and along with that information and advice from experts, have lead us to conclude that *Helix aspersa* is the ideal snail for Higher Ground Farm. Of the snail varieties commonly used in heliculture *H. aspersa* is most suitable for commercial production, having an advantageous life cycle rate, taste, reproductive capacity, and marketability (Avignina 2012). *H. aspersa* is capable of laying eggs up to four times a year, dependent on warm climates, in clutches of approximately 80 eggs. This high reproductive capacity and rate make it appealing to snail farmers. As the predominant snail on the market, *H. aspersa* is widely recognized as a standard and staple of the industry, and most customers are attuned to it's flavor, which may differ from that of other snail species. This has caused it to be the most popular species among snail farmers (Avignina 2012). This species is also versatile in its habitat choice, capable of surviving in many parts of Europe and in New England (Thompson 2008). Concerns that it could escape and spread are valid, however this invasive species was introduced to this area previously, and can now be found throughout the continental United States (Thompson 2008). As a crop pest *H. aspersa* is not welcome in agricultural settings, and this is the reason for the laws and regulations surrounding it as well as the containment guidelines suggested later in this report. Because this species has already been introduced to this area and proven the ability to survive, and because it is the most popular snail for escargots, we recommend using it for snail farming.

Foraging vs. Purchasing

Stoddard's pilot snail farm consisting of several snails was implemented using snails foraged from the surrounding Boston area. Foraging the snails rather than purchasing them for starting the farm could be dangerous as wild snails may harbor parasites, pathogens, and other contaminants (USDA APHIS, 2002). One such parasite is the slug mite, or *Riccardoella limacum*, which infects a variety of snail and slug species including *H. aspersa* (Graham, et al. 1996). Though the mites aren't deadly, they are very easily transmitted, can live their whole lives inside a single host, and can bore into the bodies of the gastropods, making them more susceptible to secondary infections and illnesses (Graham, et al. 1996). In general, the common snail farmer would have no way of knowing whether these locally foraged snails contain diseases that could infect the rest of the snail crop or potentially people that consume the snails. It would be in Stoddard's and his markets' best interests to populate his snail farm using purchased snails rather than foraged snails. However, purchasing snails poses a challenge as there are strict regulations in regards to the transportation of snails, which are discussed in the Laws and Regulations section under Transportation Regulations.

Enclosures

Containing the snails to their growing beds will ensure they do not escape and that predation can be challenging. On the rooftop a system of enclosed beds has been established for crops. With some modifications, this system can be ideal for snails as well. Snail enclosures are designed to keep the snails in and the predators out, while allowing ideal conditions for the snails, including shade and moisture levels. On the Boston rooftop the main predators are birds, therefore the enclosures must be covered from above. Stoddard has experimented with a test bed of snails, which has a lid covered in chicken wire. This has been demonstrated to work well against birds and the holes are too large for adult snails, however young snails could escape. We suggest using fine netting in conjunction with the chicken wire. Fine mesh netting, or mist netting, is commonly used in snail farming to provide shade to snails (Avagnina 2012). In this case it would serve as a protective against predators, the sun, and escape. Snails require a moist

environment, thus in addition to a sprinkler system or other means of misting the beds with water the netting will help provide a more humid environment.

Overwintering

Snails hibernate in the winter, a process essential in their life cycle (Murphy 2000). They are able to survive the New England winter by digging several centimeters into the soil and producing an operculum, a covering over the opening of their shells, a mechanism which protects them from the cold, effectively sealing them away (Murphy 2000). So long as the snails have sufficient soil to dig into while still being insulated on all sides, the New England winter should provide no hindrance to raising snails. However, this does mean in New England producing snails will be a seasonal activity for farmers, and therefore a seasonal item on menus.

Feeding Supplements and Soil Conditions

Our sponsor's preferred method of feeding the snails is to grow plants in their enclosures, providing as close to a natural environment as possible. Vegetable scraps from other parts of his farm can be added to supplement the snail's diets, they will eat most fruits and vegetables but not the stalks or leaves, though some experimentation and attention are required to determine which foods they prefer (Avignina 2012). Plant matter should be removed before it begins to rot as the fungus that this cultivates is unhygienic for snails and consumers alike. Snails require calcium for their shells. Therefore, in addition to fresh vegetable matter, they should be supplied with a calcium source to speed growth and development, especially during early life stages. One viable source of calcium (aside from that available naturally in the soil, which may be insufficient, standard soil tests can be used to determine this) is chicken feed formulated for egg-laying hens (Thompson 2008). Young snails may benefit from powdered milk, which they have been shown to consume readily and which contains calcium to help their growing shells (Thompson 2008). The calcium source should be supplied on a plate and may be mixed with Higher Ground Farm has experimented with growing vegetables in with the snails while supplementing with additional vegetable matter, to ensure the snails have sufficient foodstuffs and a diverse diet. This method works well, so long as decaying matter is removed before rot sets in, which may

cause conditions conducive to disease in the snails, particularly unhygienic conditions that support fungal growth. A shallow water dish should be present in each enclosure to allow easy access to water. Shallow because snails can easily drown in water deeper than their heads are able to reach (Avignina 2012).

Purging and Packaging

The transition from snail to escargots begins with the purging process, where snails are kept without food for at least ten days to empty their stomachs, a crucial step in producing an appealing product because this cleans undigested food from the snail's gut, analogous to cleaning the sand from clams and mussels (Avignina 2012). This can be done in an enclosed structure, separate from the regular beds to prevent them from feeding. Snails will require water at this time, and the purging container must have adequate drainage to facilitate the removal of wastes (Thompson 2008, Murphy 2000). Snails should be washed several times during this process to ensure adequate hygiene. Snails can then be processed and packaged through a process that begins with a brief refrigeration to induce the hibernation state, which has been deemed the most ethical way to engage in the slaughter of the snails as it is believed that they suffer less in this state (Brewer 2015). Once the snails have had some time to begin hibernation, dependent on the temperature used and detectable by a retraction of the snails into their shells, slaughter can begin. Snails must be cleaned thoroughly then either boiled or steamed, then removed from their shells. Snail meat can be frozen without loss of quality, though this may detract from the “fresh” branding (Avignina 2012). Packaging can also include canning, however this is contrary to the fresh nature of the product Higher Ground Farms desires to produce, therefore it is suggested that after boiling or steaming the snails be either vacuum sealed for longer storage or immediately transported to the purchasing restaurant. If desired by the restaurant, and legally permissible, the snails may be packaged live after purging and taken directly to the restaurant to maintain maximum freshness.

Laws and Regulations

We contacted a number of state officials on the topic of Massachusetts's laws and regulations regarding snails. As it appears, there are no snail regulations specific to Massachusetts. After contacting Rose Arruda, the Urban Agriculture Coordinator at the Massachusetts Department of Agricultural Resources, and being redirected to Bob Arini, an official at the Massachusetts Division of Fisheries and Wildlife, it came to our attention that the United States federal regulations are used across all states. These universal regulations make it easier to suggest best management practices around legal considerations. They also allow us to apply our data on laws and regulations collected from various snail ranchers across US to legal considerations for HGF.

There are strict laws and regulations regarding multiple facets of snails farming. Many regulations exist due to snails being defined as plant pests by the United States Department of Agriculture (USDA) (USDA APHIS, 2015). In order to begin establishing a snail farm, the farmer must apply for a permit to transport snails, especially nonindigenous species. While *H. aspersa*, the snail species that would be ideal to use at HGF, is not native to North America, it is widespread in the U.S. and is in fact found in New England (Thompson 2008). The permit is titled as PPQ 526 on the USDA website, and is defined as a permit “to move live plant pests, biological control agents, or noxious weeds” (USDA APHIS, 2015). In addition, people in possession of that permit must not release any of their snails into the environment, as it would be a breach of the permit.

Transportation Regulations

Since the snail species that would be used for snail farming are pests, transporting them live without a permit across state lines is not allowed. When importing snails into the US from other countries for human consumption, the snails must be “cooked, frozen, or otherwise processed” in order to transport them into the United States (USDA APHIS, 2015). Anyone in possession of the PPQ 526 permit regarding the transport of live plant pests is allowed to move live snails under normal conditions. Certain circumstances that may affect the permit owner's ability to move live snails includes “the risk the species poses if released to the environment, the

level of containment at the research facility and the risk of contaminants during importation” (USDA APHIS, 2015). The only snail species that is specifically prohibited from any importation and interstate transportation is the Giant African Snail as it poses a threat to both plants and humans (USDA APHIS, 2015). However, the snail species *H. aspersa* have no specific prohibitions against transporting them and therefore may be used for farming purposes at HGF. Stoddard should be able to purchase live snails from snail providers anywhere in the U.S., given that the permit is complete by the time he wishes to make a transaction. Without the permit, he can purchase *H. aspersa* only from snail providers in Massachusetts, however it’s not clear if any currently exist. It would be in Stoddard’s best interests to obtain the PPQ 526 permit.

Containment Guidelines

Stoddard is responsible for keeping the snails contained on his property. Because the snails are considered pests, they must be “quarantined” (USDA APHIS, 2002). Stoddard already has an advantage as his farm is located on a rooftop in a highly urban area, so the biggest risk he faces is snails escaping and eating his own crops. The USDA put out a set of guidelines for building snail containment units. The containment units must be impenetrable to the snails because if they escaped it would be considered a release of harmful pests into the environment. The guidelines list various aspects of a containment unit that would be most effective in preventing the escape of snails. These guidelines include locating an area to build where there is little risk of contaminating agriculture (i.e. to prevent them from eating commercial crops), building a sturdy structure to house the snails, and possibly adding an HVAC and plumbing system (USDA APHIS, 2002). The HVAC and plumbing system are recommendations not requirements: the HVAC system would help in climate control and the plumbing system would increase sanitation of the containment unit. While these might not be in Stoddard’s best interests to install, he should consider installing a sprinkler system as it could maintain a moist environment by lightly misting the interior of the enclosures. As Stoddard has mentioned, he wants the snails to live the most natural life possible so we’ve mainly considered a solid wooden enclosure covered with fine mesh netting. This would provide natural lighting and climate in the

enclosures while still preventing both young and adult snails from breaching the containment unit.

Ethics of Snail Farming

In order to align a set of farming techniques with Stoddard's personal philosophy, we conducted interviews with two philosophical professionals: WPI's John Sanbonmatsu and Clark University's William Lynn. Responses from both of these experts provided insight into two distinct schools of thoughts for considering if, how, and why animals should be farmed. Central to this debate is the contrast between the concepts of animal rights and animal welfare.

Sanbonmatsu is a firm believer in animal rights. According to his own definition, animal rights is a belief that all animals are entitled to the same rights as humans based on their status as fellow living creatures. He likens animals raised for food or other products to indentured servants or slaves, suggesting that to farm livestock is to violate their intrinsic rights as a living creature. Lynn, in contrast, subscribes to the belief system of animal welfare over animal rights. Animal welfare is the belief that, while it is okay for humans to hold power over animals, it is the responsibility of human caretakers to provide for the well-being of animals. He believes that predatory relationships between humans and other animals are natural, but that with the advent of factory farming, a careful balance must be maintained in order to keep animals healthy, allow them to lead fulfilling lives, and be killed in the most merciful way possible.

One example provided by Lynn is the method in which livestock animals are slaughtered. It does not take much effort to slaughter a cow carelessly. If the farmer wishes, the animal can be killed in a violent manner that causes it much suffering before its death. However, it is the farmer's ethical responsibility to ensure that the cow does not suffer, as it is a creature capable of feeling both fear and pain. A farmer that chooses to kill his livestock in a way that makes the animal as comfortable as possible before its passing, grouping them with other herding animals during the process to help ease their fear and ending their lives as swiftly as possible, is satisfying his moral responsibility as a captor. Snails can be dealt with in an analogous manner. By chilling the snails prior to processing they are put into a hibernation-like state, thus when the time comes to harvest them they are not conscious and will suffer less (Brewer 2015).

Lynn describes four features to consider when it comes to how to judge an animal: sentience, sapience, sociality, and ecology (Lynn 1998). Sentience describes the ability of an animal to perceive, and experience physical sensations such as pain. Sapience, in contrast, describes creatures that are self-aware and have the ability to think and feel. Lynn describes this as non-human personhood. Another aspect of an animal that must be taken into account is the sociality of an animal—that is, if the animal experiences relationships of caring, and how the loss of one member of a group of animals would affect its close relatives. Finally, the ecological role of the animal must be considered, as well, so that natural balances are not disturbed when the animal is farmed and the natural environmental conditions can be replicated when raising the animal.

An analysis of these two viewpoints suggests that John Stoddard's personal beliefs are closely aligned with Lynn's. Based on information gathered previously, such as the results of the study conducted by Balaban and Chase (1991) that shows that snails feel pain, and the criteria provided by Lynn, we have determined that snails are sentient, but not sapient. They have been determined to be able to feel pain, but not to be self-aware. Additionally, snails are not social creatures—though it is possible to raise snails in close living quarters together with no significant consequences, in the wild, snails are a wandering species that exist well dispersed and do not socialize with one another (Dalesman 2011). Therefore, the harvesting of any one snail is highly unlikely to have any emotional impact on the snails with which it was raised. Ecologically, snails are an invasive species and can exist in an extremely wide range of conditions, as displayed by their vast dispersal across the United States. Because of this, they do not require much specialized care, and can essentially be raised in mixed substrate and vegetation alone. Therefore, based on the simplicity of their environment, Stoddard will certainly be able to provide for them on a rooftop in a way that most closely mimics their natural living conditions. Compared to animals that have been shown to be sapient, social, and have large or complex habitat requirements that Stoddard would not be able to provide for generously in his location (such as chickens or cattle), snails are an especially promising choice for incorporating farmed protein sources ethically into Higher Ground Farms.

Market Research and Logistical Analysis

Potential Markets for HGF Snails

Heliciculture has been proven to be a profitable venture both in small-scale farms and the persistent factory-farming operations in Europe. While the market for European-produced, canned snails has been consistent for many decades, smaller escargotières have to actively seek out markets for their products. Markets can be hard to find and harder to get into. As Helen Howard of H&RH Escargot responded when asked of the difficulty to find a market for her snails, “The market is not immediately obvious - you have to search for it.” While this quote may not stress the extent of how difficult it can be, the sentiment is underscored by the fact that many snail farmers were not willing to participate or help us in our research.

The immediate outlet for a farmer selling snails is restaurants. HGF already sells its produce to many restaurants, yet The Boston Restaurant Group Inc. reported there are over 14,000 restaurants in Massachusetts (Boston Restaurant Group Inc., 2011) and, within existing laws and regulations, all of these 14,000 restaurants are candidates that HGF could ship products and create business relationships. Ric Brewer mentioned that “about 90% of my business is to restaurants” which seems to hold with little discrepancy in similar ratios to all of the snail farms we were in contact with. Restaurants will be the initial market that Stoddard will tackle and, through existing business relationships, Stoddard identified three restaurants that are willing to work with HGF to explore adding snails to their menus.



John Stoddard dropping off fresh produce to a local restaurant // photo courtesy of John Stoddard

A secondary outlet within which Stoddard already operates is farmer's markets. This would entail selling snails in smaller quantities, such as by the dozen, instead of pounds, but could still be profitable with increasing interest in local, unique, and healthy foods. Both Ric Brewer and Helen Howard cited taking individuals' orders which would align closely to Stoddard's current operation of selling produce at a market storefront, or he could explore offering them for sale online.



Part of the HGF farmers' market display // photo courtesy of John Stoddard

We were unaware of any other possible channels to sell snails before talking with Ms. Howard, who mentioned that H&RH Escargot also sells to “reptile owners, zoos, universities and schools”. This could be something to look into if HGF's supply surpasses the restaurant and, subsequently, individual consumer demand, as there are three large zoos and one hundred and twenty-four colleges and universities in Massachusetts (McSweeney, 2009).

Local Interest in HGF Snails

The first restaurant that Stoddard put us in touch with was Mei Mei's Restaurant in Boston, Massachusetts. Mei Mei's is run by siblings Andy, Margaret, and Irene Li. Apart from a traditional, sit-down style restaurant, they also procure a food truck, event catering, and a lunch spot made from a shipping container. Initially researching the restaurant before contacting them,

we were certain they would prove to be a wealth of information and perfect partner for Stoddard as their motto from their web page reads “Locally Sourced and Made With Love.” (A. Li et. al., 2016). Irene Li was our primary point of contact at Mei Mei’s. The interview with Ms. Li provided us with many insights into the business and culinary sides of a restaurant derived from Ms. Li’s time managing and cooking at Mei Mei’s. First asked about her interest in local food and snails in particular, Ms. Li affirmed much of our research regarding the crop choices of many urban farms saying, “...local [to Boston] proteins can be hard to come by and they can also be expensive, so broadening the kinds of proteins we use is definitely very exciting to me.” This backed up much of our research in which we identified trends in urban farms to either grow solely produce or a single, unique product such as Sky8 Shrimp Farm in Stoughton, Massachusetts which Ms. Li cited later on in the interview.

We identified around a dozen restaurants in Boston that already served escargot or other snail dishes on their menus. Out of those ten, we were able to get in contact with eight. All of those eight restaurants confirmed that they used canned, imported snails. The response from the majority was that they would be very interested in both exchanging their current product for fresh snails, and put greater emphasis on local businesses and products. The majority of the restaurants also informed us that their snail dishes have a very consistent demand with one restaurant saying they did over two-hundred orders that past weekend. The overwhelming interest coupled with the apparent demand bodes well towards Stoddard’s success of incorporating heliculture into HGF.

Marketing and Branding

The next biggest challenge after identifying potential markets is the education process for the product. Snails are not a staple in New England restaurants and introducing a new product requires some amount of education to introduce chefs and diners to this new ingredient. The educating process can be seen in the context of branding when saying “[branding and interest] will also depend on knowledge and experience of the brand that consumers living in different cultural and competitive contexts have.” (International, 2009). We asked Ms. Li if there would be less of an educating process for both chefs and diners since snail dished seemed

to be more popular than we had originally imagined. Ms. Li responded with what we found to be the most interesting insight of our interviews saying,

I would estimate that you would definitely have to do some educating. The reason for that is that many of the chefs who have worked with snails are probably coming from higher end, more French-style kitchens. [Therefore] I think that there's a chance that they are chefs who would be more interested in continuing to work with snails like burgundy snails. and so in filling that gap in the market you guys would be really looking for chefs who haven't worked with snails before. Certainly there are plenty of people who have cooked with snails before....Ideally you guys would be opening up a completely new market not just replacing what other chefs are getting.

This educating goes hand-in-hand with branding of the snails and the farm. Branding is summed up as “involved associating the product uniquely with a particular consumer benefit, and also against the competition” (International, 2009). Fortunately for this new venture, Stoddard has already built a solid foundation in the branding of HGF and will be able to put its weight behind the marketing of the snails. Stoddard’s branding for snails parallels Ric Brewer’s sentiments when he said “my main marketing point and my main sale point is that they're fresh...if they were canned they would just be another canned product on a shelf.”

Price Point and Food Cost in Boston

A key intent in our interviews with restaurants was fielding reactions and opinions on an agreeable price range for the snails in the context of Boston dining. Ms. Li introduced us to the statistical side of pricing ingredients, referred to as the “food cost”, which would later determine the price of the dish on a menu and therefore affect the decision of restaurant owners in deciding to buy certain products. Ms. Li said that “On average, the cost of the ingredients on a plate at a restaurant, the food cost, would fall around 20-30% of the retail price of the dish.” She

emphasized that this was more of a rule of thumb than a industry principle but it would be something to keep in mind when we were pricing out the snails.

In our interviews with the restaurants that already served snails, we learned that all of the restaurants pay around \$12-\$18.50 per can of snails, with most on the higher end of that range. Each can was typically around 0.5-0.75 pound of snails (Based on the agreed industry measurement that 1 pound of snails is approximately 100 snails (Avagnina, 2012)). This would calculate out to each restaurant paying between \$20-\$30.8 per pound of canned snails (Averaging 0.5-0.75 pounds coasting \$12 dollars and that same weight range costing \$18.50). Basing our pitch on pricing we received from Ms. Howard and Mr. Brewer, we asked all of these restaurants if they would be willing to pay around \$50 for a pound of fresh snails if they were available. The overwhelming response to this inquiry was positive. Many mentioned that seemed like a reasonable price for the quality and impact of the product with only two restaurants in disagreement with that price range.

Business Model Canvas as a Tool for Urban Farms and Higher Ground Farm

The business model canvas (BMC) was developed to be a living document⁷, which could provide users with an efficient means of organizing key information pertinent to their business. At a glance all the relevant information can be taken in, viewed wholesale in order to grasp the big picture in an organized manner. We chose to proceed with a BMC rather than with a business plan for a number of reasons. As Alexander Osterwalder, the co-inventor of the BMC, remarks, “Business modeling is a way to experiment and test your hypothesis for creating and capturing value. When done well, it is a way to experiment and reduce risk.” (Osterwalder, 2010).

Although a business plan can be useful for demonstrating a concept to new partners or investors, it has several limitations, which are overcome in a BMC. The BMC is formatted as a poster rather than a report of lengthy document, it is meant to be displayed and adjusted constantly, whereas a business plan is more likely to be created and then stored out of sight until it is needed. A BMC will display less information than is available in a business plan, however

⁷ a document that is continually edited and updated

this information is more concise and still aims to meet the same needs as the information provided in a business plan. An important feature of the BMC is its nature as a living document; it is designed to be adaptable to suit the needs of an evolving business. Our sponsor will be able to adapt the BMC as his business grows and his needs change over time. We will be incorporating HGF's business goals into the canvas in order to maximize its potential benefits. A copy of the BMC for Higher Ground Farms as it stood at publication time can be found in Appendix D. An online tool called Canvanizer™ was used to create it; it was chosen because it is a web based platform which we were able to share with our sponsor, collaborate on efficiently, and it could be taken anywhere on a cross-platform basis, allowing our sponsor to make the most use of it.

Chapter 5: Conclusion and Sponsor Recommendations

Overall, this project serves to assist the Higher Ground Farm in diversifying into heliculture as a way to increase profitability. It will also help to develop a framework for other urban farms looking into niche revenue sources. By researching and developing best practices for heliculture in New England we can create an essential guide for prospective snail farmers and other developing niche product farmers to build a foundation upon for their business. Through our research and data collection we believe this guide will be an encompassing “how-to” with general ideas and recommendations to adapt to each farm’s unique situation. Stoddard will be the pioneer of the market in New England and will therefore need the best recommendations and techniques our research will determine. Subsequently, building off of these guidelines we directed them further to conform to HGF specifically and made recommendations for heliculture in the context of HGF’s needs. The purported effectiveness of these two objectives is elevated with the exploration of a market for the newly created supply in all major economic factors that would affect a business. Looking first to restaurants before individual sale or wholesale we gauged an initial demand which we believe will only grow with time. While Stoddard has fostered many relationships with chefs and restaurant owners throughout the city, this new offering from Higher Ground Farm could procure a new facet of the business. Concluding our project, we presented the results of our project to Higher Ground Farm and provided a basis of work that can inform and be followed by other urban farmers around the globe.

Recommendations

1. **We recommend that Stoddard use *Helix Aspersa* in his farm.** These snails are found throughout the United States, including New England so foraging should be possible, however we suggest Stoddard begin his farm with snails purchased from a reputable dealer through legal channels, following all containment guidelines. This will allow a more rapid start to his farm and reduce the chance of the snails being diseased or affected by pesticides.

2. **We recommend Stoddard's enclosures contain live plants for the snails to feed on, as well as shallow water dishes and supplemental vegetable matter.** This will provide the snails with adequate nutrition. We found that overwintering snails in New England should pose no problem, provided that the snails be allowed to undergo normal hibernation and burrow into the soil approximately 3 inches. In order to slaughter snails in the most ethically sound manner, we recommend that the snails be placed in a low temperature environment, such as a refrigerator, prior to processing. □
3. **We suggest that Stoddard apply for the PPQ 526 permit regarding plant pest transport in order to begin his snail farming operation (USDA APHIS, 2015).** This is because snails are considered plant pests, a classification that prohibits transportation of potentially detrimental organisms to otherwise uncontaminated environments (USDA APHIS, 2015). The PPQ 526 permit will allow him to transport live snails across state borders, which will be greatly utilized during the growth period of the snail farm. He should be able to purchase live snails from snail providers anywhere in the U.S., given that the permit is complete by the time he wishes to make a transaction. As for housing the snails, the farmer is responsible for maintaining a quarantined area for the snails to live in to ensure that they won't contaminate the surrounding environment. Stoddard wants the snails to live the most natural life possible, so we suggest using a solid wooden enclosure covered with fine mesh netting as a containment unit. This would provide natural lighting and climate in the enclosures while still preventing both young and adult snails from breaching the containment unit. □
4. **Boston area restaurants will be an opportune market for Stoddard.** Although we only identified ten Boston area restaurants as having snails on their menus, the data we received from them proved there to be a substantial market for snails. The amount of snails served in the orders these restaurants filled each week would be enough of a

market demand for Stoddard to profit. From the data we collected, these restaurants averaged between 50-250 weekly orders of a half dozen snails, depending on the size of the restaurant. This equates to 300-1500 snails per week per restaurant at \$50/pound of snails. With the ability to raise 150-200 snails per square meter of space (Avagnina, 2012), and a pound of snails being roughly 100 snails, Stoddard would be able to see a return of \$50-\$100 per square meter of space. With HGF encompassing almost the area of a football field (55,000 square feet/~5,110 square meters), if all of that space was designated to snails, snail farming could generate revenue in the ballpark of \$250,000, the upper bound when classifying intermediate farms. In an attempt to conservatively estimate profits, designating only half of the total space would still generate around \$125,000 of revenue and leave half of a football field's area for whatever Stoddard decides to fill that space. Stoddard does not currently sell any products to these restaurants, which span from seafood restaurants to Italian Styled bistros. The interest these restaurants have in Stoddard's fresh local snails demonstrates the diversity and size of the market Stoddard could branch out into.

5. **The strong interest in fresh local snails from restaurants, coupled with Stoddard's extensive branding and business relationships will make the addition of snail farming very likely to succeed.** Three local restaurants who purchase produce from Stoddard have agreed to purchase snails from Stoddard as he explores this new venture. Ten others restaurants who sell snails, but don't have an existing relationship with Stoddard, say they are interested in purchasing fresh, local snails from Stoddard in order to replace their existing canned snails from France and Italy. With this interest, the extensive branding and the low cost investment required in heliciculture, there is little risk for Stoddard in farming snails for sale in restaurants. In the event that there is not a sustained interest in snails from restaurants, Stoddard has multiple other potential markets in zoos, universities, and farmers' markets that our research has shown to be consistently interested in purchasing snails. □

6. **The average price for snails produced by domestic snail farms holds for Stoddard's snails and market.** After interviews with snail farms located in the United States and England, we observed the average price of one pound of locally produced snails to be fifty dollars per pound. This is between 164-250% more than Boston area restaurants currently pay per pound of canned snails. Although this is much higher than restaurants presently pay, 60% of the restaurants we contacted did not shy away from this number. The rest of the restaurants contacted either responded as being against the price or that they would consider it, but would need more information. Therefore, a larger group than those who responded affirmatively remarked that \$50 per pound seemed like a reasonable price for the differences in the product. With each pound of snails selling around \$50 per pound, heliciculture would become the most profitable branch of Higher Ground Farm's business and the decisive crop to maximize the profitability of any available space at the farm. □

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Appendix A

Survey questions for restaurateurs.

Do you currently serve escargot at your restaurant?

Are you interested in serving escargot? Why or why not?

Where do you purchase your escargot? How is it packaged?

How much escargot do you generally purchase? How does this relate to the number of menu items featuring escargot on your menu?

How much do you pay for your escargot?

Are your escargot dishes popular? Are they profitable?

In Seattle, where many snail farms are already established, some restaurants pay around \$50 per pound (roughly 100 snails) for farm-fresh snails. At this price, do you think they could be a profitable ingredient for restaurateurs in New England?

If locally-grown snails were only a seasonal product, would purchasing them still interest you? Why or why not?

Most snails are purchased canned. However, if snails are grown in-state, they can be purchased freshly processed. Does this interest you? Why or why not?

Additionally, locally-grown snails can be purchased alive so that chefs may process them in-house. Would you be interested in purchasing live snails? Why or why not?

How much do your escargot dishes cost?

If you would like to be contacted with further information regarding locally produced snails available for purchase by restaurants in the Boston area please leave a name, email, and/or phone number below.

Appendix B

Sample Interview Questions for Snail Ranchers

Would you allow us to use quotes or ideas from your answers in the data we present in our final report?

What species of snail do you farm?

What conditions do you grow your snails in (temperature, humidity, etc.)?

What kind of enclosure do you keep your snails in during summer/winter?

Did you have any trouble finding a market for your snails?

How many snails do you produce? How many snails do clients typically order?

Who is your primary market? Restaurants, individuals, farmers markets, etc.

Do you feel you produce enough snails to meet the demand you've encountered?

How do your snails behave in winter?

What have your experiences with snail farming in cold weather been like? Any advice or problems you've run into?

Do you think it is feasible for our sponsor to grow snails in Massachusetts' winters? (ie. temperatures well below freezing for several weeks)

Have you been in contact with or worked with other snail farmers?

- Yes
- No

If you "Yes", did you find that it was helpful to speak with them, or vice versa?

If "No," would you like for us to put you in contact with other snail farmers?

- Yes
- No

Do you have any tips or advice for someone hoping to start snail farming and enter the escargot market?

Is there anything you wish you knew when you started your farm?

After all your experience with snail farming, are there any questions you have that are still unanswered and would like answers to? We would be curious and willing to include them in our research.

Would you like to stay updated on the results of our project?

We will be producing a report encompassing much information pertaining to snail farming and research for small and urban farms and would willingly send a copy if you would like and our sponsor allows.

- Yes
- No

Appendix C

Sample Interview Questions for In-Depth Restaurant Interviews

What interests you about local snails? About adding them to your menu?

Are snails an ingredient that many culinary professionals are familiar with? Do you think there would be a market for them immediately or would we have to educate diners/chefs as we went?

Could you elaborate more on pricing and what you think a fair average price range would be in terms of all restaurants in Boston that might be interested?

How many customers do you serve a week and in turn how many pounds of escargot would you see your restaurant needing each week?

Do you have any questions for us?

Appendix D

Expert Interview Highlights

Experts	Profession/Title	Business/Place of Employment	Topic Discussed	Notable Talking Points
Frank Hoy	Professor/Department Head	WPI - Foisie School of Business	Business Plans	-Business canvas model over buisness plan
John Sanbonmatsu	Professor	WPI - Humanities and Arts	Ethics	-Animal rights: farming any animal is a direct infringement of its intrinsic rights as a living creature -The relationship between animals and humans currently is similar to a relationship between a human slave and master, and this is not ethical -Farming any animal, including snails, is not a fair or just thing to do
William Lynn	Research Scientist	Clark University	Ethics	-Animal welfare: power imbalances between humans and animals are natural, but the animals must be raised and handled in a way that minimizes suffering and allows the animal to lead a healthy, happy life -Four criteria to consider: sentience, sapience, sociality, and ecological role -Snails are sentient, but not sapient
Ric Brewer	Snail Rancher	Little Grey Farm	Snail Ranching	- Establish an understanding of laws and regulations - The volume of snails sold determines profitability - Learn as much as possible about snails - Remain realistic and have patience
Helen Howard	Snail Rancher	H&RH Escargots	Snail Ranching	- Do as much market research as possible - Snails can be

				overwintered if placed in an indoor enclosure
Irene Li	Proprietor, Chef	Mei Mei Street Kitchen	Restaurant and Market Logistics	- Local proteins can be hard to come by and expensive - Snails are uncommon but more approachable than a lot of other uncommon foods - Most likely marketing to chefs not currently working with snails therefore there would be some education of chefs and diners - Food Cost statistics → ingredients on plate on average 20-30% of retail price therefore price per pound would be taken into account based on restaurant

Appendix E

Example of Business Model Canvas for Higher Ground Farm

Key Partners ? Insert John Stoddard Founding Farmer Higher Ground Farm	Key Activities ? Insert Snail Farming Traditional Rooftop agriculture	Value Proposition ? Insert Snails Sold in 1lb lots experimentation with other units may be required Product Distinction Locally Grown Organic Ethically Raised Fresh, never canned	Customer Relationships ? Insert Relationships with Restaurants Restaurants already served with produce	Customer Segments ? Insert Purchasers of the Snails Sweet Cheeks - Tiffany Consumers of the Snails Restaurant patrons
Cost Structure ? Insert Price per pound Market rate of canned snails? \$30-\$50 for similar products in other areas	Key Resources ? Insert Save our Stuff Volunteers Bicycle & Trailer Rooftop Crowdfunding	Revenue Streams ? Insert Restaurants -Sold by the pound -live snails? Further investigation on MA regulations required	Channels ? Insert Bike Trailer See Bike Team info Boston South End Limited to a radius around the farm that is easily accessible to bicycle traffic	Availability Snails not available year round, they have a harvest-able season and cannot be gathered in the winter Snail caviar remains a possibility, not a priority however Zoos Can be sold to Zoos as reptile food

Appendix F

Introductory Pamphlet for Snail Farming in New England



SNAIL FARMING IN NEW ENGLAND

An introductory guide
to starting an escargot
farm in New England

Laws and Regulations

Snails are considered agricultural pests by the United States Department of Agriculture because of their status as an invasive species and their ability to cause a significant amount of damage to crops. Because of this, while it is legal to farm snails, certain legal precautions must be taken when starting a snail farm,

1. Living snails and snail eggs cannot be moved across state borders without a PPO §26 permit.
2. Snail enclosures must be made of a water-resistant material to keep the snails healthy and maintain a quality product.
3. Snails must not be able to escape from their enclosures. A solid bottom and some sort of cover that the snails cannot pass through are necessary for farming enclosures.
4. Escargots that are canned prior to sale must be registered with the FDA, and must be inspected for possible botulism infections.

Want to learn more?

"Feasibility of Snail Farming as a Model for Small Urban Farms to Expand into Niche Markets for Increased Profitability", a report by the creators of this pamphlet

Snail Breeding by Giovanni Avagnina

"Raising Snails" by Rebecca Thompson for the Alternative Farming Systems Information Center

Snails in the Winter

The cold, snowy New England winter poses a unique problem to prospective snail ranchers. However, with careful planning and the right setup, a successful escargot farm can still be maintained in the winter.

Snails naturally hibernate in response to colder temperatures in order to survive the winter. During this time, they burrow up to a foot underground and seal their shells to limit moisture loss. While snails can still be harvested at this time, they will typically be of a lesser quality than active snails, as they burn off much of their fat and water while hibernating.

Some farmers may choose to allow their snails to hibernate. Not much is required to provide for them during hibernation, but deep soil must be available for them to bury themselves in. Additionally, farmers must take care in ensuring that the bottom of the enclosure is not too cold for the snails in case they come into contact with it while burrowing.

Other farmers may choose to prevent their snails from hibernating. This can be accomplished by keeping the snails in a climate-controlled area, away from cold outdoor temperatures or snow. Though the snails' life cycle may be slightly disrupted, keeping the snails warm during the winter instead could allow for more successful winter harvesting and may even yield additional breedings.



What kind of market is there for escargot in New England?

This is big question among prospective snail farmers. While escargot is very popular overseas, its market is traditionally less established in the United States. Regardless, there are many restaurants that already serve escargot, with over 20 existing in Boston alone. Beyond this, there is also great potential in implementing escargot into eco-friendly diets as a source of sustainable protein, especially when locally produced.

Research conducted by WPI in 2016 reports a positive reception of locally-farmed snails, from restaurants that do and do not already serve escargot. While snails are typically produced for escargot, other markets, such as those as food sources for pet reptiles or zoo animals, also exist. Though they may take some discovering, pursuing unique markets like these will allow for further profitability of the niche snail farm.



Species

While there are many edible species of snail, the most commonly farmed species are *Helix aspersa* and *Helix pomatia*. *Helix aspersa* is a medium-sized snail that is popular for its quick growth and adaptability. Farming them is less risky than farming other species because they can live comfortably in a wide range of habitats. *Helix pomatia* is a slightly larger snail that is regarded by some to have a better flavor than *Helix aspersa*. For both of these reasons, some farmers may choose to cultivate *Helix pomatia* over *Helix aspersa*, though they are typically more finicky than their cousins.

Snail Farming 101

Feeding

Snails are herbivorous, and will eat nearly any fruit or vegetable that humans can eat. Some favorites of snails include apples, carrots, cucumbers, and lettuce. Some farmers choose to feed their snails chicken feed. Mash for egg-laying hens is particularly good for snails because of its high calcium content. Though they can consume calcium from the soil they live in, most snails require a calcium supplement to maintain their shells.

Preparation and Sale

Before snails can be cooked and sold or eaten, they must be purged. To accomplish this, snails must be kept in an environment with no dirt or food for 48 hours. After this time has passed, the snails can be cooked and packaged. One benefit of locally-farmed snails is that chefs can choose to purchase snails that are still living and complete the purging process themselves, providing less effort on the farmers' half and a fresher product in the restaurant.

Where do I keep my snails?

When it comes to containing them, snails are relatively low maintenance. They can be housed in a variety of simple structures ranging from plastic tubs to devoted garden beds. Legally, these enclosures are required to be moisture resistant to prevent the spread of mold and parasites. They must have a solid bottom through which the snails cannot escape, and the roof of the enclosure must be escape-proof, as well. This can be achieved by covering the top of the enclosure with chicken wire, or lining the upper edges with copper plating, over which snails will not crawl. Though snails do not require soil in their enclosure to live, it is recommended that at least three inches of soil is provided, as the soil will aid in keeping much-needed water readily available to the snails. Snails will also only breed when there is enough loose soil for them to lay their eggs in. Preparing a separate enclosure in which snails can be moved to and subsequently removed for breeding purposes is a common practice, as this allows the eggs to develop undisturbed and the baby snails, once hatched, to have a safe place to grow.

