Investigating Factors of Understaffing for Natural Resource Management Agencies of Hawai‘i

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Abstract

Increased natural resource depletion has encouraged government initiatives at various levels to better conserve, protect, and manage them. Unfortunately, many objectives are impossible to achieve due to current understaffing within natural resource management agencies. Public data from Hawai‘i agencies reveal that excessive staff shortages are a large contributor to their failure to meet ecological and social targets. This project aims to better understand the factors affecting the understaffing crisis across natural resource management agencies of Hawai‘i. Primary sources reveal that there are roughly eight existing retention and recruitment factors affecting understaffing in a workplace. Factors were translated into job attributes in which an evaluation of each was performed. Using a perception survey amongst current and potential employee candidates for the natural resources field, a total of 132 survey responses were collected. Through descriptive statistics, a respondent data set was generated to separate respondents into groups based on their responses to demographic questions. Then multilinear regression and thematic analyses were performed to evaluate the differences or similarities of groups' perceptions of the identified workforce factors. Key findings reveal that across all respondent groups, factors related to compensation and work environment were ranked as highly important, while other factors such as career advancement and recognition were ranked as least important. Demographics including age, gender, education level, college major, and professional experience correlated positively with the workforce factors. Specific demographic groups were significant in determining the importance of factors. Participants identified several emerging barriers related to job satisfaction which are separate from those already identified in this study. Results were shared to interested parties through a perception dataset, this report, and a presentation. All outputs identify the advantages and potential gaps existing within current natural resource management positions. These areas of concern are addressed in the hopes that agencies across these fields will utilize project findings as evidence to target the improvement of marketing or structuring job positions. With these appropriate changes, agencies may enhance staffing and refine management operations in the near future.

Key words: Environmental Management, Conservation, Workforce Capacity, Student Perceptions, Retention, Recruitment

Motivation

Rising pressure is placed on natural resource managers as environmental challenges such as climate change and resource degradation continue to deepen with severity each year (Schwartz et al., 2017). Research finds that individuals are valuing the conservation of the environment and natural resources at a higher rate than ever before (Pew Research Center, 2020). Hence, natural resource management (NRM) agencies involving key environmental stakeholders are established to address, mitigate, and remediate respective environmental problems. This management mechanism is found to be effective across all environments when executed properly (Laurance et al., 2012). Although sectors may vary in function and execution, success is often limited by inadequate resourcing, such as funding and workforce capacity (Geldmann et al., 2018). Unfortunately, previous studies examining the performance of NRM agencies today highlight that shortfalls in staff have led to 50% of organizations failing to operate and accomplish social and ecological objectives (Gill et al., 2017; Coad et al., 2019). Adequate staffing is a critical need for agencies to function at the international, national, and local levels.

Previous research finds that current staffing has remained deficient across all levels of management. For example, the Global Deal for Nature (GDN), proposed by researchers in 2019, is a historic international action plan that aims to protect and restore ecosystem biodiversity by formally protecting 30% of Earth's natural resources by 2030. Reports on this agreement estimate that to reach this target, a global workforce of 3 million personnel must be initiated (Appleton et al., 2022). However, the world's current capacity meets only around 25% of this number. All North American countries have committed to this agreement and similar initiatives. Yet, the continent remains at the bottom regarding its ratio of personnel capacity to total natural resource area. Specifically, in the United States, reports from existing NRM state agencies have noted that excessive staff shortages and reduced capacity size have led to operational failure (Thomas & Reed, 2019; Welch et al., 2015).

In Hawai‘i, the understaffing crisis is apparent, especially in the public NRM sector. The agency responsible for managing the majority of Hawai‘i's designated natural resources is the Department of Land and Natural Resources (DLNR). Reflecting increasing demands from initiatives and agreements for improving NRM, a Hawai‘i economic report estimated a 33% increase in NRM job positions between 2014 and 2019 (Burnett et al., 2019). However, sources regarding DLNR operations in 2021 address understaffing (up to approximately 35% vacancy in some divisions) as one of the largest factors contributing to operational failure (State of Hawai‘i: DLNR, 2021; H.B. N.O. 2349, 2022).

Thus understaffing is an ongoing issue across the global and local levels, and yet the extent and reasoning behind the problem is widely understudied (Burnett et al., 2019; Coad et al., 2019). Employees choosing to leave the NRM field in spite of their passion has motivated me to investigate this issue. Among the possible factors for the shortfall in staffing are inadequate compensation, lack of advancement, quality applicants, and excessive labor demands (V. Torres, personal communication, February 6, 2023; C. Aton, personal communication,

March 3, 2023; ‘A. Lilly, personal communication, April 1, 2023). Many of these non-motivational factors such as insufficient compensation, lack of career advancement, unclear job characteristics, unstable work environment, and lack of a work-life balance, align with published workforce research, which are proven to lower employee retention (Figure 1). Although society has continued to gain interest in NRM and environmental issues, related targets are unachievable without an effective NRM workforce. In many cases, understanding the process by which individuals pursue and remain in an occupation is used as a key strategy for improving the retention and recruitment of agencies and organizations (Jones, 2020). This project examines varied perceptions from potential NRM agency applicants and current or previous employees which can be useful for mitigating the understaffing crisis in Hawai‘i.

Background

Local Level Management

The Hawaiian archipelago has been used as a model system for environmental studies over many years due to its isolation, ecosystem variation, and abundance of natural resources (Barton et al., 2021). In addition, the cultural influence of indigenous knowledge passed on by Native Hawaiians has emphasized an important connection to the natural world (Burnett et al., 2019). Hence, conserving ecosystems and their respective natural resources have been an important effort for many years in Hawai‘i. Over time, however, following modernization and urbanization, Hawai‘i’s biodiversity is now at stake, and its natural resources are facing depletion (Loope et al., 2013). The conflicting needs between a tourism-driven economy and a degrading environment influenced a movement of formal establishments of federal, state, city and county, non-profit and private NRM agencies or organizations across the islands (UHERO, 2019).

State Agency Management

Currently, the majority of NRM workers in Hawai‘i are employed by state agencies (UHERO, 2019). The primary agency, DLNR, is specifically tasked with managing the enhancement, protection, conservation, and management of Hawai‘i’s natural, cultural, and historic resources (State of Hawai‘i: DLNR, 2023). The agency initiates numerous environmental plans, with recent ones being local implementations of the GDN. To reach these new objectives and demands of ongoing initiatives, adequate resourcing, including staffing, is necessary (Hawai‘i Green Growth, 2018). However, the local GDN plans, such as the “Holomua: Marine 30 by 30” and “30 by 30 Watershed Initiative,” have already been adjusted because original goals related to protecting 30% of resources are unrealistic, partially due to understaffing and inadequate resourcing (Honore, 2023). These changes are reflective of recent budget trends and staff numbers. DLNR’s most recent Budget Overview states they are in an economic crisis after the 2020 COVID-19 pandemic, leading to excessive staff shortages today. The budgeting has resulted in several cuts including a 20% reduction of general funds for sets of positions and a 32% reduction of general-funded management projects within one terrestrial

system spanning across all Hawaiian islands (State of Hawai‘i: DLNR, 2021). Employment under this agency can be complex because the workforce spans numerous partnerships with both government and non-government agencies, which in turn may pose a limiting factor for staffing efficiency. Therefore, my project consisted of a formal assessment of perceptions across the workforce in which numerous agencies may benefit in future operations by understanding staffing demands to reach proposed objectives.

Perception-Based Research

Perception-based studies have long been used to understand the motivation behind one's actions (Gadamer, 2004). Environmental and conservation perception research is often limited to environmental awareness, sensitivity, intention to act, and marketing (Emanuel & Adams, 2011; Susilowatia et al., 2020). In this study, a perception evaluation across both NRM workforce candidates and experienced employees is examined. Such perceptions provide insight into observations, understandings, interpretations, and social acceptability of the workforce (Bennett, 2016). The insight informs, and addresses needed improvements in management functionality. Despite perception-based research increasing for environmental concerns, perception research on environmental occupations is limited and widely undermined (Coad et al., 2019; Bennett, 2016). However, with a high demand for immediate changes and increases in NRM staffing, this project took a deeper look at the perceptions of individuals related to the field. These perceptions offer unique and valuable insights as a means of adjusting the occupation and attracting quality employees.

Objectives

Appropriate and adequate staffing is a crucial component which affects NRM agencies across Hawai‘i. This capstone project aimed to clearly define and understand the factors affecting understaffing in the NRM field at the individual level. To meet this primary goal, I address the following research questions:

(1) How do interested and experienced candidates for the NRM field perceive retention and recruitment factors which affect the workforce?

(2) Is there a relationship between participant groups and their perceptions? If so, in what ways and to what extent?

(3) What areas of improvements for staffing can participants articulate?

These questions and the work behind this project help to identify and emphasize significant barriers or gaps for staffing improvements in the future. By evaluating perceptions from various groups of individuals, a broader comprehension of the workforce is made. The results of the project including the techniques employed may help inform interested NRM agencies in which future recruitment and retention may be enhanced.

Approach

Preliminary Research

Identifying the factors which currently affect the understaffing of the Hawai‘i NRM sector began with performing a literature review and informal interview with professionals who are experiencing the crisis first-hand. The literature review revealed several key factors that either aid or hinder retention rates in the average workplace: Job Security, Recognition and Awards, Compensation, Career Advancement, Job Characteristics, Work Environment, Work-Life Balance, and Career Development (Research Scholar, 2013; Samuel & Chipunza, 2009; Bodjrenou, 2016; Ramlall, 2004). Informal interviews were then conducted amongst NRM employees of O‘ahu agencies in which interviewees recognized similar concepts that are hindering staff demands: Compensation, Career Advancement, Job Characteristics, Work Environment, Work-Life Balance, and Career Development (V. Torres, personal communication, February 6, 2023; C. Aton, personal communication, March 3, 2023; ‘A. Lilly, personal communication, April 1, 2023). A total of eight specific retention factors were recognized and six of them aligned directly across both sources (Figure 1). Factors were found to have an adverse effect on both retention and recruitment in the workplace and each was to be considered as a particular job attribute. Consequently, each factor was translated into various job attributes which informed my survey questions related to predicting and understanding how individuals may perceive them.

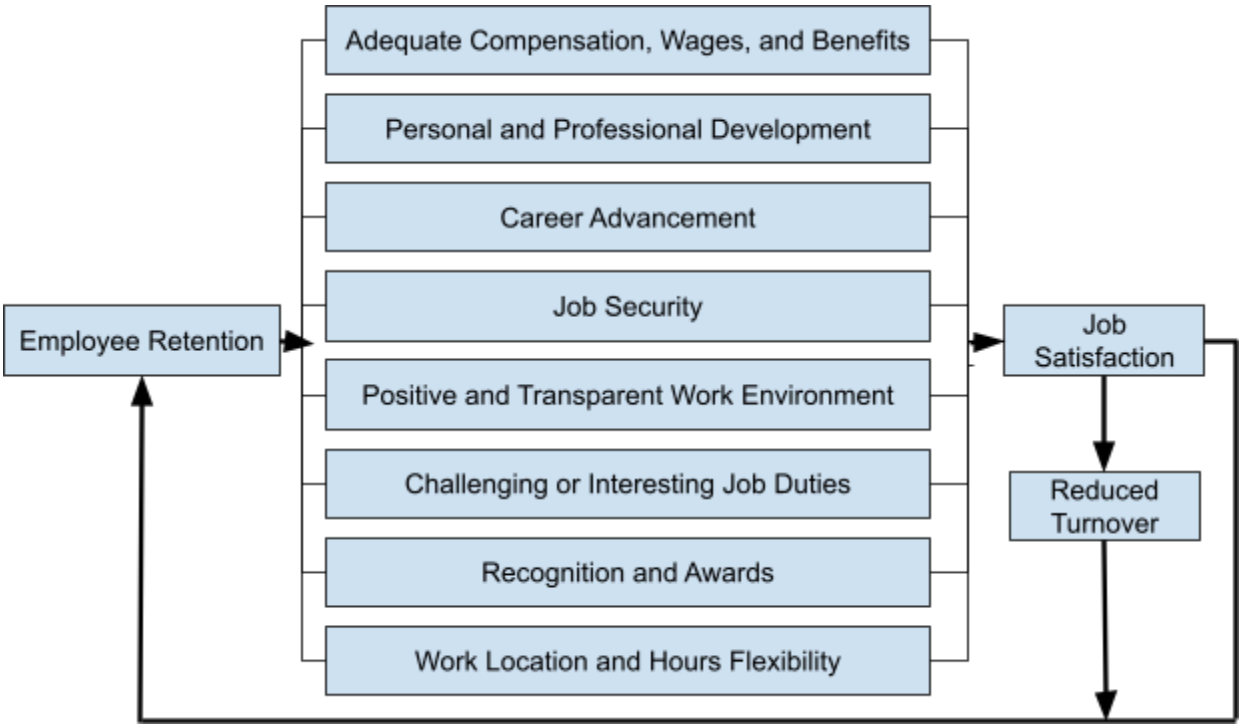

Figure 1. Employee retention and satisfaction model, developed then adapted from Research Scholar (2013). Model shows the direct relationship between retention and recruitment factors and job satisfaction. Factors listed in the middle aligned across the literature review and informal interviews with natural resource management employees in Hawai‘i (Research Scholar, 2013; Samuel & Chipunza, 2009; Bodjrenou, 2016; Ramlall, 2004; V. Torres, personal communication, February 6, 2023; C. Aton, personal communication, March 3, 2023; ‘A. Lilly, personal communication, April 1, 2023).

Study Site and Participants

I conducted a study across two main platforms in order to target audiences of candidates and professionals familiar, interested or experienced in the NRM field. Target participants encompassed the current student and alumni body of selected UHM departments of the project (Appendix 1), and Kupu employees with their relative natural resource networks.

There are various degree pathways for University of Hawai‘i at Mānoa (UHM) students to receive NRM related experience which may be an indicator for patterns of perception. Therefore, the study was sent to NRM-related departments and programs across the UHM campus which encompassed the following Schools and College: College of Natural Sciences, College of Social Sciences, Hawaiinuiakea School of Hawaiian Knowledge, School of Ocean and Earth Science and Technology, College of Education, College of Tropical Agriculture and Human Resources, and Interdisciplinary Studies (Appendix 1).

Internship experience through UHM partnerships is an option within some of the UHM educational programs and pathways, highlighting another area of interest for perception patterns. For the purpose of this project, a partnership was made with one of UHM's already established partners, Kupu. Established in 2007, Kupu is a non-profit organization that seeks to empower youth throughout Hawai‘i communities by providing environmental stewardship, service learning, and character building opportunities activities. The survey was then disseminated to their employees, partners, and wider natural resource sector network throughout Hawai‘i. Access to and insight from experienced employees in the NRM field (with or without an educational background) provided potential for additional patterns of perception.

Survey

The survey intended to address all of the significant factors and job attributes which affect retention and recruitment in NRM agencies and identify potential relationships or correlations between individuals of different backgrounds' perceptions of the factors. Original questions were drafted, discussed, then adjusted across panel members of this project and with Kupu program managers (Appendix 4). The process by which the survey was developed took roughly six months and was completed through Google Suite. The survey was then conducted online through Google Forms based on the software's easy access to data, cost-free application, and student experience (Vasantha, 2016; Nurmahmudah & Nuryuniarti 2020). In total, the survey contained 20 questions spanning across the following 6 sections: (1) Background Information, (2) Secondary Education, (3) Post-Secondary Education, (4) Natural Resource Experience, (5) Job Attributes, (6) and Future Recruitment (Appendix 4). Eighteen questions were closed-ended, while two were open-ended. This ensured that although participants were forced to select most of their responses especially for their demographic information, they also had the ability to express their opinions in more complex areas such as the job attribute section. The amount and type of data also allowed for both quantitative and qualitative analyses.

Questions in sections one through four were developed based on previous demographic indicators which already affect NRM agencies (Mejia & Griffis-Kyle, 2020; UHERO, 2019).

These questions asked participants to provide demographic information such as: age, gender, ethnicity, secondary and post-secondary education level, college degree program, and NRM or related experience (Appendix 4). All collected responses were kept anonymous and contained non-identifiable information. The demographic focused responses were used as independent variables in the analyses of this study.

Questions in section five directly addressed the job attributes and factors in which participants could rate their importance level for each. The questions in this section utilized a Likert scale to understand and quantify participant perceptions (Boone & Boone, 2012). The 6-point scale ranged between the following choices: 6 - Very Important to 1 - Very Unimportant (Appendix 4). This scale was selected based on previous perception studies focusing on student and employee satisfaction (Dawal & Taha, 2006; Gruber et al., 2010). The focus of this section was to utilize the factors and their ratings as dependent variables for the analyses of the project.

During survey development, a strong partnership with Kupu became established which allowed for questions to be added on the survey. These questions targeted Kupu's interests and goals for program enhancement and expansion. The majority of these questions were added in sections two and six, which primarily focused on understanding the motivation behind local Hawai‘i NRM candidates or professionals entering the field. In addition, the questions helped to identify possible improvements for recruitment efforts.

Data Collection

Prior to data collection, a research proposal for this project was approved by the UHM IRB to ensure research safety and compliance. The survey was then disseminated experimentally throughout established Kupu partnerships and relationships with UHM departments in several formats. The experimental dissemination began with requesting to gain access to appropriate list servers which manage the electronic email lists of the target audience. This process involved sending an email to each UHM Department, and Kupu program managers. This email included study information, participant consent process, data collection procedures, general instructions, an email recruitment script, and a recruitment flier (Appendix 2 and 3). Thereafter, departments and Kupu managers approved the request and sent an email with the project email recruitment script and flier to the appropriate list servers.

Analysis

Survey data and responses were downloaded in Microsoft Excel format directly from the Google Form. Responses were initially analyzed with descriptive statistics summarizing the responses and aggregating the results using averages and percentages. The descriptives helped to calculate means and standard deviations across the data which helped to inform the following quantitative and qualitative analyses. A multiple linear regression analysis was conducted to compare the effects of category responses to demographics and job attributes. In addition, a thematic analysis was performed for this study to identify themes throughout open response

questions. All analyses were performed in Microsoft Excel based on previous experience with this software.

The multiple linear regression was performed for this study due to its ability to determine the outcome of a single dependent variable when multiple independent variables exist (Akinyemi, 2021). This helped to forecast and better understand complex relationships between each variable (Tharu, 2019). For this analysis, the independent variables included respondents' demographic factors: age, gender, ethnic group, years of post-secondary education, and NR experience. Each demographic cohort was coded from "0-1" as responses had less variability (Table 1). On the contrary, the dependent variables for the regression included all retention and recruitment factors identified from the literature, classified as job attributes: (1) adequate compensation, wages, and benefits, (2) personal and professional development, (3) career advancement, (4) job security, work location and hours flexibility, (5) positive and transparent work environment, (6) challenging or interesting job duties, and (7) recognition and awards. Utilizing the Likert scale for job attribute related questions, responses were coded from "0-1" due to less variability between ratings of 1-6 (Appendix 5). Respondent cohorts were analyzed separately using the data analysis function and regression tool to compare patterns or differences between each. Estimated coefficients were produced with corresponding standard errors and means to determine the significance at alphas 0.01, 0.05, and 0.10 (Table 2).

Open-ended questions presented unique insights and themes in which a thematic analysis was performed. Using methods from previous qualitative analyses of online survey responses, I converted each response into a single table (Semaan et al., 2020). Data was then separated by topic while maintaining the original response. I compiled the responses to derive common themes using a general inductive approach which involved a coding system (Table 3 and Appendix 6). Due to the nature of participant expression and recurring ideas in many responses, I decided to analyze the data thematically and also depict the occurrence to describe similarities across responses.

Results

Respondent Profiles

The survey received 132 responses, however, after thorough data cleaning a total of 126 responses were analyzed in this project. 6 responses were removed due to outlier populations and incomplete answers which would complicate the analysis. Out of the 126 respondents, several respondent profiles were made using the answers to demographic questions. For age, 66 participants were under the age of 28 while 60 participants were over the age of 29. Age groups were split in this manner due to previous survey experience and differences in perception for young adults typically changing after the age of 29 (Mercer and Lau, 2023). Most of the participants identified as female (n=89) and 37 identified themselves as male. For education level, 70% of respondents stated that they have completed more than four years (categorized as Post Degree) while nearly 30% stated that they have less than four years (categorized as Unfinished). For the purpose of this project, cohorts were separated by less or more than four

years due to the general completion time of a four-year degree program. Around 62% of respondents stated that they have already declared NRM or a related program as their major throughout their college career, while 38% did not. The majority of participants had some form of experience in the NRM or related fields (n=87) and others did not have any (n=29). These differences in major choice and experience may be present due to audiences familiar with NRM or related careers which were targeted for survey distribution. Cohorts separated by each demographic category were used in the following analyses.

Table 1. Respondent profiles from participant responses to the demographic questions with the value, percentage, and coding number for Age, Gender, Years of Post-Secondary Education, Major in NRM, and NRM Experience. Participants were grouped into cohorts depending on years of post-secondary education: Unfinished (0-3 years), Post Degree (4 or more years).

Respondent Profiles		
	n	**Percentage**
Age		
Under 28	66	52.4%
Over 29	60	47.6%
Gender		
Male	37	29.4%
Female	89	70.6%
Years of Post-Secondary Education		
Unfinished Degree (0-3 years)	37	29.4%
Post Degree (4 or more years)	89	70.6%
Intended/Current Major in or related to NR		
No	48	38.1%
Yes	78	61.9%
NR Experience		
No	39	31.0%
Yes	87	69.0%

Across all of the respondent profiles, the average importance ratings for all of the job attributes were high (Figure 2). Participants expressed that the least important factors included (1) Challenging or Interesting Job Duties and (2) Recognition and Awards (both rated at an average of 4.71 out of 6). However, Adequate Compensation, Benefits, and Wages (average of 5.05 out of 6), and Positive and Transparent Work Environment (average of 5.20 out of 6) were ranked as the factors of highest importance. All other factors (Personal and Professional Development, Career Advancement, Job Security, and Work Location and Hours Flexibility) were rated between 4.66 and 4.94. The standard deviations for each average of the job attributes ranged between 1.01 and 1.51, meaning that the data did not fall far from any of the means.

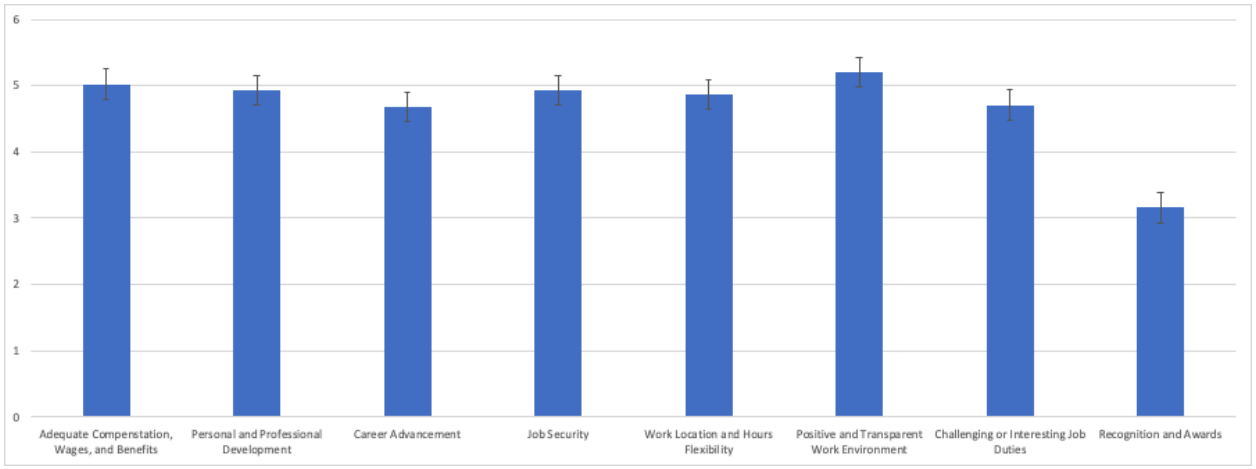

Figure 2. Average responses to job attribute questions relating to individual retention and recruitment factors out of a 6-Point Likert scale with a "6" representing a high importance and "1" representing low importance.

Multilinear Regression

Through this quantitative analysis, data was analyzed to investigate the role of the independent variables on the importance level for each workforce factor. Overall, determining the significance of socio-demographics on the attribute importance. Coefficient values are shown in Table 2 and significance levels displayed with one asterisk (*) at alpha 0.10 represent somewhat significant, while two asterisks (**) at 0.05 represent significant, and three asterisks (***) at 0.01 represents highly significant. Overall, all job attributes served as important across all demographic groups. Gender amongst the demographics played the most significant role, meaning that gender (female versus male) did make a difference in determining the importance level for all attributes. In addition, all other demographic factors (Age, Education Level, Major in NRM, and Experience) were significant but only for certain workforce factors.

Specifically, for Adequate Compensation, Benefits, and Wages, 2 demographic factors were regarded as significant and highly significant. These demographics included Gender and Major in NRM ($t = 5.527^{***}$, $t = 2.216^{**}$) (Table 2). This tells us that females regard compensation, benefits, and wages more importantly than males do. In addition, individuals who declared NRM or related programs as their major perceive this factor as more important than those in other majors.

For Personal and Professional Development, 2 demographic factors were regarded as significant and highly significant. These demographics included Gender and Experience in NRM Fields ($t = 4.613^{***}$, $t = 2.336^{**}$) (Table 2). This indicates that females regard personal and professional development more importantly than males do. In addition, individuals with experience in the NRM or related fields perceive development more importantly than those with none.

The Career Advancement job attribute had a single demographic factor which served as highly significant, being Gender ($t = 4.601^{***}$) (Table 2). This tells us that females regard this attribute more importantly than males do.

For Job Security, 2 demographic factors were deemed as significant and highly significant, including Gender and Education Level (t = 5.784***, t = 2.045**) (Table 2). This means that females value job security more than males do, and that individuals with more years of post-secondary education (4 or more years) value job security more than those with less (under 3 years).

Work Location and Hours Flexibility is another case where 2 demographic factors are deemed as significant and highly significant. These demographics included Age and Gender (t = 2.140**, t = 4.823***) (Table 2). This indicates that individuals above the age of 29 place a higher value in the flexibility of the location and hours of their job than those under 28. In addition, females value this same flexibility much more than males do.

For Positive and Transparent Work Environment, the demographic factors of Gender and Education were regarded as highly significant and somewhat significant (t = 6.766***, t = 1.895*) (Table 2). This result means that females regard this job attribute as more important than males do. In addition, individuals with more education place a higher importance on this attribute than individuals with less education.

Challenging and Interesting Job Duties helped to understand which demographic group may value or be more susceptible to being challenged at work. For this attribute, Gender and Education were regarded as significant (t = 2.530**, t = 2.201**) (Table 2). This tells us that both females and the more education an individual has, the higher they will value being challenged or interested in their work.

Lastly, for Recognition and Awards, three demographic variables play unique roles. Gender is regarded as somewhat significant (t = 1.960*) (Table 2), meaning that females placed a higher value on this attribute than males did. However, Age and Major in NRM (t = -0.403, t = -1.028) are the only negative values in this test. This indicates that there is a reversal in the direction of the effect and means that older individuals or people who are not in NRM or related majors find recognition and awards as less important.

Table 2. Coefficient values are shown with importance factors (retention and recruitment factors) as the dependent variable and demographics as the independent variables (Age, Gender, Education, Major, and Experience). Results are derived from the regression analysis in Microsoft Excel. Levels of significance are displayed with asterisks throughout the table.

Importance Factor	Age	Gender	Education	Major	Experience
Adequate Compensation, Wages, and Benefits	0.18	0.43***	0.15	0.24**	0.01
Personal and Professional Development	0.17	0.35***	0.11	0.12	0.25**
Career Advancement	0.04	0.38***	0.14	0.01	0.13
Job Security	0.08	0.46***	0.24**	0.05	0.03
Work Location and Hours Flexibility	0.24**	0.39***	0.08	0.16	0.08
Positive and Transparent Work Environment	0.09	0.51***	0.21*	0.14	0.07
Challenging or Interesting Job Duties	0.04	0.21**	0.26**	0.16	0.12
Recognition and Awards	-0.03	0.13*	0.11	-0.09	0.10

*significant at alpha 0.10 (t > 1.657, somewhat significant), ** significant at alpha 0.05 (t > 1.979, significant), *** significant at alpha 0.01 (t > 2.616, highly significant)

Thematic Analysis

Across the entire survey, two questions were optional and open-ended (Appendix 4). These questions offered participants more nuance to express their ideas and opinions about the questions presented. Specifically placed at the ends of Sections 3 (Post-Secondary Education) and 5 (Job Attributes), the open-response questions asked participants to (1) identify barriers to pursue post-secondary education in NRM or related fields and (2) share about additional and valuable position attributes within NRM or related fields.

When asked about barriers to pursuing post-secondary education in the NRM or related fields, 65 respondents identified a number of emerging themes (Table 3). Nearly half of respondents (n=49) stated that Education was a barrier to their post-secondary educational career. Among this barrier, themes related to cost, course load, support, social inequalities, and accommodations were noted. For the barrier of the NRM Field itself, participants identified recurring themes of resourcing, political and social inequalities, and marketing (n=28). The NRM Position specific barrier (n=27) presented ideas related to compensation, qualifications, nature of the work, and social inequalities. Lastly, barriers which did not fall under the three existing barriers were classified as External (n=10). Within this barrier, themes surrounding cost of living in Hawai‘i and social acceptability were highlighted.

Table 3. Barriers with themes and sub-themes identified from open responses for Question 12 from Section 3 (Post-Secondary Education) of the survey which related to pursuing post-secondary education in the NRM or related fields. Barriers were coded from 1 to 4 to describe occurrence rate across 65 responses.

Theme	Sub-Theme	Barrier	Percentage
Education	Costs	*High Cost of Attendance*	49%
		Limited External Funding	
	Course Load	*Class Availability*	
		Difficult Coursework	
	Limited Support	*Academic Mentorship*	
		Family Support	
	Social Inequalities	*Gender*	
	Poor Accommodations	*Disability Accommodations*	
NRM Field	Limited Resourcing	*Underfunded Industry*	43%
		Lack of Opportunities and Jobs	
		Private versus Public Pay Gap	
	Political Inequalities	*Research and Policy Gap*	
		Political Corruption	
	Social Inequalities	*Gender*	
	Marketing	*Difficult Recruitment*	

NRM Position	Low Compensation	*Wages and Salary*	42%
	Unreasonable Qualifications	*Years of Experience*	
		Advanced Degrees	
	Nature of Work	*Challenging Labor*	
		Schedule Inflexibility	
	Social Inequalities	*Gender*	
		Language	
External	Cost of Living	*State of Hawai'i*	15%
	Social Acceptability		

In the second open-response question, respondents shared about many job attributes for NRM related positions which helped to either amplify the existing attributes listed in this study or highlight new ones. This optional question received 54 responses, each of which contained coinciding topics and ideas. Using the coding system approach, 24 total attributes were listed (Appendix 6). Common attributes included: Passionate and Meaningful Work, Collaboration, Living-Wage, Indigenous Practices, Culture, Mentorship, Development, and Community. Each of the following themes were expressed between 5 and 11 times across responses. Other themes were expressed for 4 or less times and all themes are depicted in Figure 3.

Figure 3. Valuable and additional position attributes for NRM or related jobs expressed across 54 open responses from Question 18 from Section 5 (Job Attributes). Word cloud figure represents most occuring themes in largest and boldest font (n=5 to 11), while less occurring themes are represented in smaller and thinner font (n = 1 to 4).

Discussion

This project aimed to evaluate perceptions toward attributes of NRM jobs which involved determining differences or similarities of perceptions across various demographic groups. The analyses were appropriate in formulating key insight such as identifying and better articulating

existing and additional factors affecting understaffing. The results of the project inform NRM agencies across Hawaii which may improve retention and recruitment in the future.

"*How do interested and experienced candidates for this field perceive retention and recruitment factors which affect the workforce?"* and *"Is there a relationship between participant groups and their perception?"*

The rating level for each of the existing workforce factors that affect understaffing were relatively consistent across all demographic groups. Responses identified that the most important factors of a job include adequate compensation, benefits, and wages, and a positive and transparent work environment. While the least important factors being challenging or interesting job duties, and recognition and awards. These findings are consistent with other employment related research and suggest that NRM employers market jobs with a focus on the factors of highest importance, implying that this may improve retention (Research Scholar, 2013; Samuel & Chipunza, 2009; Bodjrenou, 2016; Ramlall, 2004). In addition, the regression revealed particular patterns and differences in importance level. Females placed a higher value on all of the job factors in the study. Individuals with more than four years of college placed a higher value on three factors (job security, positive and transparent work environment, challenging or interesting job duties). Older participants, individuals who had declared their college degree program in NRM or a related field, and people who have already gotten experience in the field each placed more value on one of the factors (work location and hours flexibility, adequate compensation, and personal and professional development. This information can be utilized by employers during recruitment phases to target demographic populations.

"What areas of improvements for staffing can participants articulate?"

General trends indicated that participants in this study dealt with numerous barriers or challenges to enter the NRM field. These areas fell within four larger topics including barriers of education, the NRM or related fields itself, positional challenges, and external sources. The most common topics within these barriers ranged from the costs of education and living in Hawaii, under resourcing in the field translating to low wages and salaries, and limited internal or external support. By exposing these trends, employers may take the information to the correct sources and alleviate the negative impact on future and current employees in the field. For additional staffing improvements, participants showcased several emerging themes which can be utilized for agency functionality, recruitment, and management as a whole. Participants shared that jobs in the NRM or related fields should provide meaningful work, collaborations with communities including indigenous peoples, good mentorship and development, and most importantly, a livable-wage.

Limitations

A clear limitation of this study was the sample size (n=132), which represents only a small fraction of interested candidates and professionals for the NRM field. Other studies

involving the improvement of retention and recruitment in other fields utilize sample sizes of more than 1,000 (Samuel & Chipunza, 2009). In addition, the smaller sample size of this study did not allow for smaller groups of individuals to be included. As mentioned previously in the Results, lesser demographic groups (n=6) were removed from the study due to outlier populations and incomplete answers which would further complicate the analysis. If conducted across a wider audience, the removed groups could provide more insight on additional perception patterns.

The broader audience types of this study across both students and professionals makes it difficult to make clear conclusions about response groups which can be used for improving staffing within individual agencies across the NRM sector. For example, although assumptions can be made from responses, participants were not specifically asked to identify if they are finished with their academic career and therefore are already an experienced professional, or if they are planning to continue. This information may be useful for agencies recruitment and marketing purposes.

Another limitation was the inconsistency of structure across the online survey. In Section 5 which focused on Job Attributes, the Likert rating system utilized the numbers "1" as Very Unimportant and "6" as Very Important, indicating an ascension of value as the number increases. However, for Section 6 which focused on Future Recruitment, the ranking system for preference of recruitment methods utilized the numbers "1" as Preferred Most and "7" as Preferred Least, which is opposite in nature than the Likert scale. If read incorrectly, the inconsistency of scales may have confused participants into selecting their untrue opinion.

Lastly, the largest limitation of this study was a time constraint. Due to the nature of this project, some questions on the survey were unable to be reported or analyzed at this time, potentially leaving out key information that could be useful to this project. Despite this, project partners may be able to perform a complete analysis in the future.

Conclusions

The findings of this project help to amplify existing knowledge on retention and recruitment but also areas of advancement for employers in the NRM sector. Key results should be utilized accordingly, mainly as evidence to provide advice on the marketing and structuring of NRM jobs. In addition to all of the results, participants also addressed key topics of interest which could be used for remarketing or restructuring in the near future, such as indigenous collaborative efforts and diversifying the workplace. Immediate next steps should involve sharing all results of this project to public and private agencies who are interested in improving the current understaffing crisis. This may include policymakers and employers in which they should utilize both the quantitative and qualitative results. It is key to use both, as they present separate but unique insight in different areas related to staffing improvements.

Future Actions

The length of this research may be extended to analyze existing data from the project.

These new findings can be used to further understand the issue and potentially find areas of improvement for ethnic diversity, local needs, and differences between NRM sectors. If respective parties are interested in replicating the study, limitations must be addressed and adjusted accordingly to ensure additional results are practical and realistic. Overall, this project reveals yet amplifies that there are a large number of individuals who are interested in the NRM field. However, this interest is restricted, as factors such as resourcing remain sparse and living costs remain high. Future research should focus on the process by which resources are developed and obtained to ensure a motive for improving staffing across these fields.

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Appendices

Appendix 1. *List of UHM departments and degree programs relative to NRM work and studies selected for this study. The list includes the larger UHM School or College in column one, then the Department and Programs in each school in column two (specific departments are bolded as a means of reason for NREM-related selection) and current population for response rate data. This list retrieved information and data from the UHM General Catalog (UHM 2023-2024 General Catalog) and UHM IRO (IRO, 2023).*

UHM List Server Requests	
Schools and Colleges	**Department(s) and Program(s)**
College of Natural Sciences	**- Astronomy** - Chemistry - Info and Computer Sciences **- Life Sciences** - Physics - Mathematics
College of Social Sciences	**- Anthropology** - School of Communication and Information - Communication - Communicology - Journalism - Library and Information Science **- Peace Studies** **- Economics** - Ethnic Studies **- Geography and Environment** - Political Science - Physcology - Public Admin **- Sociology** **- Urban and Regional Planning** - Women Gender and Sexuality Studies
Hawai‘inuiākea School of Hawaiian Knowledge	**- Kamakakuokalani** **- Kawaihuelani** **- Native Hawaiian Student Services**
School of Ocean and Earth Science and Technology	**- Atmospheric Sciences** **- Earth Sciences** **- Global Environmental Science** **- Ocean and Resources Engineering** **- Oceanography**

College of Education	- Curriculum Studies **- Educational Administration** **- Educational Foundations** - Educational Psychology - Learning Design and Technology - Special Education - School of Teacher Education
College of Tropical Agriculture and Human Resources	- Family and Consumer Sciences - Human Nutrition, Food and Animal Sciences - Molecular Biosciences and Bioengineering - Molecular Biosciences and Biotechnology Program **- Natural Resources and Environmental Management** **- Plant and Environmental Protection Sciences** **- Tropical Plant and Soil Sciences**
Interdisciplinary Studies	- Interdisciplinary

Appendix 2. *IRB approved electronic email recruitment script sent to appropriate UHM and Kupu email list servers. Email included general study information, participant consent process, data collection procedures, general instructions, and a link to the online Google Form survey.*

University of Hawai'i at Mānoa
Email Recruitment Script
Dr. Catherine Chan, Principal Investigator
Tatum Kauka, Co-Investigator
Project Title: *Investigating Factors of Understaffing for Natural Resource Management Agencies of Hawai'i*

Recruitment Email:
Subject: Graduate Research Study: Natural Resources and Environmental Management

Body: Aloha,

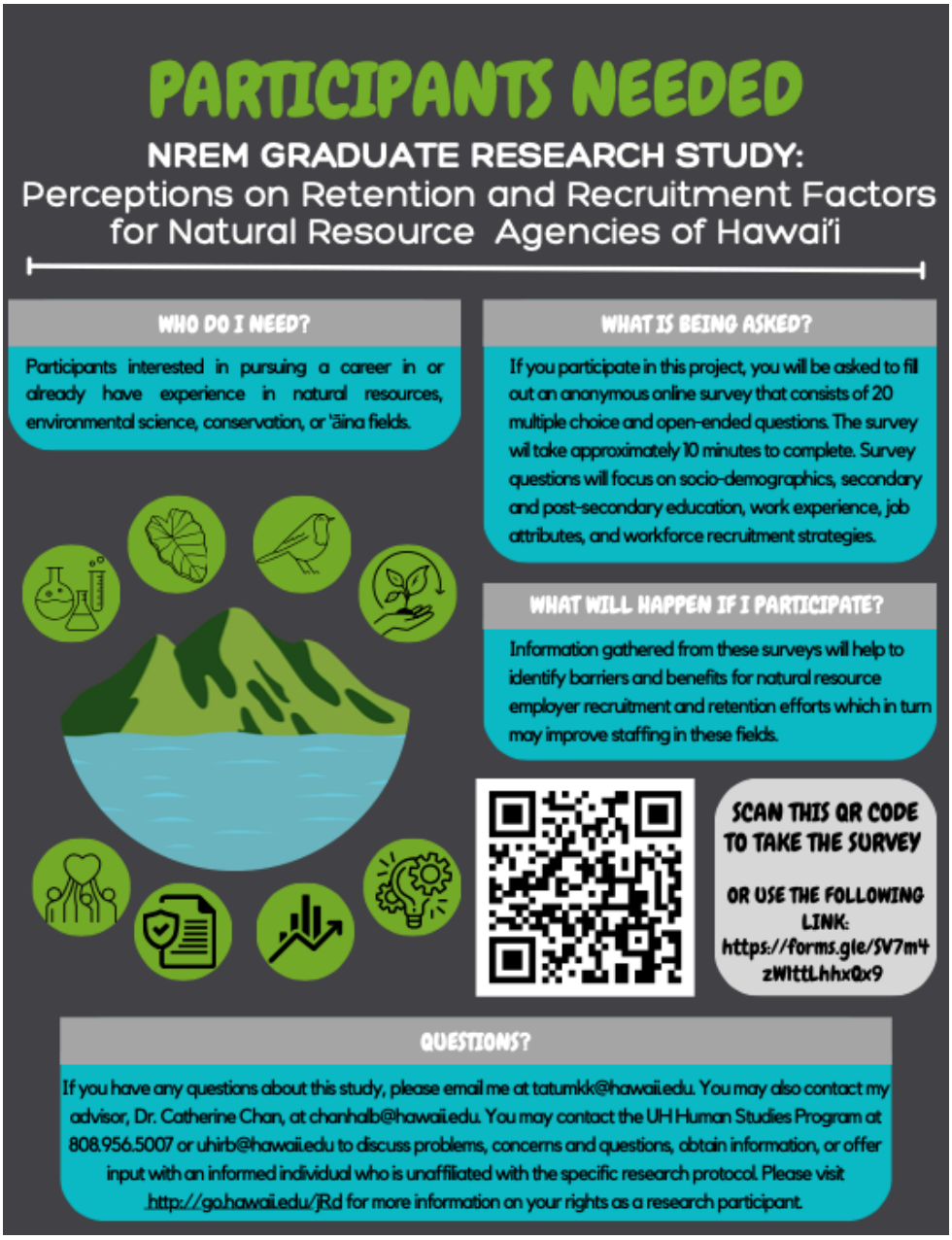
I am conducting a research study examining student perceptions on natural resource, environmental, conservation, or related jobs and you are invited to participate in the study. If you are interested, please click the following link (here). The online survey is anticipated to take no more than 10 minutes.

Participation in this study is voluntary. Your identity as a participant will remain anonymous during and after the study. There is little to no risk involved in this research.

If you have any questions pertaining to the online survey or the research study, please contact myself at tatumkk@hawaii.edu. You may also contact my faculty advisor. Dr. Catherine Chan, at chanhalb@hawaii.edu.

Mahalo nui,
Tatum K. Kauka
University of Hawaii at Mānoa
Dept. of Natural Resources and Environmental Management (NREM), CTAHR
M.E.M. Candidate, Graduate Research Assistant

Appendix 3. *Study related recruitment flier sent with IRB approved email recruitment script to appropriate UHM and Kupu email list servers. Flier created as a means of visual appeal and includes general study information, participant consent process, data collection procedures, general instructions, and a link to the online Google Form survey.*



Appendix 4. *Survey questionnaire final draft including six survey sections and twenty total questions with instructions for response selection. Table is divided by six sections: Background Information, Secondary Education, Post Secondary Education, Natural Resource Experience, Job Attributes, and Future Recruitment. Survey was implemented through Google Forms.*

Question #	Section and Question Text	Response Options
	Section 1: Background Information	
1	What is your age? (Select one)	- Under 18 **No Participation* - 18-22 - 23-28 - 29-40 - 41-55 - 56-64 - 65+
2	What gender do you identify with? (Select one)	- Male - Female - Other: ___ - Prefer Not to Say
3	What ethnic group do you identify most with? (Select one)	- Native Hawaiian - Other Pacific Islander - Asian - White or Caucasian - Black or African American - Hispanic or Latino - Native American or Alaska Native - Other: ___
	Section 2: Secondary Education	
4	Where did you attend high school? (Select U.S. State)	- (Select US State)
5	Did you study or learn about natural resource management, environmental science/studies, or conservation in high school classes? (Select one)	- Yes - No
6	Did you study or learn about natural resource management, environmental science/studies, or conservation through out-of-class activities (eg., high school sponsored activities or clubs)? (Select one)	- Yes - No
7	Did you study or learn about natural resources, environmental science/studies, or conservation outside of school (eg., volunteer workdays, internships, etc.)? (Select one)	- Yes - No
8	Which high school did you attend? (Name of school)	- (Name of School)
	Section 3: Post-Secondary Education	
9	How many years of college or post-secondary education have you completed thus far? (eg., if you are three years into college, type a 3)	- (# of Years)

10	Is your current or intended focus of study within a natural resource management, environmental science/studies, conservation, or related field? (Select one)	- Yes - No - Other: ___
11	Which of the following influenced you to pursue postsecondary education in a natural resources, environmental science/studies, conservation, or related subject? (Select ALL that apply)	- Class, Program, or Club in High School - Class, Program, or Club in University/College - Family/Friends (‘Ohana) - High School Counselor/Teacher - Inspirational Figure - Internship - Media (e.g. TV shows, Movies, Books, etc.) - Passion/Lifestyle/Hobby - Professional Network/Mentor - Relationship with or Responsibility (kuleana) to the Environment/Aloha ‘Āina - Salary and Benefits - Social Media - Summer Program or Camp - University/College Professor - Volunteer Experience - Work Experience - Other: ___
12	Please share about any barriers or challenges you have had to overcome (or are still struggling with) to pursue postsecondary education in natural resources, environmental science/studies, conservation, or related field.	- (Open Response)
	Section 4: Natural Resource Experience	
13	Do you have any paid or unpaid experience in the natural resource management, environmental science, or conservation fields? (Select one)	- Yes - No **Skip to Question 16**
14	Which position type did you complete most of your experience under? (Select one)	- Internship or course related experience - Non-course related experience(volunteer) or paid position
15	Which area did you complete the majority of your experience under? (Select one)	- Public Sector - Non-Profit/Non-Government - Private/Industry - University
	Section 5: Job Attributes	
16	The following questions will utilize a 6-point scale and will focus on job position attributes.	

	Please select the number that best represents your level of importance for each attribute with #1 being Very Unimportant and #6 being Very Important.	- Adequate Compensation, Wages, and Benefits - Personal and Professional Development - Career Advancement - Job Security - Work Location and Hours Flexibility - Positive and Transparent Work Environment - Challenging or Interesting Job Duties - Recognition and Awards
17	Which minimum salary do you expect to receive as a full-time entry-level employee in the natural resource field? (Select one)	- $30,000 - $40,000 - $50,000 - $60,000 - $70,000 +
18	Please share any additional position attributes that you value in positions within the natural resources or related sector.	- (Open Response)
	Section 6: Future Recruitment	
19	The following questions will utilize a rank order scale and will focus on methods of recruitment.	
	Please rank the following methods for learning about current and future job opportunities in the natural resource sector to the best of your ability in order of preference, with #1 being Preferred Most, and #7 being Preferred Least. (Select each number only once)	- Career Fairs/Job Fair - Community/Public Job Boards - Emails - Federal/State Job Listings (e.g., USAJobs) - Newsletters - Social Media - Radio, Music Streaming Outlets (Spotify, etc.), TV Segments, Newspapers
20	What type of work in the natural resources/aloha ʻāina field do you hope to pursue? (Select ALL that apply)	- Admin: Finance, IT, etc. - Communications: Marketing, Social Media, Photo, etc. - Community Partnerships/Engagement - Development: Grant Writing, Fundraising, etc. - Education/Outreach - Field Work - Management: Areas, Species, etc. - Native Hawaiian Cultural Practice - Policy/Advocacy/Law - Programs: Management, Coordination, etc. - Science/Research - Tech: GIS, Data, etc. - Other: ___

Appendix 5. *Respondent rating frequencies to job attribute questions using a 6-point Likert Scale. Responses were grouped into cohorts depending on rating level: Very Unimportant to Somewhat Important (1 to 4 rating), and Important to Very Important (5 to 6 rating).*

Rating Frequency			
	n	%	Coding #
Adequate Compensation, Wages, and Benefits			
1 to 4	33	26%	0
5 to 6	93	74%	1
Personal and Professional Development			
1 to 4	34	27%	0
5 to 6	92	73%	1
Career Advancement			
1 to 4	50	40%	0
5 to 6	76	60%	1
Job Security			
1 to 4	42	33%	0
5 to 6	84	67%	1
Work Location and Hours Flexibility			
1 to 4	40	32%	0
5 to 6	86	68%	1
Positive and Transparent Work Environment			
1 to 4	30	24%	0
5 to 6	96	76%	1
Challenging or Interesting Job Duties			
1 to 4	50	40%	0
5 to 6	76	60%	1
Recognition and Awards			
1 to 4	100	79%	0
5 to 6	26	21%	1

Appendix 6. *Additional position attributes valuable for NRM or related jobs that were expressed across 54 open responses from Question 18 from Section 5 (Job Attributes) on the online survey. Using a thematic coding system, 24 total themes emerged with occurrences ranging from 11-4.*

Theme	n	Percentage	Coding #
Passion	11	20%	1
Meaningful	10	19%	2
Collaboration	9	17%	3

Living Wage	7	13%	4
Indigenous Practices	7	13%	5
Culture	6	11%	6
Mentorship	5	9%	7
Development	5	9%	8
Community	5	9%	9
Engagement	4	7%	10
Political Freedom	4	7%	11
Career Advancement	4	7%	12
Training	3	6%	13
Leadership	3	6%	14
Action Oriented	3	6%	15
Work-Life Balance	2	4%	16
Communication	2	4%	17
Interdisciplinary	2	4%	18
Personal Development	2	4%	19
Support	1	2%	20
Federal Certifications	1	2%	21
Data Analysis	1	2%	22
Benefits	1	2%	23
Adaptability	1	2%	24