Countrywide patterns in the spatial ecology of Namibian leopards

Chavoux Luyt, Alison Leslie, Cang Hui, Rudi van Vuuren




Stellenbosch UNIVERSITY IYUNIVESITHI UNIVERSITEIT

National Research Foundation

“Farming with Predators” project

An agroecological approach to human-wildlife conflict on Namibian farmlands




Stellenbosch UNIVERSITY IYUNIVESITHI UNIVERSITEIT

NRF National Research Foundation

Why care about home ranges?

- Most basic aspect of spatial behaviour




Stellenbosch UNIVERSITY IYUNIVESITHI UNIVERSITEIT

NRF National Research Foundation

Why care about home ranges?

- Most basic aspect of spatial behaviour
- Density of breeding population (future survival)




Stellenbosch UNIVERSITY IYUNIVESITHI UNIVERSITEIT

NRF National Research Foundation

Why care about home ranges?

- Most basic aspect of spatial behaviour
- Density of breeding population
- How many farms per leopard (HWC)




Why care about home ranges?

- Most basic aspect of spatial behaviour
- Density of breeding population
- How many farms per leopard (HWC)
- Boundaries of home ranges and




Why care about home ranges?

- Most basic aspect of spatial behaviour
- Density of breeding population
- How many farms per leopard (HWC)
- Boundaries of home ranges and
- Preferred habitats




Reported home ranges of leopards in Namibia (km²)

Species	Author	n	Mean MCP	Range MCP	Mean 95% MCP	Range 95% MCP	CI	Mean 95% KDE	Mean 50% KDE
Leopard	Stander et al., 1997	4	188.5	182.9 - 294.4					
female	Stein et al., 2011	2			53	40- 66		109	12
	Marker & Dickman, 2005	5			179.0	52.4- 393.5			
Leopard	Stander et al., 1997	9	451.2	210 - 1163.5					
male	Stein et al., 2011	1			108			49.5	10.5
	Marker & Dickman, 2005	6			229.0	125.2 - 311.9			

Reported home ranges of leopards in Namibia (km^2)

Very large variation (e.g. the mean home range size of male leopards reported by Stander et al. (1997) are more than double the size of home range estimates by Stein et al. (2011) and Marker and Dickman (2005)).

Species	Author	n	Mean MCP	Range MCP	Mean 95% MCP	Range 95% MCP	CI	Mean 95% KDE	Mean 50% KDE
Leopard	Stander et al., 1997	4	188.5	182.9 - 294.4					
female	Stein et al., 2011	2			53	40- 66		109	12
	Marker & Dickman, 2005	5			179.0	52.4- 393.5			
Leopard	Stander et al., 1997	9	451.2	210 - 1163.5					
male	Stein et al., 2011	1			108			49.5	10.5
	Marker & Dickman, 2005	6			229.0	125.2 - 311.9			

Reported home ranges of leopards in Namibia (km²)

Very large variation (e.g. the mean home range size of male leopards reported by Stander et al. (1997) are more than double the size of home range estimates by Stein et al. (2011) and Marker and Dickman (2005)).

Species	Author	n	Mean MCP	Range MCP	Mean 95% MCP	Range 95% MCP	CI	Mean 95% KDE	Mean 50% KDE
Leopard	Stander et al., 1997	4	188.5	182.9 - 294.4					
female	Stein et al., 2011	2			53	40- 66		109	12
	Marker & Dickman, 2005	5			70	52.4- 393.5			
Leopard	Stander et al., 1997	9							
male	Stein et al., 2011	1						49.5	10.5
	Marker & Dickman, 2005	6				125.2 - 311.9			

451.2

210 - 1163.5

108

229.0

Why this large range in reported home range sizes?

Possible reasons for this large range in home range sizes:

- Different methods to estimate home ranges?

Possible reasons for this large range in home range sizes:

- Different methods to estimate home ranges?
- Translocated *vs* released on-site?

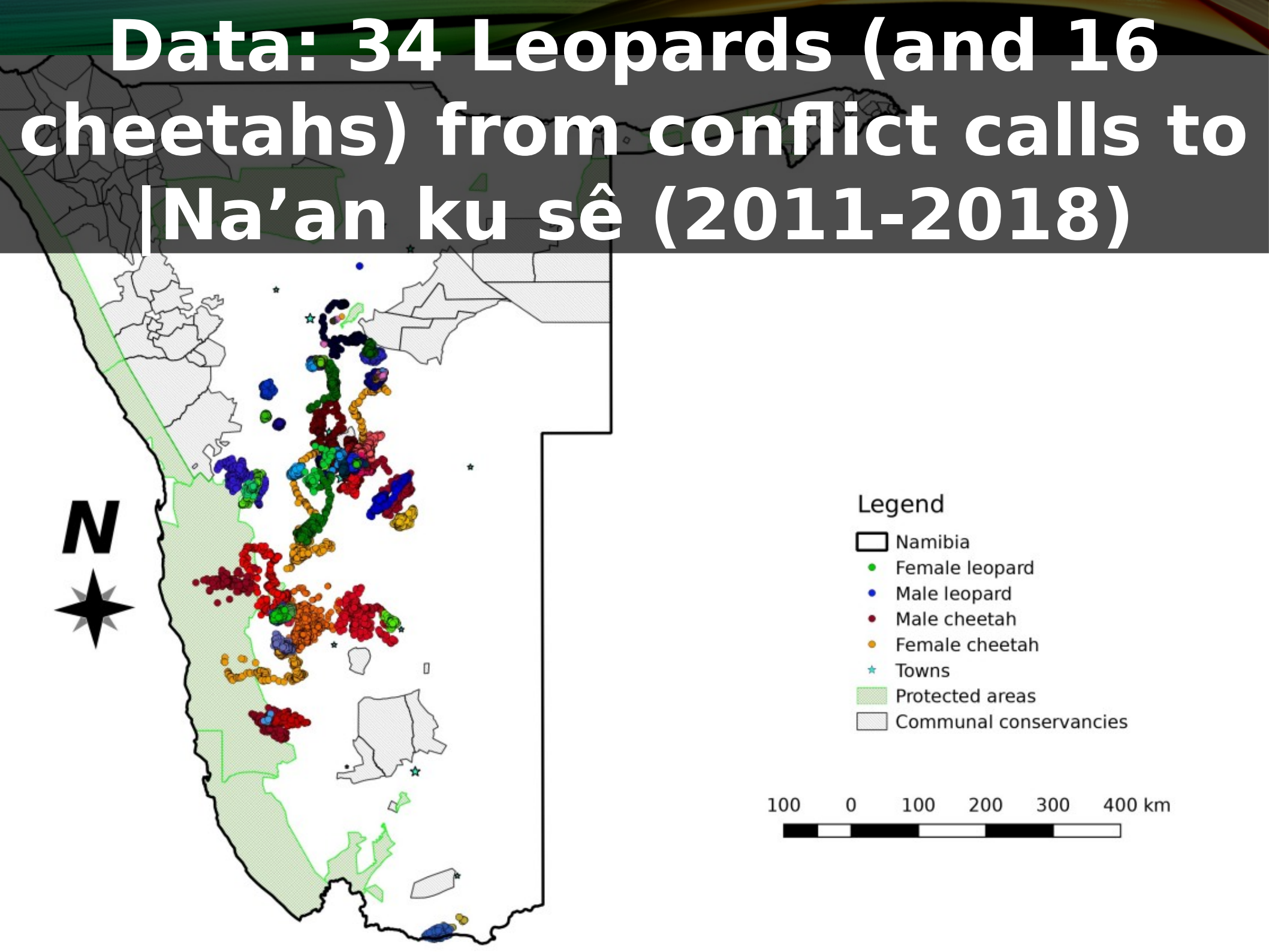
Possible reasons for this large range in home range sizes:

- Different methods to estimate home ranges?
- Translocated *vs* released on-site?
- Exploratory movements included?

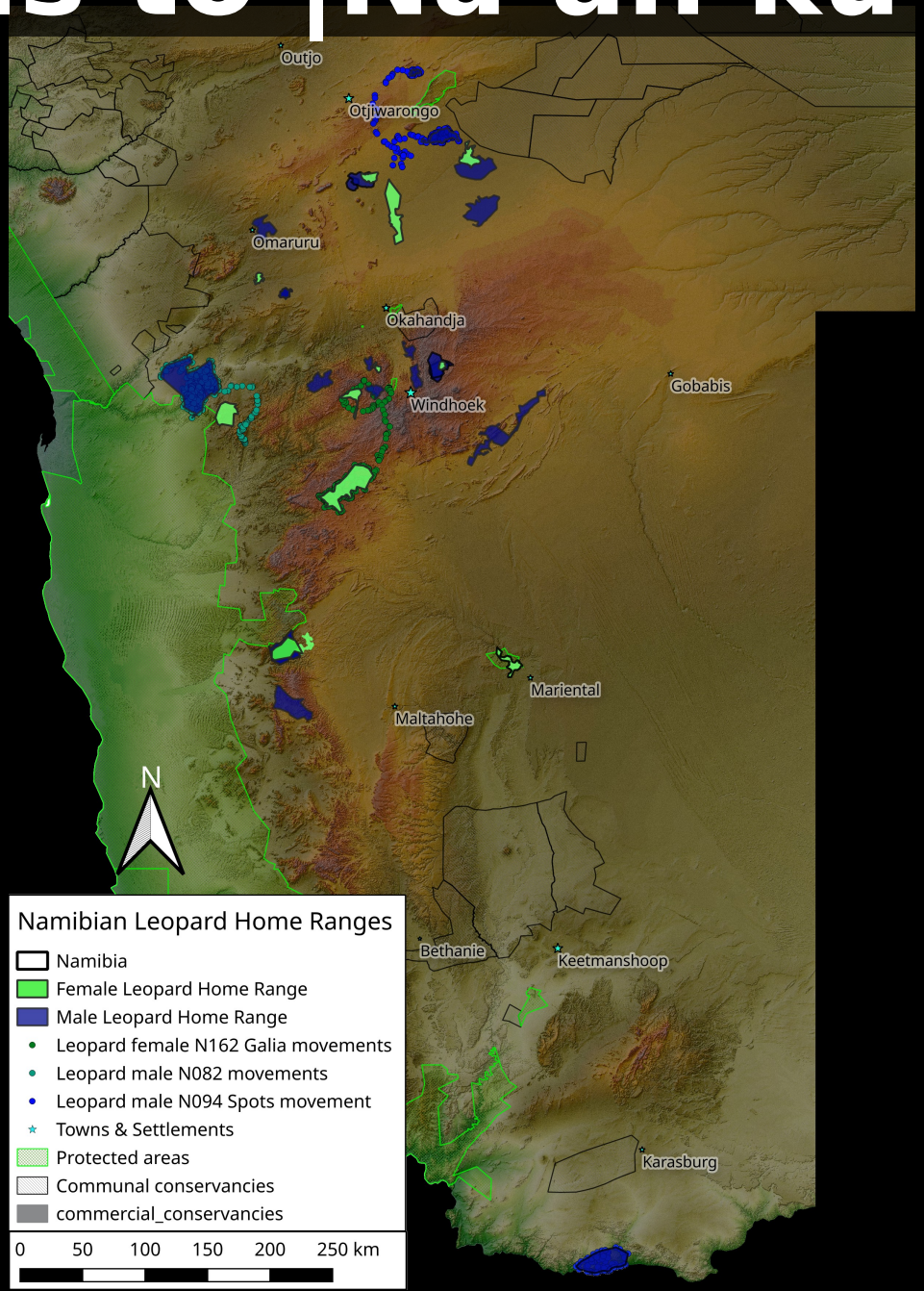
Possible reasons for this large range in home range sizes:

- Different methods to estimate home ranges?
- Translocated *vs* released on-site?
- Exploratory movements included?
- Real differences between different areas?

Data: 34 Leopards (and 16 cheetahs) from conflict calls to |Na'an ku sê (2011-2018)



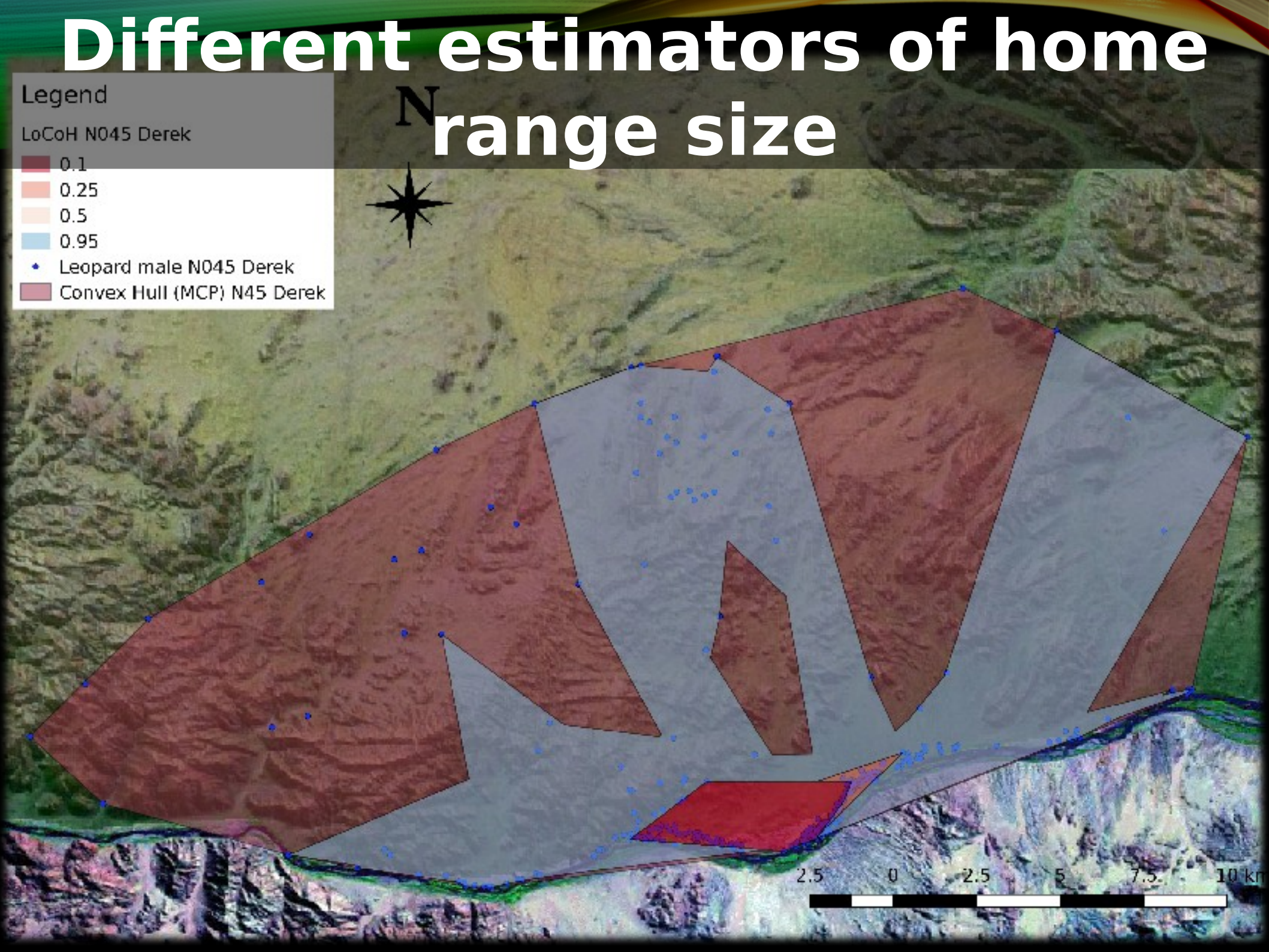
Data: 34 Leopards from conflict calls to |Na’an ku sê



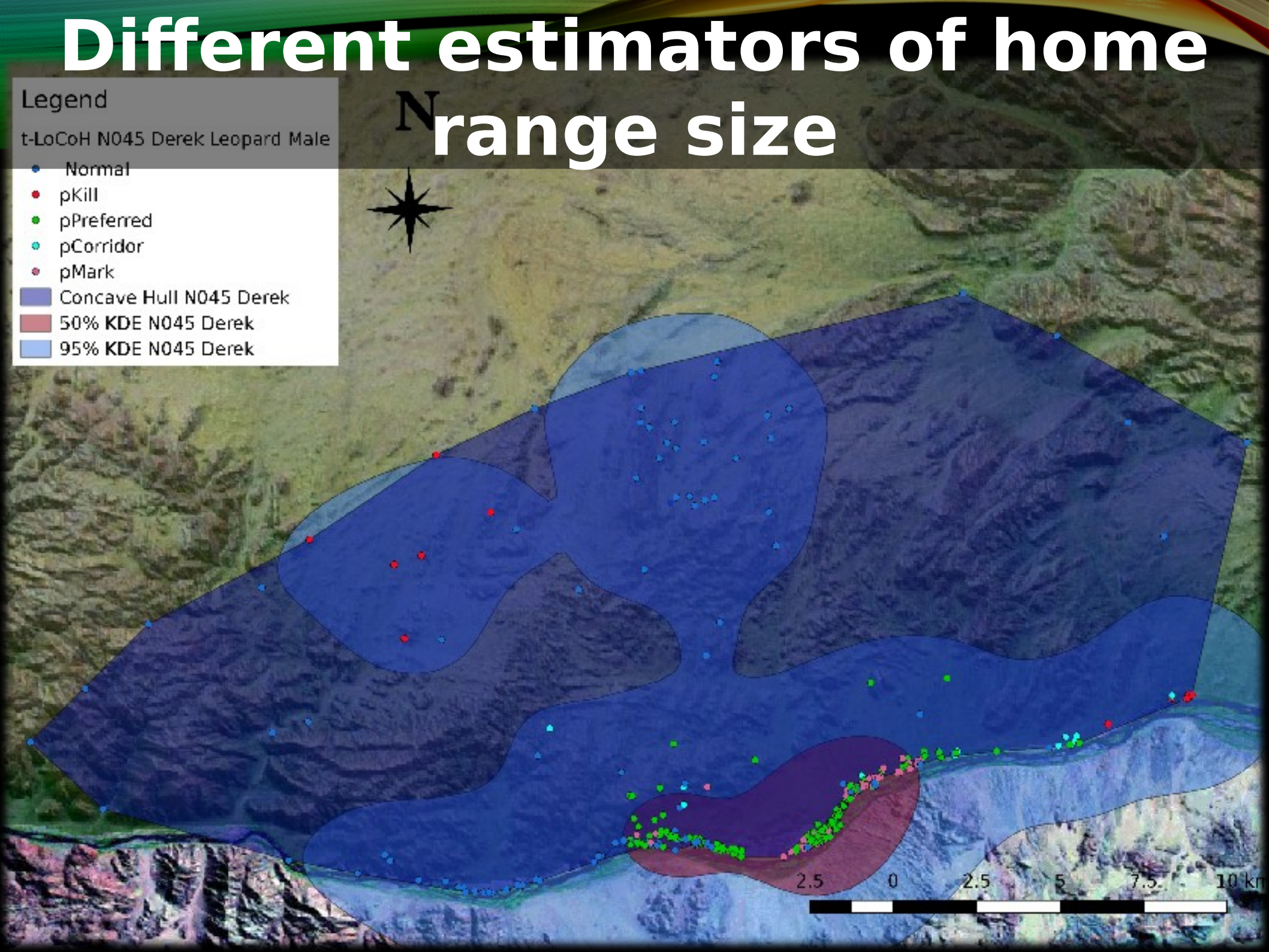
Different estimators of home range size

Species	Measure	MCP	95% MCP	Concave Hull	95% KDE	50% KDE	LoCoH	T-LoCoH	Exploratory Concave Hull	Exploratory 95% KDE
Leopard Female	Median	215.498 (28.74 - 803.59)	90.434 (22.72 - 491.52)	113.291 (21.43 - 551.31)	129.550 (25.89 - 668.44)	32.390 (7.08 - 118.05)	57.845 (13.45 - 189.14)	86.420 (18.60 - 264.54)	140.162 (21.43 - 1435.00)	135.763 (25.89 - 2157.61)
(n = 13)	Mean	249.729 (± 226.94)	150.388 (± 157.56)	161.577 (± 153.85)	188.554 (± 193.64)	35.658 (± 32.31)	70.895 (± 55.13)	103.496 (± 78.49)	395.965 (± 527.52)	492.562 (± 761.04)
Leopard Male	Median	220.923 (33.42 - 1324.12	141.919 (25.26 - 896.87)	170.031 (25.93 - 1068.71)	164.689 (25.78 - 1400.72)	40.228 (3.77 - 243.35)	92.604 (3.45 - 404.28)	139.651 (7.42 - 548.47)	247.990 (43.15 - 1458.73)	181.638 (25.78 - 2488.25)
(n = 21)	Mean	320.770 (± 326.30)	225.354 (± 227.73)	243.393 (± 240.25)	272.197 (± 331.69)	59.183 (± 60.39)	112.138 (± 97.00)	174.779 (± 143.34)	406.542 (± 452.09)	549.714 (± 779.64)

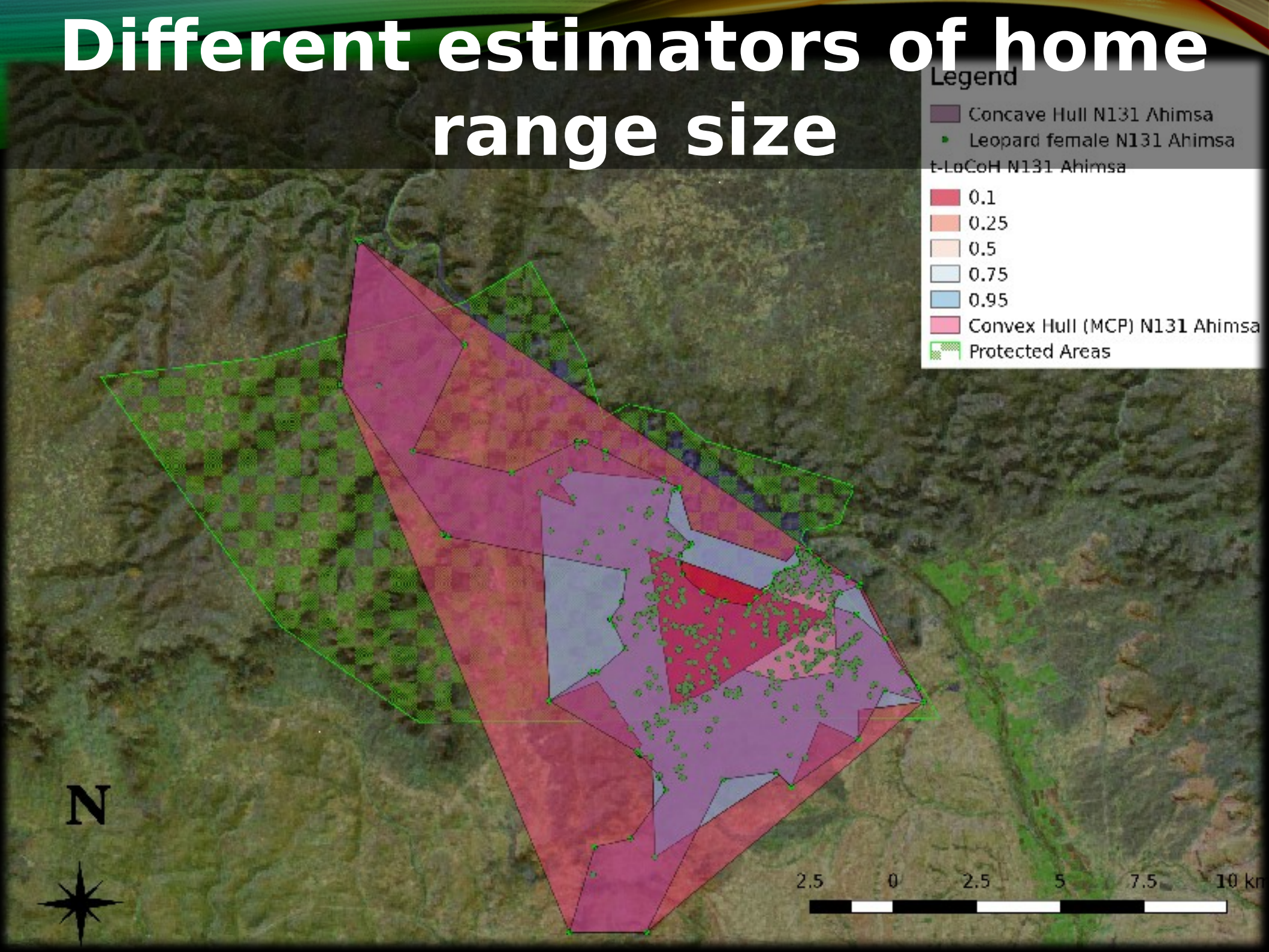
Different estimators of home range size



Different estimators of home range size



Different estimators of home range size



Possible reasons for this large range in home range sizes:

- Different methods to estimate home ranges?
  - Could be: E.g. MCP always larger than other estimates, LoCoH always smallest

Possible reasons for this large range in home range sizes:

- Different methods to estimate home ranges?
  - Could be: E.g. MCP always larger than other estimates, LoCoH always smallest
  - BUT 95% MCP and Concave Hull similar, 95% KDE inconsistent

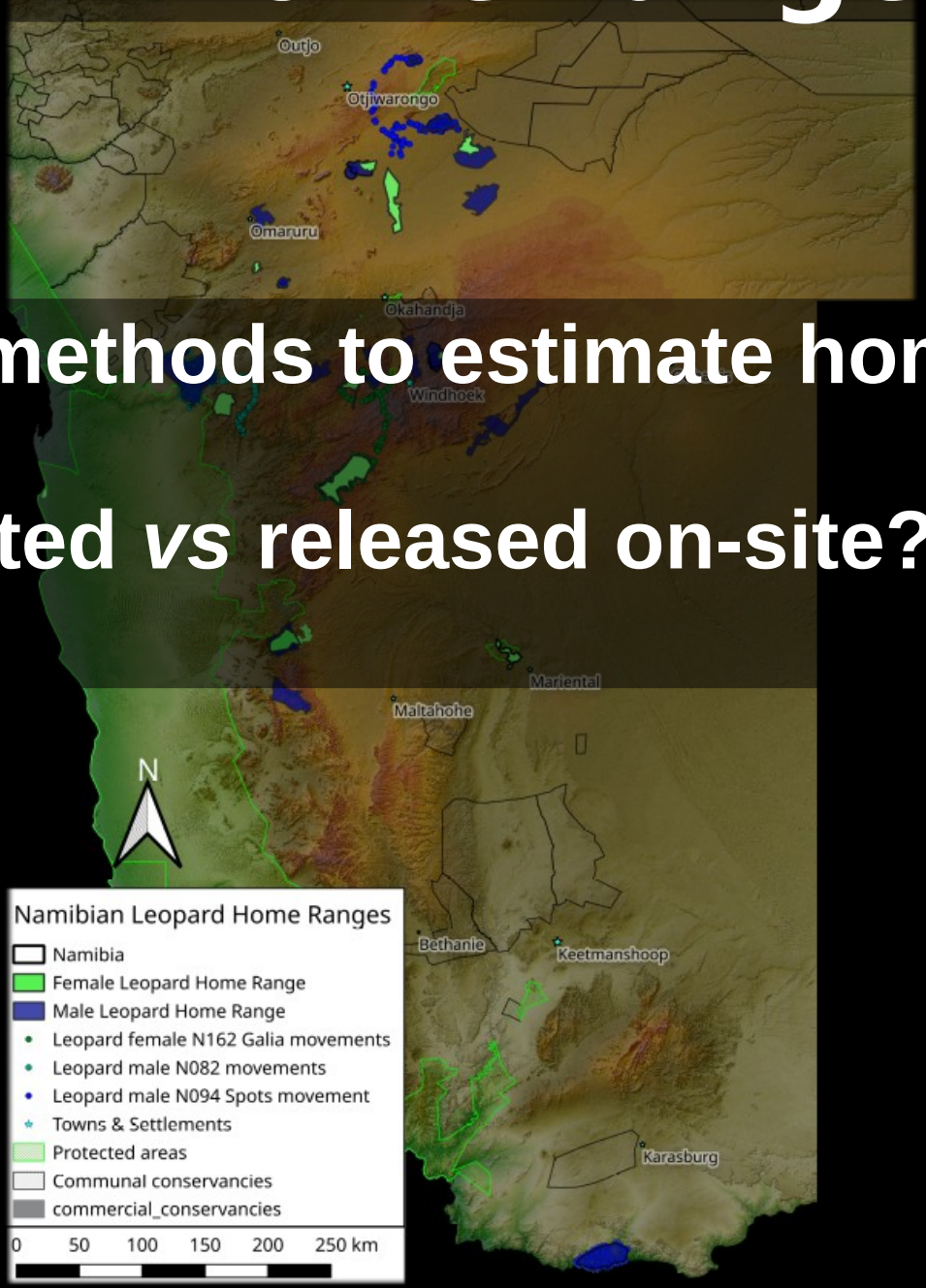
Possible reasons for this large range in home range sizes:

- Different methods to estimate home ranges?
  - Could be: E.g. MCP always larger than other estimates, LoCoH always smallest
  - But 95% MCP and Concave Hull similar, 95% KDE inconsistent
  - MCP, 95% MCP, Concave Hull & 95% KDE not significantly different ($p > 0.05$)
    - => not reason for differences

Possible reasons for this large range in home range sizes:

- Different methods to estimate home ranges?
  - Could be: E.g. MCP always larger than other estimates, LoCoH always smallest
  - But 95% MCP and Concave Hull similar, 95% KDE inconsistent
  - MCP, 95% MCP, Concave Hull & 95% KDE not significantly different ($p > 0.05$)
  - **Different strengths & weakness: use more than 1 estimate and always report software and method (rhr)**

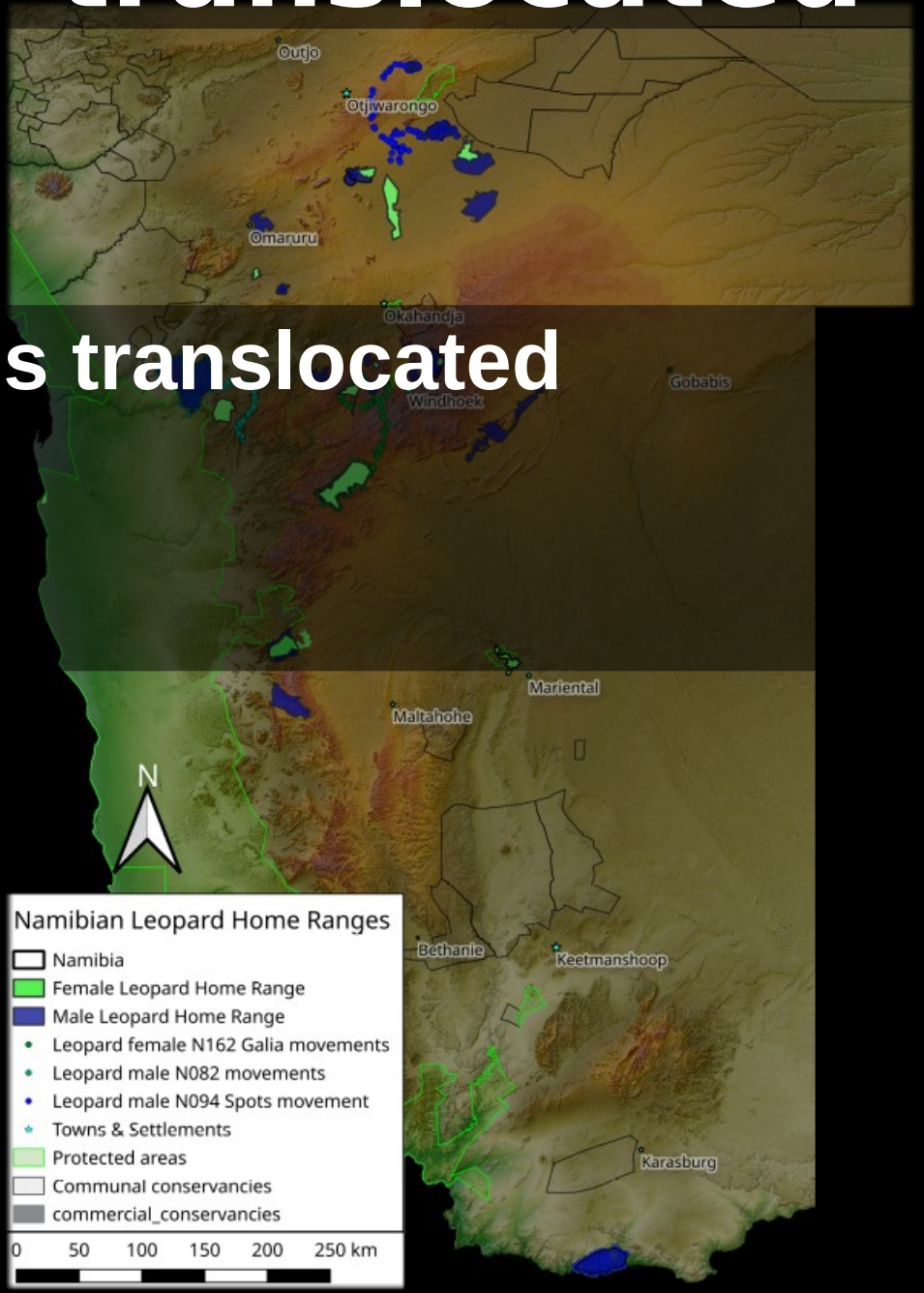
Possible reasons for this large range in home range sizes:



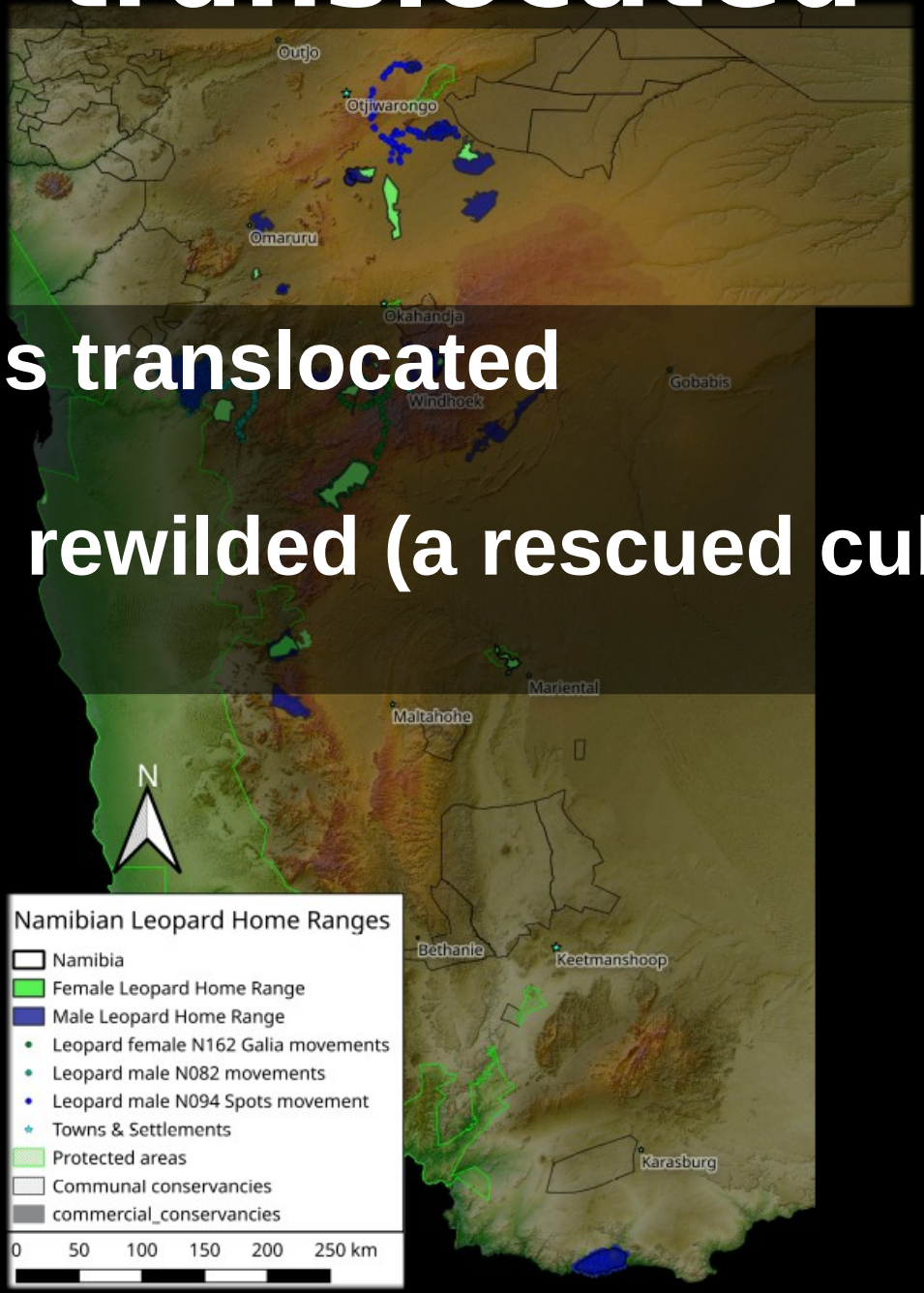
- Different methods to estimate home ranges?
  No
- Translocated *vs* released on-site?

Re-released on home range or translocated

- 7 Leopards translocated



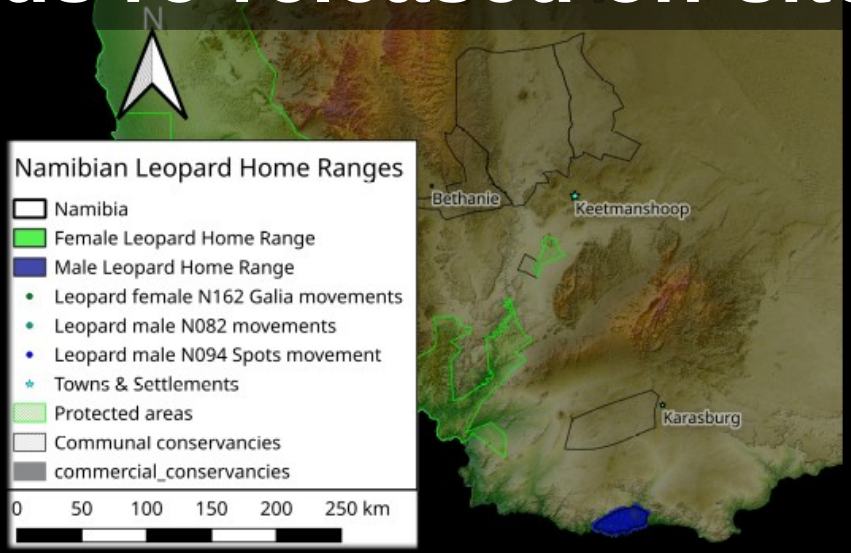
Re-released on home range or translocated



- 7 Leopards translocated
- 1 Leopard rewilded (a rescued cub)

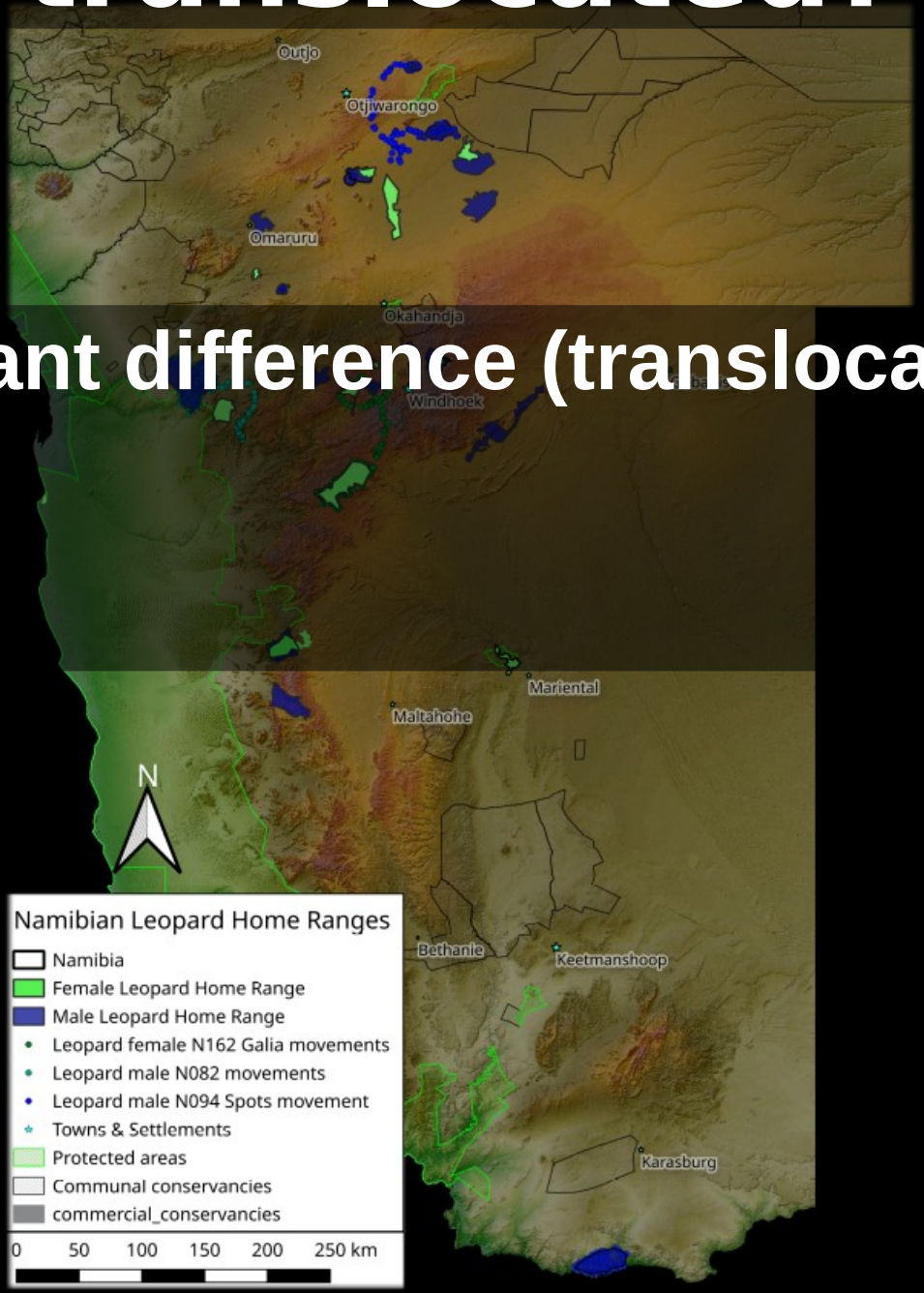
Re-released on home range or translocated

- 7 Leopards translocated
- 1 Leopard rewilded (a rescued cub)
- 25 Leopards re-released on-site



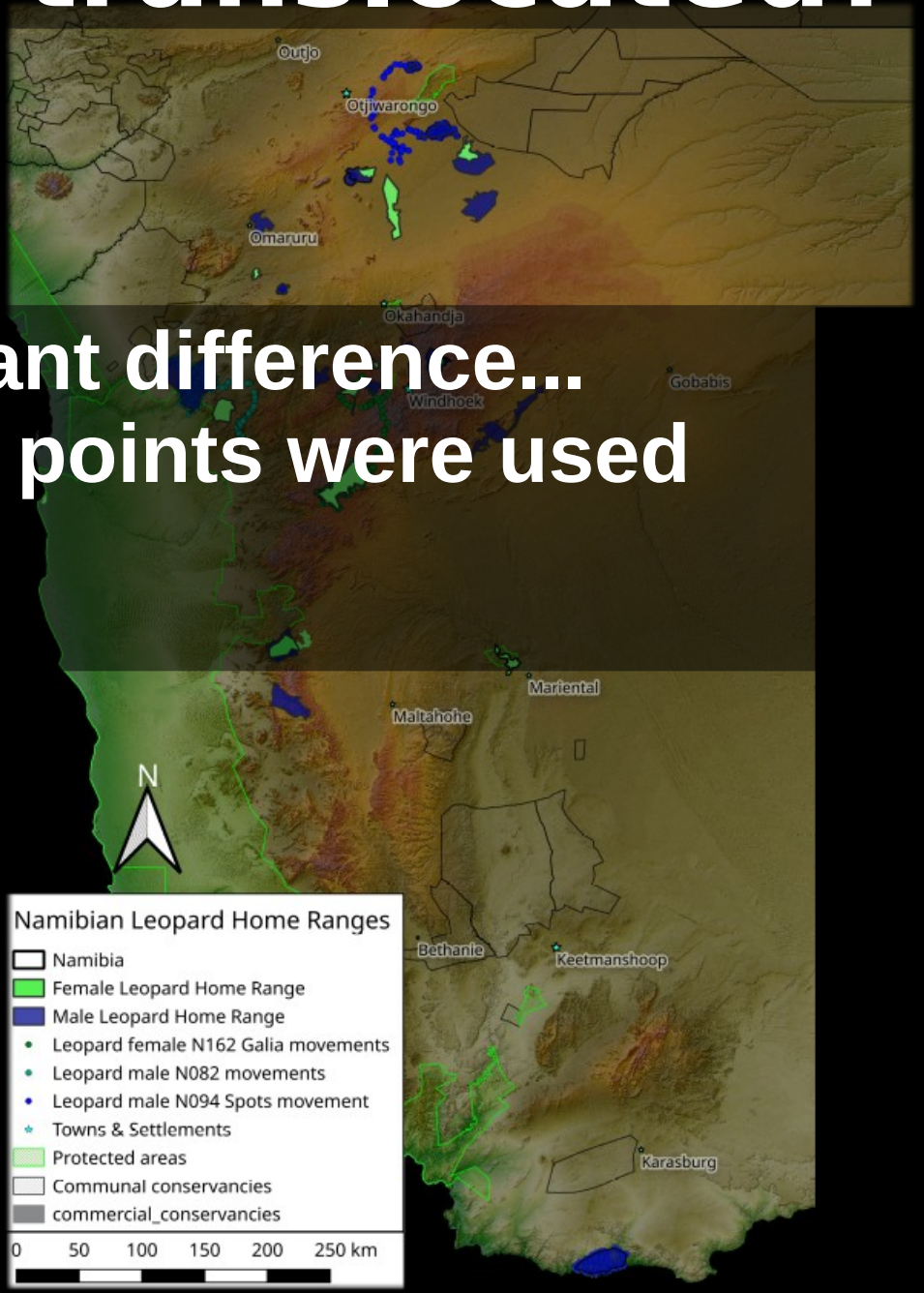
Re-released on home range or translocated?

- A significant difference (translocated >)...



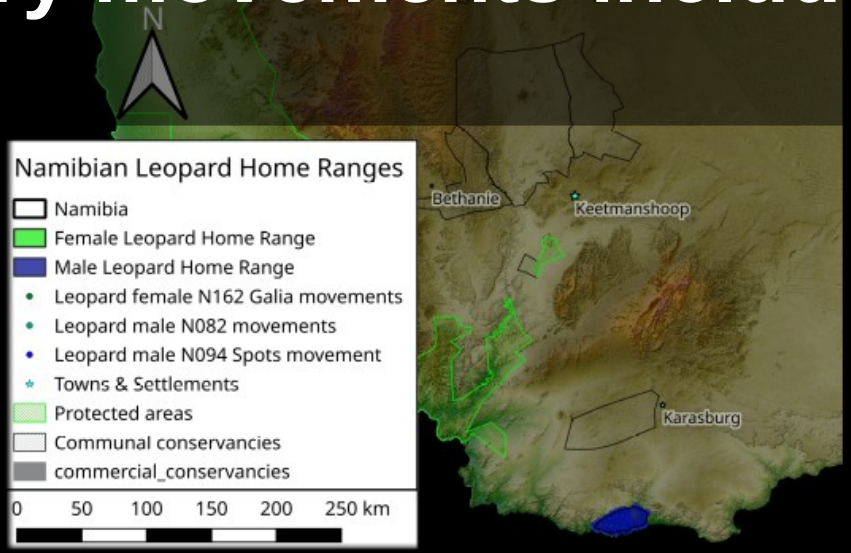
Re-released on home range or translocated?

- A significant difference...
  IF all GPS points were used

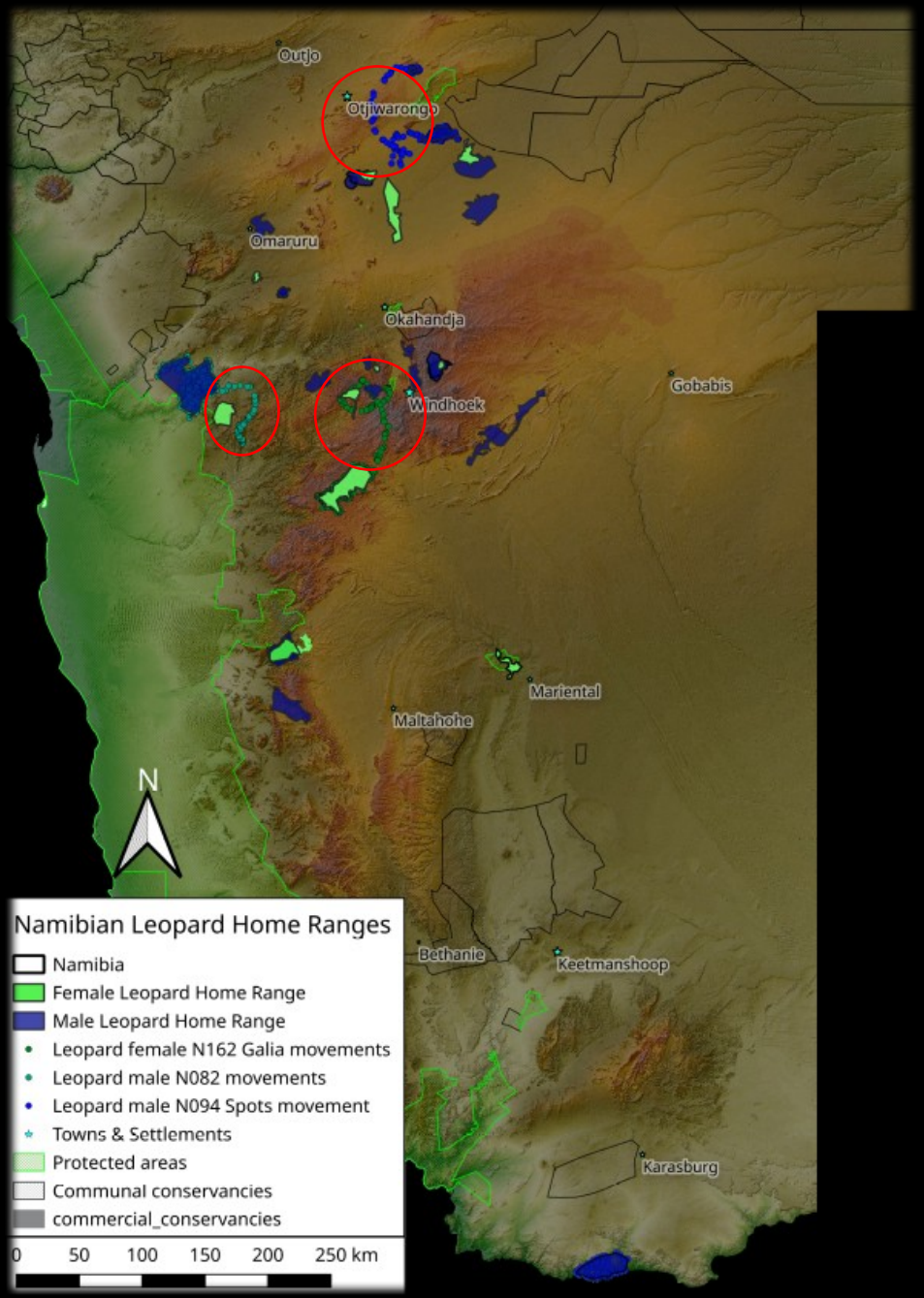


Possible reasons for this large range in home range sizes:

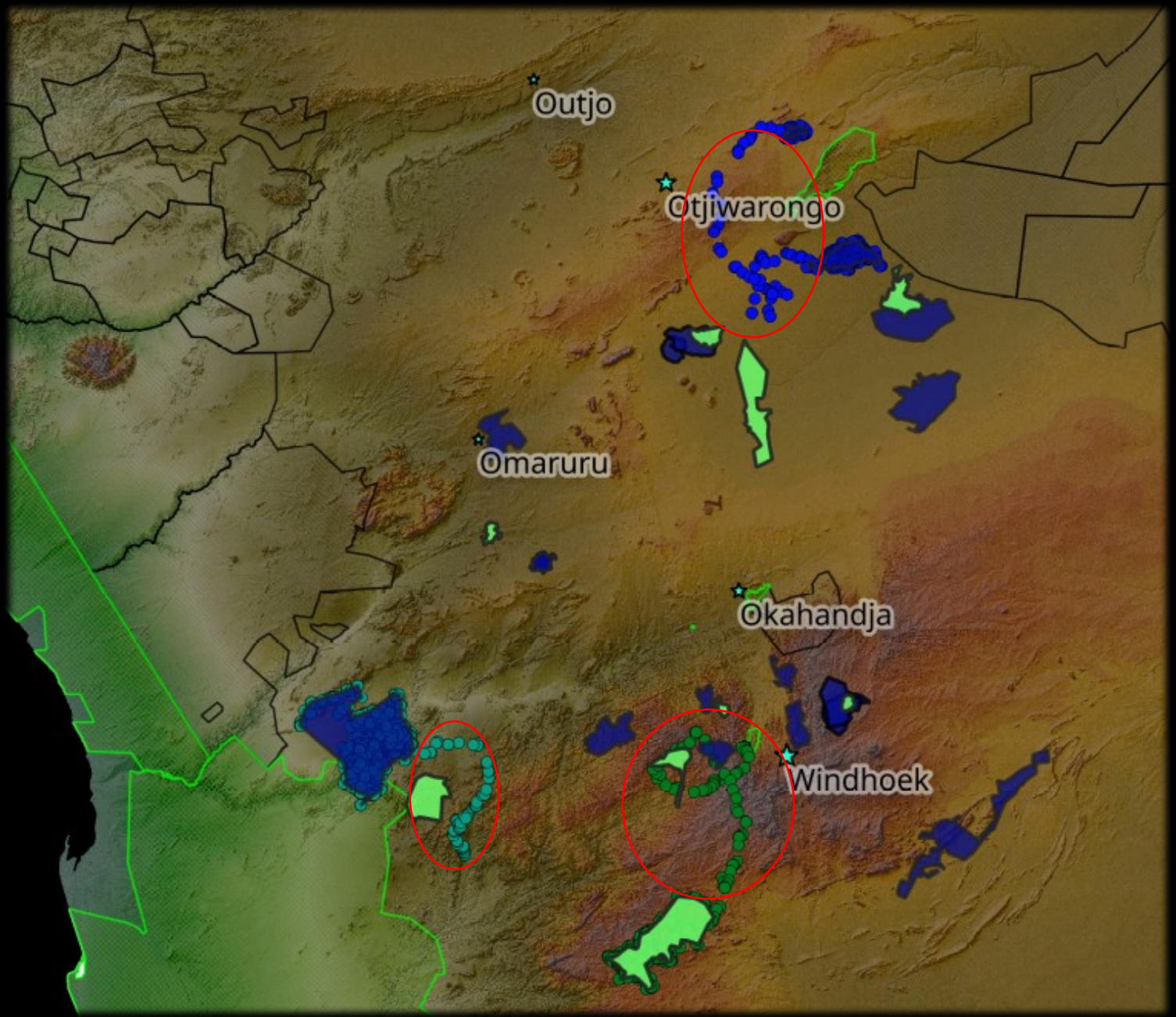
- Different methods to estimate home ranges?
  No
- Translocated *vs* released on-site?
  Yes, if
- Exploratory movements included?



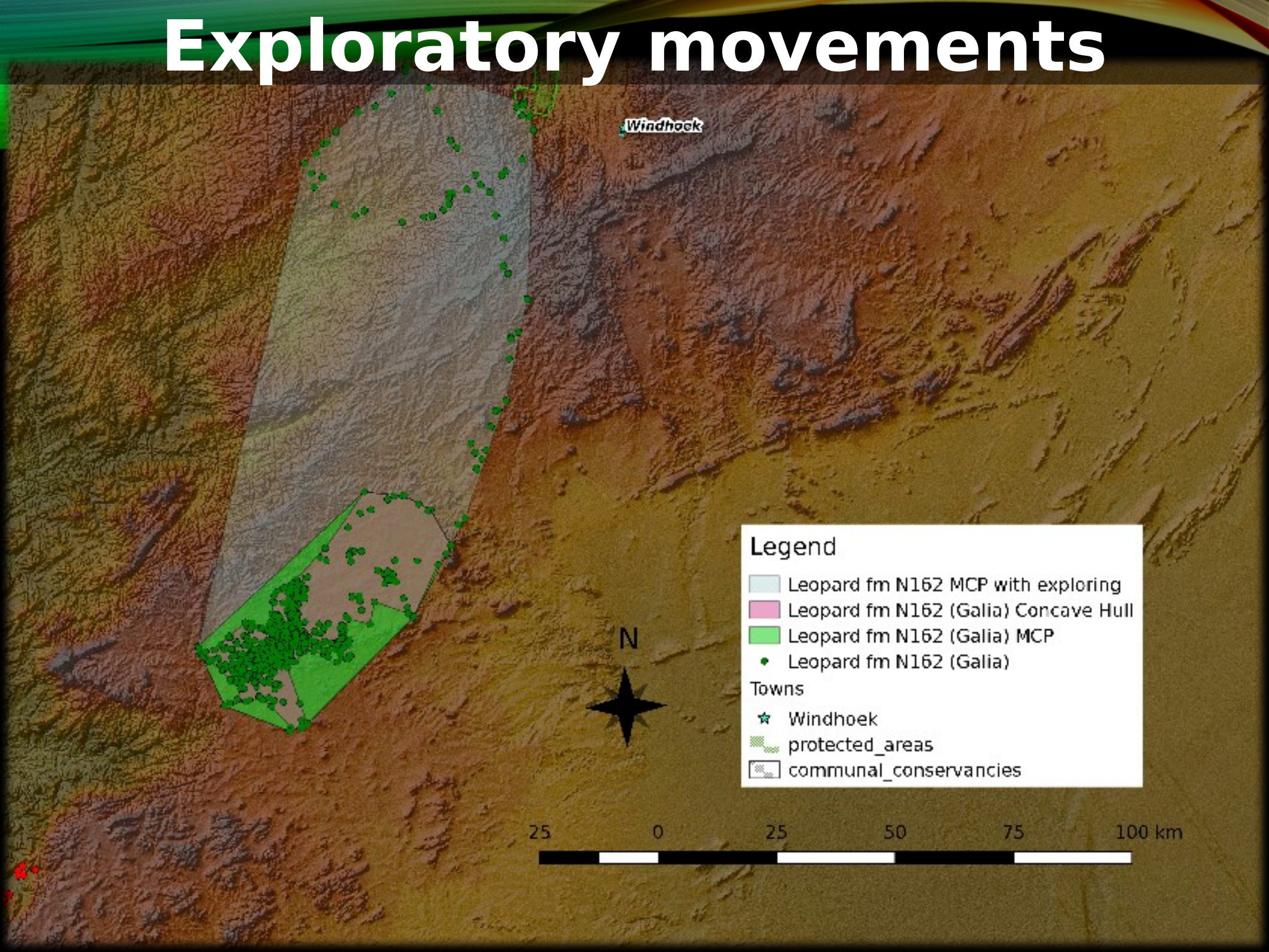
Exploratory movements



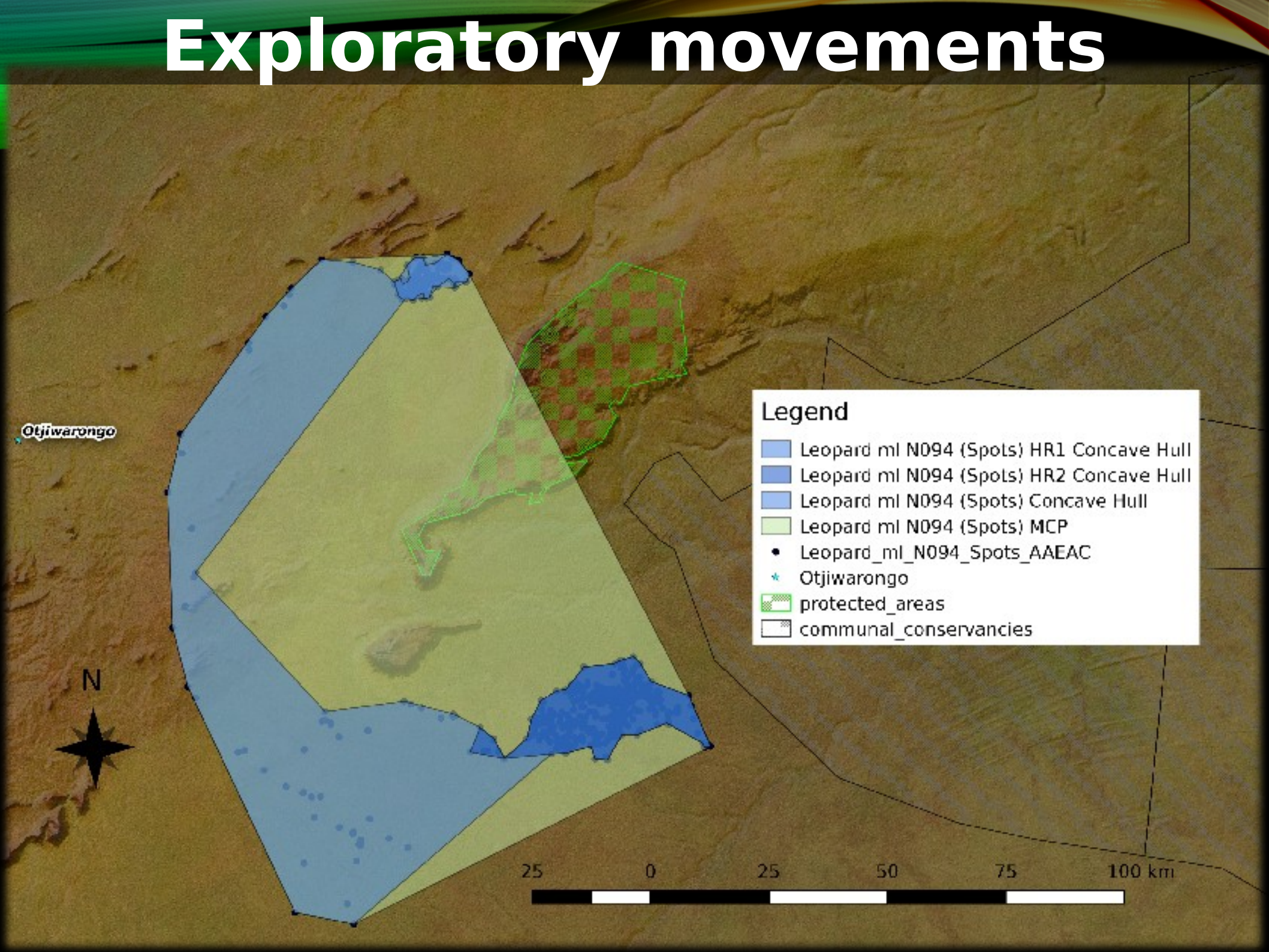
Exploratory movements



Exploratory movements

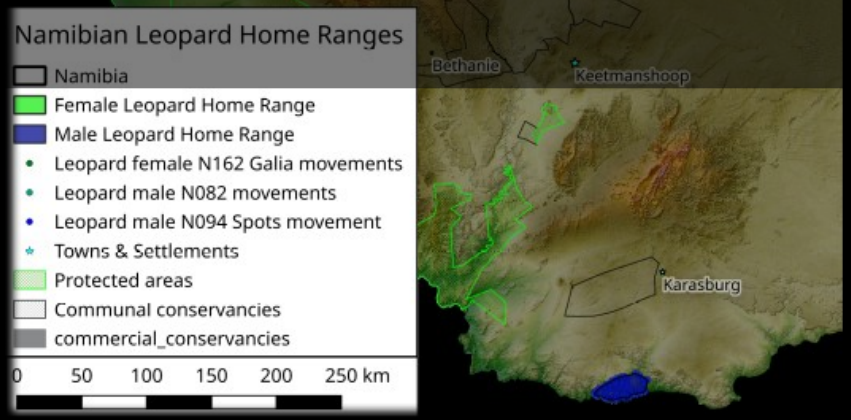


Exploratory movements



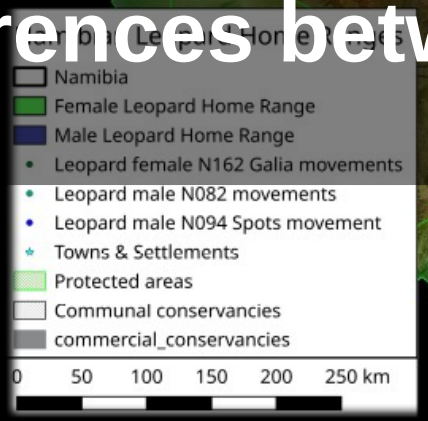
Possible reasons for this large range in home range sizes:

- Different methods to estimate home ranges?
  No
- Translocated *vs* released on-site?
  Yes, if
- Exploratory movements included?
  Yes (How do we prevent this?)

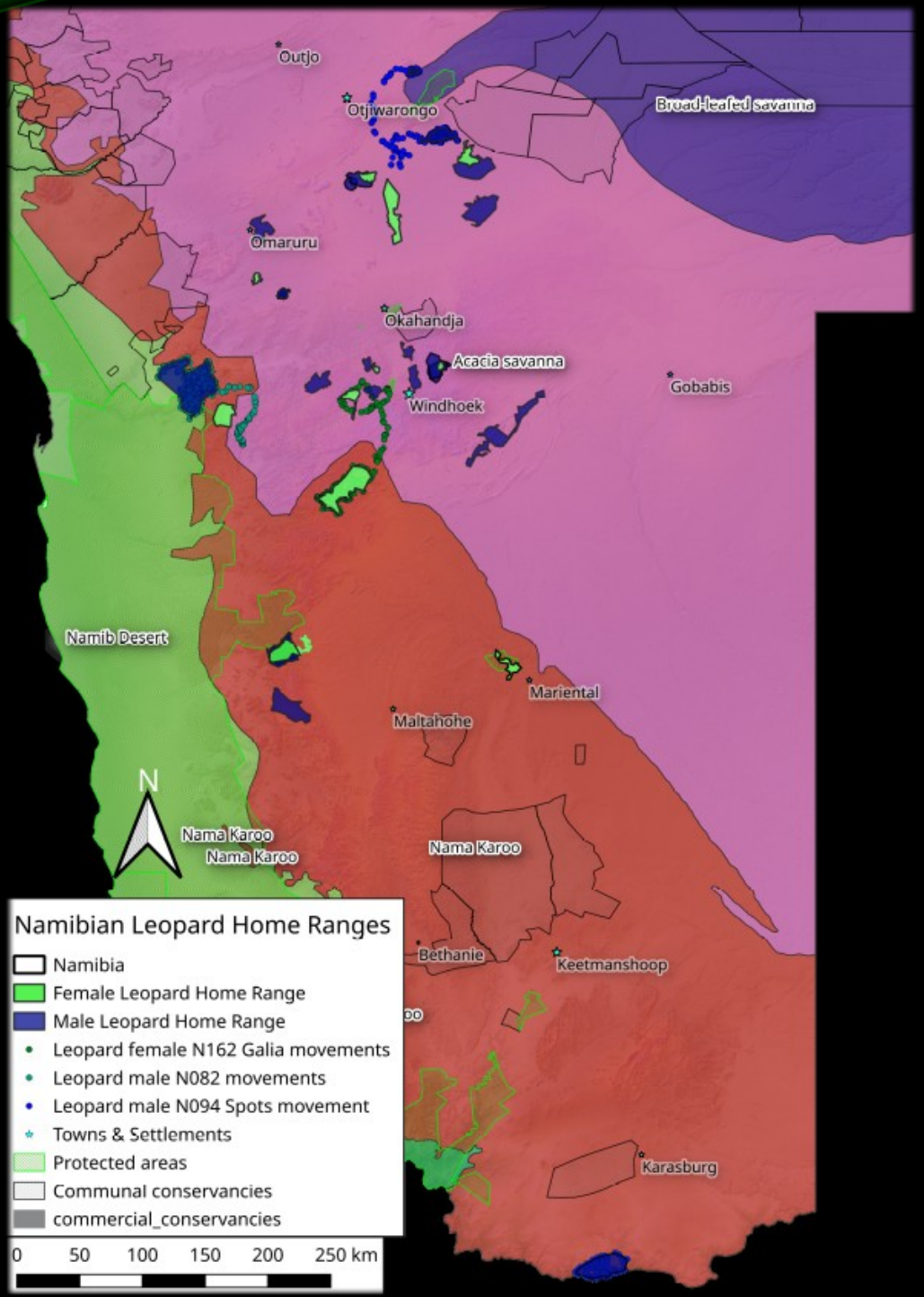


Possible reasons for this large range in home range sizes:

- Different methods to estimate home ranges?
  No
- Translocated *vs* released on-site?
  Yes, if
- Exploratory movements included?
  Yes
- Real differences between different areas?

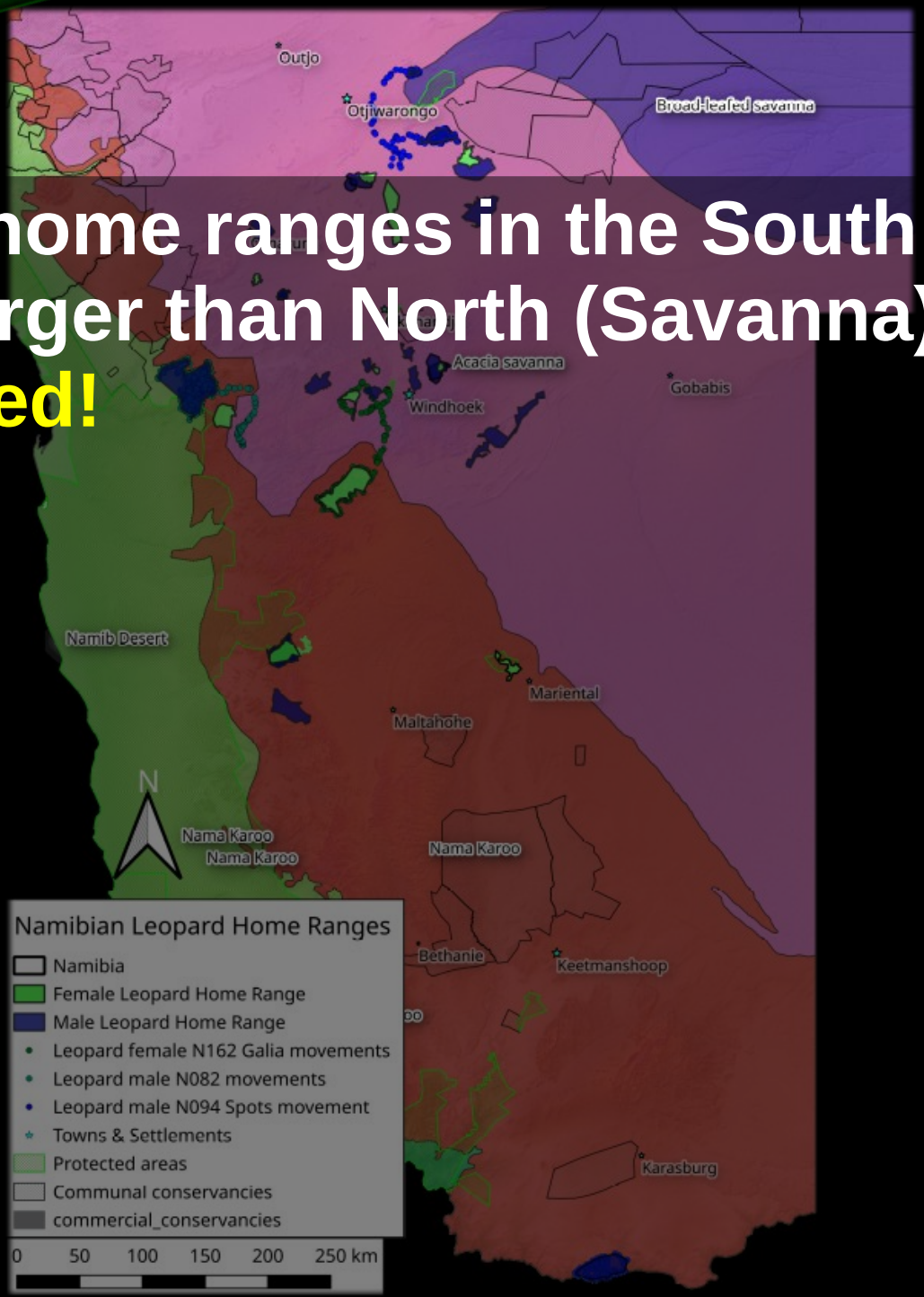


Different areas?



Different areas?

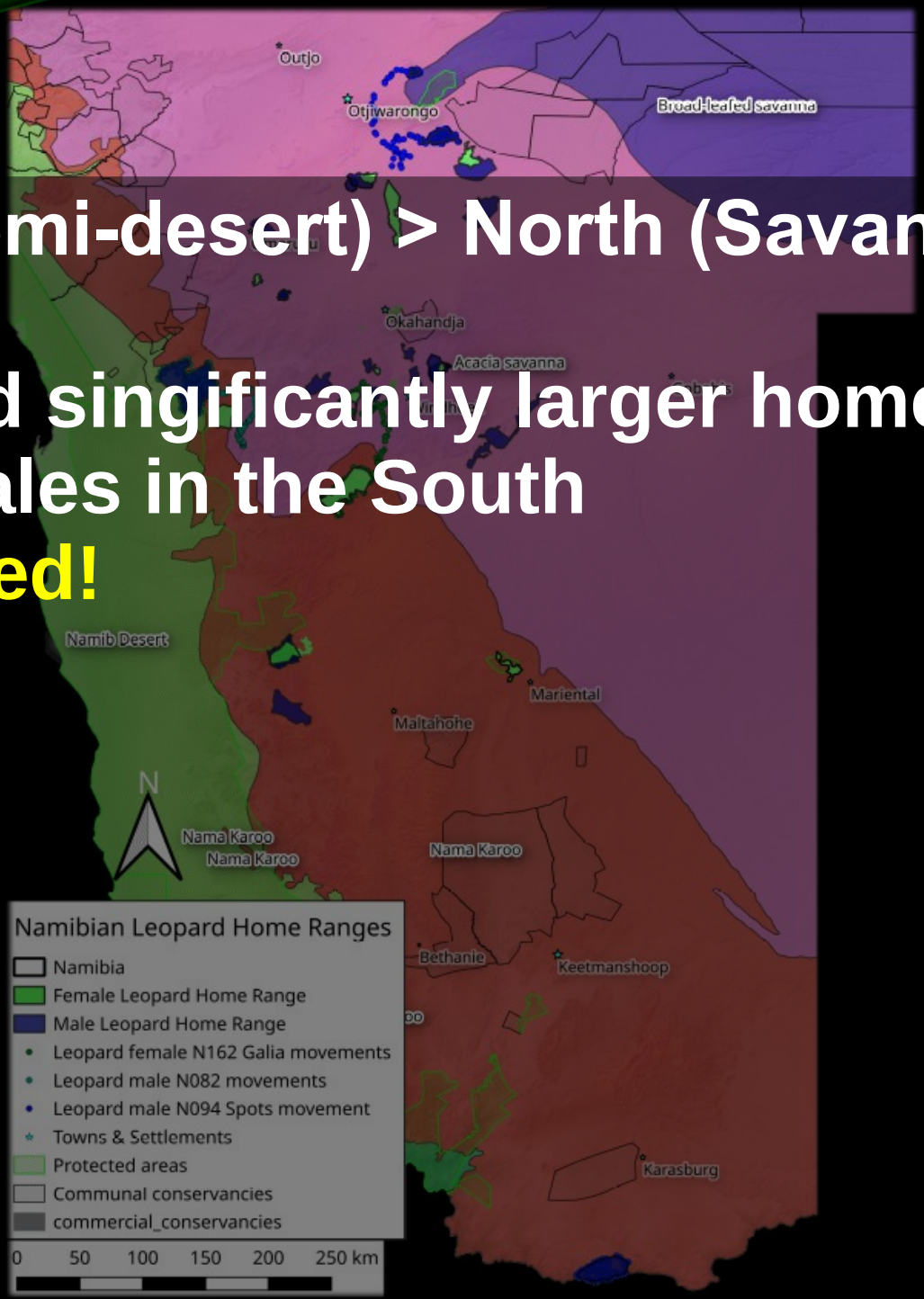
- Leopard home ranges in the South (semi-desert) larger than North (Savanna)
  Expected!



Different areas?

- South (semi-desert) > North (Savanna)
- Males had singificantly larger home ranges than females in the South

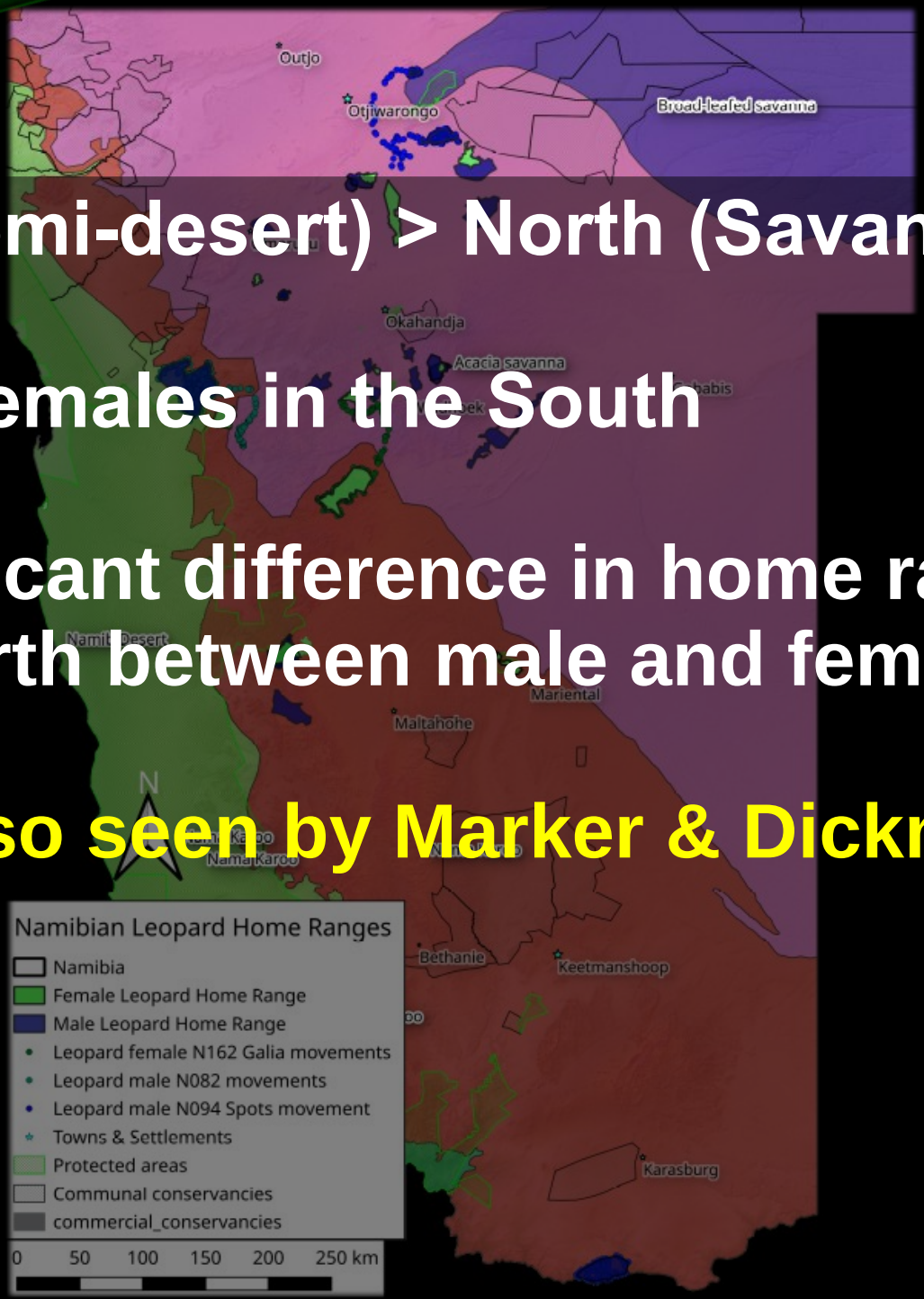
  Expected!



Different areas?

- South (semi-desert) > North (Savanna)
- Males > females in the South
- No significant difference in home range size in the North between male and female leopards

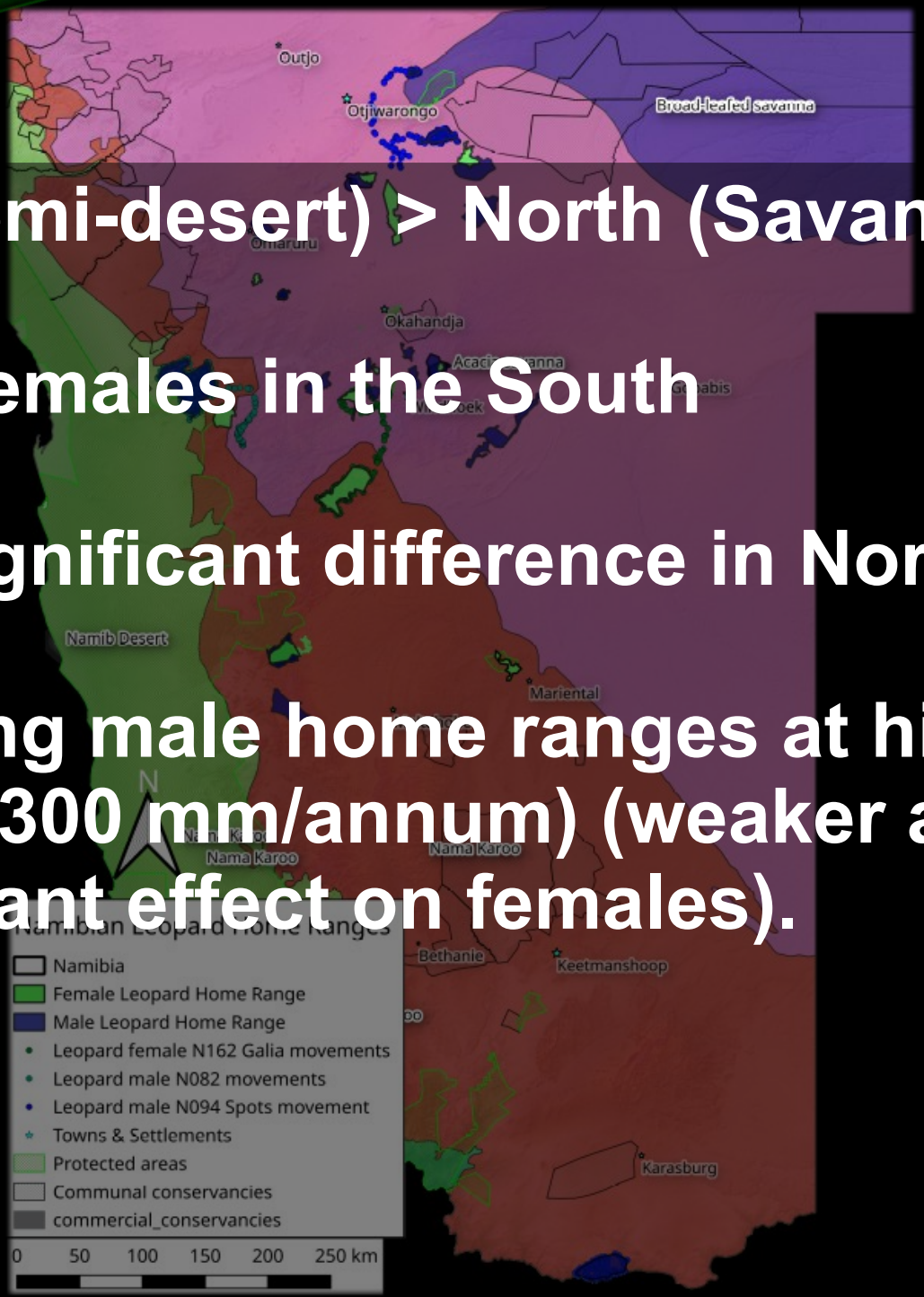
!!?? Also seen by Marker & Dickman (2005)



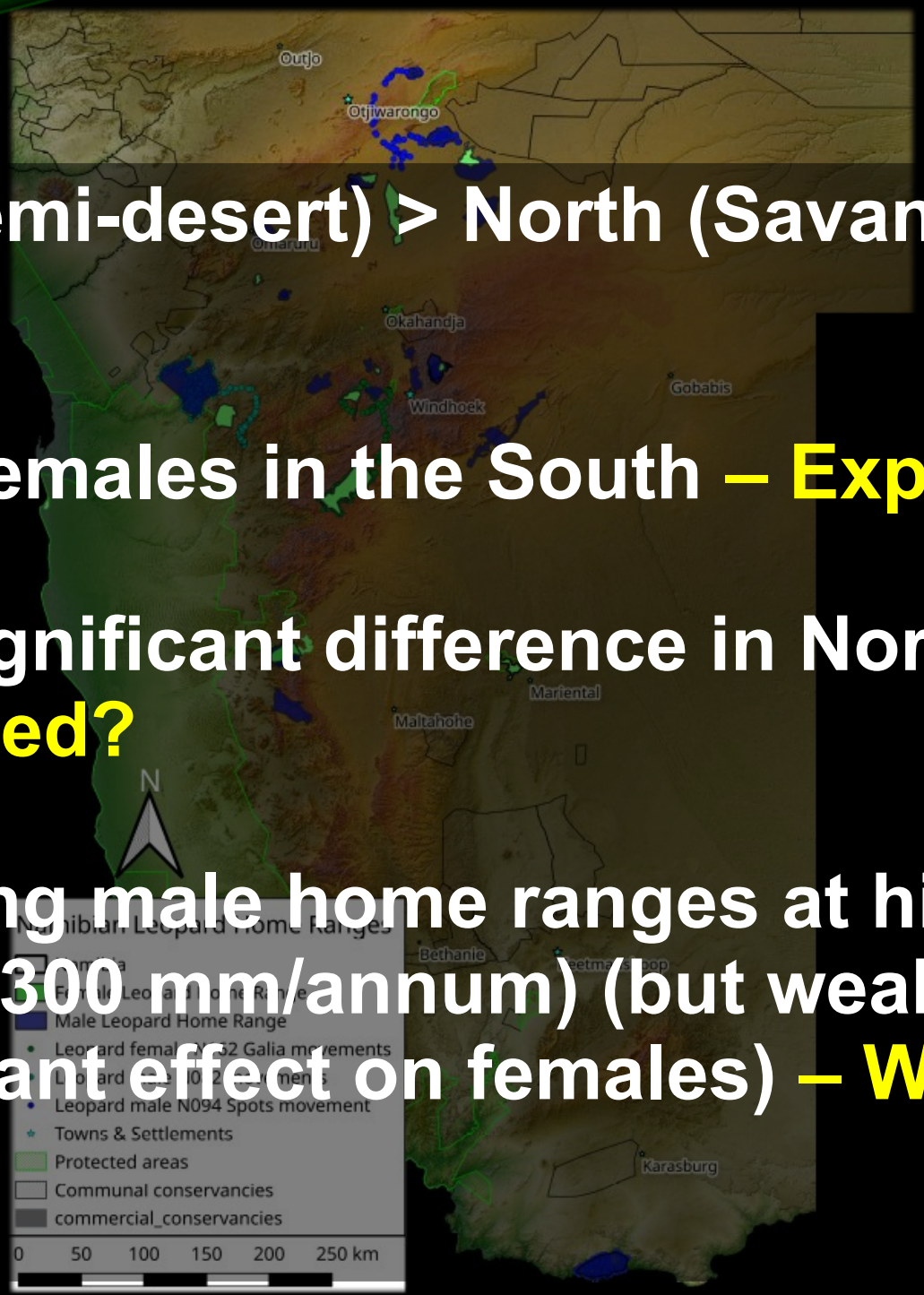
Different areas?

- South (semi-desert) > North (Savanna)
- Males > females in the South
- But no significant difference in North
- Decreasing male home ranges at higher rainfall (>300 mm/annum) (weaker and insignificant effect on females).

  Why?



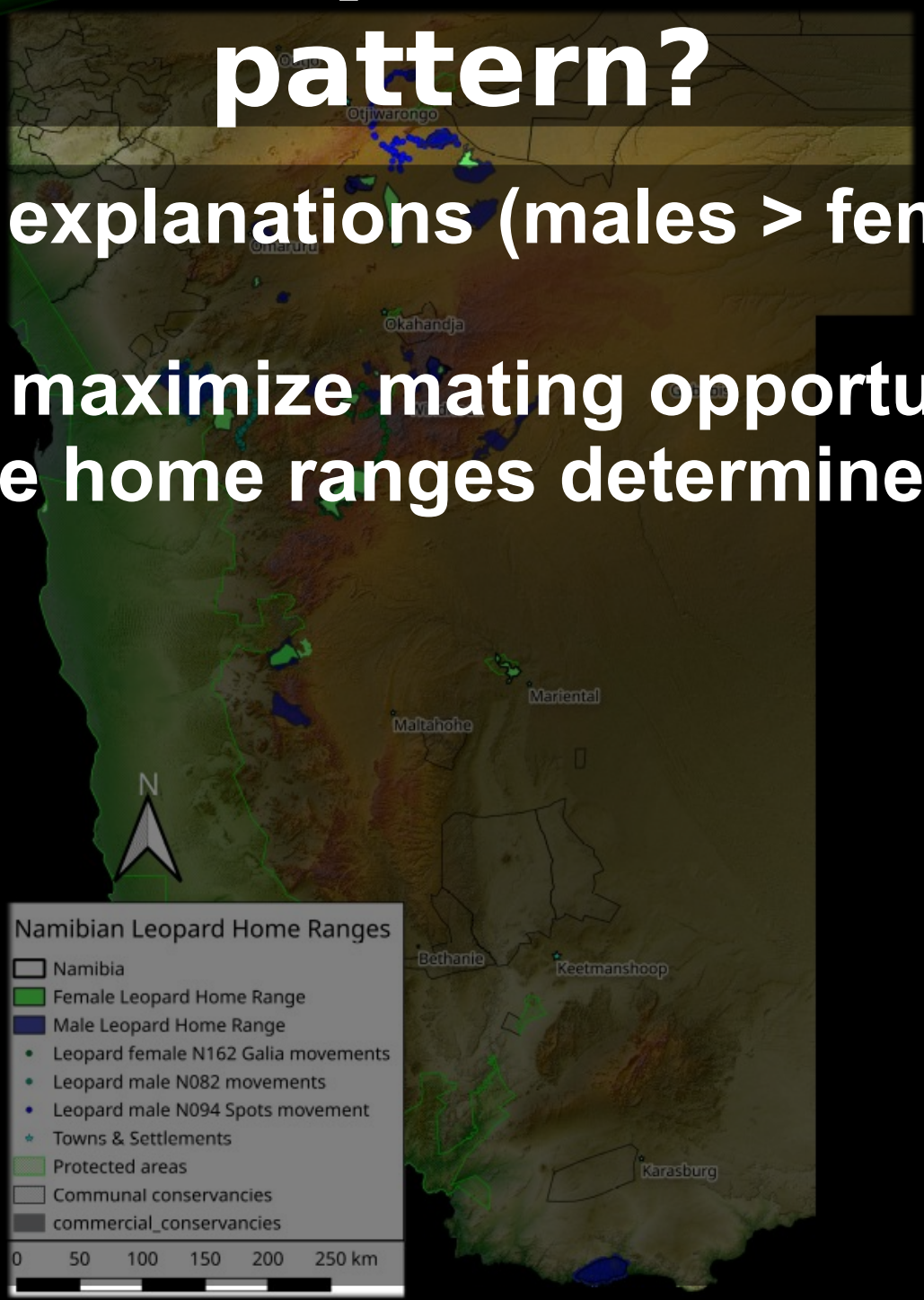
Different areas?



- South (semi-desert) > North (Savanna) – Expected
- Males > females in the South – Expected
- But no significant difference in North – Unexpected?
- Decreasing male home ranges at higher rainfall (>300 mm/annum) (but weaker and insignificant effect on females) – Why?

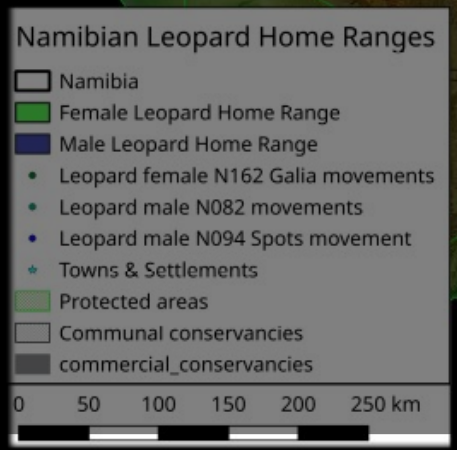
What can explain this spatial pattern?

- Common explanations (males > females):
  - Males maximize mating opportunities. Female home ranges determined by food.



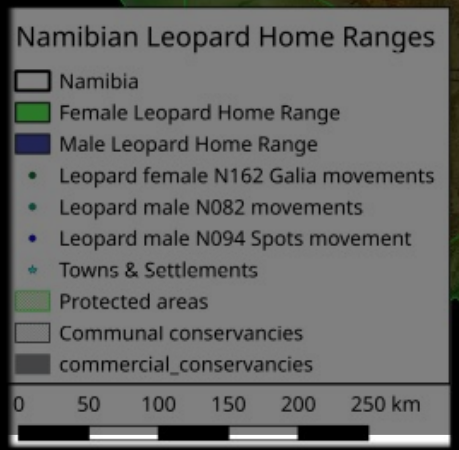
What can explain this spatial pattern?

- Common explanations (males > females):
  - Males maximize mating opportunities. Female home ranges determined by food.
  - Both male and female leopards' home ranges determined by food/habitat. Larger males need larger home ranges.



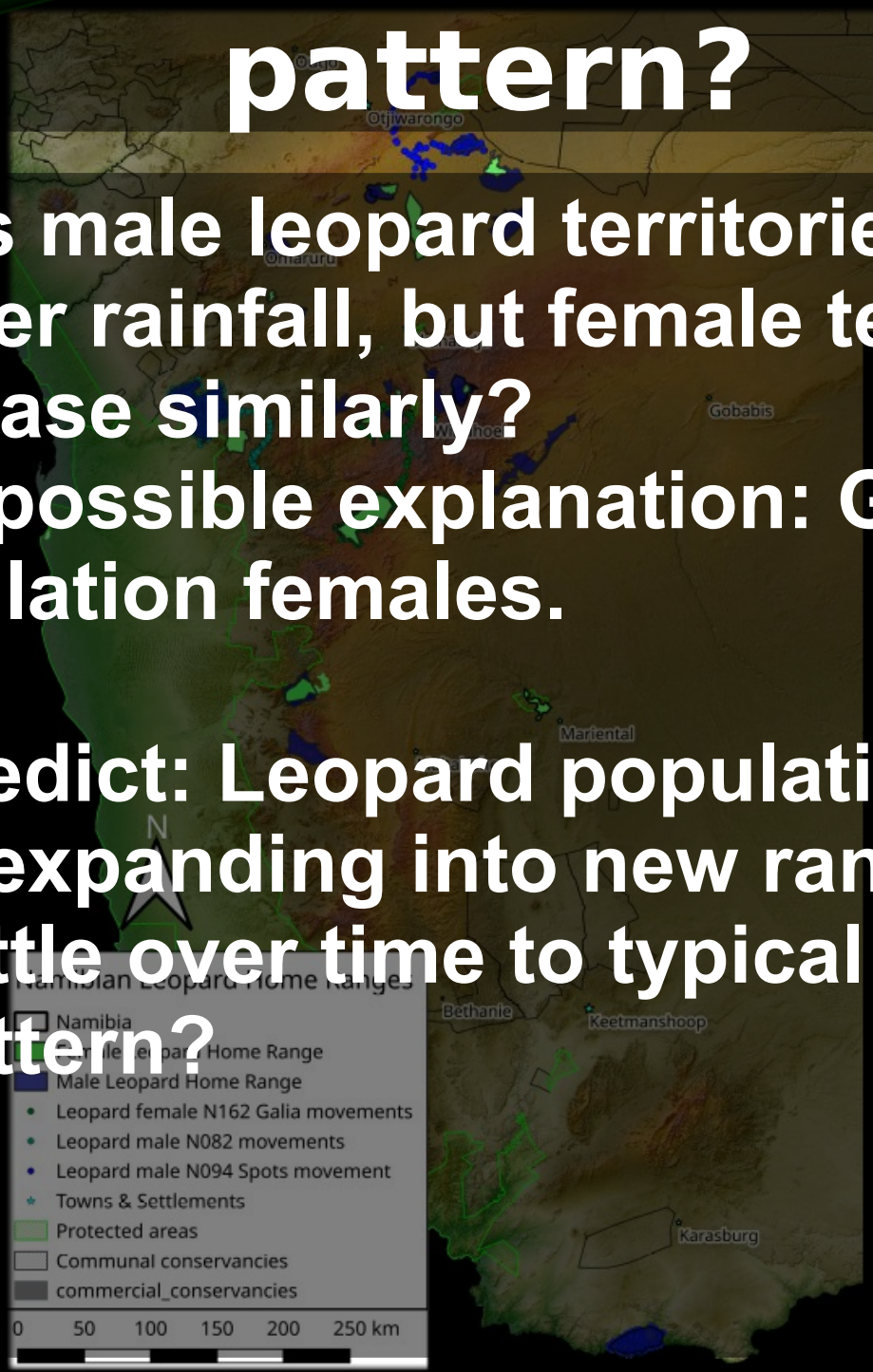
What can explain this spatial pattern?

- Why does male leopard territories decrease with higher rainfall, but female territories do not decrease similarly?
  - One possible explanation: Growing population females defend as large a home range as they can, but then cede parts of their home ranges to their daughters over time.



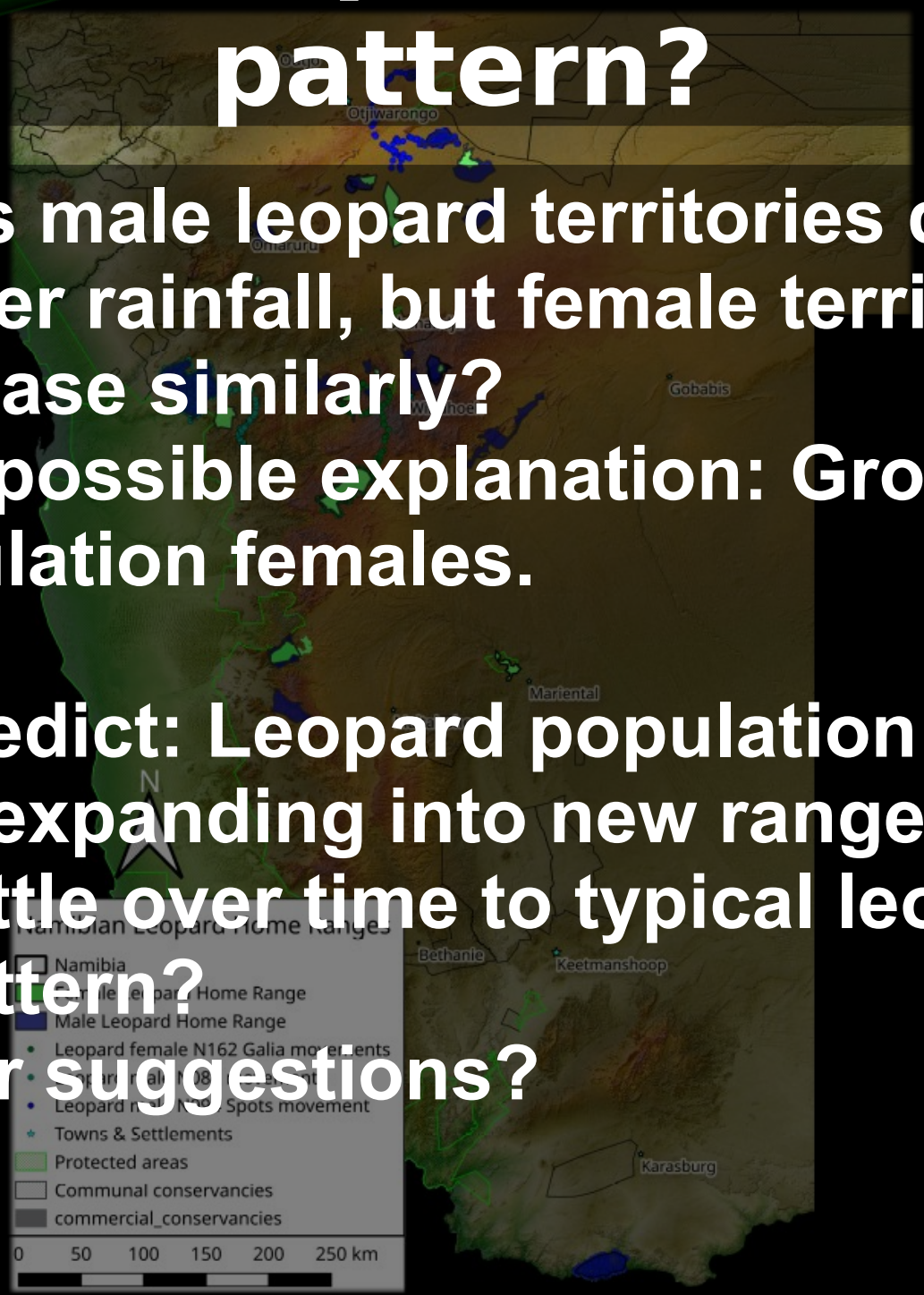
What can explain this spatial pattern?

- Why does male leopard territories decrease with higher rainfall, but female territories do not decrease similarly?
  - One possible explanation: Growing population females.
  - Predict: Leopard population in North is expanding into new range and will settle over time to typical leopard pattern?



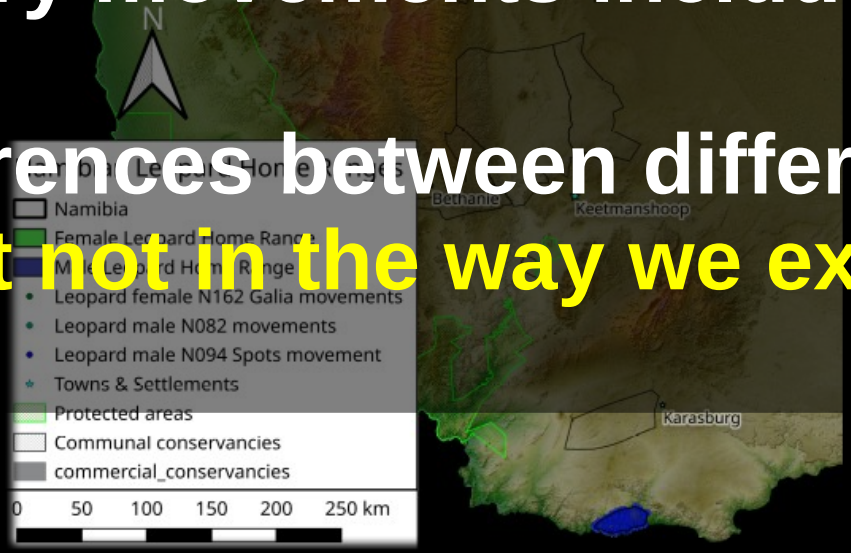
What can explain this spatial pattern?

- Why does male leopard territories decrease with higher rainfall, but female territories do not decrease similarly?
  - One possible explanation: Growing population females.
    - Predict: Leopard population in North is expanding into new range and will settle over time to typical leopard pattern?
  - Other suggestions?



Possible reasons for the large range in home range sizes:

- Different methods to estimate home ranges?
  No
- Translocated *vs* released on-site?
  Yes, if
- Exploratory movements included?
  Yes
- Real differences between different areas?
  Yes, but not in the way we expected






Thank you

Contact details:

Chavoux Luyt

082 791 1384

chavoux@gmail.com

References

- Marker, L., Dickman, A., 2005. Factors affecting leopard (Panthera pardus) spatial ecology, with particular reference to Namibian farmlands. South African Journal of Wildlife Research 35 (2), 105 – 115
- Stander, P. E., Haden, P. J., Kaqece, ||., Ghau, ||., 1997. The ecology of asociality in Namibian leopards. Journal of Zoology, London 242, 343 – 364
- Stein, A., Fuller, T., DeStefano, S., Marker, L., 2011. Leopard population and home range estimates in north-central Namibia. African Journal of Ecology 49, 383 - 387.

Stellenbosch UNIVERSITY IYUNIVESITHI UNIVERSITEIT

N/a'ankuse "CONSERVATION THROUGH INNOVATION"

NRF National Research Foundation