

Using DNA technology to monitor the movement of wildlife without invasive tracking and tagging systems



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Animal movements – a central issue in animal ecology

- Resource utilization
- Territorial defense
- Dispersal and migration - connectivity and gene flow

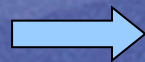
- How can these issues be addressed from non-invasive genetic sampling?

PhD studies in Uppsala 1999-2002

Development of large-scale DNA-based monitoring of Scandinavian carnivores



(1) Sample collection in the field - scats, hair, urine, blood remains



(2) Laboratory analyses



(3) DNA profiles

DNA-based monitoring Scandinavian carnivores

DNA-profiles from the scat samples provide unique ID-codes (1=6), that can be traced back to certain individuals in the target population(s)

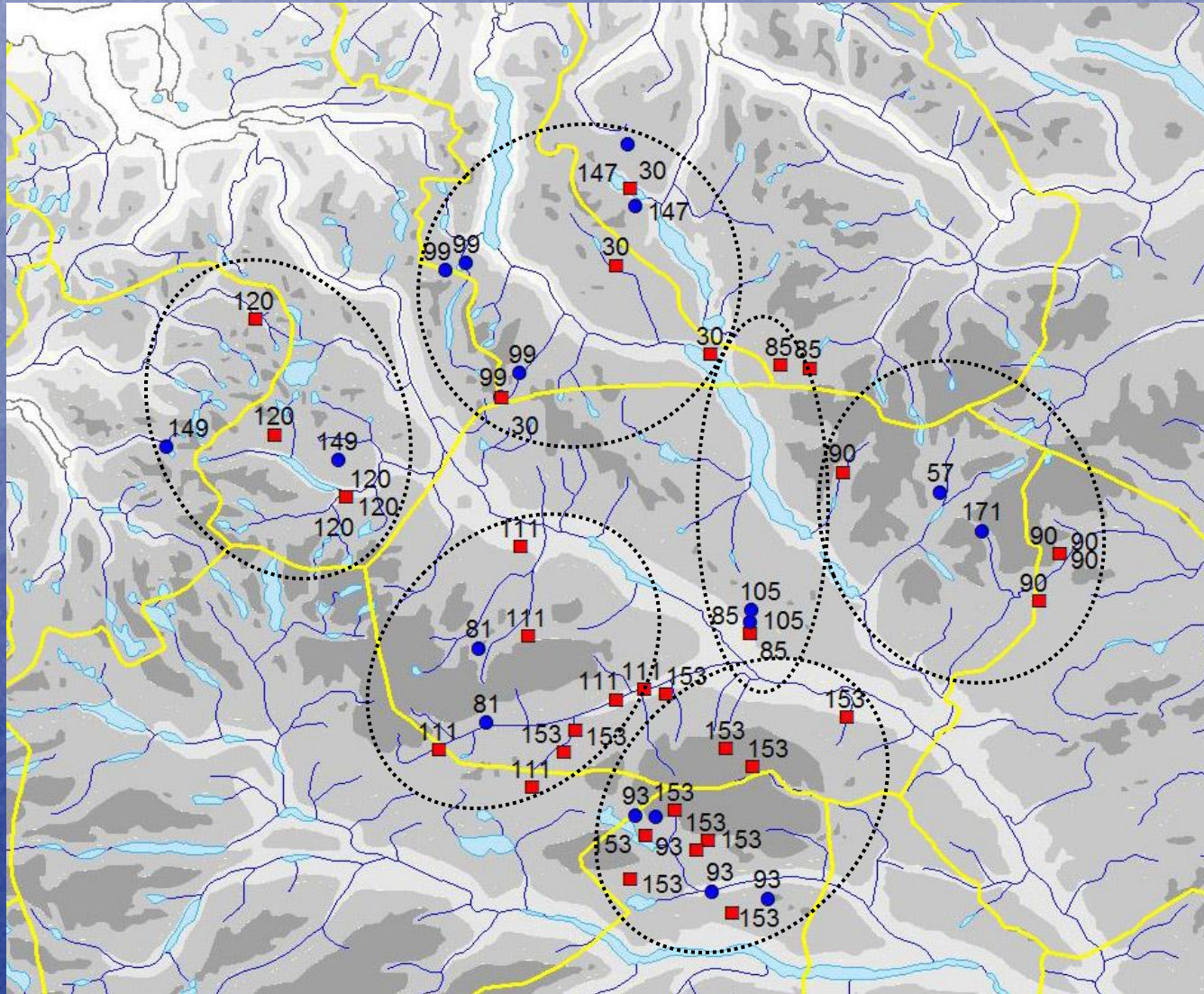
Yearly sample collection allow us to follow the same individuals during a period of several years



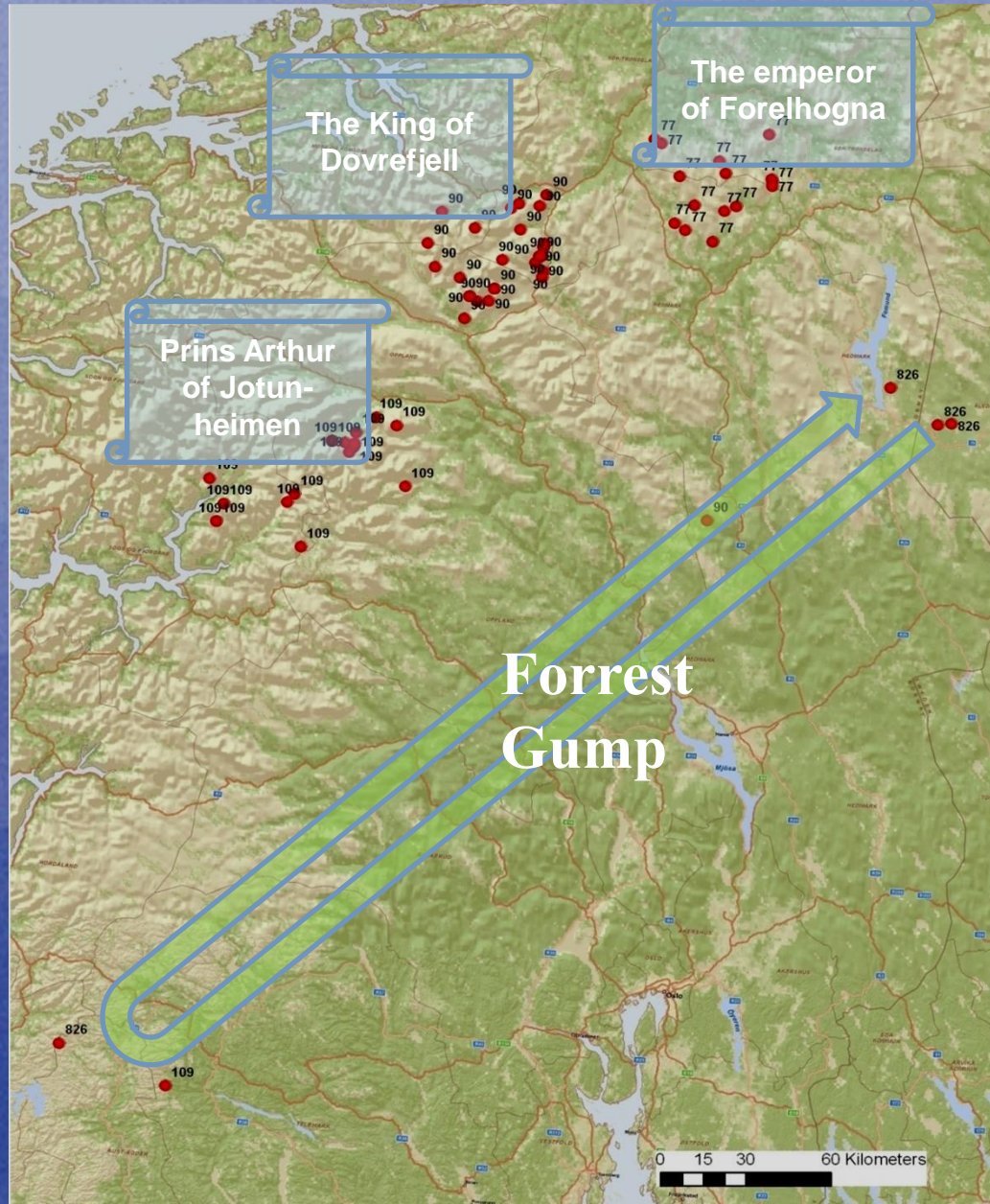
 mapping=>

- home range and territories
- reproduction
- dispersal and migration patterns
- population size and - dynamics
- genetic structure; levels of isolation

Mapping territorial wolverines



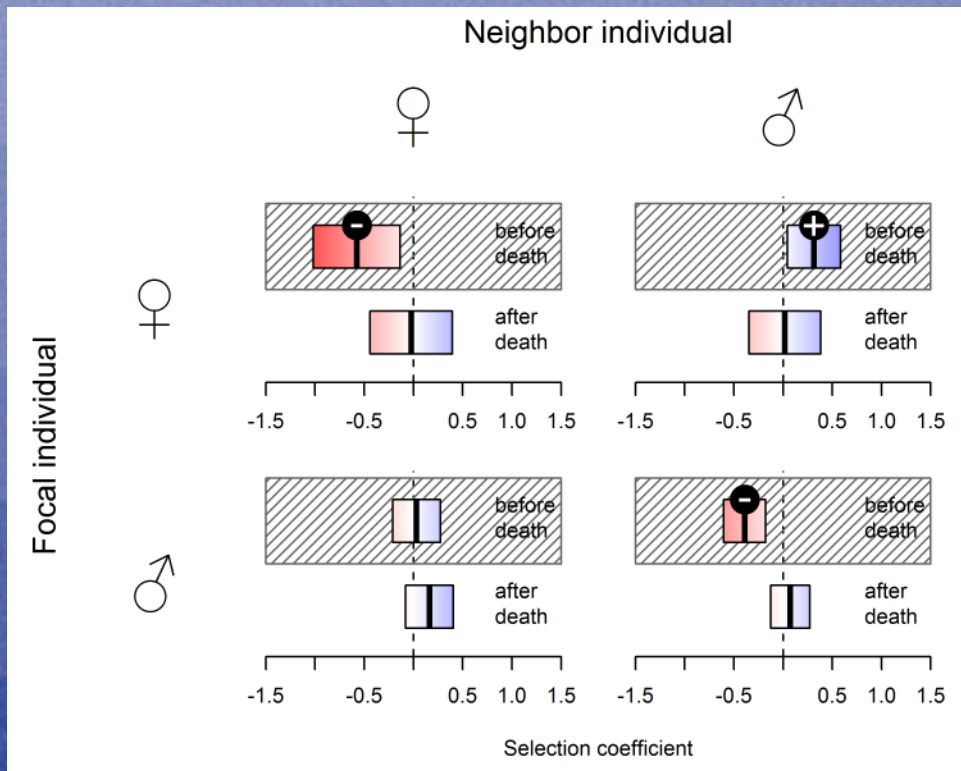
Home ranges and movements



The brown bear – males travel over vast areas

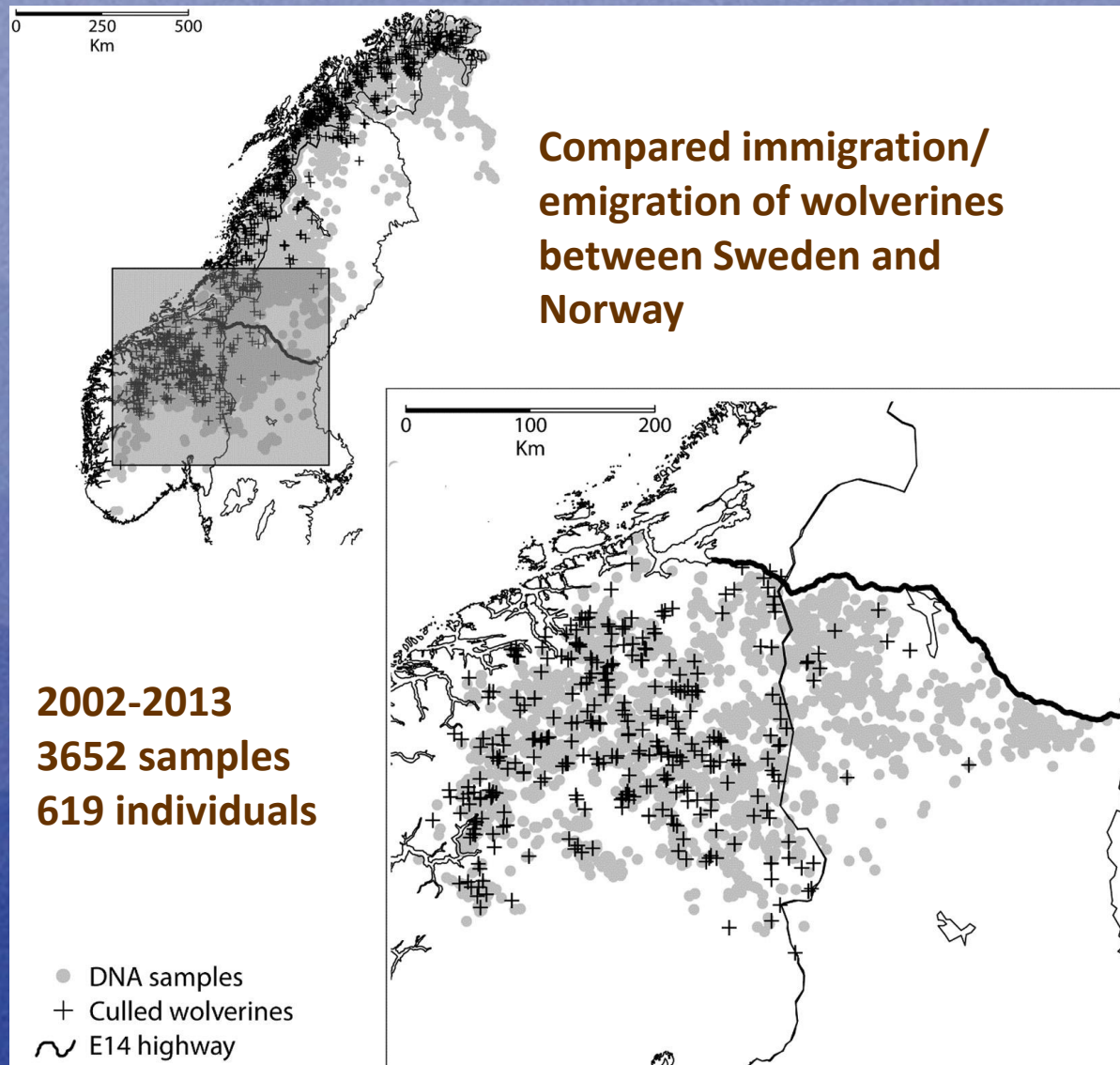


Is it possible to address territorial behaviour from scat samples?

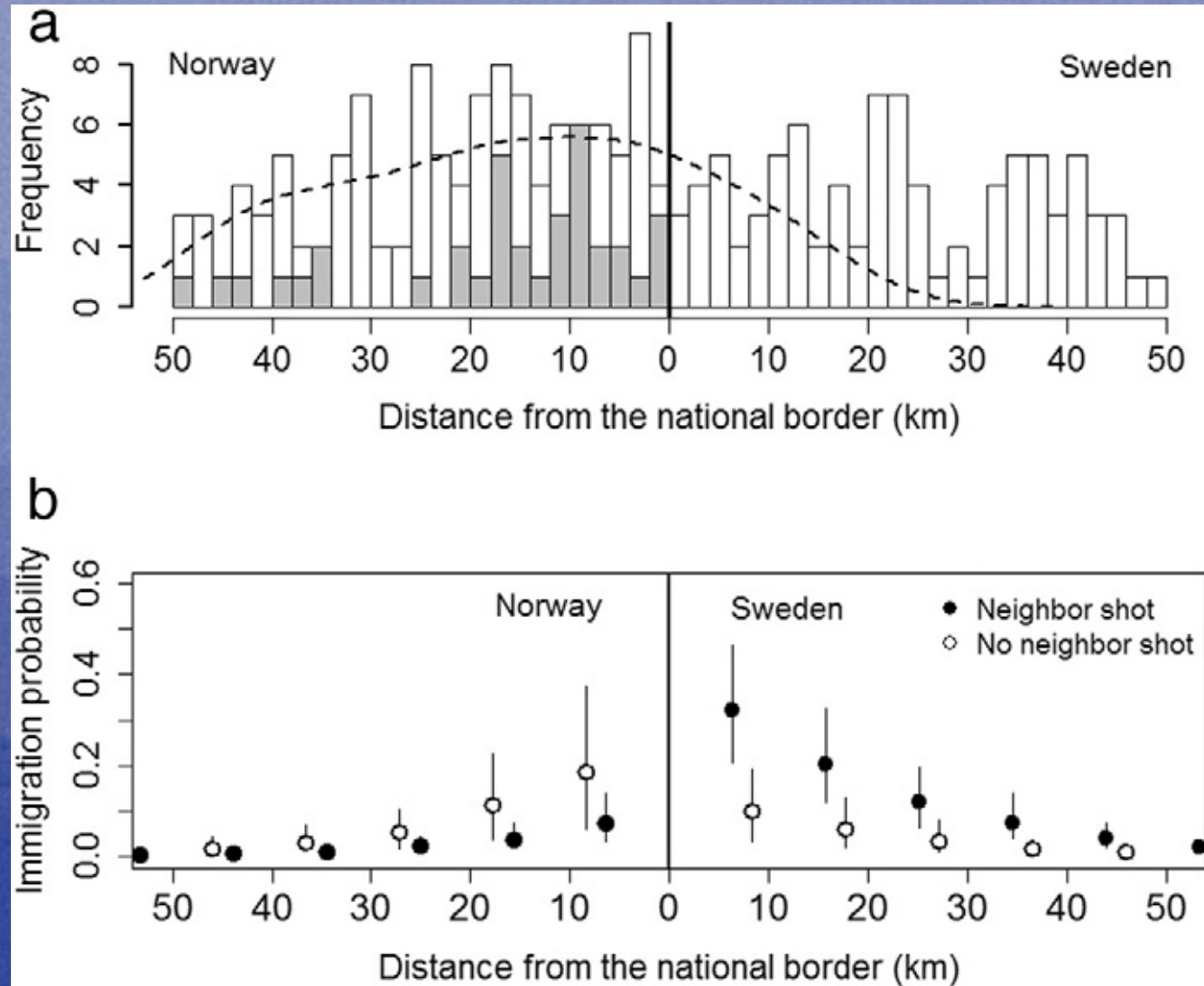


Bischof et al 2016 Ecology and Evolution 6, 1527-1536

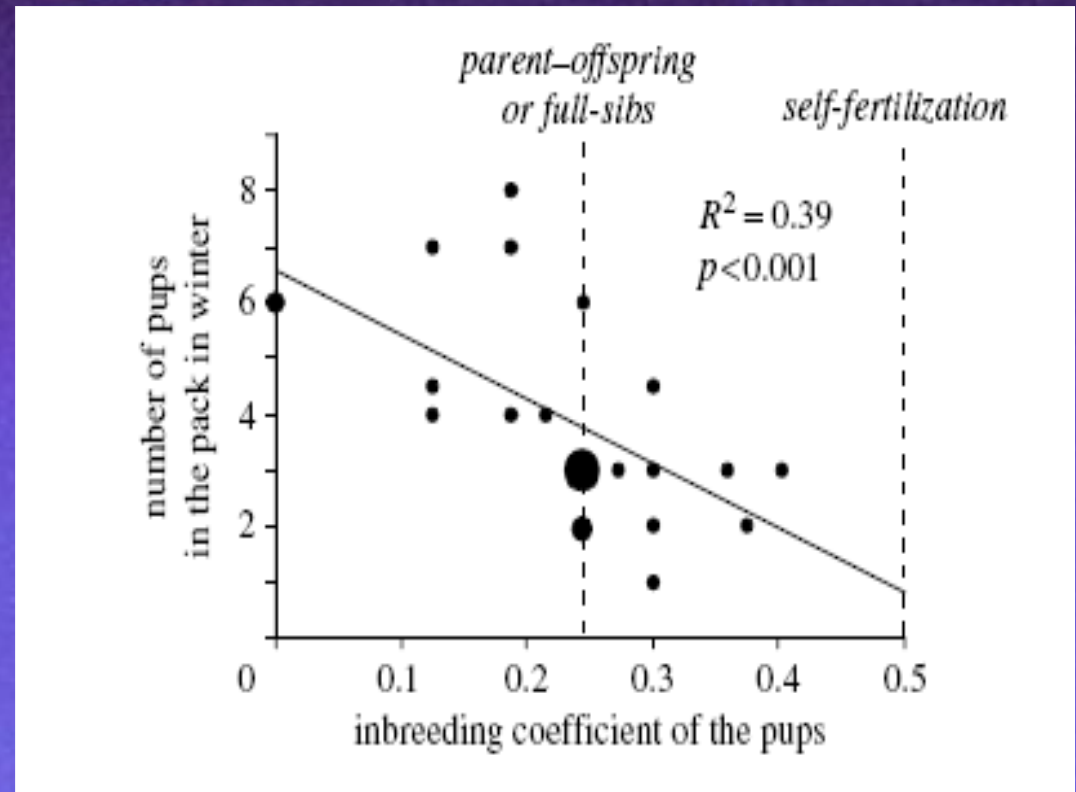
Patterns of emigration/immigration in a managed population



Compensatory immigration

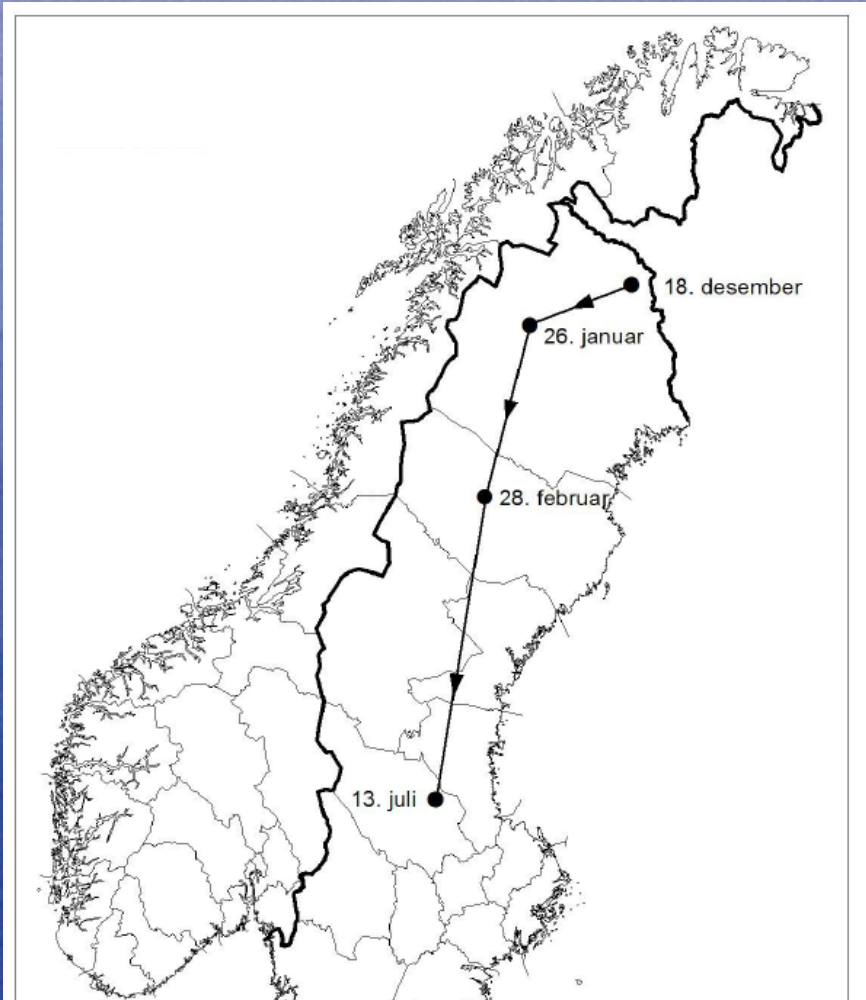


Inbreeding depression in the Scandinavian wolf population

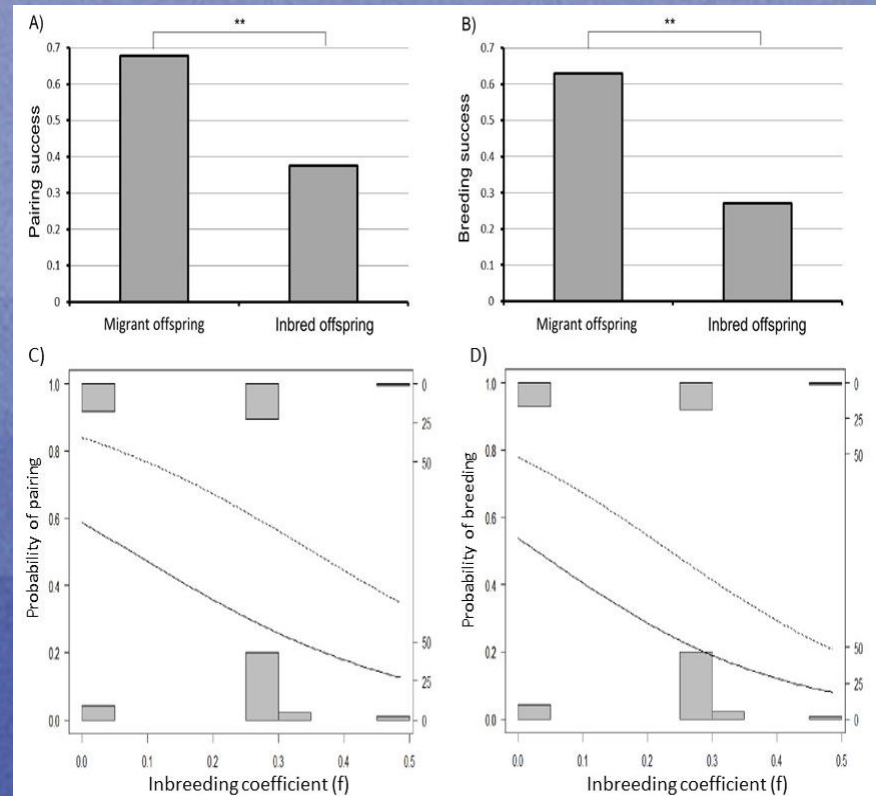
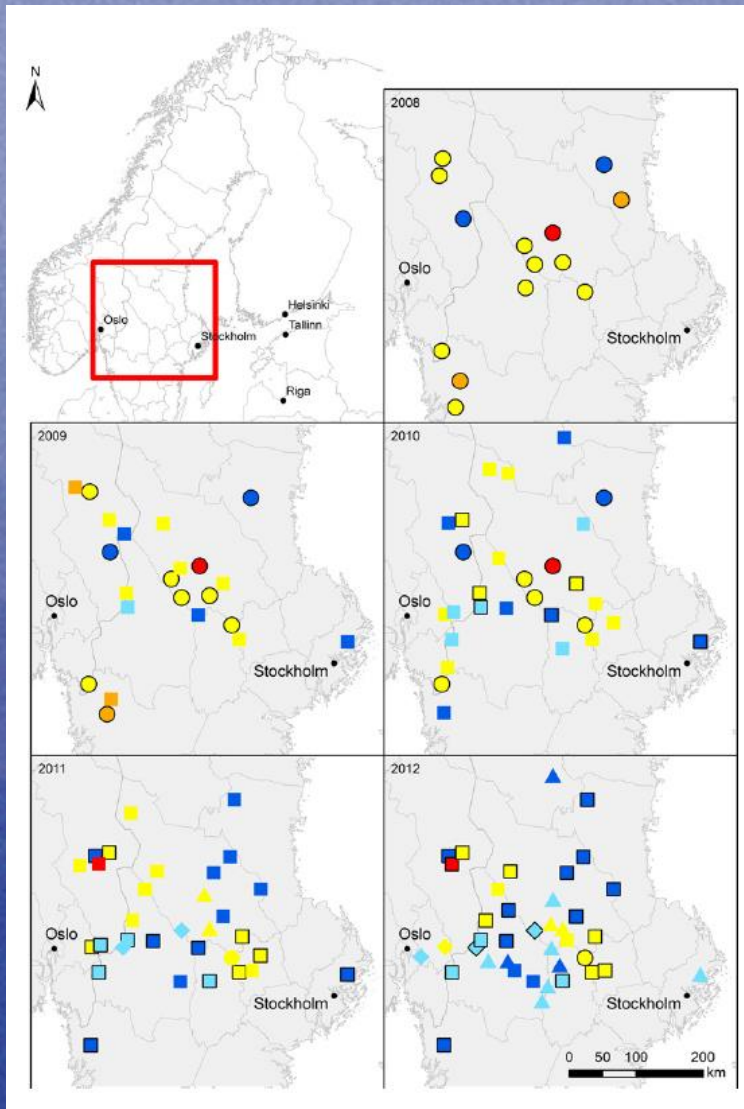


Liberg et al 2005 *Biology Letters* 1, 17-20

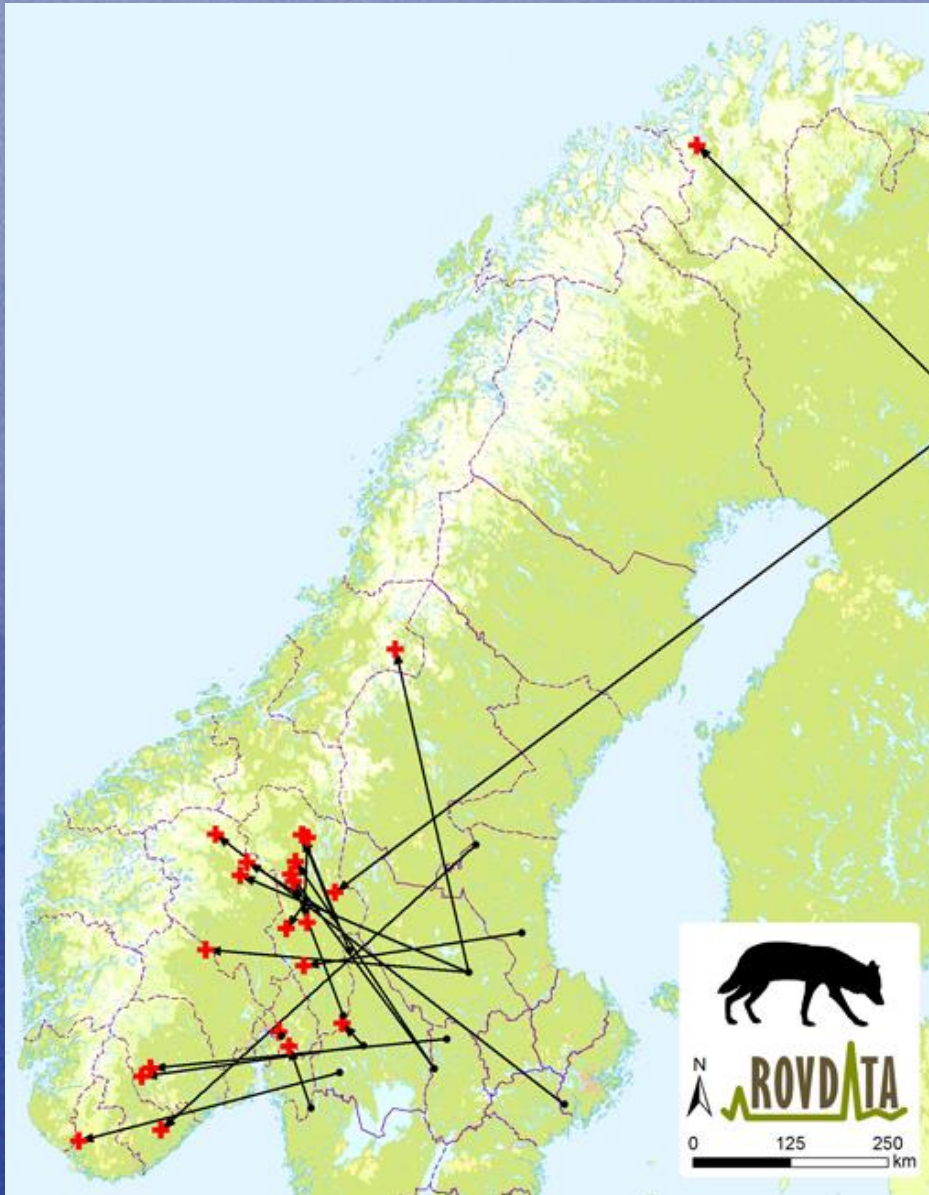
Detection of new immigrants and other genetic important individuals is highly important in the monitoring of the population



Monitoring the reproductive success of offspring to the immigrants



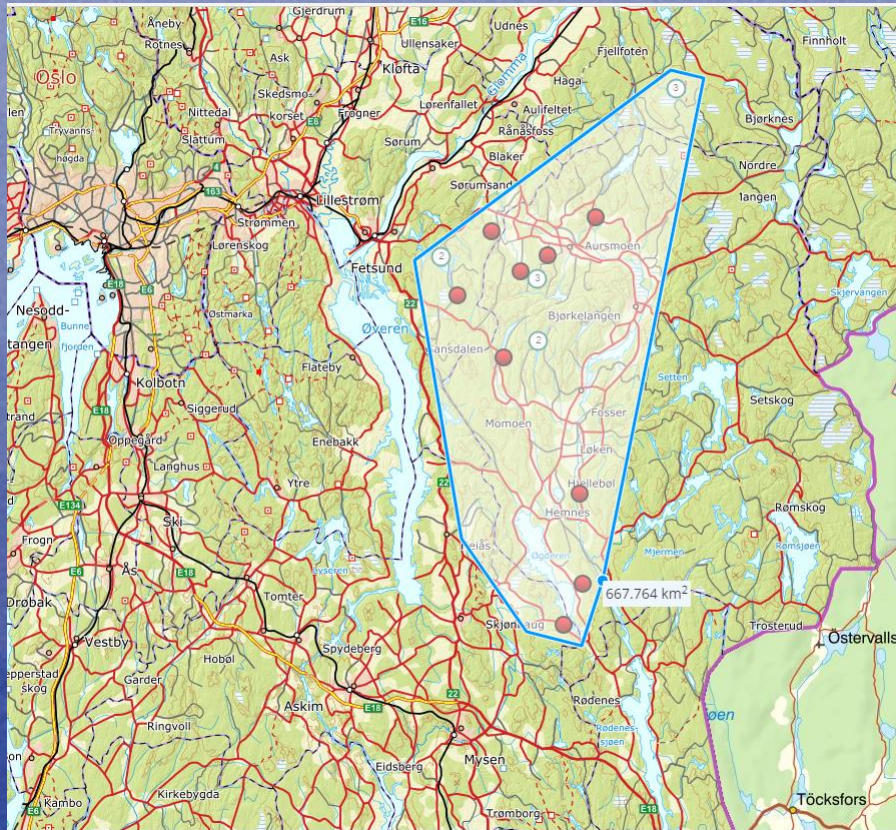
Dispersal and migration patterns



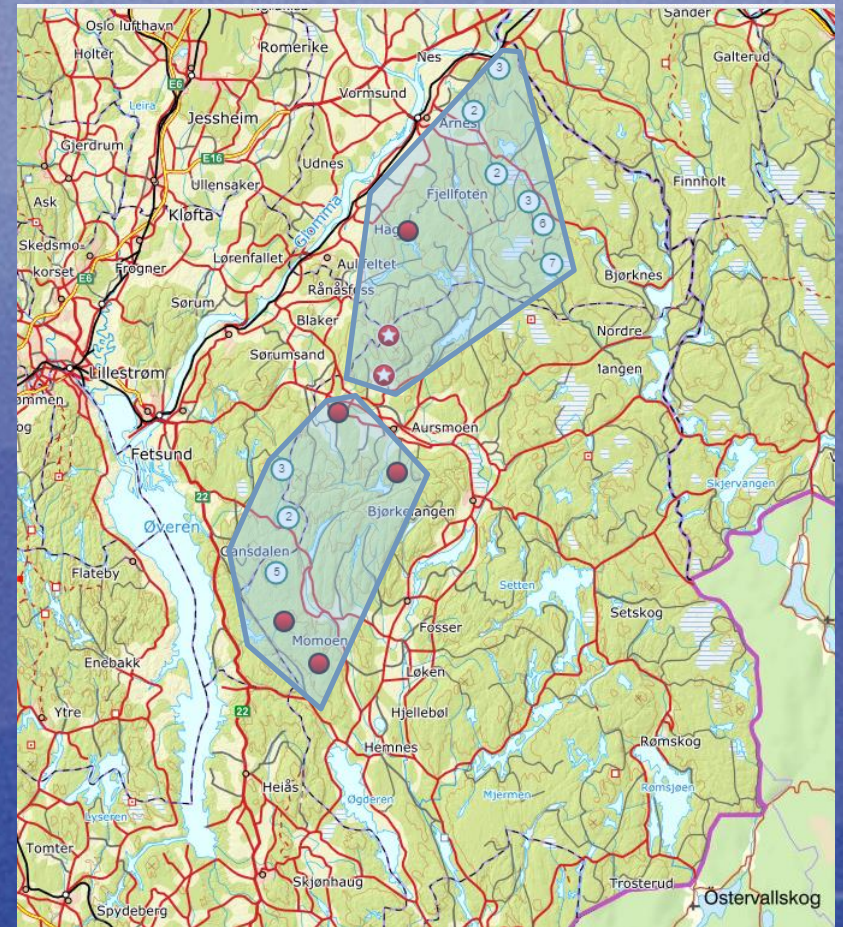
- Scandinavian wolves tend to disperse towards the center of the population
- Move further on if they do not find a partner and/or vacant territory

Territory dynamics

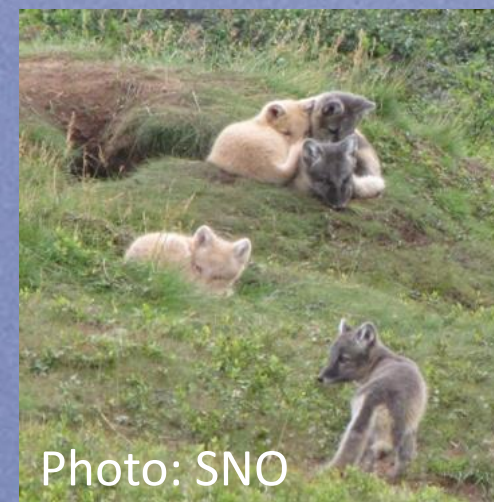
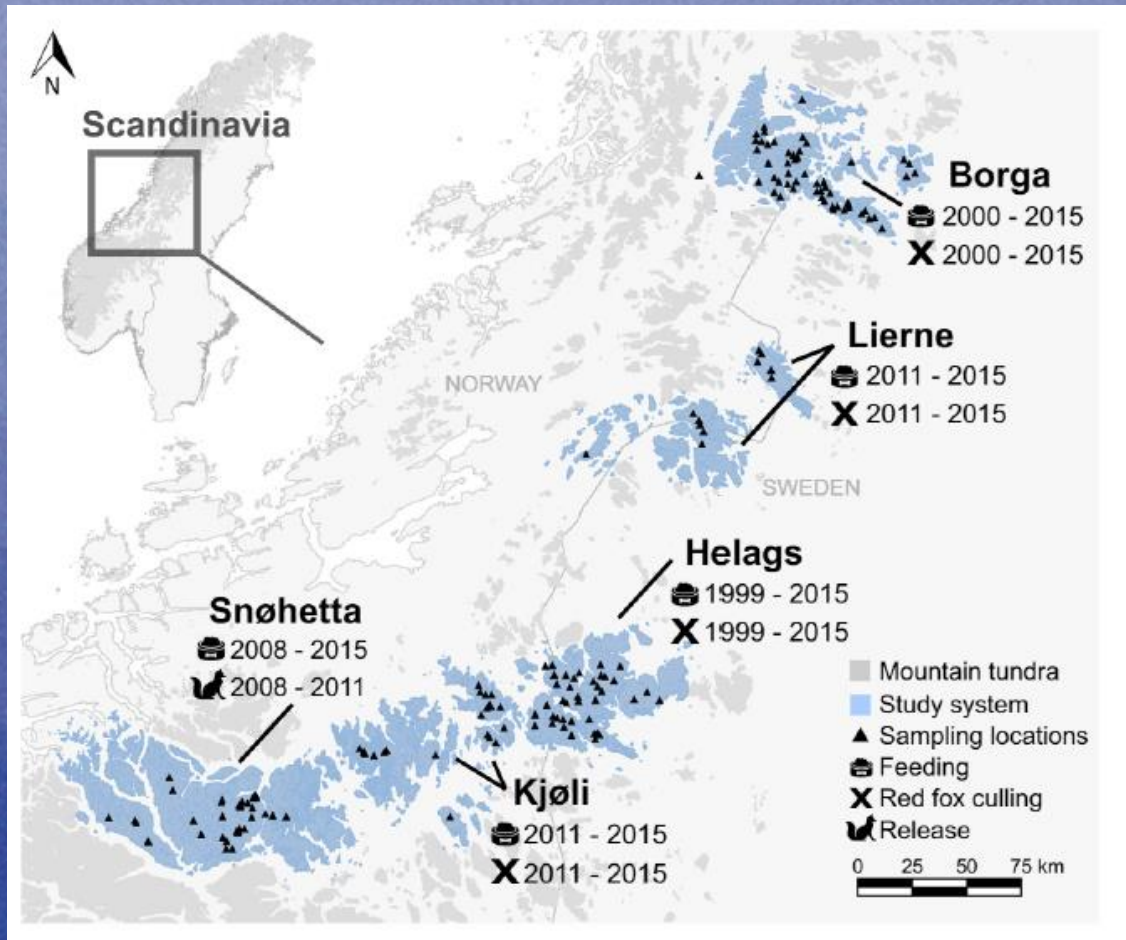
Aurskog winter 19-20



Aurskog and Svarthus winter 20-21

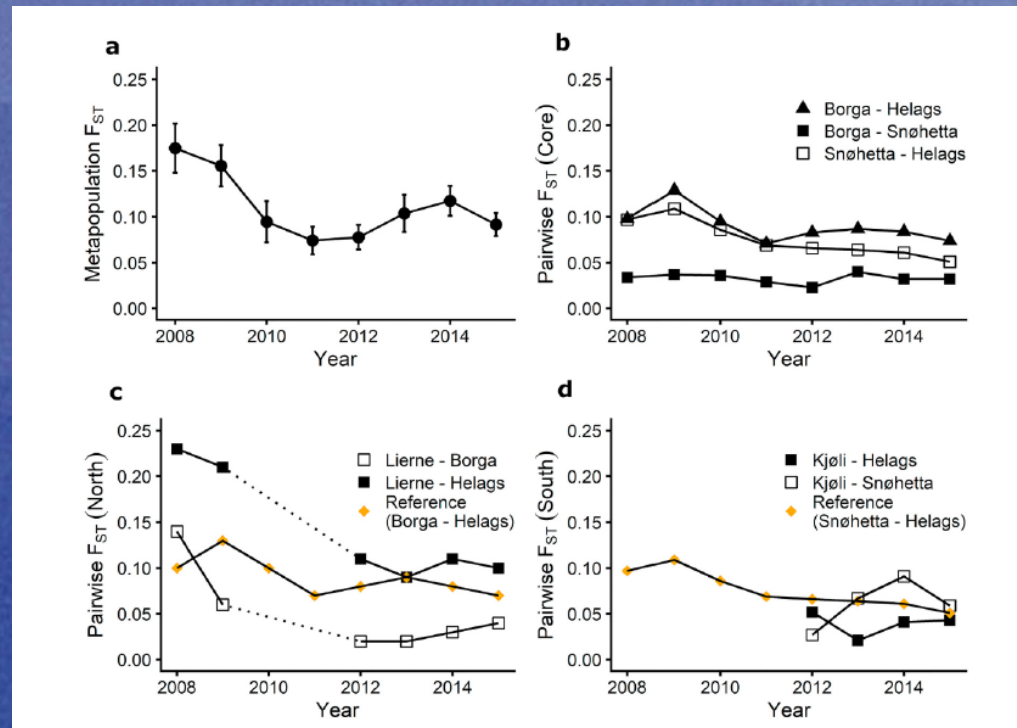
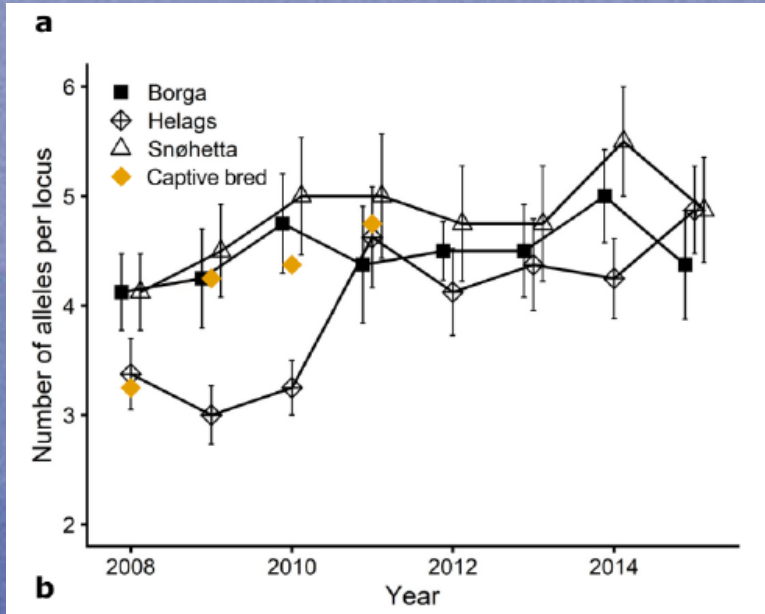


Metapopulation dynamics in the Scandinavian arctic fox population



- Study area: 65,222 km²
- 2,667 faeces and hair samples collected in the field (2008-2015)
- 290 tissue samples from Sweden from marked pups

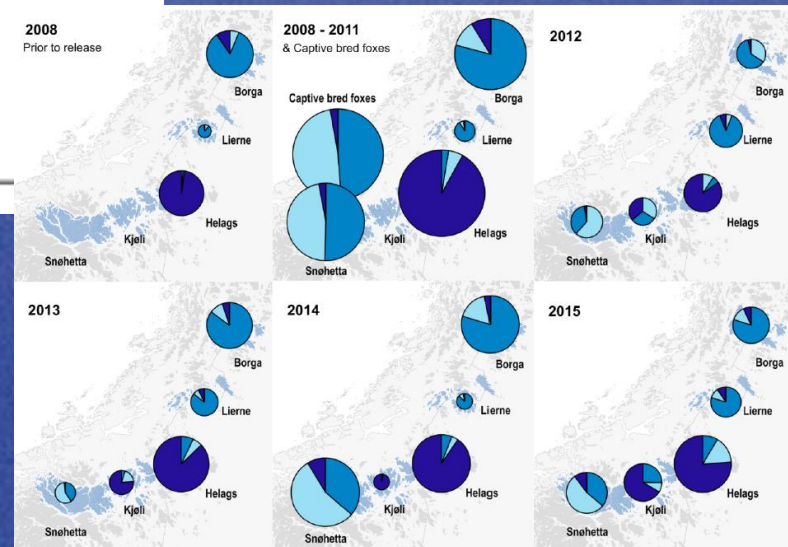
Patterns of genetic variation



Genetic structure and dispersal patterns

Population	2008/2009		
	Immigration rate	95% CI	Proportion admixed
Borga	0.046	0.036–0.055	0.139
Lierne	0.290	0.271–0.309	0.000
Helags	0.032	0.023–0.040	0.000
Kjøli			
Snøhetta	0.285	0.271–0.299	0.050

Population	2014/2015		
	Immigration rate	95% CI	Proportion admixed
Borga	0.057	0.044–0.070	0.218
Lierne	0.149	0.122–0.176	0.143
Helags	0.067	0.055–0.080	0.167
Kjøli	0.219	0.196–0.241	0.050
Snøhetta	0.229	0.220–0.238	0.312



International projects

- Chetri, M., M. Odden, K. Sharma, O. Flagstad, and P. Wegge. 2019. 'Estimating snow leopard density using fecal DNA in a large landscape in north-central Nepal', *Global Ecology and Conservation*, 17.
- Flagstad, O., N. M. B. Pradhan, L. G. Kvernstuen, and P. Wegge. 2012. 'Conserving small and fragmented populations of large mammals: Non-invasive genetic sampling in an isolated population of Asian elephants in Nepal', *Journal for Nature Conservation*, 20: 181-90.
- Flagstad, O., P. O. Syvertsen, N. C. Stenseth, J. E. Stacy, I. Olsaker, K. H. Roed, and K. S. Jakobsen. 2000. 'Genetic variability in Swayne's hartebeest, an endangered antelope of Ethiopia', *Conservation Biology*, 14: 254-64.
- Wegge, P., R. Shrestha, and O. Flagstad. 2012. 'Snow leopard *Panthera uncia* predation on livestock and wild prey in a mountain valley in northern Nepal: implications for conservation management', *Wildlife Biology*, 18: 131-41.

**Samarbeid og kunnskap
for
framtidens
miljøløsninger**