

Aerial Surveys of Forest-Dwelling Caribou

**Réhaume Courtois
André Gingras
Claude Dussault**

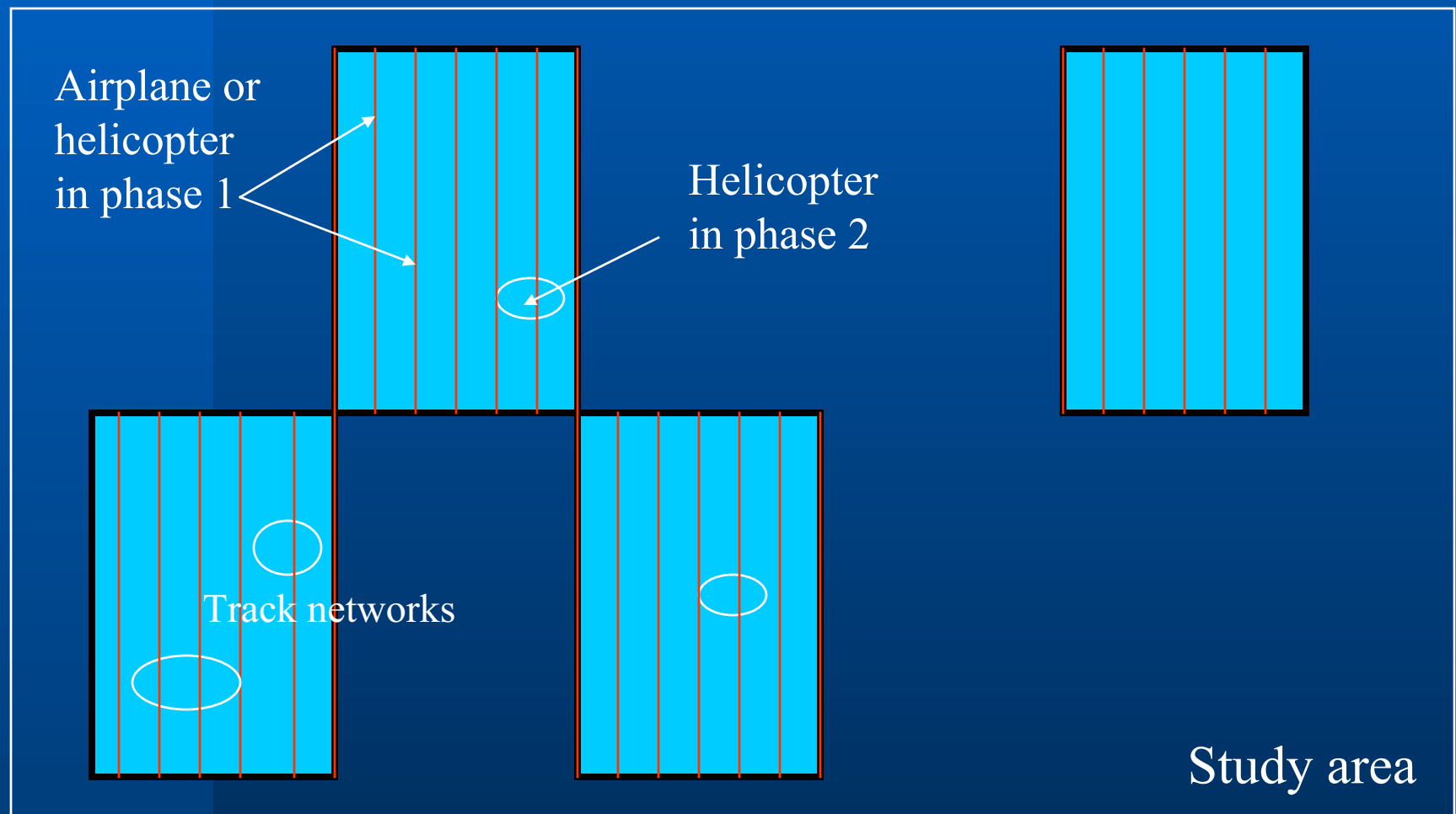
Contents

- **Typical big game aerial surveys using sample plots**
- **Previous methods for forest-dwelling caribou**
- **Limits of previous methods**
- **The 1999 approach**
- **Precision, bias and costs**
- **Conclusions**
- **Questions period**

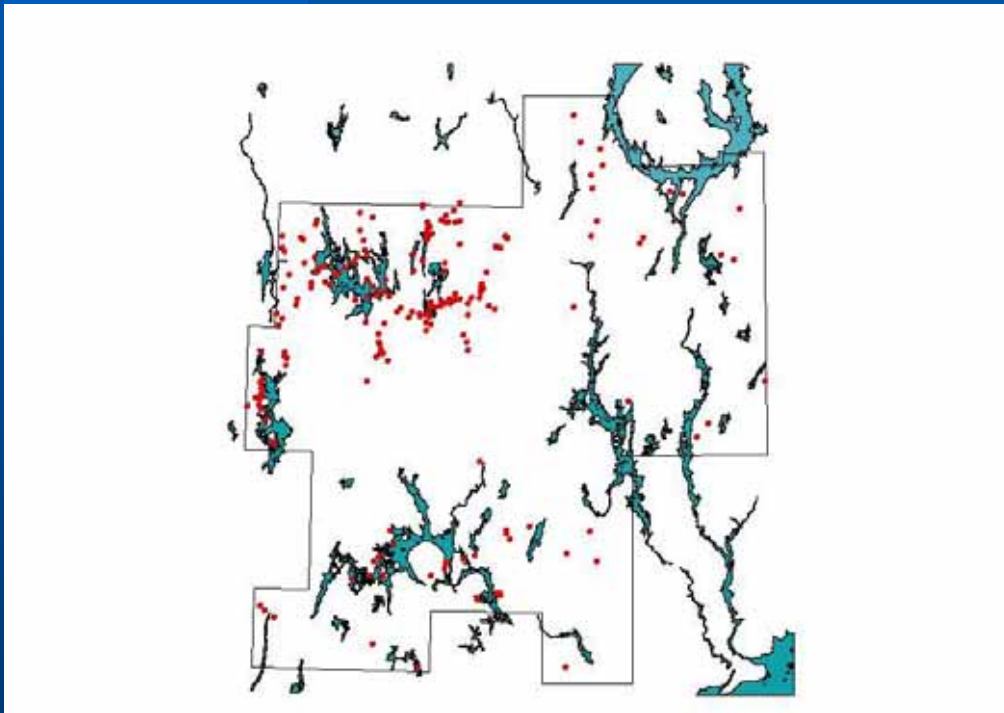
Typical Aerial Surveys Using Sample Plots

- Delimit the study area
- Subdivide the study area in sample plots
- Draw a random sample of plots to be surveyed
- Prepare maps of these plots
- Survey the plots using flight lines regularly spaced in order to find track networks (phase 1)
- Count and determine age class and sex of animals (phase 2)

An Example: Simple Random Sampling

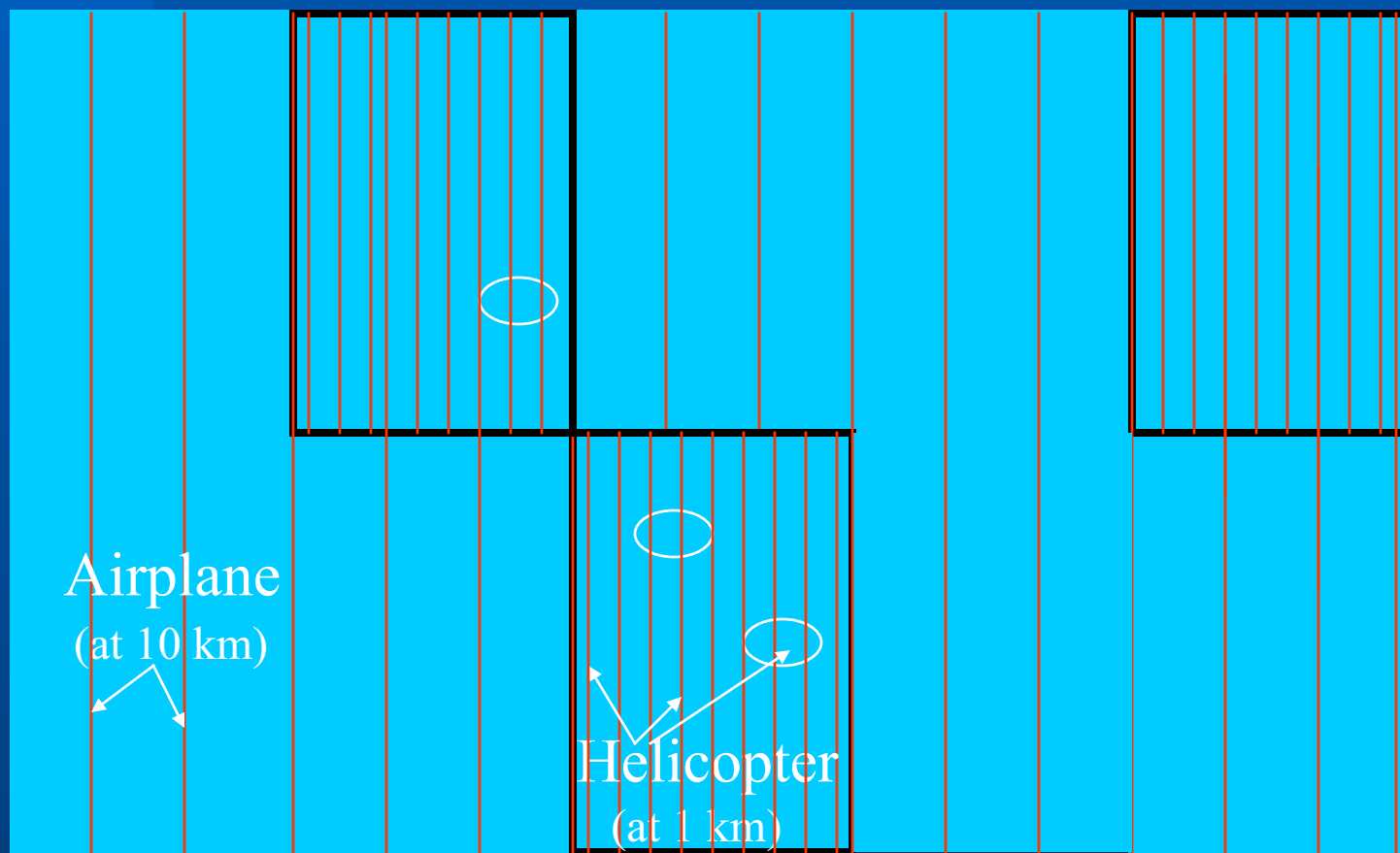


Caribou Aerial Surveys Limits



- Low precision (high variability)
 - Caribous are rare
 - Found in groups of variable size during winter
- Bias
 - Some animals are missed
 - Between flight lines
 - Not visible (dense cover)
- Increased costs
 - Important number of sample plots
 - Loss of aircraft time due to numerous travels between sample plots

A First Solution: Stratified Random Sampling: 1991 and 1993 Surveys



12 000 km²

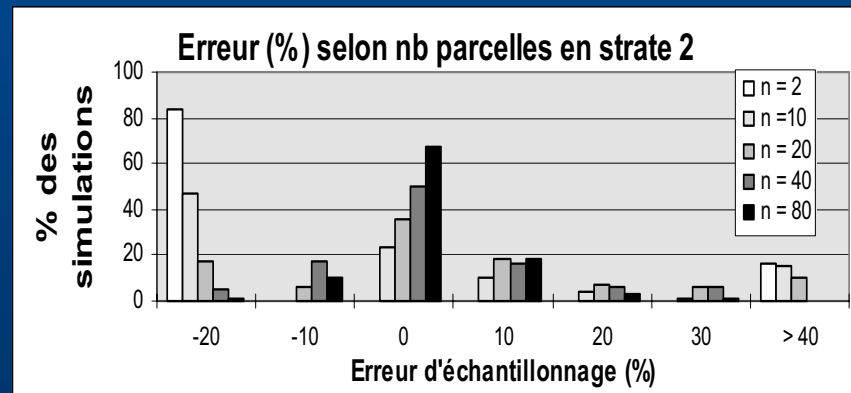
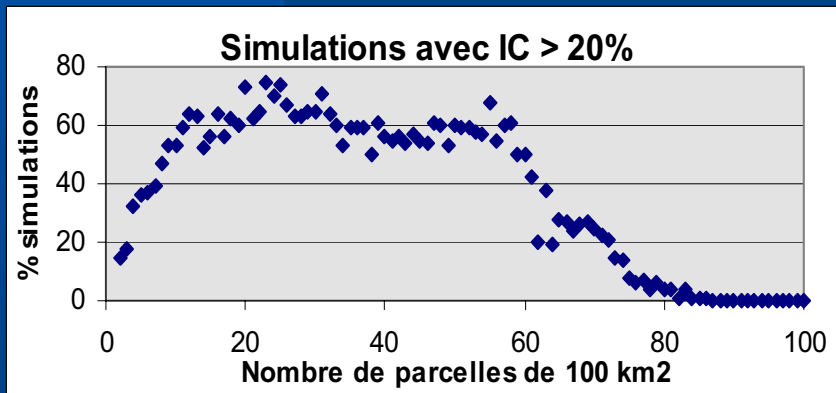
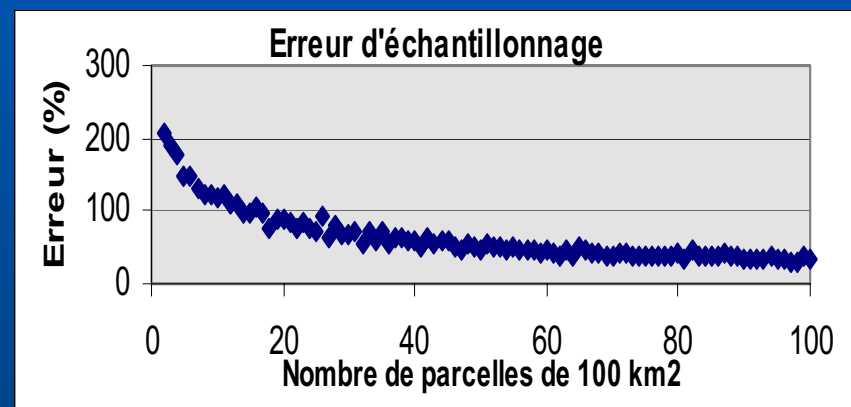
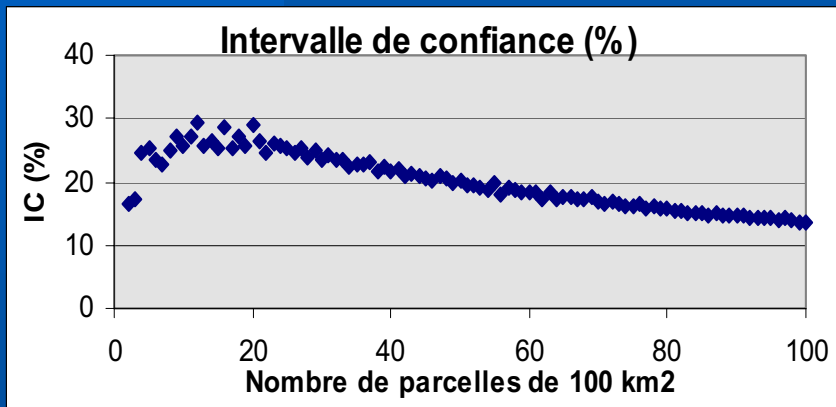
Results in Two 12,000 km² Study Sites

Year / Stratum	Caribou seen / 100 km²	Population estimate	Confidence Interval (%) ($\alpha = 0.10$)
1991			
With tracks	6.1	141	0.0
Without tracks	0.3	31	114.1
Total	1.4	172	20.1
1993			
With tracks	8.4	92	0.0
Without tracks	0.2	24	74.5
Total	1.0	116	15.6

Results in Two 12,000-km² Study Sites

- Results relatively good but:
 - Visibility bias not estimated (exact population not known)
 - High intensity survey (all plots with tracks networks)
 - Important variability in the low density stratum
 - Suggest variable results from survey to survey
- Appeared expensive
 - 84,000 \$ (ex. moose: 100,000\$ for a complete mgmt zone)
 - 7 \$ km² of surface area of the study site
- The surveys were conducted in small areas (12,000 km²)
- Difficult to apply in management zones (50 - 100,000 km²)

Simulations in a Large Fictitious Study Site



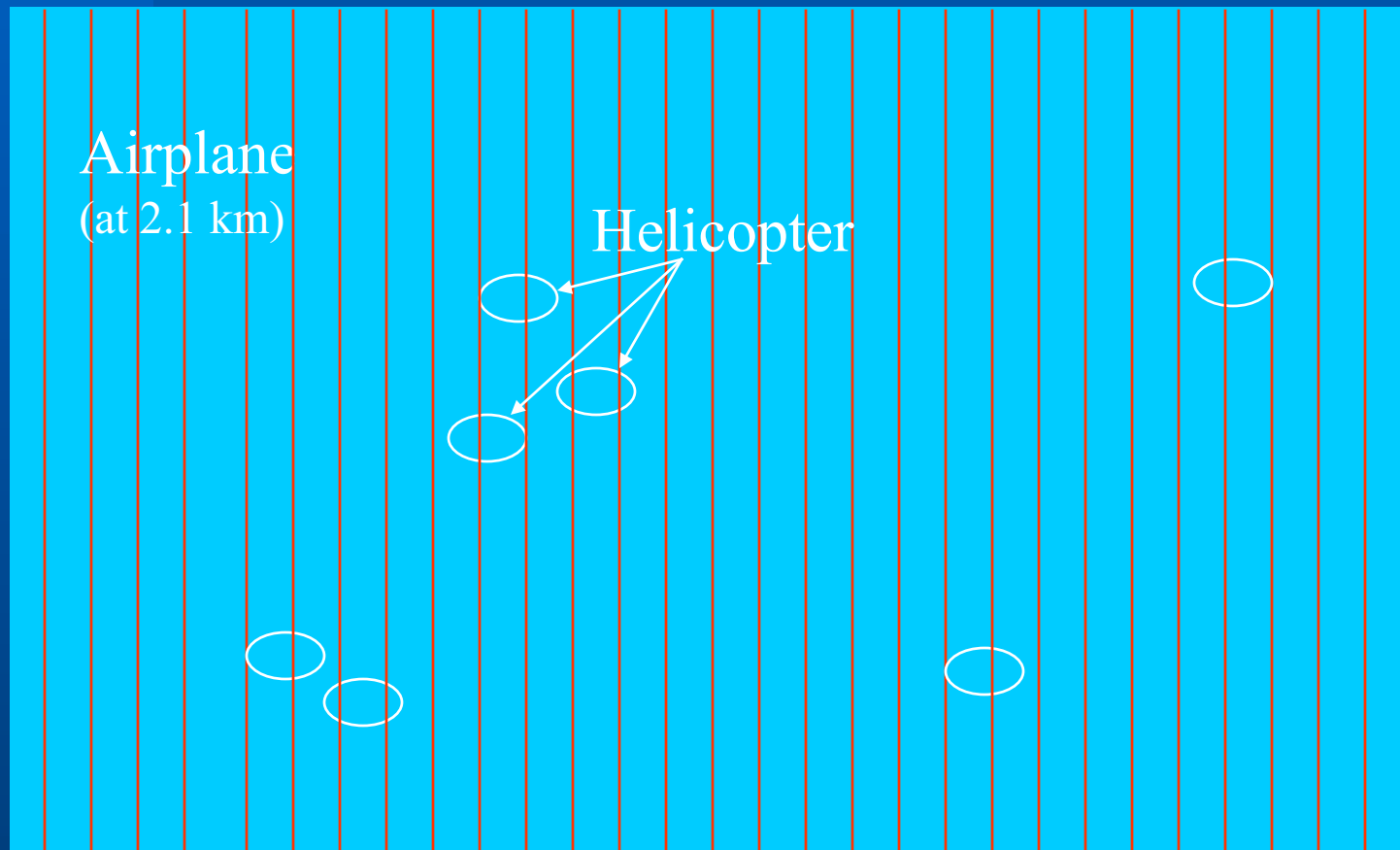
36 000 km²

Conclusions From the 1991 and 1993 Surveys

- **To obtain precise estimates**
 - Find almost all important groups
 - Diminish distance between flight lines in phase 1
 - Count caribou in all groups found in phase 1

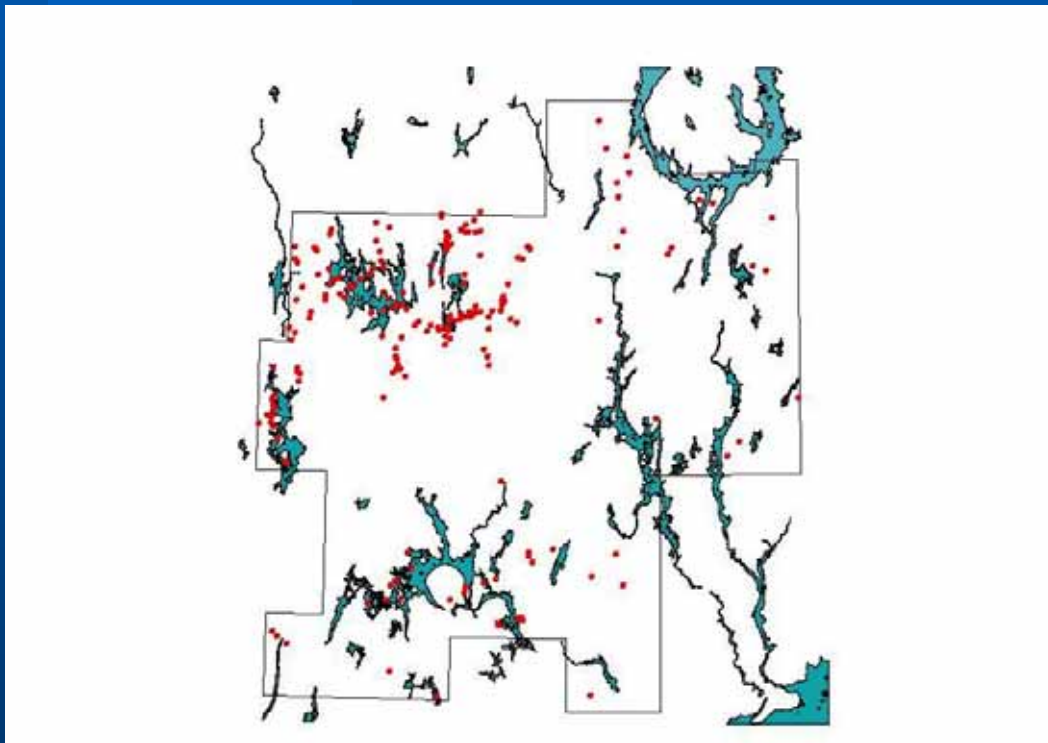
Method Used in 1999 (42,500 km²):

- 1- Total coverage: airplane at 2.1 km
- 2- Count and sex caribou: helicopter
- 3- Visibility bias: 20 collared caribou



42 500 km²

Results Obtained in 1999



- Track networks in three concentration areas
- Three populations

Results Obtained in 1999

Herd	Population estimate ¹	Density / 100 km ²	Calves (%)	Males / 100 females
Manouane	358	2.1	12	65
Manicouagan	181	1.6	16	75
Pipmuacan	134	1.2	20	52
Total	673 ± 100	1.6 ± 0.24	16 ± 1.4	61 ± 5

¹ Confidence interval ($\alpha = 0.10$): 15% (visibility bias)

Visibility Bias

	Collared caribou	Visibility		Visibility Rate
		Phase 1	Phase 2	
Western part	8	7/8	7/7	0.88
Eastern part	12	11/12	10/11	0.83
Total	20	0.90	0.94	0.85
Variance		0.0045	0.0031	0.0065

Costs of a 42,5000-km² Study Site

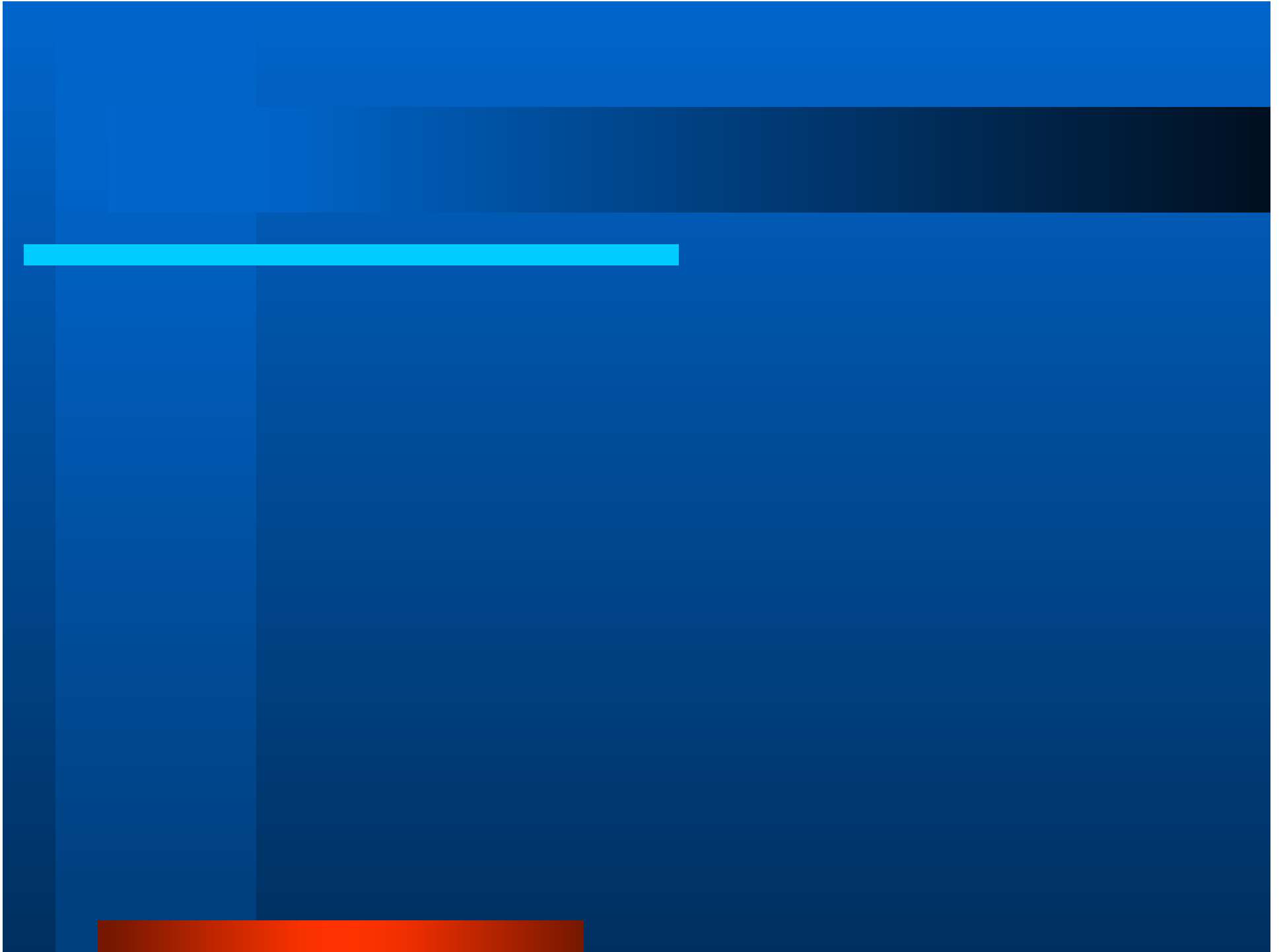
	Total coverage Airplane-helicopte
Localize track networks (airplane)	
Travel from and to airports	20.8 k\$ (13%)
Flight lines	60.8 k\$ (38%)
Counting and sexing (helicopter)	
Travel (airport and among plots)	27.2 k\$ (17%)
Counting and sexing	20.8 k\$ (13%)
Others (hotel, meals, etc.)	30.4 k\$ (19%)
Total	160,1 k\$ (4\$ / km²)

(Expected : 201.9 – 231.0 k\$)

(Including telemetry to evaluate the visibility bias)

Conclusion

- **Caribou surveys are often imprecise due to the clumped distribution of that species in winter**
- **Advantages of the 1999 sampling plan**
 - **Helps to diminish variability**
 - **Can be realized at acceptable costs (less helicopter)**
 - **Simplifies logistical problems**
 - **Allows to localize most caribou groups**
 - **useful for habitat management plans**
 - **Provides information on other species (moose, wolf)**
- **Disadvantages**
 - **Three teams (10 persons)**
 - **Airplane less safe in rough terrain**



Coûts selon 3 scénarios: site d'étude de 36000 km²

	1991 Avion-hélico (à 10 km)	1993 Hélico (à 3 km)	Couverture totale Avion-hélico (à 3 km)
Stratification			
Déplacements	5%	3%	7%
Survol	4%	19%	34%
Survol des parcelles			
Déplacements	26%	14%	-
Survol	22%	33%	-
Dénombrement			
Déplacements	8%	5%	21%
Dénombrement	16%	11%	16%
Autres	19%	15%	22%
Total	201,9 k\$	231,0 k\$	154,2 k\$
(% en déplacements)	(39%)	(21%)	(27%)