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The McNair Scholars Program

Background

The University of Wyoming McNair Scholars Program was established in September 1992 and is one of the only 150 programs in the nation. The University of Wyoming and the United States Department of Education jointly support the program named for an accomplished scholar of physics and an astronaut on the Challenger space shuttle, Ronald E. McNair. Prospective scholars represent a wide range of disciplines. These students share the common desire to pursue graduate studies, attain the doctorate, and join the ranks of the next generation of faculty members.

Program Components

The McNair Scholars Program provides exciting opportunities for undergraduate students at the junior and senior levels to prepare for acceptance into quality graduate programs of their choice. Program participants are provided services in academic skills, individual counseling support, and funded summer research internships. During the academic year a series of seminars provides information on graduate school financial aid, research skills and technical writing, the graduate school admission process, graduate school entrance exams, portfolio preparation, and more. Student concerns in financial, personal, and academic realms are addressed through individual counseling support services. Finally, the program offers participants site and mentors, provide workshops on research skills, help with report preparation, and assist as otherwise needed on an individual basis. At completion of the internship experience, McNair Scholars make formal presentations of their research to faculty and peers at the McNair Scholars Conference and submit papers summarizing their work. Opportunities to attend national research and graduate recruitment conferences and visits to other graduate campuses are encouraged and provided.

Funded Internships

Research internships are offered to those Scholars who have earned at least 60 credits by the beginning of the internship period. Stipends for internships are awarded for an eight week summer session. During the eight week internship, students work 40 hours per week under the supervision of a faculty mentor and a graduate student advisor. Students seeking involvement submit an internship application to the program.
**Eligibility and Selection**

First generation students (neither parent has received a bachelor’s degree) and income eligible or Black (non-Hispanic), Hispanic, American Indian, Alaskan Native, Native Hawaiian and Native American Pacific Islander

Have at least 50 credit hours Meet GPA requirements U.S. Citizen or permanent U.S. resident

Committed to attaining their Ph.D.

Prospective participants are encouraged to contact the project staff for information and application materials at any time during the year. Participants are selected from undergraduate applications attending the University of Wyoming on the Laramie campus. Participation in the program is limited to 33 students.

**Forward**

As the McNair staff has grown in experience over the years, so have the faculty, graduate students, and McNair interns. Each year I am struck by the increased level of sophistication I see in both the projects and the presentations, oral and written.

This continuous improvement can be attributed to the hard work and dedication of the McNair Scholars, and the faculty members and graduate students without whose help their success would have been impossible. One of the greatest joys of being a McNair staff member is the opportunity to work with such terrific colleagues as the students, faculty members, and graduate students represented in this journal.

The McNair Scholars featured in this journal can be rightfully proud of what they have achieved. We wish them well and look forward to the great things they will achieve.

Zackie Salmon, Director
UW McNair Scholars Program, Summer 2013
Ronald Ervin McNair: The Man with a Mission

Ronald E. McNair, the second African American to fly in space, was born on October 21, 1950 in Lake City, South Carolina. While in junior high school, Ronald McNair was inspired by a teacher who recognized his science potential and believed in him. He graduated as valedictorian from Carver High School in 1967. In 1971, he received his Bachelor’s Degree Magna Cum Laude in Physics from North Carolina A & T State University (Greensboro). In 1976, at the age of 26, McNair earned a Ph.D. from the Massachusetts Institute of Technology (MIT).

While working with the Hughes Research Laboratory as a staff physicist, McNair soon became an acknowledged expert in laser physics. NASA selected him for the 1978 space shuttle program and in 1984, McNair became the mission specialist aboard the flight of the shuttle Challenger. In addition, he received three honorary doctorate degrees as well as numerous fellowships and commendations.

Dr. McNair’s life ended tragically on January 28, 1986 when the Challenger space shuttle exploded and crashed into the ocean, taking the lives of six other astronauts. After his death, Congress approved funding for the Ronald E. McNair Post-baccalaureate Achievement Program, which is dedicated to the support and promotion of the high standard achievement exemplified by McNair. The University of Wyoming McNair Scholars Program is dedicated to preserving his legacy of scholarship and accomplishments.
Kristi Bear

**Faculty Mentor:** Jay Norton, PhD, Ecosystem Science & Management  
**Graduate Student Mentor:** Rajan Ghimere

**Research Topic:** Perspectives On and Effects of Conservation Agriculture in Uganda on Soil Fertility

**Problem Statement**

This study looks at the feasibility of designing and engineering a prototype Net-Zero Energy Home (NZEH) in Laramie, Wyoming using the International Energy Conservation Code 2012 (IECC 2012) standards as a starting point.

**Introduction**

The U.S. department of Energy Building Technologies Program defines a NZEH as a home that produces as much energy as it uses over the duration of a year.

Laramie, Wyoming was chosen as the location to investigate because the research is taking place in Laramie. Laramie has a few unique characteristics that make it an interesting place to engineer a net zero energy home (NZEH). In cold climates, such as Laramie, the major energy use is the heating loads. Laramie has 8406 heating degree days and only 77 cooling degree days. A heating degree day is computed by taking the difference between the base temperature of 65 degrees and the average daily temperature.4\&5 The influence of this on the design is that the cooling needs become negligible, therefore, all efforts can be devoted to decreasing the heating loads. Laramie is unique here because in most locations there is a greater need for cooling, where the design concentrates more on decreasing cooling loads. Since only the heating loads needs to be decreased the design can take advantage of solar heat gains. Solar heat gains are the heat energy that is transferred through windows from sun. These heat gains add heat to the inside of a home.

The traditional engineering process for a NZEH is to focus on passive design techniques that include high levels of roof, wall, and slab insulation, as well as, highly efficient windows. This is followed by a careful design of heating and cooling systems that minimize heat loss. Finally, onsite energy production, such as solar photovoltaic and solar thermal panels are used to run the home.
The IECC 2012 standards are often used when engineering a low energy home. IECC 2012 is a set of codes address energy efficiency by looking at cost savings, reduced energy usage, conservation of natural resources, and the impact of energy use on the environment. In the IECC 2012 there are suggestions of how to decrease energy loads. High levels of insulation and efficient windows are used to decrease the heat load of the house. Once the heating loads are decreased, the design of efficient heating systems decrease the total energy use. One example of a highly efficient heating and cooling system is a ground source heat pump (GSHP). A ground source heat pump takes advantage of the difference in temperature between the air and the earth’s crust. The ground is warmer than the air in the winter, and cooler than the air in the summer. To harness this difference, heat is pumped into the home in the winter, and out of the home in the summer. The ground source heat pump uses the renewable energy collected by the PV panels.

After heating loads are decreased, solar photovoltaic panels are used to power the heat
pumps, along with all other electricity needs of the home. In addition to PV panels, solar thermal panels are mounted on the roof which collect heat to warm the hot water needed for faucets and showers. The heated water is stored in a domestic hot water heater.

This electricity is used to run everything from heating systems to wall plug ins. The excess electricity is pumped into the grid.

**Methodology**

**Floor Plan**

The primary goal for the floor plan is to decrease the heating loads. This was achieved by decreasing the volume, increasing the south wall to window ratio, and using a simple shape. The decrease in volume was achieved by decreasing the square footage of the home, which allows for less space to be heated. To decrease the square footage the rooms are designed to be closer together than you would typically find, which minimizes hallways and circulation areas. The south wall to window ratio is increased to take advantage of the solar heat gains. In the Northern Hemisphere, the sun hits the building primarily on the south facade. By increasing the percentage of windows on this wall, more solar heat comes in and decreases the heat load. A simple shape, here a rectangle, is used to decrease air leakage at corner. A secondary design goal is to make a home that is aesthetically desirable. One method to achieve this goal was to create a double-height space with high ceilings for the living room.

**Simulations**

DesignBuilder (DB) Energy Simulation Software was used to predict the homes annual heating and cooling loads. Prior to running simulations, the first step was to recreate the floor plan with the appropriate construction material.
defaults. For this study, the base defaults were those outlined by IECC 2012:

<table>
<thead>
<tr>
<th>Construction Material</th>
<th>Insulation Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Window R-Value</td>
<td>3.125</td>
</tr>
<tr>
<td>Wall R-Value</td>
<td>20</td>
</tr>
<tr>
<td>Slab R-Value</td>
<td>30</td>
</tr>
<tr>
<td>Roof R-Value</td>
<td>60</td>
</tr>
</tbody>
</table>

After the construction materials are set, each room has to be designated as a certain zone type. These zone types include bedroom, bathroom, kitchen, etc. Each zone type has its own internal gain values, thermostat settings, and schedule. The internal gains take into account the heat put off by people and appliances in the space. The schedule identifies when the room is primarily in use. Some rooms are used during the day, such as the kitchen, while others are used at night, such as the bedrooms.

After the floor plan, materials, and zone types are set, the final step before running simulations is to assign the building materials for each construction type. The four variables tested in this study are wall R-value, window R-value, window solar transmission, and south wall to window ratio. The R-value is the value that identifies how well the material is at insulating. The solar transmission is the amount of solar radiation that passes through the window and into the home.

The south wall to window ratio is the percentage of the south wall that is composed of glazing.

For each material created for the different variables, all constraints are the same, except for the one property that is being analyzed. The wall R-values investigated were 10 through 60 with an interval of ten. The window R-values were 2.5 through 10 with intervals of .5. The solar transmission values were 30% to 70% with intervals of 10%. Finally, the south wall to window ratio values are 10% to 70% with intervals of 10%.
methodology produced a total of 35 simulations: one simulation for the default values, followed by a simulation for each modified variable.

Results

The first variable changed in the simulations was the wall R-value. Our results show a nonlinear decrease in total heat load as the wall R-value is increased.

The second variable we changed in simulations was (etc) the window R-value. The results show a linear decrease in total heat load as the window R-value is increased.

The third variable to change in simulations is the window solar transmission. The results show a linear decrease in total heat load as the window solar transmission is increased.

The final variable to change in simulations is the south wall to window ratio. The results show a nonlinear decrease in total heat load as the wall to window ratio is increased.
**Conclusion**

Based off of our simulation data, we can conclude that it is easily feasible to design and engineer a Net-Zero Energy Home in Laramie, Wyoming. The heat load values are small enough that all of the energy required to heat and run the home could be generated through a modest amount of solar thermal and solar photovoltaic panels.

**Further Research**

The next question to investigate is the economic feasibility of a NZEH in Laramie, Wyoming, with a cost comparison to a standard home. I predict that there will be a point where the cost of high performance materials outweighs the savings on energy, but through additional PV energy collection the design could remain economically feasible.

**References**


Proper spindle assembly is critical for normal cell division. The formation of a bipolar spindle of the right shape and size involves a number of proteins. The exact mechanism underlying the function of many of these proteins has not been fully elucidated. This study investigates the interactions between the motor protein dynein and the eight-subunit protein complex augmin, both of which have been shown to play an important role in spindle assembly.

The normal mitotic spindle is a bipolar structure consisting of sets of duplicated chromosomes surrounded by an array of antiparallel microtubules. The minus ends of the microtubules cluster around two poles, giving the spindle its characteristic fusiform morphology (1). The two poles consist of centrosomes in mammalian cells, but other studies have indicated that poles form even in the absence of these structures (7). Proper segregation and distribution of chromosomes into two daughter cells, and hence proper cell division, relies upon the accurate formation of this structure, specifically one with exactly two poles.

Formation of the microtubule array requires that the cell first generates these polymers from tubulin subunits. Generation of microtubules, commonly referred to as microtubule nucleation, occurs by chromosome-mediated and chromosome independent pathways. One nucleation pathway occurs via an 8-subunit protein complex, augmin. In this process, microtubules are formed by branching from previously formed microtubules (2, 6). Augmin also plays a role in localizing proteins involved in nucleation, such as components of the gamma-tubulin ring complex, to the centrosome (4, 7).

Achievement of the proper, bipolar shape is also aided by the motor protein dynein. Dynein associates with a complex of other proteins to regulate spindle length and prevent the spindle poles from separating (5). Dynein is also involved in focusing the microtubule ends into spindle poles.

Previous studies have demonstrated that malformed spindles have deleterious effects. In particular, multipolar cell divisions, which involve spindles with more than two poles, typically result in aneuploidy leading to cell death or inviability. However, some cells have the ability to resolve this multipolarity by clustering the poles into two sets (9, 10), which allows the cell
to perform a pseudo-bipolar division. Progeny of these divisions are sometimes able to survive, and they exhibit increased reproductive capacity, metastatic ability, and other hallmarks of cancer (3, 8).

Results and Discussion

Augmin antibody does not recognize Dgt4 subunit

Our preliminary results indicated that antibodies to Augmin’s Dgt4 subunit recognized a band of the expected molecular weight. To verify this result, we performed a control experiment in which the co-immunoprecipitation was performed in the absence of dynein antibody. In Western blots, the appearance of the same bands in the control lane prompted us to modify the co-immunoprecipitation protocol so as to minimize recognition of non-target proteins. Repeating the Western blot in the absence of a primary augmin antibody yielded the same banding pattern, indicating that the bands resulted from nonspecific binding of the secondary antibody. This suggested the need for an alternative augmin antibody.

Currently, the absence of a functional augmin antibody precludes further progress in our investigation. However, once we obtain this antibody, we will repeat the co-immunoprecipitation and Western Blot procedures as described in Methods and Materials. We will subsequently perform the reciprocal procedure, with augmin antibody used for co-immunoprecipitation and dynein antibody used for the Western Blot. We also plan to investigate co-localization of augmin and dynein in the spindle via fluorescent microscopy.

Methods and Materials

Aliquots of Xenopus laevis egg extract were prepared and frozen for subsequent use. Dynabeads Protein A (Life Technologies) were resuspended in CSF-XB and rinsed three times. The final CSF-XB wash was removed, and the beads were resuspended in buffer containing anti-dynein heavy chain antibody and left on a rotator overnight at 4°C. For the control experiment, anti-dynein heavy chain antibody was substituted with pre-immune rabbit serum. The following day, the sample was resuspended and washed twice with CSF-XB. The supernatant was removed, and extract was added to the test tube. The sample was left on a rotator for at least one hour to allow antigen binding. The immunodepleted extract was pulled off and saved. The beads presumably containing dynein and dynein-associated proteins were washed five times in 0.5X CSF-XB, then immersed in Laemli samplebuffer. The solution was then divided evenly into two aliquots. The first aliquot was left at room temperature for 30 minutes, while the second aliquot was boiled for five minutes. The supernatants were saved for experiments.

Samples from the co-immunoprecipitation were then run through acrylamide gel using standard SDS-PAGE protocol. The gel was divided into two, with each half containing identical
Figure 1: Co-immunoprecipitation protein bands. (A) Coomassie stained gel. Lanes 1 through 3: Molecular weight ladder, Co-IP using anti-dynein heavy chain, Co-IP using pre-immune rabbit serum. (B) Western Blot from generated alongside A. Lanes are in reversed order. (C) Stained Western Blot membrane following protocol adjustments. (D) Chemiluminescent and Brightfield image overlay from C.
Figure 2: Secondary antibody banding patterns. Left – Western blot performed with anti-augmin as primary antibody. Right – Western blot performed with no primary antibody. Note the bands around 55 kDa, which were previously interpreted as Dgt4, appear even in the absence of augmin antibody.

sample lanes. The first gel was visualized via Coomassie staining and Brightfield imaging. The second gel bands were transferred to a nitrocellulose membrane. Standard Western Blot protocol was followed, with anti-augmin antibody used for the primary antibody. A Brightfield and chemiluminescent image of the membrane were obtained and digitally overlayed.

References


Adam Grasmick

Faculty Mentor: Gregory Brown, PhD, Botany
Graduate Student Mentor: Mark Brown

Research Topic: Comparative Study of Leaf Anatomy and Morphology of *Tillandsia Complanata*; Sun vs Shade Plasticity

Abstract

The goals of this research are to describe morphological characters in the sun and shade leaves of *Tillandsia complanata*; also to describe the plasticity in these ecologically important epiphytic monocots. The major significance of this study is to identify future characteristics for taxonomic description for identifying the species *Tillandsia complanata*. These plants are considered to be hot spots of biodiversity whereas they provide a habitat for over 6000 species of vertebrates and invertebrates. One of my research goals is to describe the morphological characteristics of sun and shade leaves in *Tillandsia complanata*, a widespread epiphytic species from the family Bromeliaceae. Very little is known about leaf structure differences in bromeliads in relation to light exposure, and my work will be some of the first. Bromeliads are ecologically important epiphytic and terrestrial monocots in the New World tropics and subtropics.

Introduction

*Tillandsia* is a genus of around 630 species (M. B. Bianchi et al. 2013) and one of the genera in the subfamily Tillandsioideae. They are perennial flowering plants in the family Bromeliaceae which is a monophyletic group determined by phylogenetic testing (Almeida et al. 2009) But other studies speculate the genus to be around 610 species with exception of a few hybrids and to be the largest and most widespread within Bromeliaceae. (Versieux et al. 2013) They are native to the forested mountains, deserts, wet and cloud forests of the new world. Bromeliads are considered to be hot spots of biodiversity whereas they provide a habitat for over 6000 species of vertebrates and invertebrates. They achieve this by forming a dense rosette of overlapping leaves that acts as a tank and captures a significant amount of rain water and humus; which provide key food sources for primates, frogs, birds and insects. (Givnish et al. 2011). Around 50% of Tillandsia species are epiphytic and considered to be morphologically unique, stress tolerant and ecologically varied. (Benzing, D.H 2011 ). This study focuses on one species
*Tillandsia complanata*, with respects to its capability and tolerance to show more or less plastic leaf morphology associated with sun and shade habitat during maturity. This comparative study of *Tillandsia C.* investigated the species morphological changes within leaves and provides baseline data for comparison to show differences in leaves that matured in full sun or shade environments. The null hypothesis is there is no difference morphologically within sun and shade leaves. This was chosen because it is the first time that anyone has looked at characters regarding morphogenesis in leaves associated with sun and shade environments in *Tillandsia C.* All of the samples collected for this study were taken from specimens that have a dense rosette and varied in size and color from a cloud forest in the Napo Province, Ecuador.

**Methods:**

Leaf samples were collected in the field from a cloud forest in the Napo Province Ecuador. All samples were collected in the same hectare, 100m from each other at an elevation of 2250m.

There were eight leaf samples brought back from Ecuador consisting of full sun, semi-shade and full shade selections. Mature, healthy, mid-rosette leaves were removed from the plant and preserved in 70% ethanol in the field. Notes were made of plant habitat and some measurements were made in the field. Samples were used to make free hand cross sections using
a razor blade. Staining protocols consisted of three different dyes, saffranin, toluidine blue and alcian blue, and one section is left unstained for comparison. Three different dyes were used to outline the abaxial, axial and structural surfaces for measuring.

Dying time was 30 seconds, post staining rinse in 70% ethanol for an additional 15 seconds for de-staining. Originally propylene glycol was used for mounting but due to poor drying, paramount and eukitt were later preferred for mounting. Post mounting the leaf thickness was measured along the width of the cross section in increments of half a millimeter and recorded. Leaf cross sections recorded using an Olympus BH2 compound microscope at a magnification of 10x with a ocular ruler on a scale of 100 ocular units equaling 1mm. Data were subjected to basic, routine statistical analyses. Voucher specimens are deposited at the Rocky Mountain Herbarium, University of Wyoming.

Results

We obtained data from the cross-sectioning which resulted in the data shown in following tables and figures. Table 1 shows the leaf samples that were collected in full sun labeled 4108 to 4111. The measurements had a minimum leaf thickness ranging from 0.05 to 0.13 and the maximum had a range of 0.4 to 0.56, averages ranged from 0.33 to 0.42. The semi-shade and shade leaf samples are labeled 4112 to 4114 and had a minimum leaf thickness of 0.04 to 0.14 and a maximum range of 0.42 to 0.5, averages ranged from 035 to 0.42. The only full shade leaf sample is labeled 4115 and has a minimum range of 0.18 and a maximum of 0.49, the average was 0.41. n= the number of measurements that were taken for each leaf sample depending on leaf size.

Table 1

<table>
<thead>
<tr>
<th>Min</th>
<th>0.05</th>
<th>0.06</th>
<th>0.13</th>
<th>0.11</th>
<th>0.1</th>
<th>0.14</th>
<th>0.04</th>
<th>0.18</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max</td>
<td>0.42</td>
<td>0.51</td>
<td>0.4</td>
<td>0.56</td>
<td>0.42</td>
<td>0.5</td>
<td>0.48</td>
<td>0.49</td>
</tr>
<tr>
<td>Median</td>
<td>0.38</td>
<td>0.46</td>
<td>0.35</td>
<td>0.45</td>
<td>0.37</td>
<td>0.44</td>
<td>0.4</td>
<td>0.425</td>
</tr>
<tr>
<td>Average</td>
<td>0.34</td>
<td>0.42</td>
<td>0.33</td>
<td>0.42</td>
<td>0.35</td>
<td>0.42</td>
<td>0.35</td>
<td>0.41</td>
</tr>
<tr>
<td>SD</td>
<td>0.09</td>
<td>0.11</td>
<td>0.05</td>
<td>0.12</td>
<td>0.07</td>
<td>0.08</td>
<td>0.12</td>
<td>0.06</td>
</tr>
<tr>
<td>n=</td>
<td>76</td>
<td>115</td>
<td>83</td>
<td>79</td>
<td>49</td>
<td>40</td>
<td>56</td>
<td>48</td>
</tr>
<tr>
<td>Sample</td>
<td>4108</td>
<td>4109</td>
<td>4110</td>
<td>4111</td>
<td>4112</td>
<td>4113</td>
<td>4114</td>
<td>4115</td>
</tr>
</tbody>
</table>
Data was collected and analyzed using two different T-tests. The first t-test analyzed a two-sample assuming unequal variances shown in figure 1. The one tail values were being 2.131847 with a P-value of 0.437667 and the two tail being 2.776445 and the P-value of 0.875333. The data compared used the values of sun and semi-shade from Table 1.

**Figure 1: t-Test: Two-Sample Assuming Unequal Variances**

<table>
<thead>
<tr>
<th></th>
<th>sun</th>
<th>semi shade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>0.0875</td>
<td>0.093333</td>
</tr>
<tr>
<td>Variance</td>
<td>0.001492</td>
<td>0.002533</td>
</tr>
<tr>
<td>Observations</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Hypothesized Mean Difference</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>df</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>t Stat</td>
<td>-0.16719</td>
<td></td>
</tr>
<tr>
<td>P(T&lt;=t) one-tail</td>
<td>0.437667</td>
<td></td>
</tr>
<tr>
<td>t Critical one-tail</td>
<td>2.131847</td>
<td></td>
</tr>
<tr>
<td>P(T&lt;=t) two-tail</td>
<td>0.875333</td>
<td></td>
</tr>
<tr>
<td>t Critical two-tail</td>
<td>2.776445</td>
<td></td>
</tr>
</tbody>
</table>

The second t-test is done the same way as above but the semi-shade and full shade leaves were grouped together and compared to the sun leave values for a total of eight samples. Shown in figure 2, the results for the one-tailed T-test were 1.94318 with a P-value of 0.458469, the two-tailed being 2.446912 and a P-value of 0.916938.

**Figure 2: t-Test: Two-Sample Assuming Unequal Variances**

<table>
<thead>
<tr>
<th></th>
<th>sun</th>
<th>semi/shade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>0.37648</td>
<td>0.37978</td>
</tr>
<tr>
<td>Variance</td>
<td>0.002291</td>
<td>0.001391</td>
</tr>
<tr>
<td>Observations</td>
<td>4</td>
<td>4</td>
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<tr>
<td>Hypothesized Mean Difference</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>df</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>t Stat</td>
<td>-0.10876</td>
<td></td>
</tr>
<tr>
<td>P(T&lt;=t) one-tail</td>
<td>0.458469</td>
<td></td>
</tr>
<tr>
<td>t Critical one-tail</td>
<td>1.94318</td>
<td></td>
</tr>
<tr>
<td>P(T&lt;=t) two-tail</td>
<td>0.916938</td>
<td></td>
</tr>
<tr>
<td>t Critical two-tail</td>
<td>2.446912</td>
<td></td>
</tr>
</tbody>
</table>

The third and final t-test conducted was a t-Test Paired Two Sample for Means shown in figure 3. This was done with four sun leaves and the four grouped shade leaves. And the results were 0.322739 with a P-value of 0.322739, the two-tailed being 3.182446 with a P-value of 0.645478.
The results from leaf thickness measurements in this study analyzed using standard descriptive statistics were consistent with the null hypothesis. In conclusion all three test results were above the set P-value limit for my field and this experiment of 0.05. My data supports the null hypothesis in that, there is no statistically significant morphological difference between leaves that matured in full sun, semi-shade and shade habitats.

Discussion

Dicots such as the classic example of oak trees leaves shown below and Arabidopsis leaf development of longitudinal vascular patterns have shown morphogenesis early in the leaf development that alters the leaf structure, physiology and shape. (Dengler et al. 2001)

This process of plasticity in dicot leaves during maturation in different light environments led to the design of this experiment and raised the question if epiphytic monocots like *Tillandsia C.* show similar effects. Some future research and directions would be to look at the anatomical characters and their function, mediation or contribution in respects to morphology in the leaves of *Tillandsia C.* Anatomical analyses in monocots have shown mutual importance for morphological characters for leaf structure and how it can be beneficial in identifying future characteristics for taxonomic description (Monteiro et al.2011) in the genus *Tillandsia.*
Work Cited


The 1910s were a pivotal time for race relations in the United States. The Republican Party had alienated African Americans and many staked their hopes for the advancement of civil rights on the Democratic candidate Woodrow Wilson in the 1912 election. Those hopes were challenged however when President Wilson approved the segregation of the United States Postal Service (Wolgemuth, 1959). Then, when war broke out in Europe in 1914, it became clear to many that the United States would eventually join.

The War presented a dilemma for the African American community. Many in the community felt the need to serve their country. However, the United States Army was a segregated organization and, whereas this practice had affected approximately 4,000 people prior to the Great War, it would be the largest troop draw up since the Civil War affect more than 300,000 Black citizens during WWI (Winsboro, 2007). Many African Americans felt that they were losing ground in the struggle for civil rights and they were beginning to turn to more radical civil rights organizations for representation. Among these organizations was the National Association for the Advancement of Colored People (NAACP). It was during World War I that the NAACP would rise to prominence and test its strength in the battle between the Wilson Administration and the Black community over what role African Americans should play in the war effort.

Although much has been written about World War I, much less has been written about the African American community and Black soldiers during the time period. This paper will fill the gap in the literature by tracing the debate over the roles of Black soldiers during The War and addressing the outcome of that debate.

**The Great Migration Precipitates Racial Tensions**

The war in Europe had been raging since 1914 and, though the United States remained neutral until 1917, American manufacturing centers were booming as Northern industrialists
produced wartime goods for European countries. There was plenty of work to be had and there were severe shortages of labor. Many industries had relied on low-wage earning European immigrants as their primary labor force. However, many of these laborers returned to their countries at the onset of the war. Additionally, immigration from Europe slowed dramatically during WWI. In 1914, 1.2 million people immigrated to the US but by 1915, that number dropped to just 326,000 immigrants (Mjagkij, 2011).

To combat labor shortages, industries began to recruit African Americans. Many Northern industries had been inaccessible to Black laborers before the war except for when strikebreakers were needed. However, the labor shortage was so severe that many companies began to use White labor agents to recruit Black laborers from Southern states (Barbeau, 1974, Trotter, 2001). These agents provided information on cities and industries and often offered labor contracts and train fare to facilitate the transition North. Their recruitment methods were so successful that many Southern states began to fear losing the Black Southern workforce and began to pass legislation designed to stop recruitment activities. Alabama and Virginia each instituted a $500 licensing fee for labor recruiters and South Carolina charged recruiters with a misdemeanor for soliciting labor (Barbeau, 1974). These efforts failed to stem the flow of labor northward however, and the Black populations of Chicago, New York, and Philadelphia more than doubled between the 1910 and 1920 census.

Many Black Southerners had viewed the North as a sort of Promised Land. Wages in the North far outstripped the earning potential in the South and discrimination was illegal in public schools and accommodations. Few states had the means or will to enforce these laws however, and abuses became more common as migrants continued to flood the Northern cities (Painter, 2007). The housing situation became critical in some cities as unscrupulous realtors steered Black tenants away from White neighborhoods and into ghettos. Greedy landlords took advantage of many recent migrants by charging outrageous rent for substandard housing. Overcrowding became the norm for these communities as people took on boarders to make rent. Overcrowding in turn contributed to the spread of contagious diseases and the uptick in crime rates as people looked for recreational opportunities outside of their cramped living spaces (Painter, 2007).

This highly visible Black presence in cities began to create tensions as White residents feared that the presence of so many uneducated, rural Black men would mean fewer jobs, lower property values, and rising crime rates. White residents began to fear their very way of life was threatened and when The Birth of a Nation was released in 1915, it found appreciative audiences in many Northern states as well as the South. These tensions would soon escalate into violence and 1917 would see the bloodiest summer of the 20th century.
**Racial Violence in the Summer of 1917**

Racial violence was not a new phenomenon in the United States, but the summer of 1917 would see two major incidents that were unique for their scope. The East St. Louis massacre left Black communities across the nation anxious as they wondered whether or not similar mass violence could be reenacted in their own cities. The Huston Mutiny on the other hand terrified White communities and convinced many that Black men should not be trained for combat. These two incidents, when taken together, reflect the central fears that were prevalent in the debate over how to use Black soldiers during World War I.

**East St. Louis Massacre**

The East St. Louis massacre began on May 28, 1917 and lasted through the month of June. The massacre grew out of direct tensions between White and Black laborers in the city. Unionized white laborers organized several strikes against Aluminum Ore Company and the American Steel Company. Both companies employed scabs and, although the strikebreakers were Black and White, Black laborers became the focus of the community’s rage (Asher, 1972). On May 28th a mob of White men took matters into their own hands and proceeded to roam the city beating any Black person they could find. Local authorities were either incapable of or unwilling to stop the mob and the governor of Illinois, Frank O. Lowden was forced to call in the National Guard to stop the violence.

Tensions remained high however, and on July 2, unidentified White men drove through the city shooting randomly at Black people and businesses. An hour later, another car appeared and Black residents, mistaking this car for the previous one, shot and killed the two men in the car. The men turned out to be police officers. The car was put on display downtown and an angry mob of White people formed and went looking for Black people to kill (Asher, 1972). Members of the mob shot, burned, beat, and lynched men, women, and children as they tried to escape or defend themselves. They burned blocks of businesses and homes and, when Black owned buildings sat between White owned ones, the mob demolished them with hammers and pickaxes. Although the National Guard was called back into the city, the violence and the fires persisted until well after dark. When the smoke cleared, thirty-nine African Americans were killed and an unknown number injured, 312 buildings that had been owned by Blacks were destroyed, and the estimated dollar amount of property damage was placed at roughly $1,400,000 (Asher, 1972, Jordan, 2001). This assault left Black communities across the country on edge and precipitated the Houston Mutiny in August.

**The Houston Mutiny**

On July 28, 1917 the segregated Third Battalion of the Twenty-Fourth Infantry arrived at Camp Logan outside of Huston. Their assignment was to guard the camp during its construction process. Many in the White community in Houston were nervous about the presence of
armed Black men. To ease the fears of the local White population, the white commanders of the all-Black battalion ordered that only those on guard duty could remain armed (Williams, 2010). Trouble erupted on August 23rd when a African American soldier spending his free time in town tried to intervene on behalf of a Black woman who was being beat by a White police officer. The soldier was charged with interfering with the police, pistol whipped, and thrown in jail. When another Black soldier went to the jail to check on the state of his fellow soldier, he too was charged, beaten, and jailed (Jordan, 2001). The events of East St. Louis were still fresh in the minds of many of the Black soldiers and rumors began to circulate about the formation of a White mob and about the deaths of the two jailed men. Angry and anxious, approximately 100 soldiers armed themselves and headed for town. Although there are differing accounts as to whether Black soldiers or White townspeople fired first, the end result was that 16 Houstonians were left dead (Jordan, 2001).

In the largest court-martial in US history, 118 men from the Twenty Fourth Infantry were tried. Thirteen soldiers were sentenced to death, seven were acquitted, forty men received life in prison, and the rest were convicted of various other crimes (Barbeau, 1974). To many Whites, the Houston Mutiny was the logical outcome of arming Black men. And, in response The War Department quietly implemented Plan 6. Plan 6 was one of the options in the War Department for dealing with Black soldiers. It mandated minimal training and the relegation of Black soldiers to labor divisions. The plan would not be implemented until August of 1917 however and, long before that, the African American Community would have to decide if it would even support the war in light of the unique problem it presented for African Americans.

Like the rest of America, the Black community was divided over whether or not to go to war. However, special questions presented themselves. Should Black Americans fight Wilson’s war for Democracy when they continued to be treated as second class citizens in their own country? What was the point of bringing democracy to Europe when so many Americans were refused the right to exercise it at home? As an editorial in the Chicago Defender explained it, “Somehow it doesn’t seem quite consistent to wash someone else’s clothes and leave your own soiled” (Jordan, 2001:45). But many people saw this as a chance to expand civil rights in the United States. They felt that, if African Americans committed themselves to the war effort, the government would have no choice but to honor that pledge of democracy at home. However, these questions became secondary when, less than a month after the declaration of war, the draft was instituted. The question of whether or not to support the war became a moot one and Black leaders instead focused their energies on negotiating the terms under which African Americans would serve.
**Raising a Segregated Army**

Initially, the Wilson Administration relied on volunteers to fill the ranks of the US Army. African American volunteers quickly filled the administrations quota of 4,000 Black soldiers for the ranks of the Army’s four standing segregated regiments and further Black volunteers were turned away. Once at full strength, the regiments were sent on patrol in the American Southwest, Hawaii, the Philippines, and the Mexico (Ferrell, 2011). Many people in the African American community began to worry that Wilson’s administration did not intend to use Black men in combat roles in Europe.

However, the response in the White community for the call to military service was smaller than the War Department had hoped and, in May 1917, the draft was instituted requiring all male citizens between the age of 21 and 31 to register regardless of race. Southerners especially were fearful of the idea of training Black men for combat. Senator Vardaman of Mississippi voiced the concerns of many of his fellow Southerners when he said, “Universal military service means that millions of Negros who come under this legislation will be armed. I know of no greater menace to the South than this” (Barbeau, 1974:35). The draft was implemented despite the Southern Democrats’ attempts to defeat it and a new fear began to take hold in the South. If draft boards refused to admit Black men, more White men would be conscripted, leaving their wives and children “unprotected” at home (Mennell, 1999). These opposing fears would manifest themselves in often contradictory ways in Southern treatment of draftees.

Discrimination was prevalent throughout the draft process. Draft boards divided registered men into two classes. The first, Class I, was a list of men who could be drafted immediately. Everyone else was deferred. Over the course of the war, 19.12 percent more Blacks were placed into Class I than Whites and, though Blacks only made up 10.19 percent of registrants during the war, they would make up 12.6 percent of the draftees (Barbeau, 1974). Additionally, of the 475,000 men listed as delinquents or deserters for failing to report for induction or register for the draft, 22 percent were Black (Barbeau, 1974). This is a disproportionately high number given that the population of African Americans during the First World War was about 10 percent. Although this number was taken by many at the time to imply that Black men were unresponsive to the War efforts, military authorities dismissed the majority of the cases as unintentional. Many of the accused men were illiterate or had changed residence. Moreover, many Black men in the South were victims of a scheme in which their landlords withheld their draft notices in an effort to collect the $50 reward issued by the government for reporting draft dodgers (Mjagkij, 2011).

Additionally, many landlords withheld draft notices simply to retain Black draftees as agricultural laborers. Agricultural labor shortages had been a real problem in the South as African Americans flooded North. The draft further threatened the dwindling supply labor
and many Southern draft boards were more likely to exempt sharecroppers from service while disproportionately drafting Black land holders.

Despite the Southern fears of armed Black men, too many Black men, and not enough Black men, the draft proved effective and the next question for the War Department was where to train the African American draftees. Representatives from Southern states, including South Carolina Governor Richard Manning and Senator John Sharp Williams of Tennessee, vehemently objected to the training of Black troops within their state borders (Williams, 2010). The recent mutiny in Houston was evidence to many that Black troops could not be trusted with firearms. In an effort to assuage the fears of these representatives, the War Department, headed by Secretary of War Newton D. Baker, mandated what it called a “safe ratio” of White troops to Black troops in all of the training camps. White troops were meant to outnumber Black Troops 2:1 (Barbeau, 1974:39). This arbitrary ratio could only be accomplished by sending individual regiments from a single division to multiple camps. Troops from the 92nd Colored Division were actually sent to seven separate training camps. The regiments never trained together or even assembled as a complete division until the close of the war as they were preparing to return to the United States (Williams, 2010).

Moreover, training camps were segregated even though the original design of the camps did not include separate facilities. This lead to inferior facilities for Black troops and many had to sleep outdoors, often in floorless tents (Williams, 2010). Sanitation was an issue in the Black section of many training camps as running water for latrines and bathing was scarce. Men were often issued inadequate clothing for winter weather, made to work seven days a week, and refused time off for sickness (Barbeau, 1974). In the face of these atrocious conditions, African American men still managed to complete their training.

But what was the War Department training these men for? Many top military personnel were genuinely prejudiced and believed that Blacks had “inherent character weakness, were cowards, and increasingly showed a tendency toward moral worthlessness” (Barbeau, 1974:42). As such, military officials recommended that African American troops be relegated to labor divisions for the duration of the war. Though there were six different plans as to how to use Black troops, only one was endorsed by Chief of Staff Tasker Bliss. Labeled Plan 6, it called for delaying the Black draft, providing minimal training, and then deploying the Black troops to France where they were to be used as laborers. This plan was adopted by the War Department in response to the Houston Mutiny and kept quiet (Barbeau, 1974). However, rumors abounded and Black leaders across the country began to voice their suspicions.

Civil Rights Groups Versus the War Department

The National Association for the Advancement of Colored People was arguably the most influential civil rights organization of World War I. Headed, at the time, by Joel Spingarn
and bolstered by iconic scholar W.E.B Du Bois as the association’s director of publicity and research and the editor of The Crisis magazine, the NAACP was considered something of a radical organization. The NAACP’s position, voiced by Du Bois was that persistent agitation, political action, and academic education were the means by which civil rights would be won. The organization established offices in Black communities and reached out to newspaper editors and colleges. It was, primarily, through their regional offices that the NAACP was able to launch letter writing campaigns and get petitions signed. It was During WWI that the organizations influenced surged. In 1917 the NAACP boasted 9,000 members but, by 1919, that number had swollen to more than 90,000 members (103rd NAACP Annual Conference, 2011).

Though not every faction in the Black community would agree with the views advocated by Du Bois in The Crisis, the NAACP’s strength lay in the fact that it was able to reach out to opposing voices within the Black community. Many of whom were former supporters of the recently deceased Booker T. Washington and had become disillusioned with that leader’s refusal to demand civil rights. By contrast, the NAACP was a progressive, integrationist organization that actively advocated for civil rights. However, at the onset of the war, the organization would be faced with what Du Bois termed a “damnable dilemma” (Du Bois, Close Ranks, 1918)

At the start of hostilities in Europe, the NAACP had assumed that if the United States entered the war, the US Army would continue its segregationist policy. In response, on April 9, 1917, the organization announced a resolution reaffirming its commitment to fight discrimination in the military (Mjagkij, 2011). However, it was not long before the organization would have to back pedal on their stance.

Joel Spingarn had been pushing for military integration as far back as 1915 when he had tried to convince General Leonard Wood to admit Black cadets to his volunteer training camp in New York. The answer General’s simple answer was no. Then, in 1916 the National Defense Act barred African American men from enrolling in the fourteen established officer training camps. Spingarn reasoned that a segregated officer training camp was better than fighting the impending war with Black men barred from officer positions. Spingarn believed the creation of separate Black officers training camp to be the lesser of two evils and approached General Wood with another proposal. He asked the General if he if he would be willing to open a Black officers training camp. General Wood acquiesced on the condition that Spingarn could produce 200 signatures of Black, college educated men willing to undergo officer training (Mjagkij, 2011).

It was then that Spingarn penned an open letter urging college educated Black men to sign up to sign up for a segregated training camp for officers. NAACP leaders were shocked by his plan and initially they felt that he was betraying the organizations’ pledge to fight discrimination. Initially, he was berated by the press and was forced to step down as Chairman of the Board for the NAACP (Barbeau, 1974, Mjagkij, 2011, Jordan, 2001). He remained active
in the organization however and, though his plan was highly at first, it began to gain support in Black colleges. Additionally, the Committee of 100 Colored Citizens on the War began a write-in campaign to try and raise support for the training camp among politicians (Mjagkij, 2011).

To further sway the War Department and Secretary of War Newton D. Baker, the Central Committee of Negro College Men produced a list of 1,500 college educated volunteers for the camp (Mjagkij, 2011). The unprecedented support for the camp among colleges began to attract the attention of the board of the NAACP. Many remained ambivalent about supporting the camp. However, once Du Bois voiced his support for the camp in the April 1917 issue of the Crisis, many of the board members came to back Spingarn’s plan, too. Du Bois said “We must choose then between the insult of a separate camp and the irreparable injury of strengthening the present custom of putting no black men in positions of authority” (1917:271). A vote was taken on May 14th, and the board of directors for the NAACP affirmed support for a black officers’ training camp.

The popular support for the camp had begun to sway Secretary Baker and on May 12, he sent an unofficial letter to the president of Howard University stating his intention to open a Black officers training camp. While this was welcome news, no official public announcement was made. In response, the NAACP called a conference at Howard University for May 17th through the 19th. Approximately 700 African American community leaders and allies from newspapers, churches, schools, and business were in attendance (Jordan, 2001). Though many were still unsure about a advocating for a segregated training camp, the prospect of fighting the war without Black officers was a bleak one. The conference members were swayed and pledged to support the war effort but demanded combat roles and officer training for Black troops (Mjagkij, 2011).

The conference was a triumph for the NAACP. The organization persuaded many in the Black community to adopt its stance on one of the most important issues facing African Americans of the time. Furthermore, by bringing so many people together, the Group positioned itself as a liaison between the government and the Black community. Most importantly however, their efforts were officially rewarded on the last day of the conference when the War Department formally announced plans for the creation of a Black officers training camp.

**Fort Des Moines Officer Training Camp**

Fort Des Moines was chosen by the War Department as a suitable site for the Black officer training camp because of it provided ample room for military exercises, was easily accessible by rail, and was located in a state with a good record of race relations. And so, on June 15, 1917, 1,250 African American officer candidates began their training in Iowa. The program was to last three months and was supervised by Colonel Charles C. Ballou (Barbeau, 1974). He was a White officer who had formerly been second in command of the Black 24th
Infantry. Colonel Ballou was a staunch segregationist who publicly praised his men but, in his reports to the War Department insisted that African Americans “lacked the mental and moral capacity to lead black soldiers” (Mjagkij, 2011:60). Despite his official concerns, training continued at the camp. It lasted from 5:30am to 10:45pm and consisted of exercise, class work, and infantry drills- often without weapons. Additionally, only infantry instruction was given despite that fact that graduating officers would be expected to handle artillery.

The age range for those admitted to the camp was 24 to 40 years old and the requirement that trainees have a college degree was dropped. By not allowing college age men to apply to the camp, many recent graduates were excluded. Many of the older trainees had not been able to take advantage of the superior schools that the Northward migration had offered. The lowered educational standard and the exclusionary age requirement ensured a wide aptitude range for the graduating officers. The reservations that many military officials had expressed about the fitness of Black officers became a self-fulfilling prophecy. The selection process excluded many of the best and brightest young men from officer training, and then adequate training was denied those who were admitted.

Despite all of these difficulties, on October 15th, 639 commissions were granted to the graduating class. Then, in September, 104 physicians and 12 dentists received their commissions (Dalessandro, 2009). The graduations had been delayed a month because of the violence of the Houston Mutiny. The Mutiny had convinced Secretary Baker to implement Plan 6 which delayed the Black draft and called for African Americans to be put into labor rather than combat divisions. The plan had been kept quiet, but persistent rumors of it and the lack of combat training being given to Black troops. In December, Du Bois and other Black leaders confronted Secretary Baker with the rumors and he was forced to reiterate his pledge to use Black troops as combat soldiers and officers (Barbeau, 1974). The role of Black troops would be tentative throughout the war however, and the men of the 92nd and 93rd divisions would be at the center of the debate.

The 92nd Division

The 92nd Division was plagued with difficulties from the start. At the close of the Black officer training camp at Ft. Des Moines on November 13, 1917, General Ballou was placed in command of the division (Ferrell, 2011). Although he had been considered an adequate, if racist, commanding officer before, he lost the remaining respect his men had for him when he issued Bulletin No.35.

Bulletin 35 was issued when the 92nd Division was headquartered in Camp Funston in Kansas. The Division had been moved there specifically because of state laws prohibiting racism. However, these laws were not universally enforced and when Sargent L.E. Mathis attempted to buy a theater ticket at the Wareham Theater in Manhattan, KS, he was denied entrance for
being an African American (Mjagkij, 2011). Sargent Mathis was justly offended and lodged a complaint with General Ballou’s office.

The General’s response was to issue Bulletin No. 35 in which he described the ways in which the Black soldiers under his command were supposed to behave. He laid the blame of Sargent Mathis’ situation squarely at the Sargent’s feet when he wrote that Mathis was “guilty of the greater wrong in doing anything, no matter how legally correct, that will produce race animosity” (Mjagkij, 2011:184). The bulletin threatened “White men made the division, and they can break it just as easily if it becomes a trouble maker” (Mjagkij, 2011:184) The bulletin had the undesired effect of destroying the last of General Ballou’s credibility with his men and foreshadowed the treatment that Black troops under his command could expect to receive.

The majority of the Black officers trained at Ft. Des Moines were assigned to the 92nd and none were allowed to hold a rank higher than a captain. They worked under White Southern officers, many of whom were recent, inexperienced graduates themselves and were already predisposed to the notion that Black men should not hold officer commissions. The situation was exacerbated by the fact that none of the African American officers had received training in auxiliary arms. The Black officers often had to learn the information they were supposed to be teaching their troops the night before (Barbeau, 1974). As a result, training for the 92nd Division was never thorough and not completed until their arrival in France in June and July of 1918 (Williams, 2010).

Upon their arrival in France, the conditions were not any better for the Black Soldiers of the 92nd Division. They served as an attachment to the Second American Army under General Robert Lee Bullard and were sent to the front lines poorly equipped and poorly trained (Dalessandro, 2009). The Division lacked basics such as maps and flares and quickly racked up 1,647 casualties (Barbeau, 1974). General Bullard saw this performance as an indicator that African American servicemen were only fit for labor detail. Additionally, the White officers under Bullard’s command began to circulate rumors that the Black troops were rapists (Barbeau, 1974, Williams, 2010). Thoroughly demoralized and ill equipped, the 92nd Division continued to have a lackluster record throughout the war.

The 93rd Division (Provisional)

The 93rd Division (Provisional) was comprised largely of National Guard Units with a fourth unit of draftees. The men of the National Guard were all volunteers and many had previous military experience. The presence of experienced soldiers served to offset somewhat the substandard training that many of the men of the 93rd Division received. As with the 92nd, uniforms and guns were scarce. When the 15th New York National Guard reported to Camp Whitman in New York, they were expected to train almost 2,000 men with 250 rifles (Barbeau, 1974).
The stationing at Camp Whitman was short lived though, and eventually the regiment was ordered to Camp Wadsworth outside of Spartanburg, South Carolina. The mayor, the Chamber of Commerce, and both state senators objected vehemently to so many Black troops being stationed in South Carolina (Williams, 2010). The commander of the regiment, Colonel Hayward did his best to smooth relations between his regiment and the locals. He even arranged free concerts that were performed by the regimental band conducted by the famous James Reese Europe, and took extra security measures at night.

However, the regiment continued to be met with hostility. Black troops were forced off of sidewalks, thrown out of streetcars and, in one incident, drum major Sergeant Noble Sissle was physically assaulted by a local hotel manager (Williams, 2010). The Black and White soldiers that were with Sergeant Sissle attempted to retaliate against the hotel manager and had to be restrained by Lieutenant James Reese Europe. This incident started a boycott of segregated shops by Black and White soldiers who resented the town’s treatment of the regiment.

Fearing the tensions in Spartanburg would escalate, the regiment was moved to Camp Mills on Long Island. They had only been in Spartanburg for twelve days and they would not have to wait long for their orders to leave New York. In December 1917, the regiment was shipped to France. They were followed in short order by the 8th Illinois National guard (to be renamed the 370th Regiment) who would complete the 185th Brigade, and the 186th Brigade (Ferrell, 2011).

Upon their arrival in France on January 1, 1918, the soldiers of the 93rd Division were immediately assigned to labor detail. They felt betrayed by this breach of promise and moral plummeted. General John J. Pershing was commander of the American Expeditionary Force in Europe (AEF) and he was responsible for deciding what should be done with these men. General Pershing had previously been the commander of the all black 10th Calvary during the Spanish American War and had a reputation for dealing fairly with the troops under his command (Sutherland, 2004). However, there was still much resistance among his White officers to using Black troops in any positions other than as laborers. But the troops and the African American community had been promised that Black troops would be used in combat. General Pershing found a way around the dilemma when the French petitioned for more backup troops. He simply transferred the 93rd Division to French Command.

Though this assignment presented new problems for the soldiers, most did not speak the language and the French Army was organized differently and used different weapons, the soldiers of the 93rd Division returned with an unimpeachable war record. The 369th was the first Allied unit to make it to the Rhine. It was said they never lost a foot of ground and for their service and France awarded the division with 170 Croix de Guerre Medals for outstanding performance (Ferrell, 2011).
This treatment contrasted sharply with the treatment received from American commanders. Many were resentful of the French peoples’ treatment of African Americans and the AEF issued a communiqué to French commanders titled “Secret Information Concerning Black American Troops.” It contained guidelines for dealing with Black soldiers and suggested that French commanders were being entirely too nice to African Americans. It urged the French to refrain from “spoil[ing] the Negro” (LINARD, 1919) and insinuated that Black men were prone to rape. The Germans were well aware of the treatment Black soldiers received from American officers dropped leaflets promising more egalitarian treatment in Germany if only they would defect (Mjagkij, 2011). Not a single soldier ever did.

**Conclusion**

The debate over how to use African American troops in World War I seems like an inane one from a modern perspective. Americans of all stripes rally to serve the country in times of war and Black soldiers certainly have proved themselves willing to sacrifice in each of the United States’ wars. But at a time when racism permeated even the most basic institutions, the battle the African American community faced to put Black men into combat roles was an uphill one. Aided by the NAACP and newer, more radical civil rights organizations, the Black community was able to secure combat roles and officer training for African American men despite the obstacles laid in its way by racist politicians and the segregated traditions of the United States Military. African American soldiers returned from Europe as heroes in their communities and many fought for democracy for the Black community at home with the same determination that had helped them win democracy in Europe. However, complete desegregation of the military would take another 20 years. When in 1948 Harry Truman signed Executive Order 9981 desegregating the Armed Forces, it was in response to the calls of the new class of civil rights leaders who had been trained in the radical tactics employed during WWI.

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Appendix A: Chronology

1914
August 1         World War I starts in Europe
November 12      President Woodrow Wilson meets with William Monroe Trotter, editor of the
                 Boston Guardian for the first and last time

1915
February 8       Release of D.W Griffith’s The Birth of a Nation
June 21          Guinn v. U.S. declares grandfather clause unconstitutional
Summer           Boll weevils and flooding devastate cotton crop in the South
                 Migration begins
September 9      Carter G. Woodson launches Association for the Study of Negro Life
                 and History in Chicago
November 6       Oscar DePriest elected Chicago’s first black alderman
November 14      Booker T. Washington dies
November 25      Ku Klux Klan reestablished on Stone Mountain, Georgia

1916
Marcus Garvey arrives in the United States
May 15    Jesse Washington lynched in Waco, Texas
August 24-26  Amenia Conference seeks to reconcile factions among African Americans
November  NAACP appoints James Weldon Johnson as the organization’s first field secretary for the South
December 9  National Urban League Conference on Great Migration
December 27-30  NAACP Conference “The Negro in Wartime”

1917

January 26  National Urban League Conference on Negro Migration, New York City
February 15  Joel E. Spingarn, white chairman of the NAACP’s board of directors, publishes an open letter to the “Educated Colored Men of the United States,” urging black men to sign up for training in a segregated officers training camp
March 25  First Separate Battalion (Colored) of the District of Columbia National Guard receives orders to guard the nation’s capital
April 6  United States enters World War I
April 26  President Wilson asks YMCA to provide services for soldiers
April 27  NAACP leaders meet with Secretary of War Newton D. Baker
May 14  NAACP votes to support the creation of a segregated officers training camp
May 17-19  NAACP’s Washington Conference of black leaders to discuss role of African Americans in the war
May 18  President Wilson signs the Selective Service Act initiating the draft
May 19  The War Department announces creation of a black officers training camp
June 5  First draft call registers all men between the ages of twenty-one and thirty
June 15  The Colored Officers Training Camp opens at Fort Des Moines, Iowa
July 2  Riot in East St. Louis, Illinois
July 26  The Colored Medical Officers Training Camp opens at Fort Des Moines, Iowa
July 28  NAACP stages Silent Parade in New York City, 10,000 protest East St. Louis race riot
July 30  Colonel Charles Young, highest-ranking black officer, forced to retire
July 31  The War Department’s troop mobilization plan provides for the training of black draftees as combat soldiers
August  A. Philip Randolph and Chandler Owen oppose U.S. participation in the war and launch the socialist journal Messenger
August 23  Violent clashes between white residents of Houston and members of the all-black Twenty-Fourth Infantry spark the Houston Mutiny
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<tr>
<th>Date</th>
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<tr>
<td>August 24</td>
<td>Secretary of War, Newton D. Baker approves Plan 6, limiting black soldiers to service in one combat division and minimal training in arms</td>
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<td>August 31</td>
<td>Secretary of War, Newton D. Baker, meets with black leaders and concerned whites to discuss the role of blacks in the military</td>
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<td>September 5</td>
<td>The Selective Service System announces separate “colored” and “white” draft quotas</td>
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<td>September 11</td>
<td>Secretary of War Baker suspends the draft of African Americans</td>
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<td>September 16</td>
<td>104 black physicians and 12 dentists receive their officers commissions at Fort Des Moines, Iowa</td>
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<td>September 22</td>
<td>Secretary of War Baker announces resumption of black draft</td>
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<tr>
<td>October</td>
<td>First black draftees arrive in U.S. training camps</td>
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<tr>
<td>October</td>
<td>Riot at Camp Mills, New York</td>
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<td>October</td>
<td>Armed black soldiers from Camp Wadsworth march into nearby Spartanburg, South Carolina</td>
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<td>October 5</td>
<td>Baker appoints Emmett J. Scott, former secretary to Booker T. Washington, special adjutant to the secretary of war</td>
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<td>October 15</td>
<td>639 black officers receive their commissions at Fort Des Moines, Iowa</td>
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<tr>
<td>November 5</td>
<td>NAACP wins victory against segregated housing ordinances in Buchanan v. Warley</td>
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<tr>
<td>November 11</td>
<td>Houston Mutiny court-martial trail of sixty-three defendants</td>
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<td>November 13</td>
<td>Colored Officers Training Camp closes at Fort Des Moines, Iowa</td>
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<tr>
<td>November 18</td>
<td>First black YWCA Hostess House opens at Camp Upton, New York</td>
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<tr>
<td>November 23</td>
<td>War Department orders creation of Ninety-third Infantry Division (Provisional)</td>
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<tr>
<td>November 29</td>
<td>War Department orders creation of Ninety-second Infantry Division</td>
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<tr>
<td>December 11</td>
<td>Secret hanging of thirteen participants in the Houston Mutiny</td>
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1918

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
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<tbody>
<tr>
<td>January 1</td>
<td>369th Infantry Regiment, first black combat unit, arrives in France</td>
</tr>
<tr>
<td>January 29-31</td>
<td>National Urban League Conference on Negro Migration, New York City</td>
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<tr>
<td>February 18</td>
<td>Houston Mutiny court-martial trial of forty defendants</td>
</tr>
<tr>
<td>March</td>
<td>Riot at Camp Hill, Virginia</td>
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<td>March 28</td>
<td>Ballou issues Bulletin #35</td>
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<tr>
<td>April 4</td>
<td>Clifford L. Miller, first black chaplain, arrives at Camp Lee, Virginia</td>
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<tr>
<td>April 14</td>
<td>372nd Infantry Regiment arrives in France</td>
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<tr>
<td>April 20</td>
<td>U.S. Department of Labor, Division of Negro Economics, publishes Negro</td>
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Migration in 1916-17

April 23-

June 10 370th and 371st Infantry Regiments arrive in France

May 1 U.S. Department of Labor appoints Dr. George E. Haynes to head Division of Negro Economics

May 16 Congress passes Sedition Act

June 5 Second draft call registers all men between the ages of twenty-one and thirty

June 6-22 Colonel Charles Young rides 497 miles on horseback from Ohio to Washington, D.C., to demonstrate that he is physically fit for active duty

June 18-

July 12 Ninety-Second Division arrives in France

June 19-21 Government sponsored conference of race leaders convenes in Washington, D.C.

June 24 W.E.B. Du Bois applies for captaincy commission in the Army

June 24-29 National Liberty Congress meets in Washington, D.C.

July 24 W.E.B. Du Bois publishes “Close Ranks” editorial

President Wilson condemns mob violence

August Riot at Camp Meade, Maryland

August 4 A. Philip Randolph and Chandler Owen arrested in Cleveland

August 7 American Expeditionary Forces headquarters in Paris distributes “Secret Information Concerning Black American Troops” instructing French officers how to deal with African Americans

August 12 Alice Dunbar-Nelson appointed a Field Representative of the Woman’s Committee of the Council of National Defense

August 17 Riot at Camp Merritt, New Jersey

August 24 Third draft call registers all men between the ages of twenty-one and thirty

August 31 President Wilson commutes the death sentences of ten Houston Mutineers to prison terms

September Riot at Newport News, Virginia

September 3 German propaganda leaflets target African American troops

September 12 Fourth draft call registers all men between the ages of eighteen and forty-five

September 16 Execution of six participants in the Houston Mutiny

Committee on Public Information accredits Ralph Waldo Tyler as the only African American heads Division of Negro Activities in the U.S. Food Administration

October Riot at Camp Lee, Virginia

November 6 Charles Young reinstated

November 11 World War I ends
Appendix B: What follows are excerpts from various important primary documents.

W.E.B. Du Bois “Awake” Editorial

We Negroes ever face it. We cannot escape it. We must continually choose between insult and injury; no schools or separate schools; no travel or “Jim Crow” travel; homes with disdainful neighbors or homes in slums.

We continually submit to segregated schools, “Jim Crow” cars, and isolation, because it would be suicide to go uneducated, stay at home, and live in the “tenderloin.”

Yet, when a new alternative of such choice faces us it comes with a shock and almost without thinking we rail at the one who advises the lesser of two evils.

Thus it was with many hasty editors in the case of the training camp for Negro officers which Dr. J. E. Spingarn is seeking to establish.

Does Dr. Spingarn believe in a “Jim Crow” training camp? Certainly not, and he has done all he could to induce the government to admit Negroes to all training camps.

The government has so far courteously refused.

But war is imminent.

If war comes to-morrow Negroes will be compelled to enlist under white officers because (save a very few cases) no Negroes have had the requisite training.

We must choose then between the insult of a separate camp and irreparable injury of strengthening the present custom of putting no black men in positions of authority.

Our choice is as clear as noonday.

Give us the camp.

Let not 200, but 2,000, volunteer.

We did not make the damnable dilemma.

Our enemies made that.

We must make the choice else we play into their very claws.

It is a case of camp or no officers.

Give us the officers.

Give us the camp.

A word to those who object:

1. The army does not wish this camp. It wishes the project to fail. General Wood refuses to name date or place until 200 apply. The reason is obvious. Up to March 8, sixty-nine men have applied.

2. The camp is a temporary measure lasting four weeks and designed to FIGHT, not encourage discrimination in the army... We want trained colored officers. This camp will help furnish them.
3. The South does not want the Negro to receive military training of any sort. For that reason, the general staff reduced its estimate from 900,000 to 500,000 soldiers - they expect to EXCLUDE Negroes!

4. If war comes, conscription will follow. All pretty talk about not volunteering will become entirely academic. This is the mistake made by the Baltimore AFRO-AMERICAN, the Chicago DEFENDER, the New York NEWS. And the Cleveland GAZETTE. They assume a choice between volunteering and not volunteering. The choice will be between conscription and rebellion.

Can the reader conceive of the possibility of choice? The leaders of the colored race who advise them to add treason and rebellion to the other grounds on which the South urges discrimination against them would hardly be doing a service to those whom they profess to love. No, there is only one thing to do now, and that is to organize the colored people for leadership and service, if war should come. A thousand commissioned officers of colored blood is something to work for.

Give us the camp!
Source: Crisis (April 1917), 270-71.

“Jim Crow” Training Camps - No!

The theory that half a loaf is better than no loaf at all has long since been exploded... We have put up with the crumbs that have fallen from the white man’s table as our portion so long we are considered ungrateful if we even dare to hint it is about time we were eating at the first table. The fact that we are paying for cake and ice cream and getting skimmed milk and hardtack should strike the average mind as being a trifle unjust. There are many good people who believe we should continue to take what is handed to us without complaint, in the hopes of getting more and better things in the future...

Dr. Spingarn and some other estimable gentlemen are advocating the establishment of a “Colored Officers’ Training Camp,” and put forth arguments in its favor that are worthy of consideration only because these gentlemen are sincere, friendly, and believe they are aiding us to take a step forward...

To ask for permission to fight with a class of people who absolutely need and cannot do without our service in the event of war, is a huge joke from every point of view. White men have no objection to Colored regiments, if they can officer them... A half loaf isn’t always better than no loaf at all; better that we have no regiment than have them officered by white men. Prejudice is a barrier that cannot be broken down in a day, but the effort must come to break it, and there is no better time than the present to begin. When our country needs men to defend its honor, the black man shoulders his gun without a murmur, and the white man, through the kindness of his
heart, gives him a prominent place in the front ranks where the bullets are the thickest. Though it might seem too idealistic to have mixed regiments, that is what Uncle Sam will be compelled to do, if we are to have a united country.

No one denies that we sorely need efficient military training for officers, privates and every citizen, but we do not want it, nor will we take it in a “Jim Crow” way, if we never get it... If we are good enough to fight, we are good enough to receive the same preparatory training our white brothers receive.

**Resolutions of the Washington Conference, 1917**

We...earnestly urge our colored fellow citizens to join heartily in this fight for eventual world liberty; we urge them to enlist in the army; to join in the pressing work of providing food supplies; to labor in all ways by hand and thought in increasing the efficiency of our country. We urge this despite our deep sympathy with the reasonable and deep-seated feeling of revolt among Negroes at the persistent insult and discrimination to which they are subject and will be subject even when they do their patriotic duty.

Let us, however, never forget that this country belongs to us even more than to those who lynch, disenfranchise, and segregate. As our country it rightly demands our whole-hearted defense...

Absolute loyalty in arms and in civil duties need not for a moment lead us to abate our just complaints and just demands... [W]e demand and of right ought to demand:

1. The right to serve our country on the battlefield and to receive training for such service;
2. The right of our best men to lead troops of their own race in battle, and to receive officers’ training in preparation for such leadership;
3. The immediate stoppage of lynching;
4. The right to vote for both men and women;
5. Universal and free common school training;
6. The abolition of Jim Crow cars;
7. The repeal of segregation ordinances;
8. Equal civil rights in all public institutions and movements.

These are not minor matters. They are not matters that can wait. They are the least that self-respecting, free, modern men can have and live.
French Directive


Secret information concerning the Black American Troops.

It is important for French officers who have been called upon to exercise command over black American troops, or to live in close contact with them, to have an exact idea of the position occupied by Negroes in the United States. The information set forth in the following communication ought to be given to these officers and it is to their interest to have these matters known and widely disseminated. It will devolve likewise on the French Military Authorities, through the medium of the Civil Authorities, to give information on this subject to the French population residing in the cantonments occupied by American colored troops.

1. The American attitude upon the Negro question may seem a matter for discussion to many French minds. But we French are not in our province if we undertake to discuss what some call “prejudice.” [recognize that] American opinion is unanimous on the “color question,” and does not admit of any discussion.

The increasing number of Negroes in the United States (about 15,000,000) would create for the white race in the Republic a menace of degeneracy were it not that an impassable gulf has been made between them.

As this danger does not exist for the French race, the French public has become accustomed to treating the Negro with familiarity and indulgence.

This indulgence and this familiarity [These] are matters of grievous concern to the Americans. They consider them an affront to their national policy. They are afraid that contact with the French will inspire in black Americans aspirations which to them (the whites) appear intolerable. It is of the utmost importance that every effort be made to avoid profoundly estranging American opinion.

Although a citizen of the United States, the black man is regarded by the white American as an inferior being with whom relations of business or service only are possible. The black is constantly being censured for his want of intelligence and discretion, his lack of civic and professional conscience, and for his tendency toward undue familiarity.

The vices of the Negro are a constant menace to the American who has to repress them sternly. For instance, the black American troops in France have, by themselves, given rise to as many complaints for attempted rape as all the rest of the army. And yet the (black American) soldiers sent us have been the choicest with respect to physique and morals, for the number disqualified at the time of mobilization was enormous.
Conclusion

1. We must prevent the rise of any pronounced degree of intimacy between French officers and black officers. We may be courteous and amiable with these last, but we cannot deal with them on the same plane as with the white American officers without deeply wounding the latter. We must not eat with [the blacks] them, must not shake hands or seek to talk or meet with them outside of the requirements of military service.

2. We must not commend too highly the black American troops, particularly in the presence of (white) Americans. It is all right to recognize their good qualities and their services, but only in moderate terms strictly in keeping with the truth.

3. Make a point of keeping the native cantonment population from “spoiling” the Negroes. (White) Americans become greatly incensed at any public expression of intimacy between white women with black men. They have recently uttered violent protests against a picture in the “Vie Parisienne” entitled “The Child of the Desert” which shows a (white) woman in a “cabinet particulier” with a Negro. Familiarity on the part of white women with black men is furthermore a source of profound regret to our experienced colonials who see in it an overweening menace to the prestige of the white race.

Military authority cannot intervene directly in this question, but it can through the civil authorities exercise some influence on the population.

Notes

1. The terms “African American” and “Black” will be used interchangeably throughout this paper.
2. See Appendix B, “Awake” for the complete text of his editorial.
3. See Appendix B, ”Resolutions of the Washington Conference, 1917” for a complete list of the demands made at the conference.
4. The regiment would later be named the 369th Infantry Regiment. They are more popularly known as the “Harlem Hellfighters.”
5. See Appendix B, “French Directive” for the complete text.
Abstract

Based upon three years of ethnographic research with approximately one hundred women engaged in street-based sex work and problematic substance use, this article explores women’s perceptions of and experiences with social services gaps and access barriers. Women identified service provision gaps with respect to housing, safety, mental health, employment-related skills training, and harm reduction. Yet women also described barriers to accessing available services as part of a totalizing and iterative process whereby restrictive service provision terms, previous negative experiences with service providers, criminalization, stigma, and lack of knowledge about available services actively discouraged them from help-seeking, even when they felt that they wanted or needed assistance. Findings suggest a need for further critical exploration of the complex means by which the state, and society more broadly, continues to absolve itself of responsibility for street-involved women who violate its laws and moral practices, thereby holding them responsible for their own victimization.

Key words: Street-involved women; sex work; social services; homelessness; addiction

I know what I wanna do. It’s just the thing, I don’t have the support system… we just don’t have a lotta options. There’s no shelter. There’s no shelter for hookers!

( Bravey, personal communication)

Brandy’s decade-long struggle with homelessness, drug addiction, a lengthy criminal record of prostitution arrests, and two children in foster care, left her with no shortage of negative experiences with social services provision. Her simple assertion that “there’s no shelter for hookers” speaks volumes about the lack of resources available to street-involved women, defined as adult females who exchange sex for cash or drugs as part of their struggles with precarious housing or homelessness, addiction, compromised mental and physical health, and criminal justice system involvement. Social services providers, defined as those whose paid
work involves providing (or assistance with locating) government or charitable benefits, face indisputably difficult choices when working with street-involved women, whose participation in illegal activities often directly results from their social exclusion. Yet street-involved women almost universally report that social services providers often fail to adequately address these challenges.

**Introduction**

Analysis presented in this article derives from data collected through three years of ethnographic research with approximately one hundred street-involved women, and explores their perceptions of and experiences with social services gaps and barriers to accessing available services. Women identified significant service provision gaps in the areas of housing, safety, mental health, employment-related skills training, and harm reduction. Their descriptions of these gaps as part of an interconnected and totalizing system resembles what (Author 2) has elsewhere described as an exclusionary regime, a dense coalescence of punitive forces which involves both governance in the form of the criminal justice system and engagement with the courts and other state agents, and regular patterns of action, including myriad forms of stigma (Author 2 citation). Given these realities, it is unsurprising that women reported that barriers to available services comprise their unacceptable or unrealistic terms, disillusionment resulting from previous negative experiences, criminalization and stigma, and, less frequently, lack of knowledge about available services.

**Literature Review**

This article makes an interdisciplinary contribution to three main bodies of literature, on social determinants of health, social and healthcare services for criminalized women, and therapeutic governance, all of which have direct implications for both feminist and medical-anthropology specifically, and public health more generally. The social determinants of health literature emphasizes that street-based sex work, problematic substance use, and violence work in tandem as mutually reinforcing agents of gendered and racialized harms (Romero-Daza 2003; Cusick & Hickman 2005; Singer 2006). Related social epidemiological perspectives on the impact of social, structural, and interpersonal violence on street-involved women’s well-being likewise examines how these intersecting forces function to create a “risk environment” (Rhodes 2002) in which indirect violence compounds women’s risks of physical violence and drug-related harms (Romero-Daza, Weeks & Singer 2005; Rhodes et al. 2012).

Street-involved women face an additional set of risks that stem directly from their engagement in illegal sex work and drug use behaviors. Research strongly indicates that criminalization decreases women’s abilities to use (or to negotiate the use of) harm reduction
materials such as sterile drug paraphernalia and condoms, increases their risk of incarceration and associated negative life outcomes, and further reinforces the stigma and social exclusion they already experience (Blankenship & Koester 2002; Shannon et al. 2008a; Shannon et al. 2008b). Studies also demonstrate that women of color face further heightened risks as a consequence of their street involvement (Clarke et al. 2012; Craib et al. 2003).

Literature on social and healthcare services for criminalized women demonstrates that access barriers often stem from the same problems that services aim to ameliorate, including homelessness, addictions, and poverty (Kurtz et al. 2005). Additional access barriers include misinformation or misconceptions (Shannon et al. 2005), the psychological impacts of trauma (Stebbins 2010), and the lack of involvement in program or services design by street-involved women themselves (Rabinovitch & Strega 2004). Yet, as exemplified by literature that adopts a therapeutic governance perspective, the social services and criminal justice sectors have begun to explicitly intersect over the course of the past decade in the form of court-mandated prostitution diversion programs and transitional housing facilities specifically targeted toward women seeking to end their sex work involvement (Oselin 2009; McNaughton & Sanders 2007).

Given that at least some studies have found that engagement in community-based substance abuse treatment programs reduced the frequency with which women engaged in street-based sex work, it is not surprising that a longstanding push on the part of feminist criminologists to focus on women’s unique circumstances now enjoys operationalization in the form of such court-mandated programs (Arnold et al. 2000; Burnette et al. 2009). Critics of the diversion approach, however, note that their therapeutic focus functions to pathologize participants as problems in need of fixing (Lerum 1998; Wahab 2004). Such critiques are even more meaningful in light of evidence that street-involved women sometimes have lengthy histories of involvement with state-sponsored institutional settings, including foster care and incarceration (Cohan & Lutnick 2009; Dodsworth 2012).

The therapeutic governance literature further observes that street-involved women may have good reason to distrust a social services system aligned with criminal justice interests, particularly as it positions them as both victims of traumatic life events that led to their sex work and drug use behaviors, and criminals who must participate in state-sponsored interventions and rehabilitation programs to improve themselves. By prioritizing state-mandated values over women’s own goals and lived realities, such programmatic initiatives undermine the likelihood of women’s self-actualization within or as a result of them (McKim 2008; Sered & Norton-Hawk 2011).

Our research identified a gap in these three bodies of literature, which focus almost exclusively on either the considerable health and safety risks faced by actively street-involved women, or on the experiences of women who are fully compliant with service provision programs. By
presenting the perspectives of women who have experiences with services but who remain street-involved, this article unites and builds upon these literatures in ways that may offer significant recommendations for social services providers.

**Methods**

The ongoing multi-year study that informs this article employs a grounded theory and participatory approach that had its inception through participant observation, in which one of the researchers lived for a minimum of three days a week (as her teaching schedule permitted) over the course of a year in a transitional housing facility for women leaving the sex industry. She slept in a futon in a back office so as to avoid taking space from another woman, an arrangement also served an ethical research function in that it differentiated her from other residents in a way that made them aware that she was not in the same dire straits as they were; likewise, her sleeping at the facility rather than going home like managerial staff communicated to residents that she did not have direct authority over them. From that liminal location between staff and resident, she also actively informed residents of her desire to learn and write about the lives of street-based sex workers, which the majority of women enthusiastically supported.

Next, the researchers employed the cultural knowledge and embodied practices learned in the transitional housing facility to carry out 50 semi-structured interviews with women in the street environment. The researchers, including a former neighborhood resident who works at a service provision program for sex workers, recruited interview participants by walking slowly down the street. After making eye contact with a potential interview participant, they introduced themselves as researcher and outreach worker, and offered a rapport-building cigarette to the potential respondent as they explained purpose of the study. None of the women approached refused to participate, and all received information about the service provision program as well as a small plastic bag from the program containing three condoms, deodorant, and inexpensive cosmetics, and, soda and snacks during the interview. Many interviewees said that they felt the study was important and brought their friends and co-workers to participate, facilitating a snowball sample approach.

The researchers asked general questions about the street income generation and survival strategies as a respectful means to allow women themselves to make the decision about what to disclose regarding their involvement in illegal and stigmatized activities as well as their lives more generally. All women permitted audio-recording of the interview, which the researchers jointly transcribed and then coded using approximately 35 key emergent themes. This methodological approach resulted in analysis of service provision gaps and access barriers presented below.
Service Provision Gaps

Interview respondents rarely hesitated in response to the researchers’ question about what the women regarded as currently unavailable, but necessary, services. Housing, safety, mental health, employment-related skills training, and harm reduction emerged as significantly underserved or unaddressed issues. While it is analytically expedient to separate these service provision gaps by category, women did not necessarily experience these issues as completely discrete due to their mutually reinforcing and iterative nature. A woman experiencing homelessness, for instance, may find that her criminal record bars her from particular types of jobs or transitional housing programs, creating a situation that further compromises her health and safety.

Housing

All of the women were experiencing homelessness or were precariously housed in a motel room, shelter, or with friends, at the time of the interview. While none of the women reported actually sleeping outdoors due to the cold weather conditions, affordable, long-term housing was the most prevalent concern for all participants, and one that they felt had a totalizing negative impact upon their abilities to find work or feel secure in the world. Respondents repeatedly expressed confidence in their abilities to handle their other life issues once they had obtained housing, which they saw as a primary concern and drain on their income and time due to the cost of the area’s nightly rental motels. As one woman concisely noted:

First of all, that’s the most important fuckin’ thing, that’s what we’re out here workin’ for! We need a place to live. We don’t care about food stamps, we don’t care about some motherfucker handin’ out some benefits, what we care about is having a place to go. Somewhere to lay your fuckin’ head down, that is ours, that is ours. Period. I mean, at the end of the fuckin’ night, everything else can be taken care of.

Like this respondent, women frequently mentioned the need to pay for motel housing as a key reason for engaging in street-based sex work. One woman observed that a major concern within the transactional sexual act involved the hope that the client would help a woman “to pay for a room, to just get somewhere to sleep” whether through allowing her to remain overnight in the motel room he rented for their sexual encounter or by providing her with extra money to pay for a room of her own. Women frequently mentioned this as a desirable outcome, particularly given their concerns that staying in a shelter might expose those with active warrants to the threat of arrest. One respondent described an ideal situation as one in which there were “no questions asked when you come in, and you can sleep for a minute, shower…without fear of the law.”

Many of the women in this study described the absence of family support, which, in many of the women’s words, at least partially resulted in their precarious housing situation. A
majority of respondents who chose to share personal information about their own life trajectories reported a chain of events that involved disputes with a family member or intimate partner that pushed the respondent from a situation in which poverty and precarious housing were already prevailing concerns to one in which homelessness became the respondent’s biggest problem. This shift, in turn, often precipitated the respondent’s entry into the shelter system and what almost all women regarded as a system of surveillance in which they did not want to involve themselves:

They get more involved in your life, they only shut your ass down, they don’t help you. It’s like bein’ in prison. They don’t wanna help you. They don’t help you. Any money you make over a dollar they shut your fuckin’ insurance off, they’ll shut your food stamps off, they’ll shut your fuckin’ everything off. Even if you make $400 a month regular money, they don’t care. I know I had a part-time job though because as long as I make under $999 when I was applying for social security, I can make that. But it was to be under that. But like I said, they don’t care. It’s all about the profit they make from prosecuting us.

In depicting shelter, and the broader social services system of which it is a part, as a profit-generating machine, this respondent understandably experiences street involvement as a more desirable choice. Yet a woman’s subscription to this worldview can also come at considerable costs to her wellbeing.

**Safety**

Women all reported an almost complete lack of services to protect or maintain their health and wellbeing, which they described as threatened by violence, inadequate mental health treatment or medications, and limited access to condoms. Respondents described violence as an almost inevitable occurrence, leading a woman to observe that improved access to medical services would be “good, you know, cause the rapes happen, the beatings happen.” This pervasive belief prompted another participant to simply state, “we need bodyguards.” The majority of women who participated in the research reported working alone and in areas with high levels of drug trafficking and street violence, factors that made women more vulnerable when working on the street late at night.

Despite high reported levels of violence, women felt that police officers would not help them as a result of their participation in illegal, stigmatized activities. The most common suggestion for services to deal with violence involved information about self-defense for women, such that they could be better prepared to protect themselves. One woman described the content of such an initiative as involving “little programs that’ll teach you, like in time of any kind of
distress, you know, like wear a whistle, mace.” Many women spoke about the need for a safe, recuperative location for women to go, following an incidence of violent victimization. One woman described the potential for such a place as “somewhere to come if you just got beat up and don’t wanna deal, you know, with the law.” Many women complained that one existing drop-in center for street-involved women was so far away that, unless a client drove them there, “you gotta be super desperate” to either walk several miles or find poorly connected public transportation necessary to reach it.

**Mental Health**

Mental health issues, including those stemming from violent trauma, emerged as a serious concern among women interviewed. One participant concisely summarized this issue by simply noting that “mental health services should be more accessible.” Respondents noted that consistent access to required medications presented challenges, as having no permanent address, regular phone service, or transportation made keeping appointments challenging in ways that social services providers did not fully grasp:

[mimics condescending voice] “go over to this building at this time”, really?
They’re not going to make that appointment. I wouldn’t know if maybe, it’s not like
[a social service provider] can go to a hotel and say “hey, here’s your medication”
because I’m in this hotel for the night, I don’t know where I’m going to be in two weeks.

The added dynamic of substance abuse further complicates the situation for many women; as one respondent observed, “nine times out of ten you’re not going to remember to go to your appointments cause you’re out getting high. I mean, most people who are out getting high aren’t going to remember to take their medication.”

Respondents also described mental health counseling and talk therapy as necessary, but missing, elements, such that women could have more “been there done and did it, them kind of talks” with others who had themselves experienced or had empathy for the street-involved. Many participants expressed a sense of being on their own in the street environment, leaving them feeling isolated and unable to ask for help even when they needed or wanted assistance.

Women also expressed a need for condoms to be made available, as they were especially cognizant of the risks associated with having unprotected sex. Access to condoms is surprisingly limited, as many stores in the area do not carry condoms because they are an item that is frequently shoplifted. Women claim that services that do provide condoms limit how many can be given out to each woman because carrying more than three condoms, considered “prostitution paraphernalia” by police, puts women at risk of arrest.
Employment-Related Skills Training

None of the women who participated in this study worked for wages at the time of the interview and all generated their income through street-based sex work, theft, or drug-related transactions. Yet almost all women had previously engaged in legal forms of work, and many expressed the hope that they would eventually do such work again at some point in their lives. Most expected this transition back into the legal workforce to involve particular restrictions and expectations that they worried they would not be able to meet. Some participants were skeptical that they would ever be able to, as one woman put it, “work some job in a regular business, like a department store” if they did not have the support needed to put together a resumé, complete job applications, and prepare for the type of interactions and self-presentation expected during interviews.

A number of women felt that they required training and assistance in order to engage in legal income generation strategies. In addition to lack of a permanent address, criminal records, and associated challenges in obtaining such employment, women who have been street-involved for lengthier periods of time face the dual problem of extensive resumé gaps that they must explain to prospective employers. Transitioning from the cultural environment of the street, where the ability to cleverly subvert the law is both lauded and highly prized, to the subservience required by the low wage service sector economy, presents additional challenges. One woman noted that this transition required support, which she described as,

…more job search places, places that could actually help you fill out a resumé, learn how to do all that stuff so you could try to get a job. Even temporary internships would be helpful. I think they should make a program for women, some kind of special program to help ladies out and teach them about things, just, you know, to help them bein’ out there, help them in another way.

Women expressed frustration that leaving an admittedly difficult lifestyle characterized by precarious housing situation, multiple socioeconomic vulnerabilities, activities that require vigilance towards police officers, and stigma, presented so many challenges. Yet shelters and other social services that women were aware of rarely offered assistance in such transformative endeavors, leaving many respondents with the impression that such facilities are little more than holding centers offering a place to sleep. As one woman observed, “there are no classes there, there’s no real help there, it’s just a place to lay your ass, then get up and leave the next morning, you’re back out there until you get to come back in at five or six o’clock.”
**Harm Reduction**

All respondents described experiencing stigma as a result of their street involvement and strongly felt that their help-seeking endeavors were influenced by social services providers’ negative perceptions of them. Without actually using the phrase “harm reduction”, women advocated for nonjudgmental services that accounted for the everyday realities inherent in street involvement. One participant puts it this way:

Don’t even offer to help me if you cannot even go through the same process, or have been through the same process I have been through. To try to come to you, to swallow my pride, to get off the street, and fuckin’ come to you and say, “I need help, can you please fuckin’ help me?” And then be turned away! [mimics condescending tone] “You’re a hooker, you got no income, you got nothin’, we’re just gonna take your kids and the rest of whatever you got.”

This speaker paints a vivid portrait of marginalization in which a system unwilling to accept her involvement in sex work not only refuses her assistance but also actively works to further destabilize her already difficult life.

The vast majority of women interviewed understandably expressed a desire to feel that service providers “give a damn”, as many respondents put it. Many expressed a feeling of isolation brought on by their almost completion occupation and exhaustion by survival activities, including soliciting clients, avoiding arrest, and procuring drugs, food, and other basic daily needs. Women described a need for interaction and conversation with other women who have either previously been street-involved or remain a part of street life, essentially advocating for a peer support network. One woman describe the potential for such a network as “like a women’s group or a group, so when they feel like they wanna get out, they can go to this place.”

Several women also suggested the establishment of a hotline that women could call in order to receive emotional support from an understanding and empathic person. A respondent said this service is necessary “cause we get stressed out out there, and our men, our kids, people don’t know what we go through on them streets.” This idea was reiterated by several participants, who suggested that women with histories of street-involvement should staff such an endeavor: “ex-hookers and stuff, they could do a hotline, because, we need somebody to talk to, and it’s hard.”

Participants repeatedly stressed the belief that their intimate partners and others in their lives are not sympathetic to the troubles that they encounter on a daily basis. This woman clearly explained both the preferred language for and the direct benefits of a brochure directing women to a hotline number to call:

And have that in the brochure, say, “if you need someone to talk to, or your pimp done beat you up and you just wanna talk to somebody”, that’d be cool. That would really be
cool because sometimes these pimps don’t understand that sometimes you been gone two hours and you ain’t made no money.

The desire for such harm reduction support, which does not require women to make immediate and substantial changes to their behaviors, also extended to respondents’ recommendations for improved substance abuse services. One woman noted that the most potentially beneficial change to existing services could come from embracing a harm reduction model that includes an empathic approach to addiction:

Givin’ em security, and showin’ em that they can change and, I mean, that’s what I would want, somebody to show that they care, and it’s a big step because, the drugs is somethin’ that’s hard to overcome. That’s the biggest problem. It’s all because of drugs out here. They’re not just doin’ it to survive, it’s because it’s a drug problem.

Women also expressed frustration about a lack of information disseminated in accessible ways. Participants in this study reported minimal interactions with service providers through outreach endeavors; as one woman put it, “we street people, they [service providers] don’t come out here.” The absence of regular outreach only perpetuates the lack of knowledge that street-involved women have regarding services available to them and thus functions to compound their feelings of isolation.

**Barriers to Accessing Services**

Participants in the research emphasized that even when services were available and easy to reach on poorly connected public transportation, other factors inhibited them from seeking these out. As with their descriptions of service provision gaps, women described service barriers as overlapping such that each negative experience with service providers informed subsequent interactions or the desire to seek assistance at all. Women noted four broad barriers that restricted or completely prevented them from engaging in help-seeking behaviors, including restrictive service provision terms, previous negative experiences, criminalization and stigma, and lack of knowledge about available services.

**Restrictive Service Provision Terms**

Women spoke at length about service providers’ restrictive or even unrealistic requirements, including mandatory drug testing, strict rules about admittance times and keeping appointments, threats posed by mixed gender shelters, and mandatory disclosure of emotional inner states and past trauma. Respondents generally positioned street-involvement as providing more autonomy and dignity than existing alternatives, particularly as it allowed them to continue using drugs and living independently with money they earned themselves.
According to many women, the most problematic aspect of existing services involved their restrictions on women’s bodily autonomy in ways that positioned them as troubled deviants in need of control. Respondents were highly sensitized to this reality; as one woman explained her reasons for avoiding shelters or other social services targeted at the poor, “it’s a pride thing for me… I ain't about to be fittin’ in with them derelicts in shelter.” This rather commonly expressed sentiment allowed women to position themselves as distinct from those in seemingly more desperate circumstances.

Mandatory drug testing presented a significant obstacle to seeking services, as women reported that many programs or overnight shelters refused admittance to individuals whose urine tested posted for controlled substances. This requirement seemed counterintuitive to women, all of whom used illegal drugs, leading one woman to note, “you’re coming off the street, of course you’re not going to be clean and sober, hello!” Another expressed frustration at requirements that seemed to exclude those it ostensibly aimed to help:

…you have to do a drug and alcohol screen when you first go in and if you have any drugs in your system then they tell you, you know, well, we can’t accept you, and come back in 30 days. Well, where does that put a woman? I mean, if you’re comin’ from the street, you have to figure that they’ve been doin’ somethin’ to try to survive.

Strict rules about admittance times to shelter likewise posed a problem to women, who expressed frustration that “you gotta be there at a certain time and they kick you out at five p.m.”

Almost all respondents noted that the independent quality of street involvement, wherein many women feel that they choose when, where, and with whom they engage to earn money, did not involve the same time and behavioral restrictions necessitated by social services providers. “Even just a phone call is hard for women, or keepin’ an appointment”, one woman explained. Another echoed many other respondents when further elaborating on how such time limitations and other requirements, often described as inculcating a sense of responsibility, just further alienated women. “We’re already broke down” she explained, “We don’t need to be tore all the way down to the ground. We’re already there.”

From this perspective, street involvement certainly appears to offer more dignity, and with far fewer restraints on personal autonomy and decision-making. Many women accordingly observed that they had little incentive to change their way of life, which provided both an income and a level of independence that they regarded as unachievable by any other means. “I don’t wanna go ask for public assistance for somethin’ that I can go sell my ass to make money for,” one woman observed, while another described income earned from street-based sex work as “quick and easy, a lot more than a week’s paycheck at a regular job.”
Respondents also noted that their street involvement provided them with a level of confidence and flexibility that, like the income generated from it, was difficult to match. A woman observed that, “it’s hard to convince a woman to get off the streets and give up that money…there’s a lot of excitement to it, a lot of power. It kind of feeds your ego, too.” While these rewards functioned to neutralize or rationalize risks incurred, this was not the case with the mixed gender shelters that women regarded as dangerous and to be avoided at all costs. As one woman put it, such facilities are “like a warehouse full a men, and you want me to sleep right there? Oh, no! No, man, I’d rather just walk the streets.”

Previous Negative Experiences

For these women, one negative experience with service providers can have extremely damaging and permanent effects. As one woman characterized her experience, “they are lookin’ for a reason to fuckin’ kick your ass out. As soon as they let you in, as soon as they let you know, I mean they are on your ass.” Some women have had their children taken from them, charges pressed against them, spent time in institutional settings including foster care and various forms of incarceration, or have been excluded from services because of their sex work involvement. One woman concisely summarized her disillusionment with social services providers as the product of her own negative experiences:

They don’t help you do shit. They don’t help you do anything! I had a job, okay, I can get a job, I got skills, I got experience. But will anybody fuckin’ help me? Can I get into shelter, can I do anything? No! No, you can’t even do anything! Instead, I lost everything that I loved. My life, my kids, my belongings, my values, my morals, everything went out the fuckin’ window when I got in these fuckin’ shelters. Because they won’t help you: their only aim is to take mothers away from their children, and keep criminals off the street for the night, that is it.

Such accounts contribute to a corpus of knowledge shared among street-involved women, who sometimes seek one another out to inquire about how particular programs and services treat those who have been engaged in sex work. For instance, women frequently discussed a court-mandated diversion program that the city court provided as a sentencing alternative for women charged with prostitution. The program requires a six-month residential stay in a transitional housing facility with many other women, all of whom have received this sentencing alternative and many of whom have, at some point, worked together in the street environment. Women who leave the program prior to completion must go to jail to serve their sentence and receive a criminal record that includes a prostitution conviction.

Nonetheless, some women prefer jail to sharing living space with other women they have previously worked with on the street, and participating in the mandatory self-disclosure
of therapeutic groups. One woman described going to jail after leaving the house because there were “too many women, I don’t like the too many women environment.” Some women described negative experiences with residents in this program continuing their drug use and associated activities, which, in their opinions, prevented real changes from taking place in their lives if they desired them.

Others preferred jail to a restrictive transitional housing environment that required sometimes emotional discussions about the past trauma and abuse that had, in the view of the program, led to women’s engagement in sex work. Yet such disclosure presents very real risks to street-involved women, as disclosing information about their (or others’) involvement in criminal activities or health status, particularly with respect to sexually transmitted infections, could lead to violent repercussions in the street environment, where “snitches” do not fare well. As one woman noted about the need for a woman in the program to be guarded in her statements, “it’s confidential, so you can say something but don’t go crazy.”

Therapeutic groups can demand disclosure of very intimate information about substance abuse, sexual and physical abuse, self-harm, and other potentially shame-inducing personal details that individual participants may not keep confidential. A woman recounted how a public breach of trust, by a woman with whom she had participated in a group therapy program, resulted in her decision to never again participate in a group therapeutic endeavor, noting, “she’s sitting at the other bus stop with her man and she’s saying, ‘she’s crazy, she cuts herself’ and… I just stopped going back.”

Criminalization and Stigma

Street-involved women are keenly aware of the social consequences they face as a result of their participation in multiple socially devalued and illegal activities. Women frequently expressed the view that the illegality of their work precluded them from receiving help, often using some variation of the phrase “it’s illegal, you can’t tell nobody.” The participants also commented on how the criminalization of their behavior not only restricts what kind of help they can request, but also limits the assistance that service providers are able to offer:

…with the laws of the government the way it is, I mean they have to follow by a certain kind of guideline you know, and that, sometimes it can get misconstrued into your personal opinion of a person. What can you do about it?

This speaker explicitly links criminalization and stigma as intersecting forces that inhibit women’s abilities to seek assistance, even when they have been violently victimized or otherwise illegally harmed. Women clearly noted that criminal records and especially active warrants for arrest precludes help-seeking; one woman succinctly noted that, no matter what happened,
“if you got any warrants you better suck it in, okay, move on.” Women’s belief in the increased likelihood of facing arrest as a consequence of reporting assault or other crime against them constituted a significant inhibiting factor for many respondents.

A powerful and prevalent barrier that all the women in this study attested to was the presence of stigma when attempting to obtain services. Many women firmly believe that what they often gloss as “the system”, a term they use to refer to the complex intersections between the social services and criminal justice institutions and mechanisms that frame their lives in such powerful ways, only aids those who fit a narrow model of deserving help. In their view, this typically involves being drug free, law-abiding, and obedient, three criteria that rule out the street involvement that leads women to seek out help in the first place. A respondent described social services providers as grouping help-seekers into artificially neat categories of “good” and “bad”:

But they look at it like, “well, we’re just gonna try and weed out the bad ones.” Well, you know what? You can’t weed out the bad ones because even the bad ones need help, and that’s not givin’ any help to em.

Many of the women in this study generally expressed their sense that services providers disrespected and judged them. Women attributed this to the stigma associated with street life generally and street-based sex work specifically, which one woman summarized as “the girls that work, we have such a bad rap. You know, we’re not the disgusting people that people think we are, a lot of us have good hearts.” Many women described stigma as just one more heavy weight they had to carry in the course of their everyday survival strategies, and many expressed a feeling of being overwhelmed by their problems. For a number of respondents, it combined with a number of constraining life factors that resigned them to avoiding social services all together. As one woman put it, “who has time for all that when you’re out there living on the streets?

Lack of knowledge about available services

While many of the women interviewed could readily list the limited services available to them as a consequence of their homelessness, addictions, and other marginalizing life factors, others felt that there were few places that could offer them what they regarded as substantial or meaningful help. Women generally knew about court-mandated programs and service provision groups that directly contacted them through outreach activities, and had a clear sense of what these offered. However, in numerous instances, women located the problem in themselves rather than in the systemic cultural forces that created at least some aspects of their situation. In the words of one respondent, “I don’t know how, I just know that things need to change, somehow, one day. They can’t stay the same forever.”
**Discussion and Concluding Thoughts**

Findings presented here indicate three potential areas for improved social services provision among those who work directly with street-involved women, a population with multiple and overlapping needs that present unique challenges. Yet social services providers must consider these challenges in tandem with the considerable resources that women must mobilize as they formulate their everyday survival strategies while simultaneously facing struggles with homelessness, addiction, criminal records, as well as other life constraints. The issue, as such, is not that street-involved women eschew available help, but rather that such assistance comes at far too high a cost.

First, social services providers must critically inspect themodus operandithey employ with street-involved women in conjunction with its underlying assumptions. All of the women whose insights form the basis for this article were actively street-involved at the time of the interview, and many offered a rather damning indictment of social services providers, who they characterize as judgmental and uncaring bureaucrats. Surely these are traits that most social workers, harm reduction practitioners, and others who work with street-involved women, actively eschew. With a view toward creating and engaging in evidence-based service provision programs, such critical inspection must necessarily entail a thorough (and perhaps painful) exploration of whether service provision goals actually reflect women’s self-reported needs, rather than a program’s moral or political stance.

Second, social services providers must critically interrogate the assumptions and beliefs underlying programs that focus upon individual women’s “readiness to change” from a life of street involvement and its accompanying rollercoaster of excitement, to a life that, more often that not, demands subservience through employment in the low wage service sector. Study findings presented here clearly indicate that although none of the women interviewed for this article regarded their street involvement as desirable, they took enormous (and often well-deserved) pride in the survival skills they developed as a result of it. Likewise, providers must ask the question of how, why, and what kind of change is a beneficial outcome for individual women.

In order to advance these aims and provide evidence-based knowledge in support of their implementation by social services providers, academic researchers must further explore the complex means by which the state continues to absolve itself of responsibility for those who violate its rules, thereby holding them responsible for their own victimization. A voluminous interdisciplinary literature, concentrated primarily in public health and the social sciences, has already clearly documented the health and safety risks that street-involved women routinely face, as well as the additional harms caused by criminalization and a lack of relevant social services. The task ahead involves a thorough exploration of the social and institutional factors that directly enable the continuance of such an exclusionary regime.
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Abstract

This study will examine the differences between the timbre and pitch of the middle B as played on both the D and A strings of the violin. In terms of this study pitch will be regarded as the fundamental frequency with associated harmonics or the ‘note’ on the treble cleft, and timbre will be regarded as the clarity of the sound. It is hypothesized that there will be a distinct observable difference between the timbre and the pitch of the middle B when played on different strings. The power function of the middle B will be estimated from both the D and A strings using a violin and basic sound recording software, outlining physical differences. These models will be analyzed for the parameters that account for the physical differences as heard by the human ear. This research will help define the cause of differences in timbre of the violin and provide a mathematical insight into the sound of the violin.

Introduction

There are many notes on the violin that can be played on more than one string. When bowing the violin, it is a common practice to use the fourth finger position in playing the note on the previous string instead of playing that same note on the open string itself. There is a common belief among players that the sound of the open string note somehow sounds different if it is played using the fourth finger. Musically the difference is regarded as the timbre of the instrument.

Much of the work done on the sound of the violin was done nearly seventy-five years ago with Hermann Von Helmholtz. He found that the partial tones of the viola were different from the violin, and that “…this seems to be connected with the altered quality of the instrument. Unfortunately this influence cannot be expressed numerically.” (88) Since then, there have been many advances in the ability to look at the sound of an instrument (Bissinger and Oliver 10-15, Schmacher, Garoff and Woodhouse 723-750). There is a much better understanding of timbre, but there still isn’t a direct quantifier for it.
Figure 1: A top view of a violin finger board. The straight lined arrows depict the position of the A on the A and D strings. The box arrow depicts the position of the middle B, the positions the samples were taken from.

Figure 2: The motion of the string if only influenced by the simple wave equation. In this case, 0 would be at the nut of the violin and 1 at the bridge. As the first harmonic is added to the sound, the waveform with $1/2$ is added in the wave. And so on for subsequent harmonics.
It is also likely that there are many factors in the sound of the violin. The sound can be affected by the amount of contact it has with other objects (Bissinger and Oliver 12), the consistency of the bowing of the instrument (Helmholtz 83) and even the temperature of the environment it is bowed in (Schmacher, Garoff and Woodhouse 749). If an accurate quantifiable difference in timbre is to be found, these errors must be accounted for.

1. Material and Methods

To begin this study, sound samples of the middle B on the D and A string were collected. The middle B was chosen for the property of it being played using a finger, or soft stop, on both the A and the D string but maintains the ability to be accurately in tune with relative easiness. The samples were recorded in one large sound file using a sound program called Audacity. In

Figure 3: The five Frequency Vs. Power graphs of the samples of B on the A string.
order to maintain consistency, a tuner was placed at eye level while playing and the areas that were well in tune were marked for samples. The sound file was then split for samples of about two seconds long through Audacity. Overall there were five samples of middle B on the A string, and seven samples of middle B on the D string. These amounts were chosen because the middle B is harder to keep accurately in tune on the D string and extra samples were taken to prevent unnecessary error in sound. Finally, the sound samples were saved as eps files.

The collected sound files were then analyzed to get data from the frequency vs. power of the samples. Professor Mark R. Peterson at CU Boulder, Colorado created a MatLab script to give the Waveform and Frequency vs. Power graphs of eps sound files. Using this file as a starting base, the sample files were run through and analyzed to confirm consistency of the
This file did not give any data of the graphs and waveform graph was not something needed for the analysis of the sound. With this in mind, the Analyze file was revised into the Revisedanalyze file that provided a matrix of data from the Frequency vs. Power graph, and graphed the Frequency vs. Power of the sound file. This process was used on all the samples giving mathematical data to use in future calculations.

Now that data has been obtained from the sound files, yet another MatLab script was created to average the data and graph the averaged data. This was done individually for each string by simply averaging the data of the Frequency vs. Power matrices from the sound file samples taken from that string on cell by cell basis. Each matrix of the average was then graphed. The A string average was graphed in blue and the D string average was graphed in red to keep

![Average graphs of D on the A string and B on the D string from averaging the sample sound files.](image)

*Figure 5: The Average graphs of D on the A string and B on the D string from averaging the sample sound files.*
Figure 6: the Average overlay graph of the data. The arrow is pointing at the most visible double peak on the image.

Figure 7: an image of what would happen to the string under a torsion wave. The torque would be provided by the string and define the angle.
them distinct. In order to see the changes in the data a third average graph was created overlaying the average graphs of the A and D string averages.

2. Results and Discussion

This overlaid graph of Averages is showing something more than the basic wave equation would say there should be. The most intriguing of these is the appearance of double peaks at a given frequency in the one thousand to ten thousand hertz range, which is the range at which human hearing is best. This implies that there is something other than the simple wave equation acting on the string when it is bowed.

To ensure these results, the next step in this research is to normalize and apply an audio weight to the overlay of the averages graph. This will ensure that there is not variation due to power input and will emphasize the main differences that would cause a change in the sound. The most likely cause of a difference would be found in the motion of the string itself. Due to the bowing of the string rather than plucking, it is likely that this result is the result of a torsion wave from the bow twisting the string while also forming the basic wave form.
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Appendix

1. Introduction
According to the US Geological Survey, phenology is the study of the influence of climate on the timing of biological events such as plant flowering (NASA, n.d.). An integral part
of phenological studies is the identification of a chronology of development phases. Examples of these phases for a plant are: budburst, flowering, fructification, leaf senescence, and leaf fall (Soudani et al., 2012). These phases are genetically predetermined but the timing of them is strongly influenced by environmental factors such as temperature, day length, and water availability (Soudani et al., 2012). Knowledge of phenology is thus useful in understanding the interaction between climate and vegetation and their impacts at local, regional, and global scales (Hmimina et al., 2013). As a result, phenology is studied in order to characterize factors that influence change in an environment. The resulting information can help to predict how that environment might react in future conditions.

Few vegetation phenology studies have been performed in semiarid environments using remote sensing. In these environments, water availability is the primary limitation factor instead of temperature (Crimmins, Crimmins, & David Bertelsen, 2010). Ranching and pasturing are common agricultural activities in semiarid environments heavily influenced by moisture availability. Ranchers in Southeastern Wyoming are concerned that the soil will not be suitable enough to obtain the desired output of forage for their livestock, due to a lack of precipitation (Adams, 2013). Analysis of phenological information may help to prepare ranchers by identifying areas of vegetation that have higher plant vigor. Semiarid areas are also vulnerable to fire because of dryness. Wyoming has had a history of drought conditions and according to the U.S. Drought Monitor, the majority of Southeastern Wyoming is expected to continue to experience severe or extreme dryness in 2013 (Pollreisz, 2013). Analysis of phenological information could help firefighters locate vegetation with low plant vigor that are susceptible to fire.

In recent years, remote sensing has proved to be a preferred method of studying vegetation phenology. Remote sensing is the technique of obtaining information about objects through the analysis of data collected by instruments not in physical contact with the objects. In vegetation phenology, field observations involve a rigorous amount of labor and are inconvenient to perform at large scales so remote-sensing has become a preferred method (Crimmins et al., 2010; Hmimina et al., 2013). Even so, these two methods should be used in conjunction with each other rather than separately. The use of remote sensing in vegetation phenology is possible because, chlorophyll in healthy leaves reflect a larger amount of light in the near-infrared portion of the electromagnetic spectrum and a low amount in the red portion of the electromagnetic spectrum. In stressed or unhealthy leaves, less chlorophyll results in less spectral reflectance. The reflectance values in a selected study area are collected by the bands of the remote sensing platform. These values are then used to derive the Normalized Difference Vegetation Index (NDVI), a measure of plant vigor that can be used to quantify concentrations of green-leaf vegetation in the desired study area.
Two remote sensing platforms have historically been used in phenological studies. One platform, the Advanced Very High Resolution Radiometer (AVHRR) has recorded data from various NOAA weather satellites since 1981. Its primary function is monitoring clouds through the detection of electromagnetic radiation. As a result, it acquires data through its two bands at a spatial resolution of 1 km and is prone to spatial distortion (Tarnavsky, Garrigues, & Brown, 2008). Another remote sensing platform, Système Pour l’Observation de la Terre (SPOT) is a series of French satellites that carry vegetation sensors. The SPOT VEGETATION sensor is able to acquire data in the visible and near-infrared portion of the spectrum with less spatial distortion than AVHRR (Tarnavsky et al., 2008). The Moderate Resolution Imaging Spectoradiometer (MODIS) is now increasingly being used as a remote sensing instrument for studying phenology (Hmimina et al., 2013). This platform aboard NASA satellites Terra and Aqua acquires data in the red and infrared bands of the electromagnetic spectrum at 250 meter spatial resolution (NASA, n.d.). This results in images with a higher spatial resolution than its predecessors AVHRR and SPOT. MODIS also has more spectral bands for detecting subtle differences in electromagnetic radiation, less spatial distortion for more accurate analyses, and improved noise reduction capabilities (Hmimina et al., 2013; Tarnavsky et al., 2008).

Because of the stated advantages over its predecessors, MODIS has been used in various studies of vegetation phenology, spanning multiple scales and ecosystems. In one example of a phenological study using MODIS by Xiao et al., researchers examined evergreen forests in the Amazon Rainforest (Xiao, Hagen, Zhang, Keller, & Moore III, 2006). The authors obtained NDVI derived from MODIS data for the years 2000-09 and plotted it against precipitation by month. Using these methods, they were able to observe that peak greenness in the rainforest coincides with the dry seasons rather than the wet seasons. One possible explanation mentioned for this is that trees purposely flush their vulnerable new leaves out during drying periods to achieve maximum solar radiation intake and to avoid herbivores that feed on the leaves (Xiao et al., 2006). Researchers have also examined the phenology of coniferous evergreen forests in Sweden using remote sensing techniques (Jönsson et al., 2010). They created NDVI curves from by plotting data derived from MODIS against time, while applying a mathematical transformation. There were significant differences in the curves of the different study areas. The northern study areas had more snowfall leading to more pronounced oscillations in their vegetation index curves. They found that commonly used vegetation index threshold values used for monitoring spring phenology were not applicable to these areas because of the amount of snow. The curves of southern areas had less snowfall and were less pronounced. Despite the unexpected results, it was concluded that this method would have use for monitoring future climate impacts for the area (Jönsson et al., 2010).
While observations of phenology using MODIS have been performed in many different study areas, a similar study has yet to be performed in the Laramie Basin. A study like this may uncover valuable information about the use of MODIS to obtain phenological information in semiarid areas. This investigation also has the potential to yield information about the factors that influence phenological change in this study area.

2. Data and Methods

2.1 Study Area

The Laramie Basin lies between the Medicine Bow Range and the Laramie Mountain Range. The total area of the basin is about 3,400 square miles. The basin’s vertical extent is roughly between 42.00° N and 40.84° N. Its horizontal extent is roughly between -106.32° S and -105.43° S. Big Hollow, the second largest wind eroded depression in the world, is located near the center of the basin. The area is also a closed drainage basin meaning no water in the area flows to external bodies of water such as rivers or oceans. The predominant vegetation type according to the 2007 ReGap analysis is Northwestern Great Plains mixed-grass prairie.

Fig. 1. Study site location, in the Laramie Basin, Lower Wyoming, Upper Colorado
The study areas to be analyzed were determined using considerations of the MODIS imagery and the distribution of the mixed-grasses. First, the study area was classified by NDVI using the June 2007 Mean Annual NDVI data downloaded from MODIS; areas of high and low vigor were located using processes from ESRI’s ArcGIS. Next, 750 x 750 meter areas (9 MODIS pixels), situated completely within mixed-grass classification according to the 2007 ReGap analysis, were located also using ArcGIS processes. Lastly, three of the 750 x 750 meter areas that were within low vigor classification and three of the 750 x 750 meter areas that were within high vigor classification were selected. The reasoning behind this was to capture any phenological differences between the grasses of varying amounts of vigor. The areas were also chosen along a latitudinal gradient (see Fig. 2) to observe any possible changes moving upward throughout the basin.

Fig. 2. Map of study areas (red) and empirically validated locations (blue), all of which are in 2007 ReGap mixed-grass classification. Study areas were selected across a latitudinal gradient. The empirical locations were abbreviated as follows: nearly homogeneous grasses (NHG), grasses many shrubs (GMS), grasses few shrubs (GFS), grass, lichen, rocks (GLR).
Four additional areas (denoted NHG, GMS, GFS, and GLR in Fig. 2) located by field observation using a GPS unit were also analyzed for phenological changes. All of the areas visited were within the mixed-grass classification according to the ReGap analysis. These sites were validated empirically by visiting the sites in person and making field observations. The composition, in terms of vegetation community structure, of these areas varied.

2.2 MODIS Data

The data used in this study was downloaded from the NASA MODIS server and preprocessed at the Wyoming Geographic Information Science Center (WyGISC). The data contains imagery in the form of 8-day composites at a resolution of 250 meters throughout the entire selected year. Composites are imagery within a defined period of time that are averaged together to minimize the influence of cloud cover in imagery. Using PRISM data (Table 1) from the Oregon State Climate Group, the average annual precipitation in the Laramie basin for years 2002-2010 (years in which data was available) was ascertained. A year with relatively low precipitation (2002), medium precipitation (2006), and high precipitation (2010) were selected for analysis. For the purposes of this study, imagery for these years was obtained in order to analyze the effect of water availability on local phenology.

<table>
<thead>
<tr>
<th>Year</th>
<th>Precipitation (Inches)</th>
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<tbody>
<tr>
<td>2002</td>
<td>8.69</td>
</tr>
<tr>
<td>2006</td>
<td>10.88</td>
</tr>
<tr>
<td>2010</td>
<td>13.93</td>
</tr>
<tr>
<td>2002-2010 Avg.</td>
<td>12.34</td>
</tr>
</tbody>
</table>

*Table 1. Precipitation data from PRISM, Oregon State Climate Group. 2002 was used to study Laramie Basin Grassland phenology in a year with lower precipitation, 2006 was used for medium precipitation and 2010 was used for higher precipitation (NACSE, n.d.)*

2.3 NDVI Calculation

A vegetation index is essential to phenological analyses because it allows data from the remote sensing platform to be interpretable in the context of plant vigor. NDVI was selected as the vegetation index for examining vigor in mixed-grasses because it is one the most commonly used indices in the literature (Hmimina et al., 2013; Jönsson et al., 2010; Zhang et al., 2003). NDVI is calculated using the following difference formula:

\[
\text{NDVI} = \frac{(\text{NIR} - \text{Red})}{(\text{NIR} + \text{Red})}
\]

Each pixel in a MODIS image contains a value of reflectivity in the red portion of the spectrum (Band 1) and a value of reflectivity in the near-infrared portion of the spectrum (Band 2). Average NDVI was derived using the above formula for each study area using code in the
python programming language. The code helped to automate the process of calculation of NDVI for each study site and year. It also helped minimize error in data manipulation.

2.4 Outlier Removal

One of the challenges of using MODIS is that cloud cover and presence of snow over vegetation leads to unintentional calculation of NDVI of those objects. MODIS uses 8-day composites in order to mitigate the effect of clouds and snow but outliers are unavoidable because of local climate characteristics. NDVI outliers were identified by plotting NDVI against time and searching for abrupt decreases in amount of NDVI. Whether the decrease was abrupt or not was based on the discretion of the person manipulating the data; no statistical technique was applied. The corresponding MODIS imagery was then inspected for instances of cloud cover over the study area. If the disturbance was confirmed on the imagery, the outlier was replaced by the average of 1) the NDVI value of the previous composite and 2) the NDVI value of the subsequent composite. The averaging was performed in order replace the outlying NDVI value with a value that is likely to be more accurate.

2.5 Curve Fitting and Analysis

The phenology metrics known as 1) start of season (SOS), 2) time of maximum (TOM) and 2) end of season (EOS) in the curve were the primary aspects of the annual curves developed that were analyzed. The start of season according to the USGS is the day of the year identified as having a consistent upward trend in an annual time series NDVI. Time of maximum is the day of the year corresponding to maximum NDVI in an annual time series. The end of season is the day of the year identified as having a consistent downward trend in an annual time series NDVI (U.S. Geological Survey, 2011). Before these metrics are studied, a mathematical technique is commonly implemented on the raw NDVI data in order to compare NDVI with time (Bolton & Friedl, 2013; Hmimina et al., 2013). Linear regression was selected to fit an annual curve to the NDVI data. This allowed for a smoother looking curve, without abrupt fluctuations. The process was performed for each study area. The curves were then analyzed to observe any changes in SOS, TOM, or EOS that corresponded with amount of precipitation in a year. The curves were also compared by geographic location in order to examine possible changes in NDVI by latitude. Annual NDVI curves for the four empirically validated locations within the ReGap mixed-grass classification were also captured and analyzed for differences in phenology. The locations were categorized into general categories: nearly homogeneous grasses (NHG), grasses many shrubs (GMS), grasses few shrubs (GFS), grass, lichen, rocks (GLR). Analysis on these locations was performed in order to observe any phenological changes in type of land cover observed on the ground. The importance in this analysis is that we observed the characteristics of these areas
first-hand and can use those characteristics for analysis. The exact vegetation composition of the six study areas mentioned previously was not observed and thus cannot be used for analysis.

3. Results

Annual NDVI curves for the low, medium, and high precipitation years for each study area were obtained and can be viewed in Fig. 3. Tables containing SOS, TOM, and EOS days are located in the Appendix. Annual NDVI curves for the empirically determined locations were obtained and can be viewed in Fig. 4. The differences by latitude were also examined. The results and discussion of each are reported in the forthcoming sub-sections.

3.1 Differences between Low, Medium, and High Precipitation Years

The annual NDVI curves for each year differed much in terms of shape and timing of phenological metrics. The shape of the curves in 2002 appeared flat with slight fluctuations throughout the year in 4 of the 6 study areas. SOS in this year generally occurred between day 65 and day 89. TOM varied greatly with some sites reporting its highest value of NDVI earlier in the season and some sites much later in the season. EOS generally occurred between day 257 and day 273. The shape of the curves in the 2006 appeared more pronounced than those of 2002. SOS in this year generally occurred between day 73 and day 81, occurring sooner in the high NDVI study areas. TOM again varied with most sites reporting its highest value of NDVI between days 137 and 153 and other sites around day 265. EOS generally occurred between days 281 and 323, later than the low precipitation year. The shape of the curves in 2010 consistently appeared to have much more defined peaks than the previous years. SOS in this year generally occurred between day 73 and day 81, generally occurring sooner than in other years. TOM occurred between days 153 and 161. EOS occurred between days 289 and 321, again later than the 2002.

There were a few consistent observations of the annual NDVI curves. 2010 had the highest average NDVI and max NDVI value in every study area. 2002 generally had the lowest average NDVI in each study area. Secondary peaks where NDVI briefly increased and decreased around day 250 are visible in many of the curves, a likely result of mid-summer showers. Average NDVI was generally higher in the selected high NDVI study areas than the low areas.

3.2 Examination of Empirically Selected Locations

Based on the annual NDVI curves of the four empirically selected locations (see Fig. 4), there were apparent phenological differences between the observed vegetation categories. In all three years in which data were collected, the location GMS displayed the highest average NDVI and the location GLR was a consistent second. NHG and GFS consistently displayed the lowest amount of NDVI.
Fig. 3. Annual NDVI Curves for the study areas. 2002 (lower precipitation) is in red, 2006 (medium precipitation) is in green, 2010 (higher precipitation) is in blue.
Fig. 4. Annual NDVI Curves for the empirically validated areas. Nearly Homogenous Grasses are in blue, Grasses with many shrubs are in purple, grasses with few shrubs are in green, grass with lichen and rocks are in orange.
3.3 Difference in Latitude

There did not appear to be any immediate, discernible differences in the annual NDVI curves in respect to latitude. Timing of SOS, TOM, and EOS all appeared to occur around similar days. Also, NDVI between areas did not appear to vary moving from north to south.

4. Analysis and Conclusions

4.1 MODIS Ability to Detect Phenological Changes

MODIS proved to be an effective platform for detecting intra-annual changes in Laramie Basin grassland phenology. By comparing the annual NDVI curves we were able to observe variances in the timing of SOS, TOM, and EOS between years with three different amounts of precipitation (low, medium, high). As one might expect, the curves for 2010 had the highest average NDVI and the curves for 2002 had the lowest average NDVI. Generally the average amount of NDVI decreased with amount of precipitation for a year. SOS generally occurred earlier in 2010 than in the other years. This is likely due to the grasses in the study areas flowering earlier because of the extra water available.

Using data from MODIS we were also able to effectively capture the differences in amount of NDVI for the empirically selected locations. GMS and GFS had higher average annual NDVI because those areas contained more shrubs. Shrubs have a higher leaf area index than the mixed grasses so more NIR light is reflected, resulting in higher NDVI. GLR likely had high average annual NDVI because a very small amount of soil was exposed in that area in comparison to the other areas. Soil tends to absorb NIR light resulting in lower NDVI calculations.

We were not able to identify any differences in phenology in respect to latitudinal location using MODIS. This is probably a result of the size of the study area rather than MODIS’ capabilities. Professor William Reiners, an expert of the Laramie Basin study area, expressed that latitudinal location has a miniscule role on phenology in the Laramie Basin due to its relatively small size. The distance from the upper extent to lower extent is a mere 81 miles and the local geography does not vary much across that extent (personal communication, June, 2013). As a result this possible factor was not as thoroughly researched.

4.2 Usage of ReGap Dataset

Other interesting observations came from the use of the 2007 ReGap land cover data. Prior to visiting the study locations, the general assumption was that areas classified as mixed-grass prairie would generally appear as areas of mostly homogeneous grasses that may or may not include some shrubs like sagebrush. Upon making observations in the field, it became apparent that the community assembly of locations classified as mixed-grasses can vary.
Three general sub-categories (see Fig. 4) were observed: near-homogeneous mixed-grasses (of which can be further divided based upon recency of grazing), mixed-grasses with varying amounts of shrubbery, and gravelly areas with short grasses, lichen and shrubs. The differences in characteristics of the annual NDVI curves for each type of area were apparent. It appears that higher NDVI are a result of the additional vegetation types covering more of the exposed soil. Generally, the more shrubs that an area had, the higher NDVI was for that area. The NDVI curves for the stony area with grass, lichen, and shrubs were interesting. One might believe, because of the area’s barren appearance that NDVI would appear lower than the other areas. Contrary to that belief, that location consistently had the second highest average amount of annual NDVI.

Fig. 4. Pictures of the empirically validated locations. Nearly Homogenous grasses are displayed in the top-left image, grasses with many shrubs are displayed in the bottom left image, grass with lichen and shrubs are displayed in the right image.
4.3 Limitations

Although the results from the MODIS data were valuable in understanding Laramie Basin phenology, there were some limitations within the methods. One limitation was that the only the amount of total precipitation in a year was considered not what time of year the precipitation actually occurred. For example: A year in which much precipitation occurs in the earlier months might see SOS begin sooner. The influence of timing of precipitation could have been explored in more detail. Another limitation was the amount of uncertainty with the MODIS data. Because of the climate of Laramie Basin, there was usually much cloud cover and snow that contaminated some of the earlier MODIS composites for each year. This made calculation of NDVI for those times difficult and possibly inaccurate. It also made determining when SOS occurred difficult. A curve fitting technique that is more specific to this study area might produce more accurate annual NDVI curves and metrics. Further studies could help to address these limitations.

4.4 Future Studies

Further knowledge of variations in Laramie Basin phenology may be obtained through the implementation of future studies. Vegetation phenology can be influenced by surface geology, bedrock geology and soil type (Dr. William Reiners, personal communication, June, 2013). It may be interesting to stratify sample areas across these different attributes to observe any possible changes. Another way to explore these variations may be to interview land owners and resource managers who might be more familiar with changes occurring in their area of interest.

4.5 Conclusion

MODIS is an effective platform for observing changes Laramie Basin Phenology. Based on the data, we know when SOS, TOM, and EOS usually occur in this study area. This information could be useful for determining grazing schedules or analyzing fire vulnerability during a year. We also know that NDVI calculations for mixed-grasses tend to increase with higher precipitation for a year. From the empirically located areas analysis, it has been realized that amount of NDVI in an area may be a direct to the local community structure within mixed-grass areas. Areas with the highest amount of NDVI might not be the most suitable for grazing because of the chance they are filled with shrubs. Looking for areas with a lower amount of NDVI may reveal more suitable locations for grazing. Further studies relating to geology could possibly help refine our knowledge of the phenology of the Laramie Basin.

Acknowledgements

This study was financially supported by the McNair Scholars Program, Trio, and the University of Wyoming.
Works Cited


Appendix

2002 Phenology Metrics

<table>
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<th>Start of Season (Day)</th>
<th>Time of Max (Day)</th>
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<td>249</td>
<td>357</td>
</tr>
<tr>
<td>L2</td>
<td>89</td>
<td>161</td>
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</tr>
<tr>
<td>L3</td>
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<td>265</td>
<td>273</td>
</tr>
<tr>
<td>H1</td>
<td>81</td>
<td>137</td>
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<td>273</td>
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2006 Phenology Metrics

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<th>Start of Season (Day)</th>
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<td>321</td>
</tr>
<tr>
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<td>141</td>
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</tr>
<tr>
<td>L3</td>
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</tr>
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2010 Phenology Metrics

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<th>Start of Season (Day)</th>
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<th>End of Season (Day)</th>
</tr>
</thead>
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<td>57</td>
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<td>321</td>
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<tr>
<td>L2</td>
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</tr>
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</tr>
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<td>H3</td>
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</table>
Kimberly Sanchez

Faculty Mentor: Todd Surovell, PhD, Anthropology
Graduate Student Mentor: Stacy Sewell, MS

Research Topic: Working Hard or Hardly Working? The Division of Labor among the Dukha Pastoralists in Mongolia

Introduction

The sexual division of labor has long been a topic of study within anthropology. Many have claimed or displayed evidence that there is a difference in male and female labor activities and that this difference is a near universal trait among small scale societies (Murdoch and Provost 1973, White, Burton and Brunder 1977, Kelly 1995, Hodgson 2000, Crate 2006, Homewood 2008). One of the most argued causes of the sexual division of labor relates to physical constraints. Some have argued that women’s activities are greatly influenced by pregnancy, nursing, and childcare (Brown 1970 and Goodman et al. 1985) while others have put forward that, because of their relatively greater physical strength, men partake in more physically demanding kinds of work (Murdoch and Provost 1973).

Regarding the division of labor with age, adults are usually portrayed as doing much, if not all, of the work within a society. The very words “men” and “women”, which have the idea of adult age embedded in their meaning, have often been said in place of “males” and “females”, when being used to discuss labor activities and workloads. Although it is ignorant to propose that only adults perform work or they perform the most amount of labor, there is some biological truth present in the ideas. The ability to perform manual labor or other work tasks generally increase with age then decrease later in life.

Within pastoral societies specifically, the allocation of labor by age and sex has common themes such as the separation of men’s and women’s work areas, where specific structures or areas within or outside the camp are used, maintained, and/or ascribed to either men or women (Jarvempa and Brumbach 2006) and the use of child labor (Fratkin 1989). However, the division of labor practiced by some pastoral societies is not always clearly defined nor always enforced (Jarvenpa and Brumbach 2006) and may be influenced by political, economic, and sociocultural trade-offs (Thompson and Homewood 2002).

This study examines Dukha labor activities to test the traditionally held beliefs that there
is a universal division of labor among men and women and varying age groups, as well as whether these divisions or lack thereof are practiced by the entire group.

**Background**

In the coniferous forests and sprawling mountains of the northernmost province of Mongolia live the Dukha, a group of reindeer herders, or tsaatans, who for centuries have roamed the area that now makes up the Russian Republics of Tuva and Buryatia and the Khövsgöl province of Mongolia (Wheeler 2000). The Dukha, as they call themselves, have only recently become, in just a matter of decades, Mongolia’s only nomadic pastoralists who herd reindeer and are currently the southernmost herders of reindeer in the world (Wheeler 1999). Currently, along with milk and meat from domesticated animals like goat, reindeer, and yak, the Dukha survive off of hunting small, large, and aquatic animals, gathering native flora including wild onions and pine nuts, selling goods such as antlers and hides, and income provided by accommodating tourists. While current data is unavailable, past research has indicated that around 30 households were living in Khövsgöl province in 1999 (Wheeler 1999 and Inamura 2005). Typically, a nuclear family lives in a conical lodge known as an ortz and usually reside in a camp comprising many families.

It should also be noted that in the past, the Dukha constituted a part of a larger ethnic group that encompassed the neighboring Tuvans, Tofalar, and Oka Soyots. However, since the annexation of Tuva to what was the Soviet Union in 1921 and a virtually closed border, the four groups have become distinct cultural entities (Wheeler 2000). The closed border not only separated the four groups, it has severely impacted the reindeer upon which the Dukha depend. Without new genes, reindeer constantly suffer from inbreeding and poor health. Additional factors that have played into the decline of reindeer herds in the last half of the 20th century include a lack of veterinary services, the selling of reindeer by younger herders for income, increased predation from wolves and death resulting from inexperienced herders (Wheeler 2000 and Inamura 2005).

**Methods**

Data for this research were adapted from an ongoing ethnoarchaeological study examining the spatial behavior within a Dukha summer camp. To study the spatial patterning, a camera was mounted on a mast some 13 feet into the air in front of a household and set to take a photograph every 2 or 3 minutes, of the area directly surrounding the dwelling, from early morning until late evening. Although nine households made up the camp, only four households, Houses 1, 3, 6, and 7, were photographed in the systematic way described previously. Various aspects of each photo were then analyzed and recorded, including identifying any individuals
present within the photo, digitally mapping the location of individuals and any activities that were being performed by them. Direct observations of activities that occurred inside the dwellings were also recorded.

For the purpose of this study, only identifiable residents of the camp were included in the exterior data analysis. Interior activities, which were directly observed and recorded every minute over a 20 or so minute time frame, were included in the analysis. Categories regarding labor activities were taken from Murdoch and Provost’s 1973 cross-cultural analysis of the division of labor and separated into domestic (cooking) and non-domestic (animal tending, production of goods, and other) activities. As they were not found among the tasks examined by Murdoch and Provost, the additional categories of cleaning and childcare were added to the domestic work activities. Along with collecting data regarding work being performed, leisure time occurrences were also sorted into categories, including “Moving”, “Stationary Activities”, “Sustenance Activities”, “Personal Activities”, “Sensory Activities” and “Other”, and analyzed, so as to give a more holistic picture of Dukha activities.

As several households could be seen in the backgrounds of the images gathered at Houses 1 and 3, due to the camp set-up and placement of the camera during fieldwork, extra measures had to be taken in order to examine the work being carried out at those locations (although these measures were established specifically for those houses, they were later applied to Houses 6 and 7 to ensure conformity in the data analysis). A unique 30 by 30 meter square boundary was defined for each locale in excel then, using these artificial perimeters, a program was written to sort through all the camp data and take out data points that did not lie within the borders. The resulting data points were used to investigate household labor behaviors.

**Results**

A chi-square test was performed to examine the hypothesis that there is a significant difference in men’s and women’s labor activities. As demonstrated in Figure 1., the camp exhibited a significant difference in the amount of work performed by men and women ($\chi^2=368.58$, df=1, p<<.001).

Adjusted residuals were calculated and, as noted in Table 1., demonstrated that women spent noticeably more time in labor activities then men.

The second hypothesis, also tested using chi-square, stated there was difference in workload by age among the camp residents. There was a statistically significant difference in the performance of work by age within the camp ($\chi^2=1136.99$, df=2, p<<.001).

Adjusted standardized residuals, shown in Table 2, displayed that adults were working more than expected and children less than expected.
Percentage of Time Spent by Sex

![Bar chart showing the percentage of time spent by sex: Male and Female.](Diagram)

*Figure 1. Relative frequency of work performed by each sex*

<table>
<thead>
<tr>
<th></th>
<th>Working</th>
<th>Not Working</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>-13.73</td>
<td>13.73</td>
</tr>
<tr>
<td>Female</td>
<td>13.73</td>
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*Table 1. Adjusted Standardized Residuals for the amount of work performed by sex*

<table>
<thead>
<tr>
<th>Age Group</th>
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<td>Children (0-12)</td>
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<tr>
<td>Adolescents (13-19)</td>
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<td>-1.71</td>
</tr>
<tr>
<td>Adults (20+)</td>
<td>28.69</td>
<td>-28.69</td>
</tr>
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</table>

*Table 2. Adjusted Standardized Residuals for the amount of work performed by age groups*
Although not a part of the original hypotheses, a series of tests were performed to examine the sexual division of labor within individual age sets. As seen in figures 3a and 3b, there is a significant difference in the amount of labor performed by both male and female children ($x^2=121.63$, df=1, $p<<.001$) and male and female adolescents ($x^2=72.85$, df=1, $p<<.001$).

![Children](image1)

*Figure 3a. Relative frequency of work performed by each sex within the child age set*

![Adolescents](image2)

*Figure 3b. Relative frequency of work performed by each sex within the adolescent age set*

However, this relationship, in which females and seen working more than males, was not seen within the adult age set. On the contrary, adult men and women workloads weren’t significantly different ($x^2=.60$, df=1, $p=.436$), as seen in Figure 3c.

![Adults](image3)

*Figure 3c. Relative frequency of work performed by each sex within the adult age set*
The third hypothesis, which states that there is a difference in the types of work tasks performed by men and women, was tested using chi-square. The camp provides data that supports the hypothesis that men and women perform different types of labor ($x^2=242.24$, df=5, $p<.001$), as seen in Figure 4.

![Percentage of Labor Time Spent in Different Tasks](image)

**Figure 4. Relative frequency of types of work performed by each sex**

Adjusted standardized residuals, as shown in Table 3., showed that certain tasks are performed more by either males or females, such as females in animal tending and men in the production of goods.

<table>
<thead>
<tr>
<th>Labor Task</th>
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<th>Female</th>
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<tbody>
<tr>
<td>Child Care</td>
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<td>-0.65</td>
</tr>
<tr>
<td>Cleaning</td>
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<td>Cooking</td>
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<td>Animal Tending</td>
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<tr>
<td>Production</td>
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<td>-10.84</td>
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<tr>
<td>Other</td>
<td>7.13</td>
<td>-7.13</td>
</tr>
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</table>

**Table 3. Adjusted Standardized Residuals for the type of task carried out by males and females**

**Discussion**

This study demonstrates that there is a clear, but fluid division of labor among the Dukha pastoralists. As shown, there were significant differences between male and female workloads. In the camp, women were observed performing labor activities more often than men. This observation doesn’t necessarily mean that men work less hard or less often; it simply means that men work
less often than women in camp. The placement of the camera limits the extent to which the data can be considered a holistic picture of Dukha society because we don’t see what is happening outside the settlement. This might bias the data towards women due to the fairly common practice among pastoralists of male herders, whose work regularly occurs outside the confines of camp.

However, this significant difference is not driven by adults, but rather children and adolescents. It is non-adults who have a sexual division of labor when in regards to work load. The high amount of work performed by younger females, compared to younger males, could be attributed to preparing for marriage. It is a widely documented phenomenon that, in smaller scale societies, women marry older men (Kelly 1995) and they marry at an earlier age, around the time of menarche (Lee 2003, Nyamongo 2000, Hern 1992). Men’s average age at first marriage is in the late 20’s to early 30’s among the Maasai (Gray, Ellison, and Campbell 2007 and Coast 2006) and about 32 among the Turkana (Dyson-Hudson and Meekers 1996). Women, however, are seen marrying at an earlier age: 15-20 among the Gabbra (Mace 1996), late teens among the Datoga (Borgerhoff Mulder 1992), early to mid-teens among the Borana (Nyamongo 2000). As women marry earlier, they consequently need to start preparing for married life, and the work that comes with it, earlier in life. Since men typically marry at a later age, they do not need to begin preparing until a later age, perhaps late teens to early 20’s.

The task differentiation of men and women revealed that women were more often seen taking care of goats, yaks, and most of all reindeer; about 50% of their working time to be specific. The female’s work with the reindeer in camp could be attributed to the desire to control the flow of milk. Those that gather the milk may have more say in where it goes and what it is made into, just like a hunter has some leeway over where and to whom a portion of their kill might go. Another possible explanation of this phenomena is simply that males and females are acting cooperatively by taking turns caring for the animals; men away from camp and women inside camp. At the same time, men were observed in the production of goods (e.g. wood working) more than any other task. This preoccupation with wood working might be because this labor activity doubles as a social event for men. It wasn’t often that one would see a lone wood worker. Usually there were groups of men and adolescent boys sitting in a rough circle; some lounging while others worked. However, it seems highly likely that, like milking, wood working could be undertaken in order to control where the finished product goes. This idea is supported by the fact that the individual who had by far the highest number of observations (around 250) was, as a new groom, making furniture to be used in his new house.

With the division of labor by age, the pattern at the Dukha camp follows the pattern found in many, if not the majority, of societies small and large; where children begin doing small amounts of work when they are young and continue to work, with workloads increasing, as they
grow older. What makes the Dukha division of labor by age interesting is the how the sexual division of labor plays into each age sets work behaviors. When the sexual division of labor was examined within each age set, child and adolescent gender relations mirrored the overall pattern, where there was significantly less male work than female work. However, within the adult age set, there was no significant difference between the workloads of men and women. These phenomena could be the result of cultural or societal pressures that push female children and adolescents to work more and allow males more leisure time. These differences could also be due to childcare by other children or teens, a common task performed in small scale societies, especially by girls.

The results of this study and its statistical analysis demonstrate the sexual and age related differences in labor performance as well as the significance of spatial, temporal, and social variables in Dukha work behaviors. Taken as a whole, these results demonstrate the impact that non-adults have on group work behaviors and the importance of incorporating children and adolescents into research on the division of labor.

References
Over the past two decades, a new form of theoretical framework has come to light in the area of research within the social sciences. Intersectionality, which is the study of how multiple identities work for or against the person or group who houses them, is the main foundation for this research. Examining the lives of lesbian, gay, bisexual, and transgender people in rural Wyoming is the premise of this study, where identifying how they navigate intersectionality in their own lives is the main outcome.

Previous Literature

While previous research focused on white LBQ women has drawn on such aspects such as recognizing the importance of the coming out process (Petzen 2012), Dr. Katie Acosta’s book, Amigas y Amantes (friends and lovers) highlights previously unrecorded aspects of LBQ Latina life in the hope of better understanding the intersections of race, gender, and sexuality in the context of the family. Acosta accomplishes this by focusing on the theme of femininity in the Latina/o community, the role of religion, the issues surrounding interracial or interethnic same-sex relationships, strains imposed on these relationships due to immigration status, and how these Latinas not only accomplish family life, but navigate the split between families of choice and families of origin.

Dr. Acosta’s study was laid in the foundations of feminist scholarship and intersectional analysis in the attempt to identify a Latina feminist standpoint. The study comprised of forty-two in-depth interviews paired with fourteen months of participant observation. Participants were acquired primarily through New York’s Lesbian, Gay, Bisexual and Transgender Center, word of mouth, and queer online communities. Of these participants, eighteen were women who immigrated to the United States as adults while the remaining twenty-four were either born in the United States or had been raised in the country for most of their lives (7).

The majority of first-generation Latinas in this study were college-educated women who
enjoyed a relatively comfortable standard of living, while most second-generation participants were raised in poor, working-class communities of color. It is noted, however, that many of these women had achieved social mobility through obtaining various forms of college, and in some cases, professional degrees. Most participants were involved in a romantic relationship with a partner of a different ethnicity, and only eight of the interviewees were involved with someone of the same nationality. This proved to be a significant aspect in emotion work in regards to body image and cultural clashes within the relationship and family spaces (8-10).

An important aspect in Acosta’s research involves the language in which she uses to describe the individuals she worked with. For the purpose of obtaining a variety of Latin ethnicities, the term ‘Latina’ was used as a vehicle to create a space where all ethnicities would be recognized on an equal platform. Similarly, the use of the term ‘sexually nonconforming’ created an umbrella for Latinas to move freely in their sexual identities without terminological constraints (4-5). Previous research dictates that language used to describe the sexuality of women of color can affect who participates and may or may not create an unsafe space for which participates are able to speak to these identities (Asencio 2009; Acosta 2010; Moore 2011).

Notions of positionality have proven essential in regards to research involving sexually nonconforming women of color. Dr. Mignon Moore speaks continuously to the importance of having “insider status” (Moore 2011), which Acosta notes and defends throughout the text. Insider status can be as simple as knowing the person being interviewed, or as complex as having specific identification markers that send a message of ease to the population being researched. One aspect of Acosta’s research that adds to this idea of positionality is the antithesis of insider status. During participant observation, Acosta specifically notes the way she was received when she brought her woman partner to social gatherings as opposed to her later male partner. This caused a sense of cognitive dissonance among the participants which resulted in a layer of distrust (11). This event speaks to the bearings and legitimacy of a queer notion of family, where certain intersections hold great importance to how Latinas perceive each other as well as outsiders.

That being said, a major finding in the study also revealed that LBQ identified Latinas go back and forth at holding certain intersections of identity above others. The study found that these women straddled the borderlands (or the gray area between one identity and way of life to another), where many found themselves choosing to be surrounded by unsupportive family of origin rather than associating within already established gay communities (12). While it may seem contradictory to find that LBQ Latinas exhibit feelings of distrust in Acosta’s partner switching and then themselves reject integration into a gay community, Gloria Anzaldúa (2002) justifies this anomaly with the term “nepantla”, a place where one lives in a constant state of displacement. Acosta uses nepantla in her research to describe the space that sexually
nonconforming Latinas negotiate with their families of origin and choice: the space where they negotiate the visibility and invisibility of their sexualities in different contexts. In this way, women in this text are nepantleras; they are always in between spaces, always in transition.

Acosta succeeds in creating a Latina feminist space, as she identifies modes of resistance by way of emotion work. The text contributes to the queering of this subfield by exploring the lengths that sexually nonconforming Latinas go to in caring for families of choice and origin. Weston (1991) defines chosen families as those that gay and lesbian individuals create to incorporate their friends, lovers, and children as kin. Existing scholarship on the LGBTQ community and family has frequently looked at families of choice and origin in separate isolation (Moore, Stambolis-Ruhstorfer 2013; Rincon, Trung Lam 2011), whereas it is a goal of this study to determine how creating families of choice aide in expanding one’s support network and promote resiliency for the individual or couple in question. In creating families of choice, Latinas resist traditionally held notions of the nuclear family and the importance of such a structure in traditional Latin households (13).

Perhaps one of the greatest contributions this text provides is the examination of not only how these women negotiate original family, but how original family negotiates them and how that affects these women’s overall identity. The study described how at times, the woman’s sexual variance had small bearing compared to race in the family’s eyes. Previous literature on interethnic and interracial relationships is plentiful on heterosexual relationships, but lacks in the department of sexually nonconforming relationships. Within a heterosexual context, men are more likely to date interracially than are women, and women in particular report familial disapproval as a deterrent from transgressing racial boundaries (Clark-Ibañez, Felmlee 2004). Prior to this text, the question begged: How much does familial disapproval influence same-sex interracial/interethnic couples in particular? As family of origin has proven to be a central component to the foundation of an LBQ Latina’s identity, the study participants were tasked with negotiating familial support for their unions (78-79). The research pointed to a very structured racial hierarchy, where more familial stress was expressed by respondents who engaged in a relationship with a woman of a lower racial standing. It was learned from this study that racial minorities do not always find solidarity within each other, as one participant clearly indicated her family’s racist tendencies towards her black partner (77). This finding contrasts with existing literature which indicates that same-sex couples have experienced more family stress in regards to their sexuality rather than race (Rostosky et al 2008).

According to the Williams Institute, Wyoming (and specifically Fremont County) holds one of the largest populations of LGBT families in the entire nation (Williams Institute 2012). While the vast majority of the state is predominantly heterosexual and white, the Wind River
Indian Reservation is an oasis of diversity, which many gay and lesbian families call home. The State of Wyoming is widely known for vast open spaces and measuring distance from Point A to Point B in hours rather than miles. Towns and counties foster their own individual flavor, as do the roads that take its drivers to their destinations. One of the major interstates, I-80, leads its drivers to several towns with racial diversity. For example, there are substantial Hispanic populations in Laramie, Rawlins, Rock Springs, and Jackson Hole. According to U.S. Census data, the majority of Wyoming’s ethnic diversity comes from these towns along the interstate (U.S. Census 2010).

While there has been research conducted on people of color in rural areas, what is largely left out of the literature is the experiences of LGBT individuals in those ethnic groups. In order to obtain a better understanding of the LGBT ethnic experience in a rural area, I conducted several interviews of individuals who identified with a non-white ethnic group as well as LGBT. Because the LGBT community is a traditionally disenfranchised group, I was careful when choosing my participants. Having an “in” in the community (as Dr. Katie Acosta does in her book, Amigas y Amantes) is important when handling these groups, as it creates a sense of trust and confidence. This leads to substantially better results, so I was fortunate to have many LGBT friends both in Laramie and on the Wind River Indian Reservation (where I am from). Through my personal connections with them, I was able to spread word about my intended research, and had those who were interested contact me by phone or social media.

While I had many volunteering to interview with me, I narrowed my selections by several factors. My respondents needed to be 18-30, as that is the age group that I grew up with and therefore have a stronger sense of relation. This also gains trust and confidence within my relationships to the respondents. Another requirement for my respondents was number of years lived in Wyoming. Wyoming has a very distinct culture, and I wanted to be sure I was capturing the heart of Wyoming in my respondents. These individuals had to have lived in the state for five or more years. Understanding the Wyoming LGBT experience was fulfilled in setting this requirement in place. Another two strict requirements of my respondents were to identify as LGBT and a person of color. As this is the basis of my study, further explanation is not required.

In terms of data collection, I recorded my interviews with a voice recorder and then stored the information on my personal laptop. Each of my respondents signed an agreement that gave my permission to do so, and each interview lasted anywhere from 45 minutes to two hours. Each individual remains anonymous and agreed to follow up questions and interviews. Being that I wanted to have an open ended discussion rather than a question and answer style interview, I asked basic questions and then follow up questions to promote elaboration.
Results:

Uneven Experiences

One of the most compelling aspects of my research was the uneven distribution of discrimination over the intersections between race and sexual orientation. Three of my respondents were Native American (Eastern Shoshone or Northern Arapahoe), and all three emphasized their experiences as Native Americans living in Wyoming. To them, experiences of racism and classism did more to form their identities as a minority in a largely homogeneous state. While their families often struggled with their sexual orientation, they did not cite sexual orientation as a major factor in how they identified as individuals with their surroundings. This was not the case, however, for one of my Native American participants. Identifying as Two Spirit, which means possessing both a male and female in one body, not only experienced discrimination from racism, but harassment in his own community for being Two Spirit. He blames this primarily on Western influence, as Native American tribes and communities traditionally regarded Two Spirit individuals as more spiritual and gifted than the general population. My lone Hispanic participant found that his sexuality was one of his most elevated aspects of identity, due to the Catholic nature of his family. All five respondents placed high value on family and their family’s perceptions on sexuality and gender. On the outside, however, race was generally a topic all respondents had to navigate on a regular basis.

Rural Experiences

When asked about their experiences as LGBT people of color in a rural environment, the majority of my respondents noted the “live and let live” nature of Wyoming culture. While racism was prevalent across the board, my participants were noticeably at ease discussing sexuality due to what little impact it had on how they were perceived by the outside. Even though the majority confessed they were nervous to hold a partner’s hand in public, they took solace in the fact that they were confident they wouldn’t face any outward homophobia. One respondent went so far as to say: “I think since more states are legalizing same-sex marriage, the people in Wyoming are catching on to the idea that we don’t need that Matthew Shepard dark cloud over us.” The respondent then went on to say that Wyoming’s history with LGBT people is not the brightest, and public consciousness seems to err on the side of caution when regarding these issues. This creates a unique environment for a rural area: sensitivity is displayed amongst the public in recognition of LGBT issues, while the Wyoming Legislature continues to vote against LGBT legislation such as marriage equality and employment nondiscrimination.
Conclusion

Overall, my five participants in this introductory study expressed their everyday struggles navigating an environment where they are not the majority. On the inside of their communities, factors such as religion and family affected their status as LGBT individuals, and on the outside they spent most of their time dealing with race. Further research on the intersectionalities of LGBT people of color in rural locales would benefit from a stronger sampling pool, where more voices may be heard and more area in Wyoming could be covered. The research paints a promising picture; one where there is hope for a growing LGBT presence and acceptance for the LGBT community. There are several things that could have been changed or done differently in this study, one major aspect being time allowed for follow up interviews. I did not anticipate that my participants would not only have other things to say, but want to set up another time to speak to me after the initial interview. As the summer progressed, I found myself pressed for time and did not get to each of the five respondents that wanted to speak. I also found myself wanting to ask further questions, and was only partially able to with those that lived in Laramie, Wyoming (where I currently live). However, for the purpose of this research, LGBT lives of racial minorities have not only been recognized, but gained legitimacy through personal stories and experiences.

Works Cited


