

Des femmes, des hommes, des régions, nos ressources...



Etiology of a new(?) white spruce decline syndrome in the Laurentian Mountains, QC

Rock Ouimet, DRF - MRNFQ

Northeastern Soil Monitoring Cooperative, March 8-9, 2011

*Ressources naturelles
et Faune*

Québec 

Mount Mégantic, Sept. 1987

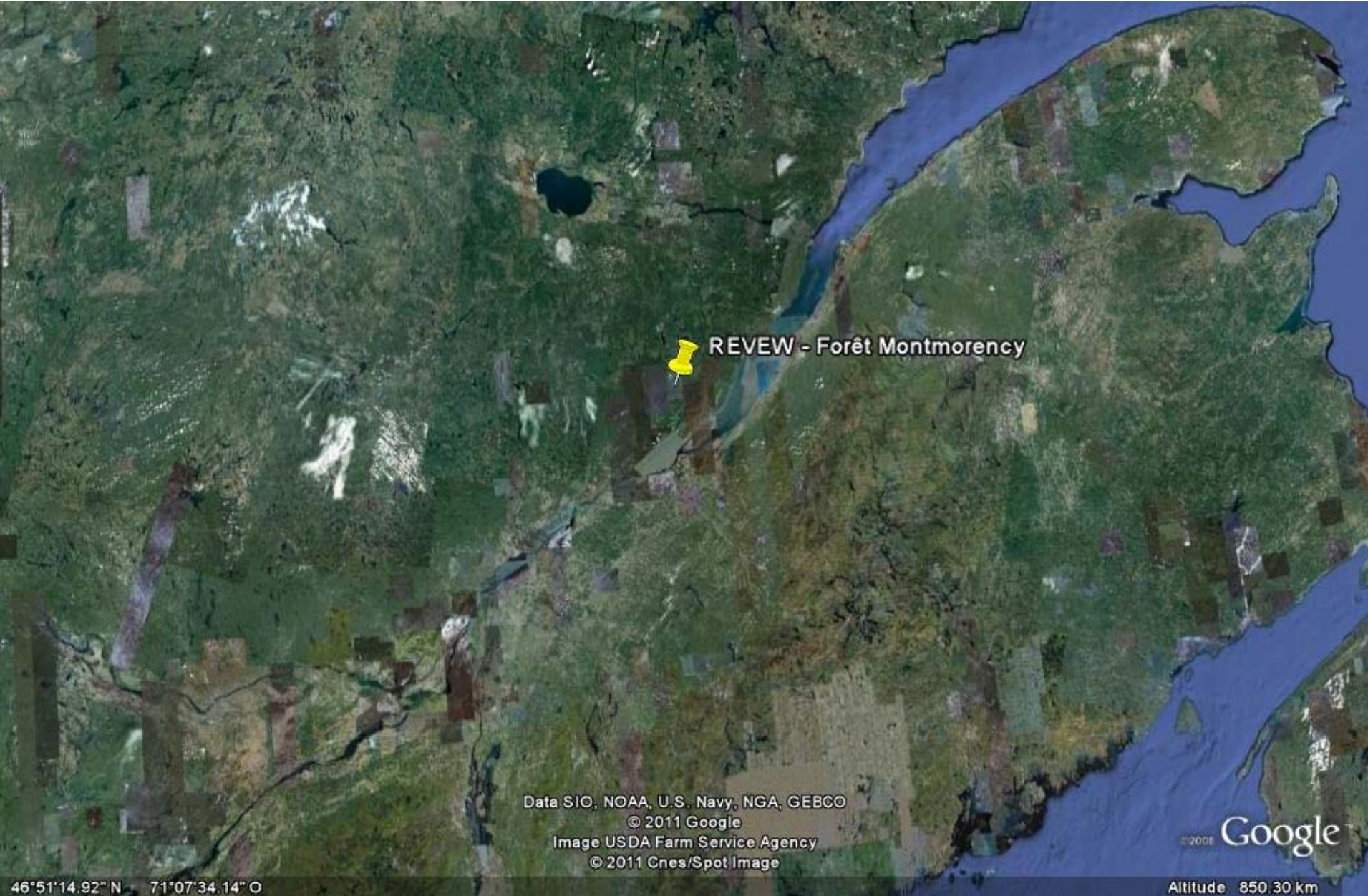


Camp Mercier, March 1996



Forêt Montmorency, 1997





REVEW - Forêt Montmorency

Data SIO, NOAA, U.S. Navy, NGA, GEBCO
© 2011 Google
Image USDA Farm Service Agency
© 2011 Cnes/Spot Image

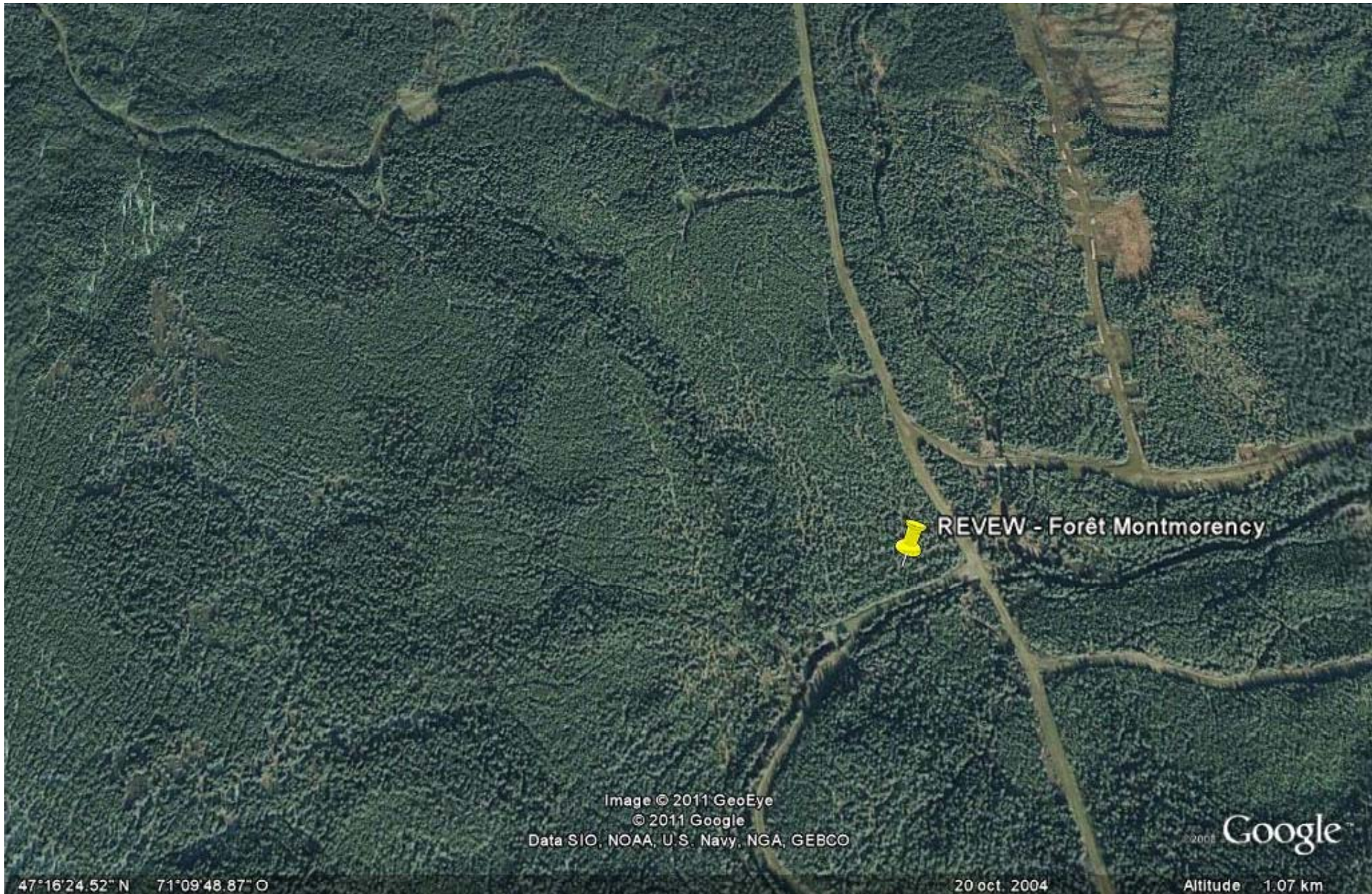
©2008 Google

46°51'14.92" N 71°07'34.14" O

Altitude 850.30 km

Ressources naturelles
et Faune

Québec 



REVEW - Forêt Montmorency

Image © 2011 GeoEye
© 2011 Google

Data SIO, NOAA, U.S. Navy, NGA, GEBCO

© 2008 Google™

47°16'24.52" N 71°09'48.87" O

20 oct. 2004

Altitude 1.07 km

Ressources naturelles
et Faune

Québec 









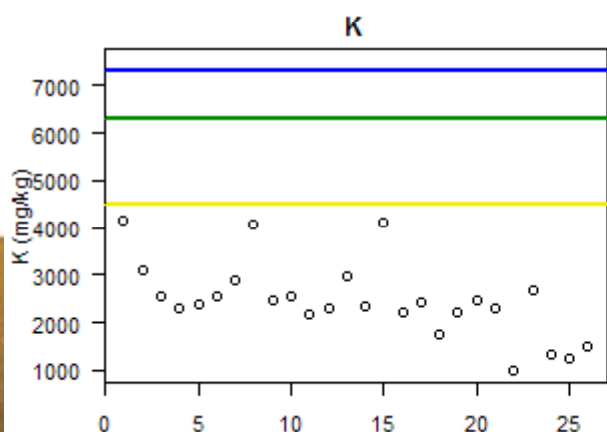
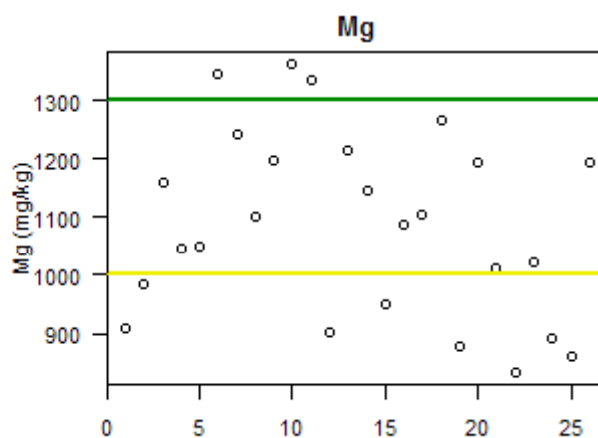
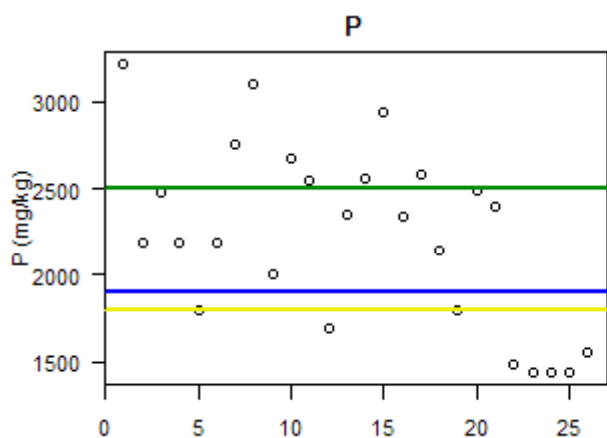
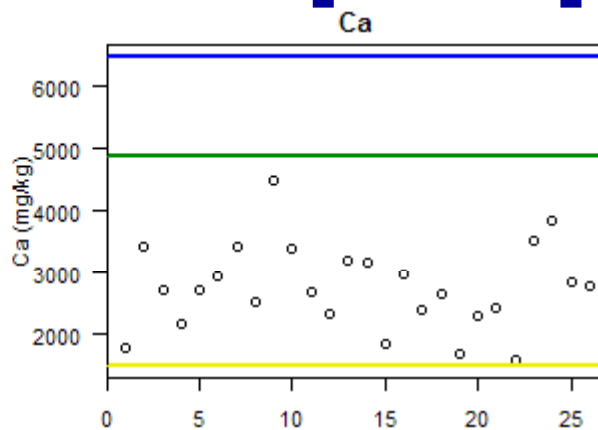
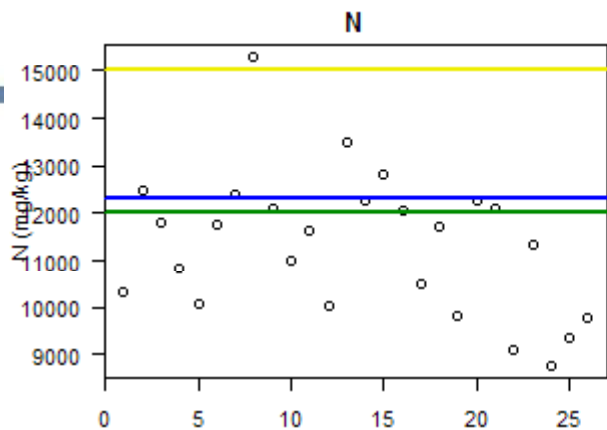
Orthic ferro-humic Podzol



1. Diagnosis of WS decline

- Site: Ruisseau des Eaux-Volées Watershed (REVEW)
- Atmospheric depositions: 10 kg N / yr
20 kg SO₄ / yr
- Clear-cut by patches between 1941 and 1945 and again in 1974-1976
- Precommercial thinning in 1987-1988
- Diagnosis of decline: 1997-2008

WS Eaux-Volées vs. norms [conc.]



Current-year foliage

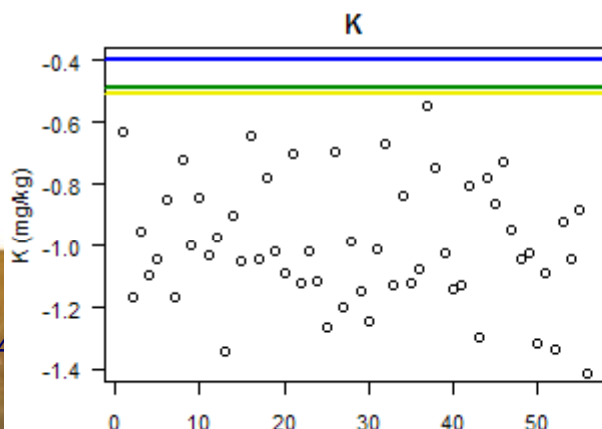
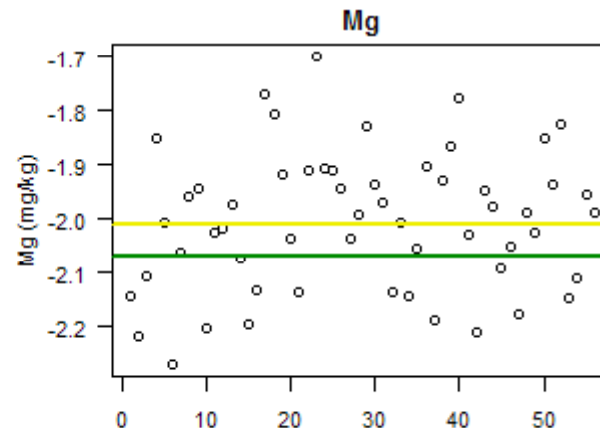
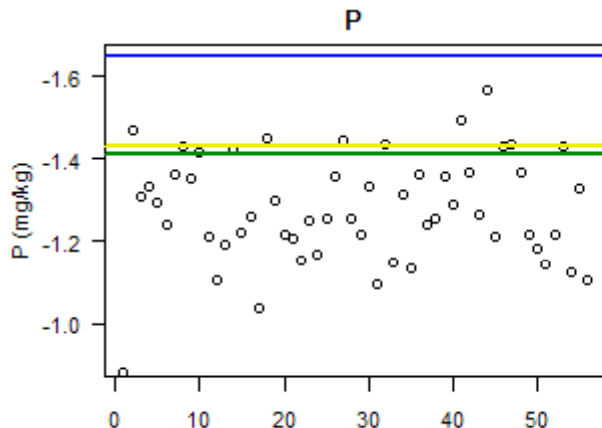
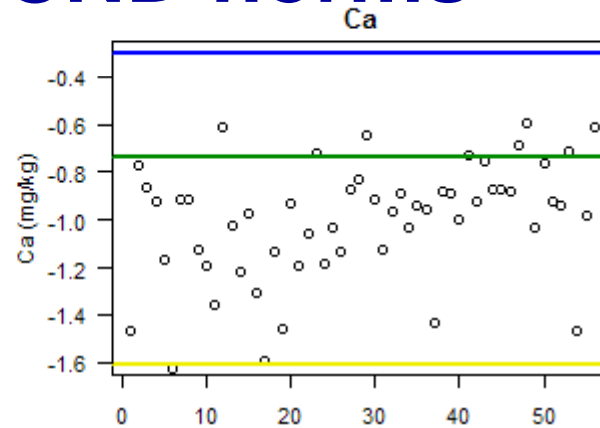
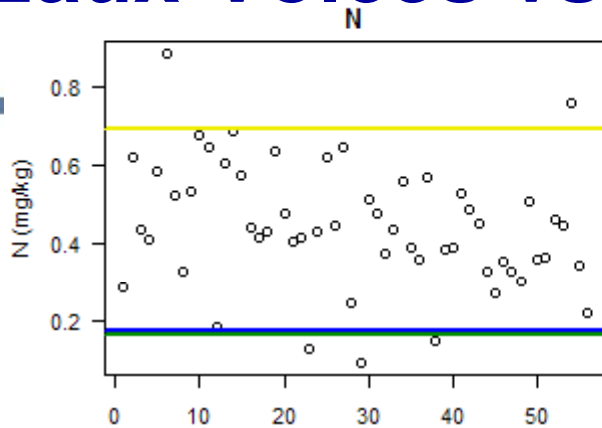
Valeurs optimales

- Quesnel et coll. (2006)
- Wang et Klinka (1997)
- Swan (1971)

naturelles



WS Eaux-Volées vs. CND norms



Current-year foliage

Valeurs optimales

- Quesnel et coll. (2006)
- Wang et Klinka (1997)
- Swan (1971)

ituelles



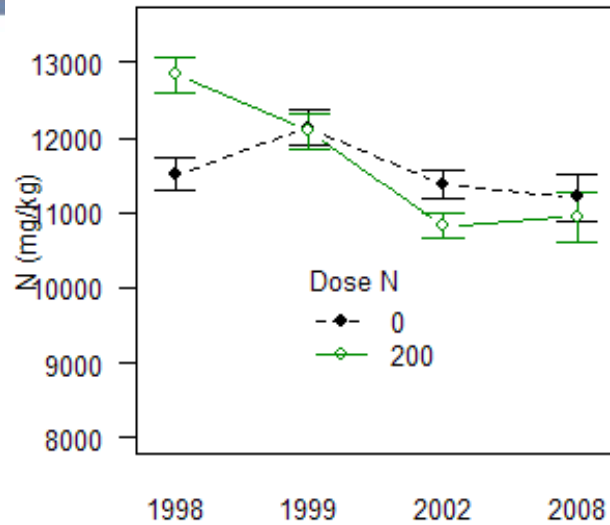
2. Diagnosis fertilization experiment

- Factorial design (8 treatments, rep = 7)
 - N : 0, 200 kg/ha - $(\text{NH}_4)_2\text{SO}_4$
 - K : 0, 100 kg/ha - K_2SO_4
 - Mg : 0, 200 kg/ha - MgSO_4
- Foliar analysis: 1998, 1999, 2002, 2008
- Basal area increment (BAI): 1997-2008

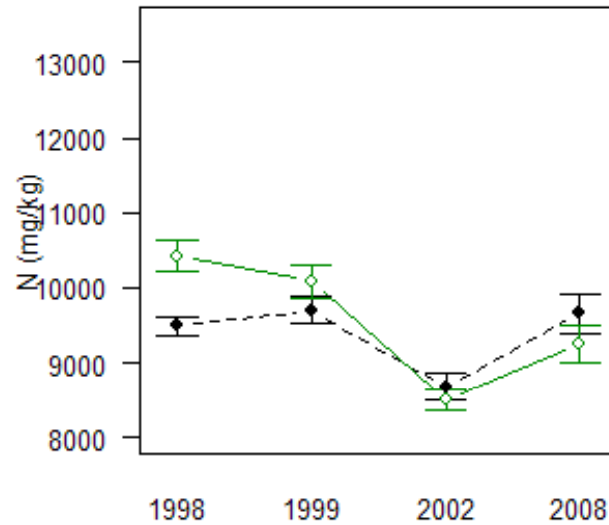
N fertilization: main effect on foliar N & Mg

N

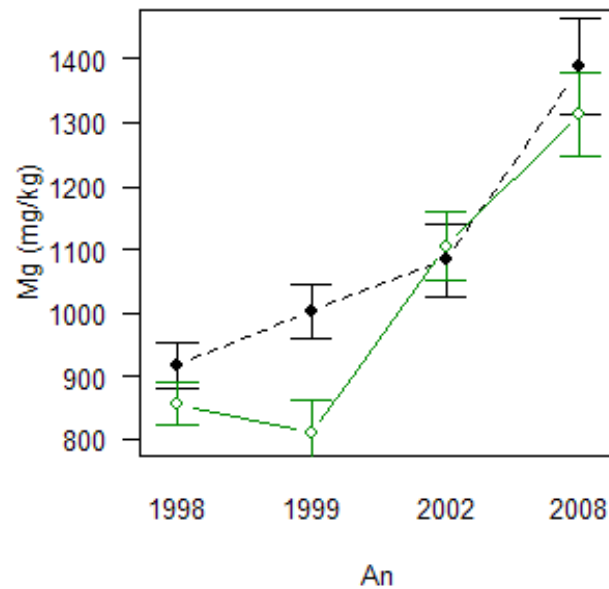
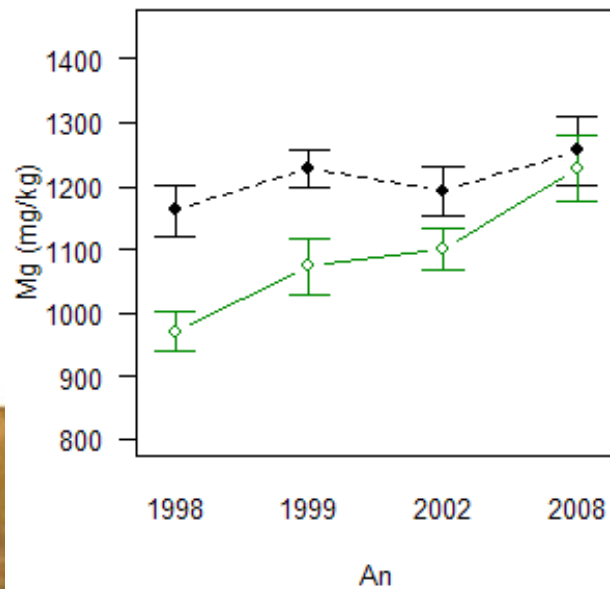
Current-year



One-year old



Mg



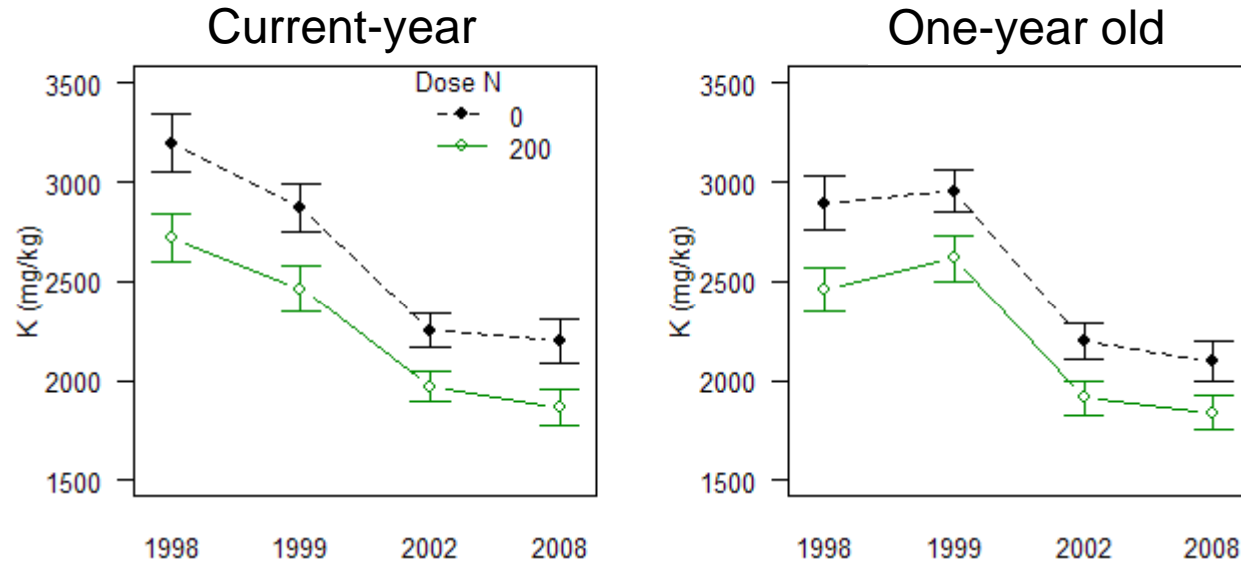
naturelles

ébec

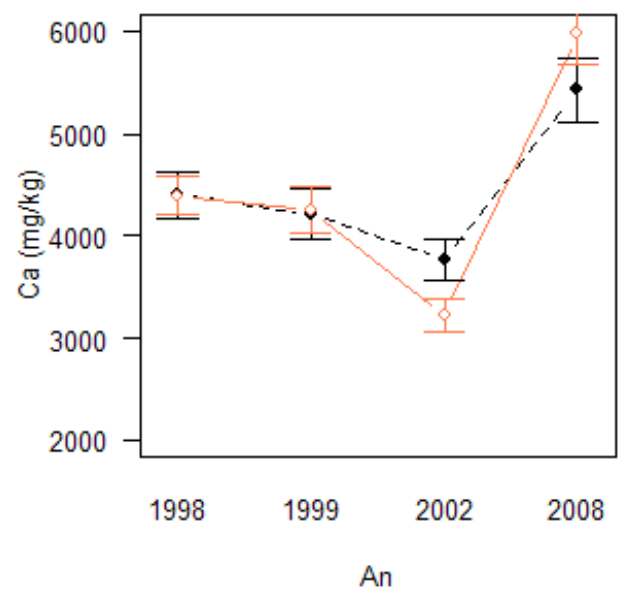
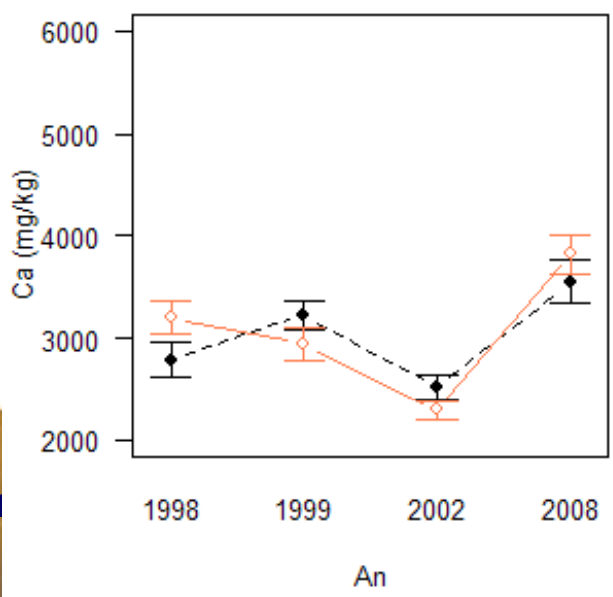
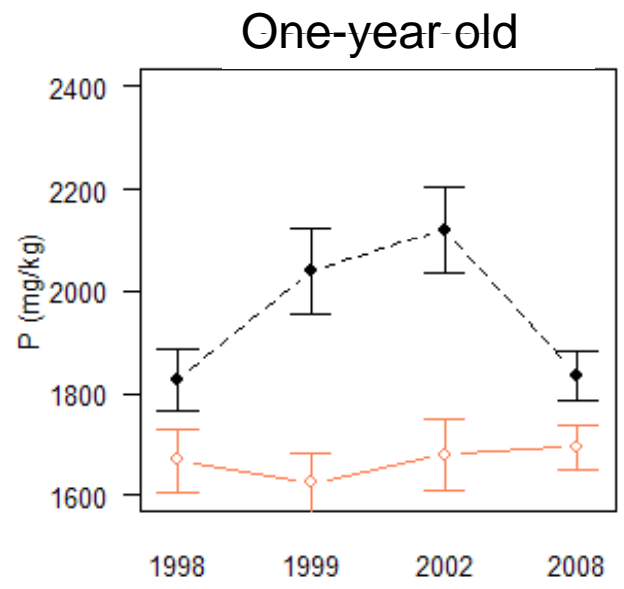
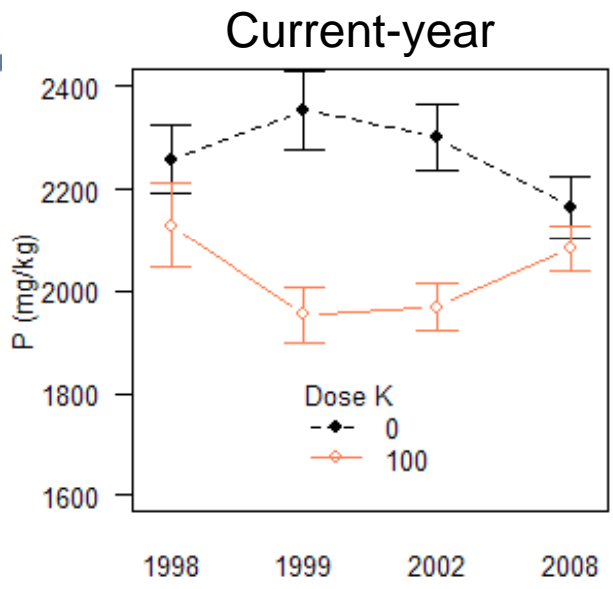
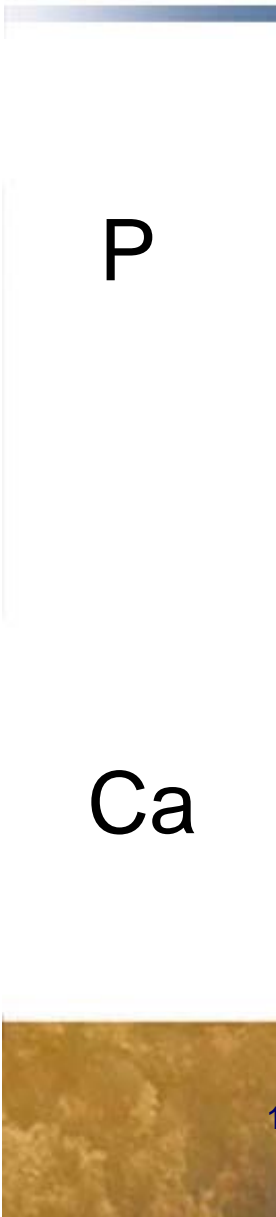


N fertilization: main effect on foliar K

K

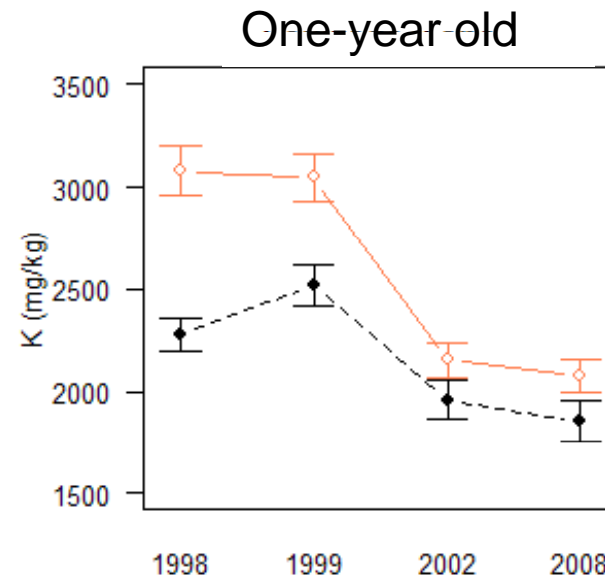
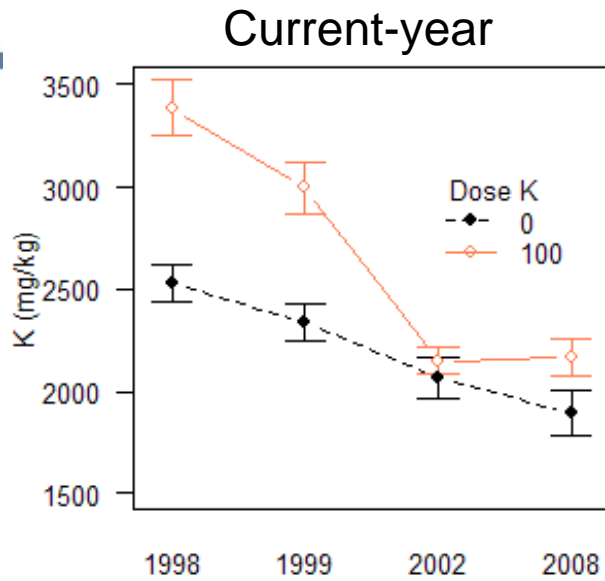


K fertilization: main effect on foliar P & Ca

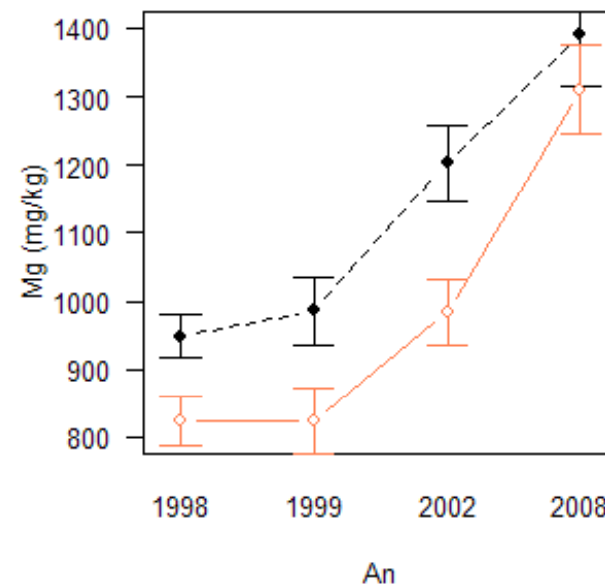
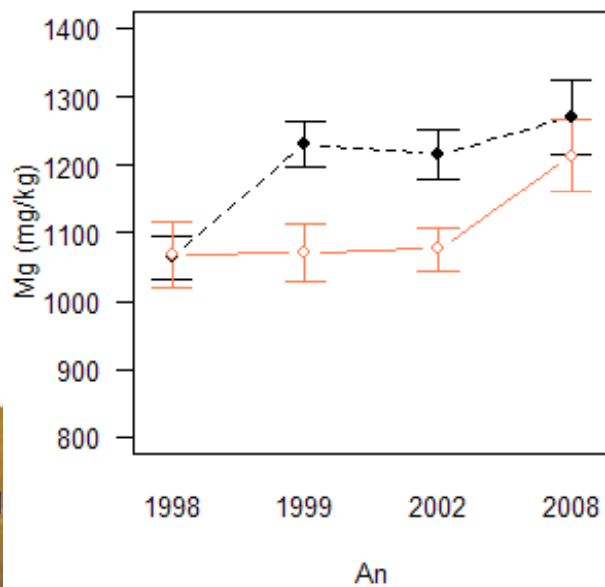


K fertilization: main effect on foliar K & Mg

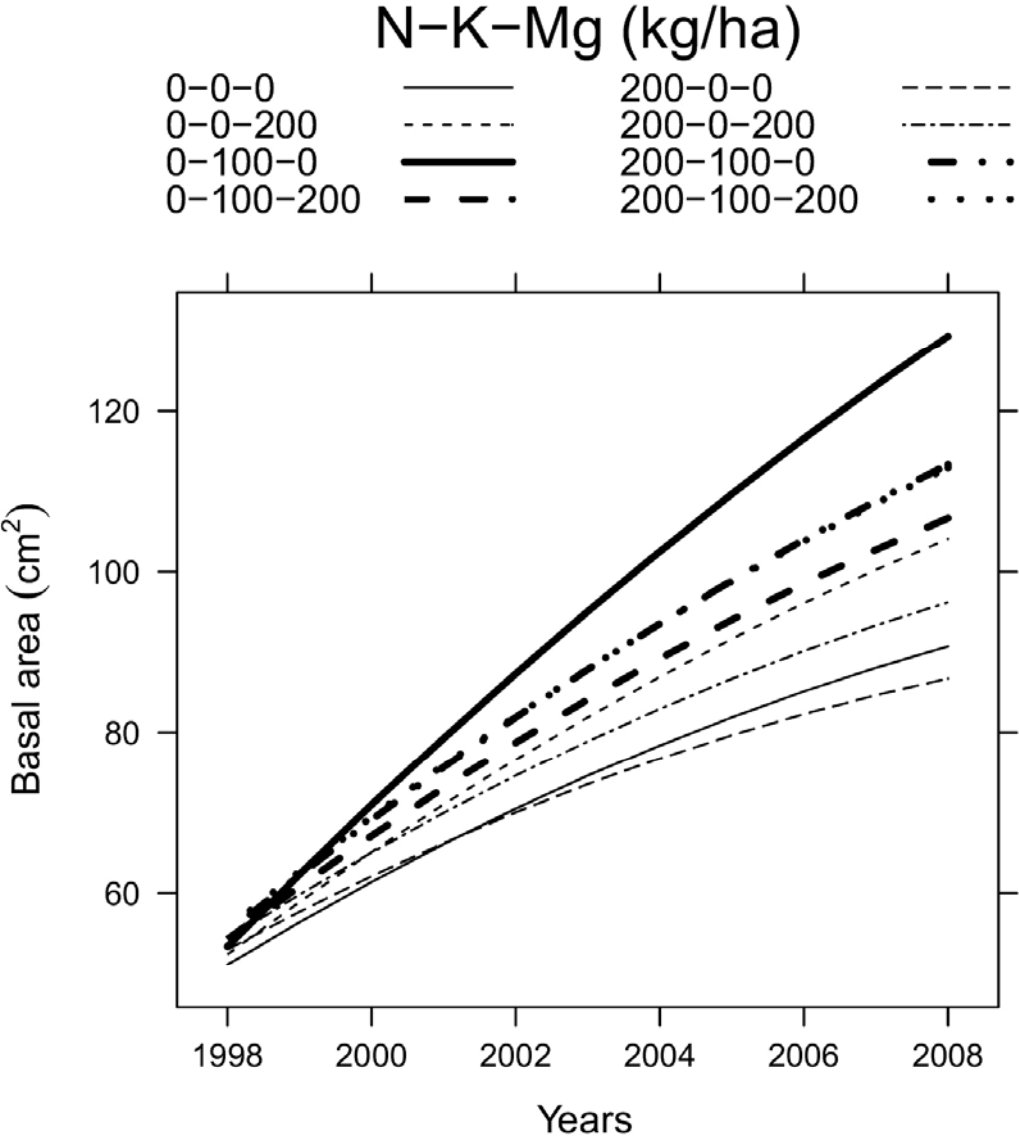
K



Mg

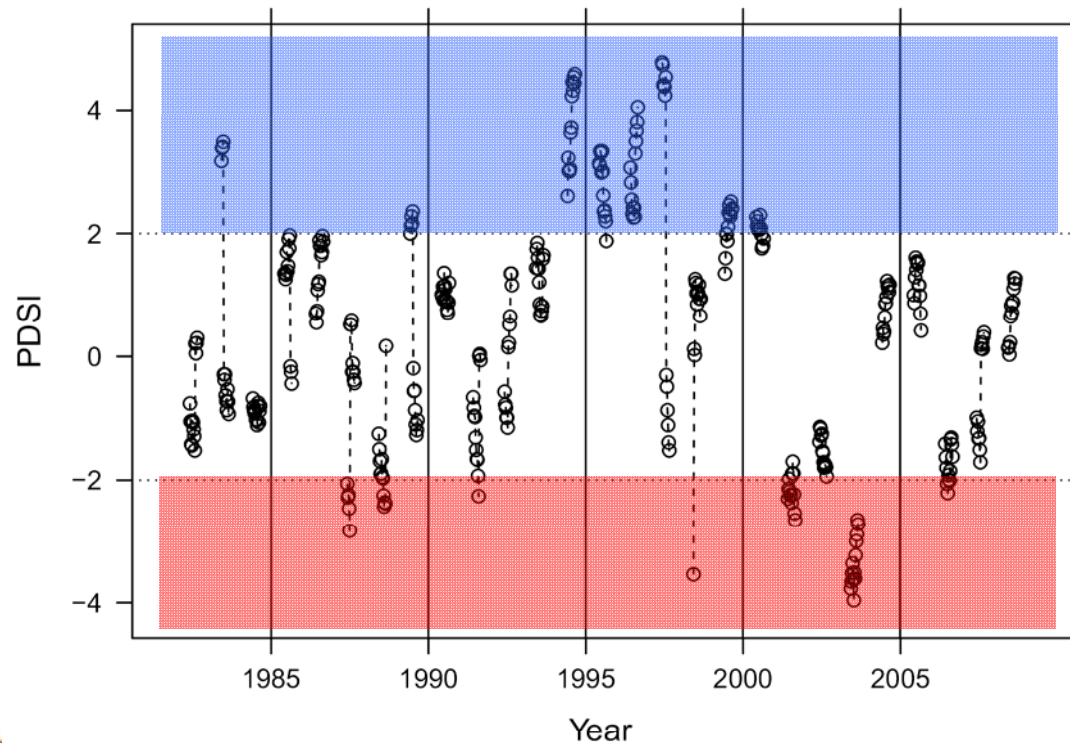


K fertilization: main effect on tree growth

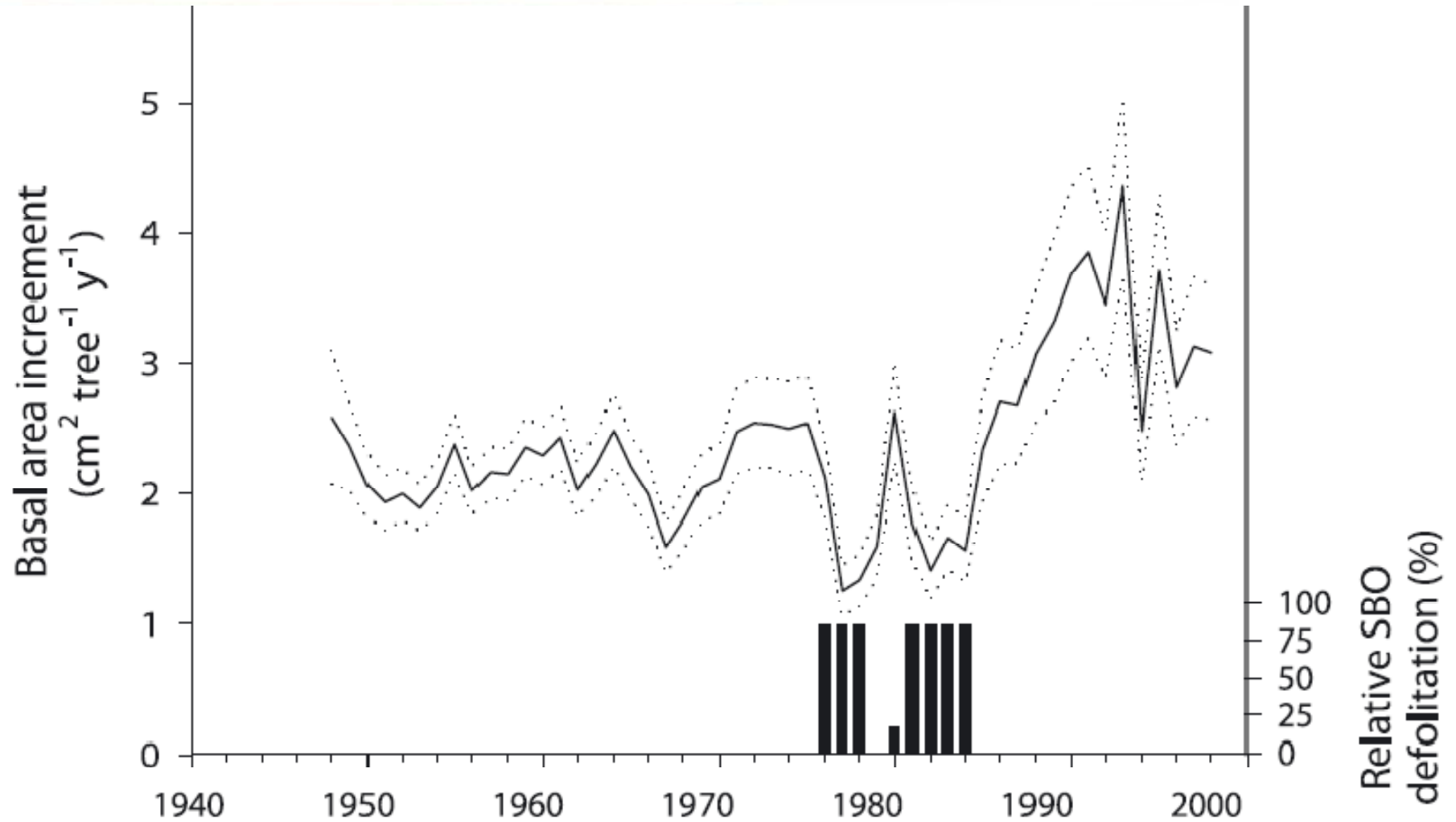


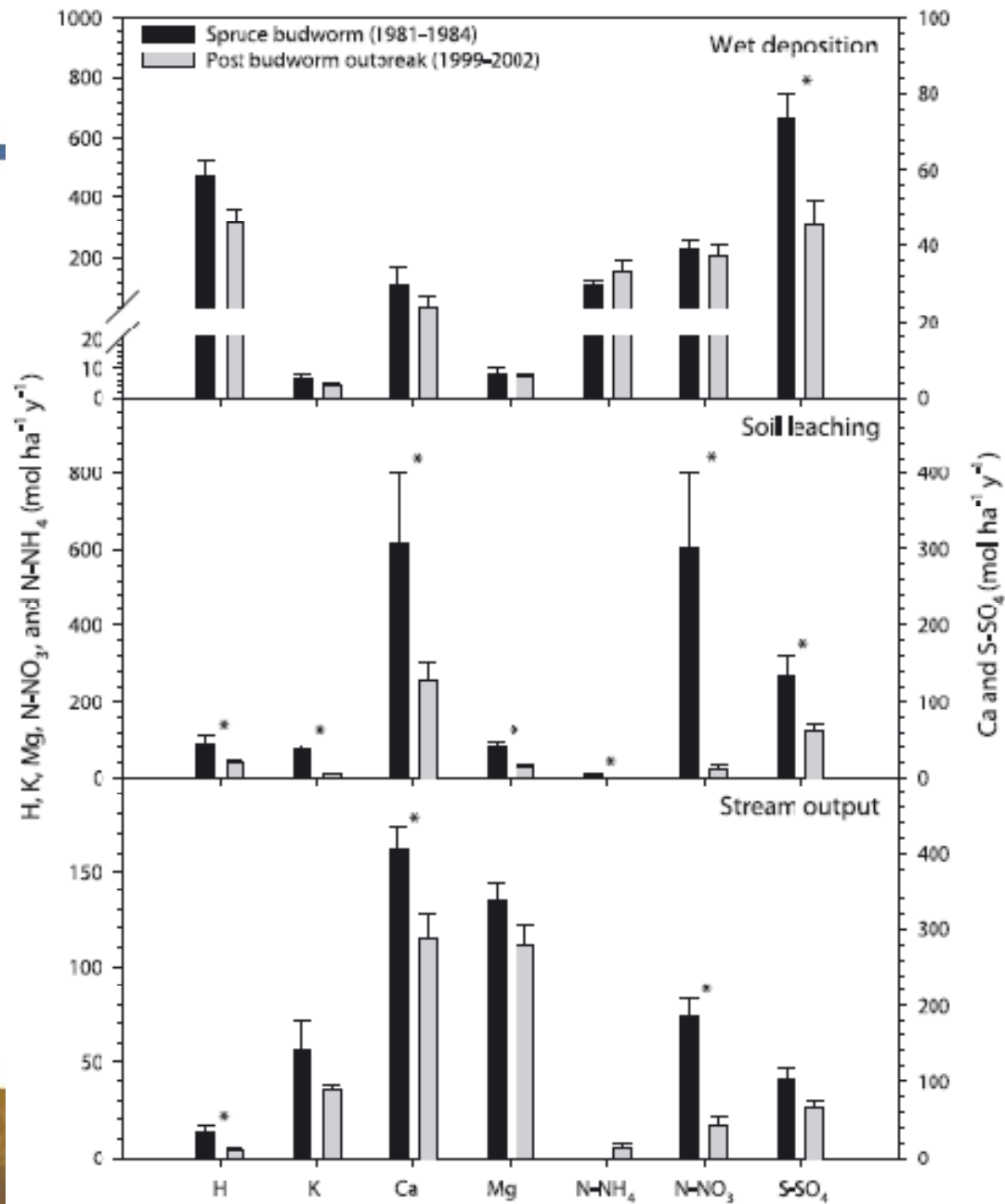
Water stress

Occurrence of plant water stress events (Palmer Drought Severity index (PDSI)) at the REVEW Watershed between 1982 and 2008. Points represent calculated weekly PDSI values from June to August. Dashed horizontal lines at +2 and -2 PDSI show the thresholds for moderate wet spell and moderate drought, respectively.

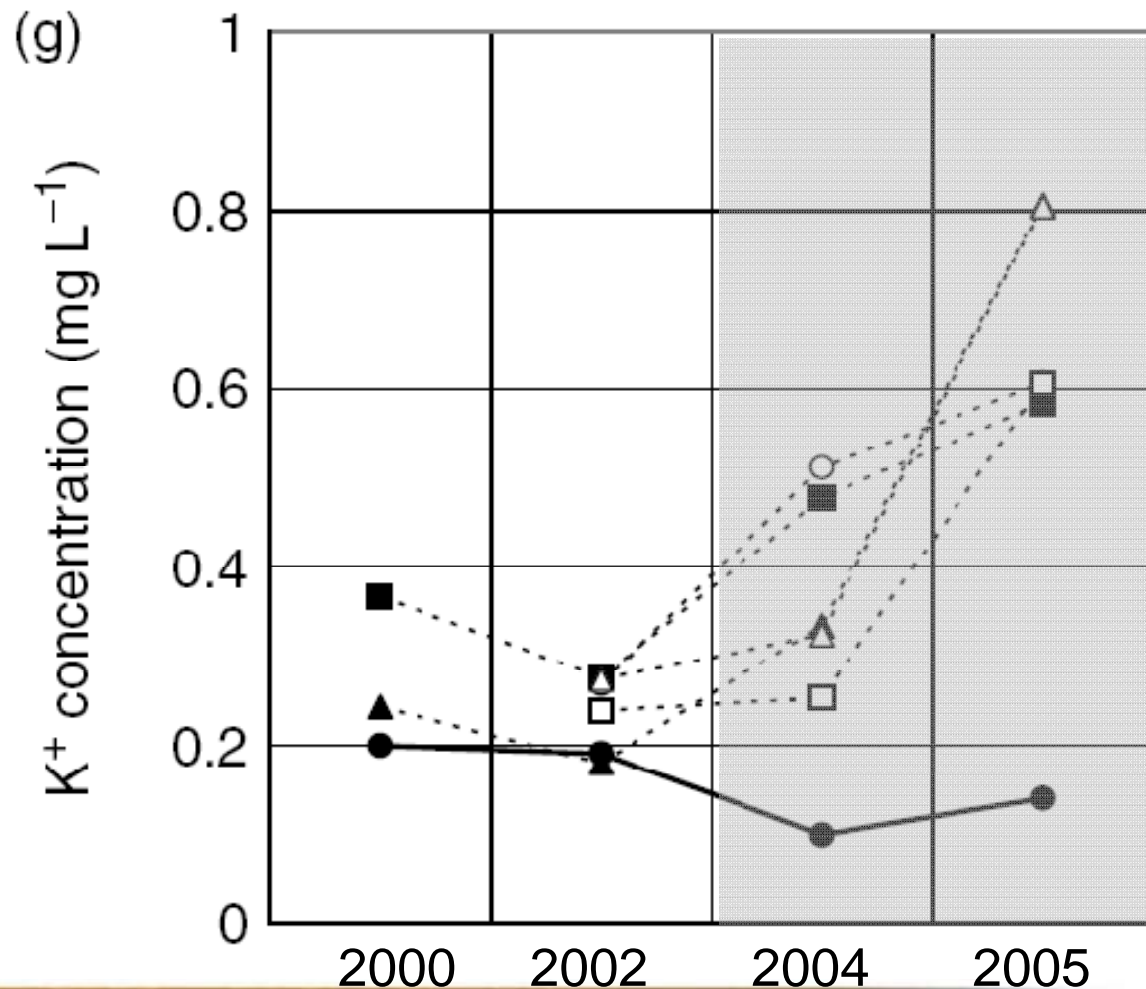


Spruce budworm outbreak (SBO)





Hydrological losses through forest operations at the REVIEW Watershed



Conclusions

Recent WS decline appears to be related to:

- Low foliar K (and Ca?)
- K fertilization increases growth
- History of ecosystem K cycle is « weighty »:
 - N deposition
 - Insect outbreaks
 - Harvesting

