



Investigating career pathways of undergraduates interested in seismology/geophysics: Longitudinal tracking of the IRIS Undergraduate Internship Program (1998 – 2018)



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Introduction

Since 1998 the IRIS Undergraduate Internship Program has provided research experiences for 216 undergraduates interested in exploring the fields of seismology/geophysics. Through this internship program, students take part in an intensive week-long preparatory course, and work with leaders in seismological research, in both lab-base and field-based settings, to produce research products worthy of presentation and recognition at large professional conferences. Prior to participating, a majority of students indicate an intention to go to graduate school. However, few are set on seismology/geophysics as their career field. For example, when identifying reasons for participating in the IRIS internship program, the 3 most common reasons to participate were; "I wanted to do something different than what I had done before" (59%), "The research project(s) sounded interesting" (54%), and "I wanted to know if geophysics was for me" (47%). To investigate long term impacts of the program, longitudinal data about the academic pathways of alumni was collected.

Data Collection

Data for this study was collected via an online survey consisting of 21 items covering the following areas.

- Basic contact information
- Academic history
- Fulltime employment information
- Any influence the program has had on educational/career trajectory
- Demographic information

The survey was administered via IRIS's new Alumni Tracking System which seeks to minimize the burden on alumni to participate by piping responses, where applicable, from previous tracking efforts in 2011 and 2014. Using existing email addresses, alumni receive a unique URL inviting them to "update" their information with IRIS. The survey was sent to 216 alumni of the IRIS internship program in June of 2018. When necessary, emails were supplemented with web/LinkedIn/Facebook searches and communication. This effort generated responses from 169 alumni (69.4%). To achieve a more complete picture of alumni career pathways, responses were supplemented with an additional 18 surveys that manually verified and updated by IRIS staff. These 18 surveys consisted of alumni who had completed the 2014 survey and had publicly available information online to allow IRIS staff to verify the accuracy of the information or update as needed. New perception items on the 2018 survey could not be completed using this method. Thus, the number of responses for some items vary. As illustrated in Figure 1, the combined effort generated a total of 187 completed surveys for a total response rate of 87.0%.

Data Analysis

Pathway data (Figure 1) was analyzed by tabulating, in R, the responses for all possible degree and employment statuses (shown as boxes). Similarly, pathways between these categories were mapped and the number of alumni who had followed that pathway were tabulated. The data was then filtered in R to only provide both status and pathway information for sub-populations (e.g. Figure 1b & 1c).

Alumni employment responses (Figures 2 & 3) was classified using a list of employment categories developed by the American Geosciences Institute for classifying the employment of geoscience students (Wilson, 2018). AGI's list was derived primarily from the North American Industry Classification System with several other geoscience specific categories identified from federal and other data sources that collect industry hiring information.

A chi-square test of independence was applied to determine if there are associations between intern's post-bachelors education/career step and other categorical factors. Chi-square tests were calculated in R (chisq.test). Where counts within the contingency table were less than five, an Fisher's exact test was applied instead of chi-squared. The Fisher's exact test was calculated in R (fisher.test). A standard significance level of p=0.05 was used to determine significance. Effect size for each table was determined by applying the Cramer's V test calculated in R (assocstats).

Acknowledgements

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Results

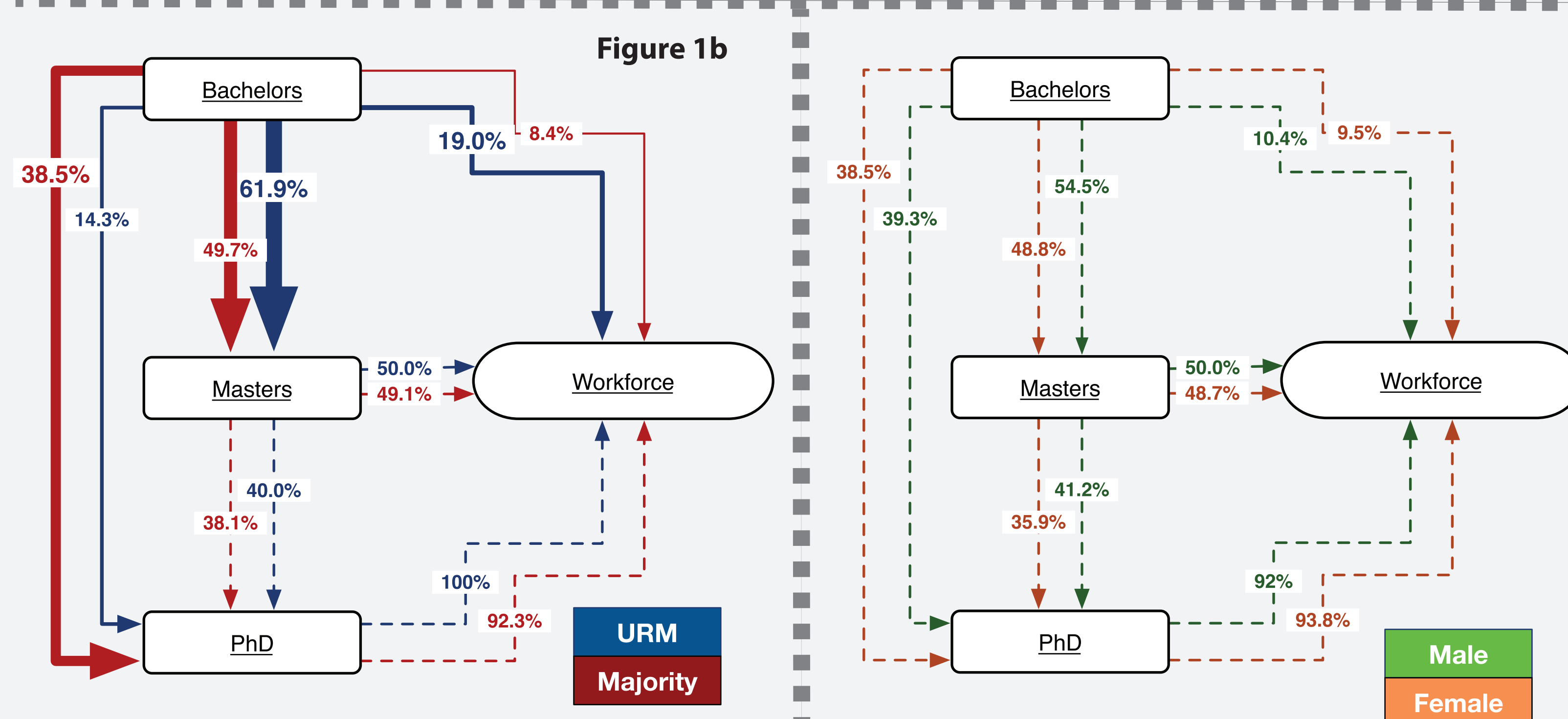
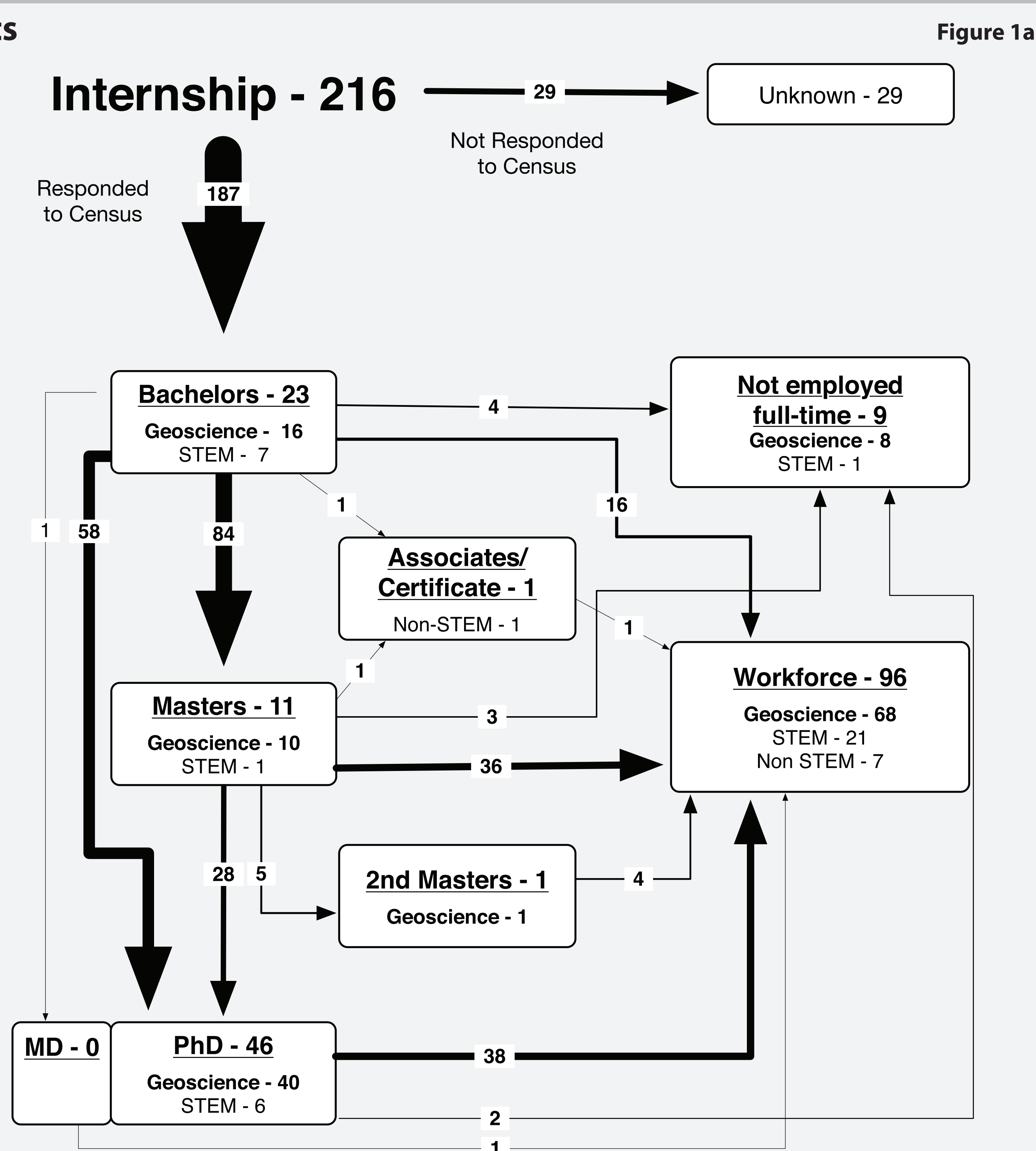


Figure 1 – Alumni career paths post IRIS internship. In Figure 1a, arrows are labeled with the number of interns who completed that pathway and are scaled accordingly. Boxes indicate a snapshot of the number of interns that are in that stage of their career as of the time of the survey. For example, 23 alumni are still completing their bachelors, 56 alumni completed undergraduate degrees and enrolled directly into a PhD program, and 36 alumni have completed Master's degree and entered the workforce. The "Not Employed" category includes primarily recent graduates that have not yet entered the workforce.

Alumni pathways for underrepresented minority and majority participants (Figure 1b), and male and female participants (Figure 1c) are compared by percentage. Pathways with differences of greater than 10% are indicated with solid lines and scaled accordingly, while pathways with differences of less than 10% are indicated with a dashed line and are not scaled.

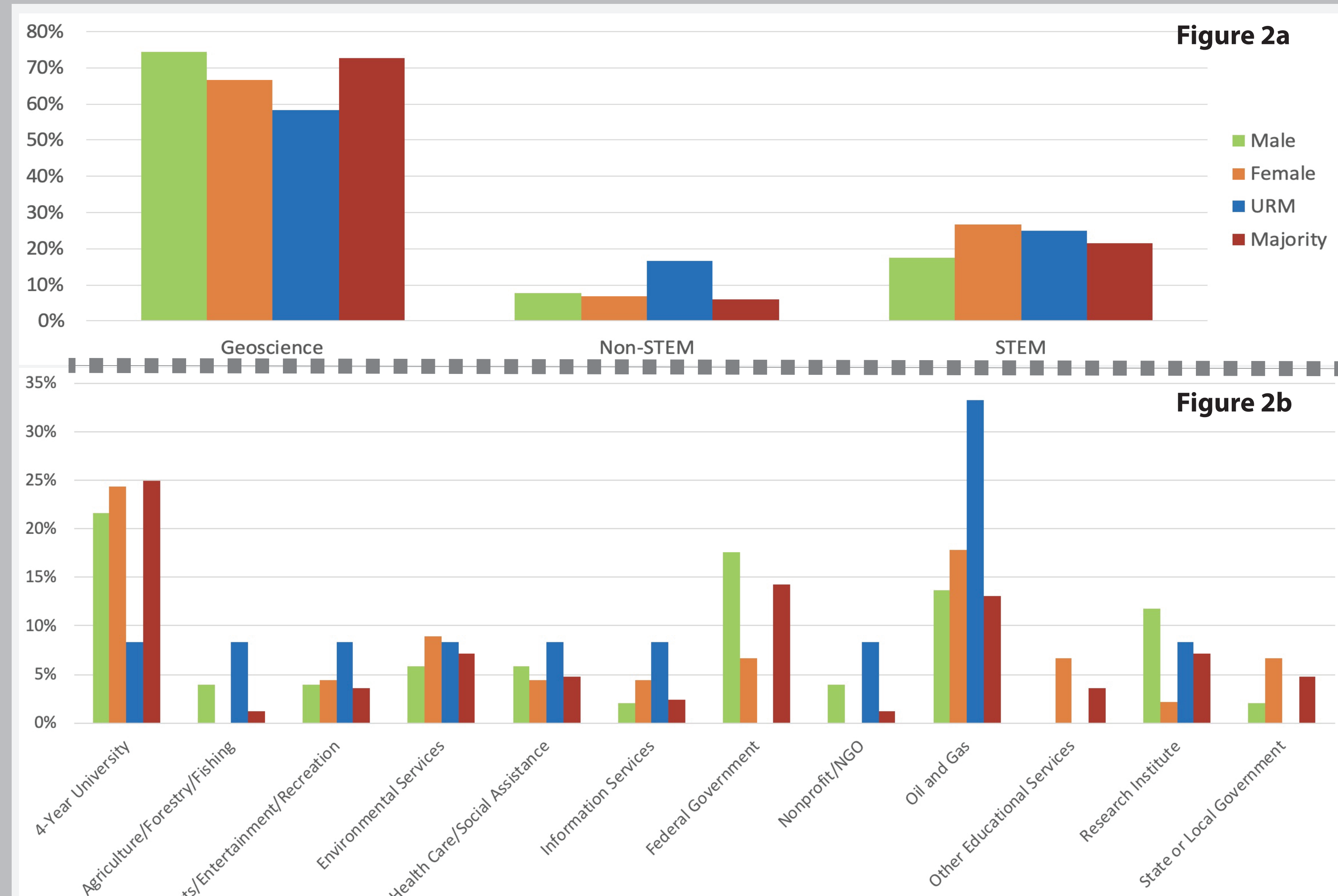


Figure 2 - Percentages of alumni employment (Male=51, Female=45, URM=12, and Majority=84) by broad category (Figure 2a) and by sectors (Figure 2b). Sectors with <5% for all groups were omitted.

Table 1: Comparisons of internship factors (e.g. participant demographics and self-reported programmatic impacts) and post-bachelors outcomes and as of June 2018. Factors associated with post bachelors outcomes at the p < 0.05 level and an effect size above Cohen's definition of "small" are indicated with an (*).

Factors	Total	Post-bachelors education/career step			Chi square tests of independence
		Workforce	Masters	PhD	
Gender					X ² = 0.81(2) p = 0.67 Cramer's V = 0.16
Male	77	10 (13%)	42 (54.5%)	25 (32.5%)	
Female	84	10 (11.9%)	41 (48.8%)	33 (39.3%)	
*Underrepresented minority status					X ² = 6.03(2) p = 0.04 (Fisher's Exact Test) Cramer's V = 0.19
Yes	20	5 (25.0%)	12 (60.0%)	3 (15.0%)	
No	141	15 (10.6%)	71 (50.4%)	55 (39.0%)	
Graduate degree earned by either or both guardians					X ² = 4.50(2) p = 0.11 Cramer's V = 0.18
Yes	88	8 (9.1%)	44 (50.0%)	36 (40.9%)	
No	52	10 (19.2%)	28 (53.8%)	14 (26.9%)	
*Program's impact on participant interest in a geoscience education/career					X ² = 14.51(4) p < 0.01 (Fisher's Exact Test) Cramer's V = 0.23
Decreased	7	3 (42.9%)	4 (57.1%)	0 (0%)	
Maintained	38	8 (21.2%)	21 (55.3%)	9 (23.7%)	
Increase	92	7 (7.6%)	45 (48.9%)	40 (43.5%)	
*Degree of influence of program on educational/career trajectory					X ² = 11.53(6) p = 0.04 (Fisher's Exact Test) Cramer's V = 0.19
Of little influence	5	1 (20.0%)	4 (80.0%)	0 (0%)	
Moderately influential	27	6 (22.2%)	12 (44.4%)	9 (33.3%)	
Influential	48	9 (18.8%)	24 (50.0%)	15 (31.3%)	
Very influential	80	4 (5.0%)	42 (52.5%)	34 (42.5%)	

Conclusion

- 77.4% of tracked alumni are either engaged in a geoscience career or in an advanced geoscience degree program.
- The most common post-bachelors pathway is into a Master's degree program. However, differences between racial and ethnic groups exist.
- Both minority status and the program's impact on educational/career interest are associated with post-bachelors pathway decisions.
- Alumni employment appears to vary by both race and ethnicity, and gender.

Future work

- Explore association between additional factors from applications and pre/post survey data (e.g. General Self-Efficacy, geoscience career score [measures of domain specific self-efficacy, desire/interest, future plans], science identity, etc.) and outcomes.
- Explore the relationships between associated factors and program outcomes through a multinomial logistic regression model.
- Identify other long running REU sites and explore across sites.