Monitoring of wild ungulates: a review

Compiled by Fridolin Zimmermann,

Presented by Manuela von Arx & Urs Breitenmoser

Carnivore Ecology and Wildlife Management

KORA

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Counting ungulates: review of the methodologies

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1. **Counting ungulates in landscape compartments from optimal observation sites**
2. **Spotlight counts**
3. **Kilometre index**
4. **Distance sampling**
5. **Track and signs counts**
6. **Count drive (battue)**
7. **Pellet counts**
8. **Retrospective cohort analyses (hunting statistics)**
9. **Indicators of ecological changes (KI, body weight & measurements, browsing rate)**

- Capture-mark-recapture (most powerful and intensive method with high requirements)
- Crop damages index (e.g. wild boar)

1. Counting ungulates in landscape compartment from optimal observation sites:

Type of landscape: to a large extent **<u>open landscape</u>**, especially above the tree line

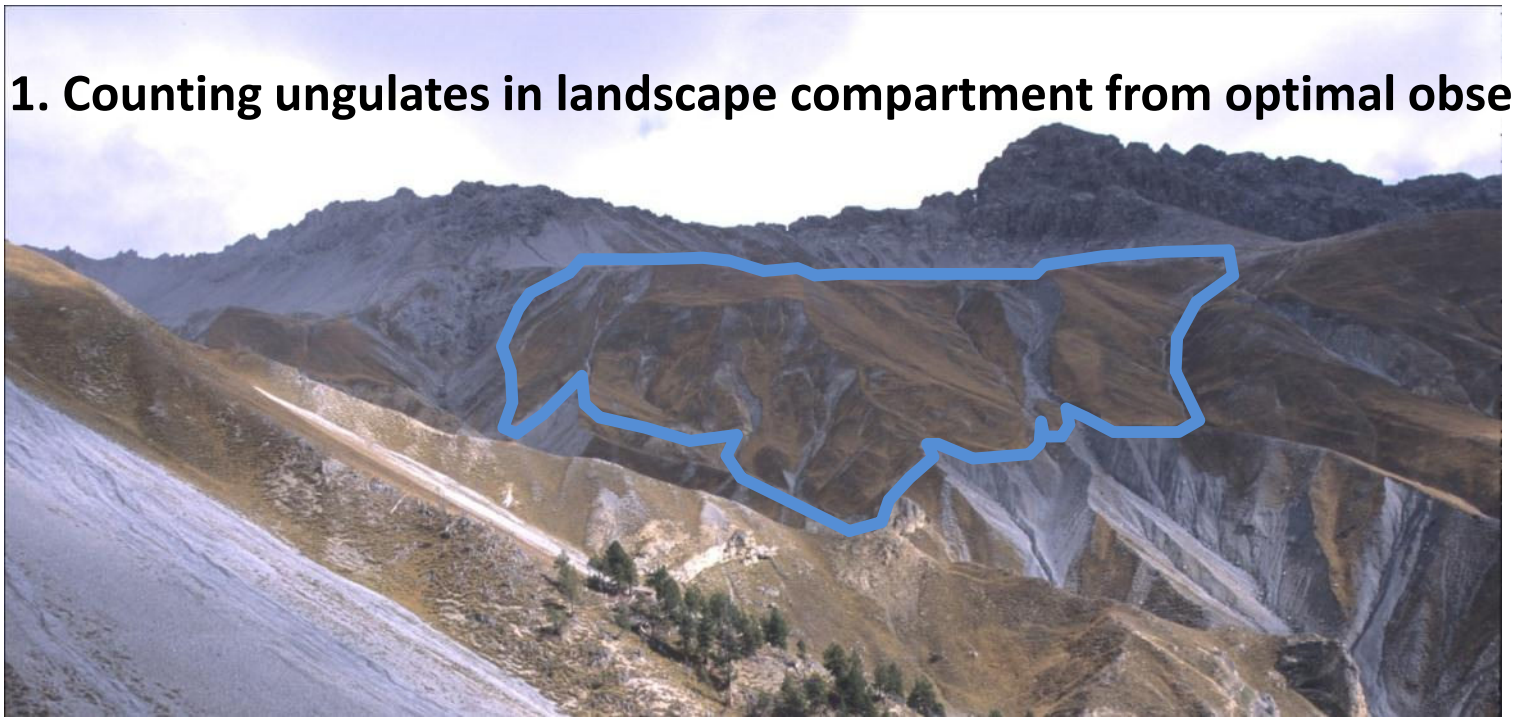
1. Counting ungulates in landscape compartment from optimal observation sites:

Species: Ibex, chamois, to a lesser extent **red deer**, not suitable for **roe deer**

Season: Spring counts are generally conducted, summer and autumn counts also of interest

Area: About 5–7 km^2 large areas. Depends on the species and environmental productivity

1. Counting ungulates in landscape compartment from optimal observation sites:



Description of the methodology and data collection:

- Borders of the area are set to ensure demographically closure (know home range size,...)

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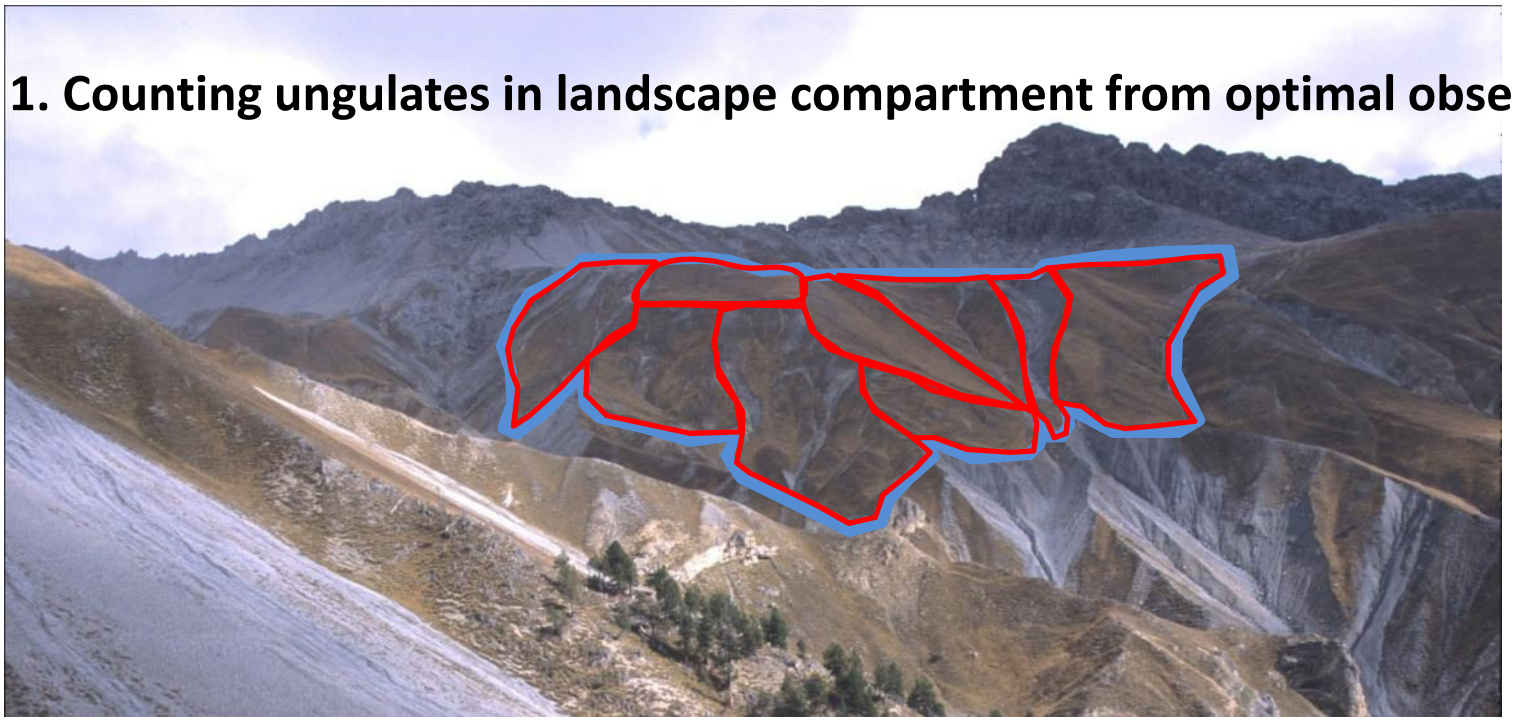
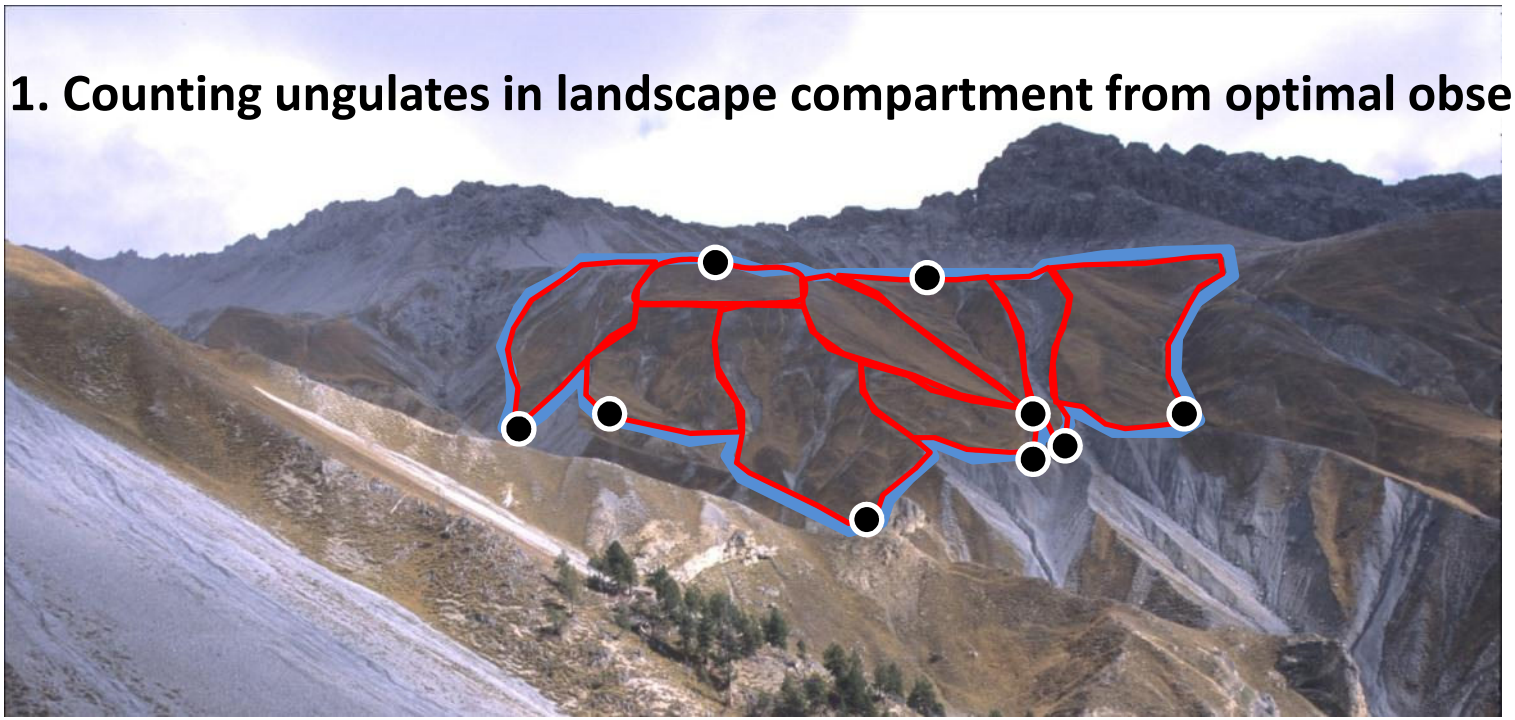


Description of the methodology and data collection:

- Borders of the area are set to ensure demographically closure (home range size,...)
- Delimitation of the landscape compartment (≈ 1 km^2) according to topographical features (⇒ whole area within one compartment needs to be visible from single site)

1. Counting ungulates in landscape compartment from optimal observation sites:



Description of the methodology and data collection:

- Borders of the area are set to ensure demographically closure (know home range size,...)
- Delimitation of the landscape compartment (≈ 1 km^2) according to topographical features (⇒ whole area within one compartment needs to be visible from single site)
- A single observer is counting out a landscape compartment (≈ 90')
- Counts needs to be conducted simultaneously in all compartments at several predefined time periods in the morning and evening hours (⇒ coordination)
- If the counts of single observers vary too much (random fluctuations) they should be repeated the next day

1. Counting ungulates in landscape compartment from optimal observation sites:

Description of the methodology and data collection:

- All animals present in the compartment should be counted (⇒ good selection of the observation sites and visibility)
- Movement of animals from one landscape compartment to the other during each count period are registered (time and direction) to avoid double counting

1. Counting ungulates in landscape compartment from optimal observation sites:

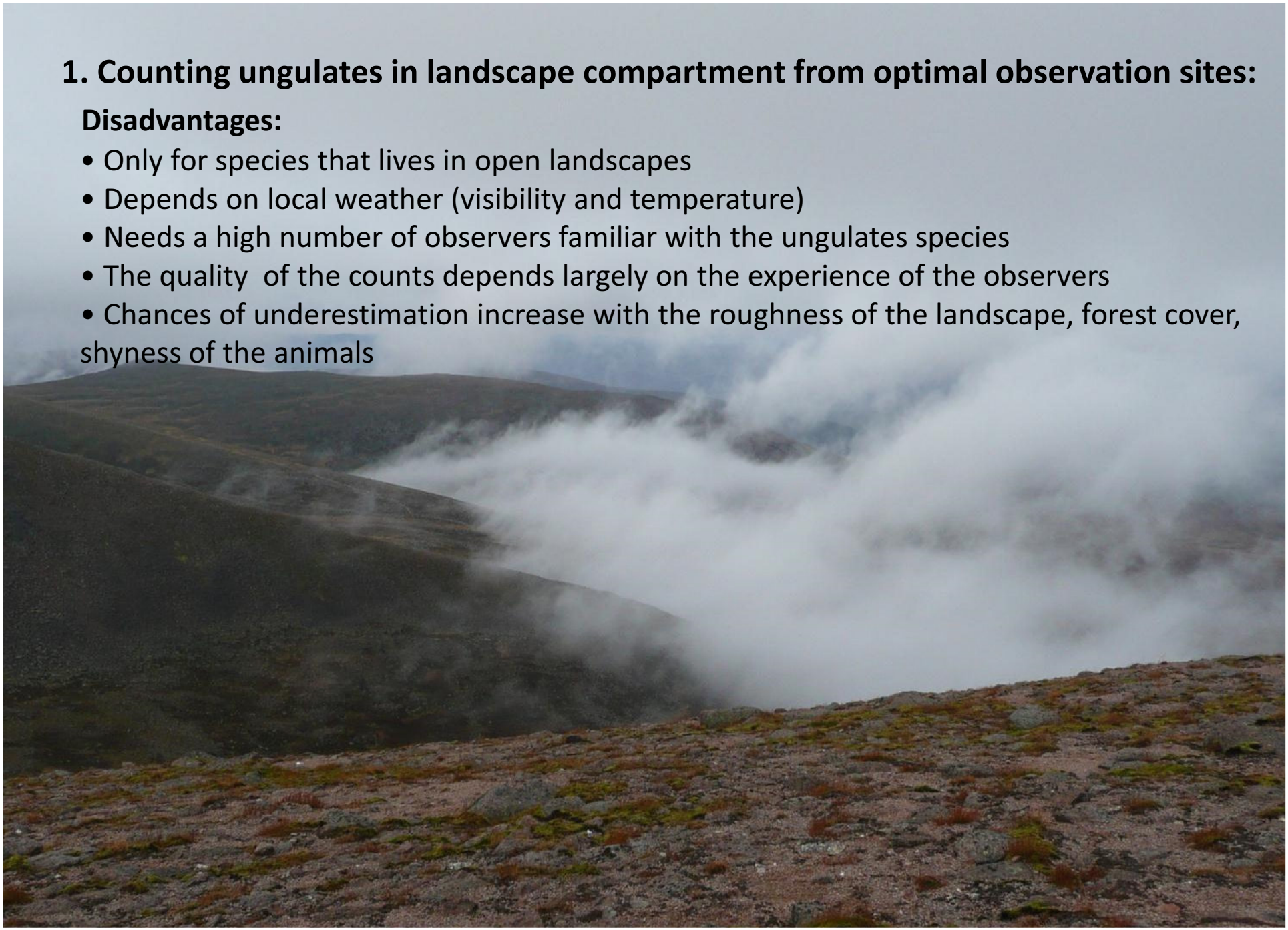
Expected results:

- Under good conditions (temperature, visibility, optimal observation sites) delivers precise estimation of the abundance
- Maximum numbers of animal counted (in each category) ⇒ minimum abundance
- Provides furthermore information about animal categories (e.g. chamois juveniles, yearlings, males, females) ⇒ information about reproduction, recruitment , juvenile mortality
- Marked animals in the population ⇒ proportion of marked animal in the total counts enables to estimate the total population size including animals that were never observed

1. Counting ungulates in landscape compartment from optimal observation sites:

Advantages:

- Method of choice in open landscapes particularly above the tree line
- Hard to find a more simpler method
- Easy to plane, provides successful results during day and clear weather
- Hunters & local people can be involved in the counts
- Little disturbances to wildlife

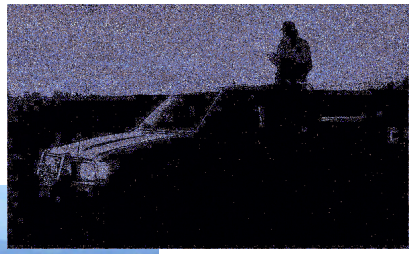


1. Counting ungulates in landscape compartment from optimal observation sites:

Disadvantages:

- Only for species that lives in open landscapes
- Depends on local weather (visibility and temperature)
- Needs a high number of observers familiar with the ungulates species
- The quality of the counts depends largely on the experience of the observers
- Chances of underestimation increase with the roughness of the landscape, forest cover, shyness of the animals

2. Spotlight counts:



Type of landscape: accessible (good network of roads ⇒ usually flat areas) **<u>open landscape</u>**, particularly suitable when animals are periodically concentrated in some landscape compartments (e.g. red deer in spring)

2. Spotlight counts:

Species: suitable for **<u>nocturnal animals</u>** such as **<u>red deer</u>** (use more open habitat as during the day)

Season: beginning of the year (March, April) animals are in the field to eat the fresh grass
Area: Area corresponds to the range of the spot light (≈150 meter in open landscape) by the length of the route and should be minimum 10 km^2 large

2. Spotlight counts:

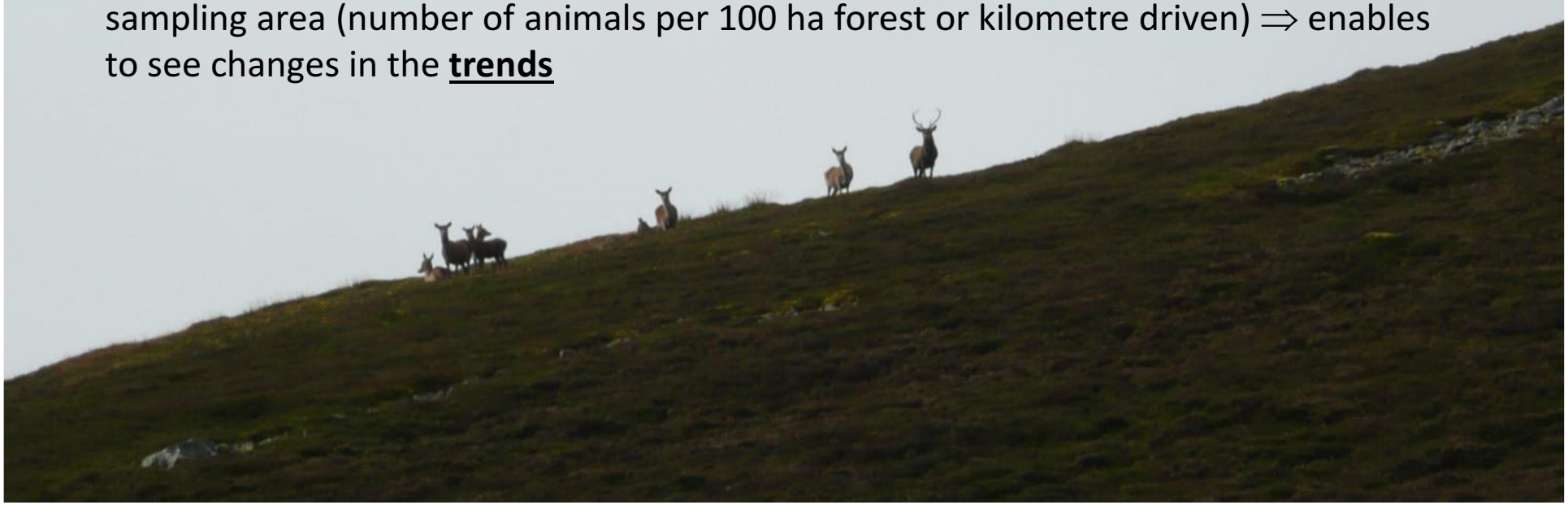
Description of the methodology and data collection:

- Start adjusted to the time animals leave cover: usually 1.5 hours after sunset (later for red deer)
- Predefined transects are slowly (5-10 km/h) patrolled with the car and each sides of the road are illuminated with two hand held halogen spotlights
- Instead of spot lights night vision or thermo graphic detectors could be used
- Animals are registered without stopping: species, sex and exact location are reported on a map. Age can often not be estimated
- It is recommended to repeat it 2 to 3 times to see the variability of the counts (especially for roe deer)
- In case of mist or rain the survey must be reported
- An alternative to spotlight counts is distance sampling

2. Spotlight counts:

Expected results:

- The results provide **absolute abundances** when large parts of the area are sampled
- Otherwise spotlight counts can be used as **an index** when compared to the sampling area (number of animals per 100 ha forest or kilometre driven) ⇒ enables to see changes in the **trends**



2. Spotlight counts:

Advantages:

- Easy to achieve
- Needs few peoples (4 people per car)
- Large distances can be covered quickly $\Rightarrow$ cheap!

2. Spotlight counts:

Disadvantages:

- Can only be used in open landscapes **with a good network of roads**
- Good visibility needed ⇒ good weather!
- Unreliable results already for **medium height vegetation** (grass, corn) ⇒ cannot be used in **forested areas**
- Wildlife can be disturbed

3. Kilometre index:

Type of landscape: the kilometre index by foot is particularly suitable in **forested areas without a road network**

3. Kilometre index:

Species: reliable method to see **changes in the abundance** of **roe deer** and **chamois** ⇒ **trends**

Season: Spring, early summer when the animals reached their summer habitats and before the vegetation grew too much

Area: 2,600 ha with 12 transects between 5.8-6.8 km long covered by foot or 2 circuits of 27.2 km covered by car

3. Kilometre index:

Description of the methodology and data collection:

- Transects are covered slowly by foot or by car (no stop!) alternatively in the morning and in the evening and forward and backwards
- Each transect should be repeated 4 to 5 times within a year
- The ideal time is around dusk and dawn
- The position of the animals is registered precisely on a map including age and sex
- Animals outside the boundaries before the beginning of the transect or encountered on the way back are not registered
- Experience shows that transects should be 3 km long per 10 ha forest or sampling area

3. Kilometre index:

Expected results:

- Delivers information about **population trends** and not absolute abundances
- The results correspond to an **index**: number of animal observed per covered distance along trails or roads (average of the repeated measures)
- Provides precise results about the evolution of the total abundance (growth, decrease, maintenance)
- In early summer the number of fawns per females can be collected in addition useful for game management

3. Kilometre index:

Advantages:

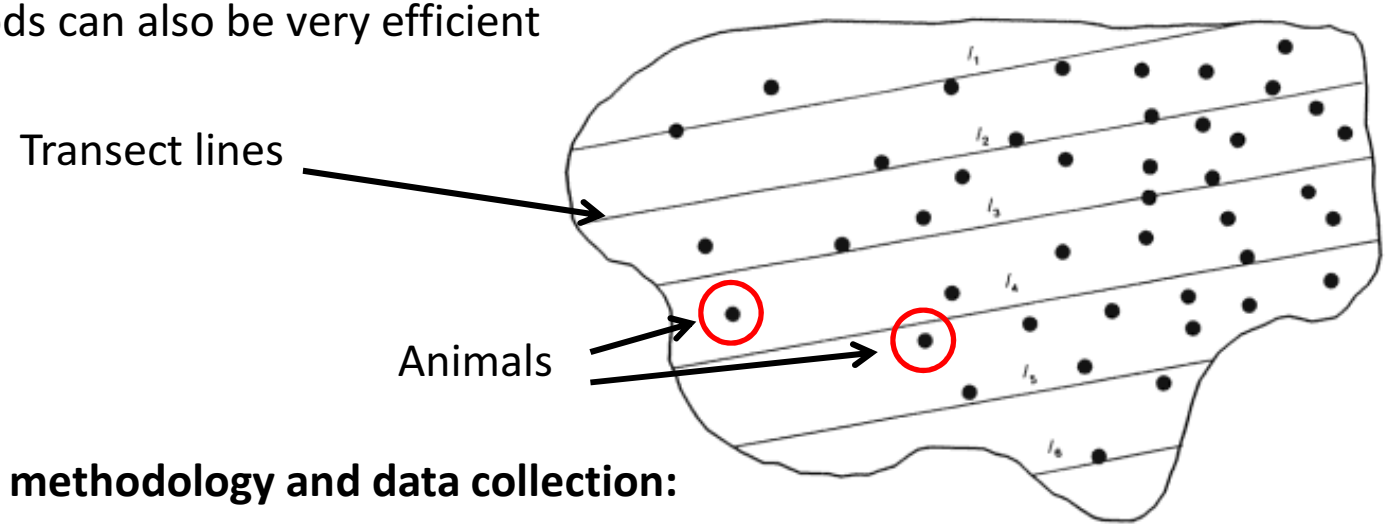
- Can also be used in forested areas without a road network
- According to studies in Chizé (F) most reliable approach to see trends in roe deer and chamois populations in countinous forests

Disadvantages:

- No information about absolut abundances without a calibration
- Effectiv trend after at least three years
- Very sensitive to changes in the environmental conditions (e.g. windthrow after storms $\Rightarrow$ reduced visibility $\Rightarrow$ results cannot be compared to the previous years
- Observational conditions need to be stable to compare the results over the years. However biais can be corrected if position of each animal is reported accurately on a map

4. Distance sampling:

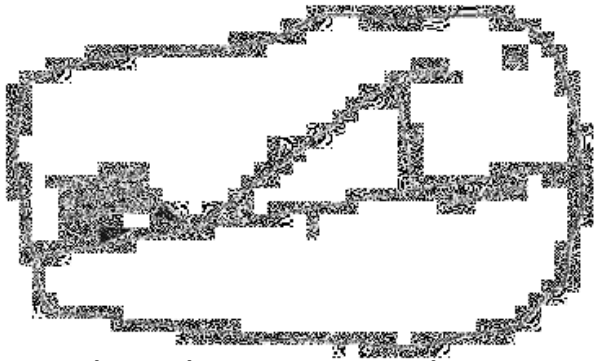
- Animal abundance survey methods that do not incorporate a probability of detection ⇒ standardized conditions
- Distance sampling estimate a probability of detection, based on few assumptions, transect in form of lines or points
- The assumptions for distance sampling met through training, effective field techniques, and appropriate field design
- At least 60-80 detections needed for fitting the detection function. Same # of detections is required for both very large and small areas ⇒ distance sampling methods can also be very efficient



Description of the methodology and data collection:

- Lines are positioned within the study area (generally parallel straight lines)
- The transects are covered by foot, with the car or airplane
- All “objects of interest” are recorded according to a precise procedure

4. Distance sampling:



- The resulting perpendicular distance to each “object” needs to be measured
- Accurate measurements of distances and angles: GPS, laser rangefinders and GIS
- The method assumes that all objects on the transect line (0 distance) have a 100% probability of detection
- Detection probability decreases (Bell curved shaped detection probability) with increasing distance from the transect line
- In mountainous habitat the effective area sampled around each path can be estimated by means of 3D model using GIS
- The abundance can be estimated from the detection probability

4. Distance sampling:

Advantages:

• **Not all animals** need to be detected. Total abundance can be estimated thanks to the detection function

Disadvantages:

• Labour intensive, needs high-tech material (GPS, laser) and sophisticated analyses
• At least 60-80 detections needed to fit the detection function
• Behavioural bias (animals hiding)

5. Track and signs counts:

Species: all ungulate species

Season: fresh snow cover ⇒ winter

Area: can be applied over large areas up to 4,000 km^2 (depends on the number of trained people)

Description of the methodology and data collection:

- Tracks are counted if the cross transect routes (subsequent crossing is ignored if there was good evidence that it was the same animal)
- Only tracks made within the last 24 h are recorded
- Track of a range of ungulates and carnivore species can be recorded
- Winter transects are broken into segments each of which represent a continuous sample of a single habitat type (total length 100 to 1,800 km)

Description of the methodology and data collection:

- Provides information about occupancy (detection/non detection)
- Information about family groups in case of carnivores
- If data about animal daily distances are available population density can be estimated from track counts using the Formozov-Mayshev-Perelshin formula
- However this approach was **never** validated with an **independent data set** up to now!

Advantages: simple method, can be conducted over large areas

Disadvantages: depends on the substrate, habitat and season, tracks of different species could be mixed up

5. Count drive (battue):

Type of landscape: count drives (battues) are used in small forest patches

5. Count drive (battue):

Species: suitable for **roe deer** at high densities (> 15 roe deer/100 ha forest)

Season: spring and beginning of summer
Area: 30-100 ha

5. Count drive (battue):

Description of the methodology and data collection:

- The count drives are conducted during the day as soon as animals settle down for the day
- From 50 to 100 people are needed depending on forest patch size
- When surrounding the forest watch out that animals do not move in and out of the forest
- A line of drivers is pushing the roe deer toward the counters
- Risk of traffic collisions should be taken into account when streets border forests
- Count drives should be repeated several times to get better results

5. Count drive (battue):

Expected results:

- Results of the reference areas are processed as an index (growth, decrease, maintenance)
- Provides good results at a local scale
- However it is difficult to generalize the results to a larger scale

5. Count drive (battue):

Advantages:

- Ideal for areas with distinct forest patches

Disadvantages:

- Only suitable at high densities
- Needs a lot of personal (50-100)
- Abundance is underestimated when animals leave forest patch before the start of the count battue or remain undetected
- The disturbance is highest compared to other methods
- To avoid double counts ⇒ adjacent patches should not be processed successively

6. Pellet counts:

Type of landscape: used in all habitats but works best in forest for ungulates

6. Pellet counts:

Species: all forest ungulate species

Season: pellet piles counts mainly reflect autumn–winter–spring distribution of the ungulates (outside the growing and decomposition seasons)

Area: small scale

6. Pellet counts:

Description of the methodology and data collection:

- The sampling area or transect need to be marked exactly in the field
- All pellets need to be removed from the sampling area or transect or marked
- After a given amount of time (e.g. one month) the delimited area or transects are counted out and the pellet piles (= 6 pellets for roe deer) are recorded
- All pellets are removed after the count
- The time between two counts should not be too long to avoid the decomposition of the pellets due to weather and temperature

6. Pellet counts:

Expected results:

- Small scale habitat use
- When dividing the number of pellet groups by the defection rate (e.g. 20 pellet piles per day for roe deer) enables to estimate the number of animals present in the area
- The defecation and decomposition rates vary with the region and food und thus should be determined experimentally!
- This method is combined with **distance sampling** to get information about the abundance over larger areas

6. Pellet counts:

Advantages:

- Easy to apply
- Needs few material and personal

Disadvantages:

- Few applications as it can only be applied at small spatial (habitat use) scales and does not provide information about absolute abundance
- Pellets from different species could be mixed up

7. Retrospective cohort analyses:

Type of landscape: can be used in every type of habitats as long as hunting statistics are collected appropriately

7. Retrospective cohort analyses:

Species: all ungulate species for which hunting statistics are available: exact age at death and year of death

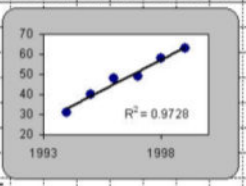
Season: none
Area: population level

7. Retrospective cohort analyses:

Description of the methodology and data collection:

- Elegant and simple approach to analyses hunting statistic data
- This method assumes that the age and the year of death of almost all animals of a population (hunting bag, perished animals) is known
- Using the animal's year of death and age at death it is assigned to a given birth cohort (i.e. birth age-group)
- This is best done by means of a table:

		Year of birth																								
Year	Hunting bag	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
1994	25	1		1	3	2	5	2	3	5	3															
1995	28	1	1	1	1	1	3	2	2	5	6	5														
1996	31		1		2		2	2	3		5	9	7													
1997	42	1		1		1	1	1	3	5	6	7	10	6												
1998	43			1	1		2	1	1	4	2	4	8	11	8											
1999	55		1		1	2		1	3	1	2	4	7	10	14	9										
2000	59		1	1			1	1	1	3	0	2	5	8	11	14	11									
2001	59					1		1	1		1	0	3	4	6	12	15	15								
2002	76			1					2	2		2	3	4	5	9	15	18	15							
2003	91						1	1		1	3	1	3	2	6	8	13	17	19	16						
2004	86				1	1					1	4		2	3	6	5	10	16	20	17					
2005	90							1	2		1		1		1	3	2	8	12	19	22	18				
2006	123							1		1			1		2	0	4	6	15	21	24	26	22			
2007	111							2			1	1		1		1	2	1	4	10	18	19	25	26		
2008	125								1	1		1		1	2	1	2	0	3	8	13	12	21	30	29	
2009																										
2010																										
Birth cohort		3	4	6	9	8	15	16	22	28	31	40	48	49	58	63	69	75	84	94	94	75	68	56		



- As soon as a large part of the animals of a given birth year are dead (90% of the chamois in a hunted population are dead after 10 years) ⇒ the strength of the corresponding birth cohort can be calculated

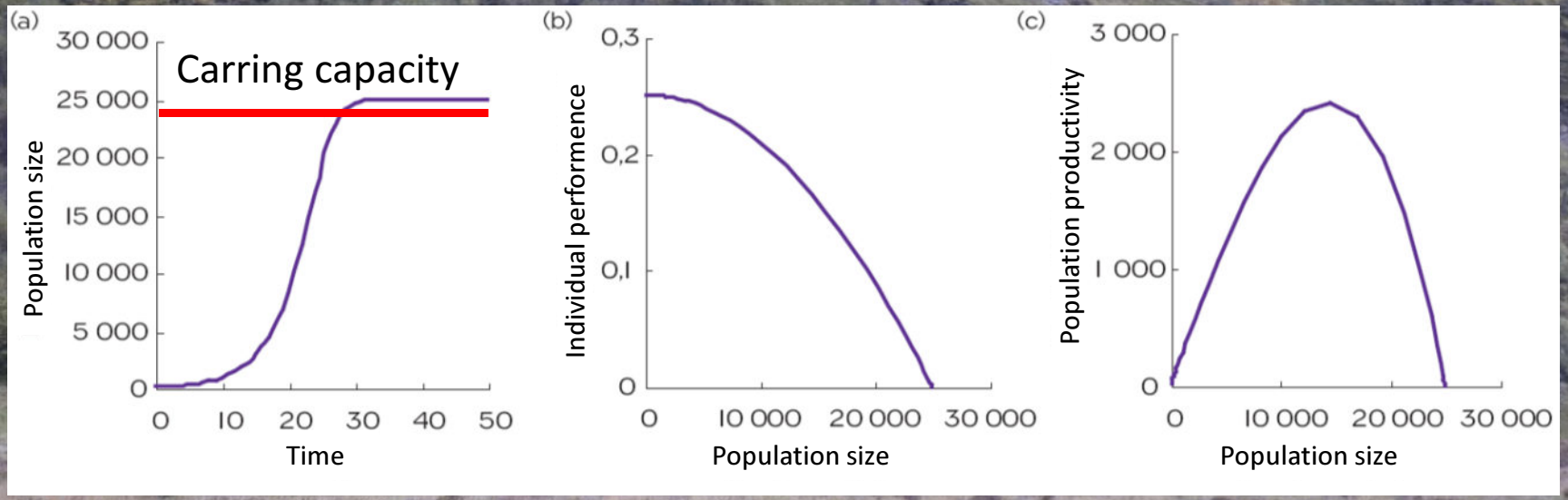
7. Retrospective cohort analyses:

Expected results:

- Estimation of the absolute abundance
- Provides furthermore information about age and sex structure of the population
- Can be use to verify and estimate the rate of undetected animals from past abundance estimation
- This information can in turn be used to improve the estimate of present counts

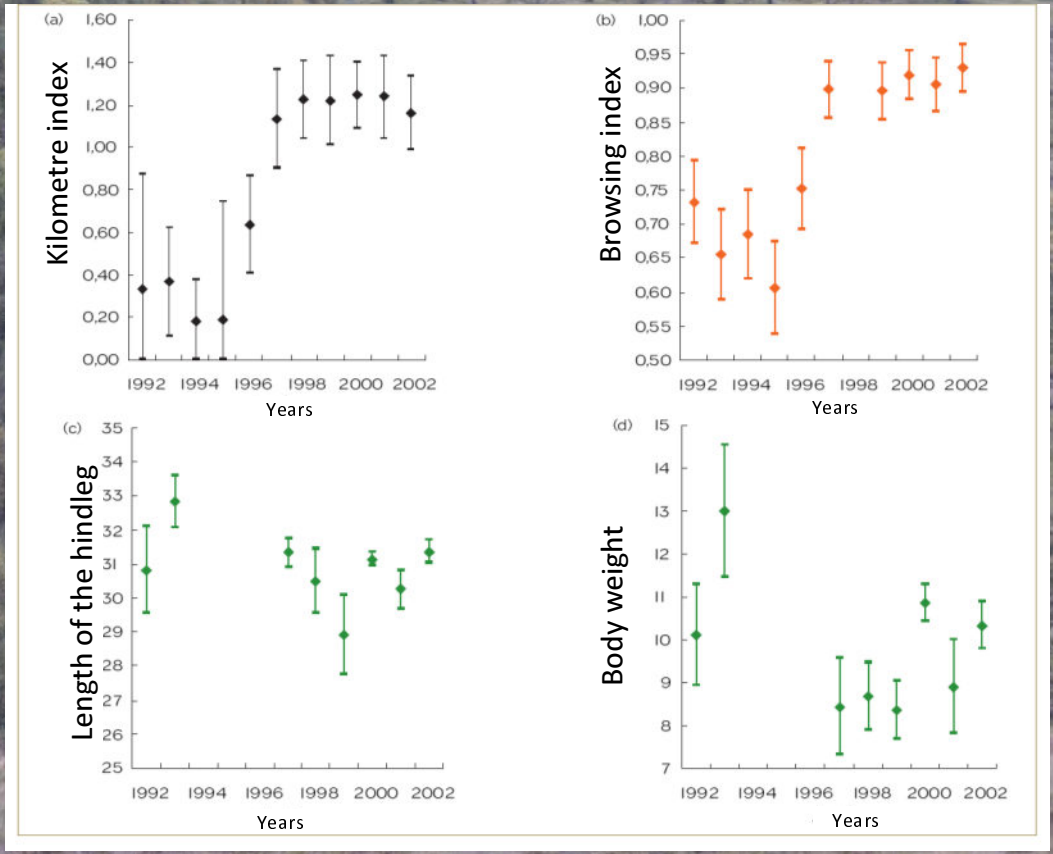
8. Indicators of ecological changes: kilometre index, body weight of the fawns, browsing

- Based on the concept of density dependence
- Functional relationship between one or more demographic parameters and changes in the number of individuals within a population
- The study of density dependence enables to measure the relationship between population and environment



8. Indicators of ecological changes: Dourdan (F) roe deer population 1992/2002 (830 ha)

- No hunting between 1986 & 1989 to see the effect of density dependence
- Roe deer density reached 25 individuals/km^2
- From 1989-1995 population hunted again (on a high level until 92 and medium level from 93-94) to study the forest regeneration
- From this point onward the aim was to ensure a commercial hunt and a good forest productivity



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