# Home range methods on indoor data

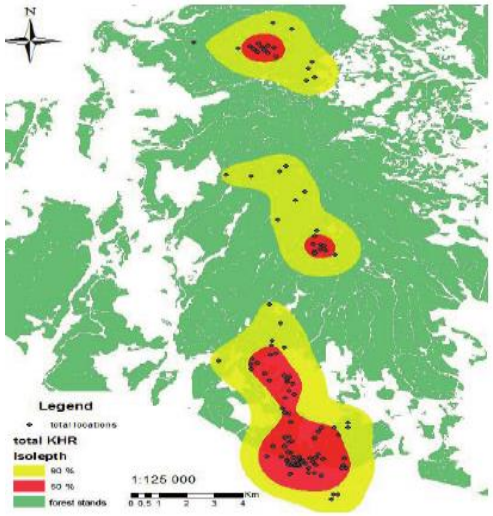
Hector Marina

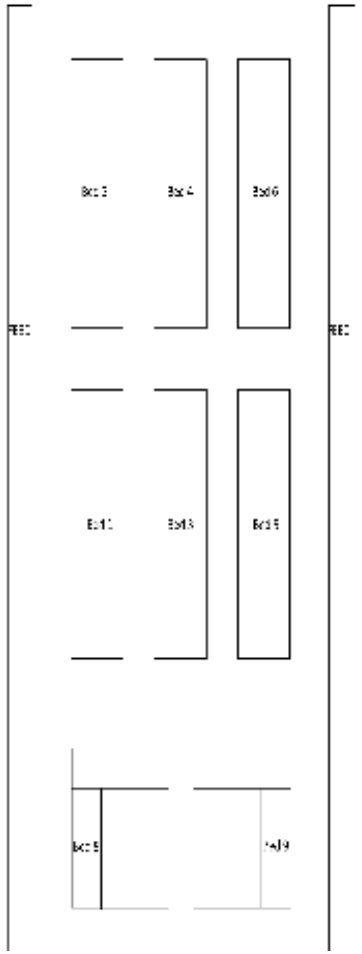
# Brief introduction

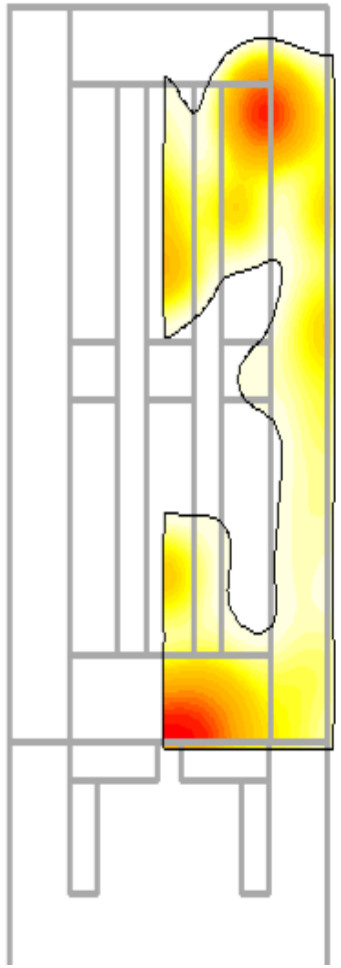
Home range:

- Area where it spends its time
- Encompasses all the resources the animal requires to survive and reproduce

(Burt, 1943)





# Different methods

## First-generation estimators

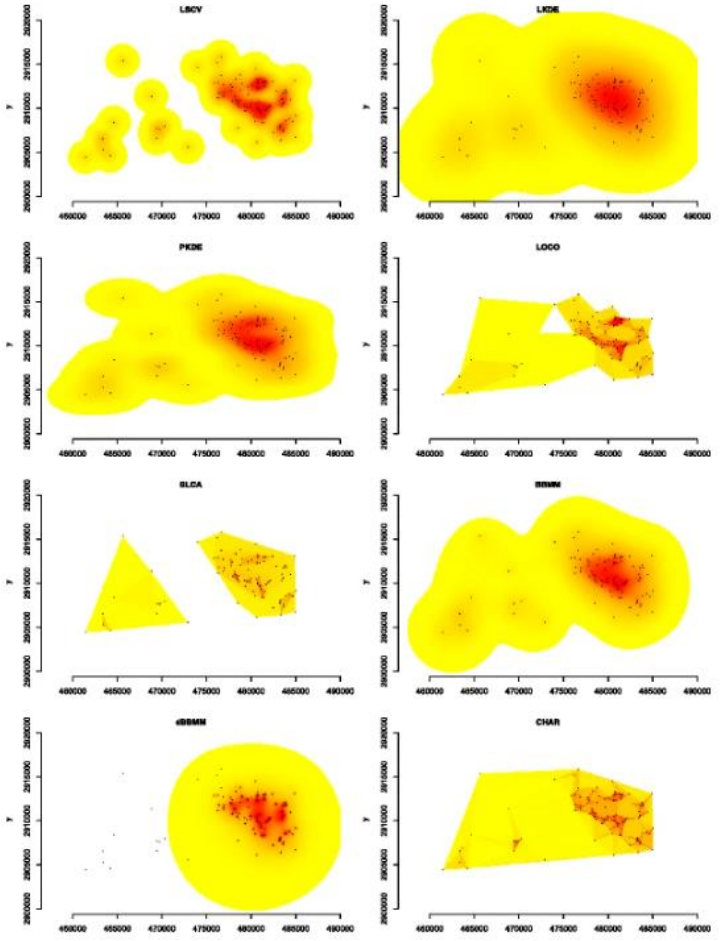
- Local convex hull
- Fixed kernel home range

## Second-generation estimators

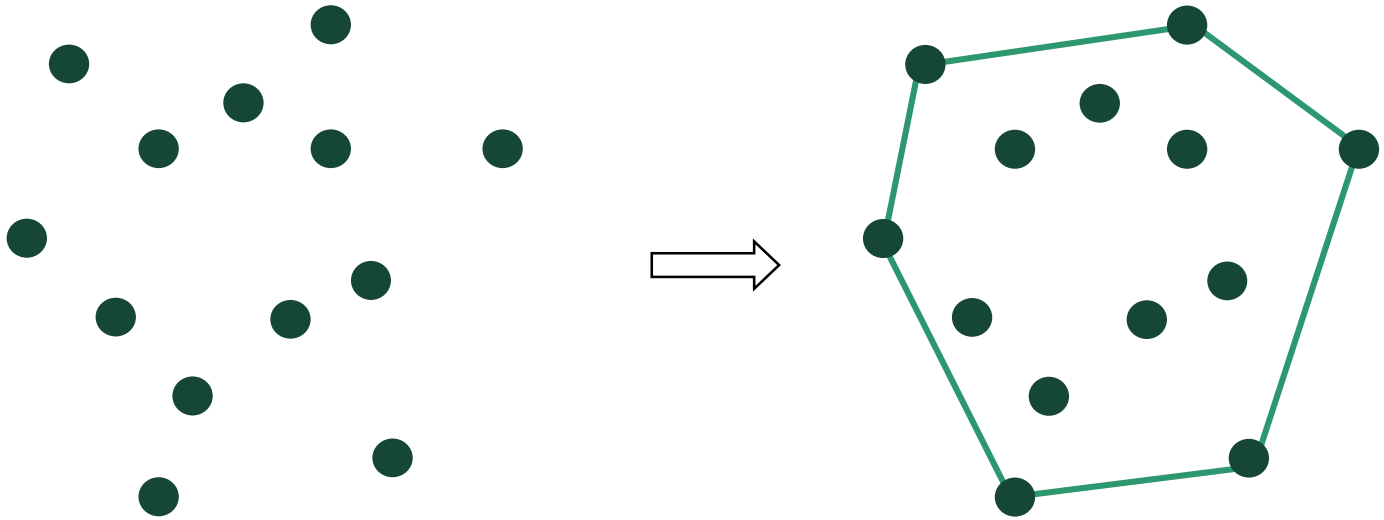
- Plug-in Kernel home range

## Third generation estimators

- Movement-based kernel density estimator
- Brownian bridge movement model

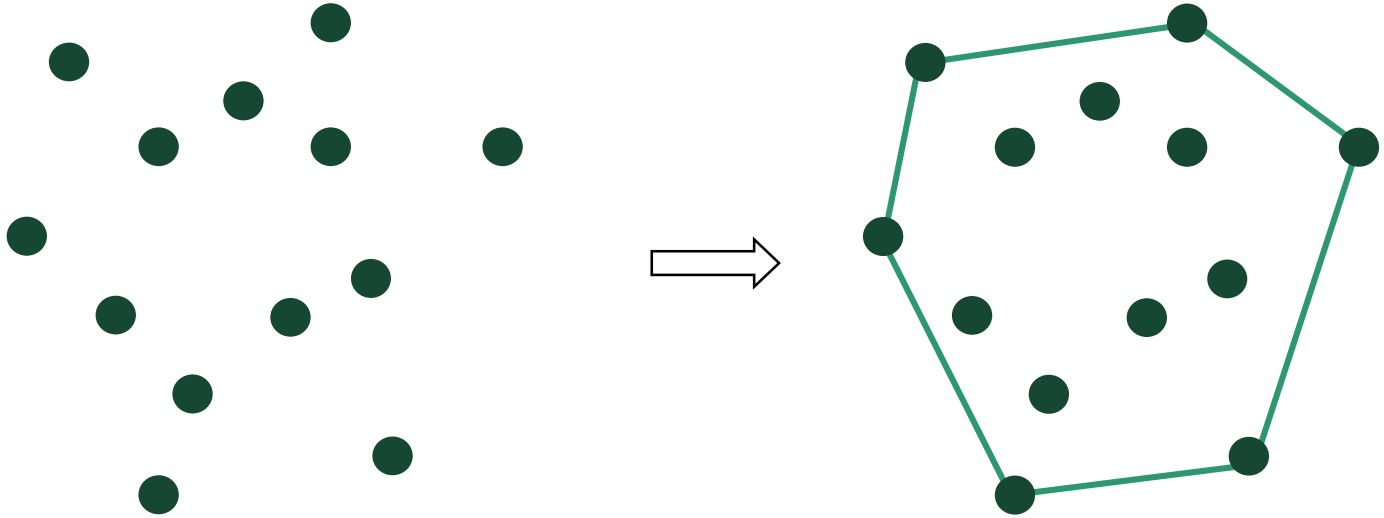



(Walter, 2015)



# Minimum Convex Polygon

- Convex hull or convex envelope or convex closure



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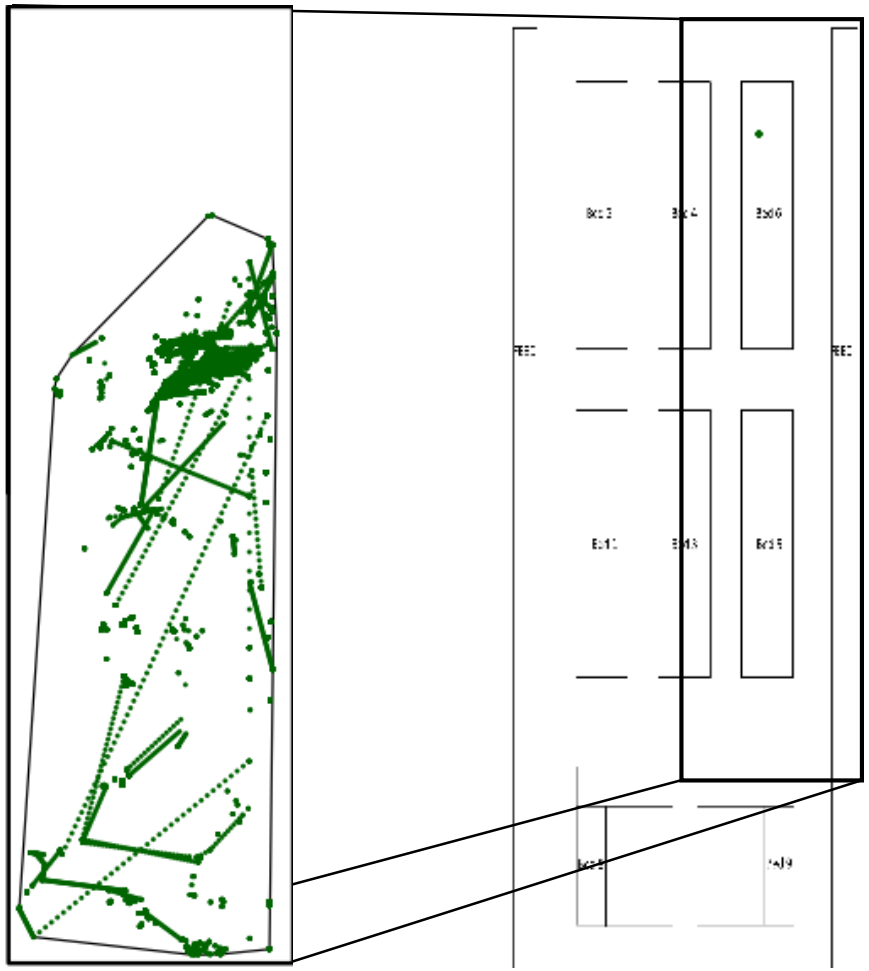

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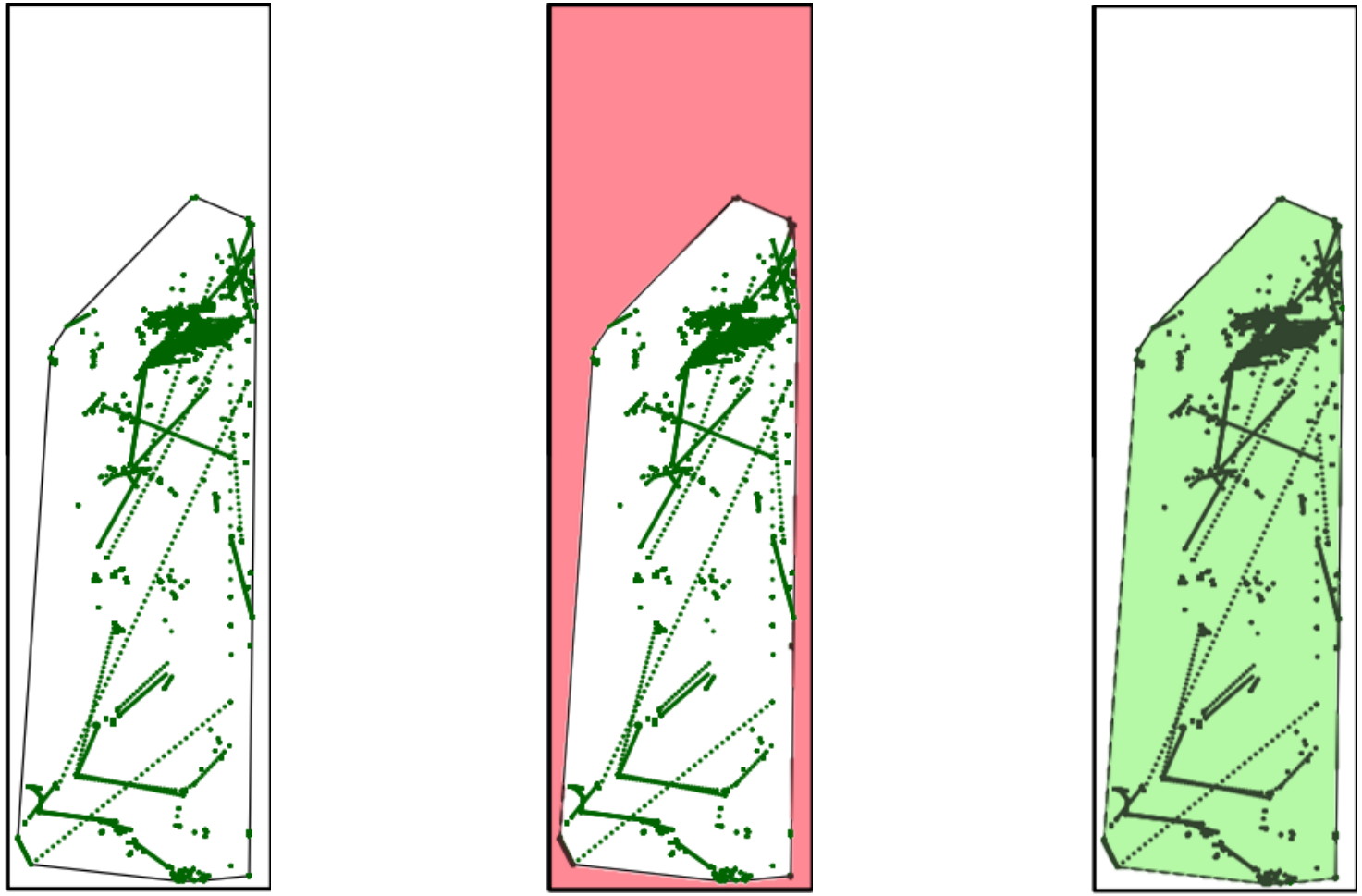
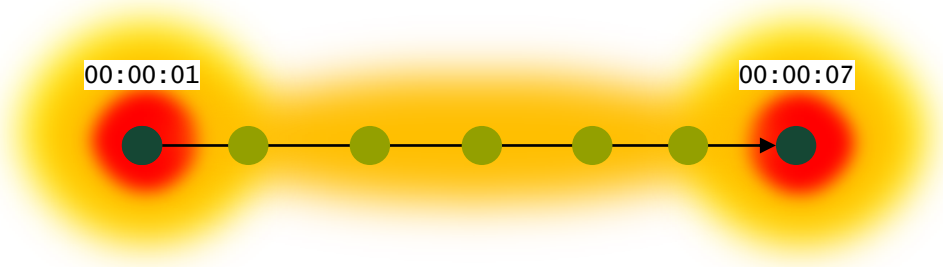


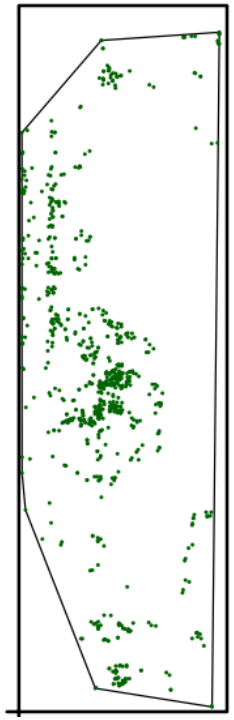
# Utilization Distributions

- Brownian bridge movement model
  1. Sequential location data
  2. Estimated error
  3. Grid-cell size for utilization distribution

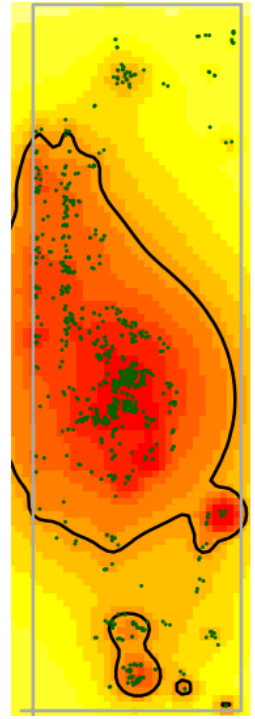
  – Paired locations becomes less realistic as the time interval increases




Convex hulls



Brownian bridge



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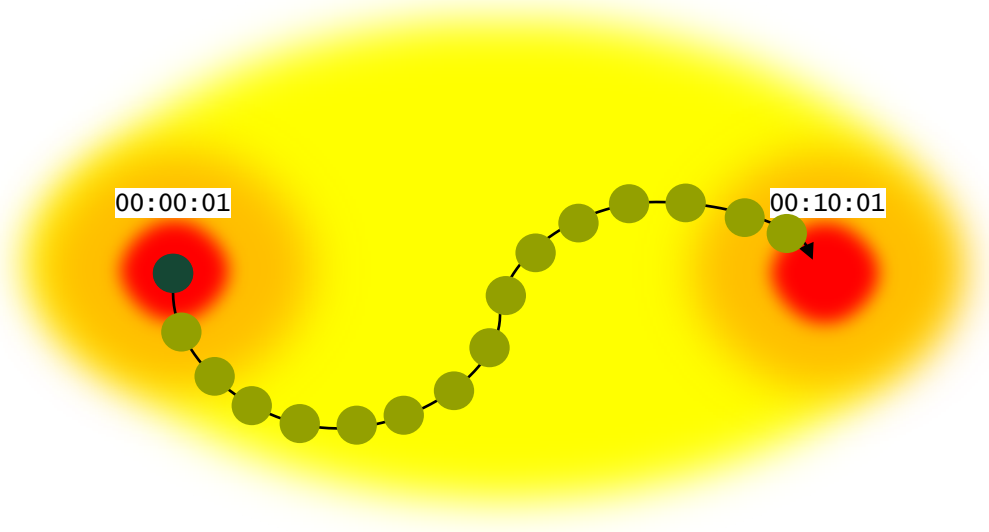


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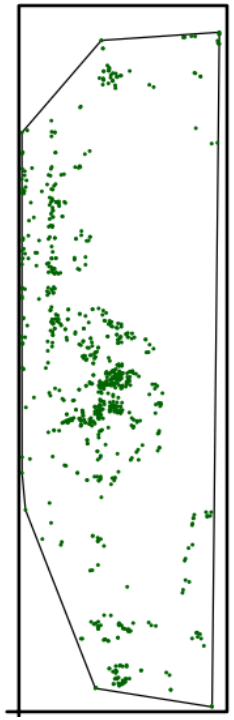

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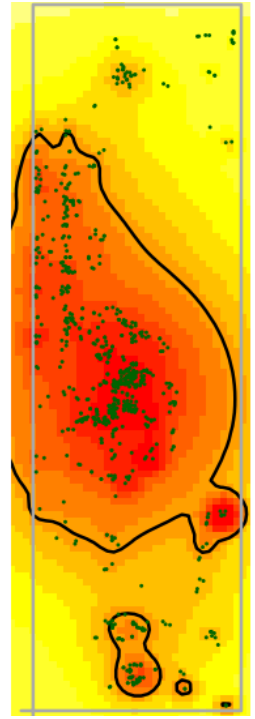


# Utilization Distributions

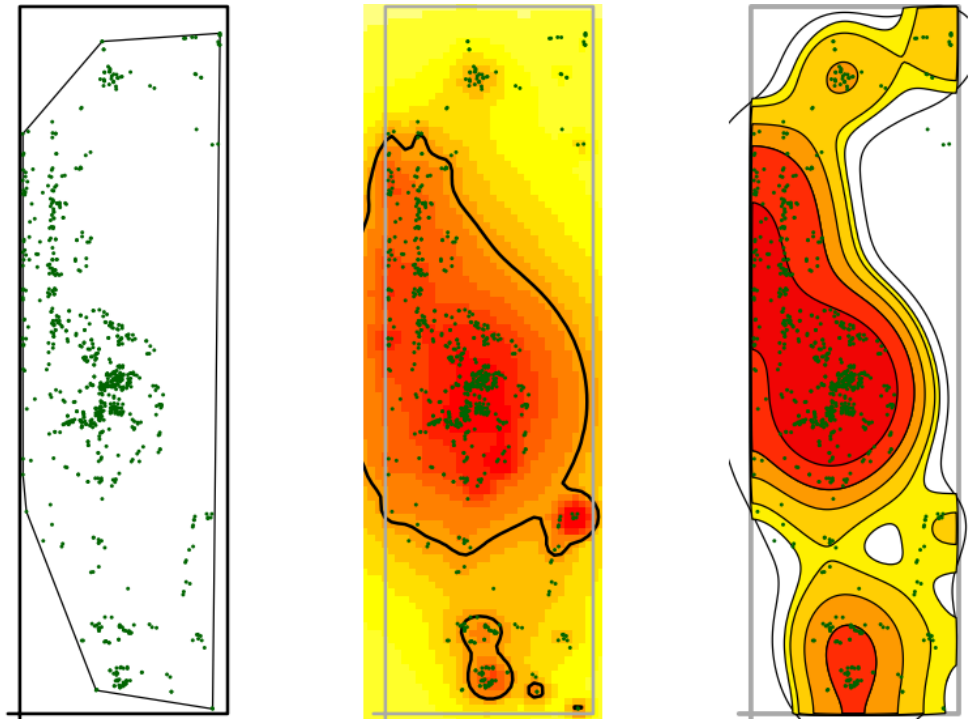
- Kernel density estimators
  - One of the most popular methods for measuring home ranges.
  - Several types of kernels
  - Similar results
  - Smoothing bandwidth (*ad hoc* method)

Number of data points

$$h = \sigma * n^{-1/6}$$

$$(0.5 * (sd_x + sd_y))$$

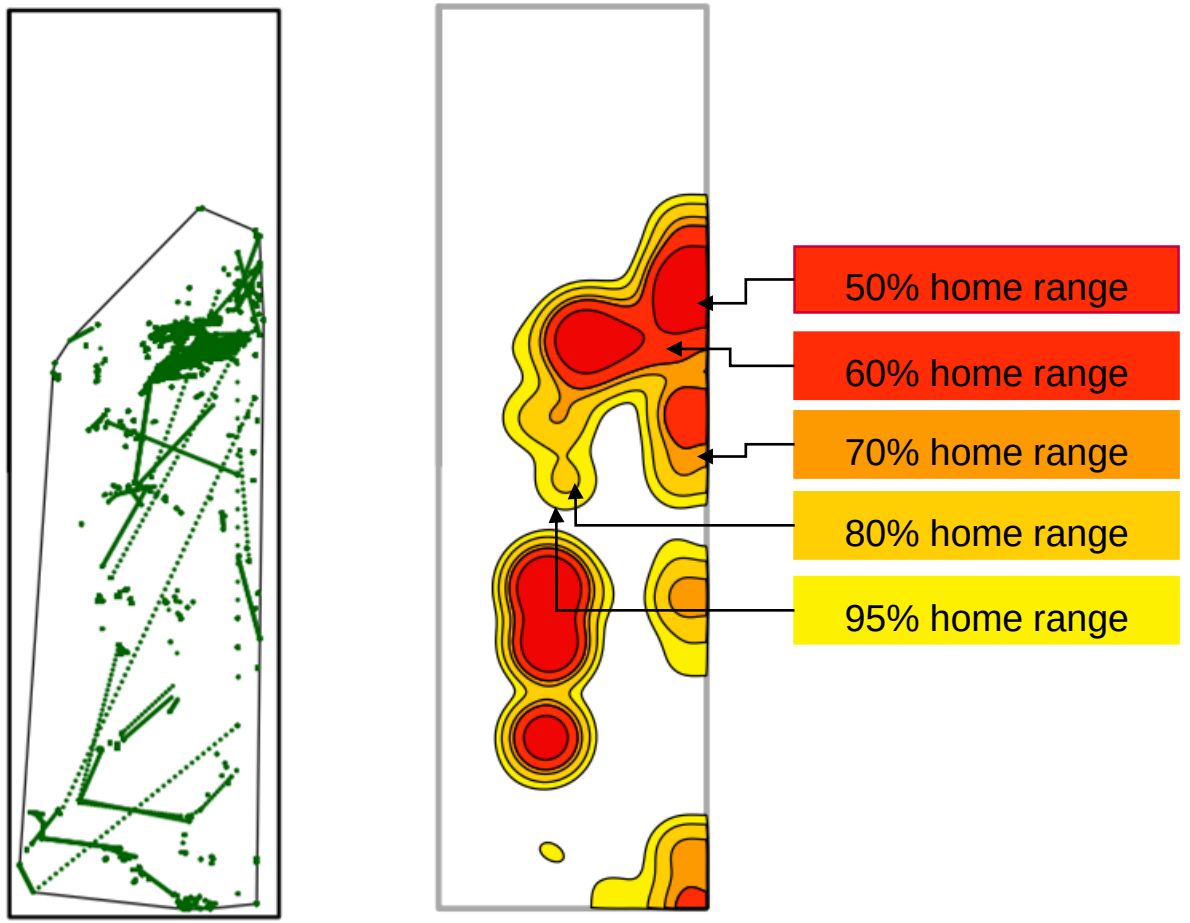
Convex hulls | Brownian bridge | Kernel



Krysten et al., (2014):
"*Examine the point distribution; justify the choice of smoothing parameter based on the objectives of the study*."

# Utilization Distributions

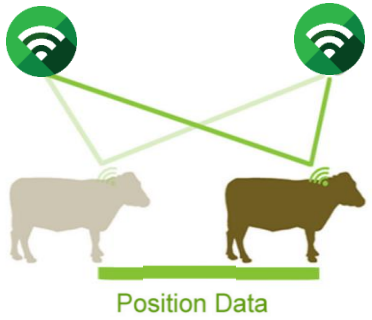
- Kernel density estimators

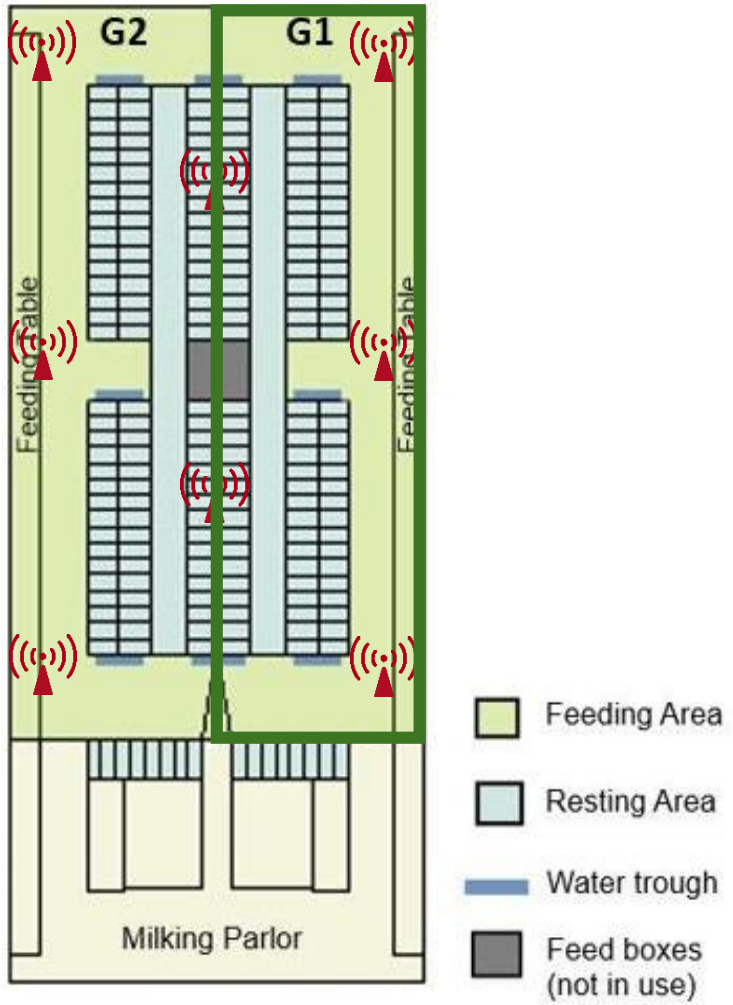


# Data manipulation

# Data manipulation

Real-time Location System

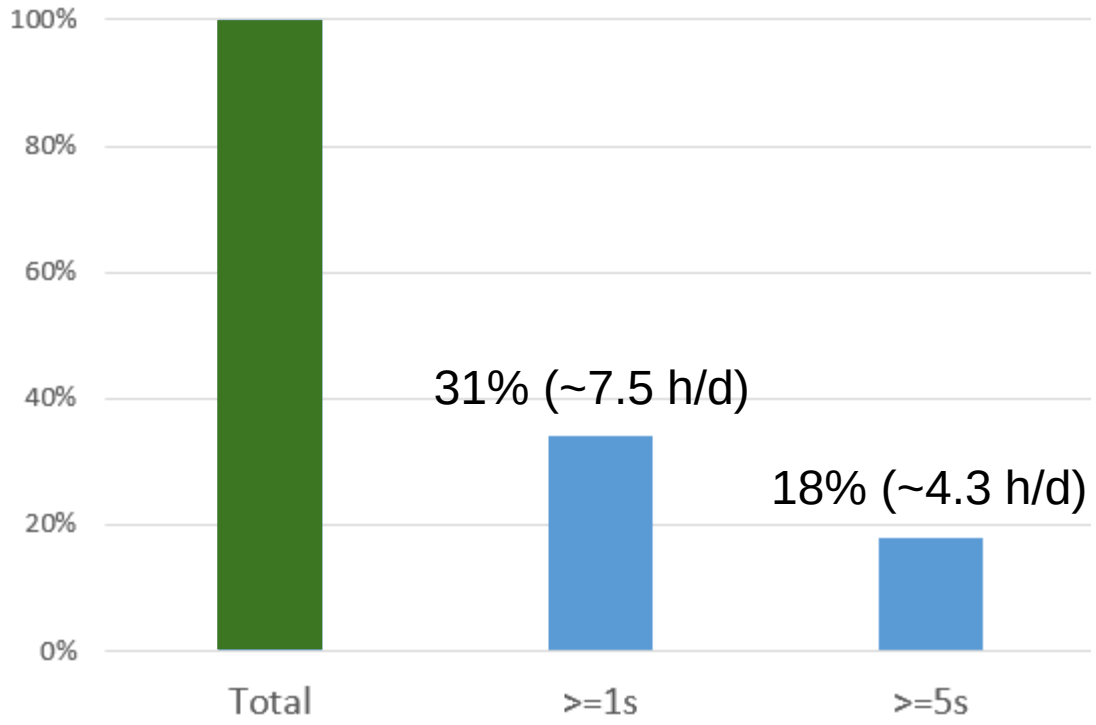


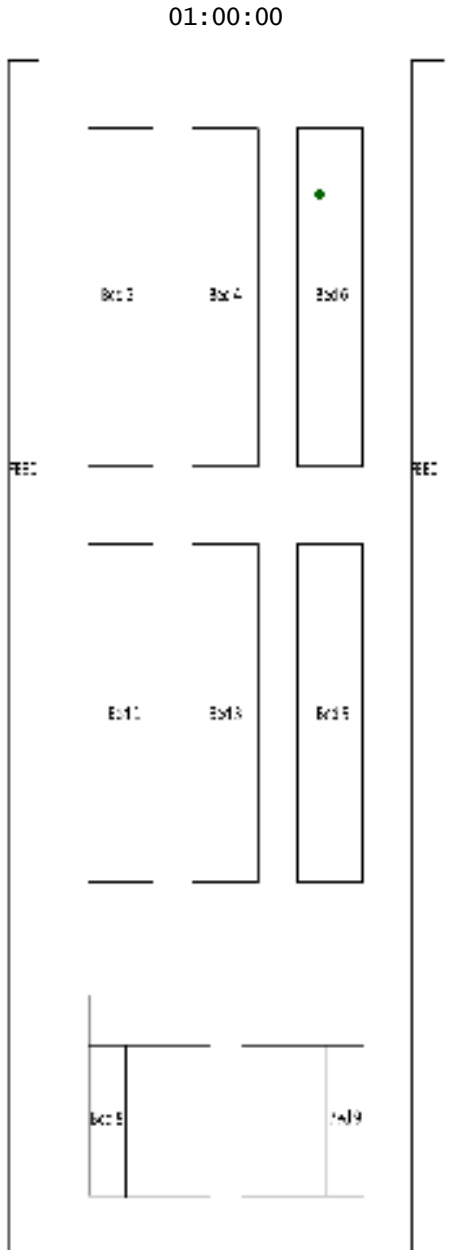

(Hansson et al., 2023)

# Data manipulation

## Interpolation methods



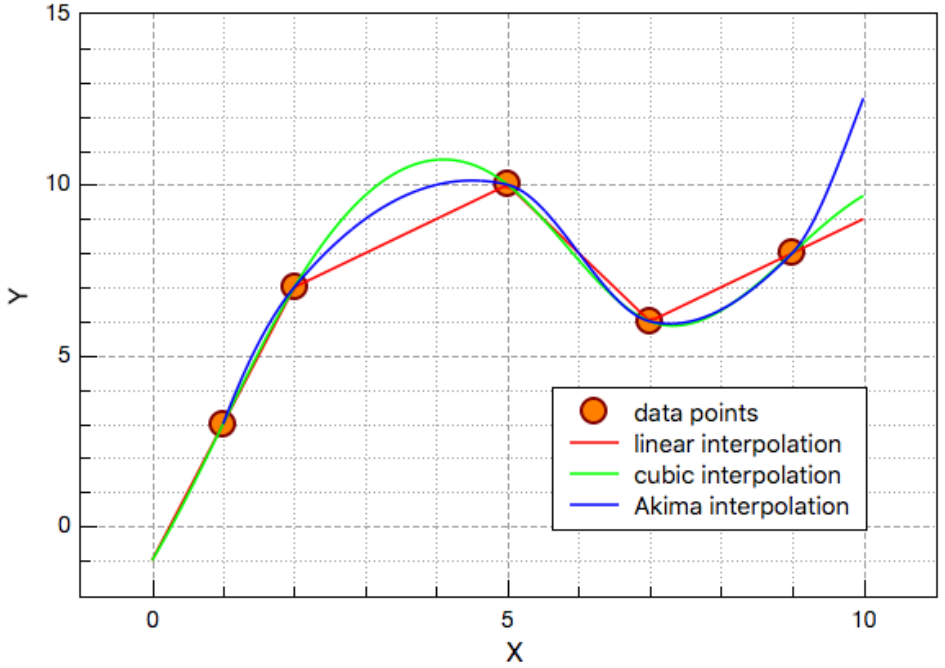

(Ren et al., 2021)



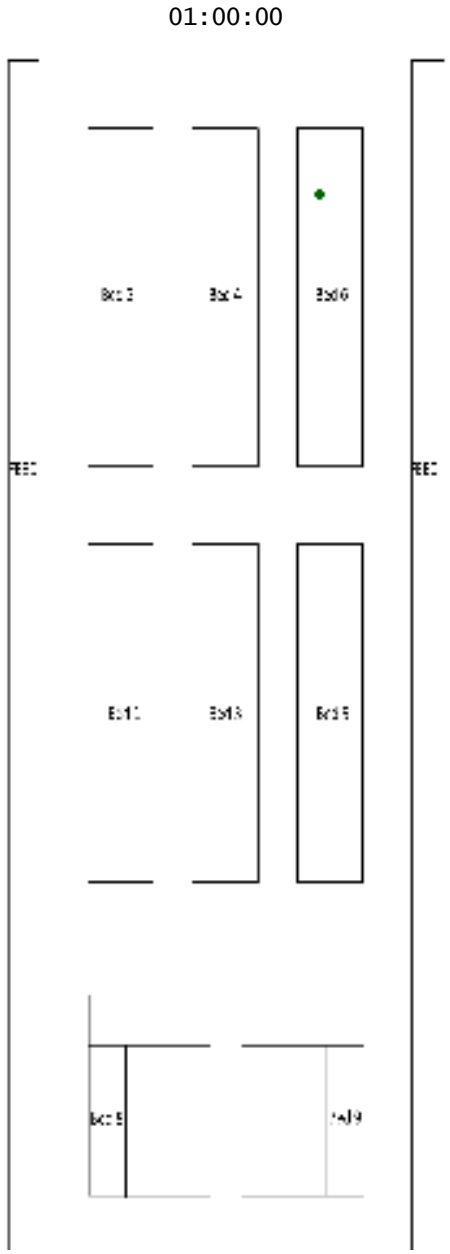
# Data manipulation

## Interpolation methods

- Maximising the information

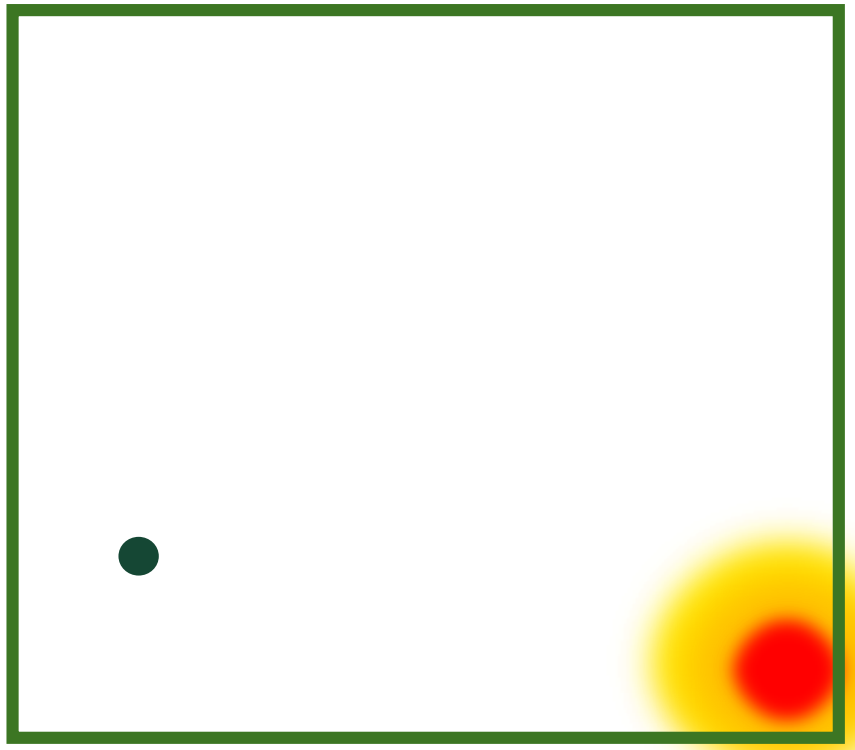


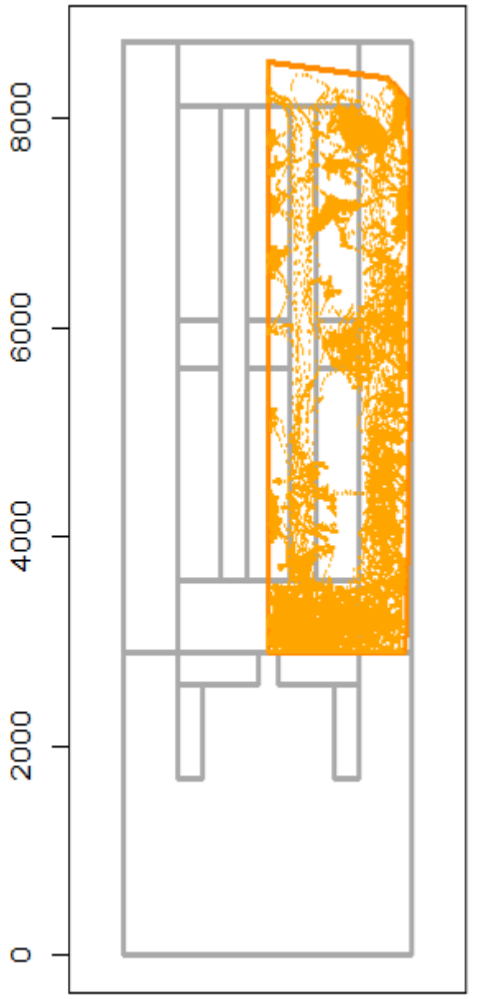

(Ren et al., 2022)

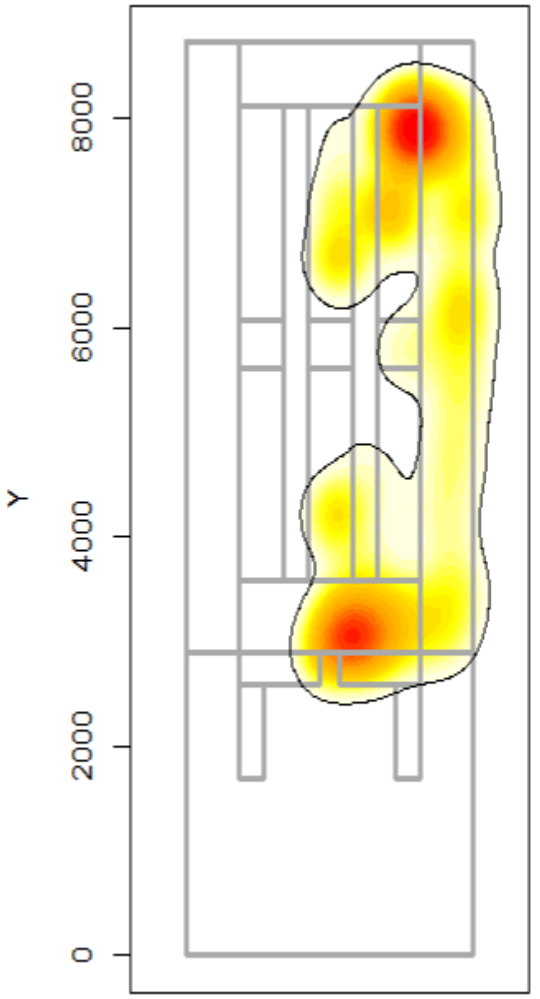


# Data manipulation

Boundaries





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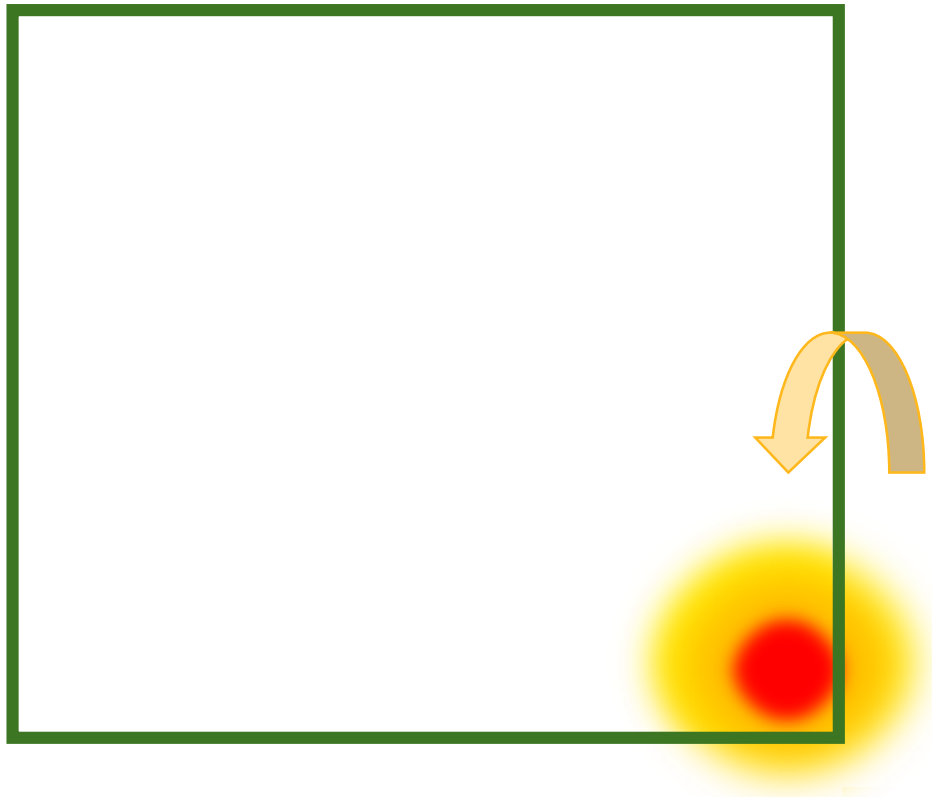
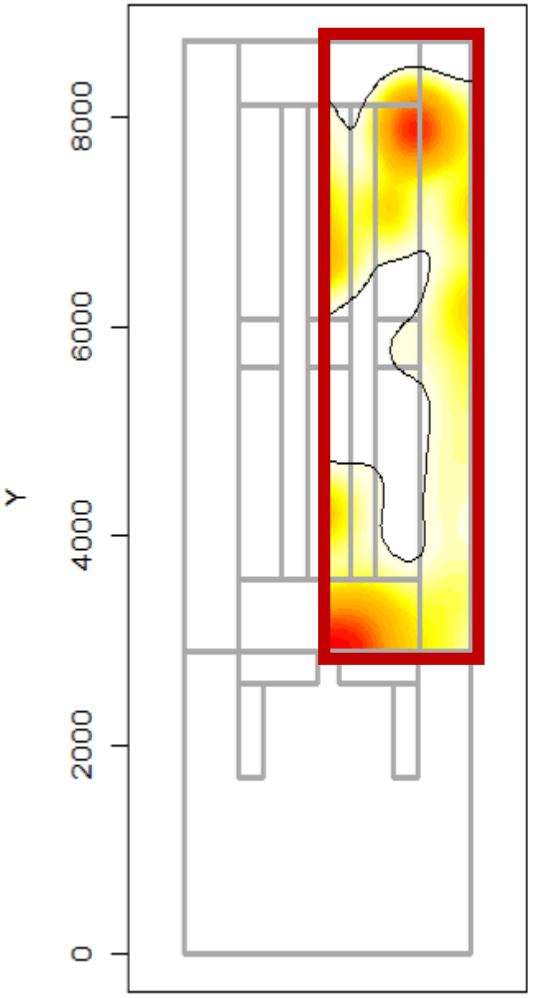


(Benhamou and Cornélis, 2010)

# Indoor home ranges applications

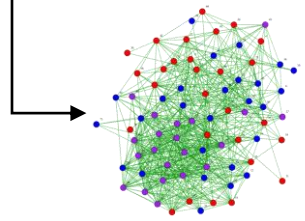
# Applications of indoor home ranges

- Area usage of the animals
  - Cubical preference
  - Feed bunk preference
- Locate high density areas

# Applications of indoor home ranges

- Barn area preference

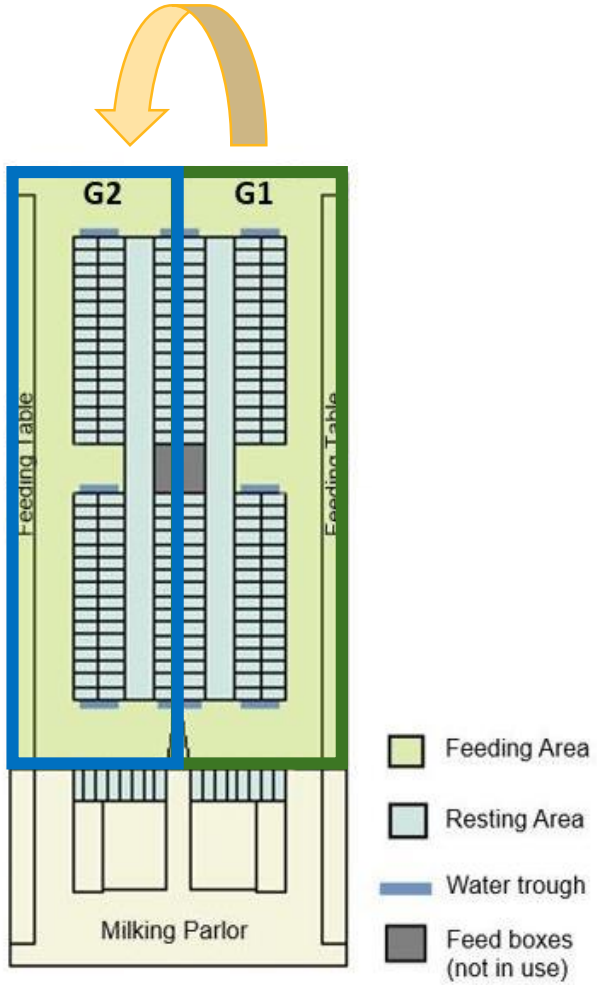
- Detect changes in behaviour

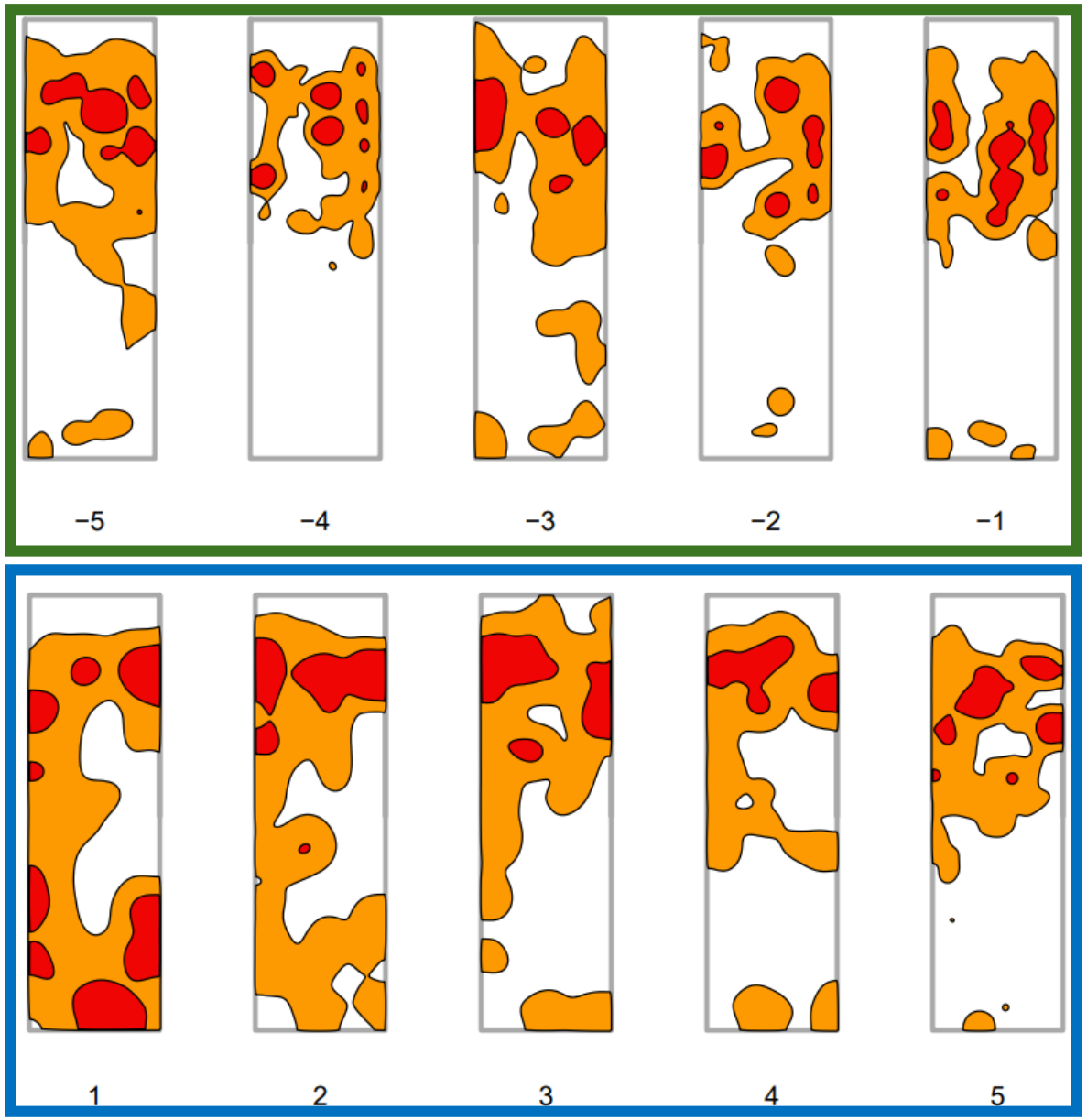


Social networks

# Applications of indoor home ranges

(Gussman et al., 2025)



# Recommended literature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10. Hansson, I., Silvera, A., Ren, K., Woudstra, S., Skarin, A., Fikse, W.F., Nielsen, P.P., Rönnegård, L., 2023. Cow characteristics associated with the variation in number of contacts between dairy cows. J. Dairy Sci. 106, 2685–2699. https://doi.org/10.3168/JDS.2022-21915



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6th PLE workshop / seminar

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hector.marina@slu.se

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