Appendix A - Table A2. Summary of appropriate study design, camera spacing, and survey effort (adapted from Wearn & Glover-Kapfer [2017] with additional references included) for various modelling approaches. Note – these are guidelines only, using best available information. There is uncertainty associated with each of the different approaches. To address this, the table contains 'minimum', 'ideal' and 'often' used values, as well as qualifiers.

Approach	Camera arrangement	Camera spacing	Number of cameras	Camera days per camera location	Total number of camera days	Survey duration	References
Species inventory	• Targeted[1,2] • Random if species poorly known[3] • Flexible[4]	• No minimum[1,4,5] • Ideally 1-2 km[1,5,6]	• No minimum[5] • Ideally ≥ 20[2,3]	• No minimum[5] • Ideally ≥ 30[5] • < 30 for highly detectable[5]	• No minimum[2,3,5]	• No maximum[2,4,5]	[1] Rovero et al., 2013 [2] Tobler et al., 2008 [3] Wearn et al., 2013 [4] Rovero & Tobler, 2010 [5] Wearn & Glover-Kapfer, 2017 [6] Colyn et al., 2018 [7] O'Brien, 2010 [8] O'Connell & Bailey, 2011 [9] Cusack et al., 2015 [10] Ahumada et al., 2011 [11] Kinnaird & O'Brien, 2011 [12] Wearn et al., 2016 [13] Li et al., 2012 [14] Kays et al., 2020 [15] MacKenzie et al., 2002
Species diversity & richness	• Ideally, random[1,5] • Stratified[5] • Stratified random[5] • Clustered[7,8]	• Spatially independent[i,5] • Ideally ≥ 1 km, but closer may be justified[2,9] • 1-2 km is often adequate (provided each camera is treated as an independent sample)[2,5,10,11]	• Minimum 20[5] • Commonly 30[10] • Ideally ≥ 50[5] • If stratified, 20-50 per stratum[5] • 20-100 to reach species-accumulation asymptote[10,12,13] • 25-35, scale-dependent[14]	• Ideally ≥ 30[5,10]	• Generally, 600-1500[5] • ≥ 1000[5]	• Ideally < 6 months[5] • 3-6 months for medium-large mammals[5]	
Occupancy models[15]	• Ideally random[7,8,16–18] • Targeted[7,16–18]	• If home range size known, ideally, > home	• Minimum 40[5] • Ideally ≥ 100[16–18]	• ≥ 30 for most[16–18] • 80-100 if detection probability is low[18]	• Species-dependent[5] • > 1200 for most[5]	• Species-dependent[17]	

Approach	Camera arrangement	Camera spacing	Number of cameras	Camera days per camera location	Total number of camera days	Survey duration	References
	• Clustered[8,19] • Stratified random[5]	range diameter[5] • If home range size unknown, > 1 km[5] • ≥ 1 km is typical[5]	• > 60; species-dependent[1] • < 20 for common (occur at > 75% of camera locations)[ii,14] • ≤ 30 if ψ > 0.8 (occur at > 80% of camera locations)[ii,18] • > 150 for rare (occur at < 25% of camera locations)[ii,14] • 30-60 sites for less common[18]		• > 1,000 for most[7,16–18] • > 5,000 for rare / hard to detect[18]	• Ideally < 6 months[7,16–18]	[16] Mackenzie & Royle, 2005 [17] Guillera-Arroita et al., 2010 [18] Shannon et al., 2014 [19] Pacifici et al., 2016 [20] Rowcliffe et al., 2008 [21] Rovero & Marshall, 2009
Relative abundance indices (RAI)	• Ideally random[5] • Systematic random[5]	• No minimum[5] • Ideally ≥ 1 km[3] • Ideally 1-2 km[5]	• As many as possible[5,20] • Minimum 20[5,20] • Ideally ≥ 50[5,20] • If stratified, 20-50 per stratum[5]	• No minimum[5] • Ideally ≥ 30[5] • As many as possible[5]	• Ideally > 2000[5] • Enough to capture > 10 detections[5] • Ideally > 20 detections[5] • Usually > 2,000 for many carnivores / rare ungulates[5,20] • > 250 for common[5,20,21] • > 20,000 "hyper-rare" (caught 0.1% of the time)[5,7]	• No maximum[3] • Ideally < 12 months[3]	[22] Karanth & Nichols, 1998 [23] Karanth, 1995 [24] Sollmann et al., 2012 [25] Clarke et al., 2023 [26] Tobler & Powell, 2013 [27] Krebs et al., 2011 [28] Noss et al., 2012
Capture-recapture (CR) / Capture-mark-recapture (CMR)[22,23]	• Ideally paired[iii,1,2,5] or random[5] • Targeted[iv,2,5,24] • Targeted for carnivores[1] • Systematic[25]	• Spatially dependent[v,5] • Species-dependent[vi,1] (< home range diameter) • 1-4 km is typical[2,5,24]	**CR/CMR:** • At minimum, enough to encompass the home ranges of 5-10 individuals[5,26–28] • > 2-4 per smallest home range[1,22]	• ≥ 30 for all but the most detectable[5,26] • > 60 for reasonable precision for most[5,26] • > 60-120 if capture probability is low[5,26]	• > 1,000 for most[5] • > 1200 for common[5] • > 3,600 if detection probability or species density is low[5]	• As short as possible[5] • Species-dependent[2,24] • Ideally < 3 months[2,24]	[29] Borchers & Efford, 2008 [30] Royle & Young, 2008 [31] Royle et al., 2009 [32] Sun et al., 2014

Approach	Camera arrangement	Camera spacing	Number of cameras	Camera days per camera location	Total number of camera days	Survey duration	References
			CR/CMR / SECR/SCR: • Minimum 20[5,28,37] • > 4 per home range[5,39] • If used suggested 4 camera per home range, 40-120 locations[5] **SECR/SCR:** • > 4 per home range[5] • At minimum, enough to expose 10-30 individuals to sampling[1,5,26–28,35] • Ideally, enough to capture > 20 individuals[5,36,37] (encompass home ranges) and 20-50 total recaptures[5,28,38] • 60-100 if detection probability is <0.1[26]		• Enough for > 20-detections[5,28,37] • > 60 recaptures[1]		[33] Burgar et al., 2018 [34] Burgar, personal communication, April 23, 2023 [35] Karanth et al., 2011 [36] Foster & Harmsen, 2012 [37] White et al., 1982 [38] Efford, 2004 [39] Dillon & Kelly, 2008 [40] Chandler & Royle, 2013 [41] Sollmann et al., 2013b [42] Burgar, 2021 [43] Clark, 2019 [44] Sun et al., 2022 [45] Augustine et al., 2019 [46] Augustine et al., 2018 [47] Davis et al., 2021 [48] Rowcliffe et al., 2013 [49] Loonam et al., 2021
Spatially explicit capture-recapture (SECR) / Spatial capture-recapture (SCR)[29,30 31,38]	• Paired[1,5] • Clustered[5,32] • Systematic[25]	• Species-dependent (< home range size)[5,24,32] • Ideally, 1/3 the home range radius[5,24,32] (~4-7 camera per home range)[5] • Maximum of 0.8 times the home range radius[5,24,32]		• ≥ 30 for all but the most detectable[5,26] • > 60 for reasonable precision for most[5,26] • > 60-120 if detection probability is low[5,26]	• > 1,000 for most[5] • > 1200 for common[5] • > 3,600 if detection probability or species density is low[5] • Enough for 20-50 recaptures[5,28,38]	• Minimum 1 month per survey (presuming multiple surveys)[33,34] • Ideally > 12 months total (based on minimum for SCR models)[33,34] • Ideally 1-3 months (depending on time required to maximize detections while minimizing violation of "population closure" assumption)[33,34]	
Spatial mark-resight (SMR) (type of SCR model)[24,32,40]	• Random relative to activity centres[41] • Systematic random[25] • Clustered[25]	• 1-3 sigma (related to home range size)[32]	• Minimum 30[34,42] • 60 (but will depend on detection probability and resight data)[34,42]	• Minimum 30 (precision dependent on number of marked individuals in a population)[34,42] • ≥ 30 for all but the most detectable[5,26] • > 60 for reasonable precision for most[5,26] • > 60-120 if detection	• 360 days[34,42]		
Spatial count (SC)[40] (type of SCR model)	• Systematic random[25,32,43] • Clustered[25,32,43]	• Close enough that individuals will be detected at multiple locations[25,31]	• Minimum 30[33,44] • 60 (but will depend on detection probability and resight data)[33,44]		-		

Approach	Camera arrangement	Camera spacing	Number of cameras	Camera days per camera location	Total number of camera days	Survey duration	References
				probability is low[5,26]			[50] Rowcliffe et al., 2016
Spatial Partial Identity Model (Categorical SPIM; catSPIM)[44,45]	• Same as SC[25,32,44,45]	• Similar to SC[25,32,44,45]	• Similar to SC or with fewer cameras[44]	• Similar to SC or less[25,32,44,45]	• Similar to SC or less[25,32,44,45]	• Similar to SC or less (such that identity traits [e.g., antlers present/ absent] don't change)[32]	[51] Nakashima et al., 2018 [52] Moeller et al., 2023 [53] Becker et al., 2022
Spatial Partial Identity Model (2-flank SPIM)[46] (extension of SCR that uses probabilistic identities)	• Same as SCR[25,46]; however, more flexible[47]	• Similar to SCR[25,46]	• Fewer cameras than SCR (or same but larger sampling area)[viii,46]	• Similar to SCR or less[25,46]	• Similar to SCR or less[25,46]	• Similar to SCR or less[25,46]	[54] Huggard, 2018 [55] Warbington et al., 2020 [56] Howe et al., 2017 [57] Moeller et al., 2018 [58] Ridout & Linkie, 2009 [59] Rowcliffe et al., 2014
	• Ideally, systematic closely-spaced (relative to home range size)[vi,46]						
Random encounter models (REM)[20,48]	• Random relative to movement[ix,1,5,48,49] • Systematic[49] • Systematic random[x,5] • Stratified random[5] • Stratified targeted[xi,5]	• No minimum[5] • Ideally ≥ 1 km[5] • Spatially independent[48] • > home range diameter[5] • 1-2 km without home range size, closer if using mixed models[5]	• Minimum 20[5,20] • Ideally > 50[5,20] • Dependent on species' density[5]	• No minimum[5] • Ideally > 30[5]	• Minimum 10 detections[1,20] • Ideally > 20 detections[1,20] • Often 2,000[1,20] • 1,000-10,000 for most, if estimates of activity and speed are to be reasonable precise[48] • > 2000 for low-density carnivores / rare ungulates[5]	• Ideally < 12 months[5] • No maximum[20]	
Random encounter and staying time (REST)[51]	• Same as REM[52 53]						

Approach	Camera arrangement	Camera spacing	Number of cameras	Camera days per camera location	Total number of camera days	Survey duration	References
Time in front of the camera (TIFC)[53–55]	• Random or stratified random (representative) relative to movement[53]	• Same as REM[52,53]					
Distance sampling (DS)[56]	• Random relative to movement, pointing in either random or consistent direction[25,49] • Systematic[49] • Random or targeted across known density gradient[52]	• Dependent on spatial extent of interest[52]					
Time-to-event (TTE) model[56] Space-to-event (STE) model[56] Instantaneous sampling (IS)[56]	• Random relative to movement[49] • Systematic[49] • Systematic random[49]	• No minimum if random sampling used[56] • None (uses instantaneous snapshots)[57]	• Dependent on species density and distribution (e.g., more cameras with lower density and more clumped distribution)[56] • Minimum 20[57] • Ideally > 50[57]	• No minimum[56]	• Dependent on species density and distribution[57]	• None required[57] • If demographic/ geographic closure assumptions not met the estimate will be mean abundance or density in study area during the survey[57]	
Behaviour	• Ideally, random[5] • Stratified[5] • Usually targeted[5]	• Objective-dependent[5] • Ideally, independent (> home range diameter or > 1 km)[58,59]	• Activity patterns: Enough to obtain > 100 detections[58,59] • If stratified, > 20 per stratum[5]	-	-	• Dependent on behavioural metric (e.g., if it occurs during a certain period)[5]	

[i] **Camera spacing to achieve spatial independence for species diversity and richness:** locations should be independent, meaning that any two locations do not sample the same community of animals. Note - this may be hard to achieve when considering the movement distances of some species, such as big cats, and in practice, a camera spacing of 1-2 km is often used (e.g., Tobler et al., 2008; Ahumada et al., 2011; Kinnaird & O'Brien, 2012)

[ii] **Number of cameras for occupancy models:** should based on expected occupancy probability (i.e., the expected probability that a given camera site is occupied, for a given species [Kays et al., 2020]).

[iii] **Paired design camera arrangement for CR:** due to the higher chance of recognizing all individuals captured in a survey; using two cameras also decreases the chances of missing captures entirely (Tobler et al., 2008).

[iv] **Targeted camera arrangement for CR:** This design is commonly used when estimating densities of marked populations (e.g., spatially explicit capture-recapture [SECR; Borchers & Efford, 2008; Efford, 2004; Royle & Young, 2008]) or behaviour studies. However, targeted sampling may impede the ability to draw inferences beyond the survey area (Wearn & Glover-Kapfer, 2017).

[v] **Camera spacing to achieve spatial dependence for CR:** "camera locations should be sufficiently close to one another such that individuals are picked up across more than one location" (Wearn & Glover-Kapfer, 2017).

[vi] **Camera spacing should be species-dependent (home range size) for CR/CMR:** There is a trade-off between density and survey extent: 10-30 individuals exposed with a camera location density of at least 2-4 per smallest home range.

[vii] **Ideally, systematic camera arrangement, closely spaced cameras for 2-flank SPIM:** due to the increased likelihood of capturing both sides of the animal (Augustine et al., 2018)

[viii] **Fewer number of cameras 2-flank SPIM than for SCR (or same but larger sample area):** Note - larger sampling areas preferred for **2-flank SPIM** since there will be fewer samples collected on the periphery of the sampled area and thus less uncertainty in identifying individuals (Augustine et al., 2018).

[ix] **Random camera arrangement for REM:** Note that species with very restricted distributions in a landscape are best sampled using a stratified design (Wearn & Glover-Kapfer, 2017).

[x] **Systematic random camera arrangement for REM**: to ensure a minimum separation between cameras (Wearn & Glover-Kapfer, 2017).

[xi] **Stratified targeted camera arrangement for REM:** species that are highly restricted in occurrence (Wearn & Glover-Kapfer, 2017).