RETENTION FACTORS FOR UNDERREPRESENTED UNIVERSITY STUDENTS IN THE NATURAL RESOURCE AND RELATED SCIENCES AT TEXAS A&M

A Dissertation

by

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Submitted to the Office of Graduate and Professional Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

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May 2017

Major Subject: Wildlife and Fisheries Sciences

ABSTRACT

Hispanics, Blacks, and American Indians are historically underrepresented minorities in the sciences and even more so in the natural resource and related science (NRRS) majors. An effort to better understand retention and recruitment factors at Texas A&M University for underrepresented minorities was evaluated. In 2011, using Dillman's methodology, a comparative study comprised of 279 online survey questions with Likert scale responses was designed and then administered to 4,779 pre-professional minority and majority undergraduate and graduate students within the five NRRS colleges (Science, Agriculture and Life Sciences, Geosciences, Veterinary Medicine and Biomedical Sciences). The study objectives first identified relevant individual and institutional retention factors, and secondly, determine significant associations for the demographic variables of race/ethnicity, gender, income, classification, and transfer status using non-parametric Chi-square tests. Results found seven factors significantly contribute to retention among NRRS disciplines, two of which were individual retention factors: (1) self-reliance (self-efficacy) and (2) the influence/support from a university advisor. The remaining five were institutional factors: (1) study skills, (2) participation in faculty-led research, (3) general academic advising, (4) participation in organizations that foster an interest in the outdoors, and (5) secondary education experiences. "Perseverance" (self-efficacy) was the most influential retention factor (90% of responses) for all survey respondents, regardless of

demographics at TAMU. My results indicated that among underrepresented minority populations, American Indians have a strong self-reliance rating (100%) but the rating for advising, socialization and research opportunities with faculty were low (0%). Conversely, Mexican (native) (40%) and Asian/Pacific Islander engagement in social and academic exchanges with faculty was higher (39%) compared to other respondents' (~22%). General academic advising had high usage Among Black (44%) and Mexican (native) (46%) respondents. The Mexican (native) reported a higher reliance on individual study skills (94%) when compared to Blacks (59%). In secondary education experiences, Other/International (66%) and Whites (64%) indicated middle school was important in skill development in contrast to Blacks (52%) and Hispanics (46%) whose career interests were not stimulated by earlier academic experiences. Income, although important, was not a significant ($P>0.05$) predictor compared to ethnicity and race. Texas A&M in its commitment to retain NRRS students should acknowledge that higher self-efficacy levels among its students along with student service support in the forms of effective general academic advising, systemic socialization, and research opportunities with departmental faculty would be effective in the pre-professional success of its future NRRS professionals. Finally, diversity and retention in the NRRS shows signs of beginning at the K-12 level, therefore, Texas A&M should consider forging interdisciplinary collaborations and partnerships in the public sector as well as in higher education to develop necessary academic skills for retaining underrepresented minorities in the NRRS.

DEDICATION

To Charlotte, the truest "12th Man" and friend I could ask for in this lifetime.

ACKNOWLEDGEMENTS

I would like to thank my committee chair, Dr. Roel R. Lopez for his professional guidance and never failing endorsement. Dr. Russell A. Feagin, Dr. Nova J. Silvy, and Dr. William H. Neill, your editorial remarks were invaluable. Thank you for holding true to your expectation of scholarly work and making me a better writer

Thank you to all my friends and colleagues at Texas A&M University who were consummate in their never failing professionalism and their gift of good humor and service above and beyond the call of duty. The Wildlife and Fisheries Sciences Department- chaired by Dr. Michael Masser- who exemplified the Aggie Spirit by their belief in my scholarly journey. To my students, you inspire me and remind me to have the heart of a child: to be loving, understanding, and forgiving. To all my family, thank you for your love and encouragement. Finally, I would like to thank my mother and father, Anita and Guillermo Moreno who never understood why, but always supported me.

CONTRIBUTORS AND FUNDING SOURCES

This work was supervised by a dissertation committee consisting of Professors Roel R. Lopez, William H. Neill, and Nova J. Silvy of the Department of Wildlife and Fisheries Sciences and Professor Russell A. Feagin of the Department of Ecosystem and Science Management. Dr. Joni Ricks, statistician at University of California, Los Angeles assisted with statistical analysis and consultations. All other work for the dissertation was completed independently by the student.

Graduate study was supported by a dissertation research fellowship from the Sloan Foundation.

NOMENCLATURE

Academic classification	Freshman, Sophomore, Junior, Senior, Graduate and Post-Graduate
American Indian	Individuals self-reporting as Native American/or American Indian/or Alaska Native
Asian/Pacific Islander	Individuals self-reporting as Asian/or Pacific Islander
Black	Individuals self-reporting as Black and African American
College of Science	College of Science; or, College of Biological Sciences
Gender	Male or female
Graduate	Graduated, with Master, Doctoral, and Post-Doctoral Degree
Hispanic	Individuals self-reporting as Hispanic, not Mexican (native)
HS	High School
Jr. HS	Junior High School
Majority	White population
Mexican (native)	Individuals self-reporting as Mexican, not Hispanic
Minority	All underrepresented populations other than White
MS	Middle School
Native American	Individuals self-reporting as American Indian/or Native American/or Alaska Native
NRRS	Natural Resource and Related Sciences

OISP	Office of Institutional Studies and Planning
Ethnicity/Race	For the purpose of the this study, terminology based upon Texas A&M University's Office of Institutional Studies and Planning
STEM	Science, Technology, Engineering and Math
TAMU	Texas A&M University, College Station
Transfer	Students not initially enrolled in the TAMU System
Underrepresented	All minority populations, both men and women
Undergraduates	Freshman, Sophomore, Junior, Senior
WFSC	Wildlife and Fisheries Sciences Department
White	Individuals self-reporting as White only

For the purpose of this dissertation, unless otherwise noted, underrepresented and minority (non-White) will be synonymous throughout the text and will include women, both White and non-White, as it pertains to statistical significance in reporting the numerical results.

For the purpose of this research, "students in related sciences" is defined as students not in the Wildlife and Fisheries Sciences Department, but pursuing other majors in Science, Agriculture and Life Sciences, Geosciences, Veterinary, and Biomedical Sciences within the TAMU System.

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1. INTRODUCTION

1.1 Texas A&M University and Commitment to Diversity

The Texas A&M University (TAMU) has grown from its main campus located in College Station to one of the largest higher education systems in the United States, known as the Texas A&M University System (TAMUS). With a network comprised of 11 university campuses, the Texas A&M University System (TAMUS) throughout the state of Texas, remains the main campus fro most undergraduate and graduate students (TAMU OISP 2007). The addition of these satellite campuses has increased the number of students with diverse backgrounds and unique experiences. Although, the TAMU Campus has been successful in recruiting new undergraduate students from a wide variety of backgrounds, retention rates for underrepresented and all students remain a concern in all colleges (TAMU Vision 2020). As a result, TAMU's commitment to student and faculty diversity was codified into the *Texas A&M University Diversity Plan* and *Vision 2020* the Office of the Vice President and Associate Provost for Diversity developed and disseminated to achieve a higher rate of student retention.

The *Vision 2020* and the Campus Diversity Plan identifies phases of current implementation goals focused on the development and recruitment of students from underrepresented or minority-identified groups. Through these efforts, TAMU has quantified, monitored and collected head-counts and graduation rates along with the Office of Institutional Studies (TAMU OISP 2011). The OISP tracks student enrollment

numbers for all TAMU colleges and departments. Per the TAMU's OISP data, this effort has not increased student retention in general. Most recently, TAMU has continued to acknowledge and address the student retention need as efforts have included: a revised plan of Vision 2020; accountability at the unit level (colleges and departments) with student enrollment data collection and campus college/departmental climate surveys; and continuing support to a Diversity Office with a $1 million fund committed to rewarding units making progress with regard to retention (Smith 2015). Implementation of TAMU's Vision 2020 has focused on moving towards a formalized plan of research by investigating and identifying retention factors for all majors within the colleges on the TAMU Campus (i.e., diversity committees and campus wide climate surveys and reports).

Some of these climate surveys measure students' experiences on campus and include questions about perceptions based on their race and gender (Smith 2015). Climate surveys and reports generated from the data collected are used as indicators for the university to determine the condition of the university campus. Some of these surveys were salient to capturing the interface of the university and the underrepresented or minority-identified student groups. Despite university efforts, the indication of increasing TAMU enrollment rates for underrepresented populations, and retention of these students throughout the university remains a concern and priority for TAMU (Smith 2015). More importantly, there is a lack of retention for minority-identified students in the sciences, and specifically, minority-identified students in the natural resource and related sciences at TAMU (Fig. 1; TAMU OISP 2012).

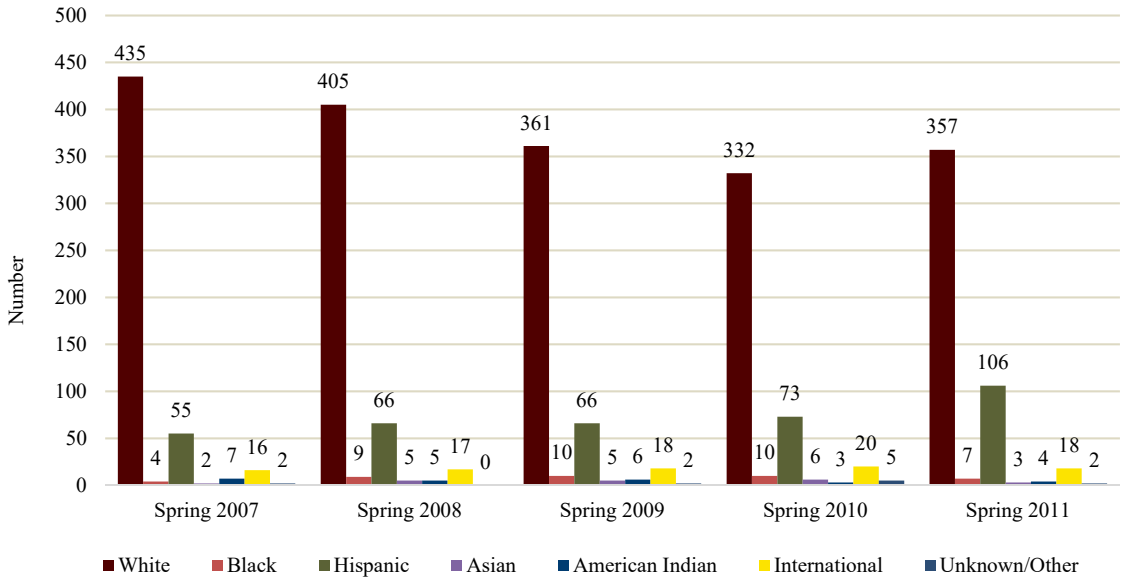

Figure 1. TAMU undergraduate Wildlife Fisheries Sciences Department enrollment from spring 2007 to spring 2011 by ethnicity/race.

1.2 Texas A&M University and Attrition in the Natural Resource and Related Sciences

TAMU is a recognized leader for faculty, and holds an internationally recognized reputation of excellence in the fields of natural resource and related sciences with faculty and professional support for undergraduate and graduate student success. However, despite TAMU's reputation of excellence, underrepresented or minority undergraduate and graduate students are more likely to drop out of the natural resource and related science programs in comparison to their White identified counterparts (Fig. 2). For example, the 2006 cohort, the average dropout rate for a White identified student in the natural resource and related science colleges was 22% (TAMU OISP 2006). The

dropout rate remained stable for such students (22%) in 2007 (TAMU OISP 2007). In contrast, underrepresented or minority-identified natural resource and related science students in the same 2007 cohort had a slightly increased dropout average of 29.3% from 28.6% in 2006.

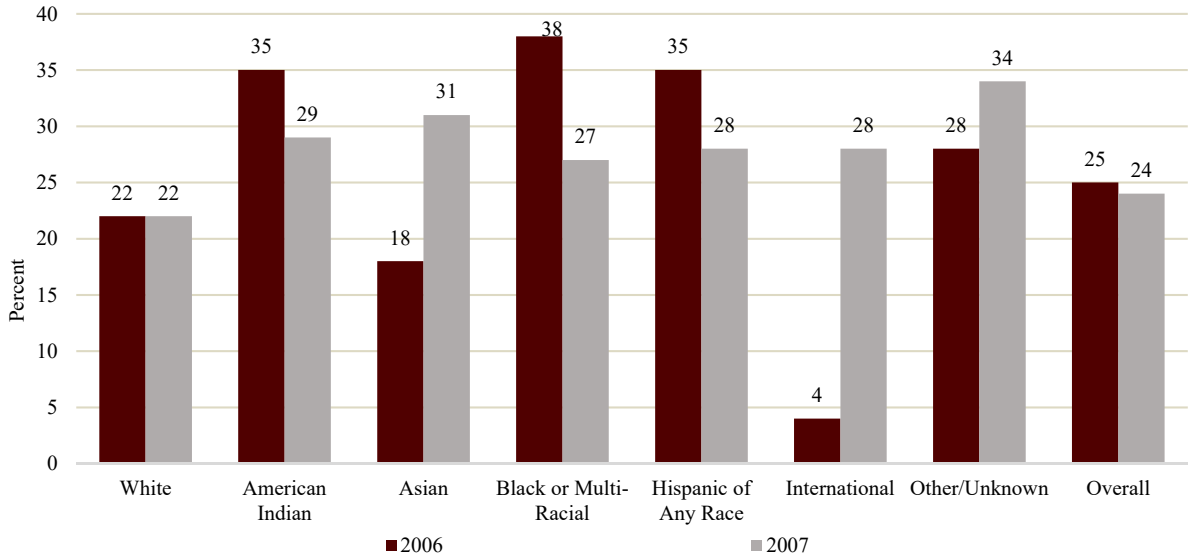

Figure 2. Percent of dropouts with ethnicity/race by cohort years 2006 and 2007.

In 2015, the Hispanic student population was 19.4% compared to 15.2% in fall 2011. Over the same time period, the percentage of Asian students has increased from 4.5% to 5.6%. However, Black-student enrollment has lagged behind other underrepresented racial/ethnic groups. They comprised 3.7% of the student body, up slightly from 3.4% in fall 2011 (Smith 2015). Thus, because of these upward but small trends, there is an emerging and growing need for TAMU to develop viable retention programs for minority groups to meet the goals stated in the *Vision 2020* document. While these trends are reported for the university, for the Wildlife and Fisheries Sciences

Department (WFSC) in the College of Agriculture and Life Sciences and other departments in the colleges supporting natural resource related sciences, numbers have trended downward for all undergraduate and graduate students. Within the TAMU system, the natural resource and related sciences, more specifically WFSC, a department within the five colleges (Agriculture, Science, Geo-Science, Veterinary Medicine, Biomedical Sciences) producing these majors, are mirroring these same reported overall trends with respect to recruitment and retention: recruitment in this discipline is increasing, and retention is decreasing (TAMU OISP 2011).

1.3 Wildlife and Fisheries, Natural Resource and Related Sciences Attrition

While the number of Hispanics and other underrepresented (minority-identified) populations in Texas continues to increase (U.S. Census 2013, Texas State Data Center 2011), fewer of these underrepresented (minority-identified) populations are entering institutions of higher education, and even fewer of them comprise students who are identifying natural resource and related sciences as a possible major (Wolter et al. 2011). TAMU, the leader in producing natural resource and related professionals, has consistently recorded an increase from 2007 to 2011 in Hispanic and all other underrepresented student populations as verified by the Office of Institutional Studies and Planning (TAMU OISP 2011). While TAMU records an increase in the underrepresented populations, for the WFSC and other related natural resource and related science majors, the OISP records fewer and fewer Black identified students, Hispanic identified students, Native American identified students, and other identified

ethnicities (underrepresented undergraduate and graduate students) enrolled in these departments (TAMU OISP 2007). In Fig.1, although there may be an upward trend in Hispanic enrollment in WFSC, the enrollment is still small when compared to the majority population. This upward trend suggests that the WFSC department is consistent in increasing the Hispanic student enrollment.

These enrollment numbers indicate more candidates are available for entry into science related fields. Yet, underrepresented or minority-identified professionals in natural resource and related sciences has been and remains a concern among federal and state agencies, as well as professional societies, responsible for cultivating the next generation of diverse and underrepresented natural resource scientists (The Wildlife Society, American Fisheries Society, etc.; Valdez 1995, Adams and Moreno 1998, Lopez et al. 2005). According to Valdez (1995), historically, there are very few wildlife graduates in the United States (Valdez 1995). The increase in recruitment is not congruent to the retention levels in the natural resource and related science majors. Although, there is research that accounts for enrollment numbers of undergraduates and graduates in these majors (Valdez 1995), more research is needed to identify retention factors. Moreover, WFSC, a leader in supplying majors in natural resource and related sciences (Holzman 2014), is experiencing a scarcity of underrepresented or minority-identified students (minorities and women) in the field (Wolter et al. 2011, Holzman 2014).

For example, TAMU's graduation rates have declined steadily for minorities and so have those in WFSC reporting graduation rates of 57.1% in 2004, 45.7% in 2005, and

dropping to an all-time low of 39% in 2006 (TAMU OISP 2007). In particular, the WFSC is experiencing the same shortage of minorities as reported at the university level. Interestingly, despite a decrease in enrollment, there is an increase in the number of Hispanic identified wildlife students who are graduating (TAMU OISP 2007). However, this number is small compared with the number of White identified students who graduate (TAMU OISP 2007).

1.4 Purpose

The discussion for retention at the university level continues to focus on the demographic representation of students through student profiles, student enrollment figures and university-generated reports. Such reports address the lack of diversity in science and other related majors and fields, while monitoring success with graduation rates. These profiles, figures and reports include numerical representations of student populations as well as existing programs and goals that promote recruitment and retention for all students. However, for the colleges within the university representing natural resource and related sciences, this is a greater concern because TAMU is one of the nation's leaders in producing these professionals. To increase and retain the minority-identified populations, TAMU must examine specific reasons for student persistence in the natural resource and related science majors. Therefore, this study moves beyond current university accountability reports and enrollment quantification efforts, by furthering the retention literature through identifying key factors that enable minority students' academic success specifically for the natural resource and related

sciences.

The two primary objectives for this study are as follows:

1. Identify individual and institutional retention factors of underrepresented undergraduate and graduate students in the natural resource and other related majors that are represented by the five natural resource and science related colleges and programs (Science, Agriculture and Life Sciences, Geosciences, Veterinary Medicine and Biomedical Sciences) at TAMU

2. Identify individual and institutional retention factor(s) that are significantly associated with the demographic variables tested.

Ultimately, this study may identify retention factors that can be used by TAMU's system to develop and facilitate programs to improve and increase minority representation and diversity within the natural resource workforce and support TAMU's *Vision 2020* goals (TAMU 1999). The purpose of this research is to identify retention factors and separate them into individual and institutional retention categories, that surveys undergraduate and graduate students within the natural resource and science related colleges.

Additionally, this project will determine significance of demographic differences such as ethnicity and gender, transfer status, academic classification and income or socio-economic status based on the answers provided by the respondents. According to the results of the quantitative data, the respondent's answers will identify factors that are associated with improved retention rates for undergraduate and graduate students in the natural resource and related sciences.

Finally, research concerning baseline retention factors has not been well documented and quantified from the perspective of minority-identified students in the natural resource and related sciences. Therefore, the identification and categorization of

the individual and the institutional retention factors may guide future research.

1.5 Retention Factors of Interest

For this study, factors of interest were considered based on previous research that focused on identifying reasons for retention in undergraduates and graduates within general science and Science, Technology, Engineering, and Math (STEM) majors. In the STEM literature, many retention factors are attributed to retaining students in particular fields of science (Swarat et al. 2004, Blickenstaff 2005, Russell 2005, Russell and Atwater 2005, Venezia and Kirst 2005, Adamuti-Trache and Andres 2008, Good et al. 2008, Varma and Hahn 2008, Lott et al. 2009, Concannon and Barrow 2010, Wolter et al. 2011). These previously identified retention factors were then discussed with a focus group of undergraduate and graduate students in the natural resource and related sciences. The focus group of students were chosen by membership in pre-professional groups associated with, but not limited to, natural resource and related sciences majors (i.e., Minorities in Natural Resource and Related Sciences, Association of Graduate Wildlife and Fisheries Sciences, and other related student pre-professional organizations. In addition, natural resource faculty members provided guidance by reviewing the identified retention factors. Finally, the retention factors were modified to meet the specific need for the natural resource and related sciences majors. Once identified, this list divided the retention factors into two categories: individual and institutional.

1.6 Individual Retention Factors

As noted in the above paragraph, the individual factor is one of the key categories for the study of student retention in science related fields and higher education. For example, STEM literature from previous studies on retention factors, in general and natural resource sciences when possible, demonstrated that individual factors were found as significant markers for determining student success in science related fields and education (Valdez 1995, Tobias and Venkatesan 2002, Swarat et al. 2004, Lopez et al. 2005, Russell 2005, Varma and Hahn 2008, Lott et al. 2009, Wolter et al. 2011).

Individual retention factors that were previously identified to assist college and science retention rates are listed in Appendices D and E. The research revealed those factors ranged from personal and academic relationships to experiences in education such as hands-on training opportunities. Section three explains this in more detail and notes that only certain respondents said they would prefer educational experiences outside of the classroom. Additionally, the notion of self-efficacy such as personal perception or the idea that a student will complete a program, major, or degree, was an important factor (Bandura 1986, Blickenstaff 2005, Russell and Atwater 2005, Adamuti-Trache and Andres 2008, Concannon and Barrow 2010, Strayhorn 2015). Similar studies found that students who participated in research or experienced opportunities to work in the field were more likely to complete their academic program (Moreno et al. 1999, Bianchini et al. 2001, Cejda and Rhodes 2004).

Additionally, female and non-White identified students were most likely retained

if a portion of the population shared physical or cultural similarities (Lott et al. 2009). The individual factors such as "myself" and the intent to "persist" were important elements (Wolter et al. 2011) to retention in past research studies. In fact, such outcomes of "persistence" were identified and supported in several studies (Blickenstaff 2005, Adamuti-Trache and Andres 2008). For example, certain male identified students in this study reported that if they believed they would finish, then they were most likely to complete the coursework, even if they lacked the academic skill set (Concannon and Barrow 2010, Strayhorn 2015). However, unlike their male identified counterparts, certain female identified students who lacked the intent to "persist," were not retained in their major field of study even if they had the academic skill (Concannon and Barrow 2010).

Lastly, concerning individual factors for retention, high school experiences or secondary school experiences played a significant role for post-secondary success, specifically for girls and boys who are well prepared through their science courses (Blickenstaff 2005). In such cases, female identified students were more likely to be successfully retained in college (Adamuti-Trache and Andres 2008). Other studies supported results that a student's gender and their personal experience in high school also were an important retention factor (Good et al. 2008, O'Shea et al. 2010).

1.7 Institutional Retention Factors

Similar to the individual factors for retention, the institutional factors for retention also were determined meaningful from previous studies that focused on certain skills, opportunities and experiences during a student's educational career (Wolter et al. 2011, Strayhorn 2015). Interestingly, the previous studies showed a correlation between individual factors and institutional factors. In other words, the individual factor is part and parcel of the institutional factor, which underscores the notion that one's self-perception determines success.

For instance, as stated in the above section, qualified female identified respondents, who lacked a sense of self-efficacy or persistence, did not complete their academic program (Bandura 1986, Jones et al. 2000). In contrast, the male identified respondents, who were not as qualified, completed their academic program. Thus, the institutional factors included an interaction between personal factors such as self-esteem and study skills, along with mentoring opportunities from faculty members and instructors and an active involvement with science experiences during the undergraduate years. These experiences were based on the involvement in the high school and the K-12 pipeline (Jones et al. 2000).

Therefore, it can be argued that students who are retained as science majors are those students who would have had involvement in a high school or secondary school setting that inspired an interest in science. More importantly, this interest in science, which was fostered in primary and/or possibly secondary school, could continue into their undergraduate program (Adams and Moreno 1998, Jones et al. 2000, Adamuti-

Trache and Andres 2008).

Another way that institutional factors work to support persistence and retention is through motivational factors. Motivation may include following a course of academic and career pathways based on the individual and what that particular student determines to be relevant for their experience (Bandura 1986, Jones et al. 2000, Adamuti-Trache and Andres 2008). Research has shown that in the computing sciences (Varma and Hahn 2008) there were different motivational factors for male identified and female identified students. For example, Varma and Hahn (2008) noted that motivational factors for male identified students included desire for future employment, and for female identified students, classroom exposure to certain technology inspired them in their academic pursuits. In addition, the male identified respondents assumed they were going to have employment in computer science fields. In contrast, the female identified respondents were more likely to state "no clue" as to where their pathway would lead.

Since, motivational factors and a student's persistence to succeed are highly correlated to a student's self-perception concerning retention at the higher education and general science level, questions concerning whether or not these findings relate to the natural resource and related sciences as well can be formulated (Jones et al. 2000, Adamuti-Trache and Andres 2008, Varma and Hahn 2008).

2. METHODS

2.1 Survey Methodology

A modified version of the Tailored Design Method (Dillman 2000) was used as a protocol for the online questionnaire regarding retention factors for natural resource and related sciences majors among all eligible, undergraduate and graduate students in the Colleges of Agriculture, Science, Geo-Sciences, Veterinary, and Biomedical sciences at TAMU. Upon TAMU's Institutional Review Board (IRB) approval (IRB2010-0955M), the survey was automatically disseminated three different times to study participants via the Vovici Survey Software program (Vovici 6 2012). The survey was administered twice via email to a representative group of White students and all self-identified racial/ethnic natural resource and related science undergraduate and graduate students in these majors (n = 4,997) during the spring 2011 semester and a final time during the summer 2011 semester.

Following this protocol, a second attempt for the online questionnaire was administered to potential survey non-respondents. To capture a greater response rate among underrepresented respondents, the third follow-up electronic survey was conducted in July 2011. The non-respondents were cross-referenced with the original survey population to eliminate duplication of responses, and were subsequently combined for eligible survey respondent totals discussed in section three.

Additionally, the invitation to participate provided a short explanation of the

purpose and goals for the survey questionnaire (Appendix G). Vovici 6 (2012), a web-based software program, also was used to compile and export data, which was subsequently imported to SPSS 2011(Coakes 2009) and STATA SE version 13 (2013), for statistical analysis.

2.2 Study Region

TAMU the fourth largest university in the United States is comprised of 5,200 acres and located in College Station, Texas. Consistently placed among the top 20 public universities in the United States, TAMU is a land-grant university. TAMU was designated to teach agriculture, military tactics, the mechanical arts and classical studies so that members of the working classes could obtain a practical education. Currently, TAMU's Systems agencies conduct research that brings practical applications of research findings to the people of Texas and its global partners (TAMU 2016).

2.3 Survey Participant Selection

Survey participants were anonymously selected from the TAMU Registrar's Office, and identified as natural resource or related science majors within TAMU's five colleges: Agriculture and Life Sciences, Veterinary Medicine, Geosciences, Sciences and Biomedical sciences. Survey participants for the 2011 WFSC survey include undergraduate (freshman, sophomore, junior, and senior classifications) and graduate (Master, Doctoral and Post-Doctoral) natural resource and related science students within these majors from the TAMU spring and summer 2011 semesters at TAMU.

The TAMU Registrar's Office provided all underrepresented or minority students and all majority or White student names as self-identified by student candidates in the ethnic/racial demographic on admission applications (n = 10,628) from the colleges of Agriculture, Science, Geosciences, Veterinary Medicine, and Biomedical Sciences. All majors, undergraduate and graduate, related to Natural Resource and Related Sciences were included in this study (Appendix C). These colleges within TAMU provided a list of all undergraduate and graduate students for the spring 2011 (n = 10,628). The list of majors consisted of all ethnic backgrounds for the spring 2011 headcount at TAMU (Fig. 3).

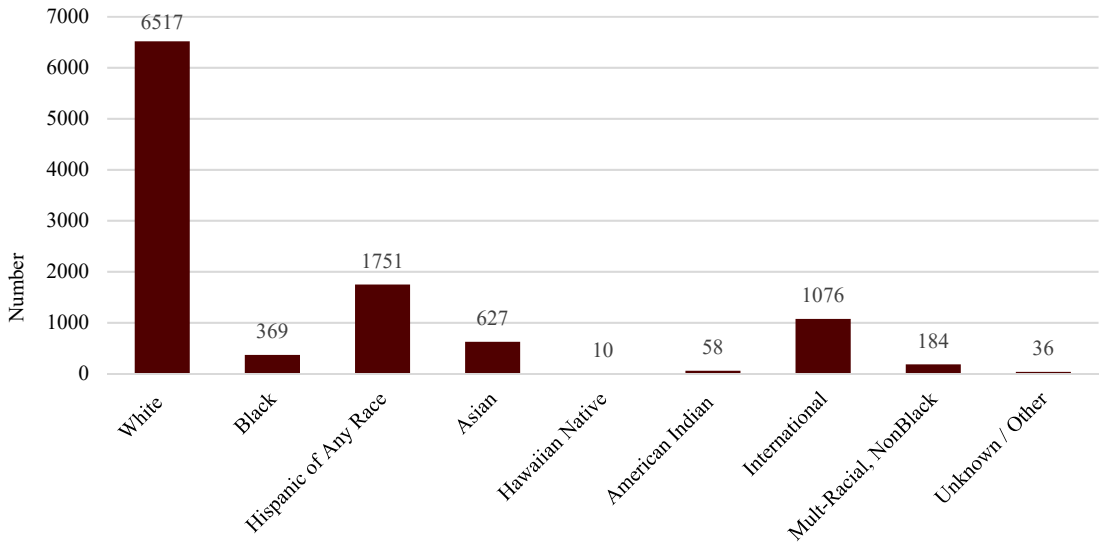

Figure 3. Headcount of students by ethnicity/race in spring 2011 (5 colleges).

From these majors, the students were then divided, and categorized into underrepresented or minority-identified groups and majority or White identified groups.

These groups were further differentiated by gender, and other demographic variables for statistical analysis. The demographic selection criteria of survey respondents followed self-identification categories from the U.S. Census Bureau (2013) and were cross-referenced with definitions as noted by the university registrar for TAMU.

2.4 Survey Instrument

The survey instrument for this research was developed from a review of previous survey instruments and studies on retention (Cowart 1987, Mitchell 1993, Kuh et al. 2006, Kuh 2009). These studies identified factors that are most likely to influence retention in the broader sciences such as biology, engineering, general science, and natural resource and related sciences. However, for WFSC, natural resource and related science majors, these factors have not yet been specifically identified. As a result, general science retention factors were used to develop two categories: individual and institutional categories (see Appendix C for the full list). Finally, a draft of the questionnaire was developed that included categories such as individual and institutional factors for comparisons between White identified and underrepresented or minority-identified respondents.

The questionnaire was presented to an expert panel of TAMU faculty, concluding with a field test using students from the five colleges within the university system who identified as natural resource and related sciences majors. Based on the results of this field test, a 279-item electronic email questionnaire which included questions about the respondents' demographics, perceptions of natural resource majors,

along with individual and institutional factors that are believed to influence a student's retention in their major, was developed to collect baseline data.

The newly developed instrument consisted of close-ended questions. The online survey instrument consisted of 13 sections with 279 randomly arranged questions organized from two main themes: individual and institutional factors. The ordinal scale consisted of 3–5 levels of Likert scale responses. For example, ranging from "not much" or "some", to "much" or "very much". The binomial scale consisted of a "yes" or "no" response. The number of possible responses to each question ranged from 1 to 5. Each question had 2–5 possible levels of response on either an ordinal or binary scale that depended on the nature of the question. The full survey is in Appendix A.

2.5 Questionnaire Content

The survey focused on identifying, describing and quantifying important individual and institutional factors influencing retention in the natural resource and related sciences. Questions included academic background, identification of natural resource career interests and desired results from pursuant major, factors facilitating the retention of current candidates, and demographic information. Included in this instrument were queries made of natural resource and related science majors. These queries focused on the influence, and the effectiveness of each of the factors experienced in the academic career pipeline from kindergarten to high school (K–12) and higher education experiences at the departmental, college, or overall university retention program level.

2.6 Data Analysis

Approaches to data analysis including statistical analyses were identified in consultation with social scientists and statisticians at TAMU and University of California, Los Angeles. Chi-square tests were used to test for significant ($P \leq 0.05$) differences between groups on the questionnaire items. Results were reported based on the frequency of responses to the selected questions concerning the four demographic variables: income, transfer status, ethnicity and gender. Each of the latter four-response variables was tested against 22 factors consisting of the 18 individual (Appendix D) and 22 institutional variables (Appendix E) identified in the questionnaire (Appendix A).

Additionally, statistical analyses were conducted in STATA SE (2013). Univariate analyses were performed to describe the sample characteristics and determine the distribution of each variable. Bivariate analyses were performed using a Pearson chi-squared test for independence that assessed association between demographic variables, institutional factors and individual factors, and reasons for exiting the major. When the expected cells' sizes fell below 5, violating the assumption of the chi-square test, a Fisher's exact test was employed. Significance was evaluated at the standard alpha level of 0.05. Basic demographic data were compiled to depict the current state of student enrollment in 2011.

In survey research, respondent characteristics should approximate corresponding characteristics of the population studied. This study initially examined two populations (White and Minorities). Because the number of responses to each question varied, statistical tests were run separately to maximize sample sizes.

3. RESULTS

3.1 Response Rate

The survey was emailed to 4,997 natural resource science and related science undergraduate, graduate, and transfer majority, or White identified students and underrepresented or minority-identified students. Out of the 4,997 students who were sent the survey, only 43.4% (*n* = 2,170) of the students opened the survey, and of the 2,170 students who opened the survey, only 85.6% (n = 1,859) actually started filling out the survey. Of the 1,859 students who started the survey, 78.1% (n = 1,452) finished the survey. Thus, overall, only 29.1% of the original 4,997 students who were emailed the survey finished the survey. The latter response rate falls within what is conventionally considered a typical or common response rate for other web-based research surveys (Kwak and Radler 2002).

Most students who completed the survey (n = 1,119, 60 % of the 1,859 who began the survey) were minority-identified undergraduate and graduate students (Table 1). But, the largest category to complete the survey was White-identified students, at 40% (n = 740). The largest non-White identified population to begin the survey identified themselves as Unknown/Other ethnicity at 20% (n = 372). For the underrepresented or minority-identified respondents, Hispanic was the second largest population at 13.4% (n = 249). Additionally, Asian/Pacific Islander was the next largest group with a combined 12% (n = 230). The participating racial demographic with the

lowest population identified was 4.4% (n = 68) Black survey respondents and American Indian at 1% (n = 18). Only the survey respondents who completed the entire survey and identified their own race/ethnicity (n = 1,452) were included in the data analysis.

Table 1. Survey respondents by ethnicity/race.

Ethnicity/Race	Ns (%Ns)	Nf(%Ns)
Total	1,859 (100)	1,452 (100)
Ethnicity		
Mexican (native)	30 (2)	29 (2)
Hispanic	249 (13)	235 (16)
White	740 (40)	739 (51)
Black	68 (4)	53 (4)
American Indian	18 (1)	12 (1)
Asian/Pacific Islander	230 (12)	163 (11)
Multiracial	62 (3)	60 (4)
Other/ International	90 (5)	83 (6)
Other/ Unknown	372 (20)	20 (5)

3.2 Significant Results

Due to the high number of questions on the survey ($n = 279$), a discussion of results is limited to the two individual and five institutional factors giving statistically significant effects ($P \leq 0.05$). Analysis was performed using the Chi square and/or Fisher's exact tests. According the survey results, the two significant individual factors concerned questions regarding an individual who the students perceived to provide the most support during their college years. For example, students reported themselves as the most significant factor contributing to their retention in their fields, regardless of ethnicity, income or socioeconomic status or gender. Another type of support that was statistically significant, but at a lower level, was the influence of a university advisor. Although affiliated with the university, the retention factor was categorized as an individual retention factor because the undergraduate and graduate student perceived this individual to be in a support position for their academic program.

Additionally, ranked in the order of importance, the five most important institutional factors reported as statistically significant by the respondents, are as follows: (1) their own study skills obtained from an institution; (2) participating and socializing in faculty-led research opportunities; (3) accessing general academic advising; (4) an afterschool organization that fosters an interest in the outdoors; and (5) middle school/junior high experience that prepares them with the academic skill set for high school success. The individual and institutional factors are further discussed in the next two sections below.

3.3 Individual Retention Factors

3.3.1 Self Reliance

The most important individual factor students considered to influence their retention in a scientific field of study was "Myself," with a 90% (n = 1,374) agreement among survey respondents (Table 2). Students also were asked how much they relied on specific people or groups for support during their academic programs. The results showed that relying on one's self was the most reported (overall 90%, range 83–100%) and a significant factor influencing all respondents (Table 2). For this factor, there also was a significant difference related to ethnicity ($\chi^2 = 17.21$, $P = 0.016$). A Fisher's exact test supported the statistical significance of this factor ($P = 0.023$, conducted because expected cell counts were less than 5 due to the small number of American Indians in the sample). All (100%) of the 12 American Indian- identified respondents reported they most often relied on themselves (Fig. 4). In contrast, Asian identified students had the lowest proportion (12% of 163 respondents) of responses indicating they relied on themselves for academic retention "a lot". Although they relied on themselves, there was no significant relationship with regard to income, gender, transfer status, academic classification and type of science major.

Table 2. Students who relied on themselves for support.

Student Characteristics	N	% of Total	% A lot	% Not much
Total	1,374	100	90	10
Ethnicity				
Mexican (native)	26	2	90	10
Hispanic	235	17	92	8
White	739	54	90	10
Black	53	4	94	6
American Indian	12	1	100	0
Asian/Pacific Islander	163	12	83	17
Multiracial	60	4	88	12
Other/ International	83	6	96	4
			$\chi^2(7) = 17.21,\ P = 0.016$*	

*Fisher's exact $P = 0.023$

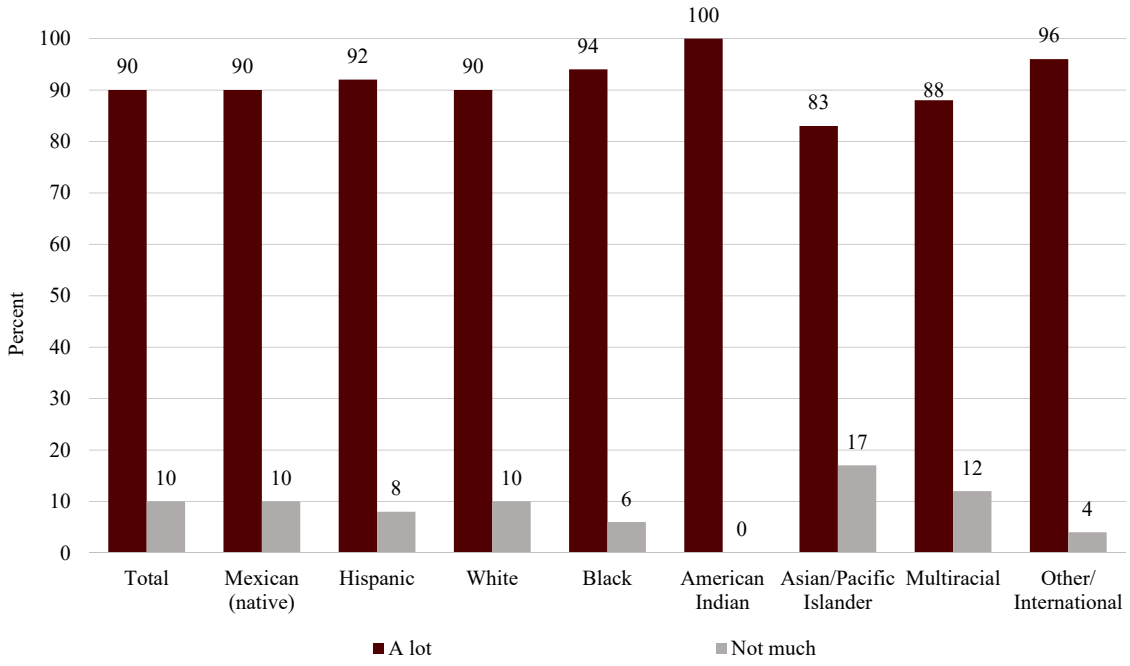

Figure 4. How often students relied on themselves for support by ethnicity/race.

3.3.2 Reliance and Support from an Advisor

The second most important individual factor reported by student respondents regarding retention was the influence of a university or college advisor. In response to the question "How often the student relied on a university or college advisor for help or support," 42% of the students responded positively (Table 3).

In response to how often students relied on university or college advisor for help or support (with choices being "a lot" or "not much"), over half (58%) of all responding students indicated they did not rely on their advisor much (Table 3). However, there were significant differences based on ethnicity in this response ($\chi^2 = 19.35$, $P = 0.007$; Table 3). For instance, individuals reporting multiracial ethnicity were the most likely to rely on an advisor (60%) followed by Black identified students (53%).

Additionally, the least likely ethnicities to rely on an advisor (Fig. 5) were the White identified respondents (62%), followed by the American Indian identified respondents, (75%) though the latter sample size was relatively small ($n = 12$). Notably, the overall response rate for the White identified respondents to this particular question (54%) was substantially larger than other ethnicities whose response rate was small as noted in Figure 5 (1–17%). The Fisher's exact test supported this statistical significance ($P = 0.007$) and was conducted since some of the expected cell counts were less than 5 due to the small sample of American Indians (n = 12).

When reliance on one's self and an advisor were considered together with ethnicity, White respondents were most likely to rely on themselves as well as on an advisor. Interestingly, the factors when tested separately were not significant for

retention, but when tested together the results showed the White identified respondents benefited from general academic advising combined with self-motivating strategies or self-reliance. In contrast, the American Indian respondents reported the relying on themselves at the highest percentage and lowest level for asking for help from an advisor. How often a student looked to an advisor for support was not found to be significantly associated with socioeconomic status, gender, transfer status, academic classification and type of science major.

Table 3. Students who relied on a university or college advisor for support.

Student Characteristics	N	% of Total	% A lot	% Not much
Total	1,365	100	42	58
Ethnicity				
Mexican (native)	29	2	48	52
Hispanic	234	17	47	53
White	738	54	38	62
Black	51	4	53	47
American Indian	12	1	25	75
Asian/Pacific Islander	62	12	50	50
Multiracial	60	4	60	40
Other/International	79	6	51	49
			$\chi^2(7) = 19.35$, $P = 0.007$*	

*Fisher's exact $P = 0.0007$

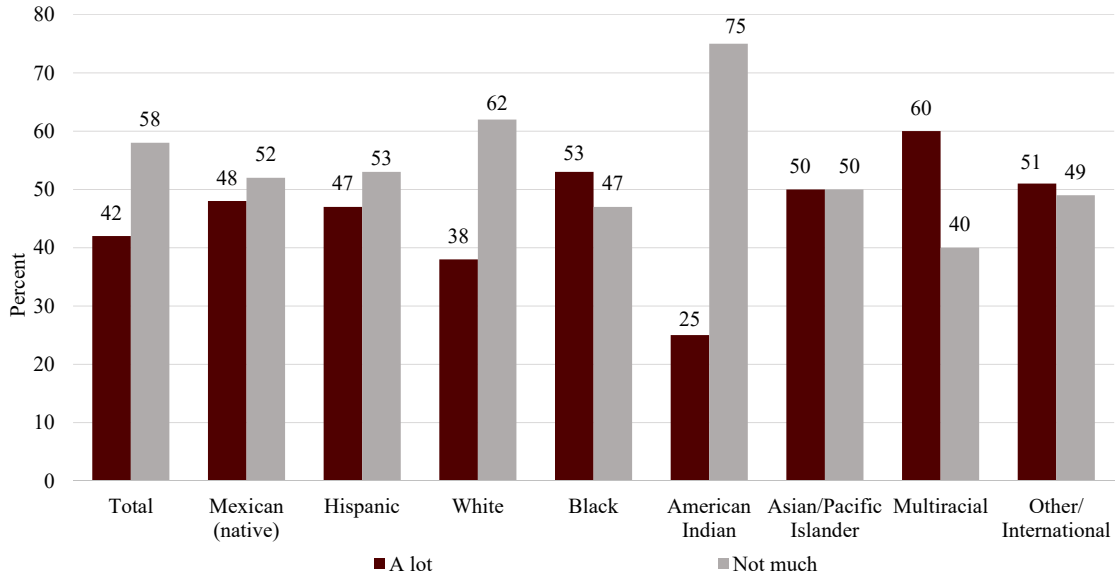

Figure 5. How often students relied on university or college advisor for support by ethnicity/race.

3.4 Institutional Retention Factors

There were no significant relationships between the 22 institutional retention factors when tested against income or socioeconomic status, gender, transfer status, academic classification and type of science major. However, the three most frequently related responses identified by students were as follows: (1) the ability to study based upon their own skills [personal], (2) whether the middle school they attended provided the proper skills to persist in a science major [personal], and (3) if an afterschool or extra-curricular activity fostered their interest in the outdoors [personal, if the activity preceded or was independent of college]. The two factors that were reported the least were socialization and participation in faculty-led research experiences.

Even though less than one-quarter of the students sampled reported participating

in faculty-led research opportunities, it was a significantly important factor for these respondents based on ethnicity ($P < 0.001$), income or socioeconomic status ($P = 0.028$) and transfer status ($P = 0.031$; Table 4). A Fisher's exact test further supported this significance ($P < 0.001$), since some of the expected cell counts were less than 5 due to the small number of American Indian identified respondents in the sample. In fact, none of the 12 American Indian respondents participated in faculty-led research opportunities.

In contrast, transfer students ($n = 961$) were most likely to participate in research (Table 4). However, the frequency a student participated in faculty research was not found to be significantly associated with gender, academic classification, or type of science major. Interestingly, students from either the lowest socioeconomic background or income or from highest incomes or socioeconomic background were significantly more likely to participate in faculty-led research than other income brackets ($\chi^2 = 14.15$, $P = 0.028$; Table 4).

3.5 Faculty-led Research and Socializing Opportunities

Overall, only 23% of the 1,196 student respondents indicated they often participated in faculty-led research opportunities (Table 4). However, there was a significant difference in this response based on self-reported ethnicity ($\chi^2 (7) = 39.85$ $P < 0.001$). A Fisher's exact test supported this significance ($P = 0.001$). For example, Mexican (Native; 40%, n = 25) and Asian/Pacific Islanders (39%, n = 82) were the most likely to participate in faculty-led research opportunities. In contrast, American Indians (0% of 11 respondents) and Hispanics (16% of 166) were the least likely to participate in

this activity (Fig. 6).

Additionally, income or socioeconomic status and transfer status also were significantly related to how often student respondents participated in faculty-led research opportunities (Table 4). For instance, students who reported themselves as lower socioeconomic status or in the lower income category (<$15,000) were the most likely (35%) to participate in this activity compared to the remaining higher income categories (17–24%; $\chi 2(6) = 14.15$; $P = 0.028$; Fig. 7). Similarly, transfer students who came from other colleges or universities (27%) also were significantly more likely to participate in faculty-led research (Fig. 8) than those who started in the TAMU System (21%; $\chi 2(2) = 4.67$; $P = 0.031$). However, there were no significant relationships between faculty-led research opportunities and gender, academic classification or type of science major.

Table 4. Institutional Retention Factor: Participated in faculty-led research

Student Characteristics	N	% of Total	% A lot	% Not much
Total	1196	100	23	77
Ethnicity				
Mexican (native)	25	2	40	60
Hispanic	166	17	16	84
White	529	55	20	80
Black	28	3	28	72
American Indian	11	1	0	100
Asian/Pacific Islander	82	11	39	61
Multiracial	45	5	20	80
Other/International	49	6	32	68
			$\chi^2(7) = 39.85$, $P < 0.001$*	
Income				
< $15,000	54	7	35	65
$15,000–$24,999	42	6	24	76
$25,000–$34,999	35	5	17	83
$35,000–$49,999	76	10	21	79
$50,000–$74,999	142	19	18	82
$75,000–$89,999	100	13	14	86
$90,000 +	299	40	27	73
			$\chi^2(6) = 14.15$, $P = 0.028$	
Transfer				
Started Here	538	62	21	79
Started Elsewhere	323	38	27	73
			χ^2 (2) = 4.67, $P = 0.031$	

*Fisher's exact P <0.001

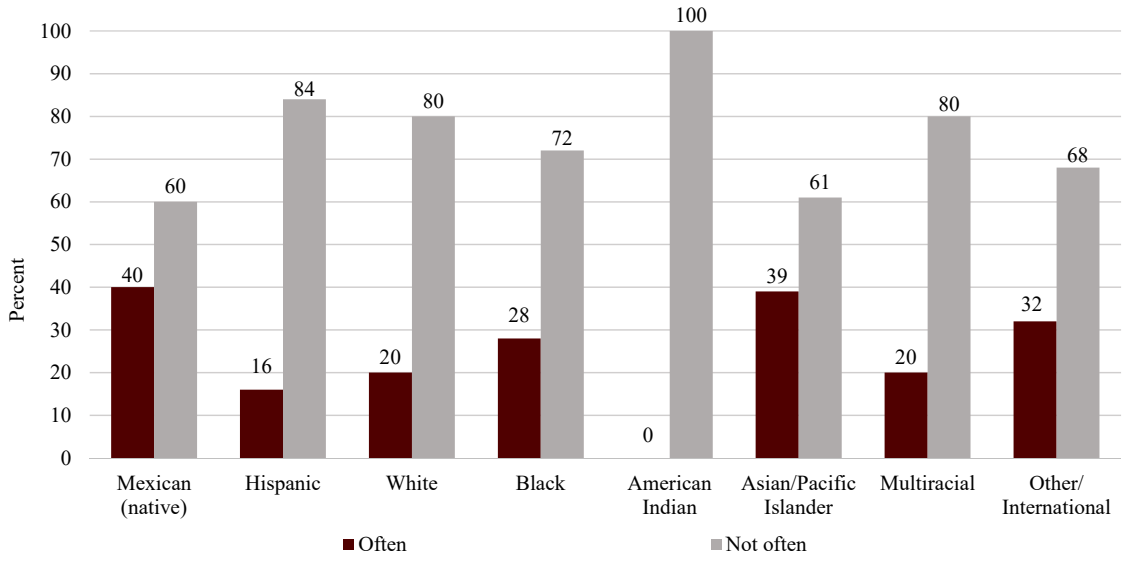

Figure 6. How often students were involved in faculty-led research by ethnicity/race.

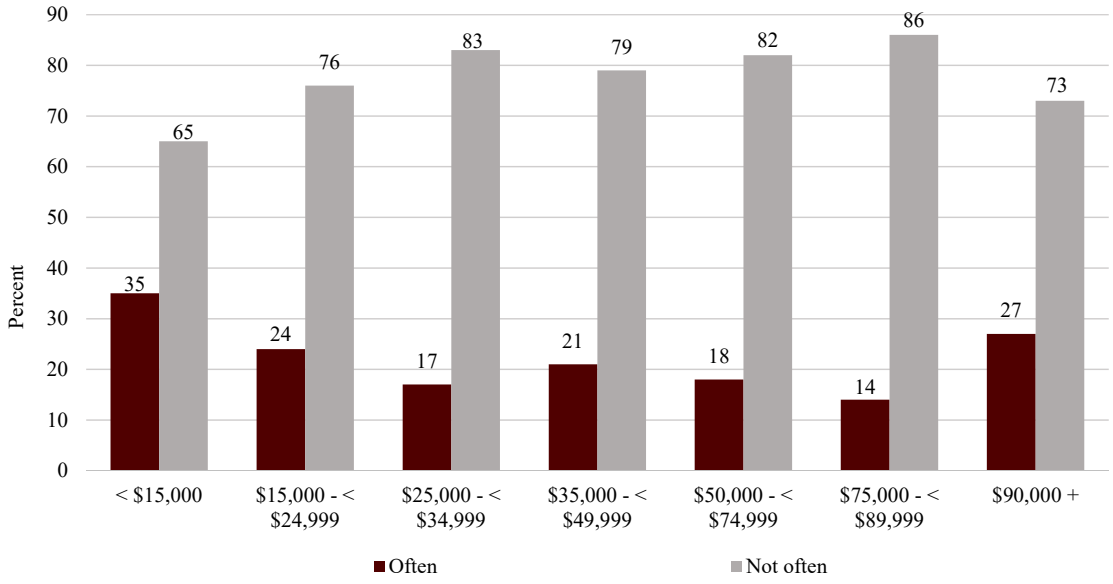

Figure 7. How often students participated in faculty-led research by income.

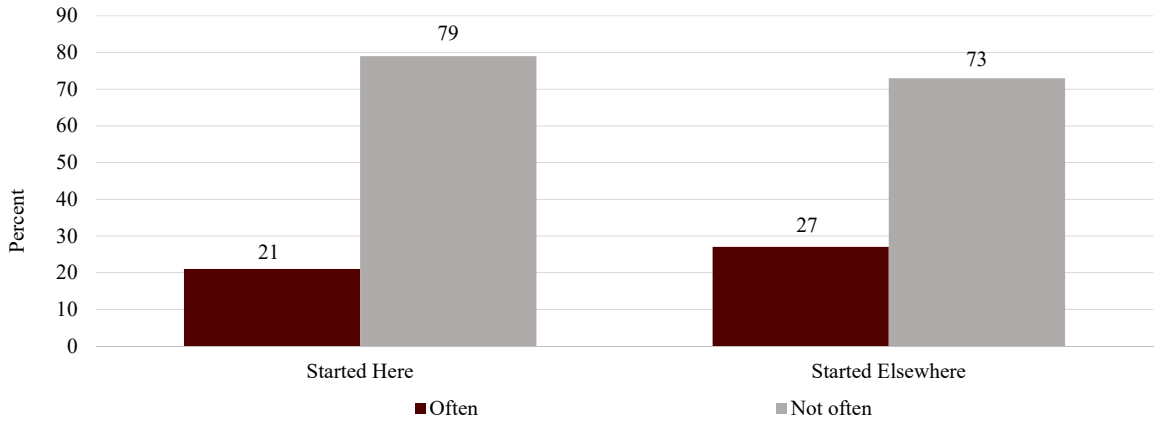

Figure 8. How often students participated in faculty-led research by transfer status.

Moreover, there was a significant association between socializing with faculty as part of faculty-led research opportunities and ethnicity. 23% of the survey respondents reported they participated in faculty-led research opportunities ($\chi^2 = 16.43$, $P = 0.021$; Table 5). For this question, a Fisher's exact test was significant ($P = 0.03$). The remaining respondents (77%) did not often socialize with faculty when engaged in research opportunities.

Further, the Mexican (Natives) were (48% of 25 respondents) most likely to socialize with research faculty, followed by Other/International respondents (32%). In addition, fairly equal proportions representing approximately 25% of Hispanic, Black, White and Asian/Pacific Islander students participated in a faculty-led social activity (Fig. 9). However, American Indians (9% of 11 respondents) were least likely to participate (Table 5). The correlation between how often a student socialized in faculty-led research and their reported gender, income level, transfer status, academic classification and type of science major did not have a significant influence.

Table 5. Institutional Retention Factor: Socialized with faculty-led research

Student Characteristics	N	% of Total	% Often	% Not often
Total	1194	100	23	77
Ethnicity				
Mexican (native)	25	2	48	52
Hispanic	199	17	22	78
White	661	55	24	76
Black	41	3	22	78
American Indian	11	1	9	91
Asian/Pacific Islander	132	11	23	77
Multiracial	54	5	13	87
Other/ International	71	6	32	67
			$\chi^2(7) = 16.43$, $P = 0.021$*	

*Fisher's exact P =0.03

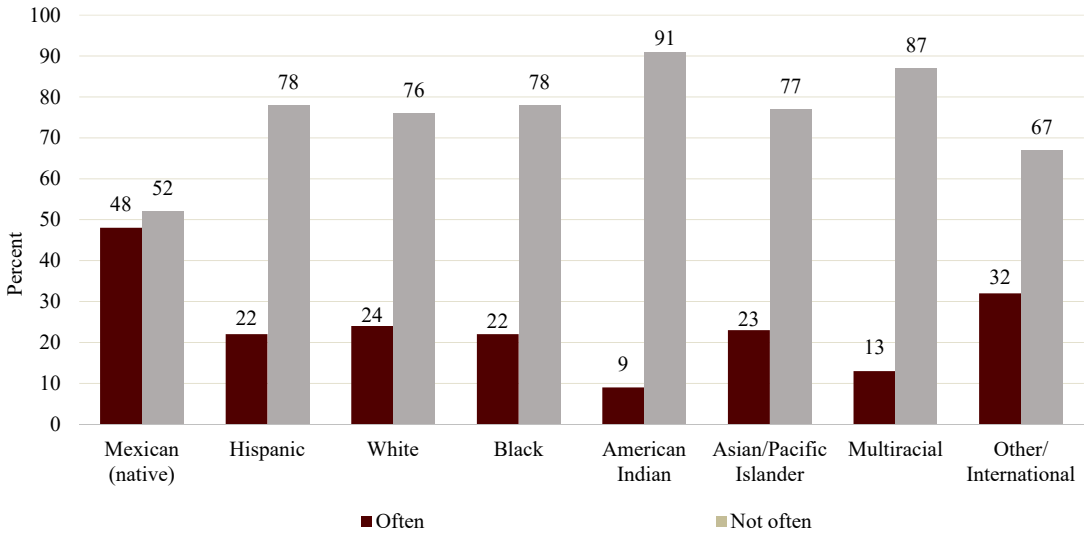

Figure 9. How often students socialized with faculty-led research opportunities by ethnicity/race.

3.5.1 General Academic Advising

For this portion of the survey, how often a student reported accessing general academic advising at their institution was significantly related to their ethnicity and income or socioeconomic status ($\chi^2(7) = 19.03$, $P = 0.007$ and $\chi^2(7) = 13.47$ $P = 0.036$, respectively; Table 6). Both of these results also were supported by Fisher's Exact test results at $P = 0.007$. Respondents who identified as Mexican (Native) and Black were most likely to access general academic advising (46 and 44%, respectively). However, White identified respondents and Multiracial identified respondents (Fig. 10) were least likely to access general academic advising (21–26%; Table 6).

Additionally, a respondent's income level or socioeconomic status was found to be an important consideration for how often a student accessed general advising (Fig. 11). While, the survey respondents who reported the smallest and largest income categories were the least likely (≤25%) to access general advising, the majority of the survey respondents reporting middle income levels did seek general advising opportunities. Similar to the other institutional factors discussed thus far, this institutional factor, access to general academic advising, is not significantly associated with gender, transfer status, academic classification or type of science major.

Table 6. How often students accessed general academic advising.

Student Characteristics	N	% of Total	% Often	% Not often
Total	1,443	100	29	71
Ethnicity				
Mexican (native)	26	2	46	54
Hispanic	199	16	35	65
White	670	55	26	74
Black	43	4	44	56
American Indian	11	1	36	64
Asian/Pacific Islander	134	11	33	67
Multiracial	58	5	21	79
Other/ International	74	6	34	66
			$\chi^2(7) = 19.03$, $P = 0.007$*	
Income				
<$15,000	55	7	25	75
$15,000 - < $24,999	42	6	16	74
$25,000 - < $34,999	34	5	53	47
$35,000 - < $49,999	77	10	35	65
$50,000 - < $74,999	142	19	29	71
$75,000 - < $90,000	100	13	30	70
$90,000 +	301	40	25	75
			$\chi^2(7) = 13.47$, $P = 0.036$	

*Fisher's exact $P = 0.007$

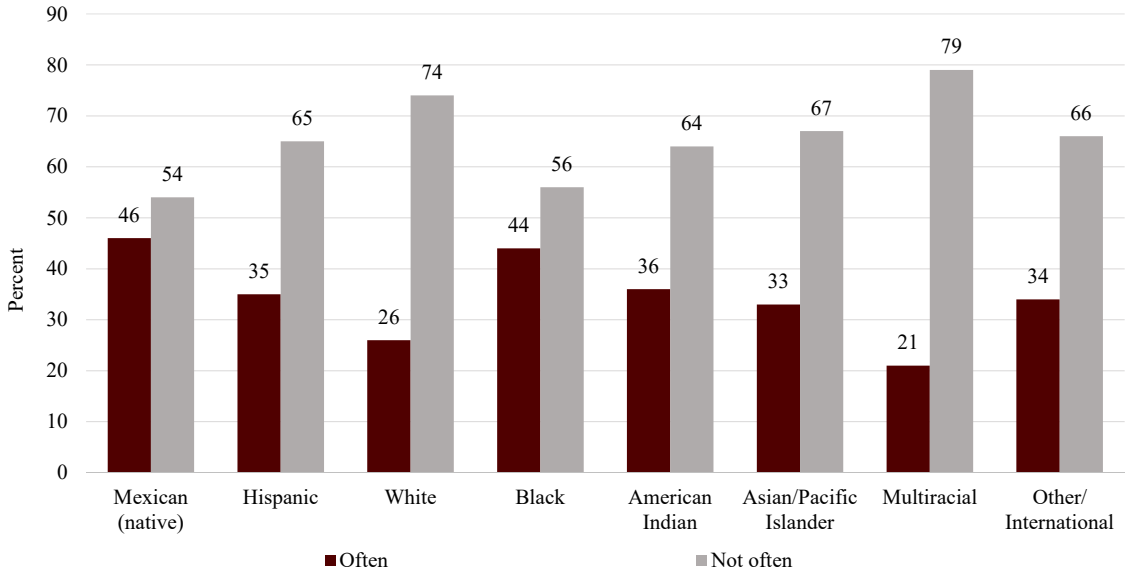

Figure 10. How often accessed general academic advising by ethnicity/race.

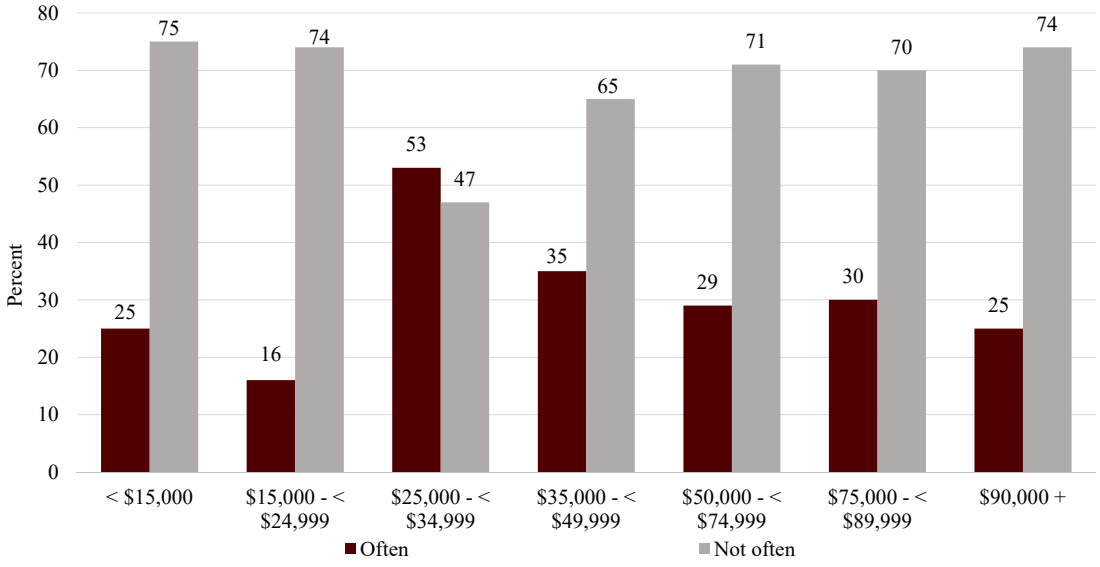

Figure 11. How often accessed general academic advising by income.

3.5.2 Afterschool Programs Foster Outdoor Interests

A significant association was observed between transfer student status (P = 0.044), ethnicity/race (P = 0.006) and gender (P = 0.047), for the respondents who answered that an extra-curricular or afterschool organization fostered their interest in the outdoors (Table 7; Fig. 12). Additionally, for the overall sample of students answering this question, 45% agreed with the statement that an extra-curricular or afterschool organization fostered an interest in the outdoors. Similarly, relative to ethnicity/race, Mexican (native) and American Indian identified respondents were most likely to agree with the latter statement at 67%; while Black identified respondents (29%) and Multiracial identified respondents (24%) were least likely to agree with this statement (Fig. 13).

Concerning the demographic of sex, there was a significant difference for those who agreed with the statement that an extra-curricular program or an afterschool program fostered an interest in the outdoors (Fig. 14). For example, the male identified respondents were more likely than the female identified respondents to agree that an extra-curricular or afterschool organization fostered interest in the outdoors (P = 0.047; Table 7). For this portion of the survey, the demographic markers such as student academic classification, income or socioeconomic status and type of science major were not significantly associated with this institutional factor.

Table 7. Student's response if afterschool activity fostered interest in outdoors.

Student Characteristics	N	% of Total	% Agree	% Do Not Agree
Total	1008	100	45	55
Transfer				
Started Here	528	52	43	57
Started Elsewhere	322	31	50	50
			$\chi^2(1) = 4.04$ $P = 0.044$	
Ethnicity				
Mexican (native)	18	2	67	33
Hispanic	143	14	40	60
White	542	53	48	52
Black	28	3	29	71
American Indian	9	1	67	33
Asian/Pacific Islander	106	11	46	54
Multiracial	46	5	24	76
Other/ International	53	5	43	57
			χ^2 (7) = 20.01 $P = 0.006$	
Gender				
Male	370	36	49	51
Female	632	62	43	57
			χ^2 (6) = 3.94 $P = 0.047$	

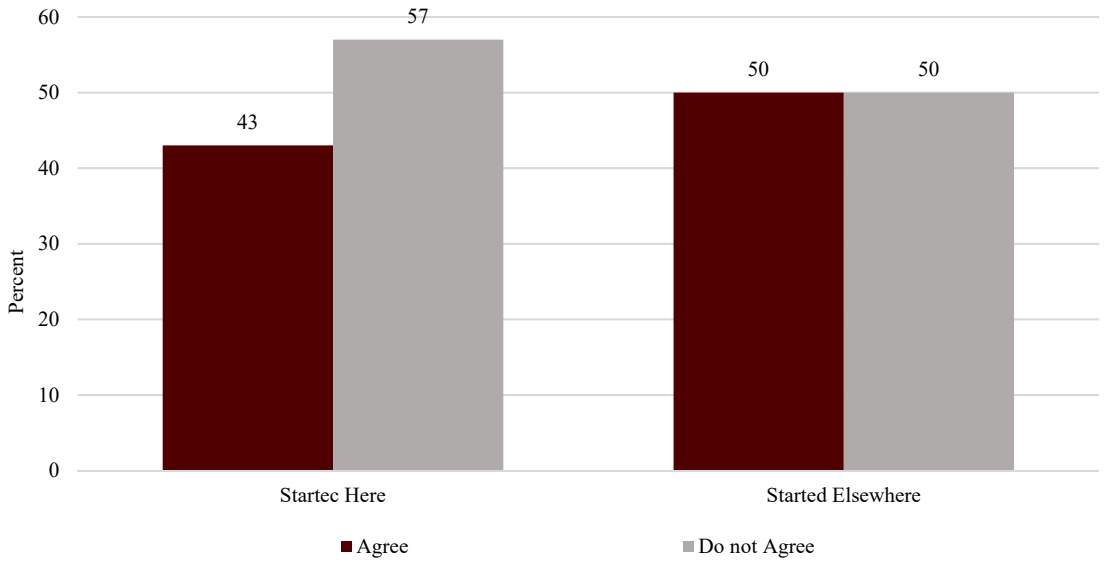

Figure 12. An extra-curricular or afterschool organization fostered the student's interest in the outdoors by transfer status.

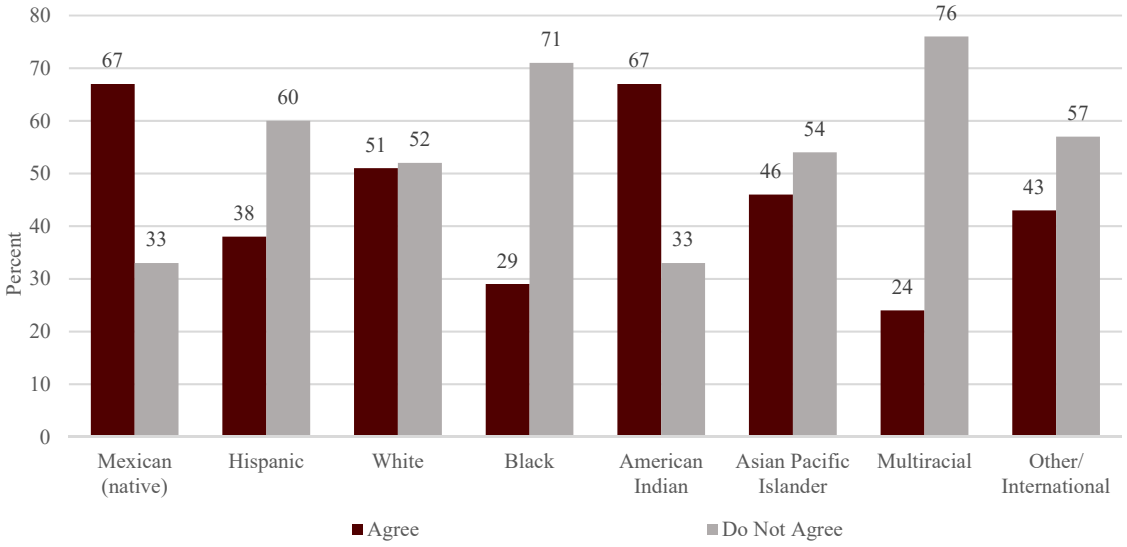

Figure 13. An extra-curricular or afterschool organization fostered an interest in the outdoors by ethnicity/race

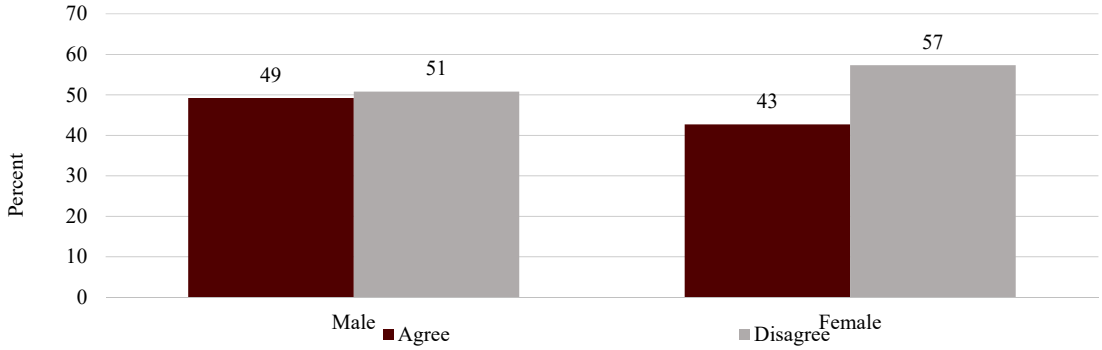

Figure 14. An extra-curricular or afterschool organization fostered an interest in the outdoors by gender.

3.5.3 Middle School Preparation for High School Success

Overall, most (59%) of the respondents agreed that middle school provided the necessary academic skills for success in high school. Additionally, there was a significant association between transfer student status ($P = 0.037$), ethnicity ($P = 0.009$) and self-reported income ($P = 0.002$) that a middle school provided academic skills for high school success (Fig. 15). Students who started at TAMU were significantly ($P = 0.037$) more likely to agree with this statement than transfer students (Table 8).

Further, among the different ethnic groups identified, Other International identified respondents (66%) and White identified respondents (64%) were significantly more likely to indicate that middle school was important, compared to the Hispanic identified respondents who reported the lowest at 46% (Fig. 16). Students who reported the highest income status (Fig. 17) also reported a significantly higher proportion of agreement compared to other income brackets (Table 8). However, the demographic markers that did not have a significant influence were student academic classification, gender and type of science major.

Table 8. Institutional Retention Factor: My middle or junior high school experience provided academic skills sets to be successful in high school.

Student Characteristics	N	% of Total	% Agree	% Do Not Agree
Total	997	100	59	41
Transfer				
Started Here	526	62	61	39
Started Elsewhere	316	38	54	46
			$\chi^2(1) = 4.33$ $P = 0.037$	
Ethnicity				
Mexican (native)	18	2	50	50
Hispanic	143	15	46	54
White	536	57	64	36
Black	27	3	52	48
American Indian	9	1	56	44
Asian/Pacific Islander	104	11	53	47
Multiracial	46	5	61	39
Other/ International	53	6	66	34
			χ^2 (7) = 18.86, $P = 0.009$	
Income				
< $15,000	53	7	51	49
$15,000 - < $24,999	42	6	38	62
$25,000 - < $34,999	34	5	62	38
$35,000 - < $49,999	77	10	47	53
$50,000 - < $74,999	139	19	57	43
$75,000 - < $89,999	96	13	65	35
$90,000 +	297	40	67	33
			χ^2 (6) = 20.85, $P = 0.002$	

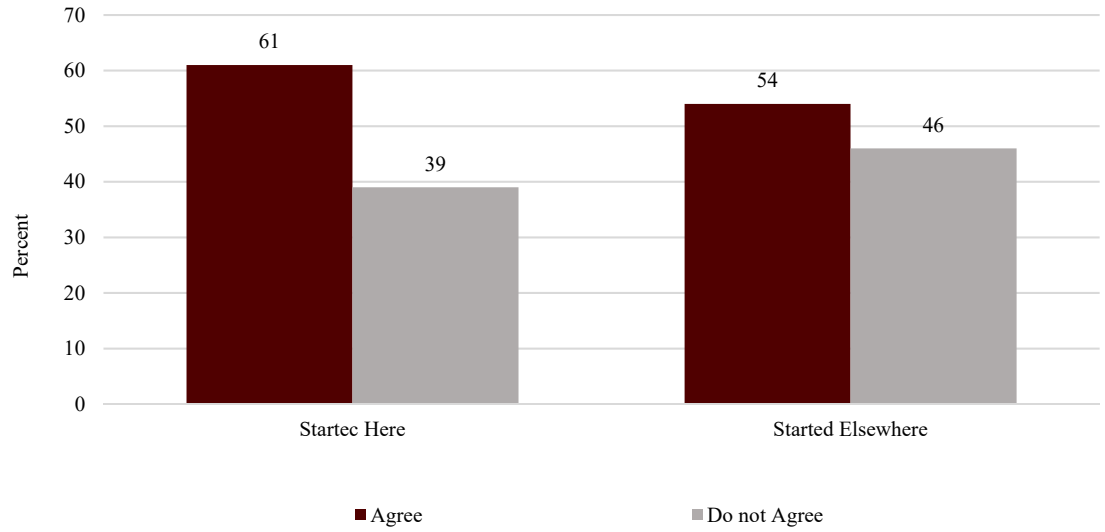

Figure 15. Middle school provided academic skills to be successful in high school by transfer status.

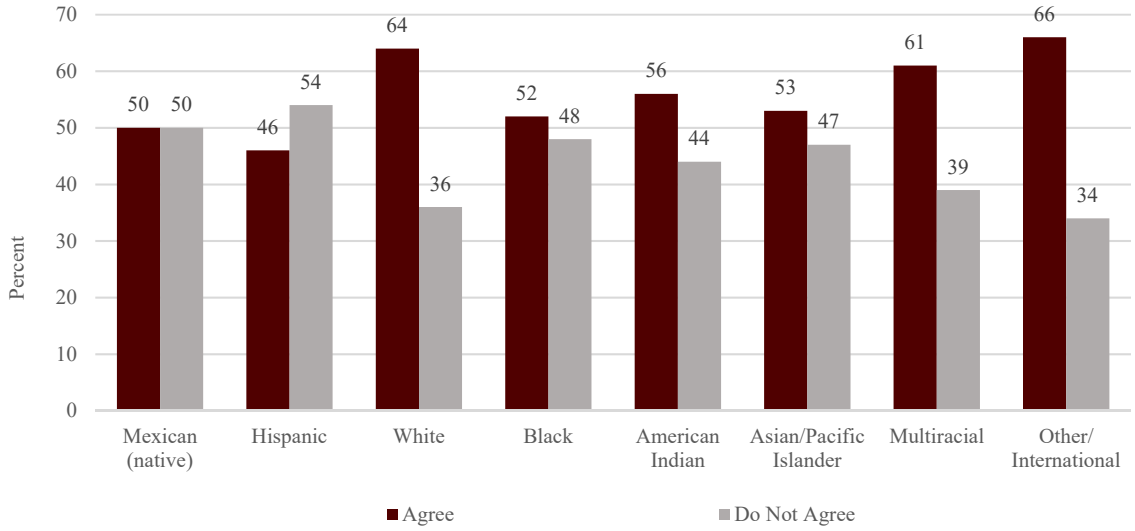

Figure 16. Middle school provided academic skills to be successful in high school by ethnicity/race.

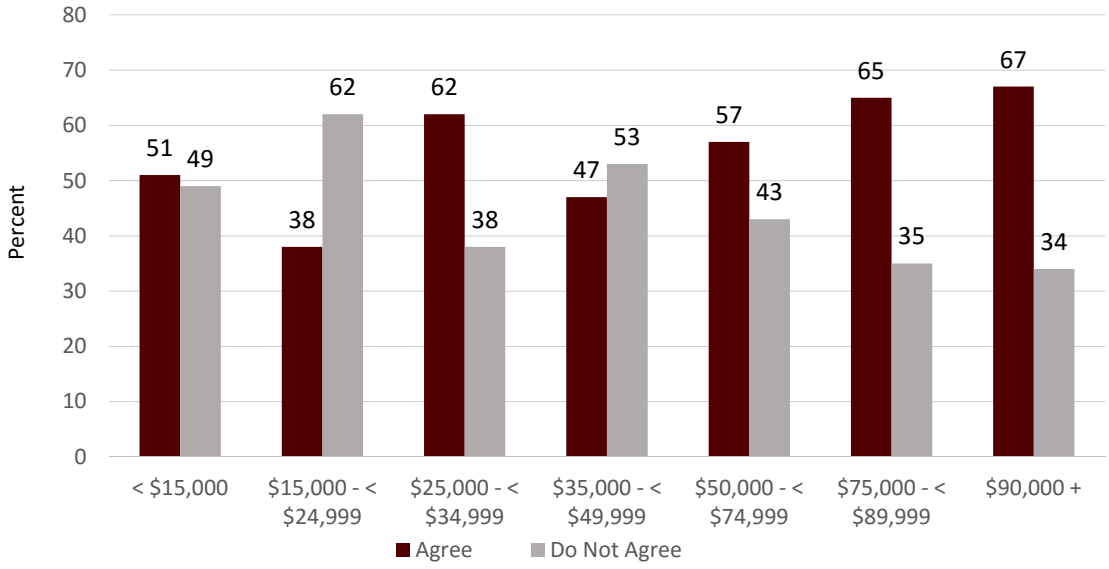

Figure 17. Middle school provided academic skills to be successful in high school by income.

3.5.4 Study Skills and Science Major Persistence

Taken as a whole, almost 90% of all survey respondents in this study agreed that individual study skills helped them persist in a science major (Fig. 18). However, ethnicity was a significant variable in this institutional factor ($\chi 2 = 14.39$, $P = 0.049$). For example, this factor was of least importance for the Black identified respondents (59%), and the highest of importance among the Mexican (native) identified respondents (94%; Table 9). Likewise, the Fisher's exact test results indicated a similar trend ($P = 0.082$). Student academic classification, gender, income, transfer status and type of science major were not significantly associated with this institutional factor.

Table 9. Institutional Retention Factor: Individual study skills helped me persist in a science major.

Student Characteristics	N	% of Total	% Agree	% Do Not Agree
Total	1,015	100	81	19
Ethnicity				
Mexican (native)	18	2	94	6
Hispanic	143	14	80	20
White	545	54	80	20
Black	29	3	59	41
American Indian	9	1	89	11
Asian/Pacific Islander	105	10	84	16
Multiracial	47	5	83	17
Other/International	119	11	87	13
			$\chi^2(7) = 14.39$,	$P = 0.049$*

- Fishers exact $P = 0.082$

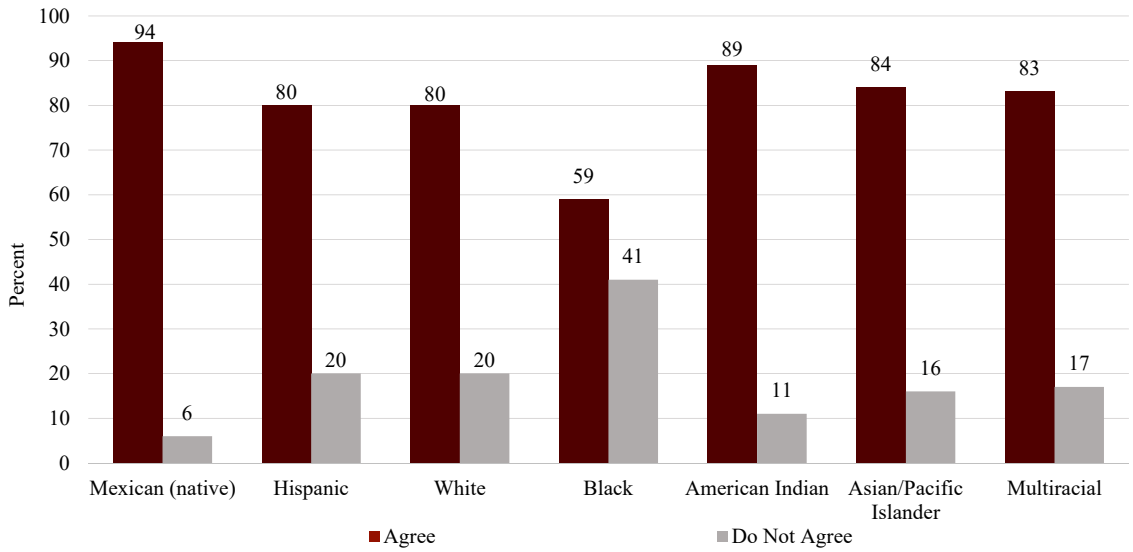

Figure 18. Individual study skills helped to persist in science major by ethnicity/race.

4. DISCUSSION

Understanding which retention factors, individual and institutional, that affect student academic success, particularly minority student retention is relevant to the natural resource and related sciences pipeline for retaining future scientists (Jones 1993, Valdez 1995, Wolter et al. 2011). When considering retention, individual factors as well as institutional factors may be important for retaining natural resource and related science students at TAMU. This chapter discusses the identified individual and institutional retention factors as related to significant demographic variables of TAMU underrepresented undergraduate and graduate students in the natural resource and related sciences.

4.1 Individual Retention Factors

4.1.1 Self Reliance

According to my research, the most important individual factor for student retention in the natural resource and related sciences was "myself". However, this finding is inconsistent with other research that attributes the demographics of ethnicity/race and gender; parental education levels; academic coursework classes taken during the senior year of high school, as some, but not all, factors for persisting in a scientific field of study (Swarat et al. 2004, Russell 2005, Adamuti-Trache and Andres 2008, O'Shea et al. 2010). In other studies, parental and teacher influence as well as

support in high school were factors attributed to Black identified students persisting in college science programs (Russell 2005, Russell and Atwater 2005, Good et al. 2008, Strayhorn 2015). While others reported a general awareness of academic and social support groups attributing to their success in college for the engineering and related sciences, Concannon and Barrow (2010) found self-confidence was the most important for persistence in the sciences. However, the findings of my research suggesting natural resource and related science students are different in their retention needs when compared to the general STEM undergraduate and graduate students is evident in their self-efficacy response.

Additionally, the finding of self-efficacy also referred to in research as self-reliance, although not exactly the same as self-confidence, correlates with the idea that self-confidence and self-efficacy which both lead to whether or not an individual, based on his or her own beliefs, will achieve desired goals (Bandura 1986). Self-confidence provides motivation to continue in a natural resource and related science major. For example, this study showed the Black identified male respondents felt they would succeed even though the desired academic skill sets were lacking. In contrast, certain female identified respondents who had the academic skill sets, but lacked self-confidence or self-motivation, were less likely to persist.

In fact, this is important because the current study found a student retained in the natural resource and related sciences major was due to "self" (Table 4). "Self," as an individual factor for retention in the natural resource and related sciences majors, is supported by a contributing line of research that supports academic self-efficacy, or a

student's confidence in their academic ability for college success (Strayhorn 2015). For example, in Strayhorn's study, the "self" was an indicator among Black identified males to know their success. More importantly, factors are still not identified addressing this demographic for their non-representation in STEM fields (2015).

The importance of an individual's confidence and self-efficacy are consistent with the study by Concannon and Barrow (2010) indicating that students who succeed and complete their university degrees are confident in their abilities, and thus have a passion to continue or persist even when their major is difficult. This finding suggests students must persevere through their major and is congruent with self-efficacy theory (Bandura 1986) and other studies suggesting personal motivation (Russell and Atwater 2005) and persistence (Hedges and Mania-Farnell 2002). Although their findings were from the greater body of STEM research, they were able to conclude that men and women in their field of study (undergraduate engineering) have similar intentions to persist. If the Concannon and Barrow (2010) study attributed confidence (self-efficacy) to both men and women's intent to persist in the field of engineering, then this factor of self-efficacy may be a relevant individual retention factor for the natural resource and related science major.

4.1.2 Reliance and Support from an Advisor

Universities have long held the belief that relying on college and departmental advisors are important for student success (Drake 2011), but the findings of this study suggest otherwise for the natural resource and related science student. For example, in

my study, when respondents were asked, "How often the student relied on a university or college advisor for help or support," the results found the second most important individual factor identified was advisor support. However, this was not the case for all respondents. For instance, 42% of all the survey respondents reported in favor of the reliance on the general academic advisor (Table 3). However, the data found more than half of the survey respondents, in general, do not seek advice from an advisor in their field. These results suggest students, in general, do not attribute their retention in the natural resource and related sciences to meeting with their academic advisor.

Conversely, other Multiracial and Black identified survey respondents did rely on the general academic advisor. In past studies, (Moreno et al., 1999, Hedges and Mania-Farnell 2002, Cejda and Rhodes 2004), students indicated the reliance on an advisor for help or support was a significant factor influencing their continued pursuit of their degree. Findings for the Black and Multiracial identified survey respondents in the natural resource and related science majors contradict previous results reported in past studies suggesting support from a faculty member was a significant factor for their academic retention, but not for all survey respondents as past studies have indicated (Hathaway et al. 2001, Hedges and Mania-Farnell 2002). This result seems to indicate that perhaps the role of the university and its academic advisor may be important for certain populations only and may dispel previous perceptions that all students need to rely on an advisor for retention. However, at TAMU, undergraduate and graduate students, may be accessing advisors and advising tools through different methods available to them. For example, the advancement of new technology that may serve in

the capacity to advise students and was not considered in this study. Finally, this finding may indicate a future program development need to change methods of information exchange and advisement between the student and the advisor.

4.2 Institutional Retention Factors

4.2.1 Faculty-led Research Opportunities and Socialization

In the TAMU 2011 study, the respondents were asked if they were involved in academic research opportunities with their faculty. In addition to this question students were queried about socializing with faculty, as well. At TAMU academic programs for the natural resource and related science majors have been established to develop future professionals through academic and pre-professional activities. Therefore, these two questions collected baseline date to determine if these activities providing opportunities to interact with peers and faculty members were of significance with regard to the undergraduate and graduate students at TAMU. These opportunities to bring undergraduates, graduates, and faculty together focus on two levels of interaction: (1) research led opportunities and (2) university sanctioned social events such as seminars, mixers, conferences, committees, brown bag luncheons, cook-offs and other social gatherings. With these unique academic programs, faculty-led research has supported academic involvement along with socialization, which has been associated with retention and success in the sciences (Bianchini et al. 2001, Cejda and Rhodes 2004). Such programs foster recruitment into the natural resource and related science major with a possibility of retention, but not for all populations. Notably, research by Bianchini et al.

determined that academic participation, involvement, and experiences help women and ethnic minorities find success in the sciences in general (2001). Additionally, these researchers were able to identify three sets of actors shaping differential student success in science: (1) students, (2) their instructors, and (3) forces outside the university. However, it is not certain if their findings hold for the natural resource and related sciences major.

According to the results of my study, when asked if they were more likely to participate in faculty-led research opportunities Mexican (Native), Asian/Pacific Islander, respondents in the lower and higher income levels categories, and transfer students were the most likely to have these factors appear to be significant for retention.

When considering the income categories (lowest and highest income survey respondents) faculty-led research opportunities are more important than socializing with faculty. The lower income survey respondent may comprehend the new opportunity to work directly with faculty providing opportunity for professional development; whereas for the higher income student, this maybe an expected experience facilitating their career pathway in the natural resource and related sciences. The reporting of extreme low and high income survey respondents is important and necessitates further investigation.

Some research has reported that retention rates and future success of transfer students is through both academic and social support (Xu, et al., 2016,). However, in Cejda and Rhodes' (2004) reported that one of the barriers for continuing in the science pipeline is the transfer student status. At TAMU, transferring credits and accessing baccalaureate programs, the transfer student may face some of these same challenges;

but in the natural science fields such an obstacle might be mitigated by the incentive of faculty led research and social opportunities in order to complete their academic program. Incoming transfer students also report mentoring as essential to Hispanic's retention (Cejda and Rhodes 2004). In my research study, those who identified as a transfer student, socializing and participating in faculty led research may be representative of an informal mentoring experience, and thus facilitating retention. For the transfer students in this study, engaging with the faculty in formal, faculty-led research opportunities was of more value than social activities as reported factors for retention. Additionally, the transfer students queried may persist and be retained as they report that institutionalized faculty-led research opportunities are valued for retention, but not necessarily socializing with faculty.

In a separate, but related, question, survey respondents were asked if they socialized with faculty as part of the academic environment. Socialization was defined to be in an informal academic setting in which faculty-led research opportunities were separated. However, often in the field of natural resource and related sciences both activities are closely related due to the nature of the profession. In the natural resource and related sciences, the research is often conducted in the field for extended lengths of time in isolated areas where the intersection of research and socialization will most likely occur. Therefore, due to these intersections of interactions between academics and socialization, future questions regarding these two activities may direct research to determine the relevance and significance, if any, to retaining a natural resource and related science student.

Of all the possible retention factors and variables analyzed ethnicity showed significance. Whereas the socialization factor was relevant for the Mexican (native) and Other/International, the Multiracial, Black, White, and Hispanic identified respondents it was not as important. For the American Indian identified respondent, 91% did not socialize with faculty and they did not participate in faculty-led research at all (100%).

Thus, this research has indicated that opportunities to participate in faculty led research is important for retention in the sciences.

4.2.2 General Academic Advising

The survey indicated that certain respondents, when asked if they accessed general academic advisors, not advisors in their major field of study, was significant for Native Mexican and Black identified students respectively; for White and Multiracial identified advisors were least likely to access. Additionally, income or socioeconomic status for the same query concerning accessing general academic advising proved to be an important factor. For example, respondents who identified either within the lowest or highest income categories were least likely to consult with a counselor. Although important, this institutional factor was not found to be significantly associated with sex, transfer status, academic classification or type of science major.

Venezia and Kirst (2005) found that persistence in college could be credited to educational reform policies. They explain that one particular reform would be to clarify the role of the college counselor (i.e., advisor) and the misconceptions held by the student body. For example, Venezia and Kirst's (2005) results revealed students

believed counselors were used by motivated and honor students who are academically successful, not the students who were in need of academic guidance and could have benefitted from their advisement. According to another study, the intervention of college counseling was determined to not be causal evidence for self-efficacy and subsequently completing college for the respondents who identified as lower income (Castleman and Goodman 2015). However, their study did find that college counseling in the third year was important, and had a profound impact on female identified respondents and those who spoke English at home (Castleman and Goodman 2015). The results of this study do not support the aforementioned studies. Although these studies come from the greater body of STEM and retention research, other demographic variables may be associated with the retention factor of general academic advising for the natural resource and related science undergraduate and graduate student.

4.2.3 The Role of Afterschool Activities Fostered Outdoor Interests

For this study, the question of afterschool activities influencing outdoor experiences as a retention factor for the survey respondents was asked to further the connection between recruitment, retention, and the perceptions held that positive outdoor and extra-curricular middle and secondary school experiences will lead to retention along the academic career pathway. In previous research, outdoor and afterschool activities to recruit natural resource and related science students (Adams and Moreno 1998, Haynes and Jacobson 2015) are generally recognized as an important factor for interest levels for this specialized science career pathway. In this study, the question

posed indicated that relative to ethnicity, Mexican (native) and American Indian identified respondents agreed it was important to have afterschool organizations foster an interest in the outdoors; while the Black and Multiracial identified respondents were not in agreement (Table 7).

A perception held in many of the natural resource and related science programs is that afterschool activities and experiences in the outdoors may interest and recruit secondary school students to these majors in college (Haynes and Jacobson 2015). This is of interest because identifying connections between children's engagement with nature in afterschool activities suggest links towards adult environmental interest in later life and possible career pathways (Haynes and Jacobson 2015). In addition, in a previous research study, positive outdoor and extra-curricular experiences during middle school and high school were highlighted as variables leading to the recruitment of natural resource and related science professionals (Adams and Moreno 1998).

My findings are not fully consistent with those of the aforementioned study, in that for some survey respondents in my study these experiences were important, but not for all. Transfer status and gender also were important regarding this institutional factor in that both sets of respondents reported these activities were not important for fostering their interest in the outdoors. Although both groups agreed it was not important for fostering their interest in the outdoors, the TAMU students reported a higher percentage (57%) than the transfer student (50%). For both male and female survey respondents they stated afterschool activities were not relevant to fostering their interests in the outdoors. Results of my study is contrary to perceptions held that participation in

afterschool activities fostered their outdoor interests. The implication of this finding is that for the undergraduate, graduate, male or female, with the exception of Mexican (native) and American Indian, the outdoor experience may not supported by afterschool activities and outdoor interest exposure. Other experiences may need to be considered to foster an interest and at different educational levels along the academic pathway.

4.2.4 The Role of Middle School and High School Preparedness

In my study, most (59%) respondents agreed that middle school prepared them for high school where the development of personal study skills facilitated their academic success. These survey responses are congruent with the results in postsecondary education research where academic skill sets are important in order to persist in the STEM science pipeline (Lotkowski et al. 2004, Concannon and Barrow 2010, Hein and Smerdon 2013).

In addition, a significant association between transfer student status ethnicity, and self-reported income with agreement that middle school provided the necessary academic skills for success existed. Students who started within the TAMU system were more likely to agree with academic skills were necessary for success than transfer students.

Additionally, Other International (66%) and White (64%) identified respondents were significantly more likely to indicate that middle school was important compared to the lowest indication among those respondents who identified as Hispanic. These data reporting that Hispanic identified respondents did not identify the importance of middle

school, may suggest a need for further research among specific ethnicities when it comes to middle school and high school preparing them for college coursework.

Students reporting the highest income also reported the highest proportion of agreement with this statement (Table 8). This may be attributed to the notion that higher incomes are typically associated with better schools and/or private schools and therefore confidence instilled and more opportunities provided for academic success (Snellman et al. 2015).

The importance of study skills has been attributed to success in high schools, and used as indicators for success in higher education (Lotkowski et al. 2004, Concannon and Barrow 2010, Hein and Smerdon 2013). Extracurricular activities cost money to participate in throughout the course of an academic K-12 and collegiate program. Whether it is paying the school activity fee or paying for private tutorial lessons some families are not economically capable of involvement with out-of-school academic support activities. On the other hand, the economically advantaged survey respondent who may have access to these afterschool academic activities and participate in them fully as a routine activity. Therefore, when both the lower and higher income identified respondents surveyed for this question indicated that experience of afterschool activities was not necessarily relevant to retention, this response was interesting in those with the higher income levels did not report these activities to be of importance. However, for those in middle school with middle income responses afterschool experiences were of some importance when it comes to retention. Further, among certain ethnicities identified, Other International and White identified respondents were most likely to

indicate middle school was important (Fig. 16).

Similar to results reported herein, Middle School/Junior High experience has been shown to be as important in preparing survey respondents with the academic skill set to be successful in a high school (Concannon and Barrow 2010). However, student academic classification, gender and type of science major were not significantly associated with this institutional factor.

4.2.5 The Role of Study Skills and Persistence in Science

For this section, almost 81% of all survey respondents agreed individual skills helped a student persist in a science major (Table 9). However, ethnicity was a significant variable in this institutional factor, with the Black identified respondents reporting this as the least important institutional factor for academic retention (Table 9 and Fig. 18). Student academic classification, gender, income, transfer status and type of science major were not significantly associated with this institutional factor.

Previous research indicates academic skills, in combination with persistence, have been reported to support retention for sciences in general (Adamuti-Trache and Andres 2008, O'Shea et al. 2010). However, in this study, Black survey responses demonstrated a significant statistical finding: 41% reported study skills were not an important factor in persisting in their major. This response is contradictory to the findings of Russell and Atwater (2005) who concluded high expectations for academic success played a critical role for Black students in science and mathematics.

5. CONCLUSIONS

TAMU is a national leader in professional development for the natural resource and related sciences. The recruitment of future natural resource and related science professionals is important and retention of students preparing to enter this workforce—and our society—is even more valuable. Recruitment of motivated, prepared and capable students leads to retention—but appropriate strategy and tactics may need to differ between majority and minority students. Determining the factors for student retention, specifically minority-identified students, in this particular science field will facilitate their academic success.

The primary objectives of this study were to identify which retention factors were influential to natural resource science majors and for whom these factors were most relevant. From STEM retention literature, institutional retention factors of importance presented to survey respondents had them identify academic coursework and skill sets needed to persist at the public and higher education level, and the role of mentors and other college personnel, i.e. advisors and faculty as relevant to persisting in the major. Of the many retention factors presented to the survey respondents, the results identified individual (myself and general academic advisor) and institutional (study skills, participation in faculty-lead research, general academic advising, participation in organizations to foster interest in outdoors, and middle school/high school experiences) were important to these 2011 TAMU undergraduate and graduate natural resource and

related science majors.

The survey data I collected indicate, in general, that all students, regardless of classification and demographic, rely on themselves to persist in the major. From all undergraduate and graduate natural resource and related science majors queried, most identified the responsibility of persisting in the natural resource sciences as being through their own support and efforts. Thus, it is the responsibility of the student to be motivated and desire a successful course of academic progress as an individual pursuit. While most students agree with this finding, within the individual category of retention factors, Black and Other ethnic identified undergraduate and graduate students found relying on a university advisor was of value to them for persisting in the natural resource and related science major as well.

There were some significant differences among students when it came to their interaction with TAMU's faculty-led research opportunities and academic advising. These variations or differences existed for a significant, but important few based on income, transfer status, and ethnic background. K–12 experiences and outdoor activities contributed positively to the notion of persisting in the natural resource and related major years later for survey respondents at TAMU.

The institutional retention factors in this study suggest TAMU may want to examine the retention programs already in place to determine if any of the identified factors are considered to facilitate retention for the undergraduate and graduate student. Changing the academic and social climate at the university may be amenable for retaining underrepresented students. More active involvement in the secondary school

setting may lead to involvement with faculty-led research opportunities for undergraduate and graduate students. Faculty could help to retain students in the sciences by offering research led opportunities and providing social interactions for students willing to participate, such as including more active involvement by scientists in K-12 settings. With Texas A&M University facing an increase in Hispanic enrollment, in future research studies in this intersection of faculty-led research and socialization may be a possible retention factor for the natural resource and related science student. Further, faculty can provide greater mentoring of members of underrepresented or minority-identified groups in undergraduate natural resource and related science disciplines to make university science courses more amenable to the needs, experiences, and interests of minorities.

It was not in the scope of this research to determine frequency of the activity nor if the student actually participated in those activities, but rather if they had a perception these experiences retained them. Prior to this study, TAMU has been quantifying enrollment and proposing accountability measures for increasing and retaining diverse student populations. The data from this study shows that in the future the university may want to look to its student body for vital retention information about possible contributing individual and institutional factors to retention from the individual natural resource and related science student. In addition, the university can initiate or continue, as identified by the survey respondents, program offerings at the college and departmental level where “as needed” and “general academic advising” and research opportunities exist for students.

TAMU and its role in professionally developing the nation's natural resource and related science professionals require baseline data from its own students. The ultimate goal of this study was to identify retention factors that can be used by TAMU System to develop and facilitate programs to improve and increase minority representation and diversity within the natural resource and related science majors which contribute to the natural resource and related science workforce, and in doing so, make progress toward the goals of the TAMU *Vision 2020*.

First and foremost, examine the individual factors that influence the natural resource and related undergraduate and graduate student to correctly identify evolving retention needs in completing their academic program. The survey responses provided information stating communication and interaction at the faculty level are important. From the survey results the university should provide general university advising for Black identified male respondents at any point in the higher education pipeline along with assisting this population the understanding that their self-efficacy and confidence levels may lead to increased retention levels.

This research was not designed to determine causality for retention, but rather to identify themes for further research for retaining natural resource scientists at TAMU. In order to understand the cause-and-effect of the retention factors selected by the spring/summer 2011 undergraduate and graduate natural students, further research should be designed to include longitudinal studies. Longitudinal research may account for actual exit factors of those who abandon the natural resources and related science pipeline. Mechanisms for this may include, but are not limited to, periodic focus groups

throughout the course of their studies such as periodic surveys, exit interviews for change of major, permanent drop outs, or those that finalize their degrees.

Additionally, isolating the retention factors as individual and institutional may assist TAMU by considering that natural resource retention in higher education truly originates at the K–12 level thus challenging the university to partner with these institutions in the future. TAMU has documented efforts to address campus climate and diversity suggesting systemic change is part of their vision (Vision 2020).

While minority, undergraduate, and graduate students are underrepresented in the natural resource and related sciences, TAMU has committed to its Vision 2020 goal for increasing diversity. The OISP collects and maintains student enrollment profiles that suggest the minority population is well represented; however, in the sciences TAMU needs to face the greater challenges that natural resource and related sciences demand of their candidates and address the retention of their underrepresented students. TAMU is committed to retention of all students and has enforced many retention services and approaches (peer academic services, mentors, web site resources, academic success centers, financial assistance), however, the results of this research suggest that more focus on minority students may be needed. For the American Indian, TAMU may want to partner with organizations that have a successful retention and graduation rate for this respondent group. These organizations (Society for the Advancement of Chicano and Native American Scientists, Tribal Colleges, and Native American-Serving Nontribal Institutions) may offer different approaches to support services needed for these populations. For the Black student, if at any point in the academic/science pipeline

pathway they encounter obstacles, this may restrict their academic and career path even with the reported high self-efficacy rating. This result along with the little influence afterschool activities had for retention in the (NRRS) may direct TAMU to the K-12 S.T.E.M. pipeline research and initiate partnerships with science educators at the secondary school level as well as initiate interdisciplinary, institution-wide support services for multi-faceted approaches to retaining these students. For example, although they do not initiate socialization or interactions with faculty or other activities, perhaps scheduled structured activities, i.e. mentoring opportunities are more valuable as a retention tool. Finally, for the International students, in particular the Mexican (native), if socialization is needed with faculty members, TAMU should provide more opportunities to include these students in structured, formalized research. These approaches must be at all levels of the institution and with extended partners to better retain students already committed to TAMU.

Research on this topic is fairly new to the natural resource sciences; thus there is a need for additional research. This study is not intended to serve as a complete or comprehensive guide and there are two important limitations to consider. First, the data collected spanned two semesters, spring and summer 2011; and secondly, responses reflect those of natural resource and related science students from TAMU. Therefore, the outcomes cannot be generalized to other programs or populations. The strength of this study is the provision of research results that have been designed to provide baseline data. Whereas, enrollment figures and headcounts for enrollment profiles and dropout rates serve a greater purpose for the university on many levels, individual and

institutional factors serve an even greater need for retention program design at the department, college and university level. Second, there is very little research that focuses specifically on the retention factors identified by the student populations enrolled in coursework and pursuing professions in the natural resource and related sciences. Thus this research is designed to provide baseline data only, not data that will predict retention and success for specific subgroups. Finally, further research is needed to resolve the outcomes of these results to determine if these retention factors can be referenced for other universities engaged in developing the natural resource and related science student.

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APPENDIX A: SURVEY INSTRUMENT

Different individuals offer help and support during the **college years.** How much do you rely on this support provided by the following individuals and groups?

		A great deal of support	Quite a lot of support	Some support	Not much support	No support
1.	Myself	1	2	3	4	5
2.	Husband/Wife/Significant other	1	2	3	4	5
3.	Grandmother	1	2	3	4	5
4.	Grandfather	1	2	3	4	5
5.	Mother	1	2	3	4	5
6.	Father	1	2	3	4	5
7.	Brother/sister/siblings	1	2	3	4	5
8.	Relative (other than grandparents, parents, brothers or sisters)	1	2	3	4	5
9.	Administrative assistants/secretaries/other staff	1	2	3	4	5
10.	Teaching assistants	1	2	3	4	5
11.	University college advisor	1	2	3	4	5
12.	High school teacher	1	2	3	4	5
13.	College professor	1	2	3	4	5
14.	Friends	1	2	3	4	5
15.	Other students	1	2	3	4	5
16.	Retention advisor	1	2	3	4	5
17.	Personal mentor	1	2	3	4	5
18.	Religious leader	1	2	3	4	5
19.	Junior high/Middle school teacher	1	2	3	4	5
20.	Church/Spiritual leader	1	2	3	4	5
21.	Boy/Girl Scouts' leaders	1	2	3	4	5
22.	Girls'/Boys' Club leaders	1	2	3	4	5
23.	Sports/Athletic coaches	1	2	3	4	5
24.	Social Networks	1	2	3	4	5
25.	Virtual Communities	1	2	3	4	5
26.	Legal Guardian	1	2	3	4	5
27.	Minority retention advisor	1	2	3	4	5

Service/Organization groups can help college students in many different ways to receive help and support throughout college. During the past year, how often have you participated in any of the following activities? The "not available" response applies when service/organization groups are not available on your campus.

		Very Often	Often	Sometimes	Never	Not Available
28.	Accessed **general** academic advising	1	2	3	4	5
29.	Participated in academic/or advising conversations with **science major advisor**	1	2	3	4	5
30.	Participated in academic/or advising conversations with students in **science majors**	1	2	3	4	5
31.	Participated in pre-professional **science related** clubs	1	2	3	4	5
32.	Participated in academic conversations with university sponsored **general** tutorial clubs	1	2	3	4	5
33.	Participated in informal tutorial sessions with peers in the class or related **science majors**	1	2	3	4	5
34.	Participated in university sponsored cultural diversity activities	1	2	3	4	5
35.	Participated in student leadership/campus government activities	1	2	3	4	5
36.	Attended a university sponsored cultural arts program (gallery, play, dance, or other theater performance)	1	2	3	4	5
37.	Participated in social events for science society clubs	1	2	3	4	5
38.	Participated in social events for academic society clubs	1	2	3	4	5
39.	Attended a university sports event	1	2	3	4	5
40.	Attended residence hall socials	1	2	3	4	5
41.	Participated in activities to enhance your spirituality (worship, mediation, prayer, etc.)	1	2	3	4	5
42.	Participated in academic blogs, podcast	1	2	3	4	5
43.	Used an electronic medium (listserv, chat group, Internet, instant messaging, twitter etc.) to discuss or complete an assignment	1	2	3	4	5
44.	Accessed study tables	1	2	3	4	5
45.	Used e-mail to communicate with an instructor	1	2	3	4	5
46.	Participated in academic success programs	1	2	3	4	5
47.	Socialized with faculty members in after class events	1	2	3	4	5
48.	Attended lunchtime academic seminars	1	2	3	4	5
49.	Participated in faculty-led research opportunities	1	2	3	4	5
50.	Engaged in an exercise/physical fitness routine	1	2	3	4	5

Sometimes there are other reasons students leave their major field of study. Below are some reasons for natural resource and related sciences majors. Please select reasons that could apply to you.

		Always a Reason	Sometimes a Reason	Never a Reason
51.	Apathetic/detached sentiment from advisor	1	2	3
52.	Poor communication with my advisor	1	2	3
53.	Lack of personal financial resources	1	2	3
54.	Lack of funding from departmental support	1	2	3
55.	Lack of funding from a scholarship/fellowship	1	2	3
56.	The feeling of isolation	1	2	3
57.	There are not other or few students of my sex in classes	1	2	3
58.	There are not other or few students of my racial demographic in classes.	1	2	3
59.	Treated differently because of my sex.	1	2	3
60.	Offensive sexist remarks by other students			
61.	Offensive sexist remarks by instructors/professors.	1	2	3
62.	Offensive sexist remarks by advisor.			
63.	Treated differently because of my race	1	2	3
64.	Offensive racist remarks by other students			
65.	Offensive racist remarks by instructors/ professors	1	2	3
66.	Offensive racist remarks by advisor			
67.	Lack of camaraderie by other students			
68.	Lack of camaraderie by instructors/professors	1	2	3
69.	Lack of camaraderie by advisor			
70.	Lack of mentoring	1	2	3
71.	Hostile environment in the classroom			
72.	Hostile environment in the department	1	2	3
73.	Hostile environment in the university			
74.	Academic abilities not validated by professors	1	2	3
75.	Poor communication with my professors	1	2	3
76.	Poor communication with my peers	1	2	3
77.	Intimidating environment in the classroom			
78.	Intimidating environment in the department	1	2	3
79.	Intimidating environment in the university			
80.	Overt favoritism by the chair			
81.	Overt favoritism by the professor/instructor	1	2	3
82.	Overt favoritism by the advisor			
83.	Covert favoritism by the chair			
84.	Covert favoritism by the professor/instructor	1	2	3
85.	Covert favoritism by the advisor			
86.	Lack/Absence of peer support			
87.	Lack/Absence of departmental support	1	2	3
88.	Lack/Absence of college support	1	2	3
89.	Financial hardship	1	2	3

90.	Atmosphere/environment not inclusive of men			
91.	Atmosphere/environment not inclusive of women			
92.	Family hardship	1	2	3
93.	Time management issues	1	2	3
94.	Substance addiction related to alcohol	1	2	3
95.	Substance addiction related to other drugs	1	2	3
96.	Lack/Absence of familial support to complete major/degree	1	2	3
97.	Apathetic/detached sentiment from peers	1	2	3
98.	Apathetic/detached sentiment from professors	1	2	3
99.	Projected entry level salary not enticing	1	2	3
100.	This major is perceived to be for men only	1	2	3
101.	This major is perceived to be for women only	1	2	3
102.	Not enough employment opportunities presenting themselves upon graduation of this major	1	2	3
103.	Projected degree not prestigious	1	2	3
104.	Projected salary not sufficient	1	2	3
105.	Grades not sufficient	1	2	3
106.	Not adequately prepared academically for this major in high school	1	2	3
107.	Technological skills lacking	1	2	3
108.	I am the first to go to college in my family	1	2	3
109.	Classes too large	1	2	3
110.	No opportunity to collaborate with peers	1	2	3
111.	No opportunity to collaborate with professors	1	2	3
112.	No career advancement opportunities in my selected major field of study	1	2	3
113.	Lack of tutoring opportunities	1	2	3
114.	"Weed out" or introductory course in my major designed to systematically remove weaker academically-skilled students shattered my confidence	1	2	3
115.	**C**lasses were boring	1	2	3
116.	There are very few women in my classes	1	2	3
117.	My professors do not have the time to advise me	1	2	3
118.	Negative public perception of my field of study	1	2	3
119.	People of my cultural descent are not equally represented in my courses.	1	2	3

People hold very different opinions about how early academic and non-academic experiences influence retention for college science majors. Please indicate your level of agreement with the following statements.

		Strongly Agree	Agree	Neither Agree or Disagree	Disagree	Strongly Disagree
120.	My individual study skills helped me persist in a science major	1	2	3	4	5
121.	My high school science programs prepared me to compete in 4 yr university science fields	1	2	3	4	5
122.	Exposure to science activities in elementary school encouraged my science interests	1	2	3	4	5
123.	My middle school science programs encourage me to pursue my current science major	1	2	3	4	5
124.	My elementary school science programs prepared me to be interested in science	1	2	3	4	5
125.	Preparing students for today's competitive science professions is not a major concern for most public schools	1	2	3	4	5
126.	My middle/junior high school experience provided "laboratory/hands-on" science activities	1	2	3	4	5
127.	My high school experience provided "laboratory/hands-on" science activities	1	2	3	4	5
128.	My middle/junior high school experience provided academic skill sets to be successful in high school	1	2	3	4	5
129.	My high school experience provided the math courses necessary to be successful in a natural resource and related sciences major	1	2	3	4	5
130.	My high school science programs encourage me to pursue my current science major	1	2	3	4	5

131.	An extra-curricular/afterschool organization fostered an interest in the outdoors	1	2	3	4	5
132.	An extra-curricular/afterschool organization fostered an interest in science	1	2	3	4	5
133.	Acquisition of science skills is a personal pursuit	1	2	3	4	5
134.	My high school experience provided the math courses necessary to be successful in a 2yr./junior college in a natural resource and related sciences major	1	2	3	4	5
135.	My high school experience provided the science courses necessary to be successful in a 2yr/junior college in a natural resource and related sciences major	1	2	3	4	5

Which of the following opportunities do you plan to pursue?

		Have not decided	Do not plan to participate	Plan to participate	Have participated in
136.	Practicum in natural resource and related sciences majors.	1	2	3	4
137.	Internship in natural resource and related sciences majors.	1	2	3	4
138.	Co-op experience in natural resource and related sciences majors.	1	2	3	4
139.	Clinical assignment in natural resource and related sciences majors.	1	2	3	4
140.	Apply to medical school in natural resource and related sciences majors.	1	2	3	4
141.	Pursue another profession in natural resource and related sciences majors.	1	2	3	4
142.	Community service or volunteer work in natural resource or related sciences majors.				
143.	Apply to veterinary school or program.				
144.	Apply to graduate school in another field or related not related to natural resource or related science fields.	1	2	3	4
145.	Participate in undergraduate research opportunities related to natural resources or related sciences.				
146.	Participate in a learning community or some other formal program where groups of students take two or more classes together	1	2	3	4
147.	Work on a research project with a faculty member outside of course or program requirements	1	2	3	4
148.	Foreign language coursework	1	2	3	4
149.	Study Abroad	1	2	3	4
150.	Independent study or self-designed major	1	2	3	4
151.	Culminating senior experience (capstone course, senior project or thesis, comprehensive exam, etc.)	1	2	3	4
152.	Talk about career plans with faculty members outside of class	1	2	3	4
153.	Talk about career plans with academic advisors provided by the university.	1	2	3	4
154.	Attended career fairs related to natural or related sciences.	1	2	3	4

If you have participated in any of the activities below how helpful were they in supporting your decision to stay in your field of study?

		A great deal of support	Quite a lot of support	Some support	Not much support	Hardly any support
155.	Practicum	1	2	3	4	5
156.	Internships	1	2	3	4	5
157.	Co-op experience	1	2	3	4	5
158.	Clinical assignment	1	2	3	4	5
159.	Apply to medical school					
160.	Pursue another major outside of the natural resource field community	1	2	3	4	5
161.	Community service or volunteer work	1	2	3	4	5
162.	Participate in a learning community or some other formal program where groups of students take two or more classes together	1	2	3	4	5
163.	Work on a research project with a faculty member outside of course or program requirement requirements	1	2	3	4	5
164.	Foreign language coursework	1	2	3	4	5
165.	Study Abroad	1	2	3	4	5
166.	Independent study or self-designed major	1	2	3	4	5
167.	Culminating senior experience (capstone course, senior project or thesis, comprehensive exam, etc.)	1	2	3	4	5
168.	Talk about career plans with faculty members outside of class	1	2	3	4	5

Even though most college students would like to complete their degree, below is a list of reasons why people might not graduate from college/university. For each reason, please indicate whether it would be a reason for you *not* to graduate.

		Yes	No
169.	Time management difficulties	1	2
170.	Physical health reasons	1	2
171.	Mental health reasons	1	2
172.	Inadequate transportation	1	2
173.	GPA too low	1	2
174.	Personal issues related to immediate family	1	2
175.	Extended family issues	1	2
176.	Loss of personal motivation	1	2
177.	Dislike of selected natural resources related major	1	2
178.	Academic difficulties in natural resource and related science majors	1	2
179.	Academic difficulties with university required coursework pertaining to natural resources and related science majors	1	2
180.	Considering transfer to another university	1	2
181.	Not academically prepared	1	2
182.	Considering transfer to a junior/2ys. college	1	2
183.	Financial hardship	1	2
184.	Interference from outside employment	1	2
185.	Personal financial crisis	1	2
186.	Family health crisis	1	2
187.	Personal health crisis	1	2
188.	Unplanned pregnancy	1	2
189.	Substance addiction	1	2
190.	Less than anticipated starting salary for a natural resource or related science graduate	1	2
191.	Unfriendly/uncomfortable environment in your department	1	2
192.	Unfriendly/uncomfortable environment in your college	1	2
193.	Unfriendly/uncomfortable environment in the university	1	2
194.	Other. (Please specify.)		

Retention concerns occur at different levels, e.g., University, College/Departmental, individual. Below is a list of some of the most common retention concerns. Please indicate how serious you think each problem is, first in the University, then in College/Department of your selected science major, and finally in your own individual experience as a science major.

		Very Important	Somewhat Important	Not very Important	Don't Know
University environment					
195.	How important a problem is the "retention of a natural resource and related sciences majors" at the University level?	1	2	3	4
196.	U.S. universities are the major preparation academy for the world's scientists. How important is the university's role in this responsibility of providing **academic** training?	1	2	3	4
197.	U.S. universities are the major preparation academy for the world's scientists. How important is the university's role in this responsibility of providing **field/research/laboratory** training?	1	2	3	4
Department environment					
198.	How important is the "retention of natural resource and related sciences majors" at the College/Department level?	1	2	3	4
199.	U.S. universities are the major preparation academy for the world's scientists. How important is the College/Department's role in this responsibility of providing **academic** training?	1	2	3	4
200.	U.S. universities are the major preparation academy for the world's scientists. How important is the College/Department's role in this responsibility of providing **field/research/laboratory** training?	1	2	3	4
201.	How important is the "retention of science majors"?	1	2	3	4
202.	U.S. universities are the major preparation academy for the world's scientists. How important is your approach in accessing this **academic** training?	1	2	3	4
203.	U.S. universities are the major preparation academy for the world's scientists. How important is your approach in accessing **field/research/laboratory** training?	1	2	3	4

Activities beyond traditional educational experiences sometimes influence interests in natural resource careers, i.e., (hiking, boating, fishing, hunting, camping, etc.). How much did each of the following events influence your interest in a natural resource career?

	Great Deal	**Some**	**Not at All**
Gone swimming in a lake, river, or bay	1	2	3
Visited a state park or other natural area	1	2	3
Gone boating or fishing	1	2	3
Organized school trips (e.g., zoos, museums) related to coursework	1	2	3
Outdoor physical fitness activities	1	2	3
Rural family life	1	2	3
Camping	1	2	3
Hunting	1	2	3
Fishing	1	2	3
Hiking/backpacking	1	2	3
Canoeing/boating	1	2	3
Family travel and vacations	1	2	3
Exposure to nature through family	1	2	3
Exposure to nature through middle/jr. high school	1	2	3
Exposure to nature through high school	1	2	3
Exposure to nature through college	1	2	3
Bird-watching	1	2	3
Volunteering in environmental groups	1	2	3
Reading nature stories in magazines or books	1	2	3
Watching TV/Cable programs about nature	1	2	3
Personal Concern for the environment	1	2	3
Youth participant in natural resource programs	1	2	3
A job with a natural resource agency became available	1	2	3
Outdoor/nature photography	1	2	3

Of the five most influential activities you participated in the list above, how helpful were they in supporting your decision to stay in your field of study?

	A great deal of support	Quite a lot of support	Some support	Not much support	Hardly any support
Gone swimming in a lake, river, or bay	1	2	3	4	5
Visited a state park or other natural area	1	2	3	4	5
Gone boating or fishing	1	2	3	4	5
Organized school trips (e.g., zoos, museums related to coursework	1	2	3	4	5
Outdoor physical fitness activities	1	2	3	4	5
Rural family life	1	2	3	4	5
Camping	1	2	3	4	5
Hunting	1	2	3	4	5
Fishing	1	2	3	4	5
Hiking/backpacking	1	2	3	4	5
Canoeing/boating	1	2	3	4	5
Family travel and vacation	1	2	3	4	5
Bird-watching	1	2	3	4	5
Volunteering in environmental groups	1	2	3	4	5
Reading nature stories in magazines or books	1	2	3	4	5
Watching TV/Cable programs about nature	1	2	3	4	5
Personal Concern for the environment	1	2	3	4	5
Youth participant in natural resource programs	1	2	3	4	5
A job with a natural resource agency became available	1	2	3	4	5
Outdoor/nature photography	1	2	3	4	5

I. **Education**

Mother Attended

	Yes	No
High school	1	2
Technical school	1	2
College	1	2
Graduate school	1	2

Graduated/Received a degree

		Yes	No
204.	High school	1	2
205.	Technical school	1	2
206.	College	1	2
207.	Graduate school	1	2

Father Attended

		Yes	No
208.	High school	1	2
209.	Technical school	1	2
210.	College	1	2
211.	Graduate school	1	2

Graduated/Received a degree

		Yes	No
212.	High school	1	2
213.	Technical school	1	2
214.	College	1	2
215.	Graduate school	1	2

Please indicate your parents combined annual income:

	Parent's Combined Annual Income
1	Under $1,000
2	$ 1,000 to 2,999
3	$ 3,000 to 3,999
4	$ 4,000 to 4,999
5	$ 5,000 to 5,999
6	$ 6,000 to 6,999
7	$ 7,000 to 7,999
8	$ 8,000 to 9,999
9	$10,000 to 14,999
10	$15,000 to 19,999
11	$20,000 to 24,999
12	$25,000 to 34,999
13	$35,000 to 39,999
14	$40,000 to 49,999
15	$50,000 or 59,999
16	$60,000 to 74,999
17	$75,000 to 89,999
18	$90,000 to 109,999
19	$110,000 or over

216. Are you an international student or foreign national?

a. Yes

b. No

217. What have most of your grades been up to now at this institution?

a. A (4.0)

b. A- (3.75)

c. B+ (3.5)

d. B (3.0)

e. B- (2.75)

f. C+ (2.5)

g. C (2.0)

h. C- or Below

i. C- (1.75) or below

218. Did you begin college at your current institution or elsewhere?

a. Started here

b. Started elsewhere

219. Thinking about this current academic term, how would you characterize your enrollment?

a. Full time

b. Less than full-time

220. Are you a member of a social fraternity or sorority?

a. Yes

b. No

221. Are you a student athlete on a team sponsored by your institution's athletics department?

a. No

b. Yes, (what

222. Which of the following best describes where you are living now while attending college?

__ Fraternity or sorority house

__Dormitory or other campus housing, not fraternity or sorority house

__Residence (house, apartment, etc.) within **walking** distance of the institution

__Residence (house, apartment, etc.) within **driving** distance of the institution

People think of themselves in many ways, below are some possibilities. For each item listed, please indicate which is in closer agreement with your personal views.

Political Orientation

Do you consider yourself an active environmentalist, sympathetic to environmental causes, but not active, neutral, or unsympathetic to environmental causes?

Active
Sympathetic
Neutral
Unsympathetic
Don't Know

Generally speaking, do you usually think of yourself as a…?

Republican
Democrat
Independent
Other (Please specify) _____

Did you get a chance to vote in the last election?

Yes
No

How important is a candidate's position on environmental issues in influencing the way you vote?

Very important
Somewhat important
Not very important

Demographic Information

Next we would like to ask you some questions that will help us get to know you better. Please answer all questions where indicated.

What is your:

Major?_____
Academic classification?_____
age?_____
Sex?

Which of the following ethnicities best describes you?
Mexican (born in Mexico)
Mexican-American (born in the United States)
Anglo-American
African-American
American Indian
Asian or Pacific Islander
Mixed
Other (Please Specify) _____

In the text below, describe challenges you have overcome in pursuing your major

_____

In the text below, describe future challenges you anticipate as you progress in your selected major?

_____

In the text below, describe why you think students fail to complete their course of study in the natural resource and related sciences majors.

_____

In the text below, describe challenges you have overcome while enrolled in your college.

_____

In the text below, describe challenges you may encounter while enrolled in your selected college.

_____

Did we miss anything? Please use the space provided for any additional comments you would like to make concerning reasons why you might no graduate from college/university.

_____

The space provided is for your feedback about any of the categories in the survey. If you care to make any comments, feel free to do so. Thank for your participation.

APPENDIX B: LIST OF MAJORS AND CODE

AGCJ- Agriculture Communication and Journalism
AGEC- Agricultural Economics
AGLS- Agriculture and Life Sciences
AGSC- Agricultural Science
AGSM-Agricultural Systems Management
ANSC- Animal Science
ALEC- Agricultural Leadership, Education and Communication
ALED- Agricultural Leadership & Development
ANSC- Animal Science
ASTR- Astronomy
ATMO-Atmospheric Sciences
BAEN- Biological and Agricultural Engineering
BESC- Bioenvironmental Sciences
BICH- Biochemistry
BIMS- Biomedical Science
BIOL- Biology
BIOT- Biotechnology
BMEN- Biomedical Engineering
BOTN- Botany
BUSH- George Bush School of Governance
CHEM- Chemistry
DASC- Dairy Science
ENTO- Entomology
ESSM- Ecosystem Science and Management
FIVS- Forensic & Inv. Science
FORS- Forestry
FRSC- Forest Science
FSTC- Food Science and Technology
GENE- Genetics
GEOG- Geography
GEOL- Geology
GEOP- Geophysics
GEOS- Geosciences
HLTH- Health
HORT- Horticultural Sciences
INST- Interdisciplinary Studies
LAND- Landscape Architecture
LDEV- Land Development
MASC- Integrated Math & Sciences
MICR- Microbiology
NUTR- Nutrition
NVSC- Naval Science
OCEN- Ocean Engineering
OCNG- Oceanography
PHYS- Physics
PLPA- Plant Pathology
POSC- Poultry Science
PSYC- Psychology
RENR- Renewable Natural Resources
RLEM- Rangeland Ecology and Management
RPTS- Recreation, Park and Tourism Sciences
SCEN- College of Science
SCSC- Soil and Crop Sciences
SENG- Safety Engineering
SPMT- Sport Management
SPSC- Spatial Sciences
STAT- Statistics
UGST- Undergraduate Studies
URSC- Urban Science
VIST- Visual Studies
VLCS- Veterinary Large Animal Clinical Studies
VMID- Veterinary Medicine-Interdisciplinary Studies
VPAR- Veterinary Parasitology
VPAT- Veterinary Pathology
VSCS- Veterinary Small Animal Clinic
VTMI- Veterinary Microbiology
VTPB- Veterinary Pathobiology
VTPP- Veterinary Physiology and Pharmacy
WFSC- Wildlife and Fisheries Science
WMHS-Water Management and Hydrology Sciences
ZOOL- Zoology

APPENDIX C: INDIVIDUAL FACTORS

Individual Factors		
Academic Relationships	**Social Relationships**	**Lifestyle**
MS teacher	Themselves	Engaged in exercise/physical activity
HS teacher	Husband/wife/significant other	Activities to enhance your spirituality
University college advisor	Mother	
Teaching assistants	Father	
Retention advisor	Legal guardian	
Admin support	Personal mentor	
	Grandmother	
	Grandfather	
	Relatives	
	Virtual communities	

APPENDIX D: INSTITUTIONAL FACTORS

Institutional Factors	
Before College	**During College**
An extra-curricular/afterschool organization fostered interest in the outdoors	Individual study skills helped me persist in a science major
Exposure to science activities in MS encouraged my science interests	Informal tutorial sections with peers in the class
MS/JR, HS experience provided academic skill sets to be successful in …	Accessed general academic advising
MS provided laboratory hands on activities	Faculty-led research opportunities
HS provided laboratory hands-on activities	Socialized with faculty-led research opportunities
HS science program prepared to compete in a 4 year university science field	Academic/or advising conversations with students in science majors
HS science experience provided the math courses necessary to be successful in my major	Attended lunchtime academic seminars
HS science program encouraged to pursue current science major	Pre-professional science-related clubs
	Electronic medium
	E-mail to communicate with an instructor
	University-sponsored cultural arts program
	Academic blogs, podcast
	Electronic medium
	Study tables

APPENDIX E: SURVEY EMAIL 1

Notification letter

Howdy,

In the next few days you will receive an email requesting your participation in an important research project being conducted at Texas A&M University. You are being asked to participate in a study regarding factors that contribute to retention in your science major. The email you will receive will contain a link to a brief questionnaire. We are writing in advance because we have found that many people like to know ahead of time they will be contacted. This study is important; your input will be used to determine what is needed to help improve the graduate student experience. We are certain that you will agree this is a goal worthy of your support.

Completion of the survey should take 20-30 minutes. This study is completely voluntary. If you agree to participate, your responses will be confidential. There is no personal benefit, consequence, compensation, or cost for participation or non-participation in this study. Should you choose not to participate in this study, please reply to this e-mail message with "Not Participating" in the subject line so that we do not send you a follow up questionnaire. Rest assured that your refusal to participate in this study will not affect your relationship with Texas A & M University.

For your convenience, we will provide an option to receive a paper version of the questionnaire as an alternative electronic version that you will receive in the email. If you would prefer to complete the questionnaire via paper, simply reply to this message, with your mailing address and type "paper version" in the message. We will then gladly send you the paper questionnaire.

If you have any questions regarding this study, please contact any of us by phone or e-mail which are listed below. Thank you for your time and consideration. It's only with the generous help of people like you that our research can be successful.

Marisela Moreno
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APPENDIX F: SURVEY EMAIL 2

Survey greeting letter for electronic survey:

Dear Student,

You have been invited to participate in a survey about the background, goals and experiences of students studying natural resources and related sciences. By starting this survey, you will be entered in a raffle to win an iPad. You will be automatically entered in the raffle regardless of whether or not you complete this survey. If you win the iPad, you will be contacted though your TAMU student e-mail account.

This survey is sponsored by the Wildlife and Fisheries Sciences at Texas A&M University. The purpose of the survey is to gather information that will help us encourage more students to enter the natural resources fields and find ways to retain students in the field.

You were selected at random from all students in your major and related majors. Your participation is completely voluntary. You may refuse to take the survey without penalty to you and you may leave at any time. Any responses you give are completely confidential. Results will be reported only in the aggregate and you will not be identified in any way.

This survey will take about twenty minutes of your time to complete, but you need not complete it in one sitting. You may save your results and return later to complete the survey. If you have questions with the operation of the survey, please contact Mark Troy at srf@tamu.edu. For other information about this survey or project, please contact Marisela Moreno (marisemore6@aol.com)

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APPENDIX G: EXPLANATION OF ETHNICITY/RACE CATEGORIES FOR TEXAS A&M UNIVERSITY

Student Demographics

Student Demographics report provides student enrollment for the most recent five fall terms. The report is presented by university, college, and department as well as by student level which based on degree objective. All enrollment numbers include students reported to the Texas Higher Education Coordinating Board (THECB) as well as out-of-state distance education students.
To access this report, select the Campus, College, Department, Student Level, Ethnic Origin and/or Sex to view detailed data. Click one category from the bar chart of crosstab table to view detailed data of that category.

Student Race/Ethnicity

Ethnicity/Race categories indicate the ethnic origin of the student. The student reports use the THECB categories. Students are classified as "International" if they are not citizens of the United States, but are in the United States on a temporary basis and do not have the right to remain indefinitely. Non-citizen students, who are lawfully admitted for permanent residence, or Resident Aliens, are reported in the appropriate racial/ethnic category along with United States Citizens. The unknown classification is reserved for US citizens that have not selected a racial/ethnic designation.

Starting in the fall 2010 semester, in order to comply with the Federal mandate, THECB ethnicity/race reporting methodology changed in accommodate the new two part format. Part one is an indicator of Hispanic or Latino ethnic identity and the second part allows the student to indicate one or more races. In order to facilitate reporting and trend analysis, we mapped the old race categories into the most relevant new category.

The new categories are:
- White Only
- Black only +2 or more/1 Black (Any student selecting Black as a race.)
- Hispanic or Latino of any Race
- Asian Only
- Native Hawaiian Only
- American Indian Only
- 2 or more/excluding Black (Excludes students selecting Black as one of their races.)
- International
- Unknown or Not Reported

These changes should be taken into account when reading this research study as it began in 2007 and will not reflect the current ethnicity/race categories in use.
(https://accountability.tamu.edu/All-Metrics/Mixed-Metrics/Student-Demographics)