## Topic Info

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| **info\_id** | mod\_is |

## Note banner

:::{seealso}

{bdg-link-primary-line}`Space-to-event (STE)<https://ab-rcsc.github.io/rc-decision-support-tool\_concept-library/02\_dialog-boxes/03\_22\_mod\_ste.html>`

:::

## Overview

```{include} include/00\_coming\_soon.md

```

## In-depth

```{include} include/note\_adapted\_clarke\_et\_al\_2023.md

```

The instantaneous sampling model (IS) is an extension of the space-to-event model (STE; see {bdg-link-primary-line}`Space-to-event (STE)<https://ab-rcsc.github.io/rc-decision-support-tool\_concept-library/02\_dialog-boxes/03\_22\_mod\_ste.html>`) that uses counts of animals in time-lapse images – instead of the area until an animal is first detected – to estimate density ({{ rtxt\_moeller\_et\_al\_2018 }}). As with the STE, all cameras in a randomly-deployed array are programmed to take time-lapse images at predefined intervals (e.g., every hour) to get instantaneous “snapshot” samples of the study area. During image processing, the number of animals in each photograph is recorded. Thus, the IS is essentially a series of fixed-area point counts ({{ rtxt\_moeller\_et\_al\_2018 }}): camera traps act as “standing observers” tabulating the number of individuals seen within a set area and time.

The IS equation is as follows:

:::{figure} ../03\_images/03\_image\_files/clarke\_et\_al\_2023\_eqn\_is1.png

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where \*𝐽\* is the total number of sampling occasions, \*𝑀\* is the total number of camera stations, and \*𝑛<sub>𝑚𝑗</sub>\* is the count of animals in the viewshed and \*𝑎<sub>𝑚𝑗</sub>\* is the area of the viewshed at station \*𝑚\* on sampling occasion \*𝑗\* ({{ rtxt\_moeller\_et\_al\_2018 }}).

## Simulations and Field Experiments

The IS is relatively untested opposite its sister models. Simulations have shown that the IS is unbiased to animal movement speed or population size, so is applicable to slow- and fast-moving animals and to low- and high-density populations ({{ rtxt\_moeller\_et\_al\_2018 }}). When tested on a population of elk in Idaho, the IS produced a similar density estimate as an aerial survey, but which was less precise than both TTE- and STE-derived estimates ({{ rtxt\_moeller\_et\_al\_2018 }}).

## Figures

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| --- | --- | --- | --- |
| **Image** | **file\_name** | **Caption (if applicable)** | **ref\_id** |
| A diagram of a process flow  Description automatically generated | moeller\_lukacs\_2021\_fig1.png | \*\*Moeller & Lukacs (2021)\*\* The spaceNtime workflow for count data. The user will go through five major steps for STE, TTE, and IS analyses. If the user has presence/absence (0 and 1) data instead of count data, the IS analysis is not appropriate, and the IS pathway should be removed from the flowchart. | moeller\_lukacs\_2021 |
|  | clarke\_et\_al\_2023\_eqn\_is1.png |  | clarke\_et\_al\_2023 |
|  | figure3\_filename.png | figure3\_caption | figure3\_ref\_id |
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## Video

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## Shiny

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## Analytical tools & resources

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| **Type** | **Name** | **Note** | **URL** | **ref\_id** |
| R package | spaceNtime: an R package for estimating abundance of unmarked animals using camera-trap photographs | free and open-source R package designed to assist in the implementation of the STE and TTE models, along with the IS estimator | <https://github.com/annam21/spaceNtime;<br><https://link.springer.com/article/10.1007/s42991-021-00181-8> | moeller\_lukacs\_2022 |
| resource2\_type | resource2\_name | resource2\_note | resource2\_url | resource2\_ref\_id |
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## References / Glossary

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| {{ rbib\_clarke\_et\_al\_2023 }}  {{ rbib\_moeller\_et\_al\_2018 }}  {{ rbib\_moeller\_et\_al\_2021 }} |  |

## Notes

# Markdown

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

# POPULATE - MOD

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

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\*\*{{ term\_mod\_is }}\*\*: {{ term\_def\_mod\_is }}

:::::::{dropdown} Assumptions, Pros, Cons

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::::{grid-item-card} Assumptions

- {{ mod\_is\_assump\_01 }}

- {{ mod\_is\_assump\_02 }}

- {{ mod\_is\_assump\_03 }}

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- {{ mod\_is\_assump\_05 }}

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::::{grid-item-card} Pros

- {{ mod\_is\_pro\_01 }}

- {{ mod\_is\_pro\_02 }}

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::::{grid-item-card} Cons

- {{ mod\_is\_con\_01 }}

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

This section will be available soon! In the meantime, check out the information in the other tabs!

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

:::{note}

\*\*This content was adapted from\*\*: The Density Handbook, “[Using Camera Traps to Estimate Medium and Large Mammal Density: Comparison of Methods and Recommendations for Wildlife Managers](https://www.researchgate.net/publication/368601884\_Using\_Camera\_Traps\_to\_Estimate\_Medium\_and\_Large\_Mammal\_Density\_Comparison\_of\_Methods\_and\_Recommendations\_for\_Wildlife\_Managers)” (Clarke et al., 2024)

:::

The instantaneous sampling model (IS) is an extension of the space-to-event model (STE; see above) that uses counts of animals in time-lapse images – instead of the area until an animal is first detected – to estimate density ({{ rtxt\_moeller\_et\_al\_2018 }}). As with the STE, all cameras in a randomly-deployed array are programmed to take time-lapse images at predefined intervals (e.g., every hour) to get instantaneous “snapshot” samples of the study area. During image processing, the number of animals in each photograph is recorded. Thus, the IS is essentially a series of fixed-area point counts ({{ rtxt\_moeller\_et\_al\_2018 }}): camera traps act as “standing observers” tabulating the number of individuals seen within a set area and time.

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```

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**## Simulations and Field Experiments**

The IS is relatively untested opposite its sister models. Simulations have shown that the IS is unbiased to animal movement speed or population size, so is applicable to slow- and fast-moving animals and to low- and high-density populations ({{ rtxt\_moeller\_et\_al\_2018 }}). When tested on a population of elk in Idaho, the IS produced a similar density estimate as an aerial survey, but which was less precise than both TTE- and STE-derived estimates ({{ rtxt\_moeller\_et\_al\_2018 }}).

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\*\*Caravaggi et al. (2017) - Fig. 1.\*\* Examples of animal behaviour captured by camera traps:

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(A) Scent marking by an American black bear (\*Ursus americanus\*); (B) intraspecific competition in moose (\*Alces alces\*); (C) interspecific interactions between a European hare (\*Lepus europaeus\*; anti-predator response), a common buzzard (\*Buteo buteo\*; avoidance and attempted predation) and a hooded crow (\*Corvus cornix\*; anti-predator behaviour) captured on video (available at 10.6084/m9.figshare.4508369); (D) predation of a European rabbit (\*Oryctolagus cuniculus\*) by a red fox (\*Vulpes vulpes\*); (E) investigation of a squirrel feeding station by a pine marten (\*Martes martes\*); (F) nut caching by a grey squirrel (\*Sciurus carolinensis\*). Images provided by A.C. Burton (a, b), A. Caravaggi (c, d) and C.M.V. Finlay (e, f).

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::::{grid-item-card} {{ rtxt\_caravaggi\_et\_al\_2020 }}

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\*\*Caravaggi et al. (2020) - Fig 1.\*\* Examples of mammals detecting camera traps and/or olfactory cues associated with camera traps.

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(a) Chimpanzee, \*Pan troglodytes\*; (b) African elephant, \*Loxodonta africana\*; (c) sitatunga, \*Tragelaphus spekii\*; (d) moose, \*Alces alces\*; (e) Eurasian lynx, \*Lynx lynx\*; (f) polar bear, \*Ursus maritimus\*; (g) roe deer, \*Capreolus capreolus\*; (h) African leopard, \*Panthera pardus\*; (i) mountain gorilla, \*Gorilla beringei\*; (j) red fox, \*Vulpes vulpes\*; (k) wolverine, \*Gulo gulo\*; (l) grizzly bear, \*Ursus arctos\*; (m) spotted hyena, \*Crocuta crocuta\*; (n) red deer, \*Cervus elaphus\*; (o) grey wolf, \*Canis lupus\*. Images provided by Ammie K. Kalan (a–c,i), T. R. H. (d,e), D. R. (f,o), S. G. (g,n), A. C. (h,j), J. T. F. (k,l), A. G. (m). Visit <https://doi.org/10.6084/m9.figshare.c.4593902.v1> for selected source video.

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\*\*Moeller & Lukacs (2022)\*\* The spaceNtime workflow for count data. The user will go through five major steps for STE, TTE, and IS analyses. If the user has presence/absence (0 and 1) data instead of count data, the IS analysis is not appropriate, and the IS pathway should be removed from the flowchart.

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

Check back in the future!

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:::::{tab-item} Analytical tools & Resources

| Type | Name | Note | URL |Reference |

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

| R package | spaceNtime: an R package for estimating abundance of unmarked animals using camera-trap photographs | free and open-source R package designed to assist in the implementation of the STE and TTE models, along with the IS estimator | <https://github.com/annam21/spaceNtime;<br><https://link.springer.com/article/10.1007/s42991-021-00181-8> | {{ rbib\_moeller\_lukacs\_2022 }} |

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{{ rbib\_moeller\_et\_al\_2018 }}

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