Black Bear Home Range Size in North America: A Meta-Analysis

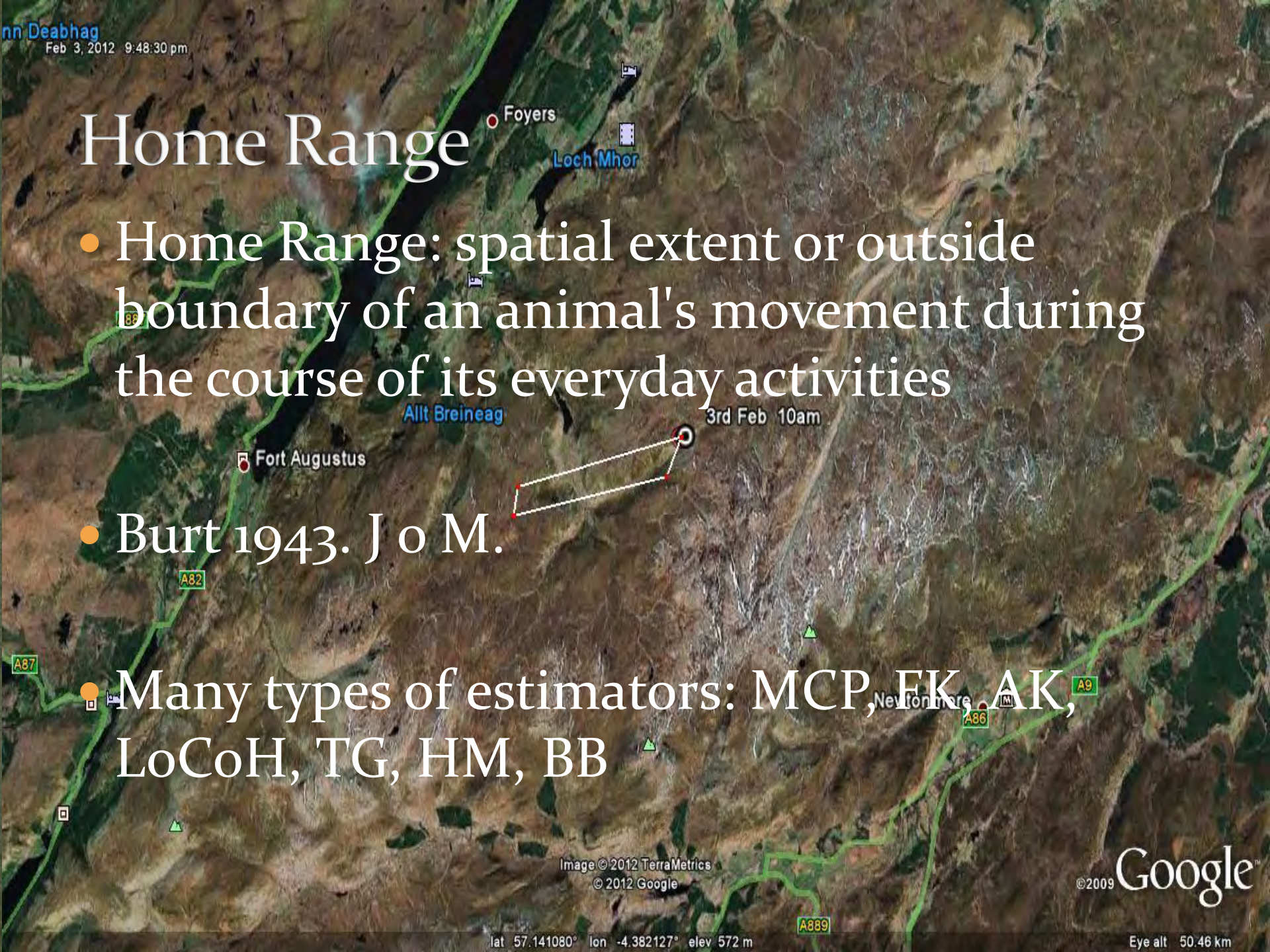
Andrew N. Tri
Michael D. Jones
John W. Edwards
West Virginia University

Black bear (*Ursus americanus*)

- Large and highly variable home range
- Large movements
- Habitat generalist

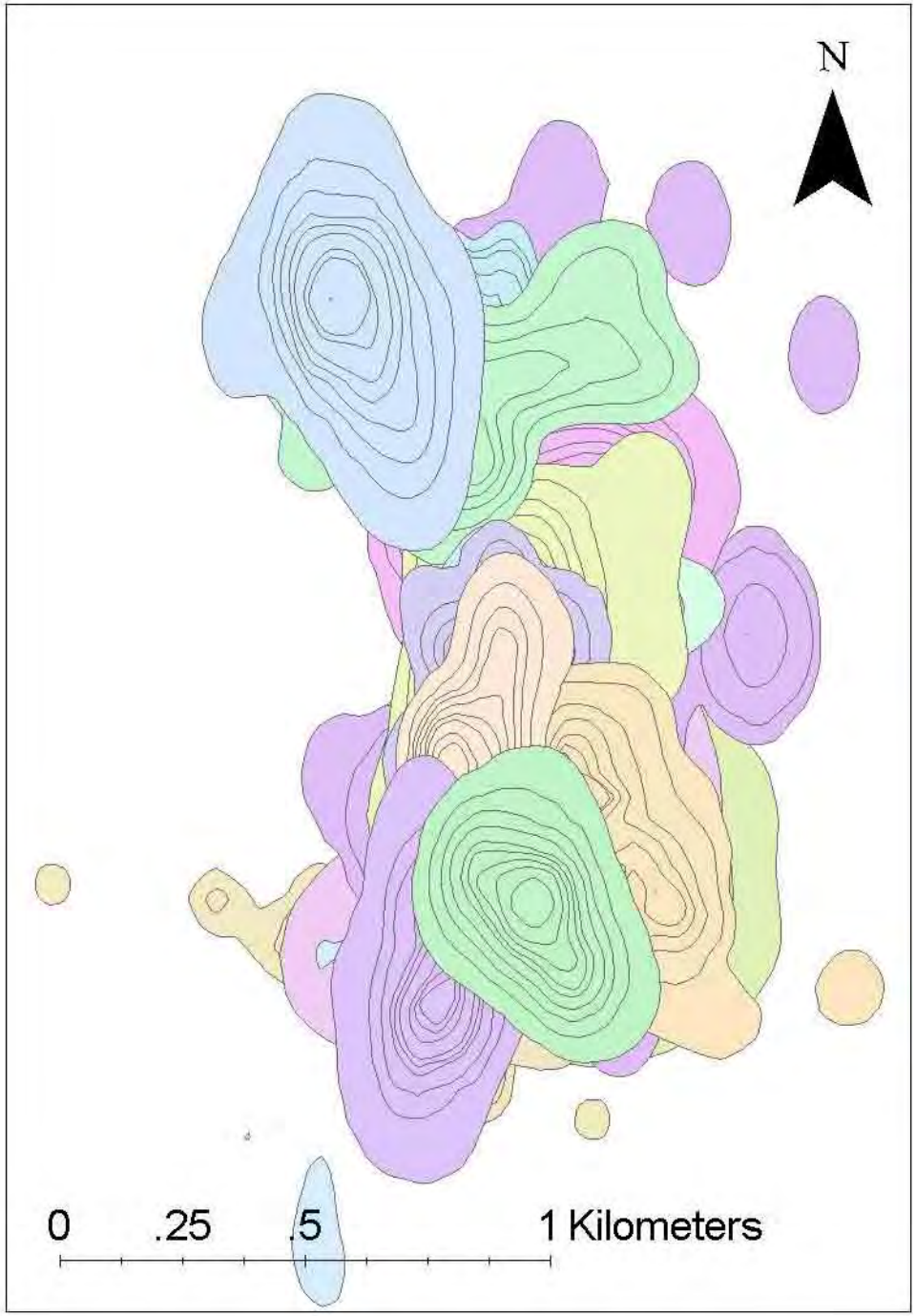
Home Range

- Home Range: spatial extent or outside boundary of an animal's movement during the course of its everyday activities
- Burt 1943. J o M.
- Many types of estimators: MCP, FK, AK, LoCoH, TG, HM, BB



Home Range

- Home range is affected by:
  - # of Relocation points
  - Telemetry error/GPS fix rate
  - Habitat selection by animals
  - Sex of animal
  - Social behavior
  - Social structure
  - Territoriality
  - Estimator type, etc.

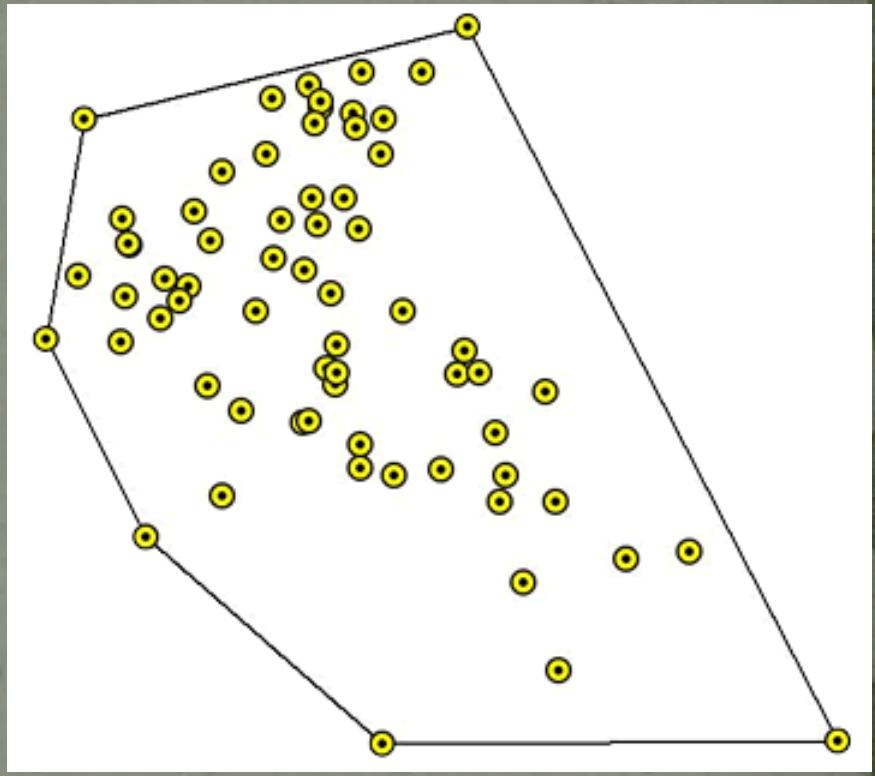


Estimators

- 2 Kinds:
  - Parametric and non-parametric
- Both have pros and cons
- Non-Parametric:
  - MCP, TG, LoCoH
- Parametric
  - KDE,HM

Minimum Convex Polygon (MCP)

- Mohr 1940
- Pros:
  - Estimates often similar to KDE HR size
  - Simple to calculate
- Cons:
  - No Utilization Distribution (UD)
  - Highly dependent on the # of locations/HR
  - Overestimation
  - Non-comparable (*n*)



Jennrich-Turner Ellipse (JT)

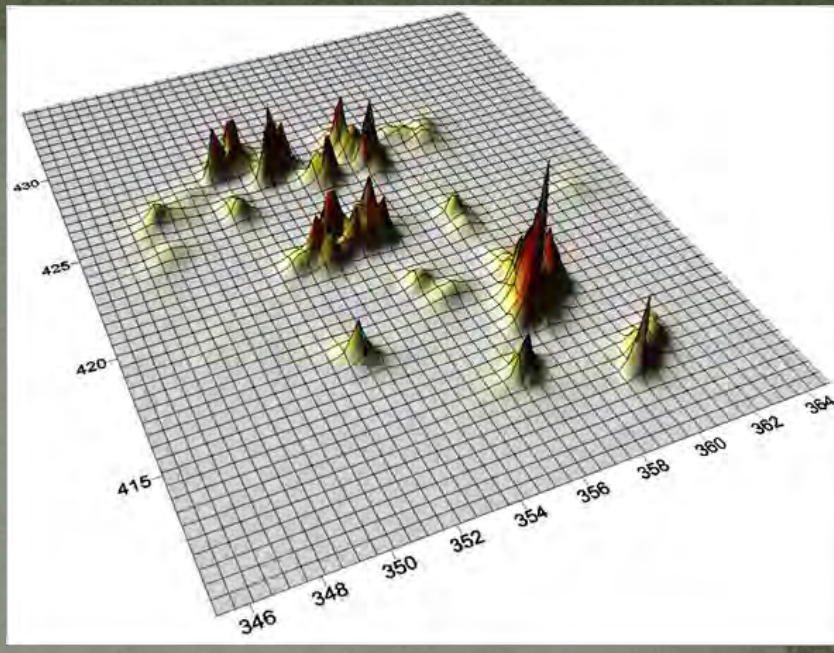
- Ellipse methods on the scene before KDEs
  - Jennrich and Turner 1969, Koeppl et al. 1975
- Pros:
  - Precurser to KDE, some type of UD
- Cons:
  - Assumptions… Ellipsoids
  - Overestimates

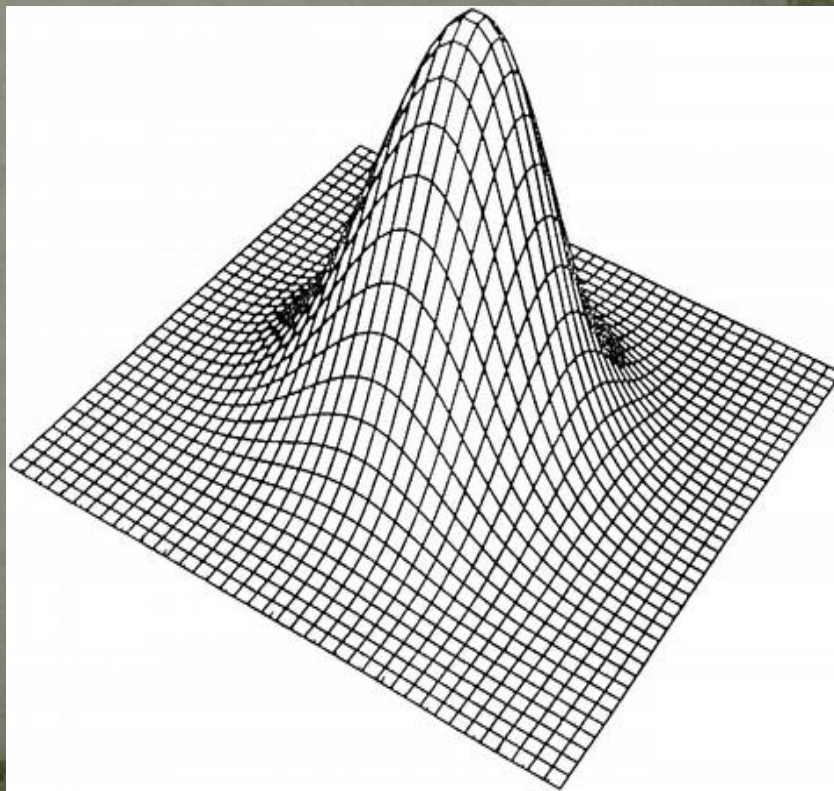
Harmonic Mean

- Dixon and Chapman 1980
- Precursor to KDE
- Pros:
  - Isopleth UDs
- Cons:
  - Edge effects, empty isopleths
  - Gives undue weight to edge points

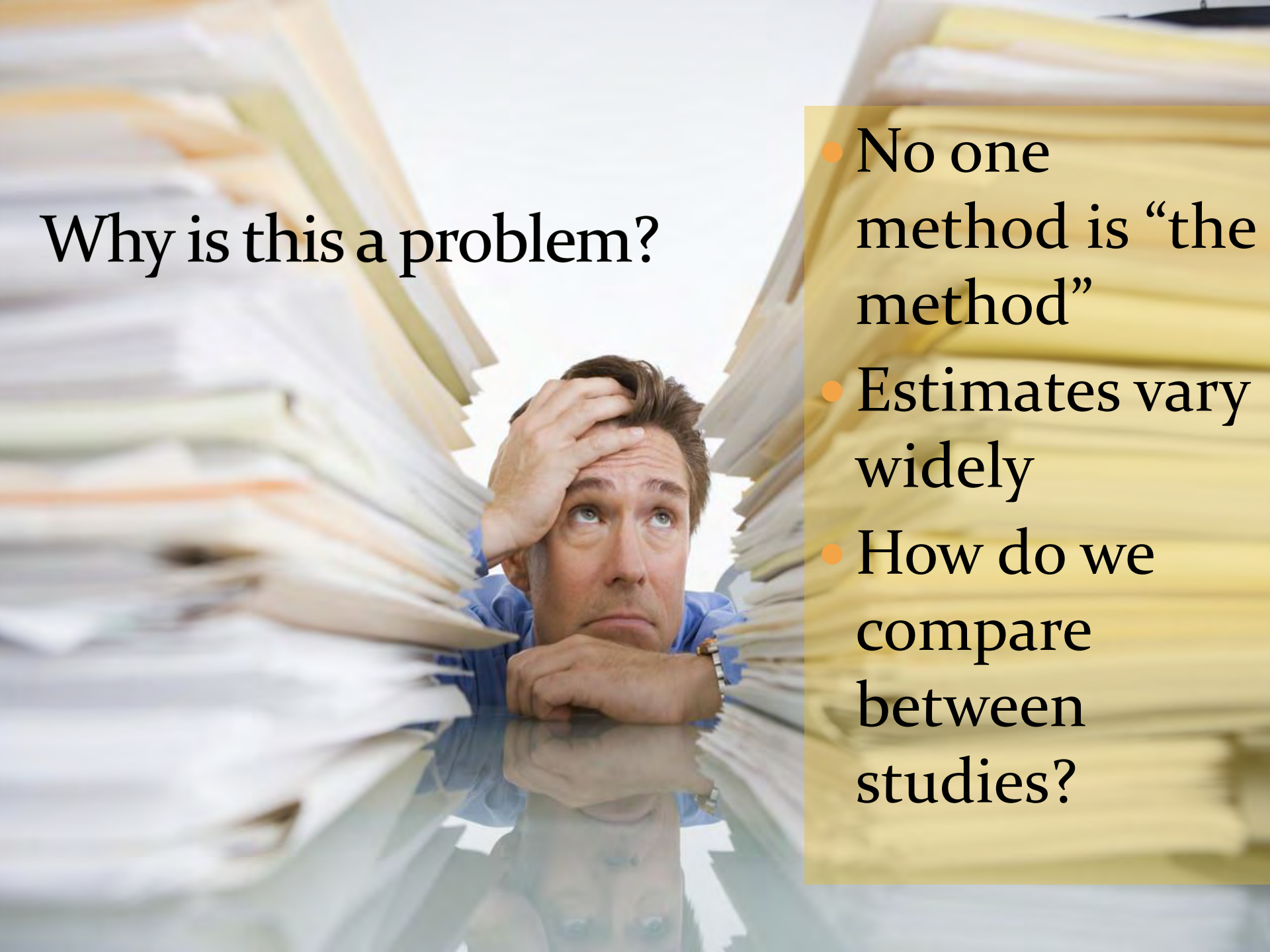
Kernel Estimators (FK,AK,KDE)

- Worton 1989
- Preferred technique
- Pros:
  - UD
  - Robust to some bias; kernel type
- Cons:
  - *h*-smoothing factor
  - Often data hungry, especially AK





Why is this a problem?



- No one method is “the method”
- Estimates vary widely
- How do we compare between studies?

Question

- What factors influence black bear home range size?

Methods

- An Information-Theoretic Approach
- Meta-Analysis
- Bear Home Range Estimates
  - Method, Study Area Location, Sex
  - Proquest, Google Scholar
- Goal: All black bear HR estimates published or in thesis/dissertation

Methods

- Ecoregion:
  - EPA Level I
  - Proxy for habitat
- Estimators:
  - MCP
  - BN
  - HM
  - FK
  - AK

a priori hypotheses

- H1: HR size is a function of a bear's sex
- H2: HR size is a function of the estimation method
- H3: HR size is a function of the ecoregion
- H4: HR size is a function of sex and ecoregion
- H5: HR size is a function of sex and estimation method
- H6: HR size is a function of ecoregion and estimation
- H7:HR size is a function of none of these factors
- H8:HR size is a function of all three factors

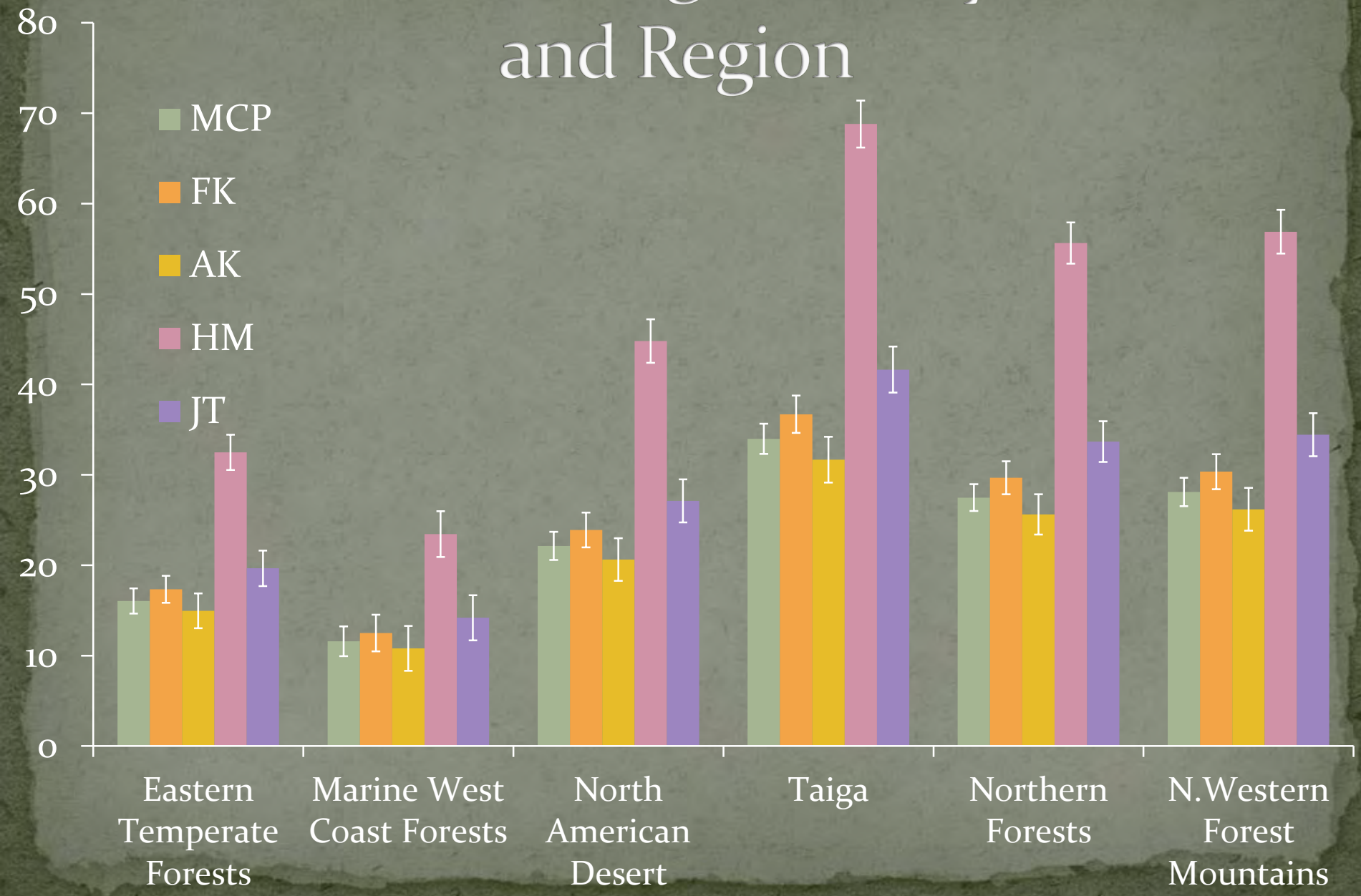
Analysis

- 314 estimates of black bear home range size
- Hypotheses were modeled as GLMs
  - Ln(HR size) =response
- AICc
- Model averaged models by AICc weights
- R^2: 0.408 for top model
- Tested for interactions (*ad hoc*) between sex & ecoregion and sex & method
- No test for ecoregion*method
  - Not enough data, not all factors

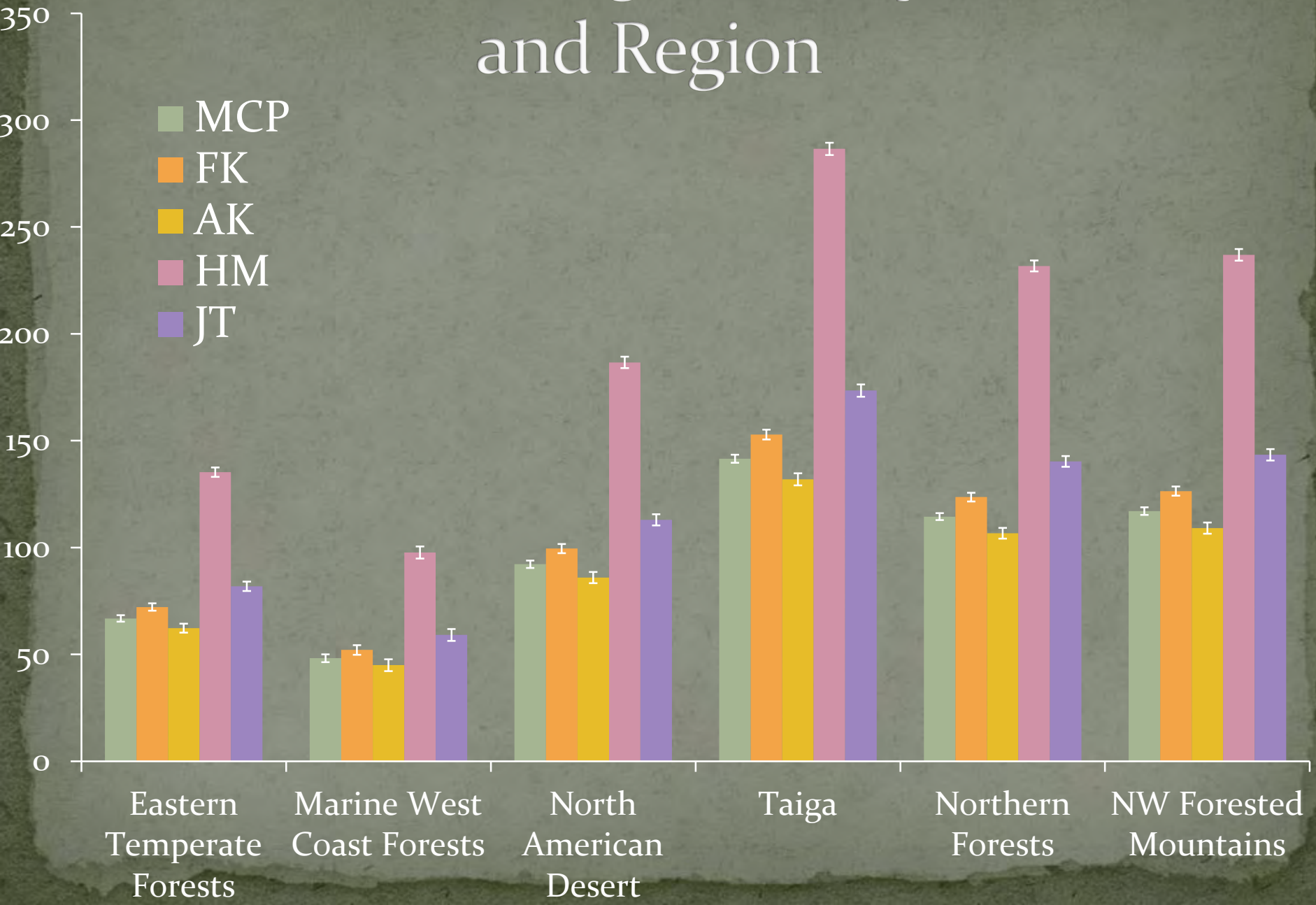
Results

Model	K	-Log-Likelihood	AICc	ΔAICc	Akaike Weights
HR Size = Sex + Ecoregion + Method	14	-149.785	326.8	0.00	0.899
HR Size = Sex + Ecoregion	9	-157.344	331.2	4.37	0.101
HR Size = Sex + Method	8	-163.029	342.5	15.74	0.000
HR Size = Sex	3	-170.512	347.1	20.31	0.000
HR Size = Ecoregion	8	-227.961	470.3	143.50	0.000
HR Size = Ecoregion + Method	13	-223.845	472.7	145.94	0.000
HR Size = Null Model	2	-237.186	478.4	151.62	0.000

Female Home Range Sizes by Method and Region



Male Home Range Sizes by Method and Region



Discussion

- Sex, ecoregion, and method are important
- Males have larger home ranges
- Harmonic mean consistently overestimated

Discussion

- MCP, FK, AK, J&T similar in size within each ecoregion

- E. Temperate forests and Marine W. Coast forest “best”

Limitations

- We weren't able to construct full interaction
- Ecoregion level I is broad
- Define bear habitat
- Does not account for:
  - Annual Mast
  - Development
  - Habitat Fragmentation
  - Local Food Sources
  - Drought

Conclusions

- Home ranges vary by region, method, sex of the bear…
- “We are likely approaching near-perfect knowledge of locations that an animal has visited, as required by Burt's (1943) definition” (Kie et al. 2010:2228)
- Without “hard thinking” about what data and information we need, we are just chasing animals around.


QUESTION: WHAT KIND OF BEAR IS BEST?
FALSE
BLACK BEAR
quickmeme.com