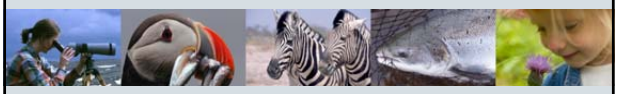

Technology and the 3Rs in wildlife research: the state of the art

John Linnell

NINA
Norsk institutt for naturforskning

Who am I, and where am I coming from?

Roe deer:
Storfosna 1989 - 1994
South Norway 1995 - -

Arctic foxes: 1996-2005

Eurasian lynx: 1995 - -

European large carnivores:
Baltic states: 2003 – 2005
Balkan: 2006 - 2013

Jaguars
2011 - 2013

Muskox / reindeer:
1999 - 2001

Rodents
2000 - 2005

Leopards:
2007 - 2012

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Plan for the talk

- Introduction to wildlife research – context, motivations & approaches
- Conventional research methods – capture and collars
- New technology – non-invasive methods
- New technology – invasive methods
- Wildlife research and the 3Rs

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Context: wild ungulates

Context: Large carnivores

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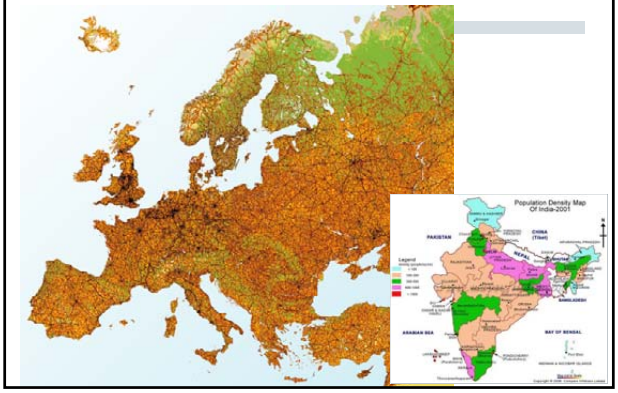
Context: crowded continents



Context: human-dominated landscapes





Why is wildlife research different?

- Because it involves many different ethical frameworks, including those related to biodiversity conservation.
- Because the benefits are for humans and for domestic animals and for the populations of the species being studied.
- Because society interacts with wildlife in many different ways (e.g. hunting) which also sets precedents about what is, and what is not, viewed as acceptable.

Why is wildlife research different?

- Most of our work is not experimental – in that we do not deliberately influence our study animals quality of life.
- We mark them (with collars and sensors) so we can study them without further influence.
- The premise of our work is that they are not significantly influenced by the methodology.
- Akin to the control group in a laboratory setting.

Why is wildlife research different?

- Difference with respect to the humane end-point.
- We don't kill our animals at the end of the study!
- Many studies are intended to follow the animals throughout their lives.
- Multiple goals from a project – including communication
- Research vs Conservation vs Management

Motivation #1 : Sustainable use

- Norwegian management of wildlife is heavily based on sustainable use – e.g. hunting
- Most of Norwegian wildlife research has been motivated by the need to mange populations to;
  - Provide sustainable source of income for landowners and recreation for hunters
  - Ensure harvest does not negatively effect viability or ecology of the species
  - Balance multiple interests in shared landscapes

Motivation #2 : Conflict reduction

- Forest damage caused by ungulates
- Vehicle collisions caused by ungulates
- Depredation on sheep and reindeer caused by large carnivores


Motivation #3 : Conservation

- Wildlife conservation is a global endeavour.
- Norway has important populations and habitats for many species (wolverine, wild reindeer, arctic foxes etc).
- Their conservation in multi-use landscapes requires balancing many interests and a hands-on approach which requires presise knowledge.
- Naturmangfoldsloven (2009).

Motivation #3 : Conservation

- Knowledge for coexistence!
- (Knowledge for existence)

Motivation #4 : Knowledge

- Wildlife research has been mainly driven by applied questions – but spin-off analysis has been used to conduct vast amount of basic research.
- Result is that our large mammal species are some of the best studied model wildlife species in the world.
- Has laid the foundation for asking many more basic questions about their ecology, life history, physiology.
- Knowledge shapes the way we look at the world.

Motivation #4 : Knowledge

- Wildlife species often have extreme adaptations …. to cold, drought, heat etc. Pushing our boundaries of understanding how life works!
- Recently turning studies of these adapations to human applications
  - E.g. Hibernating bears and osteoporoses.

Conventional methods

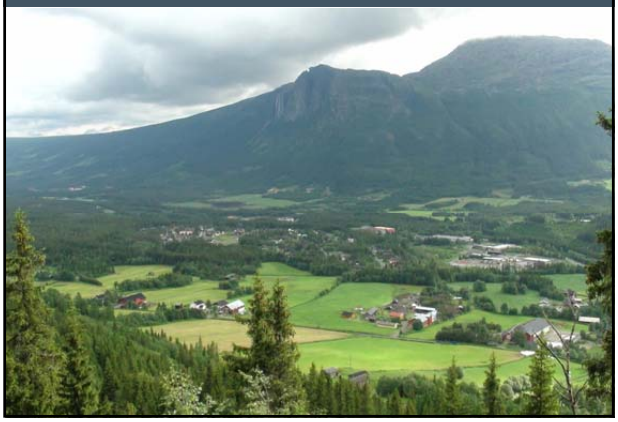
- Problem of observing rare and elusive species
- «Capture and collar»
- Issues related to capture – stress, injury, death
- Issues related to instrumentisation
  - Weight
  - Attachment – collars vs implants
  - Drop-off

Capture

- Largely constrained by practicality
- Battle of wits – outsmarting crafty beasts!
- Safety issues for both humans and anumals
- Huge diversity of approaches – depending on species, habitats, landscapes, climate, regulations and traditions.

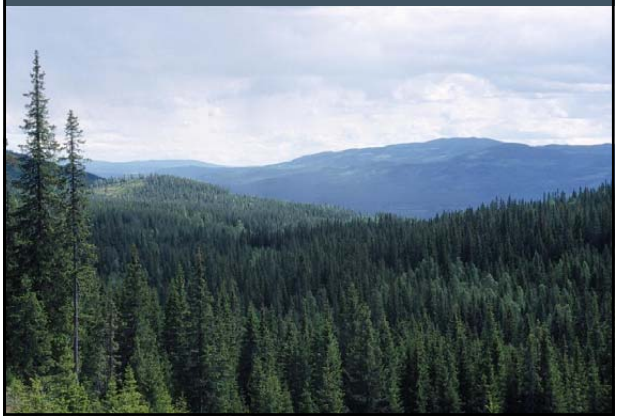
Lynx studies in different landscapes…

Lynx studies in different landscapes…



Lynx studies in different landscapes…

Lynx studies in different landscapes…



Lynx studies in different landscapes…

Animal capture: methods

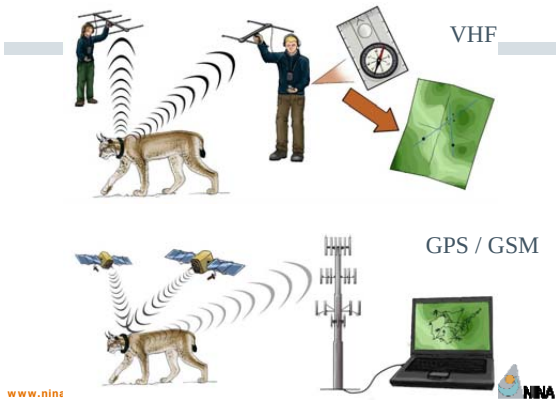
Animal capture: methods

Animal capture: methods

Animal capture: methods

Animal capture: methods

Evolving technology



GPS vs VHF

GPS with GSM download and VHF beacon = 320g

VHF = 150g

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GPS vs VHF

VHF	GPS
Light (50%).	Heavy.
Reliable.	Not always reliable.
Locations must be collected manually.	Many locations in short time.
Cheap (10%).	Human safety.
Long battery life.	Short battery life.
Best for long term study with extensive follow-up.	Best for short term intensive study.
Best for life history data collection.	Best for movement data collection.

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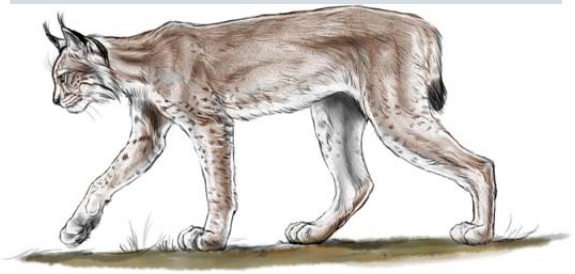
GPS vs VHF

GPS

VHF

These legs are made for walking ….



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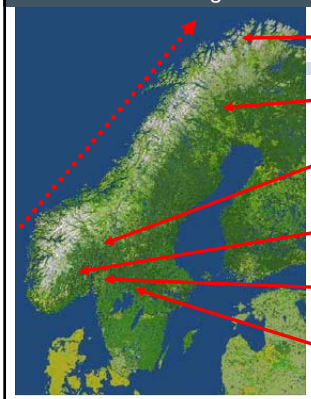
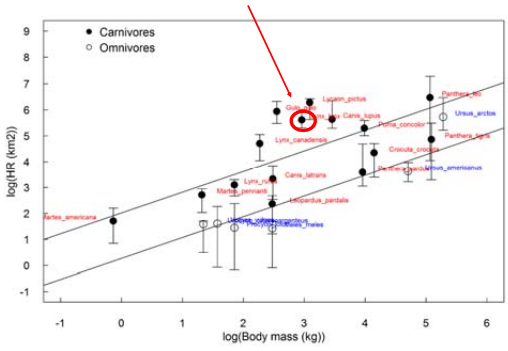


	Troms / Finnmark	Troms / Finnmark
	♂: 2800 km²	♀: 1500 km²
Sarek	♂: 2300 km²	♀: 900 km²
Østerdalen	♂: 1500 km²	♀: 800 km²
Østafjells	♂: 900 km²	♀: 500 km²
Akershus	♂: 600 km²	♀: 350 km²
Bergslagen	♂: 600 km²	♀: 300 km²

Linnell et al. (2001) Environmental Management 27 (6) 869–879.

These legs are made for walking ….

Lynx are an outlier



The Lone Ranger

- N = 120
- **Males**
- 100% disperse
- 32 – 428 km (av = 148)
- **Females**
- 65% disperse
- 3 – 215 km (av = 47)
- **Seperation at around 10 months of age**
- **High survival**

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Sarmiento et al. (2012) Journal of Zoology 286: 120-130.

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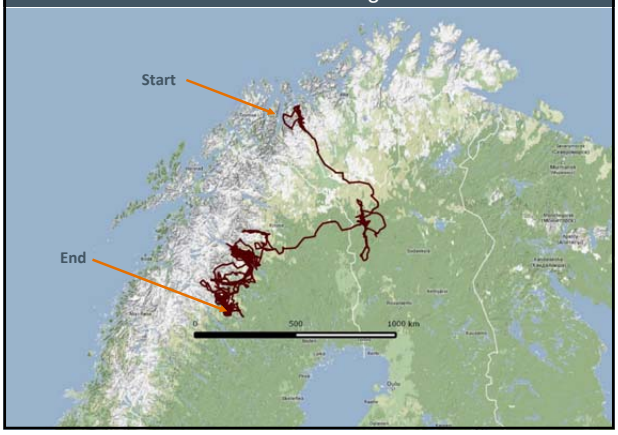
The Lone Ranger



Life history

Mortality

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Andrén et al. (2006) Biological Conservation 131: 23-32

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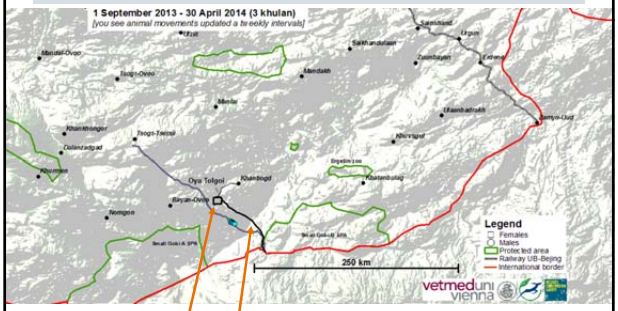
Scales of movement



Mine Road

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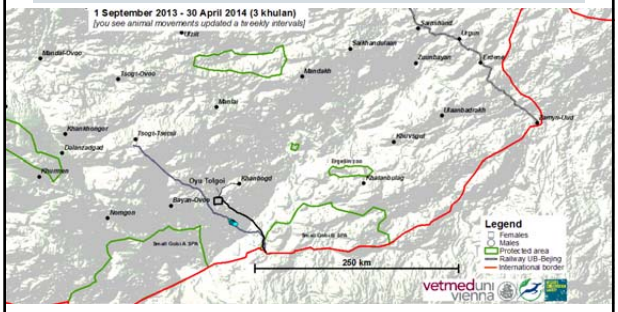
Scales of movement



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Telemetry and wildlife research

- VHF and GPS telemetry have revolutionised wildlife research
- Technology (GPS with GSM / satellite download) has increased precision and allowed us to work in places where we could never have worked
- We are still waiting for drop-offs that always drop
- Similar data on movement and life history cannot be obtained in any other way

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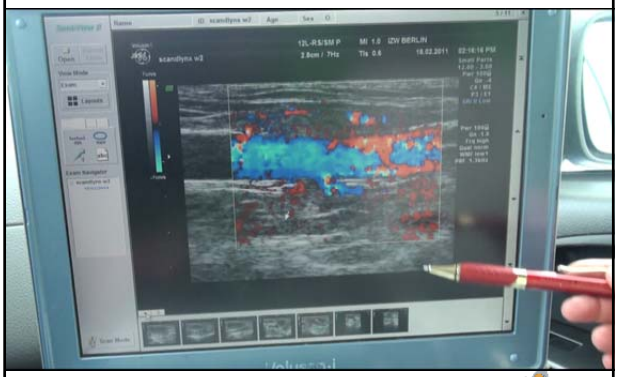
Non-invasive methods

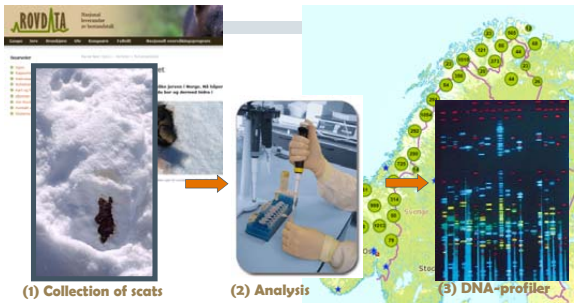
- Ultra-sound – now in the field
- Camera trapping – the digital revolution
- DNA from faeces, urine and hair

Reproductive seasonality

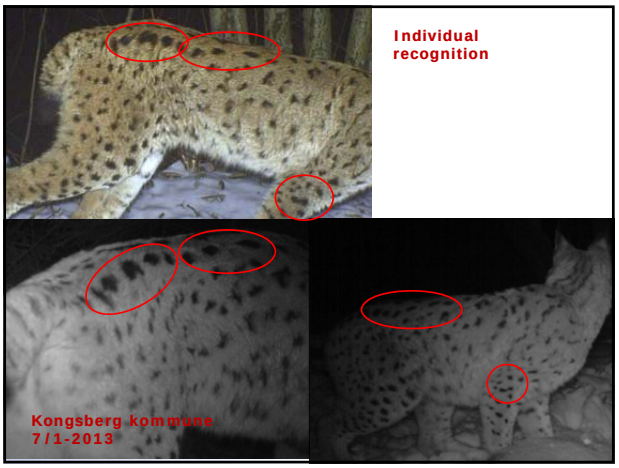
Reproductive seasonality



DNA approaches



Camera traps



Non-invasive methods

- These methods offer powerful supplimentary tools to our existing toolbox
- Not really able to directly replace invasive methods in research, although they do allow for some alternative approaches based on indirect estimation
- Especially useful for long term monitoring – and for habitat / distribution studies
- Not good for movement and cause specific mortality

Emerging invasive technology

- Bio-sensors / bio-loggers
- Need to be implanted – intra-peritoneal, sub-cutaneous
- Some can be placed within stomach
- Access to data on temperature and heart rate

Emerging invasive technology

- These new tools open for many new questions – of great interest for general scientific understanding of wildlife physiology
- Very useful for studying stress and potentially improving animal welfare – e.g. hunting or disturbance induced stress
- Including studying the impact of research !

Technology and the 3Rs

Replace

- Very difficult to transfer experience between species
- Some experience can be transferred between populations and species ..... but caution is needed
  - e.g. Lynx home range size – species and populations

Technology and the 3Rs

Refine

- Constant process of evaluation and refinement
  - Drop-offs on collars
  - SMS alarms on box traps
  - GPS-collars – weight / reliability / batteries ……..
  - Evaluation of stress
- Publication of protocols, methods and experience

Technology and the 3Rs

Reduce 1

- Many questions have been addressed – so need to ask if we know enough about some topics
  - But …… the world is constantly changing around us!
- We are already running on minimal sample sizes – constrained by budgets and logistics
- New technology can reduce some marking – but will also motivated more marking

Technology and the 3Rs

Reduce 2

- Make the most out of every capture
- Fewer, bigger, more integrated studies
- Cooperation between applied and basic research

Technology and the 3Rs

Reduce 3

- The need for knowledge will remain high with present political frames concerning nature management
- Minimum goals that require micro-management
- High levels of exploitation
- Failure to address conflicts
- Human footprint – loss of wild spaces

Acknowledgments

- John Odden for all lynx work
- Jon Arnemo and Alina Evans for biosensors
- Petra Kaczensky for Mongolian wild asses
- Colleagues at NINA for all discussions

More information

http://scandlynx.nina.no/
http://www.dyreposisjoner.no/
http://viltkamera.nina.no/
http://www.lcie.org