

# Bear Home Ranges from GPS Tracks

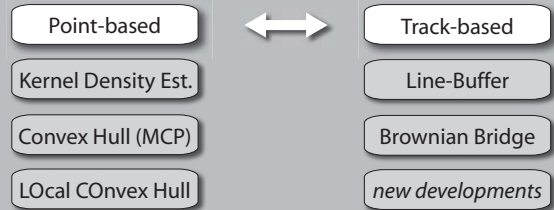
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## 1. Aims

- animal home range (Burt 1943): “[the] area traversed by an individual in its normal activities of food gathering, mating, [...]”
- grizzly bears are considered an endangered species in Alberta, Canada (# < 700)
- home range determination of grizzly bears enables wildlife managers and researchers to spatially focus on issues related to protection & conservation, but raises certain questions:
  - ➔ How do different home range estimators perform for grizzly bear movement data from GPS collars?
  - ➔ What poses problems for the estimators when considering geographical and ecological context?

## 2. Home Range Estimators

- developed originally for point-based observation data e.g. sightings or VHF telemetry
- data from GPS collars are different:
  - (i) number of points (1000s vs. 50-150 pts)
  - (ii) sampling interval ( → auto-correlation?)
  - (iii) additional temporal information stored ( → tracks & velocity)



## 3. Grizzly Bear Life

### Grizzly bears

- omnivor
- roam widely
- not territorial
- males have larger home ranges
- home range size is influenced by population density
- they avoid certain environments that provide no food: snow, rocks, glaciers, ...



### Expectation of GPS data/home ranges

- point distribution with multiple centres
- large areas covered (500-1000 km<sup>2</sup>)
- patches connected by corridors
- few GPS points on glaciers, and few tracks that cross mountain ridges
- GPS points around edge of lakes (not in)



grizzly bear - ursus arctos horribilis (photo: US Gov.)

## 4. Estimator Comparison

### Data

- GPS collar data from 20 bears, for one year, April-Nov.
- ca. 1...6 locations per day
- male vs. female bears
- living in Rocky Mountains vs. Alberta Foothills
- landcover data from Foothills Research Institute

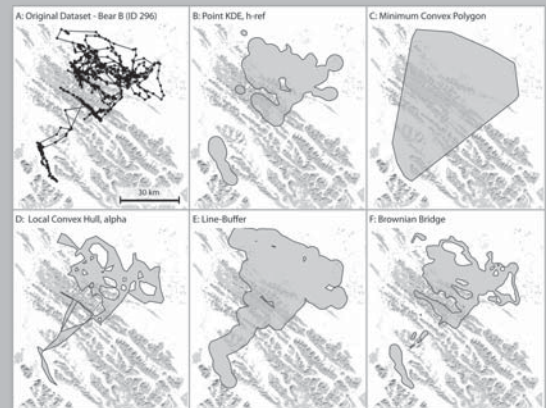
### Methods Implemented & Tested

- Point-based Kernel Density (KDE) - variants: h\_ref, ad-hoc, LSCV
- Local Convex Hull (LoCoH) - variants: r, k, a
- Minimum Convex Polygon (MCP)
- Line-Buffer
- Brownian Bridge

### Implementation

- implemented with free desktop GIS OpenJUMP
- raster functions from Sextante Toolbox
- Brownian Bridge ported from R - adehabitat module

### Selected Graphical Results for one 'Mountain' Grizzly



Home ranges for Brownian Bridge and point-KDE (h\_ref) are retrieved for the 95% utilization probability. Grey background represents non-vegetated areas, e.g. steep mountain slopes.

## 5. Outcome

### Major Results

- MCP doesn't work well for patch-based (concave) home ranges
- KDE (with h\_ref) is fast and reliable, no big difference among kernels
- Brownian Bridge results 'look' best, but problems with corridors\*

### Problems with Estimators

- KDE- param. estimation with LSCV failed for all 20 datasets (large # pts.)
- point-based estimators don't model corridors between patches well
- home ranges cover areas that are not really used by the animal (ridges)
- estim. don't take context into account (e.g. elevation/habitat constraints)

### Recommendations

- MCP only useful if home range is known to be convex
- advantage of KDE & Brownian Bridge are resulting density grids, so contours for different probabilities of utilization can be generated, hence:
- use KDE if no time information is available
- use Brownian Bridge\* when time is recorded and utilization probability grids are needed, otherwise use Line-buffer

\* we noticed additional problems with Brownian Bridges with respect to numeric instabilities, and for the calculation of core areas (using methods by Harris et al. 1990, Seaman and Powell 1990)

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