

## Purpose (Major Goals)

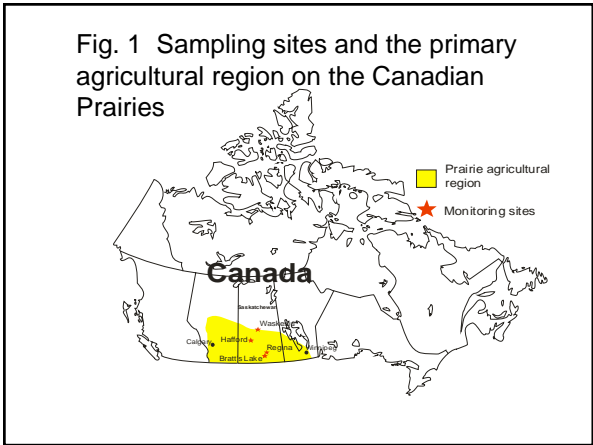
- To achieve a better understanding of the loss of currently-used pesticides from farm lands through volatilisation
- To understand the atmospheric deposition of currently-used pesticides to regional surface waters
- To estimate the atmospheric transport of currently-used pesticides to remote regions such as the Canadian Arctic

## Rationale

Economic – Pesticides are expensive  
Volatilisation from farm land means economic loss for the farmer

Environmental – Pesticides are toxic  
Transport to non-target ecosystems affects ecosystem health

Regulatory – We licence pesticides for use  
We are morally responsible for the repercussions



Over **7000** pesticide **products** and **500 active ingredients** registered for use in Canada,

- 1 - glyphosate 4,608,767.47 kg (every province)
- 3 - MCPA 1,540,427.84 kg
- 4 - 2,4-D 1,490,050.57 kg
- 6 - triallate 708,555.96 kg
- 8 - ethalfuralin 598,041.49 kg
- 10 – bromoxynil 544,170.68 kg

Saskatchewan, the largest pesticide user in Canada with 36% of sales is not included

(Brimble et al. 2005, Pesticide utilization in Canada: A compilation of current sales and use data)

Pesticide formulations registered for application in Saskatchewan 2006

**Herbicides 136**

**Foliar Fungicides 34**

**Seed Treatments 40**

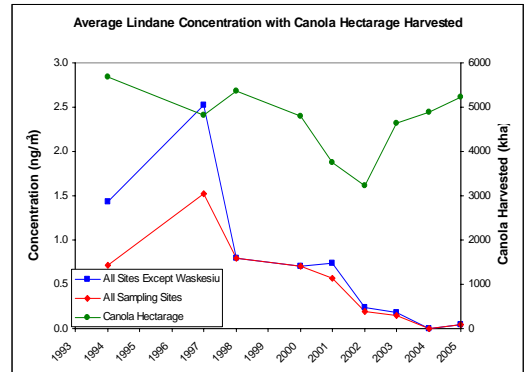
**Insecticides 35**

1990 Estimated 20,000 tonnes of herbicides applied in the prairies

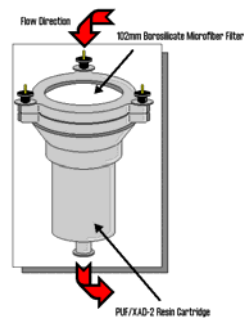
~46% of these applied in Saskatchewan

1998 Estimated 510.4 tonnes lindane applied as canola seed treatment in Canada

(1 tonne = 1000 kg = ~ 2200 lb)



### High-Volume Sampling



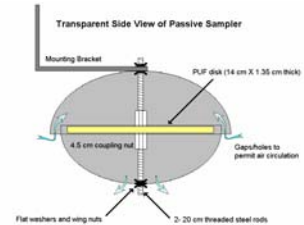
### PUF-XAD-2 Cartridge



### Dry/wet deposition sampler.



### Passive Sampling



### Pesticides Detected in Prairie and Northern Region Air from 1983 to 2004

#### Herbicides

- 2,4-D
- Dicamba
- Bromoxynil
- MCPA
- Triallate
- Trifluralin
- diclofop-methyl
- ethalfluralin
- Atrazine
- Alachlor
- Metolachlor
- Mecoprop

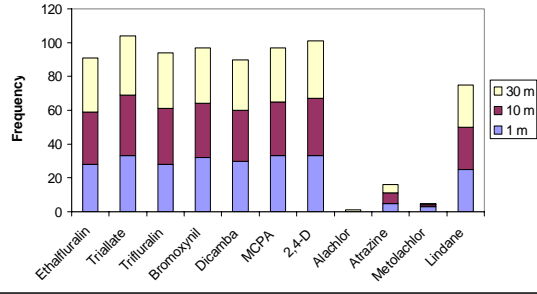
#### Insecticides

- 4,4'-DDT
- 4,4'-DDD
- 4,4'-DDE
- $\alpha$ -HCH
- $\gamma$ -HCH (lindane)
- Toxaphene

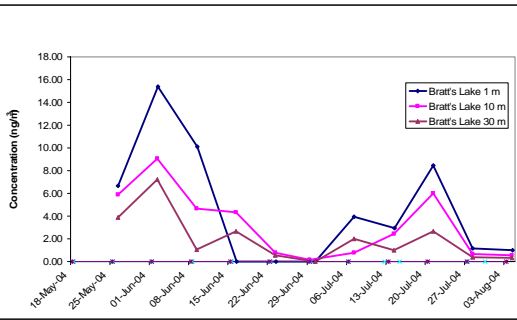
#### Other

- pentachlorophenol
- quintozone (PCNB)

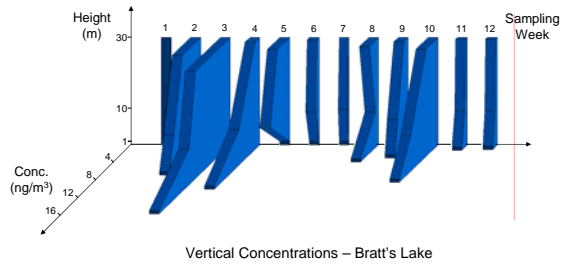
### Frequency of Occurrence in Air at Bratt's Lake 2003 - 2005



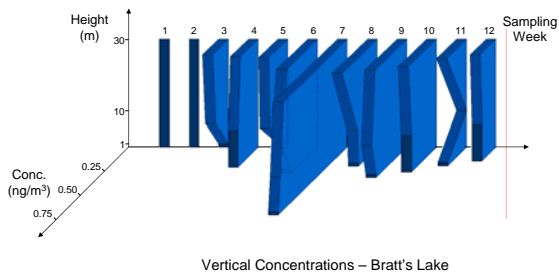
### Atmospheric concentrations of TRIALLATE at 3 elevations, Bratt's L., 2004



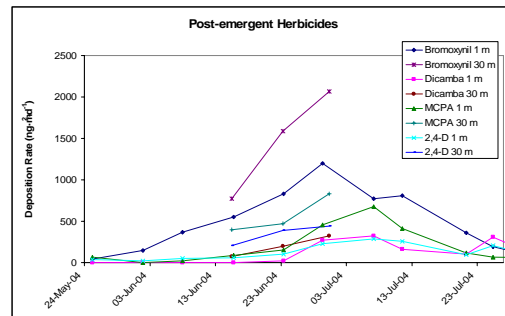
### Triallate 2004

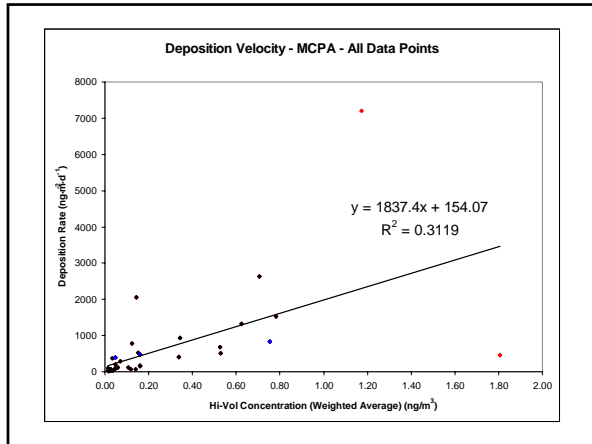


### 2,4-D 2004



### Dry deposition of post-emergent herbicides at 1 and 30 m elevation Bratt's L., 2004



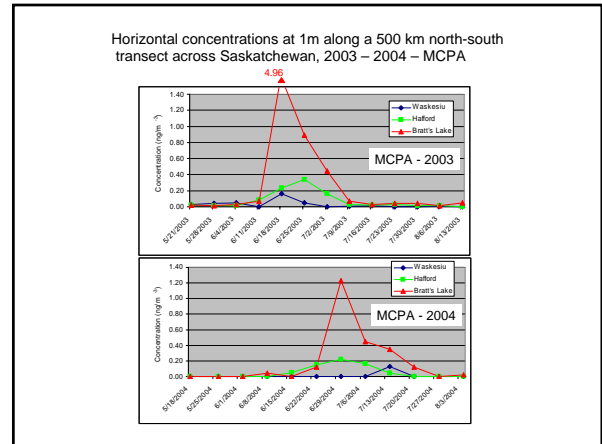
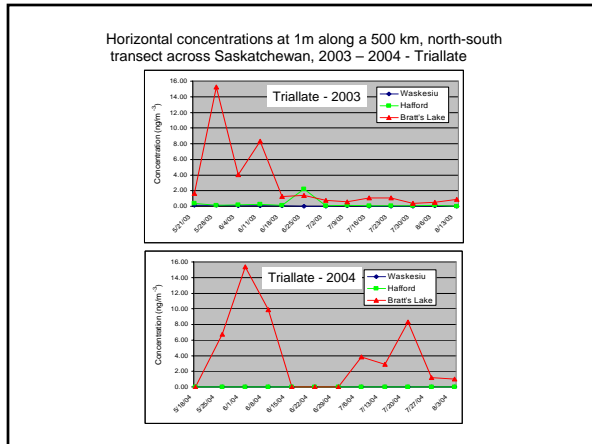
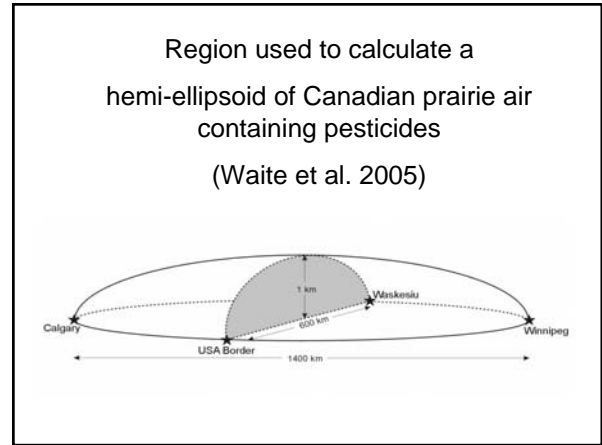


**Total dry and wet deposition, pre-emergent herbicides, measured 2003 + 2004 + 2005**

Pesticide	Dry Deposition (mg m <sup>-2</sup> )	Wet Deposition (mg m <sup>-2</sup> )
Ethalflluralin	58.5	ND
Triallate	426	0.1
Trifluralin	21.4	ND

**Total dry and wet deposition, post-emergent herbicides, measured 2003 + 2004 + 2005**

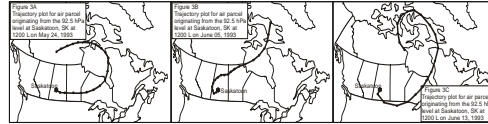
Pesticide	Dry Deposition (mg m <sup>-2</sup> )	Wet Deposition (mg m <sup>-2</sup> )
Bromoxynil	91.5	30.9
Dicamba	45.7	6.1
MCPA	149.6	10.4
2,4-D	111.3	11.9



Weekly average quantities of herbicides in prairie air for week of highest atmospheric concentration, 2002.

Herbicide (week sampled)	Quantity (kg) in hemi-ellipsoid with 439,879 km <sup>3</sup>
Trifluralin (June 5/02)	75
2,4-D (July 3/02)	541
MCPA (July 3/02)	418
Dicamba (July 3/02)	207
Bromoxynil (July 3/02)	510

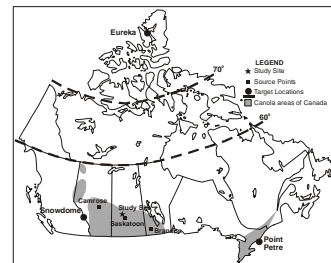
### Forward trajectories from the prairies to the low Arctic



Combined Class 1 plus Class 2 events from three source sites, for 1993, 1997 and 1998.

Destination	Class 1 + Class 2
Point Petre	20%
60°N	30%
70°N	5%
Eureka	0%
Snow Dome	27%

### Proposed location for passive samplers, 2005



### Duration of sampling

Location	Days	Period
Bratt's L. Period 1	36	May - June
Bratt's L. Period 2	36	June - July
Coral Harbour	73	May - August
Arviat	78	May - August
Yellowknife	106	May - August
Fort Simpson	83	May - August
Nahanni	92	May - August

DEPURATION COMPOUNDS ADDED TO  
PASSIVE SAMPLERS

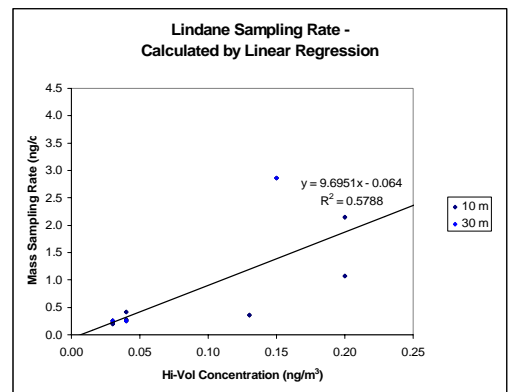
Depuration Compound	Quantity added per PUF µg
$\gamma$ -HCH d6	2.62
Diazinon d10	25.00
Parathion d10	25.00
PCB 107	0.20
PCB 198	0.20

RESULTS

**NOTHING  
DETECTED**

Average sampling rate for passive samplers for all sites based on  $\gamma$ -HCH d6 depuration compound

Location	m <sup>3</sup> d <sup>-1</sup>
Bratt's Lake	9
Coral Harbour	7
Arviat	6
Yellowknife	4
Fort Simpson	3
Nahanni	4



Pesticide	Laboratory Detection Limit (ng)	Passive Sampling Rate <sup>1</sup> (m <sup>3</sup> /d)	Atmospheric Detection Limit <sup>2</sup> (ng/m <sup>3</sup> )
Post-emergent Herbicides			
Dicamba	50	18	0.03
MCPA	50	14	0.04
Bromoxynil	50	12	0.05
2,4-D	50	17	0.03

<sup>1</sup> Based on regression ng d<sup>-1</sup> passive PUF vs ng m<sup>-3</sup> atmospheric concentration

<sup>2</sup> Assuming 90 day exposure

Pesticide	Laboratory Detection Limit (ng)	Passive Sampling Rate <sup>1</sup> (m <sup>3</sup> /d)	Atmospheric Detection Limit <sup>2</sup> (ng/m <sup>3</sup> )
Pre-emergent Herbicides			
Ethalfuralin	50	10	0.06
Trifluralin	50	8	0.07
Triallate	50	13	0.04
HCH			
$\gamma$ -HCH	10	10	0.01
$\alpha$ -HCH	10	ND	ND

<sup>1</sup> Based on regression ng d<sup>-1</sup> passive PUF vs ng m<sup>-3</sup> atmospheric concentration

<sup>2</sup> Assuming 90 day exposure

We suggest that atmospheric concentrations of the target compounds were below the minimum detection levels presented in the previous slides.

