
ANIMOVE
P1.y=diag(c(0, 0.001, 0.001))
splayPar(mov.model=~1, err.model=list(x=~errX, y=~errY),
data=nfsNew, fixPar=c(NA, 1, NA, 1, NA, NA, NA, NA))
t <- crwMLE(mov.model=~1, err.model=list(x=~errX, y=~errY),
data=nfsNew, coord=c("longitude", "latitude"),
Time.name="Time", initial.state=initial.drift,
fixPar=c(NA, 1, NA, 1, NA, NA, NA, NA),
control=list(maxit=2000,trace=1, REPORT=10),

June 2024

Movement data in R

Area centered analysis: space use

Home range

A “home range” is the area that an individual utilizes to maintain its own energetic and behavioural demands.

Definition

Burt 1943[#]:

- “[…] I would restrict the home range to that area traversed by the individual in its normal activities of food gathering, mating, and caring for young […].”
- migratory animals have different home ranges during summer and winter, their migratory route is not part of a home range.
- “[…] young adolescent animals often do a bit of wandering in search of a home region. During this time they do not have a home, nor […] a home range.”

General understanding: “home range” is the area that an individual utilizes to maintain its own energetic and behavioral demands, due to technical and/or logistic limitations, the term ”home range” nonetheless remains widely used and is often understood in a loose reference to the area a tagged individual was observed in during the time of the study period.

[#]Burt, W. H. (1943). Territoriality and home range concepts as applied to mammals. Journal of mammalogy, 24(3), 346-352.

How to quantify “home range”?

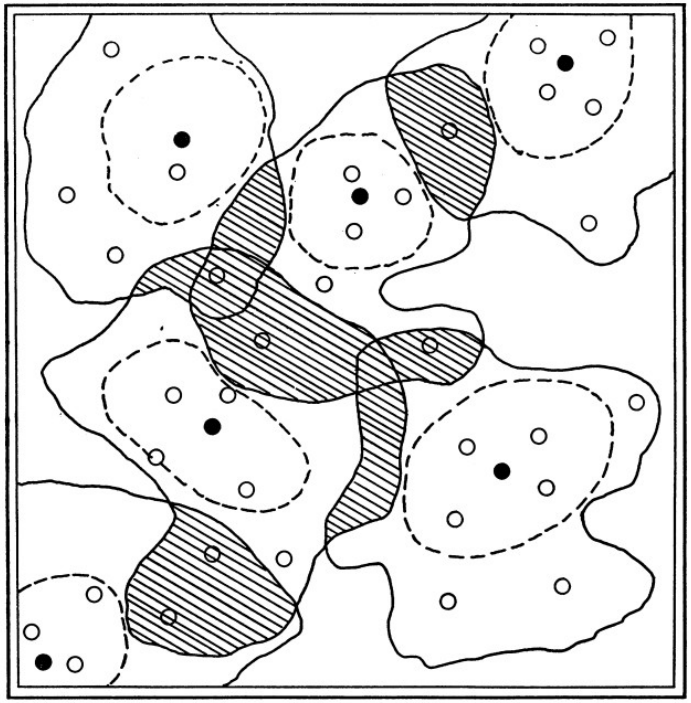
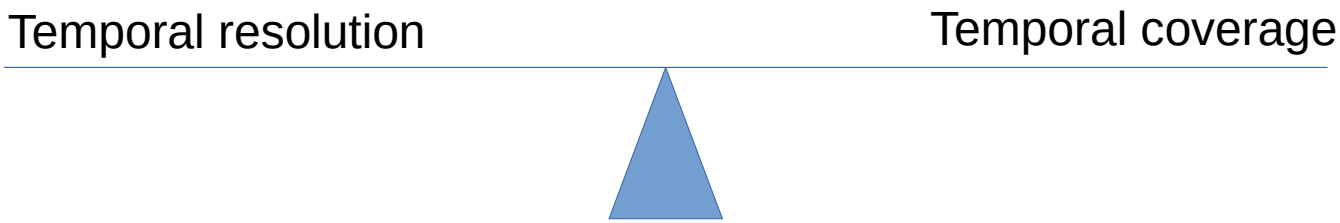


FIG. 1. Theoretical quadrat with six occupants of the same species and sex, showing territory and home range concepts as presented in text.

Burt, J Mammal 1943

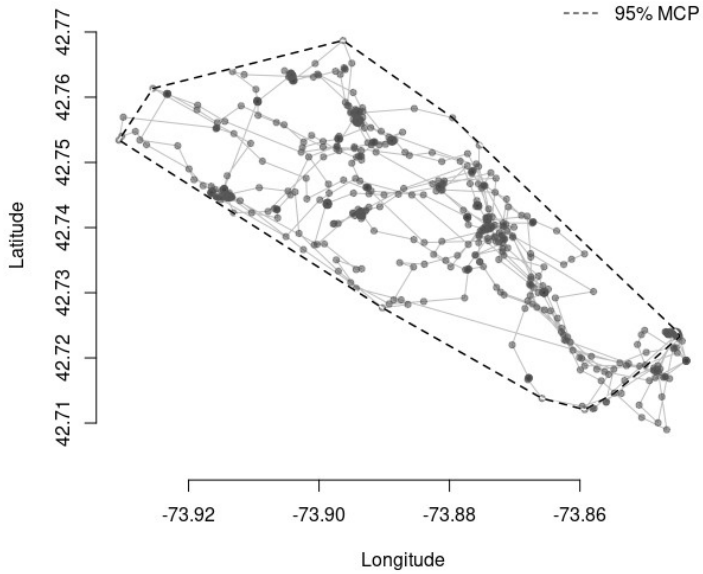
From observation to movement

Trade-off between how much for how long.



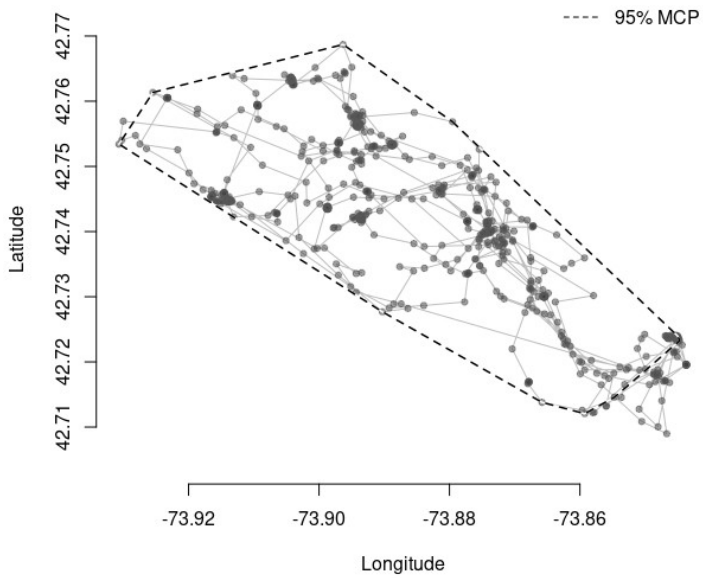
MCP (Minimum Convex Polygon)

* polygon with the minimum area containing e.g. 95% of the points (MCP95)



MCP (Minimum Convex Polygon)

* polygon with the minimum area containing e.g. 95% of the points (MCP95)
    - + simple approach
    - - assumes independence between observations
    - - does not account for errors
    - - includes areas that maybe do not make sense
    - - intensity of space use is lost



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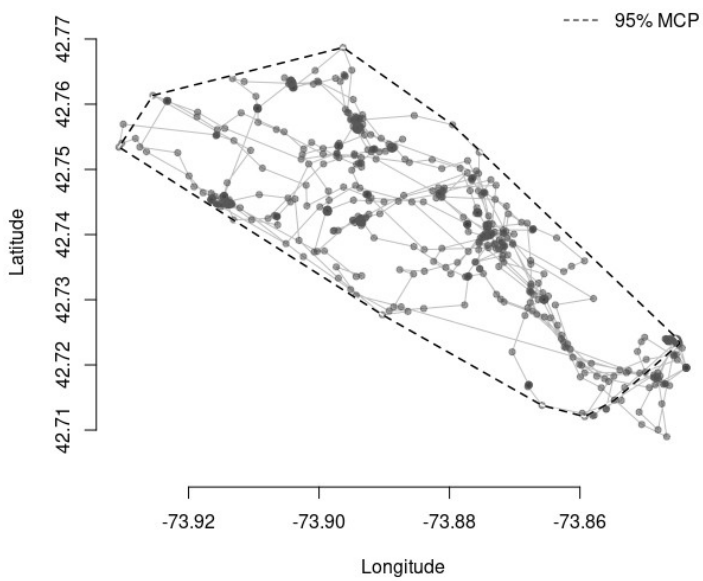
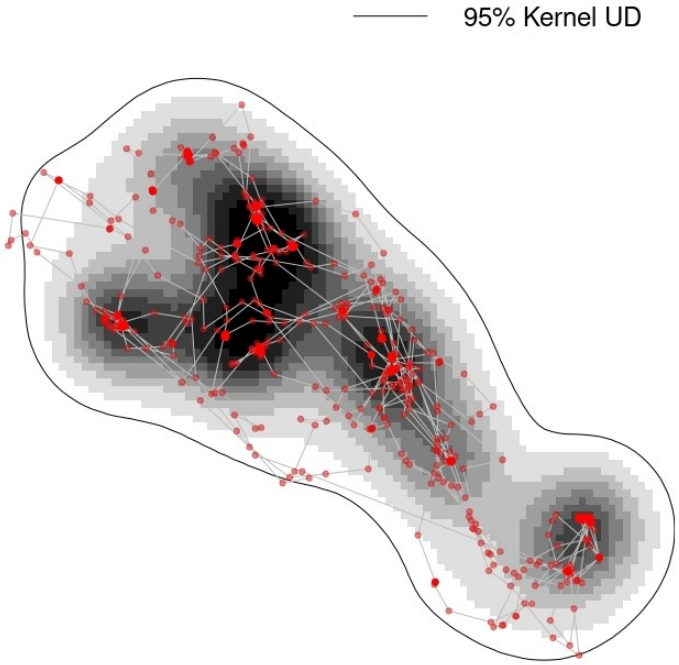


Note!: always reproject locations into equidistant projection before calculating MCP

KDE (Kernel-density estimation)

* calculates density of locations. Estimates the probability of encountering the animal given the independence of sampling.



KDE (Kernel-density estimation)

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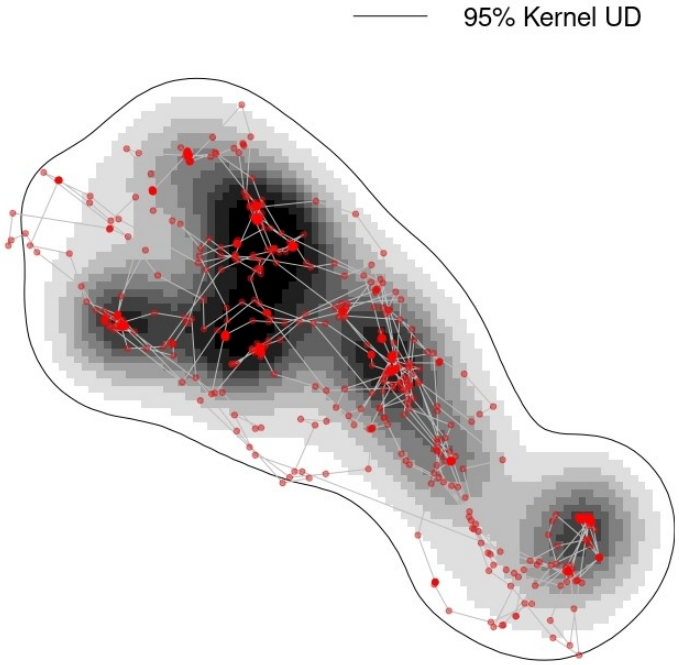
  - assumes independence between observations and regular sampling. Auto-correlation results in underestimating the area, often dramatically
  - results highly dependent on the chosen h value



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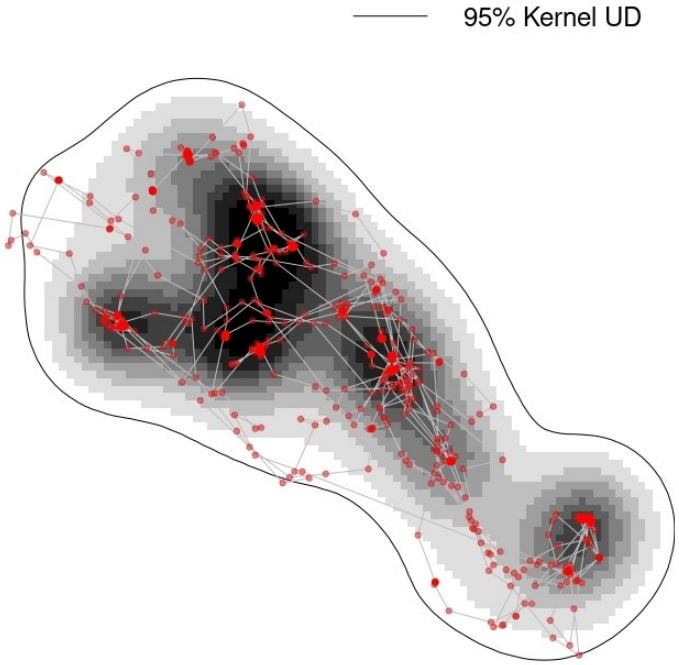
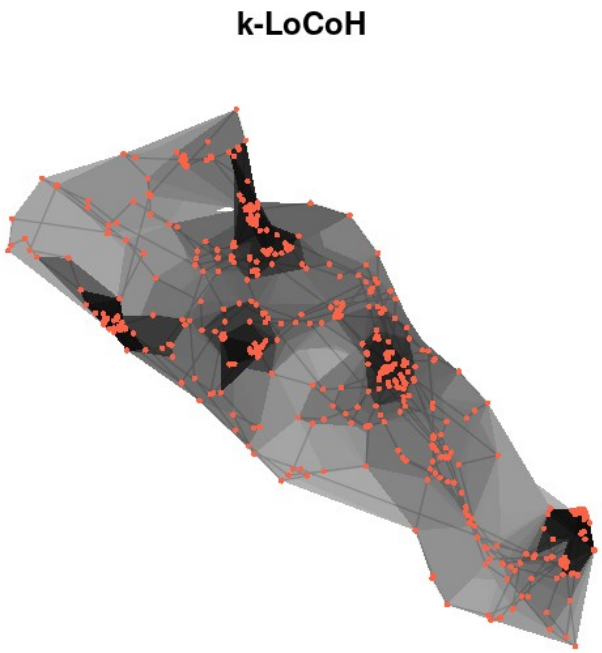
These assumptions where not such a problem when data was scarce.



LoCoH (Local Convex-Hull)

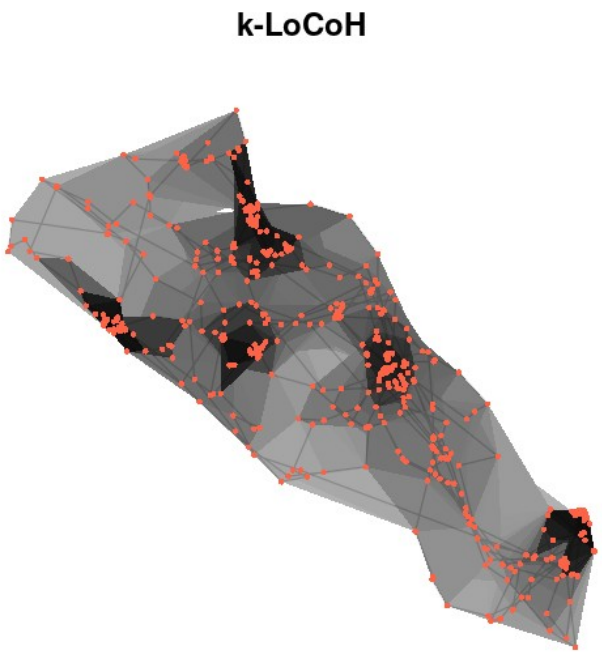
* builds local MCP (Hulls) for each location with *k* neighbors, or in *r* radius, or in a *a* sum of distances



LoCoH (Local Convex-Hull)

* builds local MCP (Hulls) for each location with *k* neighbors, or in *r* radius, or in a *a* sum of distances

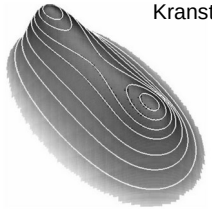
  + it takes into account that points are somewhat related
  + it excludes the areas that are not used
  - choosing k, r or a values in non-trivial
  - assumes independence between observations and regular sampling

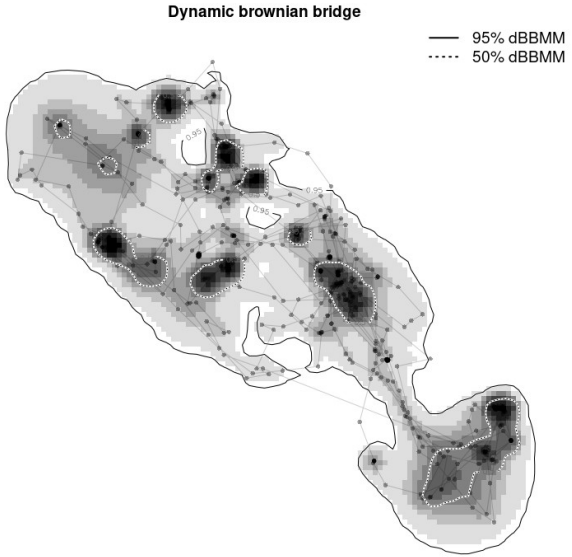


dBBMM (dynamic Brownian Bridge Movement Model)

* calculates the probability landscape for the transition between any two known consecutive locations given the amount of time it had available (assumes conditional random (Brownian) motion between locations)
* ”dynamic” because it allows the variance to change along the trajectory (see Lesson 4)

Horne, Ecology 2007
Kranstauber, J Anim Ecol 2012





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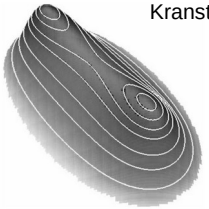

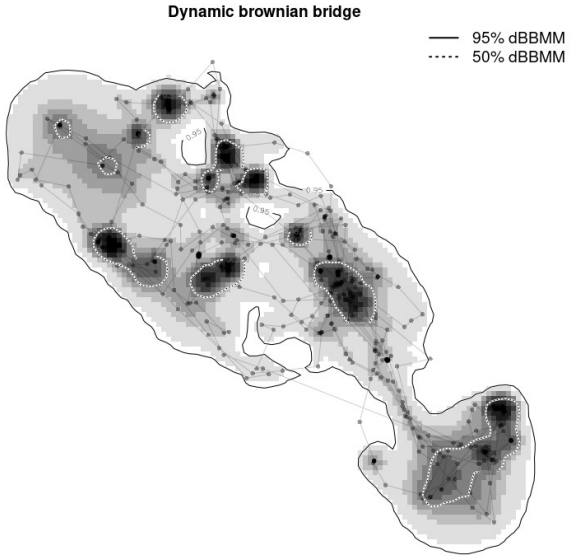

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! obtained area is highly scale dependent, it changes with sampling rate and with error of locations

Horne, Ecology 2007
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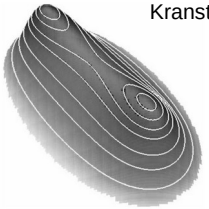

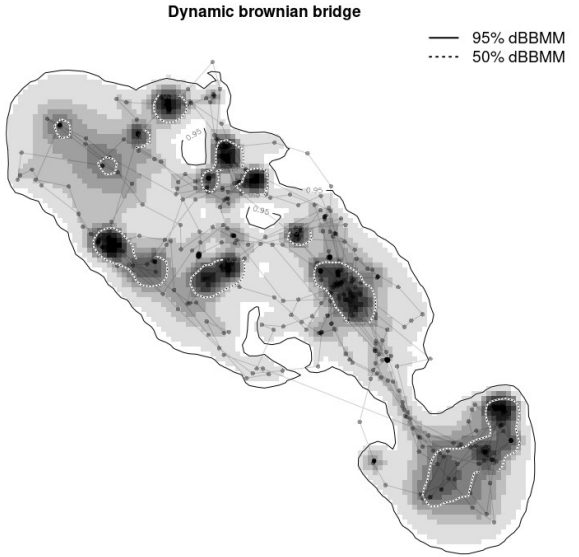

Space use

Range distribution[§] :

Occurrence distribution[§] :

[§]Fleming, et al. (2015). Rigorous home range estimation with movement data: a new auto-correlated kernel density estimator. Ecology, 96(5), 1182-1188.

Space use

Range distribution[§] :

- Lifetime space requirements of an animal (~ Home range)
- Provides a metric that should be comparable across individuals
- Ideally not affected by sample size and study duration (not the case for MPC, LoCoh and KDE)
- MCP, LoCoH, and KDE assume independent observations, but teleportation is not possible
- ➔ Targeted by MPC, LoCoH, KDE, **AKDE**(`ctmm`)

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- ➔ Targeted by MPC, LoCoH, KDE, **AKDE**(`ctmm`)

Occurrence distribution[§] :

- Estimates where an animal was located during the observation period
- Area cannot be compared across individuals (it would be comparing ”lack of knowledge”)
- Sensitive to sampling frequency but robust to data irregularity
- ➔ Targeted by dBBMM (`move`), ocurrence (`ctmm`)

[§]Fleming, et al. (2015). Rigorous home range estimation with movement data: a new auto-correlated kernel density estimator. Ecology, 96(5), 1182-1188.