

1 Conducting urban ecology research on private property: advice for new
2 urban ecologists

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16 ABSTRACT

17 Private property makes up a large proportion of urban green space and differs from public
18 greenspace in ecologically important ways. While including private property in urban landscape
19 research is necessary, ecologists are frequently unprepared to work on private property and
20 thus often exclude private land from empirical studies. To address this gap and encourage
21 research on private property, we ask: “What lessons have urban ecologists learned from
22 designing their research and completing their fieldwork that are relevant to researchers new to
23 private property?” We present ten common methodological and practical challenges faced by
24 urban ecologists, with solutions synthesized from semi-structured interviews with 24 urban
25 ecologists from 7 countries, along with public health researchers and police officers. The
26 compiled advice addresses all stages of research, including research design, sample design,
27 gaining access to study sites, collecting data on study sites, and sharing results. Ecologists
28 reported that their research and sampling design were shaped by the need to work with
29 property owners, found communicating honestly and respectfully with property owners for the
30 duration of the research influenced success, and emphasized practicing good field safety and
31 preparing for both routine and stressful in-person encounters. Further research and
32 collaboration among ecologists and private property owners is necessary to improve our
33 understanding and management of urban ecosystems given the proportion of urban
34 greenspace that is on private property. We hope that our suggestions will help guide the next
35 generation of urban ecologists to take up this challenge.

36

37 1 INTRODUCTION

38 Private property makes up a large proportion of urban greenspace in many cities and is
39 important for maintaining biodiversity and ecosystem functions and services in urban areas
40 (Loram et al 2007, Hilty and Merenlender 2003, Cerra 2017). Research increasingly shows that
41 ecological patterns and processes on private greenspace can differ from public greenspace in
42 ecologically meaningful ways (Edmondson et al. 2014, Belaire et al. 2016, Ziter and Turner
43 2018). For example, researchers in Leicester, UK, found that the presence of trees increased soil
44 organic carbon stocks in residential yards more than on public land (Edmondson et al. 2014),
45 and research in Madison, Wisconsin, USA, showed that both temporal trends and spatial
46 variability of three soil-based ecosystem services differ in private yards compared to public
47 greenspaces (Ziter and Turner 2018). Patterns within private property can also yield insights
48 into urban ecology; a multi-city study of residential landscapes found that back yards had
49 higher species richness than front yards (Locke et al 2018), highlighting the leverage that urban
50 residents have to enhance biodiversity conservation. Thus, including private property in
51 research programs is necessary to fully understand the ecology of heterogeneous urban
52 landscapes.

53 Despite this need, ecologists are frequently unprepared for, or wary of, working on private
54 property. Managing access to a sufficiently large sample of study sites is difficult, requiring
55 approval from multiple parties as ownership is fragmented both in space and time due to
56 changes in ownership. Appropriate communication with landowners and managers around
57 project goals and results demands additional time, resources, and effort. Safety of researchers
58 and field assistants may be a greater concern than when working on public land. Consequently,
59 many urban landscape studies are limited to public greenspaces such as parks (Tonn and Ibanez
60 2016; McDonnell et al 1997) or use designs that eliminate the need to ask for permission to
61 access private property (e.g., remotely sensed data: Loram et al 2007, Walker et al 2017;
62 limiting study sites to publicly viewable front yards: Lowenstein and Minor 2017, Melles et al
63 2003).

64 While such methods can yield important insights, research assessing private property without
65 involving the property owners or obtaining permission (e.g. via roadside observations or taking
66 photos) can also create conflict with residents (as in Beumer and Martens 2016) and precludes
67 many types of sampling and research designs. These challenges can lead to exclusion of private
68 land from empirical studies, with many types of private property lacking representation in the
69 literature (Strobach and Haase 2012, Davies et al 2011). Due to ecological differences among
70 urban land use types, this lack of representation could bias our understanding of urban
71 ecosystems.

72 To facilitate the inclusion of private land in urban ecology research, it is necessary to
73 understand common questions and challenges and their solutions. Here, we identify and
74 summarize common challenges and their solutions for ecologists considering urban ecology
75 research on private property, drawing both from the experiences of urban ecologists who have
76 successfully completed private property research and from disciplines that work with people
77 and their communities. We ask, “What lessons have urban ecologists learned from designing
78 their research and completing their fieldwork that is relevant to researchers new to private
79 property?” We present ten common methodological and practical challenges faced by urban
80 ecologists, with solutions synthesized from semi-structured interviews with 24 urban ecologists
81 from 7 countries, along with public health researchers and police.

82 We define private property as property owned by an individual or non-state agent (e.g.
83 corporation) where the owner's rights include limiting the use, management of, and access to
84 the property (Schlager and Ostrom 1992). Though some of the advice is applicable, we do not
85 explicitly address challenges unique to survey design or community science and volunteer
86 management, or to exurban and agricultural private property (Hilty and Merenlender 2003).

87 2 METHODS

88 We interviewed researchers of urban landscapes who negotiated access to private property for
89 their research. We used purposive sampling of professional outlets, scientific literature, and
90 social media, coupled with snowball sampling to identify possible interviewees. We interviewed
91 researchers regardless of study organism, habitat type, geographical location, or methods used

92 to ensure a widely applicable set of lessons for urban ecologists working on private property
93 and minimize our own biases. In total, we interviewed 26 urban ecologists from 7 countries
94 including multiple regions throughout the United States, along with researchers in public health
95 and police officers. 24 ecologists' responses provided useable data, while further discussions
96 with two ecologists found their work was not on private property as defined here. Research
97 took place on residential and commercial property, in yards, parking lots, green roofs, ponds,
98 and irrigation ditches. Study focus included vegetation, soils, aquatic and terrestrial insects,
99 birds, fungi, and mammals. Despite these diverse experiences, we achieved a remarkable
100 redundancy in the problems and lessons learned (Baxter and Eyles 1996).

101 We established email communication with each potential interviewee, described our research
102 and questions, and obtained written consent to be interviewed for the paper. We then verbally
103 reiterated the goal of the study and how the information they shared would be used at the
104 start of each interview. The University of Washington Human Subjects Division granted a
105 'Determination of Exempt Status', finding that the research is exempt from the federal human
106 subject regulations. The IRB approval number is STUDY00000728.

107 We conducted open-ended interviews using the 'expert' interview technique (Dexter 1970,
108 Harvey 2011). Briefly, a core set of open-ended questions acts as a template for a semi-
109 structured interview. The interviewer uses these questions to guide in-depth discussions based
110 on what the interviewee thinks is important and their areas of experience. Our core set of
111 open-ended questions covered all phases of a research program and centered around problems
112 that the interviewee ran into, how these were addressed, what worked well, and what the
113 interviewee would do differently if repeating their study.

114 Our analysis of the research data was an applied qualitative approach also used in applied
115 policy research (Ritchie and Spencer 2002). It is driven by answering one central question:
116 "What lessons have urban ecologists learned from designing their research and completing
117 their fieldwork that is relevant to researchers new to private property?" It is not designed to
118 generate theory or analysis of the researchers themselves, but instead to highlight problems
119 other researchers have encountered and how they addressed them. Though not generalizable,
120 we provide descriptive statistics of our sample to illustrate the prevalence of key challenges.

121 3 RESULTS: PRACTICAL ADVICE FROM EXPERIENCED RESEARCHERS

122 3.1 WHAT SHOULD I CONSIDER WHEN DESIGNING RESEARCH FOR PRIVATE 123 PROPERTY?

124 Urban ecologists considered multiple issues when designing their research. These include:

125 **Legal compliance including photos:** Ethical and legal compliance may limit methods choice. For
126 example, one researcher found that urban camera trap images often include people, including
127 children, and may be restricted by law. For publication, images require extra scrutiny to protect
128 identifiable information of property owners. Addresses, license plates, and signs may need to
129 be obscured; GPS coordinates should be stripped from image metadata.

130 **Potential for property damage:** Research methods may cause property damage. For example,
131 of seven researchers contemplating soil sampling, two reported avoiding research methods
132 that required digging; one cited a colleagues' experience damaging an irrigation system that
133 required costly repairs. Five others successfully collected soil samples. Both researchers
134 considering tree aging chose not to core trees, or reduced the number of cores taken, to avoid
135 damage or blame for potential future tree injury (Norton 1998). Three researchers altered
136 vegetation and insect sampling designs to avoid property damage.

137 **Hazard discovery:** Two researchers reported avoiding soil analyses that could reveal heavy
138 metal contamination and trigger property owner liability or disclosure requirements. Recording
139 or encountering trespassers or illegal activity is also a potential hazard and was reported by
140 four researchers.

141 **Imposition on the property owner:** Fourteen researchers modified research designs to require
142 fewer or shorter visits, or shifted the research start time to reduce imposition on the property
143 owner. For example, changing the length of bird counts to avoid asking for access twice, or
144 delaying bird surveying until a time more convenient for property owners.

145 **Destructive and invasive sampling:** Two of three researchers using destructive (euthanasia) or
146 invasive (bird banding) methods reported pushback from property owners. Significantly,

147 pushback occurred with bird research/bycatch though not with frogs. If destructive sampling is
148 necessary and an owner asks directly, be truthful about the need to kill organisms for the
149 research. Property owners with whom the researcher has cultivated a relationship are more
150 likely to be amenable to destructive or invasive data collection.

151 **Leaving equipment on site:** Of 8 researchers that considered leaving equipment on site, only
152 one researcher altered their study design to avoid it. Four researchers left equipment, but only
153 on private or inaccessible locations, and agreed that publicly accessible locations were more
154 vulnerable to theft and vandalism. Equipment clearly marked 'science' may or may not be
155 respected (see also Clarin et al 2013; Meek et al 2016). Just as in more remote settings, urban
156 livestock and wildlife can disturb equipment.

157 **Methodological scale or spatial mismatch:** Some area-based methods commonly used in
158 wildland research are not appropriate in the private property context where the parcel is the
159 natural unit of analysis. Common methods may require modification or replacement to avoid
160 changing the unit of analysis from the parcel to that of the method—e.g. for birds, from parcel
161 to the point count area. Methods may need to be adapted to fit parcel geometry (generally
162 small and dominated by a central building).

163 **Boundary issues:** Official property boundaries and 'as managed' boundaries may not align; four
164 researchers reported mismatches discovered in the field. Choose which to use based on your
165 research objectives and be consistent.

166 **Pilot Studies:** Pilot studies were used by 5 researchers, all of whom found them useful,
167 particularly when working in urban systems for the first time. For example, one author
168 discovered issues with bird detection which—in addition to unit of analysis mismatch—
169 contributed to their use of the standardized search method over a traditional point count
170 method (Watson 2003).

171 **Engagement and participatory research:** Working on urban private property provides
172 opportunities to involve property owners, organizations, residents, and others in research using
173 community-based participatory research and other methods. If used, provide value to
174 participants (including food), use people's time wisely, and focus on what they care about to

175 get them involved. Accept that you will make mistakes—apologize immediately, don't get
176 defensive, and do better in the future. Collaboration is particularly important if your research is
177 expected to have policy outcomes that could impact community members (Israel et al 1998,
178 Kramer 2016).

179

180 3.2 HOW DO I OBTAIN AN ADEQUATE SAMPLE SIZE?

181 Each study site or unit of analysis requires at least one (and sometimes multiple) property
182 owners to grant access, which complicates good sampling design practices in two important
183 ways.

184 **Rejection and Non-response:** First, sampling designs must account for property owner
185 rejection or non-response to access requests. There are two main approaches to obtaining an
186 adequate sample size: either solicit more requests than needed to ensure n_{needed} are accepted
187 ($n_{solicited} = \frac{n_{needed}}{\text{expected response rate}}$); or continue conducting rounds of requests until reaching
188 n_{needed} . With the first approach, site selection protocols should be in place before contacting
189 property owners in case the number of acceptances is greater than n_{needed} . Of our
190 interviewees, 8 requested access to more sites than needed and 16 conducted rounds of
191 requests until their quota was met. Researchers using either approach frequently generate a
192 list of potential sites larger than their target n_{needed} with the correct sample characteristics
193 (proportion of land uses, distance to natural area, ownership, etc.).

194 Some sampling designs or study characteristics may be prone to high rejection and non-
195 response rates. Lower acceptance rates may be caused by longer studies with multiple visits or
196 more complicated study designs; study designs where each sampling point requires permission
197 from a cluster of adjacent neighbors; and certain land use types, particularly those with more
198 liability concerns such as commercial buildings.

199 Different strata in a stratified random sampling design may have different response rates; those
200 with lower response rates must be solicited more frequently to obtain the desired sample size.
201 Small strata also require special attention. One author addressed a particularly small strata by

202 modifying sampling site restrictions to this stratum and requesting access to every eligible site
203 to receive access to enough sites.

204 **Site Retention:** Second, some fraction of the sample sites may drop out once the study has
205 begun. New owners may not provide consent following property turnover, existing property
206 owners may withdraw consent, or data loggers might be lost, stolen, or damaged. Sample sites
207 may also need to be eliminated by the researcher for a variety of reasons, including hard to
208 manage property owners. Eight of eleven researchers using a multi-visit design reported site
209 loss during their study. We suggest designing your study such that dropping a site will not
210 compromise your overall analysis or results.

211 3.3 HOW SHOULD I CONTACT PROPERTY OWNERS FOR ACCESS?

212 There are multiple effective methods for contacting property owners to ask for property access.
213 The most common approaches are mailed requests and in person verbal requests; these
214 approaches are not mutually exclusive.

215 **Mailed requests:** Eight researchers used mailed requests, with one citing previous hostile in-
216 person encounters as the motivating factor. Mailings should be on professional letterhead and
217 contain both a clear project description and explicit information about the proposed methods
218 (using photos/diagrams if possible). If part of an ongoing research project, include previous
219 results so property owners can see how their data will be used. Mailings should also contain an
220 easy way for the property owner to respond, including a self-addressed and stamped postcard
221 with yes/no checkboxes. A frequently used mailing protocol is the Dillman approach (Dillman,
222 1991).

223 Some researchers have mailed requests or surveys including an access request to entire
224 neighborhoods they are interested in sampling. While more expensive, researchers using this
225 approach reported getting more volunteers than needed and could compare the yes/no
226 property access groups.

227 Access requests can be mailed to the physical address associated with the property or with the
228 property tax bill. For multi-family housing, commercial, and industrial sites, requests to the

229 address associated with the property tax bill may be more successful. In the United States, both
230 addresses are accessible with publicly available tax assessor's data. A proportion of mailed
231 requests will be returned to sender due to incorrect address information.

232 **In person verbal requests:** Fifteen researchers used in person requests, including knocking on
233 residential doors, approaching homeowners in yards, or approaching commercial and multi-
234 residential front desk staff. Successful communication when approaching in person includes
235 quickly identifying yourself as a researcher, a short, easily communicated research statement,
236 and a well-defined access request. Language and word choice are important; for example, one
237 researcher found that 'student' and 'frog' were well received while 'chemistry' was not.
238 Carrying contact information, institutional information, and information about the project can
239 also be useful. Day and time determine how many properties have someone available—and on
240 residential properties, which demographics are available. Multiple researchers reported
241 knocking on doors on the weekends/socially convenient times in residential areas or during
242 business hours on commercial areas to increase response rates.

243 As with in person interactions generally (see Question 3.9), researchers encountered a range of
244 reactions approaching property owners in person—including enthusiastic engagement, interest,
245 indifference, confusion, suspicion, and hostility. Five of the fifteen researchers using in person
246 requests reported hostile or suspicious responses from at least one property owner. Mailing,
247 emailing, or otherwise advertising your intentions to be in the neighborhood may smooth your
248 path. Researchers reported more positive in person request reactions when: 1) they have good
249 soft-skills; 2) there are good town-university relationships; 3) the population is environmentally
250 conscious; 4) research is tied to local concerns, and; 5) local students are working on the
251 project, particularly in smaller cities.

252 Note that when approached in person, some property owners will want to schedule a time for
253 you to come back. Others may expect or want you to carry out the research right away, so be
254 prepared to do your fieldwork.

255 **Other contact methods:** Eleven researchers used other methods, including master gardener
256 associations, listservs, Facebook groups, churches and community groups, partnerships with

257 relevant retailers like garden stores, and word of mouth to recruit part or all their property
258 owners. Recruiting via local media or via groups not explicitly tied to the environment (e.g.
259 neighborhood groups) may be more robust and less likely to produce responder bias (see Q3.5).
260 If you expect any volume of responses, consider setting up a web form to deal with them
261 efficiently. Leaving pamphlets at a location had a very poor response rate for all three
262 researchers who tried.

263 Researchers sometimes access private property without permission; for example, while
264 following a bird or tagged animal across residential property boundaries without verbal or
265 written consent. However, we cannot condone such an approach. Trespassing poses serious
266 risks, both legally and to the researcher's safety.

267 **Choosing a contact method:** Consider access to mailing addresses, cost of recruitment, culture,
268 willingness of homeowners to answer the door, land use type, and study design when
269 determining which approach to use. Researchers doing in-person requests generally only
270 sampled the property once and did not make significant 'asks' of the property owner. Written
271 requests may be a better approach for longer-term or more complex research projects, though
272 mailed requests had lower response rates than in-person requests. For example, one author
273 conducted a multi-visit, multi-year intensive sampling design. Three rounds of access requests
274 were required to obtain the desired sample size; of 46 mailed requests, 20 were accepted, 6
275 were rejected, and 20 received no response. For all methods, researchers must be sure that the
276 person granting access has the authority to do so, particularly for multi-visit or intensive and
277 invasive sampling.

278

279 3.4 HOW SHOULD I APPROACH UNIQUE PROPERTIES?

280 Some types of properties require specialized access or require additional credentials. For
281 example, green roofs are relatively rare, and sampling involves increased risk/liability.
282 Researchers successfully recruited properties to the study by networking at industry
283 conferences and cold calling property owners or managers specializing in these properties to

284 gain access to an initial group of sites, then using snowball sampling to build sample size when
285 property owners could vouch for their ability to do the research safely and without damaging
286 property. Though non-probability sampling, non-traditional sampling methods like this may be
287 the only way to recruit enough samples to complete the research. Researchers may also need
288 additional credentials before they can approach some land use types. In England, for example,
289 clearance from the Criminal Records Bureau (CRB) is required to conduct research on school
290 property.

291 3.5 WHAT TYPES OF BIAS SHOULD I WATCH FOR WHEN SAMPLING SITES?

292 **Sample selection bias:** As with all ecological research, the end goal in sampling private property
293 is an unbiased set of sample sites that will effectively address the research questions. Sampling
294 bias occurs when different members of the target group are more or less likely to be included
295 than others. Researchers should understand potential sources of sampling bias and mitigate
296 them.

297 A key source of sampling bias occurs when different groups of property owners accept or reject
298 access requests at different rates (Kho et al 2009, Strohbach and Haase 2012). For commercial
299 properties, some management companies have a blanket 'no access' policy. Homeowners may
300 be biased in granting permission based on their level of environmental concern, interest in
301 gardening, level of education, socioeconomic status, ownership structure (owner vs. renter
302 occupied) and their relationship with your institution (prestige and reputation of the
303 university). Funding partners and social or traditional media used as outreach platforms can
304 also bias your sampling pool.

305 These biases manifest at different scales, including between neighborhoods and 'microscale'
306 bias between adjacent households. Differences in conservation-oriented individuals may show
307 up as spatial patterns; one researcher received acceptances from a larger than expected
308 number of properties near parks and forests and had to implement new distance to park rules
309 for additional sites.

310 Some researchers relied on non-probability convenience sampling to find more sites and help
311 intense research designs proceed. Researchers should be realistic about the potential for
312 sampling bias to influence results and may want to quantify how sampled properties differ from
313 others in the sampling frame.

314 **Measurement bias when sampling:** Scheduling times with private property owners (see Q3.6)
315 may introduce measurement bias. For example, surveying birds at parks at dawn and at
316 residential properties at mid-morning means time-dependent differences in bird behavior may
317 confound your study design. One approach to evaluate potential bias is to add additional
318 sampling visits to parks at mid-morning to quantify the effect of time. Additionally, some
319 property owners may request you sample only in specific locations on their property,
320 particularly if you are taking soil or other samples. Explaining bias, probability, and the need to
321 choose a random location in easy to understand terms is often sufficient to convince people to
322 let you sample.

323

324 3.6 WHAT CAN I EXPECT FROM PROPERTY OWNERS WHEN IT IS TIME TO SAMPLE?

325 **Coordination:** As mentioned, when asking for access in person many property owners will
326 expect you to conduct your sampling immediately. In most other cases, you will need to
327 coordinate sampling with the property owner and visit at a time convenient to them. Do not
328 underestimate the time and work required to coordinate with your property owners—
329 particularly if your research is weather dependent or you are visiting multiple sites per day.
330 Property owners may or may not want to be present, watch you sample, or be notified when
331 you arrive or leave.

332 **Alert to potential hazards:** Animals, including dogs, urban livestock, and honeybees are
333 common on residential property and can interfere with data collection or damage equipment.
334 When making appointments with residential property owners, remember to ask if there are any
335 animals present and how they should be handled. Be cautious, because residents may not
336 communicate their presence.

337 **Commercial property:** Commercial property requirements tend to be more formal. Most
338 commercial properties require notice of research visits (24 to 72 hours is standard), and some
339 properties may require written documentation. Even when not required, communicate with the
340 owner or manager prior to visiting their property. Commercial access may also require signing a
341 liability waiver. You should read these and all other documents carefully. You may need to drop
342 the property from your study if the requirements are too onerous. In some instances (e.g.
343 larger buildings, golf courses), someone may also escort you on the property for part or your
344 entire visit.

345

346 3.7 WHAT CAN I EXPECT WITH MULTI-VISIT/YEAR STUDIES?

347 Multi-visit—and particularly multi-year—designs are needed to further urban ecology
348 (Lindenmayer et al 2012). 11 of the researchers we spoke with used a repeated sample design,
349 seven utilized a multi-year design. 15 used single-visit study designs only. In these counts are
350 two researchers who used both single- and multi-visit designs.

351 **Communication:** Researchers with multi-visit and multi-year studies found ongoing
352 communication particularly important. Communication frequency and method should be
353 tailored to each property manager or owner. Reminders about the start of a new field season
354 are particularly important. It is good practice to contact properties 6-8 weeks in advance, so
355 you can resolve any issues that arise or renegotiate access before data collection needs to
356 begin. Researchers found that Twitter, email lists, blogs, websites, and Facebook groups are all
357 effective for communicating with groups of property owners, creating a community, and
358 encouraging continued engagement with the research.

359 **Access loss:** As mentioned in Question 3.2, access to study sites may be lost during a study, e.g.
360 due to property manager turnover or property sale. New managers/owners are not always told
361 about ongoing research, and you may need to re-negotiate for continued access. Be prepared
362 to adjust your communication style and frequency, sampling time, and protocols based on new

363 owner/manager requirements. Of 11 researchers using a multi-visit design, eight lost access to
364 at least one study site due to non-response or hostility of the new owners or managers.

365 Multi-visit designs also require accepting property alteration over the course of study more
366 than single-visit designs. Alterations include moving or cutting down trees and shrubs and
367 paving additional portions of the site. Consider how to handle changes before starting your
368 research.

369 3.8 HOW CAN I WORK IN NEIGHBORHOODS ETHICALLY AND RESPECTFULLY?

370 Anthropologists have adopted ethical guidelines that are also applicable to urban ecologists
371 (Association of Social Anthropologists of the UK and the Commonwealth 2011, Anthropology
372 Southern Africa 2005, and the American Anthropological Association 2012). Key guidelines
373 include: treating participants (property owners) as people, not subjects of research; that the
374 researchers' primary responsibilities to participants are to protect them from harm, ensure
375 informed and ongoing consent, and share research results; and that the researcher is also
376 accountable to research assistants and students, colleagues, and the public. For urban
377 ecologists, these guides from anthropology are more relevant than many developed for
378 ecology, which focus more on professional responsibility as a scientist (e.g. not falsifying
379 results) and less on treating the communities in which ecologists work with respect (Ecological
380 Society of America 2013). This is insufficient for a discipline that regularly interacts with
381 communities and members of the public.

382 3.9 HOW CAN I PREPARE FOR IN-PERSON INTERACTIONS?

383 Working on urban private property means frequent contact with residents, neighbors, tenants
384 and passersby both during fieldwork and when approaching people in person to ask for
385 property access. For your safety, strongly consider conducting research in pairs (or teams),
386 preemptively greeting and introducing yourself to neighbors or tenants who might be
387 suspicious, letting someone know the addresses where you are going, and checking in with a
388 trusted individual at set times. If team fieldwork is not possible, consider 'borrowing' trusted
389 helpers (significant others, friends) so that you are not alone when visiting a site. If you will be

390 working in an area for a substantial period, getting to know key community members can help
391 build relationships and avoid confrontation with community members and police.

392 **A framework for interactions:** We find it helpful to frame interactions with other people on a
393 four-point scale. These interactions will be colored by local attitudes and by how people
394 perceive your gender, race, age, and nationality. A critical assessment of the target community
395 and the researcher's relative position is essential prior to approaching properties to request
396 permission in person or collect data. If you are not a local, consult other researchers or trusted
397 individuals familiar with the area.

398

399 **Level 0: Curious Interest.** The authors and all urban ecologists interviewed experienced people
400 approaching to ask questions about their work, what they were doing, and ecology in general
401 while they were in the field. Though these interactions can be time consuming, they are an
402 investment in the site and your research. Several researchers stated that they felt they were
403 ambassadors for science as well as urban ecologists and valued the time they spent interacting
404 with people. This is a more personal 'broader community impact' that you can't get via public
405 lectures and other traditional outlets.

406 **Level 1: Suspicious Interest.** 16 of the 24 researchers reported encounters with people who
407 were suspicious or challenged their right to be on the property. These situations occurred in
408 multiple contexts, including: when one resident/owner had given consent to the research but
409 did not inform other residents/tenants; with vigilant neighbors; and in a public space when
410 assessing trees or something else people value. Most concerns were addressed and deescalated
411 after researchers demonstrated that they knew the property owner or manager and had their
412 permission to be on site.

413 Unfortunately, "Level 1" situations can also escalate if the person persists in their suspicion of
414 you and your team or the organization you are with. Deep prejudices can lead to additional
415 confrontation—both racism and anti-government hostility have been encountered by
416 researchers. If the person asks you to leave, it is probably best to do so, and you may need to
417 drop the site for your own safety. When a neighbor seems irate or unreasonable, it may be

418 more prudent to retreat and re-negotiate a future sampling date when the property owner can
419 be present. Asking the property owner to reach out to this neighbor may help.

420 **Level 2: Police Response.** 6 researchers were approached by police or security officers, and
421 while they were able to peaceably resolve the calls, police shootings are a real concern in the
422 United States and elsewhere. Researchers addressed these situations by showing proof that
423 they have permission to be on the property (signed letter, email, etc.) and explaining their
424 research when law enforcement or private security arrived.

425 For example, one author was approached by security officers employed by one of the property
426 owners when an employee called in a complaint. They were allowed to resume work after the
427 security officers examined their documentation and consulted internal records, however after
428 this incident they had to re-negotiate access and email formal requests prior to each visit. They
429 also changed to more professional attire and appearance afterwards.

430 **Level 3: Direct Threats.** Three researchers encountered direct threats to their safety. In this
431 situation, we advise moving to safety, and considering a call to 911 or your local equivalent if
432 warranted and you feel safe doing so. Strongly consider dropping the site from your study—no
433 data are worth your safety.

434

435 **Prepare for stressful situations:** Researchers should prepare for both stressful situations and
436 routine questions, with safety as the most important objective. For stressful situations (Levels 2
437 & 3) and situations that could escalate (Level 1), the authors and other researchers converged
438 on several approaches to avoid or de-escalate, which aligned with police officer suggestions.
439 These include:

- 440 1) Have a way to prove that you have permission to be on the property—written
441 documentation is best, but if that is not possible a phone number for the owner;
- 442 2) Carry photo identification that shows who you are and any institution you belong to;
- 443 3) If you are not the project PI, have the PI's and property owner's contact information on
444 hand;
- 445 4) Use an institutional vehicle or place a placard with a phone number on your dashboard;

- 446 5) If the police are called, keep your hands visible; and
447 6) Consider giving your non-emergency dispatch a call to give them a heads up about who
448 you are, where you are working, and what you are doing.

449 **Prepare for routine questions:** Addressing routine questions (Level 0) in a concise and
450 informative way requires practice, and these interactions can help develop science
451 communication skills. Though generally short answers are sufficient, not everyone is adept at
452 asking questions. Pay attention to how people respond to your answers to common yet vague
453 questions like “What are you doing?” to help you refine the balance between brevity and
454 sufficient detail. Multiple researchers reported that people asked, “Why did you pick this
455 property?” and needed to explain probability sampling or their sampling method in a way
456 laypeople understand. People may also volunteer information about the property and its
457 history that is valuable to your research. Consider carrying business cards and a straightforward
458 informational handout to give to people who are curious about your research. For more
459 interruption-sensitive methods like bird counts, consider having a sign or placard that explains
460 what you are doing and asks people not to disturb you. Having a research partner in the field is
461 very useful for these situations.

462 Sometimes people go beyond asking questions—for residential properties, nine researchers
463 reported that some residents wanted to get involved in the science and help collect data, or
464 that they wanted their children involved and would send them out to help. Consider what you
465 will do if the situation arises; if you feel comfortable this can be a great way to expose children
466 and lifelong learners to science.

467 Depending on your research context, it may help to dress to communicate intent (high visibility
468 clothing, clipboard, obvious research equipment, institution logo gear, hard hat) or to fit in
469 (professional clothing, including nice hiking/field clothing). If you are comfortable doing so,
470 consider consulting your local police community outreach officers to see if they have any local
471 suggestions.

472 If you are overseeing students, be sure they are adequately prepared and supported during
473 fieldwork. Supervisors, principal investigators, and senior students should steward a culture of

474 respectful behavior, raise awareness, and adopt or make students aware of independent
475 reporting and enforcement mechanisms (Clancy et al 2014). Creating lab safety protocols is a
476 good first step.

477

478 3.10 SHOULD I ENGAGE WITH PROPERTY OWNERS POST-STUDY?

479 The authors believe that researchers should plan from the start of their projects to share the
480 knowledge gained (Israel et al 1998, Kramer 2016). 15 researchers indicated that they had or
481 were planning to share information with property owners, while 9 indicated that they did not
482 and were not planning to for various reasons including time and monetary cost. Sharing
483 knowledge shows property managers/owners that they are part of a larger project and
484 demonstrates the impact their participation had. Many participants will also be interested
485 specifically in the information gathered from their property.

486 Communicating results can take many forms, including publishing research highlights in
487 neighborhood or industry newspapers or blog posts, distributing copies of published papers,
488 and providing summaries of what was found on each site with or without comparisons to other
489 sites (with identifying information removed). Publicly accessible options like newspapers, blog
490 posts, radio and television appearances, and public talks are important when you cannot follow
491 up in person due e.g. to privacy concerns or not collecting contact information. Holding industry
492 and public workshops provides opportunities for dialogue, and libraries and community centers
493 can make great partners.

494 When presenting results, consider the property owner perspective. First, property owners may
495 be upset if you did not find something (e.g. a species of interest) on their property. In these
496 cases, emphasize how important their property was for the research, and deemphasize that
497 they did not have what you were looking for. Second, people like to see themselves and their
498 neighborhoods reflected in the research. Consider presenting a 'how X is your neighborhood?'
499 section, explain what X means for their industry/neighborhood, and show how their
500 involvement made a difference. Third, consider presenting information in different but

501 complimentary ways so it is more accessible. Most importantly, if you say you are going to
502 provide results, be sure to follow through on your word, although you may need to warn
503 people how long it will take.

504 At the very least, be sure to always thank participants in your studies; your research would not
505 be possible without access to their property. In addition to thanking their participants,
506 researchers have expressed gratitude by sending personalized letters, small gifts (e.g. plants for
507 residential gardens, souvenirs from their institution), and acknowledging property owners in
508 any resultant presentations or published papers.

509 4 CONCLUSION

510 Urban ecosystems contain complex mosaics of green space governed by multiple stakeholders
511 (Aronson et al. 2017). Due to ecological differences among these green space types, private
512 property research is crucial to our understanding of urban ecosystems. However, little formal
513 guidance for new researchers is present in field protocols or the ecological literature, and early
514 career scientists are thus frequently unprepared for, or wary of, working on private property.
515 Key questions and challenges include managing access to a sufficiently large sample of study
516 sites, contacting multiple parties to gain approval, and respectfully and safely communicating
517 with property owners and managers.

518 We present practical advice from experienced researchers to help guide researchers
519 considering working on urban private property for the first time (Box 1). Overall, researchers
520 reported that their research design and sampling designs were influenced by the need to work
521 with private property owners, reported success using multiple methods to recruit property
522 owners though recognized the potential for bias, emphasized practicing good field safety and
523 preparing for both routine and stressful in-person encounters, and found that communicating
524 honestly and respectfully with property owners for the duration of the research was important
525 to their success, particularly for multi-visit and multi-year studies.

526 We hope to reduce conflict between property owners and researchers (as in Beumer and
527 Martens 2016) and provide foundational knowledge and tools to new private property

528 researchers balancing scientific merit, safety, and respect to property owners. We encourage
529 ecologists to think more holistically about their research approach, and how it impacts people.
530 This may include implementing methods more commonly practiced in the social sciences,
531 including ethics training and community-based participatory research.

532 Increased research on private property will allow researchers to ask questions addressing
533 diverse land uses and management approaches and examine a broader range of organisms and
534 ecosystem processes. Landscape scale studies can also facilitate cross-city comparisons within
535 and among biomes and allow for multi-visit and multi-year approaches to examine seasonal
536 and yearly trends. Expanding the types of study sites included in empirical urban ecology
537 research will also facilitate studies that address potential biases in study design. For example,
538 how do response rates to access requests differ across land use type, demographic status,
539 environmental awareness, and locale? Are certain types of studies—organisms methods—
540 performed more on one land use than others, and how does this shape our theory of urban
541 ecology? Sociologists and medical researchers have quantified differences in response rates,
542 and ecologists should also (e.g. Phillips et al 2016).

543 Given the rate at which urban land use is expanding, and the prevalence of private property
544 among urban greenspace, further research and collaboration among ecologists and private
545 property owners is necessary to improve our understanding and management of urban
546 ecosystems. We hope that our suggestions will help guide the next generation of urban
547 ecologists to take up this challenge.

548

549 5 BOX 1: CHECKLIST FOR CONDUCTING URBAN ECOLOGY RESEARCH
550 ON PRIVATE PROPERTY.

551 **Before Data Collection**

- 552 • Be safe, respectful, and ethical
- 553 ○ Scout potential research areas first or consult local colleagues or residents.
- 554 ○ Create safety protocols tailored to your context: personal, institutional, research
555 objectives, and site/neighborhood. Plan to work in pairs/groups when possible.
556 Make sure someone knows when and where you are sampling every day.
- 557 ○ Contact property owners in a safe and respectful way. In person requests are
558 faster but may be riskier; mailed requests are slower with higher non-response
559 rates. Ensure the person granting access has authority to do so.
- 560 ○ Photos, conceptual diagrams, and videos are great tools to explain your research
561 to potential participants. The easier these are to understand, the better. Make
562 sure that you give property owners enough information about your project.
563 Treat it as a public engagement activity to explain the importance of your
564 research.
- 565 ○ There should never be a single property you must have—if that person says no,
566 you can't convince them. Thank them for their time and move on.
- 567 ○ Consider property owner perceptions when developing research questions and
568 methods. Ensure property owners understand and are comfortable with
569 methods. If not, adjust accordingly (e.g. revise methods, drop site).
- 570 ○ Ensure you comply with your institution's human and animal subject
571 requirements.
- 572 ○ If possible, consider adopting community centric approaches from public health
573 and the social sciences, e.g. community-based participatory research.
- 574 • Expect—and plan for—the unexpected
- 575 ○ Start looking for sites early. Make sure that your initial sampling design is robust;
576 rejections and non-responses will occur when contacting property owners, data
577 can be lost due to crows/vandals/etc., and sites may drop out over time.
- 578 ○ Have a plan in place for unanticipated site changes (e.g. construction,
579 landscaping, tree removal).
- 580 ○ Conduct a pilot study if feasible. Not all field methods work well in urban
581 settings!

582

583 **During Data Collection**

- 584 • Be respectful (and realistic) with your scheduling
- 585 ○ Treat the property owner's time and property with respect.
- 586 ○ Clearly communicate your sampling schedule and activities with property owners
- 587 and avoid rescheduling if possible. Follow any property-specific rules to which
- 588 you have agreed.
- 589 ○ Plan site visits to balance urban commuting time, methodological requirements,
- 590 and property owner preferences. Try to avoid sampling bias caused by visiting
- 591 sites at specific times, e.g. site * time interaction.
- 592 ○ Budget time for passersby, tenants, or neighbors to talk to you. Remember that
- 593 each conversation is an investment in the site, a source of new information, and
- 594 a valuable opportunity for public outreach. However, balance being polite with
- 595 completing your work.
- 596 ○ Consider having a script or pamphlet ready for people who approach you.
- 597 • Safety first!
- 598 ○ Trust your gut. Be prepared to move or drop sites in unsafe situations.
- 599 ○ Have a plan for handling any illegal activity you come across (e.g. trespassing,
- 600 drugs).
- 601 ○ Dress professionally, but appropriately for the context in which you're working.
- 602 ○ Use an official vehicle if possible (or, place your institutional name and contact
- 603 info on the dashboard).
- 604 ○ Be prepared to prove you belong (carry ID, a letter describing your work, and
- 605 permission to be on the property).
- 606 ○ If appropriate, contact the local police precinct(s) where you will be working to
- 607 let them know who you are, where you will be, who has authorized you to be
- 608 there, and contact numbers.
- 609 • Think ahead
- 610 ○ Don't slack on field season prep because you're in the city. Plan for any critical
- 611 needs (food, water, bathrooms, equipment), weather, insect pests, and terrain.
- 612 ○ For multi-year studies, contact property owners well in advance of a new field
- 613 season. Build in time to replace study sites or build up relationships with the new
- 614 property owners if a property was sold.
- 615 ○ Don't underestimate the time and logistical effort it will take to schedule
- 616 appointments with property owners.

617

618 **After Research**

- 619 • Follow up

- 620
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- 628
- Make results available to property owners in an accessible form. Although not everyone will be interested, outreach is an important part of giving back to property owners, particularly if policy decisions might be made based on your results.
 - Plan to keep in contact with property owners, particularly if you anticipate future use of sites (e.g. mailing lists or social media can be effective).
 - Don't forget to say thank you!
 - Budget time and money for outreach/dissemination of results.

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633 7 DATA AVAILABILITY

634 Data are not available online to comply with IRB approval granted by University of Washington
635 Human Subjects Division.

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