## Topic Info

|  |  |
| --- | --- |
| **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

:align: center

:width: 150px

```

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

|  |  |  |  |
| --- | --- | --- | --- |
| **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)\*\* The IS equation | clarke\_et\_al\_2023 |
|  | figure3\_filename.png | figure3\_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 |
|  | figure7\_filename.png | figure7\_caption | figure7\_ref\_id |
|  | figure8\_filename.png | figure8\_caption | figure8\_ref\_id |
|  | figure9\_filename.png | figure9\_caption | figure9\_ref\_id |
|  | figure10\_filename.png | figure10\_caption | figure10\_ref\_id |
|  | figure11\_filename.png | figure11\_caption | figure11\_ref\_id |
|  | figure12\_filename.png | figure12\_caption | figure12\_ref\_id |
|  |  |  |  |
|  |  |  |  |

## Video

|  |  |  |
| --- | --- | --- |
| **caption** | **URL (no < / > before/after URL** | **ref\_id** |
| vid1\_caption | vid1\_url | vid1\_ref\_id |
| vid2\_caption | vid2\_url | vid2\_ref\_id |
| 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 |
| vid7\_caption | vid7\_url | vid7\_ref\_id |
| vid8\_caption | vid8\_url | vid8\_ref\_id |
| vid9\_caption | vid9\_url | vid9\_ref\_id |
| vid10\_caption | vid10\_url | vid10\_ref\_id |
| vid11\_caption | vid11\_url | vid11\_ref\_id |
| vid12\_caption | vid12\_url | vid12\_ref\_id |
| vid13\_caption | vid13\_url | vid13\_ref\_id |
| vid14\_caption | vid14\_url | vid14\_ref\_id |
| vid15\_caption | vid15\_url | vid15\_ref\_id |
|  |  |  |
|  |  |  |
|  |  |  |

## Shiny

Shiny name = shiny\_name

Shiny caption = shiny\_caption

Shiny URL = shiny\_url

Shiny name = shiny\_name2

Shiny caption =shiny\_caption2

Shiny URL = shiny\_url2

## Analytical tools & resources

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **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\_2021 |
| resource2\_type | resource2\_name | resource2\_note | resource2\_url | resource2\_ref\_id |
| resource3\_type | resource3\_name | resource3\_note | resource3\_url | resource3\_ref\_id |
| resource4\_type | resource4\_name | resource4\_note | resource4\_url | resource4\_ref\_id |
| resource5\_type | resource5\_name | resource5\_note | resource5\_url | resource5\_ref\_id |
| resource6\_type | resource6\_name | resource6\_note | resource6\_url | resource6\_ref\_id |
| resource7\_type | resource7\_name | resource7\_note | resource7\_url | resource7\_ref\_id |
| resource8\_type | resource8\_name | resource8\_note | resource8\_url | resource8\_ref\_id |
| resource9\_type | resource9\_name | resource9\_note | resource9\_url | resource9\_ref\_id |
| resource10\_type | resource10\_name | resource10\_note | resource10\_url | resource10\_ref\_id |
| resource11\_type | resource11\_name | resource11\_note | resource11\_url | resource11\_ref\_id |
| resource12\_type | resource12\_name | resource12\_note | resource12\_url | resource12\_ref\_id |
| resource13\_type | resource13\_name | resource13\_note | resource13\_url | resource13\_ref\_id |
| resource14\_type | resource14\_name | resource14\_note | resource14\_url | resource14\_ref\_id |
| resource15\_type | resource15\_name | resource15\_note | resource15\_url | resource15\_ref\_id |
| resource16\_type | resource16\_name | resource16\_note | resource16\_url | resource16\_ref\_id |
| resource17\_type | resource17\_name | resource17\_note | resource17\_url | resource17\_ref\_id |
| resource18\_type | resource18\_name | resource18\_note | resource18\_url | resource18\_ref\_id |
| resource19\_type | resource19\_name | resource19\_note | resource19\_url | resource19\_ref\_id |
| resource20\_type | resource20\_name | resource20\_note | resource20\_url | resource20\_ref\_id |
| resource21\_type | resource21\_name | resource21\_note | resource21\_url | resource21\_ref\_id |
| resource22\_type | resource22\_name | resource22\_note | resource22\_url | resource22\_ref\_id |
| resource23\_type | resource23\_name | resource23\_note | resource23\_url | resource23\_ref\_id |
| resource24\_type | resource24\_name | resource24\_note | resource24\_url | resource24\_ref\_id |
| resource25\_type | resource25\_name | resource25\_note | resource25\_url | resource25\_ref\_id |

## References / Glossary

|  |  |
| --- | --- |
| **ref\_id** |  |
| {{ rbib\_clarke\_et\_al\_2023 }}  {{ rbib\_moeller\_et\_al\_2018 }}  {{ rbib\_moeller\_et\_al\_2021 }} |  |

## Notes

##### POPULATE - MOD

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

---  
jupytext:  
[[space2]]formats: md:myst

[[space2]]text\_representation:

[[space4]]extension: .md

[[space4]]format\_name: myst

[[space4]]format\_version: 0.17.2 <!--0.13-->

[[space4]]jupytext\_version: 1.16.4 <!-- 6.5.4-->  
kernelspec:  
[[space2]]display\_name: Python 3

[[space2]]language: python

[[space2]]name: python3  
editor\_options:   
[[space2]]markdown:

[[space4]]wrap: none  
---

(i\_mod\_is)=  
# {{ title\_i\_mod\_is }}

:::{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>`

:::

```{include} pro\_con\_assump/mod\_is\_apc.md  
```

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

::::::{tab-item} Overview  
```{include} include/00\_coming\_soon.md

```  
::::::

::::::{tab-item} 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

:align: center

:width: 150px

```

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 }}).

::::::

::::::{tab-item} Visual resources

:::::{grid} 3  
:class: wrapper

::::{grid-item-card} {{ rtxt\_moeller\_lukacs\_2021 }}  
:::{figure} ../03\_images/03\_image\_files/moeller\_lukacs\_2021\_fig1.png  
:class: img\_grid  
:::  
\*\*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.  
::::

::::{grid-item-card} {{ rtxt\_clarke\_et\_al\_2023 }}  
:::{figure} ../03\_images/03\_image\_files/clarke\_et\_al\_2023\_eqn\_is1.png   
:class: img\_grid  
:::  
\*\*Clarke et al., (2023)\*\* The IS equation  
::::

::::{grid-item-card} {{ rtxt\_figure3\_ref\_id }}  
:::{figure} ../03\_images/03\_image\_files/figure3\_filename.png   
:class: img\_grid  
:::  
figure3\_caption  
::::

::::::

::::::{tab-item} Shiny apps/Widgets  
Check back in the future!  
::::::

:::::{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\_**Error! Reference source not found.** }} |  
| resource2\_type | resource2\_name | resource2\_note | resource2\_url | {{ rbib\_resource2\_ref\_id }} |  
| resource3\_type | **resource3\_name |** resource3\_note | resource3\_url | {{ rbib\_resource3\_ref\_id }} |  
| resource4\_type | resource4\_name | resource4\_note | resource4\_url | {{ **rbib\_**resource4\_**ref**\_id }} |  
| resource5\_type | resource5\_name | **resource5\_note |** resource5\_url | {{ rbib\_resource5\_ref\_id }} |  
| resource6\_type | resource6\_**name** |resource6\_note | resource6\_url | {{ rbib\_**resource6\_**ref**\_id }}** |  
| resource7\_type | resource7\_name | resource7\_note | **resource7\_url** | {{rbib\_resource7\_ref\_id }} |  
| resource8\_type | resource8\_name **|** resource8\_note | resource8\_url | {{ rbib\_resource8\_ref\_id}} |  
| **resource9**\_type | resource9\_name | resource9\_note | resource9\_url | {{ rbib\_resource9\_ref\_id }} |  
| resource10\_type | resource10\_name | resource10\_note | resource10\_url | {{ rbib\_resource10\_ref\_id }} |  
| resource11\_type | resource11\_name | resource11\_note | resource11\_url | {{ rbib\_resource11\_ref\_id }} |  
| resource12\_type | resource12\_name | resource12\_note | resource12\_url | {{ rbib\_resource12\_ref\_id }} |  
| resource13\_type | resource13\_name | resource13\_note | resource13\_url | {{ rbib\_resource13\_ref\_id }} |  
| resource14\_type | resource14\_name | resource14\_note | resource14\_url | {{ rbib\_resource14\_ref\_id }} |  
| resource15\_type | resource15\_name | resource15\_note | resource15\_url | {{ rbib\_resource15\_ref\_id }} |  
| resource16\_type | resource16\_name | resource16\_note | resource16\_url | {{ rbib\_resource16\_ref\_id }} |  
| resource17\_type | resource17\_name | resource17\_note | resource17\_url | {{ rbib\_resource17\_ref\_id }} |  
| resource18\_type | resource18\_name | resource18\_note | resource18\_url | {{ rbib\_resource18\_ref\_id }} |  
| resource19\_type | resource19\_name | resource19\_note | resource19\_url | {{ rbib\_resource19\_ref\_id }} |  
| resource20\_type | resource20\_name | resource20\_note | resource20\_url | {{ rbib\_resource20\_ref\_id }} |

<!-- END\_RESOURCE\_TABLE -->  
::::::

::::::{tab-item} References  
{{ rbib\_clarke\_et\_al\_2023 }}

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

{{ rbib\_moeller\_et\_al\_2021 }}   
::::::

:::::::