

THE IMPORTANCE OF MAPPING TECHNOLOGY KNOWLEDGE AND SKILLS FOR STUDENTS SEEKING ENTRY-LEVEL FORESTRY POSITIONS: EVIDENCE FROM JOB ADVERTISEMENTS.

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ABSTRACT. We investigated in this study the importance of mapping technology (GIS, GPS, aerial photo interpretation) qualifications for entry-level forestry employment opportunities, based on relevant job advertisements made available through Internet services. The basis for the study is an expectation that the relevant details regarding the educational background and desired work experience of a position would be evident in the job advertisement. We collected data from eighty-four employment and recruitment related websites, which were monitored between May 2015 and November 2015. Using content analysis, we analyzed the inclusion of mapping technology requirements in job advertisements as basic criteria for screening candidates for forestry employment. The main focus of the data collection process was on forestry positions available in the United States that seemed to require a four-year degree in forestry and one year or less of work experience. The data came from 234 job advertisements; 165 (72%) of the job advertisements that had a requirement of basic knowledge, experience, or proficiency with regard to mapping technology or the ability to read and follow maps. Differences in the frequency with which mapping technologies were required varied among regions, types of employer, and types of jobs offered.

Keywords: Content analysis; GIS; GPS, spatial information technologies, mapping technologies

1 INTRODUCTION

While professional and communication skills are often considered of greater importance, from an employer's perspective the technical skills, knowledge and abilities with respect to mapping technologies are also among the most important aspects of entry-level forestry positions (Sample et al. 2015). For example, most (over 60%) early-career professionals in natural resource management related fields may use geographic information systems (GIS) at least once per week in their jobs (Merry et al. 2007). In general, forestry programs at colleges of higher education in the United States tend to emphasize the rigor of technical skills (Bullard 2015), and a thorough grounding in these areas has been noted as being important in other surveys of foresters (Sample et al. 1999). As with any area of employment, competencies of forestry graduates need to meet the needs of prospective employers (Connaughton 2015). Job advertisements can be used as a guide to measure the most important skills required within various segments of certain profes-

sions (Gold and Grotti 2013), and effective recruitment of people for open positions is a theme that guides their development and facilitates cost-effective screening and selection processes (de Cooman and Pepermans 2012). Job advertisements should ideally list the core competencies of candidates, and a summary of this detail may help inform new graduates of the importance of mapping technology as a component of their undergraduate program of study. These advertisements can imply skill requirements for various positions (Sodhi and Son 2010). Ideally, the skills of the potential employee should match the skills desired for the position. Much more broadly there is a feedback loop where employer expectations lead to offered positions and wages, which in turn lead to investments in developing desired skills by others. The employer then develops an understanding of the relationship between education and performance and adjusts its expectations (Spence 1973), perhaps as evidenced through subsequent job advertisements. Educational systems devoted to preparing potential employees would

benefit from a comprehensive understanding of the skills employers are seeking, to enable appropriate and evolving adjustments to their curriculum. Accordingly, analyses of job advertisements can supplement traditional methods (e.g., interviews) in developing such information (Sodhi and Son 2010).

This study performs a content analysis regarding the occurrence and presentation of descriptors - responsibilities and qualifications - from job advertisements of forestry positions posted over a six-month period in 2015. The purpose of the study is to determine the importance of a mapping technology background of the job applicants for initial screening of them for entry-level forestry positions. The presented content analysis is unobtrusive, empirically grounded, and involves a systematic reading and analysis of a set of verbal, graphic, symbolic, or other communicative matter (Krippendorff 2013); in our case, the considered job advertisements were posted on the Internet. At its most basic level, we are attempting to decide whether any reference to mapping technology skills has been included in a job advertisement. Each observance is later coded into one of several classes or categories. Throughout the analysis, we addressed the common components of content analysis (unitizing, sampling, recording, reducing) through the methodology that was employed to collect and analyze the information. A number of fields have used content analysis in a similar manner, which included recent studies focusing on job advertisements for librarians (Detmering and Sproles 2012), logisticians (Kovács et al. 2012), operations research professionals (Sodhi and Son 2010), project managers (Ahsan et al. 2013), and non-profit business managers (de Cooman and Pepermans 2012).

2 METHODS

Our methods consisted of the following five general steps: (1) define the job category for the analysis and the variables to be assessed in job advertisements; (2) identify a set of Internet-based websites where these opportunities might be posted; (3) collect sample data; (4) develop the coded classes or categories to further characterize the individual samples with respect to the study theme (mapping technology skills important for entry-level forestry positions); and (5) assess the frequency of use of the coded items within each job advertisement.

The sample frame included job advertisements targeting entry-level forester positions situated in the United States. Our sampling frame was further confined to positions posted on the Internet between May 16 and November 15, 2015. For these positions, we assumed that professional registration was not required, and that the required job experience was no more than one year. We were searching for the mapping technology require-

ments for forestry positions that required a bachelor's degree in forestry with no requirement of a Master's degree. A sample list of the titles of these positions can be found in Table 1. We focused on employment opportunities that were related to specific openings with advertisements (i.e., not an outreach effort exploring interest in the position), and where preference for specific demographic groups was not evident. The considered employment opportunities were situated only within the United States, and were offered by state, federal, private, and non-governmental organizations. All advertisements were screened to determine whether they involved part-time opportunities or were duplicated advertisements or identifiable re-advertisements of positions. These were subsequently excluded from the study. In accordance with the above, the sampling units for this study were the individual job advertisements.

Table 1: Alphabetical list of annotated position titles for the job descriptions that were assessed in this survey.

Area forester
Consulting utility forester
Distribution utility forester
District forester
Division forester
Forest health forester
Forest inventory and analysis (FIA) forester
Forester
Inventory forester
Operations forester
Procurement forester
Resource forester
Resource manager
Service forester
Silviculture forester
Staff forester
State lands forester
Timber cruiser
Timber management forester
Transmission forester
Watershed forester

We examined 84 employment-related Internet sites devoted to the posting of job opportunities. Each of these were accessible free of charge, did not require registration on the part of the job seeker, and did not require the development of a job seeker profile. Some of these were forestry-specific (Forestry Careers USA, Society of American Foresters Career Center), while others were much broader (e.g., Monster.com, USAJOBS.gov, state employment agencies). Some state-level Internet sites were inaccessible (computer cookie issues with the computer

used to conduct the study), others were not assessed due to the low likelihood of advertisements meeting the needs of the study (e.g., Nevada). Thirty-one of the Internet sites were managed directly by private organizations (e.g., Plum Creek, Weyerhaeuser, and Sierra Pacific Industries). Six of the Internet sites were managed by university forestry programs (Michigan State University, Oregon State University, Pennsylvania State University, Purdue University, University of Georgia, University of Minnesota), and did not require a student identification number to access and view employment opportunities. When a new job advertisement was located on Internet intermediaries (e.g., Monster.com, university websites), an attempt was made to locate the original advertisement on the offering organization's website. Where possible within these Internet sites, we employed two keywords, "forester" and "forestry."

Each Internet site was visited approximately once per week over the monitored period. Some Internet sites were available less than 100% of the attempts to visit them. However, with repeated visits, older advertisements that may have been missed were accessible during later successful visits. Some Internet sites became inaccessible for different reasons (e.g., changes in employment listing system) during our period of study, and required periodic browser searches to locate the changed, or updated, employment system URLs. Two Internet sites that required cookies, and were persistently inaccessible, were discarded from the potential set of monitored sites.

Each job advertisement was carefully read, and during our search, we recorded the organization name, the job title, the location of opportunity, and the relevant content that related to skills regarding GIS or mapping technology (GPS, remote sensing, aerial photography, and navigation). This content was recorded verbatim as the collected raw data. The raw data were subsequently processed by coding them into five main categories (Appendix A). The criteria for determining the characteristics of the textual material to be derived from each job advertisement were based on one research question:

How important are mapping technology skills important for entry-level forestry positions?

The descriptors of interest related to mapping technology skills that students may have obtained while pursuing their undergraduate degree. Dividing the descriptors into job responsibilities, required qualifications, and preferred qualifications (as in Hartnett 2014), was difficult because many advertisements were not specific with regard to these groupings; therefore, this division was not pursued and all relevant content was considered as *requirements* of the proposed position. Where possible, the requirements were further described as those that had an expectation of experience and those that simply desired knowledge

or familiarity with mapping technologies and related skills. We noted the state and region (South, West, Midwest, and Northeast) of the location of the opportunity. For the purpose of this study, northeastern states included West Virginia, Maryland, Pennsylvania, New York and all other northeastern states. Midwestern states included Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin. All other states, from Oklahoma and Texas toward the eastern seaboard, were considered southern states. Other states, including Alaska and Hawaii, were considered western states.

Coding of the text is necessary to transform what we found into analyzable representations (Krippendorff 2013). The recording or coding units were separate statements reflecting the importance of mapping technology with respect to the job advertised. For example, the statement *Basic knowledge of GPS/GIS systems is required* was considered a recording unit from one of the job advertisements. At most, four separate recording units were acknowledged with a sampling unit (a job advertisement). We used a deductive approach (as in Gold and Grotti 2013) to determine the larger categories or classes (see the Appendix) for skills in job advertisements. The categories were based on expert opinion of the researchers regarding the theme of the study, and the material was evaluated several times until the final categories had been revised sufficiently to settle upon the final set. Six categories were derived from the job advertisements: geographic information systems, global positioning systems, compass, maps, aerial photogrammetry, and remote sensing. Each category was further subdivided into sub-categories; mainly *knowledge* and *skills* related to each category. Short descriptors (e.g., *experience* or *proficiency*) were then developed for the sub-categories. This dictionary (see the Appendix) was then used to assign membership of a recording unit to a sub-category. A binary (yes/no) variable was used to indicate whether or not a particular type of mapping technology statement was found in a job advertisement. For example, using the recording unit *Experience with GIS is a plus*, the descriptor *experience* associates this statement with the *GIS category / General knowledge sub-category*.

Our process was performed manually, and thus formal content analysis software was not employed. We cross-checked each categorization to ensure consistency in the coding process. These steps represent the qualitative process of the analysis (Mayring 2000, Ahsan et al. 2013). The frequency with which the coded classes or categories were mentioned in job advertisements reflects the importance of those skills for employers. This represents the univariate portion of the quantitative analysis. Cross-tabulations of the frequencies with which coded

Table 2: Distribution (number) of employment opportunities for foresters, by region and by employer type.

Region	Private	Public			Other ^a	Total
		Federal	State	Sub-state		
Midwest	18	2	4	4	1	29
Northeast	19	2	3	–	–	24
South	65	–	33	–	–	98
West	45	13	22	–	2	82
Region	1	–	–	–	–	1
Total	148	17	62	4	3	234

^aIndian reservation, non-governmental organization

statements were presented (e.g., by region of the country and by organization) represents the bivariate portion of the quantitative analysis (Sodhi and Son 2010).

3 RESULTS

We have analyzed 234 unique entry-level employment-related forestry advertisements that were posted on the employment-related Internet sites during the period of our study (Table 2). Forty-two percent of the employment opportunities were located in southern states, 35% were located in the western states, 12% were located in the Midwestern states, and 10% were located in northeastern states. One advertisement was for broader, non-specific regional wood procurement positions of an unknown quantity (thus counted as one employment opportunity). Regardless of the employer, about 48% of these opportunities were general forestry or land management positions. A large portion (32%), all offered by private companies, were utility forester positions (e.g., consulting utility forester, distribution utility forester, transmission utility forester).

Thirty-five percent (83) of the employment opportunities were offered by a governmental agency. Of these, 4.8% were with a sub-state organization (county or city), 74.7% were with state agencies, and 20.5% were with federal agencies. Of the state agency opportunities, 53.2% were situated in southern states, 35.5% were in western states, 6.5% were in Midwestern states, and 4.8% were in northeastern states. Of the federal agency employment opportunities, most (76.5%) were located in western states, while 11.8% each were located in Midwestern and northeastern states. Of the public employment opportunities, 78.3% were general forestry or land management positions, and 7.2% were forest inventory and analysis (FIA) positions. The remaining positions were more narrow in scope (e.g., pre-sales forester, timber preparation forester), had a specific function (e.g., longleaf pine forester), or were associated with an allied field (e.g., recreation forester).

Sixty-three percent (148) of the employment opportunities were offered by private companies. Of these, 43.9% were offered in southern states, 30.4% were in western states, 12.2% were in Midwestern states, and 12.8% were in northeastern states. Again, one of these opportunities was located in a non-specific regional location. Of the private company opportunities, 50.7% were utility forestry positions, 32.4% were general forestry or land management positions, and 10.8% were wood procurement positions. The remaining positions varied, and included those were more narrow in scope (e.g., inventory forester), or had a specific function (e.g., operations forester, research forester). The utility forester positions were widely distributed across the country: 41.3% were located in the South, 36% in the West, 13.3% in the Northeast, and 9.3% were in the Midwest. Of the general forestry opportunities, 43.8% were situated in the South, 29.2% in the West, 14.6% in the Midwest, and 13% were in the Northeast. Of the procurement opportunities, 56.3% were situated in the South, 18.8% in the Midwest, 12.5% in the West, and 6.3% were in the Northeast. Again, one of these was in a non-specific location.

From the 234 job advertisements, 122 unique statements regarding mapping technologies were identified. Some job advertisements (nearly 30%) contained no content that related to skills regarding GIS or mapping technology. Of the job advertisements that contained content of interest to this study, most (62%) contained only one statement, which may have referenced several of the categories we developed in the Appendix. One job advertisement contained four separate statements related to GIS or mapping technology skills.

3.1 Knowledge and skill with regard to GIS

When keyword groupings are examined, several interesting observations can be made. Overall, 53% of job advertisements noted a requirement of some level of GIS general knowledge or skill (Table 3). General knowledge of GIS was more frequently mentioned than general skills (Figure 1). With respect to the keywords in our

Table 3: Percentage of job advertisements that had keywords associated with the categories and sub-categories.

Category and <i>Sub-category</i>	Percent of advertisements
Geographic Information Systems	53.0
<i>General knowledge</i>	36.3
<i>General skills</i>	17.1
<i>Specific data management skills</i>	5.1
<i>Software program experience</i>	9.0
Global Positioning Systems	33.8
<i>General knowledge</i>	15.4
<i>General skills</i>	23.5
Compass	4.7
<i>General knowledge</i>	0.9
<i>General skills</i>	3.8
Maps	29.1
<i>General knowledge</i>	3.8
<i>General skills</i>	22.6
<i>Map navigation skills</i>	19.2
Aerial photogrammetry	12.0
<i>General knowledge</i>	11.5
<i>General skills</i>	3.8
Remote sensing	7.3
<i>General knowledge</i>	7.3
<i>General skills</i>	0.9

dictionary (see Appendix), 25.2% of job advertisements indicated that *experience* with GIS was needed while 10.3% cited *knowledge* of GIS was needed. *Proficiency* with GIS was noted in about 3% of the job advertisements. With regard to specific skills, *management* of GIS data (1.7%) was most often cited. Experience using ERSI software products was noted in approximately 7.7% of all job advertisements.

In the South, 26.5% of the job advertisements required knowledge of GIS, while 8.2% required general skills with GIS. Of the four regions, this was the lowest. In the West, 50% required knowledge of GIS and 26.8% required general skills. In the Midwest, 31% required knowledge of GIS and 13.8% required general skills. In the Northeast, 37.5% required knowledge of GIS and 25% required general skills. *Experience* and *knowledge* were the two most often used keywords in the general knowledge sub-category.

Approximately 37% of public sector job advertisements required GIS knowledge or skill (Figure 2); 21.7% asked for knowledge of GIS, while 22.9% asked for skill in this area. Conversely, approximately 61% of private sector job openings asked for knowledge and/or skill with regard to GIS (Figure 3); 43.9% required knowledge, while 14.2% required skill. About one in five job advertisements for general forestry positions required general knowledge

(19.5%) and general skills (20.4%) with regard to GIS. *Knowledge* of, and *experience* with GIS were noted most frequently. Of the utility forester job advertisements, 62.7% required general knowledge of (mainly experience) using GIS, while 6.7% required general skills related to using GIS. One in eight (12.5%) procurement job advertisements required general knowledge and general skills related to GIS.

3.2 Knowledge and skill with regard to GPS

Overall, 33.8% of job advertisements noted a requirement of some level of GPS general knowledge or skill (Table 3). GPS skills were emphasized more frequently than GPS knowledge. Approximately 15.4% of job advertisements indicated that knowledge of GPS was needed while approximately 23.5% cited skills of using GPS was needed. *Knowledge* (8.1%) and *experience* (6.8%) were the most frequently used keywords with respect to general knowledge of GPS. *Use* (9.4%) and some variant of *collection* (13.6%) were the most frequently used keywords with respect to GPS skills.

In the South, 12.2% of the job advertisements required knowledge of GPS, while 14.3% required general skills with GPS. Of the four regions, this was the lowest with regard to knowledge of this area. In the West, 18.3% required knowledge of GPS and 36.6% required general skills. In the Midwest, 13.8% required knowledge of GPS and 13.8% required general skills. In the Northeast, 20.8% required knowledge of GPS and 29.2% required general skills. Data collection skills were noted in over 23% of the job advertisements from the West.

A little over 19% of public sector job advertisements required knowledge or skill with regard to GPS; about 12% asked for general knowledge of GPS, while 14.5% asked for skill. Almost 42% of private sector job advertisements asked for knowledge or skill with regard to GPS; 16.9% desired knowledge of GPS, and 29.1% required skill (mainly data collection skills). For general forestry positions, general knowledge (9.7%) and general skills (22.1%) with regard to GPS were noted. *Knowledge* of, and *experience* with GPS were noted most frequently. Of the utility forester job advertisements, 14.7% required general knowledge of using GPS, while 28% required general skills (mainly data collection) related to using GPS. With respect to procurement positions, 12.5 of the job advertisements required knowledge of GPS, yet none of them required skills with this technology.

3.3 Knowledge and skill with regard to using a compass

Compass skills were very infrequently mentioned in job advertisements (Figure 1). In the South and Midwest, none of the job advertisements required knowledge of or skill with using a compass. In the West, 2.4% of job advertisements required knowledge of compasses

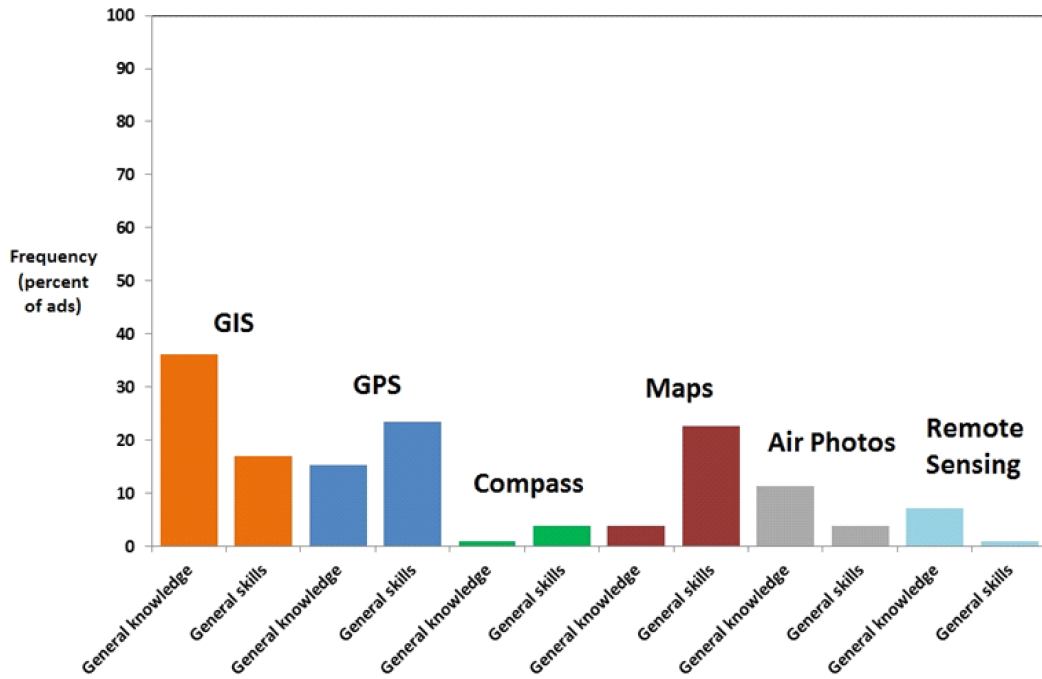


Figure 1: Percentage of job advertisements that referenced knowledge or skills desired in six general mapping technology categories.

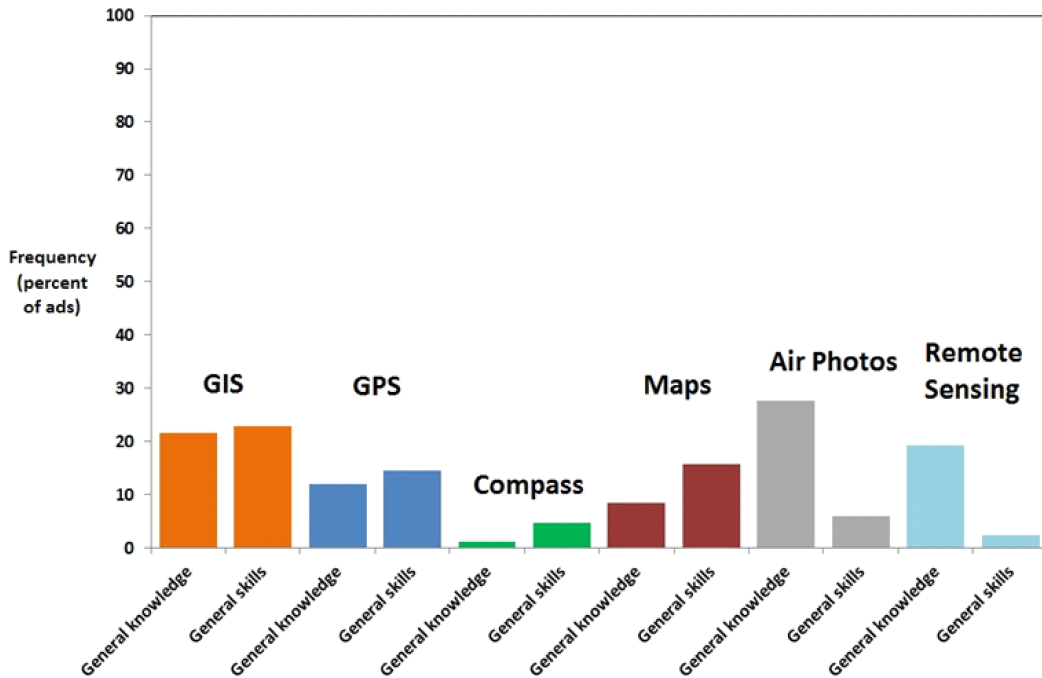


Figure 2: Percentage of public agency job advertisements that referenced knowledge or skills desired in six general mapping technology categories.

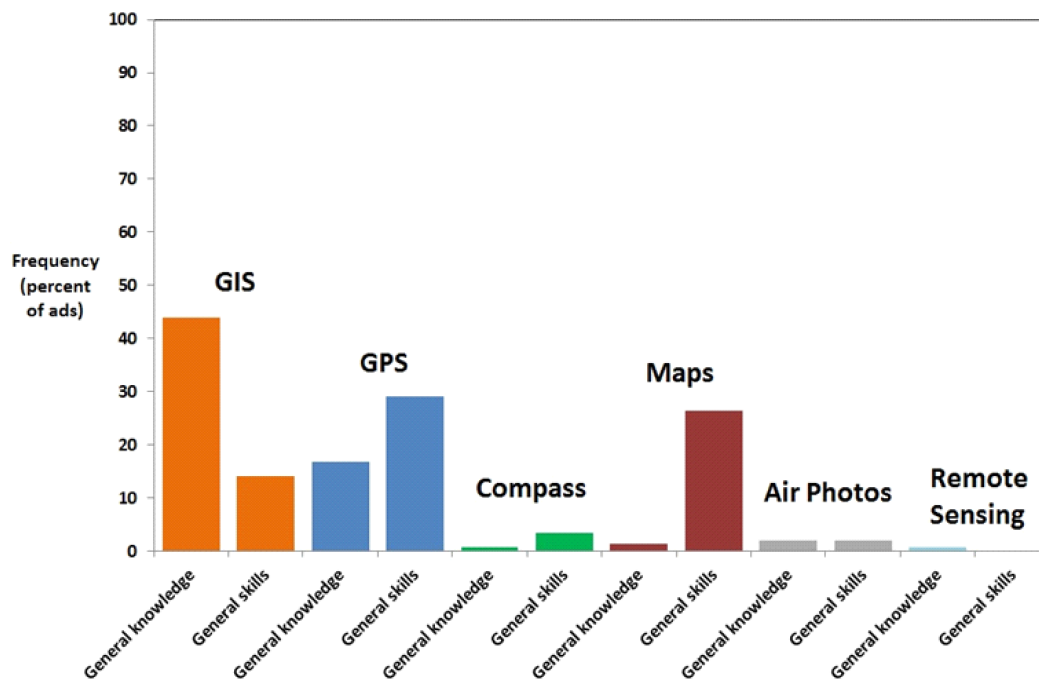


Figure 3: Percentage of private organization job advertisements that referenced knowledge or skills desired in six general mapping technology categories.

and 9.8% required general skills. In the Northeast, 4.2% required general skills with regard to the use of a compass. About 6% of public sector job advertisements required knowledge or skill with regard to using a compass; 4.8% of advertisements specifically asked for the ability to use a compass, while 1.2% asked for experience. Only about 4% of private sector job advertisements asked for knowledge or skill with regard to using a compass. For general forestry positions, 6.2% of job advertisements asked for knowledge and skills with respect to using compasses. None of the utility forester or procurement forester job advertisements required knowledge or skill of using a compass.

3.4 Knowledge and skill with regard to maps

Overall, 29.1% of job advertisements required knowledge of, or skill of using, maps. The keywords *follow* (10.7%), *read* (12.4%), and *ability to navigate* (14.1%) were the most frequently used with respect to maps. In the South and Northeast, none of the job advertisements required general knowledge of maps. However, in the South 24.5% of the job advertisements required general skills with maps and in the Northeast 29.2% required these skills. In the West, 8.5% required knowledge of maps and 17.1% required general skills. In the Midwest, 6.9% required knowledge of maps and 27.6% required general skills.

About 17% of public job advertisements required knowledge or skill with regard to using maps. About 7.2% of public sector job advertisements asked for knowledge of topographic maps, while about 5% asked for skill in *reading* and creating maps. In general, about 36% of private sector job advertisements mentioned map knowledge and skill in their job advertisements. The ability to *navigate* using maps (18.9% of advertisements) and to *read* and *follow* maps (16.9%) were the highest skills noted in private sector job advertisements. Forty-eight percent of the utility forester job advertisements required skill in map navigation, while 33.3% required other general map use skills. About 19.5% of the general forestry positions asked for knowledge (5.3%) and/or skills (17.7%) with regard to the use of maps. A small portion (6.3%) of procurement positions required skills related to the use of maps.

3.5 Knowledge and skill with regard to aerial photographs

Overall, 12% of job advertisements required knowledge of, or skill of using, aerial photographs. In the South, 2% of the job advertisements required knowledge of aerial photographs, and 2% required general skills. Of the four regions, this was the lowest. In the West, 19.5% required knowledge of aerial photographs and 4.9% required general skills. In the Midwest, 13.8% required knowledge and 3.4% required general skills. In

the Northeast, 20.8% required knowledge and 8.3% required general skills.

About 29% of public sector job advertisements asked for knowledge and skills using aerial photographs or photogrammetry (mostly skills), while only 2% of private sector job advertisements asked for these. Nearly 20% of the general forester job advertisements required knowledge of the use of aerial photographs, while 5.3% required skills in this area. None of the utility forester or procurement forester job advertisements required knowledge or skill of using aerial photographs.

3.6 Knowledge and skill with regard to remote sensing Overall, 7.3% of job advertisements required knowledge of, or skill of using, remote sensing. Very few job advertisements noted remote sensing knowledge or skill as important. General knowledge of remote sensing was required in 14.6% of the job advertisements from the West, and most of these were federal positions that simply noted remote sensing as a knowledge area. About 19.3% of public sector job openings asked for knowledge of remote sensing; this was not seen as important in private sector job advertisements (0.7%). For general forestry job advertisements, 14.2% required knowledge of the use of remote sensing technology, while 1.8% required skills in this area. None of the utility forester job advertisements required knowledge or skill of using remote sensing technology.

4 DISCUSSION

In general, it is reasonable to expect that a field associated with managing vast areas of natural resources, such as forestry, is necessarily relying and dependent on strong components of mapping technologies. However, in the modern era the technology is changing so rapidly that the science and the general education may struggle to keep up with the progress. This is observable in all areas that are peripheral to the individual technological venues of different fields, and the forestry is not an exception in this case. One can therefore expect disparities between the actual needs of different forestry professional positions versus their job descriptions and versus the educational preparation for these positions at different forestry programs.

While the frequency with which mapping technology knowledge and skills were noted in job advertisements may have been lower than expected, GIS, GPS, and mapping technology knowledge and skills cannot be assumed inherent in a forestry education degree program today; although maybe it should. Within forestry schools, one or two classes may have emphasized these areas of development, and the individual job applicant needs to be both competent and confident with regard to their ability

in these areas. Our findings suggest that some sets of mapping technology knowledge and skills may not seem to be as important as others are. For example, we found regional differences in the frequencies with which GIS and GPS knowledge and skills were important. We also found differences with regard to type of employer (public and private) and with regard to type of job opportunity. For example, procurement forester opportunities emphasized business and negotiation skills rather than mapping technology skills, while utility forester opportunities emphasized GIS knowledge and skills.

In today's environment, where technical skills have been emphasized in forestry schools for decades, one might wonder whether it is even of importance to list these areas of knowledge and these sets of skills in job advertisements. Some employers may assume that these should be inherent in every graduate of a forestry program. Others may assume that knowledge and skills in these areas will become apparent during an interview. In discussing this issue at the 10th Southern Forestry and Natural Resource Management GIS Conference (Athens, Georgia USA, December 7-8, 2015), the consensus among employers was that it should be important to list these knowledge or skills in job advertisements, particularly with respect to GIS. On the other hand, job recruiters may feel that general communication, organization, and writing skills are more important for the job recruitment process than technology-related technical skills, which are inherently easier to develop on the job on an as needed basis.

From an employer's point of view, minimization of content within a job advertisement should not be a problem with postings made available through the Internet. As others have suggested (e.g., Marchal et al. 2007), more content related to job requirements can be found on the version of the job advertisement located on the Internet; newspaper and magazine versions of job advertisements tend to be shorter in part due to space limitations and publication costs (Ahsan et al. 2013). It has been suggested that the appearance of important criteria (experience, education, knowledge and skills) may be more frequently available through Internet-based job advertisements because advertisement writers may be able to provide more selective criteria since content volume may not be an issue (Marchal et al. 2013). However, time constraints and organizational convention may be precluding the development of statements targeting mapping technology knowledge and skills. From the research point of view, we are aware of these and other limitations of our study. For example, we were aware that there might have been other Internet-based resources posting employment opportunities that were not included in this analysis. Therefore, some opportunities may have been omitted from our sample. Further, due to the use of only

two keywords (forestry, forester), omissions and matching failures (due to mistakes in typing the keywords) may have also occurred (Marchal et al. 2007). We are also aware that many employment opportunities for foresters are not advertised on the Internet. Our analysis did not involve job advertisements placed in newspapers or magazines (e.g., the Society of American Forester's *Forestry Source*). This type of analysis was time-consuming in that searching for job advertisements on the Internet requires the researcher to learn how to navigate through the various processes used to locate and view the content. Our six-month experience with 84 Internet sites suggests that a job seeker would benefit from repeated visits to each, in order to understand the most effective way to obtain job advertisement content. In addition, as we noted, we may have missed some job advertisements that were unavailable through the Internet sites because smaller companies may not advertise widely, if at all, for potential applicants.

Finally, while content analysis of job advertisements posted on the Internet can be useful in determining important information regarding desired knowledge and skills of entry-level foresters, the method has been criticized because it only reports the frequency of statements made in the content reviewed, not an interpretation of the meaning of these statements (Sodhi and Son 2010). Therefore, one can argue that an analysis of job advertisements does not provide a complete synthesis of the types of skills employers most desire within a segment of a profession (Gold and Grotti 2013). However, it provides a glimpse into the importance of mapping technology knowledge and skills for students seeking entry-level forestry positions.

5 CONCLUSIONS

Our content analysis of job advertisements can help graduating forestry students understand the importance of mapping technology in the eyes of the employers. Differences seem to exist regionally, by employer type, and by job type. These differences can help graduating students prepare their case for employment (resume, cover letter, and interview). This information may also be of value to educators, as they continuously evaluate the content and use of mapping technologies in forestry courses. Some of the main general findings were that private sector job opportunities require experience with GIS more often than public sector opportunities. Utility forester positions seemed to require GIS and GPS knowledge and experience more often than general forestry positions. Procurement forester positions very infrequently mentioned these as desired aspects of job applicants. Knowledge and skill with respect to GIS and GPS also

seemed to be noted with the lowest frequency in job advertisements from the South.

REFERENCES

- Ahsan, K., M. Ho, and S. Khan. 2013. Recruiting project managers: A comparative analysis of competencies and recruitment signals from job advertisements. *Project Management Journal*. 44(5): 36-54.
- Bullard, S.H. 2015. Forestry curricula for the 21st Century - maintaining rigor, communicating relevance, building relationships. *Journal of Forestry*. 113(6): 552-556.
- Connaughton, K. 2015. Forestry employment trends. *Journal of Forestry*. 113(6): 571-573.
- de Cooman, R., and R. Pepermans. 2012. Portraying fitting values in job advertisements. *Personnel Review*. 41(2): 216-232.
- Detmering, R. and C. Sproles. 2012. Forget the desk job: Current roles and responsibilities in entry-level reference job advertisements. *College & Research Libraries*. 73(6): 543-555.
- Gold, M.L. and M.G. Grotti. 2013. Do job advertisements reflect ACRL's *Standards for Proficiencies for Instruction Librarians and Coordinators?*: A content analysis. *The Journal of Academic Librarianship*. 39(6): 558-565.
- Hartnett, E. 2014. *NASIG's Core Competencies for Electronic Resources Librarians* revisited: An analysis of job advertisement trends, 2000–2012. *The Journal of Academic Librarianship*. 40(3-4): 247-258.
- Kovács, G., P. Tatham, and P.D. Larson. 2012. What skills are needed to be a humanitarian logistician? *Journal of Business Logistics*. 33(3): 245-258.
- Krippendorff, K. 2013. *Content analysis, An introduction to its methodology*. Third edition. Sage Publications, Inc., Thousand Oaks, CA.
- Marchal, E., K. Mellet, and G. Rieucan. 2007. Job board toolkits: Internet matchmaking and changes in job advertisements. *Human Relations*. 60(7): 1091-1113.
- Mayring, P. 2000. Qualitative content analysis. *Forum: Qualitative Social Research*. 1(2): Article 20.
- Merry, K.L., P. Bettinger, M. Clutter, J. Hepinstall, and N.P. Nibbelink. 2007. An assessment of Geographic Information System skills employed by field-level natural resource managers. *Journal of Forestry*. 105(7): 364-370.

Sample, V.A., R.P. Bixler, M.H. McDonough, S.H. Bullard, and M.M. Snieckus. 2015. The promise and performance of forestry education in the United States: Results of a survey of forestry employers, graduates, and educators. *Journal of Forestry*. 113(6): 528-537.

Sample, V.A., P.C. Ringgold, N.E. Block, and J.W. Giltmier. 1999. Forestry education: Adapting to the changing demands. *Journal of Forestry*. 97(9): 4-10.

Sodhi, M.S., and B.-G. Son. 2010. Content analysis of OR job advertisements to infer required skills. *Journal of the Operational Research Society*. 61: 1315-1327.

Spence, M. 1973. Job market signaling. *Quarterly Journal of Economics*. 87(3): 355-374.

A APPENDIX - CATEGORIES, SUB-CATEGORIES, AND KEYWORDS

The following categories (bold), sub-categories (italic), and descriptors (keywords) were used for the analysis of forester job advertisements with respect to mapping technologies:

Geographic Information Systems

General knowledge

Coursework
Experience
Familiarity
Knowledge
Operations
Understanding

General skills

Advanced computer skills
Capabilities
Field collection
Perform
Possess
Proficient
Proficiency
Seasoned
Skill
Skills
Use
Using
Utilize

Specific data management skills

Analyze
Capabilities
Document
Evaluate
Input
Query
Measuring

Maintenance
Management
Software program experience
ArcGIS
ArcMap
ArcView
AutoCad
Erdas
ESRI

Global Positioning Systems

General knowledge

Coursework
Experience
Familiar with
Familiarity
Knowledge
Training

General skills

Capabilities
Collect
Collecting
Collection
Field collection
Proficient
Proficiency
Skills
Update maps
Uploading
Use

Compass

General knowledge

Experience

General skills

Reading
Use

Maps

General knowledge

Experience
Ownership maps
Topographic maps

General skills

Preparation
Prepare
Create
Draw
Follow
Interpret
Mapping
Perform
Produce
Read
Reading
Record work on
Review

Update
Use
Map navigation skills
Ability
Proficient in
Aerial photogrammetry
General knowledge
Experience
Photogrammetry
Aerial photo
General skills

Interpretation of
Identify
Skills
Use
Remote sensing
General knowledge
Experience
Remote sensing
General skills
Identify