Supporting Graduate Field Leadership through Community-Sourced Advice, Action, and Policy

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Abstract:

Ecology and environmental science graduate degrees often involve fieldwork, frequently led by the graduate student. Few formal resources exist to support graduate students in successfully planning and implementing a data collection field campaign, even though this experience may be fundamental to completing a graduate degree. Graduate fieldwork requires leading and managing a team, often in unique circumstances (long hours, remote regions, etc.), and therefore can be challenging even for those with previous leadership or field experience. Our objectives were to a) collect general advice for graduate students on leading fieldwork safely and effectively, b) solicit specific suggestions on resources and actions to take before, during, and after the field season, and c) develop a series of recommendations for labs, departments, and universities to better prepare and support their students. We developed a survey to solicit community input and distributed it widely to the ecological sciences community via email listservs and social media. Here, we present results from the survey responses, including a summary of the perceived challenges that graduate students face while leading their own fieldwork, and suggestions for how to prepare and complete fieldwork successfully. Graduate field leaders can improve success via clear communication, risk assessment and procedural

planning implemented before, during, and after the field season. Labs, PIs, departments, and professional societies can support graduate field leaders through formalizing institutional resources, financial support, and incentivizing skill development. Field leadership is a critical skill to develop during graduate education, and contributes to the success, retention, and advancement of researchers in the natural sciences.

Keywords: Ecology, Fieldwork, Graduate Education, Graduate Field Research, Professional Development, Graduate Research

Introduction

Successfully planning and implementing a data collection field campaign can be fundamental to completing a graduate degree in ecology or other field sciences (Cooke et al. 2021; Mogk and Goodwin 2012). These campaigns often require a team effort for safety, time constraints, or other reasons. However, programs and labs often provide little formal training in the leadership and management skills required to manage a team successfully in field conditions. Many programs and lab principal investigators (PI's) may not have any formal training themselves, so structured graduate student training can be limited. One further complication is the unique nature of fieldwork, with its specialized skill sets, work requirements (e.g., hours of work, conditions), regions, equipment, and interpersonal and mental health challenges (Tucker and Horton 2019; Leon-Beck and Dodick 2012; John and Khan 2018).

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 is uncontrolled and complex by nature. Graduate research is independent by nature and may occur 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; Posselt and Nuñez 2022). At the same time, graduate students have less institutional power than principal investigators or other scientists and may be unable to control aspects of the field experience (i.e., pay, equipment, etc.) 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, Chapman, and Vickery 2004), regionally specific (Daniels and Lavallee 2014), deal with a specific aspect of risk (e.g., minority identity individuals; Demery and Pipkin 2021), or focus on the pedagogy of the field experience (Leon-Beck and Dodick 2012). Few provide an overview of the skills graduate students need to develop to be successful.

Guidance for team leaders is especially important because field conditions may exacerbate the harassment pervasive in academic workplaces (National Academies of Sciences, Engineering, and Medicine et al. 2018). Field researchers, especially trainees, report high rates of harassment and violence (Clancy, Cortina, and Kirkland 2020; Clancy et al. 2014; Demery and Pipkin 2021). Although research has focused on issues of gender and sexual harassment, field team members may also experience interpersonal violence related to their sexual orientation or gender identity; race, ethnicity, or country of origin; or physical ability. Team leaders are uniquely positioned to prevent this and ensure their team members experience safe, supportive work environments. Many of the recommendations made by survey respondents align with guidance from working groups on this topic (i.e., Kelly, Yarincik, and Murphy 2021).

In the following, we provide both suggestions of strategies specifically aimed at a graduate student audience as well as recommendations for lab, department, scientific association or institution-level policies and resources that can support graduate fieldwork. We first report the

key themes that emerged from the community-sourced advice; then we discuss specific actions to take before, during, and after the field season. We acknowledge that the advice compiled is not exhaustive and suggest that graduate leaders work with their labs, teams, and advisors to develop their own approach to fieldwork. 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. Finally, we provide a series of policy suggestions for labs, departments, and scientific associations to formally support graduate field leaders through financial support, institutional resources, and incentivizing skill development.

Methods

We developed a survey to collect generalized advice for graduate students leading and managing fieldwork (Appendix S1). 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 (Inouye 2018; Kelly, Yarincik, and Murphy 2021), the 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 personal networks.

Results

Survey demographics

Across 10 weeks (11/22/2021 to 1/31/2022), 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' which included research staff, college administrators, and former academics.

Respondents had a mix of experiences and backgrounds (Fig. 1): 45% of respondents had >5 years conducting fieldwork not as a team leader (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 (i.e., supervising a graduate student leading fieldwork, n = 13). 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% did not specify. Some respondents (5%) reported working in a mix of regions.

Upon closing of the survey, we compiled responses, condensed duplicate answers, and identified key threads. We used those key threads to develop a framework, allowing us to simplify the wide varieties of answers and experiences into synthesized advice and specific action recommendations.

Survey Responses

We identified three primary themes in survey responses: 1) team communication, 2) honest risk assessment, and 3) logistics and procedures. 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. Logistic and procedures include all formal or structural 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. We conclude by synthesizing survey suggestions for leadership actions that take place after fieldwork.

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 were suggested to prioritize before the field season.

Survey respondents identified hiring as a key element of communicating expectations and creating a strong team before the field season. Without prior experience, the logistics of attracting, interviewing, and selecting field crew can be daunting. Thus, several survey respondents recommended asking fellow graduate students or faculty about their hiring experiences and for resources, such as example interview questions, where available. Many respondents suggested posting job advertisements early to attract more applicants and to allow for interviewing prospective crew members multiple times. Survey responses highlighted identifying responsible and collaborative people, who can work well in diverse teams, during the interview process by asking specific questions about experiences that demonstrate teamwork and the ability to learn new skills. Avoid broad questions (i.e., “are you comfortable outdoors?”) or those likely to build bias into the hiring process.

After team selection, but prior to the season, survey responses highlighted discussing and developing the norms, expectations, and boundaries of the field season as a key element of communication. Given that aspects of these elements will differ from crew to crew and 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 also set and manage their own expectations for the team and the campaign 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 new field crew can start out slow while team members learn the group dynamics, expectations, tasks, and specialized skills required for the season.

While the goals of each team may differ according to each season, some expectations should remain consistent. Survey respondents emphasized the importance of prioritizing 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. It is the job of the field leader to create an environment where crew members can address concerns about safety and are freely able to ask questions about the work. This can be promoted with open communication prior to the season. Leaders should also establish behavioral norms well in advance of entering the field. For example, a universal expectation is that discrimination and harassment will not be tolerated in any form. Team leaders can model expected behavior by making a point to respect important aspects of crew members identities (such as their pronouns), as well as sharing and discussing materials related to harassment and discrimination in the biological sciences (i.e., Table 1). Field leaders who set up appropriate boundaries will establish

a sense of authority and professionalism, clarifying group dynamics and decision-making processes.

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 in preparation for fieldwork: assessing anticipated risks and developing a safety plan to mitigate and respond to risks 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 any lessons learned from past seasons. Risks can be physical, interpersonal, or both. Possible risks to consider include: accidents with vehicles and equipment, terrain that is difficult to navigate or evacuate; local weather conditions; flora, 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 on their own experiences and identities; therefore, it is important to seek-out and follow the recommendations of diverse field researchers. Reaching out to new contacts to have these conversations will also help develop a support network and community to draw on during the field season.

Based on the information they gather, field leaders should develop a safety plan that reviews potential hazards, both natural and human, 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, while the locations and phone numbers

for other resources (i.e., gas stations, grocery stores, automotive repairs shops, and mental health resources) may 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 reviewed in detail with the crew. It is important not to skip over any risks as "common sense," especially when team members have different backgrounds, or to let any team members be exempt from reviewing the plan. Even senior scientists may believe inaccurate folk wisdom and confidence can mask misconceptions. 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 alongside first aid supplies.

Logistics and procedures

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

First, devise trainings for team members to either mitigate or anticipate the risks teams are likely to encounter in the field (i.e., physical and interpersonal). For example, cold weather survival, bear safety, hazardous waste operations and emergency response, and electrofishing trainings are all reasonable for team members to take prior to specific studies. First aid/CPR training is necessary for essentially all field operations. Field leaders should also consider specific training in Title IX responsibilities, bystander implicit bias, mental health first aid, 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 such as water bottles) and inspect each team member's gear prior to going into the field. Generally, the more specific these lists are, the better, up to and including brand names and sizes if there is the potential for confusion. 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, personal locator beacons, 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 kit (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), and enough time that work is not unduly rushed. This includes planning for reasonable delays (i.e., weather, transportation, access) and potential major incidents; for example, are team members still paid for the duration of the season if they get injured? Formal communication procedures for communicating grievances and problems

(including a pre-defined chain of command for emergencies) should be established. This should also include determining roles of team members; for example, determining a lead for work involving ropes, 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 pre-trip trainings and confidence in their gear/equipment use, a sense of competence.

Actions to take during fieldwork

Team Communication

Communication during the field season was also an important theme. Maintaining the previously established norms, behaviors, boundaries, and goals requires daily reinforcement. Survey respondents emphasized maintaining team morale 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 field crew. Leaders can do so verbally, but also by maintaining good working conditions: clear expectations, even distribution of labor, a specific daily plan, and opportunities for team input.

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. Repeating tasks can emphasize to field crews that mistakes, which do not endanger the safety of themselves or others, are opportunities to learn.

If field crew assistants do not meet previously established expectations, survey respondents asserted the importance of respectful and constructive communication. One participant suggested 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. Team leaders should always start from the assumption that everyone is trying hard and feels unappreciated for their effort. Lastly, another response emphasized the importance of maintaining professionalism, giving feedback directly, and never speaking critically of one team member behind their back to another. This will help maintain trust.

Risk Assessment and Management

Once in the field, leaders can minimize risk by monitoring conditions and ensuring that all team members have relevant information. Survey respondents identified frequent check-ins and debriefs as important tools 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 that the terrain of a new field site is more treacherous than expected, and it will be unsustainably tiring to keep up the same pace there as at other sites. Then future work can be planned appropriately. Normalizing these conversations by building them into the rhythm of the day can 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 build in a way to highlight positives during these conversations by noting progress, asking for everyone’s best moment of the day, or exchanging compliments.

Field leaders should also make sure to check on team members’ 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 midway through the season are useful for assessing fatigue levels, interpersonal dynamics, and whether schedules or task

assignments need to be adjusted. When these conversations include suggested changes, accommodate these requests whenever possible.

In the field, team leaders are responsible for monitoring their crew. If keeping all members within eyesight is impractical, everyone can work in pairs. 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 of safe behavior by taking breaks for water and food, wearing sunscreen, resting regularly, and adhering to safety protocols. Field leaders can model work ethic by 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, following up on offhand comments to avoid being blind-sided by a situation that has become severe. All team members should feel comfortable voicing concerns. Survey answers suggested to respond to anyone raising an issue - even an inconvenient one - with gratitude. This is especially important in front of other team members. Field leaders should never joke about safety or harassment in front of their crew.

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 communicate to the perpetrator this will not be tolerated. Severe or repeated incidents merit consequences. As with any other major safety violation that endangers

297 other crew members (i.e., drinking on the job, not wearing a lifejacket), the perpetrator may even
298 need to be sent home.
299 Logistic and procedures
300 Enacting logistic procedures were a key element of day-to-day actions suggested by
301 survey participants. Establishing regular procedures during the trip creates a sense of
302 predictability and normality that improves confidence in the team lead and study plan, fosters
303 morale, and creates a way to anticipate and address problems before people may even be aware
304 they are happening.
305 Daily check-ins should be regular procedure, as noted above. Previously discussed daily
306 briefings can also include time to clearly communicate the risks involved in each day's tasks.
307 Discussing daily risk as a team is not only an important reminder, but it can be important for
308 soliciting feedback and concerns. Gear and safety checks should be done each morning as well,
309 with redundant checks for especially key safety equipment.
310 Making and using a clear daily checklist will be very beneficial for remembering that the
311 little things are important, such as ensuring that everyone has enough pencils and data sheets. An
312 additional advantage is that clear outlines of hypotheses and associated data collections can
313 prevent "mission creep," the tendency to collect additional unnecessary information which may
314 be useful, but often only serves to slow progress. Consider making the specific procedures for
315 the day available to all team members. For example: "1) Outline site locations for today, 2)
316 Describe data to be collected today, 3) Assign roles for (2), 3) Discuss potential risks/team
317 opportunity for concerns and objections, 4) Confirm and check gear (water, food, satellite phone,
318 batteries, scientific equipment, engine has sufficient oil and fuel) , 5) Secondary check satellite

phone, and 6) Distribute weight to packs." Having written procedures 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 the 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 themselves and the team. This serves as an important record in the case of any incident (interpersonal, hazards, etc.), for planning future seasons 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 measure 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 aid in future research efforts.

Second, survey participants advocated for providing multiple avenues for feedback. Field crews and partners can provide feedback on the leader 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 to thank 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 and 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 as 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 important, if not more so, than the collection of data.

Policy Recommendations

While the initial 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. 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 implementing resources like safety plans, hiring policies, behavior expectations, and equipment checklists. Labs and PIs can support graduate student leaders by formalizing some of these

resources; labs can not only develop their own specific safety plans, field policies, and equipment checklists, but also share past job advertisements and interview questions when useful. Departments and graduate programs can contribute by requiring graduate leaders to submit a safety plan prior to the field season.

Financial support can also aid 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. Wilderness first aid training, while potentially critical for field leaders, can be cost-prohibitive for many students.

Finally, developing skills as a graduate field leader can be incentivized by treating it as part of professional development or diversity, equity, and inclusion efforts—something to be included on CVs and considered in evaluations or award decisions. PIs and mentors can include details on strong field leaders in letters of recommendations, and departments could offer field leadership awards in the same vein as teaching or research awards.

Conclusions

Graduate field leadership is a critical component of conducting research in the ecological and natural sciences. Graduate field leaders can improve success through clear communication, risk assessment and management, and logistic and procedural planning and implementation. It is crucial to implement these tactics before, during, and after a field season. Importantly, the success of the field work may vary due to conditions outside of graduate field leaders' control. Thus, policy to better support graduate student leaders from labs, departments, and professional societies is needed to supplement success. Graduate field leadership is a critical component to

the development of professionals within the natural sciences (Cooke et al. 2021; Mogk and Goodwin 2012) and it follows that the skills necessary to complete field work successfully need to be explicitly developed, supported, and rewarded by both the student and their institutions, societies and mentors.

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Table 1. 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. Cooper, K.M., Gin, L.E., Barnes, M.E. and Brownell, S.E., 2020. An exploratory study of students with depression in undergraduate research experiences. *CBE—Life Sciences Education*, *19*(2), p.ar19. Nelson, R.G., Rutherford, J.N., Hinde, K. and Clancy, K.B., 2017. Signaling safety: Characterizing fieldwork experiences and their implications for career trajectories. *American Anthropologist*, *119*(4), pp.710-722. Greene, S.E., Antell, G.S., Atterby, J., Bhatia, R., Dunne, E.M., Giles, S., Groh, S.S., Hanson, E.M., Hilton, J., Knight, H. and Kraftl, P., 2021. Safety and Belonging in the Field: A Checklist for Educators. Demery & Pipkin 2021 - Safe fieldwork strategies for at-risk Individuals, their supervisors and institutions McGill, B.M., Foster, M.J., Pruitt, A.N., Thomas, S.G., Arsenault, E.R., Hanschu, J., Wahwahsuck, K., Cortez, E., Zarek, K., Loecke, T.D. and Burgin, A.J., 2021. You are welcome here: A practical guide to diversity, equity, and inclusion for undergraduates embarking on an ecological research experience. *Ecology and Evolution*, *11*(8), pp.3636-3645 Dyson, K., Ziter, C., Fuentes, T.L. and Patterson, M.S., 2019. Conducting urban ecology research on private property: Advice for new urban ecologists. *Journal of Urban Ecology*, *5*(1), p. juz001 Clancy, K.B., Nelson, R.G., Rutherford, J.N. and Hinde, K., 2014. Survey of academic field experiences (SAFE): Trainees report harassment and assault. *PloS one*, *9*(7), p. e102172.
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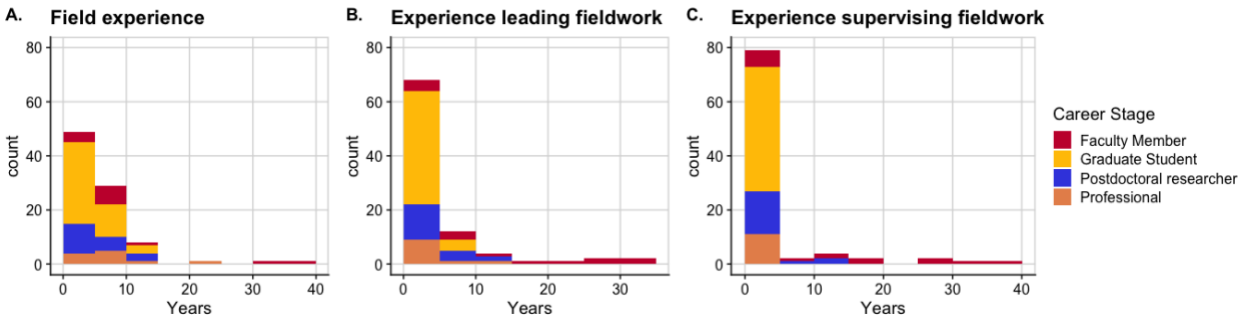
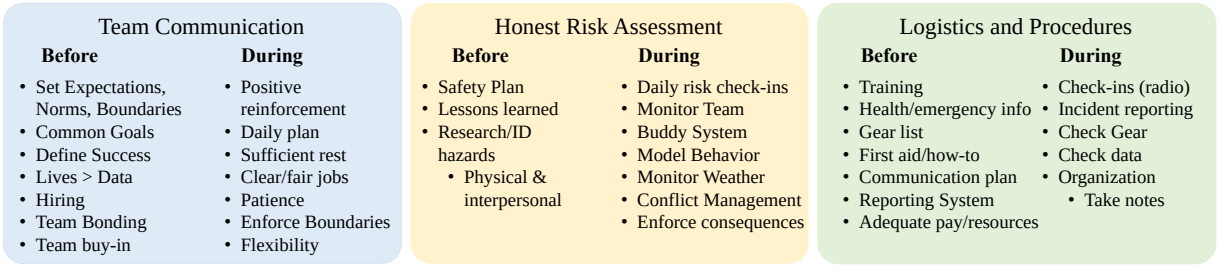
Books	*Fieldwork Ready: An Introductory Guide to Field Research for Agriculture, Environment, and Soil Scientists*, Sara Vero *Personal Narrative of Travels to the Equinoctial Regions of the New Continent, During the years 1799-1804*, Alexander Von Humboldt *University of California Field Operations Safety Manual*, University of California Office of the President – Environment, Health & Safety



441 Figure 1. Years of experience of survey respondents. A) Respondent's years of experience in the
442 field in any capacity. B) Respondent's years of experience leading fieldwork for at least 3 weeks
443 in the field (cumulative) per year. C) Respondent's years of experience supervising fieldwork for
444 at least 3 weeks in the field (cumulative) per year.



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

Appendix S1

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?