## INFO ENTRY - QUESTION INFO

ENTRY NOTES:

* green = does not need to be editted
* yellow = info for the inputter
* ref\_id = “refs\_glossary\_2024-08-09.xls > “references” tab
  + if the reference not present, either add it (if you’re confident that you can follow the format), or add a comment in this doc with the info and I will adjust
* **images – file name in** “refs\_glossary\_2024-08-09.xls > “references” tab
* Ignore everything in the “POPULATE MARKDOWN” section
* Size of columns in tables and text format do not matter; see note on bold and italize below
* Any content with “glue}`` prefix or surrounded by “{{ “ / “ }}” indicates where text will be inserted from the keys
* You may see “<br>” throughout, you can ignore these
* additional formatting notes (optional)
  + \*\***bold**\*\*
  + \**italics*\*
* **Topic Info**
  + If the topic is NOT related to a question, you can leave “question” as NULL
  + “question” here is more for your reference
* **Assumptions, Pros, Cons**
  + Only for modelling approaches; can ignore otherwise (leave table here)
  + [WILL BE HERE, BUT INSERTED DIRECTLY FROM CSV FILE (THUS NO INPUT NEEDED)]
* **Advanced**
  + If the topic doesn’t warrant inclusion, you can leave as NULL
* **Figures**
  + Placeholders here as “filename” can leave in if not <5 images
* **Video**
  + no “<” before the URL text and a “>” after URL in this case
  + ref\_id in this example is not correct, just for illustrative purposes
* **Analytical tools & resources**
  + The ref\_id should be included in the reference column (and the full text reference in the master reference file). If you aren’t sure if the reference is in the master doc, add the full text ref as a comment.
  + Please add a “<” before the URL text and a “>” after (e.g., <http://www.somesitelink.com>)
  + Type can be something similar to: Article, App/Program, R package
* **References / Glossary** 
  + items in-text above (IGNORE FOR NOW)
* **Notes**
  + (future ref / not included in markdown conversion)

## Topic Info

|  |  |
| --- | --- |
| **info\_id** | sp\_rarity |
| **question** | How rare or common is the Target Species?  describe rarity + Determine "cut-off" values or provide comparable species for users to base selection  Note about relating to site as well as species characteristics  **\*\* [NEED]\*\*:**  - caveats, how to determine rarity  - Percentages for laymans terms  Headers:  \*\*<font size="4"><span style="color:#2F5496">How does this relate to study design?</font></span>\*\*  \*\*<font size="4"><span style="color:#2F5496">How does that work?</font></span>\*\*  \*\*<font size="4"><span style="color:#2F5496">Why do we care?</font></span>\*\*  > \*\*Select “Unknown” if you’re not sure.\*\* |

## Note banner

:::{info}

\*\*Species rarity\*\*: the number of individuals present of the species in question, relative to the total number of individuals of all species (or how “represented” is the species when considering the total number of individuals of all species).

While technically “how rare” a species is will be change from place to place (e.g., will depend on geographic range, habitat specificity, local abundance, etc.; {{ref\_intext\_crisfield\_et\_al\_2024}}), for the purposes of informing study design recommendations, the \*\*species rarity categories are defined as follows\*\*:

- \*\*Common\*\*: probability of occupancy > ~0.75-0.8 (> 0.75 [{{ref\_intext\_kinnaird\_obrien\_2012}}; {{ref\_intext\_kays\_et\_al\_2020}}]; > 0.8 [{{ref\_intext\_shannon\_et\_al\_2014}}; {{ref\_intext\_wearn\_gloverkapfer\_2017}}])

- \*\*Less common\*\*: 0.25-0.75

- \*\*Rare\*\*: probability of occupancy < 0.25 {{ref\_intext\_kays\_et\_al\_2020}}

- \*\*Very-rare\*\*: probability of occupancy < 0.001 ({{ref\_intext\_wearn\_gloverkapfer\_2017}}; {{ref\_intext\_rowcliffe\_et\_al\_2008}}; {{ref\_intext\_obrien\_2010}})

- \*\*Unknown\*\*: select this option if you’re not sure of the rarity of your Target Species (single or multiple species)

- \*\*Multiple\*\*: select this option if your study includes multiple Target Species that vary in rarity.

Refer to the tabs below for more information.

:::

:::{seealso}

{bdg-link-primary-line}`Species-accumulation curves<https://ab-rcsc.github.io/rc-decision-support-tool\_concept-library/02\_dialog-boxes/01\_10\_sp\_asymptote.html>`

{bdg-link-primary-line}`Species rarity<https://ab-rcsc.github.io/rc-decision-support-tool\_concept-library/02\_dialog-boxes/01\_19\_sp\_rarity.html>`

:::

## Overview

Generally, species rarity can be thought of as the probability that the species occupies the site, for a given species (or study area, depending on the scale of interest) {{ref\_intext\_kays\_et\_al\_2020}}.

::: {note}

Species rarity can be generally thought of as a species characteristic, however, “not in the same sense that hair colour or wing venation… it’ an emergent trait of a species' population and its environment rather than a trait of an individual organism” {{ref\_intext\_kunin\_1997}}

:::

\*\*<font size="4"><span style="color:#2F5496">How does this relate to study design?</font></span>\*\*

\*\*Species' rarity can influence the ideal camera arrangement. \*\* For example, when monitoring rare or cryptic species that are unlikely to be detected with other designs, it may be appropriate to use a \*Targeted design\* where cameras are placed in areas that are known or suspected to have higher activity levels (e.g., game trails, mineral licks, etc.).

\*\*Species' rarity can influence the ideal number of cameras and [survey](#survey) length\*\* ({{ ref\_intext\_chatterjee\_et\_al\_2021 }}). Low [detection probability](#detection\_probability) of rare or cryptic species can result in imprecise estimates if there are too few cameras or if cameras are not deployed for long enough (e.g., {{ref\_intext\_steenweg\_et\_al\_2019 }})). Chatterjee et al. (2021) suggested that for [occupancy models](#mods\_occupancy) ({{ref\_intext\_mackenzie\_et\_al\_2002 }}) of common species, to survey a minimum of 50 sites for 15–20 days. For rare, elusive species, they recommended surveying 100 sites at a minimum for 20–30 days ({{ref\_intext\_chatterjee\_et\_al\_2021 }}).

\*\*Species' rarity can influence the appropriate modelling approach.\*\* For measures of species richness or diversity, it is presumed that a camera is active long enough to detect rare species that may occur at a specific location ({{ ref\_intext\_wearn\_gloverkapfer\_2017 }}). If this is not the case, the results will indicate that the species was not present when it was (i.e., a “false negative”).

**\*\* [NEED]\*\*:**

- caveats, how to determine rarity

- Percentages for laymans terms

:::

Species’ rarity can influence the ideal number of cameras and [survey](https://ab-rcsc.github.io/RCSC-WildCAM_Remote-Camera-Survey-Guidelines-and-Metadata-Standards/3_glossary/3_Glossary.html#survey) length (Chatterjee et al., 2021) (see also [section 6.4.2](https://ab-rcsc.github.io/RCSC-WildCAM_Remote-Camera-Survey-Guidelines-and-Metadata-Standards/1_survey-guidelines/1_6.0_Study-design.html#id3)). Low [detection probability](https://ab-rcsc.github.io/RCSC-WildCAM_Remote-Camera-Survey-Guidelines-and-Metadata-Standards/3_glossary/3_Glossary.html#detection_probability) of rare or cryptic species can result in imprecise estimates if there are too few cameras or if cameras are not deployed for long enough (e.g., Steenweg et al. 2019). Chatterjee et al. (2021) suggested that for [occupancy models](https://ab-rcsc.github.io/RCSC-WildCAM_Remote-Camera-Survey-Guidelines-and-Metadata-Standards/3_glossary/3_Glossary.html#mods_occupancy) (MacKenzie et al., 2002) of common species, to survey a minimum of 50 sites for 15–20 days. For rare, elusive species, they recommended surveying 100 sites at a minimum for 20–30 days (Chatterjee et al., 2021).

## Advanced

Add some info here

## Figures

|  |  |  |  |
| --- | --- | --- | --- |
| **Image** | **file\_name** | **Caption (if applicable)** | **ref\_id** |
|  | leroy\_2024\_Rarity\_cutoff-point.png | \*\*Leroy (2024)\*\* The rarity cut-off point is here defined as the threshold of occurrence below which species are considered rare. | leroy\_2024 |
|  | leroy\_2024\_Weight\_assignation-curve.png | \*\*Leroy (2024)\*\*Weight assignation curve adjusted to an arbitrary rarity cut-off. | leroy\_2024 |
|  | figure3\_filename.png | figure4\_caption | figure3\_ref\_id |
|  | figure4\_filename.png | figure4\_caption | figure4\_ref\_id |
|  | figure5\_filename.png | figure5\_caption | figure5\_ref\_id |
|  | figure6\_filename.png | figure6\_caption | figure6\_ref\_id |

## Video

|  |  |  |
| --- | --- | --- |
| **caption** | **URL (no < / > before/after URL** | **ref\_id** |
| Species accumulation and rarefaction curves | https://www.youtube.com/embed/4gcmAUpo9TU?si=\_S-JYDDskR8QbHs5 | mecks100\_2018 |
| Generating a rarefaction curve from collector's curves in R within the tidyverse (CC198) | https://www.youtube.com/embed/ywHVb0Q-qsM?si=\_xJ5jbFc6MDEQlAh | riffomonas\_project\_2022b |
| vid3\_caption | vid3\_url | vid3\_ref\_id |
| vid4\_caption | vid4\_url | vid4\_ref\_id |
| vid5\_caption | vid5\_url | vid5\_ref\_id |
| vid6\_caption | vid6\_url | vid6\_ref\_id |

## Analytical tools & resources

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Type** | **Name** | **Note** | **URL** | **ref\_id** |
| R package | **Package ‘Rarity’:** Calculation of Rarity Indices for Species and Assemblages of Species | Allows calculation of rarity weights for species and indices of rarity for assemblages of species according to different methods (Leroy et al. 2012, Insect. Conserv. Divers. 5:159-168 <[doi:10.1111/j.1752-4598.2011.00148.x](https://doi.org/10.1111%2Fj.1752-4598.2011.00148.x)>; Leroy et al. 2013, Divers. Distrib. 19:794-803 <[doi:10.1111/ddi.12040](https://doi.org/10.1111%2Fddi.12040)>). | <https://cran.r-project.org/web/packages/Rarity/> | leroy\_2023 |
| Online resource | Rarity Indices | Brief, understandable explanation of rarity indices. | <<https://borisleroy.com/en/research/rarity-indices/>> | leroy\_2024 |
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| resource4\_type | resource4\_name | resource4\_note | resource4\_url | resource4\_ref\_id |
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| resource15\_type | resource15\_name | resource15\_note | resource15\_url | resource15\_ref\_id |

## References / Glossary

|  |  |
| --- | --- |
| **ref\_id** |  |
| {{ ref\_bib\_chatterjee\_et\_al\_2021 }}  {{ref\_bib\_crisfield\_et\_al\_2024}}  {{ ref\_bib\_flather\_sieg\_2007 }}  {{ ref\_bib\_kays\_et\_al\_2020 }}  {{ ref\_bib\_kinnaird\_obrien\_2012 }}  {{ ref\_bib\_kunin\_1997 }}  {{ ref\_bib\_leroy\_2023 }}  {{ ref\_bib\_leroy\_2024 }}  {{ref\_ bib\_mackenzie\_et\_al\_2002 }}  {{ref\_bib\_obrien\_2010}}  {{ ref\_bib\_riffomonas\_project\_2022b }}  {{ ref\_bib\_rowcliffe\_et\_al\_2008 }}  {{ ref\_bib\_shannon\_et\_al\_2014 }}  {{ ref\_bib\_southwell\_et\_al\_2019 }}  {{ref\_bib\_steenweg\_et\_al\_2019 }}  {{ ref\_bib\_ mecks100\_2018 }}  {{ ref\_bib\_wearn\_gloverkapfer\_2017 }} |  |

## Notes

(future ref / not included in markdown conversion)

* MacKenzie, Darryl I., James. D. Nichols, Nicole Sutton, Kae Kawanishi, and Larissa L. Bailey. “IMPROVING INFERENCES IN POPULATION STUDIES OF RARE SPECIES THAT ARE DETECTED IMPERFECTLY.” *Ecology* 86, no. 5 (May 2005): 1101–13. <https://doi.org/10.1890/04-1060>.
* “low to moderate occupancy (ψ < 0.9)” ([Fuller et al., 2022, p. 14](about:blank)) ([pdf](about:blank))
* “Rarity is a species characteristic, but not in the same sense that hair colour or wing venation or other morphological traits are;it is an emergent trait of a species' population and its environment rather than a trait of an individual organism.” ([“The Biology of Rarity”, 1997, p. 3](zotero://select/library/items/GA55PMBU)) ([pdf](zotero://open-pdf/library/items/XPPSEZIT?page=16))
* The difficulties with estimating occupancy for very rare species are compounded by the fact that there is often a positive correlation between occupancy and detectability (e.g. Shannon et al. 2014), meaning that many rare species also have low detection probabilities. When this is the case, for example if detection probability is < 0.05, it may be very difficult to obtain any occupancy estimate at all (O’Brien 2010; Shannon et al. 2014), or it may erroneously be estimated as 1 (a “boundary effect”; Guillera-Arroita et al. 2010). When this is the case, another option is to employ hierarchical multi-species occupancy models, in which occupancy and detection probability parameters for rare species are estimated by “borrowing strength” from information on more common species (e.g. Tobler et al. 2015; Wearn et al. 2017).
* For species which are especially elusive and difficult to detect (with detection probabilities < 0.05), 80-100 days of sampling may be required (Shannon et al. 2014).
* ψ (occupancy): the expected probability that a given camera site is occupied, for a given species (Kays et al., 2020)
* The three-dimensional rarity typology proposed by Rabinowitz in 1981, based on geographic range, habitat specificity, and local abundance, is among the most widely used frameworks for describing rarity in ecological and conservation research.

<https://www.researchgate.net/publication/236965289_Species_rarity_definition_causes_and_classification#:~:text=Rarity%20is%20a%20relative%20concept,of%20other%20organisms%20of%20comparable>

# POPULATE – INFO

## File from = 00\_00\_template-master\_2024-09-30.docx

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jupytext\_version: 1.16.4 <!-- 6.5.4-->

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name: python3

editor\_options:

markdown:

wrap: none

<!--template v2024-09-30-->

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**(i\_**sp\_rarity)=

# {{ title\_i\_sp\_rarity }}

:::{info}

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- \*\*Less common\*\*: 0.25-0.75

- \*\*Rare\*\*: probability of occupancy < 0.25 {{ref\_intext\_kays\_et\_al\_2020}}

- \*\*Very-rare\*\*: probability of occupancy < 0.001 ({{ref\_intext\_wearn\_gloverkapfer\_2017}}; {{ref\_intext\_rowcliffe\_et\_al\_2008}}; {{ref\_intext\_obrien\_2010}})

- \*\*Unknown\*\*: select this option if you’re not sure of the rarity of your Target Species (single or multiple species)

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Refer to the tabs below for more information.

:::

:::{seealso}

{bdg-link-primary-line}`Species-accumulation curves<https://ab-rcsc.github.io/rc-decision-support-tool\_concept-library/02\_dialog-boxes/01\_10\_sp\_asymptote.html>`

{bdg-link-primary-line}`Species rarity<https://ab-rcsc.github.io/rc-decision-support-tool\_concept-library/02\_dialog-boxes/01\_19\_sp\_rarity.html>`

:::

**:::::::{tab-set}**

**::::::{tab-item} Overview**

Generally, species rarity can be thought of as the probability that the species occupies the site, for a given species (or study area, depending on the scale of interest) {{ref\_intext\_kays\_et\_al\_2020}}.

::: {note}

Species rarity can be generally thought of as a species characteristic, however, “not in the same sense that hair colour or wing venation… it’ an emergent trait of a species' population and its environment rather than a trait of an individual organism” {{ref\_intext\_kunin\_1997}}

:::

\*\*<font size="4"><span style="color:#2F5496">How does this relate to study design?</font></span>\*\*

\*\*Species' rarity can influence the ideal camera arrangement. \*\* For example, when monitoring rare or cryptic species that are unlikely to be detected with other designs, it may be appropriate to use a \*Targeted design\* where cameras are placed in areas that are known or suspected to have higher activity levels (e.g., game trails, mineral licks, etc.).

\*\*Species' rarity can influence the ideal number of cameras and [survey](#survey) length\*\* ({{ ref\_intext\_chatterjee\_et\_al\_2021 }}). Low [detection probability](#detection\_probability) of rare or cryptic species can result in imprecise estimates if there are too few cameras or if cameras are not deployed for long enough (e.g., {{ref\_intext\_steenweg\_et\_al\_2019 }})). Chatterjee et al. (2021) suggested that for [occupancy models](#mods\_occupancy) ({{ref\_intext\_mackenzie\_et\_al\_2002 }}) of common species, to survey a minimum of 50 sites for 15–20 days. For rare, elusive species, they recommended surveying 100 sites at a minimum for 20–30 days ({{ref\_intext\_chatterjee\_et\_al\_2021 }}).

\*\*Species' rarity can influence the appropriate modelling approach.\*\* For measures of species richness or diversity, it is presumed that a camera is active long enough to detect rare species that may occur at a specific location ({{ ref\_intext\_wearn\_gloverkapfer\_2017 }}). If this is not the case, the results will indicate that the species was not present when it was (i.e., a “false negative”).

::::::

**::::::{tab-item} In-depth**

Add some info here

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###### ::::{grid-item-card} {{ ref\_intext\_leroy\_2024 }}

:::{figure} ../03\_images/03\_image\_files/leroy\_2024\_Rarity\_cutoff-point.png

:class: img\_grid

:::

\*\*Leroy (2024)\*\* The rarity cut-off point is here defined as the threshold of occurrence below which species are considered rare.

::::

::::{grid-item-card} {{ ref\_intext\_leroy\_2024 }}

:::{figure} ../03\_images/03\_image\_files/leroy\_2024\_Weight\_assignation-curve.png

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\*\*Leroy (2024)\*\*Weight assignation curve adjusted to an arbitrary rarity cut-off.

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figure4\_caption

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figure4\_caption

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\*\*Leroy (2024)\*\* The rarity cut-off point is here defined as the threshold of occurrence below which species are considered rare.

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\*\*Leroy (2024)\*\*Weight assignation curve adjusted to an arbitrary rarity cut-off.

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::::{grid-item-card} {{ ref\_intext\_figure3\_ref\_id }}

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figure4\_caption

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figure4\_caption

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figure5\_caption

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figure6\_caption

###### ::::

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###### ::::{grid-item-card} {{ ref\_intext\_mecks100\_2018 }}

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Species accumulation and rarefaction curves

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Generating a rarefaction curve from collector's curves in R within the tidyverse (CC198)

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vid3\_caption

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**::::::{tab-item} Shiny** apps/Widgets

Check back in the future!

::::::

**::::::{tab-item} Analytical** tools & resources

| Type | Name | Note | URL |Reference |

|:----------------|:-------------------------------|:----------------------------------------------------------------|:----------------------|:----------------------------------------|

| R package | Package ‘**Rarity’:** Calculation of Rarity Indices for Species and Assemblages of Species **|** **Allows calculation** of rarity weights for species and indices of rarity for assemblages of species according to different methods (Leroy et al. 2012, Insect. Conserv. Divers. 5:159-168 <doi:10.1111/j.1752-4598.2011.00148.x>; Leroy et al. 2013, Divers. Distrib. 19:794-803 <doi:10.1111/ddi.12040>). | <https://cran.r-project.org/web/packages/Rarity/> | {{ ref\_bib\_leroy\_2023 }} |

| Online resource | Rarity Indices | Brief, understandable explanation of rarity indices | <https://borisleroy.com/en/research/rarity-indices/> | {{ ref\_bib\_leroy\_2024 }} |

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| resource4\_type | resource4\_name | resource4\_note | resource4\_url | {{ ref\_bib\_resource4\_ref\_id }} |

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