**Title:** Strategies for managing and leading fieldwork successfully as a graduate student

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# Abstract: (183/350)

Ecology and environmental science graduate degrees generally involve fieldwork, often led by the graduate student. While successfully planning and implementing a data collection field campaign can be fundamental to completing a graduate degree, little formal training and resources exist to support graduate students or their supervisors in preparing for that aspect of the degree. Fieldwork requires leading and managing a team, often in unique circumstances (specialized skillsets, long hours, remote regions, etc.), and thus can be challenging even for those with previous leadership or field experience. Our objectives were to a) collect general advice for graduate students without prior experience leading fieldwork, b) solicit specific suggestions on resources and actions to take before, during and after the field season and 3) develop a series of policy recommendations for labs, departments, and universities. We developed a survey to solicit community input and distributed it widely to the ecological sciences community. Here, we present initial results from the survey responses, including a summary of the perceived challenges that face graduate students leading their own fieldwork and suggestions for how to prepare and complete fieldwork successfully.

**Keywords**: Ecology, Fieldwork, Graduate Education, Graduate Field Experiences

# Introduction

Successfully planning and implementing a data collection field campaign can be fundamental to completing a graduate degree in ecology or other field sciences. However, programs and labs often provide little formal training in the leadership and management skills required to manage a field team successfully. Many programs and lab PI’s may not have any formal training themselves, so structured graduate student training can be limited. Complicating this is the unique nature of fieldwork, with specialized skill sets, work requirements (e.g., hours of work, conditions), regions and equipment. However, completing a field season successfully can be a critical element of completing a graduate degree in ecology and other natural sciences.

While some individuals may enter graduate school with prior experience leading a team, the skills required for managing a field crew in various environments, under high stakes and potentially facing physical risks may differ. Conducting graduate research in a field environment has two key challenges: it is uncontrolled and complex by nature, and it often takes place independently, sometimes with little to no contact with advisor or mentor guidance, isolating students to make decisions on their own early in their research career (Leon-Beck and Dodick 2012, Bowen and Rurth 2007): For those with leadership experience, this can be complicated, for those with no background in leadership, this can be daunting. While some resources and studies exist that examine graduate field experiences, they can often be highly method-specific (i.e., tree climbing, Houle et al. 2004), deal with a specific aspect of risk (e.g., minority identity individuals, Claire Demery et al. 2021 or physical challenges, Daniels and Lavalleee 2014), or focus on the pedagogy of the field experience, rather than the skills graduate students need to develop to be successful (Leon-Beck and Dodick 2012) .

In the following, we provide both suggestions of strategies specifically aimed at a graduate student audience, and recommendations for lab, department, scientific association or institution-level policies and resources that can support graduate fieldwork. To make this piece as applicable as possible, we report the results of the survey in two formats: 1) general advice, 2) specific actions to take at various points of the field season, designed to be more applicable to those leading a field season for the first time, and 3) policy recommendations for labs, departments, and universities. We acknowledge that the advice compiled here may often overlap and may not be applicable to every graduate student. For example, individuals conducting fieldwork in remote areas without cell service may need to respond differently to scenarios than those working in urban or semi-rural environments. We also include a checklist of questions and actions in the supplemental materials, meant to guide labs in establishing their own lab-specific protocols and policies.

# Methods

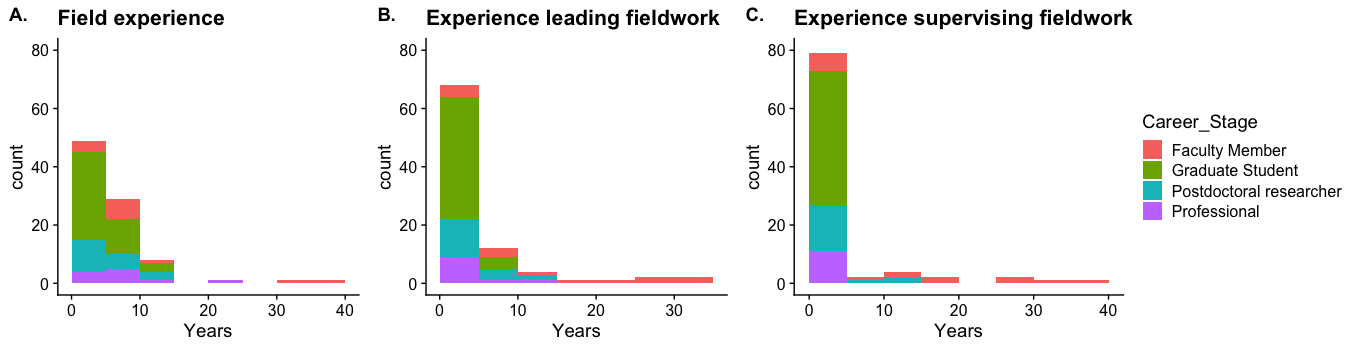
We developed a survey to collect generalized advice for graduate students leading and managing fieldwork. Survey answers were anonymous, and we excluded survey responses that included identifying information (i.e., study site, region, affiliate groups, etc.) from the results. The survey went through IRB approval and was deemed exempt. We distributed the survey on 11/22/2021 to the following listservs: Ecolog ([**ECOLOG-L@community.esa.org**](mailto:ECOLOG-L@community.esa.org)**,** Inouye 2018), North American chapter of the International Association of Landscape Ecology (https://www.ialena.org/listserv.html) and the American Geophysical Union Biogeosciences email list (AGUbiogeosciences@ConnectedCommunity.org). We also circulated the survey on twitter and among our personal networks.

# Results

## Survey responses

Between 11/22/21 and 1/31/22, 96 individuals completed the survey. 49% of respondents were graduate students (n = 46), 16% were faculty members (n = 15), 20% were postdoctoral researchers (n = 19) and 12% self-identified as 'other' (including research staff, college administrator, and ex-academic).

Respondents had a mix of experiences and backgrounds: 45% of respondents had >5 years conducting fieldwork not as a team lead (n = 43), 24% of respondents had >5 years of experience leading field crews (n = 23), and 14% of respondents had >5 years of experience supervising fieldwork (n = 13) (Fig. 1).



**Figure 1. Years of experience of survey respondents. A) Respondent’s years of experience in the field in any capacity. B) Respondent’s years of experience leading fieldwork for at least 3 weeks in the field (cumulative) per year. C) Respondent’s years of experience supervising fieldwork (i.e., supervising a graduate student leading fieldwork) for at least 3 weeks in the field (cumulative) per year.**

57% of respondents typically conducted fieldwork in remote environments (n = 54), 7% described working in urban areas (n = 7), 40% worked in semi-remote regions (i.e., wildlands near cities) (n = 38) and 1% worked in coastal habitats. Some respondents (5%) reported working in a mix of regions.

***Survey Responses***

We identified three primary themes in survey responses: 1) team communication, 2) honest risk assessment, and 3) procedural preparation. Team communication includes any actions field leaders take to communicate with their crew or to encourage communication. Risk assessment captures the actions that field leaders take to assess, identify, manage, and mitigate risk, both before and during the field season. Procedural preparation represents the logistic planning and management that a field leader is responsible for throughout the season. We used those three themes to categorize survey answers into a conceptual framework that broke down survey suggestions into actions that take place before and during fieldwork (Fig. 2). In the following, we present communication, risk, and procedural actions to take before and during fieldwork, before addressing survey responses that take place after fieldwork.



**Figure 2. Conceptual framework of the three themes that arose from survey responses (team communication, honest risk assessment and procedural preparation) and the list of actions to take before and during fieldwork for each.**

## Actions to take before fieldwork

Team Communication

A crucial theme that arose throughout the survey responses was proper communication. In this section we outline some of the major components of communication that occur before the field season.

Survey respondents identified hiring as a key element of communication that takes place before the field season. Without prior experience, the logistics of attracting, interviewing, and selecting fieldcrew can be daunting. Thus, several survey respondents recommended asking fellow graduate students or faculty about their hiring experiences and for resources like interview questions where available. Many respondents suggested posting job ads early to attract more applicants and to allow for interviewing prospective crew members multiple times. Survey responses highlighted identifying safe, inclusive, and collaborative teammates during the interview process by asking specific questions about resilience, teamwork experience and skillsets and avoiding broad questions (i.e., “Are you comfortable in wilderness environments?”).

Survey responses highlighted discussing and developing the norms, expectations, and boundaries of the field season as a key element of communication prior to the field season. Given that norms, expectations, and boundaries will differ from crew to crew and from season to season based on the interpersonal relationships, goals, and safety requirements of each team, respondents recommended co-developing behavioral contracts with each crew. While some behavior standards should remain consistent, teams can develop their own goals and definitions of success. Team leaders can take this opportunity to build a sense of team buy-in by contributing transparency behind the project. Explicitly describing why the project is being done helps crew members understand how their efforts are contributing to the whole and can minimize corner cutting.

Survey respondents discussed that field leaders should set and manage their own expectations prior to the field season. Several survey participants commented on the value of setting realistic and achievable expectations for timelines and workloads as the field leader. Leaders should keep in mind that leading a field crew can start out slow while team members learn the group dynamics, expectations, tasks, and specialized skills required for the season.

Finally, while the goals of each team may differ according to each season, some expectations will and should remain consistent. Survey respondents suggested the following: 1) Prioritize the physical and mental wellbeing of crew above the data being collected. Field leaders can and should establish this expectation prior to the field season and reinforce throughout. 2) Create an environment where crew members can address concerns about safety and are freely able to ask questions about the work. It is the job of the field leader to create such an environment and to promote open communication prior to the season. 3) Establish behavioral norms, including that discrimination and harassment will not be tolerated in any form. This expectation can be outlined by making a point to know the important aspects of crew members identities (such as their pronouns) and by sharing and discussing materials related to harassment and discrimination in the biological sciences. 4) Establish professional boundaries. Field leaders who set up appropriate boundaries will establish a sense of authority and professionalism.

Risk Assessment and Management

A critical step in preparing for any field work is becoming familiar with potential risks before the season begins. Survey responses identified two key steps to take early on in preparation for fieldwork: assessing risk and developing a safety plan to manage risk accordingly.

Risk assessment begins with studying the field site prior to the field season. Visiting the site in advance can help but may not always be possible; in either case, advisors, past graduate students on the project, local collaborators, and staff should be able to provide an overview of conditions, dangers, and lessons learned from past seasons. Risks can be physical, interpersonal or both. Possible risks to consider include accidents with vehicles and equipment; areas that are difficult to navigate or evacuate; local weather conditions, flora and fauna, and diseases; drinking and substance abuse; worsening of existing medical and mental health conditions; bullying, harassment, and violence; and local landowners and law enforcement. Some risks may not be immediately apparent to field leaders based their own past experiences, and so it is important to seek out and follow the recommendations of diverse field researchers. Reaching out to contacts to have these conversations will also help develop a support network and community.

Based on this information, field leaders should develop a safety plan that reviews potential hazards, both natural and human, and that outlines how the team will respond. Contact information for all team members, emergency contacts, directions to emergency care, and evacuation instructions should always be included, and locations and phone numbers for other useful resources such as gas stations, grocery stores, automotive repairs shops, and mental health resources may also be helpful. This plan does not need to be invented from scratch. University policies around harassment and discrimination will be available online and researchers with experience in the area will likely have existing plans that can be adapted. Once drafted, these plans should be gone over in detail with the crew. It is important not to skip over any risks as “common sense,” especially when team members come from different places and levels of familiarity, or to let any team members be exempt from reviewing the plan. Even senior scientists may believe inaccurate folk wisdom. Confidence can mask misconceptions, so make sure everyone is on the same page. After discussion the plan can be altered as needed, finalized, and signed by all team members. Written copies should be kept in each field vehicle or with each field crew where they will be seen when needed, for example with first aid supplies.

Procedural Preparation

A major component of safe and effective field seasons is set by the procedures, expectations, and experiences established prior to the season beginning. There are three major components identified by the survey and literature.

First, devise trainings to either mitigate or anticipate the risks teams are likely to encounter in the field (physical and interpersonal). For example, cold weather survival, bear safety, hazardous waste operations and emergency response, or electrofishing trainings are all reasonable for specific studies. First aid/CPR training is necessary for essentially all field operations. Field leaders should also consider specific training in Title IX, implicit bias, mental health, and leadership skills. Although these trainings cannot completely substitute for experience in the field, nor eliminate risk entirely, they set the norms and expectations that risks are to be taken seriously and preparation is important.

Second, gear and equipment should be carefully inspected and outlined, and the procedures for doing so communicated to the entire team. Field leaders should create a detailed list of required and recommended field gear (including clothing and personal gear like water bottles) and inspect each team member’s gear prior to going into the field; generally, the more specific the better – experienced team members will know what is adequate, and novice field personnel will have clear instructions to follow. The team should have detailed instructions on how to use the equipment prior to going into the field, including motors, scientific equipment, and safety gear. Emergency communication equipment (satellite phones, PLB’s, etc.) should be tested and each member trained in their use, with written procedures, phone numbers/contacts for local hospitals or emergency services, and backup batteries/power stored in a safe and known location. A robust first aid kid (with training in its use, noted above) should be provided and inspected each season. Importantly, gear lists and inspections should consider redundancies of key equipment, including maps, safety gear, and other vital components.

Third, the team itself should have procedures for operation established in advance. This starts with adequate resourcing for the study – viable pay rates, housing, transportation, food (“An army travels on its stomach,” after all, a quote attributed to Napoleon), and time such that work is not rushed. This includes planning for reasonable delays (e.g., weather, transportation, access) and major issues – for example, are team members still paid, or covered by insurance, if they get injured? Communication procedures should be established – a clear procedure for communicating grievances and problems, which includes a pre-defined chain of command for emergencies. This also includes determining roles of team members, for example determining a lead for work involving ropes, or heavy lifting, or carrying firearms. This ensures that each team member has a predefined place in the team, engendering a sense of ownership and, when coupled with the pre-trip and confidence in their gear/equipment use, a sense of competence.

***Actions to take during fieldwork***

Team Communication

Communication was also an important theme during the field season: communication of previously-established norms, behaviors, boundaries and goals requires daily reinforcement. Survey respondents emphasized maintaining team moral through positive reinforcement, treats and sufficient rest or breaks during the day. Several responses pointed out the value of the field leader communicating respect for the time and efforts of their fieldcrew. Leaders can do so via clear expectations, even distribution of labor, a specific daily plan and flexibility and patience if things don’t go according to plan.

Flexibility and patience were key themes in survey responses. Several participants emphasized allowing for crew members to ask many questions at the start of the season and planning for extra time to develop and practice new skills. In particular, repeating tasks can emphasize to field crews that mistakes that do not endanger the safety of themselves or others are teachable moments.

In the event that field crew assistants do not meet previously established expectations, survey respondents asserted the importance of respectful and constructive communication. One participant emphasized beginning the process of conflict resolution by acknowledging the hard work and good intentions of the crew members before asking for more out of a member or addressing a dispute. In moments of conflict, team leaders can start from the assumption that everyone is trying hard and feels unappreciated for it, and treat it as their responsibility to fix it.

Risk Assessment and Management

Once in the field, field leaders can minimize risk by monitoring conditions and ensuring that all team members have up-to-date information. Survey respondents identified frequent check-ins and debriefs as an important tool for making sure everyone is aware of weather forecasts and other relevant conditions as they change. For example, during a weekly planning meeting, field leaders might notify all team members that hunting season has begun and review how they can make themselves highly visible. During a debrief at the end of the day, the leader might learn from a team member that the terrain of a new field site is more treacherous than expected, and it is unsustainably tiring to keep up the same pace as at other sites. Then future work can be planned appropriately. Building these conversations into the rhythm of the day can normalize them and lower the threshold to someone raising a concern or asking a question. Some survey respondents conduct these conversations over group meals. Another suggested a morning “stretch and share” session. Others suggested that these conversations can include highlighting positives, such as noting progress, everyone’s best moment of the day, or exchanging compliments.

Field leaders should also make sure to check on team member mental health, both by creating an atmosphere where these topics can be discussed during team meetings and by checking in individually. In-depth individual conversations mid-season are useful for assessing fatigue levels, schedules or task assignments, and interpersonal dynamics. When these conversations include suggested changes, accommodate these requests whenever possible.

In the field, field leaders are responsible for monitoring the crew. If keeping all members within eyesight is impractical, everyone can work with a buddy. Field leaders should always know where all team members are and when they are due back. Keep an eye out for signs of hunger or thirst, exhaustion, stress, and tension between crew members. Survey responses suggested setting an example for safe behavior by taking breaks for water and food, wearing sunscreen, resting, and adhering to safety protocols. Field leaders can model work ethic, taking on the same tasks as the rest of the crew while still prioritizing safe, reasonable hours.

One key theme of survey answers is the reminder that the words and actions of field leaders carry weight. Respondents emphasized taking all safety concerns seriously, including following up on offhand comments, to avoid being blind-sided by a situation that has gotten severe. All team members should feel comfortable saying they have concerns. One way survey respondents suggested to encourage this is responding to anyone raising an issue–even an inconvenient one–with thanks. This is especially important in front of other team members. Field leaders should never joke about safety or harassment in front of their crew. They can show their commitment and intent by enforcing consequences for safety violations, even sending crew members home for major violations that endanger life (i.e., drinking on the job or not wearing a lifejacket).

Survey respondents recommended keeping an eye on potentially harmful interpersonal interactions as well: bullying and harassment are orders of magnitude more likely than a bear attack. Field leaders should discreetly intervene to break up cliques or separate people before they become sick of each other. If conflicts arise, field leaders should mediate them. At the first sign of unwanted romantic or sexual interest, name calling, or other unacceptable behavior, field leaders should immediately make it clear that this will not be tolerated.

Procedural Preparation

Procedural preparations were a key element of day-to-day actions suggested by survey participants. Establishing regular procedures during the trip creates a sense of predictability and normality that improves confidence in the team lead and plan, fosters morale, and creates a way to anticipate and address problems early before people may even be aware they are happening.

Daily check-ins should be regular procedure. Each evening, plan for the next day, which will demonstrate competence to the team the next morning, limiting downtime, and improves efficiency. List sites to be visited, data to be gathered, and the role of each team member. Immediately prior to work (e.g., morning meetings), communicate the plan with clear daily roles for each team member, as well as risks (“What risks are we likely to encounter”). This time is also important as a regular check-in for concerns as the field season evolves. Solicit feedback and concerns, and if the fieldwork contains a meaningful amount of risk, confirm that the team members are comfortable expressing concerns. Gear and safety checks should be done each morning as well, with redundant checks for especially key safety equipment.

Little things are important – do you have enough pencils and data sheets? – and making a clear daily checklist ahead of time will be very beneficial. An additional advantage is clear outlines of hypotheses and associated data collections can prevent “mission creep,” the tendency to collect additional unnecessary information which “may be useful” but often only serves to slow progress. Consider making the specific procedures for the day available to all team members, for example: “1) Outline site locations for today, 2) Describe data to be collected today, 3) Assign roles for (2), 3) Discuss potential risks/team opportunity for concerns and objections, 4) Confirm and check gear (e.g., water and food, sat phone, scientific equipment, engine has sufficient oil and fuel, etc., 5) Secondary check sat phone, 6) Distribute weight to packs.” Having the procedures written down will ensure important steps are not skipped, even late in the season when repetition can lead to complacency.

At the end of each workday, make it a written procedure to consolidate data sheets from team, clean and stow gear, report in, or other necessary daily activities. Budget time for these activities to avoid asking team members to work unexpected overtime. Finally, field leaders should keep a journal outlining decisions, feedback, and observations from themself and the team. This serves as an important record in the case of any incident (interpersonal, hazards, etc.) as well as an opportunity to improve field leadership in the future and a spark for future work.

**Post-Season**

Field leadership does not end once the field season ends. Survey responses suggested four key steps to take to analyze the “success” of the season and reflect on how to improve the next field season. First, while the information is still fresh, respondents advised processing and reviewing data immediately to troubleshoot missing data and summarizing the work done (i.e., number of samples taken, location and names of plots surveyed, collection of notes made throughout the season, etc.) to aide in future research efforts.

Second, survey participants advocated for providing multiple avenues for feedback. Field crews and partners can provide feedback on field leadership and the season (via group exit meetings, one-on-one’s, anonymous exit surveys) and field leaders can provide team members with a performance assessment or constructive criticism if needed or requested. Ensuring a safe space for communicating concerns or issues without penalization will allow field leads to update policies and safety plans for the next field season.

Third, respondents recommended budgeting for an end-of-season celebration (i.e., making a nice dinner/potluck, planning a camping/float trip) to praise teams for their hard work. Some suggested dinners, potlucks, even camping or floating trips. Similarly, respondents recommended verbally acknowledging each team member’s contribution to the research to show appreciation (i.e., hand-out “awards,” thank-you gifts, one-on-one meetings, etc.) One key form of appreciation is proper credit: including field crew names in publications and presentations, offering co-authorship opportunities when appropriate, and updating individuals on the progress of the project where relevant are all key elements of providing credit where needed.

Finally, survey responses suggested following up after the field season, both with partners/relevant stakeholders to maintain those relationships and to share results and with crew members. Field leads can serve as references and write letters of recommendation to ensure the crew members can move forward in professional and educational opportunities. These active and supportive relationships are the foundation to successful and long-term field work, and they are just as, if not more, important than the collection of data.

## Policy Recommendations

While the goal of this survey and paper was to identify leadership strategies and suggestions for graduate field leaders, one key gap identified by survey respondents was the need for formal support of graduate student field leaders by labs, departments, programs, and scientific societies. Labs, departments, and professional societies can support graduate student field leaders by formalizing institutional resources, providing financial support and incentivizing skill development.

Many of the survey suggestions for field preparation included developing and depending on resources like safety plans, hiring policies, behavior expectations and equipment checklists. Labs and PIs can support graduate student leaders by formalizing some of those resources: labs can develop their own specific safety plans, field policies and equipment checklists, or share past job ads and interview questions when useful.

Financial support can also support graduate field leaders in crucial ways. PIs can support their graduate students in the field by ensuring adequate pay for assistants, which will aid students by attracting high-quality applicants. At the department or professional society level, groups can provide financial support to graduate students leading fieldwork by creating funding opportunities for training. [more here]

# Conclusions

Graduate field leadership is a critical component of conducting research in the ecological and natural sciences. Graduate field leaders can develop their interpersonal skills intentionally through clear communication, risk assessment and management and procedural planning. [more here]

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# Data Availability Statement

Code used in this research available on Zenodo (doi link).

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# Appendix

## Survey questions

* *Background questions*
  + What stage of your research career are you currently in? [Graduate student, faculty member, postdoc, other]
  + How many years of experience do you have led a field crew for at least 3 weeks in the field (cumulative) per year?
  + How many years of experience do you have conducting fieldwork not as a team lead?
  + How many years of experience, if any, do you have supervising fieldwork (e.g., as a PI with graduate students who are themselves leading fieldwork)?
  + Where has the majority of your fieldwork experience taken place? [Remote regions, semi-remote (e.g., wildlands near cities), urban areas, a mix of areas]
* *Action Questions*
  + **Before the field season**, what are 2-3 specific actions a successful field crew leader takes to promote physical safety?
  + **Before the field season**, what are 2-3 specific actions a successful field crew leader takes to promote safe and productive interpersonal interactions?
  + **During the field season**, what are 2-3 specific actions a successful field crew leader takes to promote physical safety?
  + **During the field season**, what are 2-3 specific actions a successful field crew leader takes to promote safe and productive interpersonal interactions?
  + **After the field season**, are there any actions a successful field crew leader takes?
  + How, if all, do you change your strategy for leading volunteers vs undergrad/grad students gaining experience vs paid assistants?
* *Reflection Questions*
  + Think about a field season you had that was successful. Without giving identifying details, what leadership traits and/or actions made it successful?
  + Think about a challenging field experience. Without giving identifying details, what made the situation difficult?
  + In general, what advice would you give to incoming graduate students leading a field season for the first time?
* *Exit Questions*
  + Are there specific resources (e.g., online readings, workshops, etc.) you recommend for new field crew leaders?
  + Are there specific resources/policies/processes at the department, lab, or program level that you recommend to help support new or existing graduate field leaders?
  + Are there other strategies to leading fieldwork successfully that you’d like to mention that have not been addressed above?

## Survey resources

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| --- | --- | --- | --- |
| **Table 1. Resources suggested by survey respondents.** | | | |
| Type of Resource | Host | Topic | Link |
| Webinar | IARPC |  |  |
| Cornell |  |  |
| Training | ADVANCEGeo |  |  |
| UC Santa Cruz |  |  |
| FISST |  |  |
| Workshop |  |  |  |
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| --- | --- |
| **Table 2. List of readings suggested by survey respondents.** | |
| Type | Citation |
| Peer-reviewed article | John, C.M. and Khan, S.B., 2018. Mental health in the field. *Nature Geoscience*, *11*(9), pp.618-620. |
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| Website |  |
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| Book | *Fieldwork Ready: An Introductory Guide to Field Research for Agriculture, Environment, and Soil Scientists*, Sara Vero |
| *Personal Narrative of Travels to the Equinoctial Regions of the New Continent, During the years 1799-1804*, Alexander Von Humboldt |

|  |  |
| --- | --- |
| **Table 3. A suggested checklist of actions for a graduate field leader to take before, during and after a field season.** | |
| Before |  Decide on the data to collect and develop an initial schedule |
|  |  Develop a job ad describing the responsibilities and conditions of the job. Post early. |
|  |  Research and apply for permits. |
|  |  Contact local collaborators / landowners / etc. |
|  |  Arrange local housing. |
|  |  |
|  |  |
| During |  |
|  |  |
| After |  |
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