



# The marten paradigm

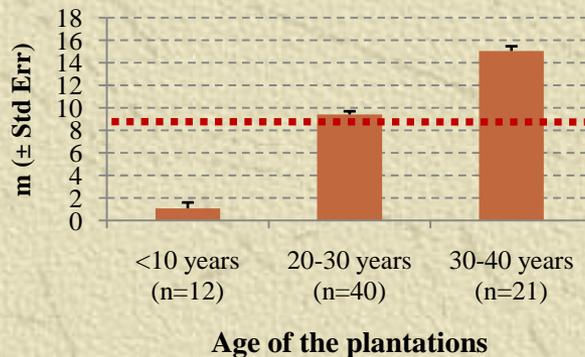
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- ✦ Martens were traditionally associated with large tracts of old growth coniferous forests and populations are known to be sensitive to clear cuts:
  - ◆ Marten typically select home range with <40% of early successional stands (Payer 1999; Potvin et al. 2000)
  - ◆ Significant population decline when >20% of the landscape is covered by early successional stands (Bissonette et al. 1997; Chapin et al. 1998)
- ✦ Martens are attracted by stands with *relatively complex structure* (Payer & Harrison 2003; Fuller & Harrison 2005):
  - ◆ Basal area: >18 m<sup>2</sup>/ha
  - ◆ Height: >9 m
  - ◆ Snags: >20 cm dbh, >10 m<sup>3</sup>/ha, >4.5 m<sup>2</sup>/ha

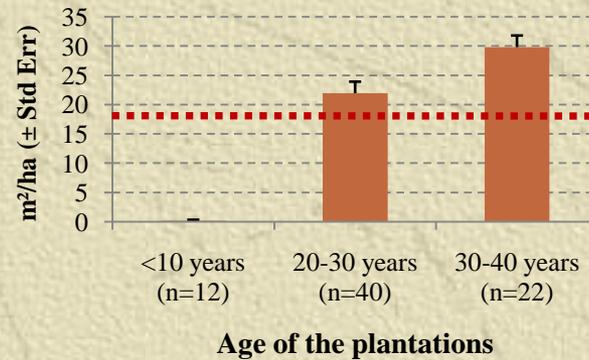
# To what extent plantations are suitable for martens?



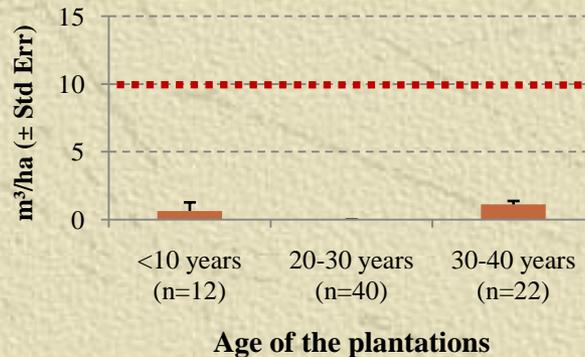
### Height



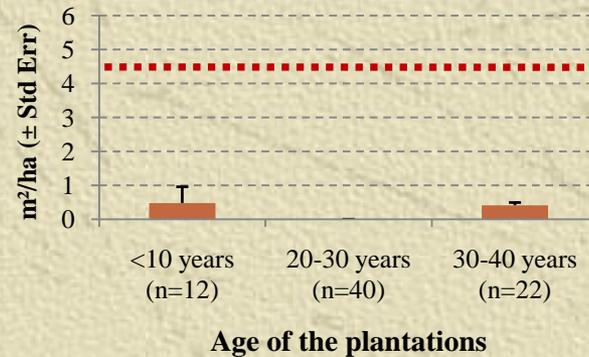
### Basal area



### Snag volume



### Snag basal area



(-.-.-) : thresholds proposed by Payer & Harrison 2003 and Fuller & Harrison 2005

Laurion (2005)

# To what extent plantations are suitable for martens?



# Habitat quality is known to influence marten...



- ...population density (Thompson 1994; Thompson and Colgan 1987; Payer and Harrison 1999)
- ...breeding success (Aune & Schladweiler, 1997)
- ...age structure (Hodgman et al. 1997; Payer and Harrison 1999)
- ...body mass (Hargis and Bissonette 1997; Fryxell et al. 2008)

*Does the scarcity of dead wood in plantations have an influence on these parameters?*

# Objectives

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- ✦ Evaluate population density, age structure and body mass of martens in four study sites covered by various amount of plantations of different ages.
- ✦ Compare female reproduction in the industrial forest of the Black Brook District to female reproduction in the surrounding private and public forest.

# Study area and sites

✧ Skin Gulch: 35 km<sup>2</sup>

- ✧ Plantations: 32% of surface area, mostly aged 30-40 year-old
- ✧ Sampled from 2001-2006

✧ Jardine: 48 km<sup>2</sup>

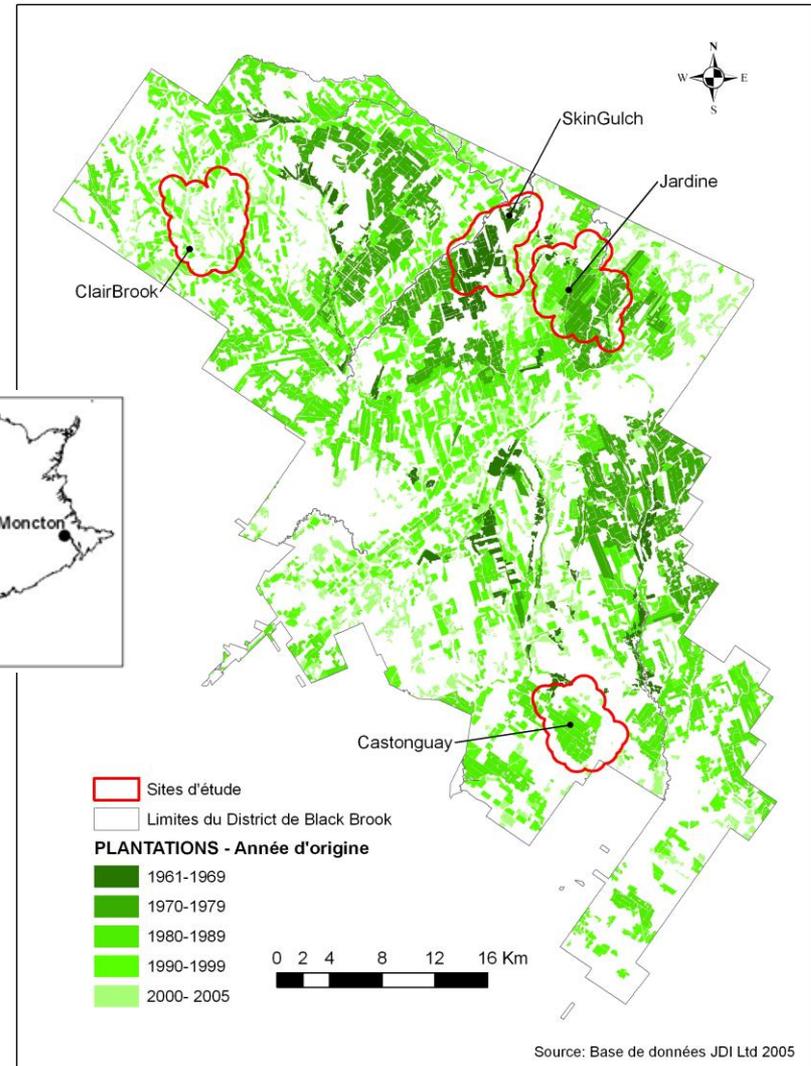
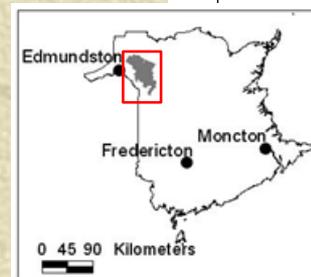
- ✧ Plantations: 52% of surface area, mostly aged 20-30 year-old
- ✧ Sampled from 2001-2006

✧ Clair Brook: 42 km<sup>2</sup>

- ✧ Plantations: 36% of surface area, mostly aged <10 year old
- ✧ Sampled from 2003-2006

✧ Castonguay: 35 km<sup>2</sup>

- ✧ Plantations: 39% of surface area, mostly aged 10-20 year-old
- ✧ Sampled in 2005-2006



# Methods



✦ Body masses and population density estimated from live trapping during fall

- ◆ 37-50 traps / site.
- ◆ 7 trapping days / site / year
- ◆ Average distance between traps : 800 m.
- ◆ No commercial trapping during the study

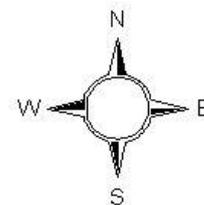
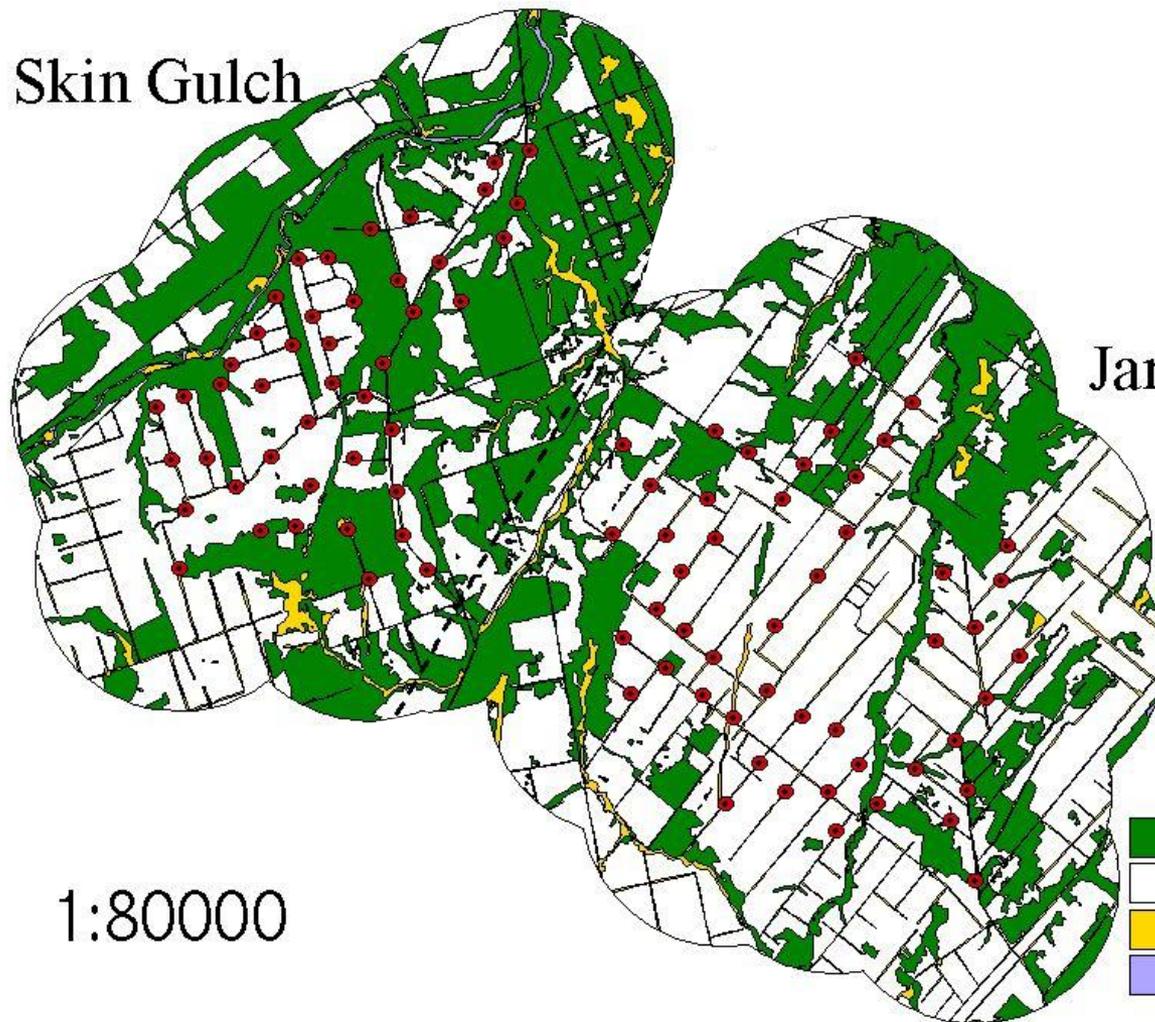


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# Skin Gulch



# Jardine

- Sites de piégeage
- Forêts d'origine naturelle
- Plantations
- Peuplements improductifs
- Cours d'eau

1:80000

# Methods



- ✦ Premolar extraction for age determination
- ✦ Pregnancy rate and litter size determined by presence of blastocysts in uterus of martens harvested by trappers in BBD and WMZ 2&6



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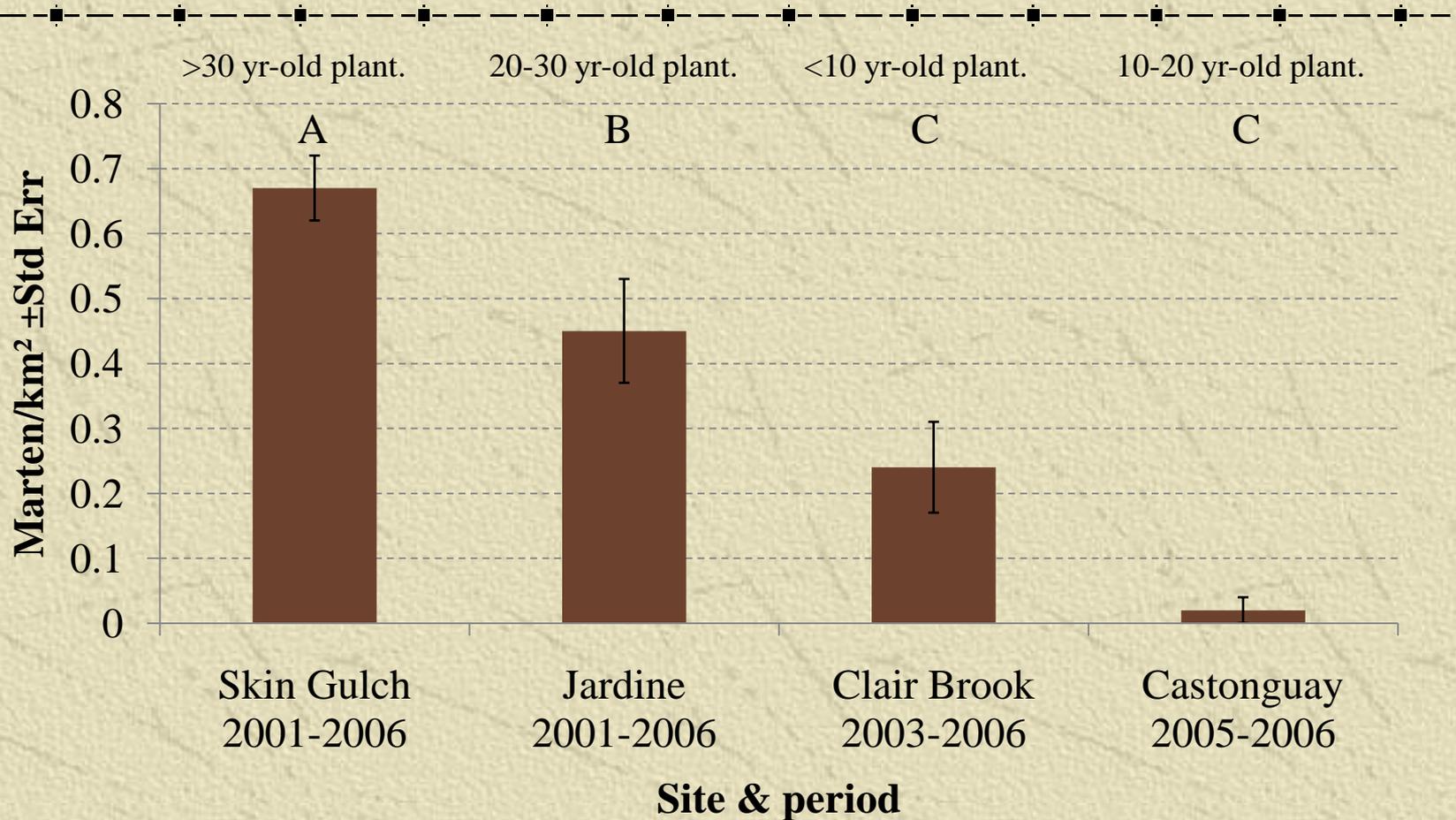


# Live-trapping data analysis

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- ✦ Annual population abundance estimated with a Schnabel closed population model in POPAN-5 software (Arnason et al. 1998)
  - ◆ When recapture rate was  $<15\%$ , a minimal population size was assumed using the nb of individuals captured (Clair Brook 2005-06, Castonguay 2006)
- ✦ Effective trapping surface area determined by assuming a 500 m buffer zone around each trap sites (Thompson 1994; Potvin 2008).

# Population density estimates



n = 119 martens (81 males, 38 females) captured 160 times during 4612 trap-nights

F = 12.0, d.f. = 14, p < 0.01

# Population density - Discussion

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Area	Season	Type of forest	Marten/km <sup>2</sup>	Reference
British Columbia	Winter	Managed - Boreal	0.3	Mowat and Paetkau (2002)
Ontario	Fall	Managed – Boreal	0.1 - 0.2	Thompson (1994)
		Unmanaged – Boreal	0.8 - 2.4	Thompson and Colgan (1987)
Maine	Summer	Managed – Mixed	0.3 - 0.4	Payer and Harrison (1999)
		Unmanaged - Mixed	0.5 - 0.7	
North-Western NB	Fall	Managed – Mixed		This study
		Total	<0.1 - 0.7	
		Resident (> 0.5 yr-old)	<0.1 - 0.4	

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## Limitations of comparison

- Resident (Payer and Harrison 1999) vs total population (other studies)
- Effective trapping area
- Season

# Age Structure

AGE (year)	Site and period							
	SkinGulch 2001-2006		Jardine 2001-2006		Clair Brook 2003-2006		Castonguay 2005-2006	
	Male	Female	Male	Female	Male	Female	Male	Female
0.5	18	9	15	6	5	2		
1.5	10	5	7	2	1		1	
2.5	4	4	3	2	1	1		
3.5	4		2	1				
4.5	4	3						
5.5	3	2		1	1			
6.5	2	1		1	1			

## Comparison between sites

Age distribution\*:

- Males :  $G = 5.7$ ; d.f. = 6;  $p=0.45$
- Females\*\* :  $G = 0.3$ ; d.f. = 2;  $p=0.86$
- Males + females:  $G = 4.1$ ; d.f. = 4;  $p=0.39$

Mean proportion of resident (>0.5 year-old)\*:  $\chi^2 = 1.7$ , d.f. = 3,  $p=0.64$

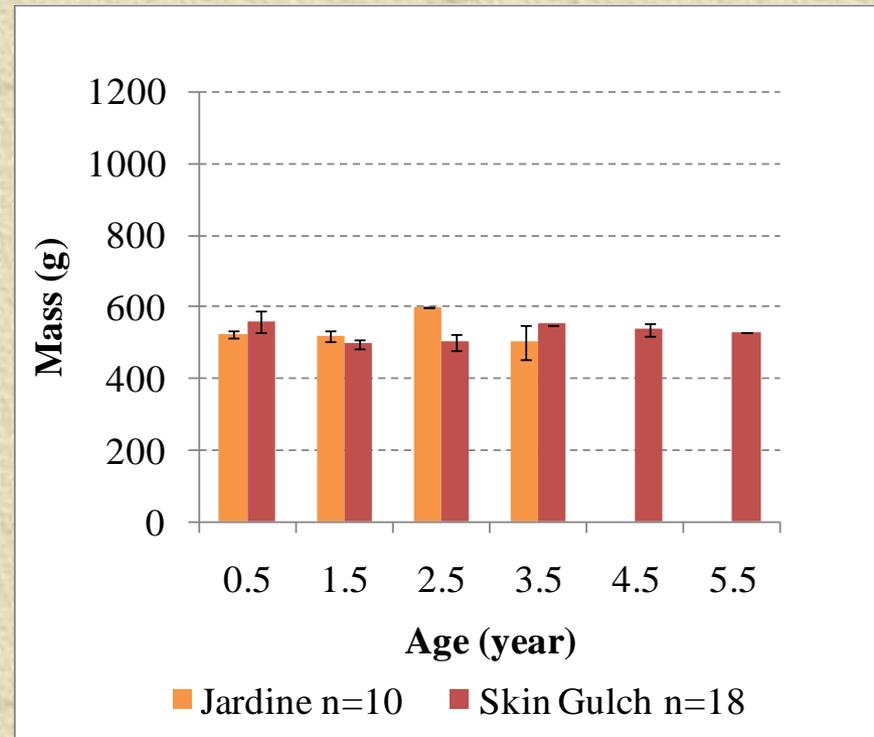
\*Castonguay excluded    \*\*Clair Brook excluded

# Age Structure - Discussion

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- ✦ The sample contained a relatively high proportion (45%) of juveniles (0.5 year-old)
  - ◆ Typical age structure of mustelid populations (Marshall, 1951; Jessup & Archibald, 1984; Katnik et al., 1994; Garant 1996; Potvin & Breton 1997; Aune and Schladweiler 1997)
  - ◆ Comparison with marten populations in Maine:
    - Similar to a naturally-regulated population: 37-44% (Hodgman et al. 1997)
    - Lower than untrapped population in an industrial forest: 71% (Payer and Harrison 1999)
  - ◆ The higher is the proportion of juvenile, the lower is survival. In these conditions, the population is maintained in large part by immigration (Payer and Harrison 1999).

# Body mass - Females

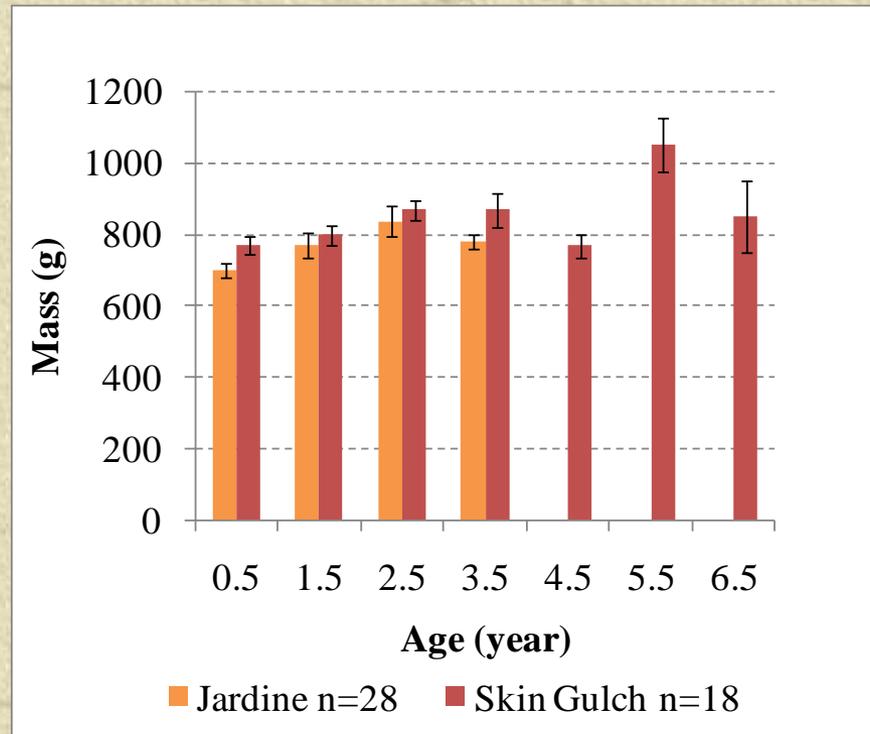


Effects	F	df	p
Age <sup>1</sup>	0.74	3	0.54
Site	1.00	1	0.33
Age <sup>1</sup> *Site	1.96	2	0.17

<sup>1</sup>>3.5 year excluded



# Body mass - Males



Effects	F	df	p
Age <sup>1</sup>	4.54	3	<0.01
Site	3.55	1	0.07
Age <sup>1</sup> *Site	0.30	2	0.82

<sup>1</sup>>3.5 year excluded

# Pregnancy rates 1996-2002

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Area	Age Class		$\chi^2$	d.f.	p
	1 year	$\geq 2$ year			
Black Brook District	57% (12/21)	88% (21/24)	4.4	1	0.04
Wildlife Management Zones 2 & 6	52% (37/71)	59% (68/115)	0.4	1	0.52

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BBD vs WMZ	$\chi^2$	d.f.	p
1 year-old	2.4	1	0.12
$\geq 2$ year-old	6.8	1	<0.01

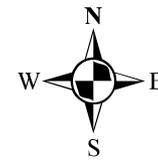
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# Litter size



Area	Age Class		Z	d.f.	P
	1 year	≥2 year			
Black Brook District	2.3 ± 1.0 (n = 12)	2.7 ± 1.0 (n = 21)	1.3	1	0.20
Wildlife Management Zones 2 & 6	2.3 ± 1.1 (n = 37)	2.6 ± 1.0 (n = 68)	1.7	1	0.08

BBD vs WMZ 2&6 :  $Z = -0,171$ , d.f. = 1 ,  $p = 0,864$



WMZ 2

BBD

WMZ 6

 WMZ and BBD limits

**Landsat cover types**

 Water & Wetlands

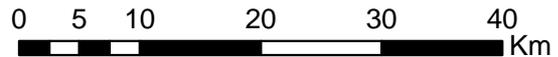
 Open areas

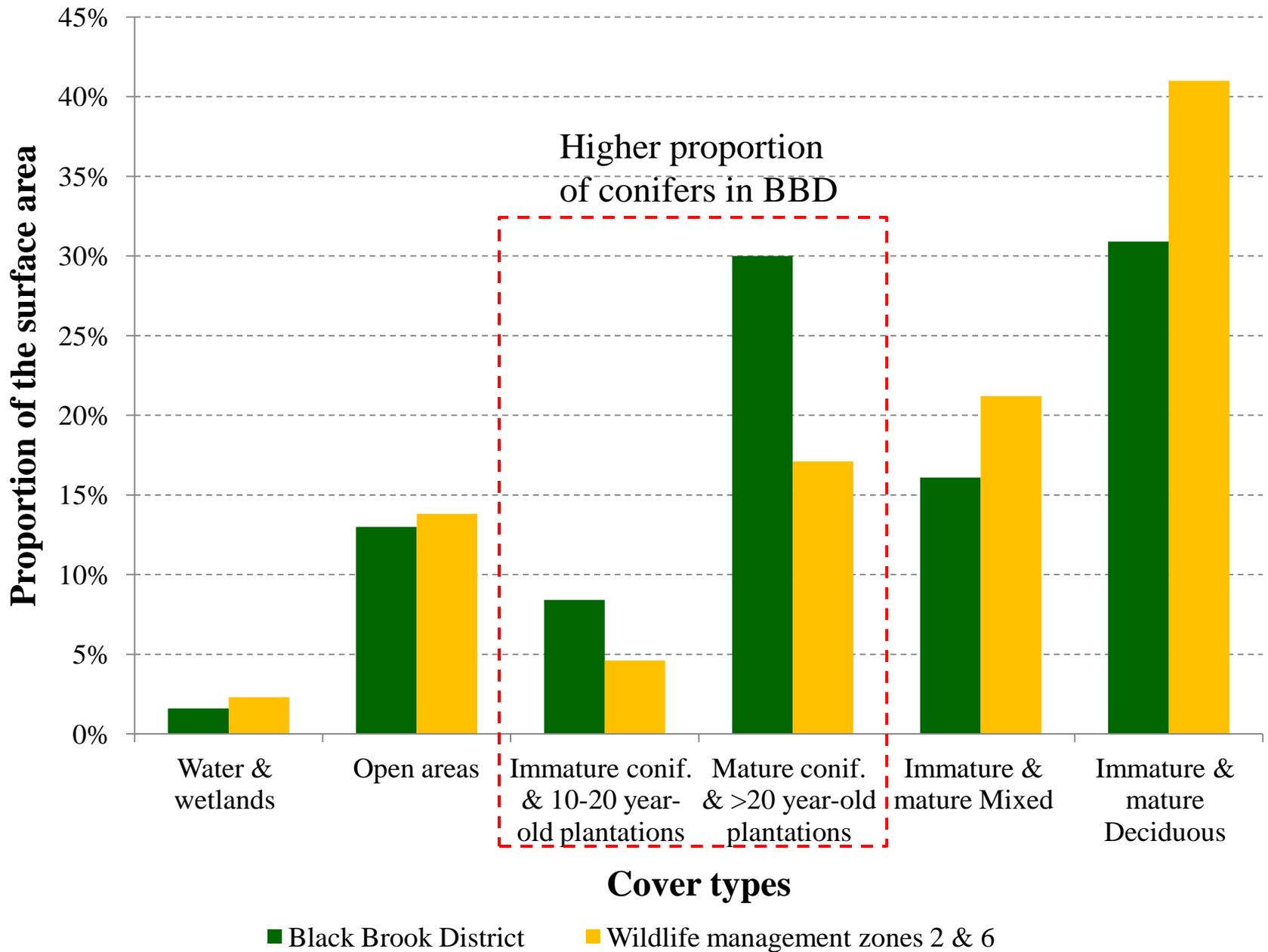
 Mixed

 Mature conifers and >20 year-old plantations

 Immature conifers and 10-20 year-old plantations

 Deciduous





# Body mass & Reproduction - Discussion

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✦ A larger body mass and higher breeding rate indicate a better habitat quality (Hargis and Bissonette 1997; Fryxell et al. 2008) although the cause and effect of this relationship remains unclear :

Martens are larger and more productive because of higher resources availability?

OR

Larger and productive martens are more competitive and occupy the best habitats than smaller counterparts?

# Conclusions

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- ✦ Population densities in areas covered by plantations aged <20 year-old were lower than in areas covered by plantations aged >20 year-old
- ✦ We observed a higher body mass, and a higher density of martens on the site where plantations were the oldest (>30 years) (Skin Gulch).
- ✦ The site where plantations were 20-30 year-old (Jardine) supported a fair population of martens, but we observed a lower body mass of males and population density.

# Conclusions

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- ✦ The age structure of the population do not appear to be influenced by age of plantations. The proportion of juveniles in the sample was relatively low compared to other populations in industrial forests.
- ✦ The higher pregnancy rate of  $\geq 2$  year-old females in the Black Brook District may be the consequence of the higher prevalence of coniferous stands compared to WMZ 2&6



# Conclusions

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- ✦ When plantations reach 20 years, they can contribute to the maintenance of a marten population in a intensively managed forest as long as a certain level of “natural” stands are maintained and interspersed in the landscape.



# Conclusions

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- ✦ Composition of landscapes, assuming a 1 km buffer around trap sites, equivalent to the diameter of a marten home range:

Site	Surface area (km <sup>2</sup> )	Marten density (nb/km <sup>2</sup> )	<20 year-old plantations	>20 year-old plantations	« Natural » stands
Skin Gulch	35	0.7	16%	34%	45%
Jardine	47	0.5	16%	52%	28%
Clair Brook	42	0.2	36%	0%	57%
Castonguay	35	<0.1	39%	4%	53%

- ✦ Population density will likely reach higher level if plantations cover <50% and “natural” stands cover >40% of surface area in 35-50 km<sup>2</sup> landscapes

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