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2 **Main Manuscript for**

3 A set of principles and practical suggestions for equitable fieldwork in biology.

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77 **Abstract**

78

79 Field biology is an area of research that involves working directly with living organisms *in situ* through a
80 practice known as “fieldwork.” Conducting fieldwork often requires complex logistical planning within
81 multiregional or multinational teams, interacting with local communities at field sites, and collaborative
82 research led by one or a few of the core team members. However, existing power imbalances stemming
83 from geopolitical history, discrimination, and professional position, among other factors, perpetuate
84 inequities when conducting these research endeavors. After reflecting on our own research programs, we
85 propose four general principles to guide equitable, inclusive, ethical, and safe practices in field biology:
86 Be Collaborative, Be Respectful, Be Legal, and Be Safe. Although many biologists already structure their
87 field programs around these principles or similar values, executing equitable research practices can prove
88 challenging and requires careful consideration, especially by those in positions with relatively greater
89 privilege. Based on experiences and input from a diverse group of global collaborators, we provide
90 suggestions for action-oriented approaches to make field biology more equitable, with particular attention
91 to how those with greater privilege can contribute. While we acknowledge that not all suggestions will be
92 applicable to every institution or program, we hope that they will generate discussions and provide a
93 baseline for training in proactive, equitable fieldwork practices.

94

95 **Significance Statement**

96

97 Parachute science, harassment, and discrimination during fieldwork perpetuate global inequalities in
98 resource investment and career advancement. Many biologists are actively engaged in dismantling these
99 inequities, yet there is no general set of best practices for biological fieldwork. Here we propose four
100 organizing principles that are grounded in relevant literature, evidence-based practices, and input from
101 field biologists representing different countries and cultures. The suggested actions and tools included
102 herein can be useful to anyone, whether they are building a new field program or implementing small
103 changes in long-standing collaborations. We believe that following these principles will help promote
104 positive experiences that encourage diverse participation in field biology and facilitate collaborations
105 between communities and researchers.

106

107

108 **Main Text**

109

110 **Introduction**

111

112 Field biology, the practice by which investigators seek out organisms in their natural habitats to collect
113 samples and abiotic parameters, perform experiments, and/or record natural history observations, is
114 essential for the description, analysis, and conservation of biodiversity (1). Fieldwork not only provides
115 foundational materials in the form of vouchered and unvouchered biological samples (e.g., blood,
116 feathers, skin clips), but it also produces vast amounts of scientifically valuable data on species’ natural
117 history including distributions and abundances, habitat characteristics, environmental measurements,
118 ecological interactions, and behaviors (2, 3). Moreover, voucher specimens obtained through fieldwork
119 are invaluable for scientists aiming to quantify the effects of historical changes in climate, pollutants,
120 diseases, and other features of the environment on biodiversity (4–6). The value of natural history
121 collections to the broader research community is only increasing over time, as recent collection
122 digitization initiatives have made remote inspection and analysis of the world’s biodiversity possible for
123 anyone with internet access (7–10). Given ongoing biodiversity declines (11, 12), research that
124 incorporates natural history collections and field data have garnered sustained interest (13). Thus, field

125 studies continue to be essential for the advancement of biology, while also serving as an impactful
126 educational tool.

127 Despite the value of fieldwork and field-collected data, we recognize that this activity has been shaped by
128 power asymmetries tied to the foundations of the modern world (14, 15). For example, the early history of
129 biodiversity sampling was intimately associated with colonialism. Colonial nations and later industrialized
130 countries sent scientists around the world with the aim of furthering scientific progress, but also often with
131 capitalist goals and resource extraction in mind (16–19). Although many field biologists today are aware
132 of this inequitable history and are working to make field biology more ethical, parachute science – a non-
133 reciprocal practice wherein scientists conduct research with local help and then publish those data
134 without further involvement of local communities – remains common (20). Moreover, research programs
135 are often highly asymmetrical in terms of how the scientific benefits (e.g., authorship, funding, etc.) are
136 distributed among team members (21–23). Dozens of scientific articles describing these issues exist (*S/*
137 *Appendix*, Table S1). Additional quantitative surveys could help shape relevant solutions.

138 The conscious need to confront power asymmetries gained traction in the USA after the murder of
139 George Floyd in 2020, with a focus on addressing inequities for people of color, people with disabilities,
140 women, Indigenous people, the LGBTQ+ (Lesbian, Gay, Bisexual, Transgender, Queer) community, and
141 others (e.g., 24, 25). These conversations opened space to re-evaluate aspects of current scientific
142 practices that perpetuate inequalities, including fieldwork. We are optimistic that self-reflective and action-
143 oriented discussions, combined with proactive planning of research, will help address existing
144 inequalities.

145 146 **Core Principles for Equitable Fieldwork**

147 In the last decade, many scientific institutions, societies, and conferences have adopted codes of conduct
148 to clarify community norms and provide guidelines for reporting harassment or misconduct (e.g., 26–28).
149 Likewise, most scientific disciplines that work directly with human participants, such as public health and
150 anthropology, have established guidelines for ethical fieldwork (29–32). Furthermore, international
151 agreements and regulations have helped to promote more equitable and conservation-oriented practices
152 (e.g., Convention on Biological Diversity [CBD], Convention on the International Trade in Endangered
153 Species [CITES], Nagoya Protocol for Access and Benefit Sharing [ABS]). In this spirit, and through
154 assessment and reflection of our own field programs, we created a set of four general principles for
155 biological fieldwork that are intended to help researchers from any country or career level engage
156 proactively in equitable and inclusive practices (Box 1; Figure 1). Although some guidelines exist for field
157 courses and stations (e.g., 33), here we focus our discussion specifically on field research programs that
158 are not directly oriented towards commercialization.

159 **Figure 1. Four principles to promote equitable fieldwork. Illustrations by Camila Pacheco** 160 **Bejarano.**

161
162 For institutions and research groups, we envision that these principles can foster discussions of field
163 practices and act as a basis for generating or revising codes of conduct and designing pre-fieldwork
164 training programs. For researchers starting a field program, we hope that the four principles provide a
165 useful baseline for creating fieldwork plans that are intentionally ethical. By discussing how to apply these
166 principles, research teams can increase awareness about how field activities affect other people(s) and
167 communities, especially in contexts where pre-existing power imbalances and implicit biases exist. We
168 note that the principles and suggestions described herein are derived from experiences mostly in the
169 context of academic and natural history museum settings, and mostly involving researchers from the USA

170 (see *SI Appendix*, Positionality Statement). Fieldwork is diverse and involves many different types of
171 communities and cultures, and not all of our suggestions are appropriate or feasible in every
172 circumstance. However, we envision that the content of this perspective can apply to an array of
173 scientists who conduct field research within their home country or internationally, especially when working
174 in locations where local communities and/or scientists are less privileged than the organizing institution.
175 To facilitate following the proposed principles, we provide a set of potential actions and considerations, an
176 overview of permitting processes, and a field safety plan template, and a set of open questions that arose
177 during the creation of this document (*SI Appendix*). Intentional planning that emphasizes inclusivity and
178 equity in field biology is fundamental to the set of principles proposed herein.

179
180 ***Be collaborative: We embrace collaborative science and fieldwork practices with our partners,***
181 ***field teams, and the communities with whom we work***

182 Equitable collaboration is necessary to conduct field operations safely, legally, and respectfully (34). The
183 involvement of local collaborators in logistical but not intellectual aspects of research can perpetuate
184 historical power imbalances and exclude those with more marginalized identities from a sense of co-
185 ownership of the science being produced (21, 35). Such asymmetries may erode trust in the scientific
186 enterprise and deter local interest in future scientific collaborations (20). Disrupting these structural
187 imbalances requires a constant effort by everyone – but especially by those who have historically held
188 positions of privilege globally and/or locally – towards decentralizing one’s own perspective and creating
189 spaces for new perspectives in science. Furthermore, collaborations that equitably include people and
190 scientists from host regions can help foster inclusivity and a diversity of ideas in field biology (36). Below
191 are some suggestions to foster intentionally reciprocal and collaborative research among scientists from
192 different regions.

193
194 *Communication among colleagues.* We encourage team leaders to discuss the research goals,
195 responsibilities, and expected products before, during, and after fieldwork, allowing all collaborators to
196 shape the fieldwork and research. It is also important to establish regular communication among
197 collaborators throughout the research process, not only during fieldwork. Flexibility, fairness, and honesty
198 about goals and limitations is key during these conversations, yet perceptions of fairness can be biased
199 by one’s historical viewpoint and institutional norms, and desired outcomes may differ among
200 collaborators. For example, institutions (e.g., academic vs. governmental) differ in whether they reward
201 researchers for being first or last author, for having many publications rather than a few high-impact ones,
202 or for bringing in infrastructure and funding. General research program goals also may differ depending
203 on institutional interest and limitations (37). Understanding each parties’ desired outcomes at the outset,
204 and discussing any changes as the project progresses, can help promote equality amongst all team
205 members.

206
207 *Forming inclusive research teams.* We encourage researchers to reflect on the diversity of their field
208 teams and to provide opportunities for individuals of identities historically excluded from fieldwork (e.g.,
209 women, LGBTQ+, Black, Indigenous, People of Color, disabled individuals, low-income communities).
210 Examples include training, invitations to join expeditions, inclusive hiring practices, and inclusion in
211 decision-making. Students, including from local communities, can also benefit from financial support,
212 especially if they are undertaking thesis work that might otherwise be financed with personal funds (38).
213 Involving social scientists in the research process can help identify power imbalances and promote
214 inclusion and equity at all stages of field research. Equitably structured and reciprocally designed
215 collaborations (e.g., inviting local researchers to serve on student committees) can diversify and enhance
216 the research programs of each group by providing new ideas that draw on different forms of expertise.

217 *Compensation.* Planning ahead for fair compensation of field assistants and other team members is
218 necessary to conduct equitable fieldwork (38). We suggest working in advance with collaborators to set
219 salary rates or organize other types of compensation (e.g., providing training, equipment, or resources)
220 that reflect local norms and are fair for the work being undertaken (see also *Be Respectful*). When
221 recruiting assistants to find specific organisms, we recommend paying by the hour or day as it is
222 important to pay for effort even if it is unsuccessful. Overall, communication with local collaborators about
223 how their research programs can be supported shows reciprocity and helps reinforce the value of host-
224 region research (see also Figure 2). Finally, we note that inequitable access to funding is likely a major
225 source of power imbalance in multinational or multiregional teams. In our Open Questions section (*SI*
226 *Appendix*, Box S1), we encourage the global research community to consider how to increase the
227 resources that are directly available to less-privileged researchers.
228

229 *Sample and data management.* An agreement among parties on how to equitably share and store
230 research products such as specimens, tissues, photographs, recordings, etc., is recommended *prior to*
231 conducting fieldwork. We strongly recommend that all products of fieldwork and their associated
232 metadata be deposited in a collection where they will be taken care of and made accessible to others.
233 Research materials that are held in private or non-curated collections (e.g., personal lab freezers) risk
234 getting lost or discarded. When permits require information about where materials will be deposited,
235 researchers should communicate with personnel during the application process to confirm that the
236 intended repository is able to house the materials. Given ongoing financial challenges faced by museums
237 (39, 40), funding could be provided to help with curation and student training (41).

238 Material sharing or repository agreements often require that specimens and samples be
239 deposited or subdivided among participating institutions. These agreements should be equitable and
240 reciprocal and have the added benefit of insuring against the risk of catastrophic loss. Pertinent examples
241 include the destruction of the California Academy of Sciences in the 1906 San Francisco Earthquake, the
242 loss of museums in Dresden, Hamburg, and Manila during World War II, the destruction of the collection
243 at Museo La Salle in Bogotá during the 1948 riots, and the more recent losses by fire of priceless
244 specimens and documents in Portugal, Brazil, South Africa, and India. Special consideration should be
245 given to the disposition of type specimens. As recommended by the International Code of Zoological
246 Nomenclature (ICZN) and the International Code of Nomenclature for algae, fungi, and plants (ICN), type
247 specimens are best deposited in collections publicly accessible to researchers. The disposition of
248 holotypes in their country of origin recognizes that country's natural heritage, while depositing paratypes
249 or topotypes across multiple collections facilitates access to comparative material and protects against
250 complete loss of reference material for a species. We recommend working on a case-by-case basis with
251 local collaborators to decide where to deposit type specimens, and to follow any legal obligations outlined
252 by permits. To increase access to materials stored outside of their countries of origin, museums could
253 adopt a policy of prioritizing loans of collection materials (or returns in cases of unethical possession) to
254 institutions from those respective countries. In countries or regions without a collection, collaborators
255 affiliated with a museum can agree to hold specimens in trust until local institutions reclaim them,
256 although we recognize that such an arrangement may face logistical and legal challenges. Further,
257 collaborators can help set up local teaching collections as a way of educating students and the
258 community about local biodiversity and potentially generating institutional interest in starting a research
259 collection.

260 Researchers also can take steps to ensure that field data are documented in an accessible and
261 reproducible manner (42, 43) and shared with team members. Digitization and/or duplication of field notes
262 and data provides a timely resource documenting recent work. In addition, collaborators can help
263 implement collection management systems that follow Darwin Core data standards (44), establish portals
264 that provide access to regional biodiversity resources (e.g., 45), and register museums with the national
265 CITES authority to facilitate exchange of CITES-listed species (see *SI Appendix*, Scientific Permit

266 Checklist). Collection management systems can track the current location of specimens (important if
267 materials are divided among institutions), manage sample loans or exchanges, link to publications, and
268 protect sensitive data (e.g., locality data for endangered species), among other features.

269 *Rethink authorship criteria.* Recent proposals have been made to expand the CRediT authorship criteria
270 system to recognize that collaborators who, for instance, secure permits, foster important relationships,
271 and act as the responsible authority in the field are often integral to project success and thus deserve to
272 be involved in the writing process and offered co-authorship (21, 46). Additionally, local experts who
273 participate in data collection can be included as authors (47). It is important to have a conversation with
274 collaborators and community members to ask what attribution or credit they would value most, and to
275 recognize that authorship may not always be meaningful, or may not be requested due to norms
276 surrounding workplace hierarchy (21). The process of obtaining Prior Informed Consent (PIC; see *Be*
277 *Respectful*) can inform these decisions. If community members are not interested in being co-authors,
278 they can still be included in the acknowledgments section along with the proper name of their
279 communities. In general, we recommend discussing and working collaboratively with local team members
280 to decide on authorship.

281 *Publishing and sharing research results.* Language can present a substantial barrier to sharing and
282 obtaining scientific knowledge (48–50). To help lower this barrier, investigators can translate their
283 research results into national and local language(s) and include it in the supplementary material of Open-
284 Access publications or on other forums such as ResearchGate, preprint servers, trip reports, etc., when
285 publishing via Open Access journals is not affordable (51, 52). Resources such as DeepL or Google
286 Translate can facilitate translations for some languages. Making translation more common could be
287 valuable to local scientists and policymakers, while also showing academic goodwill that is locally
288 impactful and strengthens international collaboration (49, 53, 54).

289
290 ***Be respectful: We prioritize local sovereignty and long-term benefits for the community, and we***
291 ***invest time and effort in learning about and respecting local history and cultures.***

292 Many researchers are drawn to different countries or regions to collect data and study the flora and fauna.
293 Interacting respectfully with local communities is fundamental to ensuring reciprocally beneficial long-term
294 relationships. Moreover, aligning research goals with in-region rules, expectations, and needs is
295 fundamental for ethical fieldwork.

296 *Honoring local sovereignty.* Conducting fieldwork often means that local communities open their territory
297 (and sometimes their homes) to researchers. It is important to be respectful and to prioritize the
298 perspectives of the local community in these situations (32). Moreover, working with communities to
299 collaboratively assess whether project goals are relevant and realistic helps researchers generate
300 positive and long-lasting impacts for local communities (Figure 2). Community peer review
301 methodologies, including Prior Informed Consent (PIC) and Free Prior Informed Consent (FPIC)—
302 specific rights that give indigenous peoples and other ethnic communities the ability to give or withhold
303 access to work that affects their territory, as well as negotiate the terms of work and/or withdraw consent
304 at a later time— offer models of how to incorporate community feedback (55, 56). PIC and FPIC are often
305 legally required to conduct commercial or high-impact activities; however, PIC/FPIC may not be legally
306 required for non-commercial scientific research. Thus, we recommend asking for consent in any
307 circumstance and to approach this process with humility and from an equity perspective, as one's
308 expectations, knowledge, and experiences are not universal or more important than those of another.
309 Furthermore, there is no single conception of "nature" or of what it means to "use nature"; how we interact
310 with a territory and its inhabitants (organisms and otherwise) is a cultural construction (57). Thus, we

311 suggest that researchers respectfully engage in discussions about views on non-humans that do not
312 necessarily align with their own and to pay particular attention to respecting spiritual or ceremonial areas
313 and species. Fluency in at least one of the local language(s) is critical for discussions to take place on a
314 level playing field. Thus, team leaders in particular should make a concerted effort to gain a working
315 fluency in the local language (if different from their own), and groups can invest in paid translators or
316 guides when that is not possible. Questions about the impact of the research, source of funding, methods,
317 accessibility of generated data, and beneficiaries of the project should be discussed.

318 Indigenous nations (e.g., Guna Yala in Panama, highland communities in Perú, Cherokee Nation
319 in the USA) and African-descendant communities (e.g., San Basilio de Palenque in Colombia) may have
320 explicit rules, laws, or constitutions that pertain to scientific sampling in their territories, including
321 PIC/FPIC. This can be especially complex in countries such as Indonesia, where 1,300 ethnic groups are
322 recognized (58). In general, it is important for researchers to follow national *and* local regulations and to
323 work with regional collaborators to ensure proper communication with communities living in or near
324 research sites. We suggest that territorial and local regulations hold precedence even if they are more
325 restrictive than research permits allow.

326 **Figure 2. Collaborate with local communities using Prior Informed Consent and/or other methods**
327 **to maximize the immediate and long-term benefits of fieldwork for the region. Illustration by**
328 **Camila Pacheco Bejarano. See Box S2 for more information.**
329

330 *Cross-cultural relationships.* Diverse customs and communication styles, including within our own teams,
331 are often encountered during both domestic and international field research (59, 60). Learning from cross-
332 cultural interactions allows us to be more empathetic with our teams and local communities, to have a
333 broader view of our research, and to avoid misunderstandings or conflict. Special considerations can be
334 given to interpersonal distance, attire, host and guest behavior, monetary compensation (“tips”), preferred
335 styles of communication, local culture surrounding work and holidays, and addressing community
336 leaders/elders. An action that may be commonplace in one culture can have an unexpected meaning in
337 another, so it is helpful to familiarize oneself with local norms while also reflecting on one’s own customs.
338

339 *Incorporating local knowledge when publishing.* When describing new species, it is worth acknowledging
340 that local people are often familiar with their biology, behavior, meaning, value, uses and other aspects,
341 long before they are described for science (61–64). Including local names, terms, and knowledge (65–
342 67), and/or working directly with local communities to select new species names (68), are simple ways to
343 honor and integrate communities with scientific pursuits and to generate local pride and awareness that
344 can dovetail with conservation efforts (69). Reviewers and editors of manuscripts describing new species
345 can suggest incorporating local knowledge if such data are not already included. PIC/FPIC should be
346 discussed by having open conversations with community members about the work being done to gain
347 consent, if any local knowledge or input may become part of a research product (56). Additional
348 processes not addressed here are required when working with human-related data (70).
349

350 *Designing locally impactful fieldwork.* Researchers can intentionally plan activities that not only maximize
351 immediate and long-term benefits for local communities (Figure 2, Box S2; 71–73), but also strengthen
352 relationships with regional collaborators and create a better understanding of scientific practices in
353 general. Communicating logistical details can also make a difference, such as teams formally introducing
354 themselves and explaining research to local communities when a project begins, and discussing results,
355 future collaborations and outreach, and preferred method of acknowledgement when the project ends.

356 *Conflict resolution.* Despite our best intentions, conflicts may arise within research teams and local
357 communities. Because fieldwork often involves groups of researchers spending long periods of time

358 together in stressful conditions, training in conflict resolution can be important in smoothing team
359 dynamics. In addition, conflicts with the local community may arise. It is important to be aware of one's
360 position in existing power structures and to try to reach an agreement that respects local sovereignty.

361 ***Be legal: We commit to obtaining all necessary permits, authorizations, and land permissions, and***
362 ***to following all legal guidelines and requirements.***

363
364 A key to successful fieldwork entails following the laws of the host country or region. While legality does
365 not always translate to justice, many legal frameworks are geared towards creating symmetrical and
366 ethical relationships. For centuries, researchers and collectors from high-income countries traveled
367 around the world to collect and export specimens to their home institutions for study or profit, without local
368 authorizations or credit to local contributions (17, 18; Table S1). The establishment of international laws
369 and regulations partially leveled the playing field by requiring that scientists obtain the necessary permits
370 and honor expectations for collaborative science. Unfortunately, the practices of conducting research
371 without appropriate permits, working with specimens of questionable origins, and bribing officials to
372 circumvent regulations continue today (20, 74, 75). These approaches are not only illegal and unethical,
373 but they also threaten biodiversity, deepen existing power imbalances, and create wariness among
374 researchers and between science and society. To facilitate tracking of legally sourced data and material,
375 we encourage researchers to associate permit numbers with samples in published works and online data
376 repositories. Moreover, some data aggregators require evidence of legality (e.g., 76). We encourage
377 journals to adopt and enforce policies requiring authors to provide information on permits as they do for
378 animal care protocols.

379
380 *Permit requirements.* Identifying and obtaining all the necessary documents to collect samples or data
381 can be a daunting challenge, often involving substantial time and effort, visits to multiple government
382 offices, and working closely with local institutions. We encourage institutions to provide clear, accessible
383 guidelines about permit requirements for researchers, especially because the permit landscape is
384 constantly changing. Many countries require research visas, Material Transfer Agreements (MTAs), and
385 Memoranda of Understanding (MOUs) or Agreements (MOAs), in addition to research, collecting, and/or
386 export permits, to conduct legal research (*SI Appendix*, Scientific Permit Checklist). In China, for example,
387 permits for aquatic animals are managed by the Ministry of Agriculture, while those for terrestrial animals
388 are managed by the National Forestry and Grassland Administration. In the United States, permit
389 requirements depend on national and state regulations, land ownership, and species. As mentioned,
390 commercializable research such as bioprospecting has additional requirements not discussed here and
391 may require its own set of guidelines. Field teams should always carry copies of permits, letters of
392 invitation from local institutions, and/or other legal documents while conducting fieldwork. These proactive
393 measures can help foster positive interactions with local community members and law enforcement
394 officials.

395
396 *International transfer of field-collected samples.* International agreements governing the movement of
397 genetic resources or endangered organisms add another layer of complexity to the permitting process
398 (77–79). For instance, the Nagoya Protocol on Access and Benefit Sharing outlines the equitable use of
399 genetic resources for biodiversity conservation and has important implications for how research is
400 conducted, collections are managed, and information is shared among collaborators (80). Likewise,
401 CITES regulates import/export of endangered organisms and species that are subject to international
402 trade (81), and may require additional permits.

403
404

405 ***Be safe: We work proactively to promote a safe physical and emotional working environment for***
406 ***all members of research teams and local communities with clear guidance and communication***

407 Working in the field comes with inherent risks, but field teams can reduce risks to themselves, to the
408 communities in which they work, and to wildlife with proper preparation. Here we provide some examples
409 of proactive safety practices that can be modified as needed. For more ideas and information, see the
410 Field Safety Plan template (*SI Appendix*).

411
412 *Field safety plans.* Fieldwork is often fast-paced and presents novel situations (82), but having a safety
413 plan for responding to dangerous, medical, or interpersonal scenarios can help mitigate or avoid risk (83).
414 At their core, safety plans include information about nearby medical facilities, law enforcement authorities,
415 and local contacts, as well as plans for specific emergencies such as medical evacuations and political
416 instability. We also recommend developing a specific communication and check-in plan with an
417 emergency contact, identifying multiple safety officers, and investing in the resources needed to facilitate
418 check-ins (e.g., a satellite phone or spot tracker). Field plans should consider mental and emotional
419 safety in addition to physical safety, especially for coping with Sexual Violence and Sexual Harassment
420 (SVSH) or discrimination, which is not uncommon in field teams. In general, people with different
421 identities (racial, ethnic, cultural, gender, sexual orientation, ability status, religion, caste), as well as job
422 title (e.g., Principle Investigator vs. Field Assistant), may be more or less at risk of SVSH or health issues
423 within the context of a research environment (24, 84–88). Ideally, field safety plans address SVSH by
424 including procedures for dealing with inappropriate interactions within field teams and between field
425 teams and local communities. Other considerations include having more than one SVSH contact, having
426 team members work in pairs or groups, and including a set of responses team members can use in
427 events of discrimination.

428
429 *Biosafety.* Teams should be careful to avoid contaminating local ecosystems (e.g., with soap, chemicals,
430 or foreign biological material) and to protect themselves from potential biological dangers, including
431 animals and pathogens. Any potentially dangerous chemicals or animals being used for research should
432 be labeled clearly in all languages used by team members and locals. To mitigate the risk of spreading
433 potentially detrimental pathogens and invasive species, teams can disinfect field equipment when moving
434 between sites, before returning home, and/or between sampling individual organisms (89). The spread of
435 white-nose syndrome, chytridiomycosis, and the possible transmission of viruses between wildlife and
436 humans underscore the importance of these steps (90–93). In addition, scientists can consider
437 undergoing wellness checks and quarantining before moving between sites where infecting local
438 populations with diseases is possible (for example, in times of global pandemics like COVID-19). We
439 recommend that team leaders (and other participants) take a wilderness first aid or responder course,
440 provide personal protective equipment to all field members, and lead by example, always handling
441 potentially dangerous wildlife, equipment, and materials in a safe manner.

442
443 *Health care.* Team leaders are responsible for emergencies that occur during fieldwork. Thus, being
444 informed and prepared about local health care options, such as obtaining short-term travel insurance for
445 all team members – including local collaborators – can facilitate response to emergencies. Additionally,
446 team members may need to receive vaccinations and medications prior to fieldwork depending on the
447 country and possible diseases present, the species that may be handled, and available health care
448 infrastructure (e.g., getting an influenza vaccine could help prevent an outbreak in a region without
449 regular access to flu vaccines).

450
451 *Safety meetings.* Field safety plans can be improved if teams meet prior to trips to provide input on
452 procedures and scenarios (see examples in *SI Appendix*, Box S3), discuss codes of conduct, and

453 distribute hard copies. Although medical history is personal by nature and team leaders may be limited in
454 what they can ask, knowledge about basic health including prescriptions (e.g., blood pressure), pre-
455 existing conditions (e.g., asthma, extreme allergies), and blood group can make a critical difference in an
456 emergency. Consider volunteering health information to team leaders when developing the safety plan,
457 and/or sealing medical documents where they can remain confidential unless an emergency occurs.

458 Team leaders should be upfront (in a way that does not reveal sensitive identities) about specific
459 challenges and dangers that team members may face because of health issues or personal identity (e.g.,
460 LGBTQ+, women). Further, team leaders can make a good faith attempt to defer to the group's comfort
461 levels, and to create space for private or subgroup conversations regarding safety (see 24). If a given
462 area or field site is too dangerous for some members of the group, team leaders can reconsider whether
463 it is appropriate to conduct field research there. In the field and afterward, we suggest that team leaders
464 proactively check-in with team members and to ensure that everyone feels positive about the experience,
465 as well as debrief afterward to improve future trips.

467 **Concluding Remarks**

468 Here, we present a set of principles based on our self-assessment of how to ingrain equity, reciprocity,
469 access, benefit-sharing, and safety into field biology practices. While many of our suggestions are not
470 new (94, 95) and could be applied more generally to other fields, we believe that compiling these ideas
471 into a single document can help researchers plan intentionally inclusive fieldwork. We recognize that our
472 suggested actions may not be applicable to all institutions, teams, or regions and that each group of
473 collaborators will need to make decisions about how to carry out their own fieldwork as equitably and
474 inclusively as possible. Conducting fieldwork can have a positive, transformative effect on an individual's
475 and a community's relationship with science and nature; conversely, bad field experiences can
476 discourage students from pursuing careers in STEM and can dissuade communities from collaborating
477 with scientific researchers (20, 38, 96). We believe that following the proposed principles can help ensure
478 positive outcomes.

479 In reflecting on our own research programs, we recognize that power imbalances are prevalent within
480 field teams and that they can impact collaborative dynamics. Power imbalances can be a product of
481 economic asymmetries (e.g., high- and low-income regions or countries), geopolitical history (e.g., former
482 colonies and colonialist countries, indigenous communities, Black communities in the Americas), job title
483 (e.g., field assistant), and discrimination of specific groups of people (e.g., women, LGBTQ+, racialized
484 people, people with disabilities). In field biology, power imbalances can result in the formation of
485 collaborative agreements and structural norms that consistently favor those with greater power (e.g.,
486 parachute science; 20). Recognizing and taking power dynamics into consideration can promote equity
487 and safety in field biology, ultimately leading to a more inclusive scientific community and practice.

488 As power imbalances favor those in privileged positions by default, deliberate planning and proactive
489 efforts, especially by privileged individuals and institutions, can allow for more equitable benefits in
490 science. This could mean discussing each collaborator's goals at the start of a project and asking rather
491 than assuming what collaborators and communities expect and need out of the research program. We
492 ask field researchers to be respectful by prioritizing the safety, comfort, and decisions of local
493 communities in all stages of their field research. In being legal, we promote adherence to all relevant laws
494 and hope that researchers will follow precedents by allowing local authorities to have the final decision on
495 whether and how research is conducted. Finally, in thinking about field safety, we encourage team
496 leaders to emphasize concerns and feedback from team members with less experience or power.

497 This document represents a collective agreement resulting from months of discussion among the authors.
498 As such it does not entirely reflect each individual's precise point of view, but instead captures ideas
499 created by consensus that represent our shared goal of making field biology a more ethical, inclusive, and
500 fair domain of knowledge production. During the process of writing this paper, numerous unresolved
501 questions arose that we could not fully address, but we hope that reporting some of them here will initiate
502 further discussion (*SI Appendix*, Box S1). We encourage other programs, institutions, and individuals to
503 engage in such discussion and to join us by taking action to foster more inclusive and equitable fieldwork.

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517

518

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Be collaborative



Be respectful



Be legal



Be safe



1

Educational opportunities

Share your research and collaboratively create educational products. Get to know the community and learn how knowledge is shared.



2

Grassroots science

Conduct community-led (participatory action) research, which can provide tools to the local community and ensure that research is in line with local goals and interests.



How can we give back to the communities where we work?

5

Collaborative science

Work reciprocally with local scientists by sharing logistical and intellectual support for local research programs.



3

Broadcasting local issues and achievements

Remain informed about and share local issues and achievements. Promoting local efforts brings new allies and resources to communities.



4

Remuneration and infrastructure

Hire local workers. Fair compensation as well as providing training and infrastructure is crucial to support the community.

