# 02\_ rec\_sample-design

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[(#i\_num\_cams)= 10](#_Toc170830937)

[(#i\_survey\_duration)= 11](#_Toc170830938)

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## (#i\_cam\_config)=

# Camera arrangement

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| **Overview** | | | | |
| **Advanced** | | | | |
| **Figures & Videos** | | | | |
| A close-up of a grid  Description automatically generated with low confidence  Figure 3. Examples of sampling designs: (a) simple random, (b) systematic, (c) stratified (each grid cell is a stratum), and (d) clustered (adapted from Schweiger, 2020).  ```{figure} ./images/  :align: center  ``` | | | ```{figure} ./images/Wearn\_GloverKapfer\_2017\_Fig7-2.png  :align: center  ``` | |
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| **Analytical tools & resources** | | | | |
| **Name** | **Link** | **Reference** | | **Additional\_info** |
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|  |  |  | |  |
| **References**  (Alberta Remote Camera Steering Committee (RCSC) et al., 2023) | | | | |

**notes**

## (#i\_cam\_config\_random)=

# Random (or “simple random”) design

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| **Overview** | | | |
| **Advanced**  Simple random design (Figure 3a) – cameras occur at randomized locations (or sample stations) across the study area, sometimes with a predetermined minimum distance between camera locations (or sample stations). A random design may help reduce biases that arise from selecting camera locations deliberately. It may also allow the user to make inferences about areas that were not surveyed when employing use-based approaches (e.g. occupancy models [MacKenzie et al., 2002]; intensity of use methods [Keim et al., 2019]). Some modelling approaches (e.g., random encounter and staying time [REST]; Nakashima et al., 2018) and random encounter models [REM; Rowcliffe et al., 2008, 2013]) require a simple random design (Appendix A - Table A2).  A disadvantage of using a simple random design is the tendency to see fewer animals (i.e., is less efficient) when animals are clustered or exhibit habitat preferences, and the possibility of missing rare habitat types. The proportion of different strata (e.g., habitat types) sampled should be the same as (or close to) the true proportion in the study area. For example, if the study area consists of 25% young deciduous forest, then 25% of randomly selected sites should be within young deciduous forest, on average. | | | |
| **Figures & Videos** | | | |
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| **References**  (Alberta Remote Camera Steering Committee (RCSC) et al., 2023) | | | |

**notes**

## (#i\_cam\_config\_stratified)=

# Stratified design (+Stratified random design)

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| **Overview** | | | |
| **Advanced**  **Stratified random design (Figure 3c)** – the area of interest is divided into smaller strata (e.g., habitat type, disturbance levels), and then a proportional random sample of sites is selected within each stratum (e.g., 15%, 35% and 50% of sites within high, medium and low disturbance strata). This design can help ensure that the sample adequately reflects the major or uncommon strata of interest and may be an efficient approach when users are limited by accessibility constraints (Wearn & Glover-Kapfer, 2017). This design can also be used to increase precision if animal densities are known to be highly variable (Junker et al., 2021) or when a species is expected to occur in certain habitat types more often (Gillespie et al., 2015). For example, studies that wish to assess species richness, or occupancy rates for a particular species, amongst strata would use a stratified random design. | | | |
| **Figures & Videos** | | | |
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| **References**  (Alberta Remote Camera Steering Committee (RCSC) et al., 2023) | | | |

**notes**

## (#i\_cam\_config\_systematic)=

# Systematic design (+Systematic random design)

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| **Overview** | | | | |
| **Advanced**  **Systematic design (Figure 3b) –** camera locations occur within a regular pattern (e.g., a grid pattern) across the study area.  **Systematic random –** camera locations are selected using a two-stage approach. Firstly, grids are selected systematically (to occur within a regular pattern) across the study area. The location of the camera within each grid is then selected randomly. This method is similar to the simple simple random design. The same advantages apply in terms of unbiased landscape representation, and the same modelling approaches can be used. The disadvantage of using a systematic random (or simple random design) is that rare habitat types may be missed.  **Systematic non-random design –** sets of clustered cameras can be deployed within a systematic non-random approach (i.e,. “systematic clustered” or “systematic paired”) to assess the effects of disturbance along a gradient, over time, at multiple scales and/or with control (i.e., reference) sample stations. Hierarchical Before-After Dose-Response (BADR) is one such method that requires cameras to be placed within a systematic non-random approach, where camera locations occur along transects or in clustered arrays (sample stations), selected using a nested spatial hierarchy of sampling to control for variability in land-use type and large-scale patterns (Bayne et al., 2022). The study area is divided into land-use regions based on land-use type, then into landscape units, which are assessed for environmental variability to determine where sample stations should be placed (Bayne et al., 2022). The “Before-After” component of BADR incorporates the phase of stressors (i.e., proposed or current development) (Bayne et al., 2022). The “Dose-Response” component of BADR controls for the variable distribution of activity (and the potential impacts) by incorporating control (or reference) sample stations and/or by placing cameras in sample stations along a gradient of disturbance (Bayne et al., 2022). | | | | |
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| **References**  (Alberta Remote Camera Steering Committee (RCSC) et al., 2023) | | | | |

**notes**

## (#i\_cam\_config\_clust\_paired)=

# Clustered + Paired designs

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| **Overview** | | | | |
| **Advanced**  **Clustered design** (Figure 3d) – multiple cameras are deployed at a sample station. The distance between cameras (camera spacing) will be influenced by the chosen sampling design, the Survey Objectives, the Target Species and data analysis. A clustered design can be used within a systematic or stratified approach (i.e., systematic clustered design or as a clustered random design) (Wearn & Glover-Kapfer, 2017). A clustered design is common when users are interested in individual identification, such as density estimation from marked or partially marked populations (e.g., spatially explicit capture-recapture [SECR; Borchers & Efford, 2008; Efford, 2004; Royle & Young, 2008] or spatial mark-resight [SMR; Doran-Myers, 2018]). A clustered design can also be used in an occupancy framework (O'Connell & Bailey, 2011; Pacifici, 2015) when interested in measures of species richness (O'Brien et al., 2011).  A clustered design can be a cost-efficient approach to increase the number of replicates at each site (especially when accessibility is limiting; Gálvez et al., 2016) and to reduce measurement error and improve precision (Clarke et al., 2019). However, spatial autocorrelation may occur with this design (Moqanaki et al., 2021), depending on the camera spacing (see section 6.2.7).  **Paired design** – a form of “clustered design“ where two cameras that are placed closely together to increase detection probability ("paired cameras"), to evaluate certain conditions ("paired sites", e.g., on- or off trails), etc. Paired placements can help to account for other variability that might occur (i.e., variation in habitat quality). For some objectives, pairs of cameras might be considered subsamples within another sampling design (e.g., simple random, stratified random, systematic). | | | | |
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| **References**  (Alberta Remote Camera Steering Committee (RCSC) et al., 2023) | | | | |

**notes**

## (#i\_cam\_config\_targeted)=

# Targeted design

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| **Overview** | | | | |
| **Advanced**  **Targeted design** – cameras are placed in areas that are known or suspected to have higher activity levels (e.g., game trails, mineral licks, etc.). This design is useful when monitoring rare or cryptic species that are unlikely to be detected with other designs. 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. It is, however, important to understand that targeted sampling may impede one’s ability to make inferences beyond the survey area. For some objectives, targeted sampling may be used within another sampling design (e.g., a stratified random sample of game trails and seismic lines; Keim et al. 2021). | | | | |
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| **References**  (Alberta Remote Camera Steering Committee (RCSC) et al., 2023) | | | | |

**notes**

## (#i\_cam\_config\_convenience)=

# Convenience design

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| **Overview** | | | | |
| **Advanced**  Convenience sampling design – camera locations or sample stations are chosen based on logistic considerations (e.g., remoteness, access constraints, costs). When cost is a key consideration, other more rigorous sampling designs (e.g., stratified; van Wilgenburg et al., 2020) that can incorporate cost should be considered first. One should be cautious when generalizing or drawing conclusions from data collected using convenience sampling, given that estimates can be biased if the sample poorly represents the population of interest. The convenience sampling design can be used where the goal is to survey a specific location(s) without the intent to generalize to un-surveyed areas (Gillespie et al., 2015; e.g., Kusi et al., 2020) or to survey an area following a report of the occurrence of a rare species. Both randomized (e.g., Found & Patterson, 2020) or targeted approaches can be used within a convenience sampling approach, although the user should still be cautious about extrapolating inferences to areas (or habitat types in an occupancy framework [MacKenzie et al., 2002]) that were not sampled and, therefore, not represented in the data (Gillespie et al., 2015). | | | | |
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| **References**  (Alberta Remote Camera Steering Committee (RCSC) et al., 2023) | | | | |

**notes**

## (#i\_cam\_spacing)=

# Camera spacing

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| **Overview**  **Camera spacing:** The distance between cameras (i.e., also referred to as "inter-trap distance"). This will be influenced by the chosen sampling design, the survey objectives, the target species and data analysis. | | | | |
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| **References**  (Alberta Remote Camera Steering Committee (RCSC) et al., 2023) | | | | |

**notes**

## (#i\_cam\_days\_per\_loc)=

# Number of camera days per camera location

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| **References**  (Alberta Remote Camera Steering Committee (RCSC) et al., 2023) | | | | |

**notes**

## (#i\_num\_cams)=

# Number of cameras

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| **References**  (Alberta Remote Camera Steering Committee (RCSC) et al., 2023) | | | | |

**notes**

## (#i\_survey\_duration)=

# Survey duration

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| **References**  (Alberta Remote Camera Steering Committee (RCSC) et al., 2023) | | | | |

**notes**

## (#i\_cam\_days\_total)=

# Total number of camera days

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| **Overview**  **Total number of camera days:** The number of days that all cameras were active during the survey. | | | | |
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| **References**  (Alberta Remote Camera Steering Committee (RCSC) et al., 2023) | | | | |

**notes**