

SHORTFOR Meeting

WP4 – Environmental sustainability

Nutrient and hydrological balance of a SRF system

Mark O'Connor
Liwen Xiao

Department of Civil, Structural and Environmental Engineering
TCD

SRF and Water

- SRF has the potential to both threaten and benefit water quality.
- Undisturbed forests or woodland represent the best possible protection for land from sediment and pollutant losses (Novotny, 2003).
- The level of forestry is critical factor affecting the quality of water resources in Ireland (O'Donoghue et al., 2010)
- SRF is expected to improve water quality compared to arable cropping and intensive farming:
 - Lower nitrate and other nutrient leaching,
 - Soil erosion control and lower suspended solid release,

Nisbet et al., 2011

SRF and Water

Arable fields	Grassland	Woodland
26.4 kgN/ha/y	15.5 kgN/ha/y	0.4 kg/ha/y

Winter cereals	Oilseed rape	Potato	Woodland
2.8 kgN/ha/y	3.4 kgN/ha/y	4.7 kgN/ha/y	1.2 kgN/ha/y

0-24 kg N/ha/y for woodland

Nisbet et al., 2011

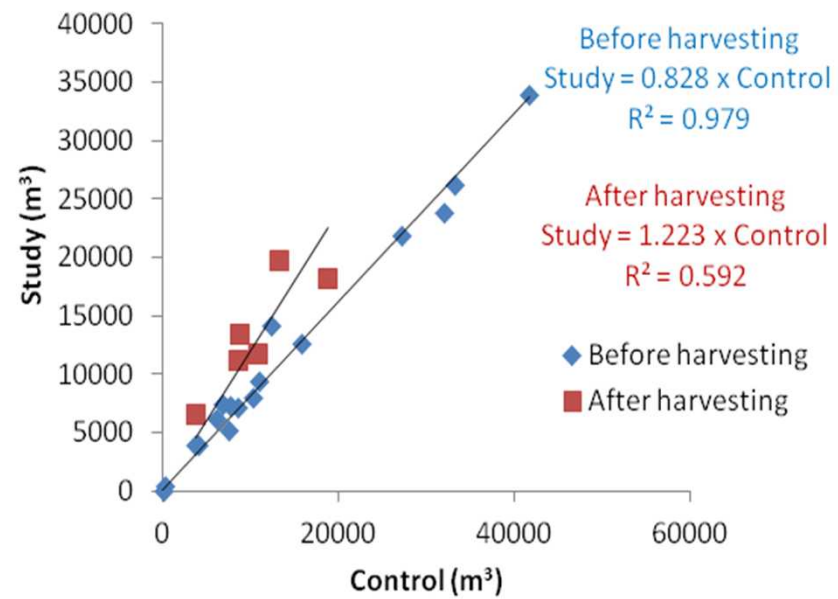
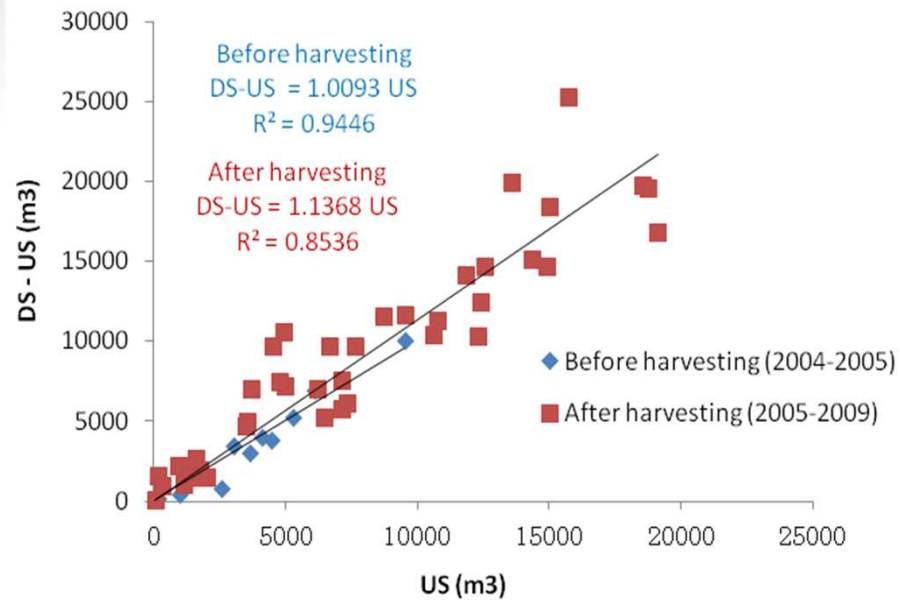
- In Ireland, arable land increased by 1%, maximum chlorophyll in the lake increased by 0.48%. Forest increased by 1 %, maximum chlorophyll increased by 0.07%. (Curtis and Morgenroth, 2013)
- Lough Leane catchment, 47% from agriculture, only 3% P from forest (**Coillte**)

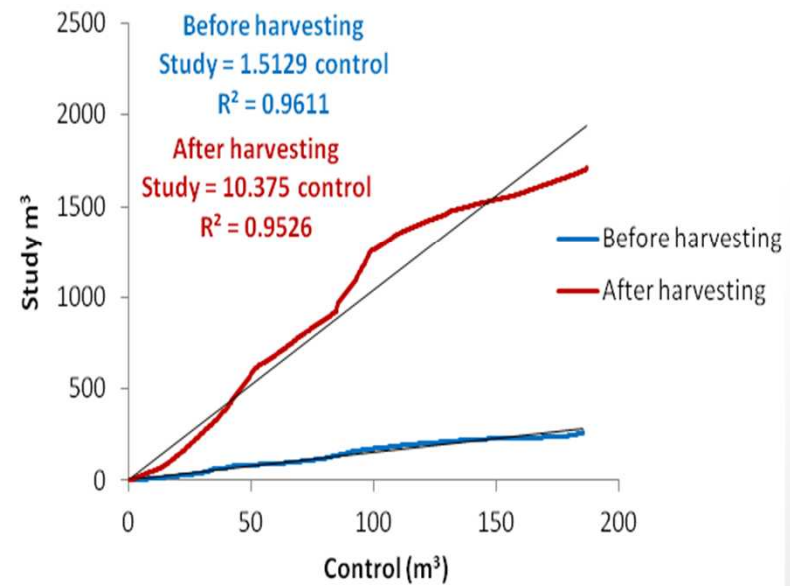
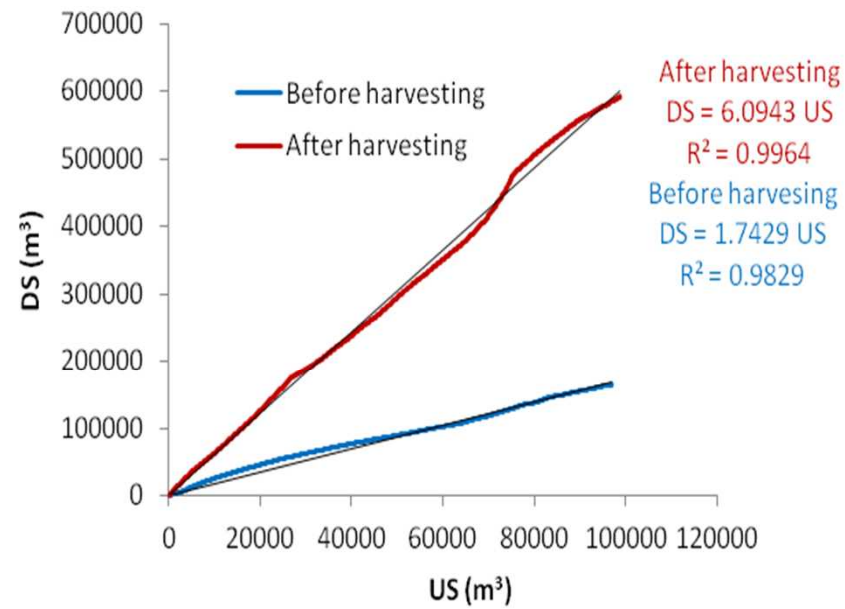
SRF and Water

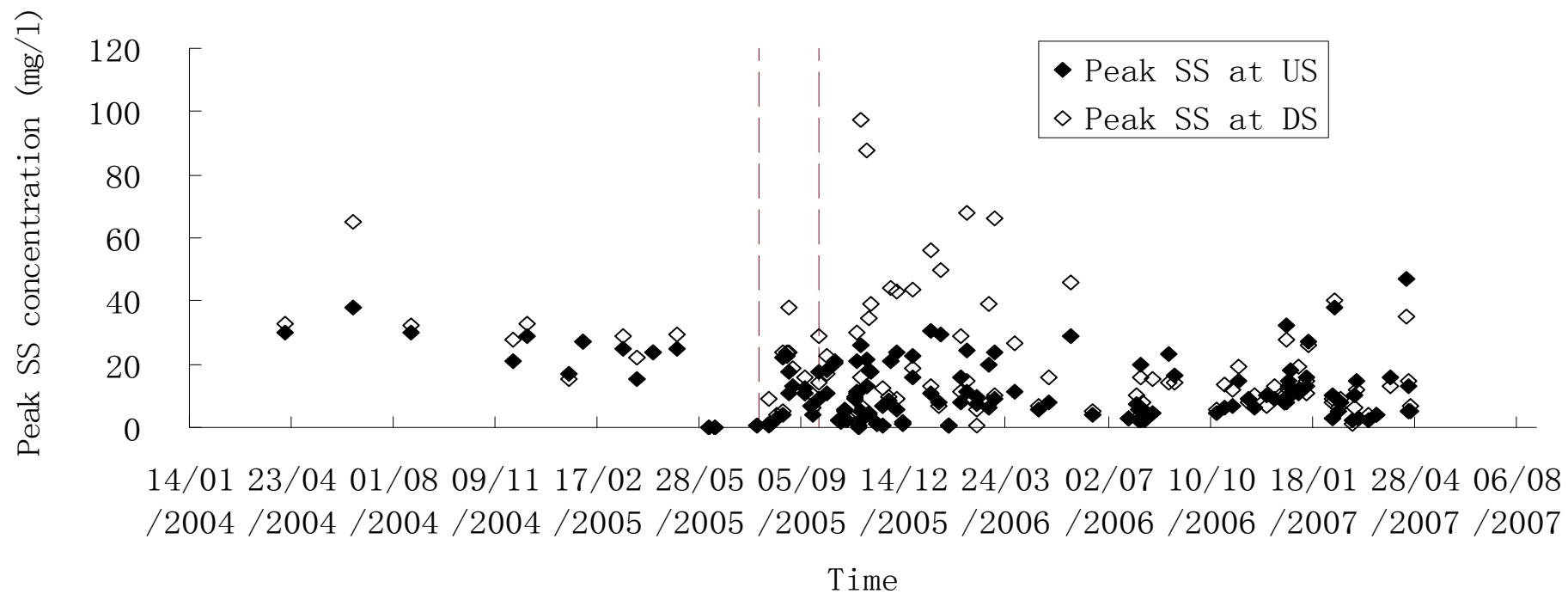
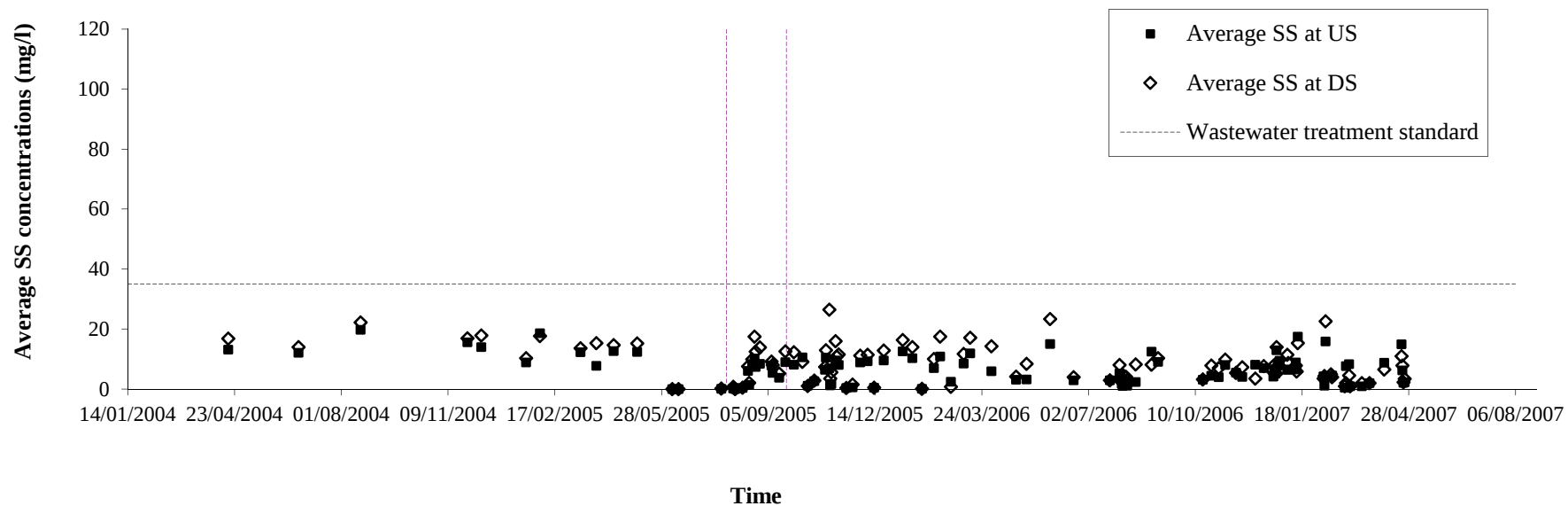
- SRF for treatment of contaminated lands, water and wastewater
- SRF could be used to improves water quality where N and P release are high
- Potential beneficial for flood management

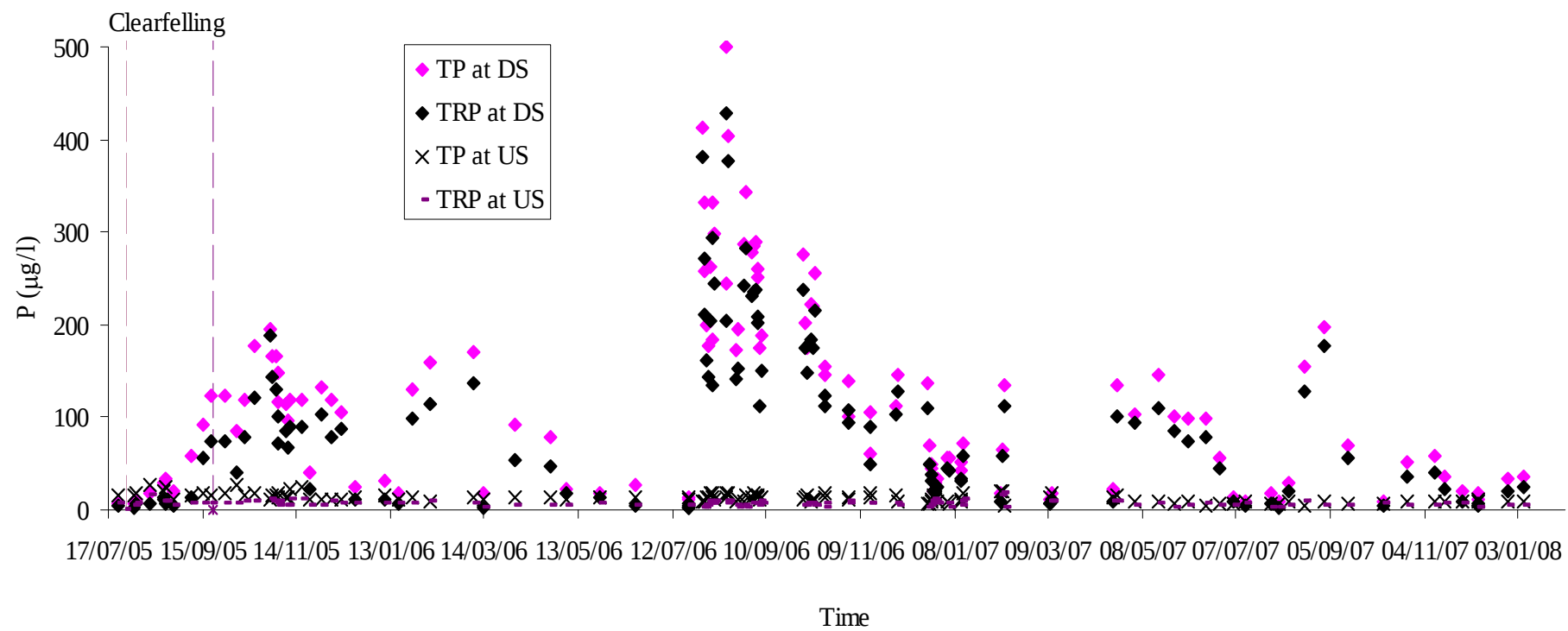
SRF and Water

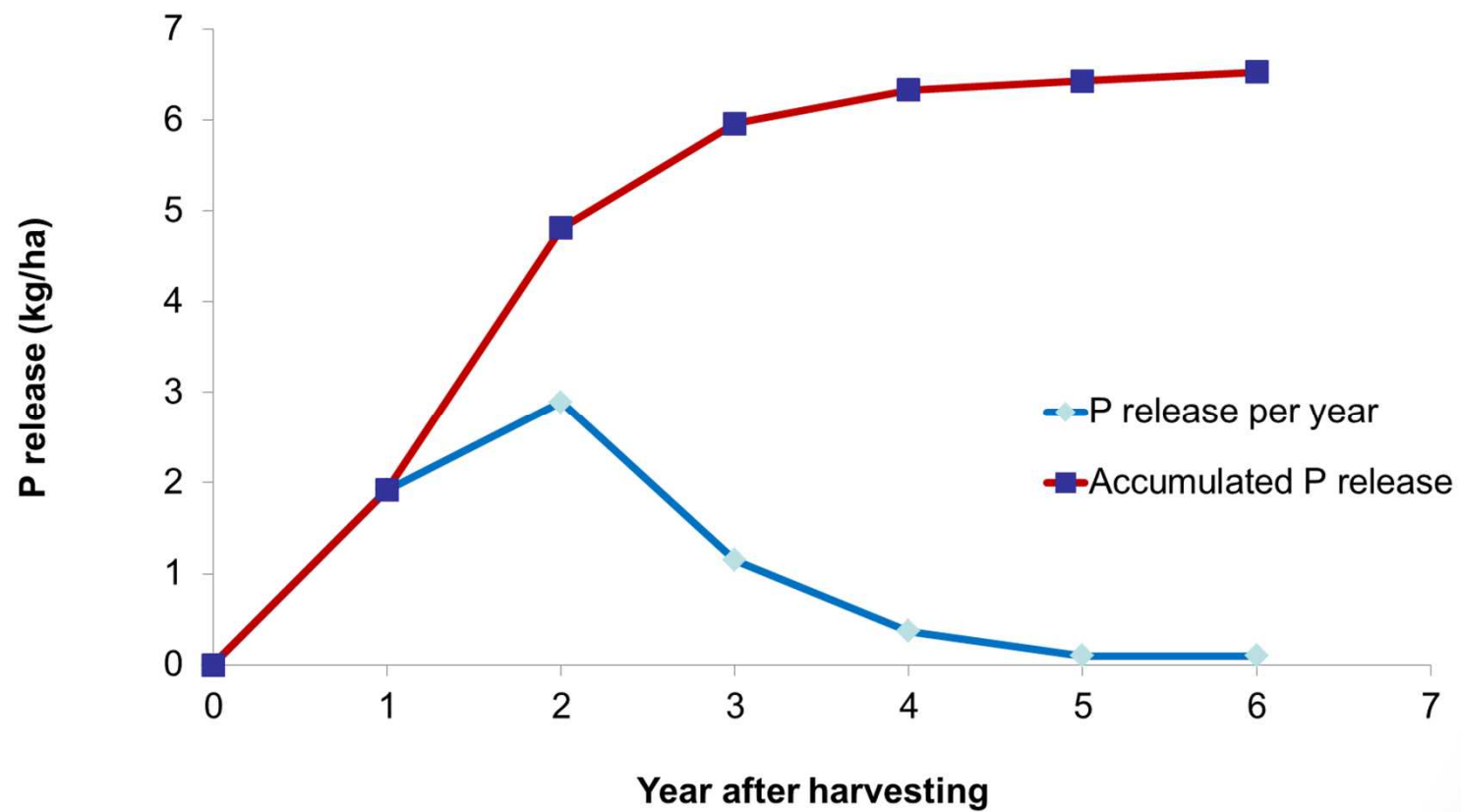
- The potential high water use of SRF crops
- Acidification in acid sensitive areas
- Potential high N/P/SS release during fertilise/pesticide use and harvesting period
- Can be mitigated by apply good management practices











Microcosm setup for nutrient and hydrological demand comparison

BNM
standard
nursery mix



Raised platform,
secure enclosure
and rain gauge,
PAR and soil
temp onsite

7 x Italian alder, *E.nitens*,
E.rodwayi, Sitka spruce,
lodgepole pine.
5 x Control/peat only



39L pots filled
with 42L of
compost

Leachate
collection in
HDPE
canisters
under pots

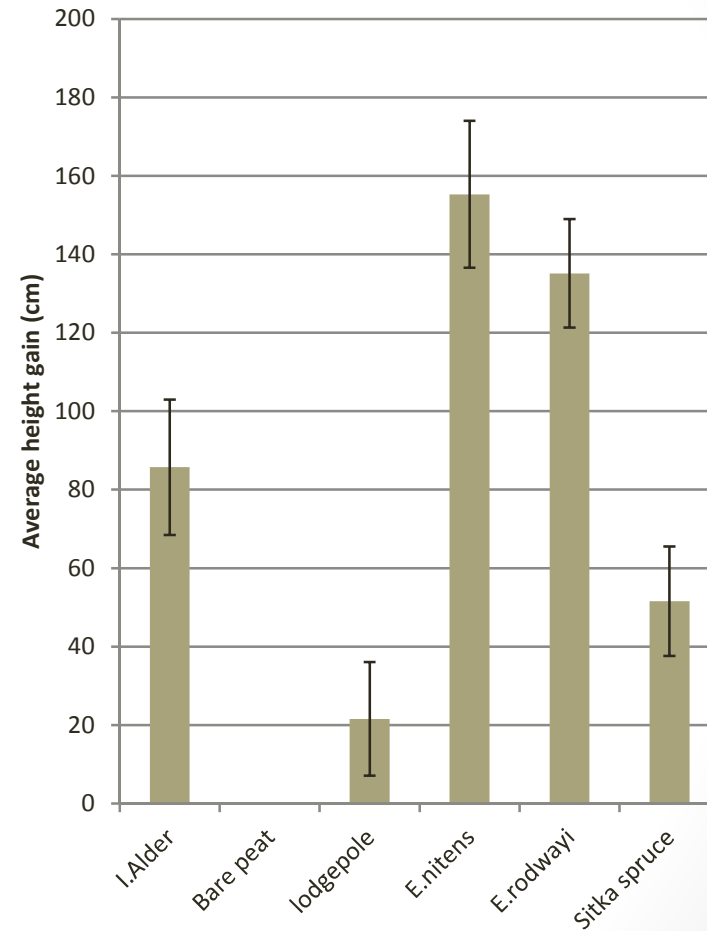
2016 season height gain

Scaffold for hanging scales
Kern Ch50k50 50g increments

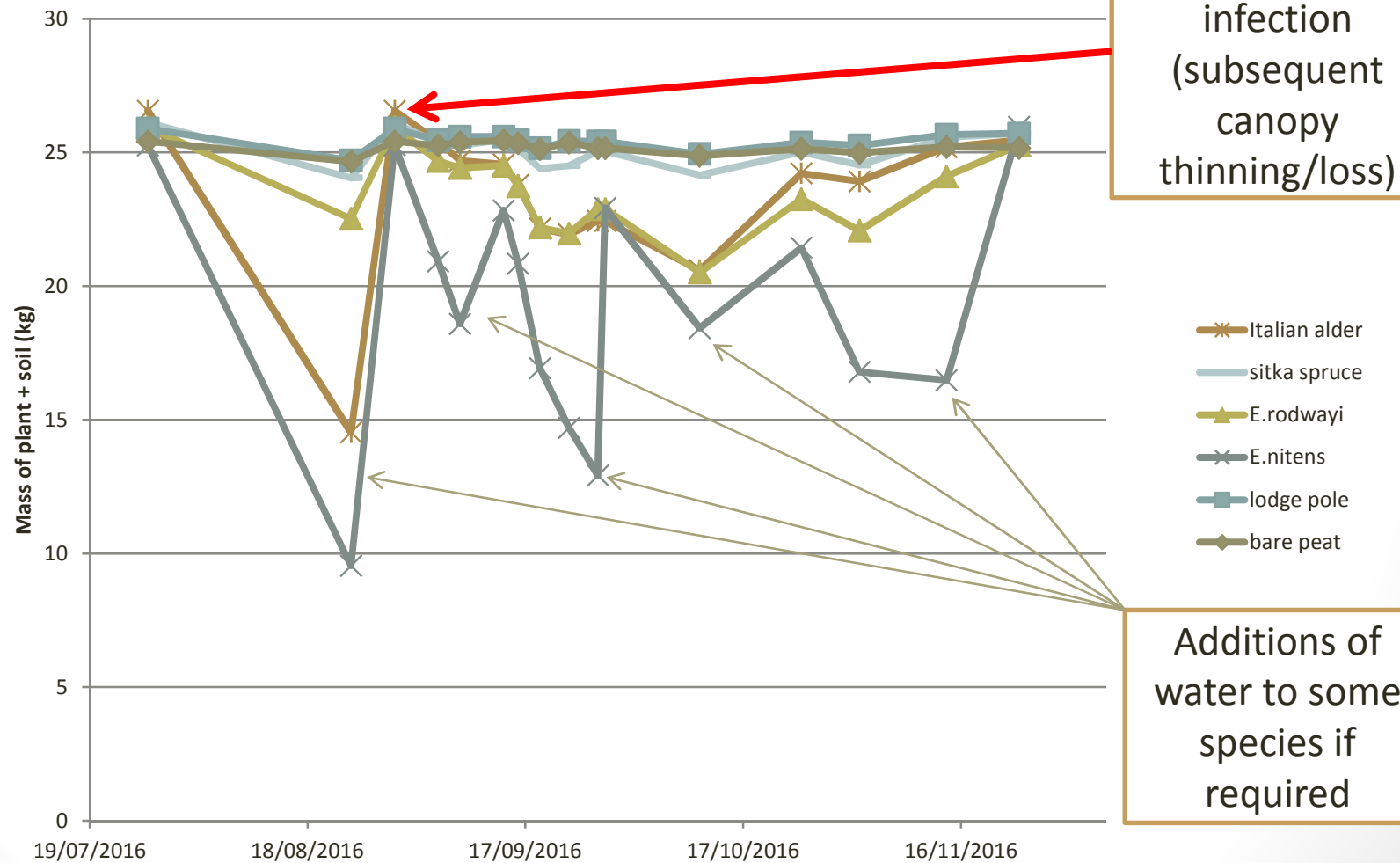


Issues to note:

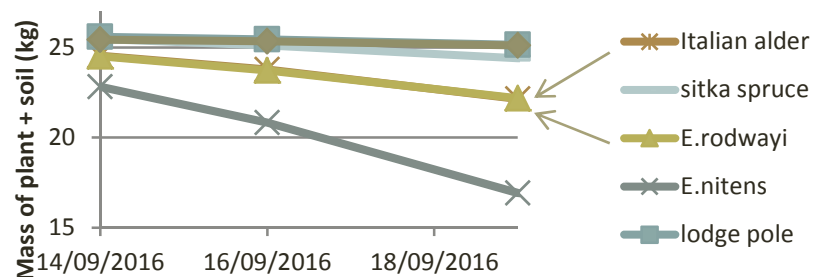
- Alder rust September onwards
- Poor performance of lodgepole, may be due to light competition or initial handling



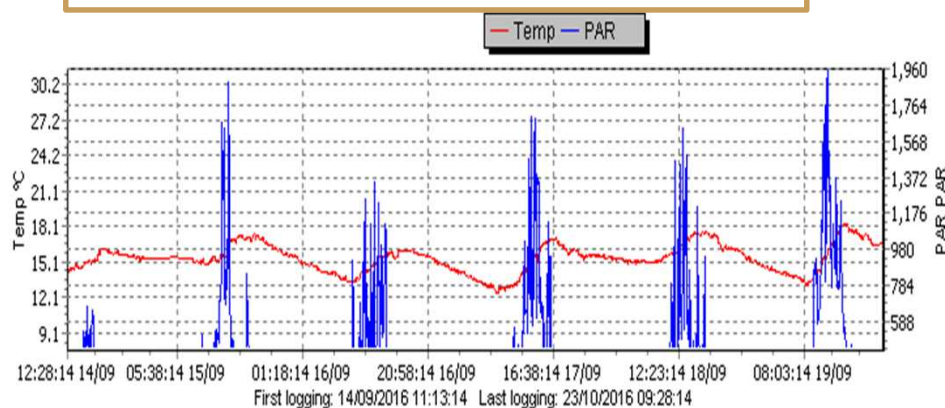
Gravimetric mass over time (comparative transpiration estimates)



Gravimetric mass over time (evapotranspiration estimates)



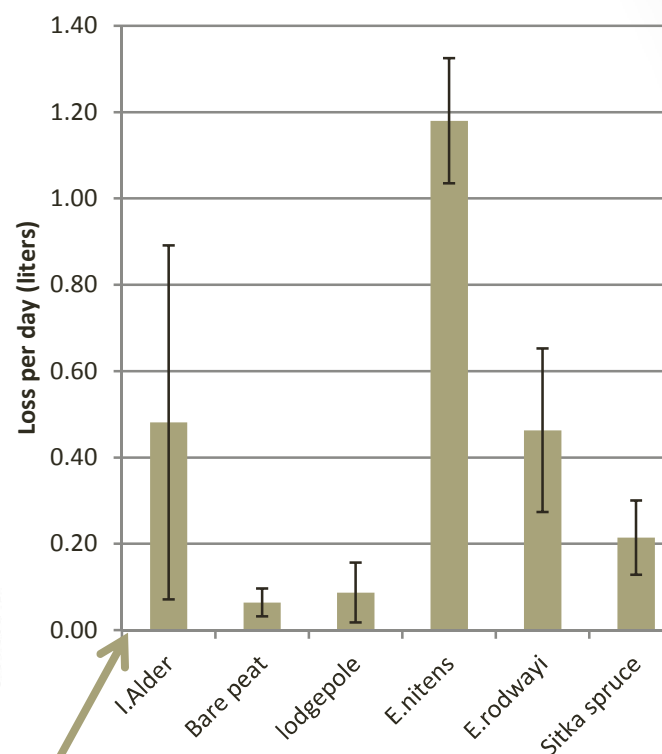
Weighed loss (above) and subsequent conversion to evapotranspiration estimates (right)



Logging: 1281
Date: 18/09/2016 21:53:14
Temp: 16.0 Minimum: 1.1 Maximum: 31.3
PAR: 4 Minimum: -1 Maximum: 1959
Single Scale
Cross

Note: Temperature is soil temp @5cm. Temp and PAR indicate high vapour pressure deficit

Averaged daily evapotranspiration estimates 14-19 September 2016



Note: I.alder with total canopy loss are included in calculations

Indications of higher DOC from increased wet/dry soil cycling.

Forestry intensification: potentially non-point source for DOC on soils with high organic content.

Leachate Nov 2016

Problems downstream include drinking water treatment

Colour
Odour
Trihalometanes
Haloacetic acid



Italian alder



Sitka Spruce



E.rodwayi



lodgepole
pine



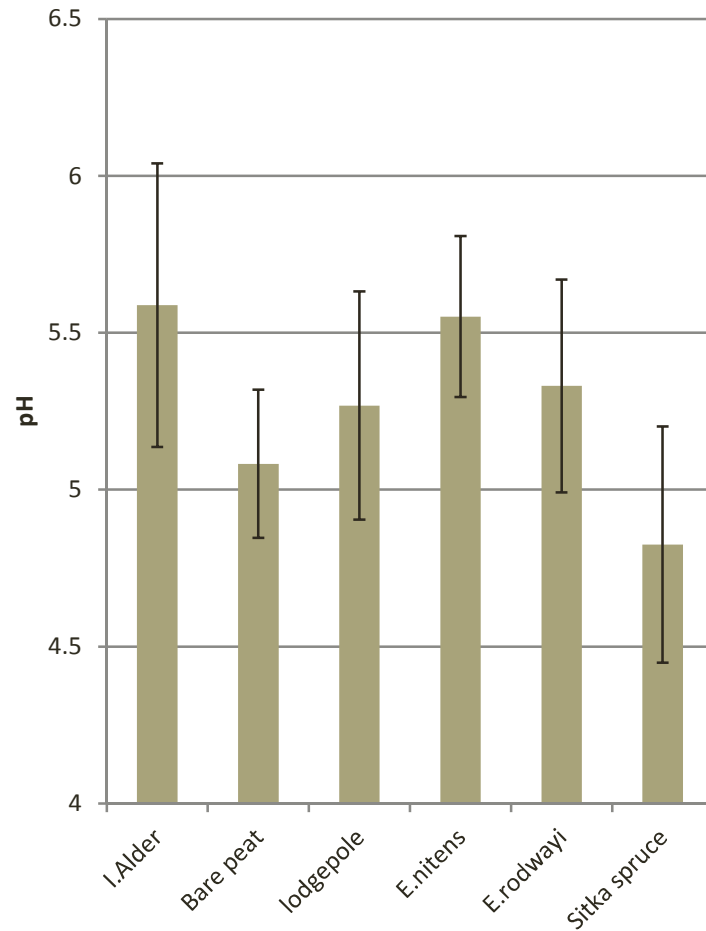
E.nitens



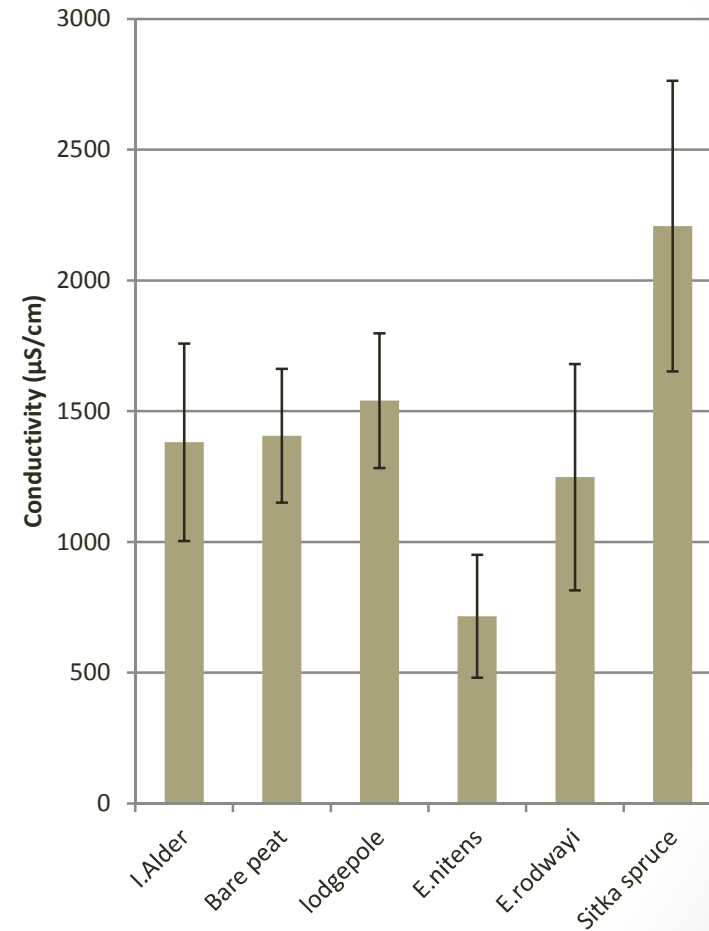
Control/peat
only

Leachate properties

Combined results of replicates from four leachate sampling occasions.



Nutrient analysis of samples remains incomplete.



Site setup peatland SRF study

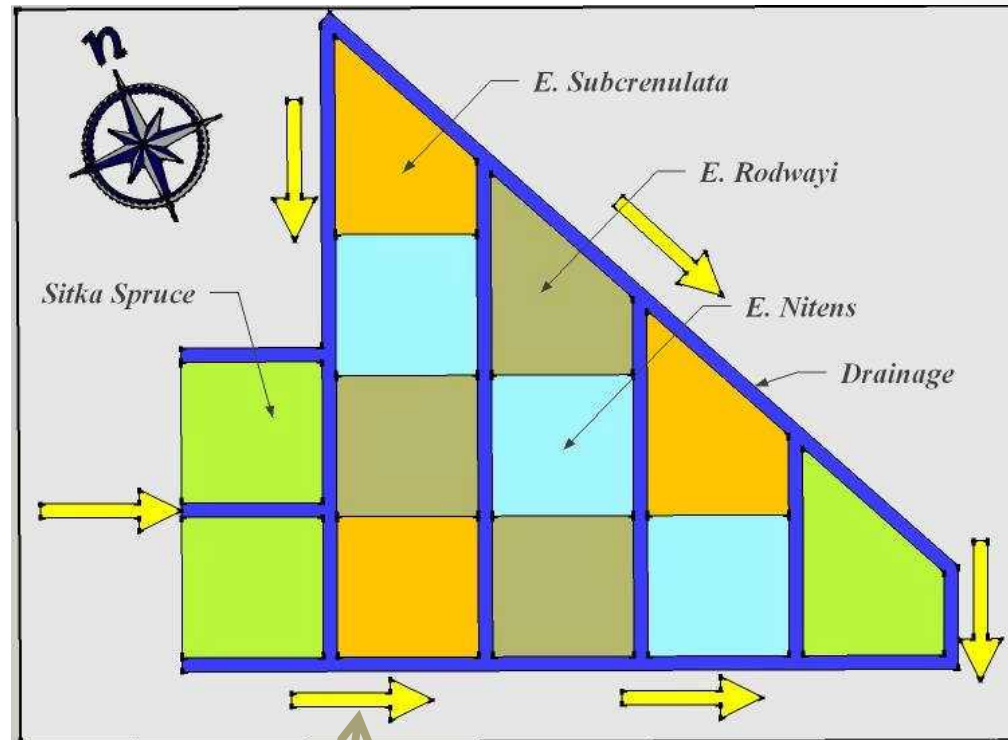


- Exposed south facing site
- 150masl
- Second rotation from SS/LP mix
- Peat depth generally 1m+
- Site left 3-4 years prior to restocking



Site layout

- Mounded and drained at 8-10m intervals
- Restocked with SS March/April 2014 (coillte)
- Restocked with eucalyptus june 2014 (source D-plant)
- No fertiliser/fisheries area
- 30 per plot/90 per species
- Species selected for cold hardiness, swamp affiliation, popularity and availability.



Drainage
direction and
slope

September 2016

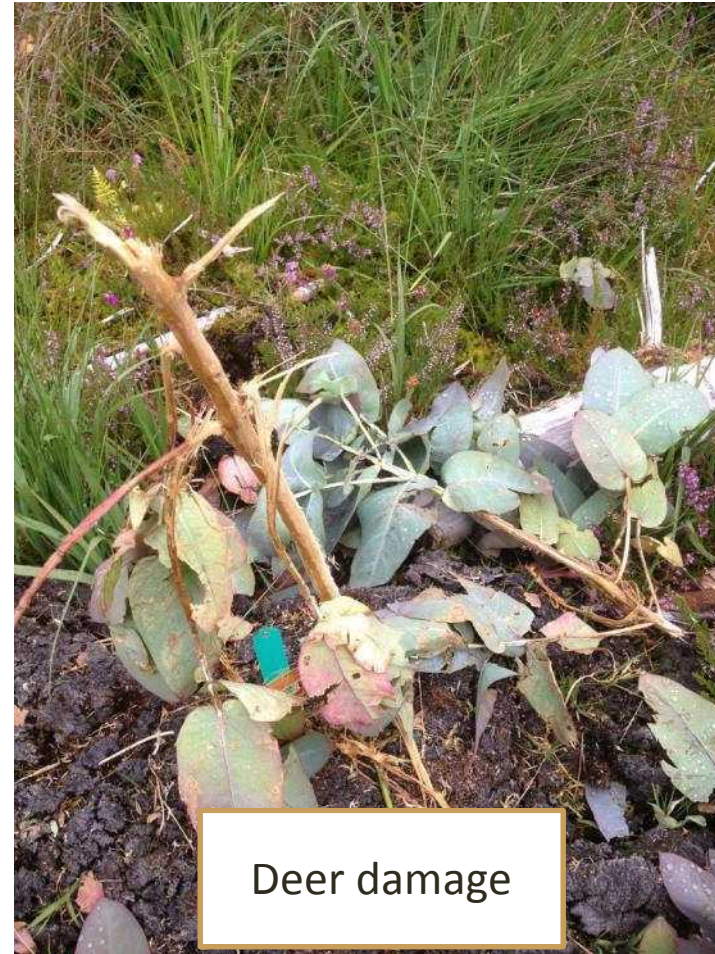


Complete ground
cover with no weed
control

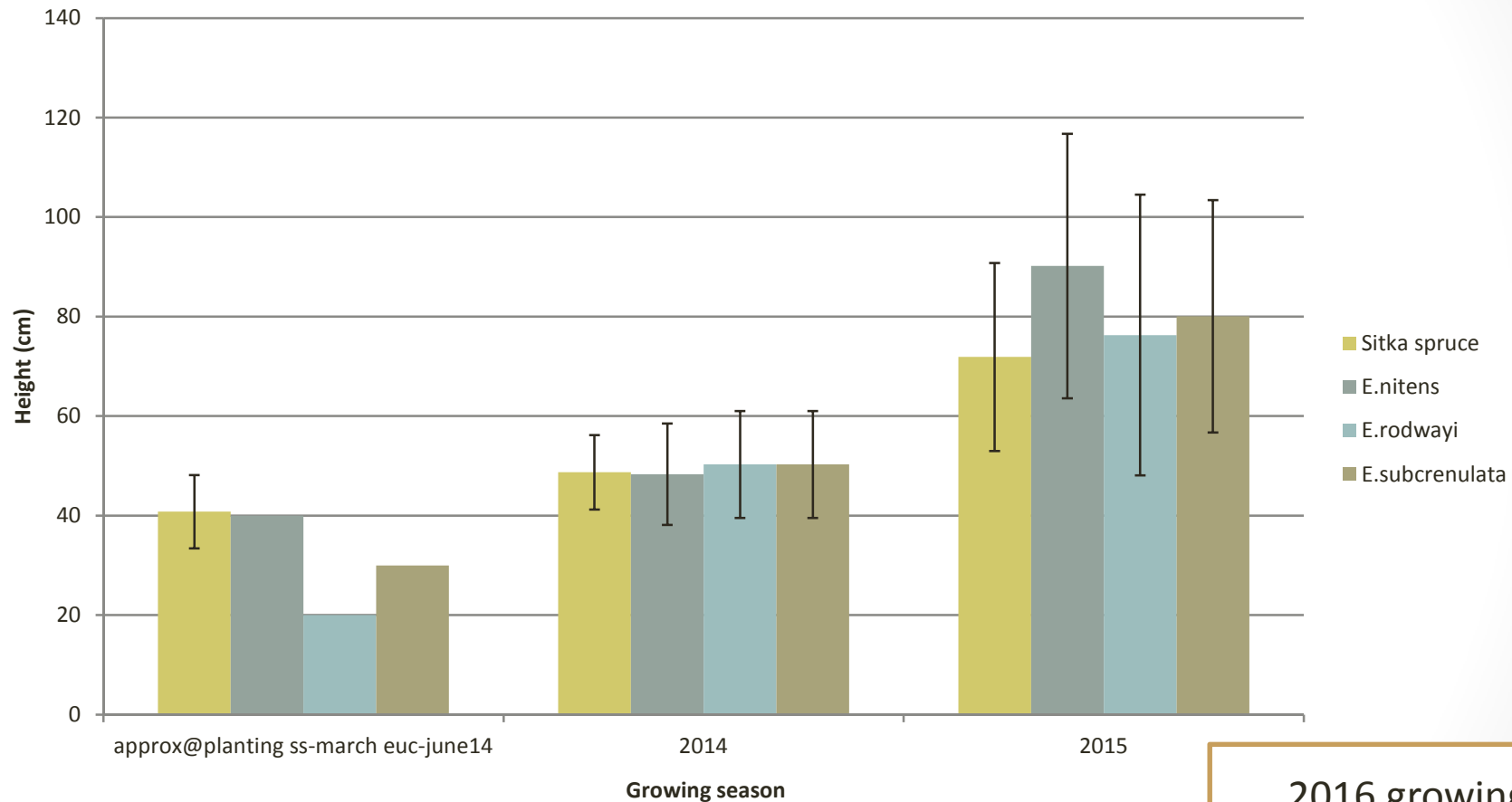
E.rodwayi (good&bad)



E.Nitens (good&bad)



Species height with STDEV



2016 growing
season remains to
be measured